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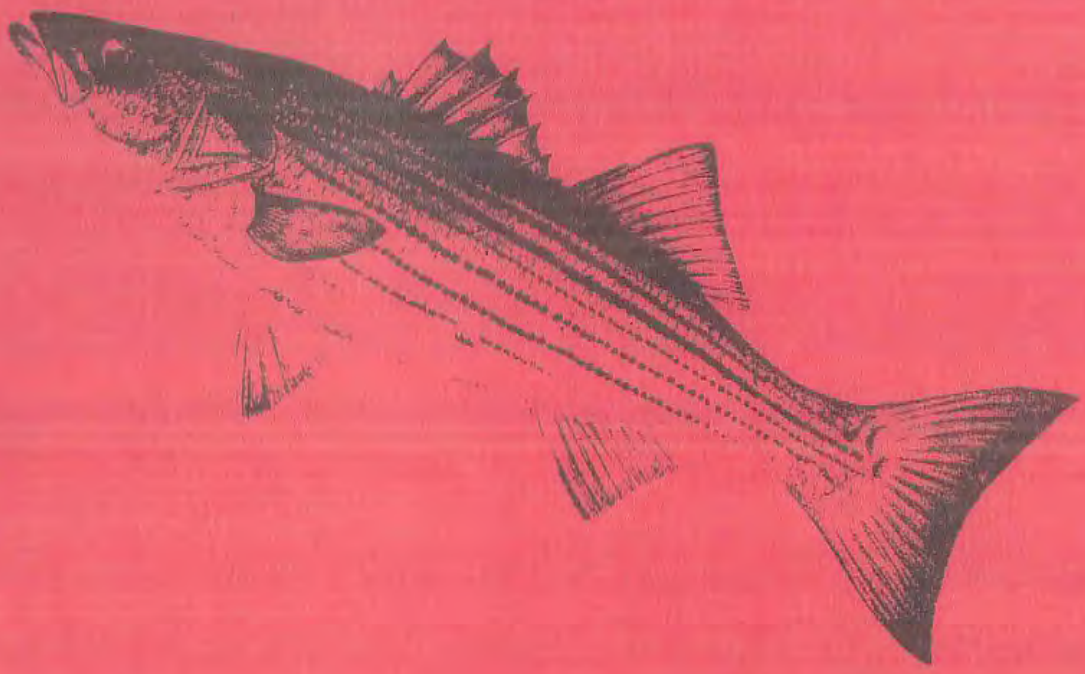

Gulf States Marine Fisheries Commission
Special Report No. 6-WB

SPORT FISH RESTORATION

A PROFILE OF STATE AND FEDERAL SAMPLING PROGRAMS FOR EGGS, LARVAE, AND JUVENILES OF STRIPED BASS

Edited By

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Gulf States Marine Fisheries Commission

September 1989

This project was conducted in cooperation with the U.S. Fish and Wildlife Service, and funded by Federal Aid in Sport Fish Restoration administrative funds Project No. 14-16-0009-87-1203.

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ACKNOWLEDGEMENTS

Gratitude goes to the GSMFC Anadromous Fish Subcommittee for their dedication to the ongoing effort to restore striped bass to historic levels in the waterways of the Gulf of Mexico. Also many thanks go to the staff of the GSMFC for their professional attention to the preparation and publication of this document. Of course, gratitude is due to the U. S. Fish and Wildlife Service for their continued support, moral and monetary, of our efforts in the Gulf of Mexico.

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INTRODUCTION

Striped Bass (Morone saxatilis) were once common in the rivers and estuarine environment of the northern Gulf of Mexico. They were found from Texas to the Suwannee River, Florida, and inland to St. Louis, Missouri on the Mississippi River. Historical reports indicate the fish were landed commercially from the late 1800's through the early 1960's. Except for a remnant population of "gulf race" striped bass in the Apalachicola-Chattahoochee-Flint River system in northwest Florida and infrequent catch reports in a few other river systems, they are no longer common throughout their historical range.

The reasons for the decline of native striped bass along the northern gulf coast are speculative. According to Barkuloo (1989), circumstantial evidence indicates a major decline in the 1940's and 1950's due primarily to pesticides and possibly other contaminants. Environmental alterations in the form of water control structures and extensive channelization may also have contributed to the decline of striped bass in the Gulf of Mexico area.

Extensive efforts were initiated by the five gulf coast states in the late 1960's to reestablish striped bass through concerted restocking programs. This ambitious endeavor required that striped bass derived from Atlantic coast and gulf race brood stock from Apalachicola River system be introduced in the tributaries and estuaries of the northern Gulf of Mexico. By 1986 this program had resulted in over 66 million fingerlings and 18 million fry being stocked (Figure 1). These introduced striped bass have created fisheries in most of the major coastal tributaries.

