San Marino Environmental Associates

Results of the Year 5 (2005) Implementation of the Santa Ana Sucker Conservation Program For the Santa Ana River

Draft Annual Report

Prepared For:
Santa Ana Sucker Conservation Team
Composed of:
City of Riverside (Regional Water Quality Control Plant)
City of San Bernardino Municipal Water Department
Orange County Resources Development Management Department
Orange County Water District
Orange County Sanitation District
Riverside County
Riverside County Flood Control and Water Conservation District
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Introduction

This year's annual report presents the results of this past year's work and compares those results to the results previously reported. We have concentrated on analysis of data because we now have sufficient data over enough years to make this analysis productive.

It should also be noted that the time period covered by this year's report extends through June of 2006. Also, the Habitat Utilization study is not continued because it was concluded that the two years of data already collected was sufficient. Also, tagging of suckers was not done this year because of the low numbers found (see below) and the feeling by the Sucker Discussion Group that the lack of recaptures was possibly making this work uninformative.

Sucker Spawning and Distribution of Fry

Table 1shows the dates and locations of sites examined specifically for fry during the 2006 breeding season. (These observations were made mostly by J. Dean and L Muro with participation by J. Baskin, A. Gonzales, and C. Stout. Dr. C. Swift assisted in the identification of the some of the smallest specimens.) Note that fry were found starting April 23rd in the two drains that were examined, Sunnyslope and Rialto. Gravel substrate apparently adequate to support spawning was observed at both of these sites. Fry were found consistently at these sites every time the sites were examined (12 times) through May 15th. After this date no fry were found. During this period Main stem sites (Mission, Riverside Ave., Jurupa and La Cadana) were examined a total of 7 times, and only once were fry found. This was on May 7th at Mission (Figs. ---). No spawning gravel substrate was observed here or in the vicinity. This leads us to believe that fry may have drifted to this site from some upstream locality. We plan to make another attempt at catching drifting fry during next year's breeding season, if possible. This was attempted during the 2003 breeding season, without success.

Table 1. Santa Ana sucker fry observations, 2006.

Date	Location of Sites	Sucker Fry	No Sucker Fry
2/11/2006	Sunnyslope		X
2/20/2006	Sunnyslope		X
3/31/2006	Sunnyslope		X
3/31/2006	Rialto		X
4/11/2006	Sunnyslope		X
4/11/2006	Rialto		X
4/22/2006	Sunnyslope		X
4/23/2006	Sunnyslope	X	
4/23/2006	Rialto	X	
4/23/2006	Mission Bridge-Main Stem SAR		X
4/30/2006	Sunnyslope	X	
4/30/2006	Rialto	X	
4/30/2006	Riverside Ave. Bridge-Main Stem		X
4/30/2006	Mission Bridge-Main Stem SAR		X
5/01/2006	Sunnyslope	X	
5/01/2006	Rialto	X	
5/02/2006	Sunnyslope	X	
5/05/2006	Rialto	X	
5/05/2006	Mission Bridge Main Stem-SAR		X
5/05/2006	Sunnyslope	X	
5/07/2006	Sunnyslope	X	
5/07/2006	Rialto	X	
--> 5/07/2006	Mission Bridge Main Stem- SAR	X	
5/08/2006	Jurupa Main Stem- SAR		X
5/15/2006	La Cadena Main Stem-SAR		X
5/15/2006	Rialto	X	
5/19/2006	Sunnyslope		X
5/24/2006	Sunnyslope		X
5/27/2006	Sunnyslope		X

Figure 1 Sunnyslope with fry present in picture on May 7th.

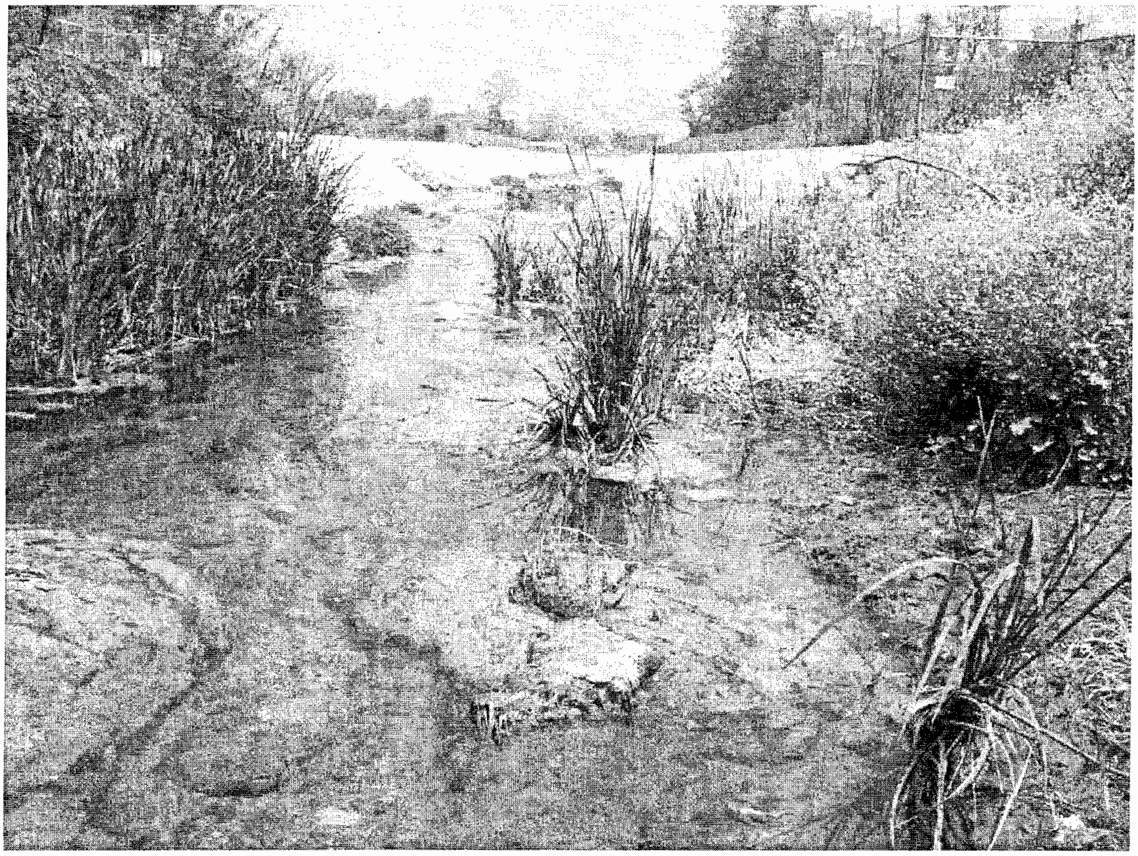


Figure 2. Sunnyslope drain, upper end were fry were found on May 7th.

Figure 3. Mission Bridge sites were fry found on May 7th.

On April 16th a non-quantitative seining survey was implemented to look for suckers in breeding condition. See Table 2. Numerous males and females in breeding condition (tuburculate males with milt and females with eggs evident) were found in Rialto Drain, one ripe male was found in the main stem opposite the mouth of Sunnyslope drain, but none were found in the main stem at Riverside Drive or Mission Blvd., or in Sunnyslope drain. However, some newly transformed juveniles were found in Sunnyslope Drain, indicating that breeding had taken place there this year.

Table 2.

				pH	Cond.	Turbid.	DO	T (°C)
Main Stem Opposite Mouth of Sunny Slope, East Bank				8	0.34	73	8.7	22
Suckers								
	Sex	Weight (g)	Length (mm)					
1	Tuberculated Male	15.1	99.6					
Main Stem Mission Bridge				8.1	0.33	95	8.2	25
	No fishes							
Main Stem Downstream Riverside Drive Bridge, South Bank				8.1	0.27	99	8.3	25
Suckers								
	Sex	Weight (g)	Length (mm)					
1	Non-Tuberculated	17.4	99.2					
Mouth of Rialto Drain				8.1	0.71	9	8.5	25
Suckers								
	Sex	Weight (g)	Length (mm)					
1	Tuberculated Male	29	115					
2	Tuberculated Male w/ Milt	21.4	106					
3	Tuberculated Male w/ Milt	28.1	121					
4	Non-Tuberculated	25.2	115					
5	Non-Tuberculated	29.9	118					
6	Tuberculated Male	40.6	124					
7	Tuberculated Male	24.3	109					
8	Female	32.4	125					
9	Tuberculated Male	23.3	110					
10	Non-Tuberculated	25.3	109					
11	Non-Tuberculated	41.7	130					
12	Non-Tuberculated	24.9	111					
13	Tuberculated Male w/ Milt	13.2	92					
14	Non-Tuberculated	16.6	100					
15	Tuberculated Male w/ Milt	21.8	109					
16	Sucker Fry? Observed Near Bank							
Sunny Slope After Channel Before First Barrier				8.1	1.1	2	15.1	23
Time	# Indiv.							
11:00am	~5-6 Fully Morphed							

Note also in Table 2 that the turbidity in the main stem is substantially higher than in the drains. It is possible that sustained high turbidity observed here and on other dates in the main stem could be in part degrading the main stem habitat for suckers, both adults and young. We have been given additional water quality data from the RIX facility by The City of San Bernardino Municipal Water District, which we will analyze in for next year's report to see if this is a real condition.

