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EVALUATION OF STOCKED WATERS IN THE TANANA DRAINAGE, 1988[1]

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

This report presents the results obtained during the evaluation of the Region III lake stocking program performed in 1988. A combined total of 2,567,469 rainbow trout *Oncorhynchus mykiss*, Arctic grayling *Thymallus arcticus*, coho salmon *Oncorhynchus kisutch*, chinook salmon *Oncorhynchus tshawytscha*, sockeye salmon *Oncorhynchus nerka*, sheefish *Stenodus leucichthys*, and Arctic char *Salvelinus alpinus* were stocked in 58 lakes and ponds in interior Alaska. The request for 1989 is 1,782,480 fish to be stocked in 75 waters.

Mark-recapture estimates of rainbow trout abundance were performed at Birch and Quartz Lakes. Subcatchable rainbow trout survival in Birch Lake to August 1988 from March and May 1988 stockings was 41 percent and 58 percent, respectively. Subcatchables stocked into Quartz Lake in May 1988 had a survival rate of 28 percent contrasted with 19 percent for fingerling rainbow trout stocked in August 1987. Mark-recapture estimates of Arctic char fingerling overwinter survival rates ranged from 38 percent to 77 percent in five smaller lakes. Arctic char and rainbow trout stocked together in a small lake both showed acceptable performance. Chinook salmon survival rates were drastically lower in two small lakes than in 1987.

Initial assessments indicate that sockeye salmon and Arctic char can survive in Harding Lake. Rainbow trout stocked in Piledriver Slough survived both the winters of 1987-88 and 1988-89.

KEY WORDS: stocked lakes, Birch Lake, Quartz Lake, Harding Lake, population estimates, survival, growth, Arctic char, *Salvelinus alpinus*, sockeye salmon, *Oncorhynchus nerka*, Arctic grayling, *Thymallus arcticus*, rainbow trout, *Oncorhynchus mykiss*, sheefish, *Stenodus leucichthys*, chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, lake trout, *Salvelinus namaycush*.

INTRODUCTION

The Sport Fish Division of the Alaska Department of Fish and Game (ADFG) stocks numerous lakes and ponds in interior Alaska with rainbow trout *Oncorhynchus mykiss*, coho salmon *Oncorhynchus kisutch*, Arctic grayling *Thymallus arcticus*, Arctic char *Salvelinus alpinus*, lake trout *Salvelinus namaycush*, and chinook salmon *Oncorhynchus tshawytscha*. Sockeye salmon *Oncorhynchus nerka* are being experimentally stocked in one lake. These stocked lakes are an important component of the area fisheries, supporting over one-third of the recreational angling in the Tanana River drainage. The stocking program in interior Alaska is conducted in an approximate 150,000 square km area bordered by the Kantishna River on the west, the Tok area to the east, the Delta River drainage south to Black Rapids, and the Steese Highway area north to the town of Central (Figure 1). Most of the stocked lakes are near communities and along road systems, but a number of remote stocked lakes are accessible only by dog team, all terrain vehicle, snow machine, or airplane.

Increasing human population in the Tanana Valley is putting a greater demand on limited sport fishing opportunities. Temporal and financial constraints cause the majority of fishermen to favor roadside fisheries over more remote angling opportunities. Thus, native fish populations near the Interior road system are receiving heavy angler use. The fish stocking program in interior Alaska has been successful in diverting some angling effort away from native stock fisheries. In 1987, an estimated 58,390 stocked rainbow trout and coho salmon were harvested by Tanana drainage anglers (Mills 1988). The stocking program also increases recreational opportunity during the winter. Over half of the yearly sport fishing effort on the large, accessible stocked lakes takes place in the winter.

To provide more year round fishing opportunities and to shift pressure away from heavily used wild stocks, ADFG is expanding its lake stocking program to include new waters, and is increasing the species diversity available in presently stocked waters with multiple species stockings and experiments with new species. In 1989 an anticipated 662,900 rainbow trout, 288,300 coho salmon, and 115,700 Arctic grayling will be stocked. These "production" stockings will be augmented by experimental stockings of 67,630 Arctic char, 47,950 lake trout, and 500,000 sockeye salmon. Some experimental stocking (100,000) of sheefish *Stenodus leucichthys* will be continued in 1989, but success to date of sheefish enhancement has been poor and will be discontinued after 1990.

Quartz and Birch Lakes are the largest fisheries in terms of effort in interior Alaska, contributing up to 75% of the harvest of rainbow trout. Therefore, a significant amount of effort has been devoted to estimating optimum stocking parameters (numbers, size, timing, and strain) in these lakes. For example, experimental stocking of 20 g subcatchable Swanson strain rainbow trout into Birch Lake was begun in 1980 and 1981. This resulted in higher fish survival rates and higher harvests than were obtained from fish stocked as fingerlings in 1983, 1984, and 1985 (Doxey 1985). Subsequently, stocking of subcatchable rainbow trout has been expanded to include Quartz Lake. Evaluation of the success of this experiment is continuing.

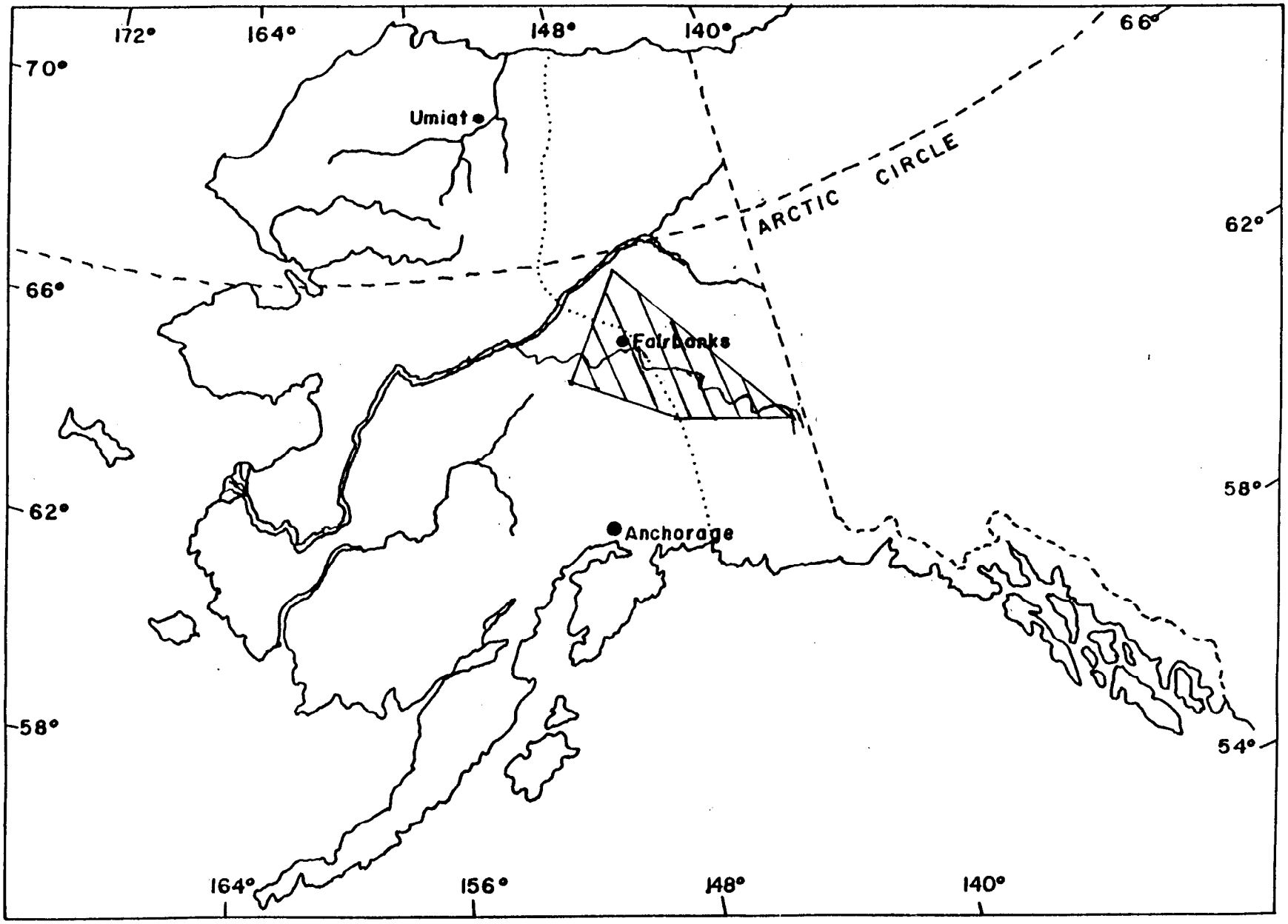

Figure 1. Fairbanks lake stocking study area.

