Salton Sea Fisheries Long-term Monitoring

Draft Quarterly Report: Summer 2003

Salton Sea Program
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Introduction:

The California Department of Fish and Game (CDFG) is monitoring the status and trends of the Salton Sea fisheries. This will require a compilation of sampling results over several years. In the spring of 2003, Department personnel started quarterly sampling at fourteen stations around the sea, as the basis of a long term monitoring program. To allow comparison of current and future monitoring efforts by CDFG to past results, the following protocol was adapted from those previously used by researchers at the Salton Sea.

Each quarter, if conditions allow, this protocol will produce about 816 net-hours of sampling. After each quarter's sampling is completed this draft report will be prepared, summarizing the numbers and species of fish netted, and calculating the overall and species-based catch-per-unit-effort (CPUE). This report will also offer qualitative comments on the condition and breeding status of each species. After annual repetitions of seasonal sampling, enough data will be collected to allow statistical tests for significant differences in numbers, seasonality, and site use, by and among the four species of fish.

Methods:

The sampling sites comprise three broad habitat types: pelagic (3 sites), near-shore (8 sites), and estuarine (3 sites). The pelagic sites are in the approximate middles of the north basin, south basin and inter-basin areas of the Sea. The near-shore sites are spaced widely apart, four each, near the west and east shores, to capture as much breadth of habitat as possible. The estuarine sites are in the body of the Sea, close enough to the mouths of the New, Alamo, and Whitewater Rivers, to be under the influence of their outflows. See Table 1. for the exact locations of all sites.

Sampling takes place during each of the putative seasons, as follows: spring- April and May; summer- July and August; fall- October and November; winter- January and February. We will attempt to compress the total sampling period into as few days as possible, to the extent that the weather, equipment maintenance, and personnel scheduling constraints allow. Nets are typically set at one or two sites in the morning, and hauled in after approximately 24 hours. The exact number of hours set is recorded for each net, to the nearest quarter-hour.

Fish are sampled by deploying multi-panel monofilament gill nets with 6 X 30 foot panels of 0.5, 1, 2, 3, and 4 inch mesh. Two nets are set at all sites at the water's surface. The nets are set far enough apart to allow room for maneuvering a boat during setting and retrieval, usually 100-200 meters. The nets at near-shore and estuarine sites are set in 2.5 to 4.5 meters of water, typically 200-300 meters from the shore.

Two additional nets are set at the bottom of water column at the three pelagic sites. The conditions fish experience at the bottom in deep water is different enough from the surface water,

in dissolved oxygen, light, food availability and temperature, that this can be considered a discrete habitat, and thus we sample it as though it were a separate site.

At the time of each set and retrieval, water depth, water temperature, conductivity, salinity, and dissolved oxygen are measured and recorded.

When nets are pulled in the following day, all fish are removed and immediately stored on ice. Data are collected from these fish as soon as possible, almost always the same day they are hauled in.

All fish are identified to species level and counted. For the four sport fish in the Salton Sea, (tilapia, Gulf croaker, orangemouth corvina and sargo) weights, lengths (fork length), sex, physical condition, and reproductive status are recorded. Fish above five pounds are weighed to the nearest ounce. Fish below five pounds are weighed to the nearest half ounce. Lengths of fish under 50 centimeters are recorded to the nearest millimeter. Lengths of fish over 50 centimeters are recorded to the nearest centimeter. The sex of all adult fish is determined by dissection. A sample of at least ten fish of each species is also dissected to determine physical condition and breeding status.

Results:

The Summer 2003 sampling session took place from July 15 to August 18. Table 2. shows the totals of fishes sampled at each site. Total numbers of fishes sampled, with CPUE in parentheses, were: 686 tilapia (.87), 0 Gulf croaker (.00), 0 orangemouth corvina (.00), 0 sargo (.00). The overall CPUE (.87) was the same as for tilapia, since they comprised almost the entire sample for the period: 686 of 688 fish. Two threadfin shad were also netted.

Tilapia were in two discrete size classes: fish which were young from this year's reproduction (83 fish, from 60-78 mm), and a larger class which we believe to be from last year's reproductive efforts (602 fish, from 120-167 mm). We did not determine a definite age of these cohorts by scale annuli or otolith analysis, but merely estimated their approximate age.

