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Jay S. Hammond, Governor

Annual Performance Report for

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

by

Alan C. Havens

ALASKA DEPARTMENT OF FISH AND GAME
Ronald O. Skoog, Commissioner

SPORT FISH DIVISION
Rupert E. Andrews, Director

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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.

As part of the collection of baseline data on Swanson strain rainbow trout, Salmo gairdneri Richardson, (for comparison with future brood stock candidate strains of native Alaska rainbow trout) mean lengths and weights of several age classes of Swanson trout are presented, as are data which reveal significant correlations between morphoedaphic index values and instantaneous biomass estimates of Age I+ Swanson fish in stocked lakes.

An investigation of two stocking sizes of Swanson strain rainbow trout in six Matanuska-Susitna Valley lakes indicates survival to Age I for fingerling planted at 350 per pound were two to six times greater than for fry stocked at 1,000 per pound. Survival estimates ranged from 13 percent in Tigger Lake to 60 percent in Johnson Lake for the fingerling plant, while fry survivals in Tigger and Johnson Lakes were 2 percent and 25 percent, respectively.

Release methods for stocking rainbow trout fingerlings were tested in rehabilitated Johnson Lake and in Long Lake which has a population of threespine stickleback, Gasterosteus aculeatus Linnaeus. In each lake one marked group of fish was released directly from the hatchery truck at a single release site, another group was scatter-planted around the shoreline and the third group was put into a small mesh holding pen from which the fish could escape. Population estimates from Johnson and Long Lakes suggest the penned trout had a 4 percent and 6 percent, respectively, higher survival than the fish stocked at a single release site.

Ongoing investigation of techniques and equipment for sampling fish populations in stocked lakes reveal substantial differences in gear efficiency for the capture of various size ranges of rainbow trout. Catch comparisons between two gill net designs, two sizes of fyke net and between fyke nets, gill nets and seines are discussed.

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 equipment to 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); and (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); (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); and (3) coho salmon in landlocked lakes exhibit significantly greater survival than do domestic rainbow trout strains (Chlupach, 1978).

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); and (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).

Another facet of the investigation was the selection of a native Alaskan strain of rainbow trout from the Swanson River on the Kenai Peninsula as brood stock for Alaska's lake stocking program. Six years of research, from 1974 to 1979, indicated the Swanson trout had 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 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 on the growth and survival of the Swanson strain in all types of stocked lakes are being collected. There are plans for a larger, more modern rainbow trout hatchery in the Anchorage area, which should have the capability to hold and rear several brood stock strains. Candidate brood strains can be examined for hatchery suitability, then tested against the Swanson strain in field performance 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 Big No Luck, Junction, Marion, Ravine, Sliver and "Y" Lakes.

2. Population estimates should be obtained for Swanson strain rainbow trout planted in Johnson and Long Lakes.

3. Investigations 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.

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
Ninespine stickleback	*Pungitius pungitius* (Linnaeus)	NS
Arctic grayling	*Thymallus arcticus* (Pallas)	GR

Table 2. Morphoedaphic Index Values for Selected Lakes in the Matanuska-Susitna Valleys (Watsjold, 1976).

Lake	MEI*	Lake	MEI*
Lucille	23.5	Memory	5.3
Harriet	21.3	Reed	4.9
Canoe	18.1	Meirs	3.4
Falk	16.7	Rocky	3.1
Echo	15.9	Christiansen	1.8
Seymour	14.6	Benka	1.3
Finger	13.3	Loon	1.3
Junction	13.2	South Rolly	1.2
Kepler	11.6	Big No Luck	1.1
Irene	10.4	Twelve Mile	1.0
Long	9.4	Prator	0.9
Victor	9.3	Milo #1	0.7
Knik	9.1	Chicken	0.5
Matanuska	8.2	Byers	0.5
Florence	7.6	Marion	0.4
Johnson	7.4		

* MEI (morphoedaphic index) = conductance divided by mean depth. MEI gives a gross measure of relative potential productivity useful for categorizing and management purposes. MEI values above 13 are most productive, values below 3 are least productive, while values between 3 and 13 range from moderately low to moderately high in productivity (Chlupach, 1978).

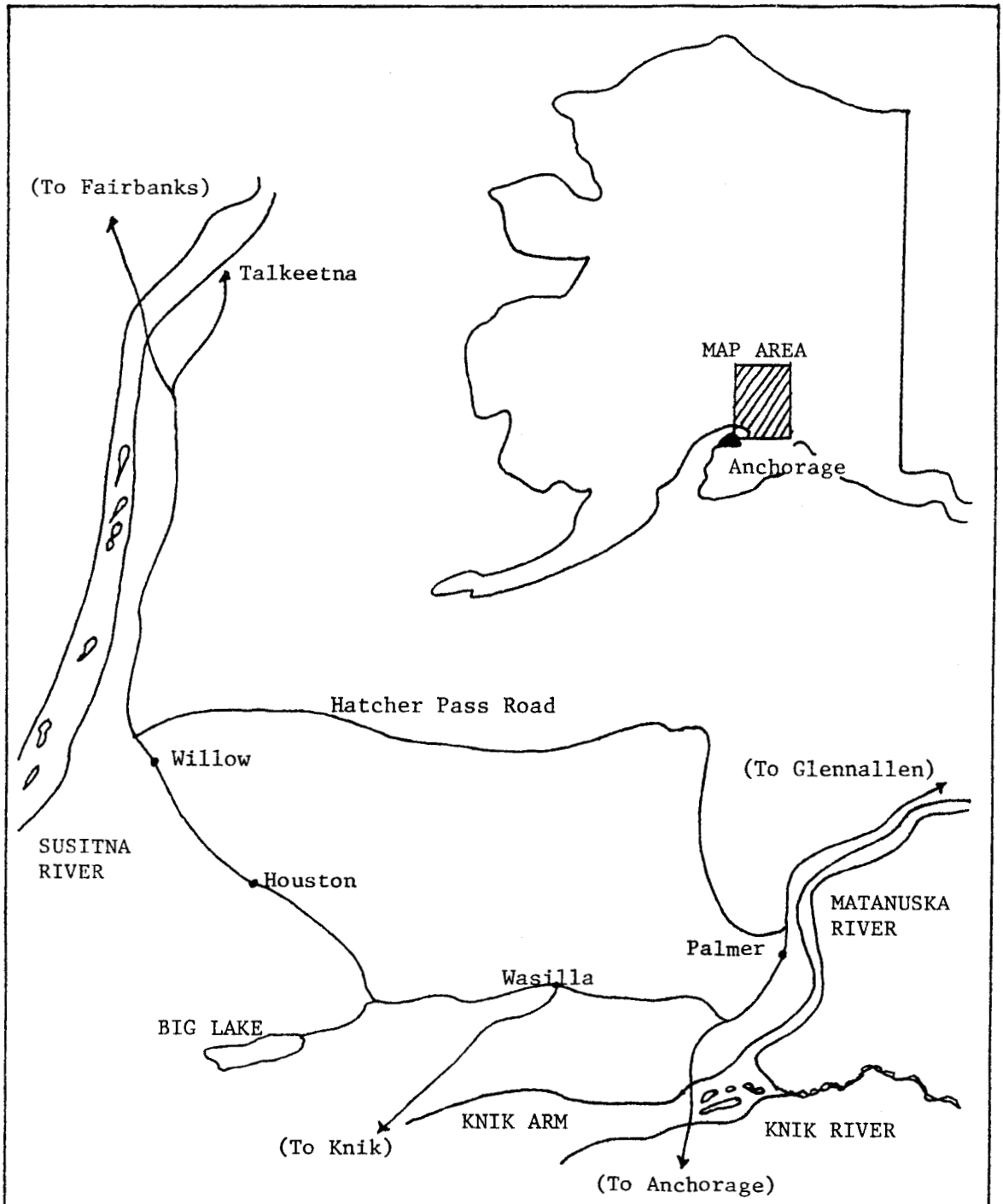

Fig. 1. Study Lake Area of Matanuska-Susitna Valleys.

