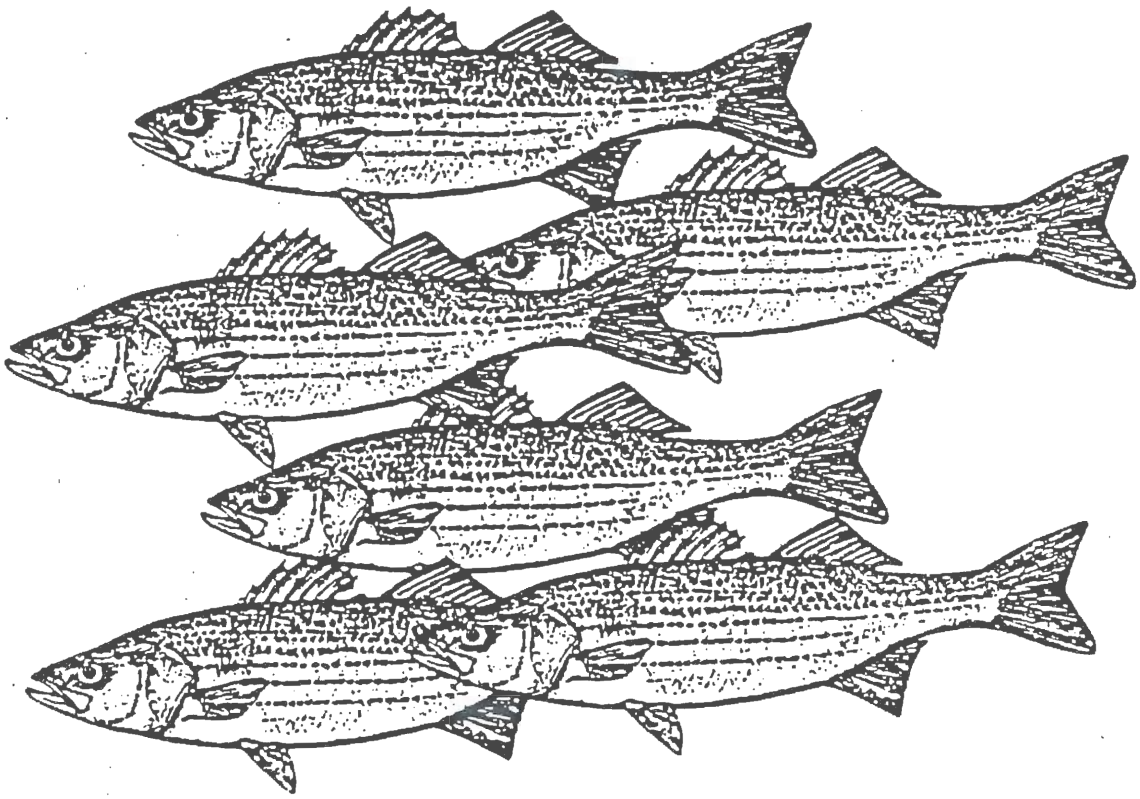
HABITAT CRITERIA FOR STRIPED BASS

STOCKED IN RIVERS IN THE NORTHERN GULF OF MEXICO



GULF STATES MARINE FISHERIES COMMISSION

HABITAT CRITERIA

FOR

STRIPED BASS

Stocked in Rivers of the Northern Gulf of Mexico

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INTRODUCTION

Striped bass (Morone saxatilis) were historically found in rivers and estuaries all along the northern Gulf of Mexico from Texas to the Suwannee River, Florida. Inland they ranged to St. Louis, Missouri on the Mississippi River. Published reports dating from the late 1800's indicate that striped bass were landed commercially through the early 1960's. These fish no longer support commercial fisheries in any of the Gulf States. Why the populations declined is a matter of conjecture. Several theories have been proposed, such as environmental alterations in forms of water control structures and extensive channelization and pollution from urban, agricultural, and industrial sources. In some areas overfishing is thought to have contributed to striped bass population decline.

In order to restore striped bass to the northern Gulf of Mexico, the five States bordering the Gulf of Mexico began an extensive stocking effort in the late 1960's. Striped bass were procured from Atlantic and Gulf race brood stock and introduced in rivers and estuaries of the northern Gulf. To date, over 84 million fry and fingerlings from these races have been stocked. The behavior of striped bass resulting from the stocking programs has been studied extensively. These studies have revealed the fish to be primarily riverine, only occasionally entering the open water of the Gulf of Mexico. Movement of the striped bass is essentially within the confines of the river and its estuary in which they are stocked. Adults generally migrate upstream in early spring in response to increased day length, rising water temperature, and increased discharge rates of the rivers. This upstream movement is repeated in the late fall. Striped bass spend the winter months in the lower reaches of coastal rivers, and following the spring spawning runs, disperse downstream. They spend the hot summer months in the mouths of cool water streams or springs. The fish feed irregularly during the summer and apparently grow very slowly. Literature regarding the behavior of striped bass in rivers of the northern Gulf is extensive (Nicholson et al, 1986; Minton, 1985; Crateau et al, 1981; Horst, 1976; and Ware, 1971). However, there is a dearth of published information concerning the physico-chemical, biological, and hydrological parameters that limit the species in rivers discharging into the Gulf of Mexico.

OBJECTIVE AND NEED

To create a self sustaining striped bass population, the habitat that the fish are introduced into must meet minimum life supporting parameters for each life stage and the requirements for spawning. The objective of this project is to define these parameters in order for stocking programs to be successful in achieving their goal and to list by priority the rivers by State and region which meet these parameters.

The Anadromous Fish Subcommittee (AFS) of the Gulf States Marine Fisheries Commission (GSMFC) developed a fishery management plan (Nicholson et al, 1986) in which the paucity of data relevant to critical population parameters was delineated. The need for these data is essential to the Gulf States as they endeavor to rebuild the decimated striped bass population of the region. The success attained will be determined to a great extent by the reestablishment of naturally reproducing populations of striped bass all along the Gulf Coast. The reproductive success of the striped bass, and subsequently year class strength, is controlled to great extent by freshwater flow, water temperatures, and numerous other biological and physico-chemical parameters. Since natural recruitment is still limited in Gulf Coast rivers, the fishery is dependent on the stocking programs.

METHODS

The Anadromous Fish Subcommittee (including representatives from Florida, Alabama, Mississippi, Louisiana, Texas, National Marine Fisheries Service, and the U.S. Fish and Wildlife Service) of the Gulf States Marine Fisheries Commission compiled information relating to water temperature, dissolved oxygen, current velocity, pH, pollution, physical barriers, and food sources from streams and river systems in the five Gulf States in which striped bass occur, are stocked into, or may be stocked into in the future.

RESULTS

SUMMARIES OF HYDROGRAPHIC PARAMETERS

Figures 1 through 5 illustrate the location of the rivers within each state that are addressed in this report. Locations of sampling stations of the U.S. Geological Survey (USGS) on those rivers are provided in Table 1. Table 2 provides hydrographic summaries for velocity, discharge, temperature, dissolved oxygen (DO), and pH from data acquired from the USGS stations. Table 3 lists the reporting periods from which the data in Table 2 were recorded. Table 4 provides the minimum, maximum, and mean values of the data reported from the USGS stations during the months of March and April, which are critical spawning months, from the rivers addressed in this report.

REGRESSION MODELS FOR ESTIMATING VELOCITIES

For coastal states bordering on the Gulf of Mexico, the primary months for spawning of striped bass in coastal streams are March and April. It is during this time that stream velocity is of importance. Adult striped bass require a minimum velocity of 1 ft./sec. for successful spawning, except in the lower river where the eggs would encounter higher salinity water. The increased density of the saline water would increase the buoyancy of the eggs thus requiring less velocity to keep the eggs in suspension. Other factors such as suspension of eggs and successful hatching likewise require a minimum velocity of 1 ft./sec. (Crance, 1984). Because velocity is a critical factor, some method of obtaining rough estimates of velocity for individual streams is needed. Collaboration with the U.S. Geological Survey (L. Pearman, personal communication, 1988) and the Texas Parks and Wildlife Department (H. Maddux, personal communication, 1988) resulted in regression models for estimating velocity for 39 coastal streams and rivers from Texas to Florida (Table 5). By entering discharge values, available from U.S. Geological Survey offices, estimates for velocity can be derived.

Again, using data from the U.S. Geological Survey, values for river discharge during the months of March and April were obtained for 39 river systems over the period of record for each river at specific stations. Those data appear in Table 6 as the percent of time that a specific river at a specific station revealed a discharge at a certain level or higher. For instance, 95% of the time from 1944 to 1986 a discharge of 115.0 cubic feet per second or greater was measured at a station on the Calcasieu River in Louisiana. By entering the values presented in Table 6 in the regression models presented in Table 5, an estimate of velocity for the critical months of March and April can be derived with a specific level of confidence related to the period of record. Table 7 presents those estimated velocities for the rivers addressed in this study during the months of March and April over the period of record for each station. The linear regression models developed for this report do not account for discharges of zero. Discharge values above and below the range of data used to develop the models may or may not provide an acceptable estimate for velocity. Table 8 provides the range of discharge values used to develop the regression models.

CONTAMINANTS

Tables 9, 10, and 11 provide contaminant levels extracted from the flesh of several species of freshwater fish (striped bass not included) collected from the Apalachicola, Tombigbee, Alabama, Brazos, Colorado, San Antonio, Nueces, and Rio Grande Rivers in 1976-1979 and 1984 (Schmitt et al, 1983 and Anonymous, 1988). Of the 240 samples represented in Tables 9 and 10, 79% of those samples resulted in less than 1% of the minimum acceptable standards as set by the National Academy of Sciences and the National Academy of Engineers. According to those data, fish analyzed from the Tombigbee River in Alabama carried the highest contaminant load. Fish analyzed from the Nueces River in Texas were the least contaminated. This same trend was evidenced by the data from Table 11.

Of the 15 contaminants reported in Tables 9 and 10, the most prevalent across all eight rivers from 1976-1979 was toxaphene, while the least prevalent was gamma-Benzene-hexachloride. Dacthal was reported as not being present in the fish analyzed. According to Table 11 for 1984, the most prevalent contaminant compound was DDT, including DDD and DDE. The least prevalent was Endrin. Oxychlordane appeared in only two samples. All of the compounds discussed above are chlorinated hydrocarbon pesticides used in the agricultural industry with the exception of Dacthal which is a chlorinated phthalate used as a preemergence herbicide. Compounds of the phthalate family are products of the plastics industry. All of the chlorinated hydrocarbon insecticides are potentially toxic to natural river systems. Dacthal is considered a contaminant, but is less toxic than the other compounds discussed (W. Walker, personal communication, 1988).

Of the seven toxic metals reported in Table 11, the most prevalent was zinc and the least prevalent was mercury. Cadmium appeared in only one sample.

PHYSICAL BARRIERS

Crance (1984) indicated that stable high volume stream flow and water velocity probably enhance habitat for reproduction by helping to stabilize temperature, facilitate migration of spawning adults, suspend eggs until hatching, and suspend larvae until swimming is accomplished. Dams or other physical barriers may serve to prevent migration of adult spawning stock and may shorten the river length to the extent that eggs may reach the estuary before they hatch, and therefore cause the eggs to drop out of suspension where they may die for lack of oxygen.

