Fishery Data Series No. 00-5

Abundance and Composition of Arctic Grayling in Mendeltna Creek, 1999

by

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and

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Alaska Department of Fish and Game May 2000 Division of Sport Fish

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
metric ton	mt
Milliliter	ml
Millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
Foot	ft
Gallon	gal
Inch	in
Mile	mi
Ounce	oz
Pound	lb
Quart	qt
Yard	yd

Spell out acre and ton.

Time and temperature

Day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
Minute	min
Second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
Ampere	A
Calorie	cal
direct current	DC
Hertz	Hz
Horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
Volts	V
Watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
And	&
At	@
Compass directions:	
East	E
North	N
South	S
West	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
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
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
Trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

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	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
Covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
Equals	=
expected value	E
fork length	FL
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.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
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
standard length	SL
total length	TL
variance	Var

FISHERY DATA SERIES NO. 00-5

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

Abundance and composition of the Arctic grayling ***Thymallus arcticus*** population in Mendeltna Creek in early to middle July **1999** was described using mark-recapture techniques. In **1999,** the estimated abundance of Arctic grayling ≥ 200 mm FL in July was **845** fish (SE = 284 fish; **95%** profile likelihood bounds were **464** and 2,261 fish). Even though this estimate is an indication of relative abundance, the estimate may be biased due to a very small number of marked fish caught in the recapture event (n=6). Fork lengths measured from **148** Arctic grayling **≥ 200** mm FL ranged from **200** mm to **309** mm (mean = **241** mm; SE = 2 mm). Within this size range Arctic grayling ages ranged from one to **5** years, with **92%** of these between three and five years. No Arctic grayling were observed in Mendeltna Creek during the spawning season, suggesting that summer resident Arctic grayling may spawn elsewhere in the drainage. Questionnaires sent to anglers indicated that one angler caught 100 fish in one day but fish size was small.

Key Words: Arctic grayling, ***Thymallus arcticus,*** population abundance, length composition, age, Mendeltna Creek, mark-recapture, questionnaires.

INTRODUCTION

The Alaska Department of Fish and Game (ADF&G) initiated Arctic grayling ***Thymallus arcticus*** studies in Mendeltna Creek in response to increased angling pressure reported on annual Statewide Harvest Surveys (Mills 1994; Howe et al. 1995, 1996, 1997, and 1998). From 1991 to 1995, the estimated catch increased from 716 fish to 3,112 fish, the estimated harvest increased from 102 fish to 1,041 fish, and there was an average annual harvest of 702 fish (Mills 1992, 1993, and 1994; Howe et al. 1995 and 1996). The increase in sport fishing catch and harvest in this Arctic grayling fishery is thought to come from an increased awareness of access opportunities, primarily during the summer and particularly at the Glenn Highway crossing and adjoining camping area.

There is no historical abundance data for this fishery. In 1998, Fish (1999) conducted an age and length composition study and found that a large proportion of fish captured in May were ≥ age-4 ($p = 0.35$, $SE = 0.06$), whereas in July the proportion of these older fish was much smaller ($p = 0.05$, $SE = 0.03$). Fish (1999) hypothesized that many adult Arctic grayling from the Tazlina River drainage enter Mendeltna Creek during early spring to spawn, and later emigrate to summer feeding locations outside Mendeltna Creek. This, if true, would suggest that Mendeltna Creek is important for spawning and rearing for Arctic grayling of the Tazlina River drainage. To fully answer these questions information on abundance and life history characteristics such as spawning activities, distribution, and movement of Mendeltna Creek Arctic grayling is needed.

OBJECTIVES

The research objectives for the 1999 Mendeltna Creek Arctic grayling study were to:

1) estimate abundance of Arctic grayling (≥ 150 mm FL) in an 11 km section of Mendeltna Creek during July, such that the estimate is within 25% of the true abundance 95% of the time;

2) estimate age and length compositions of Arctic grayling (≥ 150 mm FL) in an 11 km section of Mendeltna Creek during July such that all proportions are within 5% of the true proportions **90% of** the time; and,

3) contact 1998 Statewide Harvest Survey respondents by letter to inquire about their fishing history in Mendeltna Creek to determine which months anglers fish most often for Arctic grayling in Mendeltna Creek.

