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THE PARTYBOAT FISHERY OF THE SALTON SEA AND THE APPARENT EFFECT OF TEMPERATURE AND SALINITY ON THE CATCH OF ORANGEMOUTH CORVINA, *CYNOSCION XANTHULUS*

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ABSTRACT

Examination of partyboat logs from the Salton Sea for 1962 through 1972 showed that the orangemouth corvina (*Cynoscion xanthulus*) was almost exclusively sought after by the partyboat angler even though bairdiella (*Bairdiella icistia*) and sargo (*Anisotremus davidsoni*) were abundant. The partyboat angler was very successful from 1962 through 1970, with the exception of 1965 when partyboat fishing was poor. Partyboat anglers caught the most corvina, 9,267, in 1970 and had the highest catch rate of 1.88 corvina per angler hour. There was a severe decline in the total partyboat catch of corvina to 849 in 1971 and 158 in 1972. Angler success rates also dropped to 0.50 in 1971 and 0.24 in 1972. The best angler catch rates were during the hot months of July, August, September and October, with the highest rate in August. Analysis of water temperatures from 1965 through 1971 revealed that angler catch rates were directly correlated with water temperatures in the Salton Sea.

Average salinity of the Sea increased from 34.9 parts per thousand (^{o}/oo) in May of 1962 to 39.4^{o}/oo in December of 1972, an average increase of about 0.45^{o}/oo per year. Lasker, Tenaza and Chamberlain (1972) showed that Salton Sea water of 40°/oo salinity is detrimental to the bairdiella and sargo during embryonic development. It is likely that this level of salinity has the same effect on corvina eggs and larvae. This could account for the dominance of larger corvina in the 1971 and 1972 catch; a fact supported by the partyboat logs for these years which showed a doubling of the average weight of corvina. In 1971 and 1972, there was a marked upward shift in the size composition of the corvina, a sharp decline in the total catch of corvina, and a drop in angler success, suggesting that the rise in salinity may be adversely affecting corvina recruitment. However, more direct evidence is needed to determine whether hypersalinity of 40°/oo is detrimental to corvina eggs and larvae in the Salton Sea.

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INTRODUCTION

The Salton Sea was formed in 1905-1907 by accidental diversion of flood water from the Colorado River, and has since been maintained by agricultural drainage from surrounding land. The Sea is approximately 58 km (35 mi) long and 24 km (15 mi) wide at its maximum. It is located in Imperial and Riverside counties and is the largest inland body of water in California (see Carpelan, 1961, for a map of the Sea).

Despite earlier introductions of numerous species of fish by the California Department of Fish and Game, it was not until the years 1950 through 1956 when the Department planted about 200 orangemouth corvina, 67 bairdiella and 65 sargo that the right combination was found that would survive and reproduce to provide a sport fishery at the Salton Sea (Walker, Whitney and Barlow, 1961). This fishery contributed greatly to the economic growth of the Salton Sea area. In 1967 the Sea provided about 1,444,000 total water use recreation days which included 355,500 angler days and 1,088,500 "general recreation" activities (Development Research Associates, 1969).

As a result of the growth of the sport fishery, partyboat operations began at the Salton Sea in 1962. The California Fish and Game Code requires skippers of sport fishing boats operating under hire to keep logs of their catch, fishing effort, area of operation and other information as directed by the Fish and Game Commission. Operators of these partyboats also are required to send in monthly notices even though they did not fish.

This paper examines the partyboat fishery at the Salton Sea for the years 1962 through 1972[3/], and evaluates the relationship between fishing success, water temperature, and rising salinity. It is this increase in salinity which has caused so much concern for the future of the Salton Sea sport fishery (Calhoun, 1969).

The orangemouth corvina, the top piscine predator in the Salton Sea, is the most sought after game fish. Few of the partyboat logs list catches of sargo or bairdiella, and then only when corvina fishing is poor. Therefore, the data on them have not been included in the analysis.