According to Crance (1984) minimum stream length for successful spawning is a function of current velocity multiplied by egg hatching time. Assuming a hatching time of 48 hours at a current velocity of 1 ft./sec. (Crance, 1984), then a minimum stream length of 32.7 miles is required. This figure may not represent actual minimum stream length due to variations in water density, velocity, temperature, egg density, and hatching time. Rivers such as the Blackwater and the Pokomoke in Maryland appear to be exceptions to the above. Striped bass are known to spawn successfully in the lower fourteen miles of those rivers. The eggs are suspended in the water column long enough to hatch by a combination of the higher density of the saline waters and the tidal action found there (Mansueti and Hollis, 1963). Table 12 provides river length within the state reporting for 37 rivers. In cases where dams occur, the latitude and longitude of the dam is provided along with the number of river miles below the dam. Information relating to river lengths and physical barriers for rivers in Louisiana was not made available for this report.

FOOD AVAILABILITY

Primarily there are three food types for striped bass. Larval stripers depend on zooplankton. Pond-reared larvae generally prefer copepod and cladoceran nauplii and as they get larger feed on the adults. Small juveniles also feed on zooplankton but change to mysid shrimp, insects, and small soft-rayed fish as they grow larger.

Where juveniles are found in the estuary, larval and post-larval shrimp and crabs are a good food source. Adult stripers are primarily piscivorous, generally preferring soft-rayed fishes such as menhaden and shad (Crance, 1984). Table 13 provides occurrence of appropriate food types for larval, juvenile, and adult striped bass from rivers addressed in this report. Information relating to food availability from rivers in Louisiana and Texas was not made available for this report.

It is important to remember that if suitable food items are present, in order for striped bass to utilize those food sources they must be available at the right time, in the right size, and in enough quantity.

DISCUSSION

WATER TEMPERATURE

Eggs and Larvae - For the purposes of this report, spawning in coastal streams of the Gulf of Mexico is generally considered to occur during the months of March and April. Raney (1982) indicated that spawning of striped bass usually began at around 15°C to 19°C (59° to 62°F). Kernehan et al. (1981) indicated that the most intensive spawning around the Chesapeake area coincided with water temperatures of 13.5°C to 18°C (56.3° to 64.4°F). The commonly accepted ranges for spawning success is 12°C to 23.9°C (54° to 75°F) (Crance, 1984).

Water temperature limits for survival of eggs and larvae vary only slightly from spawning temperature; ranging from 12°C to 22°C (Crance, 1984). Doroshev (1970) and Morgan et al. (1981) indicate that the optimum range of temperature for survival of eggs is 17°C to 20°C (62.6° to 68.0°F). Other reported ranges are 15°C to 18°C (Rogers et al, 1977) and 16.7°C to 18.2°C (Bayless, 1972).

For larvae, temperatures of 23.9°C and above are fatal (Albrecht, 1964). Doroshev (1970) reported a lower lethal limit at 10°C for larvae. Rogers et al. (1977) and Rogers (1978) reported an optimum survival range for larvae at 18°C to 21°C.

Juveniles - Davies (1970) reported that juvenile striped bass can tolerate a temperature range of 3°C to 34°C. This is a considerably larger range than eggs and larvae or adults can withstand. According to Loeber (1951) and Dorfman and Westman (1970) the upper lethal limit for juveniles is 34°C to 35°C. Optimum temperature levels for growth of juveniles fall between 23.0°C to 26.0°C (Cox and Coutant, 1981).

Adults - Several researchers (Waddle 1979, Schaich 1979, Cheek 1982, Merriman 1941, and Dudley et al, 1977) have indicated that adult striped bass avoid water temperatures of 25°C to 26°C (77° to 78.8°F). An average temperature sought by adults in a reservoir habitat was 20°C (68°F). Van Den Avyle and Evans (1984), working on the Apalachicola River, found that when ambient river temperature exceeded 24°C, adult striped bass actively sought out cooler water temperatures. From mid-June through August when water temperatures ranged from 27.5°C to 31.0°C, the majority of striped bass located were in areas of 20.0°C to 23.0°C water temperature. Coutant (1985 and 1986) reported similar temperature preferences working in the Cherokee Reservoir in Tennessee.

Areas where water temperatures are lower than the ambient river or lake temperature, usually maintaining 20.0°C to 21.0°C temperature, are known as thermal refuges. The fact that adult striped bass seek out thermal refuges is evidenced on the Apalachicola River by Crateau et al. (1981) and Wooley and Crateau (1983). It is generally thought that survival of striped bass in habitats that customarily exceed adult temperature tolerances is totally dependent on the presence of thermal refuges (AFS of GSMFC, Personal Communication, 1987).

DISSOLVED OXYGEN

Eggs and Larvae - Harrell and Bayless (1981) reported that survival of eggs to hatching required a dissolved oxygen (DO) concentration of 3.0 m/l or greater. Larvae, likewise, cannot long withstand low DO levels, and a DO of 3.0 m/l or greater is required for survival (Chittenden, 1971). A DO level of 5.0 m/l is generally considered to be the safe lower limit for larval survival (Turner and Farley, 1971).

Juveniles - According to Krouse (1968), juveniles also require at least 5.0 m/l of DO for survival. At 3.0 m/l and less juveniles were observed to die.

Adults - As reported by the U.S. Environmental Protection Agency (1976), a minimum DO level of 5.0 m/l is necessary for maintaining fish populations. Crance, 1984, has stated that if DO concentrations are adequate for egg, larval, and juvenile survival, then adults would also survive. Meldrim et al. (1974) have stated that adult striped bass avoid water of 44% or less in oxygen saturation.

pH

The U.S. Environmental Protection Agency (1976) has stated that a pH range of 6.5 to 9.0 standard units is recommended for survival of freshwater aquatic life. It is also cautioned that the toxicity of some compounds can vary with varying levels of pH. Bonn et al. 1976, Regan et al. 1968, Shannon 1968, and Bailey 1975 have placed the pH tolerance range of larval and juvenile striped bass at 6 to 10 standard units. A optimum range, reported by Bogdanov et al. (1967), Davies (1973), and Bonn et al. (1976) is 7.5 to 8.5 standard units. According to Nicholson (personal communication, 1988) a pH of 8.0 standard units is optimum for survival of eggs and larvae. If pH levels are adequate to support eggs, larvae, and juveniles, then adults will also survive.

FOOD

Larvae - Upon hatching, striped bass larvae depend upon availability of zooplankton as a food source for survival (Miller 1977, Cooper and Polgar 1981, and Eldridge et al. 1981). Miller (1977) reported a minimum concentration of 1,864 zooplankters per liter of water is required during initial feedings. Crance (in preparation) indicated that in some areas zooplankton densities are lower than the minimum level reported by Miller (1977) and larvae still survive.

Juveniles - Initially, juveniles also feed on zooplankton. Crance (in preparation) reported an optimal density of 4,000 zooplankters per liter for juveniles. McIlwain et al. (1980 and 1981) reported juveniles feeding on mysid shrimp, insect larvae, and small fish. Nicholson (1983) reported that juveniles larger than 114 mm (4.5 inches) select soft-rayed fish as their primary food source.

Adults - Many researchers (Stevens 1958, Mensinger 1971, Ware 1971, Edwards 1974, Bailey 1975, Weaver 1975, Combs 1978, Deppert and Mense 1979, Gustaverson et al. 1980, and Persons and Bulkley 1982) have reported that adult landlocked striped bass prefer gizzard and threadfin shad as a prey source. Crance (in preparation) has reported an optimal standing stock of clupeids at 84.1 kg/ha (75 pounds/acre) for support of striped bass populations. McIlwain (1980) has reported adult striped bass feeding on Gulf menhaden and threadfin shad in riverine habitats. It is important, however, to keep in mind that juvenile and adult striped bass are opportunistic feeders and will feed on species other than the clupeids.

WATER FLOW AND VELOCITY

Water flow and velocity are primarily critical for purposes of spawning and egg and larval survival. Fish and McCoy (1959) reported that spawning in the Roanoke River became more prevalent as stream discharge increased above 5,500 cubic feet per second (cfs). They indicated that at 3,500 cfs no spawning occurred. Crance (in preparation) reported successful spawning in the Apalachicola River, Florida when river discharge was 9,000 to 290,000 cfs.

It is generally thought that a stream velocity of about one foot per second (fps) is required to keep striped bass eggs and larvae suspended in the water column long enough to survive. This figure can vary as water and egg densities vary. Marcy (1971 and 1973) and Morgan et al. (1976) reported that stream velocities of about 7.9 fps could be detrimental to eggs and larvae.

In a riverine habitat, there is a relationship among stream velocity, egg density, water temperature, and distance from the spawning site to the estuarine habitat downstream. It is important that hatching of the larvae coincide with arrival in the estuarine habitat, since zooplankton concentrations are greater in the estuary and thus feeding is facilitated.

It is important to remember that in cases such as reported by Mansueti and Hollis (1963) where salinity and tidal action act in concert to keep eggs suspended, successful spawning can occur in the absence of river velocity in the lower reaches of a river.

CONTAMINANTS

Contaminant studies on striped bass have been conducted along the Atlantic coast in conjunction with the Emergency Striped Bass Research

Study (Anonymous 1980-1985). Indications are that salinity levels of 2 to 5 ppm are effective in buffering the effects of insecticides when striped bass were exposed to up to four times the estimated environmental concentrations of those contaminants. A major cause of mortality to striped bass reported by those studies was aluminum toxicity. Another important finding was that low pH values play a significant role in intensifying the lethal effects of aluminum and other inorganic contaminants.

As evidenced in Tables 9 and 10, the primary contaminants identified from the analysis of fish flesh were pesticides of the family of chlorinated hydrocarbons; however, for 83% of those contaminants reported in Tables 9 and 10 there was either no residue or detectable residue in at least one sample. This would indicate that in the majority of cases from the rivers listed in Tables 9 and 10, survival of striped bass is not threatened by those contaminants. In cases where salinity is encountered, the margin of safety would even be higher.

As evidenced in Table 11, aluminum was not listed as a contaminant found in the fish flesh from those rivers sampled. Other inorganic pollutants appeared to be at relatively low concentrations. Perhaps the pH levels of the rivers studied plays a role in lessening the severity of those inorganic pollutants.

The U.S. Fish and Wildlife Service in Panama City, Florida, has reported that relatively high levels of organochlorines, especially Toxaphene and PCBs, were present in striped bass from the Flint and Apalachicola Rivers in 1986 samples (Unpublised Report, 1988).

The levels found were probably high enough to affect reproduction and/or quality of fry from these fish, although critical levels for these chemicals have not been established. Without this information it is impossible to assess the impact of contaminants on striped bass reproduction in the rivers addressed in this report. For a detailed listing of the toxicity of certain chemicals to striped bass, see Guidelines for Striped Bass Culture (Bonn et al., 1976).

CONCLUSIONS

Tables 14, 15, and 16 provide the results of the analysis of data from the various habitat parameters addressed in this report for eggs and larvae, juveniles, and adults, respectively. The letter Y indicates that conditions fall within the acceptable range for striped bass survival for each particular parameter. The letter N indicates that conditions are not suitable for survival, and M indicates that conditions are marginal. N/A indicates that data for that parameter were not available and consequently point to areas where data collection or dissemination need work. By way of prioritizing the rivers as to their suitability, each habitat parameter listed in Tables 14, 15, and 16 are assigned a maximum value of 1, allowing for a total value for each river of 8. The letter Y = 1.0, M = 0.5, N = 0, and N/A = 0. By adding up the values for each river, a priority class of high, medium, and low can be obtained for values of 5 and 6 for high, 3 and 4 for medium, and 0 to 2 for low. Table 17 provides that priority listing for eggs and larvae, juveniles, adults, and overall.

