Fishery Data Series No. 10-90

Evaluation of Stocked Rainbow Trout Populations in Interior Alaska, 2007

By

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and

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December 2010

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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Development and publication of this manuscript were partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C.777-777K) under Project F-10-23, Job No. E-3-1.

The Division of Sport Fish Fishery Data Series was established in 1987 for the publication of technically oriented results for a single project or group of closely related projects. Since 2004, the Division of Commercial Fisheries has also used the Fishery Data Series. Fishery Data Series reports are intended for fishery and other technical professionals. Fishery Data Series reports are available through the Alaska State Library and on the Internet: http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm This publication has undergone editorial and peer review.

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This document should be cited as:
Skaugstad, C. and, A. Behr. 2010. Evaluation of stocked waters in Interior Alaska, 2007. Alaska Department of Fish and Game, Fishery Data Series No. 10-90, Anchorage.

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ABSTRACT

Fish populations in 14 lakes in the Tanana River and Copper River drainages were selected for sampling in 2007. Fishery managers needed information about the population length-age structure for rainbow trout populations in Four Mile Lake and Geskakmina Lake to determine if current stocking strategies created the desired population structures. For the other 12 lakes, managers were only interested in basic information to determine if stocked fish were present and to crudely estimate their length distributions. All captured fish were also visually examined for external signs of disease, parasites, and body condition (robust or thin).

The management criteria for the rainbow trout population structures at Four Mile Lake and Geskakmina Lake were not achieved. Criteria were defined by mean lengths and relative abundances that were calculated for specific length categories and age cohorts. These parameters were developed from population models that were based on generalized growth curves, survival rates, and preferred stocking strategies. Visual inspection of length frequency distributions indicated that rainbow trout at Four Mile Lake were smaller than expected and the relative abundance of the age-2 cohort of rainbow trout at Geskakmina Lake was less than expected.

Sampling in the other 12 lakes found stocked game fish from prior years in 6 lakes, no fish or only recently stocked game fish in four lakes, and only non-game species in two other lakes. Length data indicated rainbow trout were smaller than expected in two lakes. This information along with ancillary information about dissolved oxygen levels during winter for these lakes were used to modify current stocking schemes for 11 lakes and remove one lake from the stocking program.

Key words: fish population monitoring, rainbow trout, *Oncorhynchus mykiss*, coho salmon, *Oncorhynchus kisutch*, Four Mile Lake, Kenna Lake Square Lake, Geskakmina Lake, Otto Lake, Chena Hot Springs Road 47.9, Steese 31.6, Steese 34.6, Steese 36.6, Buffalo Lake, Old Road Lake, Peanut Lake Round Lake, Two Mile Lake, population structure, stocking evaluation, stock assessment, stocking method, stocking strategy, length at age, regional management objective.

INTRODUCTION

The Alaska Department of Fish and Game (ADF&G) stocks game fish in 134 lakes and one stream in the Tanana River drainage in Interior Alaska and the Upper Copper/Upper Susitna (UCUS) river drainages in the Glennallen area (Figure 1). The goal of the stocking program is to provide diverse and dependable angling opportunities near population centers and offer alternatives to the harvest of wild fish stocks. The stocking program began in the early 1950s, when lakes along the road system were stocked with rainbow trout Oncorhynchus mykiss, or coho salmon Oncorhynchus kisutch. Today, the stocking program provides year-round sport-fishing opportunity for rainbow trout, coho salmon, Chinook salmon Oncorhynchus tshawytscha, Arctic grayling Thymallus arcticus, and Arctic char Salvelinus alpinus.

The stocking program has multiple roles and provides many benefits. The program supports consumptive fisheries and creates new angling opportunities along the road system where potential fishing effort is greatest. It also supports rural and remote fisheries that are typically less crowded and have fish population structures with a greater proportion of large fish. As a conservation tool, it serves to divert fishing pressure away from wild populations that cannot support high levels of harvest desired by anglers. Anglers and businesses in the Tanana Valley value the stocking program because it provides angling opportunities that normally would not be present and it benefits local economies through the sales of fishing related sporting goods and guiding services. Anglers particularly enjoy opportunities to catch highly desired species such as rainbow trout and Arctic char which are not native to the Tanana Valley.

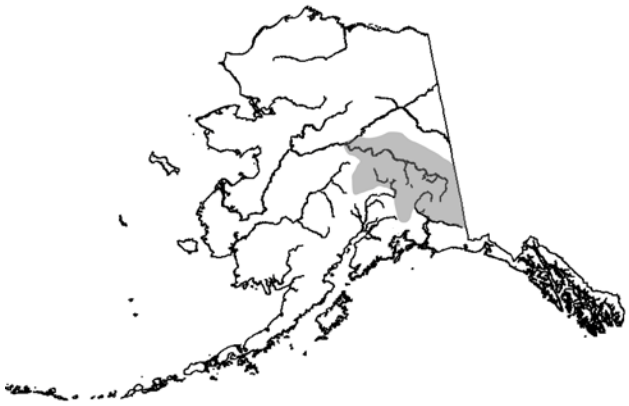

Figure 1.–The Tanana River and Upper Copper/Upper Susitna River drainages (shaded area).

STOCKED WATERS MANAGEMENT PLAN

In 2004, the Board of Fisheries (BoF) adopted two new general management plans for the stocked waters fisheries within Region III (5 AAC 70.065 and 5 AAC 52.065; 2004). The management plans state: "The department shall manage stocked waters in the Arctic-Yukon-Kuskokwim Region (and the Upper Copper River and Upper Susitna River Area) in order to meet public demand for diverse fishing opportunities." The plans outline three management approaches (regional, conservative, and special) and corresponding objectives and regulations for each.

- Regional Management Approach. Stocked waters will be managed for a reasonable expectation of high catch rates and harvesting a daily bag limit. The bag and possession limit is 10 fish in combination of all stocked species, and only one of those fish may be 18 inches (457 mm TL) or greater in length. The fishing season is open year round and bait may be used.
- Conservative Management Approach. Stocked waters will be managed for a reasonable expectation to catch a daily bag limit with a reasonable chance of catching fish 18 inches (457 mm TL) or greater in length. The bag and possession limit is five fish in combination of all stocked species, and only one of those fish may be 18 inches (457 mm TL) or greater in length. The fishing season is open year round and bait may be used.
- Special Management Approach. Stocked waters will be managed for a high probability of an angler catching more than one fish a day that is 18 inches (457 mm TL) or greater in length. When considering a proposal regarding this management approach, the board should consider taking the following actions:

    (1) limit fishing;

    (A) catch-and-release fishing;

    (B) fly fishing;

(C) trophy fishing, which means that a fish retained must be 18 inches or greater in length;

(2) establish seasonal periods when fishing is closed or is restricted to catch-and-release fishing; or,

(3) establish a bag limit of one fish, 18 inches (457 mm TL) or greater in length, or another appropriate bag and size (length) limit.

Stocked Waters Program Assessment

ADF&G will need to focus on anglers in the future to directly assess their understanding of the three management approaches, their expectations, and whether their expectations are being met. However, ADF&G is currently stocking fish at levels that are less than desirable and fishery managers must deal with numbers of fish, sizes, and production schedules that don't meet angler needs. Any direct evaluation of our success in meeting management objectives should be suspended until 2012 when the fish hatchery in Fairbanks is completed and producing fish. Any efforts to directly survey anglers now will only serve to evaluate an interim sub-desirable condition. But it is prudent to begin planning such a survey now.

By 2012, as hatchery production improves, a scientific survey of anglers will provide information needed by managers to directly assess the stocking program. For now, defining and using population structure as the objective for each of the three management approaches is an indirect but reasonable approach to assessing the stocking program.

POPULATION STRUCTURE AND STOCKING STRATEGY

Each management approach lists general objectives for numbers and sizes of fish that anglers should have a reasonable expectation to catch and harvest. To meet these objectives, we designed a general population structure for each management approach that would provide a reasonable opportunity for an angler to catch and harvest the sizes and numbers of fish described in each approach.

To determine what size fish would meet angler's expectations, we conducted informal interviews with anglers and biologists. General agreement was that most anglers would be "satisfied" catching a rainbow trout that was at least 250 mm (FL) and the minimum length for a "quality" fish was 460 mm (FL).

To support the Regional Management approach with a high catch rate and liberal bag limit, a population structure was designed that emphasized large numbers of fish from 200 mm to 350 mm. The Conservative Management approach emphasized population structures having fish from 350 mm to 500 mm and the Special Management approach emphasized fish larger than 400 mm. However, compared to the Regional Management approach these populations have fewer fish. To promote a greater proportion of larger fish in a population the Conservative and Special Management approaches reduced the bag limits to increase survival rates and ADF&G stocked fewer fish per hectare to promote higher growth rates.

A model was used to generate the abundances and length distributions for the various age cohorts that made up a population structure. The abundance and length distribution for an age cohort were calculated using generalized values for survival rate-at-age and length-at-age which were obtained from a review of the literature, past experience, and results from recent population studies. Survival rate-at-age and length-at-age were specific to each management approach (Table 1).

Table 1.–Generalized survival rate-at-age and length-at-age for Regional, Conservative, and Special management approaches.

Approach	Age 1	Age 2	Age 3	Age 4	Age 5
Regional					
Survival	0.10	0.40	0.40	0.20	0.10
Length (mm)	210	300	370	410	450
Conservative					
Survival	0.10	0.50	0.50	0.40	0.40
Length (mm)	230	320	390	440	480
Special					
Survival	0.10	0.60	0.60	0.50	0.40
Length (mm)	250	340	410	460	500

A stocking strategy was then developed for each fishery that would produce the desired population structure. The stocking strategy had goals for the size (length or weight) and number of fish to stock, number of stockings each year, time of year, and whether stockings were annual or biennial. These strategies were then used to determine production schedules for the ADF&G fish hatcheries.

FISHERY SPECIFIC MANAGEMENT CRITERIA

The population structures that we designed for each fishery were used as quantitative targets to measure the success of the stocking program. The successful creation and maintenance of a population structure was used as a surrogate to indicate that we successfully met the management approach objectives.

To compare the observed population structures to the target (management) population structures, we established criteria for mean length and relative abundance for each rainbow trout population based on length categories and age cohorts. The length categories for the Regional Management approach were < 250 mm and ≥ 250 mm. The length categories for the Conservative and Special Management approaches were < 460 mm and ≥ 460 mm along with secondary length categories of < 250 mm and ≥ 250 mm. Mean length and relative abundance for fish in each size category were then calculated using the management population length-age structures for each fishery. Mean length and relative abundance was also calculated for each age group.

Because actual stockings were not consistent and often failed to meet all strategy goals for number and size of fish, the observed population structures were also compared to mean length and relative abundance criteria that were predicted from the actual stocking history for each lake.

POPULATION SAMPLING

Fish populations in 14 lakes were selected for sampling (Table 2 and Figures 2, 3, and 4). Fishery managers needed information about the population length-age structure for rainbow trout populations in Four Mile Lake and Geskakmina Lake to determine if current stocking strategies created the desired population structures. In the other 12 lakes managers were only interested in basic information to determine if stocked fish were present, to visually assess their condition (robust or thin) and health, or to make a crude estimate of their length distribution.

This information was used:

- To determine if stocked Arctic grayling fingerlings survived to age-1;
- To determine if single or multiple age cohorts were present;
- To determine if stocked fish populations had survived changing lake conditions;
- To visually examine fish for external signs of disease, parasites, and body condition (length to volume); and,
- To provide anglers with current information about fish populations.

Fish stocking records from 2000 through 2006 for all 14 lakes are summarized in Appendix A.

Table 2.–Description of fisheries sampled in 2007.

