Volume 4

1962-1963

STATE OF ALASKA

William A. Egan, Governor

ANNUAL REPORT OF PROGRESS, 1962 - 1963

FEDERAL AID IN FISH RESTORATION PROJECT F-5-R-4

SPORT FISH INVESTIGATIONS OF ALASKA

Alaska Department of Fish and Game

Walter Kirkness, Commissioner

E. S. Marvich, Deputy Commissioner

Alex H. McRea, Director

Sport Fish Division

Richard Haley, Coordinator

INTRODUCTION

This report of progress consists of Job Segment Reports from the State of Alaska Federal Aid in Fish Restoration Project F-5-R-4, "Sport Fish Investigations of Alaska".

The project is composed of 25 separate studies designed to evaluate the various aspects of the State's recreational fishery resources. While some studies are of a more general nature and deal with gross investigational projects, others have been developed to evaluate specific problem areas. These include studies of king salmon, silver salmon, grayling and State Access requirements. The information gathered will provide the necessary background data for a better understanding of local management problems and development of future investigational studies.

The assembled progress reports may be considered fragmentary in many respects due to the continuing nature of the respective studies. The interpretations contained therein, therefore, are subject to re-evaluation as work progresses and additional information is acquired.

Volume 4 Report No. 10-E

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigations of Alaska.

Project No: F-5-R-4 Title: Investigation of Residual Toxaphene Effects in Six Matanuska Valley Lakes.

Job No: 10-E

Period Covered: January 1, 1962 to December 31, 1962.

Abstract:

Six lakes between Palmer and Willow, experimentally rehabilitated in 1961 with a concentration of 10 parts per billion toxaphene, were followed by a study in an effort to determine the effects of the toxicant.

Mortality of fish in live-cars proceeded more rapidly in the first series of tests in June and July than in the second series which began in August. Last survivors of the first series from each lake, plus plankton, water and mud samples were sent to a professional laboratory for residual toxaphene analysis.

Following the study of test fish and analysis of findings, Willow Lake was considered clear. By late summer stickleback and silver salmon were observed and their re-entry is attributed to the access provided by the permanent outlet. Finger Lake was estimated to be non-toxic and 50,000 rainbow trout were planted in September. The remaining four waters contained amounts of toxaphene considered toxic for game fishes.

Data indicates that lake water becomes increasingly toxic at depths below 15 feet.

Invertebrate species abundance was measured using a dip net and plankton net for collection of bottom organisms and plankters.

Recommendations:

It is recommended that test-fish studies be continued in 1963 until 80 per cent of fish in the test lakes survive for a period of three weeks. Survivors of the first series should be analyzed for toxaphene content.

It is recommended that future water samples be taken during turn-over periods.

Crystal, Florence, Bumblebee and Loon Lakes should be stocked with 100 trout or salmon per surface acre if toxaphene content becomes allowable.

Samples for acquatic insect and plankton progression should be collected twice during the 1963 summer season.

A final recommendation is that Willow Lake not be planted. An increasing number of stickleback and juvenile salmon, plus possibility of planted fish migration to Willow Creek, would complicate a survival study. Marginal winter dissolved oxygen levels would further complicate matters.

Objectives:

To determine the existence and distribution of residual toxaphene in six of the Matanuska Valley lakes rehabilitated in 1961.

To determine the toxicity of these lakes in relation to game fishes.

To determine the time these lakes become suitable habitat for game fishes.

To provide recommendations for future studies and management of these and similar lakes.

Techniques Used:

1. A study of the six lakes was begun in June, with screened live-cars. Each box consisted of a wood frame covered with screen measuring five mesh to the inch, with a hinged door at one end. Dimensions of the boxes were 18 x 18 x 30 inches. The number of units placed in each lake was:

Lake	No. Live-cars
Bumblebee Lake	2
Crystal Lake	2
Finger Lake	4
Florence Lake	2
Loon Lake	2
Willow Lake	1

Before boxes were placed, dissolved oxygen and temperature measurements were made to assure that a suitable natural environment existed at the various depths for which the units were destined (Figure 1). An attempt was made to place one live-car below the thermocline of each lake.

Two series of tests were tun, one in June and July, and one from late August to Mid-October. Series one was terminated after four weeks, and series two after seven weeks. Two control lakes were employed during the second series. Locations of the rehabilitated and control lakes are shown in Figure 3.

Wild rainbow trout and silver salmon fingerlings, three to five inches in length, were used for the tests. Eighteen fish were placed in each live-car for series one test and twenty for series two test (Figure 2).

