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Annual Performance Report

For

LAKE AND STREAM INVESTIGATIONS

Evaluation of Interior Alaska Waters and Sport Fish with Emphasis on Stocked Lakes

by

Richard D. Peckham

ALASKA DEPARTMENT OF FISH AND GAME

James W. Brooks, Commissioner

DIVISION OF SPORT FISH

Rupert E. Andrews, Director

Howard E. Metsker, Chief, Sport Fish Research

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RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigations of Alaska.

Project No.: F - 9 - 6

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Job No.: G - III - E Job Title: Evaluation of Interior Alaska Waters and Sport Fish with Emphasis on Stocked Lakes.

Period Covered: July 1, 1973 to June 30, 1974

ABSTRACT

Thirteen lakes stocked with rainbow trout, Salmo gairdneri, and/or silver salmon, Oncorhynchus kisutch, were sampled with gill nets, bag seine, and a boat shocker to evaluate stocking success. Survival and growth as related to timing, stocking rates, size, and strains of introduced fish are evaluated. A population estimate of age I silver salmon in Lisa Lake indicated a survival of 55% from fingerling stocked in 1972. Spring stocking of rainbow trout from the Ennis strain resulted in better survival than later stocking of Winthrop strain rainbow trout, as indicated by gill net sampling.

Creel census interviews from 252 anglers on Quartz Lake (May 21 - September 2) revealed a season catch rate of 0.35 rainbow trout per hour.

Craig, North Twin, South Twin, and three smaller lakes were rehabilitated with liquid rotenone. The target species in Craig Lake was lake chubs, Couesius plumbeus. Fish species killed in the other lakes were longnose suckers, Catostomus catostomus, and slimy sculpins, Cottus cognatus. Estimates of the sucker population were made in North and South Twin lakes by mark and recapture. Pounds per surface acre estimates were 17.5 and 16.4, for North Twin and South Twin lakes, respectively.

Creel census and angler counts were conducted at Tangle Lakes (June 24 - August 9) based on a randomized schedule, stratified to provide increased sampling during high use periods. The total estimate for the period was 3,105 angler hours. Overall catch success was 1.23 fish per hour. Catch

rate for grayling, Thymallus arcticus, was 1.09 fish per hour. Mean length of angler-caught grayling was 300 mm.

A total of 642 grayling was tagged above and below the falls on the Delta River to determine movement.

Three remote area lakes were surveyed. These included Healy Lake and two previously unsurveyed lakes near the Robertson River.

RECOMMENDATIONS

1. Continue the evaluation of stocking rates, timing, size of introduced fish, and other stocking variables in Interior Alaska lakes stocked with rainbow trout and silver salmon.

2. Sample stocked lakes by under-ice gill netting to provide better growth comparisons and to allow more time in the summer for other important projects.

3. Stock an equal number of marked rainbow trout from the Ennis and Winthrop strains in a selected study lake for comparison of survival, growth, and return to the creel.

4. Initiate a comprehensive study on George Lake with special emphasis on the northern pike population.

5. Devote increased effort to monitoring the harvest of fish from area waters.

6. Conduct follow-up capture efforts on grayling tagged in the Delta River in 1973, to determine movement.

OBJECTIVES

1. To evaluate stocking policies for rainbow trout and silver salmon and continue intensive studies of stocking rates, timing, size of introduced fish, and interspecies and intraspecies relationships to formulate stocking recommendations for optimum survival and growth.

2. To determine the environmental characteristics and fish species composition of the waters of the job area, and where practicable, estimates of existing or potential angler use and sport fish harvest.

3. To evaluate application of fishery restoration measures and determine availability of sport fish egg sources.

4. To assist as required in the investigation of public access status to the area's fishing waters.

5. To evaluate multiple water-use development projects (public and private) and their effects on the area's streams and lakes for the protection of the sport fish resources.

TECHNIQUES USED

Graduated mesh monofilament gill nets, 125' x 6', with five mesh sizes ranging from 1/2" - 2-1/2" square measure were used to sample fish populations in lakes. Nets were fished 18 - 80 hours. In addition, an alternating current boat shocker as described by Van Hulle (1968), and a 50' x 6' nylon bag seine with 1/4" mesh were used to sample fish in selected lakes.

Fish were measured to fork length in millimeters and weight in grams.

Chemical analysis of water samples was done with a Hach (Model AL-36-WR) kit. Lake depths were determined with a Lowrance echo sounder. Craig Lake was sounded in the winter using a grid system. Distance between grids was 100 feet, except where steep bottom contours were indicated. At those points soundings as close as 25-foot intervals were taken. The transducer was immersed in a shallow depression in the ice containing ethylene glycol. Other lakes were sounded in the summer.

Rehabilitated lakes were treated with liquid rotenone (Pro-Noxfish). The chemical was dispersed in Craig Lake into the outboard motor prop wash. On North Twin, South Twin, and the three smaller lakes a hose running from the barrel was attached to the intake on an outboard motor jet unit. Some chemical was dispersed in the deeper portion of North Twin Lake by means of a centrifugal pump and a weighted hose.

Angler counts conducted on the Tangle Lakes were based on a randomized schedule, stratified to provide increased sampling during high use periods. Anglers having completed trips were interviewed for creel census information.

Grayling were tagged with red Floy (FD-67) vinyl tubing tags.

FINDINGS

Fish Stocking Evaluation

Sampling Results and Gear Comparisons:

Thirteen lakes stocked with rainbow trout, Salmo gairdneri, and/or silver salmon, Oncorhynchus kisutch, were sampled with gill nets, June - August, 1973, for comparison of growth and survival of stocked fish. Due to widely variable results of summer gill net samples in some lakes, winter test gill netting was conducted in November and December, for comparison on all lakes except Craig, which was rehabilitated. Table I shows the gill net catches and age classes represented in both the summer and winter samples. Table 2 compares the summer and winter netting results. Age 0 fish captured in the winter netting had not been stocked in the lakes at the time of the summer netting and are therefore not included in Table 2. The catch per hour was higher in all but two lakes in summer, as would be expected because the fish are more active. However, an advantage of winter netting is that growth comparisons are more valid, since they are made at the end of the growing season. Other advantages of winter gill netting as suggested by Redick (1971) include the following: 1) Winter thermal conditions are more stable. Thus, the depth distribution of fish is more predictable and catch rates should be less variable. 2) Less interference with sampling nets is encountered from anglers in winter than during the summer. 3) Winter sampling extends the field season and allows time for other projects that must be completed during the summer.

In addition to gill net sampling, selected lakes were further sampled with a bag seine and a boat mounted shocker for fish population analysis, population estimates, and gear efficiency comparisons.

TABLE 1 Population Characteristics of Stocked Lakes Determined by Graduated Mesh Gill Nets, Interior Alaska, 1973.

Lake	Date Sampled	Species*	Number	Age Class	Length (mm) Range	Length (mm) Mean	Frequency **
Bolio	7/3	SS	33	II	232-277	255	0.87
		SSc	13		88-103		0.34
	11/29	SS	7	II	269-294	285	0.14
		SS	12	0	94-106	101	0.24
Craig	6/14	SS	45	III	141-285	157	0.59
		RT	2	V	366-486	426	0.03
		GR	2		243-252	248	0.03
		CH	20		91-140		0.26
West Craig	8/17	RT	10	II	212-256	230	0.23
	12/19		0				
Donna	8/2	RT	1	III	429		0.02
		RT	8	II	291-321	304	0.19
	12/12	RT	2	IV	372-433	403	0.05
		RT	2	III	382-386	384	0.05
		RT	3	II	310-330	322	0.07

TABLE 4. (cont.) Population characteristics of fish from lakes sampled by experimental Mesh Gill Net, Interior Alaska, 19 5.

Lake	Date Sampled	Species*	Number	Age Class	Length (mm) Range	Length (mm) Mean	Frequency **
		RT	1	0	100		0.02
Little Donna	8/2	RT	18	II	304-363	336	0.47
	12/12	RT	3	II	341-376	357	0.07
		RT	4	0	104-138	116	0.09
Four Mile	7/5	SF	3	V	484-523	509	0.09
	7/5	SS	50	I	145-165	156	1.56
	12/21	SF	4	V	517-535	526	0.11
		SS	17	I	252-310	281	0.49
Jan	7/10	RT	1	VII	335		0.03
		RT	29	II	228-306	269	1.00
		SS	22	I	133-150	145	0.76
	12/18	RT	6	II	243-339	275	0.12
		SS	10	I	150-196	174	0.20
Lisa	7/12	RT	16	II	310-372	341	0.44

TABLE 1. (cont.) Population Characteristics of Stocked Lakes Determined by Graduated Mesh Gill Nets, Interior Alaska, 1973.