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 populations in Johnson, Long, Weiner, Florence and Tigger Lakes were determined by Chapman's modification of the Peterson estimator or by Chapman's modification of the Schnabel multiple census estimate of population size (Ricker, 1975).

In each lake, fish were captured for marking purposes with minnow traps or fyke nets or both. Minnow traps used to capture newly stocked fingerlings 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. The traps used to sample populations with larger fingerlings were either the 1/8 inch traps or 1/4 inch minnow traps. 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 3/8 inch square mesh knotless nylon; (2) small mesh fyke nets were 9 feet in length, 30 inches in diameter and including two 3-foot X 20-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 3/16 inch square mesh knotless nylon.

All captured trout were held in a tub, oxygenated with a portable 20-lb 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. Rainbow trout in Florence and Tigger Lakes were marked by the removal of the left ventral fin. Trout in Weiner, Johnson and Long Lakes were marked with one of three cold brand designs, depending on the test, on the right or left side between the lateral line and the dorsal fin. The marking tools consisted of a raised symbol of a half-moon, double-dot or 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. The fish was then returned to the water.

Rainbow trout were later recaptured using minnow traps, fyke nets or gill nets or a combination of the three gear types. Gill nets were of two designs: (1) 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; (2) 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, minnow traps or seines. The seine used in Johnson Lake was 150 feet long and 8 feet deep, with an 8 foot X 8 foot bag. Nets and traps were usually fished for 24 hours while each seine haul took from 15 to 30 minutes.

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 study lakes in August and September 1980 were anesthetized and finclipped at the hatchery and hand counted into transport tanks while unmarked fish numbers were obtained by weight sample.

FINDINGS

Effect of Stocking Size on Fish Survival

1979 Experiment:

To compare survival between two stocking sizes of Swanson strain rainbow trout in various lake types, six Matanuska-Susitna Valley lakes were each stocked in 1979 with two size groups of fish, i.e., unmarked fry at approximately 1,000/lb and adipose-clipped fingerling at approximately 350/lb (Table 3). Although each size group was 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 Sampling

Sampling in the Fall of 1979 in Johnson and Irene Lakes indicated no significant difference between the numbers of unmarked and adipose-clipped Swanson trout captured by fyke nets and minnow traps as shown in Table 4. However, when only minnow trap catches are considered the ratio of stocked fry to fingerling in Johnson and Irene Lakes is 1:1.6 and 1:3.5, respectively. Minnow trap catches in Johnson Lake in March 1980 produced unmarked fry to adipose-clipped fingerling ratios of 1:2.1, while sampling in Irene Lake in June 1980 indicated a fry to fingerling ratio of 1:3.8.

Preliminary sampling was conducted in Tigger, Weiner, Florence and Reed Lakes but an insufficient number of trout were captured to develop a meaningful stocked fry to fingerling ratio.

Table 3. Stocking Summary for Swanson Strain Rainbow Trout in Selected Matanuska-Susitna Valley Lakes, 1979.

Lake*	MEI	Surface Area (Acres)	Littoral** Area (Acres)	Mark***	Date Stocked	Number Stocked	Stocking Size (Fish/lb)	Stocking Density (Fish/ Surface Acre)	Stocking Density (Fish/ Littoral Acre)
Johnson	7.4	40.3	18.5	NM	8/14/79	3,980	970	193	421
				AD	9/10/79	3,800	362		
Irene	10.4	18.0	6.7	NM	8/14/79	1,790	970	206	554
				AD	9/7/79	1,920	349		
Florence	7.6	54.6	28.9	NM	8/13/79	5,300	970	205	388
				AD	9/7/79	5,900	349		
Reed	4.9	19.5	13.7	NM	8/14/79	1,995	970	212	302
				AD	9/7/79	2,145	349		
Tigger	2.7	18.9	10.8	NM	8/13/79	2,200	980	247	433
				AD	9/7/79	2,477	349		
Weiner	. . .	27.0	. . .	NM	8/14/79	2,690	970	189	. . .
				AD	9/10/79	2,425	362		

* Tigger Lake contains stickleback populations; Weiner Lake contains a reproducing population of grayling originally stocked in 1972; rainbow trout had been stocked in Johnson and Irene Lakes in 1978, Florence Lake in 1977 and Reed Lake in 1974.

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

*** Mark: AD = adipose finclip; NM = unmarked.

Table 4. A Comparison of Fyke Net and Minnow Trap Catches in Johnson and Irene Lakes, 1979.

Lake	Gear* Type	Trout** Captured	Number Captured	Mean Length (mm)	Length Range (mm)	Total Catch by Gear	Mean Length (mm) by Gear	Length Range (mm) by Gear
Johnson	FN	NM	78	81	66-92	133	77	62-92
		AD	55	72	62-80			
	MT	NM	56	78	66-94	140	69	50-94
		AD	84	62	50-76			
	TOTAL	NM	134	80	66-94			
		AD	139	66	50-80			
Irene	FN	NM	139	85	68-102	229	80	58-102
		AD	90	73	58-87			
	MT	NM	15	78	63-93	72	69	55-93
		AD	57	67	55-85			
	TOTAL	MN	154	85	63-102			
		AD	147	71	55-87			

* Gear type: FN = fyke net; MT = minnow trap.

** Trout captured: NM = unmarked (stocked 8/14/79 @ 1,000/lb); AD = adipose-clipped (stocked 9/10/79 @ 350/lb).

Estimates of Survival

Population estimates performed in Johnson, Florence, Weiner and Tigger Lakes to evaluate survivals of the 1,000/lb fry and 350/lb fingerling plants at Age I are shown in Table 5. Estimates for the fingerling plant range from 13% to 60% while survivals for the stocked fry range from 2% to 25%. In each lake the population estimates indicate a significantly higher survival for the trout stocked at 350/lb than those planted a month earlier at 1,000/lb.

