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STATE OF ALASKA

Bill Sheffield, Governor

Annual Performance Report for

POPULATION STUDIES OF GAME FISH AND EVALUATION OF MANAGED LAKES IN THE UPPER COOK INLET DRAINAGE

by

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TABLE OF CONTENTS

Study: G-III LAKE AND STREAM INVESTIGATIONS Page

Job: G-III-D Population Studies of Game Fish and Evaluation of Managed Lakes in the Upper Cook Inlet Drainage
by: Alan C. Havens

LIST OF TABLES AND FIGURES

RESEARCH PROJECT SEGMENT

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Cooperator: Alan C. Havens

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ABSTRACT

This research project was initiated in 1973 to provide information for the development of improved stocking practices through identification and analysis of various limnological parameters and their effects on stocked fish populations.

Dissolved oxygen measurements were collected in February or March 1984 in 16 Matanuska-Susitna Valley lakes. Johnson Lake and Irene Lake had dissolved oxygen levels of 0.8 and 1.0 parts per million, respectively, just below the ice. Subsequent trap and net sampling in both lakes in May and August 1984 indicated a complete winterkill of fish stocked in 1983 and prior years.

Survival estimates at Age I for Swanson strain rainbow trout, *Salmo gairdneri* Richardson, stocked as 250 per pound fingerling in seven Matanuska-Susitna Valley lakes, ranged from 16 percent to 61 percent and averaged 44 percent. Rainbow survivals in Junction, Knik and Matanuska Lakes were similar to survivals found prior to lake rehabilitation in October 1982. However, average trout length at Age I+, 12 months after stocking, exceeded the maximum found for previous fingerling plants by over 1 inch, snout to fork, in Junction and Knik Lakes and by 2 inches in Matanuska Lake.

A comparison of net catch rates for Age 0+ chinook salmon, *Oncorhynchus tshawytscha* (Walbaum), and for Age 0+ coho salmon, *Oncorhynchus kisutch* (Walbaum), planted in several Matanuska-Susitna Valley lakes indicated the chinook survival was substantially less than that of the coho. The chinook salmon that survived, however, grew more rapidly than the coho

and, at least in one lake, were captured in the sport fishery about 6 months after stocking. A population estimate completed in Prator Lake revealed a 3.3 percent survival of Age 0+ chinook stocked at 227 per pound fingerling 5 months earlier.

A population estimate on Arctic grayling, *Thymallus arcticus* (Pallas), stocked as sac fry in rehabilitated Johnson Lake indicated a survival of 1.9 percent from time of introduction in May 1984 through August 1984.

Threespine stickleback, *Gasterosteus aculeatus* (Linnaeus), population estimates in Tigger Lake and Walby Lake, which are stocked annually with rainbow trout fingerling, revealed stickleback densities of 1,367 fish per acre and 13,914 fish per acre, respectively.

KEY WORDS

Southcentral Alaska, stocking practices, rainbow trout, landlocked salmon, Arctic grayling, threespine stickleback, population estimates, fish growth.

BACKGROUND

Alaska's lake stocking program makes an important contribution to recreational fisheries within the State, but does not always produce desired results. A high cost to the creel often occurs due to poor game fish survival which, in turn, reduces recreational fishing opportunity.

A study designed to provide information for development of improved lake stocking practices was initiated in 1973. This study has focused on selected Matanuska-Susitna Valley lakes and is based on identification and analysis of various limnological parameters and their effects on fish populations. Long range project goals are: (1) to develop a lake stocking manual with guidelines for determining optimum sizes, densities, times, species and strains of fish for various lake types to achieve maximum survival, growth and harvest potential; and (2) to develop methodologies which efficiently sample stocked fish populations with minimum detriment to harvestable stocks.

The early phase of this project concentrated on detailed collection of physical and chemical data and identification and relative quantification of various planktonic and invertebrate populations in both untreated and treated lakes prior to, during and after chemical rehabilitation with rotenone. Findings from the initial investigative phase indicate: (1) a morphoedaphic index (MEI, or specific conductance divided by mean depth) can give a gross measure of relative potential productivity and, in most cases, it is easier to determine than statistically comparable plankton, periphyton, chlorophyll *a* indicies or definitive water chemistry (Chlupach, 1977); (2) lakes chemically treated with rotenone may require between 1 and 2 years to reestablish zooplankton production and 3 years to attain invertebrate production

levels of previous dominance and abundance (Chlupach, 1977); and (3) a chemical test for the determination of rotenone in water (Post, 1955) can give a reasonable accurate measurement of residual rotenone concentrations at or below 0.2 ppm (Kalb, 1974).

The second phase of this project has concentrated on determining stocked game fish survival and growth in lakes of known limnological characteristics, some of which contain competitor or predator species, or both. Findings from this research segment show: (1) growth of rainbow trout may be restricted in waters infested with stickleback, (Kalb, 1975; Havens, 1984); (2) rainbow trout survival appears to be greater in waters where stickleback have been eradicated than in waters where these competitors are present, although in a stickleback environment fish survival increases when relatively larger fish are stocked at lower densities (Chlupach, 1978; Havens, 1984); (3) coho salmon in landlocked lakes exhibit significantly greater survival than do domestic rainbow trout strains (Chlupach, 1978); (4) the most critical period affecting the survival of rainbow trout fingerlings stocked in lakes may be within a month following introduction and possibly within the first several hours or days following release (Havens, 1981).