There has been concern that suckers in Sunnyslope Creek in the Nature Center, where breeding and fry have been observed consistently in the past, would be cutoff from the main stem flow by drying or other modification of the stream now making that connection. The breeding habitat here could then be lost to adult suckers in the river. So on Feb. 20th we also examined the entire length of stream, about .5 miles, from the mouth of Sunnyslope Creek to the point where this flow enters the main stem flow of the Santa Ana River. This flows in the low flow channel of the Santa Ana River. The entire reach had a good strong flow, capable of supporting suckers as habitat and as a passage. The bottom was predominantly sand and sediment with little gravel, so breeding habitat was limited here, but not entirely absent. There was considerable stream braiding, and instream vegetation forming cover and habitat heterogeneity. It appears therefore that sucker access to Sunnyslope is still in tact.

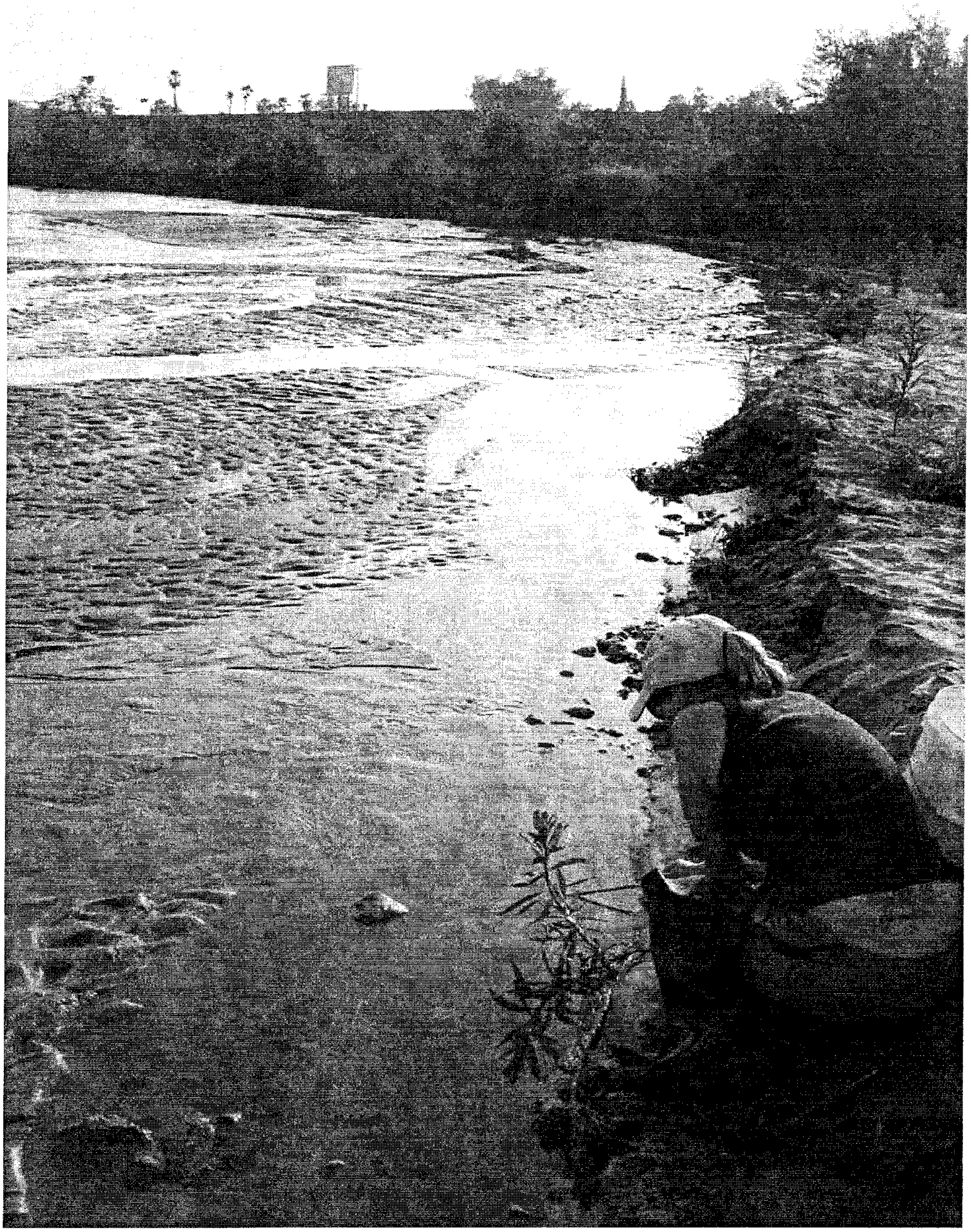


Figure 4. Mission Bridge site in main stem where fry found on May 7th.

On June 23rd J. Dean and L. Muro examined a tributary at Goose Creek Golf Course (Fig. 5). This appears to be a promising site for suckers and fry, so it will be sampled and examined during the 2006 breeding season, if possible.

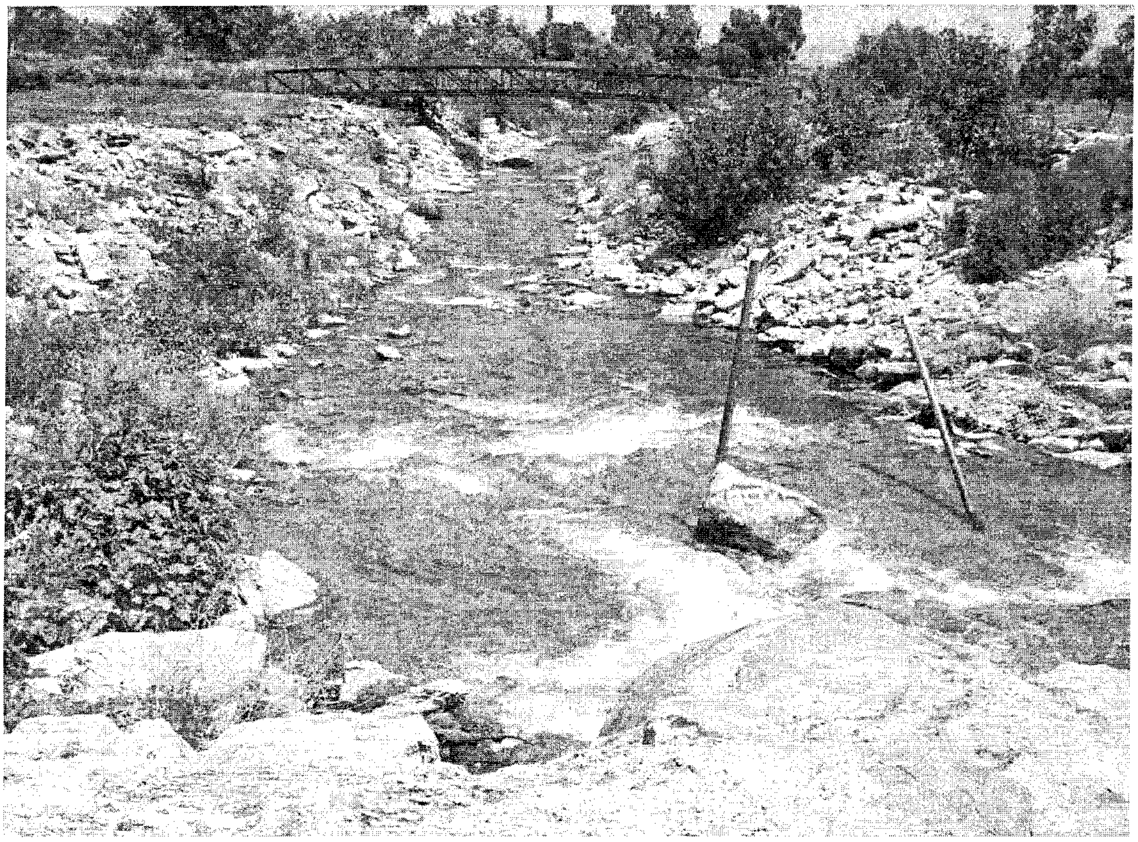


Figure 5. Goose Creek Golf Course site examined June 23, 2006.

Examination of Mountain Sites for Possible Sucker Placement

SMEA (Baskin) also participated in three field trips, June 6, 16 and 21, organized by the Department of Fish and Game (Raul Rodriquez) to examine possible sites for putting suckers and/or dace in places in the Santa Ana River upstream of the study area, where they are not presently found. These trips were to Santa Ana River above Seven Oaks Mill Creek, and Cajon, City, Mill, Plunge and Strawberry/Twin Creeks. Baskin also examined Lytle Creek. The findings of these site visits are being reported on by Raul.

Santa Ana Sucker Population Monitoring 2001-2005

2005 is the fifth year SMEA has monitored Santa Ana sucker populations at three sites in the Santa Ana River: Site 1, upstream of Mission Boulevard (sampled on August 20th); Site 2, just downstream of Highway 60 (sampled on August 21st); and Site 3, downstream of Riverside Avenue (sampled on August 30th). In each case a sequential depletion of 100 meters of stream has been used to estimate the number of fish. A triple-pass depletion provides a good balance between effort (cost) and accuracy, and is therefore the standard method.