Additional tasks were to determine if Arctic grayling spawn in Mendeltna Creek during early spring (middle April) and if so, to collect composition data from spawning fish.

DESCRIPTION OF STUDY AREA

Located in the Tazlina River drainage, Mendeltna Creek is approximately 36.8 km in length and runs from Old Man Lake and Mendeltna Springs into Tazlina Lake. This stream is crossed by the Glenn Highway 55.4 km west of Glennallen. Mendeltna Creek is accessed at the Glenn Highway Bridge and by Lake Louise Road (approximately 43.2 km from Glennallen), which, after 9.6 km, connects to Oilwell Road (Figure 1). From the Lake Louise Road access anglers can walk approximately 3.2 km upstream to Old Man Lake or float downstream approximately 11.2 km to the Glenn Highway Bridge. In addition to Arctic grayling, Mendeltna Creek also supports fisheries for rainbow trout *Oncorhynchus mykiss*, chinook salmon *O. tshawytscha,* and Dolly Varden *Salvelinus malma.*

METHODS

In the middle of April, the study site was visited to observe and catch spawning fish via hook and line, and to collect length and age composition data. Water temperatures and substrate information were collected as well.

In July, the abundance and age and size compositions of Arctic grayling (≥ 200 mm FL) were estimated in a section of Mendeltna Creek, between Oilwell Road and the Glenn Highway (Figure 1). This section of the creek encompasses two road accessible locations and is the section of stream where most angling occurs.

SAMPLING TECHNIQUES

A crew of three individuals conducted a two-event mark-recapture sampling experiment from July 9 to July 15. Both sampling events began at the Oilwell Road access point and ended at the Glenn Highway Bridge, with a three-day hiatus between events. Initially, both backpack electrofishing gear and rod and reel were used to capture fish. However, no Arctic grayling were caught using electrofishing gear in the first three days, after which only rod and reel were used.

All data from Arctic grayling captured during the mark-recapture experiment were recorded on ADF&G Tagging Length Mark-Sense Form, Version 1.0. A new form was used for each date, with sampling location recorded on the description line. All crewmembers were aware of the importance of thoroughly examining all Arctic grayling for Floy tags, tagging wounds, and fin clips and the importance of accurately recording the data.

During the marking event (July 7 through July 12), all Arctic grayling >149 mm FL that were captured were measured for length, tagged with a Floy FD-94® internal anchor (T-bar) tag at the base of the dorsal fin, and the upper caudal fin was slightly clipped. Two or more scales were taken for age determination and mounted directly on gummed cards at the time of sampling. During the recapture event (July 13 through July 15), all fish greater than 149 mm were

