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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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RESEARCH PROJECT SEGMENT

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

An investigation of two differing sizes of Swanson strain rainbow trout, Salmo gairdneri Richardson, stocked in nine Matanuska-Susitna Valley lakes indicated average survival to Age I+ for fingerling planted at 200 per pound was more than 1-1/2 times greater than for trout stocked at 500 per pound.

Results of 32 survival estimates for Swanson strain rainbow trout stocked at sizes ranging from 1,000 per pound to 130 per pound in Matanuska-Susitna Valley lakes revealed an average survival to Age I+ of 15 percent in lakes containing threespine stickleback, Gasterosteus aculeatus Linnaeus, while the average for all stocking sizes in rehabilitated lakes was 37 percent. Fingerlings planted at 200 per pound or larger in stickleback waters had an average survival of 19 percent. In rehabilitated lakes the average survival for rainbow trout stocked at 350 per pound or larger was 48 percent.

Biomass estimates for Swanson strain rainbow trout in three rehabilitated and six stickleback infested Matanuska-Susitna Valley lakes in the fall 1982 ranged from 1.4 to 37.4 pounds per surface acre. Two stickleback waters, Knik and Tigger Lakes, had 9.8 and 24.1 pounds of rainbow trout per surface acre, respectively, while respective stickleback biomass estimates were 34.1 and 28.0 pounds. A biomass estimate for stickleback in Junction

Lake was 180 pounds per surface acre, while the highest biomass estimate for any rehabilitated Matanuska-Susitna Valley lake was 46 pounds of rainbow trout per surface acre.

Results of six experiments examining release methods for stocking rainbow trout fingerling in landlocked lakes indicate fish held in a nylon mesh holding pen for up to 48 hours before release experienced up to 6 percent higher survival, and averaged 2 percent greater survival than fingerling stocked directly from a hatchery transport tank at a single release site.

Age I+ Swanson strain rainbow trout collected from three Matanuska- Susitna Valley lakes following chemical rehabilitation had a mean length of 189 millimeters. Trout were captured from those lakes prior to rehabilitation with fyke nets, standard gill nets and modified gill nets which included a 5/8-inch mesh panel. Mean length of Swanson strain trout trapped in fyke nets was 168 millimeters, while mean length of fish taken by standard gill net was 200 millimeters. Rainbow trout captured by modified gill net most closely paralleled the length-frequency distribution of the rotenone sample and averaged 188 millimeters.

KEY WORDS

Southcentral Alaska, rainbow trout, Salmo gairdneri, population estimates, fish growth, competition, limnology, productivity, habitat, capture techniques.

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 untreated lakes and in 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); (3) a chemical test for the determination of rotenone in water (Post, 1955) can give a reasonably 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, 1982); (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, 1982); (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 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. Research from 1974 to 1979 indicate the Swanson trout have a 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).

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. Table 2 gives the morphoedaphic index for selected Matanuska-Susitna Valley lakes and 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, Reed, Ravine, Tigger, Sliver and Walby Lakes.

2. Morphologies, sizes, age classes and relative numbers of threespine stickleback should be investigated in Tigger, Sliver 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 population levels in Reed, Johnson, Ravine, Tigger, Matanuska, Knik, Junction, Sliver and Walby Lakes were determined by Chapman's modification of the Peterson estimator or by Chapman's modification of the Schnabel multiple census estimate (Ricker, 1975).

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
Arctic grayling	Thymallus arcticus (Pallas)	GR
Longnose sucker	Catostomus catostomus Forste	LNS

Table 2. Morphoedaphic Index Values for Selected Lakes in the Matanuska-Susitna Valleys.

Lake	MEI*	Lake	MEI*
Walby	33.5	Matanuska	6.9
Sliver	25.8	Memory	5.3
Lucille	23.5	Meirs	3.4
Harriet	21.3	Rocky	3.1
Canoe	18.1	Tigger	2.7
Falk	16.7	"Y"	2.0
Echo	15.9	Christiansen	1.8
Junction	14.8	"X"	1.4
Seymour	14.6	Benka	1.3
Finger	13.3	Loon	1.3
Kepler	11.6	South Rolly	1.2
Irene	10.4	Big No Luck	1.1
Long	9.4	Twelve Mile	1.0
Victor	9.3	Prator	0.9
Knik	8.7	Milo #1	0.7
Florence	7.6	Chicken	0.5
Johnson	7.5	Byers	0.5
Reed	7.4	Marion	0.4

* MEI (morphoedaphic index) = conductance divided by mean depth. MEI gives a gross measure of relative potential productivity useful for categorizing and management purposes. Higher numerical values indicate increased potential productivity.