It is necessary to consult Tables 14, 15, and 16 to ascertain which parameters influenced a particular priority listing. In some cases a priority listing may not accurately reflect habitat conditions. For instance, the Yellow River in Florida received high priority for all categories in Table 17; however, as indicated in Tables 14 and 16, food availability for larvae and adults in not considered satisfactory for survival. Also in some cases, such as the Leaf River, a low priority is assigned to a particular river because of a lack of data. Situations such as these provide indications of research that needs to be conducted prior to any concerted initiative to introduce striped bass into a given river system. The primary lack of data appears to be food availability for all life stages. This is particularly critical for larval striped bass due to their lack of swimming ability. Martin and Setzler-Hamilton (1983) correlated densities of larval striped bass with densities of copepods and cladocerans, two of their preferred food items. If sufficient prey densities are not available at the critical period, larval survival would be decreased.

Referring to Table 2, temperature ranges for most of the rivers listed exceed the upper tolerance limit of adult striped bass during various periods of the summer months. For adult striped bass to survive and reproduce in these rivers during those times, the occurrence of thermal refuges is important. Thermal refuge is loosely defined as a distinct pocket of water within a river or lake that maintains sufficient oxygen levels for survival and a temperature of 22°C or lower during the summer months (F. Ware, personal communication, 1987). Sufficient data are not available to assess the thermal refuge situation in the rivers addressed in this report. This is an area of research that is vital in the effort to determine a river's suitability for holding and sustaining populations of striped bass.

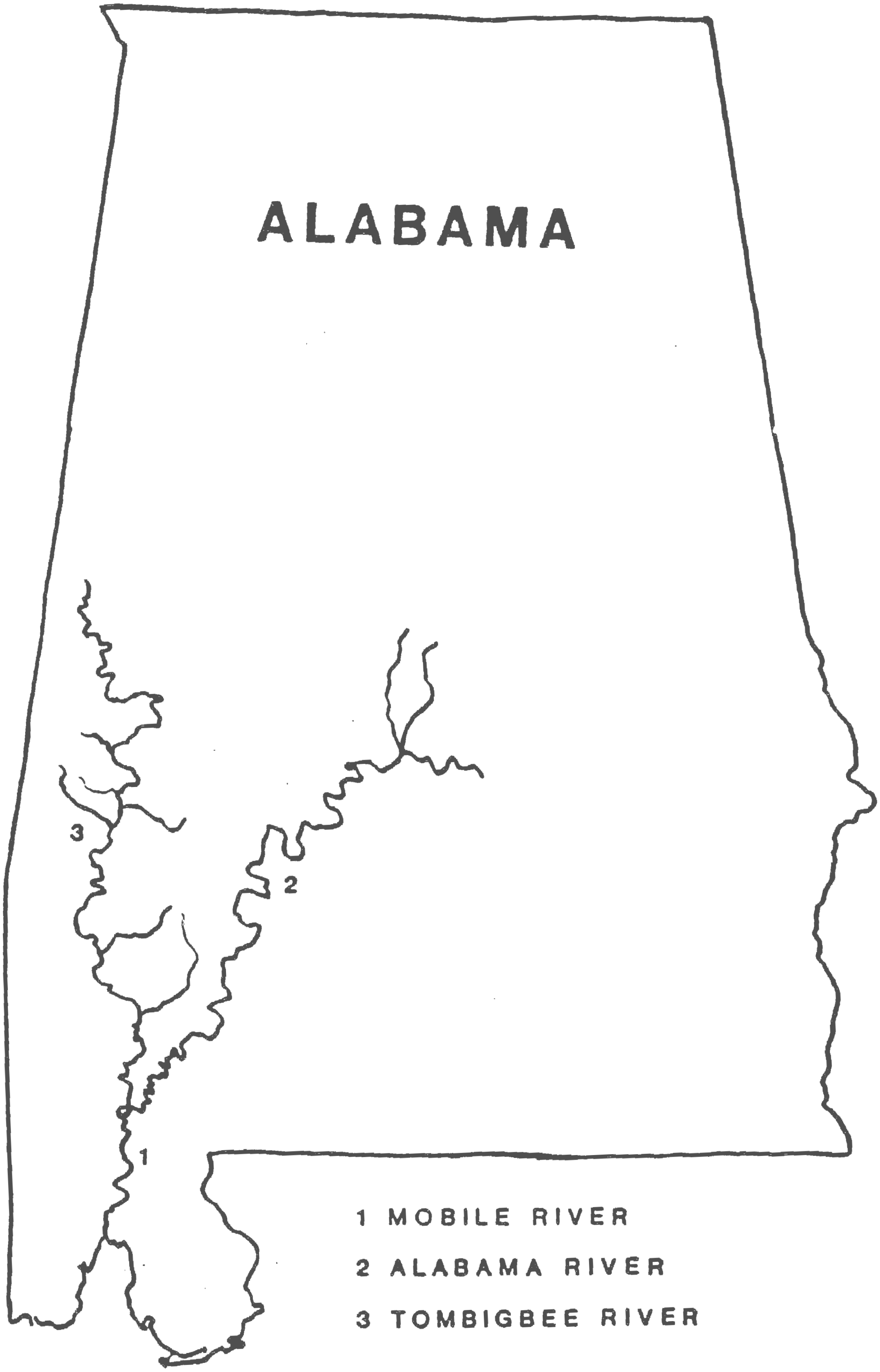

Figure 1. Rivers in Alabama that are addressed in this report.

Figure 2. Rivers in Florida that are addressed in this report.

Figure 3. Rivers in Louisiana that are addressed in this report.

Figure 4. Rivers in Mississippi that are addressed in this report.

Figure 5. Rivers in Texas that are addressed in this report.

Table 1. Station numbers, latitude, and longitude for U.S. Geological Survey stations used in this report (USGS 1985 for all five Gulf States).

State	River	Station No.	Latitude	Longitude
Alabama	Alabama	02429500	31°32'48"	87°30'45"
	Tombigbee	02469762	31°45'30"	88°07'35"
Florida	Apalachicola	02358000	30°42'03"	84°51'33"
	Big Coldwater Creek	02370500	30°42'30"	86°58'20"
	Blackwater	02370000	30°50'00"	86°44'05"
	Chipola	02359000	30°32'02"	85°09'55"
	Choctawhatchee	02365500	30°46'32"	84°49'40"
		02366500	30°27'03"	85°53'54"
	Escambia	02375500	30°57'54"	87°14'03"
	Ochlockonee	02329000	30°33'14"	84°23'03"
	Perdido	02376500	30°41'25"	87°26'25"
	Suwannee	02315500	30°19'32"	82°44'18"
		02315550	30°23'34"	82°56'00"
		02320500	29°57'20"	82°55'40"
		02323500	29°35'22"	82°56'12"
	Yellow/Shoal	02368000	30°45'10"	86°37'45"
		02369000	30°41'50"	86°34'15"
Louisiana	Bayou Laccasine	08012470	30°04'12"	92°52'43"
	Calcasieu	08013000	30°59'45"	92°40'25"
		08013500	30°38'25"	92°48'50"
		08015500	30°30'10"	92°04'55"
	Mermentau	08012150	30°11'23"	92°35'25"
	Whisky Chitto Creek	08014500	30°41'55"	92°53'35"
Mississippi	Biloxi	02481000	30°33'30"	89°07'20"
	Chickasawhay	02477000	32°10'32"	88°49'10"
		02478500	31°08'54"	88°32'52"
	Leaf	02472000	31°42'25"	89°24'25"
		02473000	31°20'33"	89°16'46"
		02474560	31°13'27"	89°03'01"
		02475000	31°06'10"	88°48'30"
	Pascagoula	02479000	30°58'40"	88°43'35"
	Pearl	02486000	32°16'54"	90°10'43"
		02488500	31°33'12"	90°05'16"
	Wolf	02481510	30°29'00"	89°16'28"
Texas	Aransas	08189700	28°16'56"	97°37'14"
	Brazos	08096500	31°32'06"	97°04'22"
		08098290	31°08'02"	96°49'29"
		08109000	30°36'50"	96°29'11"
		08111500	30°07'44"	96°11'15"
		08114000	29°34'56"	95°45'27"
		08116650	29°20'58"	95°34'56"

Table 1. (continued)

State	River	Station No.	Latitude	Longitude
Texas (cont.)	Coleto Creek	08177500	28°43'51"	97°08'18"
	Colorado	08158000	30°14'40"	97°41'39"
		08159200	30°06'20"	97°19'08"
		08161000	29°42'22"	96°32'12"
		08162000	29°18'32"	96°06'13"
		08162500	28°58'26"	96°00'44"
	Copano Creek	08189200	28°18'12"	97°06'44"
	Guadalupe	08167800	29°51'32"	98°10'47"
		08168500	29°42'53"	98°06'35"
		08175800	29°03'57"	97°19'16"
		08176500	28°47'34"	97°00'46"
	Lavaca	08164000	28°57'35"	96°41'10"
	Mission	08189500	28°17'30"	97°16'44"
	Navasota	08110500	31°10'12"	96°17"51"
		08111000	30°52'10"	96°11'32"
	Neches	08040500	30°47'36"	94°10'28"
		08041000	30°21'20"	94°05'35"
	Nueces	08211000	28°02'17"	97°51'36"
	Sabine	08026000	31°03'50"	93°31'10"
		08028500	30°44'49"	93°36'30"
		08030500	30°18'13"	93°44'37"
	San Antonio	08178000	29°28'24"	98°28'26"
		08181800	29°13'19"	98°21'20"
	San Bernard	08117500	29°18'47"	95°53'36"
	San Marcos	08170000	29°52'06"	97°55'38"
		08172000	29°39'54"	97°38'59"
	Trinity	08066250	30°34'19"	94°56'55"
		08066500	30°25'30"	94°51'02"
		08067000	30°03'27"	94°49'05"
	Yegua Creek	08110000	30°19'18"	96°30'26"

Table 2. Ranges in values and mean values for velocity (feet per second), discharge (cubic feet per second), temperature (°C), dissolved oxygen (parts per million), and pH (standard units) from U.S. Geological Survey stations on rivers in states bordering on the Gulf of Mexico.[1]