Stocking success in smaller lakes is evaluated intermittently. The level of evaluation varies according to the size and accessibility of the lake, the importance and intensity of the sport fishery, and the research needs for the species stocked in the lake. Minimal evaluations involve overnight net sets, and answer the question of whether the stocked fish survived and whether they have reached catchable size.

The major goal of the stocking program is to create, maintain, or improve a variety of sport fishing opportunities in the region. Specific project objectives in 1988 were to:

1. estimate abundance, mean length, and cohort composition of rainbow trout in Birch Lake, Quartz Lake, Backdown Lake, and Ken's Pond;

2. document presence of stocking cohorts of rainbow trout in Piledriver Slough;

3. estimate abundance, cohort composition, and mean length of populations of chinook salmon in Bolio Lake, Little Harding Lake, and Donnelly Lake;

4. document presence and average size of rainbow trout in Johnson Road Pit # 1;

5. estimate abundance, cohort composition, and mean length of coho salmon in Eight Mile Lake, 28 Mile Pit, and Earthmover Pit;

6. estimate abundance and mean length of sockeye salmon in Harding Lake; and,

7. estimate abundance, cohort composition, and mean length of populations of Arctic char in Brodie Lake, Rangeview Lake, Dick's Pond, Ken's Pond and Backdown Lake.

A major task of the lake stocking project is to formulate future stocking procedures and to assist the Fisheries Rehabilitation, Enhancement, and Development (FRED) Division with stocking all area lakes. Results of these activities are also presented in this report.

METHODS

Project research activities in 1988 fell into two major categories: mark-recapture experiments and test netting evaluations of stocking success.

Mark-Recapture Experiments

Abundance of stocked fish using mark-recapture experiments was estimated by species at the locations and times listed in Table 1. Fish were captured with

Table 1. Lakes on which population abundance estimates were attempted during 1988.

Lake	Species	Date
Birch	Rainbow Trout	19 August
Quartz	Rainbow Trout	25 August
Bathing Beauty	Rainbow Trout	17 June
45.5 Mi. CHSR[1]	Rainbow Trout	25 May
Backdown	Rainbow Trout	19 July
Backdown	Arctic Char	19 July
Ken's	Rainbow Trout	19 July
Ken's	Arctic Char	19 July
Brodie	Arctic Char	19 July
Brodie	Arctic Grayling	19 July
Rangeview	Arctic Char	19 July
Last	Arctic Char	19 July
Dick's	Arctic Char	19 July
Bolio	Chinook Salmon	06 June
Donnelly	Chinook Salmon	06 July
Little Harding	Chinook Salmon	07 June
Harding	Sockeye Salmon	07 October
Eight Mile	Coho Salmon	05 August
28 Mile	Coho Salmon	29 June
Earthmover	Coho Salmon	05 August

[1] Chena Hot Springs Road.

fyke nets baited with salmon eggs. Fyke nets were 6.1 m long and 1.2 m in diameter with 9.53 mm knotless nylon webbing and 1.2 m x 30.5 m center leads. Center leads were attached to shore and the nets were set perpendicular to shore in about 0.5 m to 2 m of water. All captured fish were anesthetized with MS-222, marked with a partial clip of a lobe of the caudal fin, measured to the nearest millimeter fork length (FL), and released away from the site at which they were captured. Initial marking generally took place over four days. Subsequent sampling took place after a one to four week period to allow marked fish to mix throughout the population. All captured and recaptured fish were measured as described above and released. At Quartz Lake, subcatchable (20 g) rainbow trout were marked prior to stocking with adipose finclips (so that they could be distinguished from fish stocked as fingerlings), and at Birch Lake a cohort of subcatchable rainbow trout stocked under the ice in March were given the same mark to distinguish them from subcatchables stocked after breakup.

At Quartz and Birch Lakes, four to six fyke nets were fished during each sampling event. To allow assessment of mixing of marked and unmarked fish at Quartz and Birch Lakes, fish captured on one half of the lake were marked with an upper caudal finclip and those captured on the opposite half of the lake were given a lower caudal clip. Sampling in all other lakes (Backdown, Ken's Pond, Donnelly, Eight Mile, 28 Mile Pit, Earthmover Pit, Brodie, Rangeview, Dick's Pond, Bolio, and Little Harding) was similar to that of Quartz and Birch Lakes except that only one to three fyke nets were set at each lake and fish were not given differential finclips in each half of the lake.

The preferred population abundance estimator was Chapman's modification of the Petersen mark-recapture technique (Chapman 1951):

$$(1)\quad \hat{N} = \frac{(n_1 + 1)(n_2 + 1)}{R + 1} - 1;$$

where:

$\hat{N}$ = the estimated abundance;

n_1 = the number of marked fish in the population;

n_2 = the number of fish caught in the second sampling event; and,

R = the number of marked fish caught in the second sampling event.

The approximate variance of this estimate is:

$$(2)\quad \hat{V}[N] = \frac{\hat{N}(n_2 - R)\,(n_1 - R)}{(R + 1)\,(R + 2)}.$$

Assumptions necessary for the accurate use of these estimators are:

1. the population is closed (no immigration or emigration);

2. all fish have the same probability of capture in the marking sample or in the recapture sample, or marked and unmarked fish mix completely between marking and recapture events;

3. marking does not affect their probability of capture in the recapture event;

4. fish do not lose their mark between the marking and recapture events; and,

5. all marked fish are reported when recovered in the recapture sample.

Validity of these assumptions was tested with a battery of chi-square and/or Kolomogorov-Smirnov tests generated from the mark-recapture data (Seber 1982).

In several of the lakes, the fish population was made up of more than one stocking cohort (year class or stocking size group). The proportions of fish in all stocked cohorts were simultaneously estimated as multinomial and binomial proportions. The proportions of each category were estimated as follows (Cochran 1977):

$$(3) \quad \hat{P}_j = \frac{n_j}{n}; \text{ and,}$$

$$(4) \quad \hat{V}[P_j] = \frac{\hat{P}_j(1-\hat{P}_j)}{n - 1};$$

where:

n_j = the number in the sample from group j;

n = the sample size; and,

$\hat{P}_j$ = the estimated fraction of the population that is made up of group j.

Numbers of fish sampled from each stocked cohort were determined through length frequency analysis.

The abundance of survivors in each stocking cohort is the product of the estimated fraction and estimated abundance of the population:

$$(5) \quad \hat{N}_j = \hat{N}\ \hat{P}_j .$$

The variance of this equation is the product of two variances according to Goodman (1960):

$$(6) \quad \hat{V}[\hat{N}_j] = \hat{N}^2 \hat{V}[\hat{P}_j] + \hat{V}[\hat{N}]\hat{P}_j^2 - \hat{V}[\hat{P}_j]\hat{V}[\hat{N}] .$$

The survival rate since stocking and associated variance for each cohort was calculated as follows:

$$(7) \quad \hat{S} = \frac{\hat{N}_2}{N_1}; \text{ and,}$$

$$(8) \quad \hat{V}(\hat{S}) = \frac{\hat{V}(\hat{N}_2)}{N_1^2};$$

where:

N_1 = number of fish stocked;

$\hat{N}_2$ = the estimated abundance of the stocking cohort; and,

$\hat{S}$ = the estimated survival rate from the time of stocking to the time of the abundance estimate.

Estimates of mean length of each stocking cohort were generated with standard normal procedures. Simple averages and squared deviations from the means were used to calculate means and variances of the means.

Tow Netting

The abundance and mean length of sockeye salmon in Harding Lake was estimated by collecting fish during night tow netting operations as described in Clark and Doxey (1989).