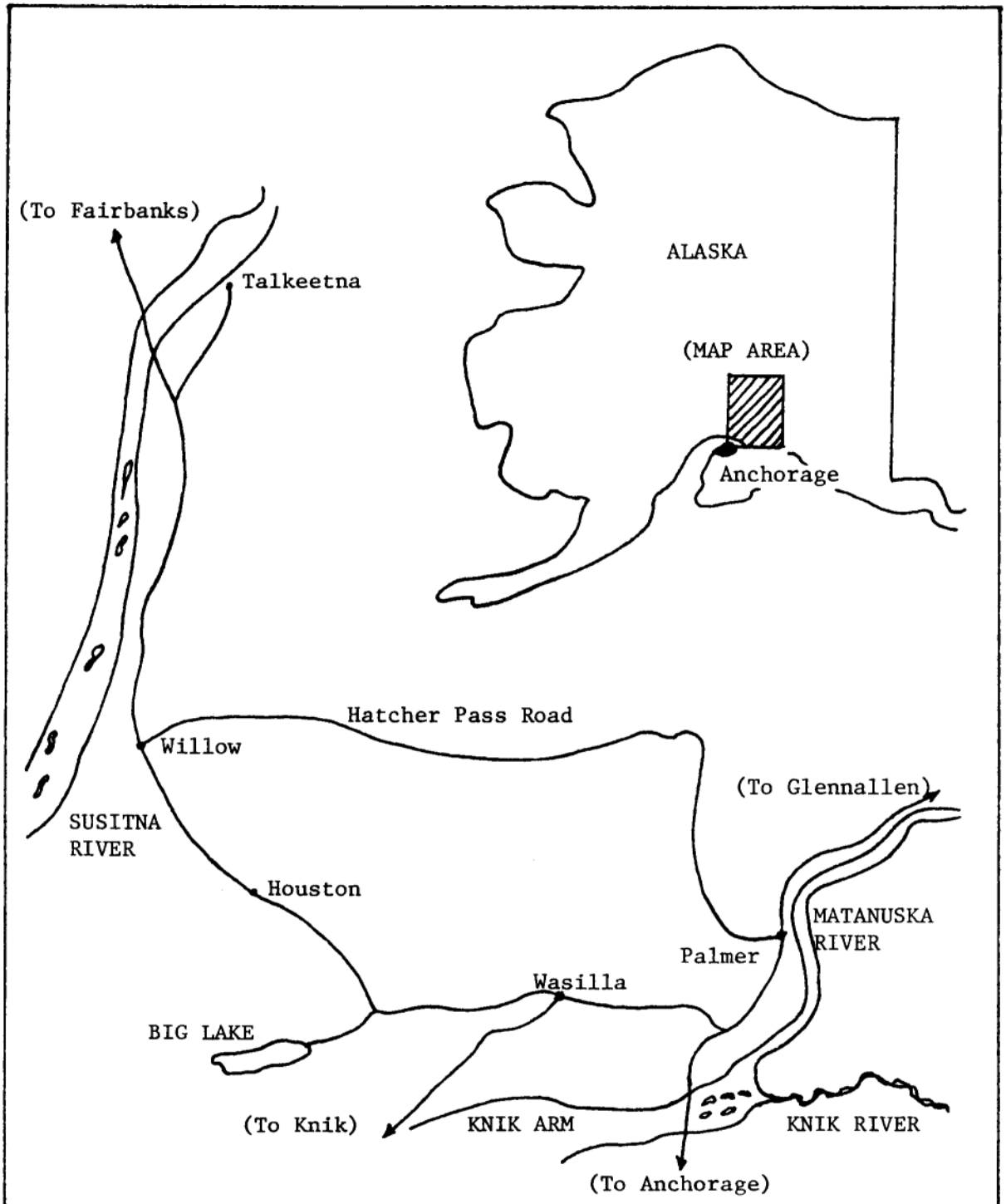

Fig. 1. Study Lake Area of Matanuska-Susitna Valleys.

In each lake, fish were captured for marking purposes with minnow traps or fyke nets or both. Minnow traps used to capture stocked rainbow trout fingerling were semi-collapsible and 17-1/2 inches in length with either 1/8-inch or 1/4-inch square wire mesh painted green and brown and baited with salmon eggs. Fyke nets, baited with salmon eggs, were two sizes of a similar design: (1) large mesh fyke nets 12 feet long, 40 inches in diameter, including two 4-foot X 25-foot wings (two square aluminum frames and five aluminum hoops supported the entrance and body of the fyke net), internal throats, body and wings were of a 3/8-inch square mesh knotless nylon and; (2) small mesh fyke nets 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 and had body of the fyke net), internal throats, body and wings were of 3/16-inch square mesh knotless nylon.

All trout 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 measured, 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 designed 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 trout was then returned to the water.

Rainbow trout were later captured using minnow traps, fyke nets or gill nets, or a combination of the three gear types. Gill nets were of two designs: (1) a standard 125-foot X 6-foot variable mesh monofilament gill net composed of five mesh sizes, 1/2-inch, 3/4-inch, 1-inch, 1-1/2 inch and 2-inch, each in a 25-foot panel and (2) a modified 120-foot X 6-foot variable mesh monofilament gill net composed of six 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.

Catch rates and growth of rainbow trout in stocked lakes were determined by the use of variable mesh gill nets, fyke nets or minnow traps. Trout killed by rotenone in Junction, Knik and Matanuska Lakes were collected with a long handled dip net. Junction, Knik and Matanuska Lakes were chemically treated with Chem-Fish Synergized 2.5% rotenone at 1.5 ppm in October 1982.

All catch and survival ratios for rainbow trout were adjusted for stocking densities. Fish measurements were expressed in fork lengths to the nearest millimeter and in weight to the nearest gram. Rainbow trout biomass estimates were converted from total grams to pounds.

Marked Swanson strain rainbow trout stocked in August and September 1981 and 1982 were anesthetized and fin-clipped at the hatchery and handcounted into transport tanks, while unmarked fish were either handcounted or numbers were obtained by weight sample.

FINDINGS

Effect of Stocking Size on Fish Survival

To continue experiments started in 1979, comparing survival between stocking sizes of Swanson strain rainbow trout in various lake types, nine Matanuska-Susitna Valley lakes were each stocked in 1981 with two size groups of fish; i.e., unmarked or ventral fin-clipped fingerling at approximately 500/lb and adipose or adipose and ventral fin-clipped fingerling at approximately 200/lb (Table 3). Although the two size groups were planted at near equal densities another variable, time of stocking, was not excluded from the experiment because the hatchery could not provide both size groups simultaneously.

Preliminary estimates performed in May and June indicated higher survival for fingerling stocked at a larger size with the exception of Matanuska and Sliver Lakes (Table 4). The lower survival of the larger stocked fingerling in Matanuska and Sliver Lakes may have been due to unobserved stress while the fish for both lakes were being marked and then transported from the hatchery on September 25, 1981. Estimated survivals for the 200/lb stocking group ranged from 5% in Johnson Lake to 72% in Ravine Lake, while survivals for the 500/lb fish were likewise lowest in Johnson Lake at 4% and highest in Ravine Lake at 63%. The low survival for both size groups in Johnson Lake may have been due to a partial winterkill as evidenced by a dissolved oxygen level in Johnson Lake of only 2.3 milligrams per liter in March 1982, no catch of large older fish stocked in previous years and observation of several dead trout in May.

Length and weight measurements recorded in June are also shown in Table 4. In each lake the rainbow trout fingerling that had been stocked at 500/lb were larger than fingerling stocked approximately 6 weeks later at 200/lb. The largest fish for both size groups were found in Johnson and Reed Lakes, both stickleback-free lakes with relatively low fish densities.

All nine lakes were sampled again in September and October when the trout reached catchable size at Age I+. Population estimates (Table 5) revealed higher survivals for fingerling stocked at 200/lb except for Matanuska and Sliver Lakes as was indicated in spring 1982 sampling. The lowest and highest survivals for both groups were again recorded in Johnson Lake and Ravine Lake, respectively. Survival ratios, 200/lb: 500/lb, ranged from 0.6:1 in Sliver Lake to 4.2:1 in Tigger Lake with an average ratio for all nine lakes of 1.6:1.

Length and weight measurements recorded in September are shown in Table 6. As noted during the spring sampling, rainbow trout that had been stocked at 500/lb were larger than those stocked about 6 weeks later at 200/lb. Mean lengths for the 500/lb stocking group ranged from 170 mm in Walby Lake to 305 mm in Johnson Lake while mean lengths for the fish stocked at 200/lb ranged from 156 mm in Knik Lake to 275 mm in Johnson Lake. Trout from both stocking groups were again largest in Johnson and Reed Lakes and had the greatest percent increase in both length and weight from the spring sampling period.

Table 3. Stocking Summary for Swanson Strain Rainbow Trout in Selected Matanuska-Susitna Valley Lakes, 1981.