		VELOCITY[2]				DISCHARGE				TEMPERATURE				DISSOLVED OXYGEN				pH			
		Values[3]		$\overline{X}$[4]		Values		$\overline{X}$		Values		$\overline{X}$		Values		$\overline{X}$		Values		$\overline{X}$	
State	River	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
Alabama[1]	Alabama	-	-	-	-	-	-	-	-	6.5	31.0	19.3	21.0	7.0	12.7	8.6	9.4	6.6	7.8	7.1	7.4
	Tombigbee	0.49	6.70	0.79	5.86	2,296	286,000	5,636	286,000	5.0	33.0	19.5	21.3	7.4	13.4	8.5	9.9	6.4	7.8	6.9	7.6
Florida	Apalachicola	1.00	2.50	1.23	1.87	4,890	63,400	9,043	32,650	7.5	30.0	18.4	20.3	5.9	12.0	8.3	8.9	5.9	8.3	7.0	7.8
	Chipola	1.03	3.70	1.61	2.45	410	8,660	770	2,588	12.0	26.0	19.0	20.3	5.3	9.8	7.8	8.3	6.7	8.4	7.5	8.0
	Choctawhatchee	0.38	2.47	0.79	2.02	840	20,900	2,414	8,763	10.5	31.0	20.4	20.8	5.1	9.3	7.2	7.5	6.2	8.0	6.8	7.6
	Escambia	1.29	2.59	1.46	2.12	935	8,530	1,957	5,162	8.0	30.0	18.4	21.3	5.3	11.4	8.0	8.6	5.9	7.7	6.7	7.6
	Ochlockonee	0.55	2.19	0.83	1.92	37	30,100	174	3,694	8.0	29.0	18.1	19.8	5.0	10.8	7.5	8.2	4.1	7.9	5.9	6.7
	Perdido	0.88	2.40	1.62	1.95	241	2,780	382	902	9.0	26.5	17.2	19.7	5.1	11.6	7.2	8.8	3.9	7.4	5.4	6.0
	Suwannee	0.19	3.12	0.95	2.23	27	42,000	553	14,785	9.0	26.0	18.7	22.1	4.6	10.2	6.5	6.7	5.8	8.2	6.9	8.0
	Yellow	0.75	2.27	1.25	1.64	235	10,400	580	2,073	9.0	27.0	18.8	23.1	5.3	10.7	7.7	8.5	5.6	7.6	6.6	7.4
Louisiana	Calcasieu	0.23	2.65	0.45	1.70	23	7,830	55	2,256	4.5	30.0	18.2	22.4	4.6	13.5	7.9	8.8	5.2	7.4	5.9	6.9
	Mermentau	0.02	2.55	0.12	0.76	210	49,400	1,224	12,012	7.0	31.0	18.4	23.8	7.0	9.9	2.5	6.3	5.6	7.4	6.3	7.2

Table 2. (continued)

		VELOCITY[2]				DISCHARGE				TEMPERATURE				DISSOLVED OXYGEN				pH			
		Values[3]		$\bar{X}$[4]		Values		$\bar{X}$		Values		$\bar{X}$		Values		$\bar{X}$		Values		$\bar{X}$	
State	River	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MA[illegible]
Mississippi	Biloxi	0.17	3.65	1.20	2.20	3	6,330	77	1,069	9.5	30.3	9.9	27.9	4.9	10.0	5.7	9.7	4.0	6.5	4.2	5.[illegible]
	Chickasawhay	0.54	3.98	1.30	2.70	68	32,500	503	7,889	10.6	29.0	11.7	27.9	4.6	12.2	6.0	10.7	5.9	7.4	6.2	7.[illegible]
	Leaf	0.13	3.95	1.20	2.20	88	72,800	326	13,826	-	-	-	-	-	-	-	-	-	-	-	-
	Pascagoula	0.67	4.15	1.30	1.90	1,350	125,000	4,094	21,045	9.5	30.5	11.2	29.3	6.1	9.8	6.6	9.5	5.2	7.6	6.3	7.[illegible]
	Pearl	0.14	4.58	1.00	2.40	56	79,300	1,997	28,694	12.0	31.1	12.8	30.2	6.1	9.5	6.2	9.0	6.1	7.1	6.4	6.[illegible]
	Wolf/Jourdan	0.10	5.44	1.70	2.30	42	18,400	275	2,448	9.5	31.0	10.2	28.0	5.6	11.0	6.3	10.2	4.6	6.9	4.7	6.[illegible]
Texas	Brazos	0.18	5.38	0.59	2.84	23	84,900	424	25,663	7.5	31.5	20.1	21.3	5.4	14.9	8.7	9.1	6.7	8.7	7.8	8.1
	Colorado	0.24	5.37	0.85	4.14	9	51,000	455	7,646	6.0	30.0	18.7	20.4	2.6	15.0	8.6	9.3	7.1	8.7	7.6	8.3
	Copano Creek	0.07	2.32	0.59	1.24	<1	1,070	1	230	5.0	32.0	9.5[5]	32.0[5]	3.0	11.6	4.3[5]	9.8[5]	6.2	8.3	7.1[6]	7.1
	Guadalupe	0.30	3.84	0.82	2.55	16	116,000	49	24,416	7.0	32.0	15.3	21.7	5.6	12.0	8.0	10.3	7.3	9.0	7.8	8.2
	Lavaca	0.61	2.25	0.87	1.55	7	793	40	177	6.5	31.5	11.5[5]	22.0[5]	6.4	10.8	6.9[5]	10.5[5]	7.6	8.3	8.1[6]	8.1
	Mission	0.21	2.28	0.30	1.27	22	5,940	77	1,477	9.5	31.5	15.5[5]	30.5[5]	4.9	12.5	7.3[5]	11.0[5]	7.0	8.6	7.8[6]	7.8
	Navasota	0.28	1.72	0.63	1.30	3	9,770	14	1,776	6.0	32.5	19.3	21.2	4.9	11.0	4.9[5]	11.0[5]	6.4	7.4	6.9[6]	6.9
	Neches	0.46	4.10	1.27	2.46	284	17,200	1,908	6,662	4.0	32.0	20.4	21.2	6.2	13.0	7.4	12.6	6.2	7.6	7.0[6]	7.0
	Nueces	0.39	2.00	1.00	1.54	22	5,940	77	1,477	9.5	31.5	15.5[5]	30.5[5]	4.9	12.5	7.3[5]	11.0[5]	7.0	8.6	7.8[5]	8.2
	Sabine	0.46	4.10	1.27	2.46	239	30,800	1,233	9,916	8.0	30.5	20.0	20.7	5.8	6.9	8.8	8.9	6.2	6.4	6.8	7.0
	San Antonio	0.24	3.55	0.72	1.40	<1	17,800	21	3,727	9.0	32.0	22.0	23.4	2.5	19.8	4.7	9.5	7.3	8.9	7.7	8.1

Table 2. (continued)

State	River	VELOCITY[2] Values[3] MIN	MAX	X̄[4] MIN	MAX	DISCHARGE Values MIN	MAX	X̄ MIN	MAX	TEMPERATURE Values MIN	MAX	X̄ MIN	MAX	DISSOLVED OXYGEN Values MIN	MAX	X̄ MIN	MAX	pH Values MIN	MAX	X̄ MIN	MAX
	San Bernard	0.57	2.05	0.96	1.39	29	4,000	241	778	12.0	30.0	13.5[5]	29.5[5]	5.5	11.8	6.0[5]	9.9[5]	6.6	8.3	7.6[6]	7.6[6]
	San Marcos	1.13	4.43	1.73	3.63	82	37,700	115	4,439	11.5	30.0	14.0[5]	29.0[5]	-	-	-	-	7.3	8.6	8.2[6]	8.2[6]
	Trinity	0.23	3.49	0.72	2.72	685	47,700	1,975	26,638	8.5	30.0	10.5[5]	29.0[5]	6.9	12.5	8.7[5]	11.9[5]	6.5	8.8	7.9[5]	8.4[5]
	Yegua Creek	0.22	3.83	0.71	1.11	<1	1,620	75	466	12.5	31.5	14.0[5]	30.0[5]	4.8	11.3	6.9[5]	11.2[5]	7.1	8.5	7.5[6]	7.5[6]

[1]United States Geological Survey, 1979-1986

[2]Reported as a Mean Value of a Cross-section of the River

[3]Range of Measurements Over the Reporting Period

[4]Range of Annual Mean Values of Reporting Period Except Where Indicated

[5]Monthly Mean Values for the Reporting Period

[6]Overall Mean Value for the Reporting Period

Table 3. Reporting periods for data which appear in Table 2.

State	River	Velocity/ Discharge	Temperature, DO, pH	All Data Except pH	pH Only	All Data
Alabama	Alabama River					1980-1986
	Tombigbee River	1966-1983	1980-1986			
Florida	Apalachicola River	1980-1987	1979, 1980, 1985			
	Chipola River	1980-1986	1979, 1980, 1985			
	Choctawhatchee River	1980-1987	1979, 1980, 1985			
	Escambia River	1980-1987	1979-1986			
	Ochlockonee River	1980-1987	1979, 1980, 1985			
	Perdido River	1980-1987	1979-1986			
	Suwannee River	1980-1986	1979, 1980, 1985			
	Yellow River	1980-1987	1979-1986			
Louisiana	Calcasieu River					1980-1987
	Mermentau River	1984-1986	1980-1987			
Mississippi	Biloxi River					1980-1986
	Chickasawhay River	1980-1986	1984-1986			

Table 3. (continued)

State	River	Velocity/ Discharge	Temperature, DO, pH	All Data Except pH	pH Only	All Data
	Leaf River					1980-1986
	Pascagoula River	1980-1986	1984-1986			
	Pearl River	1980-1986	1984-1986			
Texas	Brazos River	1978-1985	1979-1985			
	Colorado River	1980-1985	1979-1985			
	Copano Creek	1979-1984	1979-1985			
	Guadalupe River	1978-1985	1979-1985			
	Lavaca River	1982-1986	1979-1985			
	Mission River	1980-1985	1979-1985			
	Navasota River	1981-1985	1979-1985			
	Neches River	1981-1985	1979-1985			
	Nueces River	1977-1985	1979-1985			
	Sabine River	1981-1985	1979-1985			
	San Antonio River	1981-1985	1979-1985			
	San Bernard River	1983-1985	1979-1985			
	San Marcos River			1979-1985	1981-1985	
	Trinity River	1975-1985	1979-1985			
	Yegua Creek	1982-1985	1979-1985			

Table 4. Range and mean of temperature (°C), dissolved oxygen (ppm), and pH (standard units) for the months of March and April reported by the U.S. Geological Survey from various stations on rivers in states bordering the Gulf of Mexico.

