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FEDERAL AID IN FISH RESTORATION
AND
ANADROMOUS FISH STUDIES

POPULATION STRUCTURE, MIGRATION AND HABITAT OF ARCTIC GRAYLING

R—I—A Jerome Hallberg

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ALASKA DEPARTMENT OF FISH AND GAME
Ronald O. Skoog, Commissioner
Division of Sport Fish
E. Richard Logan, Director
Juneau, Alaska

Volume 23

Study R-I-A

STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

POPULATION STURCTURE, MIGRATORY PATTERNS AND HABITAT REQUIREMENTS OF THE ARCTIC GRAYLING

by

Jerome Hallberg

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Volume 23 Study No.: R-I

RESEARCH PROJECT SEGMENT

State:	ALASKA	Name:	Sport Fish Investigations of Alaska
Project No.:	F-9-14		
Study No.:	R-I	Study Title:	DISTRIBUTION, ABUNDANCE AND NATURAL HISTORY OF THE ARCTIC GRAYLING IN THE TANANA DRAINAGE
Job No.:	R-I-A	Job Title:	Population Structure, Migratory Patterns and Habitat Requirements of the Arctic Grayling

Cooperator: Jerome Hallberg

Period Covered: July 1, 1981 to June 30, 1982

ABSTRACT

Data on age and length composition of Arctic grayling *Thymallus arcticus* (Pallas) sampled during population estimates in the lower Chena River are presented. Population estimates of grayling greater than 150 millimeters fork length, conducted on four index sections of the lower 70 miles of the Chena River in 1981 showed increases in three areas over the 1981 estimates. Grayling sampled in the four areas were predominantly immature, evidenced by 97 percent that were less than 270 millimeters (10.5) inches fork length. Ages III and IV were the dominant age classes and represented nearly 52 percent of the total sample. The mean fork length for all four sampling areas was 185 millimeters.

Creel census information collected from May 1 through August 31, 1981 along the upper Chena River revealed that 15,396 angler hours were expended to catch 13,549 grayling, with a seasonal success rate of 0.80 fish per hour. Angler pressure and harvest figures by month, along with angler composition, and creel census summary since 1970 are presented.

A synopsis is presented of the test of the Chena River Lakes Flood Control Project that occurred in July of 1981 as a result of high water in the Chena River from unusually heavy rainfall.

Surveys were conducted on three area streams, Beaver Creek, and the Chatanika and Salcha Rivers during the field season. Data on those surveys are included.

Tagging studies on Chena River grayling continued for the second consecutive year and results thus far are presented.

KEY WORDS

Interior Alaska, Chena River, Tanana drainage, Grayling populations, movements, catch data, tagging studies.

BACKGROUND

The Chena River is typical of the clear, rapid-runoff type streams common to interior Alaska. Originating in the Tanana hills approximately 100 mi east of Fairbanks at lat. 65^{o}N, long. 145^{o}W, it flows in a westerly direction, emptying into the Tanana River 7 mi below the city of Fairbanks. The entire watershed occupies approximately 1,900 sq mi, with the river basin 100 mi long and a maximum of 40 mi wide. The flow of the Chena River at Fairbanks has an annual average of 1,418 cfs based on data collected by the U.S. Geological Survey since 1947. The maximum annual average was 3,160 cfs in 1949 and the minimum was 708 cfs in 1958. The 1967 flood resulted in the record maximum flow of 74,400 cfs through Fairbanks.

Like most clear runoff streams, the Chena River supports a large population of Arctic grayling, *Thymallus arcticus* (Pallas). While the Chena River contains many species of fish, the grayling is the principal species of recreational importance and the grayling fishery here is presently the largest in the state. Table 1 lists common and scientific names of all fish species mentioned in this report.