While collecting survival and growth information in stocked lakes, various capture techniques and sampling gear have been utilized for experimentation purposes. Data from this research indicate: (1) minnow traps painted a camouflaged green and brown appear to catch more rainbow trout fingerling per trap hour than do unpainted silver (galvanized wire) traps when fished in stocked lakes during ice-free seasons (Havens, 1979); (2) fyke nets fished in late summer and fall, when water temperatures are at or below 10°C (50°F), are capable of catching sufficient numbers of Age I+ rainbow trout for marking purposes when performing population estimates (Havens, 1980); (3) fyke nets with 3/16-inch square mesh capture fish in size ranges comparable to those caught by 1/4-inch mesh minnow traps. [The catch per unit of effort with the fyke nets can greatly exceed that of minnow traps and, when fished in conjunction with minnow traps, are an effective means for capturing rainbow trout fingerling for both the mark and recapture portions of a population estimate (Havens, 1981)]; and (4) monofilament gill nets which include a 5/8-inch square mesh panel in addition to 1/2, 3/4, 1, 1-1/2 and 2-inch mesh panels may help to reduce error in recording growth and abundance for populations of rainbow trout with a mean length of less than 180 mm, as is often found in lakes with low relative productivity or that contain stickleback (Havens, 1981).

Another facet of the investigation was the selection of a native strain of rainbow trout from the Swanson River on the Kenai Peninsula as brood stock for Alaska's lake stocking program. Subsequent to the selection of Swanson strain rainbow trout as brood stock for Alaska's lake stocking program, as part of the long range goals of this lake study project, baseline data in the growth and survival of the Swanson strain in all types of stocked lakes are being collected. A larger, modern rainbow trout hatchery constructed in the Anchorage area has the capability to hold and rear several brood stock strains. Candidate brood strains can be examined for hatchery suitability, then compared with the field performance of the Swanson strain in the search for

rainbow trout that can provide the best possible survival, growth and harvest potential in all lake types when stocked as fry or fingerling.

Table 1 lists all species mentioned in this report. Figure 1 is a map showing the study area.

RECOMMENDATIONS

1. Growth and relative survival of Swanson strain rainbow trout should be determined in Junction, Knik, Matanuska, Ravine, Reed, Tigger and Walby Lakes.

2. Survival estimates should be performed on Arctic grayling stocked as fry and fingerling in Canoe and Meirs Lake.

3. Information should be collected regarding the growth and relative survival of coho salmon and chinook salmon in landlocked lakes when both species are available for stocking.

OBJECTIVES

1. Determine 1983 stocked rainbow trout survival (population estimates) in Johnson, Junction, Knik and Matanuska Lakes in May and June and September and October.

2. Determine rainbow trout growth and relative survival in Crystal, Finger, Kalmback, Ravine, South Rolly, Tigger and Walby Lakes in August and September.

3. Determine stocked salmon growth and relative survival in Echo, Finger, Lucille, Memory, Rocky and Victor Lakes in October, November and December.

4. Investigate threespine stickleback population dynamics in Tigger and Walby Lakes from May through October.

5. Collect water samples for dissolved oxygen measurement and other parameters in Canoe, Johnson, Junction, Lucille, Meirs, Memory, Seymour and Victor Lakes in February and March.

TECHNIQUES USED

Using Chapman's modification of the Peterson estimator (Ricker, 1975), rainbow trout survival estimates were determined in Junction, Matanuska, Knik, Ravine, Reed, Tigger and Walby Lakes. A Chinook salmon estimate in Prator Lake, an Arctic grayling estimate in Johnson Lake and threespine stickleback population levels in Tigger and Walby Lakes were determined.

Table 1. List of common names, scientific names and abbreviations.

Common Name	Scientific Name and Author	Abbreviation
Arctic grayling	*Thymallus arcticus* (Pallas)	GR
Chinook salmon	*Oncorhynchus tshawytscha* (Walbaum)	KS
Coho salmon	*Oncorhynchus kisutch* (Walbaum)	SS
Rainbow trout	*Salmo gairdneri* Richardson	RT
Threespine stickleback	*Gasterosteus aculeatus* Linnaeus	TS