This year's sampling was preceded by a record setting wet season which resulted in the channel at Mission being significantly modified into a much broader, sandier and shallow stream, and physically shifted to occupy a position extending from the middle of the low flow channel to the northeast bank. The width of the channel was much too great to block with nets. However, it was noted that the majority of the channel flow was concentrated along its southwest bank, which was well vegetated. Block nets were set extending out from this bank (Fig. 6-7) a distance of about 20 meters, to a point where the water depth was distinctly reduced. The two block nets were separated by a distance of about 200 meters, allowing the distance of vegetated bank sampled to be equal to that of a 100 meter channel made up of two sides. This would be the approximate equivalent of sampling two sides of a 100 meter channel. The channels at sites 2 and 3 remained sufficiently distinct so that procedures of blocking and sampling were the same as in previous years. However, site 2 (Figures 8-10.) had considerable more sand substrate than in previous years. All three sites had substantially more water and sites 1 and 2 appeared to have greater turbidity. Substrate type, depth and flow velocity (bottom and midwater) were recorded in cross sections at 1 meter intervals at all three sites. These data will be analyzed for all years and sites for the next annual report to quantify the habitat observations and compare sites with each other and over the sampling years to determine trends in habitat quality.

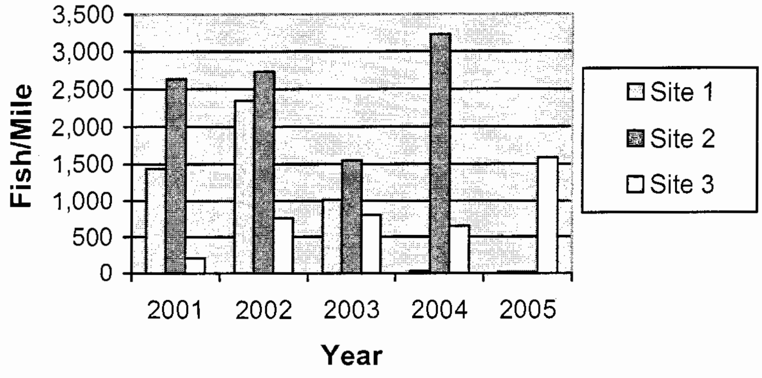
Habitat selectivity studies completed in previous years (see 2004 Annual Report) show that suckers appear to select deeper water and a gravel/cobble substrate in preference to sand and silt. As noted below, these selected conditions are found this year site 3, Riverside Avenue, where greater numbers for suckers were also found.

In the past we have typically presented the data as 100 meter estimates, this time the data are presented slightly differently. This methodology was to a large extent devised for use in the estimation of trout populations and has been most commonly applied to trout populations. It is common for abundance of trout to be expressed as fish/mile. The California Department of Fish and Game Wild Trout Crew uses a depletion of approximately 100 meters (distances vary) to estimate the number of trout per mile of stream in its annual surveys. We have adopted that method for the presentation of our Santa Ana sucker population data in this memo. The data are presented below in both a tabular form and in a graphical form.

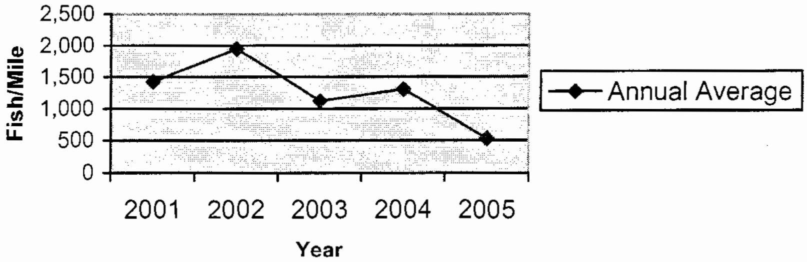
Santa Ana Sucker Abundance Expressed as Fish/Mile

Location	2001	2002	2003	2004	2005
Site 1	1,432	2,350	1,014	32	16
Site 2	2,639	2,736	1,545	3,235	16
Site 3	209	756	805	644	1,579
Annual Average	1,427	1,947	1,121	1,304	537

Population Estimates of Santa Ana Suckers Expressed as Fish/Mile at Three Monitoring Sites



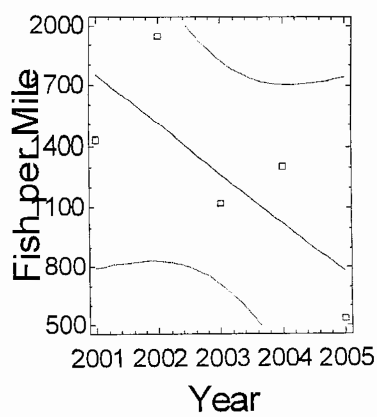
Annual Average Fish/Mile 2001-2005



A one-way ANOVA using the fish/mile data show no significant differences in mean number of fish/mile among sites over the 5 years (p=0.1388); a 95% LSD test also showed no significant differences in any pair wise comparison between sites over the five years; this is due to the large amount of variation within sites (especially Sites 1 and 2) over the five sampling years. (A two-way ANOVA showed no significant differences among sites, no significant differences among years, and no significant interaction). Such variation is not unexpected. Streams are dynamic systems and the conditions at the sites will vary from year to year due to variations in rainfall and flood events. Over the five sampling seasons, the annual average number of fish per mile of stream has decreased by a factor of almost 3, but due to the variation, there is no significant regression for average annual fish/mile over the five years (p=0.144).

The following regression is not significant:

Plot of Fitted Model



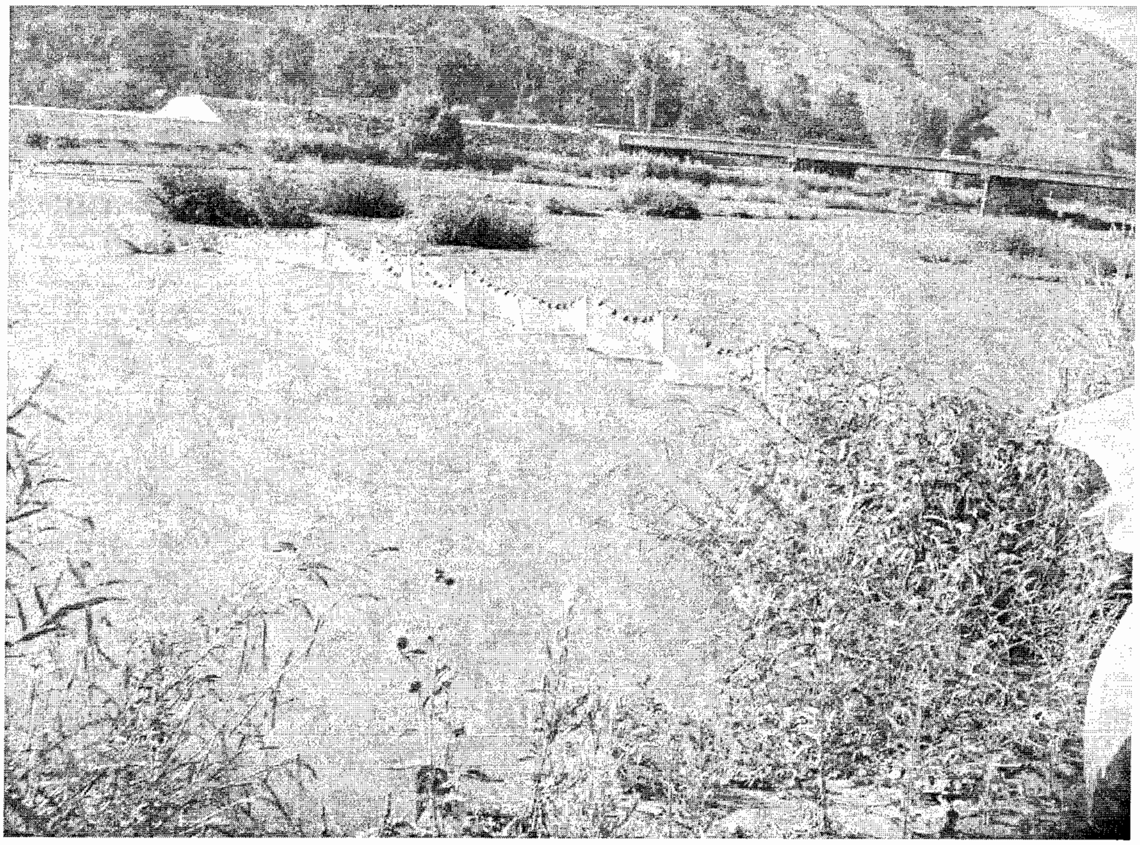


Figure 6. Site 1, Mission Blvd., population estimating site, showing the downstream blocking net in place and the excessively wide channel. Note the northeast bank and Mission Bridge in the background, and the turbid water.