The Chena Hot Springs Road, which parallels the Chena River from Mile 26 to its terminus at Mile 60, crosses the river seven times, providing easy access for fishermen and recreationists alike. It is in this area of intense fishing pressure that the 1980 creel census was conducted. Also within this area the Alaska Department of Natural Resources, Division of Parks, has recently appropriated 250,000 acres to be used as a recreation area. The U.S. Army Corps of Engineers is presently constructing a flood control project on the Chena River at River Mile 47. The project is designed to channel flood waters from the upper Chena River directly into the Tanana River, bypassing the city of Fairbanks and the lower Chena, thus protecting both from flood waters (see map page 4).

Other factors affecting the river include the hot springs and resort on the North Fork, numerous recreation cabins on the North and West Forks, and a military campground near Mullen Slough. Hydraulic gold mining operations are active on the Little Chena River and the East Fork and mining activities are scheduled on the South and West Forks. These activities, along with the fishing problems associated with a city and military complex located in the lower 15 mi of the river, pose a variety of management problems to the Division of Sport Fish in our ongoing efforts to maintain the integrity of the Chena River and its fauna.

The river was divided into 17 sections (Fig. 1, Table 2); from these, four index sections were selected and population estimates were made to determine changes in the population structure.

Table 1. Scientific and common names of fish mentioned in this report.

Common Name	Scientific Name and Author	Abbreviation
Arctic grayling	*Thymallus arcticus* (Walbaum)	GR
Burbot	*Lota lota* (Linnaeus)	BB
Chinook salmon	*Oncorhynchus tshawytscha* (Walbaum)	KS
Chum salmon	*Oncorhynchus keta* (Walbaum)	CS
Humpback whitefish	*Coregonus pidschian* (Gmelin)	HWF
Innconnu (sheefish)	*Stenodus leucichthys* (Güldenstadt)	SF
Lake chub	*Couesius plumbeus* (Agassiz)	LC
Least cisco	*Coregonus sardinella* Valenciennes	LCI
Longnose sucker	*Catostomas catostomas* (Forster)	LNS
Northern pike	*Esox lucius* Linnaeus	NP
Round whitefish	*Prosopium cylindraceum* (Pallas)	RWF
Slimy sculpin	*Cottus cognatus* Richardson	SSC