			TEMPERATURE			DISSOLVED OXYGEN			pH		
State	River	Reporting Period	MIN	MAX	$\overline{X}$	MIN	MAX	$\overline{X}$	MIN	MAX	$\overline{X}$
Alabama	Alabama	1980-1986	14.0	20.0	17.4	8.0	9.8	8.8	6.7	7.6	7.2
	Tombigee	1980-1986	14.0	20.0	16.8	7.7	11.2	9.5	6.7	7.6	7.5
Florida	Apalachicola	1979-1984	13.0	21.0	16.9	8.0	10.6	8.5	5.9	7.7	7.0
	Chipola	1980-1984	16.0	22.0	18.8	6.2	8.6	7.6	7.1	8.0	7.7
	Choctawhatchee	1979-1986	13.5	23.0	18.8	6.2	9.8	7.5	6.3	7.7	7.3
	Escambia	1979-1986	13.5	23.0	18.3	6.7	8.8	8.0	6.1	7.7	7.0
	Ochlockonee	1979-1980	13.0	20.0	16.6	6.0	9.6	7.4	6.0	7.4	6.5
	Perdido	1979-1986	14.0	21.0	17.5	7.6	9.6	8.6	4.2	6.1	5.3
	Suwanee	1979-1986	16.0	23.5	19.3	4.8	8.8	6.2	5.2	8.2	6.8
	Yellow	1979-1986	11.0	19.0	16.7	7.8	8.8	8.4	5.6	7.4	6.7
Louisiana	Calcasieu	1985	17.0	18.5	17.8	7.7	8.0	7.9	5.5	5.7	5.6
	Mermentau	1985	23	23	23	3.7	3.7	3.7	7.2	7.2	7.2
Mississippi	Pascagoula	1984-1986	18.0	23.0	20.5	7.1	8.0	7.7	6.3	6.9	6.7
	Wolf	1984-1986	19.5	20.5	19.8	8.7	10.1	9.3	5.1	6.2	5.8
Texas	Brazos	1980-1984	13.0	25.0	18.5	6.5	12.7	10.5	7.5	8.4	8.0
	Colorado	1980-1985	13.0	24.0	19.2	6.6	13.8	6.0	7.1	8.5	7.9
	Copano Creek	1980-1985	14.5	25.5	21.3	3.6	9.6	6.9	7.6	8.3	7.9
	Guadalupe	1980-1985	13.5	23.0	19.7	7.1	9.2	7.9	7.6	8.3	8.1
	Lavaca	1980-1985	20.0	25.0	22.0	7.7	9.0	8.4	7.8	8.4	8.1
	Mission	1980-1984	21.0	24.0	22.6	7.1	9.4	8.6	7.8	8.0	7.9
	Navasota	1980-1983	12.0	23.0	17.3	8.2	10.0	9.5	7.0	8.5	7.8
	Neches	1980-1985	13.0	20.0	17.5	7.4	12.8	10.0	6.7	7.5	7.0
	Nueces	1983-1984	20.5	22.5	21.5	-	-	-	8.2	8.2	8.2
	Sabine	1980-1985	7.0	25.0	16.4	7.4	11.0	9.1	6.5	13.0	7.5
	San Antonio	1980-1985	14.0	25.0	21.1	3.3	10.2	5.6	7.4	7.9	7.7
	San Bernard	1980-1985	16.0	21.0	18.9	7.4	8.6	8.4	7.5	8.3	7.9
	San Marcos	1980-1985	18.5	24.0	21.4	-	-	-	8.2	8.3	8.3
	Trinity	1980-1985	10.0	21.0	15.8	8.6	12.2	10.8	7.6	8.4	8.0
	Yegua Creek	1980-1985	14.0	25.5	20.1	4.8	8.8	6.6	7.3	7.6	7.5

Table 5. Regression models to predict velocity for coastal rivers for states bordering on the Gulf of Mexico. Station numbers represent designated stations of the U.S. Geological Survey.

State	River	Station No.	Model[1]	Correlation Coefficient[2] (r)
Alabama	Tombigbee	02469762	$V=1.09+2.77x10^{-5}(D)$	0.93
Florida	Apalachicola	02358000	$V=1.12+2.42x10^{-5}(D)$	0.74
	Big Coldwater	02370500	$V=1.51+2.68x10^{-4}(D)$	0.28
	Blackwater	02370000[3]	$V=0.90+1.96x10^{-3}(D)$	0.85
	Chipola	02359000	$V=1.57+2.75x10^{-4}(D)$	0.80
	Choctawhatchee	02365500	$V=0.53+1.0x10^{-4}(D)$	0.94
	Escambia	02375500	$V=1.39+1.43x10^{-4}(D)$	0.81
	Ochlockonee	02329000	$V=0.9+3.8x10^{-5}(D)$	0.67
	Perdido	02376500	$V=1.72+1.9x10^{-4}(D)$	0.41
	Shoal	02369000	$V=0.09(D)^{0.06}$	0.18
	Suwannee	02315500	$V=0.96+1.67x10^{-4}(D)$	0.68
		02315550	$V=1.39+5.82x10^{-5}(D)$	0.52
		02320500	$V=1.28+5.73x10^{-5}(D)$	0.87
		02323500	$V=0.86+5.73x10^{-5}(D)$	0.84
	Yellow	02368000	$V=1.36+2.25x10^{-4}(D)$	0.31
Louisiana	Bayou Laccasine	08012470	$V=0.06+1.43x10^{-4}(D)$	0.99
	Calcasieu	08013000	$V=1.29 +1.76x10^{-4}(D)$	0.48
		08013500	$V=1.23+3.1x10^{-4}(D)$	0.64
		08015500[4]	$V=0.62+6.29x10^{-4}(D)$	0.57
	Mermentau	08012150	$V=0.19+5.32x10^{-5}(D)$	0.92
	Whisky Chitto Creek	08014500[5]	$V=1.04+1.28x10^{-3}(D)$	0.36
Mississippi	Biloxi	02481000	$V=1.07(D)^{0.31}$	0.84
	Chickasawhay	02477000	$V=1.9+5.55x10^{-4}(D)$	0.67
		02478500	$V=1.08+1.55x10^{-4}(D)$	0.85
	Leaf	02472000	$V=1.05+3.99x10^{-4}(D)$	0.80
		02473000	$V=1.05+1.39x10^{-4}(D)$	0.42
		02474560	$V=0.97+9.33x10^{-5}(D)$	0.72
		02475000	$V=1.04+1.95x10^{-4}(D)$	0.91

Table 5. (continued)

State	River	Station No.	Model[1]	Correlation Coefficient[2] (r)
	Pascagoula	02479000	$V=0.88+9.97x10^{-5}(D)$	0.96
	Pearl	02486000	$V=1.41+1.69x10^{-5}(D)$	0.62
		02488500	$V=1.13+5.06x10^{-5}(D)$	0.88
	Wolf	02481510	$V=1.66+5.17x10^{-4}(D)$	0.79
Texas	Aransas	08189700	$V=0.35(D)^{0.5}$	0.83
	Brazos	08096500	$V=0.13(D)^{0.31}$	0.76
		08098290	$V=0.13(D)^{0.38}$	0.97
		08109000	$V=1.08+1.95x10^{-4}(D)$	0.93
		08111500	$V=0.07(D)^{0.39}$	0.97
		08114000	$V=0.67+1.14x10^{-4}(D)$	0.87
		08116650	$V=1.42+1.06x10^{-4}(D)$	0.89
	Coleto Creek	08177500	$V=0.86+4.1x10^{-4}(D)$	0.69
	Colorado	08159200	$V=1.78+4.62x10^{-5}(D)$	0.40
		08161000	$V=0.003(D)^{0.80}$	0.94
		08162000	$V=0.42(D)^{0.22}$	0.91
		08162500	$V=1.40+2.30x10^{-4}(D)$	0.76
	Copano Creek	08189200	$V=0.35(D)^{0.30}$	0.82
	Guadalupe	08167800	$V=0.47(D)^{0.27}$	0.86
		08168500[6,7]	$V=0.67+3.62x10^{-3}(D)$	0.83
			$V=0.02(D)^{0.67}$	0.58
		08175800	$V=0.26(D)^{0.28}$	0.52
		08176500	$V=0.04(D)^{0.53}$	0.97
	Lavaca	08164000	$V=0.52(D)^{0.22}$	0.69
	Mission	08189500	$V=0.73+9.4x10^{-3}(D)$	0.58
	Navasota	08110500	$V=0.82+7.47x10^{-3}(D)$	0.77
		08111000	$V=0.67+1.35x10^{-4}(D)$	0.57
	Neches	08040500	$V=0.06(D)^{0.41}$	0.81
		08041000	$^{1}/V=0.52+1.99x10^{-5}(D)$	0.38
	Nueces	08211000	$V=0.21(D)^{0.35}$	0.72

Table 5. (continued)

State	River	Station No.	Model[1]	Correlation Coefficient[2] (r)
	Sabine	08026000	$V=0.10(D)^{0.37}$	0.90
		08028500	$V=0.11(D)^{0.33}$	0.65
		08030500[8,9]	$V=1.16+2.95\times10^{-4}(D)$	0.86
			$V=0.55+1.01\times10^{-4}(D)$	0.95
	San Antonio	08178000	$V=0.36(D)^{0.30}$	0.83
		08181800	$V=0.18(D)^{0.27}$	0.83
	San Bernard	08117500	$V=0.36(D)^{0.22}$	0.80
	San Marcos	08172000	$V=1.75+3.31\times10^{-3}(D)$	0.72
	Trinity	08066250	$V=0.95+1.26\times10^{-4}(D)$	0.89
		08066500	$V=0.93+9.98\times10^{-5}(D)$	0.85
		08067000	$V=1.02+5.72\times10^{-5}(D)$	0.95
	Yegua Creek	08110000	$V=0.74(D)^{0.03}$	0.19

[1] V = velocity, D = discharge
[2] Significant at 0.05
[3] for discharges < 800 cfs
[4] for discharges > 100 cfs
[5] for discharges < 450 cfs
[6] for discharges < 400 cfs
[7] for discharges > 400 cfs
[8] for discharges < 3500 cfs
[9] for discharges > 3500 cfs

Table 6. River discharge in cubic feet per second at duration percentages of 95, 75, and 50, and period of record for the months of March and April.[1]

River	Station No.	Period of Record (yrs)	MARCH 95%	MARCH 75%	MARCH 50%	APRIL 95%	APRIL 75%	APRIL 50%
Tombigbee	02469762	25	14,600	27,500	50,700	6,550	18,200	50,600
Apalachicola	02358000	57	14,800	22,700	33,400	13,400	19,700	30,000
Big Coldwater Creek	02370500	47	284	405	527	269	360	460
Blackwater	02370000	35	132	246	363	107	186	265
Chipola	02359000	73	883	1,450	2,010	797	1,160	1,740
Choctawhatchee	02365500	56	3,280	5,350	7,670	2,290	4,100	6,190
Choctawhatchee	02366500	55	4,450	6,900	9,630	3,450	5,580	8,190
Escambia	02375500	51	3,290	5,710	9,310	2,430	4,560	7,530
Ochlockonee	02329000	59	318	792	1,510	206	484	1,160
Perdido	02376500	44	334	513	725	305	430	592
Shoal	02369000	47	493	848	1,150	470	725	989
Suwannee	02315500	79	70.9	624	1,790	44.8	403	1,370
Suwannee	02315550	11	590	1,630	3,300	472	916	1,810
Suwannee	02320500	54	2,650	5,270	9,210	2,630	5,160	8,910
Suwannee	02323500	55	5,180	8,600	13,000	5,230	8,440	13,100
Yellow	02368000	47	604	1,020	1,470	471	790	1,210
Bayou Laccasine	08012470	1	0.01	0.04	0.08	0.01	0.04	60.0
Calcasieu	08013000	42	115	320	702	71.3	143	368
Calcasieu	08013500	63	199	582	1,320	134	305	827
Calcasieu	08015500	63	685	1,370	2,560	536	925	1,790
Mermentau	08012150	2	0.17	48.0	643.0	0.61	0.78	577.0
Whisky Chitto Creek	08014500	47	264	424	672	224	337	514
Biloxi	02481000	33	32.6	79.9	149	13.8	36	81.2
Chickasawhay	02477000	47	509	965	1,730	343	639	1,250
Chickasawhay	02478500	47	1,790	3,510	6,270	1,430	2,600	4,920
Leaf	02472000	47	320	668	1,260	254	456	849
Leaf	02473000	47	1,090	1,940	3,280	942	1,470	2,390

Table 6. (continued)

