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LAKE AND STREAM INVESTIGATIONS

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TABLE OF CONTENTS

STUDY NO: G-III LAKE AND STREAM INVESTIGATIONS Page

Job No. G-III-D Population Studies of Game Fish and Evaluation of Managed Lakes in the Upper Cook Inlet Drainage
By: Alan C. Havens

Abstract. 1
Key Words 2
Background. 2
Recommendations 4
Objectives. 4
Techniques Used 4
Findings. 8
Swanson Strain Rainbow Trout Survival and Growth. 8
Discussion. 13
Survival 13
Growth 14
Miscellaneous Findings. 18
Literature Cited. 22

LIST OF TABLES AND FIGURES

Table 1. List of common names, scientific names and abbreviations 5
Table 2. Survival estimates at Age I for Swanson strain rainbow trout in lakes of the Matanuska-Susitna Valley, 1978-1983 9
Table 3. Growth patterns for Swanson strain rainbow trout in stocked lakes of the Matanuska-Susitna Valley, 1977-1983 11
Table 4. Survival ratios and length measurements at Age I for two stocking sizes of Swanson strain rainbow trout in four Matanuska-Susitna Valley lakes, Spring 1983 12
Table 5. Length measurements of rainbow trout harvested by sport fishermen in selected waters of the Matanuska Valley, 1955-1983 17
Table 6. A comparison of fish biomass in selected stocked lakes of the Matanuska-Susitna Valley, Fall 1983 20

Figure 1. Study area of the Matanuska-Susitna Valley. 6
Figure 2. Length - frequency histograms of threespine stickleback from Tigger Lake, 1983. 15
Figure 3. Length - frequency histograms of threespine stickleback from Walby Lake, 1983 16
Figure 4. Actual and speculated growth curves for Swanson strain rainbow trout stocked in Kepler/Bradley and Matanuska Lakes 19

Volume 25 Study G-III

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RESEARCH PROJECT SEGMENT

State:	Alaska	Name:	Sport Fish Investigations of Alaska
Project:	F-9-16		
Study No:	G-III	Study Title:	LAKE AND STREAM INVESTIGATIONS
Job No:	G-III-D	Job Title:	Population Studies of Game Fish and Evaluation of Managed Lakes in the Upper Cook Inlet Drainage

Cooperator: Alan C. Havens

Period Covered: July 1, 1983 to June 30, 1984

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. Major emphasis in recent years has been to determine survival and growth of rainbow trout in lakes of known limnological characteristics.

Results of 38 survival estimates for Swanson strain rainbow trout, *Salmo gairdneri* Richardson, stocked at sizes ranging from 1,000 per pound to 250 per pound in Matanuska-Susitna Valley lakes revealed an average survival to Age I of 29 percent in lakes containing threespine stickleback, *Gasterosteus aculeatus* Linnaeus, while the average for all stocking sizes in rehabilitated lakes was 41 percent. Fingerlings planted at 250 per pound in stickleback waters had an average survival of 36 percent. In rehabilitated lakes 36 percent was the average survival for rainbow trout stocked at 500 per pound, while those stocked at 250 per pound averaged 50 percent survival.

Samples from 53 different stocked populations of Swanson strain rainbow trout indicated fingerling stocked at 500 per pound in August had an average length of 130 millimeters in rehabilitated waters by the following June and 103 millimeters in stickleback lakes, while trout stocked at 250 per pound in September were only 113 millimeters and 87 millimeters at Age I in rehabilitated and stickleback waters, respectively. Creel census data show the majority of fishing effort in stocked lakes occurs in May and June, therefore most trout planted at 500 to 250 per pound in August and September, respectively, do not enter the fishery until Age II, about 20 months after they are stocked. In

lakes stocked annually both Age I trout and Age 0 fingerling are present through an entire winter season.

Data collected on threespine stickleback populations in Alaska lakes reveal there may be a "window period" in July when Age II stickleback have spawned and are dead or dying, and Age 0 young-of-the-year fish are not large enough to seriously compete with introduced trout fingerling for food and habitat. Speculated growth curves based on actual trout measurements indicate trout stocked at 250 per pound on July 15 should reach a catchable size of 165 millimeters by mid-May in rehabilitated lakes and by July 1 in stickleback waters.

Findings suggest that if State hatcheries can provide Swanson strain rainbow trout in July at about 250 fish per pound for stocking landlocked lakes, the trout will experience better average survival than now occurs with August and September plants and the majority of the fish can be harvested by the sport fishery the following spring or summer at Age I.

KEY WORDS

Southcentral Alaska, rainbow trout, fish stocking, threespine stickleback, competition, 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 lakes 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); 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, 1983); (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, 1983); (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 being constructed in the Anchorage area should have 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 strains 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. Survival, growth and biomass of Swanson strain rainbow trout should be determined in Johnson, Junction, Knik and Matanuska Lakes.

2. Morphologies, sizes, age classes and relative numbers of threespine stickleback should be investigated in Tigger and Walby Lakes.

3. Investigation into trout habitat preference and rearing areas in Johnson Lake should be continued.

4. Techniques and equipment necessary to determine survival, growth and biomass of stocked game fishes should be developed.

