LOSS OF STRIPED BASS (*MORONE SAXATILIS*) EGGS AND YOUNG THROUGH SMALL, AGRICULTURAL DIVERSIONS IN THE SACRAMENTO-SAN JOAQUIN DELTA[1]

by

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ABSTRACT

A sampling program was initiated in the spring of 1972 to obtain information on the losses of striped bass eggs and young through the small, agricultural diversions found throughout the Sacramento-San Joaquin Delta.

Seven agricultural diversions on Sherman Island, adjacent to the San Joaquin River, were sampled on an intermittent basis during May, June and July.

Comparisons between catches from the agricultural diversions and catches from the adjacent San Joaquin River indicated that concentrations of striped bass eggs and young diverted were of the same general magnitude as concentrations in the river.

1/ Anadromous Fisheries Branch Administrative Report No. 75-3

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INTRODUCTION

California's major striped bass population inhabits the estuary of the Sacramento-San Joaquin River system and adjacent coastal areas (Chadwick, 1967). Primary spawning areas are the Sacramento River from its confluence with the American River upstream to Colusa and the San Joaquin River from Antioch to Venice Island. The main nursery area for young-of-the-year striped bass is from the Sacramento-San Joaquin Delta downstream to upper San Pablo Bay.

Turner and Chadwick (1972) demonstrated that survival of young-of-the-year striped bass in the estuary is highly correlated with mean river outflow in June-July. Highest survival occurs in years with highest outflows.

Two of the most plausible explanations for this relationship are: (1) that estuarine productivity is increased by high outflows, or (2) that losses of eggs and young through the water diversions reduce the bass population more when flows are low than when they are high.

The largest diversions are the Federal Central Valley Project and the State Water Project pumping plants in the south Delta. Water exports by these facilities averaged 31% of the total June-July Delta inflows for the years 1959-1973.

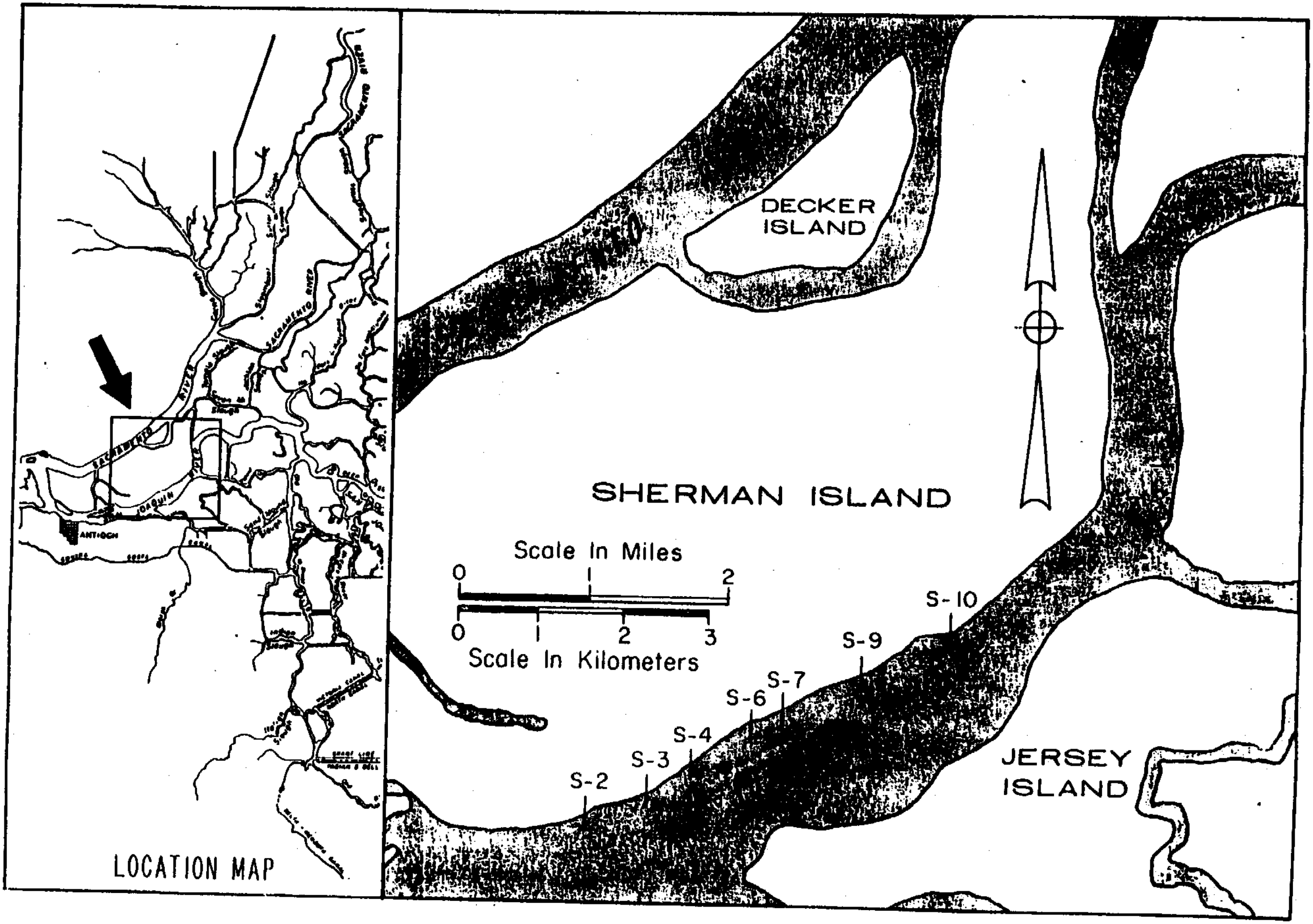
The second most important source of water removal is through the numerous, small agricultural diversions in the Delta. These sources diverted an average of about 27% of the June-July inflow from 1959 to 1973 (California Department of Water Resources, unpublished data).