PARTYBOAT FISHING METHODS

The partyboat sport fishery on the Salton Sea differs from the rest of the sport fishery in three main respects. First, the majority of the skippers either live at the Sea all year or reside there during the good fishing months. This probably gives them an advantage in knowing what methods to use in angling for corvina compared with those who only fish irregularly. Second, all partyboat skippers, but only a few private boat owners, use electronic fish-finding devices to locate schools of corvina.

The use of live-bait tanks is a third factor that distinguishes partyboat operators from other boat fishermen on the Sea. Before 1968, the longjaw mudsucker (*Gillichthys mirabilis*) was the principal live bait for corvina, but it did not require live-bait tanks to be kept alive. In 1968 it was found that, at certain times of the year, bairdiella were better bait than

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[3/] Partyboat logs not available for 1964.

mudsuckers for taking corvina. However, bait tanks were necessary to keep these fish alive. Since the partyboats were larger than most private boats operating on the Sea, the operators installed live-bait tanks, whereas most private owners did not (Hulquist, pers. comm., 1973). Partyboat anglers, therefore, usually had an advantage over private boat anglers during the periods when bairdiella were better live bait.

Bairdiella are the best bait from about mid-May through August, depending on water conditions. Although a variety of fishing methods are employed to catch corvina (e.g., using jigs near the bottom, trolling deep with lures, and using small bait fish like mudsuckers and mollies, Poecilla spp.), bairdiella are the most commonly used bait when corvina fishing is best.

PARTYBOAT LOGS

The Department of Fish and Game received 1,862 usable Salton Sea partyboat logs from 1962 through 1972 which showed that 6,845 fishermen caught 36,016 orangemouth corvina for an average of 5.3 corvina per angler day. An average of four anglers per boat trip was recorded and they fished an average of four hours each.

The number of partyboats operating each year increased from 2 in 1962 and 1963 to a high of 14 in 1966 (Table 1). These partyboats did not operate all year, but rather on a month-to-month basis depending upon fishing conditions. The average number of months the partyboats were in service ranged from a low of 2 in 1965 and 1971 to a high of 5 in 1968. The average number of trips by the partyboats also increased from 5.5 in 1962 to 32.5 in 1963 and 30.2 in 1970.

The year 1970 showed a marked increase over 1962 in total catch, effort and angler success (Table 2). The total catch of 185 corvina in 1962 rose to a high of 9,267 in 1970. The effort for this same period increased from 126 angler-hours in 1962 to 4,933 in 1970. As the total catch and effort increased, so did angler success. The highest angler success rate was in 1970 with a catch per angler hour of 1.88. The poorest success rate was in 1972 with a catch per angler hour of 0.24.

From 1962 through 1970, the average weight of corvina fluctuated between 1.4 and 2.2 kg (3.1 and 4.8 lbs). In 1971 the average weight increased to 3.6 kg (7.8 lbs) and in 1972 to 3.9 kg (8.6 lbs).

Angler success has declined sharply since 1970. In 1971 the catch per angler hour dropped to 0.50 and in 1972 it dropped still further to 0.24. The total catch of corvina also dropped to 849 in 1971 and 158 in 1972.

On a monthly basis, February and November received the most partyboat angler use, with the largest harvest of corvina occurring in February (Table 3). Both angler use and harvest were lowest in April. Angler success rates were highest during the months of July, August, September and October. August was the peak month with a success rate of 1.84 corvina per angler hour. Anglers had the least success in the months of April and December, with success rates of 0.79 and 0.86 corvina per angler hour, respectively.

