

FISHERY DATA SERIES NO.17

ASSESSMENT OF SPORT FISHERY RESOURCES IN
THE GULKANA RIVER WITH EMPHASIS ON
ARCTIC GRAYLING (*Thymallus arcticus*), 1986

By: Kent Roth and
Kevin Delaney



STATE OF ALASKA
Steve Cowper, Governor
ALASKA DEPARTMENT OF FISH AND GAME
Don W. Collinsworth, Commissioner
DIVISION OF SPORT FISH
Norval Netsch, Director



P.O. Box 3-2000, Juneau, Alaska 99802

NOVEMBER 1987

ASSESSMENT OF SPORT FISHERY RESOURCES IN
THE GULKANA RIVER WITH EMPHASIS ON
ARCTIC GRAYLING (*Thymallus arcticus*), 1986¹

By Kent Roth and
Kevin Delaney

November 1987

ALASKA DEPARTMENT OF FISH AND GAME
Division of Sport Fish
Juneau, Alaska 99802

¹This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-2, Job Nos. G-2-1 and T-2-1.

TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	iii
LIST OF FIGURES	v
ABSTRACT	1
INTRODUCTION	1
METHODS	3
Study Area	3
Study Design	3
Creel Survey	5
Arctic Grayling and Chinook Salmon Population Studies	5
Species Composition of Subsistence and Personal-Use Fishwheel and Dipnet Fisheries	5
Data Collection	6
Creel Survey	6
Arctic Grayling and Chinook Salmon Population Studies	6
Species Composition of Subsistence and Personal-Use Fishwheel and Dipnet Fisheries	6
Data Analysis	6
Creel Survey	6
Arctic Grayling and Chinook Salmon Population Studies	8
Species Composition of Subsistence and Personal-Use Fishwheel and Dipnet Fisheries	9
RESULTS	9
Arctic Grayling and Chinook Salmon Population Studies . .	9
Arctic Grayling	9
Creel Survey	12
Arctic Grayling	12
Chinook Salmon	12
Sockeye Salmon	17
Rainbow Trout	17

TABLE OF CONTENTS (Continued)

	<u>Page</u>
Species Composition of Subsistence and Personal-Use Fishwheel and Dipnet Fisheries	17
Angler Characteristics	17
Regulation Questionnaire	24
DISCUSSION	24
RECOMMENDATIONS	27
ACKNOWLEDGEMENTS	27
LITERATURE CITED	27
APPENDIX	30

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Gulkana River and Glennallen area recreational angler effort and Arctic grayling harvest, 1977 through 1985 . . .	2
2. Age composition, sex ratio, and length data for Arctic Grayling collected in Poplar Grove Creek, 1986.	10
3. Summary of tag recoveries for Arctic grayling tagged in Poplar Grove Creek and recovered in the Gulkana River sport fishery creel survey, by location and month of capture, 1986	11
4. Mean length by age class for Arctic grayling collected in the Gulkana River between Paxson Lake and Sourdough, 1986	13
5. Daily capture and recapture summaries by length category during the electrofishing survey, Sourdough to West Fork, Gulkana River, 1986	15
6. Number of anglers, mean effort, mean harvest rate, and mean catch rate for Arctic grayling, chinook salmon, sockeye salmon, and rainbow trout by sampling strata recorded during the Gulkana River creel survey, 1986. . .	16
7. Gulkana River chinook salmon sex and age class from the sport fishery and carcass surveys, 1986	18
8. Gulkana River chinook salmon mean length by age class and sex from the sport fishery and carcass surveys, 1986.	19
9. Glennallen area subsistence fishwheel catch composition data by species and sampling date, 1986	20
10. Chitina area personal-use dip net fishery and subsistence fishwheel catch composition data by species and sampling date, 1986	21
11. Angler types recorded during the Gulkana River creel survey, 1986	22
12. Number of anglers, mean effort, and mean catch rate by species for each gear type recorded during the Gulkana River creel survey, 1986.	23
13. Number of anglers, mean effort, and mean catch rate by species by the angler's area of residency recorded during the Gulkana River creel survey, 1986	25

LIST OF TABLES (Continued)

<u>Table</u>	<u>Page</u>
14. Results of the survey conducted on sport anglers concerning fishing regulations in the Wild and Scenic portion of the Gulkana River (from Paxson Lake to Sourdough), 1986.	26

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. Gulkana River	4
2. Arctic grayling mean fork length and 95% CI by age class in Poplar Grove Creek and the Gulkana River, 1986	14

ABSTRACT

Adult males comprised 69 percent of all anglers contacted while fishing the Gulkana River from 16 June through 17 August, 1986. Ninety-eight percent of all interviewed anglers were from Fairbanks, Anchorage, or Delta, and anglers released 92.7 percent of all Arctic grayling (*Thymallus arcticus* Pallas) caught during the 1986 survey. Arctic grayling caught in the Gulkana River during 1986 were predominantly age 3 and 4 fish. Arctic grayling tagged during May in Poplar Grove Creek redistributed throughout the lower Gulkana River during the summer. Angler effort and catch rates are reported for the survey period for Arctic grayling, rainbow trout (*Salmo gairdneri* Richardson) chinook salmon (*Oncorhynchus tshawytscha* Walbaum,) and sockeye salmon (*Oncorhynchus nerka* Walbaum). Steelhead comprised 18.7 percent of the total subsistence fishwheel catch surveyed in the Glennallen area. Surveyed anglers were opposed to changes on present gear restrictions and a reduction in bag limits for Arctic grayling but favored a reduction in bag limits for rainbow trout.

Key Words: Arctic grayling, *Thymallus arcticus*, chinook salmon, *Oncorhynchus tshawytscha*, sockeye salmon, *Oncorhynchus nerka*, rainbow trout, *Salmo gairdneri*, steelhead trout, creel survey, harvest, catch, effort, Gulkana River, sport fishing, intrastream migration, mark-recapture, age, length, angler characteristics.

INTRODUCTION

The Gulkana River drainage supports the largest recreational sport fishery in the Glennallen area. Arctic grayling (*Thymallus arcticus* Pallas) and chinook salmon (*Oncorhynchus tshawytscha* Walbaum) are the principal target species. The Gulkana River had the largest harvest of Arctic grayling in Alaska in 1985 (Mills 1986). In addition to Arctic grayling and chinook salmon, the Gulkana River supports sport fisheries for rainbow and steelhead trout (*Salmo gairdneri* Richardson) and sockeye salmon (*Oncorhynchus nerka* Walbaum).