5. Costs to the creel should be obtained for fish stocked in study lakes when harvest estimates are available.

OBJECTIVES

1. To determine survival, growth and total yield of stocked game fishes in landlocked lakes of the area.

2. To determine limnological conditions which affect survival and growth of game fishes stocked in study lakes.

3. To provide recommendations for the management of stocked lakes and to direct the course of future studies.

TECHNIQUES USED

Rainbow trout survival estimates in Ravine, Reed, Sliver, Tigger and Walby Lakes, threespine stickleback population levels in Sliver, Tigger and Walby Lakes and longnose sucker estimates in Walby Lake were determined by Chapman's modification of the Peterson estimator (Ricker, 1975).

Fish were captured for marking purposes with fyke nets or minnow traps, or both. Fyke nets, baited with salmon eggs, used to capture

Table 1. List of Common Names, Scientific Names and Abbreviations.

Common Name	Scientific Name and Author	Abbreviation
Rainbow Trout	*Salmo gairdneri* Richardson	RT
Coho salmon	*Oncorhynchus kisutch* (Walbaum)	SS
Threespine stickleback	*Gasterosteus aculeatus* Linnaeus	TS
Longnose sucker	*Catostomus catostomus* Forster	LNS

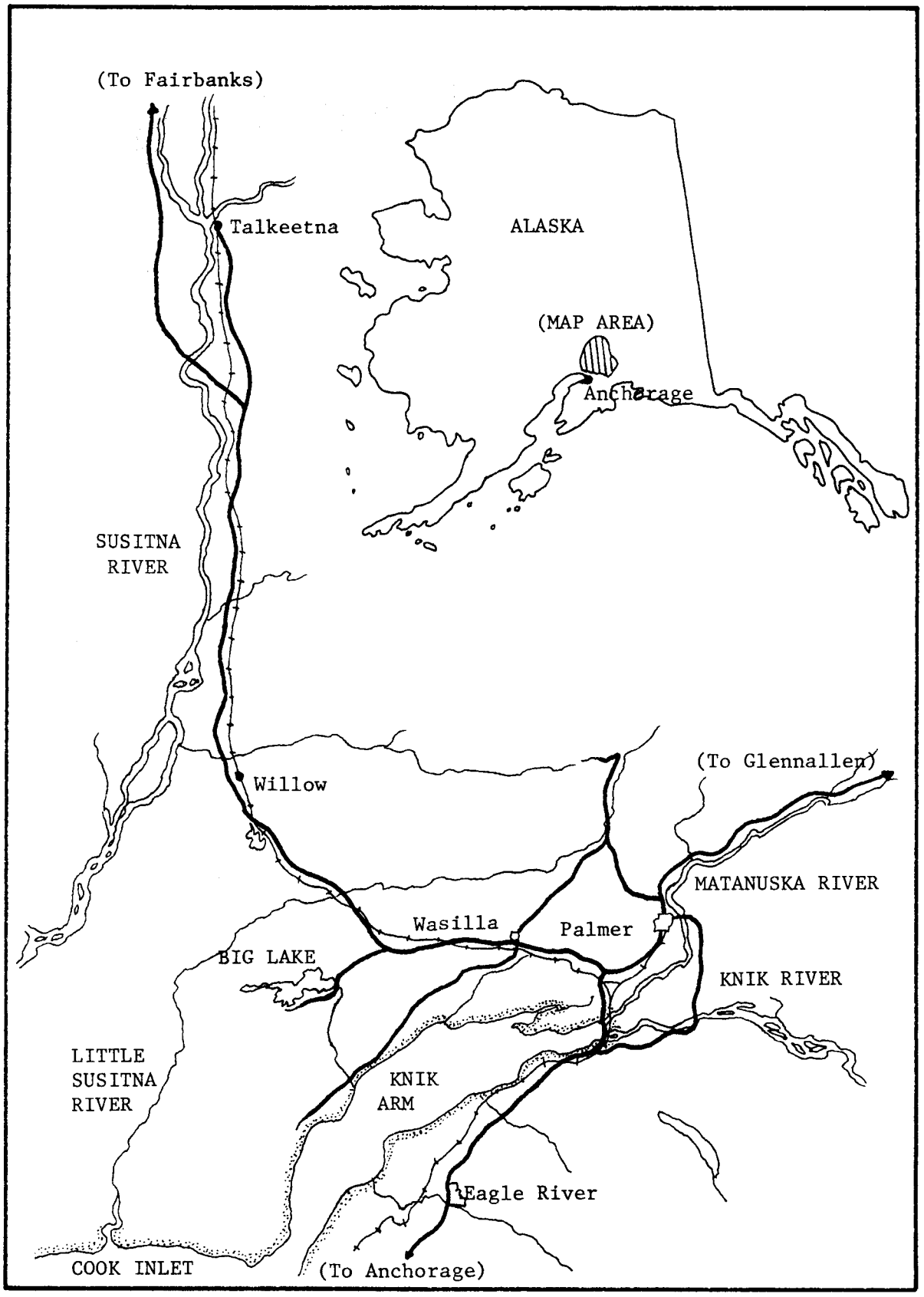

Fig. 1. Study Area of the Matanuska-Susitna Valley.

stickleback, suckers and stocked rainbow trout were 9 feet in length, 30 inches in diameter and included two 3-foot x 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 bouyed, anchored lines. All capture gear was fished approximately 24 hours.

All trout and suckers 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 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 and longnose suckers were later captured using fyke nets or 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 connecters 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 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 all captured fish were taken to the lab for mark detection under blacklight.

