Volume 15

Study G-I
Job R-IV-D
Study A-I

STATE OF ALASKA

William A. Egan, Governor

Annual Report of Performance for

INVENTORY AND CATALOGING

DISSEMINATION OF INFORMATION COLLECTED ON DOLLY VARDEN

INVESTIGATIONS OF PUBLIC FISHING ACCESS AND AQUATIC HABITAT REQUIREMENTS

by

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RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigation of Alaska.

Project No.: F - 9 - 6

Study No.: G - I Study Title: INVENTORY AND CATALOGING

Job No.: G - I - D Job Title: Inventory, Cataloging and Population Sampling of the Sport Fish and Sport Fish Waters in Upper Cook Inlet.

Period Covered: April 16, 1973 to April 15, 1974.

ABSTRACT

Twenty-five lakes were inventoried in the Matanuska-Susitna Valleys for physical and chemical characteristics. Sampled waters, ranging from 9 to 362 acres in size, were of the bicarbonate type and varied from very soft to hard. Water analyses gave mean values for Ca, Mg, K,and Na of 22.0, 4.5, 1.3, and 7.0 mg/liter, respectively. Bicarbonate, SO_4 and CI averaged 95.6, 3.5, 5.5 mg/liter. Correlation coefficients between various determinations were: conductance and total alkalinity, 0.99; conductance and total hardness 0.99; and total hardness and total alkalinity 0.99. Seasonal thermal and O_2 regimes are discussed.

Growth and relative survival, as defined by gill net sampling, were determined for stocked game fish in 17 lakes. Mean lengths for Winthrop rainbow trout, *Salmo gairdneri*, after 14.5 months of lake residency, ranged from 215 to 306 mm. Average lengths of Ennis rainbow trout ranged from 159 to 223 mm after 5.5 months. Gill net data are also presented for Arctic grayling, *Thymallus arcticus*, and coho salmon, *Oncorhynchus kisutch*.

RECOMMENDATIONS

Emphasis should be directed toward the following activities:

1. Catalog chemical and physical parameters of lakes in the area and

and determine growth and relative survival of salmonids in these waters.

2. Determine chinook and coho salmon escapements in selected streams of the area.

3. Evaluate returns of hatchery chinook to Willow Creek.

OBJECTIVES

1. To determine and record the environmental characteristics of certain potential fishery waters of the job area and to develop and evaluate plans for the enhancement of resident fish stocks.

2. To assist as required in the investigation of public access status to the area's fishing waters and to make specific recommendation for selection of sites for segregation.

3. To make recommendations for the proper management of various sport fish waters in the area and to direct future studies.

TECHNIQUES USED

Samples and/or measurements from lakes receiving intensive study were taken from permanent stations near the area of maximum depth. Water temperatures were measured with a Yellowsprings Model 43 Termistemp Tele-Thermometer graduated in degrees Fahrenheit. Water transparency was assessed during mid-day with an 18-cm diameter Secchi disc having alternating black and white quadrants.

Water samples were collected with a brass 400 ml Kemmerer bottle and then transferred to glass or plastic containers. Samples requiring detailed analyses were shipped to the U. S. Geological Survey, Salt Lake City, Utah, where the analytical work was performed following procedures described by Brown et. al (1970). Total hardness, total alkalinity and pH were analyzed with a Hach Model Al-36-WR kit. Dissolved oxygen was determined by titration with phenylarsen oxide (PAO) and the use of powder pillows developed by Hach Chemical Company. Specific conductance was measured with a Hach Model 2510 conductance meter.

Chemical milliequivalents per liter were computed by multiplying the reported concentration of the individual constituents, in mg/L, by the reciprocal of their combining weights.

Monofilament gill nets (125' x 6'), having five mesh sizes ranging from 0.5 to 2-inch bar measure, were used to collect fish specimens. Nets were normally set for approximately 24 hours in each lake.

The age of planted salmonids was determined, when necessary, by examination of scales pressed between glass slides. Fork lengths were recorded to the nearest millimeter and weights to the nearest 0.01 pound.

FINDINGS

Limnological Studies

Introduction:

The Matanuska-Susitna Valleys have a great abundance of lakes that contain, or have the potential of producing, game fish. Collectively, the lakes support a substantial recreational fishery, yet very little is known about these environments or their levels of fertility. In consideration of the need for this information, and with the ultimate objective of establishing indices of productivity, a limnological inventory was initiated during this job segment.

The goal of the inventory was to compare the area's stocked lakes by as many criteria as practical to determine causes for differences in game fish production and, if feasible, determine whether any individual factors consistently control this production. The broad scope of the inventory allows it to compliment the more specific limnolcgical-game fish studies of Kalb (1974).

The Matanuska-Susitna Valleys are situated in the heart of southcentral Alaska, immediately north of the city of Anchorage. The study area is bounded on the north by the Talkeetna Mountains, on the east by the Chugach Mountains, and on the south by waters of Cook Inlet and the Knik Arm. The Susitna River serves as a geographic barrier on the west. Much of the region has been glaciated several times (Karlstrom, 1953) and as a result the lowlands consist mainly of unconsolidated gravel, silt, clay, and sand. The entire Valley area is covered with an uneven mantle of loess derived from the barren flood plains of glacial rivers (Trainer, 1961).

Most of the lowlands lie between 150-500 feet above sea level. Cottonwood is common on the alluvial plains and along waterways, whereas birch, white spruce, and aspen dominate the well drained forested uplands. Dense thickets of alder, devils' club, and willow are dispersed throughout the area. Most of the unforested areas are muskegs, tidal plains, or openings on mountain slopes. Sphagnum moss is the principle vegetation of muskegs.

Weather stations at Talkeetna (62° 18'N, 150° 06'W) and at the Matanuska Agricultural Station (61° 34'N, 149° 16'W) typify the lower elevation climate. At the Agricultural Station, temperatures during July and December average 57.7° F and 12.1° F, respectively. The Station receives 15 inches of precipitation annually. Talkeetna weather is characterized by July and December temperatures of 57.9° F. and 9.4° F., respectively; and 28 inches of precipitation annually. Daylight varies from nearly 20 hours per day in June to about 5 hours per day in December. Ice cover forms on lower elevation lakes by late October and breakup is usually complete by mid-May. Ice thicknesses of 2.5'-3.5' are common.

Physical Characteristics of the lakes:

Morphometric and other physical features of 25 stocked lakes are presented in Table 1. The lakes range in surface area from 9-362 acres, and from

TABLE 1. Morphometric Data for Selected Lakes of the Matanuska-Susitna Valleys.