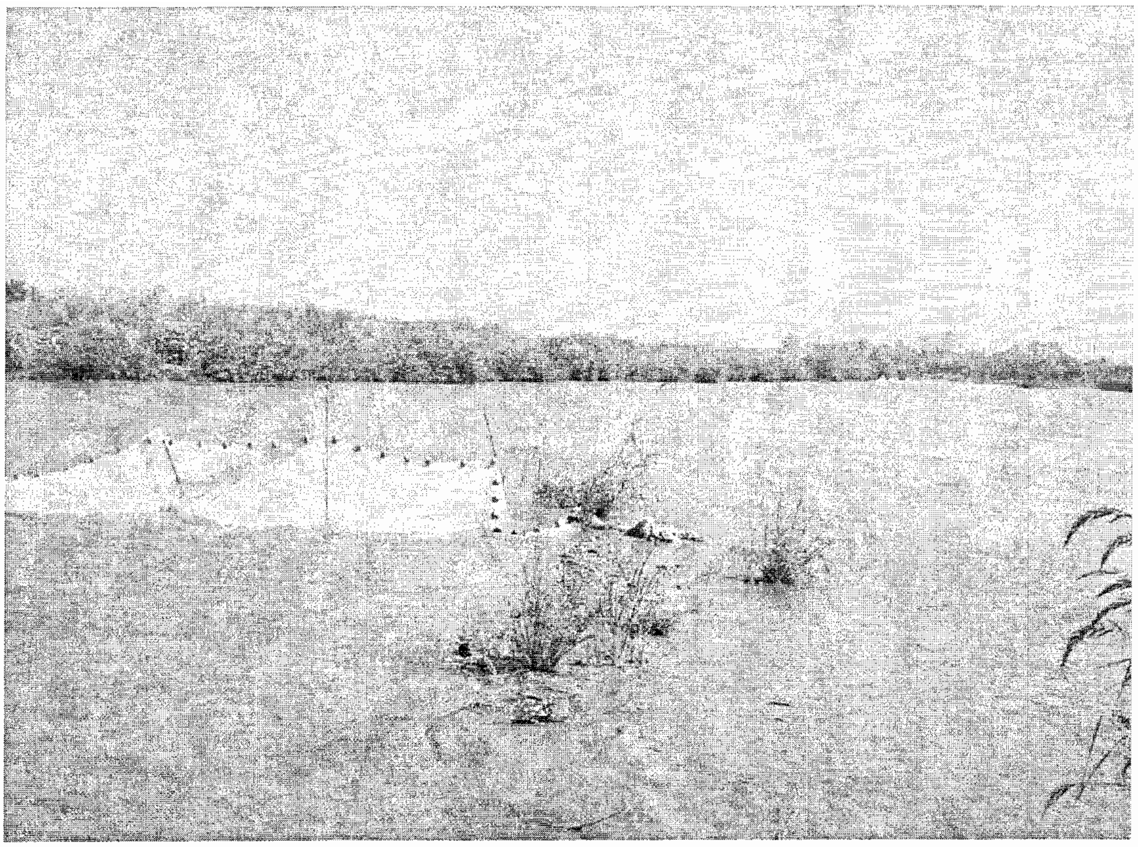


Figure 7. Site 1, Mission Blvd. Population estimation site. Note that sampling with the shocker took place along the vegetated bank only. Downstream block net in the foreground, upstream block net in the far background.

Why is there more H_2O?
Why is it turbid?

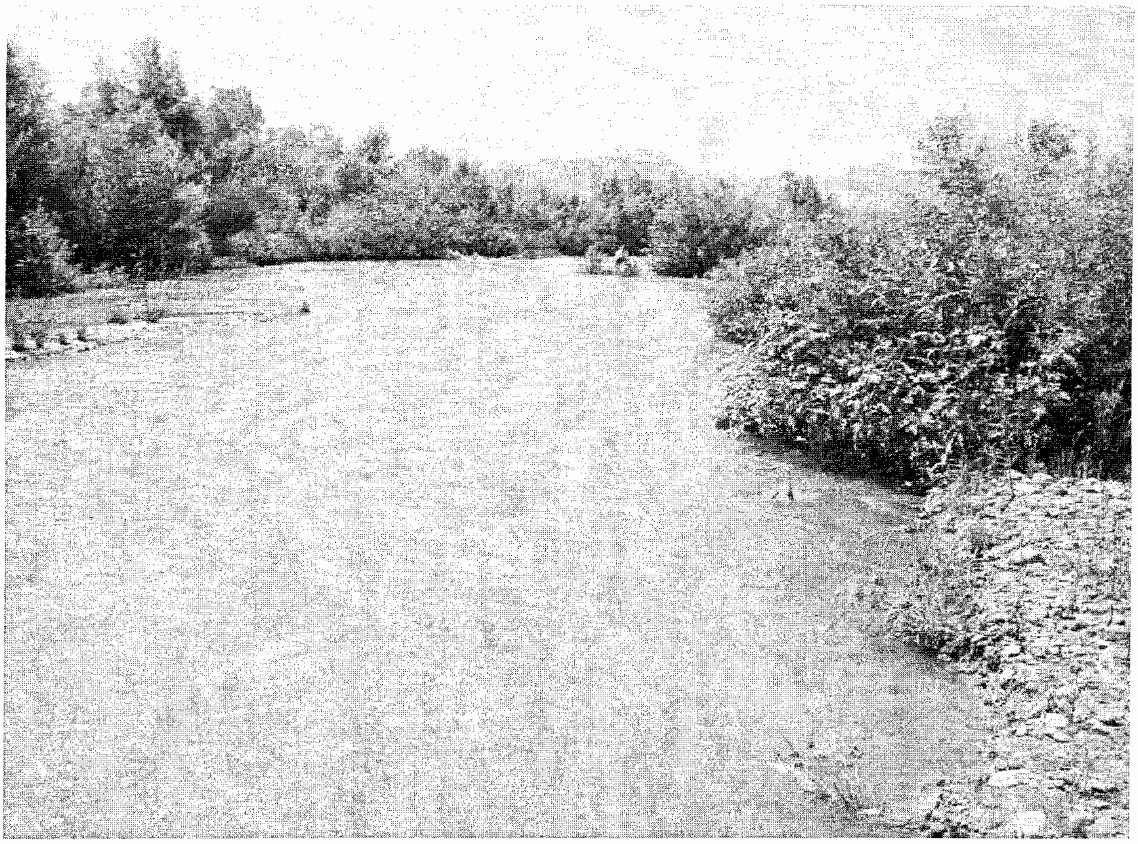


Figure 8. Site 2, 60 Freeway, showing downstream blocking net in the background.

Figure 9. Site 2, 60 Freeway, showing upstream blocking net in background. Note that the upstream end of the site is directly under the bridge.

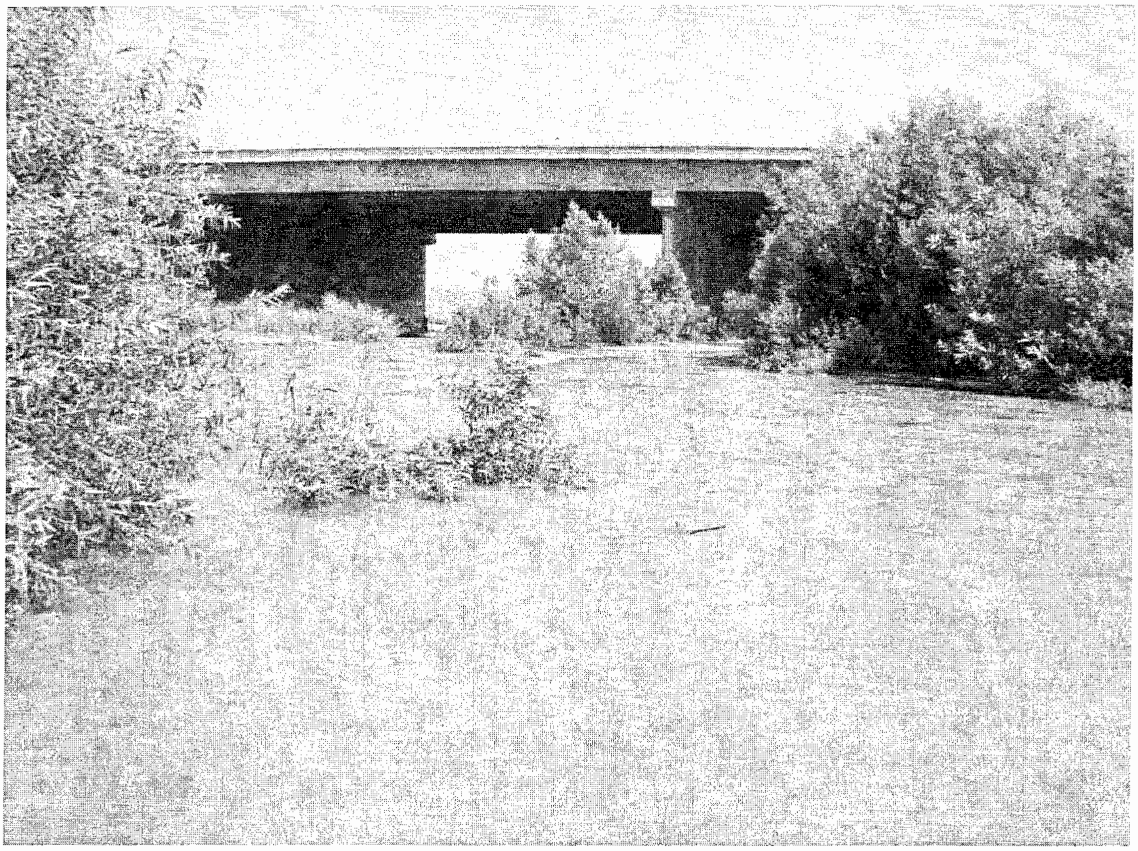


Figure 10. Site 2, 60 Freeway showing upstream blocking net in far background at bridge. Note turbid water.