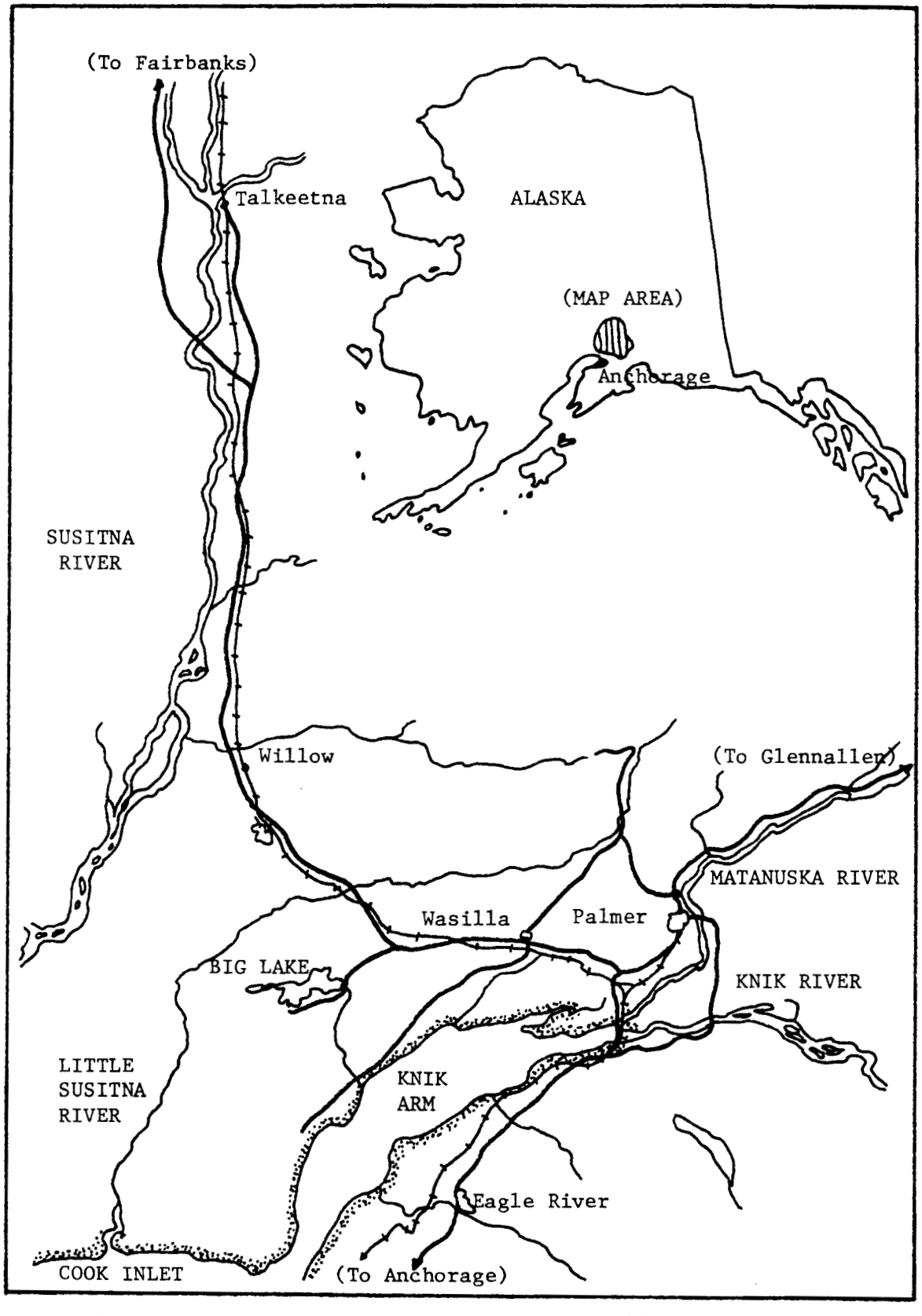

Figure 1. Study Area of the Matanuska-Susitna Valley.

Fish were captured for marking purposes with fyke nets, minnow traps, or both. Fyke nets, baited with salmon eggs, used to capture stickleback and stocked rainbow trout, Arctic grayling and landlocked salmon were 9 feet in length, 30 inches in diameter and included two 3-foot by 20-foot wings, (two square aluminum frames and six steel or aluminum hoops supported the entrance and the body of the fyke net). Internal throats, body and wings were of 3/16-inch square mesh knotless nylon. Fyke nets were set parallel to the shoreline. Minnow traps used to capture threespine stickleback were semi-collapsible and 17 1/2 inches in length with 1/8-inch square wire mesh painted green and brown and baited with salmon eggs. Minnow traps were set in 1 to 5 foot depths around the perimeter of each lake, and in deeper water in vertical arrays with traps attached at 10-foot intervals from surface to bottom on buoyed anchored lines. All capture gear was fished approximately 24 hours.

All trout, grayling and salmon captured for the purpose of estimating populations were held in a tub, oxygenated with a portable 20-pound regulated oxygen bottle and anesthetized with equal parts of MS-222 and Quinate at about 0.25 grams of anesthetic per gallon of water. Fish were then enumerated and marked by removal of the adipose fin or with a cold brand design on the right side between the lateral line and the dorsal fin. The marking tools consisted of a raised symbol of a rectangle on a 1/4-inch silver tip soldered on a 3/8-inch brass rod inserted into a wooden dowel handle. The rods were cooled to -80°C by immersion in a slurry of dry ice and 100% ethanol kept in a styrofoam container. The marking rod was removed from the slurry and applied firmly and evenly on the side of the fish for approximately 2 seconds (Everest and Edmundson, 1967). The fish was then returned to the water.

Rainbow trout, Arctic grayling and landlocked salmon were later captured using fyke nets, gill nets, or both. Gill nets were 120-foot x 6-foot variable mesh monofilament composed of six square mesh sizes (1/2-inch, 5/8-inch, 3/4-inch, 1-inch, 1-1/2-inch and 2-inch), each in a 20-foot panel.

Stickleback captured for the purpose of estimating populations were held in 4 x 4 x 8-foot holding pens constructed of 1/8-inch mesh netting framed in 1-inch PVC schedule 80 pipe with Hollander connectors at the corners. Fish were dip-netted from the holding pen, allowed to drain briefly, placed in a 3-gallon bucket containing a known weight of water, weighed on a Satter Suspended Scale, then poured into a 2-foot x 3-foot x 3-inch wire mesh marking cradle. The stickleback, an average of 785 grams per load, were marked with red, green or yellow granular fluorescent pigment sprayed at 100 psi for approximately 3 seconds. Pigment was applied using a low pressure spray gun attached by 25 feet of hose to a two stage SCUBA pressure regulator on a 70 cu ft tank. Sprayed fish were then held approximately 24 hours in a net pen before determining percent of mark retention, average weight and total number of fish marked. Mortalities sank to the bottom of the holding pen and were easily recovered. Live fish were then transferred to 5-gallon buckets and released at several sites around the lake. Stickleback were later captured using minnow traps and fyke nets and taken to the lab for mark detection under blacklight.

Rainbow trout, grayling and salmon measurements were expressed in fork length to the nearest millimeter and in weight to the nearest gram.