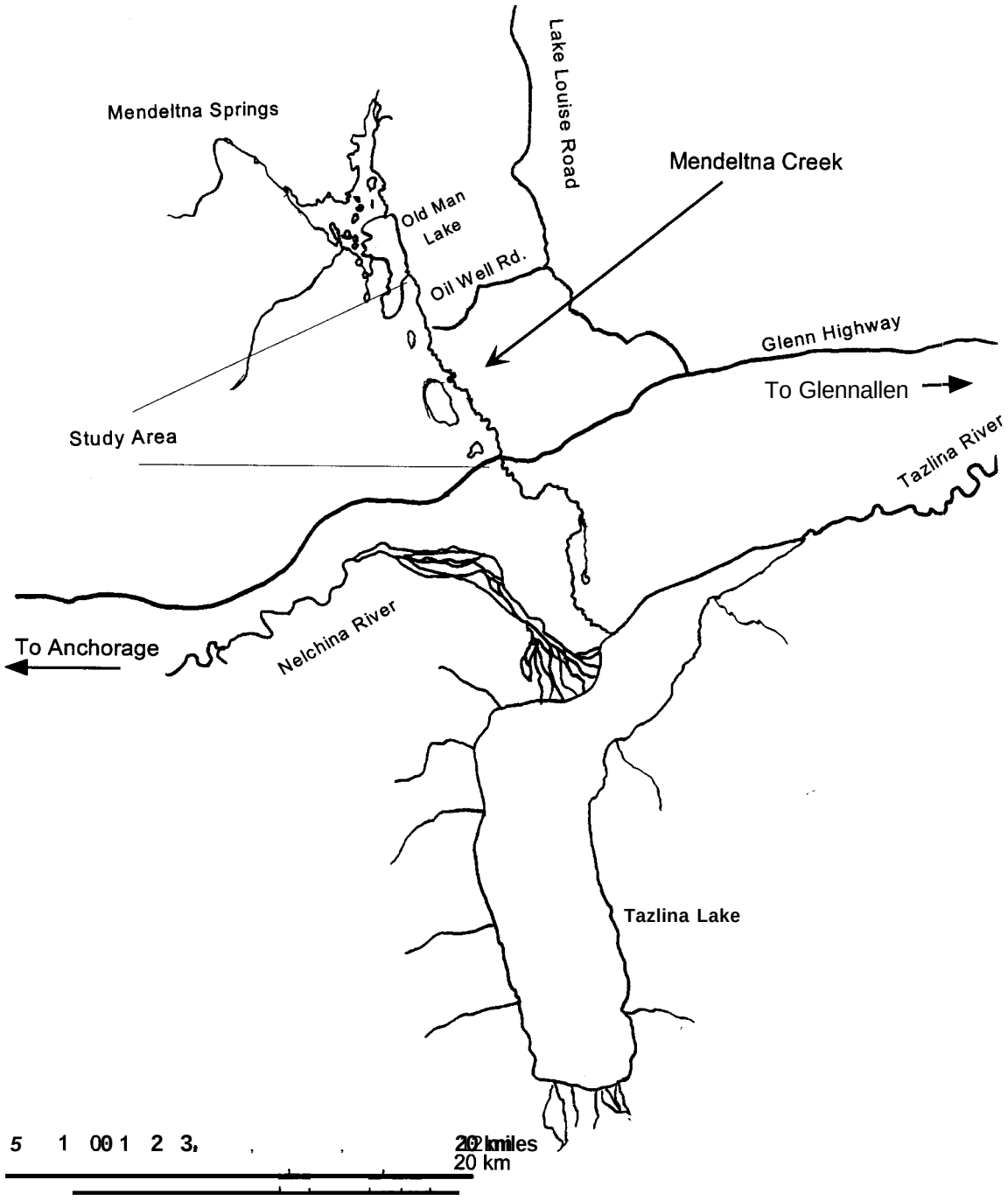

Figure 1.-Mendeltna Creek study area.

examined for marks, and any unmarked fish captured was tagged, two or more scales taken, and the lower caudal fin clipped. All healthy Arctic grayling were released immediately after data collection.

Upon the completion of the fieldwork, collected Arctic grayling scales were processed for age determination. The scale *gum* cards were used to make triacetate impressions of the scales (30 seconds at 137,895 kPa at a temperature of 97° C). Ages were determined by counts of annuli from impressions of scales magnified to 40X with the aid of a microfiche reader. Criteria for determining the presence of an annulus were: 1) complete circuli cutting over incomplete circuli; 2) clear areas or irregularities in circuli along the posterior fields; and, 3) regions of closely spaced circuli followed by a region of widely spaced circuli (Kruse 1959).

ESTIMATION OF ABUNDANCE

The mark-recapture experiment was conducted under the assumptions of a Petersen mark-recapture experiment (Seber 1982). These assumptions were that:

1) the population was closed (no change in the number or composition **of** Arctic grayling during the experiment);
2) all Arctic grayling had the same probability of capture during the marking event or the same probability of capture during the recapture event or marked and unmarked Arctic grayling mixed completely between the marking and recapture events;
3) marking of Arctic grayling did not affect their probability of capture in the recapture event;
4) Arctic grayling did not lose their mark between events; and,
5) all marked Arctic grayling were reported when recovered in the recapture event.

Assumption 1 was inferred since Arctic grayling display a tendency to be relatively stationary during summer when occupying feeding locations (Tack 1980). Therefore, movement out or into the study area was unlikely during the experiment. Assumption 1 was further ensured because of the relatively short duration of the experiment. The validity of assumptions 2 and 3 was tested by comparing the recapture rates of fish between events with tests of consistency dlesigned to detect unequal catchability by size of fish (Seber 1982). The validity of assumption 4 was ensured by double marking (Floy tag and fin-clip) each Arctic grayling during the marking event. Tag loss was noted when a fish was recovered during the recapture event with the specific fin clip but without a Floy tag. In addition, Floy tag placement was standardized, which enabled the fish handler to verify tag loss by locating recent tag wounds. The validity of assumption 5 was ensured by a thorough examination of fins for fin-clips and recording Floy tag numbers for all Arctic grayling.