The Gulkana River provides significant recreational value to the community of Glennallen as well as southcentral and interior Alaska. It is located midway between Anchorage and Fairbanks along the Richardson Highway and attracts users from both areas. Although fishing effort remained relatively stable from 1979 through 1985 (Mills 1980-1986), the harvest of Arctic grayling increased dramatically in 1985. In 1985, 12,796 Arctic grayling were harvested from the Gulkana River which represented an 108% increase over the 1984 harvest (Table 1). The 1985 harvest represented 9.2% of the estimated Arctic grayling harvest for all of Alaska.

Access to the Gulkana River is available at several locations along the Richardson Highway for bank, float, and power-boat anglers. Approximately 70% of the land adjacent to the river is public land under Federal or State ownership. The mainstem of the Gulkana River

Table 1. Gulkana River and Glennallen area recreational angler effort and Arctic grayling harvest, 1977 through 1985 (from Mills 1979-1986).

Year	Gulkana River		Glennallen Area			
	Effort ¹	Arctic Grayling	Effort ¹	% from Gulkana	Arctic Grayling	% from Gulkana
1977	4,165	3,355	51,485	8.1	25,991	12.9
1978	6,570	7,494	44,566	14.7	26,488	28.3
1979	17,323	8,726	57,266	30.3	37,232	23.4
1980	13,752	6,776	50,518	27.2	32,106	21.1
1981	14,430	9,158	53,499	27.0	32,982	27.8
1982	14,979	9,149	54,953	27.3	33,586	27.2
1983	16,911	9,683	51,276	33.0	26,832	36.1
1984	12,870	6,157	51,964	24.8	19,272	31.9
1985	14,080	12,796	48,707	28.9	32,511	39.4

¹ Effort in days fished.

above Sourdough, the West Fork, and the Middle Fork have been designated as Wild and Scenic by Congress and are administered by the Bureau of Land Management (Figure 1). This area is becoming increasingly popular with float anglers.

Specific fisheries information is needed to develop a long-term fisheries management plan for the Gulkana River. Pursuant to this goal, the objectives of the 1986 field season were to collect baseline information on catch rates by species in the recreational fishery for specific angler groups, estimate biological parameters of the Arctic grayling and chinook salmon populations, describe the migrational patterns of Arctic grayling in the Gulkana River and its major tributaries, and determine the opinions of float anglers on the quality of the Arctic grayling fishery in the Wild and Scenic portion of the river and on possible regulatory changes in that section. Information was also collected on the species composition of subsistence and personal-use fisheries in the Copper River during September.

METHODS

Study Area

Arctic grayling and chinook salmon investigations were conducted throughout the Gulkana River from Paxson Lake downstream to the mouth (Figure 1). The creel survey was conducted at two primary access sites on the Gulkana River: Sourdough, and the area from the Richardson Highway bridge to Mile 129 of the Richardson Highway. Sourdough is the major haul-out point for anglers floating the Wild and Scenic section of the river and is also a major access point for anglers using power boats to fish the river upstream and downstream from Sourdough. The area near the bridge is an access point for both float anglers and bank anglers fishing the lower section of the river.

Arctic grayling tagging was conducted in Poplar Grove Creek, a major spawning tributary of the Gulkana River. Arctic grayling were also tagged during float trips from Paxson Lake downstream to Sourdough and during boat electrofishing from two river miles above the West Fork confluence downstream to Sourdough on the mainstem Gulkana. Additionally, biological data from chinook salmon carcasses and Arctic grayling were collected during the float and electrofishing trips.

Subsistence fishwheels operated in the Copper River near Glennallen and Chitina, personal-use fishwheels operated in the Copper River near Chitina, and personal-use dipnet fishermen at Chitina were sampled for species composition of the catch.

Study Design

The major components of this project were recreational fishery monitoring by a creel survey, chinook salmon and Arctic grayling