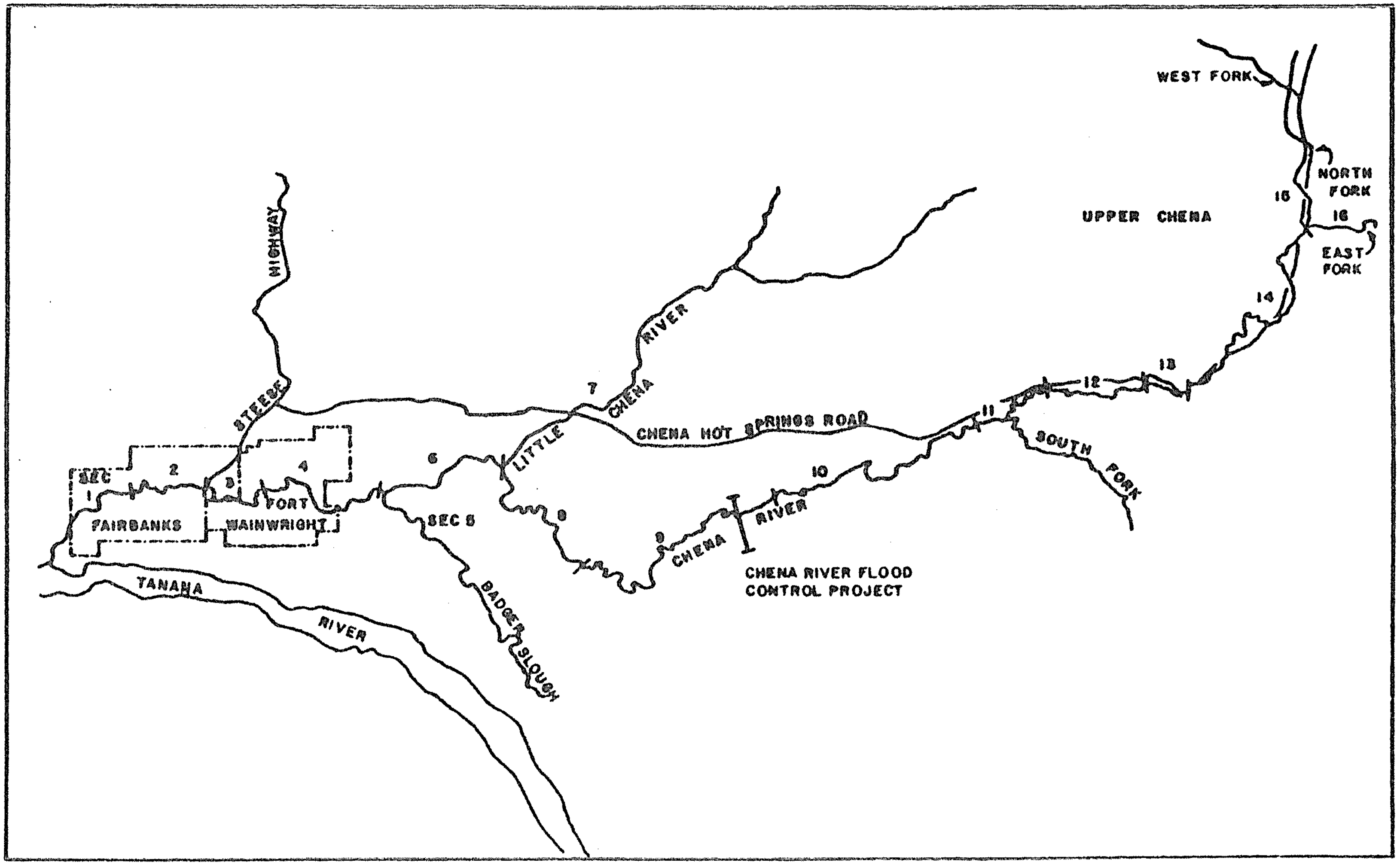

FIGURE I. CHENA RIVER STUDY SECTIONS

Table 2. Chena River study sections.

Section Number	Section Name	River Miles	Section Length Miles
1	River Mouth to University Ave.	0-6	6.0
2a	University Ave. to Peger Road	6-8	2.0
2b	Peger Road to Wendell Street	8-11	3.0
3	Wendell St. to Wainwright Railroad Bridge	11-14.5	3.5
4	Wainwright Railroad Bridge to Badger Slough	14.5-21.5	7.0
5	Badger Slough		16.5
6	Badger Slough to Little Chena	21.5-24.5	3.0
7	Little Chena River		61.5
8	Little Chena to Nordale Slough	24.5-31	6.5
9a	Nordale Slough to Bluffs	31-55.5	24.5
9b	Bluffs to Bailey Bridge	55.5-63	7.5
10	Bailey Bridge to Hodgins Slough	63-79	16.0
11	Hodgins Slough to 90 Mi. Slough	79-90	11.0
12	90 Mi. Slough to First Bridge	90-92	2.0
13	First Bridge to Second Bridge	92-94.5	2.5
14	Second Bridge to North Fork	94.5-102	7.5
15	North Fork of Chena River		35.0
16	East Fork of Chena River		62.0
17	West Fork of Chena River		35.0

Standard mark and recapture methods to estimate grayling numbers were initiated by Roguski and Winslow (1969), and continued by Roguski and Tack (1970), Tack (1971-1976) and Hallberg (1977-1980).

Information obtained during the population estimates also includes length frequencies, age and length composition, and annual survival rates, all of which aid in understanding grayling life history.