My study was initiated to evaluate losses of striped bass eggs and young through these diversions by comparing catches of eggs and young in the diversions with catches in the adjacent river channel.

Irrigators in the Delta generally siphon water from the channel, apply it to the fields through a series of ditches, then pump the remainder back into the channel. The siphons are permanent structures, and most are from 15.2 to 30.4 cm (6-12 inches) internal diameter. The siphons are unscreened. Intakes are usually set to draw water from two to three feet above the river bottom, however, their exact position may vary somewhat due to siltation or other causes. Exact quantities of water diverted by individual siphons are unknown since none are metered.

SAMPLING PROCEDURES

Samples were collected from seven diversions on Sherman Island and four stations in the San Joaquin River adjacent to Sherman Island (Figure 1). The river was surveyed on alternate days from April 30 to July 13. Siphons in use were sampled on 10 weekdays when the river was not surveyed in May, on 2 days in June, and on 3 days in July (Table 1).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S-7
S-9
S-10
LOCATION MAP
ANTIOCH

TABLE 1

Total Catches of Striped Bass Eggs and Young
From Agricultural Diversions on Sherman Island

Total Catch Striped Bass Young
Siphon

Date	S-2	S-3	S-4	S-6	S-7	S-9	S-10	Total
5-3							3	3
5-5							3	3
5-9						3	0	3
5-11						9	4	13
5-15						0		0
5-17						1		1
5-19		8				0		8
5-23		11	1			0		12
5-25		59	3					62
5-31		64	20		39			123
6-2		43	2		19			64
6-14							22	22
7-7		2		2				4
7-11		4						4
7-14	2							2
Total	2	191	26	2	58	13	32	324

Total Catch Striped Bass Eggs
Siphon

Date	S-2	S-3	S-4	S-6	S-7	S-9	S-10	Total
5-3							0	0
5-5							0	0
5-9						0	0	0
5-11						49	0	49
5-15						131		131
5-17						7		7
5-19		35				5		40
5-23		2	1			0		3
5-25		74	15					89
5-31		4	3		1			8
6-2		0	1		1			2
6-14							0	0
7-7		0		0				0
7-11		0						0
7-14	0							0
Total	0	115	20	0	2	192	0	329

The siphons were sampled with a small mesh net set on the bottom of the irrigation ditch close to the siphon discharge for 10 minutes. The net mouth rested about 5 cm (2 inches) off the bottom. Variations in ditch width and depth precluded complete sampling of the water flow. Usually 60 to 80% of the siphon discharge was sampled by the net.

In the river, a small mesh net was towed from a boat for 10 minutes. Engine speed was varied to maintain the angle of the towing cable at 72±2 degrees. All tows were diagonal from bottom to surface so all depths were sampled equally.

Samples were preserved in 10% formalin at the time of collection. In the laboratory fish eggs and young were sorted, identified, and counted. Striped bass young were measured to the nearest mm Standard Length (SL).

SAMPLING GEAR

The diversions were sampled with a net constructed of 7.87 mesh per cm (20 mesh per inch) Marquisette nylon netting, having an opening of approximately 930 microns[2/]. The net was 1.83 m (6 ft) in length and tapered from a square mouth 30 cm (11.8 inches) per side to a collecting bucket with a mouth 6.7 mm (2.6 inches) in diameter. The

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2/ #73-503 Marquisette, Nylon Netting, Turtox Inc. Chicago, Illinois.

collecting bucket was a polyethylene jar with a 7 X 8 cm (2.7 X 3.1 inch) opening on the side covered with 11.8 mesh per cm (30 mesh per inch) stainless steel bolting cloth. Water flow through the net was measured by a Pygmy-type flow meter 3/ mounted in the net mouth.