The magnitude of the stocking efforts in terms of money and manpower represents a significant investment toward the reestablishment of striped bass populations which were once plentiful in the streams and rivers of the Gulf of Mexico (Nicholson et al. 1986). Of vital importance to the ongoing restoration program is a mechanism to monitor and evaluate its effectiveness. Each State in the Gulf of Mexico region and the U.S. Fish and Wildlife Service have conducted sampling surveys to evaluate the effectiveness of stocking efforts and to determine the occurrence of natural reproduction. The following are descriptions of

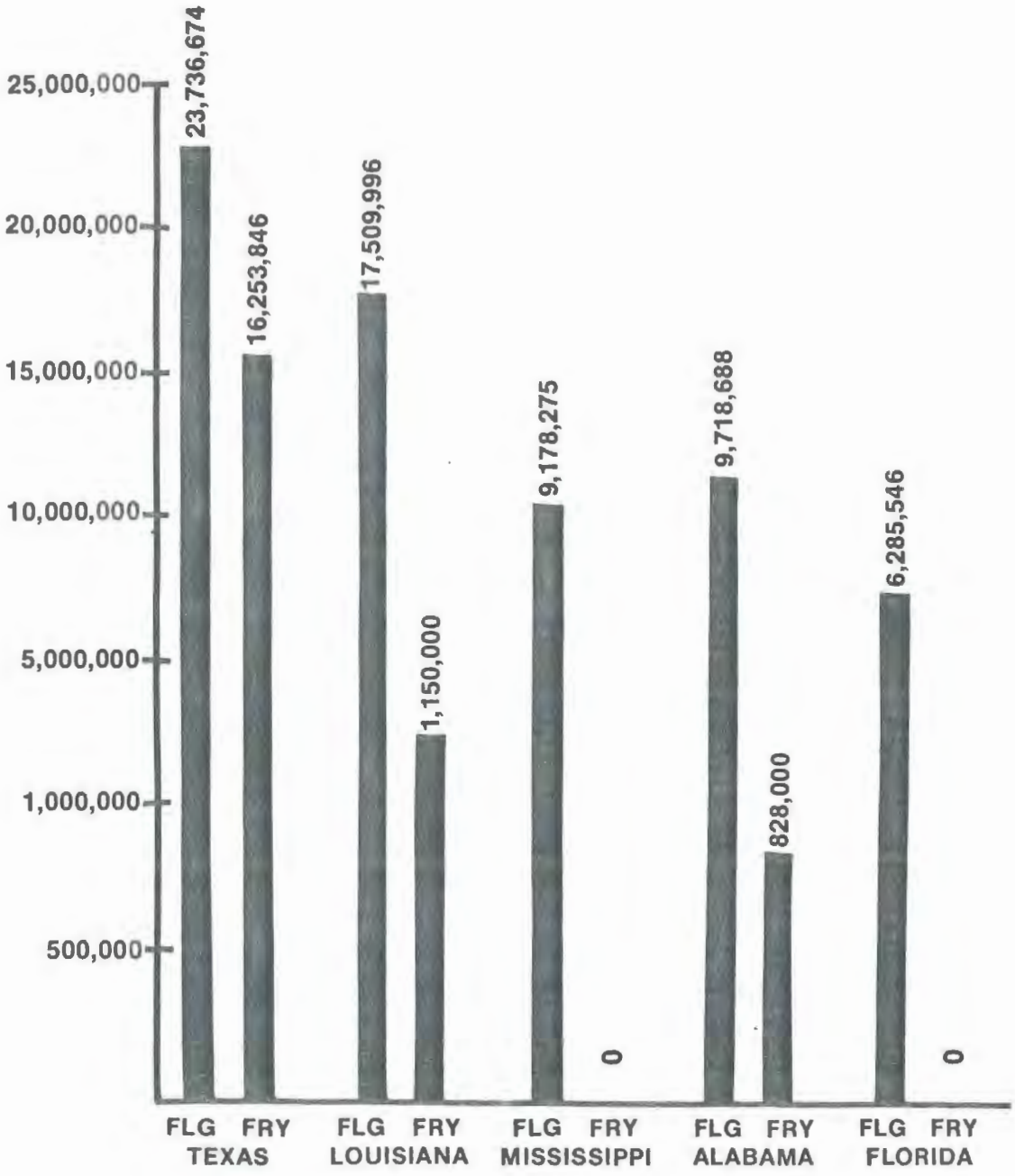

Figure 1. Striped bass fingerlings (FLG) and fry stocked in tributaries of the northern Gulf of Mexico, 1960-1986.

the methodology used by each State and the U.S. Fish and Wildlife Service to monitor and assess the occurrence and abundance of striped bass eggs, larvae, and juveniles.

DESCRIPTIONS OF STATE AND FEDERAL MONITORING AND ASSESSMENT PROGRAMS

Texas

A standardized fishery independent monitoring program was initiated in Texas in 1975 using gill nets. In 1977, bag seine sampling was added. Bay trawl and beach seine samples were incorporated into the program beginning in 1982 and 1987, respectively. One-half meter nets were used in 1987 and 1988 on the Trinity River.

The goal of Texas Parks and Wildlife Department's fishery independent monitoring program is to provide statistically valid information for evaluating present restoration efforts in Texas. This information, when combined with landings information from the fishery dependent monitoring program, will ultimately be used for achieving optimal sustainable yield for striped bass throughout their former range in Texas.