RECOMMENDATIONS

Research

It is recommended that:

1. Population estimates on index sections of the Chena River should be continued.

2. Investigations should continue on spring-fed streams and headwaters of major river systems in the Tanana drainage.

3. Tagging studies to determine Arctic grayling movements in the Chena River should be continued.

4. Creel census programs should be continued on the Chena River system with emphasis on obtaining statistically based catch data.

5. The grayling population structure in the upper Chena River in the area of heavy exploitation should be investigated.

Management

Monitoring of development projects affecting the Chena River should be continued.

OBJECTIVES:

1. To determine Arctic grayling populations and age class structure in index sections of the Chena River.

2. To monitor angler use and harvest of grayling in the upper Chena River adjacent to the Chena Hot Springs Road.

3. To keep abreast of the development projects affecting the fish habitat of the Chena River and other tributaries of the Tanana drainage.

4. To conduct surveys on area streams as time permits. Index sections will be established on the Salcha and Chatanika Rivers if feasible.

TECHNIQUES USED

Grayling for tagging, population, and length composition studies were captured by a boat-mounted electrofishing unit described by Van Hulle (1968) and Roguski and Winslow (1969). Passes were made through each section on three successive days. Population estimates were made using the Schnabel technique, as described in Ricker (1958).

Only grayling 150 mm and greater in length, captured during the population and movements and migration studies, were tagged using a numbered Floy internal anchor tag inserted in the dorsal musculature. Grayling scales used for age determination were individually cleaned and mounted on 20 mil acetate using a Carver press at 20,000 psi, heated to 200°F for 30 seconds. The scales were read on a Bruning 200 microfiche reader.

A roving creel census was conducted along the upper Chena River. Total angler hours were estimated using counts of fishermen at 2 p.m. on 6 randomly selected days per month within weekend and weekday strata. The technique of 2 p.m. counts was employed because it was shown to provide an increase in precision of angler hour estimates (Holmes 1981). Interviews were made with anglers contacted during the roving creel census to compute catch statistics and angler profile information.

FINDINGS

Population Estimates

Population estimates on Arctic grayling in 1981 were conducted on four sections in the lower Chena River, sections 2b, 8a, "Dam Site" and 10b. Section 2b and 8a both lie below the newly constructed Chena River Lakes Flood Control Project and may be directly impacted during times of flooding. Section 2b lies adjacent to Fairbanks, is easily accessible and has over the years been exposed to heavy development. Section 8a is a 3-mi section located approximately 15 mi upstream of Fairbanks and, while this area remains fairly accessible, it has not yet experienced intensive development. The upper two sections are located above the flood control structure. The area known as the "Dam Site" is the 3-mi stretch of river directly upstream of the control structure, and it is in this area that flood waters from the Chena River would enter the floodway and eventually find their way into the Tanana River. Estimates here began in 1972 (Tack 1973) and will be continued to monitor any changes in the grayling population structure as it relates to the flood control project. In 1970 a population estimate was done in the entire 16-mi length of section 10 (Tack 1971); none has been done since. This area is undeveloped, relatively inaccessible, and angler utilization is minimal; thus it serves as a control area in our population estimates.
Results of the 1981 population estimates are presented in Table 3, and a summary of population estimates conducted on the same index sections from 1968 to 1981 appear in Table 4.

These results show increases of 75, 144 and 228 fish per mile in sections 8a, Dam Site and 10b, respectively, and a slight decrease in section 2b.

Table 3. Grayling population estimates in four sections of the Chena River 1981. Only grayling greater than 150 mm fork length are included in the estimate.

Section (River Mile)	Date	Length of Section (mi)	Schnabel Estimate Gr/Mi	95% Confidence Intervals for Schnabel Est. Gr/Mi
2b (8-11)	Aug. 7-10	3	419	357-628
8a (26-29)	Aug. 3-6	3	359	262-494
Dam Site (46-49)	Aug. 11-14	3	483	279-904
10b (66-69)	July 21-24	3	1391	745-2845

Table 4. Population estimates for Arctic grayling greater than 150 mm fork length in index sections of Chena River 1968-1981.

