STRIPED BASS SPAWNING
IN THE LOWER TRINITY RIVER, TEXAS

by

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ABSTRACT

The Trinity River downstream of Lake Livingston dam was sampled to determine if striped bass (Morone saxatilis) reproduction had occurred. Two stations were sampled for eggs and larvae from March-May 1988. Physicochemical parameters were recorded for each station on sampling days and were generally within acceptable ranges for striped bass spawning and egg development. Striped bass eggs were collected at the FM 787 bridge crossing on 11, 19, 26, and 27 April, and larvae were collected at the U.S. Highway 90 bridge crossing on 11 April. Natural reproduction probably occurred in the Trinity River downstream of Lake Livingston, although the extent of reproduction was not determined.

INTRODUCTION

Striped bass (Morone saxatilis) were once part of the native fish fauna inhabiting Gulf coast waters and until the 1950's were harvested commercially along the Texas coast (Stevenson 1893; Fielder 1936; Game, Fish and Oyster Commission 1946; Maddux and Pitman 1988). The reasons for striped bass disappearance from Texas waters are not completely known, although increased agricultural water demand, increased pesticide and fertilizer use, and direct and indirect effects of industrialization may have been contributing factors (McIlwain 1980; Rulifson and Huish 1982; Maddux and Pitman 1988).

In 1960, Texas Parks and Wildlife Department (TPWD) initiated a program to reintroduce striped bass into coastal waters. Through 1988, approximately 24 million fingerlings and 16 million fry have been stocked (Gulf States Marine Fisheries Commission 1986; TPWD unpublished data). Although some striped bass have been harvested, the extent of stocking success is undocumented.

Flows and temperatures for the Trinity River (GSMFC 1986) are within acceptable ranges for establishment of a striped bass population (Bain and Bain 1982). TPWD personnel have collected striped bass for use as broodfish from the Trinity River below Lake Livingston since 1981. These fish probably originated from introductions into Lake Livingston. Reproductive success and survival of eggs and larvae in the lower Trinity River is unknown.

Survival of striped bass eggs and larvae determines both population viability and year-class strength (Bain and Bain 1982; Prager et al. 1987). Each life stage is affected by physical and biological components of the environment. Examination of these components may allow determination of factors that limit or exclude establishment of a reproducing population. The objectives of this study were to determine if striped bass reproduction occurred in the Trinity River below Lake Livingston and if so, to examine the relationship of reproduction with water temperature, velocity, and discharge.

STUDY AREA

The construction of Lake Livingston in 1969 reduced the length of the lower Trinity River to approximately 187 km; the distance from the dam to where the river enters Trinity Bay (Figure 1). Approximately 129 km of the river (from the dam to U.S. Highway 90) are within the Pineywoods Ecological Region with the remaining 58 km downstream within the Coastal Prairie Region (Gould 1975). The river substrate is mostly sand, silt, and clay with a few areas of gravel (Menn and Pitman 1986). River-bed gradients range from about 0.19 m/km near the dam to 0.06 m/km near the Trinity Bay confluence (Menn and Pitman 1986).

METHODS

Sampling for fish eggs and larvae and physicochemical parameters was conducted from 17 March 1988 through 24 May 1988. Sampling was biweekly from 17 March to 11 April and 12 May to 24 May, and weekly from 11 April to 12 May. Samples were collected once during late morning to early afternoon except on 26 and 27 April when samples were collected every 4 hours starting at 0500 hours. Three sampling stations were used (Figure 1): station 1 at the FM 787 bridge (52 km downstream from the Lake Livingston dam), and station 2 immediately upstream from U.S. Highway 90 bridge (129 km downstream from the dam). On 17 March, station 3 at State Highway 105 bridge (82 km downstream from the dam) was used because heavy traffic on the U.S. Highway 90 bridge prevented sampling from the bridge. All subsequent sampling was conducted from a boat at the U.S. Highway 90 bridge.

At each station, fish eggs and larvae were collected using a 0.5-m plankton net with 560 micron mesh. The net was deployed 1 m below the river surface. The net was equipped with floats and weights to keep the net-opening perpendicular to the river bottom and facing into the current. At station 1 and station 3, the net was lowered into the river and anchored by a rope attached to the downstream portion of the bridge at approximately mid-river. At station 2, the net was deployed from a boat anchored at approximately mid-river. Three, 15-minute samples were taken at each station. Organisms and detritus collected in each 15-minute sample were washed into a straining bucket attached to the cod end of the net, transferred to glass jars, and immediately preserved with a 4% solution of formalin.