These size classes did not seem to segregate spatially; both sizes were consistently caught in the same nets, in panels of different mesh size. We also caught a single large tilapia from an earlier cohort.

Obviously, the only species for which condition and reproductive status could be assessed was tilapia. Long set times and high water temperatures fostered rapid rates of autolysis of the sampled fish. Frequently, complete data about sex and gonadal condition could not be salvaged from all specimens. Those which allowed good visualization of internal organs were in very good condition, although most of them were visibly infected with tapeworms. Most of those in the larger size class were in advanced stages of full breeding coloration, and the females examined contained ova up to 1mm in diameter. None of those we examined presented the flaccid ovaries which would indicate a post-reproductive state.

Discussion:

Chart 1. shows a comparison of CPUEs from this and the Spring sampling sessions. Not only had Gulf croaker and orangemouth corvina "disappeared" this period, but tilapia "re-appeared.

That we netted no croaker or corvina this sampling period is perplexing, although it isn't prudent to infer much about these populations from a single season's results. The seasonal movements of these species at the Salton Sea have not been fully characterized. A primary

reason why we sample throughout the year is to elucidate these movements. Nevertheless, these results do raise the question of whether our sampling efforts are intensive enough to allow sufficient resolution of the population numbers, when the population is severely reduced. We will continue to consider this question as we compile data from future sampling periods.

The good news in this quarter's results is in two parts. The first part is proof of reproduction by tilapia this year. The smaller size class of tilapia in our nets was probably produced in March or April of this year. The second part, and of greater importance, is the recruitment of young into the population as adults. The larger class of fish we netted is at the threshold of reproductive activity.

There appear to be few large tilapia remaining in the Sea which survive from previous cohorts. In our combined spring and summer sampling we netted only a single fish of this size. The future of the Sea's tilapia population is dependent upon the recruitment of new cohorts into the population as breeders, and the small adults we sampled this summer is the first sign of that happening in several years.

That such high numbers of young tilapia were obviously present during our last sampling period, and yet went completely unsampled, raises questions about how effectively our fourteen sites sample the variation of the habitats in the Sea. The tilapia may have been in a different habitat when they were smaller, and thus evaded our nets. However, this year's young tilapia were sampled along with last year's size class during this sampling period, evidence that tilapia do indeed use the habitat we sample, during their first year.

A pattern of tilapia distribution was apparent among our habitat types. Combined CPUEs for the three habitats types were: near shore 1.76 (660 fish / 375 net-hours), estuarine .19 (26 fish / 140 net-hours), and pelagic .00 (0 fish / 275 net-hours). Riedel, Caskey and Costa-Pierce also observed that tilapia avoided deep water habitat during the summer, presumably due to low oxygen levels. Comparing east side and west side near-shore habitats also reveals a difference. The CPUE for the four east side sites was 1.26 (238 fish / 189 net-hours), and for the four west side sites it was 2.27 (422 fish / 186 net-hours).

In the last quarter's report, we called attention to the lack of fish at four sites sampled after mid-May, all of which had less than 2.0 mg/L of dissolved oxygen. We have combined our spring and summer sampling results and compared the dissolved oxygen readings at each sampling site. These values are presented in Table 3. Since we record dissolved oxygen at the times nets are both set and pulled, we averaged these values. On several occasions, rough weather made a reading impossible at the time of pulling nets, so we used the single value taken at the time nets were set.

The relationship of sampling results to dissolved oxygen levels is depicted graphically in Chart 2. Although there is a cluster of zero sampling results at oxygen levels below 2.0 mg/L, note that our second and third highest CPUEs also occurred at sites with oxygen below this level. This suggests that dissolved oxygen levels below 2.0 mg/L do not exclude fish from a site. There is good evidence, however, for 1.0 mg/L as a putative threshold for excluding fish, since the average CPUE for the six times we have sampled waters below that level, is only 0.03 (8 fish in 252 net-hours).

We will continue to add each season's data to this analysis, to determine a threshold level of dissolved oxygen which would predict the exclusion of fish from a sampling site. We think this issue may be important to consider, since continuing to sample sites which can not contain fish can negatively skew our results.