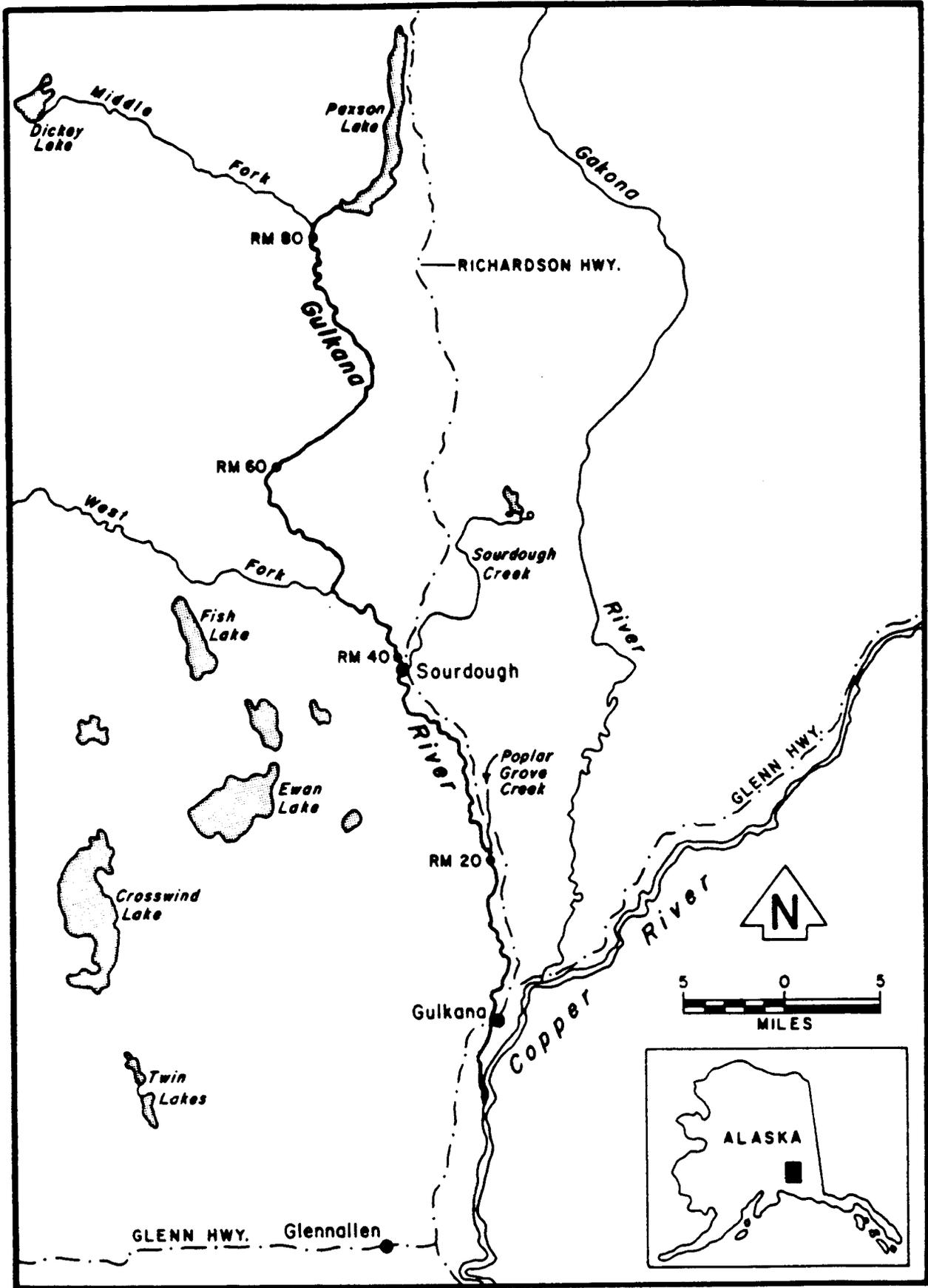


Figure 1. Gulkana River.

population studies, and surveys of fishwheel and personal-use fishery catch compositions.

Creel Survey:

In 1986, daily bag limits for anglers were: one chinook salmon greater than 50.8 cm (20 in) and 10 less than 50.8 cm; 10 Arctic grayling; and 10 rainbow trout or steelhead, of which only two could be greater than 50.8 cm. The area above the confluence of the Middle Fork was closed to chinook salmon fishing. During June and July, the portion of the Gulkana River from the Richardson Highway bridge downstream to the mouth was restricted to fly-fishing only.

The creel survey was conducted from 16 June through 17 August. Three randomly selected weekdays and both weekend days were surveyed each week. The first 2 days selected for the week were allocated to the Sourdough area and the remaining day was assigned to the bridge site. The areas were reversed the following week and the bridge area was surveyed twice and the Sourdough area once. The area to be surveyed on Saturday was selected randomly and the other area was surveyed on Sunday.

The angler day was defined to be 18 hours long, from 0600 to 2400 hrs. The angler interview period at Sourdough was 6 hours while the bridge area interview period was 7 hours. The hour to begin the creel survey was selected randomly from the whole hours between 0600 and 1800 hrs (0600, 0700, 0800, etc.) when sampling at Sourdough and from the whole hours between 0600 and 1700 hrs when sampling at the bridge area. All anglers were interviewed at Sourdough as this site had a single access point. There were five interview sites for the Richardson Highway bridge area and interview time was allocated equally between each of the five sites.

Arctic Grayling and Chinook Salmon Population Studies:

Two weirs were operated in Poplar Grove Creek from 14 May through 20 May to capture and sample Arctic grayling migrating upstream to spawn. Additional Arctic grayling were captured by seining at the confluence of Poplar Grove Creek and the Gulkana River.

Three float trips were made on the Gulkana River from Paxson Lake to Sourdough: (1) 27 June through 1 July; (2) 16 July through 21 July; and (3) 9 August through 11 August. Arctic grayling and rainbow trout were collected using hook and line. A boat electrofishing survey was conducted from 18 August through 20 August on the mainstem of the Gulkana River between Sourdough and 2 miles above the West Fork confluence. Chinook salmon carcasses were sampled during the August float and electrofishing trips.

Species Composition of Subsistence and Personal-Use Fishwheel and Dipnet Fisheries:

Subsistence fishwheels in the Glennallen and Chitina areas and the personal-use fishwheels and dipnet fishery in the Chitina area were

sampled for catch compositions during September. Three days each week were randomly selected for sampling the Glennallen area fishwheels and the Chitina area fishwheels were sampled on 2 consecutive days each week. Glennallen area fishwheels were on the mainstem Copper River from approximately 16 miles downstream of Glennallen to 16 miles above Glennallen. The Chitina area fishwheels were within one-half mile of the McCarthy Road bridge across the Copper River. The Chitina personal-use dipnet fishery occurred downstream of the McCarthy Road bridge to the confluence with Haley Creek.

Data Collection

Creel Survey:

Each angler contacted during the creel survey was interviewed for: mode of transportation (float, power boat, or bank angler), place of residence, the number of hours fished, the number of fish kept by species, and the number of fish released by species. Also recorded were the angler's sex and age category (adult, age 16 or older; youth, under age 16), the gear types they fished with, and whether their fishing trip was complete or incomplete.

All floaters who passed through the Wild and Scenic section of the river were asked seven additional questions (Appendix A). The questionnaire was designed to elicit opinions from the users of this portion of the river concerning future management strategies.

Arctic Grayling and Chinook Salmon Population Studies:

All Arctic grayling 200 mm fork length or longer were marked with an individually numbered Floy tag and released. Date and tag number were recorded for all Arctic grayling tagged in the Gulkana River and Poplar Grove Creek. A scale, the fork length (mm), and sex were collected from a random sample of the tagged grayling. Length (mid-eye to fork-of-tail), sex, and three scales were collected from chinook salmon carcasses sampled in the Gulkana River.

Species Composition of Subsistence and Personal-Use Fishwheel and Dipnet Fisheries:

All fishwheels operating in the Copper River near Glennallen and Chitina were sampled for species composition of catch. Catch by species was recorded and all steelhead trout observed were sampled for fork length and scale samples were collected.

Data Analyses

Creel Survey:

Mean angler effort and mean catch¹ by species were estimated from the interview data for four temporal strata: 16 June through 30 June,

¹ Catch refers to either fish harvested by the angler (caught and retained) or to total catch (fish kept plus those released).

1 July through 15 July, 16 July through 31 July, and 1 August through 17 August. Mean effort was estimated as:

$$\bar{f}_t = \left(\sum_{i=1}^D \sum_{k=1}^{m_i} f_{ik} \right) / \sum_{i=1}^D m_i,$$

where f_{ik} = the effort (in hours) by angler k at the time of the interview on day i ,
 m_i = the number of anglers interviewed on day i , and
 D = the number of days the fishery was open during stratum t .

The variance of mean effort was estimated using a two-stage sample design with days representing the first-stage sample units and anglers the second-stage sample units (Von Geldern and Tomlinson 1973). On a given sample day, the number of second-stage units available was unknown. The variance of mean effort was estimated as follows (Sukhatme et al. 1984):

$$V(\bar{f}_t) = [1 - (d/D)] s_B^2/d + \left(\sum_{i=1}^D s_{Wi}^2/m_i \right) / dD,$$

where d = the number of days sampled during stratum t ,

s_{Wi}^2 = the sample variance of effort for anglers interviewed during day i , and

s_B^2 = the between-day variance of angler effort.