Rainbow trout and longnose sucker measurements were expressed in fork lengths and stickleback measurements in standard length, to the nearest

millimeter and in weight to the nearest gram. Rainbow trout, longnose suckers and stickleback biomass estimates were converted from total grams to pounds.

Rainbow trout stocked for experimental purposes in Johnson, Junction, Knik and Matanuska Lakes in September 1983 were handcounted at the hatchery prior to transport.

FINDINGS

Swanson Strain Rainbow Trout Survival and Growth

Effect of Stocking Size on Fish Survival:

Havens (1979-1983) reported population and survival estimates for various stocking sizes of Swanson strain rainbow trout in landlocked lakes of the Matanuska-Susitna Valley. Rainbow trout fry or fingerling were stocked at a density of approximately 200 fish per surface acre in August, September or October, depending on when trout were available from the hatchery. Survival estimates were performed the following spring or fall after fish had experienced one winter of lake residency.

Results of 38 survival estimates for trout stocked at average sizes of 1,000/lb, 500/lb and 250/lb in rehabilitated lakes (lakes in which undesirable fish, particularly threespine stickleback, have been eliminated by the application of rotenone) and stickleback lakes (lakes containing a naturally reproducing stickleback) of the Matanuska-Susitna Valley are shown in Table 2. A pattern of survival related to stocking size does exist although individual survivals vary considerably and may depend on the condition of trout at time of stocking, absence or relative abundance of predator or competitor species or both and unknown or unmeasured parameters such as recreational harvest.

Rainbow trout stocked at approximately 1,000/lb exhibited an average survival of 19% in rehabilitated lakes while the estimate in one lake containing stickleback was a 2% survival to Age I. Fish stocked at this size are probably extremely vulnerable to predation by aquatic insects or larva and stickleback as well as larger game fish.

Fingerling planted at 430/lb to 650/lb with an average size of 500/lb had a considerably higher average survival of 36% in rehabilitated lakes and 24% in stickleback waters with an overall average survival of 28%. These results are comparable to survival estimates for lakes in the Kodiak and Glennallen regions of Alaska that were stocked with Swanson strain fingerling from 440/lb to 690/lb (Van Hulle and Murray, 1980-1981; Murray, 1982; Williams and Potterville, 1982). Fourteen stocking experiments in these regions indicated survivals ranging from approximately 9 to 35%, averaging 19%, in stickleback infested waters, while survivals in lakes free from stickleback ranged from 16 to 84% and averaged 37%. Individual survivals vary considerably but a composite follows the patterns found for that stocking size grouping in Matanuska-Susitna Valley lakes.

Table 2. Survival Estimates at Age I for Swanson Strain Rainbow Trout Stocked in Lakes of the Matanuska-Susitna Valley, 1978-1983.

Rainbow Trout Stocking Size (Fish/lb)	Number of Survival Estimates	Lake Condition	Survival Estimates at Age I Range	Survival Estimates at Age I Average
1,000/lb	3	No stickleback	10% - 25%	19%
	1	Stickleback present		2%
	4	All lakes combined	2% - 25%	15%
500/lb	5	No stickleback	11% - 61%	36%
	9	Stickleback present	8% - 35%	24%
	14	All lakes combined	8% - 63%	28%
250/lb	10	No stickleback	20% - 83%	50%
	10	Stickleback present	9% - 63%	36%
	20	All lakes combined	9% - 83%	43%
Totals:				
All Sizes	18	No stickleback	10% - 83%	41%
	20	Stickleback present	2% - 63%	29%
	38	All lakes combined	2% - 83%	35%

Twenty of the 38 estimates shown in Table 2 involved trout stocked from 130/lb to 390/lb with an average stocking size of 250 fish per pound. Ten estimates in rehabilitated lakes gave an average survival of 50% and a range of 20 to 83%, while trout survivals to Age I in stickleback waters averaged 36%.

Effect of Stocking Size and Time on Fish Growth:

A summary of data presented by Chlupach (1977-1978) and Havens (1979-1983) regarding the growth of Swanson strain rainbow trout stocked in Matanuska-Susitna Valley lakes are shown in Table 3. Data from 53 different stocked populations were segregated into two main categories; i.e., fish stocked at 500 per pound in August and fish stocked at 250 per pound in September. Each size category was further divided to show growth differences between rehabilitated and stickleback waters.

Rainbow fingerling stocked at 500/lb in August had an average length 10 months later in June of 130 mm (5.1 in) in rehabilitated lakes, while the average trout length in stickleback waters was 103 mm (4.1 in). Nine percent of the trout in rehabilitated lakes were 6.5 inches or larger by mid-June, but only 1% had reached that size in stickleback lakes.

Rainbow trout stocked in rehabilitated lakes in September at 250/lb averaged 113 mm (4.4 in) by the following June with 5% having reached or exceeded 6.5 inches in length. In stickleback lakes, fish from that stocking size group averaged only 87 mm (3.4 in).

At least 50% of both stocking groups had reached 165 mm (6.5 in) by October and would potentially enter the sport fishery the following spring at Age II.

Rainbow Trout Survival and Growth Comparisons, 1983:

Rehabilitated Ravine and Reed Lakes and stickleback infested Sliver, Tigger and Walby Lakes were stocked with equal numbers of 250/lb and 500/lb of trout simultaneously in August 1982 to compare growth and survival in common environmental conditions. The 250/lb trout were marked with an adipose fin-clip at the hatchery then all fish were hand counted for each lake prior to transport.