Test Netting

Length and relative abundance information of stocked or indigenous fish was collected incidentally to major population estimates. These data were obtained during overnight sampling with fyke nets.

Test netting of Harding Lake was performed to determine if sheefish stocked in prior years had survived and to obtain distribution information on the first stockings of large Arctic char fingerlings in October. Experimental sinking gill nets were fished in two 4-night blocks (in late June and early October) in Harding Lake. The lake was divided into four pie-shaped sample areas. Four sinking variable mesh gill nets were fished perpendicular to the shore in an evenly spaced line from about 7 m of water out to the deepest water in the

quadrant (20-40 m). The depth of each set was verified using a recording fathometer. The gill nets were fished in a quadrant for one night, then moved to the next quadrant until all four quadrants were sampled. Due to time constraints and limited gear availability, planned similar efforts for fyke nets were reduced to a single three day period in late July.

Catches of all game fish were recorded by species, gear type, depth, and location. Fork length or weight was estimated for all species captured and released. Dead fish were autopsied to determine sex, maturity, and age.

Structures taken for age determination included: scales, otoliths, and opercles (lake trout) and cleithrum bones (northern pike).

In 1988, three size classes of rainbow trout were stocked into Piledriver Slough. This was the second stocking of rainbow trout into this interior Alaska river (and the only such stocking program). To determine whether these fish can overwinter in the system, creel census interviews and sampling of the stream using seines and electrofishing gear were performed in the spring of 1988.

RESULTS

Numbers of Fish Stocked

A total of 759,626 rainbow trout, 1,351,392 Arctic grayling, 60,000 sheefish, 58,190 Arctic char, 55,985 chinook salmon, 243,800 coho salmon, 500,000 sockeye, and 38,476 lake trout were stocked in Region III waters in 1988 (Appendix Tables 1 through 8). No major logistical problems occurred during stocking. Some mortality occurred during lake trout transport and stocking. The most extreme case was the near total loss of 4,700 fingerlings stocked into Lost Lake. Thermal stress was thought to be the cause of the failure, and subsequent stocking of 2,500 lake trout during a cooler period produced no noticeable mortalities. Fish were transported to remote lakes by Sport Fish Division personnel using an all terrain vehicle, state aircraft, and snowmobiles.

Anticipated totals of 662,900 rainbow trout, 288,300 coho salmon, 115,700 Arctic grayling, 67,630 Arctic char, 47,950 lake trout, 500,000 sockeye salmon, and 125,000 sheefish will be stocked in Region III waters in 1989 (Appendix Table 9).

Mark-Recapture Experiments and Associated Sampling

A total of 20 mark-recapture experiments to evaluate the survival of stocked rainbow trout, Arctic char, coho salmon, Arctic grayling, and chinook salmon were attempted in 17 lakes during 1988 (Table 1). Additional growth and relative abundance sampling was performed in four lakes during the mark-recapture experiments (Table 2.)

Table 2. Waters in which growth and relative abundance sampling were performed during 1988.

Lake	Species	Date
Bolio Lake	Grayling Rainbow Trout	06 June
Little Harding Lake	Rainbow Trout	07 June
Eight Mile Lake	Grayling Round Whitefish	05 August
Brodie Lake	Grayling	19 July

Birch Lake Rainbow Trout:

A total of 4,225 rainbow trout were captured during the mark-recapture experiment at Birch Lake (Table 3). Of those captured, 110 were recaptures. Length frequency analysis and the capture of fish marked with adipose fin clips (subcatchables stocked through the ice in March, 1988) and those without fin clips (subcatchables stocked in May 1988 or in previous years) allowed the definition of three cohorts of rainbow trout in Birch Lake: (1) subcatchables stocked in March 1988; (2) subcatchables stocked in May 1988; and, (3) older rainbow trout stocked as fingerlings and subcatchables in previous years. Estimated total abundance of rainbow trout in Birch Lake in August 1988 was 30,795 fish (SE = 2,858). That total broke down into cohorts as follows: subcatchables stocked in March 1988, 4,068 fish (SE = 947); subcatchables stocked in May 1988, 25,766 fish (SE = 2,220); and all other rainbow trout, 961 fish (SE = 932). These represent survivals of 41% (SE = 0.09) for the 10,000 rainbow trout stocked in March and 58% (SE = 0.05) for the 44,723 stocked in May 1988.

In August 1,090 rainbow trout were captured and marked. Totals of 144 had been stocked in March, 94 had been stocked in May, and 34 had been stocked prior to 1988. A total of 654 fish were measured. In October 3,135 rainbow trout were captured, of which 110 were recaptured (Table 3).

Results from the tests for mixing of marked fish between sampling areas and probability of capture for small and large fish indicate that marked fish did mix ($\chi^2 = 0.85$, $0.90 > p > 0.75$) and the proportion of small and large fish captured during first event were not different from the proportions captured during the second event ($\chi^2 = 0.65$, $0.90 > p > 0.75$).

The Kolmogorov-Smirnov test indicated that there was length bias between the first and second sampling events ($DN = 0.17$, $p \approx 0$). However, examination of plots of the cumulative frequency distributions indicate that the distributions are similar and the difference is probably due to growth.

These tests indicate that the estimates of abundance need not be stratified and that the pooled Peterson method was appropriate.

Length data for Birch Lake rainbow trout is given in Table 4. By August, rainbow trout stocked in March 1988 had a mean length of 202 mm and those stocked in May 1988 had a mean length of 184 mm. Growth of each cohort from late June to August was about 0.6 mm per day. This growth rate estimate was probably biased by angler preference for larger fish. This would result in the larger fish in each cohort being retained in the creel through the summer while the smaller ones are released (Doxey 1980). The above growth rate should be considered a minimum figure. By October, rainbow trout from the March stocking had attained a mean length of 231 mm, while fish from the May stocking were 212 mm. Residuals from previous year's stockings ranged in length from 265 mm to 349 mm.

Table 3. Numbers of rainbow trout sampled and estimated abundance from the mark-recapture experiment at Birch Lake, 1988.

Cohort	Number Marked	Number Examined	Number Recaptured	Estimated Abundance	Standard Error
Total Population	1,090	3,135	110	30,795[1]	2,858[1]
1988 March Subcatchables	144	---[3]	---[3]	4,068[2]	947[2]
1988 May Subcatchables	912	---[3]	---[3]	25,766[2]	2,220[2]
All other Rainbow Trout	34	---[3]	---[3]	961[2]	932[2]

[1] Total abundance estimate and standard error of combined cohorts was calculated using equations 1 and 2.

[2] Cohort abundance estimates and standard errors were derived from proportions of each cohort in the total sample, using equations 3 and 4.

[3] Data not available.

Table 4. Length composition of rainbow trout sampled from Birch Lake, 1988.

Date	Stocking Cohort	Number Sampled	Length Range(mm)	Mean Length(mm)	Standard Error
22 Jun	March 1988 Subcatchables	72	126 - 201	168	1.8
22 Jun	May 1988 Subcatchables	435	107 - 194	146	0.8
25 Aug	March 1988 Subcatchables	87	124 - 245	202	2.1
25 Aug	May 1988 Subcatchables	559	75 - 244	184	0.8
25 Aug	Residuals from previous stockings	18	247 - 284	258	0.8
10 Oct	March 1988 Subcatchables	145	189 - 272	231	1.9
10 Oct	May 1988 Subcatchables	893	110 - 258	212	0.4
10 Oct	Residuals from previous stockings	17	265 - 349	258	51.4

Birch Lake Coho Salmon:

Sampling of coho salmon was performed in conjunction with mark-recapture sampling of rainbow trout. Coho salmon ranged in length from about 67 to 225 mm in late June and about 100 to 300 mm in late September (Table 5.) The mean length for age 0 coho salmon increased by 35 mm from late June to late September.