To date, the Trinity River and Galveston Bay system have been the focus for striped bass restoration. Restoration efforts include stocking fry and fingerling striped bass into Galveston and Trinity bays and monitoring the success of these stockings using both fishery dependent and fishery independent data collections. Gill nets, bag and beach seines, and trawls are used to sample for juveniles and adults in the bays. Electrofishers are used primarily for collecting brood fish and tagging juveniles and adults in the Trinity River. Most of these gears are not intended specifically to catch striped bass but are intended to get representative samples of all important species.

A past program on the Trinity River studied eggs and larvae collected in 0.5 meter nets (mesh size = 560 microns) with identifications made to family. Larvae of the percichthyidae family were identified to species. The program verified that striped bass spawning occurred in the Trinity River. As a continuation of this

study, nightly bag seines, along the lower Trinity River and upper Trinity Bay, have been conducted in attempts to find juvenile striped bass.

Sampling occurs along the entire Texas coast which includes nine bay systems: Sabine Lake, Galveston Bay, East Matagorda Bay, Matagorda Bay, San Antonio Bay, Aransas Bay, Corpus Christi Bay, upper Laguna Madre, and lower Laguna Madre systems. Types of gear used to sample within those systems include gill nets, bag seines, beach seines, trawls, 0.5 meter nets, and electrofishers.

Sampling sites for gill nets, bag seines, and beach seines are randomly selected from bay grids (1 minute longitude by 1 minute latitude) that contained $\geq$15.2 m of shoreline. Each selected grid was subdivided in 144 5-second "gridlets" that contained shoreline and were used to randomly choose sample sites.

Bays were stratified into two zones: Zone 1 (upper bay nearest mouths of rivers) and Zone 2 (lower bay farthest from rivers). Trawl sites in each zone were randomly selected from bay grids (1 minute longitude by 1 minute latitude) that contained water $\geq$ 1 m deep in at least 1/3 of the grid and which were known to by free of obstructions in 1/3 of the area. Five stations were sampled in each of Zone 1 and 2 in each bay system semimonthly.

Stations where 0.5 meter nets are used were selected by locating sites where there is access to the Trinity River. Station 1 is located where road FM 787 crosses the Trinity River near Romayor, Texas. Station 2 is located where Highway 90 crosses the Trinity River near Liberty, Texas. Electrofishing is used to collect ripe striped bass immediately below the Livingston Dam on the Trinity River.

As mentioned above several gear types are used to sample the various life stages of striped bass. A description of each follows:

A. Gill Nets - Monofilament gill nets (183 m long; 1.2 m deep with separate 45.7 panels of 7.6, 10.2, 12.7, and 15.2 cm stretched mesh) are currently used in all nine bay systems.

B. Bag Seines - Bag seines (18.3 m long; 1.8 m deep with 1.3 cm stretched nylon multifilament bag mesh and 1.9 cm stretched mesh wings) are currently used in all nine bay systems.

C. Beach Seines - Beach seines (60.9 m long; 1.8 m deep with 7.6 cm stretched mesh) are used to sample the surf in each of the nine bay systems.

D. Trawls - Trawls (6.1 m wide at the mouth with 3.8 cm stretched mesh throughout and doors 1.2 m long and 0.5 m tall) are used in all nine bay systems.

E. One-half Meter Net - 0.5 meter nets (254 micron mesh) with flow meters were used in the Trinity River from March-May 1988 to sample for striped bass eggs and larvae.

F. Electrofisher - Electrofishers are used most years below Livingston Dam to obtain ripe striped bass for collecting spawn.

Sampling frequency for each gear type varies due to the application requirements of the various gear types. Those sampling frequencies are:

A. Gill Nets - Forty-five overnight sets are made in each bay, except East Matagorda, during Spring and Fall. In East Matagorda, gill netting consists of 20 overnight sets.

B. Bag Seines - Twelve bag seine samples are collected during each month in each bay. Six stations are sampled the first half of the month and 6 stations the second half. All seines are pulled 15.2 m along randomly selected stretches of shoreline.

C. Beach Seines - Like bag seines, beach seines are pulled 15.2 m for each sample. Beach seining consists of 6 beach and 6 bag/beach seines hauls per month in each system. Half of the samples are taken in each half of the month.

D. Bay Trawls - Twenty 10-minute tows (10 tows in each half of the month; 5 in zone 1 and 5 in zone 2) are made in each bay system.

E. One-half Meter Net - Samples were collected during March and May biweekly and during April on a weekly basis. During the peak spawn (generally in April), an additional 24-h period was sampled at 4-h intervals. A replicate was taken for each sample.

F. Electrofisher - Electrofishers are used each year during the spawning season only.

Time of year and time of day for each gear type used to sample the various life stages of striped bass also differ. Gill nets are

generally set overnight, within one hour prior to sunset and retrieved within four hours of sunrise. Those sets are made from September 15 through November 15 and April 15 through June 15. For bag seines, beach seines, and trawls, samples are taken anytime from one-half hour before sunrise to one-half hour after sunset during all months of the year. The 0.5 meter nets are deployed from March through May during midday except when striped bass collected below Livingston Dam were found to be in ripe condition, during which time samples were collected every 4 hours at each station for a 24 hour period. And finally, electrofishing is conducted during daylight hours during spawning season, which is generally April. Striped bass captured by electrofishing are measured to the nearest 1 mm and either tagged or kept as brood stock.