Sliver Lake is not included in the following data presentation because in March 1983 a dissolved oxygen level of only 2.0 milligrams per liter was recorded, and observation of numerous dead stickleback and several dead trout indicated a winterkill condition in Sliver Lake. A subsequent population sampling estimated only 2% survival of the 1982 plant.

Population estimates in June 1983 indicated greater survival for fingerling stocked at a larger size (Table 4). The overall survival ratio 250/lb:500/lb was 1.7:1. Estimated survival of the 250/lb stocking group averaged 50% in the two rehabilitated lakes and 47% in

Table 3. Growth Patterns for Swanson Strain Rainbow Trout in Stocked Lakes of the Matanuska-Susitna Valley, 1977-1983.

Average Stocking Size (fish/lb)	(mm)	Approximate Stocking Date	Number of Populations Sampled	Lake Condtion	Approximate Sample Date	Average Length (mm)	(in)	Population Length Composition ≥102 mm (4.0 in)	≥165 mm (6.5 in)	≥217 mm (8.5 in)	≥254 mm (10.0 in)
500	44	August 15	14	No stickleback	June 15	130	5.1	91%	9%	0	0
					October 1	238	9.4	100%	94%	62%	39%
			14	Stickleback present	June 15	103	4.1	49%	1%	0	0
					October 1	181	7.1	100%	61%	16%	4%
250	55	September 10	15	No stickleback	June 15	113	4.4	64%	5%	0	0
					October 1	221	8.7	100%	94%	51%	21%
			10	Stickleback present	June 15	87	3.4	14%	0	0	0
					October 1	174	6.9	100%	59%	8%	1%

Table 4. Survival Ratios and Length Measurements at Age I for Two Stocking Sizes of Swanson Strain Rainbow Trout in Four Matanuska-Susitna Valley Lakes, Spring 1983.

Lake	Surface Area (acres)	Stickleback Present	Stocking Date	Number Stocked	Approximate Stocking Size (fish/lb)	Sample Date	Population Estimate Number	Population Estimate Survival	Survival Ratio 250/lb : 500/lb	Mean Length (mm)	Length Range (mm)
Ravine	12.3	No	8/13/82	1,225	250	6/14/83	883	72%	1.4 : 1	133	96-167
				1,215	500		641	53%		120	96-157
Reed	19.5	No	8/12/82	1,948	250	6/07/83	546	28%	1.3 : 1	142	105-173
				1,947	500		410	21%		119	88-177
Tigger	18.9	Yes	8/13/82	2,298	250	6/16/83	1,115	49%	2.2 : 1	101	66-146
				2,298	500		498	22%		85	59-122
Walby	53.9	Yes	8/12/82	5,385	250	6/ 8/83	2,425	45%	2.0 : 1	104	73-146
				5,385	500		1,220	23%		89	54-143

Tigger and Walby Lakes, while average survivals of the 500/lb group in rehabilitated lakes and stickleback lakes were 37% and 22%, respectively.

Rainbow trout length measurements in June and 3-1/2 months later in September revealed that the fingerling stocked at a larger size continued to maintain their size advantage. In the two rehabilitated lakes the 250/lb stocking group averaged 138 mm in June and 230 mm in September, while fish from 500/lb plant had average lengths of 120 mm in June and 220 mm in September. Measurements indicated slower growth in the stickleback lakes as the average length in June and in September for the 250/lb trout were 103 mm and 175 mm, respectively, but only 87 mm in June and 153 mm in September for fish that had been stocked at the smaller size.

DISCUSSION

The performance of stocked Swanson trout in lakes containing stickleback is often unsatisfactory because of poor survival and slow growth to harvestable size. More than half the Matanuska-Susitna Valley lakes presently stocked with fingerling are subject to the negative effect of stickleback competition, and virtually all lakes that will be added to future stocking programs throughout southcentral Alaska also contain stickleback. The following discussion examines various aspects of the current stocking program and offers suggestions for further investigations which should provide direction for improved stocking practices.

Survival

Threespine stickleback population estimates in 1982 (Havens et al., in prep.) and 1983 revealed stickleback densities ranging from 3,800 to 36,000 per surface acre and stickleback mean weights ranging from 300/lb to 800/lb in September and October in four Matanuska-Susitna Valley landlocked lakes. These lakes are annually stocked with rainbow trout fingerling at densities of about 200 per surface acre in August, September, or October at sizes ranging from 200/lb to 650/lb. All available evidence indicates that the established, more abundant stickleback represent a serious competitive challenge to nonindigenous trout that have not previously been subjected to the selection processes of the natural environment.

An obvious way to minimize the effect of threespine stickleback on survival and growth of rainbow trout in landlocked lakes is the elimination of stickleback by the application of rotenone, although rehabilitation is costly and not always successful. Stickleback reappeared in four of 11 naturally landlocked Matanuska-Susitna Valley lakes treated between 1971 and 1976 because of reintroduction or failure to completely eliminate those individual populations. Five Matanuska-Susitna Valley landlocked lakes ranging in size from 7.2 to 74.4 surface acres were treated in 1982-1983 at an average cost of about $7,300 per lake or $180 per surface acre. The cost and questionable success of treatment to remove stickleback normally limit rehabilitation efforts to a few heavily-fished roadside lakes.