The between-day variance, s_B^2 , was estimated as follows:

$$s_B^2 = \left[\sum_{i=1}^D (\bar{f}_{ti} - \bar{f}_t)^2 \right] / (d-1),$$

where \bar{f}_{ti} = the mean effort by anglers interviewed during day i of stratum t .

Mean catch (either harvest or total catch) of a species and its variance were estimated identically to effort except the corresponding quantities for harvest or total catch were substituted for all occurrences of effort (f).

Harvest per unit effort (HPUE) for a species during stratum t was estimated by:

$$HPUE_t = \bar{c}_t / \bar{f}_t,$$

where \bar{c}_t = the mean harvest during fishery stratum t.

The variance of $HPUE_t$ was approximated by the variance for the quotient of the mean of two normally distributed random variables (Jessen 1978), which is:

$$\hat{V}(\bar{c}_t/\bar{f}_t) \approx (\bar{c}_t/\bar{f}_t)^2 (s_c^2/c_t^2 + s_f^2/f_t^2 - 2rs_c s_t/c_t \bar{f}_t),$$

where s_c^2 = the two-stage variance estimate for \bar{c}_t ,

s_f^2 = the two-stage variance estimate for \bar{f}_t , and

r = the correlation coefficient between the f_{ik} and the c_{ik} in stratum t.

Catch per unit effort (CPUE) for a species and its variance were estimated by replacing the number of fish harvested with the number of fish caught in the above formulae.

Two important assumptions necessary for this analysis are: (1) the anglers interviewed are representative of the angling population, and (2) effort, harvest, and catch are normally distributed random variables.

Arctic Grayling and Chinook Salmon Population Studies:

The age compositions of the Arctic grayling sampled at Poplar Grove, chinook salmon harvested by the recreational fishery, and chinook salmon sampled during the carcass surveys were estimated. Letting p_{hi} equal the estimated proportion of age class h in stratum i, the variance of p_{hi} was estimated using the normal approximation to the binomial (Scheaffer et al. 1979):

$$V(\hat{p}_{hi}) = \hat{p}_{hi}(1-\hat{p}_{hi})/(n_{Ti}-1),$$

where, n_{Ti} is the number of legible scales read from samples collected during stratum i.

Mean length at age and by sex, if possible, and its variance were estimated using standard normal procedures.

Capture-recapture data collected during the electrofishing survey were investigated to estimate abundance. Chi-square analysis (Mendenhall and Scheaffer 1973) was used to test for differences in recapture probabilities between length increments. Appropriate

methodology for estimating abundance was then determined by examining recapture probabilities over time. The results of the program CAPTURE (White et al. 1982) were used to evaluate the validity of assumptions used for the population estimates.

Species Composition of Subsistence and Personal-Use Fishwheel and Dipnet Fisheries:

The species composition of the fishwheel catches was estimated on a daily basis. The proportion of species i in the fishwheel catches on day t (p_{it}) was estimated by:

$$\hat{p}_{it} = \frac{\sum_{j=1}^n c_{ijt}}{\sum_{j=1}^n C_{jt}}$$

where, c_{ijt} = the number of species i in fishwheel j on day t ,

C_{jt} = the total number of fish (all species) in fishwheel j on day t , and

n = the total number of fishwheels sampled.

The variance of p_{it} was calculated using the normal approximation to the binomial.

Two important assumptions necessary for this analysis are: (1) the proportional contribution of a species to the total catch by a fishwheel does not change during the day and (2) road-accessible fishwheels are representative of those which are not road-accessible.

RESULTS

Arctic Grayling and Chinook Salmon Population Studies

Arctic Grayling:

A total of 3,099 Arctic grayling were tagged and released in Poplar Grove Creek from 14 May through 20 May. Arctic grayling collected in Poplar Grove Creek were from 2 through 6 years old; age classes 3 and 4 comprised 89% of the fish sampled (Table 2). Sixty percent of the Arctic grayling sampled were males.

A total of 29 Arctic grayling tagged in Poplar Grove Creek were recaptured during the summer by Gulkana River sport anglers interviewed during the creel survey (Table 3). Tagged grayling were recovered from the Gulkana River bridge upstream to just below the falls located between the Middle and West forks indicating that following spawning, Poplar Grove Creek grayling redistributed throughout the lower Gulkana River. The largest number of recoveries (10) were made during July in the Poplar Grove Creek to West Fork confluence reach. An additional 10 recoveries were made by project

Table 2. Age composition, sex ratio, and length data for Arctic grayling collected in Poplar Grove Creek, 1986.

Sex	Parameter	Age Class					Total
		2	3	4	5	6	
<u>Age Composition</u>							
Male	Percent	0.6	28.7	25.8	3.5	0.3	59.0
	Std Error	0.5	2.6	2.5	1.1	0.3	2.8
	Sample Size	2	89	80	11	1	183
Female	Percent	0.0	13.2	21.9	4.8	1.0	41.0
	Std Error	---	1.9	2.4	1.2	0.6	2.8
	Sample Size	0	41	68	15	3	127
Combined	Percent	0.6	41.9	47.7	8.4	1.3	100.0
	Std Error	0.5	2.8	2.8	1.6	0.6	---
	Sample Size	2	130	148	26	4	310
<u>Length Composition</u> ¹							
Mean		221	237	250	265	290	246
Std Error		4	2	1	4	6	1
Sample Size		2	146	179	30	7	364

¹ Not all aged fish were sexed.

Table 3. Summary of tag recoveries for Arctic grayling tagged in Poplar Grove Creek and recovered in the Gulkana River sport fishery creel survey, by location and month of capture, 1986.

Month	Location					Total
	Poplar Grove Creek to the Gulkana River Mouth	Poplar Grove Creek to the West Fork	West Fork to the Falls	West Fork	Sourdough Creek	
June	0	0	0	0	0	0
July	0	10	4	0	2	16
August	3	2	1	1	0	7
September	2	3	0	0	0	5
October	1	0	0	0	0	1
Total	6	15	5	1	2	<u>29</u>

personnel when electrofishing during mid-August in the Gulkana River from 1 river mile below the Sourdough boat launch to 2 miles above the West Fork confluence. Five Arctic grayling tagged and released in Poplar Grove Creek were also recaptured during the float trips from Paxson Lake to Sourdough.

A total of 1,981 Arctic grayling were tagged and released in the Gulkana River during float trips and electrofishing. Age 3 and 4 fish comprised 57% of the Arctic grayling sampled in the mainstem Gulkana River during the float and electrofishing surveys (Table 4). Arctic grayling age 3 and older were significantly larger ($P \leq 0.05$) by each age class sampled in the Gulkana River than those fish collected in Poplar Grove Creek (Figure 2). Forty-eight of the Arctic grayling tagged and released during the float and electrofishing surveys were recaptured during subsequent surveys in the mainstem Gulkana River.

