

SEGMENT COMPLETION REPORT

As required by

FEDERAL AID IN FISHERIES RESTORATION ACT

TEXAS

Federal Aid Project No. F-3-R-9

Fisheries Investigations and Surveys of the Waters of Region 5-B

Job No. E-1 (Seg.7) Experimental Use of Copper Sulphate
in Killing Undesirable Fish Species

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April 9, 1962

ABSTRACT

Five lakes ranging in size from 11 to 175 acres were used as sites for field testing copper sulphate as a fish toxicant. Three were treated in an attempt to selectively kill undesirable species and two were treated with heavier concentrations to determine if copper sulphate could be used economically to eradicate entire fish populations. Before and after treatment netting samples indicated that concentrations of 1.8 to 2.0 parts per million would produce effective selective kills. It is felt that dosages greater than 2.0 parts per million could be used without appreciable damage to desirable species. Poor results were obtained on the lakes where a complete kill was attempted. It is evident that a 5.0 parts per million concentration is not enough to effect a complete kill in some cases, even though this concentration produced desired results in Tyler State Park Lake, (Job 16a26, Project F-14-D-4).

SEGMENT COMPLETION REPORT

State of Texas

Project No. F-3-R-9

Name: Fisheries Investigations and Surveys
of the Waters of Region 5-B.

Job No. E-1 (Seg.7)

Title: Experimental Use of Copper Sulphate
in Killing Undesirable Fish Species.

Period Covered: February 1, 1961 - January 31, 1962

OBJECTIVES:

To continue the studies of the toxicity of copper sulphate on the fish in the waters of Eastern Texas by a combination of laboratory and field testing techniques.

PROCEDURE:

Five small lakes were chosen as test sites during this segment. Three were chosen for selective kills and two for complete kills. Water from each lake was brought to the laboratory and put into a battery of 18 five-gallon test jars. Test animals were then placed in the jars and various dosages of copper sulphate added. After killing ranges had been determined for a particular body of water, that body of water was then treated with the optimum dosage. Each lake was netted before and after the copper sulphate treatments so that relative abundances could be compared. On one of the lakes, stomachs were taken from several species of fish and preserved for analysis. Representative samples of the organisms found in the stomachs were sent to a specialist to confirm identifications. The specialist's report has not been received as yet.

Copper sulphate crystals certified 99 per cent pure were used in the laboratory tests and in treating the lakes.

Each lake was carefully mapped, and soundings taken with a fathometer in computing the water volume. An alidade was used for mapping surface areas.

FINDINGS:

Data and findings for each lake are presented separately below.

HITT'S LAKE

Hitt's Lake, located near Tyler in Smith County, Texas, covers 175 acres and contained 953 acre-feet of water at the time of treatment. On July 12, 1961, the lake was treated with 5100 pounds of copper sulphate crystals. This brought the water to a calculated concentration of 2.00 parts per million.

On July 11, 1961, the day before the treatment, 12 gill nets (1500 feet total) were set in the lake and left overnight. Table 1, shows the relative sizes and numbers of fish taken. The same number of nets were set on July 18, 1961, six days after treatment. Table 2 shows the result of this net set. Mesh sizes of all nets ranged from 1 to 3 inches.

Table 1. RESULTS OF GILL NET SETS, HITT'S LAKE, BEFORE COPPER SULPHATE TREATMENT.

<u>SPECIES</u>	<u>NO.</u>	<u>% OF NO.</u>	<u>WEIGHT</u>	<u>% OF WEIGHT</u>
Spotted gar (<u>Lepisosteus oculatus</u>)	16	7.59	25.00	28.49
Lake chubsucker (<u>Erimyzon sucetta</u>)	9	4.26	4.37	4.98
Golden shiner (<u>Notemigonus crysoleucas</u>)	1	.48	.19	.22
Yellow bullhead (<u>Ictalurus natalis</u>)	9	4.26	9.31	10.61
Warmouth (<u>Chaenobryttus gulosus</u>)	3	1.43	.50	.57
Redear sunfish (<u>Lepomis microlophus</u>)	17	72.99	38.37	43.73
Bluegill sunfish (<u>Lepomis macrochirus</u>)	154	8.05	8.00	9.12
White crappie (<u>Pomoxis annularis</u>)	<u>2</u>	<u>.94</u>	<u>2.00</u>	<u>2.28</u>
	211	100.00%	87.74	100.00%

Table 2. RESULTS OF GILL NET SETS, HITT'S LAKE, AFTER COPPER SULPHATE TREATMENT.