The stocking of rainbow trout reared to catchable size (9/lb - 4/lb) would significantly reduce the negative effect of stickleback but this also would be costly. In the Matanuska-Susitna Valley alone, 19 of the 34 lakes requested for stocking with rainbow trout fingerling in 1983 were stickleback infested and approximately 118,000 catchable trout would have been needed just to stock those lakes at 100 fish per surface acre.

One important mitigating factor to date in the stickleback-rainbow trout problem has been 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. Research from 1974 to 1983 indicate the Swanson trout have significantly greater survival, under all natural lake conditions examined, than did an Alaskan strain of rainbow trout from Bristol Bay or the domestic Alaska-Ennis (Montana) or Winthrop (Washington) strains which had supported Alaska's rainbow trout stocking program for many years (Havens, 1980). As indicated in a previous section Swanson strain rainbow trout fingerling stocked at 1,000/lb or larger average 29% survival in stickleback waters. Ennis and Winthrop fish stocked at about 250/lb in stickleback lakes averaged only 4% survival. Greater utilization of Swanson fingerling that are 250/lb or larger would be expected to increase the numbers of harvestable trout in stickleback waters because the survival of fish this size equals the 36% average survival of 500/lb Swanson fingerling in rehabilitated lakes. The possibility that other Alaska rainbow trout strains may have even better survival and growth than the Swanson strain in landlocked lakes is an additional consideration that warrants further study.

Recent studies in Matanuska-Susitna Valley lakes as well as data gathered from studies by Alaskan researchers (Greenbank and Nelson, 1959; Engel, 1971; Cannon, 1974;) indicate there may be a July "window period" in stickleback lakes when hatchery rainbow trout fingerling could be introduced with a chance for better survival than is now experienced with trout plants in August, September or October. In Tigger and Walby Lakes (Figures 2 and 3), July appeared to be the month when most Age II stickleback had spawned and were dead or dying while Age 0 young-of-the-year fish may not have been large enough to seriously compete with trout fingerling for food and habitat. Although Age I stickleback were present throughout the lake, overall population densities were lowest in July as indicated by catch-per-unit-of-effort. As well as potentially increasing survival chances for rainbow trout fingerling with July plants in stickleback lakes, trout released in rehabilitated waters might also benefit by earlier stocking. In both lake types trout stocked at 250/lb in July would be larger going into the winter season and thus should experience higher survivals.

Growth

A compilation of fish lengths from creel census data collected from both wild and hatchery trout fisheries in the Matanuska Valley between 1956 and 1983 (Allin and Baxter, 1957; Andrews, 1961; Watsjold, personal communication; Havens, in prep.) is presented in Table 5. Trout retained by fishermen ranged from 3 inches to 23 inches, the mode was