The river was also sampled with a net constructed of 7.87 mesh per cm Marquisette. It was 3.35 m (11 ft) long and tapered from a mouth .45 m^2 (4.9 ft^2) to a collecting jar identical to that described above. Water flows were metered and the net was mounted on a ski frame.

RESULTS

A total of 329 bass eggs and 324 bass young were caught in the diversions (Table 1).

Daily catches of eggs in the diversions varied from 0 to 18.3/m^3. The mean daily catch was 2.0 eggs/m^3. Daily egg catches in the river varied from 0 to 5.8/m^3. The mean catch was 1.0 egg/m^3 (Table 2).

Young bass catches were less variable than the egg catches. The daily catch of young in the diversions ranged from 0 to 2.0/m^3. The mean was 0.5 young/m^3. These fish ranged from 4 to 16 mm SL. Their mean length was 7.5 mm. The mean catch of young bass in the river was 0.8/m^3 and the daily catch varied from 0.5 to 2.2 young/m^3. The mean length of young bass from the river was smaller (7.0 mm)

3/ #005-WA-130 flow meter, Kahl Scientific Instrument Company, El Cajon California.

1972

TABLE 2

Catches/m^3 of Striped Bass Eggs and Young from Agricultural Diversions and San Joaquin River

Date[a]	Striped Bass Eggs/m^3		Striped Bass Young/m^3		Mean Length	
	Ag. Div.	S.J. River[b]	Ag. Div.	S.J. River[b]	Ag. Div.	S.J. River[b]
5-3	0	.10	.06	.11	5.7	5.5
5-5	0	.04	.05	.08	6.7	6.0
5-9	0	.03	.17	.35	6.0	5.9
5-11	7.23	4.37	1.96	.34	6.8	5.8
5-15	18.35	.99	0	.66	—	5.8
5-17	1.31	.76	.19	.80	5.0	5.9
5-19	.91	5.79	.18	1.39	7.4	5.9
5-23	.04	.19	.10	2.22	7.4	6.2
5-25	1.87	.07	1.30	2.23	7.3	6.6
5-31	.08	.71	1.21	1.42	8.0	7.1
6-2	.02	.32	.77	1.25	8.2	7.3
6-14	0	.10	.56	.63	11.5	8.2
7-7	0	0	1.12	.11	8.5	10.7
7-11	0	0	.05	.05	9.8	10.0
7-14	0	—	.04	—	7.0	—
Mean	2.00	1.00	.52	.80	7.5	7.0
Standard Deviation	4.73	1.73	.59	.73	1.6	1.6
Variance	22.38	2.99	.35	.53	2.6	2.6

a Date of agricultural diversion sampling.

b San Joaquin River values are the mean of the mean catch at the four river sampling stations from the day proceeding and following the date of diversion sampling.

but their size range (3-34 mm) was larger than for the bass collected in the diversions (Table 2).

Nineteen other young fish were also taken in the diversions. Thirteen of these were smelt, three were shad, and three were catfish.

ANALYSIS AND DISCUSSION

Due to large catch variations and zero catches, catches plus 1 were transformed to logarithms for analysis.

Differences in the daily catch of eggs/m^3 from the two sources did not vary significantly from zero ($t = .557$, d.f. = 13). Similarly, differences in the daily catch of bass/m^3 did not vary significantly from zero ($t = 1.259$, d.f. = 13).

There was no statistically significant difference between the daily mean lengths of bass caught in the river and those diverted ($t = 1.53$, d.f. = 12); however, bass between 16 and 34 mm were taken only in the river. Two possible explanations for this finding are: (1) that large bass swim well enough to avoid the influence of running siphons, and (2) the large bass avoided the small mouth of the diversion net. The first of these explanations is the most plausible.

Young bass about 3 mm long were taken in the river, but not in the diversions. These fish probably represent late term eggs ruptured by abrasion caused by the relatively high water velocities through the towed net.

Subsequent studies have shown that the material used for both sampling nets is inefficient at catching young bass shorter than 8 mm (Miller, MS.). This deficiency biased estimates of bass densities and mean lengths; however, both sets of data should be biased equally so comparisons of the respective catches are probably valid.

Bias was introduced by comparing diversion catches, which were drawn from a fixed level in the water column, to catches made by a diagonal tow in the water. Striped bass eggs tend to be most concentrated near the bottom of the water column (Turner, MS.). The siphon intakes are also near the bottom so this probably explains why the catch of eggs/m^3 in the diversions was greater than the catch in the river. Vertical stratification may also have affected the catch of young bass.

Although the bias caused by vertical stratification of eggs and young precludes definitive comparisons between diversion and river catches, the catches were of the same general magnitude; hence, I conclude that diverted concentrations of bass eggs and young up to 16 mm long approximate concentrations in the river.

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