Fishery	Hectare (Acre)	Management Category	Stocking Frequency	Information Need
Upper Tanana Management Area				
Four Mile Lake	40(100)	Regional	alternate	Length-Age Structure
Kenna Lake	18(45)	Regional	alternate	Basic
Square Lake	40(100)	Regional	alternate	Basic
Lower Tanana Management Area				
Geskakmina Lake	103 (255)	Regional	alternate	Length-Age Structure
Otto Lake	40(100)	Regional	annual	Basic
CHSR 47.9	2.4(6)	Regional	annual	Basic
Steese 31.6	1.6(4)	Regional	annual	Basic
Steese 34.6	2.4(6)	Regional	annual	Basic
Steese 36.6	3.6(9)	Regional	annual	Basic
Upper Copper / Upper Susitna River Management Area				
Buffalo Lake	1.6(4)	Regional	annual	Basic
Old Road Lake	0.6(1.5)	Regional	annual	Basic
Peanut Lake	4.9(12)	Regional	alternate	Basic
Round Lake	0.8(2)	Regional	annual	Basic
Two Mile Lake	6.9(17)	Regional	annual	Basic

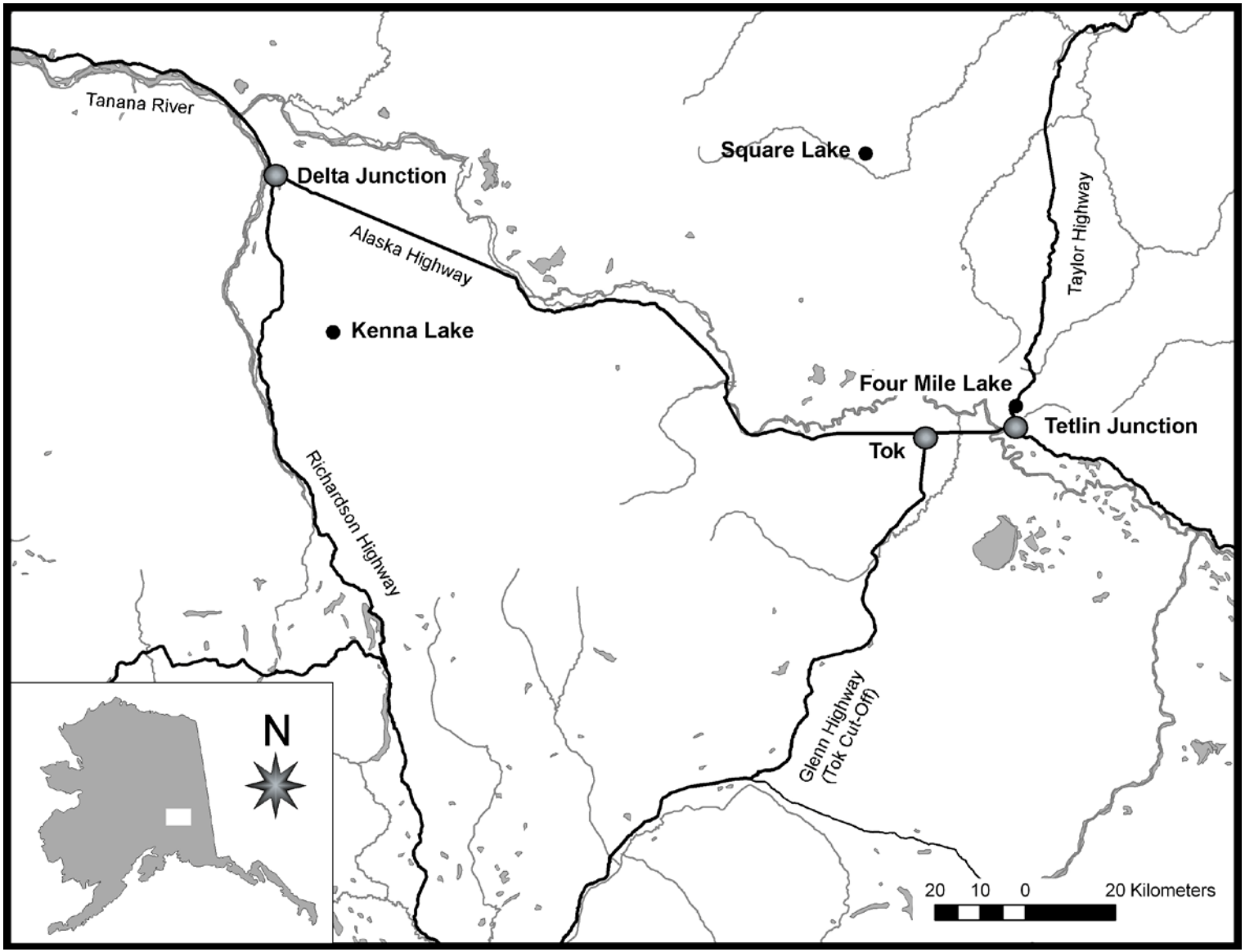

Figure 2.–Upper Tanana Management Area (Delta) - stocked lakes sampled in 2007.

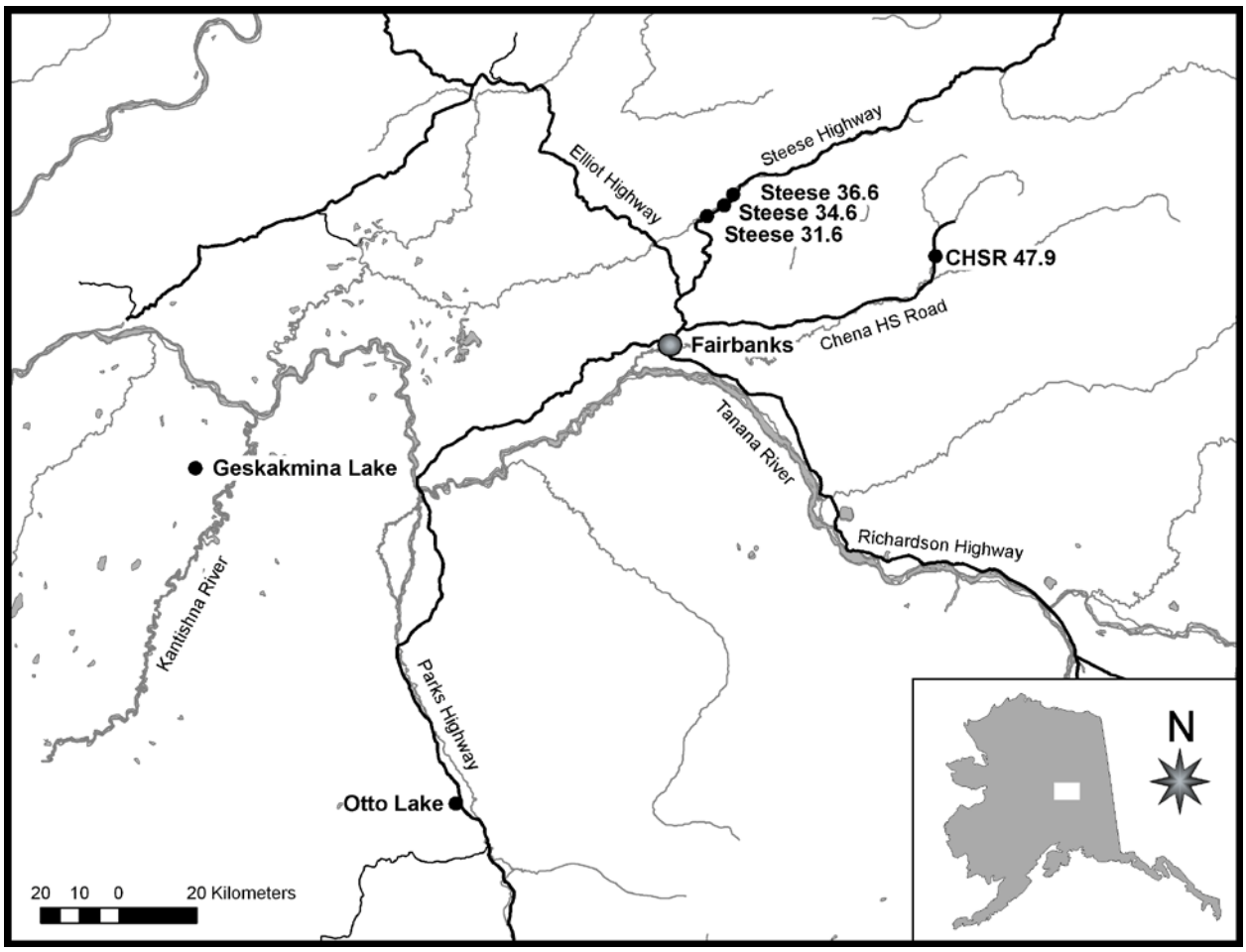

Figure 3.–Lower Tanana Management Area (Fairbanks) - stocked lakes sampled in 2007.

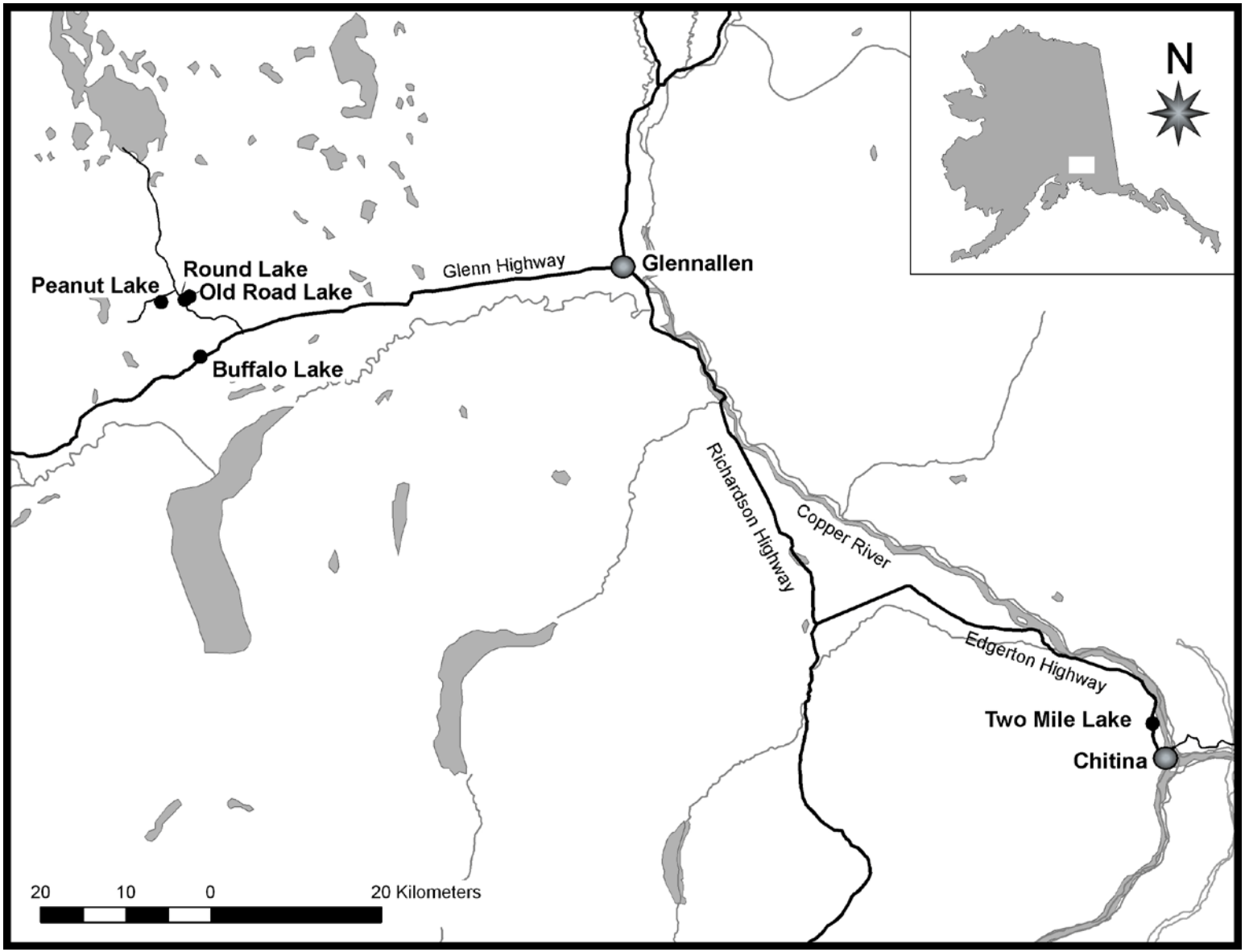

Figure 4.–Upper Copper Upper Susitna Management Area (Glennallen) - stocked lakes sampled in 2007.