River Section	Year	Date	(Schnabel Estimate) Gr/mi
2b	1968		1,095
	1969		1,890
	1970	July 2-10	1,479
	1971	Aug. 30-Sept. 3	2,095
	1972	June 22-26	978
	1973	July 3-10	679
	1974	July 25-28	642
	1976	July 22-24	596
	1977	July 11-14	479
	1978	July 25-28	254
	1979	July 26-30	316
	1980	July 1-4	463
	1981	Aug. 7-10	419
8a	1979	Aug. 20-23	269
	1980	July 14-17	284
	1981	Aug. 3-6	359
Dam Site	1972	June 27-29	1,306
	1973	July 18-19	800
	1974	July 9-11	416
	1976	Aug. 4-6	464
	1977	July 26-30	437
	1978	Aug. 8-11	495
	1979	July 17-20	261
	1980	July 29-Aug. 1	339
	1981	Aug. 11-14	483
10b	*1970	June 7-July 7	1,873
	1980	Aug. 12-15	1,163
	1981	July 21-24	1,391

* The 1970 estimate was conducted on the entire 16 miles of section 10.

In sections 2b and the Dam Site a significant decrease in fish per mile occurred in the early seventies, (Tack 1973, 1974) Table 4. Since then, those areas have experienced only slight fluctuations from 1 year to the next. No reason has ever been found to explain the drastic drop in numbers in those years or why the population was never able to recover after such a decline. One hypothesis was that a cyclic phenomenon within the population may be occurring. If this were the case, future successive year studies would point this out, and to date they show no indication that a cycle exists. Tack in 1970, at a time when grayling numbers in section 2b were increasing, stated that this increase was due to the high numbers of invertebrates found in the lower river due to the introduction of sewage and other waste. He went on to point out that if pollution levels decrease, the invertebrates and grayling will probably decrease until the natural carrying capacity of this section of river is reached. In 1976 the City of Fairbanks and Ft. Wainwright ceased dumping their sewage effluent into the Chena River. While the level of invertebrates has never been accurately measured, it appears that a decrease did indeed occur and consequently so did fish numbers. Since then a fairly stable population in section 2b has been noted with only minor yearly fluctuations.

A similar situation exists in the Dam Site section where, at about the same time (1974), the grayling numbers declined substantially then leveled off to what appears to be a fairly stable population. However, this area has no history of pollutants and the reason for its fluctuation remains unknown. As previously mentioned, this area is located directly upstream of the Chena River flood control structure and may be impacted during times of flooding. In July of 1981 heavy rains allowed the Corps of Engineers to close the flood gates and test the entire project. The "Dam Site" section was completely inundated and the Chena River actually breeched its banks in areas, but the population estimate conducted here in August showed that the flooding had little effect on grayling numbers. Continued yearly monitoring is recommended to further assess the effects of the 1981 test. Sections 8a and 10b show an increase in their estimates over the the 1980 data. In 10b a much larger population (fish/mile) was found than in the other four areas. Three possible reasons for this are: 1) less accessibility to anglers, 2) no development occurring in or along the river in this area, 3) the area is utilized quite heavily by spawning king and chum salmon, and grayling have been observed feeding extensively on their eggs during the period the estimate was conducted.

Age and Length Structure

Age determinations by scale analysis were made from a random subsample of 384 grayling (scales collected from every fourth fish captured). Age and length information presented in Table 5 show clearly that Age Class III was the predominant age class, comprising 39.6% of the entire sample, with Age Class II, IV, and V, representing around 12% each in the sample. While these four age classes account for more than 75% of the entire sample, it should be pointed out that Age I with 15.8% is the highest this age class has ever been. One possible explanation is that the estimates were conducted after the heavy rains in July while water levels were still high, allowing more maneuverability with the electrofishing boat into areas normally too shallow to sample, areas where Age I grayling are often found.