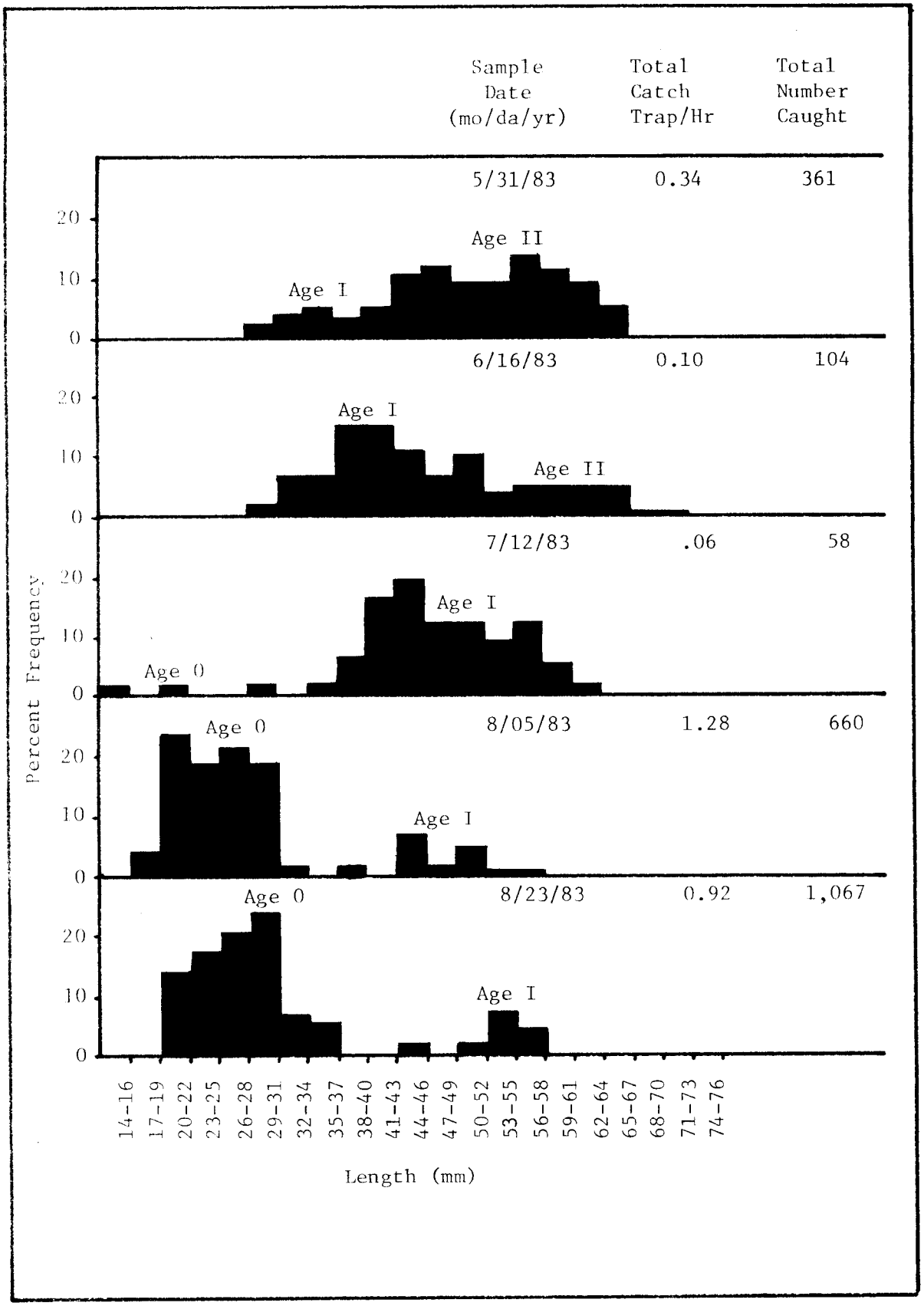

Fig. 2. Length-frequency Histograms of Threespine Stickleback from Tigger Lake, 1983.

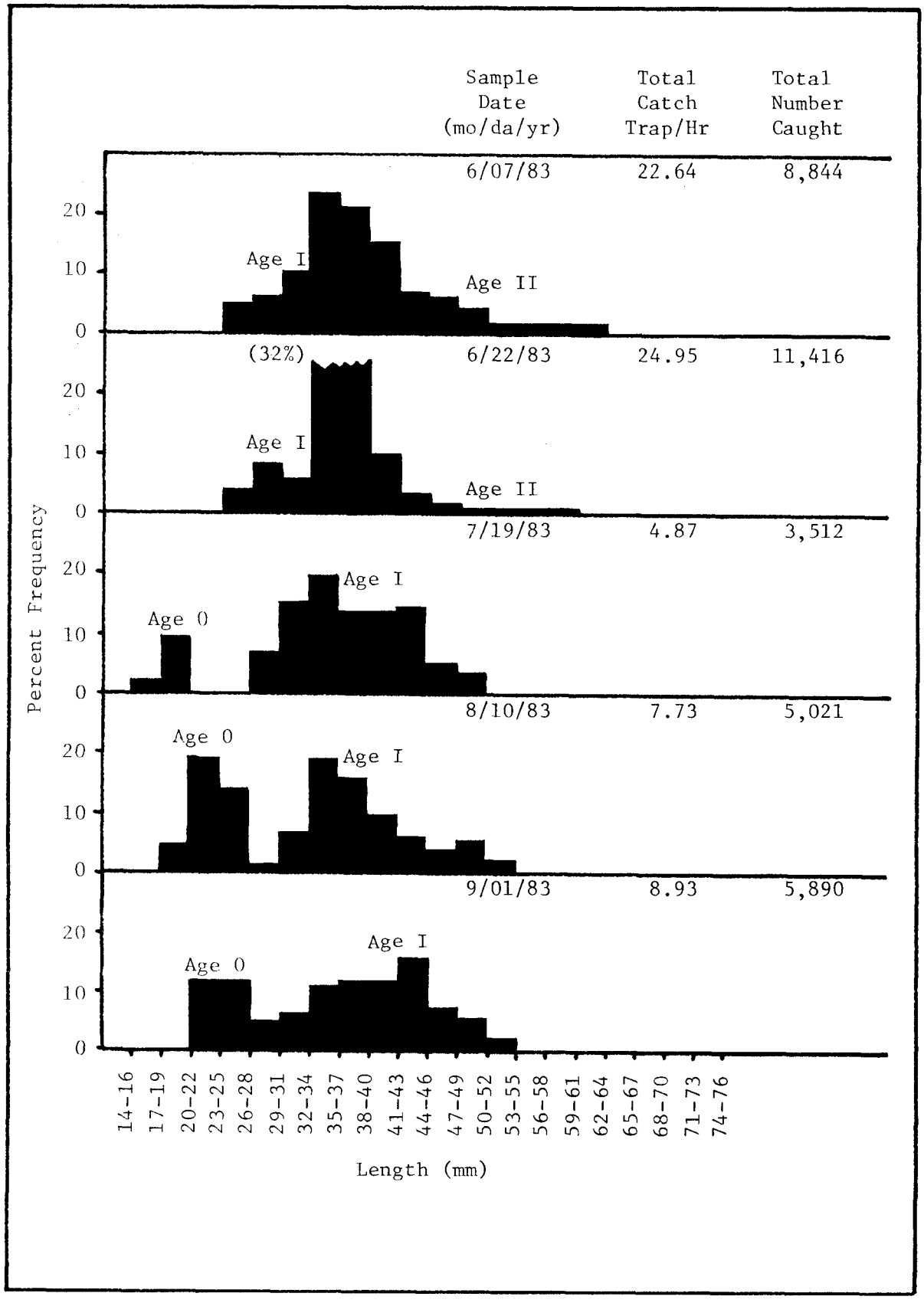

Fig. 3. Length-frequency Histograms of Threespine Stickleback from Walby Lake, 1983.

Table 5. Length Measurements of Rainbow Trout Harvested by Sport Fishermen in Selected Waters of the Matanuska Valley, 1955-1983.