SAMPLING FOR POPULATION LENGTH-AGE STRUCTURE

Four Mile Lake is located about 1.2 km east of the Taylor Highway at Kilometer 7.2 (Mile 4.5) and 19.5 km east of Tok (Upper Tanana Management Area; Figure 2). The lake covers 40 surface ha and was first stocked with rainbow trout fingerlings in 1977. Rainbow trout captured during this experiment were stocked as fingerlings in 2004 and 2006. In addition lake trout and Arctic char were stocked in 2000, 2004, and 2007.

Geskakmina Lake is located 58 km south west of Nenana (Lower Tanana Management Area; Figure 3). Access is by aircraft or snow machine. The lake covers 103 surface ha and was first stocked with rainbow trout fingerlings in 1983. The lake was also stocked with coho salmon. Rainbow trout captured during this experiment were stocked as fingerlings in 2003 and 2005. Coho salmon were stocked in 2004 and 2006.

Neither fishery appeared in the Statewide Harvest Surveys (Jennings et al. 2007) because there were too few respondents to provide reliable estimates of catch or harvest.

Objectives

Management Objective 1:	Determine if fish populations were achieving the "management" length-age structures for the rainbow trout populations listed in Table 2.
Research Objective 1:	Test the null hypothesis that mean length of rainbow trout within defined length categories and age cohorts does not differ from the predicted value with 90% power of rejecting the null hypothesis if the true mean length differs from the predicted value by more than 10% using alpha = 0.10.
Research Objective 2:	Test the null hypothesis that the proportion of rainbow trout within defined length categories and age cohorts does not differ from the predicted value with 80% power of rejecting the null hypothesis if the true proportion differs from the predicted value by more than 10 percentage points using alpha = 0.20.

Methods

Sampling Procedure

Fish populations in Four Mile Lake near Tok and Geskakmina Lake near Nenana were sampled to determine length-age structure for the rainbow trout populations (Table 2). Fyke nets and tangle nets were used to capture fish.

Fyke nets were set near shore on the lake bottom in 1 to 2 m of water. Fyke nets had openings that were either 0.9 or 1.2 m^2, the body length from opening to cod end was about 5 m, hoop size was 0.9 m diameter, and mesh size was 9 mm^2. Wings measuring 7.5 m long by 1.2 m deep were attached to each side of the open end. The net body was positioned parallel to shore and the wings set to form a "V". Each fyke net was pulled taut from the cod end and held in position with a weight.

Tangle nets were set perpendicular to shore in water deeper than 2 meters. Tangle nets measured 45 m (150 ft) long by 5.4 m (18 ft) deep and were made of 13 mm (½ in) bar fine thread monofilament. Mesh size was small to ensure that fish were captured by entanglement around

the mouth and not by the gill covers. Two styles of nets were used. One net was a "floater" - the float line buoyancy was greater than the weight of the lead line. The other net was a "sinker" - the lead line was weighted to overcome the buoyancy of the float line. The "floater" had a triple float line and 13.5 kg (30 lb) lead line. The "sinker" had a double float line and a 31.5 kg (70 lb) lead line. Generally, tangle nets were checked every 20 minutes. The time was then shortened or extended depending on an immediate assessment of the condition of the fish by the field crew leader.

The amount of capture gear and the duration of sampling projects were based on lake size (Table 3). In larger lakes, more capture gear was used and the duration of the project was increased. Sampling was stopped at the end of the allotted time even when a sample size was not achieved.

Table 3.–Amount of capture gear and duration of sampling project by lake size.

Hectare (Acre)	Days	Fyke Nets	Tangle Nets	Hoop Traps
0 to 20 (50)	1	4	1	5
>20 to 40 (100)	2	4	1	5
>40 to 200 (500)	3	4	2	8
>200 to 400 (1,000)	3	6	2	10
>400 (1,000)	3	8	2	10

All captured fish were measured to the nearest mm FL. Fish captured for the first time regardless of gear type were marked by removing a half circle of tissue from the trailing edge of the upper lobe of the caudal fin. The mark was made with a paper punch that produced a 7 mm diameter circular hole. Subsequent recaptures were recorded but the data were not used for analysis.

When more than 50 fish were captured, a spearmint oil and ethanol mixture was used to anesthetize up to 50 fish at a time in a water bath. The spearmint concentration in the water bath was 100 mg/l. This made the fish easier to handle and minimized injuries to the fish that might result from having to physically subdue an active fish.

Water temperature was monitored daily 1 m beneath the surface and all sampling was conducted when water temperature was < 18°C.

Data Reduction and Analysis

Sample data were used to enumerate rainbow trout within specific length categories and to generate length frequency distributions (LFDs) for each rainbow trout population. When possible, age cohorts were identified by visual inspection of LFD plots and the corresponding mean lengths were calculated using the appropriate length data.

The length or age composition of each rainbow trout population was calculated using (Cochran 1977):

$$\hat{p}_k = \frac{y_k}{n} \tag{1}$$

where:

$\hat{p}_k$ = the proportion (relative abundance) of rainbow trout that belong to length category or age cohort k;

y_k = the number of rainbow trout sampled that belong to length category or age cohort k; and,

n = the total number of rainbow trout sampled.

The unbiased variance of this proportion was estimated as:

$$\hat{V}(\hat{p}_k) = \frac{\hat{p}_k(1-\hat{p}_k)}{n-1} \quad (2)$$

Observed mean lengths and sampling variances within specific size categories and age cohorts were calculated using standard statistical methods (Cochran 1977).

For visual comparison, LFDs generated using sample data were plotted with the corresponding population curves that were generated from the management and predicted population structures. For each population the observed number of rainbow trout that belonged to a specific size category or age cohort was compared to the management and predicted criteria using χ^2 goodness of fit tests (Zar 1984). Observed mean lengths were compared to calculated mean lengths for management and predicted criteria for the same specific size category or age cohort using single-sample t-tests (Zar 1984). The χ^2 goodness of fit tests were evaluated using $\alpha = 0.20$ and the t-tests were evaluated using $\alpha = 0.10$.

Management and predicted criteria were considered achieved when the observed mean length or relative abundance was not statistically different from the criteria or, if statistically different, the difference was ≤ 0.10 for relative abundance or ≤ 25 mm for mean length. We considered these differences not meaningful to anglers. Management and predicted criteria were also considered achieved when the observed mean length was larger than the criteria regardless of statistical significance.

Assumptions and Bias

One potential concern with using data from this single-sample study design is that inadequate data are collected to evaluate size bias during sampling. An accurate estimate of a population LFD requires that all fish in a population have the same probability of capture. In practice this likely does not happen and this assumption can not be evaluated with a single-sample capture-event. A comprehensive review of the literature and previous work by ADF&G, including an analysis of effect of bias for various scenarios related to this and similar studies, was presented by Skaugstad et al. (*in prep*).

For our studies, the bias introduced by unequal capture probabilities for the different length-age cohorts have different effects on estimating length frequency mode location and mode amplitude. Mode location is important for determining the mean length of length-age cohorts while mode amplitude is important for determining the relative abundance of the length-age cohorts in the population. The bias caused by unequal capture probabilities when estimating mode location will be minimal when individuals in each length-age cohort have the same capture probability (i.e., capture probabilities are the same within cohorts but may be different between cohorts).

Bias will likely have a greater influence on estimating mode amplitude and, thus, on estimating proportions of fish in different length-age categories (i.e., relative abundance). Different capture

probabilities between length-age cohorts will result in catches that are not representative of cohort abundance in the population. Increasing the sample size will make the modes more prominent but it will not improve the accuracy of the estimate. However, our review of other studies has shown that the likelihood of size bias is low when sampling is restricted to periods when water temperature is < 18°C Skaugstad et al. (*in prep*). It is anticipated that two-sample mark-recapture studies will be conducted periodically for the larger lakes which are stocked on an annual basis and support a number of age cohorts. We will continue to use information from these studies to evaluate potential size bias associated with single-capture sampling.

Results & Discussion

Four Mile Lake

Population sampling was conducted August 21–23, 2007. Water temperature during sampling ranged from 16.6 to 18.9°C about 1 m beneath the surface. One hundred seventy one rainbow trout (Figure 5), 5 lake trout and 1 Arctic char (Figure 6) were captured. Three rainbow trout and 4 lake trout were captured in tangle nets and all other fish were captured in fyke nets.

Rainbow trout cohorts (age-1 and age-3) were easily identified from the LFD. Visual comparison of the observed LFD to those for management and predicted population structures showed rainbow trout were generally smaller than expected.

Differences between the observed population structure and management and predicted mean lengths were statistically significant for relative abundance and mean length for size categories < 250 mm and ≥ 250 mm (Table 4). Management and predicted criteria were not met for either relative abundance or mean length.

Similar results were found for age cohorts. Differences between the observed population structure and management and predicted population structures were statistically significant for relative abundance and mean length for age-1 and age-3 cohorts (Table 5). Management and predicted criteria also were not met.

We don't know the degree of impact that water temperature above 18°C had on the likelihood of size bias during this study. Because the difference between 18°C and 18.9°C was minor, we expect the impact was minor. However, we use caution when drawing conclusions from this study and others when the water temperature exceeds 18°C during any portion of a study.

A population model based on the management stocking scheme predicted an abundance of 2,000 age-1, 320 age-3, and 6 age-5 fish (Table 6). However, the model using actual fish stockings since 2004 predicted an abundance of 1,028 age-1 and 320 age-3 fish. The predicted abundance for the age-1 cohort was about one-half the desired abundance because the number of rainbow trout that were stocked in 2006 was reduced from 20,000 to 10,275 due to a shortage of fish from the state operated fish hatcheries in Anchorage.

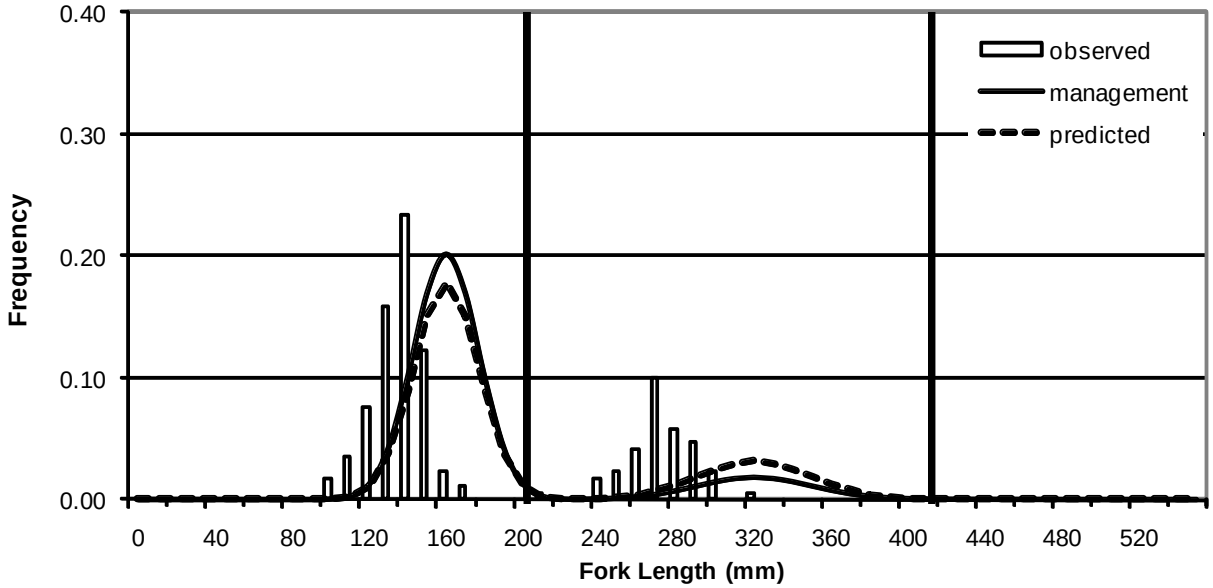

Figure 5.–Four Mile Lake, Rainbow trout: Length frequency distribution of rainbow trout captured during sampling (n = 171) plotted with the management and predicted population structures in Fall 2007. The management population structure was generated using preferred stocking schemes. The predicted population structure was generated using actual fish stockings.