Electrofishing was conducted during the period 18 August to 20 August. Captured fish were grouped into three categories: (1) less than 200 mm; (2) between 200 and 299 mm; and (3) greater than 300 mm (Table 5). Capture probabilities by length category were significantly different ($P = .05$) between the three capture events. Most of the variation occurred in the category for fish less than 200 mm and these fish were not considered for the remainder of the analysis. Recapture probabilities for the two remaining length categories were not significantly different.

Results generated from program CAPTURE showed significant temporal variation in capture probabilities. To account for temporal variation, abundance was estimated using the maximum likelihood estimator of the Darroch (1958) model (White et al. 1982). Total abundance of Arctic grayling 200 mm or greater was estimated at 7,645 fish (standard error = 1,123).

Creel Survey

Arctic Grayling:

The catch rate of Arctic grayling reported by sport anglers interviewed during the creel survey increased as the survey period progressed (Table 5). Angler effort was highest during early July; the highest catch rate of 2.1 grayling per angler-hour was recorded during the early August survey period. Interviewed anglers kept only 6.3% of the Arctic grayling they caught during the survey period. Williams and Potterville (1984) reported that anglers surveyed in 1983 kept 12.5% of the Arctic grayling they caught.

Chinook Salmon:

The chinook salmon catch rate reported by sport anglers interviewed during the creel survey was 0.07 fish per angler-hour (Table 6). Catch rates were highest during July.

Table 4. Mean length by age class for Arctic grayling collected in the Gulkana River between Paxson Lake and Sourdough, 1986.

Parameter	Age Class						Total
	1	2	3	4	5	6	
<u>Age Composition</u>							
Percent	11.7	11.5	27.0	29.6	16.4	3.8	100.0
Std Error	1.1	1.1	1.5	1.5	1.2	0.6	---
Sample Size	108	106	249	273	151	35	922
<u>Length Composition</u>							
Mean	144	216	261	282	310	333	259
Std Error	2	3	2	2	2	5	2
Sample Size	108	106	249	273	151	35	922

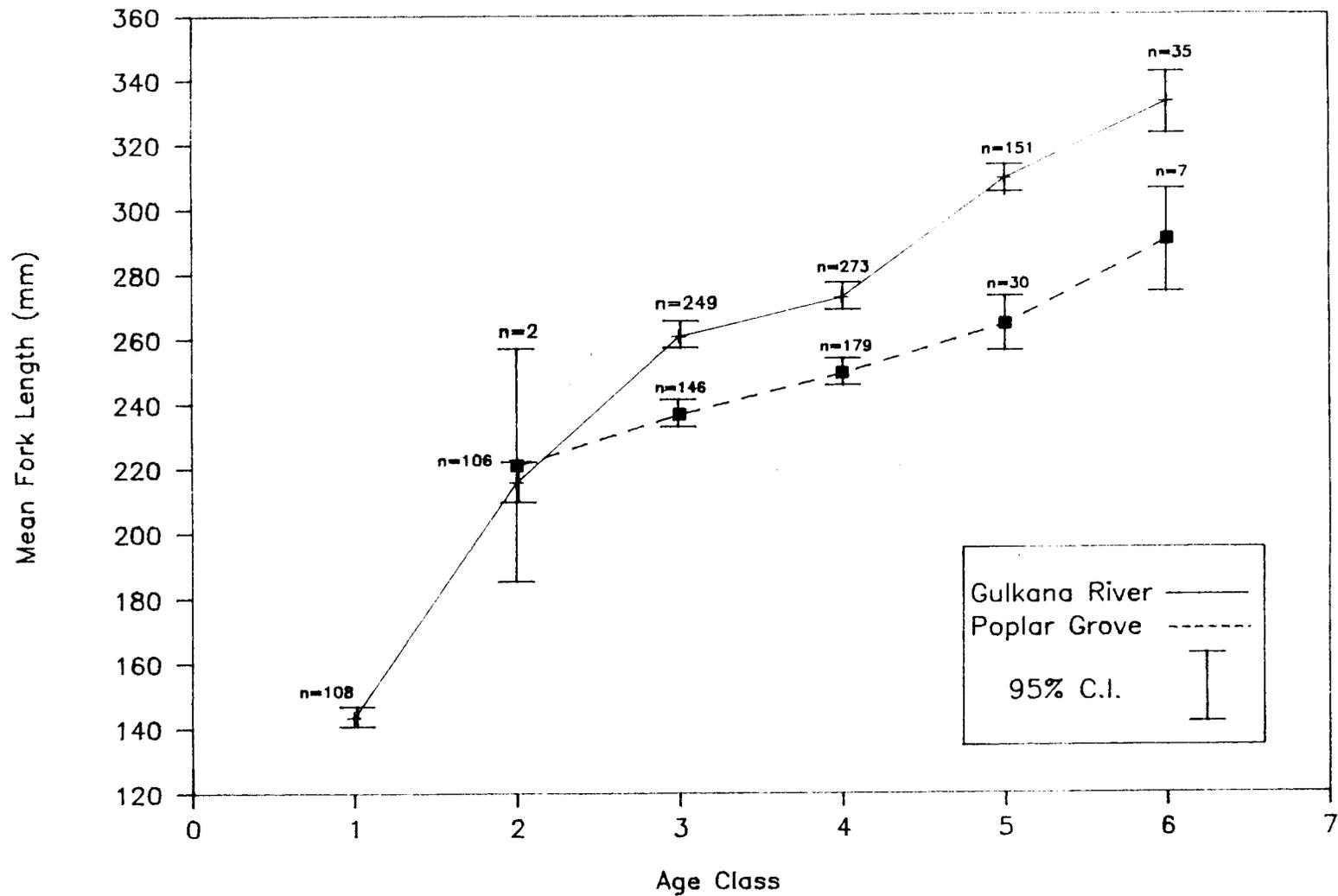


Figure 2. Arctic grayling mean fork length and 95% CI by age class in Poplar Grove Creek and the Gulkana River, 1986.

Table 5. Daily capture and recapture summaries by length category during the electrofishing survey, Sourdough to West Fork, Gulkana River, 1986.