River	Station No.	Period of Record (yrs)	MARCH 95%	MARCH 75%	MARCH 50%	APRIL 95%	APRIL 75%	APRIL 50%
Leaf	02474560	2	1,500	2,910	4,230	1,330	1,690	2,210
Leaf	02475000	46	2,240	4,230	7,860	1,810	3,000	5,790
Pascagoula	02479000	55	4,700	8,560	15,500	3,820	6,600	12,700
Pearl	02486000	80	1,260	3,540	6,800	657	2,250	5,820
Pearl	02488500	47	3,050	6,680	12,500	1,630	4,600	9,900
Wolf	02481510	14	167	322	548	104	187	400
Aransas	08189700	21	0.56	1.6	3.8	0.29	1.6	3.6
Brazos	08096500	80	45.2	210	662	82.3	338	841
Brazos	08098290	20	87.3	410	1,050	155	557	1,090
Brazos	08109000	68	255	801	2,070	302	998	2,570
Brazos	08111500	47	486	1,280	2,810	573	1,380	3,370
Brazos	08114000	80	552	1,700	4,060	520	1,560	3,780
Brazos	08116650	18	679	1,980	5,680	136	1,410	5,190
Coleto Creek	08177500	46	2.5	5.2	8.3	2.4	4.8	7.7
Colorado	08159200	26	171	377	839	536	1,290	1,770
Colorado	08161000	69	272	604	1,210	374	981	1,670
Colorado	08162000	47	318	623	1,230	469	829	1,520
Colorado	08162500	37	122	431	949	20	337	973
Copano Creek	08189200	15	0.00	0.01	0.12	0.00	0.00	0.01
Guadalupe	08167800	26	82.1	133	248	60	134	249
Guadalupe	08168500	58	41.7	114	274	41.7	118	264
Guadalupe	08175800	22	490	835	1,230	394	764	1,240
Guadalupe	08176500	51	331	679	1,120	347	655	1,150
Lavaca	08164000	47	13.8	38.7	76.4	12.6	35.6	74.1
Mission	08189500	46	2.9	4.9	11.8	2.2	4.7	10.9
Navasota	08110500	61	8.7	28.3	81.1	6.6	27.2	73.0
Navasota	08111000	35	32.3	63.4	143	18.7	54.1	125
Neches	08040500	34	966	1,990	4,490	1,090	2,330	4,530
Neches	08041000	80	1,450	3,390	7,990	1,440	3,440	7,000
Nueces	08211000	46	36	66.2	97.7	37.3	72.6	109
Sabine	08026000	30	288	1,750	5,580	208	756	3,520
Sabine	08028500	62	1,340	4,050	9,380	865	2,810	7,110
Sabine	08030500	61	2,030	5,540	11,500	1,280	4,070	9,170

Table 6. (continued)

River	Station No.	Period of Record (yrs)	MARCH 95%	MARCH 75%	MARCH 50%	APRIL 95%	APRIL 75%	APRIL 50%
San Antonio	08178000	71	8.2	17.2	32	8.9	16.7	31.7
San Antonio	08181800	23	127	221	322	130	213	298
San Bernard	08117500	31	7.9	26.5	48	9.6	24.9	53.9
San Marcos	08172000	46	86.3	142	228	88.3	140	259
Trinity	08066250	20	742	1,860	4,730	1,110	1,720	4,070
Trinity	08066500	61	719	2,030	5,420	797	1,960	4,750
Trinity	08067000	1	3,300	4,750	7,120	5,330	17,000	29,300
Yegua Creek	08110000	61	0.33	3.3	37.3	0.21	5.1	33.3

[1]Data taken from duration tables provided by the U.S. Geological Survey (L. Pearman, personal communication, 1988).

Table 7. Estimated river velocity in[1] feet per second during March and April using regression models developed for each river (Table 5).

River	Station No.	Period of Record (yrs)	MARCH 95%	MARCH 75%	MARCH 50%	APRIL 95%	APRIL 75%	APRIL 50%
Tombigbee	02469762	25	1.49	1.85	2.49	1.27	1.59	2.48
Apalachicola	02358000	57	1.48	1.67	1.93	1.44	1.60	1.85
Big Coldwater Creek	02370500	47	1.58	1.61	1.63	1.59	1.62	1.65
Blackwater[2]	02370000	35	1.56	1.38	1.61	1.11	1.26	1.42
Chipola	02359000	73	1.81	1.97	2.12	1.79	1.89	2.05
Choctawhatchee	02365500	56	0.86	1.07	1.30	0.56	0.94	1.15
Choctawhatchee	02366500	55	1.27	1.69	2.17	1.10	1.47	1.92
Escambia	02375500	51	1.86	2.21	2.72	1.74	2.04	2.47
Ochlockonee	02329000	59	0.91	0.93	0.96	0.91	0.92	0.94
Perdido	02376500	44	1.78	1.82	1.86	1.78	1.80	1.83
Shoal	02369000	47	0.13	0.13	0.14	0.13	0.13	0.14
Suwannee	02315500	79	0.97	1.06	1.26	0.97	1.03	1.19
Suwannee	02315550	11	1.42	1.48	1.58	1.42	1.44	1.50
Suwannee	02320500	54	1.43	1.58	1.81	1.43	1.58	1.79
Suwannee	02323500	55	1.16	1.35	1.60	1.16	1.34	1.61
Yellow	02368000	47	1.50	1.59	1.69	1.47	1.54	1.63
Bayou Laccasine	08012470	1	0.06	0.06	0.06	0.06	0.06	0.07
Calcasieu	08013000	42	1.31	1.35	1.41	1.30	1.32	1.35
Calcasieu	08013500	63	0.83	0.89	1.02	0.82	0.85	0.94
Calcasieu	08015500	63	1.05	1.48	2.23	0.96	1.20	1.75
Mermentau	08012150	2	0.19	0.19	0.22	0.19	0.19	0.22
Whisky Chitto Creek	08014500	47	1.38	1.58	1.90	1.33	1.47	1.70
Biloxi	02481000	33	3.15	4.16	5.05	2.41	3.25	4.18
Chickasawhay	02477000	47	2.18	2.43	2.87	2.09	2.25	2.59
Chickasawhay	02478500	47	1.36	1.62	2.05	1.30	1.48	1.84
Leaf	02472000	47	1.18	1.32	1.55	1.15	1.23	1.39
Leaf	02473000	47	1.20	1.32	1.51	1.18	1.25	1.38

Table 7. (continued)

River	Station No.	Period of Record (yrs)	MARCH 95%	MARCH 75%	MARCH 50%	APRIL 95%	APRIL 75%	APRIL 50%
Leaf	02474560	2	1.11	1.24	1.36	1.09	1.13	1.18
Leaf	02475000	46	1.48	1.86	2.57	1.39	1.63	2.17
Pascagoula	02479000	55	1.35	1.73	2.43	1.26	1.54	2.15
Pearl	02486000	80	1.43	1.47	1.52	1.42	1.45	1.50
Pearl	02488500	47	1.28	1.47	1.76	1.21	1.36	1.63
Wolf	02481510	14	1.75	1.83	1.94	1.71	1.76	1.87
Aransas	08189700	21	0.26	0.44	0.68	0.19	0.44	0.66
Brazos	08096500	80	0.42	0.68	0.97	0.51	0.79	1.05
Brazos	08098290	20	0.71	1.28	1.83	0.88	1.44	1.85
Brazos	08109000	68	1.13	1.24	1.48	1.14	1.27	1.58
Brazos	08111500	47	0.78	1.14	1.55	0.83	1.17	1.66
Brazos	08114000	80	0.73	0.86	1.13	0.80	0.85	1.10
Brazos	08116650	18	1.49	1.63	2.02	1.43	1.57	1.97
Coleto Creek	08177500	46	0.86	0.86	0.86	0.86	0.86	0.86
Colorado	08159200	26	1.79	1.80	1.83	1.81	1.86	1.89
Colorado	08161000	69	0.27	0.50	0.88	0.34	0.74	1.13
Colorado	08162000	47	1.49	1.73	2.01	1.63	1.84	2.11
Colorado	08162500	37	1.43	1.50	1.62	1.40	1.48	1.62
Copano Creek	08189200	15	0	0.09	0.19	0	0	0.09
Guadalupe	08167800	26	1.55	1.76	2.08	1.42	1.76	2.08
Guadalupe[5]	08168500	58	0.82	1.08	1.66	0.82	1.10	1.63
Guadalupe	08175800	22	1.47	1.71	1.91	1.39	1.67	1.91
Guadalupe	08176500	51	0.87	1.27	1.65	0.89	1.24	1.68
Lavaca	08164000	47	0.93	1.16	1.35	0.91	1.14	1.34
Mission	08189500	46	0.76	0.78	0.84	0.75	0.77	0.83
Navasota	08110500	61	0.88	1.03	1.43	0.87	1.02	1.37
Navasota	08111000	35	0.67	0.68	0.69	0.67	0.68	0.69
Neches	08040500	34	1.00	1.35	1.89	1.06	1.44	1.89
Neches	08041000	80	1.81	1.69	1.47	1.81	1.69	1.52
Nueces	08211000	46	0.74	0.91	1.04	0.74	0.94	1.08
Sabine	08026000	30	0.81	1.58	2.43	0.72	1.16	2.05
Sabine	08028500	62	1.18	1.71	2.25	1.02	1.51	2.05
Sabine	08030500	61	1.76[3]	1.11[4]	1.71[4]	1.54[3]	0.96[4]	1.48[4]

Table 7. (continued)

River	Station No.	Period of Record (yrs)	MARCH 95%	MARCH 75%	MARCH 50%	APRIL 95%	APRIL 75%	APRIL 50%
San Antonio	08178000	71	0.68	0.85	1.02	0.69	0.84	1.01
San Antonio	08181800	23	0.67	0.77	0.86	0.67	0.77	0.84
San Bernard	08117500	31	0.57	0.74	0.84	0.59	0.73	0.87
San Marcos	08172000	46	2.04	2.22	2.50	2.04	2.21	2.61
Trinity	08066250	20	1.04	1.18	1.55	1.09	1.17	1.46
Trinity	08066500	61	1.00	1.13	1.47	1.01	1.13	1.40
Trinity	08067000	1	1.21	1.28	1.43	1.32	1.99	2.70
Yegua Creek	08110000	61	0.72	0.77	0.82	0.71	0.78	0.82

[1]Percentages indicate discharge values used in the regression models at a specific level or above (Table 6).
[2]For discharges < 800 cfs
[3]For discharges < 3500 cfs
[4]For discharges > 3500 cfs
[5]For discharges < 400 cfs

Table 8. Range of discharge values from U.S. Geological Survey stations used to develop regression models (cubic feet per second).