In the bay systems, physical parameters sampled include water temperature, salinity, dissolved oxygen, turbidity, depth, and bottom type. Equipment used to accomplish these tasks are Yellow Springs Instrument dissolved oxygen meter, a standard refractometer, and a Hach turbidity meter (Model 2100A). Physical sampling within the Trinity River includes water temperature, conductivity (which is converted to salinity), dissolved oxygen, velocity; other parameters used come from U.S. Geological Survey and Trinity River Authority. Equipment used includes only the Yellow Springs Instrument dissolved oxygen meter.

Fish caught in gill nets, bag and beach seines, and bay trawls are identified to species, and a subsample is measured. Total lengths (nearest 1 mm) of fishes caught in gill nets are obtained for the first 19 individuals of each species caught in each mesh size each week in each bay system during seasonal sampling. Total lengths (nearest 1 mm) of fishes caught in bag and beach seines and bay trawls are obtained from a random sample of no more than 19 individuals of each species in each sample.

The Sport and Commercial Harvest Monitoring Program monitors the utilization of finfish resources and trends in fishing success. This program is not just for striped bass but is intended to obtain seasonal landings, angling pressure in man-hours, catch per effort, average length and weight of fishes, and species composition of the catches are determined for the recreational fisheries in each bay system and in the Gulf of Mexico adjacent to each surveyed bay system. Interviews of

sport fishermen are conducted at randomly selected boat access sites to obtain daily catch per effort and socio-economic data before and after fishing trips are completed. A roving counter travels by automobile to all boat access sites in a bay system on randomly selected days to count boat trailers and empty wet-slips to define relative distribution of fishing pressure. Projections of landings are then accomplished using estimator equations. The charter boat fishery is also routinely monitored to determine landings by onboard observations and dockside interviews.

The monthly commercial harvest of the resource is compiled through a Legislatively mandated reporting of purchases of seafood dealers. A research program to determine the landings of commercial vessels using dockside interviews of commercial fishermen as they land their catch has been implemented. Through this program, commercial landings, pressure in man-hours, catch per unit effort, average length and weight of finfish landed, species composition, total weight landed and ex-vessel price are recorded through direct observation of landings and survey of commercial fishermen. Interviews of commercial fishermen are conducted at randomly selected landing sites along the Texas coast as fishermen land their catch. Sites are stratified by the type of facilities present. Currently sites with commercial licensed seafood and bait dealers and recreational boat access sites are being used in surveys. Projections of landings based on mean daily landings are made on an annual basis using an estimation equation.

The Hatcheries Branch of the Texas Parks and Wildlife Department have made recent improvements in some of their facilities allowing increased production for subsequent tagging (coded wire microtags) and stocking striped bass in coastal bays. Detection of striped bass released with the coded wire microtag are currently underway. Striped bass captured by either Resource or Harvest programs will be scanned for the coded wire microtag.

Identification of suitable habitat based on ranking the major rivers, streams and bays along the Texas coast with regards to physicochemical conditions is under study.

Louisiana

The Louisiana Department of Wildlife and Fisheries (LDWF) does not have a sampling program targeted on striped bass or any other species of anadromous fish, primarily due to budget constraints. Procedures, however, have been established for egg, larvae, and juvenile sampling which would be employed if an anadromous project were undertaken.

Since no egg and larvae sampling program is currently underway, goals and objectives will not be discussed. River systems which would be included should sampling be initiated are the Mississippi, Atchafalaya, and Red. A previous sampling program for grass carp eggs and larvae was conducted in the past to which a striped bass sampling program would be almost identical. Stations were selected by determining probable spawning sites according to descriptions of spawning locations in the literature and then sampling immediately downstream of the theoretical spawning locations. Additional stations were located further downstream at least two miles apart, all stations being situated in the middle of the rivers.

Plankton samples were taken one day per week from daylight until noon throughout the theoretical spawning season according to historical accounts. Plankton samples were collected using a 0.5 meter or a 1.0 meter diameter conical net having a 0.505 mm mesh. General Oceanonics flow meters were used to determine the quantity of water sampled. Plankton nets were towed 100 feet behind the boat and kept within six inches of the water's surface. Tows were 3-5 minutes in duration. Physical parameters sampled at each station were temperatures (at one foot of depth) and river elevation using a thermometer and a General Oceanonics flow meter. Fish larvae were separated from preserved plankton samples. They were then sent to Louisiana State University for identification.

The Marine Fisheries Division has an ongoing monitoring program throughout coastal Louisiana. The goal of this project is to protect and enhance valuable saltwater resources by monitoring relevant parameters of important seafood resources. Population dynamics and associated hydrological and environmental parameters are used to make rational management decisions.

