JOB PERFORMANCE REPORT

STATE:	California		
PROJECT TITLE:	Salton Sea Sport Fish Study	PROJECT NUMBER:	F-48-R-l
STUDY TITLE:	Salton Sea Sport Fish Eggs and Larval Distribution	STUDY NUMBER:	III
JOB TITLE:	The Geographical Distribution and Relative Abundance of the Eggs and and Larvae of Three Salton Sea Sport Fish	JOB NUMBER:	I
PERIOD COVERED:	July 1, 1987 through June 30, 1988		

I. SUMMARY

Analysis of the monthly ichthyoplankton collections of **January 1987 through March 1988 indicated that Anisotremus davidsonii preferentially spawned at three locations on *the* eastern side of the Salton Sea, Sunken City (SU),** Salt Creek (SC), Treeline (TL) and one station on the western side of the Salton Sea Riviera Yacht Club (RY). In 1987, eggs were collected from January through May with the peak abundance collected during the month of March. Larvae were not collected in the ichtbyoplankton until March 1987 with a peak abundance collected during the month of April continuing until June. In 1988, eggs were not found until February with increasing numbers collected in March. These analyses also indicated that the sciaenids spawned at three stations on the western side of the Salton Sea (Riviera Yacht Club (RY), Sandy Point (SP), San Felipe Creek (SF), and one station on the eastern side Salt Creek (SC). Eggs and larvae were not found in the ichthyoplankton until April and continued *to* appear in the samples through October.

XI. BACKGROUND

In 1983 the Vantuna Research Croup of Occidental College conducted preliminary field reseach at the Salton Sea to first determine the appropriate methodology for sampling the distribution and abundance of adult, juvenile and larval forms of the sportfish,and second to examine the water quality parameters associated with their distribution. These quarterly surveys indicated that adults and juveniles were more concentrated in areas where the substrate was diverse. Ichthyoplankton sampling indicated a trend of higher concentrations towards the southeastern portion of the Sea. Some correlation with lower salinities in this area could be hypothesized, however, sampling was too infrequent to define egg and larval distribution or to correlate preferred water quality parameters_ The first fiscal year of this study (1986/1987) enabled us to collect ichthyoplankton samples beginning in January 1987. Preliminary analysis of the ichthyoplankon collected from January through June of 1987 indicated that sargo, Anisotremus davidsonii preferentially spawned at three of the stations located on the eastern side of the Salton Sea (Sunken City, Salt Creek, and Treeline). All developmental stages of eggs, including early stages, were found at these stations, whereas only later developmental stage of eggs and larvae were found at the other stations.

Additional surveys were conducted with greater frequency and encompassing more stations over a wider range of the Sea. This will ultimately enable the Department of Fish and Game to understand whether there there are preferred spawning areas for the three species of sportfish (bairdiella, Bairdiella icistia; sargo, Anisotremus davidsonii; and orangemouth corvina, Cvnoscion xanthulus) and to what extent these areas will be affected by vater diversions, placement of offshore geothermal pover plant, and salinity and water elevation control structures.

III. OBJECTIVES

Determine the geographical distribution of eggs and larvae of three species of Salton Sea sportfish.

IV. PROCEDURES

ICHTHYOPIANKTON

Field and Laboratory

Since the Salton Sea is a relatively large inland body of water (33 miles long and 14 miles vide), 11 sampling sites vere designated in order to determine the relative distribution of ichthyoplankton in the Sea (Fig. 1). Ten of the sites have both nearshore and offshore stations. The nearshore stations have an approximate depth of two meters, while the offshore stations have a depth of approximately eight meters. Since the Sea has a gradual sloping contour, the nearshore stations can be as much as three miles from the offshore stations. All stations were sampled with a 333 micron Nitex, conical, plankton net equipped with a TSK rotary flowmeter. The tows were two minutes in duration over an approximate distance of 100 meters. Stations deeper than three meters were sampled using the oblique ichthyoplankton net tows and surface tows while stations three meters or less were sampled using only surface net tows. Stations vere sampled in a random fashion both in terms of time of sampling and sequence of sampling during each monthly trip. The ichthyoplankton samples were preserved at the time of collection in 5% buffered formalin and transported to the laboratory where they were initially