Population estimates were not made on trout stocked in Irene and Reed Lakes, but all six lakes were gill-netted within a 12-day period in Fall 1980 to obtain a relative survival ratio to catchable size between the two stocking sizes. Gill net results for all six lakes are given in Table 6, as is a comparison of relative survival ratios between gill net samples and population estimates in Johnson, Florence, Weiner and Tigger Lakes. The ratio of unmarked fry to adipose-clipped fingerling from the gill net catches ranged from 1:1.7 to 1:8.9, also indicating, in each case, a substantially higher survival of trout stocked at 350/lb than those stocked at 1,000/lb. In addition Johnson Lake, the "Closed to Sport Fishing" study lake, was seined, fyke-netted and gill-netted several times between July 10, 1980 and October 7, 1980 and 314 unmarked and 816 adipose-clipped trout were captured for a ratio of 1:2.6; this is similar to the population estimate survival ratio of 1:2.5 found in May 1980.

These data suggest that it would take from two to over six times more 1,000/lb rainbow trout fry, depending on the limnological conditions of each lake at time of stocking, than 350/lb fingerling to achieve an equal survival of Swanson strain rainbow trout to catchable size at Age I+. It also must be noted that the 350/lb groups may have experienced unobserved finclip related mortalities after being planted while the 1,000/lb fish had not been marked and received minimum handling.

Growth Comparisons

In addition to differing survivals the fry and fingerling plants also demonstrated different growth features. The 1,000/lb unmarked fry stocked in August, approximately one month before the 350/lb adipose-clipped fingerling were stocked, seemed to have an advantage. Those that survived initially went into winter at a larger size (as indicated by catches in Johnson and Irene Lakes, Table 4) and maintained that size advantage at least through an entire year after being stocked (Table 7).

1980 Experiment:

To further compare survivals between two stocking sizes of Swanson strain rainbow trout in various lake types, six Matanuska-Susitna Valley lakes were each stocked in 1980 with two size groups of fish, i.e., unmarked fingerling at approximately 500/lb and adipose-clipped fingerling at 395/lb (Table 8). In each lake both groups of fish were planted at the same time and at nearly equal densities.

Table 5. Population Estimates for Two Stocking Sizes of Swanson Strain Rainbow Trout in Four Matanuska-Susitna Valley Lakes, 1980.

Lake	Date Stocked	Number Stocked	Stocking Size (Fish/lb)	Date Captured (Mo/Yr)	Population Estimate	Survival	95% Confidence Level Estimate	95% Confidence Level Survival
Johnson	8/14/79	3,980	970	5/80	974	25%	802-1,178	20%-30%
	9/10/79	3,800	362	5/80	2,288	60%	1,982-2,639	52%-69%
Florence	8/13/79	5,300	970	6/80	503	10%	394-636	7%-12%
	9/7/79	5,900	349	6/80	3,365	57%	2,867-3,391	49%-67%
Weiner	8/14/79	2,690	970	6/80	626	23%	381-973	14%-36%
	9/10/79	2,425	362	6/80	1,437	59%	885-2,300	36%-95%
Tigger	8/13/79	2,200	980	9/80	48	2%	26-96	1%-4%
	9/7/79	2,477	349	9/80	313	13%	241-406	10%-16%

Table 6. Gill Net Results and Survival Ratios for Two Stocking Sizes of Swanson Strain Rainbow Trout in Six Matanuska-Susitna Valley Lakes, 1980.

Lake	Date Stocked	Number Stocked	Stocking Size (Fish/lb)	Gill-netting Date Captured	Gill-netting Number Captured	Gill-netting Ratio 1,000/lb:350/lb	Population Estimate Number Surviving	Population Estimate Ratio 1,000/lb:350/lb
Johnson	8/14/79	3,980	970	10/3/80	18	1:1.7	974	1:2.5
	9/10/79	3,800	362	10/3/80	29		2,288	
Florence	8/13/79	5,300	970	9/29/80	7	1:4.9	503	1:6.0
	9/7/79	5,900	349	9/29/80	38		3,365	
Weiner	8/14/79	2,690	970	9/29/80	3	1:8.9*	626	1:2.5*
	9/10/79	2,425	362	9/29/80	24		1,437	
Tigger	8/13/79	2,200	980	9/24/80	6	1:5.5	48	1:5.8
	9/7/79	2,477	349	9/24/80	37		313	
Irene	8/14/79	1,790	970	9/26/80	11	1:3.1	. . .	. . .
	9/7/79	1,920	349	9/26/80	37		. . .	
Reed	8/14/79	1,995	970	9/26/80	10	1:2.1	. . .	. . .
	9/7/79	2,145	349	9/26/80	22		. . .	

* The great difference between the ratios by the two methods in Weiner Lake may be due to the inefficient gill net catch of trout which ranged from 122-173 mm in length (gill net bias is discussed in a subsequent section under miscellanous findings).

Table 7. Length-Weight Summaries for Age I+ Swanson Strain Rainbow Trout in Selected Stocked Lakes of the Matanuska-Susitna Valleys, 1980.

Lake*	MEI	Date Stocked	Number Stocked	Stocking Size (Fish/lb)	Capture Date	Number Captured	Mean Length (mm)	Length Range (mm)	Mean Weight (g)	Weight Range (g)	Catch/ Gill Net Hour
Johnson	7.4	8/14/79	3,980	970	10/3/80	18	289	232-322	313	228-464	0.21
		9/10/79	3,800	362	10/3/80	29	257	194-307	217	90-356	0.35
Florence	7.6	8/13/79	5,300	970	9/29/80	7	245	229-272	164	136-239	0.34
		9/7/79	5,900	349	9/29/80	38	213	144-274	114	31-220	1.83
Weiner	. . .	8/14/79	2,690	970	9/29/80	3	155	141-162	39	30-48	0.16
		9/10/79	2,425	362	9/29/80	24	147	122-173	35	18-54	1.29
Tigger	2.7	8/13/79	2,200	980	9/24/80	6	175	123-232	75	20-157	0.28
		9/7/79	2,477	349	9/24/80	37	175	118-250	73	19-216	1.72
Irene	10.4	8/14/79	1,790	970	9/26/80	11	256	210-282	191	114-264	0.62
		9/7/79	1,920	349	9/26/80	37	236	123-282	153	19-264	2.09
Reed	4.9	8/14/79	1,995	970	9/26/80	10	289	248-333	306	186-478	0.52
		9/7/79	2,145	349	9/26/80	22	254	168-296	196	62-292	1.15
Matanuska	8.2	8/14/79	12,765	970	10/24/80	27	225	163-294	150	47-318	0.62
Seymour	14.6	8/13/79	34,036	980	10/28/80	28	257	167-325	216	55-385	1.20
Knik	9.1	10/11/79	5,000	285	10/24/80	89	183	117-250	74	15-177	2.02
Kepler	11.6	10/11/79	5,800	285	10/23/80	113	220	150-320	131	38-370	2.86

* Tigger, Matanuska and Knik Lakes have stickleback populations; Weiner Lake has a population of grayling.

Table 8. Stocking Summary for Swanson Strain Rainbow Trout in Selected Matanuska-Susitna Valley Lakes, 1980.