Lake	Date Sampled	Species*	Number	Age Class	Length (mm) Range	Length (mm) Mean	Frequency **
		SS	191	I	105-151	141	5.30
	12/5	RT	9	II	330-375	351	0.17
		SS	14	I	156-189	175	0.27
		RT	3	0	120-126	122	0.06
Mark	6/15	RT	17	II	133-260	204	0.21
		RT	24	I	83-110	101	0.30
	11/30	RT	5	II	210-375	265	0.10
		RT	1	I	146		0.02
		RT	3	0	115-126	122	0.06
Quartz	8/8	RT	71	I	269-391	335	1.97
		RT	1	0	92		0.03
	12/14	RT	26	I	321-447	397	0.48
		RT	2	0	102-120	111	0.04
		SS	6	I	287-323	314	0.11
		KS	1	I	369		0.02

TABLE 1 (cont.) Population Characteristics of Stocked Lakes Determined by Graduated Mesh Gill Nets, Interior Alaska, 1975

Lake	Date Sampled	Species*	Number	Age Class	Length (mm) Range	Length (mm) Mean	Frequency **
Rainbow	6/26	RT	5	II	367-411	396	0.28
	12/7	RT	15	II	341-500	458	0.33
Rapids	8/1	RT	1	III	228		0.02
		RT	6	II	173-225	201	0.14
		RT	2	I	108-120	114	0.05
	12/3	RT	1	II	233		0.06
Robertson #2	8/3	RT	2	II	372-378	375	0.11
	12/20	RT	8	II	356-445	400	0.19
		RT	2	0	116-124	120	0.05

* CH - Chub
GR - Grayling
KS - King Salmon
RT - Rainbow Trout
SF - Sheefish
SS - Silver Salmon
SSc - Slimy Sculpin

** Fish per hour - 125' graduated mesh gill net.

TABLE 2. Comparison of Summer and Winter Test Netting In Twelve Interior Alaska Lakes, 1973.

Lake	Summer Netting			Winter Netting**		
	Number Fish	Net Hours	Frequency	Number Fish	Net Hours	Frequency
Bolio	46	38	1.21	7	49	0.14
Donna	9	42	0.21	7	42	0.17
Little Donna	18	38	0.47	4	43	0.09
Mark	41	80	0.51	6	48	0.13
Jan	52	29	1.79	16	50	0.32
Lisa	207	36	5.75	23	52	0.44
Quartz	72	36	2.00	35	54	0.65
Rainbow	5	18	0.28	15	45	0.33
Rapids	9	43	0.21	1	18	0.06
Robertson #2	2	18	0.11	8	42	0.19
West Craig	10	44	0.23	0	56	0.00
Four Mile	53	32	1.65	21	35	0.60

*Fish per hour - 125' graduated mesh gill net.

**Winter netting results do not include age 0 fish captured as shown in Table 1.

The various sampling methods utilized made it apparent that a reliable evaluation of the fish population is not usually obtained by only one means of sampling. Furthermore, time of day (daylight or darkness), seasons in which sampling was conducted, and fish species sampled significantly affected catch success.

Each of the three sampling methods was utilized on Lisa and Mark lakes. Gill netting and shocking were conducted on Jan Lake, but seining was not feasible because of dense submergent vegetation and stumps in the limited amount of shoal area in the lake. A comparison of the sampling methods is shown in Table 3.

In lakes having suitable shoal areas, seining is a very effective tool for sampling yearling silver salmon. During three days in June, 29 seine hauls in Lisa Lake captured 1,116 silver salmon (approximately 22% of the estimated population, as discussed later). Seining was most effective when the lake was calm and the small salmon could be seen surface feeding in schools along the shoreline, often in less than 0.5 meter depth. As many as 254 salmon were captured in a single seine haul when fish were observed near the shoreline. Similar success was had on Bolio Lake in June, 1972, when 160 silver salmon were caught in one haul.

In contrast, June seining in Mark Lake for rainbow trout was relatively ineffective. Only 14 rainbow trout were captured in seven seine hauls, compared to a mean catch rate of 38 and 53 silver salmon per haul in Lisa and Bolio lakes, respectively.

Although seining has not been tried in lakes containing silver salmon older than age I, it is expected that success would be much less on older year classes because of their greater speed and preference for deeper water. Seining in Mark Lake did capture age I and II rainbow trout in equal numbers, however, the age II fish had a mean length of only 154 mm.

A comparison of gill netting and boat shocking results shows that different fish species and age classes were not captured proportionately by each sampling method. In Jan Lake, silver salmon (age I) and rainbow trout (age II and older) comprised 42% and 58% of the gill net sample respectively, while the boat shocking sample was comprised of 81% silver salmon and 19% rainbow trout. Age 0 rainbow trout in the boat shocking sample were excluded from this comparison because they were not stocked in the lake until after gill netting.

Gill netting and shocking results in Mark Lake were also not proportionate. Age I and II rainbow trout comprised 59% and 41% of the gill net sample, respectively, while the boat shocking sample consisted of 25% age I and 75% age II rainbow trout.

Almost five hours of boat shocking on Lisa Lake resulted in the capture of only one rainbow trout. Gill netting (36 net hours), on the other hand, captured 191 age I silver salmon and 16 age II rainbow trout.

Although much of the shocking on Lisa and Mark lakes was done between the hours of 10 PM and 2 AM, the lack of sufficient darkness during June and

TABLE 3. Comparison of Capture Success With Boat Shocker, Gill Nets, and Seine in Three Interior Alaska Lake, 1973.

	Jan Lake	Lisa Lake	Mark Lake
Boat Shocker*			
Date	9/21,25	7/9,10	6/5-13
Fish Captured**	495 age I SS, 617 Age 0 RT, 114 Age II RT	1 age II RT	36 age I RT, 106 age II RT
Hours	2.7	4.7	11.5
Frequency**	183.3 SS, 227.5 age 0 RT, 42.2 age II RT	0.21	3.1 age I RT, 9.2 age II RT
Gill Nets			
Date	7/10	7/12	6/15
Fish Captured	22 age I SS, 29 age II RT, 1 age VII RT	191 age I SS, 16 age II RT	24 age I RT, 17 age II RT
Hours	29	36	80
Frequency	0.8 (SS), 1.0 (RT)	5.3 (SS), 0.4 (RT)	0.3 (I RT), 0.2 (II RT)
Seine			
Date		6/20, 21, 28	6/11, 12, 13

	Jan Lake	Lisa Lake	Mark Lake
Fish Captured		1,116 age I SS	7 age I RT, 7 age II RT
Seine Hauls		29	7
Fish/Haul		38	2

*Shocking on Lisa and Mark Lakes was done with one dipper, while shocking on Jan Lake utilized two.

**RT - Rainbow Trout
SS - Silver Salmon

***Fish per hour

July in Interior Alaska apparently reduced the effectiveness. The influence of darkness on shocking effectiveness was further demonstrated on Jan Lake in September. Shocking from 5:15 to 6:15 PM on September 21 captured only eight age 0 rainbow trout and two age I silver salmon. On September 21 and 25, during 2.7 hours of shocking from 8 PM to 1 AM, 617 age 0 rainbow trout, 114 age II and older rainbow trout, and 495 age 1 silver salmon were captured.

It is obvious that night shocking in September, was by far the most efficient method utilized in sampling all year classes of fish present in the lake. Also, night shocking in Jan Lake sampled fish in near proportion to their actual abundance as revealed by population estimates conducted at that time (discussed below).

Population Estimates:

Fish population estimates were conducted on Jan and Lisa lakes using the mark and recapture method. Attempted estimates on Mark Lake were not successful because of an insufficient number of recaptures for a reliable estimate.

An estimate of age 1 silver salmon was conducted on Lisa Lake in June. A 50-foot bag seine was utilized on June 20 and 21 to capture a total of 796 silver salmon in this 50 acre lake. The fish were transferred to galvanized tubs after each seine haul, then taken to the center of the lake where they were marked with a dorsal fin clip and returned to the water. Only one mortality from handling was recorded.

Six days were allowed to assure that the marked fish were randomly distributed in the population. On June 28, further seining captured 320 silver salmon, of which 50 were marked. A sample of 20 fish had a length range of 125 - 146 mm and a mean length of 135 mm. Mean weight was 24.3 gm. Due to light fishing pressure during the period, fishing mortality was negligible.

The standard Petersen equation provides an estimate of 5,088, representing a survival of 55% from 9,200 silver salmon stocked as 243 per pound fingerling on August 29, 1972.

A second estimate was made on July 12, when gill net sampling captured 191 silver salmon, of which 33 were marked.

This provided an estimate of 4,587, representing a survival of approximately 50% from the fingerling silver salmon stocked 11 months prior. The mean length and weight of the 191 silver salmon in the sample was 141 mm and 31.1 gms (0.07 lbs.), respectively. Thus, the total estimate was 321 pounds or an average of 6.4 pounds per surface acre. This, of course, does not include the age II and older rainbow trout in Lisa Lake for which no estimate is available.