Lake*	MEI	Surface Area (Acres)	Littoral** Area (Acres)	Shoreline Distance (Miles)	Date Stocked	Number Stocked	Mark and *** Release Method	Stocking Size (Fish/lb)	Stocking Density (Fish/ Surface Acre)	Stocking Density (Fish/ Littoral Acre)	Stocking Density (Fish/ Shoreline Mile)
Reed	7.4	19.5	13.7	0.870	8/14/81	1,930	(T)	538	198	282	4,437
					9/28/81	1,930	AD (T)	175			
Johnson	7.5	40.3	18.5	1.089	8/13/81	1,995	LV (T)	458			
					8/13/81	1,930	RV (P)	458	196	428	7,268
					9/24/81	1,998	LV/AD (T)	205			
					9/24/81	1,992	RV/AD (P)	205			
Ravine	20****	12.3	7.6	0.824	8/10/81	1,225	(T)	556			
					9/28/81	1,313	AD (T)	175	206	334	3,080
Tigger	2.7	18.9	10.8	0.862	8/14/81	2,295	(T)	538	243	425	5,328
					9/28/81	2,298	AD (T)	175			
Matanuska	6.9	61.5	14.1	1.619	9/11/81	3,070	LV (T)	514			
					8/11/81	3,060	RV (P)	455	200	871	7,588
					9/25/81	3,075	LV/AD (T)	207			
					9/25/81	3,080	RV/AD (P)	185			
Knik	8.7	50.4	23.7	1.477	8/13/81	5,070	(T)	485	201	428	6,860
					9/23/81	5,062	AD (T)	207			
Junction	14.8	10.9	6.0	0.588	8/12/81	540	LV (T)	438			
					8/12/81	543	RV (S)	422	199	362	3,692
					9/24/81	544	LV/AD (T)	205			
					9/24/81	544	RV/AD (S)	205			
Sliver	25.8	7.2	5.1	0.571	9/11/81	490	LV (T)	454			
					8/11/81	489	RV (S)	471	272	384	3,429
					9/25/81	490	LV/AD (T)	191			
					9/25/81	489	RV/AD (S)	191			
Walby	33.5	53.9	49.4	1.415	8/13/81	4,000	(T)	485	148	162	5,650
					9/23/81	3,995	AD (T)	207			

* Junction, Knik, Matanuska, Sliver, Tigger and Walby Lakes contain stickleback populations.
** Littoral area is that portion of the lake less than 15 ft deep.
*** Mark: LV = left ventral finclip; RV = right ventral finclip; AD = adipose finclip.
Release Method: P = held in pen for approximately 24 hours.
S = scatter plant; released around perimeter of lake.
T = stocked from hatchery truck at a single release site.
**** Ravine Lake MEI is approximated at 20 when specific conductance is modified for high sodium ions.

Table 4. Survival Ratios and Length-Weight Summaries for Two Stocking Sizes of Swanson Strain Rainbow Trout in Nine Matanuska-Susitna Valley Lakes, Spring 1982.

Lake	MEI	Stickleback Present	Date Stocked	Number Stocked	Stocking Size (fish/lb)	Sample Date	Population Estimate		Survival Ratio	Mean Length (mm)	Mean Weight (g)	C.F.*
							Number	Survival	200/lb : 500/lb			
Reed	7.4	No	8/14/81	1,930	538	6/23/82	214	11%	1.9 : 1	135.24	27.21	1.10
			9/28/81	1,930	175		402	21%		111.22	14.86	1.08
Johnson	7.5	No	8/13/81	3,925	458	6/14/82	161	4%	1.3 : 1	141.16	29.90	1.06
			9/24/81	3,990	205		198	5%		113.84	15.74	1.07
Ravine	20**	No	8/10/81	1,225	556	6/22/82	774	63%	1.1 : 1	111.14	14.83	1.08
			9/28/81	1,313	175		941	72%		91.30	8.07	1.06
Tigger	2.7	Yes	8/14/81	2,295	538	6/24/82	339	15%	4.2 : 1	101.14	10.55	1.02
			9/28/81	2,298	175		1,453	63%		90.29	7.51	1.02
Matanuska	6.9	Yes	8/11/81	6,130	485	6/17/82	1,720	28%	0.6 : 1	102.63	11.89	1.10
			9/25/81	6,155	195		1,086	18%		80.82	5.81	1.10
Knik	8.7	Yes	8/13/81	5,070	485	6/18/82	1,259	25%	1.5 : 1	106.17	12.09	1.01
			9/23/81	5,060	207		1,936	38%		87.08	6.67	1.01
Junction	14.8	Yes	8/12/81	1,083	430	6/16/82	307	28%	1.8 : 1	106.70	13.14	1.14
			9/24/81	1,088	205		547	50%		84.39	6.85	1.14
Sliver	25.8	Yes	8/11/81	979	462	6/14/82	371	38%	0.1 : 1	132.38	25.52	1.10
			9/25/81	979	191		51	5%		97.20	10.01	1.09
Walby	33.4	Yes	8/13/81	4,000	485	6/25/82	318	8%	1.2 : 1	100.06	10.92	1.09
			9/23/81	3,995	207		376	9%		95.04	8.93	1.04

* C.F. = Condition Factor = $\frac{100,000\ W}{L^3}$

** Ravine Lake MEI is approximated at 20 when specific conductance is modified for abnormally high sodium ions.

Table 5. Survival Ratios for Two Stocking Sizes of Swanson Strain Rainbow Trout in Nine Matanuska-Susitna Valley Lakes, Fall 1982.

Lake	MEI	Stickleback Present	Date Stocked	Number Stocked	Stocking Size (fish/lb)	Sample Date	Population Estimate	Survival	95% Confidence Level Estimate	95% Confidence Level Survival	Survival Ratio 200/lb : 500/lb
Reed	7.4	No	8/14/81	1,930	530	10/1/82	59	3%	41 - 77	2% - 4%	1.7 : 1
			9/28/81	1,930	175		101	5%	83 - 120	4% - 6%	
Johnson	7.5	No	8/13/81	3,925	458	9/24/82	109	3%	91 - 128	2% - 3%	1.1 : 1
			9/24/81	3,990	205		119	3%	101 - 137	2% - 3%	
Ravine	20*	No	8/10/81	1,225	556	10/5/82	748	61%	679 - 817	55% - 67%	1.4 : 1
			9/28/81	1,313	175		1,086	83%	1,017 - 1,155	78% - 88%	
Tigger	2.7	Yes	8/14/81	2,295	538	9/28/82	167	7%	123 - 212	5% - 9%	4.2 : 1
			9/28/81	2,298	175		700	31%	655 - 783	29% - 32%	
Matanuska	6.9	Yes	8/11/81	6,130	485	10/6/82	930	15%	870 - 990	14% - 16%	0.8 : 1
			9/25/81	6,155	195		723	12%	663 - 783	11% - 13%	
Knik	8.7	Yes	8/13/81	5,070	485	10/7/82	615	12%	541 - 690	11% - 14%	2.0 : 1
			9/23/81	5,060	207		1,242	25%	1,167 - 1,316	23% - 26%	
Junction	14.8	Yes	8/12/81	1,083	430	10/8/82	263	24%	200 - 344	19% - 32%	1.5 : 1
			9/24/81	1,088	205		397	37%	325 - 486	30% - 45%	
Sliver	25.8	Yes	8/11/81	979	462	9/30/82	117	12%	91 - 142	9% - 15%	0.6 : 1
			9/25/81	979	191		64	7%	39 - 90	4% - 9%	
Walby	33.5	Yes	8/13/81	4,000	485	9/28/82	301	8%	250 - 352	6% - 9%	1.3 : 1
			9/23/81	3,995	207		375	9%	324 - 426	8% - 11%	

* Ravine Lake MEI is approximated at 20 when specific conductance is modified for abnormally high sodium ions.