Lake*	MEI	Surface Area (Acres)	Littoral** Area (Acres)	Mark***	Date Stocked	Number Stocked	Stocking Size (Fish/lb)	Stocking Density (Fish/ Surface Acre)	Stocking Density (Fish/ Littoral Acre)
Big No Luck	1.1	67.9	36.0	NM	8/19/80	2,601	510	77	145
				AD	8/19/80	2,605	398		
Junction	13.2	10.9	6.0	NM	8/18/80	1,085	499	199	362
				AD	8/18/80	1,085	391		
Marion	0.4	113.0	37.3	NM	8/20/80	5,650	500	100	303
				AD	8/20/80	5,650	395		
Ravine****	20	12.3	7.6	NM	8/19/80	1,230	500	200	324
				AD	8/19/80	1,230	409		
Sliver	22.9	7.2	5.1	NM	8/19/80	1,000	498	278	392
				AD	8/19/80	1,000	383		
"Y"	2.0	39.7	21.9	NM	8/20/80	2,745	508	138	251
				AD	8/20/80	2,750	395		

* Big No Luck, Junction and "Y" Lakes contain stickleback populations. Sliver Lake has a remnant population of grayling that were stocked in 1970. Ravine, Marion and Big No Luck Lakes each contain residual populations of stocked rainbow trout.

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

*** Mark: AD = adipose finclip; NM = unmarked.

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

Preliminary Sampling

Sampling on October 31, 1980 in Marion Lake, using baited minnow traps, resulted in a catch of 250 unmarked fingerling (stocking size 500/lb) and 403 adipose-clipped trout (stocking size 395/lb) for a catch ratio of 1:1.6. Mean lengths of unmarked and adipose-clipped fish were 65 mm and 74 mm, respectively, while the mean lengths at time of stocking were 43 mm and 47 mm, respectively.

Ravine Lake was sampled through the ice on November 6, 1980 and one unmarked trout (stocking size 500/lb) and three adipose-clipped fish (stocking size 409/lb) were captured in minnow traps. Junction and Sliver Lakes were sampled on November 7, 1980. Minnow traps in Junction Lake caught 14 unmarked trout (stocking size 499/lb) with mean length of 67 mm and 13 adipose-clipped fish (stocking size 391/lb) with a mean length of 66 mm. No fish were captured in Sliver Lake.

An insufficient number of trout were captured in Ravine and Junction Lakes to develop a meaningful ratio between the two groups of fish. Subsequent sampling will be conducted in all six lakes that were stocked in 1980 with the two size groups of trout.

Growth of Swanson Strain Rainbow Trout

Gill Net Catches:

Data collected between 1975 and 1980 from gill net catches in a wide range of lake types showing growth of Swanson strain rainbow trout in stocked Matanuska-Susitna Valley lakes are presented in Tables 9 and 10. The wide range of mean lengths and weights of Age I+ trout are primarily due to differences in lake fertilities, stocking densities and survivals, and variable sampling dates.

As shown in Tables 9 and 10, for those lakes sampled, Age I+ trout (catchable size trout inhabiting lakes for 11 to 14 months) on the average are larger in non-stickleback lakes than in stickleback-infested waters. Age I+ trout in non-stickleback lakes average 216 mm (8.5 in) with means ranging from 153 mm to 304 mm (6 in to 12 in) while those fish in stickleback-infested lakes average 180 mm (7 in) with means ranging from 156 mm to 225 mm (6 in to 9 in). At Age II+ the average lengths for trout in stickleback and non-stickleback waters are similar at approximately 360 mm (14 in). At Age III+ data indicated fish in non-stickleback lakes are somewhat larger on the average, but individual Swanson trout up to 618 mm (24 in) and 3.3 kg (7.25 lb) have been gill-netted in stickleback lakes.

Biomass:

In conjunction with survival estimates made during population sampling, total biomass (rainbow trout weight) related to lake morphologies and respective lake productivities was examined. Table 11 gives a comparison of biomass, after one year of lake residency, of Swanson strain rainbow trout in six Matanuska-Susitna Valley lakes of differing productivity

Table 9. Mean Length and Weight Data Compiled from Gill Net Catches for Swanson Strain Rainbow Trout in Stickleback Free Stocked Lakes of the Matanuska-Susitna Valleys, 1975-1980.

Non-Stickleback Lakes	MEI	Age 0 Year Planted	Fall Age I+* Mean Length (mm)	Fall Age I+* Mean Weight (g)	Spring Age II Mean Length (mm)	Spring Age II Mean Weight (g)	Fall Age II+ Mean Length (mm)	Fall Age II+ Mean Weight (g)	Fall Age III+ Mean Length (mm)	Fall Age III+ Mean Weight (g)
Marion	0.4	1976	153	39	215	108	270	208	356	549
		1978	180	63	209	101	327	429		
Reed	4.9	1974	180	61	233	141	295	288	400	656
		1979	265	231						
Florence	7.6	1977	195	90	249	173	286	262	462	1,078
		1979	218	122						
Irene	10.4	1976	193	82	269	223	. . .	. . .	510	1,390
		1978	251	186	. . .	. . .	383	745		
		1979	240	162						
Kepler	11.6	1975	172	63	. . .	. . .	. . .	. . .	. . .	. . .
		1978	210	119	. . .	. . .	445	1,070		
		1979	220	131						
Seymour	14.6	1978	194	92	. . .	. . .	395	769		
		1979	257	216						
Echo	15.9	1978	205	102	. . .	. . .	395	768		
Canoe	18.1	1975	304	421	. . .	. . .	520	1,957	. . .	. . .
Ravine	20	1976	209	113	276	245	. . .	. . .	500	1,424
TOTAL COMBINED MEANS			216	136	242	165	368	722	446	1,017

* Size differences shown from year to year within one lake are generally caused by differences in capture dates, stocking dates, stocking densities or trout survivals.

Table 10. Mean Length and Weight Data Compiled from Gill Net Catches for Swanson Strain Rainbow Trout in Stickleback Infested Stocked Lakes of the Matanuska-Susitna Valleys, 1975-1980.

Stickleback Lakes	MEI	Age 0 Year Planted	Fall Age I+* Mean Length (mm)	Fall Age I+* Mean Weight (g)	Spring Age II Mean Length (mm)	Spring Age II Mean Weight (g)	Fall Age II+ Mean Length (mm)	Fall Age II+ Mean Weight (g)	Fall Age III+ Mean Length (mm)	Fall Age III+ Mean Weight (g)
Big No Luck	1.1	1975	177	60	. . .	. . .	240	137	297	239
		1978	179	65	. . .	. . .	. . .	. . .		
Tigger	2.7	1979	175	73						
Matanuska	8.2	1976	179	72	248	176	410	938	. . .	. . .
		1978	176	74	248	191	347	593		
		1979	225	150						
Knik	9.1	1976	156	53	. . .	. . .	. . .	. . .	398	841
		1978	177	74	. . .	. . .	383	820		
		1979	183	74						
Long	9.4	1976	161	62	220	127	375	643	. . .	. . .
		1977	193	87	. . .	. . .	343	566	458	1,668
TOTAL COMBINED MEANS			180	77	239	165	350	616	384	916

* Size differences shown from year to year within one lake are generally caused by differences in capture dates, stocking dates, stocking densities or trout survivals.