Lake	Surface (Acres)	Maximum Depth (Ft)	Mean Depth (Ft) [a]	Volume (Acre-Ft)	Shoreline Distance (Miles)	Shore Develop. [b]	Littoral Area (%) [c]	Elevation (Ft)	Location
Kepler	45.0	74	29.7	1,338	1.705	1.82	27	90	T17N, R1E, S24
Echo	23.0	40	19.3	445	0.884	1.31	42	100	T17N, R1E, S24
Matanuska	61.5	83	34.4	2,117	1.619	1.55	23	100	T17N, R1E, S23
Canoe	21.0	28	15.3	322	1.080	1.68	50	95	T17N, R1E, S13
Harriet	9.0	28	--	--	--	--	--	75	T17N, R1E, S24
Long (A)	74.4	55	26.1	1,945	2.367	1.96	28	85	T17N, R1E, S13
Victor	13.5	55	24.4	330	0.587	1.14	38	100	T17N, R1E, S24
Irene	21.0	35	--	--	--	--	--	92	T17N, R1E, S13
Finger	362.0	44	15.5	5,622	7.765	2.91	54	347	T18N, R1E, S33
Knik	50.4	37	19.1	963	1.477	1.48	47	50	T16N, R3W, S24
Johnson	40.3	41	20.0	806	1.089	1.22	46	95	T16N, R3W, S14
Florence	54.6	41	17.6	962	1.553	1.50	53	190	T19N, R5W, S23
Lucille	362.0	20	5.7	2,051	4.210	1.58	99	321	T17N, R1W, S8
Meirs	16.8	73	36.1	606	0.638	1.12	26	50	T17N, R2E, S18
Seymour	229.0	19	7.0	1,605	3.144	1.48	88	300	T18N, R2W, S32
Reed	19.9	20	11.0	219	0.795	1.27	71	550	T18N, R1E, S8
Memory	83.0	21	7.3	607	2.386	1.87	88	450	T18N, R1W, S22
Christiansen	179.0	82	22.1	3,961	4.640	2.47	47	200	T26N, R4W, S29
Rocky	58.7	27	13.0	764	1.439	1.34	59	150	T17N, R3W, S21
South Rolly	113.0	59	--	--	2.235	1.40	--	190	T18N, R5W, S11
Loon	108.0	17	10.4	1,133	1.922	1.32	73	270	T18N, R3W, S36
Marion	113.0	42	20.6	2,324	2.652	1.78	33	150	T16N, R4W, S1
Long (B)	102.0	100	--	--	--	--	--	1,487	T20N, R6E, S20
Ravine	12.3	25	11.8	146	0.824	1.69	62	1,800	T20N, R6E, S24
Lower Bonnie	100.0	35	--	--	--	--	--	1,800	T20N, R6E, S23

a Mean depth is volume ÷ surface area.

b Shore development is the ratio of the length of shoreline to the circumference of a circle having the same area as the lake.

c Littoral area is that portion of lake less than 15 ft. in depth.

17'-100' in depth. Four lakes - Lucille, Seymour, South Rolly, and Lower Bonnie - have permanent outlets, whereas the others are landlocked or have intermittent outlet discharge.

Three lakes, Long (B), Lower Bonnie, and Ravine, are located in close proximity at elevations ranging from 1,487 to 1,800 feet. The remaining waters are scattered throughout the Valley floors below 600 feet elevation. Nine lakes are situated in a group referred to as the Kepler-Bradley Complex. The Complex, which is centered in the Matanuska Valley's rich farm land, includes Kepler, Echo, Matanuska, Canoe, Harriet, Long (A), Victor, Irene, and Johnson lakes.

Monthly temperature observations were maintained on 11 lower elevation lakes between May and October, 1973, to establish summer thermal patterns. Vertical temperature series, with the date of observation, are shown in Table 2. Lakes deeper than six or seven meters (20-23 feet) were thermally stratified for at least a portion of the summer. Those with maximum depths of 7-13 meters (23-43') had hypolimnia that were generally above 40° F. in summer, whereas the hypolimnia of deeper lakes remained near 40° F.

Most deep lakes were dimictic but some probably do not mix completely during each period of circulation. Since breakup occurs shortly before the summer solstice, heat transfer to the water is rapid and subsequent stratification quickly limits circulation. In 1973, vernal mixing was incomplete in Christiansen Lake and severely attenuated in Matanuska Lake. During the fall, Christiansen Lake mixed completely but circulation in Matanuska Lake was restricted to the upper waters. Complete mixing was evident, however, at Matanuska Lake during the fall of 1972. Meirs Lake displayed meromictic circulation during 1973.

Lakes in the Palmer area were ice free (May 2-6) approximately 12 days earlier than those near Talkeetna (May 14-18). Comparison of surface temperatures revealed a similar seasonal pattern for all lower elevation lakes despite the difference in breakup dates (Figure 1). Maximum surface temperatures of 66° F. were recorded during July. Air temperature during the ice-free season was 1.5° to 2° F. cooler than normal for the area (U. S. Weather Bureau, 1973).

Thermal conditions of the three mountainous lakes did not receive detailed study; however, data collected on June 18 indicate that their surface waters were 4°-5° F. cooler than those of lakes near Palmer on the same date. Ravine Lake was a homoio-thermous 56.6° F., whereas Lower Bonnie Lake was 56° F. on the surface and 48° F. at maximum depth. Temperatures in Long Lake (B) ranged from 56.5° F. at the surface to 42° F. at 26 meters. Breakup occurred sometime between May 18 and June 5.

Transparency of the sampled lakes, as measured by Secchi disc, varied substantially (Table 3). Maximum and minimum seasonal readings of 11 and 1.5 m were recorded at Marion and Matanuska lakes, respectively. Variation in transparency was attributed primarily to plankton abundance.

TABLE 2. Vertical Distribution of Temperatures in Matanuska-Susitna Valley Lakes, 1973.

Depth (m)	Matanuska 8/1	Christiansen 8/9	Meirs 7/31	Long (A) 8/8	Johnson 8/8	Marion 8/7	Harriet 7/31	Memory 8/8	Lucille 7/31	Seymour 8/7	Loon 8/7	Depth (ft)
0	64.0	62.0	64.5	62.0	62.5	63.0	64.0	62.0	63.5	61.1	62.5	0
1	64.0	62.0	64.5	62.0	62.5	63.0	64.0	61.5	63.5	61.5	62.5	3.3
2	64.0	62.0	64.5	62.0	62.5	63.0	64.0	61.0	63.5	61.5	62.5	6.5
3	64.0	62.0	64.5	62.0	62.5	63.0	62.0	61.0	63.5	61.5	62.5	9.8
4	63.0	62.0	64.0	62.0	62.0	63.0	61.0	60.5	63.0	61.5	62.5	13.1
5	60.5	62.0	55.0	62.0	61.5	63.0	57.0	60.0	62.5	61.0	61.0	16.4
6	55.5	61.0	49.0	61.5	61.0	63.0	51.0	59.0	62.0	61.0	----	19.7
7	51.0	57.0	44.0	60.5	56.0	63.0	46.0	----	----	----	----	23.0
8	48.0	52.0	42.0	56.0	51.0	63.0	45.0	----	----	----	----	26.2
9	44.0	49.0	41.0	53.5	48.0	62.5	----	----	----	----	----	29.5
10	43.0	46.0	41.0	51.0	46.0	59.0	----	----	----	----	----	32.8
11	42.5	45.5	40.0	48.5	44.0	57.5	----	----	----	----	----	36.1
12	41.5	44.0	39.5	46.0	42.0	56.5	----	----	----	----	----	39.4
13	41.5	42.5	39.5	45.0	41.5	55.0	----	----	----	----	----	42.7
14	41.5	42.0	39.5	44.0	----	----	----	----	----	----	----	45.9
15	41.5	41.0	39.5	44.0	----	----	----	----	----	----	----	49.2
16	41.0	40.5	39.5	43.0	----	----	----	----	----	----	----	52.5
17	41.0	40.5	39.5	----	----	----	----	----	----	----	----	55.8
18	41.0	40.5	39.5	----	----	----	----	----	----	----	----	59.1
19	41.0	40.5	39.5	----	----	----	----	----	----	----	----	62.3
20	41.0	40.5	39.5	----	----	----	----	----	----	----	----	65.6
21	41.0	40.5	39.5	----	----	----	----	----	----	----	----	68.9
22	41.0	40.5	----	----	----	----	----	----	----	----	----	72.2
23	41.0	40.5	----	----	----	----	----	----	----	----	----	75.5
24	41.0	40.5	----	----	----	----	----	----	----	----	----	78.7
25	41.0	40.5	----	----	----	----	----	----	----	----	----	82.0