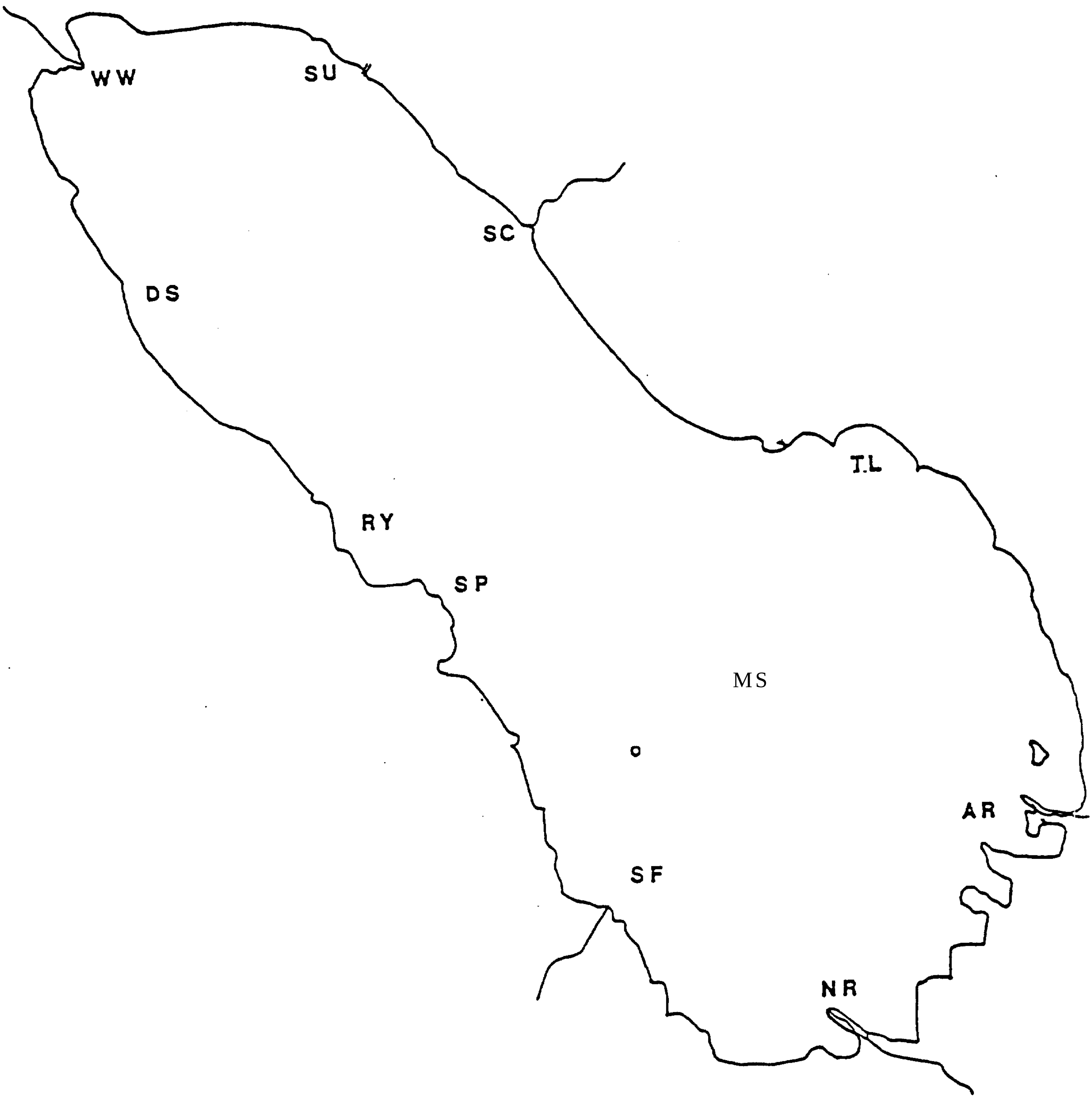

Figure 1. Salton Sea Ichthyoplankton Stations.

sorted for eggs and larvae. In addition to sorting and counting all eggs and larvae, 1000 eggs from each sample were randomly selected and assigned numerical designation of development in accordance with Ahlstrom (1943) and May (1975) (Table 1). The chorion diameter, yolk diameter, and the oil globule size were measured. Damaged eggs vere not measured or staged. In addition to the measurements, the eggs were categorized according to the position of the oil globule in relation to the head or anus and pigmentation patterns.

The larvae were sorted according to species and developmental stage. The designated stages were yolk sac larvae (still absorbing the yolk with unpigmented eye), preflexion larvae (yolk absorbed, eye becoming pigmented, no fin rays developed, mouth and gut functinal), post flexion larvae (fins developed). All larvae were counted and 50 randomly selected larvae from each developmental stage of each species were measured for taxonomic description. The measurements included 1) notochordal length for yolk sac and preflexion larvae or standard length for all post flexion larvae, 2) mouth to anus length, 3) eye diameter, 4) snout length, 5) head length, 6) body depth, 7) head diameter, 8) pectoral fin length and pectoral fin base in preflexion larvae, and 9) yolk length and oil globule size in all yolk sac larvae.

TABLE 1

Ahlstrom's Numerical Designation of Developmental Stages

Ahls trom Stage	Sub-Stage	Description
I	a	Unfertilized egg
	b	blastodisc
II	a	2 blastomeres
	b	4 blastomeres
	c	8 blastomeres
	d	morula
	e	Blastula, periblast very apparent
III	a	Early gastrula, germ ring encircles as much as 1/3 yolk, embryonic shield rudimentary
	b	Mid gastrula, embryonic shield expands, germ ring encircles as much as 2/3 of yolk
IV		bate gastrula, primitive streak forms
V		Blastopore closes, optic vesicle and Kupffer's vesicle form
VI	a	Somites begin to form; scattered melanophores appear, most dorsally behind optic vesicles, a few extending posterior along notochord
	b	Lens and otic vesicles form. Tip of tail reaches oil droplet
VII		Tail has moved beyond oil droplet and lifted off yolk; finfold apparent
		Hatching

V. FINDINGS

The data analyzed for this report includes ichthyoplankton collected from January 1987 through March 1988.