<u>SPECIES</u>	<u>NO.</u>	<u>% OF NO.</u>	<u>WEIGHT</u>	<u>% OF WEIGHT</u>
Spotted gar (<u>Lepisosteus oculatus</u>)	19	2.78	46.00	21.23
Largemouth bass (<u>Micropterus salmoides</u>)	13	1.89	15.50	7.16
Redear sunfish (<u>Lepomis microlophus</u>)	15	2.19	7.06	3.50
Bluegill sunfish (<u>Lepomis macrochirus</u>)	616	89.79	137.00	63.23
Yellowbelly sunfish (<u>Lepomis auritus</u>)	13	1.89	6.62	3.07
White crappie (<u>Pomoxis annularis</u>)	<u>10</u>	<u>1.46</u>	<u>3.88</u>	<u>1.81</u>
	686	100.00%	216.06	100.00%

Bio-assays conducted in the laboratory revealed a concentration of 1.8 parts per million copper sulphate in Hitt's Lake water would provide a good kill of undesirable species with a minimum of danger to the desirable species. However, in previous segments, it was found that some of the copper sulphate was lost rapidly after application in the lakes themselves. This loss was greater than that in the lake water used in the test jars. Therefore, the concentration used in the lake treatment was increased 0.2 parts per million, over the optimum dosage indicated by the laboratory tests. It is suspected that absorption of the copper sulphate by phytoplankton and higher aquatic plants may account for the more rapid loss in the lakes.

Water analyses were run at 2 to 4-foot intervals from the surface down to 16 feet. Table 3 shows the results of these analyses.

Table 3. WATER ANALYSIS, HITT'S LAKE, JULY 12, 1961

Depth in feet	Temperature °F	Dissolved Oxygen ppm	Methyl orange alkalinity ppm	Dissolved carbon dioxide ppm	pH
0	83	4.4	22	3.0	7.2
1	83				
2	83				
3	83	4.4	22	3.0	7.2
4	83				
5	83				
6	83	3.0	22	3.0	6.6
7	81				
8	78	2.0	25	15.0	6.2
9	76				
10	74	0.4	28	17.0	6.2
11	73				
12	72	.2	35	22.0	6.4
13	70				
14	70	trace	74	48.0	6.4
15	68				
16	67	trace	107		6.4
17	67				

Turbidity = 42 inches secchi.

Observations made one day after treatment revealed large numbers of yellow bullhead catfish (Ictalurus natalis) and lake chubsuckers (Erimyzon sucetta) were dead and in distress. Moderate numbers of spotted gar (Lepisosteus oculatus), golden shiners (Notemigonus crysoleucas) and bluegill sunfish (Lepomis macrochirus) were also found dead and in distress. These observations, plus the comparison of before and after treatment netting results, indicates that the population of undesirable species was appreciably reduced. Since 616 bluegill sunfish were taken in the nets after treatment, indicating a great abundance of this species, the reduction of this species was most likely beneficial.

The average coefficient of condition for 44 bluegill sunfish netted before the treatment was 4.22. The average for 38 bluegills taken 84 days after the treatment was 4.05. This is a reduction of a little over 4 per cent in the calculated condition value.

This lake is the first ever treated during these experiments in which gar were present and it is interesting to note that some of the spotted gar were killed by the copper sulphate.

SPRING LAKE

Spring Lake is located just above Hitt's Lake on the same stream. It covers an area of 18.28 acres and contained 146 acre-feet of water. On July 13, 1961, the lake was treated with 700 pounds of copper sulphate crystals which resulted in a calculated concentration of 1.7 parts per million. This is the optimum concentration as indicated by the laboratory tests. No correction factor was applied as in the treatment of Hitt's Lake. Before and after treatment net samples were taken on July 11 and July 18, 1961. Six gill nets (900 feet total) were used each time. The mesh size of these nets ranged from 1 to 3 inches. Tables 4 and 5 show the results of the before and after treatment netting samples respectively. Water analyses were run at 2 to 4-foot intervals from the surface to 14 feet. Table 6 shows the results of these analyses.