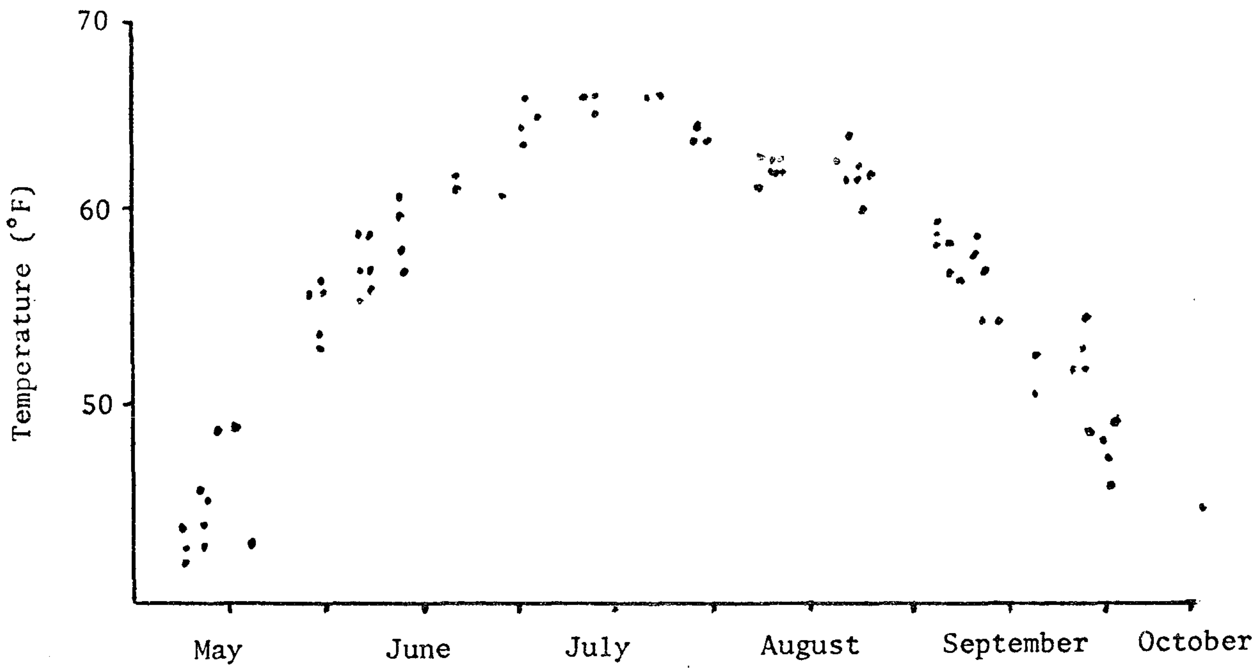

Figure 1. Surface Water Temperatures of Eleven Matanuska-Susitna Valley Lakes, 1973.

TABLE 3. Transparency Characteristic of Various Matanuska-Susitna Valley Lakes.

Lake	Secchi Disc Visibility (m) Range	Mean	Number of Measurements[1]	Depth at Station (m)
Memory	2.5-4.3	3.5	4	6.0
Matanuska	1.5-8.0	3.8	6	25.3
Leon	3.0-4.5	3.8	4	5.1
Seymour	3.8-5.0	4.4	2	5.7
Meirs	1.6-6.0	4.6	6	22.1
Harriet	3.0-6.0	4.7	6	8.4
Lucille	4.0-6.0	5.0	5	6.0
Johnson	3.6-8.0	5.9	3	12.4
Christiansen	5.9-9.0	7.6	3	24.9
Long (A)	5.3-10.7	7.7	5	16.7
Marion	7.5-11.0	8.8	5	12.7

[1] Measurements obtained at various dates between May and October, 1973.

Chemical Characteristics:

A single sample, collected one meter from the surface, was obtained from 25 lakes between May 17 and June 19 to compare chemical properties. All samples were analyzed by U. S. Geological Survey.

Lower elevation waters were of the bicarbonate type, characterized by a predominance of Ca among the cations, and HCO_3 among anions (Table 4). Percentage of cations, as calculated from reactive weights, varied from 43.2% to 77.5% for Ca, 15.6% to 25.8% for Mg, 0.9% to 18.5% for K, and 5.6% to 22.2% for Na. Of the anions, HCO_3 ranged from 63.1% to 94.2%, SO_4 from 1.3% to 19.7% and Cl from 2.6% to 22.4%. Carbonate was not evident in any of the initial samples; however, the ion was present in several waters during subsequent sampling. Summer pH of surface waters ranged from 6.7 to 9.1. Bottom waters of the deeper lakes were frequently somewhat lower pH. Seasonal variation in hydrogen ion concentrations appeared related to the CO_2 cycle, with high pH during periods of increased plant metabolism and decreased pH resulting from a buildup of CO_2 during oxidation of hypolimnetic waters.

TABLE 4. Ionic Composition of 25 Matanuska-Susitna Valley Lakes, 1973.

Lake	Cations: Ca	Mg	K	Ha	Total meg/liter	Anions: HCO_3	SO_4	Cl	Total meg/liter
Kepler									
mg/liter	49.0	8.6	1.2	6.7	-----	170.0	17.0	14.0	-----
meg/liter	2.446	0.708	0.031	0.292	3.477	2.787	0.354	0.395	3.536
% of total[1]	70.3	20.4	0.9	8.4	-----	78.8	10.0	11.2	-----
Echo									
mg/liter	43.0	8.0	1.2	6.3	-----	156.0	12.0	14.0	-----
meg/liter	2.146	0.724	0.031	0.275	3.176	2.557	0.250	0.395	3.202
% of total	67.6	22.8	1.0	8.6	-----	79.9	7.8	12.3	-----
Matanuska									
mg/liter	39.0	8.4	1.6	5.5	-----	160.0	6.8	3.8	-----
meg/liter	1.947	0.691	0.041	0.240	2.919	2.623	0.142	0.108	2.873
% of total	66.7	23.7	1.4	8.2	-----	91.3	4.9	3.8	-----
Canoe									
mg/liter	41.0	7.0	1.3	5.5	-----	136.0	9.7	13.0	-----
meg/liter	2.046	0.576	0.034	0.240	2.896	2.230	0.202	0.367	2.799
% of total	70.6	19.9	1.2	8.3	-----	79.7	7.2	13.1	-----
Harriet									
mg/liter	38.0	6.5	1.6	4.5	-----	154.0	3.2	8.7	-----
meg/liter	1.897	0.535	0.041	0.196	2.669	2.525	0.067	0.246	2.838
% of total	71.1	20.0	1.5	7.4	-----	89.0	2.3	8.7	-----
Long (A)									
mg/liter	35.0	6.7	1.2	4.7	-----	138.0	9.8	4.3	-----
meg/liter	1.747	0.552	0.031	0.205	2.535	2.262	0.192	0.122	2.576
% of total	68.9	21.8	1.2	8.1	-----	87.8	7.5	4.7	-----
Victor									
mg/liter	30.0	7.3	1.1	4.6	-----	121.0	8.2	6.6	-----
meg/liter	1.497	0.601	0.029	0.201	2.328	1.984	0.171	0.187	2.342
% of total	64.3	25.8	1.3	8.6	-----	84.7	7.3	8.0	-----
Irene									
mg/liter	30.0	6.8	1.2	4.1	-----	121.0	3.7	7.9	-----
meg/liter	1.497	0.560	0.031	0.179	2.267	1.984	0.078	0.223	2.285
% of total	66.0	24.7	1.4	7.9	-----	86.8	3.4	9.8	-----