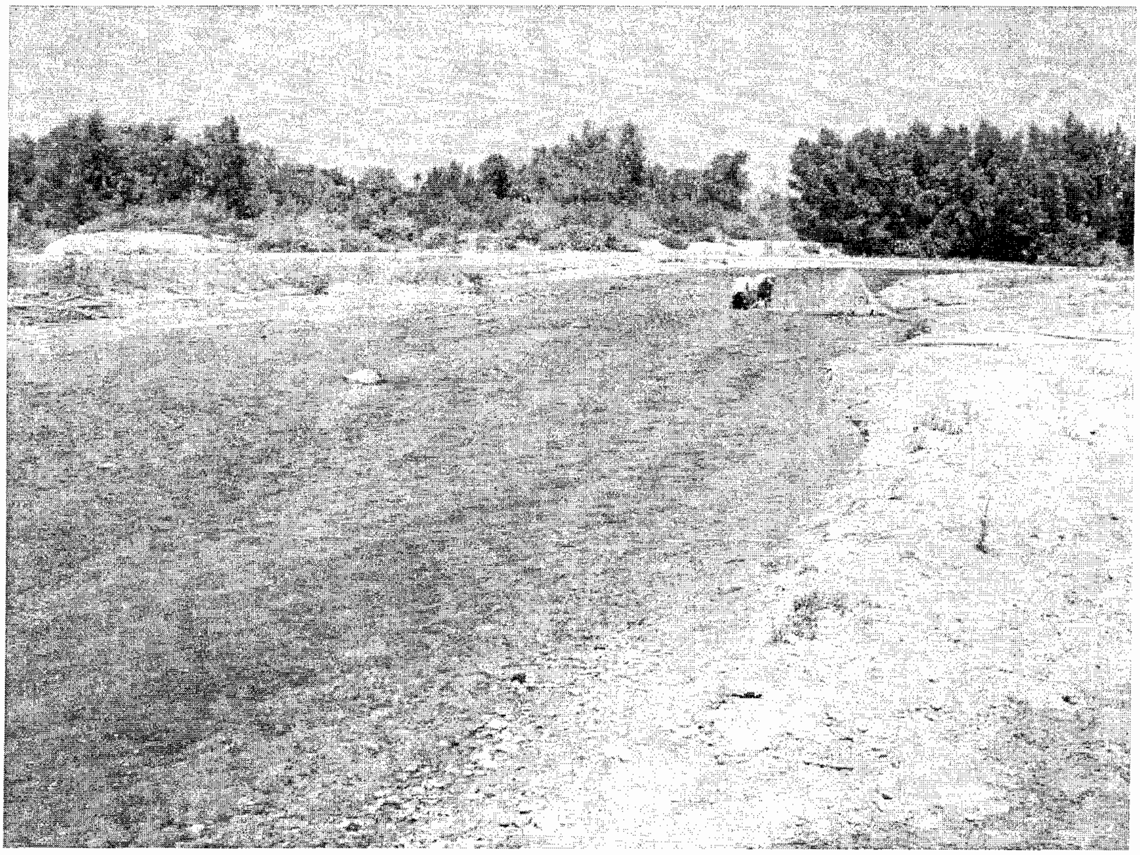


Figure 11. Site 3, Riverside Avenue, showing upstream blocking net. Note gravel substrate and relative clarity of the water compared to other sites.

"lots of suckers"

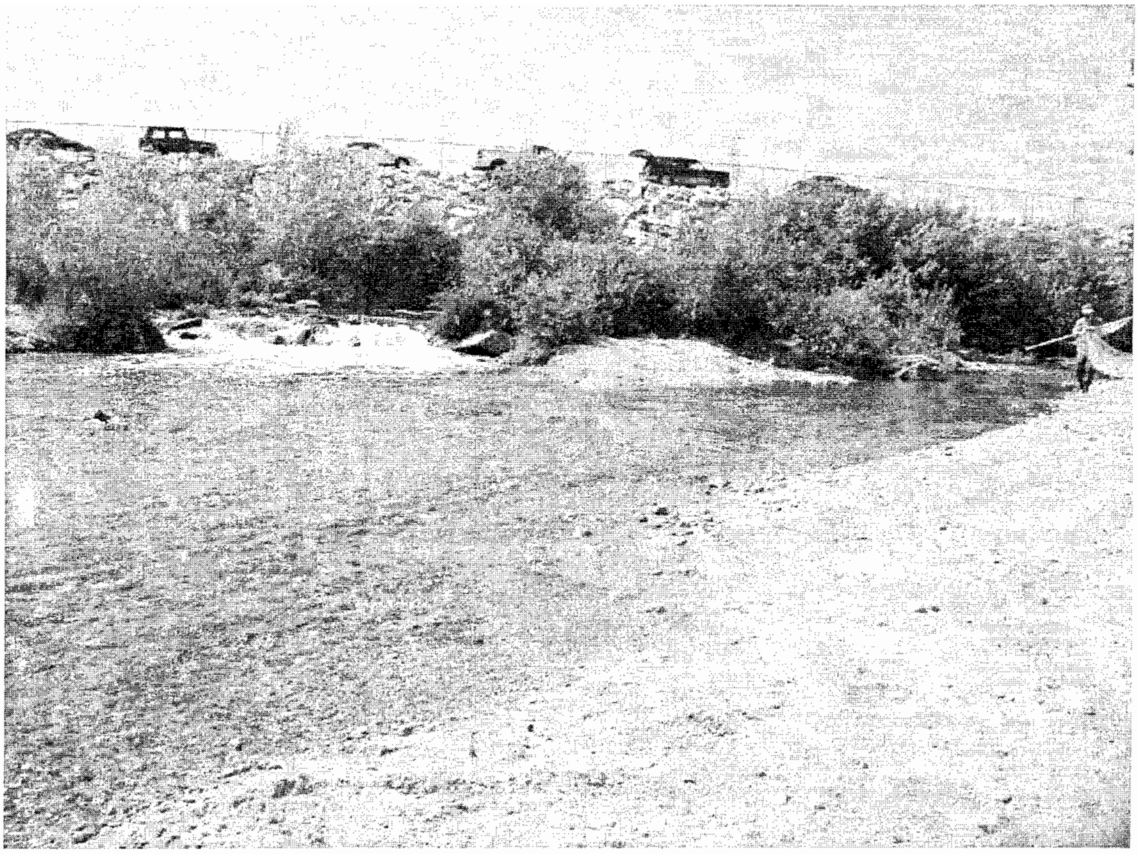


Figure 12. Site 3, Riverside Avenue, viewed in a downstream direction showing well developed overhanging vegetation and water entering the area from around an island on the left in the channel forming a cascading riffle.

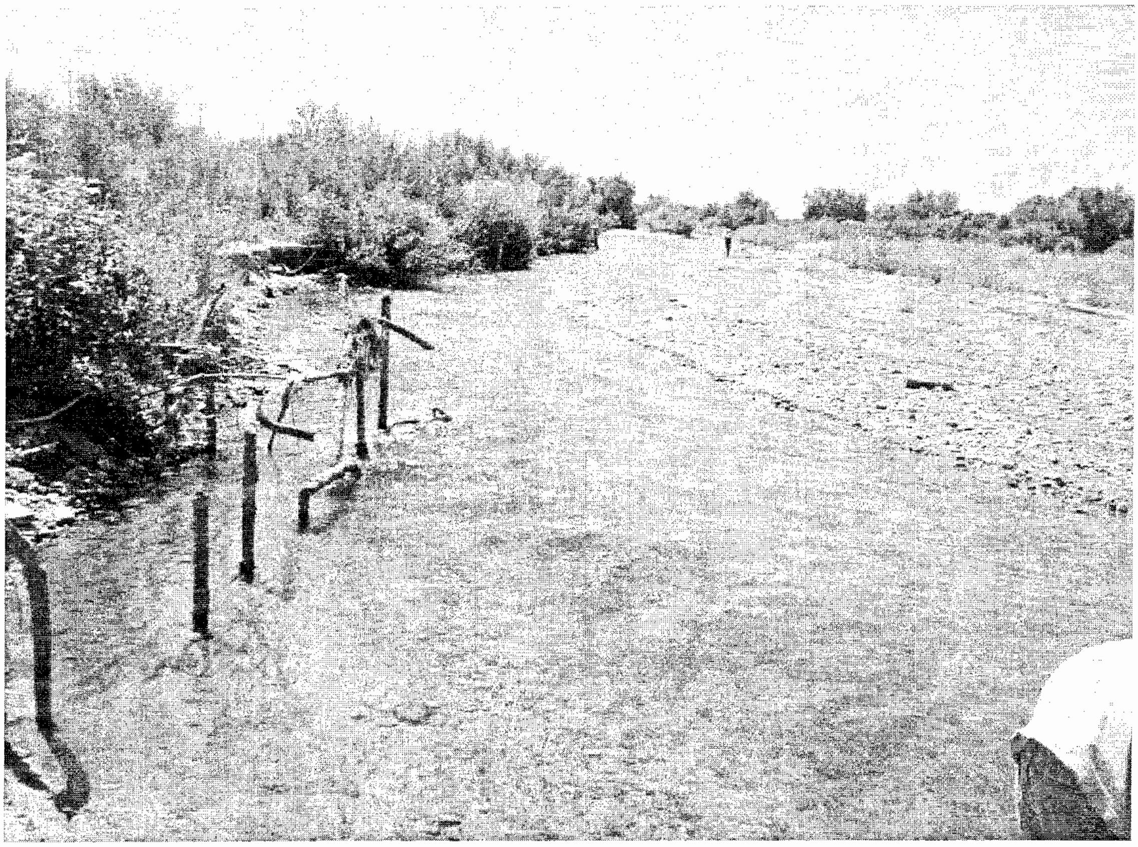
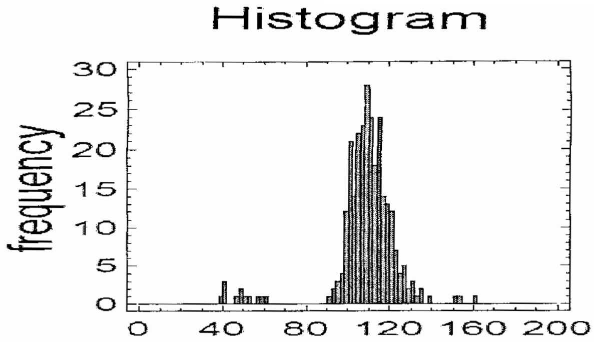