Estimated abundance of Arctic grayling was calculated from the number of Arctic grayling marked, examined for marks, and recaptured. The modified Petersen estimator of Bailey (Seber 1982) was used:

$$\hat{N} = \frac{M(C+1)}{(R+1)} \qquad (1)$$

where: M = the number of Arctic grayling marked and released alive during the marking event;

C = the number of Arctic grayling examined for marks during the recapture event;

R = the number of Arctic grayling recaptured during the recapture event; and,

$\hat{N}$ = estimated abundance of Arctic grayling at the time of marking.

Variance of the abundance estimate (Seber 1982) was estimated as:

$$\hat{V}[\hat{N}] = \frac{(M)^2 (C+1)(C-R)}{(R+1)^2 (R+2)} \quad (2)$$

ESTIMATION OF LENGTH AND AGE COMPOSITIONS

Length proportions were estimated for Arctic grayling ≥ 200 mm FL in the Mendeltna Creek Study Area in July 1999. The proportion and variance estimators used were:

$$\hat{p}_k = \frac{x_k}{n}, \text{ and} \quad (3)$$

$$\hat{V}[\hat{p}_k] = \frac{\hat{p}_k (1-\hat{p}_k)}{n-1} \quad (4)$$

where: $\hat{p}_k$ = the proportion of Arctic grayling that were length *k*;

x_k = the number of Arctic grayling sampled that were length *k*; and,

n = the number of Arctic grayling sampled that were measured.

Age composition was estimated using the same equations for proportions and variances used to estimate length composition except ages were substituted for lengths.

AGE VALIDATION

To evaluate the precision in age determination, ages were determined twice for 151 scales collected during the experiment. The average percent error (APE of Beamish and Fournier 1981) of the scale reader to reproduce the same age twice from a Mendeltna Creek Arctic grayling scale in 1999 was calculated as:

$$APE = \sum_{i=1}^{S} \left[\frac{\sum_{j=1}^{R} \frac{\left| x_{ij} - \bar{x}_i \right|}{\bar{x}_i}}{R} \right] \cdot \frac{100}{S} =$$

where: x_{ij} = age determined from the j'' reading of the i'' scale;

$\bar{x}_i$ = average age determined from the i^{th} scale;

R = total number of readings; and,

S = total number of scales in the sample.

APE provides a means to evaluate the reproducibility of ages within a year, but should not be considered independent of age (Laine et al. 1991).

ANGLER SURVEYS

From Statewide Harvest Survey respondents, additional surveys were sent to those anglers who reported fishing for Arctic grayling in Mendeltna Creek during 1996 or 1997. The survey collected data on timing, amount of effort, location fished, number of Arctic grayling caught and number harvested.

RESULTS

Of the 145 unique Arctic grayling ≥ 200 mm FL handled during the mark-recapture experiment, 80 were tagged and released alive during the marking event and 68 were examined for marks during the recapture event, of which six were recaptures fkom the marking event. There were no Arctic grayling observed with Floy tags from previous mark-recapture experiments, and there was no observed mortality during this study.

ABUNDANCE

The original objective was to estimate the abundance of Arctic grayling ≥ 150 mm FL, however, there were no recaps between 150 and **200** mm FL. Therefore, the estimate of abundance applies only to fish ≥ 200 mm FL during July 1999.

There was no significant difference between the length distributions of Arctic grayling marked and Arctic grayling recaptured ($D = 0.29$; P = 0.27; Figure 2), however, due to the low number of recaptures, the power of the test was low. Therefore, the necessity to stratify by length could not be determined satisfactorily. Estimated abundance of Arctic grayling ≥ 200 mm within Mendeltna Creek in July was 845 fish (SE=284; CV=34%). The 95% profile likelihood bounds were 464 and 2,261 Arctic grayling ≥ 200 mm FL. The recapture rate (fish recaptured divided by fish examined for marks in the recapture event; WC) was 0.15.