Table 6. Length-Weight Summaries for Two Stocking Sizes of Swanson Strain Rainbow Trout in Nine Matanuska-Susitna Valley Lakes, Fall 1982.

Lake	MEI	Stickleback Present	Date Stocked	Number Stocked	Stocking Size (fish/lb)	Sample Date	Number Sampled	Mean Length (mm)	Length Range (mm)	Mean Weight (g)	Weight Range (g)	C.F.*
Reed	7.4	No	8/14/81	1,930	538	10/1/82	29	270	236 - 307	240	160 - 391	1.22
			9/28/81	1,930	175		50	239	135 - 274	161	50 - 240	1.18
Johnson	7.5	No	8/13/81	3,925	458	9/24/82	73	305	248 - 340	393	230 - 550	1.39
			9/24/81	3,990	205		78	275	219 - 342	284	120 - 568	1.37
Ravine	20**	No	8/10/81	1,225	556	10/5/82	112	196	145 - 233	88	34 - 138	1.17
			9/28/81	1,313	175		168	180	135 - 248	68	32 - 160	1.17
Tigger	2.7	Yes	8/14/81	2,295	538	9/28/82	44	183	130 - 278	79	19 - 280	1.29
			9/28/81	2,298	175		163	164	118 - 245	58	20 - 187	1.31
Matanuska	6.9	Yes	8/11/81	6,130	485	10/6/82	84	182	132 - 250	70	26 - 176	1.16
			9/25/81	6,155	195		54	161	107 - 240	50	14 - 180	1.20
Knik	8.7	Yes	8/13/81	5,070	485	10/7/82	174	194	110 - 274	88	16 - 250	1.21
			9/23/81	5,060	207		405	156	87 - 242	47	8 - 160	1.24
Junction	14.8	Yes	8/12/81	1,083	430	10/8/82	157	215	130 - 299	121	27 - 320	1.22
			9/24/81	1,088	205		250	180	92 - 270	75	10 - 222	1.29
Sliver	25.8	Yes	8/11/81	979	462	9/30/82	47	220	177 - 260	127	62 - 222	1.19
			9/25/81	979	191		45	199	138 - 237	94	34 - 176	1.19
Walby	33.5	Yes	8/13/81	4,000	485	9/28/82	49	170	107 - 241	63	16 - 158	1.28
			9/23/81	3,995	207		66	169	102 - 253	62	14 - 180	1.28

* C.F. = Condition Factor = $\frac{100,000\ W}{L3}$

** Ravine Lake MEI is approximated at 20 when specific conductance is modified for abnormally high sodium ions.

Comparison of 1979, 1980 and 1981 Stocking Size Experiments:

This was the third year of experiments to examine the effect of stocking size on survival of Swanson strain rainbow trout in various lake types; i.e.: stickleback infested waters, rehabilitated lakes and lakes having a wide range of relative fertilities. Havens (1980) reported survival ratios for a 1979 experiment where equal densities of rainbow trout were stocked at approximately 350/lb and 1,000/lb in six lakes, then the next year reported results of a 1980 experiment (Havens 1981) where equal densities of trout were stocked in two size groups of approximately 400/lb and 500/lb. The findings of all three experiments are shown in Table 7.

In the 1979 experiment the 1,000/lb trout were stocked in mid-August about 4 weeks before the 350/lb fish were available from the hatchery. That experiment indicated survival ratios, 350/lb:1,000/lb, ranging from 2.1:1 to 5.8:1. In lakes free of stickleback, the average was 3.3:1 while in a low fertility stickleback lake the ratio was 5.8:1. Overall, 3.7 times more fingerling stocked at 350/lb survived to a catchable size than did fingerling planted at 1,000/lb.

In the 1980 experiment, both the 400/lb and 500/lb stocking groups of rainbow trout were introduced the same day in each lake in mid-August. As shown in Table 7 the survival ratio, 400/lb:500/lb, averaged 1:1 in lakes without stickleback and 1.4:1 in stickleback infested waters with an overall survival ratio to Age I+ of 1.2:1. Although the experiment had been designed to test 350/lb and 500/lb trout, only fingerling at approximately 400/lb were available for stocking simultaneously with 500/lb fish.

In the 1981 experiment the larger 200/lb fingerling were stocked approximately 6 weeks after the 500/lb fish. The survival ratio of 200/lb: 500/lb trout, as indicated in the previous section, was 1.6:1 for all lakes combined with the greatest difference in survival between stocking groups in lakes containing stickleback.

For a 1982 experiment, two size groups of Swanson strain rainbow trout fingerling at approximately 250/lb and 500/lb were stocked at equal densities on the same day in five Matanuska-Susitna Valley lakes in mid-August 1982 (Table 8). Preliminary sampling (fingerling were captured in both small mesh and large mesh fyke nets during population sampling for the 1981 stocked trout in October 1982) gave catch ratios, 250/lb: 500/lb, from 1.6:1 to 5.4:1. The ratio for two stickleback-free lakes averaged 1.7:1, in three stickleback lakes the ratio was 4.1:1 and for all five lakes 3.2 fingerling stocked at 250/lb were caught for every trout stocked at 500 fish per pound.

Survival Estimates to Age I+ for Various Rainbow Trout Stocking Sizes:

Havens (1979-1982) reported population and survival estimates for various stocking sizes of Swanson strain rainbow trout fingerling in selected landlocked lakes of the Matanuska-Susitna Valley. Survival data for different stocking sizes of trout in rehabilitated lakes and stickleback infested waters are shown in Table 9.

Table 7. Survival Ratios at Age I+ for Stocking Groups of Swanson Strain Rainbow Trout in Selected Matanuska-Susitna Valley Lakes, 1980, 1981 and 1982.