Figure 13. Site 3, Riverside Avenue, viewed downstream. Position of downstream blacking net was were person is standing on the right bank.

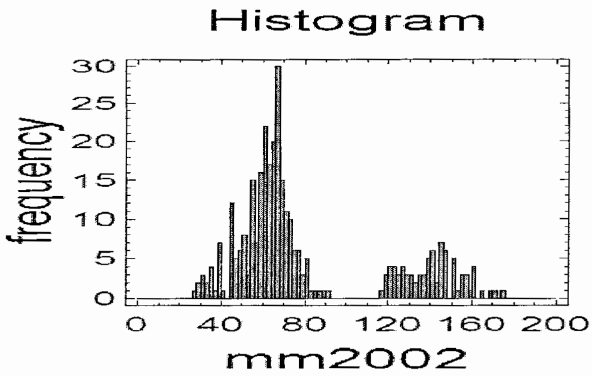
Preliminary Analysis of Population Structure of Suckers 2001 - 2005

The following are the length histograms of the caught fish for the five sampling years. There appear to be in general two size classes, which may be year classes; if so, this indicates that fish live for about two years, and perhaps reproduce and die in the second year. There may also be one or more size classes that are too small to be caught in our nets, so the two apparent size classes shown may not be age classes 1 and 2, but perhaps ages 2 and 3 or ages 3 and 4. If the apparent classes are ages 1 and 2, the graphs from, say, 2001 and 2002 make a certain amount of sense: the large second size class in 2001 reproduces and gives rise to the large first size class in 2002, while the small first size class in 2001 may be represented by the small second size class in 2002, though the first class in 2002 does not become a large second size class in 2003.

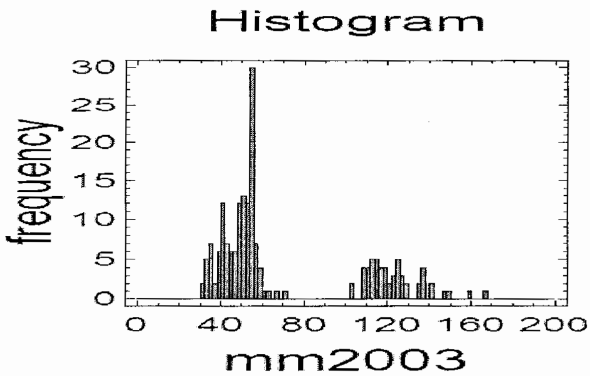
N=276
6/01



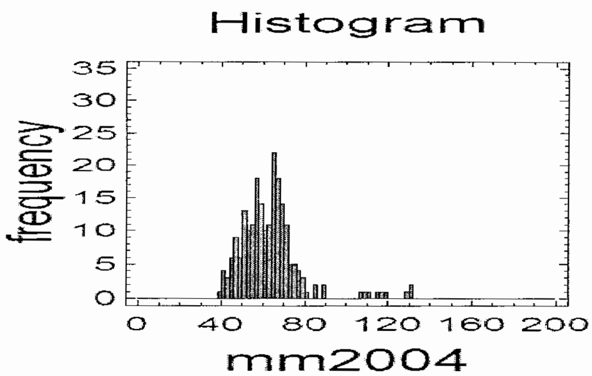
N=224
7/02



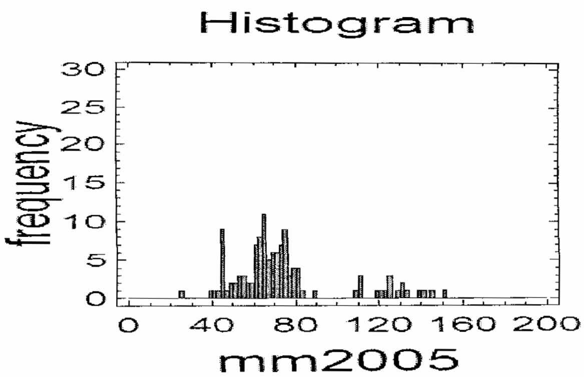
N=191
7/03



N=212
8/04



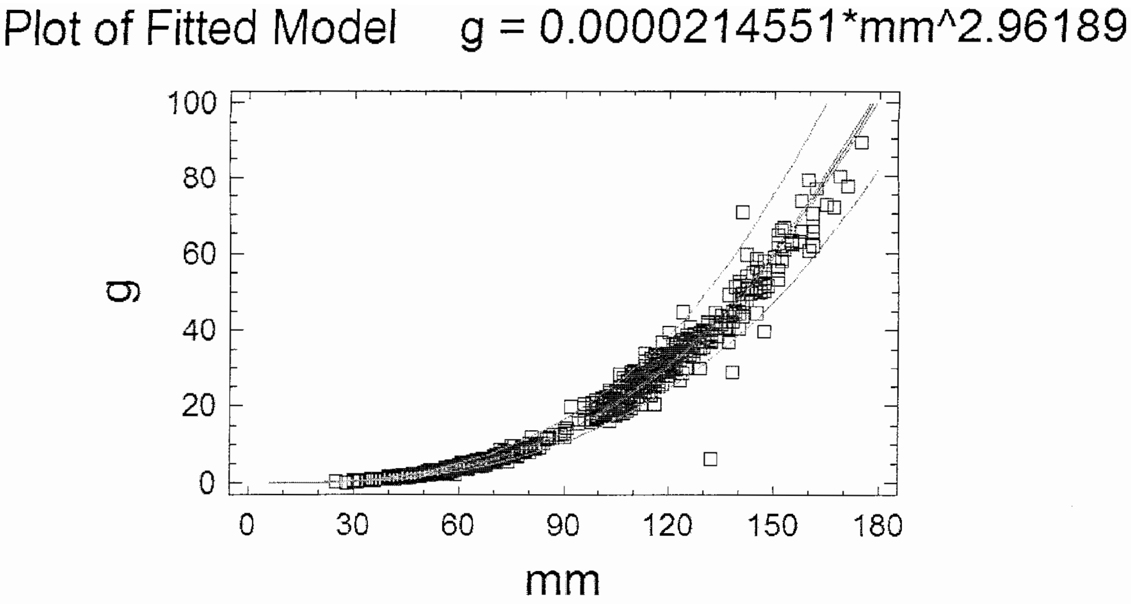
N=118
8/05



Condition of Suckers at Population Sampling Sites 2001-2005

We are also interested in the length-mass relationship of suckers, for deviation from predicted mass for a given length is one indicator of condition of the fish. We generate the "expected" mass of a fish by using the regression formula of mass on length calculated over all fish, and divide the observed mass by this predicted mass. If the ratio is more than 1, the fish is heavier than average for all fish of that length; if the ratio is less than 1, the fish is lighter than the average for all fish of that length. In general, excess food (that is, mass) is converted into reproduction, so a heavier-than-average fish is though to be in better condition.

```
Regression Analysis - Multiplicative model: Y = a*X^b
-----------------------------------------------------------------------------
Dependent variable: g
Independent variable: mm
-----------------------------------------------------------------------------
                                Standard          T
Parameter       Estimate         Error        Statistic        P-Value
-----------------------------------------------------------------------------
Intercept       -10.7495       0.0383019       -280.653         0.0000
Slope            2.96189      0.00880335         336.45         0.0000
-----------------------------------------------------------------------------

NOTE: intercept = ln(a)

                           Analysis of Variance
-----------------------------------------------------------------------------
Source             Sum of Squares     Df  Mean Square    F-Ratio      P-Val
-----------------------------------------------------------------------------
Model                    1527.76       1      1527.76  113198.83       0.0(
Residual                 15.1023    1119    0.0134962
-----------------------------------------------------------------------------
Total (Corr.)            1542.86    1120

Correlation Coefficient = 0.995094
R-squared = 99.0212 percent
R-squared (adjusted for d.f.) = 99.0203 percent
Standard Error of Est. = 0.116173
Mean absolute error = 0.0794299
Durbin-Watson statistic = 1.81474 (P=0.0010)
Lag 1 residual autocorrelation = 0.0926152

The StatAdvisor
---------------
   The output shows the results of fitting a multiplicative model to
describe the relationship between g and mm.  The equation of the
fitted model is

   g = 0.0000214551*mm^2.96189
```

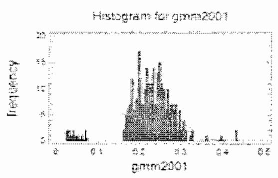


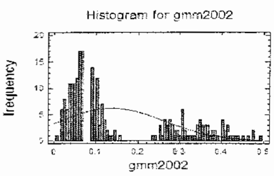
Note that mass is related to almost the cube of length, as expected for three-dimensional objects (a sphere would have the exponent equal to 3, and the coefficient equal to 4/3 PI).