Dissolved oxygen was determined by titration with phenylarsine oxide or sodium thiosulfate and powder pillows developed by Hach Chemical Company.

FINDINGS

Winter Dissolved Oxygen Sampling

Dissolved oxygen measurements were collected between February 23 and March 5, 1984 in 16 Matanuska-Susitna Valley stocked lakes and in Dawn and Wolf Lakes, which were scheduled for initial stocking in 1984 (Table 2).

Dissolved oxygen concentration at 3 feet below the lake ice surface, ranged from 0.8 ppm in Johnson Lake to 13.8 ppm in Bear Paw Lake. Johnson Lake at 0.8 ppm and Irene Lake at 1.0 ppm had oxygen levels of only 0.4 ppm at about the 10-foot depth; subsequent sampling with minnow traps and nets in May and August 1984 indicated a complete winterkill of fish that had been stocked in 1983 or in prior years. Although the Lucille Lake dissolved oxygen level was only 1.5 ppm at the 3-foot depth over the deepest portion of the lake, measurements taken over a spring area revealed an oxygen level of 2.4 ppm and subsequent sampling in September 1983 captured previously stocked fish.

Swanson Strain Rainbow Trout Growth and Survival

Havens (1984) presented data relating the survival and growth of Swanson strain rainbow trout to various fingerling stocking sizes and times, both in stickleback-infested lakes and rehabilitated waters. Overall survival for fingerling stocked at 250/lb was 43%, one and one-half times greater than for trout stocked at 500/lb, and almost three times that for rainbow fry stocked at 1000/lb. Trout stocked in August at 500/lb were almost 1 inch longer by the following June than fish stocked in September at 250/lb. The higher trout survivals at 250/lb coupled with data collected on threespine stickleback populations showing lowest stickleback densities in July suggested that if Swanson strain rainbow trout were planted in July at about 250/lb, they would experience better survival than now occurs with August and September plants and a majority of the fish would be available for harvest by the sport fishery the following spring or summer at Age I.

Requests to State hatcheries for earlier trout plants resulted in Matanuska-Susitna Valley lakes being stocked with Swanson fingerling ranging in size from 240/lb to 169/lb between August 2 and August 31, 1984, and speculation that the majority of rainbow trout fingerling can be stocked at about 250/lb in July 1985.

To continue collection of baseline data on Swanson strain rainbow trout for comparison of survival and growth with fingerling stocked earlier in the season, and for future comparison with other Alaska rainbow trout strains, population sampling was conducted in 13 Matanuska-Susitna Valley Lakes.

Table 2. Winter dissolved oxygen levels for selected Matanuska-Susitna Valley lakes, 1984.

Lake	Maximum Depth (ft)	Mean Depth (ft)	Sample Date	Snow Depth (in)	Ice Depth (in)	Dissolved Oxygen (ppm) @ 3 ft	Dissolved Oxygen (ppm) @ 10 ft	Dissolved Oxygen (ppm) Bottom or @ 20 ft
Matanuska	82	34.4	2/27/84	9	22	7.5	6.9	4.9
Kepler	74	29.7	3/02/84	8	20	4.4	3.7	1.7
Meirs	73	36.1	2/27/84	11	24	4.9	4.2	3.5
Victor	55	24.4	2/24/84	10	20	7.0	5.8	2.8
Junction	48	17.8	2/24/84	6	20	5.8	4.9	0.5
Johnson	46	20.0	2/23/84	9	16	0.8	0.4	0.5
Irene	42	21.3	3/02/84	9	23	1.0	0.4	0.5
Echo	40	19.3	3/02/84	9	25	6.8	6.3	1.0
Knik	37	15.7	3/01/84	4	24	8.5	8.3	1.0
Canoe	34	15.3	3/02 84	9	23	3.9	2.9	0.5
Lucille*	20	5.7	2/24/84	3	26	1.5	0.5	0.1
Memory	20	7.2	3/05/84	0	30	10.4	8.6	0.1
Reed	20	10.4	2/28/84	1	29	6.0	3.1	0.1
Seymour	19	7.0	2/29/84	8	24	5.4	3.4	0.6
Walby	18	5.4	2/23/84	0	28	4.0	4.6	4.2
Bear Paw	17	9.9	2/29/84	8	20	13.8	5.9	**
Dawn	17	8.1	3/01/84	9	24	9.3	2.2	0.9
Wolf	17	6.8	2/28/84	0	32	9.8	1.1	0.3

* Lucille Lake dissolved oxygen was 2.4 ppm at a 4-foot depth over a spring area where depths are 5-6 feet.

** No sample taken.

Population Estimates:

Population estimates were performed in seven lakes on Age I Swanson trout sto ked as fingerling in August and September 1983 (Table 3). Fingerling survivals of 61% in Ravine Lake, 50% in Reed Lake and 47% in Tigger Lake exceeded the average 43% survival reported by Havens (1984) for Swanson strain rainbow trout stocked at about 250 fish per pound at a density of approximately 200 fish per surface acre. Walby Lake trout survival of 6%, however, was well below the average 28% survival for fingerling sto ked at about 500/lb, and might be attributed to predation by the estimated 60 fish per surface acre population of trout stocked in prior years and competition with an estimated 17,572 fish per surface acre population of threespine stickleback (Havens, 1984). Rainbow fingerling mean lengths of 112.8 mm in Ravine Lake, 101.3 mm in Reed Lake, 91.3 mm in Tigger Lake and 64.8 mm in Walby Lake (Table 4), and mean lengths at Age I+ of 194.1 mm, 248.9 mm, 168.8 mm and 141.1 mm in Ravine, Reed, Tigger and Walby Lakes, respectively, were similar to those found in past years for rainbow trout planted at approximately the same size, time and density (Havens, 1984).