An estimate of the fish population in Jan Lake was conducted in late September utilizing the boat shocker for capture. This 44 acre lake contained essentially three age classes of fish: 1) age 0 rainbow trout stocked at 54 per pound July 18, 1973; 2) age I silver salmon stocked August 29, 1972; and 3) age II rainbow trout stocked June 24, 1971. A limited number of rainbow trout

from year classes prior to 1971 were present as revealed by July gill netting, where one of 30 rainbow trout captured was from a previous year class.

Shocking on September 21 was done after darkness between the hours of 8 PM and 1 AM, with two people dipping fish. In eight runs of 10 minutes each, a total of 340 small rainbow trout, 329 silver salmon, and 67 large rainbow trout was collected. Due to the large numbers of fish captured, the runs were limited to 10 minutes each to prevent overcrowding in the tubs and possible mortality. After each run the fish were visually separated into each of the three age classes, marked with an adipose fin clip, and returned to the water near the center of the lake. A shocking and handling mortality of approximately 1% was noted and is not included in the above figures.

After four days to allow for random distribution of marked fish in the population, Jan Lake was again sampled with the boat shocker. Four runs were made (two 15 minutes and two 25 minutes) during the same hours of darkness as before. Although an amount of shocking time equal to the 21st was expended, 19% fewer small rainbow trout, 30% fewer large rainbow trout and 50% fewer salmon were taken on the 25th. This indicates a possible avoidance reaction to continued shocking. The relatively small size of Jan Lake allows shocking of the entire shoreline in approximately 20 minutes. Fish captured were as follows: 277 small rainbow trout, of which 44 were marked; 166 silver salmon, of which 29 were marked; and 47 large rainbow trout, of which 9 were marked.

Again using the standard Petersen equation provides estimates as follows:

Small Rainbow Trout (Age 0) = 2,140

Silver Salmon (Age I) = 1,883

Large Rainbow Trout (Age II and older) = 350

The estimate of 2,140 for age 0 rainbow trout represents a survival of 26% from 8,200 rainbow trout stocked at a size of 54 per pound on July 18, 1973 (approximately 2 months earlier). These figures indicate a high initial mortality in the short period following stocking, even though the fish were larger than are normally stocked. However, it should be noted that the condition of the fish at the time of stocking was recorded as only fair due to the long hours of transporting.

Based on the estimated population of 1,883 silver salmon a survival of 24% is calculated from 8,000 fingerling stocked on August 29, 1972, at a size of 243 per pound. The lower percentage survival of silver salmon estimated in Jan Lake than was calculated for Lisa Lake may be due in part to the following two factors: 1) a higher population of rainbow trout predators from previous year classes in Jan Lake, as revealed by 1972 and 1973 test gill netting, and 2) the estimate in Jan Lake was made three months after the first estimate in Lisa Lake, so some natural mortality and fishing mortality undoubtedly occurred.

Based on the population estimate of each age group in Jan Lake an estimate of the total standing crop is presented in Table 4.

Species*	Age Group	Mean Weight** (lbs.)	Estimated Population	No per Acre	Estimated Total Pounds	Pounds Per Acre
RT	0	0.06	2,140	49	128	2.9
SS	I	0.15	1,883	43	282	6.4
RT	II	0.58	350	8	203	4.6
				Totals	613	13.9

*RT - Rainbow Trout
SS - Silver Salmon

**Mean weights of age 0 rainbow trout and age I silver salmon were from a sample of 10 and 6, respectively, taken on September 21. Mean weight of age II and older rainbow trout is based on a sample of 30 taken in July gill net samples.

The estimated population of 350, or 8 per surface acre, age II rainbow trout in Jan Lake is the highest survival to this age noted in the past two years. The age II rainbow trout summer gill net catch rate of 1.0 per net hour is the highest recorded catch of age II rainbow trout of the lakes sampled during this period. These trout were from the Ennis, Montana strain stocked as 228 per pound fingerlings at a rate of 440 per surface acre. Another consideration is that these fish, as well as others of the Ennis strain stocked in 1971, were stocked in June, whereas most rainbow trout stocking in the past has been done in late summer or fall.

Rainbow Trout Growth and Survival:

Rainbow trout of the Ennis strain (eggs obtained from the Ennis, Montana National Fish Hatchery) were first stocked in eight Interior Alaska lakes in 1971. The fish at stocking ranged from 228 - 374 per pound and were stocked at rates of 320 - 860 per acre. Although the stocking rate was higher than most have been in past years, survival to age I and II as compared to Winthrop strain trout (eggs obtained from the Winthrop, Washington National Fish Hatchery) has been higher in nearly all lakes as indicated by gill net catch per hour. Table 5 compares growth and survival rates to age I of Ennis and Winthrop rainbow trout strains stocked in Interior Alaska lakes from 1969 to 1972. All rainbow trout planted prior to 1971 were of the Winthrop strain.

Test netting in Donna and Little Donna lakes in 1970, 1971, and 1973 revealed poor survival of Winthrop strain trout. In 1971, no trout of the 1970 plant were captured in Little Donna Lake and only one was captured in Donna Lake. No fish of the 1972 plants were captured in Donna and Little Donna lakes during 1973 netting. In comparison, 1972 netting captured 30 trout in Donna Lake and 59 in Little Donna Lake from the 1971 plant of Ennis rainbow trout.

As noted in 1972 (Peckham 1973), Winthrop rainbow trout fingerlings stocked in September at 100 - 200 per pound attain a mean length of approximately 100 mm by the following June. They are therefore vulnerable to predators from previous year classes for a long period of time. An advantage of the Ennis strain is that eggs are received at the Fire Lake State Fish Hatchery in January and fingerlings are available for stocking in June. Winthrop eggs arrive in March and fingerlings normally are stocked in August or September.

Time of stocking or strains is apparently less important in lakes which do not have fish from previous year classes. Ennis rainbow trout stocked in Quartz Lake in 1972 exhibited survival and growth to age I similar to Winthrop rainbow trout stocked in Rainbow Lake in 1971. Both lakes were barren when stocked. After approximately 13 months, the Quartz Lake rainbow trout had a mean length of 335 mm and gill net catch was 1.97 per hour. The rainbow trout in Rainbow Lake 14 months after stocking had a mean length of 333 mm and were caught in gill nets at a rate of 1.69 per net hour. It should be noted that the Winthrop fish stocked in Rainbow Lake were stocked earlier and at a smaller size (666/pound) than is normal for this strain.

The data in Table 5 indicate that the size of fish stocked is less critical than timing. Rainbow trout stocked in September 1970 and 1972 were stocked at a larger size (74 - 107 per pound and 145 per pound, respectively) than those stocked in June, 1971 (228 - 374 per pound). However, test netting

TABLE 3. Net Catch and Growth Comparisons to Age I of Ennis and Winthrop Rainbow Trout Strains Stocked in Interior Alaska Lakes in 1969-1972.

Lake	Date Stocked	Per Pound	Per Acre	Date Sampled	Number Captured	Mean Length (mm)	Frequency*
			Ennis Strain				
Donna	6/22/71	262-357	860	7/12/72	30	134	0.79
Little Donna	6/22/71	262	320	7/11/72	59	239	1.28
Jan	6/25/71	228	440	8/ 3/72	42	218	1.40
Lisa	6/25/71	374	790	8/17/72	29	268	0.60
Mark	6/22/71	262	500	6/28/72	68	138	1.70
Rapids	6/22/71	357	600	7/25/72	2	147	0.08
Robertson #2	6/25/71	228	400	7/20/72	24	245	1.04
West Craig	6/25/71	374	700	7/ 7/72	5	129	0.11
Quartz	6/23-7/26/72	106-163	205	8/ 8/73	71	335	1.97
			Winthrop Strain				
Donna	7/31/69	445	170	7/8 & 22/70	3	218	0.07
	9/24/70	107	110	6/8 & 9/71	1	100	0.01
	9/12/72	145	150	8/ 8/73	0		

Lake	Date Stocked	Per Pound	Per Acre	Date Sampled	Number Captured	Mean Length (mm)	Frequency*
Little Donna	7/31/69	445	130	7/22/70	5	212	0.11
	9/24/70	107	100	6/10/71	0		
	9/12/72	147	160	8/ 2/73	0		
Jan	7/31/69	445	455	7/10/70	20	186	0.56
Lisa	7/31/69	445	400	7/10/70	1	213	0.02
Mark	7/31/69	445	250	7/17/70	3	153	0.15
	9/12/72	147	375	6/15/73	24	101	0.30
Rapids	7/31/69	445	400	7/16/70	0		
	9/15/70	74	200	6/15/71	0		
	9/12/72	147	380	8/ 1/73	2	114	0.05
Rainbow	7/22/71	666	620	9/20/72	71	333	1.69

*Fish per net hour - 125' variable mesh gill net.

showed generally poor survival of 1970 and 1972 stocked fish. Also, rainbow trout stocked in 1969 were the smallest (445 per pound) of all trout stocked in 1969-1972 (except Rainbow Lake). However, test netting in 1970 revealed better survival in Donna and Little Donna lakes than larger size fish of the Winthrop strain stocked in 1970 and 1972. Again, this may be due to an earlier stocking date of July 31, as compared to September 24 and September 12, in 1970 and 1972, respectively.