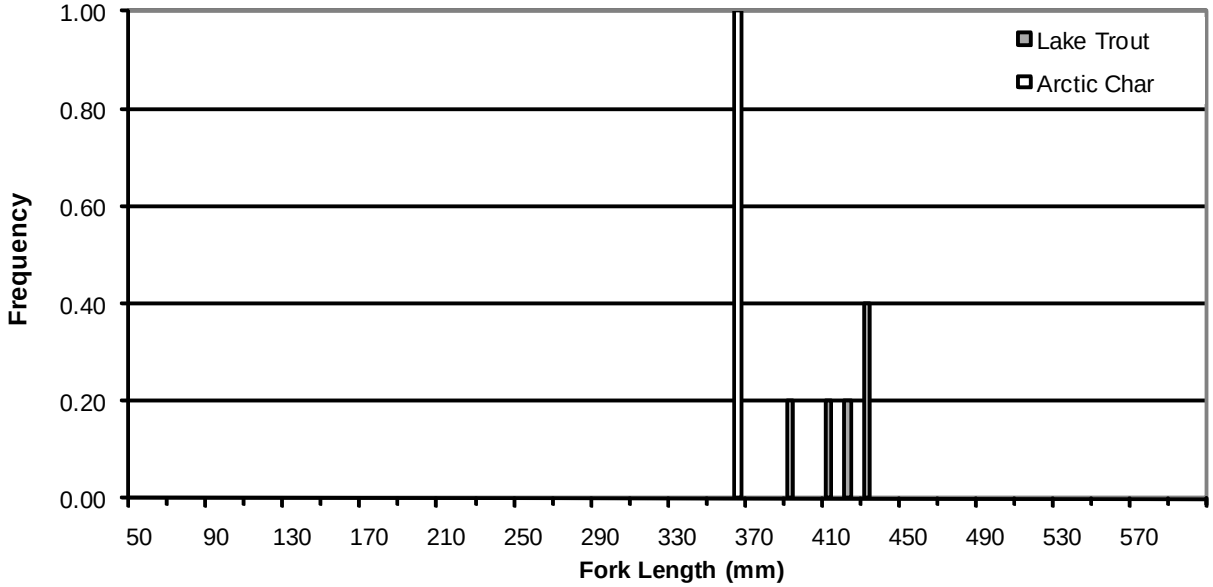

Figure 6.–Four Mile Lake, Lake trout and Arctic char: Length frequency distribution of lake trout (n = 5) and Arctic char (n = 1) captured during sampling in Fall 2007.

Table 4.–Four Mile Lake, Rainbow trout: Test results by length category.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	116 (0.68[a])	55 (0.32[a])	182 mm (1.30[b])	318 mm (2.53[b])
Management Criteria	144 (0.84[a])	27 (0.16[a])	209 mm	360 mm
Test Stat		33.24	-20.84	-16.57
DF		1	115	54
P Value		<0.0001	<0.0001	<0.0001
Predicted Criteria	128 (0.75[a])	43 (0.25[a])	209 mm	363 mm
Test Stat		4.68	-20.84	-17.75
DF		1	115	54
P Value		0.0305	<0.0001	<0.0001

[a] Proportion of catch.

[b] Standard error.

Table 5.–Four Mile Lake, Rainbow trout: Test results by age cohort.

	Relative Abundance (χ2 test)			**Mean Length** (t test)		
	age-1	age-2	age-3	age-1	age-2	age-3
Observed	116 (0.68[a])	0	55 (0.32[a])	182 mm (1.30[b])	0	318 mm (2.53[b])
Management Criteria	147 (0.86[a])	0	24 (0.14[a])	210 mm	0	370 mm
Test Stat			46.85	-21.54		-20.55
DF			1	115		54
P Value			<0.0001	<0.0001		<0.0001
Predicted Criteria	130 (0.76[a])	0	41 (0.24[a])	210 mm	0	370 mm
Test Stat			6.25	-21.54		-20.55
DF			1	115		54
P Value			0.0124	<0.0001		<0.0001

[a] Proportion of catch.

[b] Standard error.

Table 6.–Four Mile Lake, Rainbow trout: Population length-age structure based on management and predicted objectives.

	Length Category		Age Cohort				
	< 250 mm	≥ 250 mm	1	2	3	4	5
Management:							
Mean Length (mm FL)	209	360	210	300	370	410	450
Abundance	1,963	363	2,000	0	320	0	6
Proportion	0.84	0.16	0.86		0.14		<0.01
Predicted:							
Mean Length (mm FL)	209	360	210	300	370	410	450
Abundance	1,009	339	1,028	0	320	0	0
Proportion	0.75	0.25	0.76		0.24		

Values in the table were calculated for odd years. Values for even years will be different.

Mean lengths for age cohorts were calculated for fall.

The field crew that sampled the population didn't observe any obvious cause (i.e. unusually thin bodies or external signs of disease) that would explain why fish were generally smaller than expected (the LFD was shifted to the left of what was expected).

If the growth rate was depressed because individual fish did not have sufficient food resources it may be possible to increase the growth rate by stocking fewer rainbow trout in the lake. Food resources would then be apportioned among fewer fish. However, the resulting lower abundance will likely provide lower catch rates and fewer fish to harvest. Fishery managers will need to decide if the current population abundance and length-age structure is acceptable or if anglers will be better served by lowering abundance (and catch rates) to increase growth rates. The goal will be to maintain a population abundance and length-age structure that is attractive to anglers.

Recommended stockings and other actions:

- Biennial stockings of 10,000 (reduced from 20,000) fingerling rainbow trout (2 g or 60 mm FL) by mid-June.
- Biennial or triennial stockings of 3,500 fingerling Arctic char (4 g or 70 mm) by mid-June.
- Examine the rainbow trout population structure in 2009 to determine if it meets the objectives for the Regional Management approach.

Geskakmina Lake

Population sampling was conducted June 12–15, 2007. Water temperature during sampling ranged from 17.5 to 18.2°C about 1 m beneath the surface. Fifty rainbow trout (Figure 7) and 190 coho salmon (Figure 8) were captured and measured. Another 792 coho salmon and 45 blackfish were captured but not measured. All fish were captured in fyke nets except for four rainbow trout and nine coho salmon that were captured in tangle nets and one rainbow trout was captured using sport fishing gear.

Visual comparison of rainbow trout LFDs revealed little similarity between the actual population structure and those based on management and predicted criteria (Figure 7). The expected age cohorts couldn't be identified because the observed LFD did not display noticeable modes which may be due to the small sample size. Rainbow trout > 325 mm comprised the largest component of the catch which was opposite from that shown by the management and predicted population structures. The expected age cohorts for captured coho salmon were clearly defined in the LFD (Figure 8).

Differences between the observed rainbow trout population structure and the management and predicted population structures were statistically significant for mean length and relative abundance by length category (Table 7). Tests were not conducted for age cohorts. Management and predicted criteria were achieved for mean length by size category and a greater than expected portion of the population was ≥ 250 mm.

A population model based on the management stocking scheme predicted an abundance of 280 age-2 and 22 age-4 fish and was similar to abundances predicted from actual stockings (Table 8). This is a small number of rainbow trout for a 103 ha lake. It is likely that the lake could support a larger population and the length-age structure would still meet or exceed the management relative abundance and length criteria. Fishery managers could better predict the success of achieving the outcomes of various stocking schemes if they had information about the characteristics that influence a lake's capacity to sustain fish populations.

Recommended stockings and other actions:

- Biennial stockings (odd years) of 10,000 fingerling rainbow trout (2 g or 60 mm FL) by mid-June.
- Biennial stockings (even years) of 8,000 fingerling coho salmon (4 g or 70 mm FL) by mid-June.

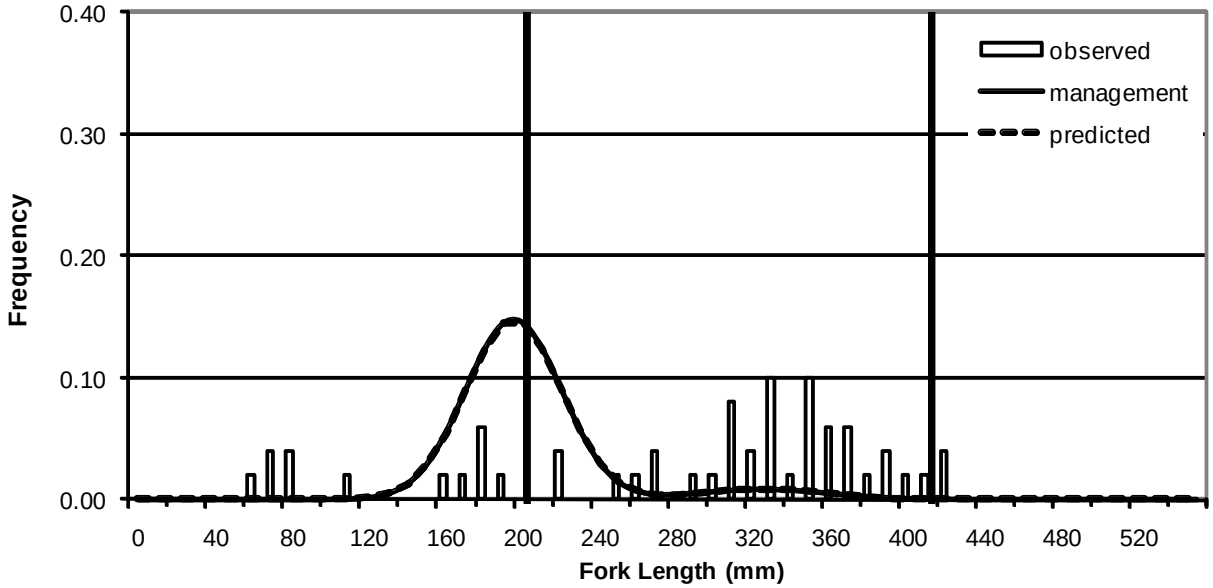

Figure 7.–Geskakmina Lake, Rainbow trout: Length frequency distribution of rainbow trout captured during sampling (n = 50) plotted with the management and predicted population structures in Spring 2007. The management population structure was generated using preferred stocking schemes. The predicted population structure was generated using actual fish stockings. Both plots are identical.