Lake	MEI	Stickleback Present	Survival Ratios at Age I+ 1979 Experiment Stocking Sizes 350/1b : 1000/1b	1980 Experiment Stocking Sizes 400/1b : 500/1b	1981 Experiment Stocking Sizes 200/1b : 500/1b
Marion	0.4	No	...	1.2 : 1	...
Reed	7.4	No	2.1 : 1	...	1.7 : 1
Johnson	7.5	No	2.5 : 1	...	1.1 : 1
Florence	7.6	No	6.0 : 1	...	...
Irene	10.4	No	3.2 : 1	...	...
Weiner	12*	No	2.5 : 1	...	...
Ravine	20*	No	...	0.7 : 1	1.4 : 1
Big No Luck	1.1	Yes	...	1.3 : 1	...
"Y"	2.0	Yes	...	2.1 : 1	...
Tigger	2.7	Yes	5.8 : 1	...	4.2 : 1
Matanuska	6.9	Yes	...	...	0.8 : 1
Knik	8.7	Yes	...	...	2.0 : 1
Junction	14.8	Yes	...	1.2 : 1	1.5 : 1
Sliver	25.8	Yes	...	0.9 : 1	0.6 : 1
Walby	33.5	Yes	...	...	1.3 : 1
Combined Lake Totals:					
No Stickleback			3.3 : 1	1.0 : 1	1.4 : 1
Stickleback Present			5.8 : 1	1.4 : 1	1.7 : 1
All Lakes Combined			3.7 : 1	1.2 : 1	1.6 : 1

* Weiner Lake and Ravine Lake MEI values are approximated at 12 and 20, Respectively, when specific conductance is modified for abnormally high sodium ions.

Table 8. Stocking Summary for Swanson Strain Rainbow Trout in Selected Matanuska-Susitna Valley Lakes, 1982.

Lake*	MEI	Surface Area (Acres)	Littoral** Area (Acres)	Shoreline Distance (Miles)	Date Stocked	Number Stocked	Mark***	Stocking Size (Fish/lb)	Stocking Density (Fish/ Surface Acre)	Stocking Density (Fish/ Littoral Acre)	Stocking Density (Fish/ Shoreline Mile)
Johnson	7.5	40.3	18.5	1.089	9/ 2/82	15,950		326	396	862	14,646
Reed	7.4	19.5	13.7	0.870	8/12/82	1,948	(AD)	255	200	284	4,477
						1,947		477			
Ravine	20****	12.3	7.6	0.824	8/13/82	1,225	(AD)	281	198	321	2,961
						1,215		537			
Tigger	2.7	18.9	10.8	0.862	8/13/82	2,298	(AD)	259	243	426	5,332
						2,298		653			
Sliver	25.8	7.2	5.1	0.571	8/12/82	977	(AD)	247	270	391	3,405
						967		477			
Walby	33.5	53.9	49.4	1.415	8/12/82	5,385	(AD)	280	200	218	7,611
						5,385		477			

* Tigger, Sliver and Walby Lakes contain populations of threespine stickleback.

** Littoral area is that portion of the lake less than 15 feet deep.

*** Mark: AD = adipose finclip.

**** Ravine Lake MEI is approximated at 20 when specific conductance is modified for high sodium ions.

Table 9. Survival Estimates at Age 1+ for Swanson Strain Rainbow Trout Stocked in Selected Lakes of the Matanuska-Susitna Valley, 1978-1982.

Rainbow Trout* Stocking Size (Fish/lb)	Number of Survival Estimates	Lake Condition	Survival Estimates at Age 1+ Range	Average
1,000/lb	3	No Stickleback	9% - 24%	19%
	1	Stickleback Present		2%
	4	All Lakes combined	2% - 24%	15%
500/lb	2	No Stickleback	3% - 61%	32%
	6	Stickleback Present	7% - 24%	13%
	8	All Lakes Combined	3% - 61%	18%
350/lb	3	No Stickleback	57% - 60%	59%
	1	Stickleback Present		13%
	4	All Lakes Combined	13% - 60%	47%
200/lb	6	No Stickleback	5% - 83%	44%
	8	Stickleback Present	7% - 37%	18%
	14	All Lakes Combined	5% - 83%	29%
130/lb	1	No Stickleback		42%
	1	Stickleback Present		23%
	2	Both Lakes Combined	23% - 42%	33%
Totals:				
All Sizes	15	No Stickleback	3% - 83%	37%
	17	Stickleback Present	2% - 37%	15%
	32	All Lakes Combined	2% - 83%	27%

* In 24 of the 32 survival estimates the rainbow trout fingerling were marked with an adipose finclip or a ventral finclip or both before being stocked.

A comparison of rainbow trout fingerling stocking sizes from 1,000/lb to 130/lb indicates a range of survivals from 2% to 37% with an average survival to catchable size at Age I+ in stickleback waters of 15%. When fingerling are stocked in stickleback lakes at a size of 350/lb or smaller, survivals averaged only 12% while trout planted at 200/lb or larger had an average survival of 19%.

In rehabilitated lakes average survival for all stocking sizes was 37%. Fingerling stocked at 500/lb or smaller in stickleback-free waters had an average survival of 24% while fingerling survival to catchable size at Age I+ when stocked at 350/lb or larger averaged 48%. These survival estimates, in most cases, must be considered minimal because of unknown or unmeasured recreational harvest. In 24 of the 32 survival estimates rainbow trout fingerling were marked at the hatchery before being stocked and therefore may have experienced unobserved fin-clip related mortalities after being planted.

Findings related to better survival and growth of Swanson strain trout in rehabilitated lakes than in stickleback infested waters are similar to data presented by Chlupach (1977) for study lakes in southcentral Alaska stocked with domestic trout strains from Montana and Washington. Data presented indicate that usually the larger the rainbow trout fingerling stocked the better the survival, and the earlier in the open- water season fingerling are planted the quicker those fish reach catchable size the following year.

Fish Biomass Estimates for Selected Matanuska-Susitna Valley Lakes

At the same time fall 1982 survival estimates were performed in nine Matanuska-Susitna Valley lakes for the 1981 stocking size experiment, population estimates were made for all age classes of rainbow trout inhabiting the lakes. Population estimates, fish sizes and total pounds of rainbow trout for each lake are shown in Table 10. In addition, population estimates and total pounds of stickleback are given for Knik and Tigger Lakes from data gathered for a separate report (Havens et al., in prep.).

Lakes containing stickleback had rainbow trout biomass estimates ranging from 1.4 to 30.4 pounds per surface acre with an average of 16 pounds per surface acre. In Knik and Tigger Lakes there were 9.8 and 24.1 pounds of trout per surface acre, respectively, while threespine stickleback biomass estimates were 34.1 and 28.0 pounds per surface acre, respectively. Population estimates in July revealed 73.6 pounds of stickleback per surface acre in Matanuska Lake and 180.4 pounds of stickleback per surface acre in Junction lake (Havens et al., in prep.).