Junction, Knik and Matanuska Lakes, which had been rehabilitated in October 1982 to remove threespine stickleback (Havens, 1983), were stocked with catchable size rainbow trout (9/lb) at about 100 fish per surface acre in May 1983 and with 253/lb rainbow fingerling at about 400 fish per surface acre in August 1983. Population estimates in May 1984 indicated less than 10% of the catchable trout stocked in each lake remained after 1 year of sport fishing pressure. Fingerling survivals in May 1984 (Table 3) were estimated at 46% in both Junction and Knik Lakes but only 16% in Matanuska Lake. These survival rates are comparable to the 50%, 38%, and 16% survivals in Junction, Knik and Matanuska Lakes, respectively, for 200/lb Swanson rainbow when fingerling were stocked at about 200 fish per surface acre prior to rehabilitation (Havens, 1983). The lower rainbow fingerling survivals in Matanuska Lake may have been due to predation by the larger trout as stocking densities per littoral acre (that portion of the lake less than 15 feet deep) were more than twice that for either Junction Lake or Knik Lake. Population estimates performed 4 months later in September 1984 indicated up to 74% of the Age I+ trout in Junction Lake, 57% in Matanuska Lake and 21% in Knik Lake were gone from the population, probably due to harvest mortality between mid-May and mid-September.

Growth of Swanson trout in Junction, Knik and Matanuska Lakes from time of stocking in August 1983 to Age I in May 1984 and to Age I+ in September 1984 surpassed that found for fingerling plants prior to rehabilitation. Mean length measurements in May (Table 4) were 108.5 mm, 110.7 mm and 111.8 mm in Junction, Knik and Matanuska Lakes, respectively, and averaged 110.3 mm for the three lakes compared to past average lengths of 82.7 mm to 94.4 mm for fingerling stocked at similar times and sizes. Trout lengths in September averaged 243.9 mm, 229.6 mm and 256.0 mm in Junction, Knik and Matanuska Lakes, respectively, while maximum mean lengths recorded for Age I+ Swanson trout between 1978 and 1982 were 218 mm in Junction Lake, 196 mm in Knik Lake and 199 mm in Matanuska Lake (Havens, 1981; 1983).

Table 3. Population estimates for Swanson strain rainbow trout in selected Matanuska-Susitna Valley lakes, 1984.

Lake	Date Stocked	Number Stocked	Stocking Size (fish/lb)	Stocking Density (fish/ surface acre)	Stocking Density (fish/ littoral* acre)	Sample Date	Population Estimate	Survival	95% Confidence Level Estimate	95% Confidence Level Survival
Junction	8/26/83	4,360	253	400	727	5/15/84	1,988	46%	1,740-2,271	40%-52%
						9/21/84	511	12%	333-777	8%-18%
Knik	8/26/83	20,135	253	400	850	5/17/84	9,317	46%	8,778-9,887	44%-49%
						9/20/84	7,470	37%	3,261-14,507	16%-72%
Matanuska	8/26/83	25,560	253	416	1,813	5/16/84	4,001	16%	3,539-4,523	14%-18%
						9/19/84	1,723	7%	942-2,883	4%-11%
Ravine	8/31/83	2,460	229	200	324	6/05/84	1,505	61%	1,086-2,080	44%-85%
Reed	8/31/83	3,900	229	200	285	5/24/84	1,937	50%	1,298-2,870	33%-74%
Tigger**	8/31/83	3,528	229	187	327	5/30/84	1,673	47%	1,398-2,002	40%-57%
Walby**	9/12/83	10,730	540	199	217	5/22/84	644	6%	285-1,267	3%-12%

* Littoral area is that portion of the lake less than 15 feet deep.
** Tigger and Walby Lakes have populations of threespine stickleback.

Table 4. Length-weight summaries and net catch rates for Swanson strain rainbow trout in selected Matanuska-Susitna Valley lakes, 1984.

Lake	Date Stocked	Number Stocked	Stocking Size (fish/lb)	Stocking Density (fish/ surface acre)	Sample Date	Sample* Gear	Number Caught	Mean Length (mm)	Length Range (mm)	Mean Weight (g)	Weight Range (g)	Condition Factor	Catch Rate (fish/hr)
Junction	8/26/83	4,360	253	400	5/15/84	FN	360	108.5	74-143	13.0	4-30	1.02	3.33
					9/21/84	GN	43	243.9	182-295	171.2	62-284	1.18	2.07
Knik	8/26/83	20,135	253	400	5/17/84	FN	2,112	110.7	66-158	12.9	3-38	0.95	17.17
					9/20/84	GN	68	229.6	152-277	143.4	40-234	1.18	3.16
Matanuska	8/26/83	25,560	253	416	5/16/84	FN	628	111.8	86-140	12.7	4-27	0.91	5.12
					9/19/84	GN	26	256.0	171-310	206.7	62-348	1.23	1.44
Ravine	8/31/83	2,460	229	200	6/05/84	FN	291	112.8	83-134	14.6	6-25	1.02	3.46
					9/14/84	GN	39	194.1	148-243	83.4	32-160	1.14	1.90
Reed	8/31/83	3,900	229	200	5/24/84	FN	232	101.3	68-152	12.5	4-42	1.20	2.32
					9/14/84	GN	76	248.9	207-285	184.0	104-270	1.19	3.75
Tigger**	8/31/83	3,528	229	187	5/30/84	FN	688	91.3	62-123	7.6	2-19	1.00	7.82
					9/18/84	GN	46	168.8	130-218	53.6	24-116	1.11	2.02
Walby**	9/12/83	10,730	540	199	5/22/84	FN	37	64.8	50-99	3.0	2-11	1.10	0.28
					9/18/84	GN	22	141.1	112-158	31.8	16-40	1.13	1.05
Crystal**	9/13/83	25,396	349	193	9/06/84	GN	65	163.2	120-267	58.6	20-212	1.35	2.99
Florence	9/13/83	6,250	349	115	9/07/84	GN	115	164.8	107-280	55.7	10-206	1.24	5.35

Table 4. (cont.) Length-weight summaries and net catch rates for Swanson strain rainbow trout in selected Matanuska-Susitna Valley lakes, 1984.