Physicochemical parameters were recorded for each station concurrent with egg sampling. Measurements were taken at the depth the net was set (1 m). Dissolved oxygen (mg/l) and temperature (C) were measured with a YSI Model 54A oxygen meter. Conductivity (micromhos/cm) and salinity (o/oo) were measured with a YSI Model 33 salinity/conductivity meter. Water velocity was measured with a General Oceanics Model 2030 flowmeter suspended in the middle of the net mouth. The difference in counts recorded by the flowmeter from start to end of each 15-minute sampling period were converted to counts per second and plotted on a calibration curve to determine water velocity (cm/sec). Additional discharge data (m^3/sec) for sampling dates were obtained from the Trinity River Authority for the Lake Livingston dam and U.S. Highway 90 bridge crossing, and from the U.S. Geological Survey (USGS) for the FM 787 bridge crossing. Water temperatures at FM 787 bridge crossing were also obtained from the USGS.

All plankton net samples were treated with a few grains of rose bengal to stain organisms and facilitate separation of specimens from the detritus. Fish eggs were identified as either striped bass or non-striped bass. All larval fishes were identified to family. Percichthid larvae were identified as striped bass or non-striped bass. Identifications were according to May and Gasaway (1967), Hogue et al. (1976), Hardy (1978), and Howells (1985).

RESULTS

Striped bass eggs were collected on 11 April through 27 April at station 1 (Table 1). Most of the eggs collected were fertilized and appeared to be less than 12 hours old based on size of the perivitelline space (Hardy 1978). Water temperatures from 11 through 27 April ranged from 17.3 to 24.8 C, and water velocities ranged from 36.7 cm/sec to 15.0 cm/sec (Table 2). No striped bass eggs were collected at station 2, and few non-striped bass eggs were collected at either station (Table 1). Two larval striped bass were collected; both were taken on 11 April at station 2. The yolk-sac was present on both larvae.

Striped bass eggs and larvae were first collected when discharges in the Trinity River were at their highest point for the sampling period (Figure 2). After 11 April, discharges decreased substantially and eggs continued to be collected until discharges leveled off near the end of April. Water temperatures at station 1, as reported by the USGS, ranged from 18 C on 11 April to 21 C on 26 April, and were similar to temperatures recorded during sampling activities (Table 2). Salinities were generally $\leq$1.0 o/oo.

DISCUSSION

Presence of striped bass eggs and larvae during this study indicated striped bass reproduction had occurred. Adult striped bass in the Lake Livingston tailrace were the nearest source of eggs. Another possible source could be striped bass spawning in Lake Livingston or the river upstream of the reservoir.

Water temperatures during sampling activities were within acceptable ranges for striped bass spawning and egg survival. Spawning usually begins at 14 C (Westin and Rogers 1978), with peak spawning occurring between 14-19 C, and ceases as temperatures exceed 23 C (Setzler et al. 1980). Morgan and Rasin (1973) reported optimal egg survival at 16-23 C.

Water temperature also influenced the amount of time required for egg and larval development. Based on Polgar et al. (1976), hatching time for eggs collected during this study were from 52 h (at 17.3 C) to 17.5 h (at 24.8 C). At these temperatures, larvae remain in the yolk-sac stage from 4 to 6 days (Albrecht 1964; Polgar et al. 1976).

Dissolved oxygen levels were above the minimum level (3-5 mg/l) for development at 17.8 C (Westin and Rogers 1978). Low salinity levels observed from March-May were probably not detrimental to egg development and survival. Morgan and Rasin (1973) observed no significant effect of 0 to 8 / salinities on percent hatch or survival.

Although striped bass eggs were abundant in samples, larvae were scarce. Water velocity less than 30.5 cm/sec in 1988 could have contributed to the scarcity of larvae in our samples. Albrecht (1964) reported that a water velocity $\geq$ 30.5 cm/sec was needed to maintain eggs in suspension. Flowmeter-estimated water velocities at station 1 on days eggs were collected were above 30.5 cm/sec only once. Water velocities at the two sampling stations calculated from USGS data ranged from 33.6-41.3 cm/sec (TPWD, unpublished data). Although these data indicate flow was sufficient, areas of low velocity as detected by flowmeter readings may have been detrimental to egg suspension and survival.