Rainbow trout biomass in rehabilitated lakes ranged from 4.1 pounds per surface acre in Johnson Lake to 37.4 pounds per surface acre in Ravine Lake. In nine fish biomass estimates for rehabilitated lakes (Chlupach, 1978; Havens, 1981) the range in pounds of rainbow trout per surface acre was 6 to 46 and the average was 20 pounds per surface acre. The highest estimate, 46 pounds per surface acre in Johnson Lake, was reached by rainbow trout stocked the first year following lake rehabilitation.

Competition as defined by Darwin (1859) is "the demand of more than one organism for the same resource of the environment in excess of immediate

Table 10. A Comparison of Fish Biomass in Selected Stocked Lakes of the Matanuska-Susitna Valleys, Fall 1982.

Lake	MEI	Stickleback Present	Surface Area (Acres)	Littoral Area (Acres)	Species	Year Stocked	Population Estimate	Mean Length (mm)	Mean Weight (g)	Pounds of Fish	Pounds per Surface Acre	Pounds per Littoral Acre
Reed	7.4	No	19.5	13.7	RT	1981	59	270	240	31	1.6	2.3
					RT	1981	101	239	161	36	1.8	2.6
					RT	1979*	26	508	1,884	108	5.5	7.9
										175	8.9	12.8
Johnson	7.5	No	40.3	18.5	RT	1981	109	305	393	94	2.3	5.8
					RT	1981	119	275	284	74	1.8	4.0
										168	4.1	9.8
Ravine	20**	No	12.3	7.6	RT	1981	748	196	88	145	11.8	19.1
					RT	1981	1,086	180	68	163	13.3	21.5
					RT	1980	151	309	330	110	8.9	14.5
					RT	1979*	15	482	1,256	42	3.4	5.5
										460	37.4	60.6
Tigger	2.7	Yes	18.9	10.8	RT	1981	167	183	79	29	1.5	2.7
					RT	1981	700	165	58	89	4.7	8.2
					RT	1979*	62	498	1,929	263	13.9	24.4
										381	20.1	35.3
					TS		164,359	48.9	1.46	529	28.0	49.0
					RT & TS					910	48.1	84.3
Matanuska	6.9	Yes	61.5	14.1	RT	1981	930	182	70	143	2.3	10.1
					RT	1981	723	161	50	80	1.3	5.7
					RT	1980	265	411	1,000	584	9.5	41.4
					RT	1979*	20	532	2,162	95	1.5	6.7
										902	14.6	63.9
					TS		...			...	...	...
Knik	8.7	Yes	50.4	23.7	RT	1981	615	194	88	119	2.4	5.0
					RT	1981	1,242	156	47	129	2.6	5.4
					RT	1980	94	383	824	171	3.4	7.2
					RT	1979*	23	454	1,370	69	1.4	2.9
										488	9.8	20.5
					TS		1,367,980	35.8	0.57	1,718	34.1	72.5
					RT & TS					2,206	43.9	93.0
Junction	14.8	Yes	10.9	6.0	RT	1981	263	215	121	70	6.4	11.7
					RT	1981	397	180	75	66	6.1	11.0
					RT	1980	42	387	803	74	6.8	12.3
										210	19.3	35.0
					TS		...			...	...	...

Table 10. (cont.) A Comparison of Fish Biomass in Selected Stocked Lakes of the Matanuska-Susitna Valleys, Fall 1982.

Lake	MEI	Stickleback Present	Surface Area (Acres)	Littoral Area (Acres)	Species	Year Stocked	Population Estimate	Mean Length (mm)	Mean Weight (g)	Pounds of Fish	Pounds per Surface Acre	Pounds per Littoral Acre
Sliver	25.8	Yes	7.2	5.1	RT	1981	117	220	127	33	4.6	6.5
					RT	1981	64	199	94	13	1.8	2.6
					RT	1980	147	361	534	173	24.0	33.9
										219	30.4	43.0
					TS		...			...	...	...
Walby	33.5	Yes	53.9	49.4	RT	1981	301	170	63	42	0.8	0.9
					RT	1981	375	169	62	51	0.9	1.0
										93	1.7	1.9
					TS		...			...	...	...
					LNS		...			...	...	...

* A few rainbow trout included in the population estimate for the 1979 stocking group may in earlier years.
** Ravine Lake MEI is approximated at 20 when specific conductance is modified for abnormally high sodium ions.

supply." While complete competitors cannot coexist (Hardin, 1960), competition is most severe between organisms with similar habits (Crombie, 1947). Competition is assumed to have occured when the presence of more than one species causes the average total biomass of one of them to be less than it would be if that species were existing alone (Maitland, 1956; Moermond, 1978).

Studies by Havens (1982) and Wenderoff (1982) comparing relative survival and growth of rainbow trout in rehabilitated Kepler-Bradley Lake and stickleback-infested Knik and Matanuska Lakes indicated superior survival and growth for trout stocked in Kepler-Bradley Lake. Examination of gut contents of rainbow trout fingerling and stickleback suggested competition, as both species utilized the same food organisms but in different proportions. In the rehabilitated lake, rainbow trout fingerling, lacking inter-species competition, fed mainly on zooplankton from the time of introduction in late summer through the following spring. In Knik and Matanuska Lakes, however, trout fingerling displayed a more varied food selection heavily utilizing insects and benthic organisms in addition to zooplankton while zooplankton, appeared to be the most important food item for stickleback throughout the year.

Havens (1981) reported data collected over several years on the lengths of Swanson strain rainbow trout at Age I+ indicated fish are normally larger in rehabilitated lakes than in stickleback infested waters. Age I+ trout in non-stickleback lakes averaged 216 mm (8.5 in) with means ranging from 153 mm to 304 mm (6 to 12 in), while those fish in stickleback-infested lakes averaged 180 mm (7 in) with means ranging from 156 mm to 225 mm (6 in to 9 in). An exception may be rainbow trout fingerling planted in stickleback lakes that have not been stocked previously, or that have not been stocked for several years. These fish exhibit first year growth not matched by a subsequent plant of trout as is indicated in Table 11. There are probably food organisms available, between time of rainbow trout fingerling introduction and Age I+, which are not being fully utilized by stickleback but which, in turn, are not available to following trout plants. This may be due to subsequent higher trout densities or because those organisms were cropped-off to some lower level.

The most critical period for rainbow trout survival appears to be within the first few weeks following introduction into a lake as fingerling (Havens, 1981). Although this initial period is critical for fingerling in both stickleback-free and stickleback-infested lakes, studies indicate additional loss of fingerling in a stickleback-infested lake, following population estimates seven weeks after trout introduction, but no similar loss of fingerling through the following spring in a rehabilitated lake (Havens, 1982).