Rainbow Trout Harvested*			
Fork Length Measurements (mm)	(in)	Number	%
76 - 101	3 - 3.9	11	(0.40)
102 - 126	4 - 4.9	59	(2.10)
127 - 151	5 - 5.9	140	(5.00)
152 - 177	6 - 6.9	346	(12.30)
178 - 202	7 - 7.9	484	(17.20)
203 - 228	8 - 8.9	529	(18.80)
229 - 253	9 - 9.9	439	(15.60)
254 - 278	10 - 10.9	272	(9.70)
279 - 304	11 - 11.9	149	(5.30)
305 - 329	12 - 12.9	134	(4.80)
330 - 355	13 - 13.9	79	(2.80)
356 - 380	14 - 14.9	44	(1.60)
381 - 405	15 - 15.9	41	(1.50)
406 - 431	16 - 16.9	39	(1.40)
432 - 456	17 - 17.9	22	(0.80)
457 - 482	18 - 18.9	11	(0.40)
483 - 507	19 - 19.9	5	(0.20)
508 - 531	20 - 20.9	2	(0.07)
532 - 558	21 - 21.9	3	(0.10)
559 - 583	22 - 22.9	1	(0.04)
		2,810	

* Wasilla Lake: 1955, 1957; Cottonwood Creek Drainage (including Wasilla Lake): 1956; Lower Bonnie Lake: 1960; Kepler Bradley Lakes Complex: 1978, 1983.

8.0 - 8.9 inches and 71% of the fish harvested were within the 4.0 - 9.9 inch range.

Swanson trout used in Alaska's rainbow catchable program are stocked at mean sizes ranging from 9/lb to 7/lb (6.5 in - 7.1 in). A sample of catchable Swanson trout stocked in three Matanuska-Susitna Valley lakes in 1983 at 9/lb revealed a size range, at time of stocking, from 4.5 inches to 9.1 inches and an average length of 6.5 inches.

Havens (1982) and Wenderoff (1982) collected length samples from Swanson strain rainbow trout in rehabilitated Kepler-Bradley Lake and stickleback infested Matanuska Lake from time of introduction at 419/lb on August 12, 1980 until the fish reached Age I+ in September 1981. Figure 4 shows growth increments based on actual fish measurements and speculated growth patterns for Swanson trout if stocked on July 15 at 250/lb. Speculated growth curves were developed using the slopes of the line calculated from actual length measurements of rainbow trout captured in each lake. When stocked at 419/lb on August 12 Swanson trout reached catchable size (6.5 in) about the end of June in Kepler-Bradley Lake and mid-July in Matanuska Lake. Swanson strain rainbow trout fingerling stocked on July 15 at 250/lb might be expected to average 165 mm (6.5 in) and enter the fishery by mid-May in Kepler-Bradley Lake and by July 1 in Matanuska Lake.

A creel census conducted on nine stocked Matanuska-Susitna Valley lakes from April 30, 1977 through September 5, 1977 (Watsjold, 1978) indicated that 48% of the fishing effort occurred during May, and 22%, 16%, 9% and 3%, occurred during June, July, August and September, respectively. Harvest rates were highest for the entire sampling period in June and September.

July plants of Swanson strain rainbow trout fingerling in the 250/lb range appear to both increase survival and allow more trout to achieve a catchable size by the following spring and summer. Harvesting a substantial number of trout in the spring and early summer would serve to suppress the population of Age I fish prior to introduction of "new" fingerling thus decreasing the chances for predation and competition for food and habitat as is now the case when both age classes are present through an entire winter season. Investigation can begin when State hatcheries are able to provide trout at 250/lb in July.

Miscellaneous Findings

Fish Biomass Estimates for Selected Matanuska-Susitna Valley Lakes:

Population estimates were performed in five Matanuska-Susitna Valley lakes in fall 1983 to obtain total fish biomass estimates (Table 6). Ravine and Reed Lakes contained only rainbow trout, Sliver and Tigger Lakes had trout and threespine stickleback and Walby Lake contained trout, stickleback and longnose suckers. Havens (1983) reported fish biomass estimates for five lakes containing both trout and stickleback and for an additional four lakes containing rainbow trout only. The biomass estimates for nine Matanuska-Susitna Valley lakes along with a