Table 5. Age and length composition of 384 randomly subsampled grayling in Sections 2b, 8a, Chena River Dam Site and 10b, 1981.

Fork Length mm	Age Class I	II	III	IV	V	VI	VII	VIII	Total No.	Length Frequency %
80-89	1								1	0.3
90-99	7								7	1.8
100-109	15								15	3.9
110-119	10								10	2.6
120-129	12								12	3.1
130-139	13	1							14	3.6
140-149	3	2							15	1.3
150-159		16							16	4.2
160-169		13	11						24	6.3
170-179		9	31						40	10.4
180-189		6	41						47	12.2
190-199		1	34	1					36	9.4
200-209			25	7					32	8.3
210-219			10	12					22	5.7
220-229				14	6				20	5.2
230-239				12	8	1			21	5.5
240-249					18	1			19	4.9
250-259					9	3	1		13	3.4
260-269					4	5	1		10	2.6
270-279					2	6	...		8	2.1
280-289						5	...	1	6	1.6
290-299						...	1	...	1	0.3
300-309						...	1	1	2	0.5
310-319						1	...	...	1	0.3
320-329							1	...	1	0.3
330-339								...	...	...
340-349								1	1	0.3
n	61	48	152	46	47	22	5	3	384	
Age frequency %	15.8	12.5	39.6	12.0	12.2	5.7	1.3	0.8		
$\bar{x}$ fork length (mm)	112	162.3	187.1	215.3	239.5	267.9	286.7	310.3		

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The length frequency in percent of sample in each section appear in Table 6. Unlike previous years, when the mean fork length and range increased from one section to the next in an upstream direction, just the opposite occurred in 1981. Section 10b, the furthest section upstream, had a mean fork length of 177 mm and a fork length range of 88-311. This is smaller than the next section downstream (Dam Site), which had a mean fork length of 187 mm and range of 90-321 mm.

This trend continued in the next section downstream, 8a, which had the largest mean fork length (196 mm) and also the largest range (86 - 343 mm). The section 2b 1981 mean fork length (177 mm) and length range (98-294 mm) were almost identical to those of 1980 (178 mm FL and 95-280 mm range). The high water that occurred in July, 1981, may have relocated some of these younger fish or, as was mentioned earlier, the high water allowed more complete sampling of the river by electrofishing boat, a possible explanation for this reversed situation. The mean fork length of the four index areas was 185 mm, down from the past 2 years with 191 mm for both 1979 and 1980 (Hallberg 1979-1980). Here again, there is evidence of more small fish in our 1981 sample.

Upper Chena River Creel Census

Results of the 123 day creel census (May 1 - Aug. 31) appear in Table 7. During this time it was calculated that 15,896 angler hours were expended to harvest 13,549 grayling along the upper river above mile 26 of the Chena Hot Springs Road. The estimated catch rate was 0.80 grayling caught and kept per angler hour.

Very high angler use, harvest, and catch rates occurred in May and June of 1981, with sharp declines in these estimates in July and August. This trend has generally occurred in past years (Hallberg 1979; 1980) but not to the extent that was found in 1981. The weather provides a probable explanation for the sharp early and late season differences found in 1981. Extremely fair weather prevailed in early summer, while heavy rains occurred in July and August. These rains caused high water levels with near flood stages in mid-July. This high, turbid water had its major effect on angler catch rate and harvest. The Catch Per Unit Effort (CPUE) fell sharply from 1.19 grayling kept per hour in June to only 0.38 grayling per hour in July (Table 7). This combination of early summer high and late summer low catch rates resulted in an average CPUE estimate of 0.80 grayling per hour for 1981 which approximates the average of 0.75 grayling per hour from 1970 to 1980.