Quartz Lake Rainbow Trout:

A total of 3,295 rainbow trout were sampled from Quartz Lake during the mark-recapture experiment conducted during August and September 1988 (Table 6). Length frequency analysis and the capture of fish marked with adipose fin clips (stocked as subcatchables) and without fin clips (stocked as fingerlings) allowed the definition of four cohorts of rainbow trout in Quartz Lake: (1) subcatchables stocked in May 1988; (2) subcatchables stocked in May 1987; (3) fingerlings stocked in August 1987; and, (4) rainbow trout stocked as fingerlings prior to 1987. Estimated total abundance of rainbow trout in Quartz Lake in August 1988 was 43,251 fish (SE = 5,320). Cohort breakdown was as follows: subcatchables stocked in May 1988, 13,461 (SE = 1,915); subcatchables stocked in May 1987, 410 (SE = 1,201); rainbow trout stocked as fingerlings in August 1987, 28,718 (SE = 3,596); and survivors of previous fingerling stockings, 662 (SE = 1,181). These estimates represent survivals of 28% (SE = 0.04) for subcatchables stocked in 1988 and 19% (SE = 0.02) for survivors of the 1987 fingerling stocking.

In August 1,372 rainbow trout were captured and marked (Table 6). A total of 427 had been stocked in May 1988, 13 had been stocked as subcatchables in May 1987, 911 had been stocked as fingerlings in August 1987, and 21 had been stocked as fingerlings prior to 1987. In September 1,985 rainbow trout were captured, of which 62 were recaptured (Table 6).

Results from the tests for mixing of marked fish between sampling areas and probability of capture for small and large fish indicate that marked fish did mix ($\chi^2 = 0.16$, $0.75 > p > 0.50$) and the proportion of small and large fish captured during the first event were not different from the proportions captured during the second event ($\chi^2 = 0.10$, $0.90 > p > 0.75$).

The Kolomogorov-Smirnov test indicated that there was length bias between the first and second sampling events ($DN = 0.39$, $p \approx 0$). However, examination of plots of the cumulative frequency distributions indicate that the distributions are similar and the difference is probably due to growth.

These tests indicate that the estimates of abundance need not be stratified and that the pooled Petersen method was appropriate.

Length data for Quartz Lake rainbow trout are given in Table 7. Rainbow trout from the 1987 fingerling stocking grew 21 mm (from 165 mm to 186 mm) from 28 August to 28 September. Similarly, the 1988 subcatchable stocking cohort grew from 172 in August to 194 mm in September. Residuals from previous stockings (since 1972) ranged from 297 mm to 560 mm in late September.

Table 5. Length composition of coho salmon sampled from Birch Lake, 1988.

Date	Stocking Cohort	Number Sampled	Length Range(mm)	Mean Length(mm)	Standard Error
22 Jun	1988 Fing.	89	67 - 124	98	1.1
22 Jun	1987 & Older	258	127 - 225	167	1.0
22 Sep	1988 Fing.	81	102 - 164	133	2.1
22 Sep	1987 & Older	38	168 - 307	202	4.5

Table 6. Numbers of rainbow trout sampled and estimated abundance from the mark-recapture experiment at Quartz Lake, 1988.

Cohort	Number Marked	Number Examined	Number Recaptured	Estimated Abundance	Standard Error
All Rainbow Trout	1,372	1,985	62	43,251[1]	5,320[1]
1988 Subcatchables	427	251	15	13,461[2]	1,915[2]
1987 Subcatchables	13	---[3]	--[3]	410[2]	1,201[2]
1987 Fingerlings	911	---[3]	--[3]	28,718[2]	3,596[2]
Older Trout Stocked as Fingerlings	21	---[3]	--[3]	662[2]	1,181[2]

[1] Total abundance estimate and standard error of combined cohorts was calculated using equations 1 and 2.

[2] Cohort abundance estimates and standard errors were derived from proportions of each cohort in the total sample, using equations 3 and 4.

[3] Data not available.

Table 7. Length composition of rainbow trout sampled from Quartz Lake, 1988.

Date	Stocking Cohort	Number Sampled	Length Range (mm)	Mean Length (mm)	Standard Error
28 Aug	1987 Fing.	914	103 - 277	165	1.0
28 Aug	Residuals from previous stockings	21	305 - 471	373	11.4
28 Aug	1988 Subcatchables	420	111 - 257	172	1.3
28 Aug	1987 Subcatchables	14	280 - 399	355	8.7
28 Sep	1988 Fingerlings	23	61 - 105	80	2.0
28 Sep	1987 Fingerlings	1,164	111 - 279	186	0.9
28 Sep	Residuals from previous stockings[1]	64	297 - 560	399	6.2
28 Sep	1988 Subcatchables	246	124 - 275	194	1.9
28 Sep	1987 Subcatchables	23	285 - 430	376	7.6

[1] Since 1972.

Quartz Lake Coho Salmon:

During sampling in late September, coho salmon that were stocked as 2 to 4 g fingerlings in May averaged 133 mm (Table 8). Coho salmon from previous stockings averaged 186 mm in late September.

Other Rainbow Trout Lakes:

During the summer of 1988, estimates of rainbow trout abundance were made at Ken's Pond, Backdown Lake, Bathing Beauty Pond, and 45.5 Mile Chena Hot Springs Road Pit (Table 9). Overwinter survivals of first year stockings in Backdown Lake and Ken's Pond were 30% (SE = 0.04) and 72% (SE = 0.08). Populations from two stocking cohorts (1986 and 1987 fingerlings) in Bathing Beauty Pond and 45.5 Mi. CHSR represented 23% (SE = 0.02) and 81% (SE = 0.05) of the original numbers stocked.

Length data for rainbow trout sampled during abundance estimates on smaller lakes is presented in Table 10. By mid-August 1988, mean length of rainbow trout stocked as fingerlings in 1987 ranged from 137 mm to 183 mm. Growth appeared to be inversely related to survival rate (Table 9).

No rainbow trout were captured during sampling efforts at Johnson Road Pit # 1.

Chinook Salmon Lakes:

Mark-recapture estimates of chinook salmon abundance were attempted in three lakes and completed in one during 1988. Data for these estimates is given in Table 11. While almost 800 Age I and Age II chinook salmon were marked in Bolio Lake during the first sampling event in June 1988, none were captured during three subsequent attempts to sample the population. This contrasts with the successful sampling events in 1987, when less recapture efforts produced 687 Age I chinook salmon. It appears that older chinook salmon virtually disappeared from Bolio Lake during the course of the summer. Two trips to Donnelly Lake to capture chinook salmon for marking produced only one survivor of the 1987 stocking. Both indigenous slimy sculpins *Cottus cognatus* and large rainbow trout from previous stockings were captured in Donnelly Lake during the attempts to capture chinook salmon, apparently eliminating winterkill as the cause of the disappearance of the chinook salmon. Efforts were more successful in Little Harding Lake, where the estimated abundance of Age I chinook salmon in June was 1,128 (SE = 116) (Table 11). Ten thousand chinook salmon were stocked in 1987, giving an overwinter survival rate of 11% (SE = 0.01).

Length data collected during population estimate efforts in lakes stocked with chinook salmon is presented in Table 12. Age I chinook salmon sampled in June were 162 and 176 mm in length in Little Harding and Bolio Lakes, respectively. Chinook salmon stocked in Bolio Lake in 1988 grew an average of 7 mm in length between late June and early August while those from the same cohort in Little Harding grew 17 mm from 25 May to 7 June.

Table 8. Length composition of coho salmon sampled from Quartz Lake, 1988.

Date	Stocking Cohort	Number Sampled	Length Range (mm)	Mean Length (mm)	Standard Error
25 Aug	1988 Fing.	121	85 - 147	121	1.4
25 Aug	1987 & Older	69	154 - 335	185	4.1
26 Sep	1988 Fing.	183	99 - 156	133	0.9
26 Sep	1987 & Older	58	159 - 257	186	2.6

Table 9. Numbers of rainbow trout sampled and estimated abundance from mark-recapture experiments on smaller lakes, 1988.

Location	Date	Date Stocked[1]	Number Marked	Number Examined	Recaps	Estimated Abundance	Standard Error	Percent Survival[2]	Standard Error
Bathing Beauty Pond	17 Jun	1986 & 1987	114	107	38	318	33	23	0.02
45.5 Mi. CHSR	27 May	1986 & 1987	567	366	128	1,615	100	81	0.05
Backdown Lake	19 Jul	1987	111	35	21	182	21	30	0.04
Ken's Pond	19 Jul	1987	106	117	34	360	41	72	0.08

[1] All fish were stocked as fingerlings.
[2] Percent survivals are calculated population estimates divided by the number of fish originally stocked.