LENGTH COMPOSITION

There was no significant difference between the length distributions of Arctic grayling marked and Arctic grayling examined for **marks** during the recapture event ($D = 0.16$, P = 0.31; Figure 2). The inconclusive difference between length distributions of Arctic grayling marked and Arctic grayling recaptured, suggested however, that there was size selectivity during either the first event only, the second event only, or both events. This uncertainty cannot be reconciled because of the low number of recaptures. Therefore, both events were combined to estimate length composition. Fork lengths measured from 151 Arctic grayling ≥ 200 mm FL in Mendeltna Creek ranged fi-om 200 mm to 309 mm (mean = 241 mm; **SE** 2 mm; Figure 3).

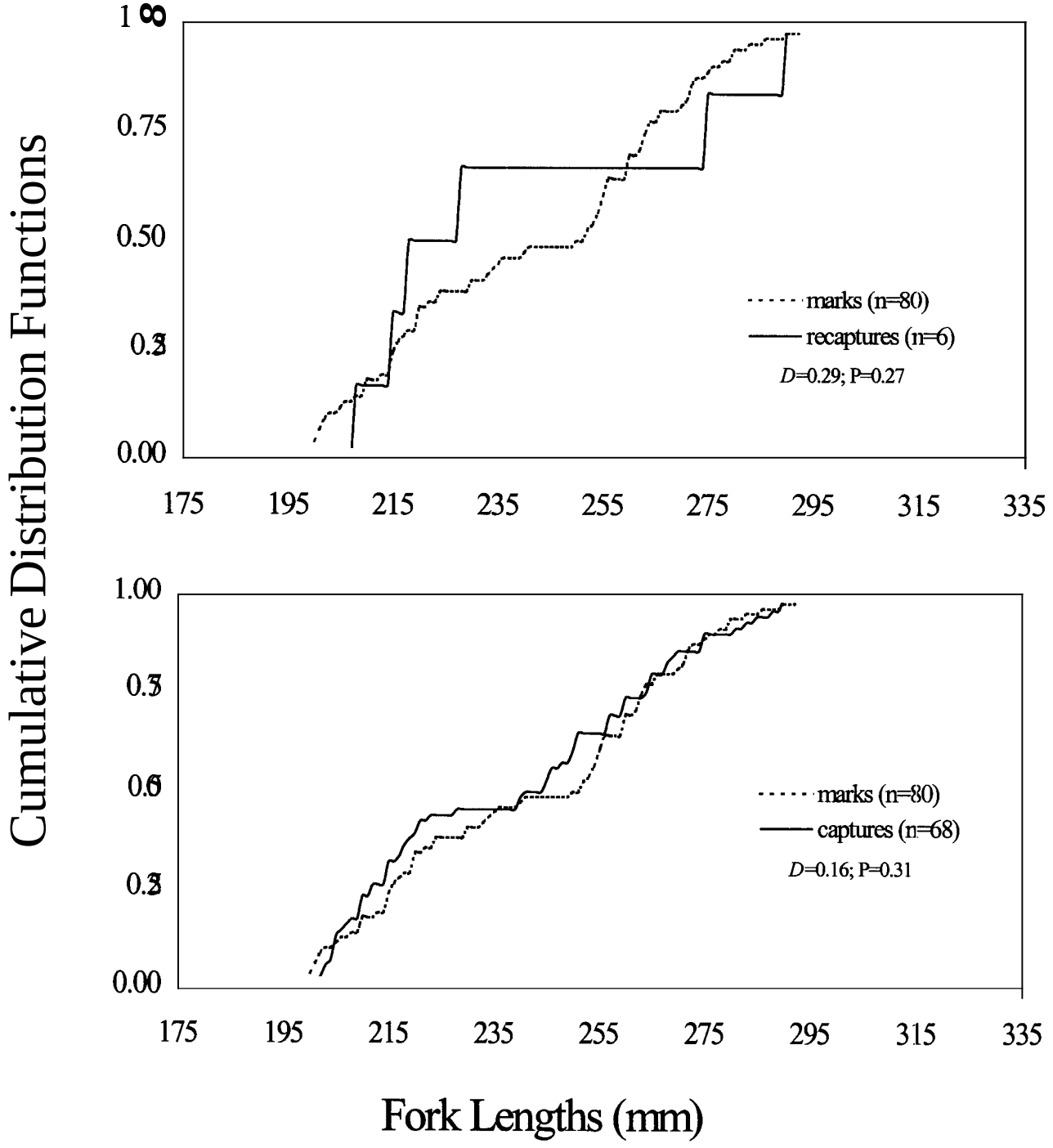

Figure 2.–Cumulative distribution functions of fork lengths of Arctic grayling marked versus recaptured and marked versus captured in Mendeltna Creek, 1999.