This study confirmed suitable conditions exist for spawning and egg development. Further research will be needed to determine if larvae are surviving and recruiting into the population.

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Table 1. Results of 0.5-m net tows collected from Trinity River at FM 787 (station 1) and U.S. Highway 90 (station 2), March through May 1988. Eggs are designated with an (E) and larval fish with a (L). Eggs were identified only as striped bass or non-striped bass, and larvae were identified to at least family.

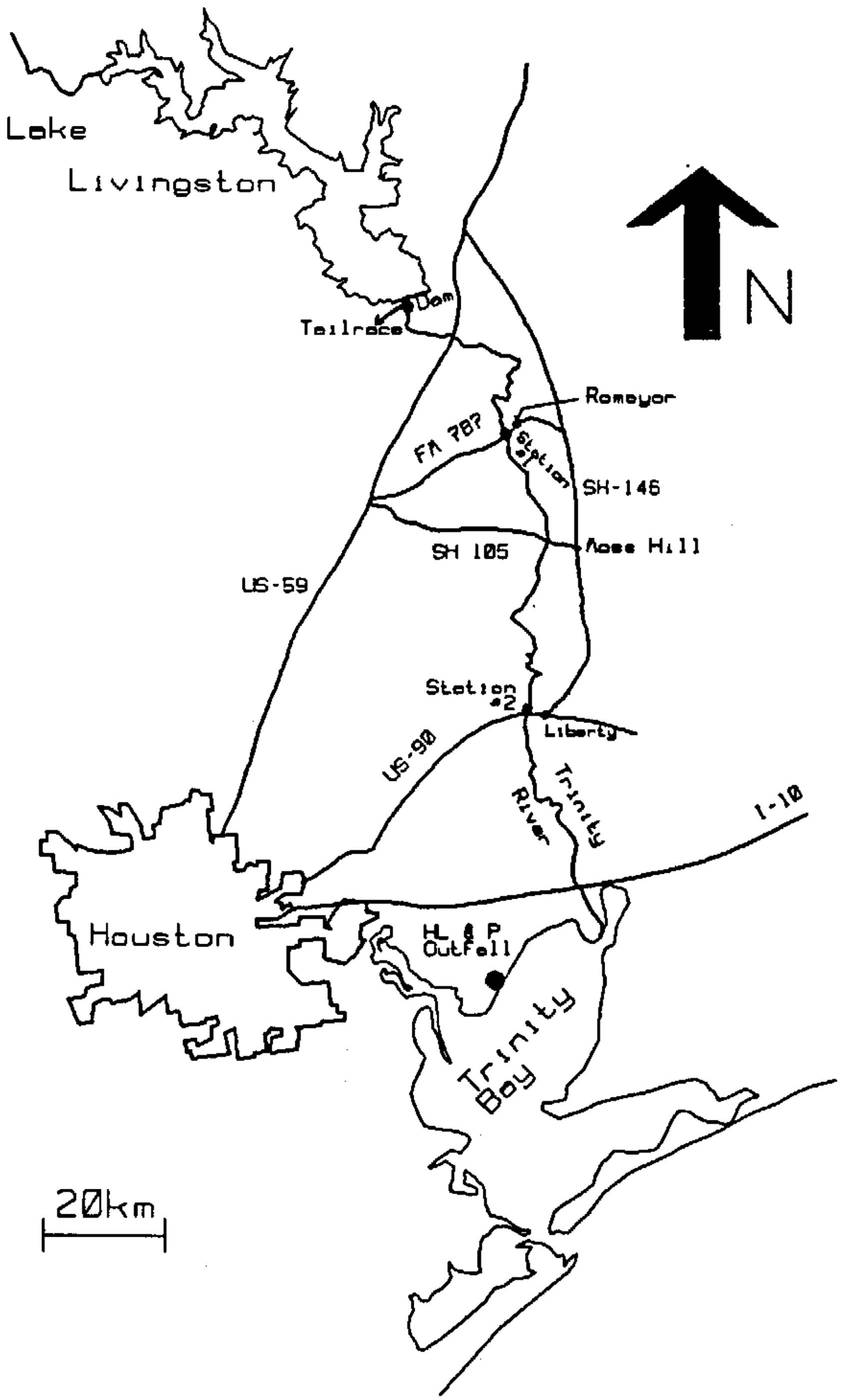
Date	Identification	Number of specimens
	Station 1	
17 Mar	Percidae (L)	1
31 Mar	Clupeidae (L)	1
	Cyprinidae (L)	2
11 Apr	Striped bass (E)	61
	Non-striped bass (E)	8
	Clupeidae (L)	5
19 Apr	Striped bass (E)	2
	Clupeidae (L)	16
	Cyprinidae (L)	1
	Percidae (L)	1
26 Apr	Striped bass (E)	36
	Lepisosteidae (L)	1
	Clupeidae (L)	33
	Cyprinidae (L)	3
	Atherinidae (L)	3
27 Apr	Striped bass (E)	28
	Clupeidae (L)	2
5 May	Clupeidae (L)	9
	Cyprinidae (L)	2
12 May	Clupeidae (L)	4
24 May	Clupeidae (L)	3
	Station 2	
17 Mar		0
31 Mar	Clupeidae (L)	3
	Cyprinidae (L)	3
11 Apr	Striped bass (L)	2
19 Apr	Non-striped bass (E)	1
	Clupeidae (L)	3
	Cyprinidae (L)	1
26 Apr	Non-striped bass (E)	1
	Clupeidae (L)	3
	Cyprinidae (L)	3
	Atherinidae (L)	1
5 May	Clupeidae (L)	1
	Cyprinidae (L)	1
12 May	Cyprinidae (L)	2
24 May	Clupeidae (L)	1