Table 4. RESULTS OF GILL NET SETS, SPRING LAKE, BEFORE COPPER SULPHATE TREATMENT

<u>Species</u>	<u>No.</u>	<u>% No.</u>	<u>Weight</u>	<u>% of Weight</u>
Lake chubsucker (<u>Erimyzon sucetta</u>)	11	9.91	7.25	16.38
Golden shiner (<u>Notemigonus crysoleucas</u>)	2	1.81	0.50	1.13
Yellow bullhead (<u>Ictalurus natalis</u>)	21	18.91	15.25	34.46
Largemouth bass (<u>Micropterus salmoides</u>)	1	.90	2.00	4.52
Warmouth (<u>Chaenobryttus gulosus</u>)	4	3.60	0.50	1.13
Redear sunfish (<u>Lepomis microlophus</u>)	4	3.60	2.19	4.94
Bluegill sunfish (<u>Lepomis macrochirus</u>)	64	57.66	15.75	35.60
White crappie (<u>Pomoxis annularis</u>)	<u>4</u> 111	<u>3.61</u> 100.00%	<u>0.81</u> 44.25	<u>1.84</u> 100.00%

A comparison of Tables 4 and 5 shows that bullhead catfish and golden shiners were still present after the treatment. However, observations made after the treatment revealed that good numbers of these species had been killed. No chubsuckers were taken in the nets after the treatment. It is felt that this lake could have been treated with a heavier concentration of copper sulphate with little or no damage to the desirable species and a greater kill of undesirable ones.

Table 5. RESULTS OF GILL NET SETS, SPRING LAKE, AFTER COPPER SULPHATE TREATMENT.

<u>Species</u>	<u>No.</u>	<u>% of No.</u>	<u>Weight</u>	<u>% of Weight</u>
Golden shiner (<u>Notemigonus crysoleucas</u>)	1	0.32	0.50	0.61
Yellow bullhead (<u>Ictalurus natalis</u>)	7	2.23	7.13	8.69
Warmouth (<u>Chaenobryttus gulosus</u>)	7	2.23	1.06	1.29
Redear sunfish (<u>Lepomis microlophus</u>)	12	3.84	4.13	5.04
Bluegill sunfish (<u>Lepomis macrochirus</u>)	275	87.86	66.00	80.48
White crappie (<u>Pomoxis annularis</u>)	<u>11</u>	<u>3.52</u>	<u>3.19</u>	<u>3.89</u>
	313	100.00	82.01	100.00

Table 6. WATER ANALYSIS, SPRING LAKE, JULY 13, 1961

<u>Depth in feet</u>	<u>Temperature °F</u>	<u>Dissolved Oxygen ppm</u>	<u>Methyl orange alkalinity ppm</u>	<u>Dissolved carbon dioxide ppm</u>	<u>pH</u>
0	84	9.0	8.0	4.0	6.2
1	84				
2	84				
3	84				
4	84	8.0	14.0	4.0	6.0
5	84				
6	83	2.0	20.0	5.0	6.0
7	78				
8	75	2.0	25.0	12.0	6.0
9	72				
10	71	2.0	30.0	13.0	6.0
11	70				
12	68	3.0	45.0	22.0	6.2
13	67				
14	66	4.0	40.0	72.0	6.0
15	65				
16	64				

SOUTTER'S LAKE

Soutter's Lake is located 15 miles southeast of Athens in Henderson County, Texas. The water covers 20 acres and contained 160 acre-feet at the time of treatments. On June 13, 1961, the lake was treated with 777 pounds of copper sulphate crystals which resulted in a concentration of 1.8 parts per million. The lake was netted with eight gill nets (900 feet total) before and after the treatment. The mesh sizes of the nets ranged from 1 to 3 inches. Results of these net sets are shown in Tables 7 and 8. Water analyses were run before and after the treatment of this lake. Results of the before and after treatment analyses are shown in Tables 9 and 10.