TABLE 1

Salton Sea Partyboat Operations,
1962 - 1972

Year	Number of boats	Boat hours fished	Total trips	Average trips per boat	Average number of months in operation
1962	2	40	11	5.5	3
1963	2	303	65	32.5	4
1964	No reports available				
1965	6	432	76	12.7	2
1966	14	1,313	354	25.3	3
1967	12	944	278	23.2	4
1968	12	1,170	322	26.8	5
1969	10	948	219	21.9	4
1970	12	1,384	363	30.2	4
1971	13	502	118	9.1	2
1972	5	225	56	11.2	3

TABLE 2

Partyboat Angler Effort and Catch Statistics for the Orangemouth Corvina at the Salton Sea, 1962 - 1972

Year	Number of anglers	Total angler hours	Total catch	Catch per angler hour	Catch per angler	Total weight (kg)	Average weight (kg)
1962	33	126	185	1.47	5.6	351	1.9
1963	218	1,054	1,030	0.98	4.7	1,963	1.9
1964	No reports available						
1965	427	3,034	1,085	0.36	2.5	1,502	1.4
1966	1,384	5,786	8,574	1.48	6.2	14,736	1.7
1967	948	3,290	4,741	1.44	5.0	8,697	1.8
1968	1,239	4,730	5,811	1.23	4.7	12,757	2.2
1969	730	3,170	4,316	1.36	5.9	7,747	1.8
1970	1,314	4,933	9,267	1.88	7.1	13,915	1.5
1971	390	1,702	849	0.50	2.2	3,034	3.6
1972	162	657	158	0.24	1.0	618	3.9

TABLE 3

Monthly Partyboat Angler Effort and Catch Statistics for the Orangemouth Corvina at the Salton Sea, 1962-1972

Month	Number of anglers	Total angler hours	Total catch	Catch per angler hour	Catch per angler	Total weight (kg)
January	479	2,311	3,223	1.39	6.7	5,178
February	792	3,603	4,360	1.21	5.5	8,467
March	514	1,872	2,768	1.48	5.4	5,276
April	244	1,076	849	0.79	3.5	1,446
May	690	2,938	2,785	0.95	4.0	6,019
June	645	2,512	2,739	1.09	4.2	5,986
July	596	2,079	3,436	1.65	5.8	6,105
August	525	1,751	3,216	1.84	6.1	5,178
September	515	1,982	3,556	1.79	6.9	6,228
October	685	2,401	3,820	1.59	5.6	6,596
November	791	3,594	3,577	1.00	4.5	6,530
December	370	1,704	1,467	0.86	4.0	2,367

WATER TEMPERATURE

The surface water temperature was recorded by State Park personnel at North Shore from 1965 through 1971. Recordings were made between 10 and 15 days each month, and at the same time each day. They were taken a quarter-mile off the State Park with a hand thermometer lowered to a depth of four feet then brought to the surface and read. January and February, with average water temperatures of 12.8°C (55°F), were the coldest months and August, with an average of 31.7°C (89°F), was the warmest (Table 4).

The mean water temperature was compared with the mean catch of corvina per angler hour and the regression line was fitted by the method of least squares (Figure 1). The coefficient of correlation equaled 0.593 which was significant at the 0.005 probability level. This indicates a highly significant, direct correlation between the success of partyboat angling for orangemouth corvina and Salton Sea water temperatures.

SALINITY

Water samples were taken twice a year, in the late spring and in late fall, by the Imperial Irrigation District at five offshore stations. These were located off Bertram, the Salton Sea Beach, the Naval Base, the State Park Headquarters at North Shore, and halfway between the New and the Alamo rivers. Each was about 305 m (1,000 ft) offshore except for the latter site which was about 403 m (1,320 ft) offshore. Data from the latter station were not included in this analysis because the heavy influence of fresh water from these two rivers gave salinity readings which were atypical of the Sea (Hulquist, pers. comm., 1973). Salinity of the water samples was determined according to Standard Methods at the Imperial Irrigation District Laboratory.

Analyses show considerable variation from year to year, probably due to seasonal and short-term climatic changes. However, a long-range increase is apparent. The mean salinity in May 1962 was 34.9°/oo, but by December 1972, it had increased to a mean of 39.4°/oo (Table 5). The average salinity increase per year from 1962 through 1972 was 0.45°/oo which is higher than the 0.35°/oo per year increase noted by Carpelan (1961) for the 1956 to 1958 period. The highest salinity readings were in the late fall after the period of greatest evaporation, while the lowest salinity was in the spring following the period with least evaporation and highest inflow of fresh water.