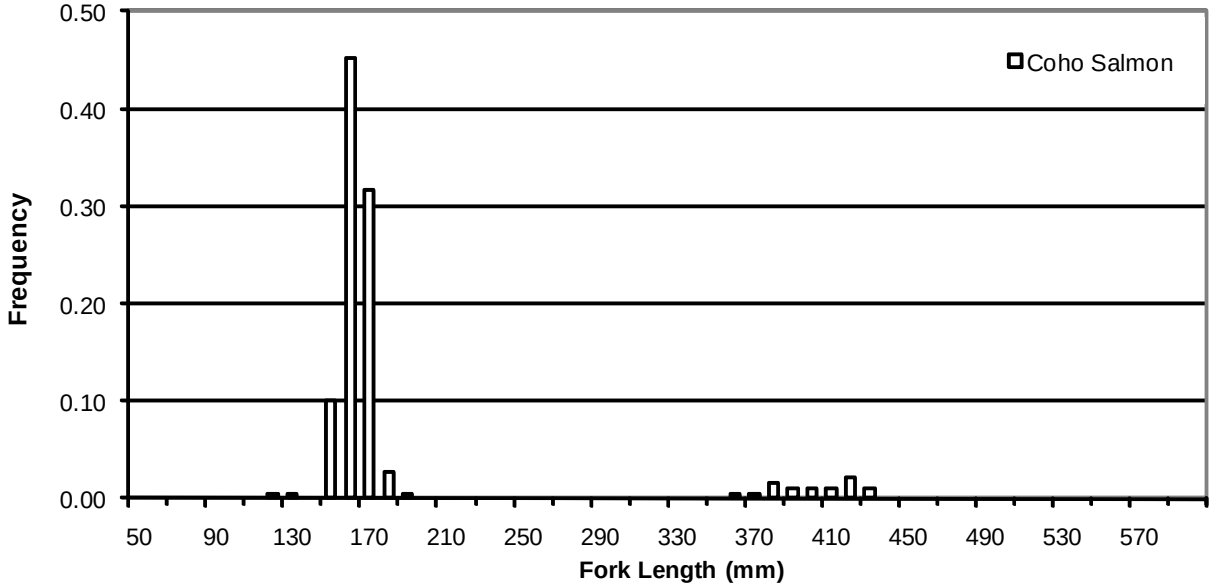

Figure 8.–Geskakmina Lake, Coho salmon: Length frequency distribution of coho salmon (n = 190) captured during sampling in Spring 2007.

Table 7.–Geskakmina Lake, Rainbow trout: Test results by length category.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	12 (0.24[a])	38 (0.76[a])	174 mm (15.15[b])	379 mm (8.06[b])
Management Criteria	23 (0.46[a])	27 (0.54[a])	225 mm	280 mm
Test Stat		9.74	-3.37	12.29
DF		1	11	37
P Value		0.0018	0.0063	<0.0001
Predicted Criteria	23 (0.46[a])	27 (0.54[a])	225 mm	280 mm
Test Stat		9.74	-3.37	12.29
DF		1	11	37
P Value		0.0018	0.0063	<0.0001

[a] Proportion of catch.

[b] Standard error.

Table 8.–Geskakmina Lake, Rainbow trout: Population length-age structure based on management and predicted objectives.

	Length Category		Age Cohort				
	< 250 mm	≥ 250 mm	1	2	3	4	5
Management:							
Mean Length (mm FL)	225	280	125	245	320	374	416
Abundance	140	162	0	280	0	22	0
Proportion	0.46	0.54		0.93		0.07	
Predicted:							
Mean Length (mm FL)	225	280	125	245	320	374	416
Abundance	128	149	0	256	0	21	0
Proportion	0.46	0.54		0.93		0.07	

Values in the table were calculated for odd years. Values for even years will be different.

Mean lengths for age cohorts were calculated for spring.

SAMPLING FOR BASIC POPULATION INFORMATION

Upper Tanana Management Area: *Kenna Lake* is in the Jarvis Creek drainage approximately 14 km east of Coal Mine Road (Figure 2). It is remote, 18 ha (45 acres), and has been stocked with both lake trout and rainbow trout. Kenna Lake was added to the stocking program in 2000 and was selected for sampling because it has not been evaluated since stocking was initiated. *Square Lake* is in the Fortymile River drainage approximately 48 km north east of the Alaska Highway (Figure 2). It is remote, 40 ha (100 acres), and is stocked with Arctic char. Square Lake was added to the stocking program in 2001 and was selected for sampling because it has not been evaluated since stocking was initiated.

Lower Tanana Management Area: *Otto Lake* is located in the Nenana River drainage near Healy on the Parks Highway (Figure 3). It is rural, approximately 40 ha (100 acres), and is stocked with rainbow trout and coho salmon annually. Otto Lake was selected because it has not been evaluated in over 10 years. *CHSR 47.9*, *Steese Hwy 31.6*, *Steese Hwy 34.6*, and *Steese Hwy 36.6* are all small roadside ponds near Fairbanks (Figure 3). These are popular rural fisheries that are sustained by stocking catchable Arctic grayling or rainbow trout annually. However, due to recent production limitations, catchable fish were not available in 2006 and Arctic grayling fingerlings were stocked in their place. These ponds were selected for evaluation because managers needed to know if the fingerlings survived through winter and will provide some level of fishing opportunity.

Upper Copper / Upper Susitna River Management Area: *Buffalo Lake* is in the Tazlina River drainage, on the north side of the road at MP 156.2 of the Glenn Highway (Figure 4). It is approximately 1.6 ha (4 acres) and is stocked with rainbow trout catchables annually. Buffalo Lake was selected because it has not been evaluated since 1999. *Old Road Lake*, *Peanut Lake*, and *Round Lake* are in the Tazlina River drainage along the Lake Louise Road (Figure 4). Old Road Lake and Round Lake are stocked annually with rainbow trout catchables, and Peanut Lake is stocked every other year with rainbow trout fingerlings. These lakes were selected because managers needed to know if multiple age cohorts were present in the lakes. The lakes are small but annual water quality analysis has shown that the lakes have adequate dissolved oxygen levels to support fish through winter. The absence of all fish or the presence of only age-1 fish would indicate that the populations were quickly removed by anglers. *Two Mile Lake* is located in the Copper River drainage at MP 30.6 of the Edgerton Highway (Figure 4). It is approximately 6.9 ha (17 acres) and is stocked with rainbow trout catchables annually. Two Mile Lake was selected because it has not been evaluated since 1999.

Objectives

Management Objective 2:	Provide fishery managers and anglers with current information about fish species presence, size range, overall appearance and condition, and document if fish survived the winter in stocked lakes throughout the Tanana River drainage and Upper Copper / Upper Susitna River drainage.
Research Objective 3:	Survey selected stocked lakes to determine fish species present, characterize the size range of the fish captured in fyke nets and tangle nets with 24 to 48 hours of sampling effort per lake, and describe the overall appearance and condition of captured fish.

Methods

The sampling procedure was designed to collect minimal but sufficient data to answer basic questions posed by fishery managers. This approach was appropriate because costs were minimized which allowed the sampling of a large number of fisheries.

Sampling Procedure

Fyke nets and tangle nets were used to sample the fish populations. Fyke nets were set for at least one 24 or 48 hour sampling period in each lake in water less than 2 m deep. Because sampling was constrained by time, the sample sizes (number of fish) were not predetermined. At least one fyke net was used per 25 surface acres. However, a minimum of two fyke nets were used per lake. The location and spacing of the nets was left to the crew leader's judgment.

Tangle nets were used to capture fish away from shore in water deeper than 2 m. These nets were used only when a crew was on site. Initially the nets were checked every 30 minutes. The time was shortened or extended depending on an immediate assessment of the condition and number of fish captured. Descriptions and methods for using fyke nets and tangle nets were described in the previous section *Sampling for Population Length-Age Structure*. Fish handling and data recording also were similar to that described previously. Water temperature was measured 1 m beneath the surface.

All fish were visually examined for external signs of disease and the presence of parasites. Fish were also subjectively judged to be "thin" if the body volume was less than what an experienced biologist considered normal for the body length.

Data Reduction and Analysis

Sampling was used to document species presence or absence and data were used to generate LFDs for rainbow trout and other game species. When data were sufficient, age cohorts were identified by visual inspection of LFD plots. LFD plots were generated when 10 or more game fish of the same species were captured.

Results & Discussion

Kenna Lake

The fishery was sampled during August 28–29, 2007. Maximum measured water temperature was about 14.5°C. Twenty rainbow trout (Figure 9) and 2 lake trout (369 mm and 371 mm) were captured. A population model based on the actual number of fish stocked predicted an abundance of 150 age-1 and 48 age-3 rainbow trout. Age cohorts for rainbow trout were not readily recognized due to the small sample size. Captured fish generally were smaller than expected but were not thin. There were no external signs of disease or parasites.

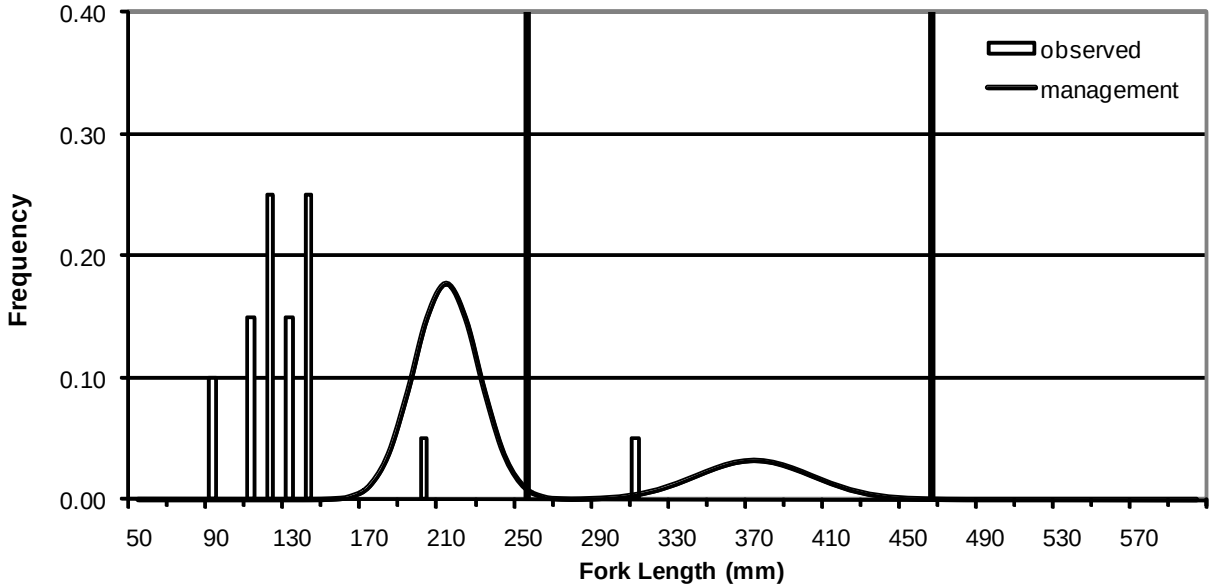

Figure 9.–Kenna Lake, Rainbow trout: Length frequency distribution of rainbow trout (n = 20) captured during sampling plotted with the management population structure in Fall 2007. The management population structure was generated using preferred stocking schemes.

Captured lake trout were age 7 (stocked in 2000) but their length was about the mean length expected for age-3 rainbow trout in fall (370 mm FL). The advantages of stocking lake trout, compared to rainbow trout, is that their life span is 20 or more years and lake trout can exceed 600 mm FL. But these advantages may not be realized in Kenna Lake for a number of years and the lake may not support sufficient numbers of lake trout > 400 mm FL to maintain an attractive lake trout fishery (Burr 1992). Lake trout size-at-age is highly variable among lakes and is likely dependent on suitable forage fish to attain larger size. Except for stocked rainbow trout there are no other fish species present. Captured lake trout and rainbow trout generally were smaller than expected but were not thin. There were no external signs of disease or parasites.

Fishery managers need to consider the value of a stocked lake trout fishery for Kenna Lake against the number and size of fish that the lake will likely provide for anglers expense of stocking a remote lake, the value that the fishery generates, and the impact of removing gametes from small populations of wild lake trout against the number and size of fish that Kenna Lake will provide for anglers.