1. Comparisons of outflow stations (Whitewater River, New River, and Alamo River) to non-outflow stations (inclusive of San Felipe Creek and Salt Creek which have periodic flow as well as all other stations not adjacent to a tributary) throughout the year indicated that 92.1% of the Anisotremus davidsonii eggs and 81.1% of the sciaenid eggs (in all developmental stages) were collected at the non-outflow stations.
2. Analysis of Anisotremus eggs categorized by developmental stage (early Stages l-3 and late Stages 4-7 according to Ahlstrom's designation) (Fig. 1) indicates that three stations on the eastern side of the Salton Sea (Sunken City, SU; Salt Creek, SC, and Treeline, TL) had a significant number of early stage eggs (Fig. 2). These three stations have extensive substrate with submerged brush and other structures. Sandy Point (SP) located on the western side of the Sea also had a significant number of early stage eggs. Sandy Point, as the name implies, has a gradually sloping sandy substrate without submerged structures. Riviera Yacht Club (RY), which is located two miles north of the Sandy Point station, has extensive areas with submerged brush. Observations on wind directions and currents during the ichthyoplankton collections suggest that the early stage eggs may have been spawned at RY and drifted to SP.
3. Figure 3 indicates the seasonality of Anisotremus eggs and larvae. During fiscal year 1987, Anisotremus eggs were collected from January through June with a peak abundance occurring in March. The rate of egg

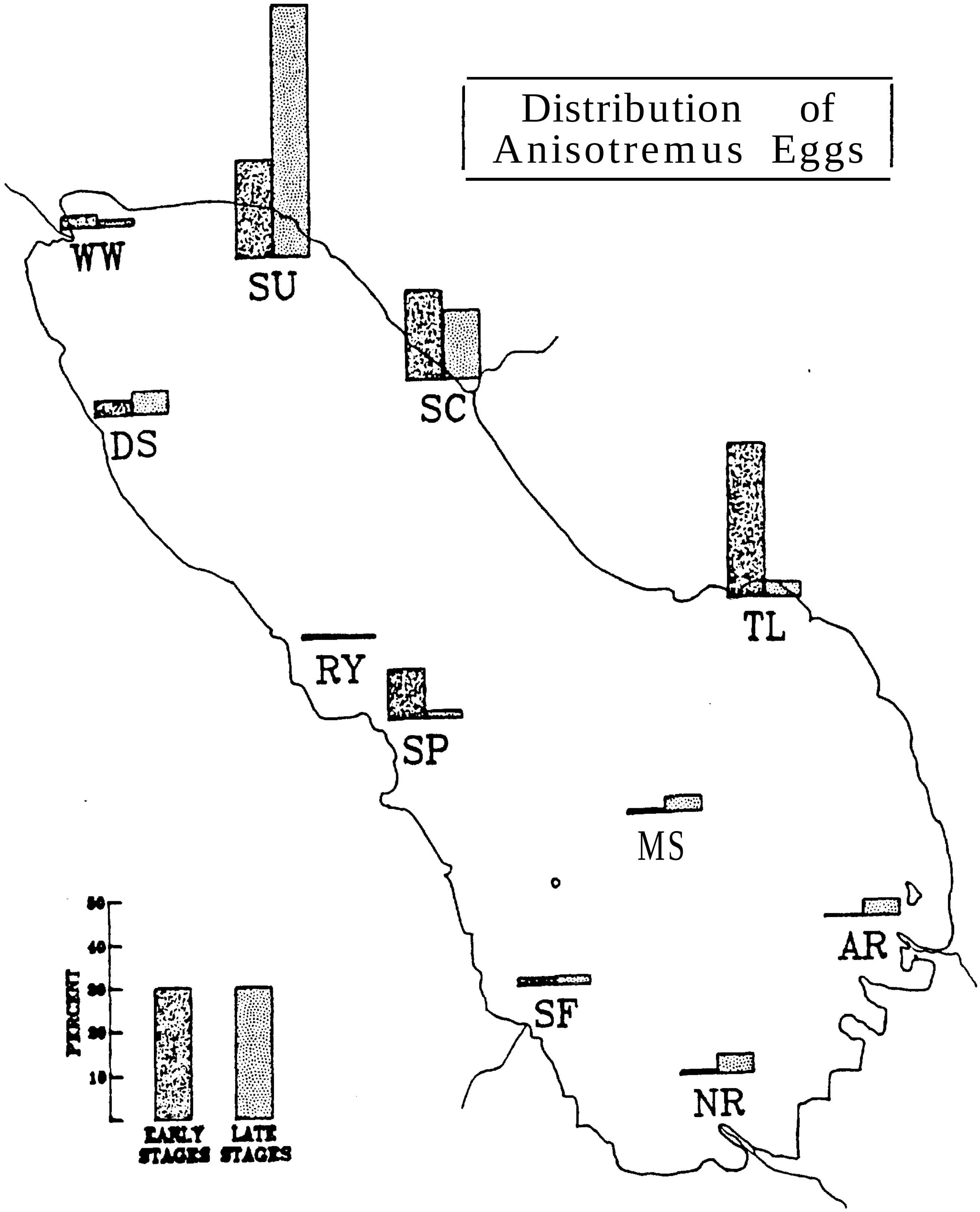

Figure 2. Distribution of Developmental Stages of *Anisotremus davidsonii* eggs.