DISCUSSION

The partyboat logs for 1971 and 1972 show that catch, effort and angler success rate for corvina fell sharply from previous years. Data for 1973 have not been analyzed; however, the fishery appeared sporadic with corvina taken only during three or four months of the year. The total catch and the angler success rates declined to their lowest points since fishing logs were first kept by the partyboat operators in 1962. Another important finding is that during 1971 and 1972 the average weight of corvina caught by fishermen had doubled. An examination of the 1971 and 1972 logs revealed very few fish caught under 2.3 kg (5 lbs). Interviews with a sample of partyboat skippers showed they had not changed their corvina fishing methods. Thus, the larger corvina being caught are not being fished selectively. These data indicate a scarcity of smaller corvina may exist and suggests a possible decrease in recruitment. The increase in salinity to around 40°/oo in 1969 may account for these changes.

TABLE 4

Average Monthly Water Temperature and Catch Per Partyboat Angler Hour of Orangemouth Corvina at the Salton Sea, 1965 - 1971

Month	Average water temperature (°C)	Average catch per angler hour
January	12.8	1.40
February	12.8	1.25
March	17.2	1.36
April	21.1	0.82
May	24.4	1.03
June	26.7	1.16
July	30.0	1.83
August	31.7	2.03
September	29.4	1.81
October	25.0	1.56
November	20.6	0.89
December	15.0	0.86

TABLE 5

Salinity Readings from Four Stations on the Salton Sea, 1962 - 1972

Month/year sampled	Salinity range (°/oo)	Mean salinity (°/oo)
5/62	34.3-35.2	34.9
11/62	34.8-36.2	35.4
11/63	34.1-39.9	36.0
5/64	33.8-35.6	34.6
11/64	37.3-40.7	38.8
5/65	35.9-37.2	36.6
11/65	36.7-37.7	37.0
5/66	36.5-37.4	37.1
11/66	34.8-36.5	35.6
5/67	37.8-38.6	38.0
12/67	37.8-38.9	38.2
7/68	37.4-39.5	38.4
11/68	38.1-39.4	38.7
5/69	38.7-39.2	39.0
12/69	40.4-41.6	41.0
5/70	37.4-38.3	37.9
11/70	38.6-39.9	39.2
5/71	38.4-38.9	38.8
11/71	39.2-40.0	39.6
5/72	38.2-38.9	38.6
12/72	38.4-40.4	39.4