Lake	Date Stocked	Number Stocked	Stocking Size (fish/lb)	Stocking Density (fish/ surface acre)	Sample Date	Sample* Gear	Number Caught	Mean Length (mm)	Length Range (mm)	Mean Weight (g)	Weight Range (g)	Condition Factor	Catch Rate (fish/hr)
Marion	9/16/83	10,640	468	94	9/07/84	GN	100	152.3	107-210	39.7	16-102	1.12	4.55
South Rolly**	9/13/83	21,593	349	201	9/06/84	GN	14	129.5	103-148	29.0	14-42	1.34	0.63
Kalmback**	9/03/82	38,985	326	300	9/05/84	GN	28	352.2	270-434	539.0	228-855	1.23	1.40
Finger**	9/12/83	72,793	540	201	6/19/84	FN	704	98.5	66-148				5.70
					10/11/84	FN	961	175.2	94-258				7.81

* Sample gear: FN = fyke net; GN = gill net.
** Tigger, Walby, Crystal, South Rolly, Kalmback and Finger Lakes have populations of threespine stickleback.

Fyke net catch rates in May and June in the seven lakes where population estimates were performed (Table 4) ranged from 0.28 fish/hour in Walby Lake to 17.17 fish/hour in Knik Lake and had a positive correlation (r=0.92) with the estimated population of rainbow trout in each lake. Both gill nets and fyke nets were fished for the recapture portion of the September 1984 estimates. Gill net catch rates in Junction, Knik and Matanuska Lakes were 2.07 fish/hour, 3.16 fish/hour and 1.44 fish/hour, respectively, while fyke net catch rates were 0.83 fish/hour, 1.36 fish/hour and 1.24 fish/hour, respectively. The combined gill net and fyke net catch rates had a positive correlation (r=0.96) with the estimated population of rainbow trout in each lake.

Additional Gill Net and Fyke Net Sampling:

Gill nets were fished in Crystal, Florence, Marion and South Rolly Lakes to collect length and weight measurements of Age I+ Swanson trout (Table 4). Gill net catch rates were 0.63 fish/hour and 2.99 fish/hour in stickleback-infested South Rolly and Crystal Lakes, respectively, while catch rates in rehabilitated Marion and Florence Lakes were 4.55 fish/hour and 5.35 fish/hour, respectively. Mean length measurements for fish which had been stocked in September 1983 at 349/lb were 129.5 mm in South Rolly Lake, 163.2 mm in Crystal Lake and 164.8 mm in Florence Lake, while trout stocked at 468/lb in Marion Lake averaged 152.3 mm.

A gill net set in Kalmback Lake, a previously unstocked lake which was stocked with Swanson trout fingerling in 1982 (Table 4), captured 28 Age II+ trout ranging from 270 mm to 434 mm and averaged 352.2 mm in length. The average mean length for Age II+ Swanson trout in stickleback lakes, as reported by Havens (1981), was 350 mm.

Fyke nets were fished in Finger Lake in June and October 1984 to collect length measurements of Swanson rainbow trout stocked in September 1983 at 540/lb. Age I rainbow trout captured in June had a mean length of 98.5 mm; the fyke net catch rate was 5.72 fish/hour. Fyke nets fished 4 months later in October 1984 captured trout averaging 175.2 mm at a catch rate of 7.81 fish/hour.

Landlocked Salmon Growth and Survival

Twelve lakes containing landlocked salmon were sampled with fyke nets in September and October 1984 to determine relative growth and survival rates (Table 5). In May 1984 three lakes had been stocked with chinook salmon fingerling, five lakes with coho salmon fingerling, and four lakes with equal numbers of unmarked coho salmon and left ventral clipped chinook salmon fingerling.

Fyke net catch rates for the Age 0+ coho salmon ranged from 0.70 fish/hour in Victor Lake to 35.28 fish/hour in Christiansen Lake with an average of 11.33 fish/hour for all nine lakes. In comparison, catch rates for Age 0+ chinook salmon in seven lakes ranged from zero in Echo, Rocky and Victor Lakes to 0.57 fish/hour in Lucille Lake with an average of 0.15 fish/hour. Eleven of the 12 lakes sampled contained coho salmon stocked in prior years, and fyke net catch rates for those fish ranged

Table 5. Summary of landlocked salmon stocking and fyke net results in selected Matanuska-Susitna Valley lakes, 1984.