State	River	Station No.	Minimum	Maximum
Alabama	Tombigee	02469762	2,296	186,000
Florida	Apalachicola	02358000	4,590	50,500
	Big Coldwater Creek	02370500	227	936
	Blackwater	02370500	92	428
	Chipola	02359000	410	8,660
	Choctawhatchee	02365500	840	20,900
		02366500	1,440	10,000
	Escambia	02375500	935	8,380
	Ochlockonee	02329000	37	30,100
	Perdido	02376500	261	2,780
	Shoal	02369000	351	2,400
	Suwannee	02315500	27	13,800
		02315550	186	13,600
		02320500	2,010	42,000
		02323500	3,760	28,700
	Yellow	02368000	235	2,270
Louisiana	Bayou Laccasine	08012470	149	7,880
	Calcasieu	08013000	33	2,920
		08013500	239	937
		08015500	133	404
	Mermentau	08012150	210	49,400
	Whisky Chitto Creek	08014500	127	404
Mississippi	Biloxi	02481000	3	6,330
	Chickasawhay	02477000	68	5,240
		02478500	502	16,900
	Leaf	02472000	88	4,920
		02473000	438	8,890
		02474560	986	27,000
		02475000	722	14,600
	Pascagoula	02479000	1,550	27,500
	Pearl	02486000	56	75,900
		02488500	439	79,300
	Wolf	02481510	42	8,570
Texas	Aransas	08189700	1	1,200
	Brazos	08096500	23	21,200
		08098290	27	17,600
		08109000	216	25,600
		08111500	645	12,800
		08114000	709	22,700
		08116650	114	20,500

Table 8. (continued)

State	River	Station No.	Minimum	Maximum
	Coleto Creek	08177500	3	159
	Colorado	08159200	189	4,240
		08161000	371	4,740
		08162000	382	5,630
		08162500	9	6,890
	Copano Creek	08189200	0	636
	Guadalupe	08167800	23	933
		08168500	16	972
		08175800	82	2,090
		08176500	155	4,540
	Lavaca	08164000	12	285
	Mission	08189500	3	166
	Navasota	08110500	3	129
		08111000	5	924
	Neches	08040500	284	16,200
		08041000	1,920	17,200
	Nueces	08211000	22	990
	Sabine	08026000	239	7,030
		08028500	661	11,300
		08030500	786	18,700
	San Antonio	08178000	1	931
		08181800	153	4,690
	San Bernard	08117500	29	900
	San Marcos	08172000	62	730
	Trinity	08066250	685	22,200
		08066500	689	19,900
		08067000	1,300	47,700
	Yegua Creek	08110000	0	1,620

Table 9. Percentage of samples from National Pesticide Monitoring Program stations equalling or exceeding criteria of the National Academy of Science - National Academy of Engineers for minimum acceptable whole-body residues of contaminants for 1976-1977 (data taken from Schmitt et al, 1983).

River	DDT[1]	PCB[2]	Tox-phene	Diel-drin	Endrin	d-BHC	7-BHC	HCB	Hepta chlor[3]	cis-Chlor-dane	trans-Chlor-dane	cis-Nona-chlor	trans-Nona-chlor	Oxy-Chlor-dane	Dacthal
Alabama	X[4]	100	100	X	1-50	X	0	X	0	X	X	X	X	-[5]	-
Tombigbee	100	1-50	100	X	1-50	X	0	100	X	0	0	0	0	-	-
Apalachicola	X	50-99	100	X	X	X	X	0	X	X	X	X	X	-	-
Brazos	X	X	100	X	0	0	0	X	X	X	X	X	X	-	-
Colorado	X	X	1-50	X	0	0	0	0	0	X	X	0	X	-	-
Nueces	X	0	100	0	0	0	0	0	0	X	0	X	X	-	-
Rio Grande	100	0	100	X	X	X	0	0	X	X	X	0	X	-	-
San Antonio	X	1-50	50-99	X	X	X	0	0	X	X	X	X	X	-	-

[1] Includes DDE, DDD, and DDT
[2] Includes aurochlors 1242, 1248, 1254, and 1260
[3] Includes heptachlor epoxide
[4] Detectable residues present in at least one sample
[5] No data

Table 10. Percentage of samples from National Pesticide Monitoring Program stations equalling or exceeding criteria of the National Academy of Science - National Academy of Engineers for minimum acceptable whole-body residues of contaminants for 1978-1979 (data taken from Schmitt et al, 1983).

River	DDT[1]	PCB[2]	Toxphene	Dieldrin	Endrin	d-BHC	7-BHC	HCB	Hepta chlor[3]	cis-Chlordane	trans-Chlordane	cis-Nonachlor	trans-Nonachlor	Oxy-Chlordane	Dacthal
Alabama	1-50	100	100	X[4]	X	0	0	X	X	1-50	X	0	X	0	0
Tombigbee	1-50	50-99	100	X	X	0	0	X	X	1-50	X	0	X	X	0
Apalachicola	X	1-50	50-99	X	0	0	0	0	X	X	X	X	X	X	0
Brazos	X	X	100	X	0	0	0	1-50	X	1-50	X	X	X	X	0
Colorado	X	X	100	X	0	0	0	0	X	X	X	X	X	0	0
Nueces	X	X	0	0	0	0	0	0	0	X	0	0	0	0	0
Rio Grande	100	1-50	100	X	X	0	0	0	0	X	X	X	X	0	0
San Antonio	X	100	100	X	X	0	0	0	X	X	X	X	X	0	0

[1] Includes DDE, DDD, and DDT
[2] Includes aurochlors 1242, 1248, 1254, and 1260
[3] Includes heptachlor epoxide
[4] Detectable residues present in at least one sample

Table 11. Contaminant levels extracted from various freshwater fish species (not striped bass) in 1984, reported in parts per million.[1,2]

River	DDE	DDD	DDT	Dieldrin	Endrin	Heptachlor	cis Chlordane	trans Chlordane	cis Nonachlor	trans Nonachlor	Oxychlordane	Toxaphene	Alpha BHC	Gamma BHC	Dacthal	HCB	$\bar{X}$ PCBS: Aurochlor 1242, 1248, 1254, 1260	Arsenic	Cadmium	Copper	Mercury	Lead	Selenium	Zinc
Alabama	0.15	0.04	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.30	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.03	0.00	0.00	0.01	1.03
Tombigbee	3.69	0.94	0.45	0.00	0.00	0.00	0.06	0.00	0.02	6.00	0.00	0.27	0.01	0.00	0.00	0.18	0.17	0.00	0.00	0.02	0.01	0.01	0.01	1.07
Apalachicola	0.45	0.09	0.04	0.03	0.00	0.01	0.02	0.01	0.03	0.04	0.00	0.04	0.00	0.00	0.00	0.00	0.13	0.01	0.00	0.02	0.00	0.00	0.01	0.82
Brazos	0.30	0.05	0.02	0.01	0.00	0.01	0.02	0.01	0.01	0.002	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.05	0.00	0.01	0.02	0.98
Nueces	0.15	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.03	0.00	0.01	0.01	0.75
Rio Grande	1.67	0.11	0.05	0.01	0.01	0.00	0.01	0.01	0.01	0.02	0.00	0.38	0.00	0.00	0.21	0.00	0.00	0.02	0.00	0.02	0.00	0.00	0.02	0.90
San Antonio[3]	0.26	0.04	0.02	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.00	0.10	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.02	0.01	0.00	0.02	1.00

[1] Reported here as the mean ($\bar{X}$) value across fish species.
[2] Data taken from Anonymous 1988.
[3] One specie analyzed.

Table 12. Total river miles or river miles below dams (within state) and dams and their locations.[1]

State	River	River Length (within state)	Dam	Latitude Longitude	River Miles Below Dam
Alabama	Alabama/Mobile	-	Claiborne Lock and Dam	31°36'53.64"N 87°33'00.36"W	149
	Tombigbee	-	Coffeeville Lock and Dam	31°45'21.95"N 88°07'41.40"W	148 148
Florida	Apalachicola	-	Jim Woodruff Lock and Dam	30°42'30"N 84°52'00"W	107
	Blackwater	49	-	-	-
	Chipola	84	-	-	-
	Choctawhatchee	125	-	-	-
	Escambia	84	-	-	-
	Ochlockonee	-	Jackson Bluff Dam	30°23'00"N 84°37'45"W	112
	Perdido	58	-	-	-
	Shoal	33	-	-	-
	Suwannee	207	-	-	-
	Yellow	61	-	-	-

Table 12. (continued)

State	River	River Length (within state)	Dam	Latitude Longitude	River Miles Below Dam
Mississippi	Biloxi	52	-	-	-
	Chickasawhay	159	-	-	-
	Leaf	185	-	-	-
	Pascagoula	81	-	-	-
	Pearl	-	Ross Barnett Reservoir	32°23'48"N 90°03'50"W	310
	Wolf	49	-	-	-
Texas	Aransas	*	-	-	-
	Brazos	-	Lake Brazos Dam	31°34'46"N 97°11'51"W	402
	Coleto Creek	-	Coleto Creek Reservoir	28°43'51"N 97°09'53"W	48
	Colorado	-	Longhorn Dam	30°14'58"N 97°42'47"W	292
	Copano Creek	*	-	-	-
	Guadalupe	-	Canyon Dam	29°52'07"N 98°11'55"W	303
	Lavaca	*	-	-	-
	Mission	*	-	-	-

Table 12. (continued)

State	River	River Length (within state)	Dam	Latitude Longitude	River Miles Below Dam
	Navasota	-	Sterling C. Robertson Dam	31°19'30"N 96°19'08"W	350
	Navidad	-	Palmetto Bend Dam	28°52'55"N 96°34'47"W	25
	Neches	-	Town Bluff Dam	30°47'43"N 94°10'48"W	114
	Nueces	-	Wesley E. Sealy Dam	28°02'17"N 97°52'15"W	47
	Sabine	-	Toledo Bend Dam	31°10'25"N 93°33'57"W	156
	San Antonio	191	-	-	-
	San Bernard	125	-	-	-
	San Jacinto	-	Lake Houston Dam	29°54'58"N 95°08'28"W	28
	San Marcos	266	-	-	-
	Trinity	-	Livingston Dam	30°38'00"N 95°00'36"W	129
	Yegua Creek	-	Lake Somerville Dam	30°19'20"N [illegible]°31'32"W	263

[1]Data not available for Louisiana
- Not Applicable
* No Data

Table 13. Availability of appropriate food items in rivers for larval, juvenile, and adult striped bass. No data were available for food availability for rivers in Louisiana and Texas.

State	River	Larvae	Juvenile	Adult
Alabama	Alabama/Mobile[1]	*	Post-larvae of shrimp and crabs, anchovies	Menhaden and shad
	Tombigbee	*	*	*
Florida	Apalachicola[2]	*	Post-larvae of shrimp and crabs	Y
	Blackwater[3]	*	M	M
	Chipola[2]	*	*	*
	Choctawhatchee[2,3]	Y	Y	Y
	Escambia[3]	*	*	Shad
	Ochlockonee[2]	*	*	*
	Perdido[2,3]	M	*	M
	Suwannee[2,3]	Y	*	Y
	Yellow/Shoal[2,3]	N	*	N
Mississippi	Biloxi[4,5,6]	Copepods, cladocerans, amphipods	Larval fish, mysid shrimp, insects, post-larvae of crabs and shrimp	Shad, anchovies, menhaden, cyprinids, suckers
	Chickasawhay[7]	*	*	Shad, suckers, cyprinid minnows

Table 13. (continued)

State	River	Larvae	Juvenile	Adult
	Leaf	*	*	*
	Pascagoula[8,9]	*	Post-larvae of shrimp and crabs, anchovies, juvenile menhaden	Shad, herring, cyprinids, anchovies, menhaden
	Pearl[10]	*	*	Shad, suckers, herring, cyprinids
	Wolf/Jourdan[4,5,6,11]	Copepods, cladocerans, amphipods	Larval fish, mysid shrimp, insects, post-larvae of crabs and shrimp	Shad, anchovies, menhaden, cyprinids, suckers, herring

[1] M. Powell, personal communication, 1987.
[2] Bass and Cox, 1985.
[3] J. Barkuloo, personal communication, 1988.
[4] Nicholson 1983, 1985-1988.
[5] McIlwain, 1984.
[6] Robinson and Rich, 1984.
[7] Robinson and Rich, 1980.
[8] L. Nicholson, personal communication, 1988.
[9] Robinson and Rich, 1977.
[10] Robinson and Rich, 1983.
[11] Lorio and Dakin, 1978.