2. Following the first test series a few survivors from each lake were quick-frozen and sent to the Food, Chemical and Research Laboratory at Seattle for toxaphene analysis. Water, mud and plankton samples were forwarded

Figure 1. Dissolved Oxygen and Temperature Sampling Prior to Live-car Tests. Cased Electric Thermometer in bow.

Figure 2. Live-car Mortality Examination.

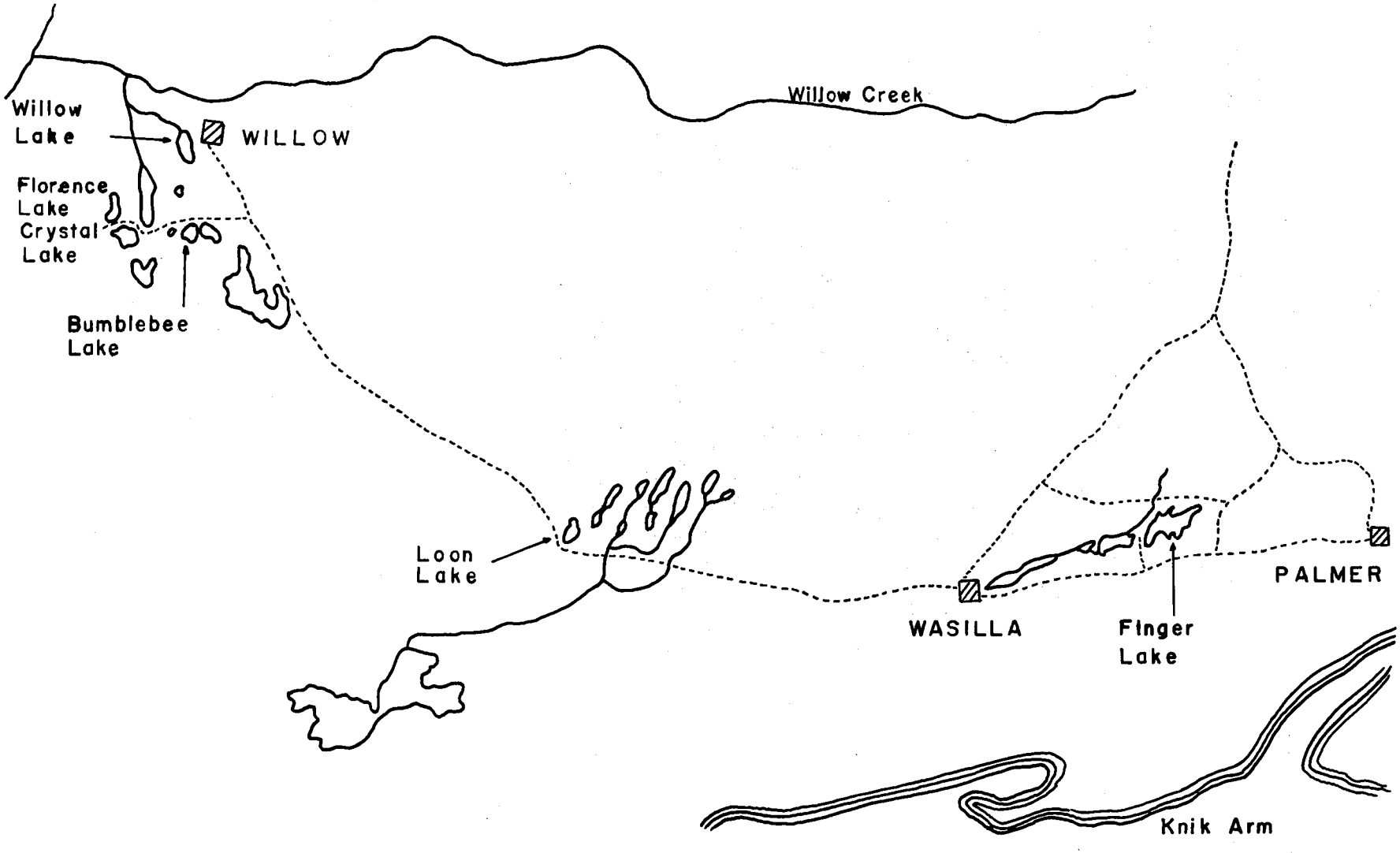

Figure 3. Location of Matanuska Valley toxaphene-treated lakes.

with the fish. As large a plankton sample as could be collected in several hours of boat tow with a standard plankton net was obtained from Finger and Florence Lakes. Two water samples, one-half gallon and one gallon, and two mud samples, one-half gallon and one quart, were taken from each lake. Mud and water samples were obtained from above and below thermocline when possible. In lakes too shallow to develop a thermocline, samples were taken from the deepest areas.