Table 2. Summary of physicochemical parameters collected at FM 787 bridge (station 1) and U.S. Highway 90 bridge (station 2) in conjunction with sampling for striped bass eggs and larvae from the Trinity River, Texas, March-May 1988. Start times indicates when sampling commenced, and water velocity was calculated as a mean of three repetitions. Samples on 26 and 27 April were part of a 24-hour series.

Date	Start time	Dissolved oxygen (mg/l)	Water temperature (C)	Salinity (o/oo)	Conductivity (micro mhos/cm)	Mean water velocity (cm/sec)
			Station 1			
17 Mar	1345	11.5	14.2	1.0	298	21.3
31 Mar	1230	8.5	16.0	0.1	310	34.3
11 Apr	1230	10.1	17.3	1.0	305	36.7
19 Apr	1247	9.8	18.5	0.0	351	19.5
26 Apr	0500	9.7	19.2	0.7	345	18.0
26 Apr	0900	9.8	20.3	0.8	352	18.3
26 Apr	1300	11.2	23.4	0.1	390	19.5
26 Apr	1718	9.3	24.8	0.4	390	19.3
26 Apr	2150	12.2	23.0	0.5	370	15.0
27 Apr	0155	10.3	22.5	0.1	360	17.7
5 May	1215	*[a]	24.0	0.1	370	24.3
12 May	1215	8.4	23.0	0.1	375	21.7
24 May	1240	9.0	26.0	0.5	410	32.3
			Station 2			
17 Mar[b]	1200	12.1	14.9	0.2	280	47.3
31 Mar	1010	9.2	14.5	0.1	290	32.7
11 Apr	1000	10.2	16.2	0.9	292	39.3
19 Apr	1023	10.1	19.0	0.2	350	44.3
26 Apr	0700	9.6	23.0	0.3	375	19.3
26 Apr	1100	10.2	22.8	0.1	320	25.0
26 Apr	1500	12.3	24.5	0.5	371	22.0
26 Apr	1932	11.6	25.0	0.3	390	20.7
26 Apr	2400	11.4	25.0	0.5	390	24.0
27 Apr	0350	10.5	24.0	0.1	390	24.3
5 May	0930	*[a]	21.0	0.2	345	30.0
12 May	0940	7.9	26.0	0.3	395	25.7
24 May	1025	8.1	24.0	0.1	380	41.0