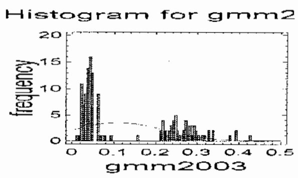
For condition, we did several comparisons with each of two different measures of condition. One measure of condition is simply the mass of a fish divided by its length ("gmm" condition); the other is the observed mass divided by the expected mass ("oe" condition"). For each of these measures of condition, we looked for differences among years and among sites, and also tried to see whether condition changes with time in years.

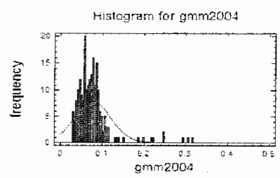
Comparisons among years and sites:
The Santa Ana River electroshocking data for the 5 years of sampling are not normal; indeed, some years for gmm condition seem to show two classes.

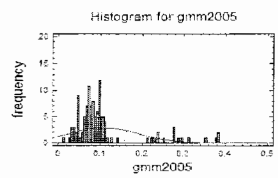
Below are the graphs of gmm condition
(none are normal and they are not homoscedastic):



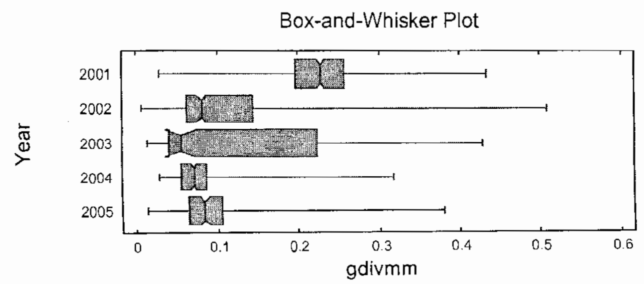








For the gmm condition, the Kruskal-Wallis nonparametric test has a value of 291 and a P=0.0. From the box-and-whisker plot below, it appears that 2001 is the outlier, while there may be no differences among the other years in gmm condition. (This is also supported by a 99% Bonferroni multiple comparison test shown below [columns show homogeneous groups], though the assumptions of this test are not met).

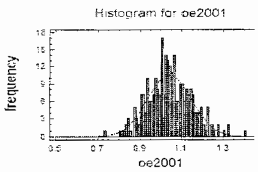


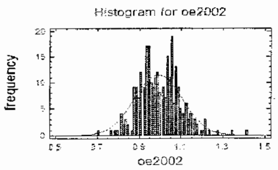
Multiple Range Tests for gdivmm by Year

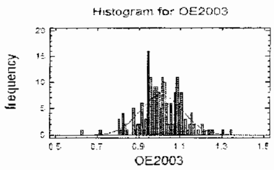
Method: 99.0 percent Bonferroni

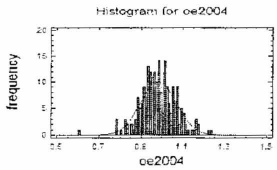
Year	Count	Mean	Homogeneous Groups
2004	212	0.0772892	X
2005	118	0.109504	XX
2003	191	0.112298	X
2002	324	0.138455	X
2001	276	0.226517	X

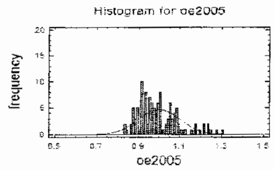
Below are graphs of oe condition:
(2001, 2002 and 2004 do not depart from normal, but 2003 and 2005 do; they are homoscedastic by Levene's p=0.7, but not by Bartlett's or Cochrane's):











For the oe condition, an ANOVA – as well as Kruskall-Wallis --was performed, even though not all groups were normal, since ANOVA is fairly robust with respect to this assumption. The ANOVA 4, 116 had an F=12.69 for a P=0.0000.

ANOVA Table for obsdivexp by Year

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	0.533713	4	0.133428	12.69	0.0000
Within groups	11.7371	1116	0.0105171		
Total (Corr.)	12.2708	1120			

The 99% Bonferroni multiple comparison test shows that only 2001 is different; the other years are not different from each other.

Multiple Range Tests for obsdivexp by Year

Method: 95.0 percent Bonferroni

Year	Count	Mean	Homogeneous Groups
2004	212	0.983965	X
2002	324	0.991057	X
2005	118	1.0002	X
2003	191	1.00823	X
2001	276	1.04179	X

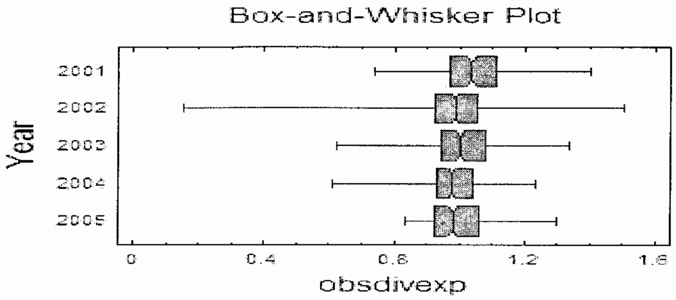
The Kruskal-Wallis nonparametric test has a value of 51 and a $P=1.5x10^{-10}$.

Kruskal-Wallis Test for obsdivexp by Year

Year	Sample Size	Average Rank
2001	276	673.694
2002	324	515.114
2003	191	577.243
2004	212	492.024
2005	118	521.034

Test statistic = 51.8531 P-Value = 1.48054E-10

The box-and-whisker plot shows 2001 more different from the other years, but not conclusively so.

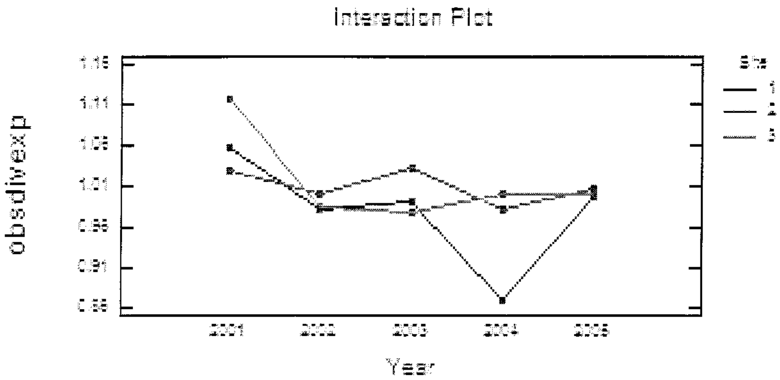


In summary, while there are differences in condition among years, and 2001 seems to be the most different year (with fish in the "best condition"), the overall differences in condition are small even though significant, and do not monotonically decrease through years.

A two factor ANOVA was run with year and site as the two factors; year is significant (we knew that from the one-factor tests), and site is not significant, but there is significant interaction (that is, sites don't do the same thing form year to year or years do not do the same thing from site to site – the most different appears to be site 1 in 2004, but that is probably because there were only two fish from that site in 2004, so this isn't likely to have much if any meaning.)

Analysis of Variance for obsdivexp - Type III Sums of Squares

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
MAIN EFFECTS					
A:Year	0.491436	4	0.122859	11.87	0.0000
B:Site	0.0397986	2	0.0198993	1.92	0.1468
INTERACTIONS					
AB	0.283589	8	0.0354486	3.42	0.0007
RESIDUAL	11.4491	1106	0.0103518		
TOTAL (CORRECTED)	12.2708	1120			



It is important to know if there is a change in condition through time. Although all assumptions for regression were not met, a linear regression was run of condition on year for both gmm and oe condition; both are significant, but year explains very little of the difference in mean condition, 18% for gmm condition (and even the best model explains only 19%). For oe condition, the data more nearly fitting the model assumptions, year only explains 1.7% of the variation in condition. Nonetheless, the slopes for both conditions on year are negative, and may bear watching, though there is not a monotonic decrease with year.