Table 10. Length composition of rainbow trout sampled during mark-recapture experiments during 1988, for lakes other than Birch and Quartz.

Location	Date	Stocking Cohort	Number Sampled	Length Range (mm)	Mean Length (mm)	SE
Ken's Pond	13 Jul	1987 Fing.	108	99 - 264	142	2.3
" "	16 Aug	" "	117	121 - 210	165	1.8
Bathing Beauty Pond	17 Jun	1987 Fing.	75	94 - 159	129	1.6
" "	23 Aug	" "	38	143 - 250	183	1.6
" "	17 Jun	1986 Fing.	39	172 - 251	208	3.1
" "	23 Aug	" "	3	188 - 257	204	20.0
45.5 Mi. CHSR	25 May	1987 Fing.	226	60 - 103	85	0.5
" "	11 Aug	" "	309	115 - 179	137	0.7
" "	25 May	1986 Fing.	146	120 - 253	181	1.7
" "	11 Aug	" "	55	182 - 254	205	2.1
Backdown Lake	19 Jul	1987 Fing.	111	101 - 192	138	1.7
" "	02 Aug	" "	35	116 - 181	150	2.9

Table 11. Numbers of chinook salmon sampled and estimated abundance from mark recapture experiments, 1988.

Location	Date	Date Stocked[1]	Number Marked	Number Examined	Recaps	Estimated Abundance	Standard Error	Percent Survival[2]	Standard Error
Bolio Lake	25 Jun	1986 & 1987	777	0	0	777	---	0	---
Little Harding	07 Jun	1987	375	167	55	1,128	116	11	0.01
Donnelly Lake	07 Jul	1987	1	0	0	1	---	0	

1 All fish were stocked as fingerlings.
2 Percent survivals are calculated population estimates divided by the number of fish originally stocked.

Table 12. Length composition of chinook salmon sampled from Little Harding, Bolio, and Donnelly Lakes, 1988.

Location	Date	Stocking Cohort	Number Sampled	Length Range (mm)	Mean Length (mm)	Standard Error
Donnelly Lake	07 Jul	1988 Fing.	78	110 - 136	122	0.5
" "	19 Aug	" "	120	123 - 150	134	0.5
Bolio Lake	21 Jun	1988 Fing.	656	92 - 130	114	0.3
"	21 Jun	1987 Fing.	777	148 - 236	176	0.5
"	07 Aug	1988 Fing.	58	109 - 135	121	0.7
L. Harding Lake	25 May	1988 Fing.	74	84 - 109	96	1.8
" "	25 May	1987 Fing.	63	121 - 201	150	1.8
" "	25 May	1986 & Older	5	222 - 331	---	---
" "	07 Jun	1988 Fing.	72	97 - 131	113	0.7
" "	07 Jun	1987 Fing.	298	140 - 221	162	0.8
" "	07 Jun	1986 & Older	9	230 - 291	252	20 0
" "	25 Jul	1987 Fing.	167	150 - 276	182	2.3
" "	25 Jul	1986 & Older	1	--- ---	334	---

Table 13. Numbers of Arctic char sampled and estimated abundance from mark-recapture experiments, 1988.

Location	Date	Date Stocked[1]	Number Marked	Number Examined	Recaps	Estimated Abundance	Standard Error	Percent Survival[2]	Standard Error
Backdown Lake	19 Jul	1987	42	279	25	462	53	77	0.09
Brodie Lake	19 Jul	1987	21	216	7	596	156	60	0.16
Dick's Pond	19 Jul	1987	105	458	53	900	80	90	0.08
Last Lake	19 Jul	1987	74	131	34	282	29	57	0.06
Rangeview	19 Jul	1987	37	150	16	337	47	38	0.05

[1] All fish were stocked as fingerlings.

[2] Percent survivals are calculated population estimates divided by the number of fish originally stocked.

Arctic Char Lakes:

Arctic char abundance estimates were attempted in six lakes and completed in five along the Coal Mine Road. Results are presented in Table 13. All of these lakes were stocked for the first time with Arctic char in 1987. The one lake in which an Arctic char estimate was not successful was Ken's Pond, where the stocking was much smaller (153 fish) than planned (500 fish) because insufficient fish were available and Ken's Pond was the last of the lakes to be stocked. Arctic char were captured in Ken's Pond, but not enough were marked to produce an estimate. However, the 34 sampled in August 1988 represent a minimum survival of 22%.

Survivals from June 1987 to July 1988 ranged from 38% (SE = 0.05) in Rangeview Lake to 90% (SE = 0.08) in Dick's Pond. Average survival was 64%.

Length data collected during Arctic char abundance estimates is presented in Table 14. By August the largest Arctic char surviving from the 1987 cohort were present in Ken's Pond, where the 34 fish sampled had a length range of 157 to 282 mm, and a mean length of 224 mm. The lower end of the growth range for the lakes was in Brodie Lake, where in mid-August the length range of the same cohort was 112 to 272 mm, and mean length was 146 mm. Similarly, the growth rate between sampling periods was lowest in Brodie Lake, where the mean length of Arctic char stocked in 1987 increased only 5 mm in 29 days, while in the other four lakes from which that data was collected the mean length increased 11 to 12 mm over a 15 day period.

Arctic char are exhibiting extremely rapid growth in the Clear Hatchery, where hatchery staff have demonstrated the ability to grow cohorts of Arctic char from the egg to 750 grams in 12 months.

Brodie Lake Arctic Grayling:

During the Arctic char abundance estimate at Brodie Lake, the lake was found to have an Arctic grayling population. These fish were undoubtedly stocked, but no record exists of the stocking and it is assumed that fish destined for another lake were mistakenly stocked into Brodie Lake. Their population abundance was estimated and length information was collected. Estimated Arctic grayling abundance in Brodie Lake on 19 July 1988 was 1,143 fish (number marked = 103, number examined for marks = 120, recaptures = 10, SE = 298). Population density of Arctic grayling was thus at least 229 fish per acre in this 5 acre lake at the time of the Arctic char stocking.

The Arctic grayling were very thin, and appeared to be from the same stocking cohort. Length range of all the grayling sampled was 122 to 202 mm (n = 213) (Table 15) and mean lengths were 150 mm (n = 103, SE = 0.9) on 12 July and 151 mm (n = 110, SE = 0.8) on 2 August.

Coho Salmon Lakes:

Attempts to estimate yearling coho salmon abundance on three lakes in 1988 were unsuccessful. In Eight Mile Lake and 28 Mile Pit insufficient numbers of salmon were captured during the marking event to start an estimate. The 28

Table 14. Length composition of Arctic char sampled during population estimates, 1988.

Location	Date	Stocking Cohort	Number Sampled	Length Range (mm)	Mean Length (mm)	Standard Error
Backdown Lake	19 Jul	1987 Fing.	42	133 - 262	174	5.6
" "	02 Aug	" "	279	135 - 247	185	1.2
Brodie Lake	19 Jul	1987 Fing.	21	113 - 248	141	6.1
" "	16 Aug	" "	80	112 - 272	146	2.9
" "	16 Aug	1988 Fing.	7	30 - 53	39	3.5
Rangeview Lake	19 Jul	1987 Fing.	56	117 - 207	163	3.6
" "	02 Aug	" "	149	135 - 260	174	1.4
Last Lake	19 Jul	1987 Fing.	74	119 - 234	186	2.9
"	02 Aug	" "	131	117 - 228	194	2.0
Dick's Pond	19 Jul	1987 Fing.	105	122 - 200	170	2.0
"	02 Aug	" "	456	136 - 250	182	0.8
Ken's Pond	16 Aug	1987 Fing.	34	157 - 282	224	5.1
"	16 Aug	1988 Fing.	64	82 - 111	97	0.8

Table 15. Sampling effort and size structure of fish sampled in other Region III stocked lakes, 1988[1].