Table 11. A Comparison of One Year Biomass Production by Swanson Strain Rainbow Trout in Six Stocked Matanuska-Susitna Valley Lakes, 1979 and 1980.

Lake*	MEI	Surface Area (Acres)	Littoral** Area (Acres)	Stocking Size (Fish/lb)	Pounds of Trout Stocked	After One Year in Lake			
						Total Estimated Pounds	Pounds/ Surface Acre	Pounds/ Littoral Acre	Pounds Available per Pound Stocked
Marion	0.4	113.0	37.3	248	18.39	127	1.1	3.4	6.9
Big No Luck	1.1	67.9	36.0	213	10.56	77	1.1	2.1	7.3
Tigger	2.7	18.9	10.8	349	7.10	51	2.7	4.7	7.2
Johnson	7.4	40.3	18.5	213	18.78	213	5.3	11.5	11.3
Irene	10.4	18.0	6.6	213	5.63	100	5.6	15.2	17.8
Ravine***	20	12.3	7.6	213	3.76	149	12.1	19.6	39.5

* Johnson Lake had no known recreational harvest.
** Littoral area is that portion of the lake less than 15 ft deep.
*** Ravine Lake MEI is approximated at 20 when specific conductance is modified for abnormally high sodium ions.

levels. Biomass in pounds of Age I+ fish per surface acre ranged from a high of 12.1 pounds in Ravine Lake to lows of 1.1 pounds in Big No Luck and Marion Lakes. Significant correlation exists between MEI (morphoedaphic index values) and pounds of fish per surface acre ($r = 0.99$), MEI and pounds of fish per littoral acre ($r = 0.97$), and MEI and pounds of fish available per pound of fish stocked ($r = 0.97$).

Havens (1980) presented data for five lakes stocked with three rainbow trout strains that showed similar significant correlations between MEI and pounds of rainbow trout per surface acre, per littoral acre and per pound of fish stocked.

These cursory investigations illustrate the need for additional research into the important subject of potential biomass production as related to fish stocking densities in both rehabilitated lakes and those containing sticklebacks.

Investigation of Stocking Methods

Havens (1980) presented data indicating significant predation, immediately following introduction, of rainbow trout fingerling by larger resident rainbow trout. Havens (1979) also reported that minnow trapping in five lakes, one month after stocking, showed a much higher catch for one strain of rainbow trout fingerling than for two other strains stocked at the same time; one year later (Havens, 1980) population estimates on the three strains showed that the percent survival of each strain in each lake had maintained the same order and a similar level of dominance. This suggested that whatever caused a selective die-off between the three strains in all five lakes took place within a month after stocking, and that any mortality after that period was similar for all three strains.

Havens (1980) indicated that in 40.3 acre Johnson Lake, Swanson strain rainbow trout fry and fingerling planted from a single release site took from 21 to 34 hours to disperse completely around the perimeter of the lake and that heavy concentrations of newly stocked fish were observed within a 50 yard radius of the release site for 2 days following introduction.

The preceeding data suggested that a critical period affecting survival of rainbow trout fry and fingerling is within a month following introduction and possibly within the first several hours or days following release. This might be a time when the fish, entering a new environment, would be susceptible to predation and starvation before they could seek and adjust to habitat that would provide protective cover and less competition.

To continue this investigation an experiment was designed to test three release methods. The two lakes chosen for this study were Johnson Lake, a rehabilitated lake containing a large population of Age I+ and Age II+ stocked rainbow trout, and Long Lake, a lake containing a stickleback population but very few remnant stocked trout.

Stocking Procedure:

Johnson and Long Lakes were each stocked with three marked groups of Swanson strain rainbow trout fingerling (Table 12). In each lake the first group of fish, marked with an adipose finclip, were placed in a nylon 1/4 inch mesh holding pen in the afternoon of the day stocked and were fed the same feed they received at the hatchery. The penned trout were inspected and fed the following morning but during a subsequent evening check it was observed that a majority of the fish had escaped through the nylon mesh. Within 15 to 27 hours in Johnson Lake and 18 to 30 hours in Long Lake most of the rainbow trout fingerling escaped through their respective pens to disperse around the perimeter of the lake even though they could have escaped anytime after they had been placed in the pen. When the pen was emptied in Johnson Lake, 48 hours after being put in, approximately 350 fish (11%) remained and 11 of those were mortalities. In Long Lake only 50 fish (1%) remained in the pen after 72 hours and 11 of those were mortalities. A few stickleback were observed in the pen in Long Lake 18 hours after the rainbow trout fingerling introduction.

A second group of trout, marked with a left ventral finclip, was uniformly released around the shoreline perimeter of each lake. The third group, marked with a right ventral finclip, was released directly from the hatchery transport tank into each lake at a single release site.

Population Estimates:

Johnson Lake

A population estimate was made on the three groups of Swanson strain rainbow trout in Johnson Lake approximately 7 weeks after they were stocked. While performing the estimate a total of 514 adipose-clipped, 407 left ventral, and 461 right ventral finclipped rainbow fingerling were captured for a total of 1,382 fish or 17.2% of the trout initially stocked. Survival estimates for the entire plant and for individual fish groups are presented in Table 13. The survival for the entire plant of fingerling was estimated at 29% while survivals for the individual groups ranged from 26% to 33%. Although the trout survival percentages within the 95% confidence interval overlap for each of the release methods, the fish that had been initially placed in the pen and fed had a 7% better survival than those planted around the shoreline of the lake and a 4% better survival than those released directly from the hatchery truck as is the normal procedure.

Long Lake

A population estimate was also made on the three groups of Swanson strain rainbow trout in Long Lake approximately 7 weeks after they were stocked. While performing the estimate 930 adipose-clipped, 693 left ventral and 830 right ventral finclipped rainbow fingerling were captured for a total of 2,453 fish or 18.1% of the trout initially planted. Survival estimates for the entire plant and for individual groups of fish are presented in Table 13. The survival estimate for the entire plant of fingerling was 53% while survivals for the individual groups ranged from 49% to 57%. Although the

Table 12. Swanson Strain Rainbow Trout Stocking Summary for Johnson and Long Lakes, 1980.

Lake	MEI	Surface Area (Acres)	Littoral* Area (Acres)	Shoreline Miles	Number Stocked	Stocking Size (Fish/lb)	Mark**	Release*** Method	Date Stocked	Stocking Density: Fish/ Surface Acre	Stocking Density: Fish/ Littoral Acre	Stocking Density: Fish/ Shoreline Mile
Johnson	7.4	40.3	18.5	1.089	2,650	424	AD	P	8/13/80			
					2,685	473	LV	S	8/15/80	199	434	7,378
					2,700	447	RV	T	8/15/80			
Long	9.4	74.4	20.8	2.367	4,963	451	AD	P	8/15/80			
					3,750	472	LV	S	8/18/80	182	651	5,717
					5,000	472	RV	T	8/18/80			

* Littoral area is that portion of the lake less than 15 ft deep.
** Mark" AD = adipose finclip; LV = left ventral finclip; RV = right ventral finclip.
*** Release method:
P = held in pen and fed; most fish escaped after 15-30 hours.
S = scatter plant; released around perimeter of lake.
T = stocked from hatchery truck at a single release site.