3. Attempts to obtain invertabrate bottom food organisms with an Ekman Dredge proved unsuccessful. A 70 to 100 foot section of shoreline area of each lake was marked off and a dip net was passed through a series of arcs, each six feet in length along the bottom in the test areas, at random intervals. Enough passes were taken to obtain a sample adequate for future comparisons. Plankton measurements were made using a standard plankton net. Contents of a 20-foot tow were emptied into a pint container. Three equal samples from each container were observed under a stereomicroscope and the quantitative counts averaged. Time and help limited this phase of testing to one measurement at each lake during August.

4. Experimental, 125-foot, graduated mesh bill nets were set, and the shoreline areas of each treated lake were searched for fish survival.

Findings:

Live-box mortality of test fish proceeded more rapidly at each lake during series one in June and July than during series two in August. Vitality of test fish was possibly lower at the earlier introduction date. Test fish in Finger Lake deep sets succumbed from oxygen deficiency soon after introduction. Only locations above the thermocline were suitable for the remainder of the summer at Finger Lake. Of the three lakes which developed thermoclines (Table 3), hypolimnion oxygen remained suitable for test fish only at Florence Lake.

Tables 1 and 2 contain mortality percentages of test fish for both series.

Table 1. Mortality Percentages of Live-box Test Fish in Six Matanuska Valley Lakes, from June 22 to August 6, 1962.

	LAKES													
	Bumblebee		Crystal		Finger				Florence			Loon		Willow
Days Tested	5 ft.	15 ft.	5 ft.	15 ft.	16 ft.	*30 ft.	5 ft.	*30 ft.	5 ft.	35 ft.	5 ft.	15 ft.		5 ft.
1											12	18.1		
4			22.2	36.3	26.3	0	20	100	0	0				
6					52.6	0	33.3							
7	65	55.5												0
8											44	72.7		
11			61.1	72.7	57.8	100	33.3		62.5	80				
13	**85	88.8	66.6	72.7					**87.5	86.6				
15			72.2	86.3										
17					63.1		33.3							
18			**88.8	90.9										
20					78.9		46.6							11.7
21											**96	95.4		
23														35.2
27														35.2
28							60							
31														52.9
35						**60								
36														58.8
40														**76.4

*Dissolved oxygen levels became submarginal.

**Survivors were sent for laboratory toxicity analysis.

Table 2. Mortality Percentages of Live-box Test Fish in Six Matanuska Valley Lakes from August 22 to October 12, 1962.

	TEST LAKES										CONTROL LAKES			
	Bumblebee		Crystal		Finger		Florence		Loon		Willow	Nancy		Wasilla	
	5ft.	15ft.	5ft.	15 ft.	5ft.	16ft.	5ft.	35ft.	5ft.	15ft.	5 ft.	5ft.	15ft.	5ft.	15ft.
Days Tested															
5-6			10	10			0	15	0	0				10	0
7-8	5	10			15	5					5	0	0		
12-13					15	5			0	0					
15-16	80	45	25	50			55	70			5	5	0	10	0
19-20			50	75					0	35					
21-22	95	80			15	5	75	90			5	10	0	10	0
25-26			75	85					15	60				10	0
27-28	100	90			15	5	100	100			5	20	0		
31-32									30	80				10	0
33-34					15	5									
35-36		100	85	100							5	35	20		
39-40			100						50	85					
41-42					15	10					5	40	30	20	0
45-46									65	100					
47-48					15	15								45	0
49-50											10	50	45		
53-54									80		10			45	5
55-56					15	35			100						
57-58					15	45									

Table 3. Temperatures at Various Depths at the Six Study Lakes, August 1962.