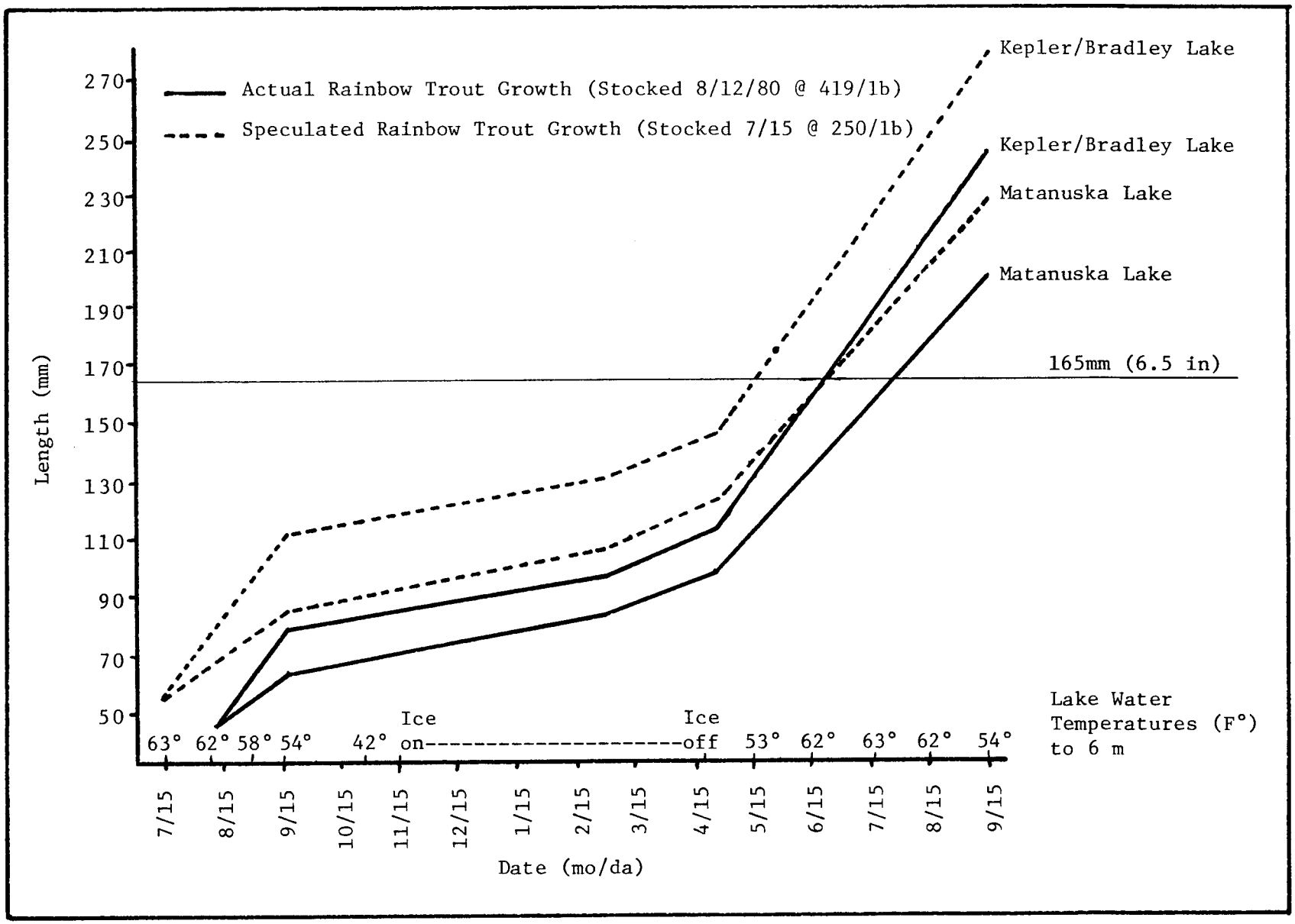

Fig. 4. Actual and Speculated Growth Curves for Swanson Strain Rainbow Trout Stocked in Kepler/Bradley and Matanuska Lakes.

Table 6. A Comparison of Fish Biomass in Selected Stocked Lakes of the Matanuska-Susitna Valley, Fall 1983.

Lake	Surface Area (acres)	Sample Date	Species*	Year Stocked	Population Estimate	Mean Weight (g)	Total Pounds of Fish	Pounds/ Surface Acre
Ravine	12.3	9/20/83	RT	1982	880	94	182	14.8
			RT	1981	107	288	68	5.5
			RT	1980	1**	2,951	7	0.5
							257	20.8
Reed	19.5	9/21/83	RT	1982	244	195	105	5.4
			RT	1981	21	594	27	1.4
							132	6.8
Tigger	18.9	9/27/83	RT	1982	968	56	119	6.3
			RT	1981	96	273	58	3.1
			RT	1979	5**	1,571	17	0.9
							194	10.3
			TS		72,647	0.73	117	6.2
							311	16.5
Walby	53.9	9/23/83	RT	1982	2,707	64	382	7.1
			RT	1981	519	656	750	13.9
							1,132	21.0
			TS		947,106	0.75	1,565	29.0
							2,697	50.0
			LNS		259	747	426	7.9
							3,123	57.9

Continued

Table 6 (cont.) A Comparison of Fish Biomass in Selected Stocked Lakes of the Matanuska-Susitna Valley, Fall 1983.

Lake	Surface Area (acres)	Sample Date	Species*	Year Stocked	Population Estimate	Mean Weight (g)	Total Pounds of Fish	Pounds/ Surface Acre
Sliver	7.2	9/22/83	RT	1982	32	290	20	2.8
			TS		256,965	0.93	526	73.1
							546	75.9

* RT: rainbow trout
TS: threespine stickleback
LNS: longnose sucker

** Total number captured; no population estimate possible.

detailed water chemistry analysis performed under contract by the United States Geological Survey are being examined for correlations related to lake fertility and potential game fish production (Woods et al., in prep.). These studies may lead to development of a model to predict potential winterkill, fish growth rates and stocked game fish production in landlocked lakes.

Stocking Experiments, 1984:

Junction, Knik and Matanuska Lakes, which were treated with rotenone in October 1982 to remove stickleback, and Johnson Lake were each stocked in late August 1983 at a density of 400 fish per surface acre with rainbow trout fingerling at about 250/lb. Population estimates will be performed in spring and fall 1984 to determine rainbow trout survival, growth and total biomass. Findings will be compared to data collected previously in Johnson Lake and prior to rehabilitation in Junction, Knik and Matanuska Lakes with Swanson trout stocked at densities of about 200 fish per surface acre.

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