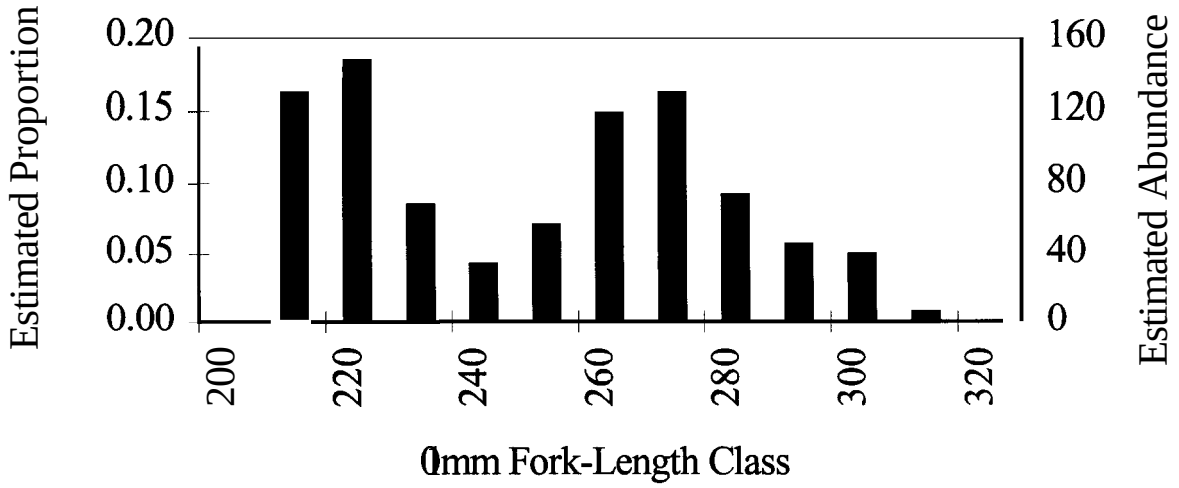

Figure 3.–Estimated proportions and abundances of Arctic grayling ≥ 200 mm FL by 20 mm length classes within Mendeltna Creek during July 1999.

AGE COMPOSITION AND AGE VALIDATION

Ages were determined for 151 Arctic grayling (≥ 200 mm FL) sampled during the Mendeltna Creek mark-recapture experiment (79 from the marking event and 72 from the recapture event). The estimated average percent error of the scale reader in reproducing the same age twice in 1999 was 1.4% (Figure 4). Of Mendeltna Creek Arctic grayling ≥ 200 mm FL, an estimated 92% (SE = 1%) were ages 2 through 4. Of the 158 unique Arctic grayling sampled, ages were not determined for seven (scales were not taken or lost from four fish and not readable because of regeneration from three fish).

ANGLER SURVEY RESPONSES

Questionnaires regarding fishing information were returned from 29 anglers who fished for Arctic grayling in Mendeltna Creek in 1996 and 1997. Fishing occurred from May through October, with June, July, August, and September being the most popular months (Figure 5).

Most of the effort was concentrated at the Glenn Highway Bridge and the Oilwell Road access points, and catches ranged from zero to over 100 fish per day (mean was 17 fish; SE = 5). The number of fish kept per angler per day ranged from zero to five (mean was 2 fish; SE = 0.4). Fourteen people indicated that they fished near the Glenn Highway Bridge, 16 people indicated they fished near Oilwell Road, and only three respondents reported fishing downstream of the Glenn Highway Bridge near Tazlina Lake. All anglers reported targeting Arctic grayling, two also reported fishing for rainbow trout, and one for lake trout *Salvelinus namaycush*.

SPAWNING SURVEY

In late April and early May, crew members surveyed an approximately 3.5 km stretch of Mendeltna Creek, from the Oilwell Road access point to Oldman Lake, to observe spawning fish (Figure 1). No Arctic grayling (spawners or otherwise) were observed in Mendeltna Creek during this time and therefore no composition data was collected. Water temperatures (4° to 7° C) and substrate appeared to be suitable for spawning.