TABLE 4. (Cont'd) Ionic Composition of 35 Matanuska-Susitna Valley Lakes, 1973

Lake	Cations					Anions			
	Ca	Mg	K	Ha	Total meg/liter	HCO_3	SO_4	Cl	Total meg/liter
Finger									
mg/liter	31.0	4.9	1.2	3.3	-----	130.0	2.5	2.9	-----
meg/liter	1.547	0.404	0.031	0.144	2.126	2.131	0.053	0.082	2.266
% of total	72.8	19.0	1.4	6.8	-----	94.1	2.3	3.6	-----
Knik									
mg/liter	26.0	3.8	0.9	2.5	-----	105.0	3.8	1.7	-----
meg/liter	1.298	0.313	0.024	0.109	1.744	1.721	0.080	0.048	1.849
% of total	74.4	17.9	1.4	6.3	-----	93.1	4.3	2.6	-----
Johnson									
mg/liter	20.0	3.5	2.3	3.0	-----	86.0	0.9	2.4	-----
meg/liter	0.998	0.288	0.059	0.131	1.476	1.410	0.019	0.068	1.497
% of total	67.6	19.5	4.0	8.9	-----	94.2	1.3	4.5	-----
Florence									
mg/liter	23.0	2.8	0.7	1.9	-----	84.0	2.4	1.6	-----
meg/liter	1.148	0.231	0.018	0.083	1.480	1.377	0.050	0.046	1.473
% of total	77.6	15.6	1.2	5.6	-----	93.5	3.4	3.1	-----
Rocky									
mg/liter	5.6	0.8	0.5	1.0	-----	24.0	0.9	1.5	-----
meg/liter	0.280	0.066	0.013	0.044	0.403	0.394	0.019	0.043	0.456
% of total	69.5	16.4	3.2	10.9	-----	86.4	4.2	9.4	-----
South Rolly									
mg/liter	3.8	0.9	0.4	0.8	-----	17.0	1.8	1.5	-----
meg/liter	0.190	0.075	0.011	0.035	0.311	0.279	0.038	0.043	0.360
% of total	61.1	24.1	3.5	11.3	-----	77.5	10.6	11.9	-----
Loon									
mg/liter	1.2	0.4	0.4	0.6	-----	6.0	0.9	1.2	-----
meg/liter	0.060	0.033	0.011	0.027	0.131	0.099	0.019	0.034	0.152
% of total	45.8	25.2	8.4	20.6	-----	65.1	12.5	22.4	-----
Marion									
mg/liter	0.7	0.2	0.4	0.4	-----	5.0	0.9	1.0	-----
meg/liter	0.035	0.017	0.0I1	0.018	0.081	0.082	0.019	0.029	0.130
% of total	43.2	21.0	13.6	22.2	-----	63.1	14.6	22.3	-----
Long (B)									
mg/liter	25.0	11.0	1.0	60.0	-----	230.0	13.0	19.0	-----
meg/liter	1.248	0.905	0.026	2.610	4.789	3.770	0.271	0.536	4.577
% of total	26.1	18.9	0.5	54.5	-----	82.4	5.9	11.7	-----

TABLE 4 (Con't.) Ionic Composition of 25 Matanuska-Susitna Valley Lakes, 1973.

Lake	Cations					Anions			
	Ca	Mg	K	Ha	Total meg/liter	HCO_3	SO_4	Cl	Total meg/liter
Ravine									
mg/liter	27.0	8.9	1.5	32.0	--------	149.0	30.0	15.0	-----
meg/liter	1.348	0.733	0.039	1.392	3.512	2.443	0.625	0.424	3.492
% of total	38.4	20.9	1.1	39.6	-----	70.0	17.9	12.1	-----
Lucille									
mg/liter	19.0	3.0	0.7	2.3	-----	81.0	2.8	3.0	-----
meg/liter	0.949	0.247	0.018	0.101	1.315	1.328	0.059	0.085	1.472
% of total	72.1	18.8	1.4	7.7	-----	90.2	4.0	5.8	-----
Meirs									
mg/liter	12.0	2.6	8.1	2.4	-----	61.0	2.1	5.1	-----
meg/liter	0.599	0.214	0.208	0.105	1.126	1.000	0.044	0.144	1.188
% of total	53.2	19.0	18.5	9.3	-----	84.2	3.7	12.1	-----
Seymour									
mg/liter	15.0	2.2	1.0	1.6	-----	59.0	0.9	2.1	-----
meg/liter	0.749	0.181	0.026	0.070	1.026	0.968	0.019	0.060	1.047
% of total	73.0	17.7	2.5	6.8	-----	92.5	1.8	5.7	-----
Reed									
mg/liter	7.1	1.0	0.7	1.1	-----	30.0	1.3	2.6	-----
meg/liter	0.355	0.083	0.018	0.048	0.504	0.492	0.028	0.074	0.594
% of total	70.4	16.5	3.6	9.5	-----	82.8	4.7	12.5	-----
Memory									
mg/liter	5.1	1.3	0.6	1.1	-----	25.0	0.9	1.6	-----
meg/liter	0.255	0.107	0.016	0.048	0.426	0.410	0.019	0.046	0.475
% of total	59.9	25.1	3.7	11.3	-----	86.3	4.0	9.7	-----
Christiansen									
mg/liter	6.0	1.0	0.5	1.3	-----	24.0	5.0	1.2	-----
meg/liter	0.300	0.083	0.013	0.057	0.453	0.394	0.105	0.034	0.533
% of total	66.2	18.3	2.9	12.6	-----	73.9	19.7	6.4	-----
Lower Bonnie									
mg/liter	18.0	5.2	0.8	19.0	-----	118.0	7.5	2.6	-----
meg/liter	0.899	0.428	0.021	0.827	2.175	1.935	0.157	0.074	2.166
% of total	41.3	19.7	1.0	38.0	-----	89.3	7.3	3.4	-----
Average									
mg/liter	22.0	4.5	1.3	7.0	-----	95.6	3.5	5.5	-----
% of total	62.3	20.5	3.3	13.9	-----	83.9	7.0	9.1	-----

[1] Percentage based on reactive weight (meg/liter).

The three mountainous lakes differed from lower elevation waters by having an abundance of sodium. Percentage of cations ranged from 26.1% to 41.3% for Ca, 18.9% to 20.9% for Mg, 0.5% to 1.1% for K, and 38.0% to 54.5% for Na. Bicarbonate varied from 70.0% to 89.3% of the reactive weight of anions.

Ionic composition of the sampled waters are compared to worldwide averages in Table 5.

TABLE 5. Comparison of Ionic Composition of 25 Matanuska-Susitna Valley Lakes with World Averages.

Lake	Percentage[1]						
	Cations				Anions		
	Ca	Mg	K	Na	HCO_3	SO_4	Cl
Mat-Su Valley	62	21	3	14	84	7	9
Worldwide	64	17	3	16	74	16	10

[1] Based on reactive weights (meg/liter).

Cation components compared favorably with world averages but among the anions, bicarbonate was substantially higher and sulfate lower than values listed by Ruttner, (1953).

Ranking of the lakes in a high-to-low order with respect to conductance, total hardness, and total alkalinity revealed strong linear relationships between these determinations (Table 6). Significant correlations exist between specific conductance and total hardness (r=0.99), specific conductance, and total alkalinity (r=0.99), and total hardness and total alkalinity (r=0.99) of the 22 lower elevation waters. Regression analyses of these three measurements permits a reasonable estimation of the unknown determination when only one has been analyzed (Figure 2). Substantial deviation from the line of best fit suggest abnormal levels of one or more other ions. The unusually high sodium levels in the three mountainous lakes raised conductance above expected for recorded alkalinity and hardness, and hence is an example of such a deviation.

Seasonal chemical variations were monitored on a monthly basis in Matanuska, Meirs, Harriet, and Lucille lakes between November, 1972 and November, 1973. As expected, alkalinity and hardness varied considerably with the highest values occurring under ice in winter (Table 7). Comparison of surface and bottom waters revealed a trend toward lower pH and greater mineral accumulation with increasing depth.

Dissolved oxygen determinations also revealed considerable seasonal change, with wind stress and thermal stratification as major influencing factors (Table 8). Biochemical oxygen demand was relatively high in each lake, as

TABLE 6. Chemical Analysis of Selected Lakes of the Matanuska-Susitna Valleys, 1973[1].