August 8		August 8		August 7		August 8		August 7		August 7	
Bumblebee		Crystal		Finger		Florence		Loon		Willow	
Depth.	Temp.	Depth.	Temp.	Depth.	Temp.	Depth.	Temp.	Depth.	Temp.	Depth.	Temp.
1.0'	67.5°	1.0'	62.0°	1.0'	68.0°	1.0'	66.0°	1.0'	68.0°	1.0'	67.0°
2.5'	67.5°	2.5'	62.0°	2.5'	68.0°	2.5'	66.0°	2.5'	68.0°	2.0'	67.0°
5.0'	67.5°	5.0'	62.0°	5.0'	68.0°	5.0'	66.0°	5.0'	68.0°	5.0'	67.0°
7.5'	67.0°	7.5'	62.0°	7.5'	68.0°	7.5'	66.0°	7.5'	68.0°	8.0	66.5°
10.0'	67.0°	10.0'	62.0°	10.0'	67.5°	10.0'	66.0°	10.0'	68.0°	*11.0'	63.5°
12.5'	67.0°	12.5	62.0°	12.5	67.0°	12.5	66.0°	12.5	68.0°		
15.0'	66.5°	15.0'	61.0°	15.0'	66.5°	15.0	66.0°	15.0	68.0°		
17.5'	66.5°	17.5'	61.0°	17.5'	64.0°	17.5	66.0°	15.0'	67.5°		
20.0'	57.5°	20.0'	58.0°	20.0'	61.0°	20.0'	66.0°	*20.0'	66.5°		
22.5'	53.5°	22.0'	55.0°	22.5	56.5°	22.5'	60.5°				
25.0'	51.0°	*24.0	54.0°	25.0'	53.5°	25.0'	57.0°				
27.5'	59.5°			27.5'	49.5°	27.5'	55.5°				
30.0'	49.0°			30.0	47.5°	30.0	54.0°				
*32.0'	48.5°			*33.0'	48.0°	32.5'	53.0°				
						35.0'	52.5°				
						*38.0'	51.0°				

*Bottom of Lake

Residual toxaphene concentrations, as determined by the laboratory for the fish, plankton, water and mud samples, are listed by lake in Table 4. Results of invertebrate bottom species and plankton sampling counts are found in Tables 5 and 6.

Numerous hours of test netting in mid-summer took fish only at Willow Lake. Presence of fingerling silver salmon and stickleback in Willow Lake is attributed to re-entry by way of the permanent outlet to Willow Creek.

Results from live-car tests and analyzed water, mud, and fish samples indicated that Willow Lake was lowest in toxicity. It was suitable for game fishes late in summer when numerous silver salmon fingerlings were observed.

Next lowest in toxicity was Finger Lake. Returns of analyses in late summer indicated that it had cleared sufficiently for restocking. Compared with Willow Lake, test fish mortality after fifty days of series two live-car studies was five per cent greater that that of Willow Lake, and 7.5 per cent over that of the control, Wasilla Lake. No measurable toxaphene was detected in mud of either Willow or Finger Lake. Water samples for both lakes contained less than one-half part per billion toxaphene. Analyzed fish samples from Willow Lake contained 100 parts per billion residual toxin. Those from Finger Lake contained less than 100 parts per billion. Some workers consider a lake clear only when all fish survive. Others declare waters safe for restocking when 80 per cent of live-car fish survive for three weeks (Stringer and McMynn, 1960). Series two tests at Finger Lake satisfied the latter requirement.

After all tests and analyses were weighed, 50,000 rainbow trout were planted in Finger Lake in September. Continued study will include winter tests of water chemistry, and spring test-net survival studies. Willow Lake was not replanted for three reasons; winter dissolved olygen levels are marginal for game fish, competing salmon and stickleback are present, and stocked fish could desert the lake at will via the outlet.

Table 4. Results of Analysis of Residual Toxaphene Content of Fish, Mud, Water and Plankton Samples.

Lake	Sample Type	Sample Size	Sample Depth	Toxaphene *p. p. b.
Bumblebee	Fish			1400
	Water	4 qts.	10'	3/4
	Water	2 qts.	25'	None detected, less than 1/2.
	Mud	2 qts.	10'	150
	Mud	1 qt.	30'	None detected, less than 50.
Crystal				
	Fish			500
	Water	4 qts.	10'	1/2
	Water	2 qts.	16'	None detected, less than 1/2.
	Mud	2 qts.	9'	50
	Mud	1 qt.	19'	None detected, less than 50.
Finger				
	Fish			None detected, less than 100.
	Plankton			None detected, less than 500.
	Water	4 qts.	10'	None detected, less than 1/2.
	Water	2 qts.	32'	None detected, less than 1/2.
	Mud	2 qts.	10'	None detected, less than 250.
	Mud	1 qt.	35'	None detected, less than 150.

* p. p. b. Parts per billion.