Table 13. Population Estimates for Swanson Strain Rainbow Trout Stocked in Johnson and Long Lakes, 1980

Lake	Mark*	Date Stocked	Number Stocked	Release** Method	Date of Estimate	Population Estimate	Survival	95% Confidence Level Estimate	95% Confidence Level Survival
Johnson	AD	8/13/80	2,650	P	10/7/80	865	33%	805-924	30%-35%
	LV	8/15/80	2,685	S	10/7/80	685	26%	629-741	23%-28%
	RV	8/15/80	2,700	T	10/7/80	776	29%	718-834	27%-31%
	TOTAL		8,035			2,325	29%	2,059-2,623	26%-33%
Long	AD	8/15/80	4,963	P	10/9/80	2,739	55%	2,600-2,878	52%-58%
	LV	8/18/80	3,570	S	10/9/80	2,041	57%	1,913-2,170	54%-61%
	RV	8/18/80	5,000	T	10/9/80	2,445	49%	2,309-2,581	46%-52%
	TOTAL		13,533			7,226	53%	6,406-8,212	47%-61%

* Mark: AD = adipose finclip; LV = left ventral finclip; RV = right ventral finclip.

** Release method:

P = held in pen and fed; most fish escaped after 15-30 hours.

S = scatter plant; released around perimeter of lake.

T = stocked from hatchery truck at single release site.

trout survival percentages within the 95% confidence interval overlap for each of the release methods, the fish that had been initially placed in the pen had 2% less survival than those planted around the shoreline of the lake but a 6% better survival than those released directly from the hatchery truck.

Discussion

Differences in overall survival rates and survival of individual stocking groups of fingerling in each lake may be due to: (1) six years of continuous stocking in Johnson Lake which may have resulted in reduced food availability for the newly stocked fingerling; (2) Johnson Lake at the time of stocking had approximately 2,000 large trout (about 50 fish per surface acre) which could have preyed heavily on the newly stocked fingerling; and (3) while Long Lake had a large stickleback population, predation by the very few large holdover trout would have been minimal.

Although no startling differences were evident between the three release methods it would be worthwhile to explore various release techniques as in both lakes the fish released by other than normal stocking method showed higher survivals. In some situations it might be worth the extra time to scatter-release or pen the fish for a short time as in a large lake where a 5% increased survival could mean a survival of several hundred more fish.

Population estimates are planned for Johnson and Long Lakes after ice-out in Spring 1981 to compare survivals over the winter to estimated survivals 7 weeks after stocking.

Fish Movement

During the population estimates in Johnson and Long Lakes in October 1980 rainbow trout fingerling were captured, marked and released in three arbitrarily designated areas in each lake (Figure 2). Fish captured and released in each area were marked with a specific cold brand (half-moon, double-dot, or rectangle). On the final day of trapping recaptured marked fish were examined for brand marks and enumerated by specific mark and area caught when those marks were readable (Table 14). Although only a small portion of the marked fish were able to be identified by specific brand mark, available data indicate there was movement of rainbow trout fingerling between areas in the six day period from time of marking to time of recapture. All three groups of fish that had been stocked 7 weeks prior were captured around the entire perimeter of each lake in relatively equal numbers.

Cold Branding

To provide a greater number of marks for population estimates and fish movement studies in Johnson and Long Lakes it was decided to experiment with cold branding, as described by Everest and Edmundson (1967), because the three regularly used marks of adipose, left ventral and right ventral finclip were used to mark the trout at the hatchery prior to stocking for the investigation of the three release methods.

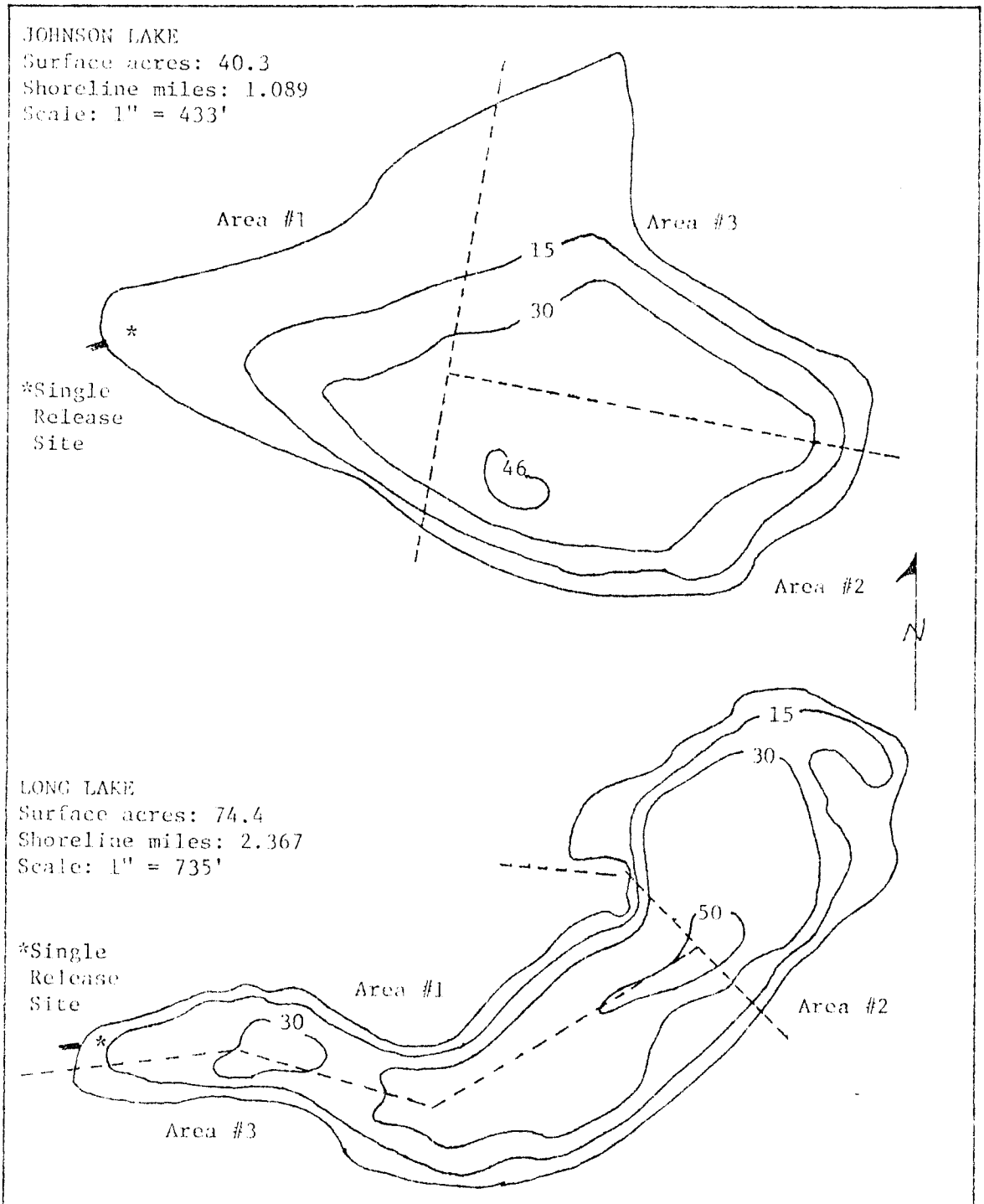

Fig. 2. Sampling Areas in Johnson and Long Lakes, 1980.