Lake	Date Stocked	Species	Number Stocked	Fish/ Lb.	Fish/ Acre	Sample Date	Number Caught	Mean Length (mm)	Length Range (mm)	Catch/ Net Hr.
Echo*	5/23/84	KS	2,310	227	201	9/29/84	0	...	...	...
	5/21/84	SS	2,302	280			470	118.6	108-135	4.12
Memory	5/23/84	KS	8,370	227	202	10/02/84	19	161.1	140-173	0.15
	5/21/84	SS	8,426	280			534	122.4	105-145	4.34
Rocky*	5/23/84	KS	5,880	227	200	10/03/84	0	...	...	...
	5/21/84	SS	5,889	280			1,009	107.1	97-117	7.82
Victor	5/23/84	KS	1,360	227	201	9/26/84	0	...	...	...
	5/21/84	SS	1,358	280			80	126.8	108-166	0.70
Loon	5/23/84	KS	10,798	247	100	10/16/84	9	160.9	141-170	0.15
Lucille*	5/23/84	KS	72,394	247	200	10/05/84	77	129.3	108-168	0.57
Prator*	5/23/84	KS	9,797	247	100	10/03/84	22	149.1	124-164	0.17
Bear Paw*	5/31/84	SS	8,990	244	200	10/16/84	210	121.6	97-155	5.25
Benka*	5/29/84	SS	18,526	291	151	10/16/84	226	101.8	73-152	4.91
Christiansen*	5/29/84	SS	28,314	291	158	10/16/84	1,623	124.3	110-175	35.28
Wolf*	5/31/84	SS	13,265	244	214	10/11/84	2,290	106.7	66-140	29.36
Finger*	5/25/84	SS	72,500	291	200	6/19/84	2,003	75.1	56-99	16.29
						10/11/84	1,259	114.3	88-168	10.24

* Echo, Rocky, Lucille, Prator, Bear Paw, Benka, Christiansen, Wolf and Finger Lakes have populations of threespine stickleback.

from .03 fish/hour in Finger Lake to 4.47 fish/hour in Memory Lake with an average of 0.77 fish/hour.

During the September-October 1984 sample period, Age 0+ coho average lengths ranged from 101.8 mm in Benka Lake to 126.8 mm in Victor Lake with an overall average of 116.0 mm for all nine lakes. Age 0+ chinook average lengths ranged from 129.3 mm in Lucille Lake to 161.1 mm in Memory Lake and for the four lakes where chinook were caught averaged 150.1 mm.

In an attempt to determine whether the large variance in catches and catch rates between coho salmon and Age 0+ chinook was due to fyke net selectivity or to chinook mortality, additional sampling was conducted. Two fyke nets and one gill net set overnight in Echo and Memory Lakes captured a total of 266 Age 0+ coho (length range 112 mm-155 mm) eight Age 0+ chinook (length range 140 mm-165 mm), and 294 Age I+ or older coho salmon (length range 166 mm-485 mm). Gill nets captured 16% of the estimated Age 0+ coho, 50% of the Age 0+ chinook and 56% of the Age I+ or older coho salmon. A population estimate was performed in Prator Lake indicating only a 3.3% survival of the 9,797 chinook fingerling stocked less than 5 months earlier; the survival range at the 95% confidence level was 1.7%-5.8%. Ice fishermen contacted at Memory Lake on December 8, 1984 harvested a total of 15 Age 0+ chinook (mean length 167 mm) and 25 Age I+ and II+ coho (mean length 193 mm); no Age 0+ coho were captured. The catch ratio for all net sampling in Memory Lake was 787 Age I+ and II+ coho, 610 Age 0+ coho, 25 Age 0+ chinook or 31:24:1, while sport fishermen captured fish in the ratio 1.6:0:1. Although relative survival of 1984 stocked chinook salmon appeared to be substantially less than 1984 stocked coho, the chinook salmon grew more rapidly and, at least in Memory Lake on one particular day, were harvested at a greater proportion than coho salmon.

Bentz (1982) reported results of an experiment where equal numbers of coho salmon at 26/lb and chinook salmon at 33/lb were stocked in each of three Matanuska-Susitna Valley lakes in May 1981. Sampling with hook and line and gill nets in December 1981 indicated the Age 0+ chinook salmon fingerling experienced relatively higher survival and growth rates than the Age 0+ coho salmon stocked in the same lakes. The chinook comprised 82, 71 and 45% of the sample populations in Victor, Memory and Rocky Lakes, respectively, and averaged 186 mm in length while Age 0+ coho averaged 163 mm. After an additional 12 months' residency in these three lakes, the two salmon populations were sampled a second time for further comparative analysis. Three chinook salmon were identified out of a sample size of 35 from Memory Lake and no chinook were identified from samples of 16 and four specimens from Rocky and Victor Lakes, respectively. During the 12 months between samples, the percentage of chinook salmon within the combined sample populations of all three lakes decreased from 65% to only 5% (Bentz, 1983).

Results of both the 1981 and 1984 stocking experiments indicate a more rapid growth of chinook salmon to catchable size and a greater harvest rate than for stocked coho. The 1981 experiment indicated a higher initial survival for the chinook salmon when both species were stocked

at about 30/lb, while the 1984 experiment indicated a much lower relative survival for chinook when both species were stocked at about 250/lb. The large coho and chinook salmon stocked for experimental purposes in 1981 were excess to the Alaska Department of Fish and Game smolt program and are normally not available for stocking landlocked lakes. Since 1974, coho stocked in Matanuska-Susitna Valley lakes in May or June each year ranged from 214/lb to 698/lb and did not enter the sport fishery until the following year. In an attempt to maximize survival to catchable size the Alaska Department of Fish and Game Elmendorf Hatchery has been requested to accelerate the hatching and growth of both species so that chinook can be stocked at about 65/lb and coho at about 130/lb in selected Matanuska-Susitna Valley lakes in mid-May 1985 for further experimentation.

Arctic Grayling Growth and Survival

Three Matanuska-Susitna Valley lakes stocked with Arctic grayling fry on June 11, 1984 were sampled with fyke nets to determine relative growth and survival (Table 6). Johnson Lake contained no fish prior to stocking, while Canoe and Meirs Lakes contained both grayling and rainbow trout stocked in prior years and rainbow trout subcatchables stocked on June 1, 1984.