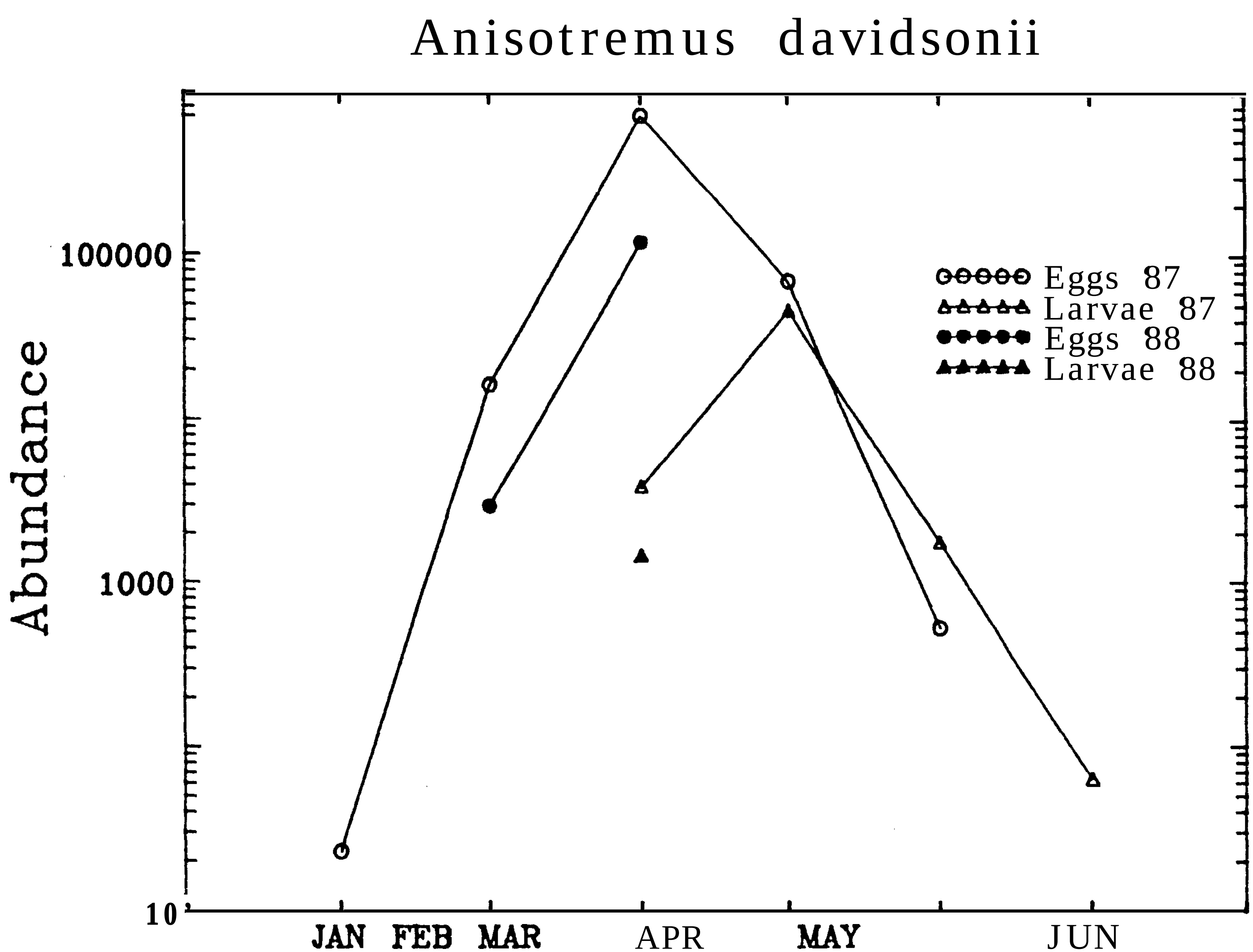

Figure 3. Seasonal Abundance of Eggs and Larvae of *Anisotremus davidsonii*

development is dependent upon the vater temperature. During March 1987, the average surface water temperature ranged fron 19-20°C. At 20°C, Anisotremus eggs require an average of eight hours to complete development through late gastrulation with the formation of the primitive streak. At cooler temperatures, the rate of development will decrease. Consequently, the collection of substantial numbers of early stage eggs may indicate a spawning area for a particular species. During 1987 and 1988, Sunken City, Salt Creek, and Treeline had a high percentage of early stage Anisotremus eggs.

Although Anisotremus eggs vere collected as early as January and February 1987 and February 1988, larvae (including yolk sac, flexion and standard length) were not found in either surface or oblique plankton tows until March in both years. This may suggest that initial spawns in the earlier months were fertilized but were not viable. Egg production depends on endogenous factors (photoperiod, temperature, and nutritional history of the female) (Bye 1984, Stacey 1984). Thus, there is considerable variability in quantity and quality of the eggs.

Egg death may be associated with predatory and non-predatory factors. Evidence of non-predatory egg death in the pilchard (Sardina pilchardus) might be linked to cytological incompetence, unfavorable environmental conditions such as temperature, salinity or dissolved oxygen, or variable nutritional state of the parents. In January and February, the water temperature of the Salton Sea was 15°C as compared to 19 or 20°C in March. Sargo did not produce viable spawns in our laboratory until the photoperiod was 13L/11D and the temperature was 20°C.

The data also indicated that although the peak in egg production was in March, the peak in larval abundance was not until April. This could be a sampling artifact since sampling was conducted one week per month. Gonadal somatic indices (GSI) for sargo were collected monthly by the California Department of Fish and Game during 1987. These data supported the ichthyoplankton data by shoving peak GSI in the month of March (Fig. 4)

No comparisons can be made about the overall magnitude of eggs and larvae comparing 1987 to 1988 until completion of April through June 1988 samples have been added to the graph and analyzed.

4. Figure 5 indicates the spatial distribution of sciaenid eggs collected. At this time, Bairdiella icistia eggs cannot be distinguished from Cvnoscion xanthulus eggs. As previously mentioned, the non-outflow stations showed the greatest abundance of eggs. Five stations appear to be spawning areas. On the western side of the Sea, Riviera Yacht Club (RY), Sandy Point (SP) and San Felipe Creek (SF) had the greatest abundance of eggs in early developmental stages. The middle of the Sea (MS) station also had a relatively high number of early stage eggs and one station on the eastern side, Salt Creek (SC) also showed similar levels of abundance.

5. Figure 6 indicates the seasonal abundance of sciaenid eggs and larvae. Sciaenid eggs were not found until April 1987 and continued to appear in the plankton collection through October.