Location	Date	Species & Stocking Cohort (If Known)	Number Sampled	Length Range (mm)	Mean Length (mm)	Standard Error	Days Fished
Bolio Lake	21 Jun	Grayling	15	168 - 266	241	8.1	2
" "	21 Jun	Rainbow Trout 1987 Subcatchables	35	162 - 246	181	2.9	2
" "	07 Aug	Lake Trout 1988 Fingerlings	33	61 - 87	33	0.9	2
" "	07 Aug	Grayling	4	223 - 255	---	---	2
Brodie Lake	12 Jul	Grayling	103	133 - 202	150	0.9	3
" "	02 Aug	"	110	122 - 171	151	0.8	3
Eight Mile Lake	05 Aug	Grayling Indigenous	37	184 - 242	219	2.0	3
Eight Mile Lake	05 Aug	Round Whitefish Indigenous	27	205 - 316	282	5.1	3
Donnelly Lake	07 Jul	Rainbow Trout 1987 Subcatchables	2	400 & 458	---	---	3
Little Harding Lake	25 May	Rainbow Trout 1987 Fingerlings	42	79 - 127	101	1.7	2
" " "	25 May	Rainbow Trout 1986 Subcatchable	1	292	---	---	2
" " "	25 Jul	Rainbow Trout 1987 Fingerlings	30	124 - 220	165	4.6	3

[1] Gear used was a fyke net.

Mile Pit efforts were further hindered when it became apparent that the weight of the mass of lake chubs *Couesius plumbeus* captured were crushing the newly stocked Arctic char fingerlings, and that separating the Arctic char and coho salmon from the chubs was further stressing and killing the gamefish. Indigenous Arctic grayling and large round whitefish *Prosopium cylindraceum* were captured during sampling efforts in Eight Mile Lake (Table 15). Sampling efforts in Earthmover Pit near Clear produced two very healthy northern pike *Esox lucius* and no coho salmon.

Length information for coho salmon sampled during these efforts is presented in Table 16. Coho salmon from the 1987 fingerling stocking cohort in Eight Mile Lake had a mean length of only 139 mm, compared to 133 mm for coho salmon from the 1988 stocking cohort sampled in Birch Lake during September 1988 (Table 5).

Test Netting

Fyke, gill, tow, and seine nets were used to sample fish in various water bodies.

Harding Lake:

During the open water period of 1988, Harding Lake was sampled for a total of four net nights with fyke nets and 24 net nights with sinking gill nets. A total of 384 fish were captured: 319 least cisco *Coregonus sardinella*; 18 northern pike, nine burbot *Lota lota*, seven lake trout, one sheefish, and 30 Arctic char.

Distributions of captured fish by depth are presented in Table 17. Gill nets were generally not set in water shallower than 5 m or along aquatic vegetation and other northern pike habitat because of the probability of injuring or killing northern pike in these areas. Distributions of indigenous species in the lake were generally consistent with previous observations (Doxey 1982, 1983, 1984). Least cisco were observed near the surface over deep water throughout the summer. Arctic char fingerlings were taken in deep water during October test netting shortly after they were stocked. The single sheefish was observed swimming in shallow water in midsummer, and had been injured during an encounter with a large lake trout. An angler reported catching four sheefish from a small school in early summer, and a staff member confirmed the species identification of one that he brought into the Fish and Game office. All weighed about 1,800 g.

Length and weight data for Harding Lake fish sampled during 1988 are presented in Table 18. The lake trout were autopsied and the data and specimens are in the archives of the regional lake trout project.

Harding Lake Tow Netting:

Results of the tow netting experiments assessing the status of the 500,000 sockeye salmon stocked into Harding Lake in late May 1988, are detailed in Clark and Doxey (1989).

Table 16. Length composition of coho salmon sampled from Eight Mile Lake and 28 Mile Pit, 1988.

Location	Date	Stocking Cohort	Number Sampled	Length Range (mm)	Mean Length (mm)	Standard Error
Eight Mile Lake	05 Aug	1988 Fing.	76	78 - 115	99	1.1
" "	05 Aug	1987 Fing.	6	133 - 145	139	1.9
28 Mi. Pit	28 Jun	1986 & Older	32	170 - 280	202	4.2
" "	02 Sep	1987 & Older	9	182 - 284	228	12.1

Table 17. Harding Lake fish distribution by depth[1].

Depth Zone	Species[2] present at depth during time periods: 29 Jun - 01 Jul	20 Jul - 22 Jul	01 Oct - 06 Oct	Total effort at depth, Net Nights
Nearshore:				
Bank to 1.3 m (Fyke nets)	Not Fished	NP, SF	Not Fished	4
Offshore:				
0 - 3 m	Not Fished	Not Fished	Not Fished	0
3 - 13 m	LCI,	Not Fished	LCI, NP LT	6
13 - 23 m	LCI,	Not Fished	LT, LCI AC, BB	9
23 - 31 m	LCI, BB	Not Fished	LCI, AC BB	6
31 - 44 m	Not Fished	Not Fished	BB, LCI AC	3

[1] All data are from gill net and fyke net samples obtained during 1988.
[2] NP = northern pike, SF = sheefish, BB = burbot, LT = lake trout, LCI = least cisco, RT = rainbow trout, AC = Arctic char.

Table 18. Size data for Harding Lake fish sampled in 1988.

Species	Number Sampled	Length Range (mm)	Weight Range (g)
Lake Trout	7	533 - 829	2,250 - 9,750
Northern Pike	18	-	1,360 - 3,200[1]
Least Cisco	319	100 - 280[2]	-
Burbot	9	300 - 400[2]	450 - 900[1]
Sheefish	1	-	1,360[1]
Arctic Char	30	110 - 185	-

[1] Estimated weights.
[2] Estimated lengths.

Harding Lake was sampled with tow nets during the nights of 5-7 October. A total of 43 tows made at varying depths within the top 10 m of the lake captured 147 sockeye salmon and 219 least ciscos. The catch-per-unit (CPUE) multiplied by area swept data were expanded by the approximate volume of the top 10 m of the lake to produce estimates that 25,495 sockeye salmon and 33,301 least ciscos were inhabiting the sampled zone during the sampling periods. The sockeye salmon survival rate was estimated at 5 to 6% for the four months that they had been present in the lake, and mean length was 72 mm (SE = 34). Survival was in the lower range of reported survivals in Alaskan lakes, and growth was slightly higher than that reported for natural stocks.

Small Stocked Lakes:

Length data for miscellaneous species collected in stocked lakes during the summer are presented in Table 15. Rainbow trout stocked as fingerlings into Little Harding Lake in August of 1987 grew from a mean length of 101 mm (SE = 1.7) on 25 May to 165 mm (SE = 4.6 mm) on 25 July. Two rainbow trout sampled from a small stocking of subcatchables into Donnelly Lake that occurred in 1987 were 400 and 458 mm.

Hidden Lake, a gravel pit on Eielson AFB, was sampled with fyke nets in summer 1987. Large numbers of lake chubs and longnose suckers *Catostomus catostomus* were captured. No stocked Arctic grayling or rainbow trout were found. In October 1987, Hidden Lake was treated with liquid rotenone just before freeze-up. Sunlight and warm water detoxify rotenone, so treating a lake in late fall can prolong the toxicity and ensure a 100% fish kill. Test netting of Hidden Lake in May 1988 confirmed the absence of fish, and coho salmon captured in nearby 28 Mile Pit and held in a tub of water from Hidden Lake confirmed that the rotenone had broken down and was no longer harmful to fish. Hidden Lake was subsequently stocked with Arctic grayling fry, Arctic char fingerlings, and 90 g rainbow trout. Based on angler reports, the Arctic grayling survived and were growing well in October of 1988, and the rainbow trout stocking was very well received.

Piledriver Slough Rainbow Trout:

Piledriver Slough was stocked with the first rainbow trout ever stocked into interior Alaska waters during 1987 (Doxey 1988). Three sizes of rainbow trout were stocked, and by fall, 1987 had distributed into suitable habitat throughout the Piledriver Slough system and into some areas of the Moose Creek system, a small tributary system of Piledriver Slough. The stockings produced considerable enthusiasm within the angling public.

Staff observations and angler catch returns in April and May 1988 indicate that large rainbow trout stocked in 1987 either overwintered in, or returned to, Piledriver Slough. A single rainbow trout was seen in an ice-free pool by Department personnel in mid-April. As breakup proceeded in late April and early May, anglers reported catching rainbow trout along with Arctic grayling. One angler reported catching (and releasing) rainbow trout at the ratio of about ten rainbow trout to 120 Arctic grayling. Some of the trout were in spawning condition. Limited sampling with seines and minnow traps in early June 1988 produced no holdover rainbow trout. Sampling in Piledriver Slough

with a shockerboat from Moose Creek down to the Tanana River produced two holdover rainbow trout. Both appeared to be in post-spawning condition. Lengths were 295 and 310 mm.