Recommended stockings and other actions:

- Biennial stockings of 1,500 rainbow trout fingerling (2 g or 60 mm FL) in early June
- Consider stocking Kenna Lake once every three or four years to reduce stocking costs.

Square Lake

Sampling occurred during July 27–29, 2007. Maximum measured water temperature was 17.5°C. No fish were captured and none were observed. The top 2 m of the water column contained suspended algae and dissolved oxygen levels were supersaturated at the surface and less than 1 mg/L from 3.5 to 15 m.

Recommended stockings and other actions:

- Discontinue stocking.

Otto Lake

The fishery was sampled during June 27–29, 2007. Maximum measured water temperature was 11.6°C. Twenty one rainbow trout were captured but only 19 were measured (Figure 10).

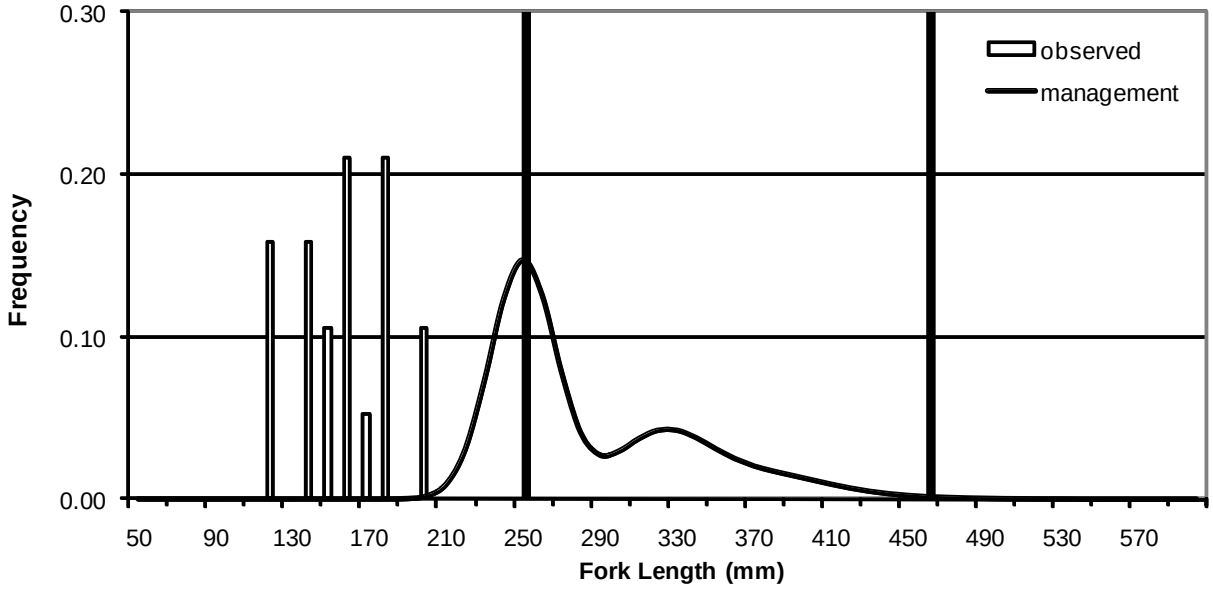

Figure 10.–Otto Lake, Rainbow trout: Length frequency distribution of rainbow trout (n = 19) captured during sampling plotted with the management population structure in Spring 2007. The management population structure was generated using preferred stocking schemes.

The rainbow trout captured during this study were probably from the cohort that was stocked the week prior to the sampling event. The LFD shows that the average size of captured rainbow trout was about 160 mm FL which was the average size of fish stocked the week before the sampling event. We expect that rainbow trout stocked in 2005 and 2006 would exceed 300 mm FL in spring 2007. Coho salmon that were stocked in 2005 also were not captured. This information suggests that a winterkill event likely occurred. Based on reports from anglers the lake may occasionally winterkill. Local anglers have reported that fish were present some years

immediately after the lake became ice-free and other years when no fish were observed or caught until the lake was restocked.

Because Otto Lake may occasionally winterkill the recommended stocking scheme is to stock catchable size fish (average 180 g or 250 mm FL). Catchables are used because fish stocked as fingerlings may not survive to catchable size. The challenge is to stock sufficient numbers of catchable fish to provide an attractive fishery from June through February but not leave an excessive number that may succumb to winterkill. However, compared to December through February, more people typically want to fish in March through May because of longer daylight and warmer weather. Sometime during this period winterkill probably occurs. If winterkill is the result of low dissolved oxygen levels and we can predict the month when lethal levels occur then we may be able to support a portion of the more popular March through May fishery. If we find that winterkill events usually occur in late April then we can provide more fish for March and April when more anglers want to fish.

Recommended stockings and other actions:

- Stock 1,500 rainbow trout (180 g or 250 mm FL) in late May or early June and another 500 in September.
- Stock 1,000 Chinook salmon (120 g or 220 mm FL) in September.
- Measure dissolved oxygen level in March, April, and May 2009 to determine when lake conditions fall outside the biological requirements for rainbow trout and Chinook salmon.
- The lake should be managed as put-and-take. When the new fish hatchery in Fairbanks becomes operational the lake can be stocked multiple times during the year to provide a consistent fishery and support angler harvest.

Chena Hot Springs Road 47.9

The fishery was sampled during May 21–22, 2007. Maximum measured water temperature was 5.3°C. One Arctic grayling (216 mm FL) and five burbot (328, 382, 500 503, and 540 mm TL) were captured. This is a small but popular lake along the Chena Hot Springs Road and for its size receives significant use by anglers and campers. We suspect that most of the stocked catchable rainbow trout and Arctic grayling were quickly harvested. Prior to 2006 the lake was stocked with catchable rainbow trout and Arctic grayling. Since 2006 the lake was stocked with fingerlings (Arctic grayling: 0.84 g or 42 mm FL and rainbow trout: 1.1 g or 46 mm FL) but the lake probably won't produce sufficient numbers of catchables from fingerling stockings to meet angler demand.

Recommended stockings and other actions:

- Stock 300 rainbow trout (180 g or 250 mm FL) in late May or early June and another 200 in late August.
- Stock 300 Arctic grayling (120 g or 220 mm FL) in late May or Early June.
- The lake should be managed as put-and-take. When the new fish hatchery in Fairbanks becomes operational the lake should be stocked multiple times during the year to provide a consistent fishery and support angler harvest.

Steese Highway 31.6

May 15–16, 2007. Maximum measured water temperature was 7.1°C. No fish were captured likely due to a winterkill event. We suggest that this lake be managed as a put and take fishery. The stocking scenario for a winterkill lake is to stock only sufficient numbers of catchable size fish to provide for an attractive summer fishery. We assume for now that the winter fishery is only a minor component of the lake's total fishery. The few fish that likely are not harvested during summer should support a minimal winter fishery until they succumb to low dissolved oxygen levels.

Recommended stockings and other actions:

- Stock 200 rainbow trout (180 g or 250 mm FL) in late May or early June and another 200 in late August.
- Stock 200 Arctic grayling (120 g or 220 mm FL) in late May or early June.
- Measure dissolved oxygen levels in April 2008 to determine if winter lake conditions fall outside the biological requirements for stocked species.
- Measure dissolved oxygen and temperature during early July 2008 to determine if winter lake conditions fall outside the biological requirements for stocked species.
- The lake should be managed as put-and-take. When the new fish hatchery in Fairbanks becomes operational the lake could be stocked multiple times during the year to provide a consistent fishery and support angler harvest.

Steese Highway 34.6

May 15–16, 2007. Maximum measured water temperature was 7.2°C. No fish were captured likely due to a winterkill event. Suggested management scenario is the same as that for Steese Highway 31.6.

Recommended stockings and other actions:

- Same as for Steese Highway 31.6.

Steese Highway 36.6

The fishery was sampled during May 15–16, 2007. Maximum measured water temperature was 5.8°C. Two hundred twenty eight Arctic grayling (Figure 11) and one burbot (607 mm TL) were captured. Unlike some of the other lakes along the Steese Highway, there is no historical evidence of winterkill events for this lake. This is the most popular fishery along the Steese Highway and receives the most use by anglers and campers. We suspect that most of the catchable rainbow trout and Arctic grayling were quickly harvested soon after stocking. In 2007, only age-1 Arctic grayling should be present but the LFD (Figure 11) suggests that age-2 and age-3 cohorts were also present. These cohorts might have entered the pond on 16 May 2006 when the Chatanika River flooded. The fish were not thin and there were no external signs of disease or parasites.

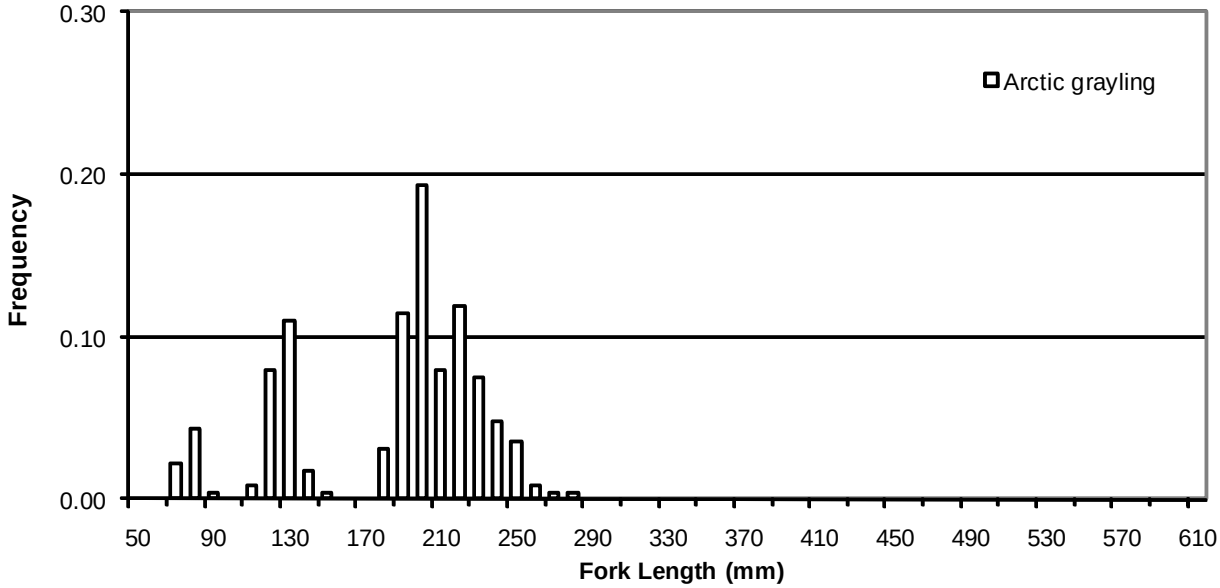

Figure 11.–Steese Highway 36.6, Arctic grayling: Length frequency distribution of Arctic grayling (n = 228) captured during sampling in Spring 2007.

Recommended stockings and other actions:

- Stock 360 rainbow trout (180 g or 250 mm FL) in late May or early June and another 360 in late August.
- Stock 360 Arctic grayling (120 g or 220 mm FL) in late May or Early June.
- The lake should be managed as put-and-take. When the new fish hatchery in Fairbanks becomes operational the lake could be stocked multiple times during the year to provide a consistent fishery and support angler harvest.

Buffalo Lake

The fishery was sampled during August 14–15, 2007. Maximum measured water temperature was 17.8°C. Eleven rainbow trout were captured (Figure 12). Captured fish were the expected size and were not thin. There were no external signs of disease or parasites. From 2000 through 2006 the lake was stocked with catchable rainbow trout because the fishery was popular and the lake could not produce sufficient numbers of catchables from fingerling stockings to meet angler demand. There is no history of winterkill events.