* = No Data   M = Marginal   N = No Availability   Y = Adequate Food Available

Table 14. Environmental parameters for survival of eggs and larvae of striped bass from rivers in states bordering on the Gulf of Mexico.

State	River	Temperature	DO	pH	Food	Velocity*	River Length
Alabama	Alabama	Y	Y	Y	N/A	N/A	Y
	Tombigbee	Y	Y	Y	N/A	95%	Y
Florida	Apalachicola	Y	Y	Y	N/A	95%	Y
	Big Coldwater Creek	N/A	N/A	N/A	N/A	95%	N/A
	Blackwater	N/A	N/A	N/A	N/A	95%	Y
	Chipola	Y	Y	Y	N/A	95%	Y
	Choctawhatchee	Y	Y	Y	Y	75%	Y
	Escambia	Y	Y	Y	N/A	95%	Y
	Ochlockonee	Y	Y	Y	N/A	M	Y
	Perdido	Y	Y	M	M	95%	N/A
	Shoal	N/A	N/A	N/A	N	N	M
	Suwannee	Y	Y	Y	Y	95%	Y
	Yellow	Y	Y	Y	N	95%	Y
Louisiana	Bayou Laccasine	N/A	N/A	N/A	N/A	N	N/A
	Calcasieu	Y	Y	M	N/A	95%	N/A
	Mermentau	N	N	Y	N/A	N	N/A
	Whiskey Chitto Creek	N/A	N/A	N/A	N/A	95%	N/A
Mississippi	Biloxi	N/A	N/A	N/A	Y	95%	Y
	Chickasawhay	N/A	N/A	N/A	N/A	95%	Y
	Leaf	N/A	N/A	N/A	N/A	95%	Y
	Pascagoula	Y	Y	Y	N/A	95%	Y
	Pearl	N/A	N/A	N/A	N/A	95%	Y
	Wolf	Y	Y	M	Y	95%	Y
Texas	Aransas	N/A	N/A	N/A	N/A	N	N/A
	Brazos	Y	Y	Y	N/A	75%	Y
	Coleto Creek	N/A	N/A	N/A	N/A	N	Y
	Colorado	Y	Y	Y	N/A	95%	Y
	Copano Creek	Y	Y	Y	N/A	N	N/A
	Guadalupe	Y	Y	Y	N/A	95%	Y
	Lavaca	Y	Y	Y	N/A	75%	N/A
	Mission	N	Y	Y	N/A	N	N/A
	Navasota	Y	Y	Y	N/A	50%	Y
	Neches	Y	Y	Y	N/A	95%	Y
	Nueces	Y	Y	Y	N/A	50%	Y
	Sabine	Y	Y	Y	N/A	95%	Y
	San Antonio	Y	Y	Y	N/A	M	Y
	San Bernard	Y	Y	Y	N/A	N	Y
	San Marcos	Y	Y	Y	N/A	95%	Y
	Trinity	Y	Y	Y	N/A	95%	Y
	Yegua Creek	Y	Y	Y	N/A	N	Y

M = Marginal Y = Yes N = No N/A = Not Available

* See Table 7

Table 15. Environmental parameters for survival of juvenile striped bass from rivers in states bordering on the Gulf of Mexico.

State	River	Temperature	DO	pH	Food	Velocity	River Length
Alabama	Alabama	Y	Y	Y	Y	Y	Y
	Tombigbee	Y	Y	Y	N/A	Y	Y
Florida	Apalachicola	Y	Y	Y	Y	Y	Y
	Big Coldwater Creek	N/A	N/A	N/A	N/A	Y	N/A
	Blackwater	N/A	N/A	N/A	M	Y	Y
	Chipola	Y	Y	Y	N/A	Y	Y
	Choctawhatchee	Y	Y	Y	Y	Y	Y
	Escambia	Y	Y	Y	N/A	Y	Y
	Ochlockonee	Y	Y	M	N/A	Y	Y
	Perdido	Y	Y	M	N/A	Y	N/A
	Shoal	N/A	N/A	N/A	N/A	Y	M
	Suwannee	Y	Y	Y	N/A	Y	Y
	Yellow	Y	Y	Y	N/A	Y	Y
Louisiana	Bayou Laccasine	N/A	N/A	N/A	N/A	Y	N/A
	Calcasieu	Y	Y	M	N/A	Y	N/A
	Mermentau	Y	M	Y	N/A	Y	N/A
	Whiskey Chitto Creek	N/A	N/A	N/A	N/A	Y	N/A
Mississippi	Biloxi	Y	Y	M	Y	Y	Y
	Chickasawhay	Y	Y	Y	N/A	Y	Y
	Leaf	N/A	N/A	N/A	N/A	Y	Y
	Pascagoula	Y	Y	Y	Y	Y	Y
	Pearl	Y	Y	Y	N/A	Y	Y
	Wolf	Y	Y	M	Y	Y	Y
Texas	Aransas	N/A	N/A	N/A	N/A	Y	N/A
	Brazos	Y	Y	Y	N/A	Y	Y
	Coleto Creek	N/A	N/A	N/A	N/A	Y	Y
	Colorado	Y	Y	Y	N/A	Y	Y
	Copano Creek	Y	M	Y	N/A	Y	N/A
	Guadalupe	Y	Y	Y	N/A	Y	Y
	Lavaca	Y	Y	Y	N/A	Y	N/A
	Mission	Y	Y	Y	N/A	Y	N/A
	Navasota	Y	M	Y	N/A	Y	Y
	Neches	Y	Y	Y	N/A	Y	Y
	Nueces	Y	Y	Y	N/A	Y	Y
	Sabine	Y	Y	Y	N/A	Y	Y
	San Antonio	Y	M	Y	N/A	Y	Y
	San Bernard	Y	Y	Y	N/A	Y	Y
	San Marcos	Y	N/A	Y	N/A	Y	Y
	Trinity	Y	Y	Y	N/A	Y	Y
	Yegua Creek	Y	Y	Y	N/A	Y	Y

M = Marginal Y = Yes N = No N/A = Not Available

Table 16. Environmental parameters for survival of adult striped bass from rivers in states bordering on the Gulf of Mexico.

State	River	Temperature	DO	pH	Food	Velocity	River Length
Alabama	Alabama	Y	Y	Y	Y	Y	Y
	Tombigbee	Y	Y	Y	N/A	Y	Y
Florida	Apalachicola	Y	Y	Y	Y	Y	Y
	Big Coldwater Creek	N/A	N/A	N/A	N/A	Y	N/A
	Blackwater	N/A	N/A	N/A	M	Y	Y
	Chipola	Y	Y	Y	N/A	Y	Y
	Choctawhatchee	Y	Y	Y	Y	Y	Y
	Escambia	Y	Y	Y	Y	Y	Y
	Ochlockonee	Y	Y	M	N/A	Y	Y
	Perdido	Y	Y	M	M	Y	N/A
	Shoal	N/A	N/A	N/A	N	Y	M
	Suwannee	Y	Y	Y	Y	Y	Y
	Yellow	Y	Y	Y	N	Y	Y
Louisiana	Bayou Laccasine	N/A	N/A	N/A	N/A	Y	N/A
	Calcasieu	Y	Y	M	N/A	N/A	N/A
	Mermentau	Y	M	Y	N/A	Y	N/A
	Whiskey Chitto Creek	N/A	N/A	N/A	N/A	Y	N/A
Mississippi	Biloxi	Y	Y	M	Y	Y	Y
	Chickasawhay	Y	Y	Y	N/A	Y	Y
	Leaf	N/A	N/A	N/A	N/A	Y	Y
	Pascagoula	Y	Y	Y	Y	Y	Y
	Pearl	Y	Y	Y	N/A	Y	Y
	Wolf	Y	Y	M	Y	Y	Y
Texas	Aransas	N/A	N/A	N/A	N/A	Y	N/A
	Brazos	Y	Y	Y	N/A	Y	Y
	Coleto Creek	N/A	N/A	N/A	N/A	Y	Y
	Colorado	Y	Y	Y	N/A	Y	Y
	Copano Creek	Y	M	Y	N/A	Y	N/A
	Guadalupe	Y	Y	Y	N/A	Y	Y
	Lavaca	Y	Y	Y	N/A	Y	N/A
	Mission	Y	Y	Y	N/A	Y	N/A
	Navasota	Y	M	Y	N/A	Y	Y
	Neches	Y	Y	Y	N/A	Y	Y
	Nueces	Y	Y	Y	N/A	Y	Y
	Sabine	Y	Y	Y	N/A	Y	Y
	San Antonio	Y	M	Y	N/A	Y	Y
	San Bernard	Y	Y	Y	N/A	Y	Y
	San Marcos	Y	N/A	Y	N/A	Y	Y
	Trinity	Y	Y	Y	N/A	Y	Y
	Yegua Creek	Y	Y	Y	N/A	Y	Y

M = Marginal Y = Yes N = No N/A = Not Available

Table 17. Priority listing of rivers in states bordering on the Gulf of Mexico for introduction of striped bass (H = High, M = Medium, L = Low).[1]

State	River	Eggs and Larvae	Juveniles	Adults	Overall
Alabama	Alabama	M	H	H	H
	Tombigbee	H	H	H	H
Florida	Apalachicola	H	H	H	H
	Big Coldwater Creek	L	L	L	L
	Blackwater	L	M	M	L
	Chipola	H	H	H	H
	Choctawhatchee	H	H	H	H
	Escambia	H	H	H	H
	Ochlockonee	H	H	H	H
	Perdido	M	M	M	M
	Shoal	L	L	L	L
	Suwannee	H	H	H	H
	Yellow	H	H	H	H
Louisiana	Bayou Laccasine	L	L	L	L
	Calcasieu	M	M	M	M
	Mermentau	L	M	M	M
	Whiskey Chitto Creek	L	L	L	L
Mississippi	Biloxi	M	H	H	H
	Chickasawhay	L	H	H	M
	Leaf	L	L	L	L
	Pascagoula	H	H	H	H
	Pearl	L	H	H	M
	Wolf	H	H	H	H
Texas	Aransas	L	L	L	L
	Brazos	H	H	H	H
	Coleto Creek	L	L	L	L
	Colorado	H	H	H	H
	Copano Creek	M	M	M	M
	Guadalupe	H	H	H	H
	Lavaca	M	M	M	M
	Mission	L	M	M	M
	Navasota	H	H	H	H
	Neches	H	H	H	H
	Nueces	H	H	H	H
	Sabine	H	H	H	H
	San Antonio	H	H	H	H
	San Bernard	M	H	H	H
	San Marcos	H	M	M	H
	Trinity	H	H	H	H
	Yegua Creek	M	H	H	H

[1] Priority levels are influenced by data gaps. Consult Tables 15, 16 and 17 to ascertain reasons for particular priority listings.

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