As in 1987, Piledriver Slough was stocked with three sizes of rainbow trout during 1988 (Appendix Table 1). By late summer, larger rainbow trout had reportedly spread throughout the system, with harvests reported downstream from the stocking areas (between the confluence of Moose Creek with Piledriver Slough and the Tanana River) and in the Moose Creek system east of the Richardson Highway. Overwintering habitat is limited in the Moose Creek system.

In late September, anglers reported that larger rainbow trout abruptly disappeared from Piledriver Slough. The disappearance followed a gradual downriver redistribution, and coincided with a similar disappearance of the Arctic grayling population. It is presumed that the rainbow trout moved with the Arctic grayling into the Tanana River to overwinter. The Tanana River clears up in late fall and winter as glacial discharge stops, and was doing so in late September 1988.

There was no reported winter fishery for those rainbow trout.

Sampling in early summer 1989 indicated that rainbow trout from all three stocking cohorts had returned to Piledriver Slough, and were distributed throughout the system.

DISCUSSION

Four of the five assumptions (as outlined in the methods) necessary for the accurate use of a Petersen abundance estimator were met during all mark-recapture experiments. These were:

1. no immigration or emigration is possible in a landlocked lake;

2. the fish do not lose their mark because the caudal finclip is recognizable even if considerable fin regeneration has occurred;

3. each fish taken during the recapture sample is examined for a fin-clip by the project leader or his assistant, and all fin clips are noted; and,

4. Chi-square tests indicated that mixing of marked and unmarked fish was random between marking and recapture events in Birch and Quartz Lakes.

The degree to which marking affects the probability of capture in the recapture event has never been assessed in these lakes.

Survival of rainbow trout stocked in Birch Lake as subcatchables in May has ranged from 54.7% (Doxey 1981) to 67% (Doxey 1986, 1987). The 1988 survival estimate (58%) is within this range. The estimated 41% survival of

subcatchables stocked in March may be lower than that of the spring stocking due to their larger size (Table 3), which may have induced a proportionately higher harvest for them than for the smaller rainbow trout from the May stocking. In some past studies, summer harvest estimates have been added to abundance estimates (Doxey 1982) to produce a true picture of survival to catchable size (180 mm) as it relates to numbers of rainbow trout available to anglers from specific stocking cohorts. Summer creel census information is not available for this report, but the past studies suggest that the survivals of the 1988 rainbow trout cohorts are probably somewhat higher than the above estimates. Based on survival and growth data, the experimental stocking of subcatchable rainbow trout through the ice was successful. The option to stock larger fish through the ice for logistical reasons or to increase hatchery production and reduce raceway crowding can be added to the list of stocking techniques in Region III.

The 28% survival to fall of the 1988 cohort of subcatchable rainbow trout in Quartz Lake is twice the estimated 14% for the 1987 cohort (Doxey 1988). While still not matching Birch Lake survival rates for the same lots of fish stocked at about the same time, it is still a distinct improvement. Growth of the survivors of the 1987 subcatchable cohort in Quartz Lake has been excellent, with Age II+ fish having lengths up to 430 mm in late September (Table 7). The 1988 rainbow trout subcatchables had only a slight (7 to 8 mm) growth advantage over the 1987 fingerling stocking. Both cohorts are the same age and from the same hatchery. Survival of the 1987 rainbow trout fingerlings was 19%, close to the lower end of survivals of rainbow trout in smaller lakes reported in Doxey (1988). Return to the sport fishery from fingerling rainbow trout stockings into Quartz Lake has been about 5%. (Doxey 1988). The relationship between survival to fall of rainbow trout stocked as fingerlings into Quartz Lake and their ultimate return to the creel has not been assessed.

As in 1987 (Doxey 1988), in 1988 a single illegally stocked northern pike was captured (and killed) in Birch Lake during sampling in September. Length was approximately 500 mm. The absence of young northern pike in the fyke nets indicates that so far there has been no discernible successful spawning in the lake by northern pike. The presence of illegally stocked northern pike in Birch Lake presents a potential threat to the sport fishery, especially if successful spawning occurs.

The rapid growth rate of Arctic char in the hatchery provides the option to produce and stock them at larger sizes of fairly short notice. This, combined with the apparent success of under-ice stockings, means that hatchery annual production might be increased and that management options for Sport Fish Division staff are expanded.

Arctic char and rainbow trout growth and survival rate sampling in the Coal Mine Road Lakes indicated that the two species are initially compatible in stocked lakes, but that survival of rainbow trout fingerlings stocked in late summer may have been influenced by the presence of Arctic char stocked earlier in the year. Backdown Lake received its full allocation of Arctic char at 100/acre in June 1987, followed by rainbow trout fingerlings at 100/acre in August 1987. Survival of Arctic char to mid-July 1988 was 77%, while survival

of rainbow trout was 30% (Tables 9 and 13). In Ken's pond Arctic char were only stocked at 24/acre due to the shortfall of numbers of fish available. No estimate of their survival could be made other than to document the minimum 22% survival represented by the 34 sampled in August. Survival of rainbow trout in this lake with a lower density Arctic char population was 72%. Similarly, rainbow trout in Ken's Pond were slightly larger (mean length 142 mm) in mid-July than those in Backdown Lake (138 mm), and the Arctic char at 224 mm were by far the largest sampled from the 1987 stocking cohort (Table 14.)

Arctic char survival was poorest (38%) in Rangeview Lake, in which the presence of large Arctic grayling was noted. The survival of the Arctic char in Brodie Lake at 60% was near the middle of the range of Arctic char survivals (Table 13), but growth was probably influenced by the presence of the apparent overstocking of Arctic grayling. Growth was poor for both species (Tables 14 and 15).

The Coal Mine Road Lakes that were stocked with Arctic char and/or rainbow trout are very similar to one another in that they all lie within 4 km of one another at about the same elevation. Size ranges from 2.5 to 6 surface acres, and all had indigenous populations of slimy sculpins. The most obvious variable is the presence of the stocked Arctic grayling in Rangeview and Brodie Lakes. Arctic char survival and growth rates may be influenced over time by consecutive stockings.

The poor performance of chinook salmon in Bolio and Donnelly Lakes and the reduced survival in Little Harding (11% compared to the 30% reported in Doxey 1988) reveals a potential for inconsistent performance that is unacceptable in a stocking program when other more reliable species (such as rainbow trout, coho salmon, Arctic grayling, and possibly Arctic char) are available. The chinook salmon stockings were undertaken to determine if the longer potential lifespan of a chinook salmon would provide more large fish over a period of years than equivalent stockings of coho salmon. Little Harding Lake has been stocked with chinook salmon since 1985 (four stocking cohorts possibly present in 1988), but only a low proportion of the chinook salmon present in the lake were larger, older fish (Table 12).

Stocking of rainbow trout in Piledriver Slough (the first time rainbow trout were stocked in a stream in interior Alaska) continues to generate considerable public enthusiasm. Numerous volunteers are always available to assist with rainbow trout stockings into Piledriver Slough. Creel census, distribution, and life history databases are beginning to be developed, but information is still minimal. It will take a number of years of consecutive stockings to reasonably assess the performance of the different stocking cohorts of rainbow trout in an interior stream. Results to date are encouraging, particularly the return of rainbow trout to the system after the severe winter of 1988 - 1989.

Results of the late season test netting and tow netting in Harding Lake were encouraging in that they showed that Arctic char were inhabiting deeper water (Table 17) where, while subject to predation from burbot and the small population of lake trout, they would not be preyed upon by northern pike.

Northern pike have never been documented at depths greater than 15 m (Doxey 1983) and are normally found above the thermocline at 6 m. Sockeye salmon survivals (Clark and Doxey 1989) indicate that at the very least the species can function in the lake through their first summer. Sheefish are not a suitable species for Harding Lake and no further requests for sheefish will be made.