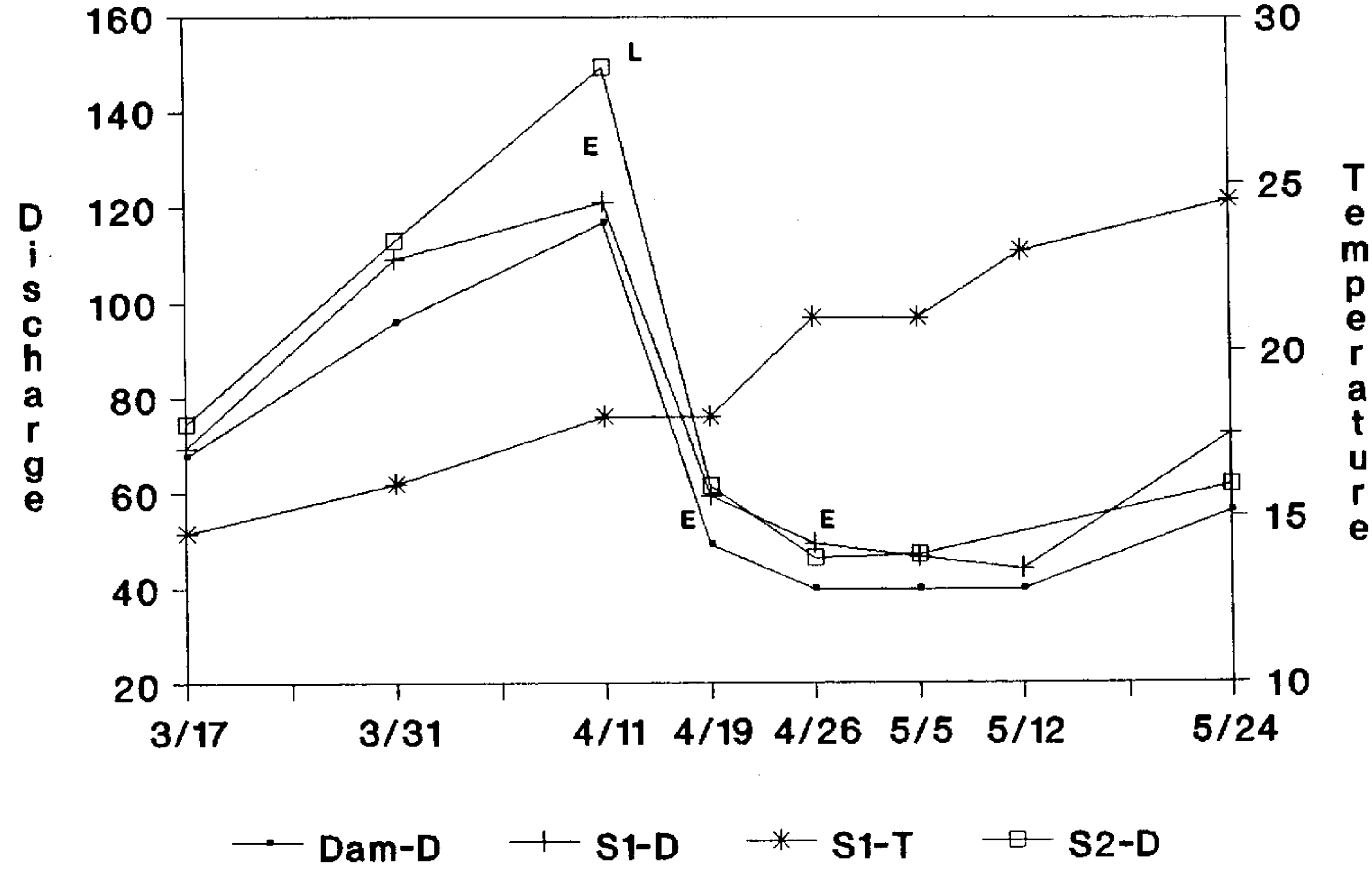
[a] Measurement not taken.
[b] Sampling location was at State Highway 105 bridge on this date and at U.S. Highway 90 bridge on all following dates.

Figure 1. Map of lower Trinity River indicating sampling stations for striped bass eggs and larvae (stations 1 and 2).



Lake
Livingston
Dam
Tailrace
N
Romayor
FM 787
Station #1
SH-146
SH 105
Rose Hill
US-59
Station #2
Liberty
US-90
Trinity
River
I-10
Houston
HL & P
Outfall
Trinity
Bay
20km

Figure 2. Summary of discharges (m^3/second) at Lake Livingston Dam (Dam-D), FM 787 bridge (S1-D), and U.S. Highway 90 bridge (S2-D), and water temperatures (C) at FM 787 bridge (S1-T) for dates when sampling was conducted for striped bass eggs and larvae on the Trinity River, 17 March through 24 May 1988. E indicates when striped bass eggs were collected, and L indicates when striped bass larvae were collected.



Discharge
160
140
120
100
80
60
40
20
Temperature
30
25
20
15
10
3/17
3/31
4/11
4/19
4/26
5/5
5/12
5/24
L
E
E
E
Dam-D
S1-D
S1-T
S2-D