Table 1. Locations of Sampling Sites

SITE NAME	HABITAT TYPE	UTM COORDINATES
Whitewater River	Estuarine	11S 0587948
		3707343
New River	Estuarine	11S 0621567
		3666958
Alamo River	Estuarine	11S 0628480
		3675635
North Shore	Near-shore	11S 0598465
		3709237
North Wister	Near-shore	11S 0628368
		3685497
Bat Caves	Near-shore	11S 0607427
		3699864
South Salton City	Near-shore	11S 0604971
		3682198
North Desert Shores	Near-shore	11S 0589366
		3699424
The Dome	Near-shore	11S 0596997
		3690022
The Cliffs	Near-shore	11S 0615062
		3691509
Test Base	Near-shore	11S 008813
		3672196
North Basin	Pelagic	11S 0596156
		3701218
Inter-basin	Pelagic	11S 0606837
		3689452
South Basin	Pelagic	11S 0618275
		3678697

Table 2. Summer 2003 Gill-netting Results

Date	Site	Net-hours	Tilapia	Croaker	Corvina	Sargo	Other	Total Fish	CPUE
7/15/2003	North Basin, Bottom	46	0	0	0	0	0	0	0.00
7/15/2003	North Basin, Surface	46	0	0	0	0	0	0	0.00
7/17/2003	New River	45	8	0	0	0	0	8	0.18
7/21/2003	Whitewater River	47	2	0	0	0	0	2	0.04
7/21/2003	North Shore	47	99	0	0	0	0	99	2.12
7/23/2003	The Cliffs	48	3	0	0	0	0	3	0.06
7/23/2003	Bat Caves	47	114	0	0	0	0	114	2.43
7/31/2003	Alamo River	48	16	0	0	0	2	18	0.38
7/31/2003	North Wister	47	22	0	0	0	0	22	0.47
8/6/2003	North Desert Shores	47	117	0	0	0	0	117	2.48
8/6/2003	The Dome	43	97	0	0	0	0	97	2.27
8/11/2003	South Basin, Bottom	44	0	0	0	0	0	0	0.00
8/11/2003	South Basin, Surface	44	0	0	0	0	0	0	0.00
8/13/2003	Inter-Basin, Bottom	47	0	0	0	0	0	0	0.00
8/13/2003	Inter-Basin, Surface	48	0	0	0	0	0	0	0.00
8/18/2003	South Salton City	48	125	0	0	0	0	125	2.60
8/18/2003	Test Base	48	83	0	0	0	0	83	1.73
TOTALS		**790**	**686**	**0**	**0**	**0**	**2**	**688**	**0.87**

Table 3. CPUE and Dissolved Oxygen (mg/L)

Date	Site	Net-hours	Total Fish	CPUE	DO In	DO Out	Ave. DO
8/11/2003	South Basin, Bottom	44	0	0.00	0.4	0.5	0.45
8/13/2003	Inter-Basin, Bottom	47	0	0.00	0.5	NA	0.46
6/3/2003	South Salton City	46	0	0.00	0.4	0.7	0.56
6/3/2003	Test Base	46	0	0.00	0.6	0.6	0.61
7/17/2003	New River	45	8	0.18	0.8	0.5	0.65
6/12/2003	Cliffs	24	0	0.00	0.8	0.7	0.74
7/23/2003	Bat Caves	47	114	2.43	1.3	NA	1.34
5/28/2003	Bat Caves	46	0	0.00	1.4	NA	1.40
8/6/2003	North Desert Shores	47	117	2.48	1.7	2.0	1.85
7/21/2003	Whitewater River	47	2	0.04	3.1	0.6	1.85
7/15/2003	North Basin, Bottom	46	0	0.00	0.7	3.9	2.30
7/21/2003	North Shore	47	99	2.12	1.4	3.5	2.45
8/13/2003	Inter-Basin, Surface	48	0	0.00	2.9	NA	2.86
8/11/2003	South Basin, Surface	44	0	0.00	3.6	2.2	2.88
7/23/2003	The Cliffs	48	3	0.06	3.0	NA	3.03
8/6/2003	The Dome	43	97	2.27	5.0	1.3	3.13
4/9/2003	North Shore	49	27	0.55	3.8	3.9	3.85
8/18/2003	South Salton City	48	125	2.60	5.0	NA	5.00
7/31/2003	Alamo River	48	18	0.38	7.2	4.8	6.00
7/31/2003	North Wister	47	22	0.47	7.4	7.6	7.50
4/24/2003	New River	48	11	0.23	7.1	9.0	8.05
8/18/2003	Test Base	48	83	1.73	8.3	NA	8.28
7/15/2003	North Basin, Surface	46	0	0.00	10.8	5.8	8.30
5/12/2003	North Desert Shores	47	22	0.47	9.4	7.4	8.40
4/9/2003	Whitewater River	48	15	0.31	7.6	10.5	9.05
4/24/2003	North Wister	49	86	1.76	9.1	9.8	9.45
4/7/2003	Alamo River	46	12	0.26	9.7	NA	9.70
5/12/2003	Dome	47	28	0.60	10.6	11.9	11.25

Chart 1.