The following stocked lake evaluations and the experimental stockings are recommended:

1. Evaluation of the performance of sport species stocked through the ice should continue.

2. Experimental stocking of Arctic char in increments of increasingly larger fish with evaluation should continue.

3. Experimental stocking of lake trout should continue and evaluation of growth and survival should begin.

4. Study of rainbow trout survival should continue at Birch and Quartz Lakes.

5. Stocking of chinook salmon in Region III lakes will be discontinued and coho salmon will fill all production needs for landlocked salmon.

6. Multi-species stocking to create mixed species fisheries should be planned, implemented, and evaluated.

7. Evaluation of rainbow trout survival and growth at Piledriver Slough should continue.

8. Sheefish production and stocking will be discontinued.

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APPENDIX

Appendix Table 1. Number and size of rainbow trout stocked in AYK waters in 1988.

Name of Water	Number	Size, g.
Birch L.	10,000	30.0
	44,723	24.0
Bullwinkle L.	800	1.1
Chena L.	30,091	90.0
Chet L.	1,600	1.1
Backdown L.	1,200	1.1
Ken's Pond	1,000	1.1
Doc L.	520	1.1
Dune L.	10,000	1.1
Firebreak L.	2,000	1.1
Four Mile L.	20,000	1.3
Geskakmina L.	5,000	1.3
Ghost L.	1,000	1.1
Grayling L.	1,000	1.1
Harding L	248,658	1.3
Hidden L. (EAFB)	1,800	90.0
Jan L.	8,800	1.1
Koole L.	30,000	1.3
Les' L.	750	1.3
L. Harding L.	3,600	1.1
Lost L.	4,700	1.1
Manchu L.	2,900	1.1

- Continued -

Appendix Table 1. Number and size of rainbow trout stocked in AYK waters in 1988 (Continued).

Name of Water	Number	Size, g.
Mark L.	4,000	1.1
Moose L.	2,254	90.0
Nickel L.	1,000	1.1
N. Twin L.	4,000	1.1
No Mercy L.	1,500	1.1
Quartz L.	48,094	25.0
	150,000	1.1
Rainbow L.	20,000	1.3
Rapids L.	2,000	1.1
Robertson 2 L.	1,600	1.1
Rockhound L.	600	1.1
Sansing L.	500	22.0
S. Twin L.	4,000	1.1
Spencer L.	5,000	28.0
Weasel L.	1,600	1.1
Earthmover Pit	1,000	1.3
JRP # 1	2,000	1.1
31 Mi. Rich Pit	500	1.1
Bathing Beauty Pond	350	1.1
Piledriver Slough	35,000	1.1
	17,927	22.0
	26,554	65.0-135.0
Total @ 1.1g:	572,683	
Total @ 25g:	126,244	
Total @ 65-135g:	60,699	
Total Rainbow Trout Stocked:	759,626	

Appendix Table 2. Number and size of Arctic grayling stocked in AYK waters in 1988.

Name of Water	Number	Size, g.
Bolio L.	20,000	0.02
Dune L.	5,000	2.4
Firebreak L.	2,000	2.4
Harding L.	1,169,806	0.02
Hidden L. (EAFB)	10,000	0.02
Luke L.	700	4.0
Sansing L.	684	60.0
	128	125.0
Sheefish L.	800	4.0
Triangle L.	80,000	0.02
Walden Pond	15,000	0.02
Earthmover Pit	324	105.0
JRP# 1	10,000	0.02
32.9 CHSR Pit	1,000	3.4
45.5 CHSR Pit	10,000	0.02
47.9 CHSR Pit	800	3.4
Bathing Beauty Pond	350	2.7
29.6 Steese Pit	1,000	3.4
30.6 Steese Pit	1,000	3.4
33.0 Steese Pit	10,000	0.02
33.5 Steese Pit	10,000	0.02
34.6 Steese Pit	800	3.4
35.8 Steese Pit	1,000	3.4
36.8 Steese Pit	1,000	3.4
Total @ 0.02 g:	1,334,482	
Total @ 2.4 - 4.0 g:	15,774	
Total @ 60 - 125 g:	1,136	
Total Grayling Stocked:	1,351,392	

Appendix Table 3. Number and size of sheefish stocked in AYK waters in 1988.

Name of Water	Number	Wt.,g.
Harding L.	60,000	0.015
Total @ 0.015 g.	60,000	

Appendix Table 4. Number and size of Arctic char stocked in AYK waters in 1988.

Name of Water	Number	Size, g.
Rangeview L.	900	4.2
Last L.	500	4.2
Brodie L.	1,000	4.2
Backdown L.	1,200	4.2
Ken's Pond[1]	~ 900	4.2
Dick's Pond	1,000	4.2
Doc L.	520	4.2
Grayling L.	1,000	4.2
Harding L.	30,820	50.0
L. Harding L.	3,600	4.2
Lost L.	4,700	4.2
Luke L.	600	4.2
Manchu L.	2,900	4.2
Weasel L.	1,600	4.2
N. Weigh Sta. Pond	1,000	4.2
S. Weigh Sta. Pond	1,000	4.2
32.9 CHSR Pit	1,000	4.2
28 Mi. Rich. Pit	800	4.2
31 Mi. Rich. Pit	800	4.2
Bathing Beauty Pond	350	4.2
30.6 Steese Pit	1,000	4.2
36.8 Steese Pit	1,000	4.2
Total @ 4.2 g:	27,370	
Total @ 50 g:	30,820	
Total Char Stocked	58,190	

[1] Char stocked into Ken's Pond were spilled during final transport and about 900 were recovered and stocked.

Appendix Table 5. Number and size of chinook salmon stocked in AYK waters in 1988.

Name of Water	Number	Size, g.
Bolio L.	13,130	8.7
Chena L.	32,855	8.7
Donnelly L.	6,400	8.7
L. Harding L.	3,600	8.7
Total @ 8.7 g:	55,985	

Appendix Table 6. Number and size of coho salmon stocked in AYK waters in 1988.

Name of Water	Number	Size, g.
Birch L.	40,000	3.4
Chena L.	15,000	3.3
Eight Mile L.	15,000	3.2
Lost L.	4,700	3.4
Manchu L.	2,900	3.3
Moose L.	10,000	3.3
Quartz L.	150,000	3.4
Sansing L.	200	3.2
Long Pond	700	3.2
Round Pond	400	3.2
Earthmover Pit	1,000	3.2
Hangar Pit	2,600	3.2
JRP # 1	500	3.2
28 Mi. Rich. Pit	800	3.3
Total @ ~3.3 g:	243,800	

Appendix Table 7. Number and size of lake trout stocked in AYK waters in 1988.

Name of Water	Number	Size, g.
Bolio L.	14,900	4.1
Chet L.	1,600	4.1
Paul's Pond	1,000	4.1
Coal Mine # 5	2,600	4.1
Ghost L.	1,000	4.1
Grayling L.	1,000	4.1
Lost L.	2,526[1]	4.1
Luke L.	800	4.1
Nickel L.	1,000	4.1
Rockhound L.	600	4.1
Sheefish L.	800	4.1
Triangle L.	6,500	4.1
Silver Fox Pit	1,200	4.1
47.9 CHSR	800	4.1
Bathing Beauty Pond	350	4.1
29.6 Steese	1,000	4.1
34.6 Steese	800	4.1
Total @ 4.1 g:	38,476	

[1] Plus survivors of an earlier stocking with very high mortality.

Appendix Table 8. Number and size of sockeye salmon stocked in AYK waters in 1988.

Name of Water	Number	Wt.,g.
Harding Lake	500,000	Fry
Total Fry	500,000	

Appendix Table 9. Stocking request summary for Region III, 1989.

Species	Size	Number Requested
Rainbow Trout	Lg. Subcatchable	52,900
Rainbow Trout	Subcatchable	110,000
Rainbow Trout	Fingerling	500,000
Coho Salmon	Fingerling	288,300
Arctic Char	Subcatchable	64,800
Arctic Char	Experimental Adults	2,800
Lake Trout	Fingerling	25,450
Lake Trout	Subcatchable	22,500
Lake Trout	Experimental Adults	7,500
Grayling	Fingerling	20,710
Grayling	Fry	95,000
Sockeye	Fry	500,000
Sheefish	Fry	100,000