Johnson Lake was fyke-netted August 17, 1984; the 33 Arctic grayling captured, ranging in length from 99 mm to 122 mm and averaging 112.2 mm, were adipose-clipped and released. Canoe and Meirs Lakes, scheduled to be stocked on August 30 with grayling fingerling averaging about 65 mm in length, were sampled with fyke nets on August 22. No grayling were captured in Meirs Lake, although the one fyke net fished caught 36 rainbow trout averaging 226.0 mm. Fyke nets in Canoe Lake captured three Age 0+ grayling ranging in length from 108 mm to 119 mm and averaging 113 mm, and 25 rainbow trout averaging 239.6 mm. Canoe and Meirs Lakes were stocked with 168/lb Arctic grayling fingerling, at a density of approximately 200 fish per surface acre, on August 30, 1984. Population estimates are scheduled to be performed on both stocking groups of Arctic grayling in Canoe and Meirs Lakes in May 1985.

Johnson Lake was sampled again in October 1984 to estimate the Age 0+ grayling population. Fyke nets and gill nets captured 298 grayling with an average length of 166 mm and average weight of 58 g; seven of the grayling captured had been adipose-clipped in August. The estimated population was 1,233 grayling, or a 1.9% survival of the 64,000 fish stocked in June; the survival range at the 95% confidence level was 1.0% to 3.9%.

Threespine Stickleback Population Dynamics

Investigation of threespine stickleback population dynamics were continued in 1984. At the same time rainbow trout population estimates were performed in Tigger and Walby Lakes in May, the stickleback population in Tigger Lake was estimated to be 25,827 with a range at the 95% confidence level of 20,038 to 36,320 and the Walby Lake stickleback population was estimated at 749,978 with a range at the 95% confidence level of 686,368 to 823,009. These figures represent

Table 6. Length measurements of Arctic grayling and rainbow trout captured in three Matanuska-Susitna Valley lakes, 1984.

Lake	Date Stocked	Species	Number Stocked	Fish/ Pound	Fish/ Acre	Sample Date	Number Caught	Mean Length (mm)	Length Range (mm)
Canoe	6/01/84	RT	1,600	12.8	75	8/22/84	25	239.6	186-273
	6/11/84	GR	13,000	32,000	613		3	113.0	108-119
Meirs	6/01/84	RT	1,600	12.8	71	8/22/84	36	226.0	192-265
	6/11/84	GR	10,000	32,000	595		0	...	...
Johnson	6/11/84	GR	64,000	32,000	1,588	8/17/84	33	112.2	99-122
						10/10/84	298	166.0	130-183

stickleback densities of 1,367 fish per surface acre in Tigger Lake and 13,914 per acre in Walby Lake. Havens (1984) reported June 1983 stickleback population densities of 1,385 per surface acre in Tigger Lake and 18,973 per acre in Walby Lake.

In addition to the samples collected to make population estimates in May and June 1984, Tigger and Walby Lakes were minnow-trapped once each month in July, August and September. As reported for samples collected in 1983 (Havens, 1984), the Age II stickleback present in minnow trap catches in May and June had virtually disappeared by the July sample period and Age 0 young-of-the-year fish were first captured in August. Overall capture densities were lowest in July.

LITERATURE CITED

Bentz, R.W. 1982. Inventory and cataloging of the sport fish and sport fish waters in upper Cook Inlet. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1981-1982, Project F-9-14, 23(G-I-D): 76-112.

_____. 1983. Inventory and cataloging of the sport fish and sport fish waters in upper Cook Inlet. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1982-1983, Project F-9-15, 24(G-I-D): 60-104.

Chlupach, R.S. 1977. Population studies of game fish and evaluation of managed lakes in the upper Cook Inlet drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1976-1977, Project F-9-9, 18(G-III-D): 1-48.

_____. 1978. Population studies of game fish and evaluation of managed lakes in the upper Cook Inlet drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1977-1978, Project F-9-10, 19(G-III-D): 1-21.

Everest, F.H. and E.H. Edmundson. 1967. Cold branding for field use of marking juvenile salmonids. Progressive Fish Culturist, 29(3): 175-176.

Havens, A.C. 1979. Population studies of game fish and evaluation of managed lakes in the upper Cook Inlet drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1978-1979, Project F-9-11, 20(G-III-D): 1-23.

_____. 1980. Population studies of game fish and evaluation of managed lakes in the upper Cook Inlet drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1979-1980, Project F-9-12, 21(G-III-D): 1-42.

_____. 1981. Population studies of game fish and evaluation of managed lakes in the upper Cook Inlet drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22(G-III-D): 1-34.

_____. 1983. Population studies of game fish and evaluation of managed lakes in the upper Cook Inlet drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1982-1983, Project F-9-15, 24(G-III-D): 68-96.

_____. 1984. Population studies of game fish and evaluation of managed lakes in the upper Cook Inlet drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-16, 25(G-III-D): 1-24.

Kalb, C.J. 1974. Population studies of game fish and evaluation of managed lakes in the upper Cook Inlet drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1973-1974, Project F-9-6, 15(G-III-D): 1-23.

_____. 1975. Population studies of game fish and evaluation of managed lakes in the upper Cook Inlet drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1974-1975, Project F-9-7, 16(G-III-D): 1-51.

Post, G. 1955. A simple chemical test for rotenone in water. Progressive Fish Culturist, 17 (4): 190-191.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin of the Fisheries Research Board of Canada, 191: 382.

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