DISCUSSION

The low catch rate and small number of recaptures (six) resulted in an imprecise estimate of abundance. Since there were no recaptured fish between 150 and 200 mm FL, the segment of the population estimated was less than desired. It was likely that the number of catchable (and harvestable) fish was greater than estimated. Unfortunately, there is no historical abundance information that can be used to make inferences about the health of the population.

Anecdotal information from survey respondents, however, suggested that catch rates and size of Arctic grayling in Mendeltna Creek have declined in recent years. This information, along with recent increases in catch, harvest, and effort, suggests that the conservation concern for this fishery is valid.

The lack of any observed spawning Arctic grayling in Mendeltna Creek suggests that Arctic grayling that inhabit Mendeltna Creek in the summer months spawn elsewhere in the drainage, perhaps below the Glenn Highway Bridge or in the inlet streams to Old Man Lake (Figure 1).

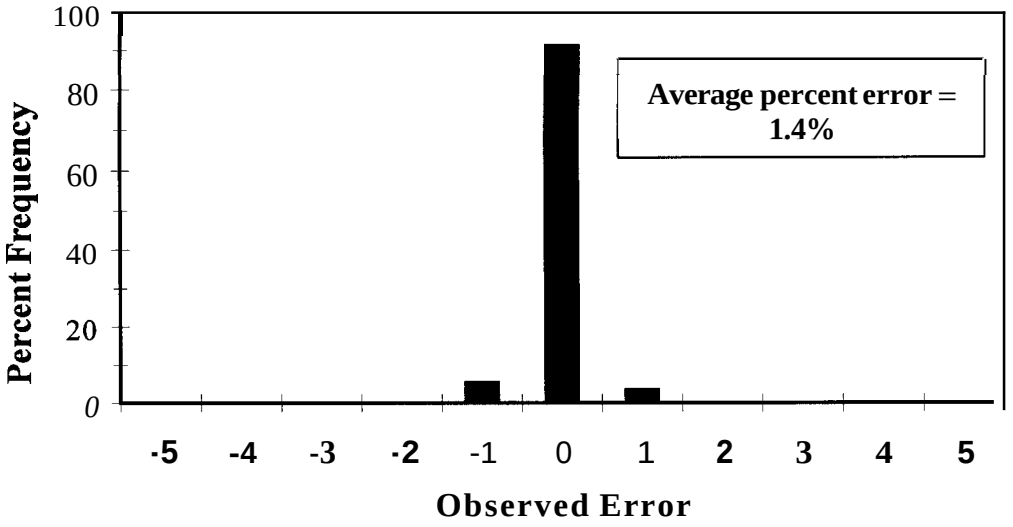

Figure 4.-Percent frequencies for observed errors in reproducing the same age twice from a Mendeltna Creek Arctic grayling scale in 1999.