Samples are taken at specific locations arranged to cover the beach, mid-marsh and upper marsh areas of all major bay systems throughout coastal Louisiana. Stations are located away from the mouths of rivers in water with salinities over 2 ppt. No juvenile striped bass have been taken in samples, however, the established procedures would be used if river sampling was undertaken.

The Freshwater Fisheries Division of the Department does not have a routine program for river sampling; although, it has spot checked the Mississippi and Atchafalaya Rivers using methods similar to those used by the Marine Fisheries Division. These attempts have been successful in recovering fingerling striped bass. Locations were selected immediately before sampling. Stations were located on sandbars suitable for hand pulling a seine with each system having 4-8 stations depending on distance between locations.

A bag seine 50' in length, 6' in depth with a 6'x 6' bag located in the middle constructed of 1/4" ace netting is used for juvenile sampling. The seine is fished perpendicular to the bank in a downstream direction with pulls of 50-100 feet in distance. Both ends are pulled ashore and all organisms are removed and preserved in formalin.

The marine sampling program has been in place for 20 years and is executed weekly throughout the year. The river spot checks conducted by the Freshwater Fisheries Division has been conducted intermittently since 1981 and is limited to low water conditions in July-September from 2 hours before sunset to 2 hours after sunset.

Equipment descriptions are a 1/4 inch mesh bag seine which is 50 feet long and 6 feet high, a temperature, salinity, and conductivity meter (Beckman RS5), and an Endeco constant recorder. Samples are evaluated by LDWF personnel at district or field laboratories. Fish are separated by species, with the first 50 of each species selected at random and measured for total length in five millimeter intervals.

Mississippi

A program for monitoring occurrence of striped bass eggs and larvae in selected Mississippi rivers was initiated in 1974; however, due to a number of years of negative results, the program was discontinued in 1983. The purpose of the program was to determine if striped bass were

spawning in the tributaries of Mississippi Sound. A secondary purpose was to assess the abundance and diversity of zooplankton that could serve as food for phase I striped bass, which is a striped bass under 2 inches total length.

River systems sampled include the Pascagoula, Biloxi, and Tchoutacabouffa. They are part of the Coastal Terrace Watershed of Mississippi. This watershed is characterized by restricted watersheds that drain into bays or arms of the Mississippi Sound and are influenced by the tide along their lower stretches. The Pascagoula River is formed by the union of the Chickasawhay and Leaf Rivers at Merrill and empties into Pascagoula Bay at Pascagoula. It together with its tributaries (Whiskey Creek, Red and Black Creeks, Bluff Creek, Beaverdam and Cedar Creeks, and Escatawpa River), drain most of George and Jackson Counties in the southeastern part of the State. The Biloxi River extends southeast from the southwestern corner of Stone County across the central part of Harrison County, picking up Little Biloxi in its course and emptying into Back Bay a western extension of Biloxi Bay. The Tchoutacabouffa River rises in the southern part of Stone County and flows south, then west to Back Bay.

In 1974 and 1975 one station each was fished in the Pascagoula and the Tchoutacabouffa Rivers. These were located at the Cumbest Bridge on the Pascagoula (T65, R9W, Sec. 33) and at Lamey Bridge on the Tchoutacabouffa (T55, R7W, Sec. 13). From 1976 thru 1982, three stations were sampled in the Tchoutacabouffa and the Pascagoula and two in the Biloxi. The stations were located 1 mile below the freshwater/saltwater interface, at the interface, and 1 mile above the interface.

Three 0.5 meter plankton nets constructed of #505 nytex were used to collect eggs, larvae, and zooplankton. The nets were fished to sample the top, middle, and bottom of the water column. In 1974 and 1975 the nets were deployed in the afternoon and fished overnight. For 1976 through 1982 the nets were towed from the bow of a small boat with the motor running in reverse. The nets were fished for 15 minutes at each station. Samples were taken twice monthly from March through May. Sampling was always conducted in daylight hours, usually beginning by 0900 and continuing until completion.

Physical parameters sampled included salinity, dissolved oxygen and temperature, using a Yellow Springs Instrument meter for oxygen and temperature and a standard refractometer for salinity.

All samples were prepared and analyzed by the staff of the Anadromous Section of the Gulf Coast Research Laboratory. Biological samples were preserved in formalin and examined microscopically. Approximate quantitative measurements were taken for each species.

A program for monitoring juveniles of striped bass was initiated in 1973. Its purpose is to monitor and assess survival of stocked striped bass and reproduction of natural stock.

The same systems sampled in the egg and larvae sampling program were sampled for juveniles. Two other Coastal Terrace Watershed rivers were added to the juvenile sampling.

The Wolf River rises in the hills of the northeastern part of Pearl River County and runs a little east of south until it reaches the southern part of Harrison County where it turns westward across coastal marshes to enter the Bay of St. Louis.

The Jourdan River rises in Hancock County and after receiving the waters of Catahoula and Hickory Creeks and several bayous, it empties into Bay St. Louis from the west.