Length Categories (mm)	Total Number Captured			Total Number Recaptured		Probability of Recapture	
	8/18	8/19	8/20	8/19	8/20	8/19	8/20
<200	17	4	72	1	0	0.059	0.000
200-299	215	261	269	17	14	0.079	0.029
>300	28	44	53	3	3	0.107	0.042
Total	260	309	394	21	17	0.081	0.030

Table 6. Number of anglers, mean effort (angler-hours), mean harvest rate, and mean catch rate for Arctic grayling, chinook salmon, sockeye salmon, and rainbow trout by sampling strata recorded during the Gulkana River creel survey, 1986.

Strata	Number of Anglers	<u>Arctic Grayling</u>				<u>Chinook Salmon</u>				<u>Sockeye Salmon</u>				<u>Rainbow Trout</u>					
		Effort		Harvest Rate		Catch Rate		Harvest Rate		Catch Rate		Harvest Rate		Catch Rate		Harvest Rate		Catch Rate	
		Mean	Rel Pre ¹	Mean	Rel Pre ¹	Mean	Rel Pre ¹	Mean	Rel Pre ¹	Mean	Rel Pre ¹	Mean	Rel Pre ¹	Mean	Rel Pre ¹	Mean	Rel Pre ¹	Mean	Rel Pre ¹
6/16-30	223	3.79	1.11X	0.07	0.17X	0.24	0.24X	0.04	0.16X	0.04	0.17X	0.02	0.33X	0.03	0.28X	0.005	0.37X	0.04	0.35X
7/1-15	488	5.00	0.73X	0.05	0.08X	0.56	0.08X	0.04	0.16X	0.08	0.15X	0.03	0.13X	0.04	0.09X	0.002	0.15X	0.08	0.21X
7/16-31	221	4.10	1.71X	0.03	0.59X	1.52	0.44X	0.03	0.23X	0.08	0.23X	0.02	0.39X	0.02	0.36X	0.004	0.63X	0.08	0.34X
8/1-17	127	2.12	2.21X	0.03	0.29X	2.07	0.40X	0.01	1.06X	0.02	0.68X	0.00	0.00X	0.00	0.00X	0.030	0.68X	0.02	0.84X
Total	1,059	4.20	0.33X	0.07	0.03X	0.79	0.04X	0.04	0.02X	0.07	0.03X	0.02	0.03X	0.03	0.03X	0.005	0.07X	0.07	0.08X

¹ Relative precision for a 95% confidence interval.

Eighty percent of the chinook salmon sampled in the sport fishery were age 1.3 and the ratio of males to females was 1:1 (Table 7). During carcass surveys, age 1.3 was also the prominent age class making up 78% of the chinook salmon sampled (Table 7). Males comprised 62% of the sample. The age compositions (males and females combined) of the two samples were not significantly different ($P \leq 0.05$). The sex composition was significantly different, however ($P \leq 0.05$). Length data are presented by sex and age class in Table 8.

Sockeye Salmon:

The sockeye salmon catch rate reported by sport anglers interviewed during the creel survey was 0.03 fish per angler-hour (Table 6). Catch rates were highest during July.

Rainbow Trout:

The rainbow trout catch rate reported by sport anglers interviewed during the creel survey was 0.07 fish per angler-hour (Table 6). Catch rates were highest during July.

A total of six rainbow trout were tagged and released during 1986. These fish were captured during the electrofishing surveys primarily in the reach of the Gulkana River near the West Fork.

Species Composition of Subsistence and Personal-Use Fishwheel and Dipnet Fisheries

A total of 21 steelhead trout were collected from fishwheels during the September surveys. Steelhead comprised 18.7% of the total subsistence fishwheel catch in the Glennallen area during the survey (Table 9). The remainder of the catch was comprised of sockeye and coho (*Oncorhynchus kisutch* Walbaum), salmon. No steelhead were observed caught in the Chitina area subsistence or personal-use fishwheels (Table 10). One steelhead was observed captured during the Chitina personal-use dip net fishery (Table 10).

Angler Characteristics

Adult males comprised 69% of the anglers interviewed during the creel survey and spent the most time fishing during the survey period (Table 11). Females, both adults and youths, made up only 16% of the total anglers. The 17 female youths interviewed during the survey recorded the highest catch rate of Arctic grayling of 2.5 fish per angler-hour while males averaged approximately one grayling per hour of fishing.

Of the 1,038 anglers interviewed for gear type (spin, bait, fly, or a combination of these types), 40% fished with spinning gear only while 33% fished with more than one gear type. Bait anglers spent the most time fishing (mean = 5.0 hours per angler) and had the highest CPUE for chinook salmon, but bait anglers recorded the lowest CPUE for Arctic grayling (mean = 0.1 fish per angler-hour) (Table 12). It is presumed that most of the anglers fishing with bait were targeting on

Table 7. Gulkana River chinook salmon sex and age class from the sport fishery and carcass surveys, 1986.

Source	Sex	Parameter	Age Class					Total
			1.4	2.3	1.3	2.2	1.2	
<u>Sport Fishery</u>	Male	Percent	8.8	3.5	36.8	0.0	0.0	49.1
		Std Error	3.8	2.5	6.4	---	---	6.7
		Sample Size	5	2	21	0	0	28
	Female	Percent	7.0	0.0	43.9	0.0	0.0	50.9
		Std Error	3.4	---	6.6	---	---	6.7
		Sample Size	4	0	25	0	0	29
	Combined	Percent	15.8	3.5	80.7	0.0	0.0	100.0
		Std Error	4.9	2.5	5.3	---	---	---
		Sample Size	9	2	46	0	0	57
<u>Carcass Survey</u>	Male	Percent	12.2	0.5	48.4	0.2	1.0	62.4
		Std Error	1.4	0.3	2.1	0.2	0.4	2.0
		Sample Size	70	3	277	1	6	357
	Female	Percent	6.8	0.5	29.7	0.2	0.3	37.6
		Std Error	1.1	0.3	1.9	0.2	0.2	2.0
		Sample Size	39	3	170	1	2	215
	Combined	Percent	19.1	1.0	78.1	0.3	1.4	100.0
		Std Error	1.7	0.4	1.7	0.2	0.5	---
		Sample Size	109	6	447	2	8	572

Table 8. Gulkana River chinook salmon mean length by age class and sex from the sport fishery and carcass surveys, 1986.