Lake	Specific Conductance (micromhos/ cm at 25° C)	Hardness Total	Hardness Noncarbonate	Total Alkalinity
		------------ mg/liter as $CaCO_3$		-----------
Kepler	344	160	18	139
Echo	307	140	16	128
Matanuska	286	130	1	131
Canoe	277	130	20	112
Harriet	265	120	0	126
Long (A)	246	120	2	113
Victor	228	110	6	99
Irene	221	100	4	99
Finger	206	98	0	107
Knik	174	81	0	86
Johnson	148	64	0	71
Florence	134	69	0	69
Lucille	134	60	0	66
Meirs	122	41	0	50
Seymour	102	47	0	48
Reed	54	22	0	25
Memory	41	18	0	21
Christiansen	40	19	0	20
Rocky	40	17	0	20
South Rolly	31	13	0	19
Loon	13	5	0	5
Marion	9	3	0	4
Long (B)	434	110	0	189
Ravine	347	100	0	122
Lower Bonnie	205	66	0	97

[1] Analysis performed by U. S. Geological Survey.

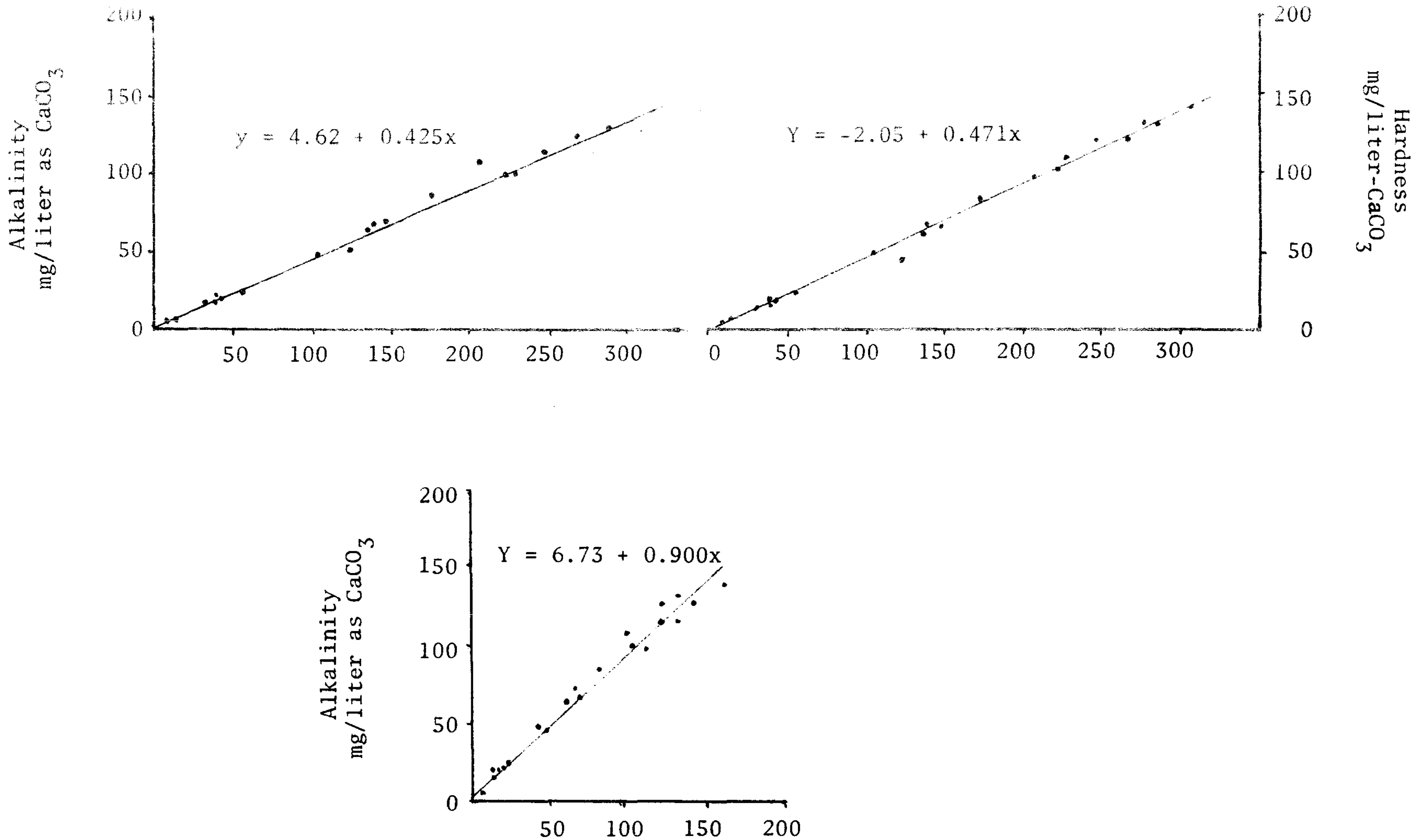

Figure 2. Regression of Total Alkalinity and Total Hardness on Conductance, and Total Alkalinity on Total Hardness for 22 Matanuska-Susitna Valley Lakes.

TABLE 7. Seasonal Chemical Characteristics[1] of the Surface Waters of Four Matanuska-Susitna Valley Lakes, 1973.

Lake	Total Alkalinity (mg/liter as $CaCO_3$)		Total Hardness (mg/liter as $CaCO_3$)		pH	
	Range	Mean	Range	Mean	Range	Mean[2]
Harriet	136-188	162	136-188	154	7.3-8.7	8.2
Matanuska	86-188	146	68-188	134	7.8-9.0	8.4
Lucille	86-171	130	68-171	119	7.0-9.1	8.2
Meirs	68-103	81	51- 86	63	6.8-8.6	7.7

[1] Determined monthly with Model A1-36-WR Hach Kit.

[2] Calculated by dividing sum of values by number of measurements.

TABLE 8. Seasonal Dissolved Oxygen Patterns for Four Matanuska Valley Lakes, 1972-73.

Matanuska Lake
ppm

Depth (m)	11/20	12/20	1/24	2/20	3/23	4/13	5/8	6/5	7/3	8/1	9/4	10/1	11/14	Depth (ft.)
1.5	8.3	7.2	6.6	6.4	8.5	8.6	10.6	11.4	11.6	11.7	11.7	10.5	6.9	5
3.1	8.1	7.5	6.7	6.2	6.7	8.0	10.6	12.7	12.5	11.5	11.8	10.0	6.9	10
6.1	8.3	7.0	6.4	6.0	4.7	7.8	10.1	11.8	20.9	18.7	12.1	10.4	6.6	20
9.1	7.8	6.5	6.2	5.0	4.4	7.6	9.3	10.0	4.7	11.3	20.7	10.3	6.4	30
12.2	7.5	6.0	5.6	4.0	3.9	4.3	8.7	6.3	2.3	0.6	0.7	0.9	5.7	40
15.2	7.8	5.6	4.7	2.4	3.6	2.0	8.3	5.1	2.6	0.4	0.1	0.4	1.2	50
18.3	7.2	5.3	4.3	1.7	2.4	1.0	6.5	4.1	0.6	0.2	0.0	0.2	0.0	60
21.3	7.0	2.9	1.8	0.7	0.6	0.3	2.5	1.6	0.4	0.3	0.0	0.0	0.0	70
22.9	3.7	1.1	0.5	0.6	0.3	0.1	0.6	1.2	0.1	0.0	0.0	0.0	0.0	75
Ice (cm)	16.5	31.8	68.6	82.5	86.4	68.6	---	---	---	---	---	---	25.0	
Snow (cm)	3.8	1.3	4.4	2.5	10.2	Trace	---	---	---	---	---	---	Trace	

Lucille Lake
ppm

Depth (m)	11/22	12/21	1/23	2/21	3/21	4/10	5/8	6/6	7/2	7/31	9/5	10/1	11/21	Depth (ft.)
1.5	13.6	5.1	0.5	0.5	1.4	8.8	18.0	12.2	10.0	6.2	9.7	10.3	11.2	5
3.1	9.8	1.7	0.4	0.2	0.3	5.4	17.8	12.1	10.2	7.9	9.7	9.9	7.9	10
4.6	3.0	0.4	0.4	0.1	0.2	1.4	17.8	11.9	10.2	8.1	9.6	10.3	6.5	15
Ice (cm)	26.7	50.8	76.2	91.4	89.0	83.8	----	----	----	---	---	----	33.0	
Snow (cm)	Trace	Trace	5.0	2.5	10.0	Trace	----	----	----	---	---	----	Trace	

TABLE 8. (Con't.) Seasonal Dissolved Oxygen Patterns for Four Matanuska Valley Lakes, 1972-73.