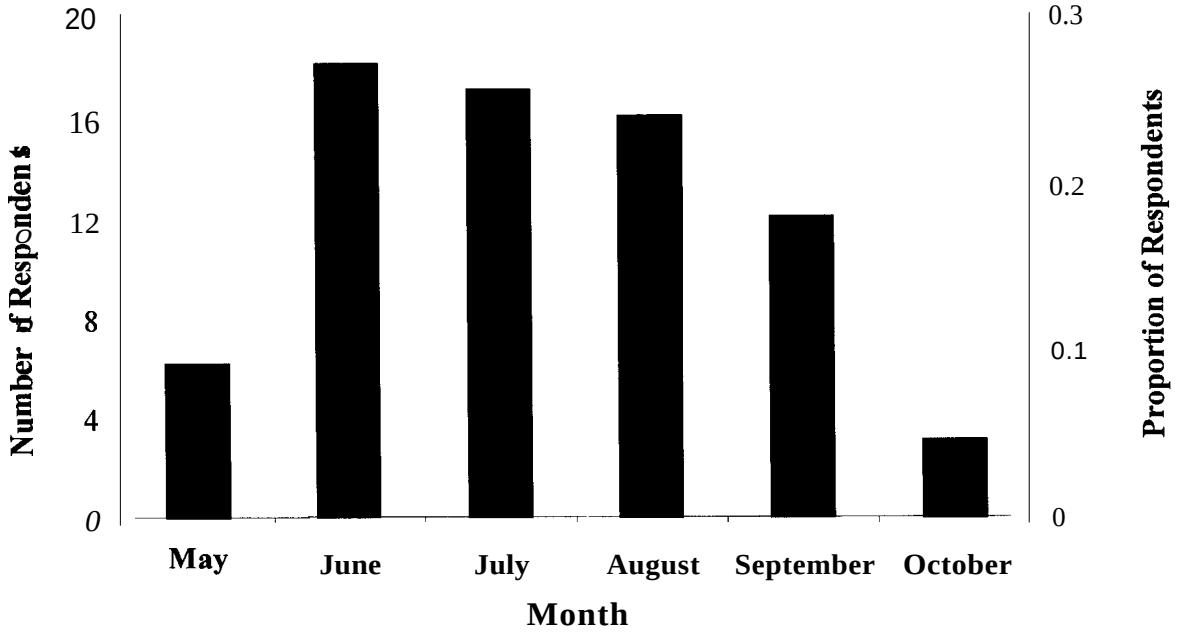

Figure 5.-Estimated proportions and abundances of Arctic grayling ≥ 200 mm FL within Mendeltna Creek during July 1999.

To increase sample sizes, future abundance projects for Arctic grayling in Mendeltna Creek should concentrate on increasing sampling effort in both events, increasing the duration of sampling events, and using added sampling gear types (seines, traps, etc.).

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APPENDIX A
DATA FILE LISTING

Appendix A.–Data files used to estimate parameters of the Mendeltna Creek Arctic grayling populations, 1999.

Data file[a]	Description
U21200L011999.DTA	Population and marking data for Mendeltna Creek Arctic grayling captured during the marking event, July 9 through July 12,1999.
U21200L011999.DTA	Population and recapture data for Mendeltna Creek Arctic grayling captured during the recapture event, July 13 through July 15, 1999.

[a] Data files were archived at and are available from the Alaska Department of Fish and Game, **Sport** Fish Division, Research **and** Policy Services, **333** Raspberry Road, Anchorage, Alaska 99518-1599

APPENDIX B
MENDELTNA CREEK ARCTIC GRAYLING ANGLER SURVEY

Appendix B.-Mendeltna Creek Arctic grayling angler survey.

Dear Angler,

The Alaska Department of Fish and Game, Sport Fish is requesting information from anglers who have fished for Arctic grayling in Mendeltna Creek, outside of Glennallen. Your name was chosen because you responded to the 1996 or 1997 Statewide Harvest Survey, and indicated that you fished in Mendeltna Creek.

Mendeltna Creek is located in the Tazlina River drainage, approximately 34 miles west of Glennallen. It flows from Old Man Lake and Mendeltna Springs into Tazlina Lake. Anglers can access Mendeltna Creek at the Glenn Highway crossing or upstream at Oilwell Road (off Lake Louise Road). Mendeltna Creek has been identified as an increasingly popular sport fishery for Arctic grayling where an approximate 6-fold increase in estimated harvest of Arctic grayling (170 to 1,041 fish) has occurred from 1991 to 1995. As project biologist, I am interested in knowing when most people fish for Arctic grayling in Mendeltna Creek so we can determine if our current fishery regulations are adequate to conserve this stock for sustained use.

Please answer the questions below and return this letter in the envelope provided (you do not require postage). I appreciate your time and help.

Best regards,

Jim Fish
Fishery Biologist
ADF&G, Sport Fish Division, Fairbanks
907-459-7207

QUESTIONS

Please indicate which months you have fished for Arctic grayling in Mendeltna Creek?

During which month did you fish most often for Arctic grayling in Mendeltna Creek (i.e. which month did you take the most number of trips?)

Did you fish near the Glenn Highway Bridge?

Did you fish near Oilwell Road?

Did you fish downstream near Tazlina Lake?

How many Arctic grayling did you catch in a given day?

Current bag and possession limits are five fish per day/five in possession. Of this five fish bag limit, how many Arctic grayling did you keep?

If you did not fish for Arctic grayling, please indicate what other species you fished for.

Please feel free to write below any comments you may have regarding this fishery.

Thank you.