Table 14. The Capture of Marked Swanson Strain Rainbow Trout Fingerling by Area in Johnson and Long Lakes, 1980

Lake	Area*	Number of Unbranded Fish Captured				Brand	Number of Fish Branded	Total Number Branded Fish Recaptured	Number of Identifiable Brands Recaptured		
		AD**	LV**	RV**	Total				(Half-moon)	(Double-dot)	(Rectangle)
Johnson	1	184	132	155	471	Half-moon	386	48	9	11	6
	2	124	108	125	357	Double-dot	248	139	6	33	3
	3	205	165	182	552	Rectangle	462	67	5	10	9
Long	1	315	234	287	836	Half-moon	461	112	5	3	6
	2	285	210	242	737	Double-dot	282	86	6	26	2
	3	347	250	303	900	Rectangle	447	51	32	0	10

* Area: refer to Fig. 2.
** AD = adipose finclip; LV = left ventral finclip; RV = right ventral finclip.

Branded rainbow trout ranged from 48 mm to 102 mm in length. It took 2 to 3 days for the brand to darken enough to show clearly. Problems encountered during field application of this marking procedure were: (1) the majority of the brands were blurred to the point of making it impossible to distinguish one mark from another because not enough time was taken to wipe off each fish and blot the liquid slurry from the rod tip before application; and (2) the half-moon and rectangle symbols were too close in size and shape to distinguish if they were not applied evenly on the side of the fish. Of the 2,286 rainbow trout fingerling marked during a 4-day period, only 182 (36%) of the 503 branded recaptures were able to be identified by specific brand.

When rainbow trout fingerling were cold branded in Johnson Lake in May 1980, the brands were clear for only 3 to 4 weeks. The fish were growing rapidly during the summer period and by August 1980 it was possible to see only a spot on the side of the fish where several small scales had replaced the scales on the tissue that had been frozen. On the rainbow trout fingerling that had been cold branded in Johnson Lake in October 1980 the brands (although not the specific brand marks) were still clear 3 months later in January 1981. These trout had grown very little during the 3-month winter period and the mean length of those captured was 80 mm, the same overall mean length that had been found in October.

Miscellaneous Findings

Catch Comparisons Between Various Fish Sampling Equipment:

Minnow Traps vs Small Mesh and Large Mesh Fyke Nets

Havens (1980) presented data showing an 8mm difference between the mean length of rainbow trout fingerling captured by 1/8 inch square mesh minnow traps and 3/8 inch square mesh fyke nets and suggested that the use of either gear as a single sampling device might lead to erroneous conclusions regarding both mean lengths and survivals. Fyke nets with the large mesh size of 3/8 inch probably let small fish escape through the mesh while larger fingerling would not enter minnow traps as readily as smaller fish.

In an attempt to compensate for these differences in catches by the two gear types, fyke nets were designed and purchased which were about one-third smaller in overall dimension and had a mesh size of 3/16 inch.

Johnson and Long Lakes were sampled between September 30, 1980 and October 9, 1980 to determine survivals of Swanson strain rainbow trout fingerling that had been planted in August 1980. Minnow traps of 1/8 inch square mesh, large mesh fyke nets with 3/8 inch square mesh and the "new" small mesh fyke nets with 3/16 inch square mesh were fished in Johnson and Long Lakes. A comparison of length frequency capture by gear and the catch per unit of effort by gear are presented in Table 15.

In Johnson Lake where the rainbow fingerling ranged from 63-102 mm, the mean lengths captured by the three sampling devices were very similar: minnow traps, 78 mm trout; small mesh fyke nets, 81 mm fish; and large mesh

Table 15. Length Frequency Comparison of Swanson Strain Rainbow Trout Fingerling Captured by Minnow Traps and Fyke Nets in Johnson and Long Lakes, 1980.

Lake	Sampling Equipment*	Number of Trout Measured	Mean Length (mm)	Length Range (mm)	Total Number of Trout Captured	Number of Traps Fished	Total Hours Fished	Number of Fish/ Trap Hour
Johnson**	Small mesh minnow traps	144	78	63-92	466	36	1,741	0.27
	Small mesh fyke nets	267	81	63-102	1,248	3	203	6.30
	Large mesh fyke nets	128	82	69-102	128	2	56	2.29
Long***	Small mesh minnow traps	201	63	48-88	1,534	35	1,900	0.81
	Small mesh fyke nets	179	64	49-85	1,221	3	215	5.68
	Large mesh fyke nets	71	72	52-87	71	2	54	1.31

* Small mesh minnow traps have 1/8 in square mesh, small mesh fyke nets have 3/16 in square mesh and large mesh fyke nets have 3/8 in square mesh.

** Johnson Lake has an MEI of 7.4, is free of stickleback but has a large population of Age I+ and Age II+ rainbow trout.

*** Long Lake has an MEI of 9.4, contains a population of stickleback but has very few remnant stocked rainbow trout.

fyke nets, 82 mm fingerling. In Long Lake, however, where the fingerling ranged from 48-88 mm in length, a greater difference in mean length by gear resulted: minnow traps, 63 mm trout; small mesh fyke nets, 64 mm fish; and large mesh fyke nets, 72 mm fingerlings. The larger mesh size fyke net probably let the smaller fish escape through the mesh. In both lakes a distinct difference in catch per unit effort can be seen; the number of trout per trap hour with the small mesh fyke nets greatly exceeded that of either the minnow traps or the large mesh fyke nets.

Comparison of Fyke Net, Gill Net and Seine Catches in Johnson Lake

Johnson Lake, the "Closed to Sport Fishing" study lake was sampled between July 27, 1980 and August 1, 1980 to compare the length frequency of catches of Age I+ rainbow trout between large mesh fyke nets, variable mesh gill nets and a small mesh seine.

Results of the sampling are presented in Table 16. The estimated number of Age I+ rainbow trout in Johnson Lake on July 27, 1980 was 2,114, thus, 8% of the population was sampled. The length range of trout captured by each gear type was similar: seine, 145-237 mm; fyke net, 143-230 mm; and gill net, 155-264 mm; but the mean length of the gill-netted fish surpassed that of the seine by 28 mm (1.1 in) and that of the fyke nets by 32 mm (1.25 in).