The ichthyoplankton collected through March 1988 have been analyzed for this report with no sciaenid eggs identified. Additional analyses of 1988 plankton samples are necessary to determine if the same trend of seasonal abundance occurred as in 1987.

Since we were sampling one week per month, the present data may be an artifact of sampling frequency, but there appears to have been a very sharp onset of spawning by sciaenids in April 1987. The surface water temperature of the Sea ranged from approximately 22-25°C. At these

Figure 4. Gonadal Somatic Index for Sargo.

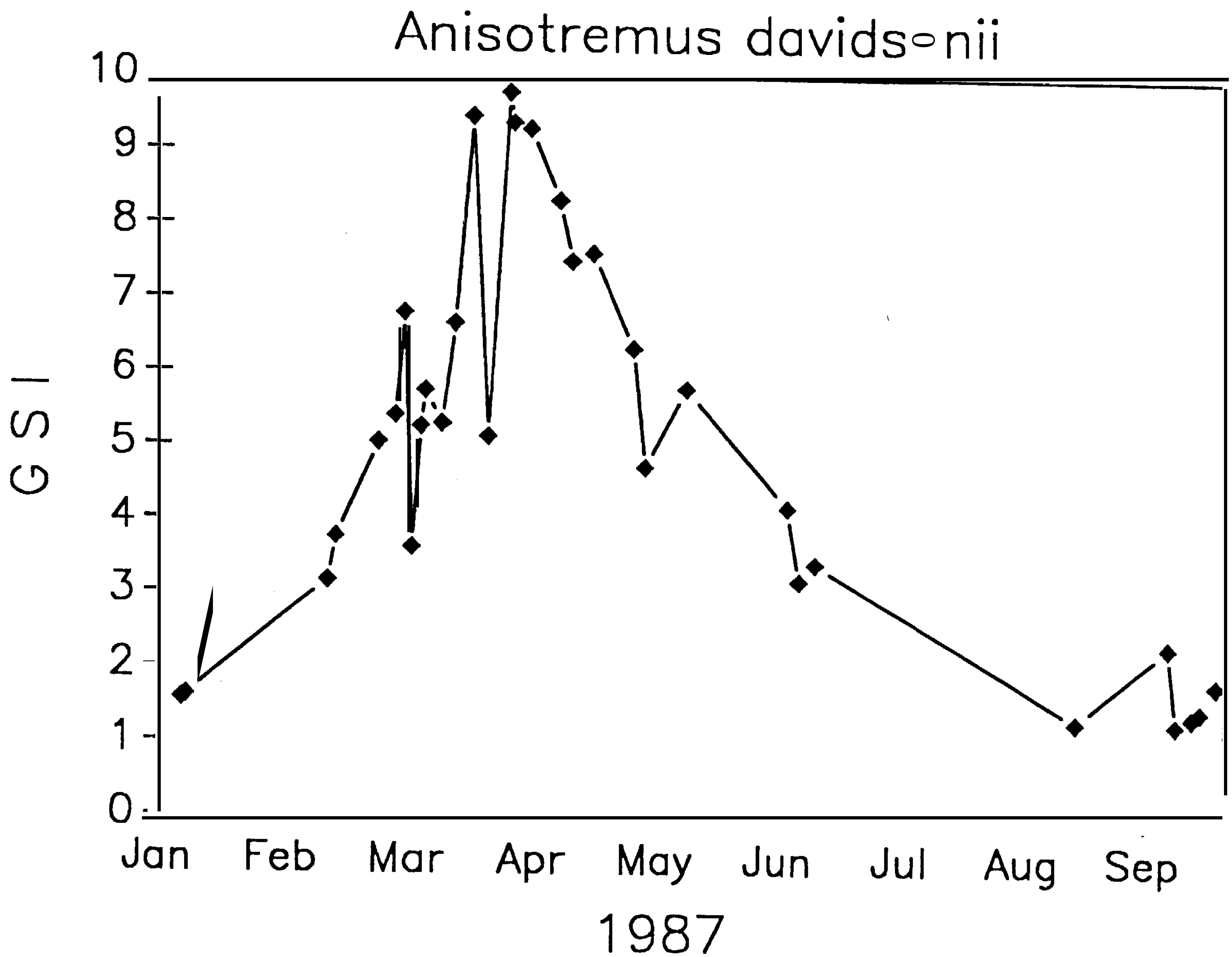

Figure 4. Gonadal Somatic Index of *Anisotremus davidsonii*

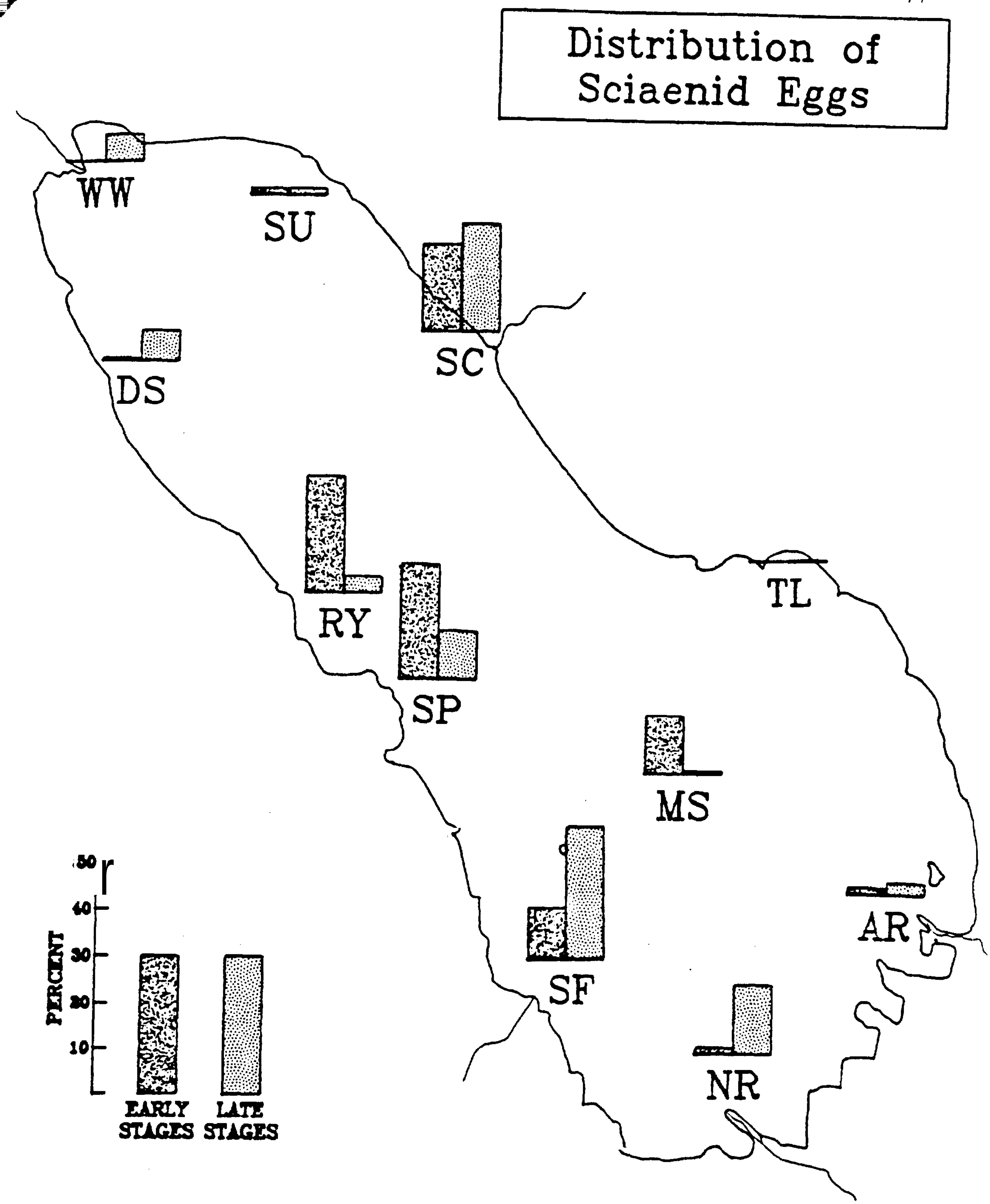

Figure 5. Distribution of Developmental Stages of Sciaenid eggs.