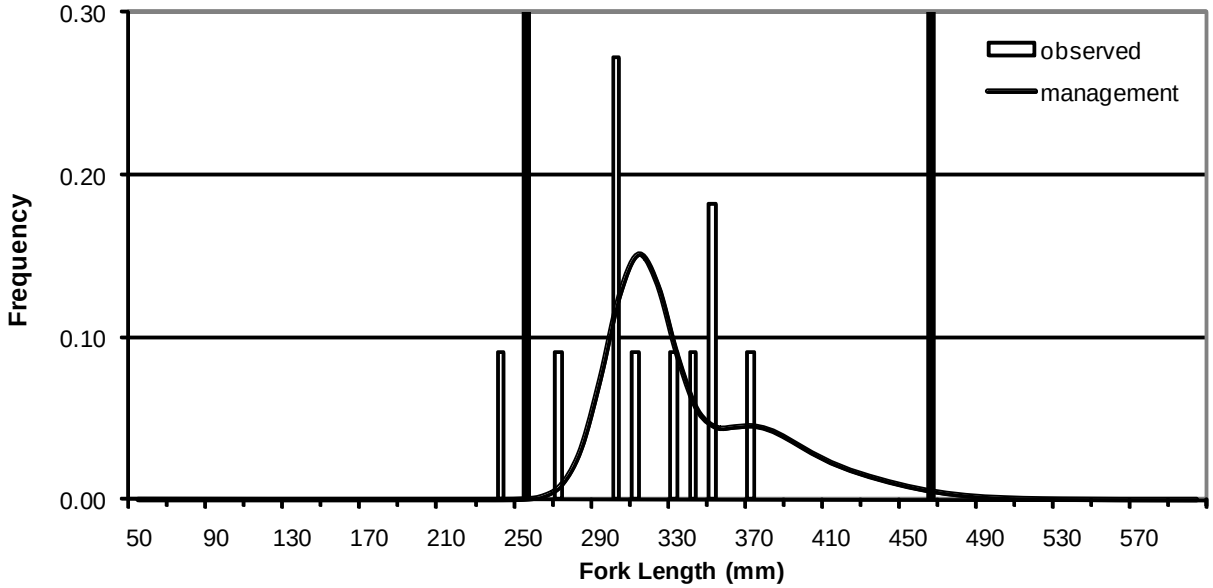

Figure 12.–Buffalo Lake, Rainbow trout: Length frequency distribution of rainbow trout (n = 11) captured during sampling plotted with the management population structure in Fall 2007. The management population structure was generated using preferred stocking schemes.

Recommended stockings and other actions:

- Stock 370 rainbow trout (180 g or 250 mm FL) in late May or early June and another 170 in late August.
- The lake should be managed as put-and-take. When the new fish hatchery in Fairbanks becomes operational the lake could be stocked multiple times during the year to provide a consistent fishery and support angler harvest.

Old Road Lake

The fishery was sampled during August 14–15, 2007. Maximum measured water temperature was 17.6°C. Five slimy sculpin and no game fish were captured. Winterkill events may occur occasionally but recent measurements of dissolved oxygen in April 2001 through 2007 (2004 excluded) show dissolved oxygen levels were sufficient for rainbow trout (ADF&G Fairbanks Limnology Records). The fishery manager suspects that the stocked rainbow trout were quickly harvested during summer. The lake is small (0.6 ha), easily accessible, and it has been stocked with 200 to 350 catchable rainbow trout annually.

Recommended stockings and other actions:

- Stock 370 rainbow trout (180 g or 250 mm FL) in late May or early June and another 170 in late August.
- The lake should be managed as put-and-take. When the new fish hatchery in Fairbanks becomes operational the lake could be stocked multiple times during the year to provide a consistent fishery and support additional harvest.

Peanut Lake

The fishery was sampled during August 13–14, 2007. Water temperature ranged from 17.0 to 20.4°C. One hundred nine rainbow trout were captured (Figure 13). Sufficient numbers of rainbow trout were captured that we were able to compare the sample LFD to that expected for Regional Management.

Visual comparison of the LFDs showed marginal similarity between the actual population structure and those based on management and predicted criteria (Figure 13). Age-1 and age-3 rainbow trout cohorts were easily identified by visually inspecting the observed LFD.

Differences between the observed rainbow trout population structure and the management and predicted population structures were statistically significant for mean length and relative abundance by length category and age cohort (Tables 9 and 10). Management and predicted criteria were not achieved for mean length by size category or age cohort.

A population model based on the management stocking scheme predicted an abundance of 240 age-1 and 38 age-3 fish (Table 11). The model using actual fish stockings was essentially the same.

The rainbow trout were smaller (length) than expected and most of the fish > 200 mm were thin. There were no external signs of parasites or disease. We don't have any direct evidence why the fish were small and thin but if we assume that their body conformation was due to inadequate food then it is reasonable that stocking fewer fish will increase the food available to individual fish. The stocking density for 2004 and 2006 was about 500 fingerlings per ha (~2,400 fish total), the typical density used for fingerlings.

Recommended stockings and other actions:

- Starting in 2008, biennially stock 1,500 rainbow trout (4 g or 70 mm FL) in late June. Stocking density is ~300 fish per ha.
- The fishery should be evaluated in 2011 to determine if the population size-age structure, based on the lower stocking density, meets or exceeds the minimal standard for the Regional Management category.
- Investigate the limnology characteristics of Peanut Lake and compare with other local lakes that meet or exceed the minimal population structure standards for Regional Management. This will provide fishery managers with information needed to determine if Peanut Lake is less productive compared to other local lakes. Stocking densities can then be based on lake productivity.

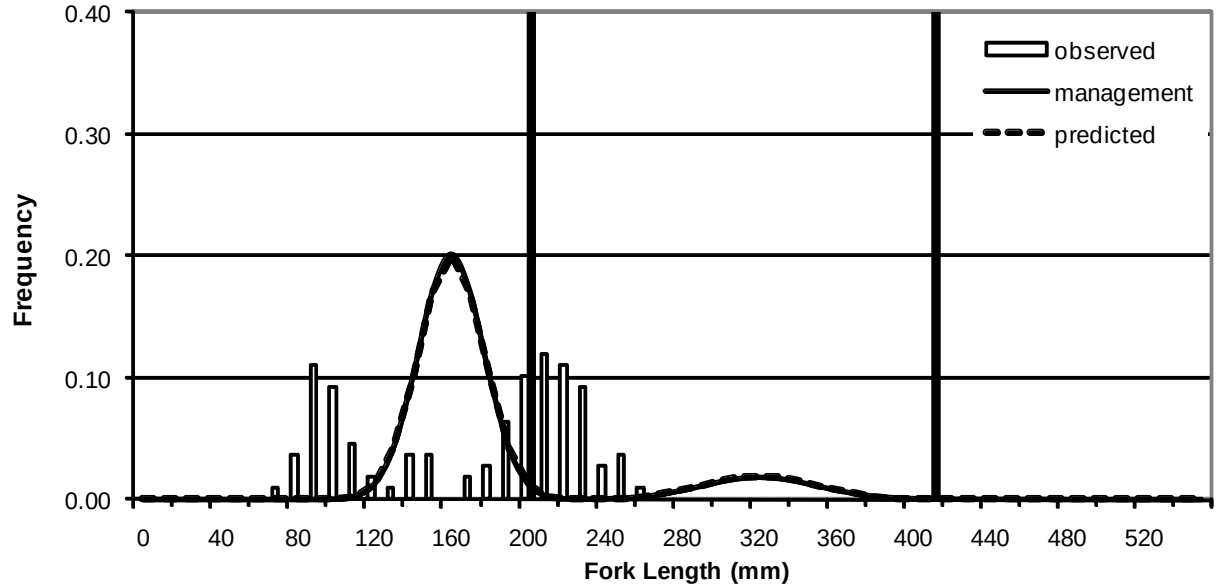

Figure 13.–Peanut Lake, Rainbow trout: Length frequency distribution of rainbow trout captured during sampling (n = 109) plotted with the management and predicted population structures in Fall 2007. The management population structure was generated using preferred stocking schemes. The predicted population structure was generated using actual fish stockings. Both plots are nearly identical.

Table 9.–Peanut Lake, Rainbow trout: test results by length category.

	Relative Abundance (χ^2 test)		**Mean Length** (t test)	
	<250 mm	≥250 mm	<250 mm	≥250 mm
Observed	66 (0.61[a])	43 (0.39[a])	182 mm (5.53[b])	269 mm (2.10[b])
Management Criteria	94 (0.86[a])	15 (0.14[a])	209 mm	360 mm
Test Stat		58.64	-4.88	-43.33
DF		1	65	42
P Value		<0.0001	<0.0001	<0.0001
Predicted Criteria	93 (0.85[a])	16 (0.15[a])	209 mm	359 mm
Test Stat		51.10	-4.88	-42.86
DF		1	65	42
P Value		<0.0001	<0.0001	<0.0001

[a] Proportion of catch.

[b] Standard error.

Table 10.–Peanut Lake, Rainbow trout: test results by age cohort.

	Relative Abundance (χ2 test)			**Mean Length** (t test)		
	age-1	age-2	age-3	age-1	age-2	age-3
Observed	32 (0.29[a])	0	77 (0.71[a])	140 mm (1.54[b])	0	248 mm (3.63[b])
Management Criteria	94 (0.86[a])	0	15 (0.14[a])	210 mm	0	370 mm
Test Stat			290.46	-45.41		-33.59
DF			1	31		76
P Value			<0.0001	<0.0001		<0.0001
Predicted Criteria	93 (0.85[a])	0	16 (0.15[a])	210 mm	0	370 mm
Test Stat			264.68	-45.41		-33.59
DF			1	31		76
P Value			<0.0001	<0.0001		<0.0001

[a] Proportion of catch.

[b] Standard error.

Table 11.–Peanut Lake, Rainbow trout: Population length-age structure based on management and predicted objectives.

	Length Category		Age Cohort				
	< 250 mm	≥ 250 mm	1	2	3	4	5
Management:							
Mean Length (mm FL)	209	360	210	300	370	410	450
Abundance	94	15	240	0	38	0	1
Proportion	0.86	0.14	0.86		0.14		<0.01
Predicted:							
Mean Length (mm FL)	209	359	210	300	370	410	450
Abundance	93	16	230	0	39	0	0
Proportion	0.85	0.15	0.85		0.15		

Values in the table were calculated for odd years. Values for even years will be different.

Mean lengths for age cohorts were calculated for fall.

Round Lake

The fishery was sampled during August 14–15, 2007. Maximum measured water temperature was 17.4°C. Seventeen slimy sculpin and no game fish were captured. Winterkill events may occur occasionally but recent measurements of dissolved oxygen in April 2001 through 2007 (no data for 2004) show dissolved oxygen levels were sufficient for rainbow trout (ADF&G Fairbanks Limnology Records). The fishery manager suspects that the stocked rainbow trout were quickly harvested during summer. The lake is small (0.8 ha), easily accessible, and it has been stocked with 200 to 350 catchable rainbow trout annually.

Recommended stockings and other actions:

- Stock 370 rainbow trout (180 g or 250 mm FL) in late May or early June and another 170 in late August.
- The lake should be managed as put-and-take. When the new fish hatchery in Fairbanks becomes operational the lake could be stocked multiple times during the year to provide a consistent fishery and support additional harvest.

Two Mile

The fishery was sampled during August 15–16, 2007. Maximum water temperature was 16.8°C. Three rainbow trout (275, 279, and 309 mm FL), 16 Arctic grayling, and 3 slimy sculpin were captured (Figure 14). The captured rainbow trout were likely from stockings in 2005 or 2004. The number of rainbow trout catchables (180 mm to 220 mm FL) stocked annually has declined from about 2,000 to 1,100 from 2001 through 2004 to less than 500 in 2005 due to production shortfalls at the Anchorage fish hatcheries. During summer this is a popular fishery and most of the rainbow trout were likely harvested soon after stocking. Fingerling rainbow trout (55 mm FL) were stocked in 2007. Most of these fish will not enter the fishery until 2009. Wild Arctic grayling reproduce in the lake.