Comparison of Tables 7 and 8 indicates that a good kill of bullhead catfish was obtained. On June 19, 1961, six days after the treatment, a count was made of dead fish on the entire shoreline. Dead fish counted at this time were as follows:

Gizzard shad -	3
Golden shiner -	26
Bullhead catfish -	6376
Sunfish(several species)	60
Warmouth	9
Black crappie	7

Many dead fish were trapped in the heavy vegetation in the lake and could not be counted. The owner of the lake reported that he had disposed of two number three washtubs of bullhead catfish before the count was made. Three gizzard shad were killed by the copper sulphate, although none were taken in the before treatment netting samples.

Table 7. RESULTS OF GILL NET SETS, SOUTTER'S LAKE, BEFORE COPPER SULPHATE TREATMENT, JUNE 12, 1961

<u>Species</u>	<u>No.</u>	<u>% of No.</u>	<u>Weight</u>	<u>% of Weight</u>
Golden shiner (<u>Notemigonus crysoleucas</u>)	1	1.04	0.25	1.12
Black bullhead (<u>Ictalurus melas</u>)	18	18.55	3.69	16.55
Yellow bullhead (<u>Ictalurus natalis</u>)	22	22.68	7.94	35.62
Largemouth bass (<u>Micropterus salmoides</u>)	4	4.13	4.62	20.73
Bluegill (<u>Lepomis macrochirus</u>)	46	47.42	4.13	18.53
Black crappie (<u>Pomoxis nigromaculatus</u>)	<u>6</u>	<u>6.18</u>	<u>1.66</u>	<u>7.45</u>
	97	100.00%	22.29	100.00%

Table 8. RESULTS OF GILL NET SETS, SOUTTER'S LAKE, AFTER COPPER SULPHATE TREATMENT, JUNE 20, 1962

<u>Species</u>	<u>No.</u>	<u>% of No.</u>	<u>Weight</u>	<u>% of Weight</u>
Warmouth (<u>Channobryttus gulosus</u>)	3	1.78	0.62	4.08
Green sunfish (<u>Lepomis cyanellus</u>)	1	.59	0.25	1.64
Bluegill (<u>Lepomis macrochirus</u>)	159	94.08	13.50	88.88
Black crappie (<u>Pomoxis nigromaculatus</u>)	<u>6</u>	<u>3.55</u>	<u>0.82</u>	<u>5.40</u>
	169	100.00%	15.19	100.00%

Table 9. WATER ANALYSIS, SOUTTER'S LAKE, JUNE 13, 1961

<u>Depth in feet</u>	<u>Temperature °F</u>	<u>Dissolved Oxygen ppm</u>	<u>Menthyl orange alkalinity ppm</u>	<u>Dissolved Carbon dioxide ppm</u>	<u>pH</u>
0	84	5.4	29	3	7.2
2	84				
3	84				
4	84	5.6	29	3	7.2
5	84				
6	84	5.2	29	2.5	7.2
7	84				
8	81	5.6	29	3	7.2
9	80				
10	78	4.0	25	4.5	6.8
11	76				
12	72	2.0	33	17.50	6.8
12.5	70.5				

Table 10. WATER ANALYSIS, SOUTTER'S LAKE, AFTER COPPER SULPHATE TREATMENT, JUNE 20, 1961

<u>Depth in feet</u>	<u>Temperature °F</u>	<u>Dissolved Oxygen ppm</u>	<u>Menthyl orange alkalinity ppm</u>	<u>Dissolved Carbon dioxide ppm</u>	<u>pH</u>
0	76	4	14	90	6.6
2	75	4	25	90	6.4
4	75	3.2	28	90	6.4
6	75	3.6	32	90	6.6
8	75	3.2	35	100	6.6
10	74	2.8	25	90	6.4
12	73	2.8	35	130	6.4
14	68				

DOUPHRATE'S LAKE

Douphrate's Lake is located six miles east of Gilmer in Upshur County, Texas. This lake was selected as a site to attempt a complete eradication of the fish population by a heavy dosage of copper sulphate. It covered 11.28 acres and contained 64.94 acre-feet of water at the time of the treatment.