Harriet Lake
ppm

Depth (m)	11/22	12/21	1/24	2/20	3/22	4/11	5/10	6/5	7/2	7/31	9/4	10/2	11/19	Depth (ft.)
1.5	9.0	7.0	5.1	3.5	2.2	2.5	8.1	10.5	9.0	8.9	8.2	7.2	5.9	5
3.1	8.7	6.7	5.0	1.6	2.0	1.6	6.1	11.1	9.0	9.6	8.2	7.4	6.3	10
6.1	5.5	2.2	1.8	0.9	0.4	0.6	1.7	3.9	3.1	2.0	2.0	7.6	3.9	20
7.6	0.7	1.2	0.5	0.2	0.1	0.5	0.5	1.6	---	0.5	---	---	1.9	25
Ice (cm)	22.9	43.2	68.6	80.0	90.2	68.6	---	----	---	---	---	---	30.5	
Snow (cm)	Trace	5.0	5.0	2.5	6.9	Trace	---	----	---	---	---	---	2.5	

Meirs Lake
ppm

Depth (m)	11/22	12/21	1/23	2/21	3/21	4/13	5/8	6/6	7/3	7/31	9/5	10/1	11/19	Depth (ft.)
1.5	5.8	4.3	3.3	2.7	1.9	5.2	11.0	11.2	9.9	9.6	9.9	8.9	6.9	5
3.1	5.7	4.0	3.0	2.2	1.7	2.4	10.0	11.5	10.0	9.6	10.0	8.8	6.7	10
6.1	5.6	3.7	2.9	2.0	1.6	1.4	10.0	7.5	7.8	6.0	6.9	8.9	6.5	20
9.1	5.6	4.1	2.5	1.6	1.6	1.3	5.6	3.9	3.0	2.9	1.1	2.3	6.6	30
12.2	5.5	3.9	1.6	0.9	1.5	1.2	2.5	1.1	0.3	0.8	0.5	1.5	6.5	40
15.2	4.9	2.4	0.7	0.5	0.7	0.6	0.5	0.5	0.3	0.6	0.5	0.4	1.0	50
18.3	1.3	0.6	0.6	0.4	0.6	0.2	0.2	0.3	0.0	0.0	0.0	0.1	0.2	60
19.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65
Ice (cm)	19.0	51.0	71.1	80.0	90.2	72.4	---	---	---	---	---	---	30.5	
Snow (cm)	Trace	2.5	3.8	2.1	15.2	Trace	---	---	---	---	---	---	1.5	

was evidenced by the rapid depletion of O_2 in deeper waters during periods of restricted circulation.

Dissolved oxygen began to decline shortly after formation of winter ice, and continued to drop until late February through early March. Beginning in late March and continuing in April, the O_2 concentration of the surface waters of Matanuska and Lucille lakes rose above mid-winter levels. Dissolved oxygen increased similarly in Meirs Lake in April but the O_2 in Harriet Lake continued to decline throughout most of the period of ice cover.

The unexpected rise in O_2 during late winter is believed to have resulted from algal blooms. During this period, the increased day length and higher solar angle apparently allows significant under-ice photosynthesis in those lakes where wind prevents heavy snow accumulation.

Lucille Lake clearly illustrates this situation during most years. Dissolved oxygen in April during eight different years ranged at the 5 foot level, from [illegible].9 to 19.8 ppm, with a mean of 9.6 ppm. The lower concentrations occurred early in April and were associated with greater than normal snow cover. Oxygen in March during four separate years ranged from 1.3 to 1.5 ppm and in February from 0.5 to 1.0 ppm.

Twenty-one O_2 samples were collected from Lucille Lake on January 3, 1973 to evaluate whether the lake's single sample station provided representative data. Dissolved oxygen at the station's 5-foot level was 0.5 ppm. Comparative samples were collected at about 400 foot intervals along a line traversing the length of the lake. Measurements, all taken within four feet of the surface ranged from 0.3 to 1.5 ppm and averaged 0.6 ppm. Eighteen of the determinations ranged between 0.4 and 0.8 ppm.

Lake Stocking Evaluations

Hatchery reared salmonids are being used in increasing numbers to augment recreational lake fisheries of the Matanuska-Susitna Valleys. Early winter gill net sampling has been the principle method of evaluating these introductions. This phase of the inventory project is a continuing attempt to determine proper initial and supplementary stocking rates, including sizes and fish species. In addition, the net sampling also permits acquisition of game fish growth data that can be compared to physical and chemical properties for possible relationships.

In 1973, 17 stocked lakes were sampled under ice with variable mesh gill nets. As in the past, the netting was directed toward determining growth of fish stocked the same year (age 0+) and the previous year (age 1+). Catches of older age groups are generally too small to allow comparative analysis. The netting also permits a gross evaluation of relative abundance.

All lakes receiving rainbow trout, Salmo gairdneri, in 1972 were planted with a spring spawning stock from Winthrop, Washington. In addition, Matanuska Lake also received a winter spawning strain originating from Ennis, Montana. Substantial numbers of both Ennis and Winthrop trout were utilized in the

1973 planting program. Ennis trout were planted in late June, 1973, as fingerling weighing 108/lb., whereas Winthrop fish were stocked at a slightly smaller size a month later.

Gill net catch data and stocking histories are presented in Table 9. Sampling, approximately 14.5 months after introduction, indicated that 1972 Winthrop plants obtained mean lengths ranging from 215 mm in Ravine Lake to 306 mm in Canoe Lake. The 1972 Ennis plant in Matanuska Lake achieved a mean length of 397 mm after 15.5 months. The average lengths of 1973 Ennis plants, after 5.5 months of lake residency, ranged from 159 to 223 mm. Minimum and maximum growth for this plant was again recorded at Ravine and Canoe lakes, respectively. The 1973 Winthrop plants in Rocky and Irene lakes obtained mean lengths of 133 mm and 150 mm, respectively, after 4.5 months.

Relative survival, as defined by net sampling, appeared acceptable for both the 1972 fall and 1973 spring plants in all lakes having substantial quantities of dissolved substances. Waters with conductance values less than 170 micromhos/cm generally yielded much poorer gill net catches. Growth was also inferior in lakes deficient in dissolved substances. Slow growth in Ravine Lake can be attributed to the lake's mountainous location and short growing season.

Coho salmon, Oncorhynchus kisutch, growth and relative survival rates were evaluated in Echo, Victor, and Lucille lakes, all rehabilitated, and in Prator Lake, which contains threespine sticklebacks, Gasterosteus aculeatus. Mean lengths of age 0+ coho in the three single species' lakes ranged 124-161 mm, whereas age 0+ fish in Prator Lake achieved an average length of 113 mm. The growth of older age groups is not directly comparable because of differing stocking dates.