The low net catch in Rapids and West Craig lakes in 1972 is considered to be a result of poor netting efficiency in both lakes due to steep and limited littoral area rather than low fish survival. A moderate number of fish were observed surface feeding in both lakes prior to netting.

Growth of rainbow trout as related to stocking rates from 1969-1972 has been variable, but in most lakes good growth can be expected at rates up to 500 fingerlings per acre. Rainbow trout stocked at rates from 320 - 455 in 1969 and 1971 in Little Donna, Jan, Lisa, and Robertson #2 lakes attained mean lengths of from 186 - 245 mm in approximately one year. Trout in Lisa and Rainbow lakes showed excellent growth to age I at higher rates of 790 and 616 fingerling per surface acre, respectively. However, survival may have been much reduced because of high mortality of stocked trout in Lisa Lake (Peckham, 1973), and survival in Rainbow Lake may have been reduced because of the small size of fish stocked.

Productivity of individual waters, as well as stocking rate, is an important factor influencing growth. Productivity appears to be more closely related to the percentage of littoral area (arbitrarily chosen as the depth less than five meters) in the lakes being studied than any other single factor. Table 6 presents morphometric and water chemistry characteristics of 13 lakes stocked with rainbow trout and silver salmon.

Silver Salmon Growth and Survival:

Stocked lakes listed in Table 6 are characterized by having summer surface temperatures ranging from 18° to 22°C. Many of the lakes experience a sharp decrease in temperature gradient of 3° to 4°C between the 3 and 5 meter levels during the summer. Dissolved oxygen levels are consistently adequate (4.0 ppm or greater) above depths of 5-6 meters in most lakes. However, dissolved oxygen levels at the three meter depth in August was 3.0 ppm in West Craig Lake and 1.2 ppm in Robertson #2. West Craig Lake was devoid of oxygen at the five meter depth. Both West Craig and Robertson #2 have experienced winter dissolved oxygen levels of less than 2.0 ppm.

Silver salmon stocked in the lakes currently being studied came from three sources during 1968-1972: Kodiak Island; Bear Lake, located near Seward; and the Delta Clearwater River, located near Delta Junction. The Delta Clearwater silver salmon are the first stocked in Interior Alaska lakes which came from an Interior Alaska source. The eggs and resulting fry were smaller than those from other sources at the Fire Lake Hatchery in spring, 1972. The Clearwater fry were 2,870 per pound as compared to 1,800 per pound fry from Ship Creek and 1,400 - 1,600 per pound fry from Kodiak, Seward, and Little Port Walter silver salmon. Although the Clearwater fry were smaller, fry mortality at the hatchery was considerably less than other sources in 1972, according to Joe Wallis, hatchery supervisor.

Lake	Surface Acres	Maximum Depth (meters)	Elevation (feet)	Littoral Area (%)*	Total Alk. (ppm)	Total Hardness (ppm)
Bolio	128	4.0	1,390	100	70	70
Craig	17	22.9	1,550	35	50	35
West Craig	2	15.3	1,575	6	50	50
Donna	58	11.0	1,660	61	50	50
Little Donna	47	8.3	1,620	67	35	35
Jan	44	12.8	1,620	39	85	85
Lisa	50	7.9	1,475	77	35	50
Mark	20	11.3	1,425	53	50	70
Quartz	1,540	12.8	950	82	240	240
Rainbow	96	10.4	1,120	58	50	50
Rapids	5	7.0	2,375	48	100	120
Robertson #2	8	4.0	1,650	100	20	35
Four Mile	100	5.8	2,000	90	35	35

*Littoral area is that portion of the lake less than five meters deep.

A comparison of net catch and growth of silver salmon stocked from 1968 - 1972 is shown in Table 7. Catch per net hour of age I Clearwater silver salmon in Jan and Lisa lakes in 1973 was considerably higher in each lake than catch rate of age I Kodiak silver salmon in 1969. However, the 1969 catch was probably low because of netting inefficiency, since catch of age II silver salmon was good in both lakes in 1970.

No survival estimates are available for silver salmon prior to the estimates made in 1973 in Jan and Lisa lakes. However, the survival estimates (55%, discussed earlier) of age I Clearwater silver salmon in Lisa Lake in June, 1973, is considered good, especially since a relatively high population of age I rainbow trout was present when the silver salmon were stocked. A good population of age I rainbow trout was also present in Jan Lake and a light population of sheefish in the four pound class was present in Four Mile Lake (Table 1).

Stress which the fish undergo due to transporting and handling is an important factor affecting fish survival, but it is difficult to evaluate. Fish transported by truck from the Fire Lake Hatchery, near Anchorage to Interior Alaska lakes are in transit for a minimum of eight hours. When several lakes are stocked in a single day, time from loading fish at the hatchery until being stocked has been as long as 16 to 22 hours. Condition of silver salmon stocked in Jan, Lisa, and Four Mile lakes in 1972 was listed as poor.

Mean length of age I Delta Clearwater silver salmon sampled in Jan and Lisa lakes in 1973 was less than that of Kodiak silver salmon sampled in 1969. However, growth is considered comparable, since the time between stocking and sampling of the Clearwater salmon was over three weeks less than for the Kodiak fish.

Stocking densities from 1968 - 1972 ranged from 100 - 375 fingerlings per surface acre, but more often were stocked at rates from 160 - 190 fingerlings per surface acre. Rates up to 190 have resulted in generally good growth. Poor growth of silver salmon stocked at 375 fingerlings per acre in Craig Lake is thought to be a result of severe competition from lake chubs, Couesius plumbeus, rather than high stocking density.

A lower density of 100 fingerlings per surface acre stocked in Four Mile Lake in 1972 showed slightly better growth than rates of 180 per surface acre in Jan and Lisa lakes. Mean lengths of silver salmon sampled in July, 1973, were 156 mm in Four Mile Lake, 145 mm in Jan Lake, and 141 mm in Lisa Lake. However, sampling in December revealed mean lengths of 281 mm in Four Mile Lake, 174 mm in Jan Lake, and 175 mm in Lisa Lake. The remarkable increase in mean length of 125 mm in Four Mile Lake, as compared to an increase of approximately 30 mm in Jan and Lisa lakes from July to December may be in part a result of lower stocking density, but is probably related more to productivity of the lake. Four Mile Lake is very fertile, consisting of 90% littoral area. Amphipods are abundant and comprised a major part of the diet of the fish sampled in December. The mean length of age I silver salmon sampled in Four Mile Lake in December exceeds the mean length of all age II silver salmon sampled in the other study lakes shown in Table 7.

TABLE 1. Net catch and growth comparisons of silver salmon stocked in Interior Alaska Lakes, 1968-197

Lake	Date Stocked	per Pound	per Acre	Date Sampled	Age Class	Number Captured	Mean Length (mm)	Frequency*
Source: Kodiak								
Bolio	7/ 8/68	610	160	6/17/69	I	6	227**	.33
				7/16/70	II	4	258	.19
				5/25/71	III	2	365	.03
	6/25/71	349	160	8/16/72	I	18	210	9.00
				7/ 3/73	II	33	255	0.87
Jan	7/ 8/68	610	180	6/12/69	I	2	155	.11
				7/10/70	II	65	222	1.81
				6/ 2/71	III	12	283	.27
Lisa	7/ 8/68	610	190	6/12/69	I	4	187	.42
				7/10/70	II	45	260	.90
				6/ 3/71	III	3	320	.07
Source: Bear Lake								
Craig	9/24/70	145	375	6/ 4/71	I	0		
				7/6&7/72	II	9	140	.10

TABLE 4 (cont.) Net Catch and Growth Comparisons of Silver Salmon Stocked in Interior Alaska Lakes, 1968 -

Lake	Date Stocked	per Pound	per Acre	Date Sampled	Age Class	Number Captured	Mean Length (mm)	Frequency*
Source: Delta Clearwater								
Jan	8/29/72	243	180	7/10/73	I	22	145	0.76
				12/18/73	I	10	174	0.20
Lisa	8/29/72	243	180	7/12/73	I	191	141	5.30
				12/ 5/73	I	14	175	0.27
Four Mile	8/30/72	243	100	7/ 5/73	I	50	156	1.56
				12/21/73	I	17	281	0.49

*Fish per net hour - 125' graduated mesh gill net.

**Age of fish in the sample is not available, so may include fish from a 1966 stocking.

The high net catch of age II silver salmon in Jan Lake in 1970 indicates good survival of silver salmon stocked at the small size of 610 per pound. A good population of rainbow trout from previous year classes was present (Spetz, 1969) at the time the silver salmon were stocked. This would suggest that size of silver salmon at stocking is not a critical factor affecting survival.

The data in Table 7 indicate that earlier stocking dates from 1968 - 1971, in Bolio, Jan, and Lisa lakes, resulted in larger age I fish available to anglers than resulted from a late August stocking in Jan and Lisa lakes in 1972.