Recent studies suggest a great numerical difference between threespine stickleback and stocked trout in landlocked lakes. Population estimates from four lakes revealed stickleback densities ranging from 8,700 to 27,000 per surface acre, and mean stickleback weights ranging from 275 to 582 fish per pound. Fingerling trout averaging between 200 to 500 per pound are normally introduced into these stickleback waters at densities ranging from 75 to 300 per surface acre. All available evidence indicates that the

Table 11. Length-Weight Summaries for Swanson Strain Rainbow Trout Stocked in Junction and Sliver Lakes, 1980 and 1981.

Lake	Stocking Size (Fish/lb)	Date Stocked	Date Sampled	Elapsed Time (Days)	Mean Length (mm)	Length Range (mm)	Mean Weight (g)	Weight Range (g)	C.F.
Junction	499	8/10/80	10/ 6/81	414	199	146-348	105	36-517	1.33
	430	8/12/81	10/ 8/82	422	180	92-270	75	10-222	1.29
Sliver	498	8/19/80	10/ 7/81	414	289	228-338	271	136-453	1.12
	462	8/11/81	9/30/82	415	199	138-237	94	34-176	1.19

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.

Rainbow trout that have survived in stickleback lakes from time of introduction as fingerling in late summer or fall through the winter to the following spring soon reach a size where they can consume organisms larger than those available to stickleback and begin to prey on stickleback. Examination of stomachs of gill-netted rainbow trout in five lakes (Table 12) revealed 38% of the trout 153 mm (6 in) or larger had consumed stickleback.

Investigation of Stocking Methods

Havens (1980) gave results of a study designed to test three methods for releasing rainbow trout fingerling into landlocked lakes. Two lakes, a rehabilitated lake and a stickleback lake, were each stocked at a total of 200 fish per surface acre. In each lake 1/3 of the fingerling were released directly from the hatchery transport truck as is the normal stocking method, a similar number of fingerling were released uniformly around the perimeter of each lake and the balance were put in a nylon 1/4-inch mesh holding pen for 48 hours then released at that point into the lake. Population estimates were performed 7 weeks later in both lakes. In the rehabilitated lake penned trout had a 7% better survival than fingerling planted around the shoreline of the lake and a 4% higher survival than those released directly from the hatchery truck. In the stickleback infested lake penned fish had a 2% lower survival than those planted around the shoreline but a 6% higher survival than fingerling released directly from the hatchery truck.

To further test release methods, three stickleback lakes and one rehabilitated lake were stocked with rainbow trout fingerling (Table 13). Matanuska and Johnson Lakes were each stocked with equal densities of fingerling at approximately 500/lb. In each lake one group of fish was planted at a single release site, whereas an equal number of fingerling were held in a small mesh holding pen for 24 hours before release. In August the experiment was repeated with rainbow trout at about 200/lb. In Junction and Sliver Lakes the fingerling were either planted directly from the hatchery truck at a single release site or stocked around the shoreline of each lake.

Survival estimates performed in June 1982 for rainbow trout fingerling in Matanuska and Johnson Lakes indicated fingerlings penned for 24 hours before release had a 2% higher survival in Matanuska Lake, while the survival for both planting methods in Johnson Lake was almost equal. In Sliver Lake the trout that had been released around the perimeter of the lake had a 2% higher survival than fingerling stocked directly from the hatchery truck at a single release site. In Junction Lake, however, the scatter planted fish released in August had a 3% higher survival than the single release site fingerling, while survival of fingerling stocked in September at approximately 200/lb was reversed with single release site fish having a 16% higher survival than scatter-planted trout. The higher survival of fingerling stocked from a single release site during the

Table 12. Percent Composition of Stickleback in Rainbow Trout Stomachs from Six Matanuska-Susitna Valley Lakes.

Lake	Sample Date (Mo/Yr)	Number Stomachs Examined	Mean Length (mm)	Length Range (mm)	Stomachs* Containing Food Items Number (%)	Rainbow Trout Containing Stickleback Number (%)	Rainbow Trout Mean Length (mm)	Rainbow Trout Length Range (mm)
Big No Luck	6/79	14	297	108-340	13 (93%)	0		
	9/79	203	196	110-376	38 (19%)	165 (81%)	217	153-376
Long	6/79	14	278	170-441	12 (86%)	4 (14%)	180	170-190
	8/79	12	343	278-510	10 (83%)	10 (83%)	345	278-510
Matanuska	6/79	12	410	344-472	5 (42%)	2 (17%)	464	460-468
	8/79	33	183	110-258	28 (85%)	10 (30%)	224	189-258
	6/80	19	248	179-378	13 (68%)	0		
	10/80	51	302	163-618	44 (86%)	34 (67%)	309	165-618
Knik	8/79	72	211	108-428	63 (88%)	19 (26%)	276	158-414
	10/80	75	206	153-520	59 (79%)	38 (51%)	231	163-520
Tigger	9/80	18	198	154-250	17 (94%)	8 (44%)	217	178-250
Combined Samples:								
	June	59	300	108-472	43 (73%)	4 (9%)	322	153-468
	August-October	464	215	108-618	386 (83%)	158 (41%)	256	158-618
All Sample Dates:		523	224	108-618	429 (82%)	162 (38%)	257	153-618

* A cursory examination of rainbow trout stomach contents showed the following items: Threespine stickleback, snails, clams, shrews, gamarus, water beetles; numerous other insects (adult and larval forms), plankton, vegetation, commercially fixed salmon eggs and heads of rainbow trout cleaned by fishermen.

Table 13. Survival Estimates for Stocked Swanson Strain Rainbow Trout in Matanuska, Johnson, Junction and Sliver Lakes, 1982.

Lake	MEI	Stickleback Present	Date Stocked	Number Stocked	Stocking Size (Fish/lb)	Mark and* Release Method	Sample Date	Population Estimate	Survival	95% Confidence Level Estimate	95% Confidence Level Survival
Matanuska	6.9	Yes	8/11/81	3,070	514	LV (T)	6/17/82	818	27%	734-903	24%-29%
				3,060	455	RV (P)		902	29%	815-988	27%-32%
			9/25/81	3,075	207	LV/AD (T)		515	17%	443-586	14%-17%
				3,080	185	RV/AD (P)		571	19%	497-647	16%-21%
Johnson	7.5	No	8/13/81	1,995	458	LV (T)	6/15/82	82	4%	66- 99	3%- 5%
				1,930	458	RV (P)		79	4%	62- 95	3%- 5%
			9/24/81	1,998	205	LV/AD (T)		93	5%	60-126	3%- 6%
				1,992	205	RV/AD (P)		105	5%	72-138	4%- 7%
Junction	14.8	Yes	8/12/81	540	438	LV (T)	6/16/82	144	27%	106-181	20%-34%
				543	458	RV (S)		163	30%	126-201	23%-37%
			9/24/81	544	205	LV/AD (T)		316	58%	258-374	47%-69%
				544	205	RV/AD (S)		231	42%	173-289	32%-53%
Sliver	25.8	Yes	8/11/81	490	454	LV (T)	6/14/82	179	37%	155-204	32%-42%
				489	471	RV (S)		192	39%	167-216	34%-44%
			9/25/81	490	191	LV/AD (T)		22	4%	10- 35	2%- 7%
				489	191	RV/AD (S)		29	6%	16- 42	3%- 9%

* Mark: LV = left ventral finclip; RV = right ventral finclip; AD = adipose finclip.
Release Method: T = stocked from hatchery truck at a single release site.
P = held in pen for approximately 24 hours.
S = scatter plant; released around perimeter of lake.