The Lucille Lake coho plant warrants further explanation because of unusual growth features. Lucille Lake was treated with rotenone in the fall of 1972 to eliminate threespine sticklebacks. The lake was subsequently stocked on July 2, 1973, with 525/lb. fish which achieved a mean length of 161 mm in 4.5 months. In contrast, coho plants on August 9, 1973, (163/lb.) in Victor and Echo lakes obtained mean lengths of 124 mm and 130 mm, respectively.

It is noteworthy that the Lucille Lake catch consisted of two distinct size groups that were not representative of the average length of the composite sample (Figure 3). This size variation is not clearly understood but may have resulted from gill net mesh selectivity and/or sharply different growth rates among individuals of the population. The length range of Lucille Lake coho was twice that of fish from Victor and Echo lakes.

Overwinter survival of the 1972 coho plant in Victor Lake suggested considerable tolerance to low O_2. Oxygen measurements on April 3, 1973, at 5' and 10' levels were 0.9 and 0.7 ppm, respectively.

Harriet, Meirs, Long and Weiner lakes were stocked with Arctic grayling, Thymallus arcticus, fry on July 3, 1972. Net sampling in December, 1973, failed to catch any of these fish in Meirs and Weiner lakes; however, Long and Harriet lakes contained age I+ grayling that averaged 220 mm and 256 mm

TABLE 9. Gill Net Results and Stocking Histories of Managed Lakes, Matanuska-Susitna Valleys, 1973.

Lake	Date Sampled	Species[1]	Number	Age Class	Length (mm) Range	Mean	Catch/ Net Hr.	Date Stocked	Total Number[2]	Per Lb.	Per Acre
Canoe	12/27/73	RT	53	0+	132-250	223	1.06	6/28/73	6,300 E	108	300
		RT	43	I+	255-357	306	0.86	9/ 8/72	8,400 W	172	400
Irene	12/27/73	RT	41	0+	94-195	150	0.82	7/26/73	8,400 W	121	400
		RT	52	I+	216-300	250	1.04	9/ 8/72	8,400 W	172	400
		RT	8	II+	385-435	403	0.16	5/28/71	8,400 E	127	400
Knik	12/14/73	RT	96	0+	141-242	200	2.40	6/30/73	20,000 E	108	400
		RT	58	I+	255-327	293	1.45	9/ 6/72	20,000 W	172	400
Matanuska	12/19/73	RT	26	0+	158-252	207	0.63	6/29/73	24,800 E	108	400
		RT	18	I+	276-343	298	0.44	9/ 5/72	21,200 W	172	340
		RT	12	I+	365-448	397	0.29	8/ 9/72	3,800 E	34	60
Ravine	12/ 6/73	RT	2	0+	155-163	159	0.05	6/29/73	2,600 E	108	215
		RT	54	I+	186-245	215	1.29	8/ 9/72	3,800 W	172	315
		RT	10	III+	332-416	375	0.24	8/ 6/70	5,000 W	349	415
Reed	12/18/73	RT	0	I+	--- ---	---	---	9/ 6/72	5,600 W	172	280
		RT	5	II+	38-362	338	0.11	5/25/71	4,500 E	126	225
Rocky	12/13/73	RT	36	0+	106-162	133	0.78	7/26/73	17,700 W	121	300
		RT	2	I+	229-255	242	0.04	9/ 6/72	23,200 W	172	395
		RT	6	II+	352-380	370	0.13	8/16/71	14,000 W	265	240
Florence	12/11/73	RT	5	I+	222-310	273	0.12	9/ 6/72	10,800 W	172	195
		RT	5	IV+	444-511	468	0.12	8/ 6/69	21,000 W	258	380
Lower Bonnie	12/ 5/73	RT	21	Mixed	93-380	201	0.49	Wild and stocked		---	---
		GR	1	II+	242	---	0.03	Wild	-----	---	---
Victor	12/21/73	SS	130	0+	100-168	124	2.83	8/ 9/73	5,400 K	163	400
		SS	20	I+	296-332	318	0.43	6/ 8/73	5,400 S	155	400
Echo	12/ 7/73	SS	16	0+	101-152	130	0.67	8/ 9/73	9,200 K	163	400
		SS	3	I+	239-292	268	0.13	6/ 8/72	7,400 S	155	320
								8/ 3/72	1,700 S	177	75
		DV	1	--	203	---	---	Unknown	-----	---	---
Lucille	12/18/73	SS	87	0+	103-245	162	3.95	7/ 2/73	55,500 G	525	150
Prator	12/12/73	SS	40	0+	102-129	113	0.93	8/10/73	15,000 K	163	150
		SS	24	II+	204-385	319	0.56	10/ 5/71	15,100 K	140	150

TABLE 9. (Con't.) Gill Net Results and Stocking Histories of Managed Lakes, Matanuska-Susitna Valleys, 1973.

Lake	Date Sampled	Species[1]	Number	Age Class	Length (mm) Range	Length (mm) Mean	Catch/ Net Hr.	Date Stocked	Total Number[2]	Per Lb.	Per Acre
Harriet	12/27/73	GR	0	0+	--- ---	---	---	6/15/73	5,400 T	Fry	600
		GR	36	I+	225-280	256	1.67	7/ 3/72	5,000 T	Fry	555
Meirs	12/21/73	GR	10	0+	152-194	169	0.22	6/15/73	10,200 T	Fry	600
		GR	0	I+	--- ---	---	----	7/ 3/72	5,000 T	Fry	295
Long (B)	12/ 4/73	GR	1	0+	116	---	0.02	Wild	------	---	---
		GR	19	I+[3]	200-239	220	0.40	7/ 3/72	40,000 T	Fry	390
		GR	5	IV+[3]	346-384	367	0.11	6/10/69	40,000 T	Fry	390
		LNS	1	---	447	---	0.02	Unknown	------	---	---
		BB	3	---	407-502	466	0.06	Wild	------	---	---
Weiner	12/ 4/73	RT	0	II+	--- ---	---	---	6/10/71	5,400 W	162	200
		GR	0	I+	--- ---	---	---	7/ 3/72	25,000 T	Fry	925
		DV	1	---	441	---	0.02	Unknown	------	---	---

1 Key: RT-rainbow trout; SS-coho (silver) salmon; GR-Arctic grayling; DV-Dolly Varden, *Salvelinus malma*; LNS-Longnose sucker, *Catostomus catostomus*; BB-Burbot, *Lota lota*.