Silver salmon stocked in Interior Alaska at the present densities attain harvestable size about 12 to 14 months after stocking. The bulk of the harvest occurs during the second winter and subsequent summer after stocking.

Quartz Lake Creel Census

Creel census was conducted on Quartz Lake at various times during the period from May 21 through September 2, 1973. The census included each of the three major holidays weekends (Memorial Day, Independence Day, and Labor Day). Results are summarized by month in Table 8.

TABLE 8. Creel Census Summary, Quartz Lake, May 21 - September 2, 1973.

Month	Anglers Contacted	Total Fish	Total Anglers Hrs.	Fish/ Hour
May	67	88	191	0.46
June	64	81	246	0.33
July	55	76	267	0.28
August	18	31	74	0.42
September	48	63	182	0.35
Total	252	339	960	0.35

Lake Rehabilitations

During 1973, Craig, North Twin, South Twin, and three smaller lakes were rehabilitated with liquid rotenone. A summary of each follows.

Craig Lake:

Craig Lake (Figure I) is a 17 acre lake located near mile 1382 on the Alaska Highway, approximately 40 miles southeast of Delta Junction. It is accessible

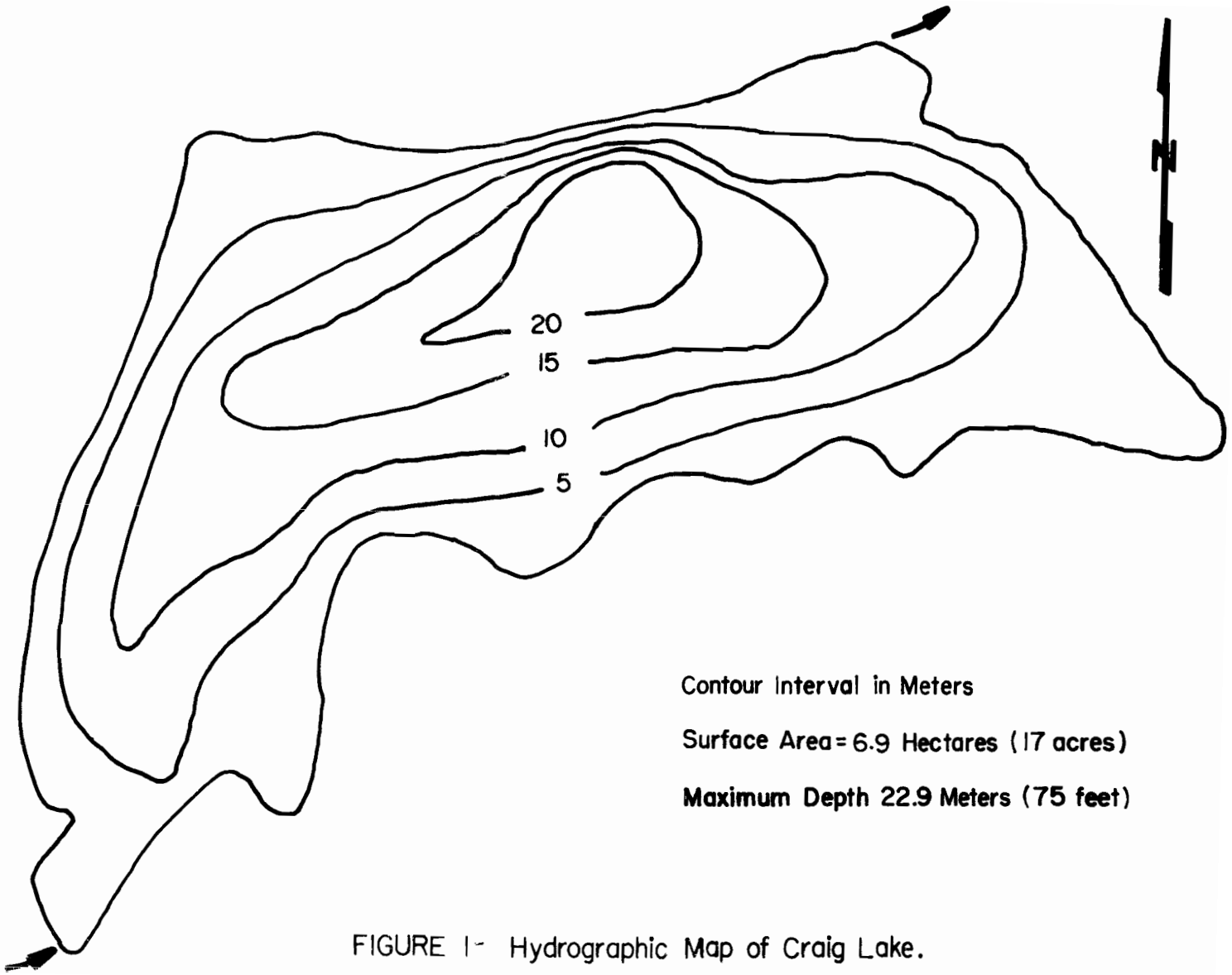


FIGURE 1- Hydrographic Map of Craig Lake.

by a one-fourth mile foot trail from a cutoff of the old Alaska Highway. The lake has a maximum depth of 22.9 meters (75 feet) and a volume of 535 acre feet. One small spring inlet (0.3 meter wide and a flow of less than 0.50 cfs) originates in a muskeg meadow approximately 250 yards south of the lake. Craig Lake drains to the northeast into a small 1.8 acre lake having a maximum depth of 9.5 meters (31 feet) and a volume of 24 acre feet. This small lake is surrounded by hills and has no outlet.

Rainbow trout and silver salmon have been stocked in Craig Lake since 1960. In recent years lake chubs have infested the lake, apparently having been introduced by fishermen. Competition from the chubs has resulted in poor survival and growth of fingerling silver salmon and rainbow trout stocked in 1970 and 1971, respectively. As shown in Table I silver salmon had attained a mean length of only 157 mm 32 months after stocking. No rainbow trout of the 1971 plant were netted, however two from stocking prior to 1970 were captured. Also netted were two grayling apparently introduced by fishermen from a small nearby lake.

Craig Lake and the small connecting lake were treated with liquid rotenone (Pro-Noxfish) at a rate of 1.0 ppm (0.025 ppm rotenone) on June 27, 1973. The The only fish observed in Craig Lake following treatment were numerous lake chubs, a moderate number of silver salmon, and two rainbow trout (170 - 190 mm). The rainbow trout, of the 1971 plant, were observed in the small connecting lake.

Fingerling silver salmon placed in test cages at depths of 1 meter and 7 meters indicated that the rotenone had dissipated after nine weeks.

North Twin and South Twin Lakes Complex:

North and South Twin lakes are located approximately 15 miles south of Delta Junction on the Ft. Greely Military Reservation. North Twin Lake has a surface area of 23 acres with a maximum depth of 12.8 meters (42 feet) and a volume of 455 acre feet, while South Twin Lake has 21 surface acres, a maximum depth of 6.4 meters (23 feet) and a volume of 273 acre feet (Figures 2 and 3). Three small nearby lakes numbered seven, eight, and nine are 3.7, 2.8, and 2.8 surface acre, respectively. The volumes range from 63 - 73 acre feet on these lakes which could potentially drain into North and South Twin lakes.

Rainbow trout fingerlings were stocked in North and South Twin lakes in 1966. Some trout were harvested by anglers during 1968-1970, but the number was limited. Survival of the stocked rainbow trout was apparently low because of longnose sucker, Catastomus catastomus, competition. Only suckers were captured in each lake during gill netting in 1970. Gill netting on May 28, 1971, captured the following: North Twin - 26 suckers (300 - 400 mm) and one rainbow trout (580 mm); South Twin - 34 suckers (290 - 410 mm).

North Twin, South Twin and lakes Seven, Eight, and Nine were chemically treated on May 24 and 25, 1973, with liquid rotenone (Pro-Noxfish) at a rate of 1.5 ppm (0.038 ppm rotenone).

The only fish observed following the rehabilitation were longnose suckers and slimy sculpins, Cottus cognatus.