Comparison of Catches by Two Designs of Gill Nets

Havens (1980) presented findings regarding the difference in mean lengths for Age I+ Swanson strain rainbow trout captured by fyke nets and gill nets in Matanuska-Susitna Valley lakes with low relative fertilities or containing stickleback populations. A large percentage of the Age I+ trout in the length range of 136-165 mm were not being captured in gill nets although fyke net catches indicated a substantial portion of the fish populations fell within that length range. When only gill nets were used for the recapture portion of a population estimate substantial error could result in recording both the growth and abundance of that population.

In an attempt to compensate for this gear bias, gill nets were utilized that contained a panel of 5/8 inch bar measure mesh between the normally used 1/2 inch and 3/4 inch mesh gill net panels.

Data collected by fyke nets and gill nets for four Matanuska-Susitna Valley lakes are presented in Table 17. In each lake, all fyke-net-captured fish were enumerated, lengths recorded, then marked and released. Fish subsequently recaptured in gill nets were enumerated by fin mark and lengths recorded.

In Long, Big No Luck and Marion Lakes, where standard gill nets without a 5/8 inch mesh panel were used, the mean lengths of fyke-netted trout were 173 mm, 175 mm and 169 mm, respectively while mean lengths of fish captured in gill nets were 196 mm, 179 mm and 180 mm, respectively. Trout having lengths between 136-165 mm comprised 36% of the fyke net catch from the three lakes whereas only 11% of the gill-netted fish fell within this

Table 16. Length Frequency Comparison of Age I+ Swanson Strain Rainbow Trout Captured by Seine, Fyke Net and Gill Net in Johnson Lake, 7/29/80 - 8/1/80.

Gear Type	Adipose-clipped Trout*			Unmarked Trout**			All Trout Combined			Catch/Unit of Effort (Fish/hr)
	Number Caught	Mean Length (mm)	Length Range (mm)	Number Caught	Mean Length (mm)	Length Range (mm)	Number Caught	Mean Length (mm)	Length Range (mm)	
Seine	27	176	145-219	19	199	149-237	46	185	145-237	11.50
Fyke Net	44	178	143-230	12	192	146-225	56	181	143-230	0.23
Gill Net	143	203	155-251	121	224	164-264	264	213	155-264	0.72

* Adipose-clipped trout were stocked on 9/10/79 at 362/lb.
** Unmarked trout were stocked on 8/14/79 at 970/lb.

Table 17. A Comparison of Fyke Net and Gill Net Catches of Rainbow Trout in Selected Stocked Lakes of the Matanuska-Susitna Valleys, 1978-1980.

Length Range (mm)	Percent Catch per Length Range by Gear*											
	Long Lake			Big No Luck Lake			Marion Lake			Tigger Lake**		
	FN	GN	GN(r)	FN	GN	GN(r)	FN	GN	GN(r)	FN	GN	GN(r)
106-135	9%	7%	8%	<1%	<1%	1%	3%	1%		9%	7%	
136-165	34%	8%	8%	30%	10%	5%	43%	14%	16%	44%	44%	44%
166-195	39%	45%	55%	55%	79%	85%	47%	72%	74%	30%	21%	33%
196-225	14%	25%	24%	14%	11%	8%	8%	13%	10%	13%	14%	
226-255	3%	7%	4%	<1%						4%	14%	22%
256-285	1%	5%	1%									
286-315	<1%	3%	<1%									
TOTAL CAPTURED	1,372	469	274	272	147	73	428	201	100	213	43	18
MEAN LENGTH (mm)	173	196	184	175	179	178	169	180	179	169	175	178

* FN = fyke nets; GN = gill nets; GN(r) = marked fish recaptured by gill net.
** Gill nets fished in Tigger Lake each included a panel of 5/8 inch bar measure mesh.

length range. Fyke netted fish, in the 136-164 mm range that were marked and subsequently captured by gill nets averaged 10% of the total recaptures from the three lakes (Havens, 1980).

In Tigger Lake, where a gill net with a 5/8 inch mesh panel was included, the mean length of fyke-netted trout was 169 mm while the mean length of fish captured by gill net was 175 mm (without the 5/8 inch mesh panel the mean length for gill-netted fish was 193 mm). Fyke net catches of trout within a length range of 136-165 mm in Tigger Lake averaged 44%, as did both the gill net catch and the recapture of marked fish in the gill net.

Table 18 shows catches of Age I+ Swanson strain rainbow trout by gill net mesh size in five Matanuska-Susitna Valley lakes. Age I+ trout caught in Irene, Florence and Reed Lakes averaged over 215 mm in length and a majority of the fish were captured in the 3/4 inch or 1 inch gill net mesh. In Weiner and Tigger Lakes, however, where the trout averaged less than 180 mm in length, fish in the 136-165 mm length range comprise 68% and 44% of the catch, respectively, and the 5/8 inch bar measure mesh contributed 56% and 39%, respectively, of all fish captured in the gill nets.

These preliminary investigations indicate gill nets which include a 5/8 inch mesh in addition to 1/2 inch and 3/4 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.

The important point of the three "gear comparison" examples is to stress the fact that, when doing a population estimate, it is necessary that every individual in a population have an equal chance of being captured both for marking and recapture purposes. In many cases, by using only a single gear size or type for a capture device, a significant portion of a given population may be missed, thus giving erroneous reading of relative growth and abundance.

Table 18. Comparison of Gill Net Catches by Mesh Size for Age I+ Swanson Strain Rainbow Trout in Selected Stocked Lakes of the Matanuska-Susitna Valleys, September and October, 1980

MESH SIZE:	1/2 in	5/8 in	3/4 in	1 in	1-1/2 in	2 in	Totals	Totals Without 5/8 in Mesh
Reed Lake								
Number Caught:	0	0	2	26	4	0	32	32
Mean Length (mm):			221	260	319		265	265
Length Range (mm):			168-273	215-302			168-333	168-333
SD_L:			74	18	11		31	31
Irene Lake								
Number Caught:	1	4	11	25	4	3	48	44
Mean Length (mm):	123	246	222	250	240	259	240	240
Length Range (mm):		233-270	191-260	210-282	218-260	253-264	123-282	123-282
SD_L:		16	26	21	18	6	29	30
Florence Lake								
Number Caught:	3	11	14	17	0	0	45	34
Mean Length (mm):	198	184	216	244			218	228
Length Range (mm):	160-268	144-257	167-272	219-274			144-274	160-274
SD_L:	61	38	34	15			39	33
Tigger Lake								
Number Caught:	2	17	15	9	0	0	43	26
Mean Length (mm):	142	147	179	227			175	193
Length Range (mm):	123-160	118-167	154-218	201-250			118-250	123-250
SD_L:	26	12	18	16			34	32
Weiner Lake								
Number Caught:	4	15	8	0	0	0	27	12
Mean Length (mm):	128	146	163				148	151
Length Range (mm):	122-133	134-157	153-173				122-173	122-173
SD_L:	5	8	6				14	18

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Prepared by:

Alan C. Havens
Fishery Biologist

Approved by:

Rupert E. Andrews, Director
Division of Sport Fish

Mark C. Warner, Ph.D.
Sport Fish Research Chief