The number of stations sampled per river has varied from as many as 12 to as few as three. Sand beaches or sandbars near a dropoff are considered the most desirable type of station. When these kinds of stations were not available selection was made on an opportunistic basis. Six station are sampled on the Pascagoula River currently. These stations are located in succeeding lower stretches of the River beginning at approximately 2 miles above Wilkerson Ferry in George County on the first date, and ending approximately 3 miles below Cumbest Bridge in Jackson County on the last date. Three fixed stations each are sampled on the Tchoutacabouffa and Biloxi Rivers. These stations are located on prominent sandbars near where adult stripers are known to have been taken.

Samples are taken with a 15 x 2 meter bag seine made of 5 millimeter knotless, nylon mesh. The seine is positioned parallel to the shore in about 1 meter of water. The seine is then pulled directly onto the beach. Sampling is conducted twice monthly during July,

August, and September. Early in the sampling program, samples were taken during daylight hours; however, that proved to be nonproductive. Currently sampling begins at dusk and continues until all stations are sampled.

Physical parameters measured include pH, temperature, and conductivity. Salinity and dissolved oxygen were measured in the past, but have been dropped. An Orion Research digital meter is used to measure pH. Temperature is measured using a glass thermometer while conductivity is measured with a Yellow Springs Instrument meter.

All samples are prepared and analyzed by the Anadromous Section of the Gulf Coast Research Laboratory. Previous samples were preserved and brought back to the laboratory for species identification and enumeration. The present technique is to examine the sample on site for striped bass and release the bycatch. When striped bass are found up to five are taken and placed in a cold 5 percent buffered formalin solution. These fish are returned to the lab and examined for length, weight, stomach contents, and scale counts.

Alabama

The stocking of fingerling striped bass in Alabama has established an adult population of fish which have been successfully artificially reproduced since 1980. Adult females have been captured and upon examination found to be in a "spent" condition (Minton 1980). Fingerling and sub-adult fish have been captured in areas and at times which do not coincide with hatchery stockings. In the past documentation of the occurrence of juveniles produced from natural spawns have involved the coordination of delays in stockings of fingerlings by the Alabama Game and Fish Division into the river systems to be sampled. Day and night sampling for juvenile striped bass was undertaken during May and June in the Alabama River drainage below areas where adult fish had been previously captured. Sampling was carried out biweekly utilizing a 15.2 m x 2 m bag seine with a 5 mm mesh size.

Twenty-four seine hauls during 1988 produced 96 yellow bass, Morone mississippensis and 6 striped bass (145 to 223 mm TL). One of the striped bass carried an AMRD tag from 1987. Due to the size of the

striped bass captured it is unclear as to their origin. Positive evidence of natural reproduction of striped bass has not been documented to date.

In addition to the juvenile sampling during 1989 a project has been proposed for Alabama personnel to initiate an intensive effort to collect striped bass eggs and larvae in the State's river systems to document the presence or absence of natural reproduction. Egg and larval sampling will be initiated when river water temperatures reach 17°C and will continue for 3 weeks. Attempts will be made to sample targeted areas on a twice-weekly basis. The location of the sampling sites will be determined by calculating river flow rates and egg hatching time prior to entry into the estuary. Sampling techniques and equipment will consist of a conical plankton net measuring 48.5 cm diameter at the mouth and 185 cm long tapering to 10 cm with a bucket size of 23 cm long and 8.5 cm in diameter. Mesh size of the net is 350 microns. Since peak spawning generally occurs following sunset and prior to sunrise, sample site location and sample time will be determined utilizing the flow rate of the river in feet/second to locate the sites and to schedule the times to sample. A 12 hour period that eggs should pass the area based on the distance from the probable spawning site and the estimated time of spawning. A similar approach will be utilized to locate larval sampling stations further down river. Multiple samples will be taken at each sampling location and time frame. Samples will be preserved and processed under contract as specified by contracting ichthyologist.

Florida

All activities in the State of Florida related to striped bass are the responsibility of the Florida Game and Fresh Water Fish Commission (Commission). Currently the Commission is conducting a juvenile monitoring program for striped bass. The goal of the monitoring program is to determine the occurrence of natural reproduction and assess stocking success of hatchery reared striped bass and striped bass hybrids at various locations throughout the Apalachicola and Ochlockonee

River systems. Egg and larval sampling is not conducted by the Commission at this time due to an active program underway by the U.S. Fish and Wildlife Service.

As indicated above, the Apalachicola and Ochlockonee Rivers and their respective reservoirs, Lake Seminole and Lake Talquin, are the gulf coast river systems on which the monitoring programs are conducted. Primary types of sampling gear are electrofishing and gill nets. Electrofishing is used in the rivers while gill nets are deployed in the reservoirs. The gill nets are experimental using 1.5, 2.5, and 3.5 inch stretched mesh sizes.

In the Apalachicola River System 16 fixed electrofishing sites are sampled on a monthly basis, while gill nets are set in Lake Seminole on a monthly basis from September through December. This effort has been ongoing since 1985. A similar sampling regime is used for the Ochlockonee River and Lake Talquin; however, it was initiated in 1978. Electrofishing is conducted only during night time periods. Likewise, gill nets are fished at night, being set at dusk and fished thereafter for up to 12 hours.