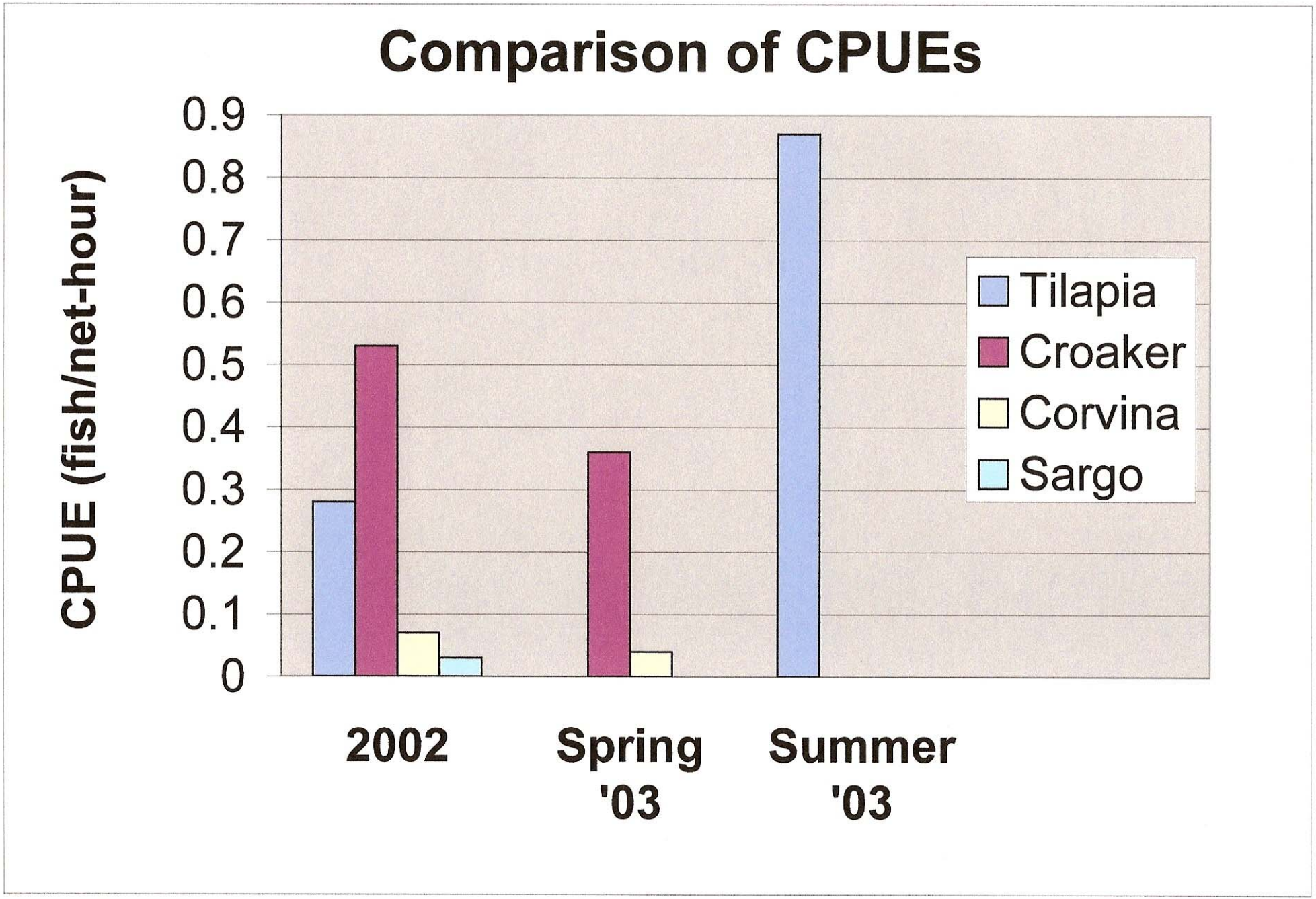
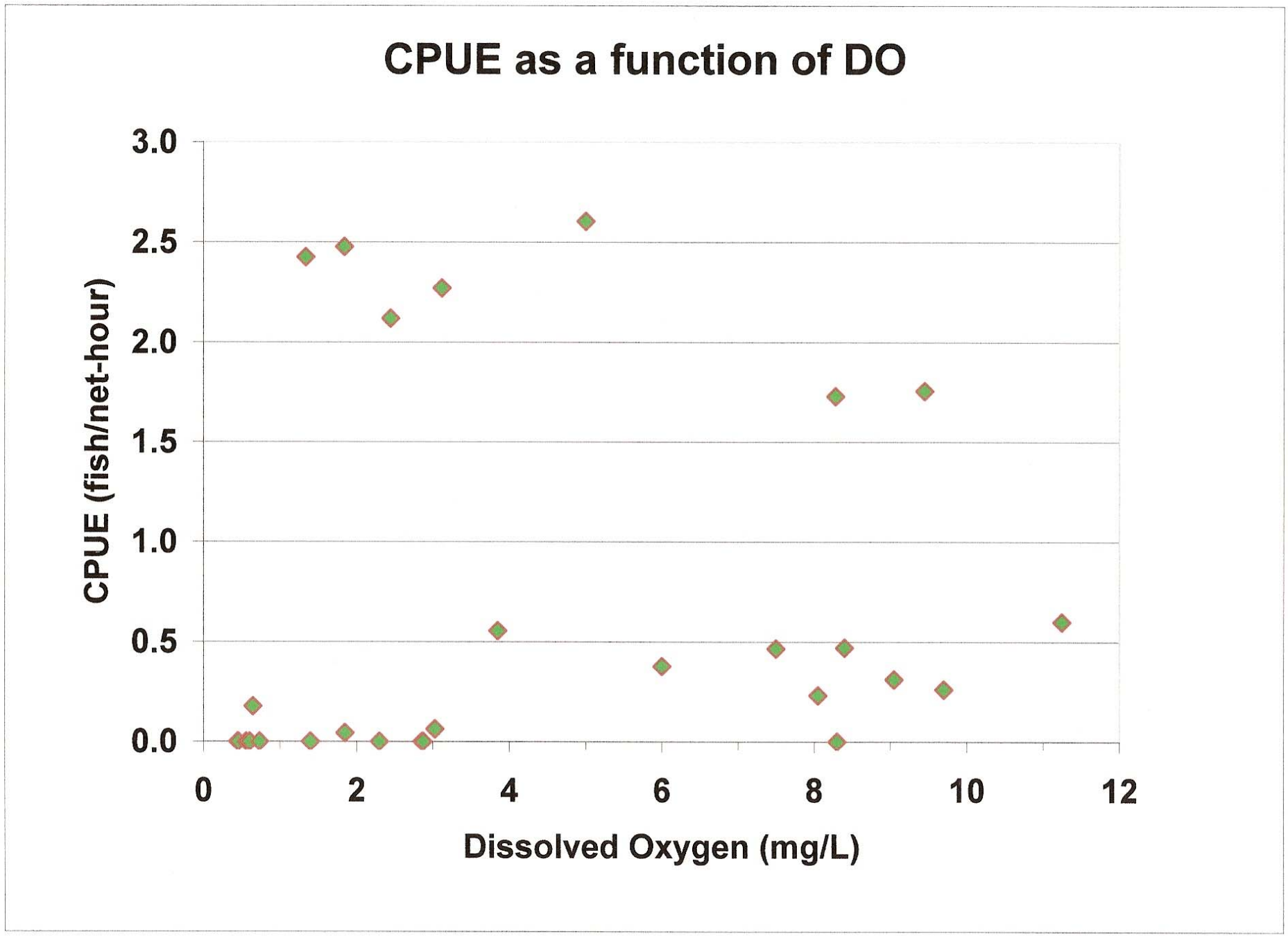

Comparison of CPUEs
CPUE (fish/net-hour)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Tilapia
Croaker
Corvina
Sargo
2002
Spring '03
Summer '03

Chart 2.


CPUE as a function of DO
CPUE (fish/net-hour)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
2
4
6
8
10
12
Dissolved Oxygen (mg/L)