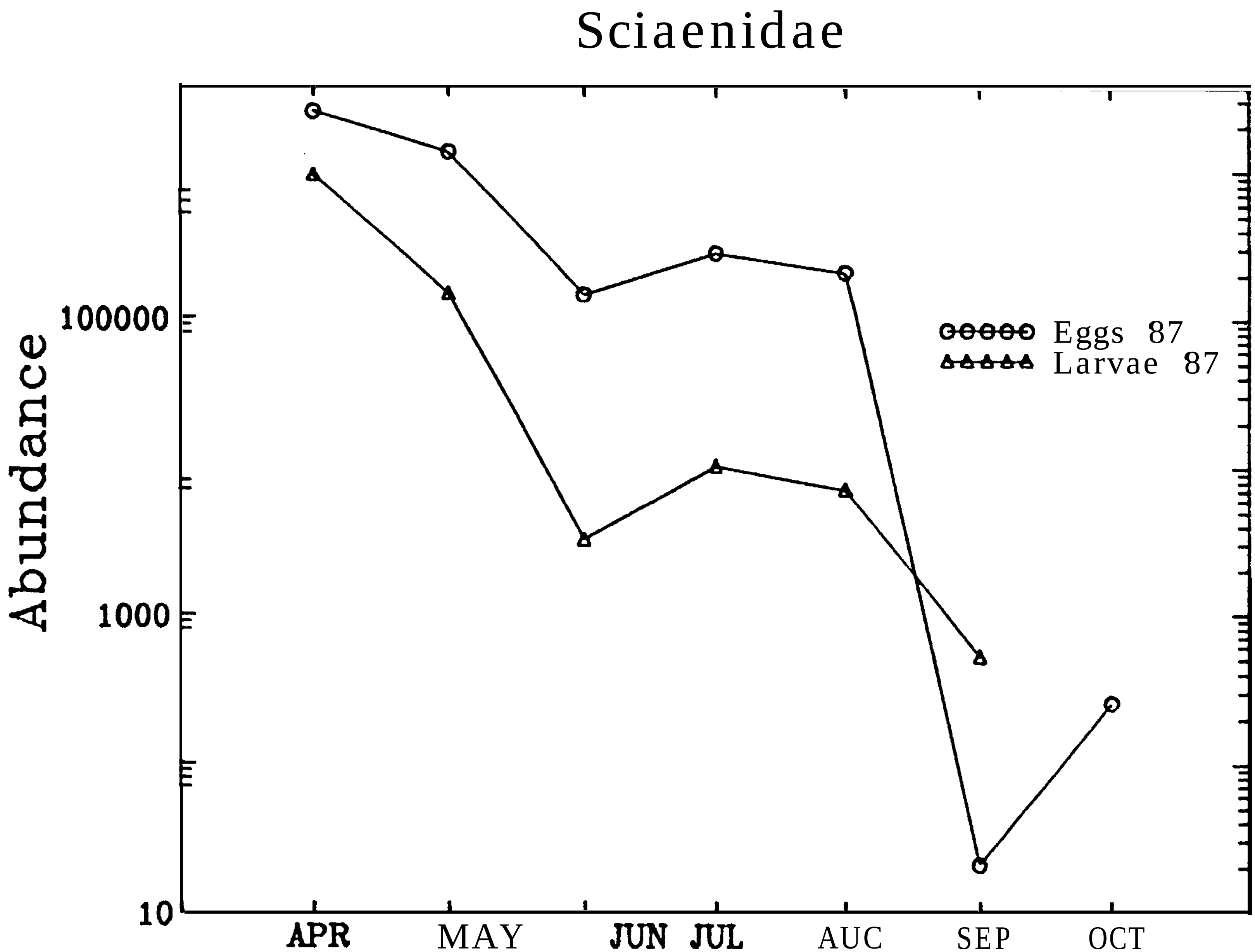

Figure 6. Seasonal Abundance of Egg and Larvae of the Sciacnids

temperature regimes, sciaenid eggs may hatch in 18-21 hrs. When surface water temperatures reach 30°C, (June through October), hatching of sciaenid eggs can occur as quickly as 12-15 hrs. Larval abundance was the highest in April when egg abundance was also the highest and the temperature regime was the lowest. Larval abundance continued to parallel egg abundance with a significant decrease in both beginning in June. This may be correlated to the radical increase in water temperature (April and May 22-25°C and June through October 30°C) or the decrease in egg and larval abundance may be attributed to a change in which species were spawning. As previously stated, the eggs of Bairdiella and Cvnoscion cannot be distinguished at this time; the yolk sac larvae also have very similar pigmentation patterns. Consequently, until the characteristic differences can be resolved this question cannot be addressed.

Gonadal somatic indices for Bairdiella icistia (Fig. 7) and for the corvina, Cvnoscion xanthulus, (Fig. 8) support the relatively sharp onset of abundance of sciaenid eggs found in our ichthyoplankton surveys during April 1987.