Physical parameters associated with biological sampling are not measured. Striped and hybrid bass collected during the electrofishing and gill net sampling are identified to species, measured (total and standard lengths), and weighed. Otoliths are removed from individuals representing distinct size classes to determine age.

A peak season, roving creel survey is conducted on the upper Apalachicola River below Lake Seminole from February 16 through May 22. The survey, initiated in 1979, is used to estimate effort, harvest, and success of striped and hybrid bass in that system. In April 1989, an access point creel survey was initiated in the lower Apalachicola River to monitor harvest and effort and to assess the potential for future stocking of striped bass in the coastal areas. All Morone species are measured, and otoliths are removed for age analysis.

Limited natural striped bass reproduction in the Apalachicola-Chattahoochee-Flint River System was documented in 1985. Natural reproduction of Atlantic striped bass (South Carolina origin) was observed in the lower Ochlockonee River below the dam in 1987. These

successful natural reproduction years were confirmed by collecting young of the year juveniles during each year when hatchery reared striped bass were not stocked in either river system.

U. S. Fish and Wildlife Service

The Fish and Wildlife Service (Service), with financial assistance provided by the Mobile District, U.S. Army Corps of Engineers conducted an ichthyoplankton study in March, April, and May, 1987 to determine the time and location of striped bass and sturgeon spawning on the Apalachicola River. (Figure 2 shows a map of the river system including the sampling location).

This report covers the first year of a planned 3 year egg and larvae project designed to yield information on timing and location of striped bass and sturgeon spawning. The objectives of this study are (1) to determine the water temperature and time of spawning in the Apalachicola River and (2) to estimate spawning location(s) by correlating egg and/or larvae age with current velocity and water temperature.

Four previous anadromous fish egg and larval studies have been documented for the Apalachicola-Chattahoochee-Flint River system, all concentrating on Morone species. The first of these, conducted by the Florida Game and Fresh Water Fish Commission, sampled the Apalachicola River between the cities of Blountstown and Chattahoochee during January, February and March of 1961. No striped bass eggs or larvae were collected (Barkuloo 1961). The second, a 1976 study by the Service, sampled 13 stations on the Apalachicola River for approximately 2 months. Four striped bass eggs were found (Smith 1976). A third study by the Service intensively sampled the Apalachicola River in 1977 for anadromous fish eggs and larvae. No striped bass were found; however, one sturgeon larva was collected (Wooley et al. 1982). A recent striped bass spawning study was conducted in 1985 by the Georgia Department of Natural Resources, Game and Fish Division, on the Flint River between the city of Albany, Georgia, and Lake Seminole. Ninety-one striped bass eggs were found (Keefer 1986).

From March 10 to May 7, 1987, one site on the Apalachicola River at river kilometer 18.7 (river mile 11.6) was sampled for striped bass and