Source	Sex	Parameter	Age Class					Total
			1.4	2.3	1.3	2.2	1.2	
<u>Sport Fishery</u>	Male	Mean	978	960	897	---	---	916
		Std Error	19	5	14	---	---	13
		Sample Size	5	2	21	0	0	28
	Female	Mean	899	---	857	---	---	862
		Std Error	24	---	6	---	---	6
		Sample Size	4	0	25	0	0	29
	Combined	Mean	943	960	875	---	---	889
		Std Error	20	5	8	---	---	8
		Sample Size	9	2	46	0	0	57
<u>Carcass Survey</u>	Male	Mean	934	976	901	876	656	904
		Std Error	7	34	4	---	34	4
		Sample Size	70	3	277	1	6	357
	Female	Mean	894	876	852	788	885	860
		Std Error	6	35	3	---	14	3
		Sample Size	39	3	170	1	2	215
	Combined	Mean	920	926	882	832	713	887
		Std Error	5	31	3	44	45	3
		Sample Size	109	6	447	2	8	572

Table 9. Glennallen area subsistence fishwheel catch composition data by species and sampling date, 1986.

Date Checked ¹	Number of Fishwheels	Species Catch Composition			
		Sockeye Salmon	Coho Salmon	Steelhead Trout	
				Number	Percent
9/4	6	16	2	5	21.7
9/6	6	5	6	2	15.4
9/7	6	14	2	1	5.9
9/8	6	8	2	5	33.3
9/10	9	20	13	7	17.5
9/11	2	3	0	1	25.0
9/16	0	0	0	0	---
9/17	0	0	0	0	---
9/19	1	0	0	0	---
Total	36	66	25	21	18.7

¹ No fishwheels were observed operating after 9/19.

Table 10. Chitina area personal-use dip net fishery and subsistence fishwheel catch composition data by species and sampling date, 1986.

Fishery	Date Checked	Number of	Hours Fished	Species Catch Composition		
				Sockeye Salmon	Coho Salmon	Steelhead Trout
<u>Personal-Use Dipnet</u>						
		<u>Interviews</u>				
	9/1	2	10.0	1	5	0
	9/2	1	4.5	2	3	0
	9/12	3	17.0	1	1	0
	9/13	7	36.4	5	4	0
	9/20	6	19.0	0	0	0
	9/21	4	22.5	0	1	1
	9/28	0	0.0	0	0	0
	9/29	0	0.0	0	0	0
	Total	23	109.4	9	14	1
<u>Subsistence Fishwheel</u>						
		<u>Fishwheels</u>				
	9/1	6		5	1	0
	9/2	4		12	2	0
	9/12	1		0	0	0
	9/13	3		0	0	0
	9/20	2		0	0	0
	9/21	2		0	0	0
	9/28	0		0	0	0
	9/29	0		0	0	0
	Total	18		17	3	0

Table 11. Angler types recorded during the Gulkana River creel survey, 1986.

Angler Type	Number of Anglers	Mean Effort (Hours/Angler)	Mean CPUE ¹			
			Arctic Grayling	Chinook Salmon	Sockeye Salmon	Rainbow Trout
Male Adults	730	4.38	0.80	0.07	0.04	0.02
Male Youths	166	3.63	0.91	0.05	0.02	0.01
Males Combined	896	4.24	0.82	0.07	0.03	0.02
Female Adults	151	4.04	0.32	0.07	0.03	0.01
Female Youths	17	2.30	2.53	0.05	0.03	0.03
Females Combined	168	3.86	0.45	0.07	0.03	0.01

¹ CPUE is presented as fish caught per angler-hour.

Table 12. Number of anglers, mean effort, and mean catch rate by species for each gear type recorded during the Gulkana River creel survey, 1986.

Gear Type	Number of Anglers	Mean Effort (Hours/Angler)	Mean CPUE ¹			
			Arctic Grayling	Chinook Salmon	Sockeye Salmon	Rainbow Trout
Spin	411	3.48	1.02	0.02	0.04	0.01
Bait	241	4.97	0.10	0.13	0.01	0.01
Fly	70	2.93	1.92	0.02	0.04	0.07
More Than One Type	316	4.91	0.85	0.08	0.04	0.01
Total	1,038	4.54	0.70	0.07	0.03	0.01

¹ CPUE is presented as fish caught per angler-hour.

chinook salmon. Fly anglers had the highest CPUE of Arctic grayling and rainbow trout of 1.9 and 0.7 fish per angler-hour, respectively.

Only 2% of the anglers interviewed were from areas of Alaska other than Fairbanks, Anchorage, or Delta. Sixty percent of the interviewed anglers were residents of the Fairbanks area while the remainder were evenly divided between the Delta and Anchorage areas (Table 13). Anchorage area residents reported the highest Arctic grayling catch rates while the catch rates for chinook and sockeye salmon were approximately equal regardless of area of residency.

Regulation Questionnaire

Sixty interviews with people who had floated the Wild and Scenic portion of the Gulkana River (from Paxson Lake downstream to Sourdough) were conducted to obtain their opinion concerning possible bag limits and gear restrictions for sport fishing in that stretch of river. Fifty-eight percent of the interviewed anglers felt that no changes should be made to the present sport gear regulations (Table 14). Anglers were more evenly split on a regulation change allowing only single hooks, but 75% were opposed to limiting the area to fly fishing only. Most (58.3%) anglers favored a reduction in the rainbow trout bag limit, but 53.3% preferred that the bag limits for Arctic grayling not be reduced.

DISCUSSION

Anglers fishing the Gulkana River from mid-June through mid-August were predominantly males from the Fairbanks, Delta, and Anchorage areas. The anglers during the survey period were fishing primarily for salmon and the catch of Arctic grayling was incidental to the salmon fishing. Those anglers catching grayling during this period released almost all (92.7%) of the Arctic grayling they caught. The harvest estimates for Arctic grayling in the Gulkana River presented by Mills (1986) indicate much higher harvest numbers than those indicated by this survey. It appears that most of the harvest of Arctic grayling takes place either before or after the period which this survey was conducted.

The tagging data indicate that Arctic grayling which spawn in Poplar Grove Creek redistribute throughout the lower Gulkana River following spawning and contribute to the sport fishery. This may also be true for Sourdough Creek, a second primary Arctic grayling spawning tributary in the Gulkana River.

The validity of the population estimate is somewhat in question due to the unexplained variation in the probability of recapture over time. There was insufficient data to test whether models that address variability due to behavioral responses, heterogeneity, or open populations were appropriate. Differential recapture probabilities for fish of different length categories likely indicate gear selectivity.

Table 13. Number of anglers, mean effort, and mean catch rate by species by the angler's area of residency recorded during the Gulkana River creel survey, 1986.

Area of Residency	Number of Anglers	Mean Effort (Hours/Angler)	Mean CPUE ¹			
			Arctic Grayling	Chinook Salmon	Sockeye Salmon	Rainbow Trout
Fairbanks	401	4.82	0.61	0.06	0.03	0.01
Anchorage	149	4.17	1.50	0.09	0.02	0.02
Delta	139	5.26	0.78	0.06	0.01	0.01
Tok	4	4.00	0.13	0.00	0.75	0.00
Other Alaskans	11	2.14	0.43	0.13	0.00	0.00
Total	704	4.72	0.81	0.06	0.03	0.01

¹ CPUE is presented as fish caught per angler-hour.