On August 15, 1961 the lake was treated with 876 pounds of copper sulphate to obtain a calculated concentration of 5 parts per million in the water. The lake was netted on December 7, 1959, by other workers for other purposes. The results of this netting were used to compare with the after treatment netting which was done on September 29, 1961. Tables 11 and 12 show the before and after treatment netting results, respectively. Table 13 shows the results of water analyses made on the day of the treatment. Although comparison of Tables 11 and 12 shows a marked reduction of the number of fish present, it is felt that the concentration used was not great enough to obtain the desired results. Although a "complete" kill is a goal very seldom attained, a successful "complete" kill should leave very few survivors. It is felt that this treatment fell short of the desired results.

Table 11. RESULTS OF GILL NET SETS, DOUPHRATE'S LAKE, BEFORE COPPER SULPHATE TREATMENT, DECEMBER 7, 1959

<u>Species</u>	<u>No.</u>	<u>% of No.</u>	<u>Weight</u>	<u>% of Weight</u>
Spotted gar (<u>Lepisosteus oculatus</u>)	24	12.6	62.0	35.6
Lake chubsucker (<u>Erimyzon sucetta</u>)	116	60.8	92.0	52.8
Golden shiner (<u>Notemigonus crysoleucas</u>)	5	2.6	1.1	0.6
Yellow bullhead (<u>Ictalurus natalis</u>)	2	1.0	1.8	1.0
Largemouth bass (<u>Micropterus salmoides</u>)	2	1.0	6.4	3.7
Redear sunfish (<u>Lepomis microlophus</u>)	14	7.3	3.7	2.1
Bluegill sunfish (<u>Lepomis macrochirus</u>)	8	4.2	1.3	0.7
Black crappie (<u>Pomoxis nigromaculatus</u>)	20	10.5	6.1	3.5
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	191	100.0	174.4	100.0

Table 12 RESULTS OF GILL NET SETS, DOUPHRATE'S LAKE, AFTER COPPER SULPHATE TREATMENT, SEPTEMBER 29, 1961

<u>Species</u>	<u>No.</u>	<u>% of No.</u>	<u>Weight</u>	<u>% of Weight</u>
Redear sunfish (<u>Lepomis microlophus</u>)	8	34.78	1.62	37.07
Bluegill sunfish (<u>Lepomis macrochirus</u>)	12	52.17	1.62	37.07
Black crappie (<u>Pomoxis nigromaculatus</u>)	<u>3</u>	<u>13.05</u>	<u>1.13</u>	<u>25.86</u>
	23	100.00%	4.37	100.00%

Table 13. WATER ANALYSIS, DOUPHRATE'S LAKE, AUGUST 18, 1961

<u>Depth in feet</u>	<u>Temperature °F</u>	<u>Dissolved oxygen ppm</u>	<u>Menthyl orange alkalinity ppm</u>	<u>Dissolved Carbon dioxide ppm</u>	<u>pH</u>
0	86	5.6	20	7	6.2
1	86				
2	86				
3	86				
4	86	5.6	5	6	6.0
5	86				
6	82				
7	79	Trace	70	60	6.2

ATTOYOC CLUB LAKE

Attoyoc Club Lake is located in the southwest corner of Shelby County, Texas. It covers 23.1 acres and contains 100.25 acre-feet of water. This lake was selected as a test site for an attempted complete kill of the fish population. On August 16, 1961, the lake was treated with 13.54 pounds of copper sulphate crystals which was a calculated concentration of 5 parts per million. Tables 14 and 15 show the results of before and after treatment netting samples. Seven hundred and fifty feet of gill nets were used on each occasion. Water analyses were not made due to depleted chemical supplies at the time of treatment. Comparison of Tables 14 and 15 reveals that the concentration of copper sulphate used was very unsuccessful in obtaining a complete kill. It is unfortunate that analyses were lacking in this test as it appears that something unusual occurred here. For instance, gizzard shad are usually very easy to kill with a concentration of around 1.8 parts per million in the waters of this area. Yet, large numbers of gizzard shad remained in this lake after a treatment using 5 parts per million.