September plant may have been due to predation of fingerling released around the shoreline by large holdover trout feeding in shallow waters of the lake.

As found during investigations by Havens (1980) the only constant results from these three release methods is that penned fingerling appear to experience higher survival than fingerling planted directly from a hatchery transport truck. The greatest survival difference between the two methods was 6% and the average of the six experiments is a little over 2%. Further assessment of stocking methods is needed.

Catch Comparisons Between Various Fish Sampling Methods

Stickleback-infested Junction, Knik and Matanuska Lakes were chemically rehabilitated in October 1982. Fyke nets, standard gill nets and modified gill nets which include a 5/8-inch mesh panel between the 1/2 and 3/4-inch mesh panels were used during the recapture portion of the estimate. In each lake all captured rainbow trout were removed from the lake and measured. Within 5 days following the population estimates in Matanuska and Knik Lakes and during the same day as the estimate in Junction Lake, the lakes were chemically treated and all rainbow trout within reach of a long-handled dip net were collected. Figure 2 shows, for each sample method, the number, mean length and catch per unit of effort for all Age I+ rainbow trout collected in all three lakes.

The rotenone sample, which should be the least biased of all collection methods, was closest to the mean length and length-frequency distribution for rainbow trout captured by modified gill nets which include a 5/8-inch mesh panel. Although the length range was similar for all sample methods, fyke-netted trout mean length was 21 mm less than the rotenone sample, while standard gill nets gave a mean length 11 mm higher. A close look at the actual length-frequency distribution depicted in Figure 2 suggests that use of only the standard gill nets, now used in most field operations, could result in substantial error for recording the growth and relative abundance of fish in many populations.

These findings are similar to data presented by Havens (1981). When performing population estimates for Age I+ Swanson strain rainbow trout in low fertility or stickleback-infested Matanuska-Susitna Valley lakes, fyke nets and minnow traps are used to capture fish for marking purposes. Standard gill nets used for the recapture portion of the estimates often completely missed trout in the 135 mm to 165 mm range. The use of modified gill nets which included a 5/8-inch mesh panel resulted in the capture of smaller trout in an approximate proportion to which they had been captured by fyke nets.

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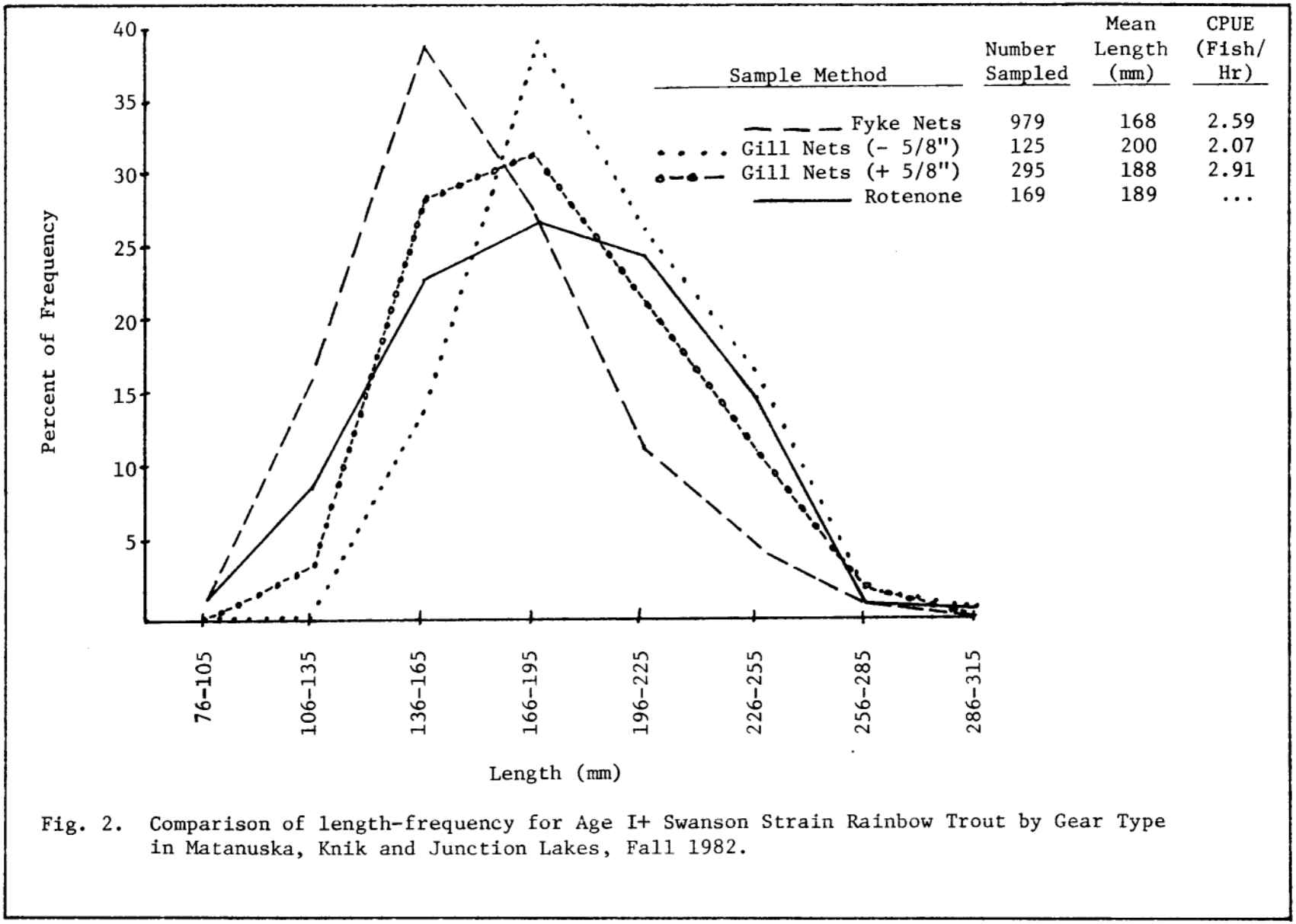

Fig. 2. Comparison of length-frequency for Age I+ Swanson Strain Rainbow Trout by Gear Type in Matanuska, Knik and Junction Lakes, Fall 1982.

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