Table 14. Results of the survey conducted on sport anglers concerning fishing regulations in the Wild and Scenic portion of the Gulkana River (from Paxson Lake to Sourdough), 1986.

Question	Approve		Disapprove		No Opinion	
	Number	Percent ¹	Number	Percent ¹	Number	Percent ¹
1. Change regulation to flies only.	5	8.3	45	75.0	10	16.7
2. Change regulation to single hook only.	25	41.7	27	45.0	8	13.3
3. Leave sport gear regulations as they are.	35	58.3	14	23.3	11	18.3
4. Only artificial bait allowed (lures and flies).	19	31.7	30	50.0	11	18.3
5. Reduce bag limit on rainbow trout. ²	35	58.3	17	28.3	8	13.3
6. Reduce bag limit on grayling. ³	17	28.3	32	53.3	11	18.3

¹ Percent of all respondents.

² Now 10 per day and in possession, only 2 over 20 inches.

³ Now 10 per day and in possession, no size restrictions.

The majority of anglers interviewed concerning proposed regulation changes for sport fishing in the Wild and Scenic portion of the Gulkana River (upstream of Sourdough) felt that no changes should be made to the present methods and means regulations. The majority would approve of a reduction in the daily bag limit for rainbow trout while opposing a reduction in the bag limits for Arctic grayling.

RECOMMENDATIONS

It is recommended that 2 years of mark-recapture studies be conducted on the Gulkana River drainage, including the operation of weirs at Sourdough and Poplar Grove creeks, to estimate the size of specific populations, relative fish sizes by age class, and intrastream migrations of Arctic grayling in this system. Recreational fishing effort is expected to continue increasing in the Gulkana River, and change to more restrictive bag and size limits and methods and means regulations may be necessary to maintain the high quality of fishing now present. These studies would allow the formulation of long-term management strategies for Arctic grayling in the Gulkana River as well as for rainbow trout and chinook salmon in this system.

ACKNOWLEDGEMENTS

We would like to extend our appreciation to the following individuals and organizations for their valuable assistance in the collection and preparation of the data. Our thanks to Fred Williams and Butch Potterville for their organization and supervision of the field program, to Robin O'Connor and Jeff Barnard for their collection of the creel survey data and the preliminary editing of the mark sense forms, and Jeff Schryer and the Bureau of Land Management for their assistance. We are grateful to Doug McBride, Robert Conrad, and Doug Vincent-Lang for their careful review and helpful suggestions on this document. We thank Carol Hepler for her timely cartography contributions and Gail Heineman and the Sport Fish RTS staff for their technical assistance.

LITERATURE CITED

- Darroch, J. N. 1958. The multiple recapture census: I. Estimation of a closed population. *Biometrika* 45(3/4):343-359.
- Jessen, R. J. 1978. *Statistical survey techniques*. John Wiley and Sons, New York. 520 pp.
- Mendenhall, W. and R. L. Scheaffer. 1973. *Mathematical statistics with applications*, Duxbury Press, North Scituate, Massachusetts. 561 pp.
- Mills, M. J. 1979. *Alaska statewide sport fish harvest studies*. Alaska Department of Fish and Game. Federal Aid in Fish

- Restoration, Annual Report of Progress, 1978-1979, Project F-9-11, 26(SW-I-A). 122 pp.
- _____. 1980. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1979-1980, Project F-9-12, 26(SW-I-A). 65 pp.
- _____. 1981a. Alaska statewide sport fish harvest studies (1979). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1980-1981, Project F-9-13, 26(SW-I-A). 77 pp.
- _____. 1981b. Alaska statewide sport fish harvest studies (1980). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1980-1981, Project F-9-13, 26(SW-I-A). 107 pp.
- _____. 1982. Alaska statewide sport fish harvest studies (1981). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1981-1982, Project F-9-14, 26(SW-I-A). 115 pp.
- _____. 1983. Alaska statewide sport fish harvest studies (1982). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1982-1983, Project F-9-15, 26(SW-I-A). 118 pp.
- _____. 1984. Alaska statewide sport fish harvest studies (1983). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1983-1984, Project F-9-16, 26(SW-I-A). 123 pp.
- _____. 1985. Alaska statewide sport fish harvest studies (1984). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1984-1985, Project F-9-17, 26(SW-I-A). 137 pp.
- _____. 1986. Alaska statewide sport fish harvest studies (1985). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1985-1986, Project F-9-18, 26(SW-I-A). 137 pp.
- Scheaffer, R. L., W. Mendenhall, and L. Ott. 1979. Elementary survey sampling. Duxbury Press, North Scituate, Massachusetts. 278 pp.
- Sukhatme, P. V., B. V. Sukhatme, S. Sukhatme, and C. Asok. 1984. Sampling theory of surveys with applications. Iowa State University Press, Ames, Iowa.
- Von Geldern, C. E. and P. K. Tomlinson. 1973. On the analysis of angler catch rate data from warmwater reservoirs. California Fish and Game. 59(4):281-292.

White, G. C., D. R. Anderson, K. P. Burnham, and D. L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory, Los Alamos, New Mexico. 235 pp.

Williams, F. T., and W. D. Potterville. 1984. Glennallen and Prince William Sound angler use and stock assessment studies. Federal Aid in Fish Restoration, Annual Report of Progress, 1983-1984, Project F-9-16, 26(G-I-F). 86 pp.

APPENDIX

Gulkana River (Wild and Scenic Portion)

Questionnaire - 1986

Certain management strategies and fishing regulations could improve the quality of fishing in the Wild and Scenic (from Paxson Lake to the mouth of the West Fork) portion of the Gulkana River and insure that this resource is available to future generations. What is your feeling on each of these possible changes to the sport fishery regulations of this area?

<u>Question</u>	<u>Approve</u>	<u>Dis- Approve</u>	<u>No Opinion</u>
1. Change regulations to flies-only.	()	()	()
2. Change regulations to single hook only.	()	()	()
3. Leave sport gear regulations as they are.	()	()	()
4. Only artificial bait allowed (lures and flies).	()	()	()
5. Reduce bag limit on rainbow trout (now 10 per day and in possession, only 2 over 20 inches).	()	()	()
6. Reduce bag limit on grayling (now 10 per day and in possession, no size limit).	()	()	()
Was fishing the primary reason for taking this float trip?	<u>Yes</u> ()	<u>No</u> ()	