2 Key: W-Winthrop strain; E-Ennis strain; K-Kodiak strain; S-Ship Creek strain; G-Green River strain; T-Tolsona strain.

3 Key: May include some natural reproduction.

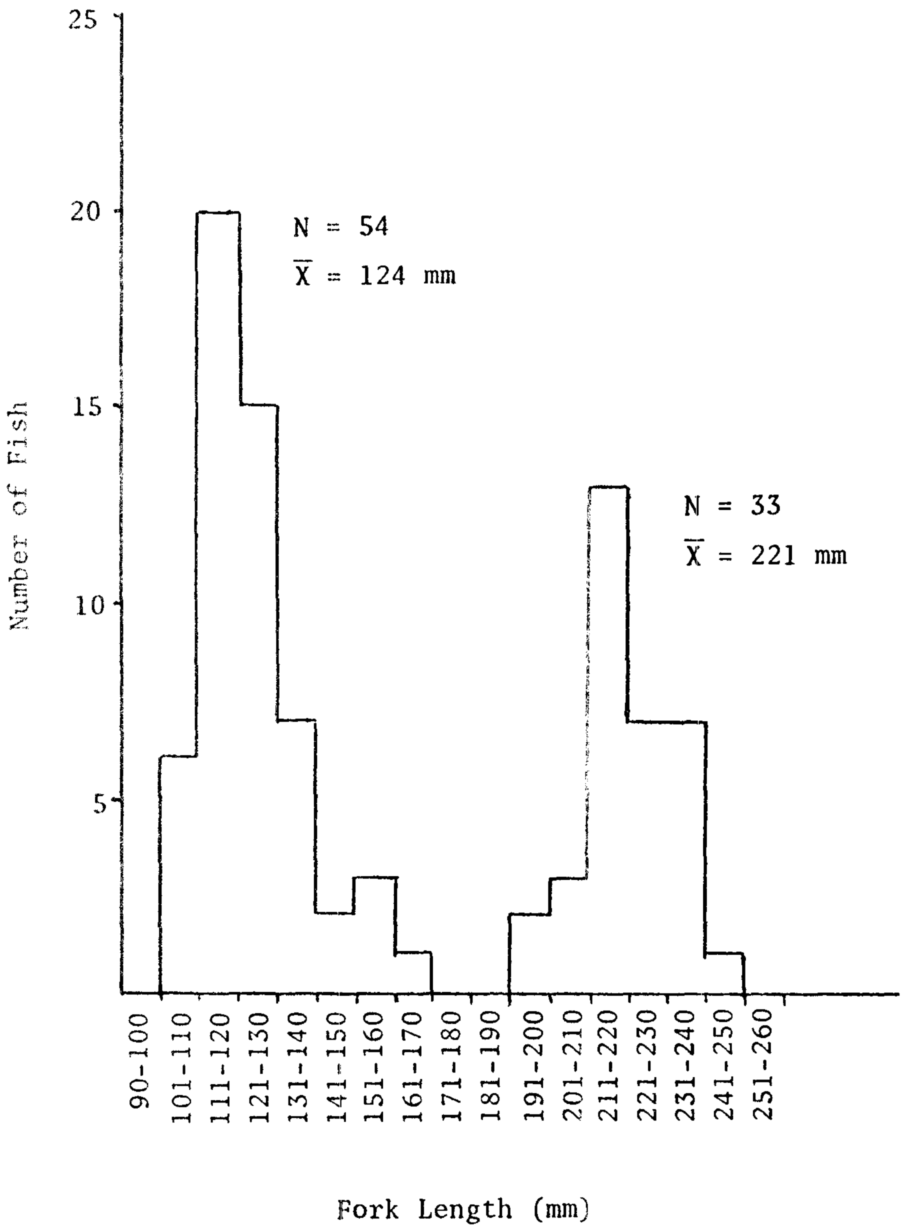

Figure 3. Length Frequency of Lucille Lake Coho, 1973.

in length, respectively The netting also revealed the presence of a June, 1973, plant in Meirs Lake, but no fish from a similar plant were captured in Harriet Lake.

Multiple Use and Access Activities

Lakes and streams of the Matanuska-Susitna Valleys are considered the most important natural features of the area. Development of lands surrounding water resources is proceeding at a pace unequaled elsewhere in Alaska. With this expanded multiple use has come a variety of conflicts that affect recreational fisheries as well as related resources.

Water problems of the area that have the most profound effect on fisheries management can be segregated into two general catagories. First, those human activities that are potentially damaging to fish habitat; and second, land disposal practices which deny public access to natural waters.

Data collected during successive stages of this catalog and inventory investigation have served as the basis for numerous decisions regarding multiple use activities. During this job segment 46 water projects were reviewed in an attempt to eliminate or minimize damage to fishery resources. Included in these activities were bridge and dam construction projects, culvert placement, oil drilling and seismic operations, herbicide use, water appropriations, logging, placer mining, streambank and lakeshore alterations, and buried cable operations. In each case, recommendations and/or permits were submitted to appropriate individuals or agencies. Periodic surveillance, to insure protection of aquatic resources, was an integral part of several projects.

Land disposal activities that feature subdivision of streambank and lakeshore tracts remain as one of the most serious threats to continued expansion of the areas sport fisheries. The ownership of lands adjoining selected waters of the area was reviewed for the purpose of selecting or withdrawing lands for public fishing sites. Recommendations, regarding these sites or easements, were made to appropriate land managing agencies or private individuals. Significant access projects during this job segment included: (1) a proposal to the Matanuska-Susitna Borough to retain an "environmental corridor: adjacent to Jim Creek and provide for public access to the corridor; (2) a proposal to the State of Alaska, Division of Lands and to the Matanuska-Susitna Borough to acquire, for public use, a 114 acre tract within the Kepler-Bradley Lake Complex. A recreational development plan accompanied this proposal.

Fish populations of six lakes were sampled with gill nets during the course of various multiple use and/or access investigations. The intensity of these surveys was determined by current management needs, and the availability of previous background data. Results of the net sampling are presented in Table 10.

TABLE 10 Gill Net Catch Data for Various Lakes of the Matanuska-Susitna Valleys, 1973.

Lake	Location	Species[1]	No. Fish	Length (mm) Range	Length (mm) Mean	Catch/net hr.
Beaver	T17N, R3W, S4	RT	9	167-245	212	0.20
		SS	9	100-173	143	0.20
		LNS	73	330-463	390	1.35
Drill	T20N, R5E, S26	RT	4	285-326	314	0.09
		Sc	7	78- 92	84	0.16
Eklutna	T15N, R2E, S8	DV	81	115-409	185	0.67
		RS	29	82-118	92	0.27
		RWF	1	112	---	0.01
Swan	T17N, R3E, S27	RWF	22	252-395	344	0.54
		SS	2	114-118	116	0.05
Jim	T17N, R3E, S21	RWF	147	122-390	246	1.73
		SS	110	73-257	116	1.30
		DV	1	265	---	0.01
Little Butte	T17N, R3E, S17	SS	13	101-269	166	2.60

[1] RT-Rainbow Trout; SS-Coho salmon; LNS-Longnose Sucker; DV-Dolly Varden; RS-Sockeye (red) salmon, *O. nerka*; RWF-Round Whitefish, *Prosopium cylindraceum*; Sc-Sculpin, *Cottus sp.*

DISCUSSION

Preceding sections have presented physical and chemical data that are generally accepted as indications of biological richness. For the present it is sufficient to state that these properties vary enough among the lakes to permit meaningful comparisons with biological parameters. The preliminary phase of the inventory has revealed differences in water chemistry that are probably unparalleled in other areas of Alaska.

Gross evaluation of game fish growth in the inventoried waters suggests a relationship to quantities of dissolved substances. This correlation as well as other relationships will receive detailed study as additional data are accumulated in future segments of the investigation.

Substantial limnological information was collected during the inventory that does not appear in this report. These data, which include results of plankton sampling and a variety of physical and chemical measurements, will be reported at a later date. Much of the miscellaneous information will be important to understanding of year-to-year variations within the lakes.

LITERATURE CITED

Brown, Eugene, M. W. Skougstad, and M. J. Fishman. 1970. Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases. U. S. Geol. Sur., U. S. Dept. of Interior, Book 5, Chapter A1, 160 pp.

Kalb, Carl. 1974. Population Studies of Game Fish and Evaluation of Managed Lakes in the Upper Cook Inlet Drainage. Federal Aid in Fish Restoration, Annual Report of Progress, 1973-1974, Project F-9-6, Volume 15, (in press).

Karlstrom, Thor N. V. 1953. Upper Cook Inlet Region, Alaska, U. S. Geol. Sur., Cir. 289, pp. 3-5.

Ruttner, Franz B. 1953. Fundamentals of Limnology. Univ. Toronto Press, 242 pp.

Trainer, Frank W. 1961. Eolian Deposits of the Matanuska Valley Agricultural Area, Alaska. U. S. Geol. Sur. Bul. No. 1121-C, 35 pp.

U. S. Weather Bureau. 1974. Climatological Data: Alaska (Annual Summary) U. S. Dept. of Commerce, ESSA, Asheville, N. C.

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