Regression Analysis - Linear model: Y = a + b*X

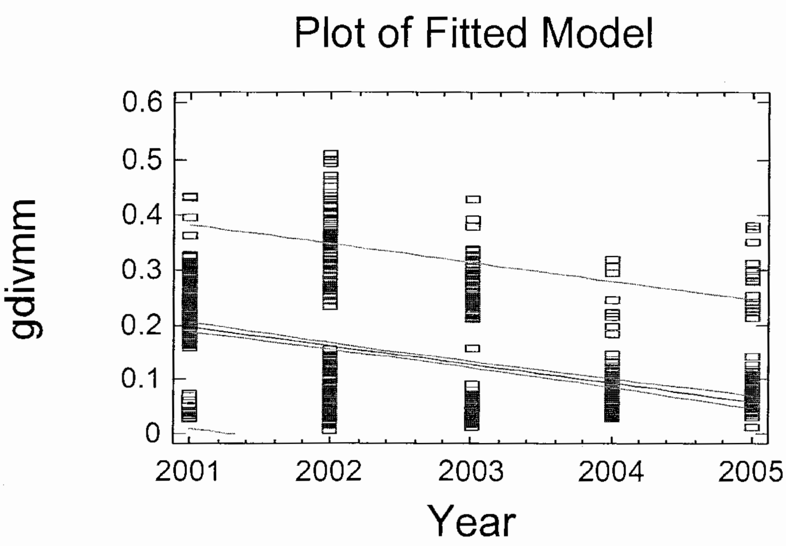
Dependent variable: gdivmm
Independent variable: Year

Parameter	Estimate	Standard Error	T Statistic	P-Value
Intercept	69.2996	4.3064	16.0922	0.0000
Slope	-0.034534	0.00215039	-16.0595	0.0000

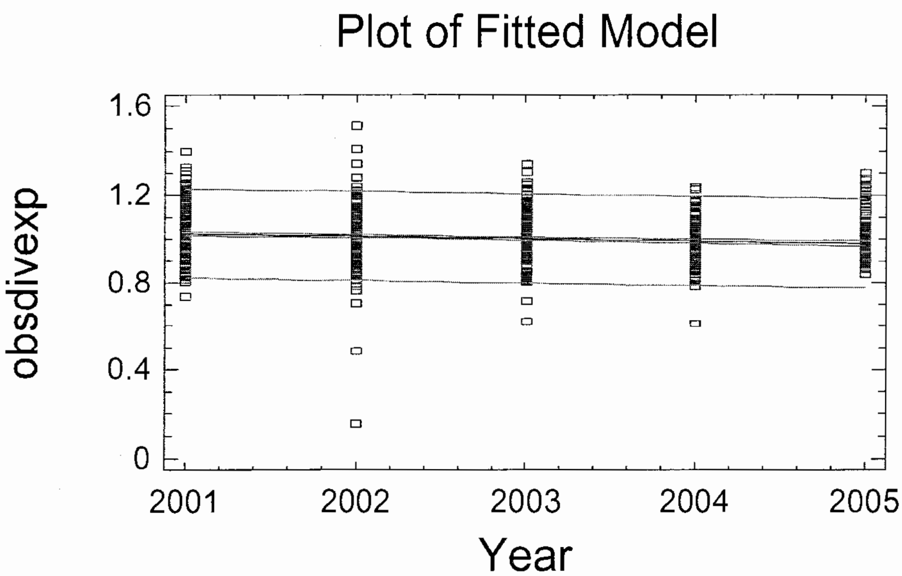
Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Model	2.32389	1	2.32389	257.91	0.0000
Residual	10.0829	1119	0.00901059		
Total (Corr.)	12.4067	1120			

Correlation Coefficient = -0.432791
R-squared = 18.7308 percent
R-squared (adjusted for d.f.) = 18.6582 percent



```
Regression Analysis - Linear model: Y = a + b*X
-----------------------------------------------------------------------------
Dependent variable: obsdivexp
Independent variable: Year
-----------------------------------------------------------------------------
                                Standard          T
Parameter       Estimate         Error        Statistic        P-Value
-----------------------------------------------------------------------------
Intercept         22.4985       4.70708        4.77971          0.0000
Slope          -0.0107321    0.00235046       -4.56597          0.0000
-----------------------------------------------------------------------------


                           Analysis of Variance
-----------------------------------------------------------------------------
Source             Sum of Squares     Df  Mean Square    F-Ratio      P-Value
-----------------------------------------------------------------------------
Model                    0.224436      1     0.224436      20.85       0.0000
Residual                  12.0464   1119    0.0107653
-----------------------------------------------------------------------------
Total (Corr.)             12.2708   1120

Correlation Coefficient = -0.135241
R-squared = 1.82902 percent
R-squared (adjusted for d.f.) = 1.74129 percent
```



To summarize the Santa Ana River data, there is not much variation from year to year, and little of what there is is explained by year. There is a small downward trend in gmm and in oe condition, though these conditions do not monotonically decrease. It will be important to see whether fish condition declines in future years, or whether it simply varies somewhat over a long time period.

We also consider it important to compare the condition of Santa Ana River suckers at SAWPA study sites with suckers taken in other river sites. This is important because we need to know if what we see in the Santa Ana River is unique or if it is also happening elsewhere. These data from other river sites were taken during work on other projects, not support by SAWPA. They are from one site in the mountains, East Fork of the San Gabriel River (EFSGR), and several lowland sites similar to the Santa Ana River sites. These are Santa Clara River at the I-5 Freeway (StaClara) and the Santa Clara River in Castaic Creek (Tapia) near the I-5 site. Both of these are lowland sites very similar to the Santa Ana River. Another lowland site is in the Los Angeles River basin, Haines Creek (Haines). This site is more intermediate in elevation and other factors. We anticipate doing further analysis of environmental factors at these sites next year, if possible. A comparison of the condition of suckers at all these sites is given below.

Again, since assumptions for ANOVA are violated, the Kruskal-Wallis tests show differences in both gmm and oe condition among locations for various sucker samples; the multiple comparison tests indicate that, notwithstanding violation of assumptions and over different years, SAWPA suckers are in the best gmm condition of the lowland locations in these data; the East Fork mountain suckers are better condition for a given length (there were no differences among the East Fork sucker samples, even though they were taken at all seasons.) OE condition was calculated for all data – SAWPA or not – using the regression obtained for SAWPA data, which may be especially questionable for East Fork populations. The SAWPA populations are in the second-worst oe condition of the samples listed, but there is not much difference among the lowland samples except Tapia, and the Bonferroni comparison doesn't even pick up Tapia as different (though assumptions are not met for the Bonferroni).

Kruskal-Wallis Test for gmm by place

place	Sample Size	Average Rank
EFSGR	244	1097.57
Haines	70	664.6
SAWPA	1121	790.75
StaClara	106	490.684
Tapia	44	93.9318

Test statistic = 262.475   P-Value = 0.0

Multiple Range Tests for gmm by place

Method: 95.0 percent Bonferroni

place	Count	Mean gmm	Homogeneous Groups
Tapia	44	0.0323909	X
StaClara	106	0.0724425	X
Haines	70	0.0846614	XX
SAWPA	1121	0.141065	X
EFSGR	244	0.246538	X

Contrast	Difference	+/- Limits
EFSGR - Haines	*0.161876	0.0809459
EFSGR - SAWPA	*0.105473	0.0421738
EFSGR - StaClara	*0.174095	0.069448
EFSGR - Tapia	*0.214147	0.0977797
Haines - SAWPA	-0.0564034	0.0735492
Haines - StaClara	0.012219	0.091945
Haines - Tapia	0.0522705	0.114855
SAWPA - StaClara	*0.0686224	0.0606653
SAWPA - Tapia	*0.108674	0.0917503
StaClara - Tapia	0.0400515	0.107063

For oe condition, there were differences among the places by Kruskal-Wallis (test statistic=109; p=0), though the 95% Bonferroni shows no differences (though the assumptions of the Bonferroni are not met).

Kruskal-Wallis Test for oe by place

place	Sample Size	Average Rank
EFSGR	244	837.051
Haines	70	883.521
SAWPA	1121	785.499
StaClara	106	968.08
Tapia	44	174.034

Test statistic = 101.281   P-Value = 0.0

Multiple Range Tests for oe by place

Method: 95.0 percent Bonferroni

place	Count	Mean	Homogeneous Groups
Tapia	44	0.836739	X
SAWPA	1121	1.0061	X
StaClara	106	1.05618	X
Haines	70	1.06374	X
EFSGR	244	194.823	X

Contrast	Difference	+/- Limits
EFSGR - Haines	193.759	451.562
EFSGR - SAWPA	193.817	235.269
EFSGR - StaClara	193.767	387.421
EFSGR - Tapia	193.986	545.471
Haines - SAWPA	0.0576453	410.299
Haines - StaClara	0.00756124	512.921
Haines - Tapia	0.227003	640.728
SAWPA - StaClara	-0.050084	338.425
SAWPA - Tapia	0.169358	511.835
StaClara - Tapia	0.219442	597.259

To summarize, it appears that the SAWPA site fish in the Santa Ana River are the "fattest" (best condition) of the lowland fish populations in this report for gmm condition, and not the lowest (no less "fat", no worse condition) among the lowland populations even for oe condition. The East Fork San Gabriel River mountain suckers are better condition for a given length (there were no differences among the East Fork sucker samples, even though they were taken at all seasons.).

We received a letter dated November 3, 2005 (attached here to this draft Annual Report) from the City of San Bernardino Municipal Water District questioning some of our conclusions on sucker condition, based on our draft October 26, 2005 progress report. The discussion given above was given in our February 20, 2006 progress report, which is an update and further analysis of this condition data.