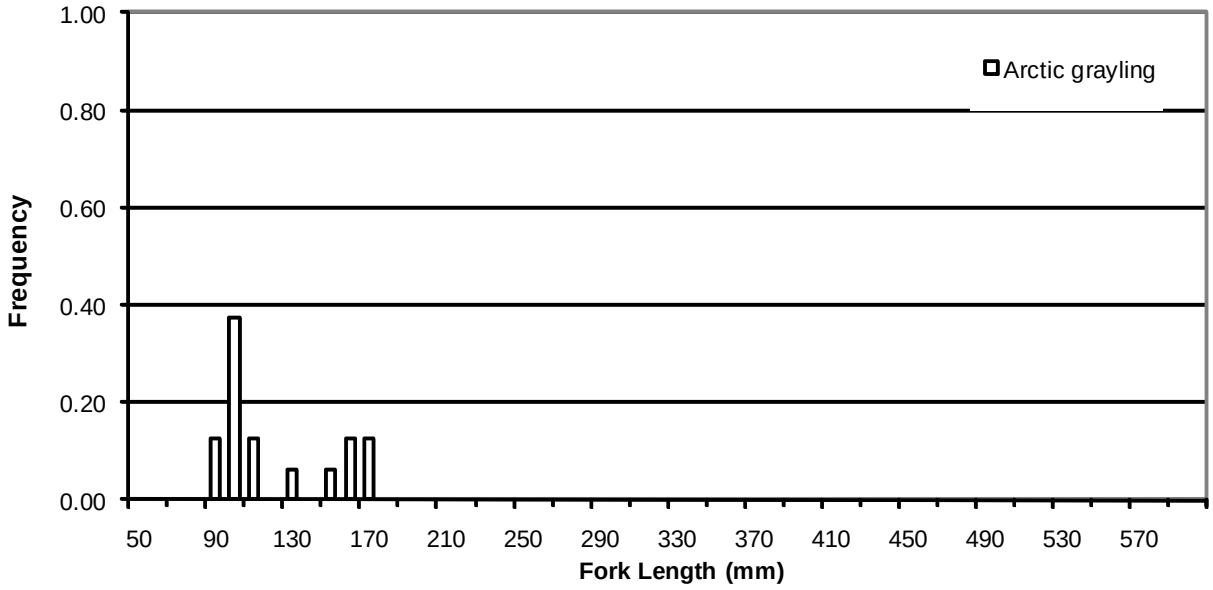

Figure 14.–Two Mile Lake, Arctic grayling: Length frequency distribution of Arctic grayling (n = 16) captured during sampling in Fall 2007.

ACKNOWLEDGEMENTS

Kelly Mansfield, Jessica Mitchell, Melissa McInelly, and Toby Viavant assisted with the field work. Rachael Kvapil provided editorial and formatting assistance. The U.S. Fish and Wildlife Service provided partial funding for this study through the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 77-777K) under Project F-10-23, Job No. E-3-1.

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APPENDIX A

STOCKING HISTORIES FOR FISH POPULATIONS SAMPLED IN 2007

Appendix A.–Stocking histories for fish populations sampled in 2007.

Lake	Species	Date	Number	Avg. Length (mm)
Four Mile	Lake Trout	27-Sep-00	6,526	6.2
Four Mile	Rainbow Trout	3-Aug-01	20,000	1.7
Four Mile	Arctic Char	16-Sep-04	4,605	3.3
Four Mile	Rainbow Trout	16-Sep-04	20,000	2.6
Four Mile	Rainbow Trout	21-Aug-06	10,275	1.8
Four Mile	Arctic Char	5-Sep-07	3,219	3.1
Geskakmina	Coho Salmon	27-Jun-00	9,653	3
Geskakmina	Rainbow Trout	6-Aug-01	12,750	1.7
Geskakmina	Coho Salmon	9-Jul-02	8,032	2.8
Geskakmina	Rainbow Trout	6-Aug-03	6,442	1.8
Geskakmina	Coho Salmon	24-Jun-04	4,933	2.3
Geskakmina	Rainbow Trout	3-Aug-05	6,400	1.6
Geskakmina	Coho Salmon	18-Jul-06	9,777	2
Geskakmina	Rainbow Trout	15-Aug-07	10,000	1.7
Geskakmina	Coho Salmon	25-Jun-08	8,000	2.3
Kenna	Lake Trout	9-Nov-00	500	6.3
Kenna	Rainbow Trout	14-Jul-04	3,000	1.9
Kenna	Rainbow Trout	21-Aug-06	1,500	1.8
Square	Arctic Char	31-Aug-01	2,000	4.2
Square	Arctic Char	16-Sep-04	3,500	3.3
CHSR 47.9	Rainbow Trout	29-Jun-00	500	7.8
CHSR 47.9	Grayling	13-Jul-00	500	7.8
CHSR 47.9	Grayling	26-Jun-01	250	7.2
CHSR 47.9	Rainbow Trout	5-Jul-01	250	8.5
CHSR 47.9	Rainbow Trout	10-Jun-02	500	8.3
CHSR 47.9	Rainbow Trout	14-Jun-04	450	9.1
CHSR 47.9	Rainbow Trout	19-May-05	550	8.6
CHSR 47.9	Grayling	11-Sep-06	4,032	2.4
CHSR 47.9	Rainbow Trout	21-Aug-07	1,000	1.8
Otto	Coho Salmon	27-May-00	2,000	2.7
Otto	Rainbow Trout	27-May-00	500	8.8
Otto	Rainbow Trout	29-May-01	1,000	8.8
Otto	Coho Salmon	11-Jun-01	2,000	2.5
Otto	Rainbow Trout	23-May-02	450	9.6
Otto	Coho Salmon	25-Jun-02	4,232	2.8
Otto	Rainbow Trout	1-Jul-02	500	9
Otto	Coho Salmon	3-Jun-03	2,000	2.6
Otto	Rainbow Trout	13-Jun-03	898	9.6
Otto	Coho Salmon	25-May-04	3,507	2.3
Otto	Rainbow Trout	25-May-04	500	8.8
Otto	Rainbow Trout	16-Jun-04	450	9.1

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Appendix A.–Page 2 of 3.

Lake	Species	Date	Number	Avg. Length (mm)
Otto	Rainbow Trout	12-May-05	500	8.7
Otto	Rainbow Trout	2-Jun-05	521	8.7
Otto	Coho Salmon	8-Jun-05	5,306	2.6
Otto	Rainbow Trout	1-Jun-06	250	10.8
Otto	Rainbow Trout	22-May-07	900	6
Otto	Rainbow Trout	7-Jun-07	859	6.2
Otto	Coho Salmon	15-Jun-07	5,570	2
Otto	Rainbow Trout	22-May-08	975	6.1
Otto	Rainbow Trout	10-Jun-08	1,026	6.6
Steese 31.6	Rainbow Trout	20-Jun-00	245	8.1
Steese 31.6	Grayling	26-Jun-01	250	7.2
Steese 31.6	Rainbow Trout	10-Jun-02	200	8.3
Steese 31.6	Rainbow Trout	4-Jun-04	180	8.8
Steese 31.6	Grayling	30-Aug-06	3,000	1.7
Steese 34.6	Rainbow Trout	20-Jun-00	368	8.1
Steese 34.6	Grayling	26-Jun-01	250	7.2
Steese 34.6	Rainbow Trout	10-Jun-02	450	8.3
Steese 34.6	Rainbow Trout	4-Jun-04	270	8.8
Steese 34.6	Grayling	30-Aug-06	3,000	1.7
Steese 36.6	Rainbow Trout	20-Jun-00	552	8.1
Steese 36.6	Grayling	26-Jun-01	400	7.2
Steese 36.6	Rainbow Trout	10-Jun-02	650	8.3
Steese 36.6	Rainbow Trout	4-Jun-04	400	8.8
Steese 36.6	Grayling	30-Aug-06	3,000	1.7
Steese 36.6	Rainbow Trout	21-Aug-07	1,000	1.8
Buffalo	Rainbow Trout	30-May-00	493	8.8
Buffalo	Rainbow Trout	24-May-01	500	9.7
Buffalo	Rainbow Trout	24-May-02	450	9.4
Buffalo	Rainbow Trout	27-May-03	475	8.9
Buffalo	Rainbow Trout	21-May-04	455	8.8
Buffalo	Rainbow Trout	19-May-05	500	8.6
Buffalo	Rainbow Trout	31-May-06	200	10.7
Buffalo	Rainbow Trout	29-Aug-07	4,000	2
Old Road	Rainbow Trout	30-May-00	250	7.8
Old Road	Rainbow Trout	18-Jul-00	266	7.2
Old Road	Rainbow Trout	13-Jun-01	250	8
Old Road	Rainbow Trout	18-Jul-01	256	8.7
Old Road	Rainbow Trout	24-May-02	230	8.5
Old Road	Rainbow Trout	27-Jun-02	250	7.9
Old Road	Rainbow Trout	27-May-03	349	9.1
Old Road	Rainbow Trout	18-Jun-03	274	8.3

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Appendix A.–Page 3 of 3.

Lake	Species	Date	Number	Avg. Length (mm)
Old Road	Rainbow Trout	21-May-04	227	8.8
Old Road	Rainbow Trout	22-Jun-04	200	8.6
Old Road	Rainbow Trout	19-May-05	250	8.6
Old Road	Rainbow Trout	29-Aug-07	1,500	2
Peanut	Rainbow Trout	22-Aug-01	2,400	2.2
Peanut	Rainbow Trout	9-Aug-04	2,439	2
Peanut	Rainbow Trout	1-Sep-06	2,300	1.9
Round	Rainbow Trout	30-May-00	250	7.8
Round	Rainbow Trout	18-Jul-00	293	7.2
Round	Rainbow Trout	13-Jun-01	250	8
Round	Rainbow Trout	18-Jul-01	257	8.7
Round	Rainbow Trout	24-May-02	240	8.5
Round	Rainbow Trout	27-Jun-02	250	7.9
Round	Rainbow Trout	27-May-03	349	9.1
Round	Rainbow Trout	18-Jun-03	274	8.3
Round	Rainbow Trout	21-May-04	227	8.8
Round	Rainbow Trout	23-Jun-04	202	8.6
Round	Rainbow Trout	19-May-05	250	8.6
Round	Rainbow Trout	29-Aug-07	1,500	2
Two Mile	Rainbow Trout	18-Jul-00	1,166	7.2
Two Mile	Rainbow Trout	13-Jun-01	2,045	8
Two Mile	Rainbow Trout	24-May-02	1,511	8.5
Two Mile	Rainbow Trout	27-May-03	1,475	9.1
Two Mile	Rainbow Trout	21-May-04	1,092	8.8
Two Mile	Rainbow Trout	9-Jun-05	430	8.9
Two Mile	Rainbow Trout	29-Aug-07	8,000	2

Species Codes:

RT Rainbow Trout
SS Silver Salmon
AC Arctic Char
GR Arctic Grayling

APPENDIX B
CAPTURE DATA FOR FISH POPULATIONS SAMPLED IN 2007

Appendix B.–Capture data for fish populations sampled in 2007.

Data File	Description
FDS Report Data Appendix for Lake Monitoring 2007.xls[a]	Lake, gear type, location, soak time, depth, species, fish length, water temperature.

[a] Data files have been archived and are available from the Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services, 333 Raspberry Road, Anchorage 99518-1599.

This file location is for reference and will be deleted before report is finalized.
W:\SWE\Reports\SWE - LK Monitoring 2007\FDS Report Data Appendix for Lake Monitoring 2007.xls