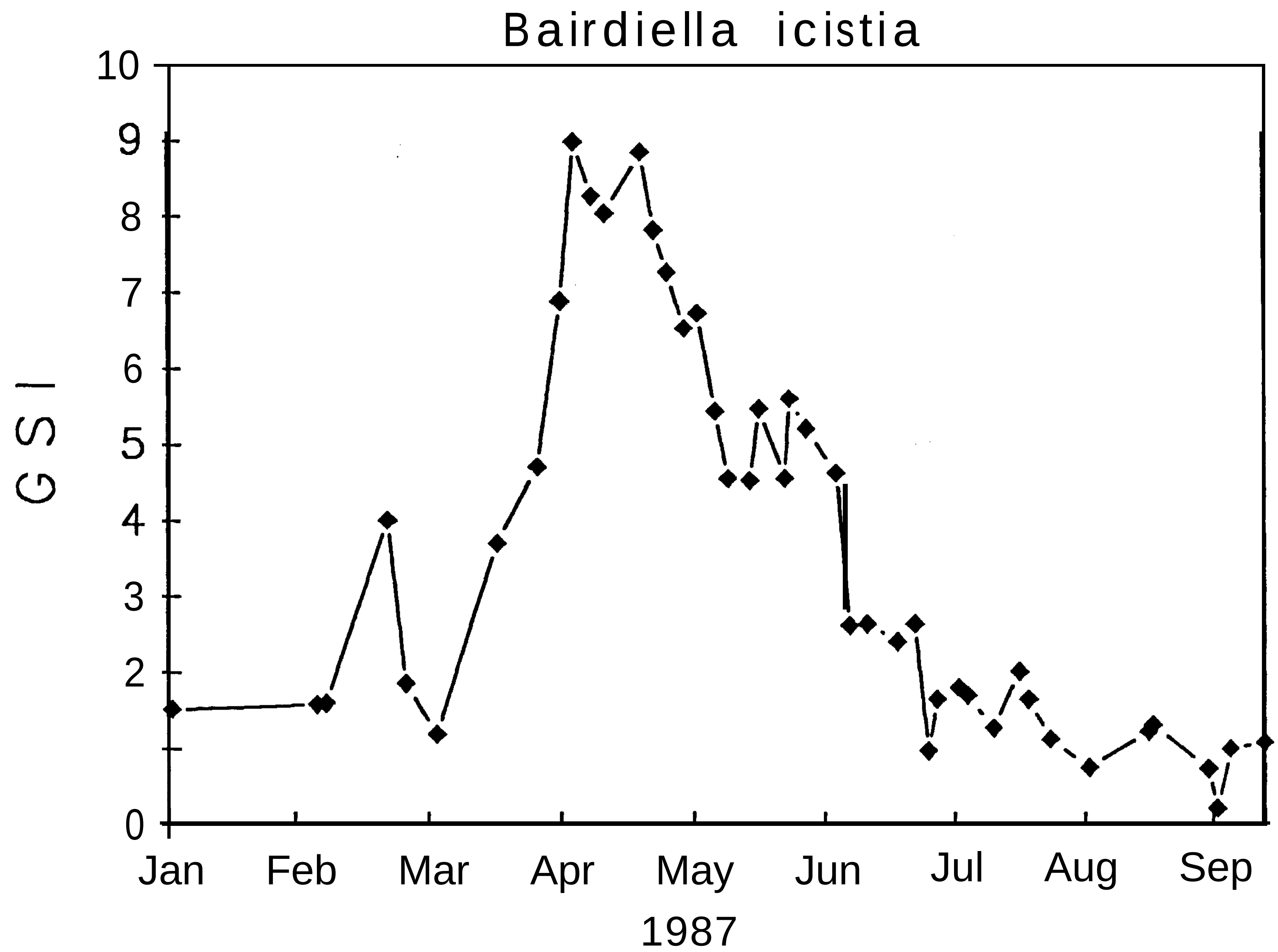

Figure 7. **Gonadal** Somatic Index of Bairdiella icistia

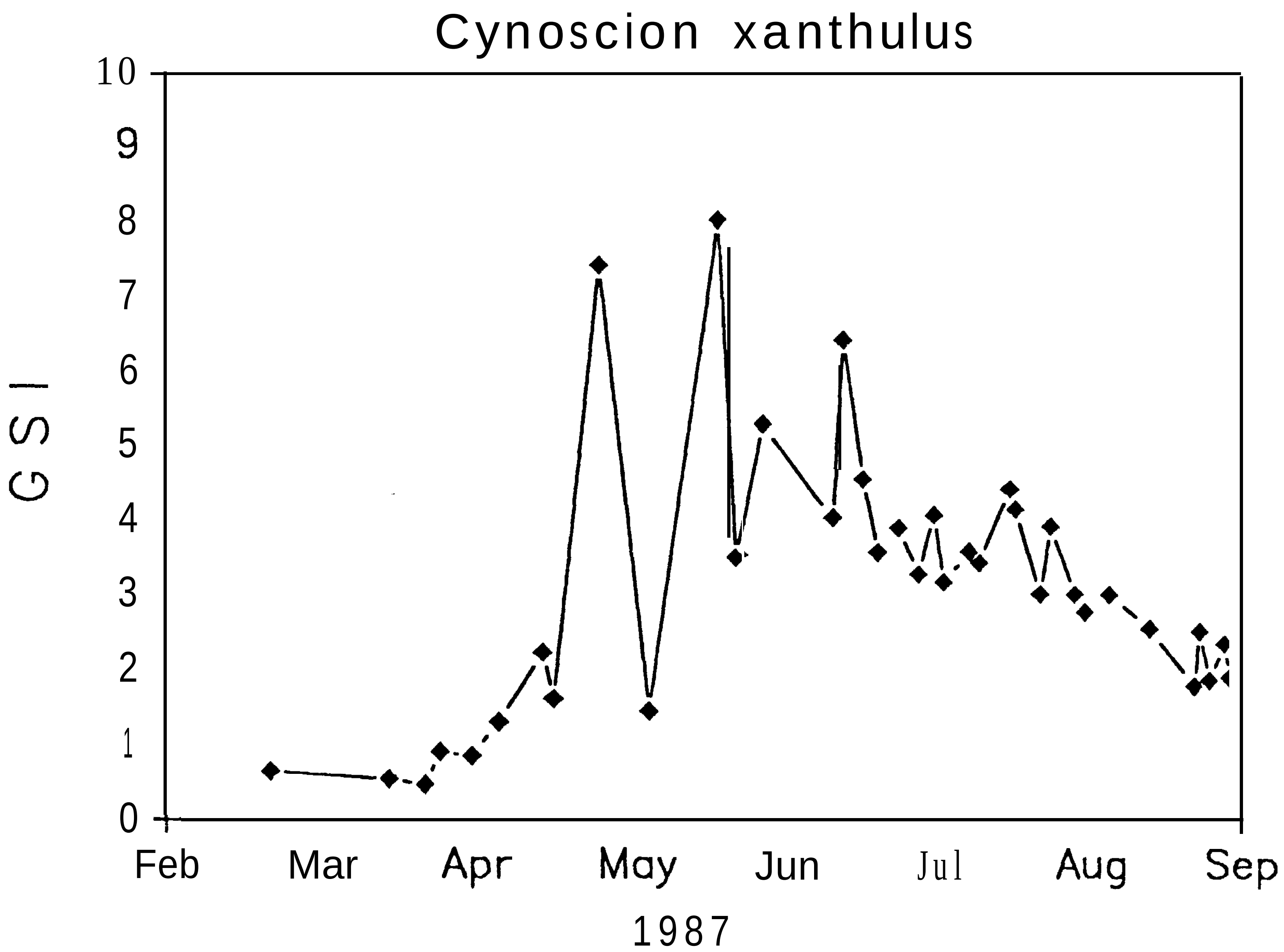

Figure 8. Conadal Somatic Index of Cynoscion xanthulus.

VI. RECOMMENDATIONS

1. Anisotremus davidsonii eggs and larvae are clearly distinguishable from the sciaenid eggs and larvae. The spawning areas have been consistent for two years of sampling. It would be reasonable to decrease sampling efforts during those months when only Anisotremus is spawning and increase sampling efforts during the months when the sciaenids are spawning (March through September). The sampling frequency should be increased to two weeks per month during these months to determine if the general trend observed in 1987 is reliable or a sampling artifact.
2. In addition to studying the ichthyoplankton after preservation during the bimonthly field sampling, taxonomic surveys should be conducted to determine the distinguishing characteristics between Bairdiella icistia and Cynoscion xanthulus. This would entail collecting live eggs, increasing the number of eggs measured as previously described in each developmental stage, while also noting pigmentation patterns and positions of the oil globule in relation to nape and anus, then hatching the eggs with similar analysis performed on the yolk sac larvae. This work will be conducted in the field with rigid control of temperature to simulate field conditions.
3. During these same taxonomic series, we will gain a better understanding of rate of development under the various temperature regimes at the Sea. It is important to have a clearer idea of the amount of time for the rate of each developmental stages to clearly understand if we are correctly classifying spawning areas in the Sea.

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