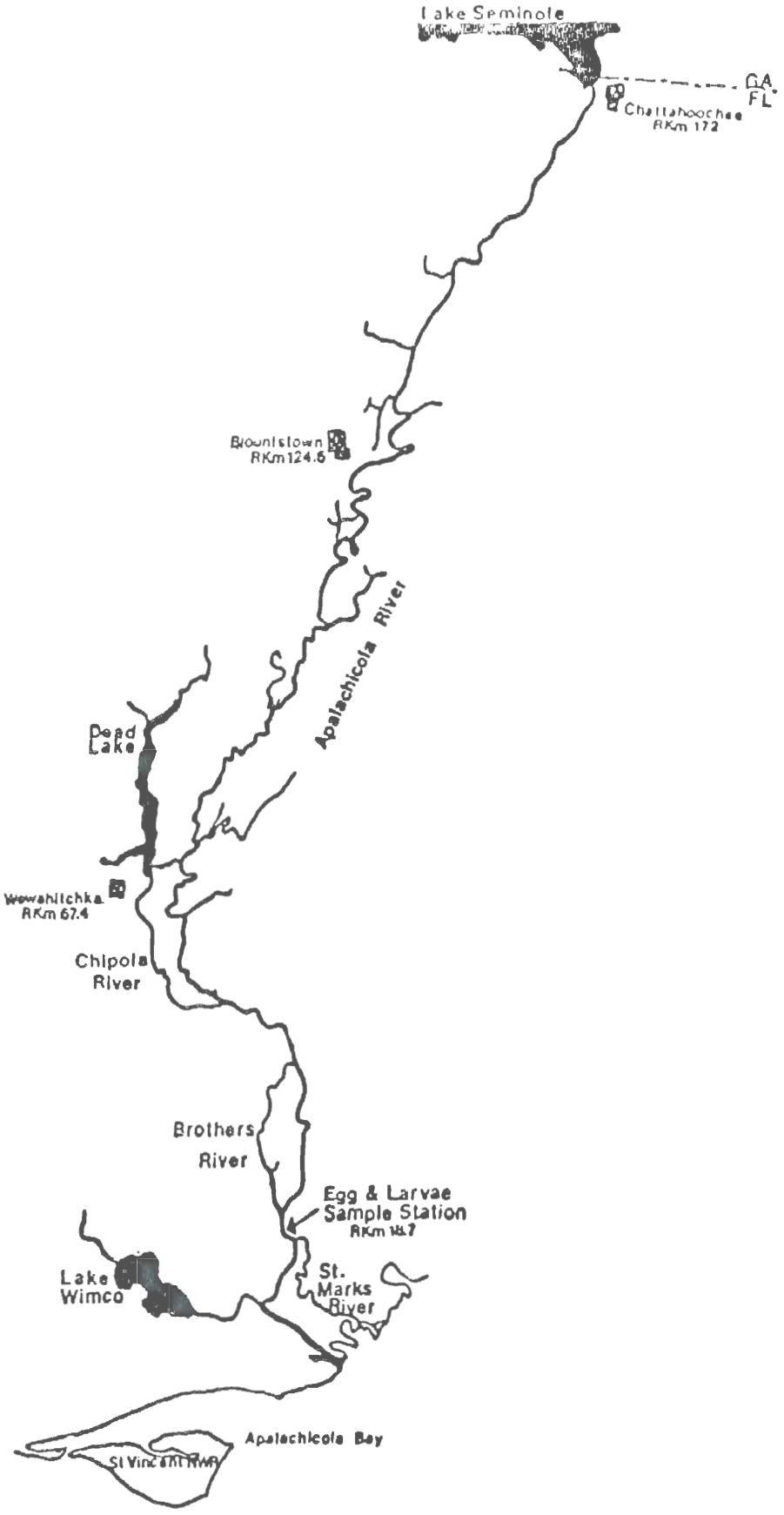

Figure 2. Map of Apalachicola River with location of egg and larval sample station.

sturgeon eggs and larvae. The site location was chosen to fall between the Brothers River, the last major distributary, and the St. Marks River, the first major tributary before the Apalachicola River flows into Apalachicola Bay. An intensive sampling regime was established with personnel based on a permanently anchored houseboat approximately 1.6 km (one mile) upstream from the study site. The base station contained facilities for sorting and identifying samples, and also served as a temporary residence for project personnel.

A single sample site was used based on the theory that any spawning of striped bass below Jim Woodruff Dam, river kilometer 172 (river-mile 107), could be sampled at the lower river site. Striped bass eggs and larvae are free-floating for the first three to 5 days after spawning, allowing sufficient time for transport to the mouth of the river, based on recorded flow data. Sturgeon eggs, however, are demersal and attach to substrate soon after spawning. A single station is unlikely to collect sturgeon eggs or larvae, unless spawning takes place immediately above the collection site. Another advantage to using the single site was that intensive sampling could be done with limited manpower.

The site was initially sampled at 6-hour intervals, three times daily, beginning at 6:00 a.m. Sampling began on March 10, when the river temperature reached 15°C (59°F). When the temperature reached 17.2°C (63°F) on March 22, a midnight sample was added, and continued until the river temperature reached 19.4°C (67°F) on April 13. Above 19.4°C the sampling regime returned to three daily. Sampling ended May 7, when river waters warmed to 23.9°C (75°F). The March 22 through April 13 sampling was intensified because this was the estimated peak spawning period for striped bass based on water temperature (Setzler et al. 1980; Dudley and Black 1978; Kornegay and Humphries 1975).

Egg and larval sampling was accomplished using a 0.5 meter plankton net set for 5 minute intervals at both the surface and bottom. Volumetric measurements were simultaneously taken at each level to estimate the amount of water filtered per set. Temperature and velocity readings were taken at the surface during each interval. River water temperature was also monitored near Blountstown and Chattahoochee using 7 and 90 day temperature recorders, respectively.

Samples collected were brought to the base station for sorting. All eggs and fish larvae were preserved in 7% buffered formalin for final sorting and identification at the Panama City Field Office. Identifications were verified or corrected by Mr. James M. Baker, Tennessee Valley Authority, Norris, Tennessee. Striped bass egg age was estimated using procedures by Hassler et al. (1981).

During 1988, egg and larval sampling was conducted; however, due to a lack of personnel, sorting and identification was not completed. Four stations were sampled three times per week during 1988.

DISCUSSION

As evidenced by the above sampling programs, each gulf State and Federal resource agency which works with striped bass recognizes the need for some method to monitor and assess the effectiveness of stocking and restoration efforts. Many of the techniques used by the various agencies are based on biological and ecological parameters with respect to striped bass behavior and as such are similar. In other cases, such as physical parameters sampled and gear used, program guidelines vary.

An important result of this document is that it will serve as a starting point for the development of a set of standard guidelines for monitoring and assessment of striped bass stocking and restoration efforts. If such guidelines were to be implemented by each of the programs operating in the Gulf of Mexico, comparison of results across the broad range of environmental conditions could prove beneficial in determining optimum habitat and biological parameters for successful restoration efforts. It is the intention of the GSMFC TCC Anadromous Fish Subcommittee to develop such a set of standard guidelines.

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