FIGURE 2- Hydrographic Map of North Twin Lake

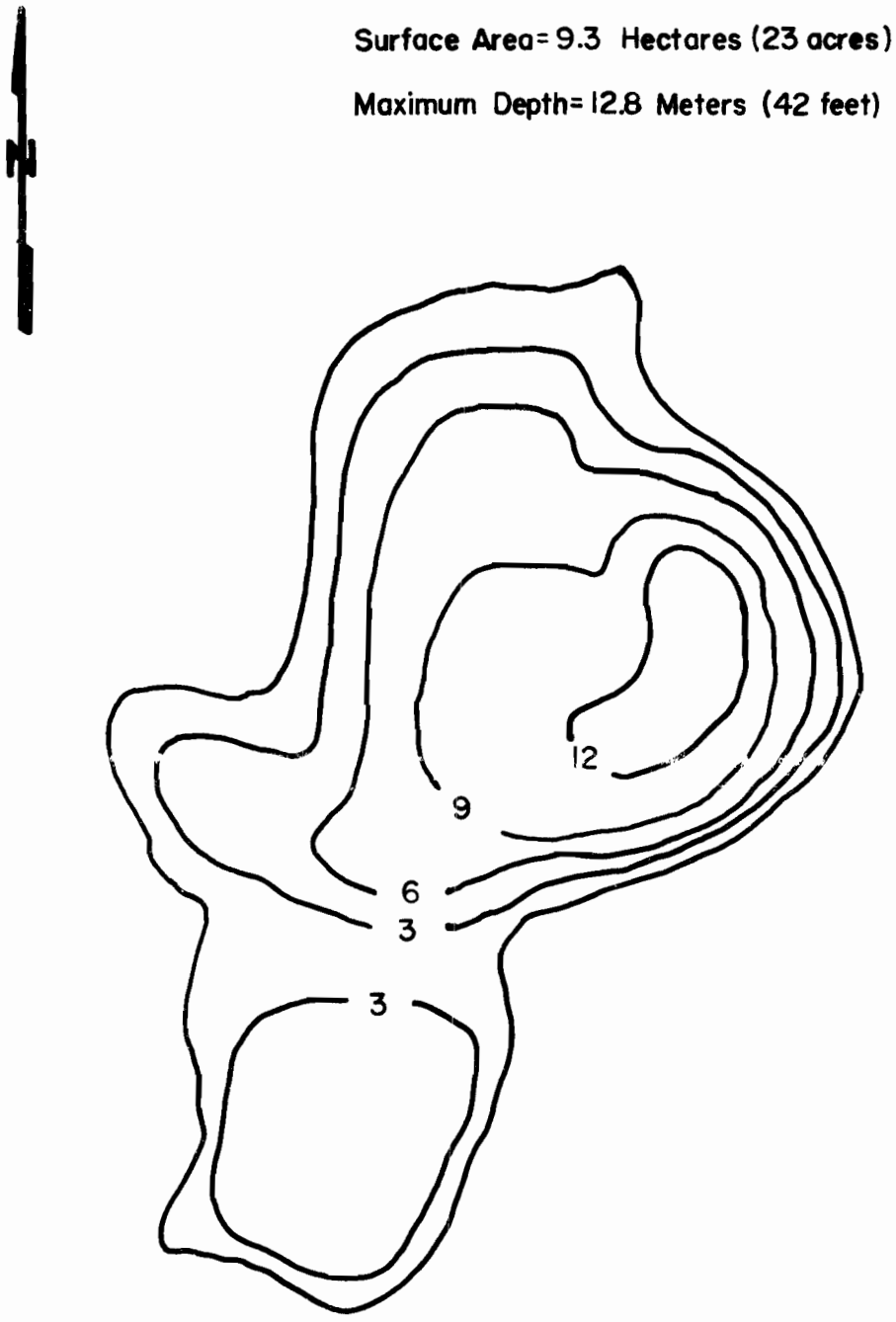
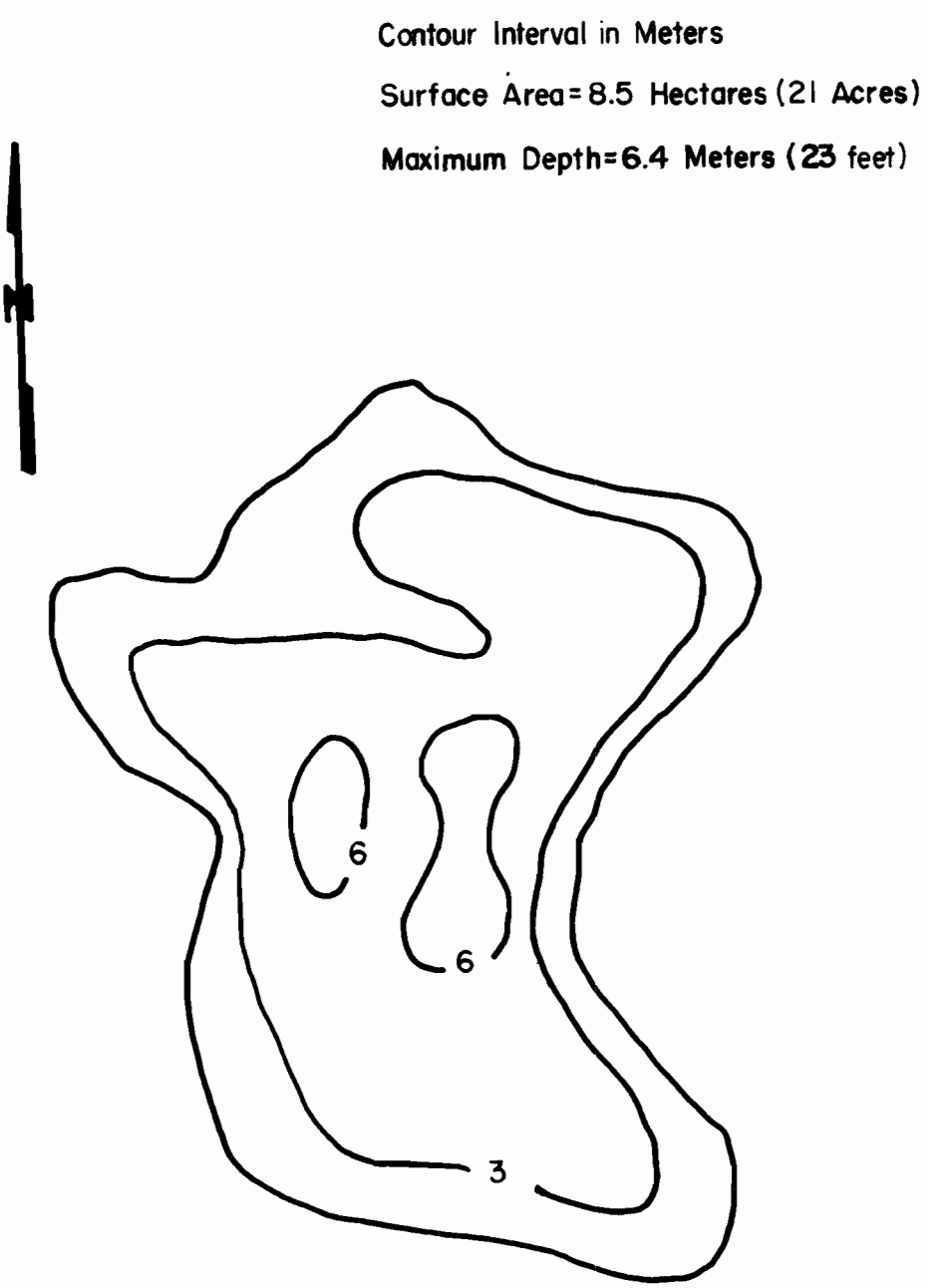


FIGURE 3- Hydrographic Map of South Twin Lake.



Silver salmon fingerlings placed in test cages in North and South Twin lakes indicated that the lakes remained toxic for over six weeks, but the rotenone had dissipated within ten weeks following treatment. A total of 570 net hours in each lake during late August resulted in the capture of no fish.

Observations on August 1 revealed an abundance of zooplankton in South Twin Lake. The lake was restocked with 6,300 fingerling silver salmon on September 20. Rainbow trout were restocked in lakes Seven, Eight, and Nine in late August.

An estimate of the sucker population was made on North and South Twin lakes to provide an estimate of the standing crop for comparison with future trout or silver salmon production. During pre-rehabilitation sampling, suckers captured in gill nets were marked by removal of the dorsal fin and returned to the lake. Only suckers exceeding 200 mm were included in the estimate.

Suckers in these lakes were quite vulnerable to gill netting. Six nets fished overnight (21 hours) in South Twin Lake captured 115 suckers, or 30% of the estimated population. An average of eight nets fished for three nights in North Twin Lake captured 151 suckers of 37% of the estimated population.

Following the rehabilitation all dead suckers exceeding 200 mm that had surfaced were examined for marks. Of 157 suckers examined in North Twin Lake, 58 were marked. In South Twin Lake 99 suckers were examined, of which 30 were marked. Using the standard Petersen estimate the estimated number of suckers in North Twin and South Twin lakes was 409 and 380, respectively. The number of suckers per surface acre (18) was identical for both lakes. Estimated pounds per surface acre for North Twin and South Twin Lake were 17.5 and 16.4, respectively.

Tangle Lakes Creel Census

The Tangle Lakes is a river-lake complex at the headwaters of the Delta River. Several camping areas are located on the lakes adjacent to the highway making this a popular stop-over for tourists and residents.

Creel census and angler counts were conducted at Tangle Lakes from June 24 through August 9. Two observers, one at the Upper Tangle Lake campground, and one at the Round Tangle Lake campground made angler counts and creel census contacts during the scheduled periods. These two locations are the primary access points to the Tangle Lakes and provided observation of and contact with most of the anglers utilizing the fishery. Anglers having completed their trip were interviewed for creel census information.