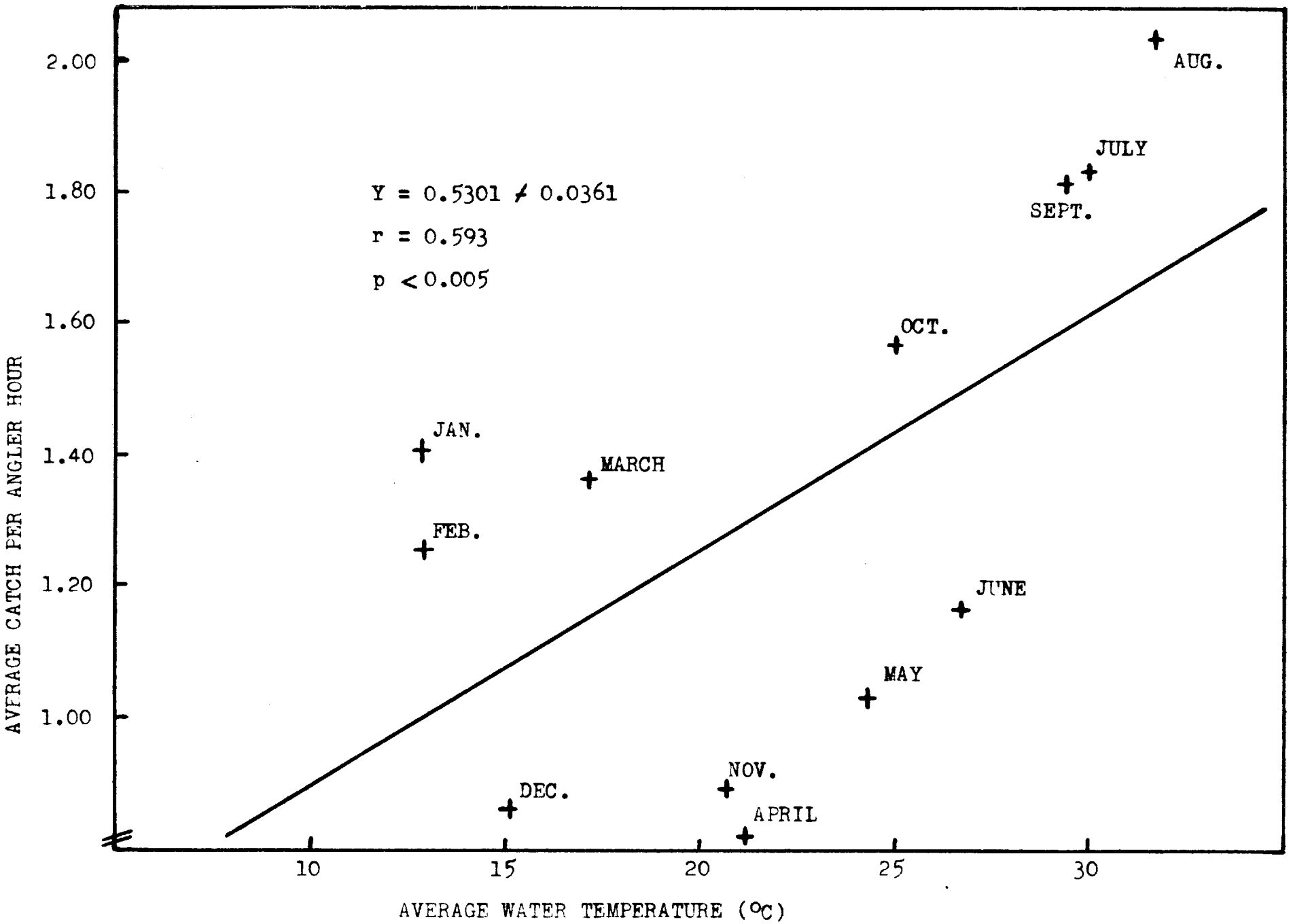

FIGURE 1. Relationship between average monthly catch per partyboat angler hour and average monthly water temperature (°C), from 1965 through 1971.

A number of experiments have demonstrated the effects of hypersalinity on the three gamefishes found in the Salton Sea. Although Hanson (1970) found that yearling and young-of-the-year bairdiella and corvina could tolerate salinities above 50°/oo without acclimation, Lasker, Tenaza and Chamberlain (1972) showed that Salton Sea water of 40°/oo salinity exceeds the maximum tolerance limits of bairdiella and sargo embryos and larvae. Unfortunately, corvina were not tested by Lasker et al. (1972), since none could be obtained which were ripe for spawning. However, I believe that similar results would be obtained with corvina because, like bairdiella and sargo, they are a pelagic fish which hatch before full development, and thus lack the ability to osmoregulate in the egg and larval stages. Brocksen and Cole (1972) found that the optimal salinity range for sargo, bairdiella and corvina in relation to growth, food consumption, food conversion efficiency and respiration was between 33 and 37°/oo. They believe that at 40°/oo the fish inhabiting the Salton Sea will have great difficulty in maintaining their population size because of the physiological stress placed on them by a rise in salinity.

Although the average salinity on the Salton Sea has not yet reached 40°/oo, it is high enough to merit serious concern for the fate of the existing fisheries. More direct evidence is needed to support the contention that corvina eggs and larvae are as intolerant of hypersalinity as similar life stages of bairdiella and sargo. There is also a need to determine if the rise in salinity is affecting the bairdiella and sargo populations.

A subsequent report will examine the evidence from the non-partyboat fishery for the effects of increasing salinity on sport fish populations.

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