Table 4. (Con't)

Lake	Sample Type	Sample Size	Sample Depth	Toxaphene p. p. b.
Florence				
	Fish			1000
	Plankton			*None detected, less than 10,000.
	Water	4 qts.	10'	None detected, less than 1.
	Water	2 qts.	32'	1/2
	Mud	2 qts.	10'	None detected, less than 250.
	Mud	1 qt.	37'	None detected, less than 350.
Loon				
	Fish			400
	Water	4 qts.	6'	1/2
	Water	2 qts.	18'	None detected, less than 1/2.
	Mud	2 qts.	6'	50
	Mud	1 qt.	20'	None detected, less than 50.
Willow				
	Fish			100
	Water	4 qts.	5'	None detected, less than 1/2.
	Water	2 qts.	8'	None detected, less than 1/2.
	Mud	2 qts.	6'	None detected, less than 50.
	Mud	1 qt.	12'	None detected, less than 50.

* Sample too small.

Table 5. Plankton Sampling of Six Matanuska Valley Toxaphene-treated Lakes, August 7, 1962

Sample No.	LAKE											
	Bumblebee		Crystal		Finger		Florence		Loon		Willow	
	zoo.	phyto.	zoo.	phyto.	zoo.	phyto.	zoo	phyto.	zoo.	phyto.	zoo.	phyto.
1	63		37		42		8		32		27	20
2	47		33		34		8		23		34	17
3	37		25		36		7		21		46	14
Average	49		32		37		8		25		36	17

Table 6. Invertebrate Species Sampling of Matanuska Valley Toxaphene-treated Lakes. August 8, 1962.

LAKE								
Bumblebee			Crystal			Finger		
Family	Genus	No.	Family	Genus	No.	Family	Genus	No.
Corixidae	Sigara	14	Corixidae	Sigara	3	Malacostraca	Grammarus	6
Aeschnidae	Boyeria	3	Aeschnidae	Boyeria	5	Corixidae	Sigara	15
			Gerridae	Gerris	1			
			Anisoptera	Gomphus	1			
8 net passes			10 net passes			4 net passes		

LAKE								
Florence			Loon			Willow		
Family	Genus	No.	Family	Genus	No.	Family	Genus	No.
Corixidae	Sigara	7	Malacostraca	Grammarus	1	Malacostraca	Grammarus	1
Aeschnidae	Boyeria	2	Corixidae	Sigara	23	Corixidae	Sigara	55
Gerridae	Gerris	5				Aeschnidae	Boyeria	1
Anisoptera	Gomphus	2				Hydroptilidae	Ochrotricha	1
8 net passes			10 net passes			4 net passes		

Table 7. A comparison of Physical Characteristics, plys Residual Toxaphene Content and Mortality of Test Fish in Six Treated Lakes, 1962.

Lake	Max. Depth in Feet	Thermocline	Toxaphene Content of Analyzed Fish	Test Fish Mortality Series 2	
				No. Days	Percentage
Willow	11	No	100 ppb*	54	10
Finger	44	Yes	None detected less than 100 ppb	58	30
Loon	20	No	400 ppb	56	100
Crystal	25	No	500 ppb	40	100
Bumblebee	37	Yes	1,400 ppb	36	100
Florence	40	Yes	1,000 ppb	28	100

* ppb: Parts per billion.

The remaining four lakes appear too toxic for the survival of game fish at present. Relative toxicity appears to be a function of maximum depth and percentage of water volume below the plant production level. Table 7 compares physical characteristics, residual toxin contents and test-fish mortalities of the six lakes. Finger Lake is not the exception it appears. Since it is not the characteristic bowl shape of the other lakes involved, its' two small deep areas and undulating shoreline result in a small percentage of volume below the plant production level.

Breakdown of toxaphene depends upon sunlight, high temperature, high oxygen from plants and wind agitation, alkaline conditions, and microorganisms. The rapid detoxification of Willow and Finger Lakes is felt to be a result of higher acquatic plant and algae production and larger percentage of shoal area exposed to sunlight and wind agitation than the other treated lakes involved. In addition, Finger and Willow Lakes are the sole waters in the test group which have small but permanent outlets for water exchange.

Factors working against detoxification in these six particular lakes are the short, cool summers, long periods of winter ice cover, slightly acid water, and general deficiency of microorganisms.

Literature Cited:

Stringer, George E., and McMynn, Robert G. 1960. Three year's use of toxaphene as a fish toxicant in British Columbia. Canadian Fish Culturist, 28: 37-44.

Prepared by:

Dan McGinnis
Fishery Biologist

Date: March 23, 1963

Approved by:

Richard Haley
D-J Coordinator

Alex H. McRea, Director
Sport Fish Division

The smaller fish was found protruding from the mouth of the lake trout.