Tangle Lakes angler estimates are summarized in Table 9. Total angler hour estimates for Upper and Lower Tangle lakes for the period from June 24 through August 9 were 1,414 and 1,691, respectively. The total estimate for the period was 3,105 angler hours. This estimate is less than half the 6,966 angler hours estimated in 1968 (Roguski, 1969). However, the 1968 estimate extended through Labor Day weekend, thus covering approximately three more weeks. The lower estimate in 1973 probably reflects

TABLE 9. Tangle Lakes Angler Pressure Estimates, June 24 - August 9, 1973.*

	Angler Hours			
	Weekdays		Weekends & Holidays	
	Upper Tangle**	Lower Tangle	Upper Tangle	Lower Tangle
June 24 - July 20	455	448	572	524
July 21 - Aug. 9	165	265	222	454
Total	620	713	794	978

Upper Tangle Total = 1,414

Lower Tangle Total = 1,691

Total Angler Hours 3,105

*Time period covered was 4 A M to 12 midnight.

**Upper Tangle includes the lake complex south of the highway and Lower Tangle includes the lake complex north of the highway.

a decrease in public use of the Denali Highway due to the completion of the Anchorage-Fairbanks Highway which provides easier access to McKinley Park. The data show a decrease in the percentage of non-resident anglers from 26% in 1968 to 10% in 1973.

Table 10 summarizes the Tangle Lakes angler composition and catch success for 1973. Anglers in Upper Tangle Lake enjoyed better success on lake trout, Salvelinus namaycush, while anglers in Lower Tangle Lake caught more grayling due to access to the connecting streams in the lower lake complex.

Data not included in the table revealed that seven anglers caught lake trout limits in the Upper Lake or 50% of the total recorded lake trout harvest for that lake. This also indicates that some anglers concentrate their efforts on lake trout.

Nine percent of the anglers in both lake systems combined caught grayling limits. Twenty-four percent (including those with limits) caught five or more grayling. Although overall success was good (1.23 fish per hour), 33% of the anglers interviewed caught no fish.

The mean length of 254 grayling sampled from the angler harvest in Tangle Lakes was 300 mm. Length frequency distribution is shown in Figure 4. Grayling in this sample revealed a pronounced mode for fish in the 310-330 mm size group, as compared to a mode of 250 mm from a sample of 279 angler-caught grayling in 1968 (Roguski, 1969).

TABLE 10. Tangle Lakes Creel Census Summary, June 24 - August 9, 1973.

	Upper Lake	Lower Lake	Total
Number Anglers Contacted	170	202	372
% Successful	60	73	67
% Resident	65	71	69
% Non-Resident	10	10	10
% Military	25	19	21
Total Hours Fished	504	670	1,174
Man Hours/Angler Trip	2.96	3.31	3.15
Number Fish Caught	369	1,074	1,443
Grayling	226	1,052	1,278
Lake Trout	140	20	160
Whitefish	3	1	4
Burbot	0	1	1
Fish/Hour	0.73	1.60	1.23
Grayling/Hour	0.45	1.57	1.09
Lake Trout/Hour	0.28	0.03	0.14
Estimated Total Harvest			
Grayling	636	2,655	3,291
Lake Trout	396	51	447
Anglers with Grayling Limits	4 (2%)	28 (14%)	32 (9%)
Anglers with 5 or more Grayling*	26 (15%)	62 (31%)	88 (24%)

*Anglers with 5 or more grayling includes those with limits.

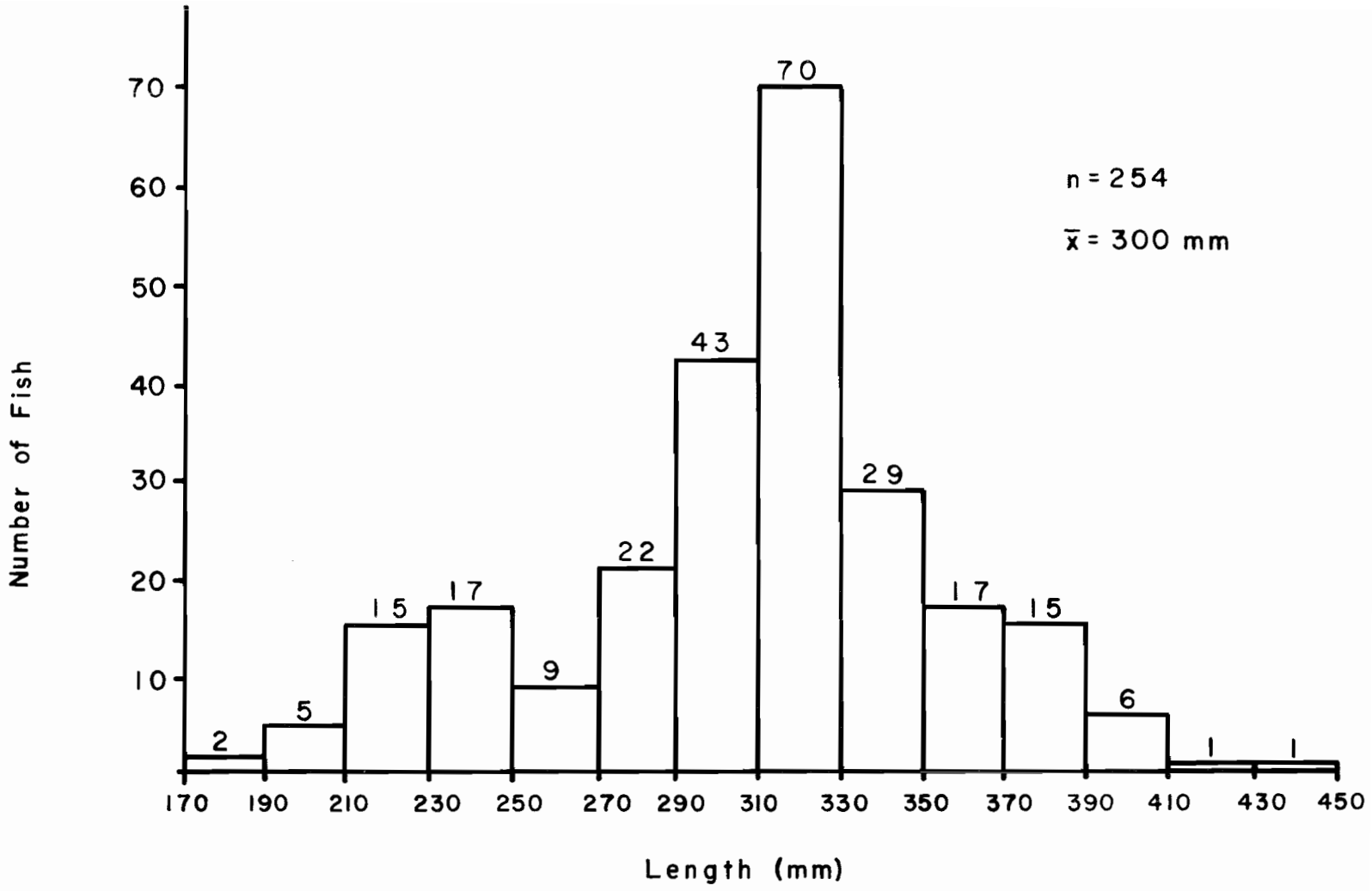


FIGURE 4. LENGTH FREQUENCY OF 254 ANGLER-CAUGHT GRAYLING IN THE TANGLE LAKES, 1973.

An important part of the Tangle lakes system is the grayling fishery available in the Delta River flowing out of the Tangle Lakes. This is a popular float trip fishery from Tangle Lakes to the Richardson Highway (milepost 212.5), a distance of approximately 35 miles. All but the last seven miles are clear water and provide excellent grayling fishing. Glacial water enters at Eureka Creek.

In an effort to learn more about the movement patterns of grayling in the system 666 grayling were tagged from July 5 through August 20. Most of the tagging was done in the Delta River in a five day period from August 16 - 20. During that time 615 grayling were caught on hook and line, tagged, and released. Of the total, 279 were tagged above the falls and 336 below. The falls are believed to be impassable to upstream migrating grayling, but angler tag returns and follow-up capture efforts in 1974 should confirm whether any upstream movement occurs and the extent of possible downstream movement.

A summary of 1973 tagging is presented in Table 11. The data show a mean length of 304 mm for grayling tagged in the Delta River above the falls as compared to a mean length of 281 mm below the falls. This may indicate better growth of fish having access to the lake system.

Length-frequency distribution of 615 grayling tagged in the Delta River from August 16 - 20 is presented in Figure 5. The mean length is 291 mm as compared to the recorded mean length of 300 mm for angler caught grayling in Tangle Lakes.

Table 11. Summary of Grayling Tagged in the Tangle Lakes and Delta River July 5 - August 20, 1973.