Table 14. RESULTS OF GILL NET SETS, ATTOYOC CLUB LAKE, BEFORE COPPER SULPHATE TREATMENT, MAY 10, 1961

<u>Species</u>	<u>No.</u>	<u>% of No.</u>	<u>Weight</u>	<u>% of Weight</u>
Spotted gar (<u>Lepisosteus oculatus</u>)	7	6.25	20.44	28.29
Gizzard shad (<u>Dorosoma cepedianum</u>)	66	58.93	21.50	29.75
Smallmouth buffalo (<u>Ictiobus bubalus</u>)	1	.89	12.62	17.48
Golden shiner (<u>Notemigonus crysoleucas</u>)	1	.89	.19	.26
Black bullhead (<u>Ictalurus melas</u>)	1	.89	2.44	3.38
Yellow bullhead (<u>Ictalurus natalis</u>)	1	.89	.50	.69
Largemouth bass (<u>Micropterus salmoides</u>)	2	1.79	8.00	11.07
Warmouth (<u>Chaenobryttus gulosus</u>)	1	.89	.31	.42
Redear sunfish (<u>Lepomis microlophus</u>)	8	7.14	3.25	4.50
Bluegill sunfish (<u>Lepomis macrochirus</u>)	17	15.19	1.75	2.42
Black crappie (<u>Pomoxis nigromaculatus</u>)	7	6.25	1.25	1.74
	<u>112</u>	<u>100.00%</u>	<u>72.25</u>	<u>100.00%</u>

Table 15. RESULTS OF GILL NET SETS, ATTOYOC CLUB LAKE, AFTER COPPER SULPHATE TREATMENT AUGUST 31, 1961

<u>Species</u>	<u>No.</u>	<u>% of No.</u>	<u>Weight</u>	<u>% of Weight</u>
Spotted gar (<u>Lepisosteus oculatus</u>)	3	.79	10.00	12.58
Gizzard shad (<u>Dorosoma cepedianum</u>)	65	17.25	20.00	25.16
Black bullhead (<u>Ictalurus melas</u>)	1	.26	.62	.78
Largemouth bass (<u>Micropterus salmoides</u>)	10	2.65	19.12	24.05
Warmouth (<u>Chaenobryttus gulosus</u>)	1	.26	.19	.24
Spotted sunfish (<u>Lepomis punctatus</u>)	2	.54	.19	.24
Redear sunfish (<u>Lepomis microlophus</u>)	27	7.16	9.00	11.32
Bluegill sunfish (<u>Lepomis macrochirus</u>)	267	70.83	20.00	25.16
Black crappie (<u>Pomoxis nigromaculatus</u>)	<u>1</u>	<u>.26</u>	<u>.37</u>	<u>.47</u>
	377	100.00%	79.49	100.00%

CONCLUSIONS:

From examination of the netting data and from observations made during the treatments of Hitt's Lake, Spring Lake and Soutter's Lake, it appears that selective treatment for the reduction of gizzard shad, lake chubsuckers, golden shiners and bullhead catfish populations can be effective to a degree that would warrant its use as a practical management practice in the waters of Eastern Texas. However, it is felt that too much caution was exercised in application on the three lakes treated during this segment. It is believed that higher concentration could have been used with little damage to desirable species and a better kill of undesirables.

The data from the two lakes on which complete kills were attempted indicates that 5.0 parts per million is not great enough to effect a kill that will approach a total eradication. However, in 1960, Tyler State Park Lake was successfully treated with 5 parts per million (Project F-14-D-4, Job 16a26). It can therefore be concluded that unknown factors are affecting the toxicity of the copper sulphate in certain waters, making it impossible thus far to predict a dosage that will effect a complete kill.

RECOMMENDATIONS:

It is recommended that this job be continued in order to maintain a reconnaissance on the lakes treated during this segment to determine what long range effects the treatment might have. More work is also needed to further explore the use of copper sulphate in complete eradication work.

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Date April 9, 1962

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