Location	Date	Number Tagged	Length (mm) Range	Mean
Lower Tangle Lake	7/5	24	195-408	288
Delta River above Falls	8/16-8/18	279	191-400	304
Delta R. below Falls	7/18-8/20	363	150-399	281
		666		291

Lake Surveys - Remote Area Waters

Three remote area lakes were surveyed in 1973. These include Healy Lake and two previously unsurveyed lakes located near the Robertson River. Netting results are summarized in Table 12.

Healy Lake:

Healy Lake was surveyed to supplement data collected in previous years. Limnological data including depth soundings, water temperatures, water chemis-

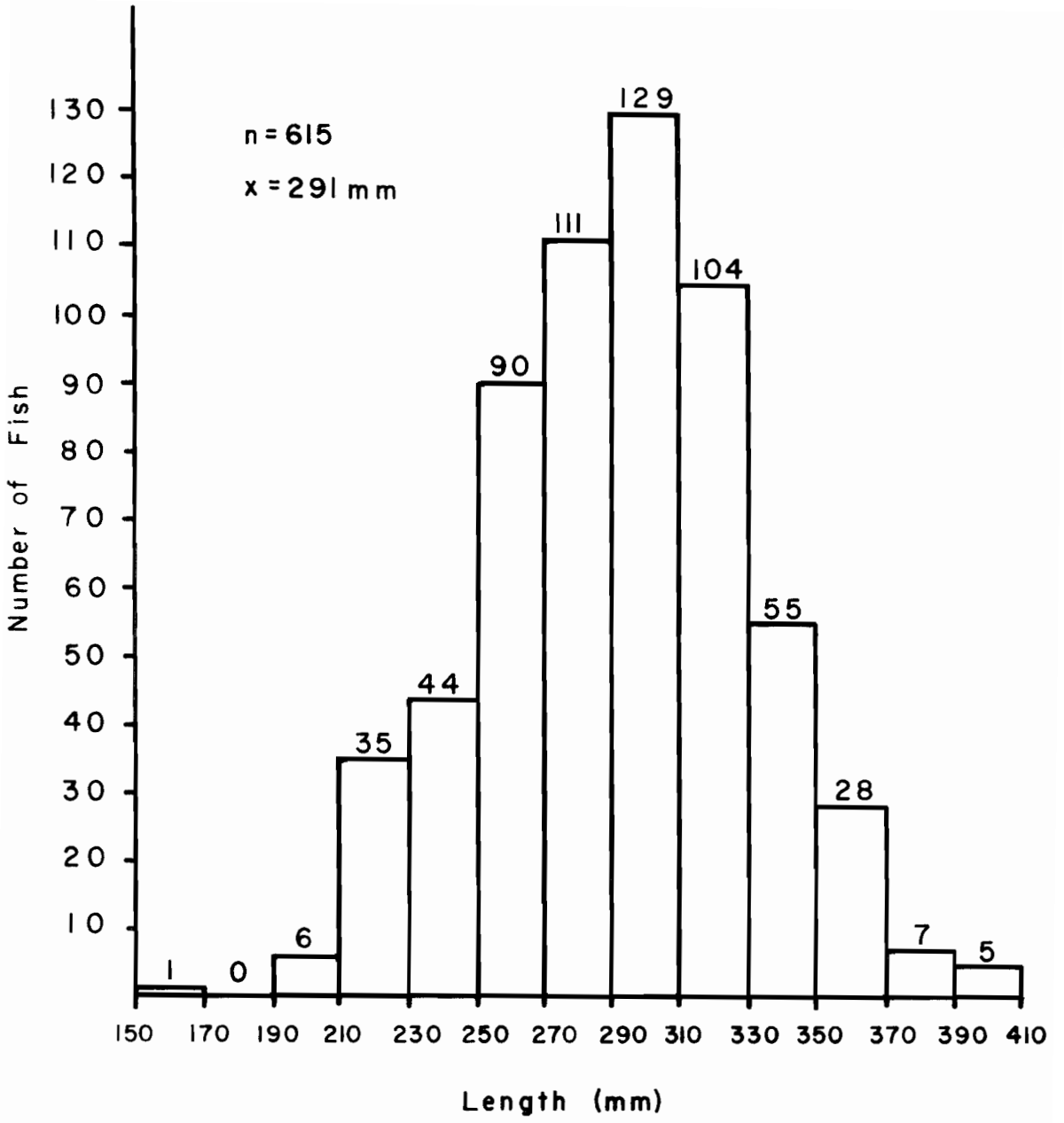


FIGURE 5. LENGTH FREQUENCY OF GRAYLING TAGGED IN THE DELTA RIVER, AUGUST 1973.

Table 12. Test Net Fishing Summary for Selected Area Lakes, Interior Alaska, 197[illegible]

Lake and Location	Date	Number	Species*	Length Range	Length Mean	Weight Range	Weight Mean	Frequency**	%Comp
Healy	7/26	16	NP	291-395	345	0.04-1.16	0.67	0.67	17.2
64° 00'N		17	LCi	98-297	243	0.03-1.10	0.53	0.70	18.3
144° 45'N		60	HWF	190-435	370	0.21-2.86	1.77	2.50	64.5
Unnamed R7E, T20N, Sec. 16 & 21	7/23	10	LT	318-398	364	0.88-1.80	1.30	0.48	100.0
Unnamed R7E, T20N, Sec. 2 & 11	7/23	No Fish Captured							

*NP - Northern Pike
LCi - least cisco
HWF - humpback whitefish
LT - lake trout

**Fish per net hour - 125' graduated mesh gill nets.

try and Secchi disc readings were collected and are on file in the Fish and Game office in Delta Junction. Maximum recorded depth in this shallow, silt-bottom lake is 3.4 meters. Surface acreage is 3,800. The lake receives backup water from the Tanana River at various times during the summer. As a result, more than one-third of the lake is often turbid. Secchi disc readings range from 5 cm near the outlet to 1 meter near the inlet at the south end of the lake. Water temperature in the deepest portion of the lake on July 27, ranged from 21°C (70°F) on the surface to 17°C (63°C) on the bottom in 3.4 meters. The two main inlet streams had water temperature of 16°C (60°F) and 18°C (64°F). Water chemistry in the lake was as follows: pH = 8.5; total alkalinity = 50 ppm; total hardness = 50 ppm; dissolved oxygen = 10 ppm (surface to 1.7 meters), 6 ppm (at 2.5 meters) and 0.6 ppm (at 3 meters).

Fish species captured during netting were as follows: 16 northern pike, Esox lucius; 17 least cisco, Coregonus sardinella; and 60 humpback whitefish, Coregonus pidschian (Table 12).

At the present time Healy Lake receives only a small amount of recreational fishing pressure. However, the whitefish in the lake and Healy River are utilized by several subsistence fishermen (five in 1973) and one commercial fisherman.

Although no burbot were captured during net sampling in the lake, they are found in good numbers in Healy River near its confluence with the Tanana River. On July 25 and 27, 19 burbot were caught in four man hours of hook and line fishing. The length range was 460 - 800 mm with a mean of 565 mm. The weight range was .45 - 2.59 kg (1.0-5.7 pounds).

Unnamed Lakes Near the Robertson River:

Two previously unsurveyed lakes located near the Robertson River were surveyed. One large lake (approximately 72.5 hectares or 179 acres) located in T20N R7E Sec. 16, 21, was found to contain lake trout. No other fish were captured.

The lake presently has no inlet or outlet, but shoreline evidence indicated a much higher water level (at least 3 meters higher) existed in past years. Maximum depth recorded was 29 meters (95 feet). The lake has a rocky shoreline and is located at an elevation of 1,750 feet.

Submergent vegetation is common around the margin of this clear lake in depths less than 4 meters.

Access is by fly-in or an eight mile unmarked foot- or all-terrain-vehicle trail. Present use is limited primarily to fly-in moose hunters. The lake is utilized very little by fishermen.

Water chemistry recorded on July 23 was as follows: pH = 8.0; total alkalinity = 70 ppm; total hardness = 70 ppm; and water temperature at the surface = 19°C (66°F).

Another lake located in T20N R7E Sec. 2, 11, was netted, but no fish were captured. This is a smaller (approximately 31.2 hectares or 77 acres) and much

shallower lake. Maximum recorded depth was 4.3 meters (14 feet). Submergent vegetation is common in more than 70% of this lake located at an elevation of 1,750 feet. The shoreline is rocky. Invertebrates are abundant in the lake, however, the shallow depth and remote location makes further investigation for management impractical at this time.

Water chemistry was recorded as follows: pH = 7.5; total alkalinity = 50 ppm; total hardness = 50 ppm; and surface water temperature was 19°C (66°F).

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Prepared by:

Richard D. Peckham
Fishery Biologist

Approved by:

s/Howard E. Metsker
Chief, Sport Fish Research

s/Rupert E. Andrews, Director
Division of Sport Fish