The 1981 creel census sampling was begun directly after breakup in early May because the 1980 creel census results indicated that angling effort and harvest during the early season could be quite high (Hallberg 1980). The high use and harvest in May, 1980 was undoubtedly enhanced by unusally low spring water levels coinciding with the major upstream migration of grayling (Hallberg 1980). It was thought that this combination of circumstances could result in excessively high harvest of spawning adults; thus the fishery was monitored closely in May.

Table 6. Length frequency (in percent of sample) of 1,641 grayling from four sections of the Chena River, 1981.

Fork Length mm	Chena River Sections 2b	8a	Dam Site	10b
80 - 89	...	0.3	...	0.2
90 - 99	0.2	1.1	2.6	6.6
100 - 109	0.9	3.1	9.6	10.9
110 - 119	8.9	1.7	5.6	4.1
120 - 129	14.2	0.6	1.1	0.2
130 - 139	4.0	0.3	0.4	0.7
140 - 149	1.2	0.3	...	0.7
150 - 159	5.1	0.6	1.1	4.1
160 - 169	5.4	4.5	5.6	8.1
170 - 179	9.1	9.8	13.3	13.3
180 - 189	8.4	17.6	13.0	15.2
190 - 199	13.3	19.6	11.5	8.4
200 - 209	11.5	8.4	6.3	5.4
210 - 219	8.0	6.4	3.7	3.2
220 - 229	4.5	6.4	5.9	2.5
230 - 239	1.4	8.4	4.8	3.2
240 - 249	1.4	4.5	4.1	3.4
250 - 259	1.0	3.4	2.2	2.0
260 - 269	0.9	1.7	3.0	3.4
270 - 279	0.2	0.8	3.7	1.8
280 - 289	...	...	0.7	2.0
290 - 299	0.2	0.3	0.4	0.2
300 - 309	...	...	0.7	0.2
310 - 319	...	...	...	0.2
320 - 329	...	...	0.7	...
330 - 339	...	...	...	...
340 - 349	...	0.3	...	...
Number	572	357	270	442
Mean Length (mm)	176.7	196.3	187.1	177.5
Length Range (mm)	98-294	86-343	90-321	88-311

Table 7. Creel census results of the Arctic grayling fishery on the upper Chena River adjacent to the Chena Hot Springs Road, 1981.

Period	Angler Hours			Grayling Harvest	Grayling Kept Per Hour
	Weekdays	Weekends	Total		
May	1.241	3,872	5,113	5,675	1.11
June	2,057	1,874	3,931	4,687	1.19
July	1,404	1,213	2,617	994	0.38
August	1,848	2,387	4,235	2,202	0.52
Total	6,550	9,346	15,896	13,549	0.80

Angler Composition (%)	
Local Residents	69
Military	24
Tourist	7
Male	80
Female	20
Adult	76
Youth	24

In 1981, water levels were again very low by early May. In May an estimated 5,113 angler hours were expended by fishermen to harvest a total of 5,675 grayling (Table 7). These values, are quite high for a single month and account for 32% and 42% of the total summer effort and harvest, respectively. The CPUE in May was also high; 1.11 grayling were kept per angler hour.

Hallberg (1980) found that the average size of grayling caught in May was larger than the total summer average size. The average grayling size in May of 1981 was 266 mm, well above the 5-year total summer average of 225 mm. Predominatly Age IV and older grayling were caught and kept by anglers in May 1981. Age and length data were not taken during the rest of the 1981 season; however, from 1977 to 1980, Age Classes III and younger fish accounted for an average of 53% of the creel for the entire summer (Hallberg 1980). These general trends of heavy fishing pressure and high harvest of larger fish in the spring make it clear that this is an important time period in the fishery which should be monitored closely, especially in years of low spring water levels.

A summary of creel census results for the upper Chena since 1970 appears in Table 8. The 1981 total angler hours and harvest figures appear somewhat higher than the average summer estimates due to the inclusion of May figures in the estimates. For the purpose of comparing the 1981 results with those of past years, the 3-month totals of June, July, and August were calculated. For this period the results were as follows: total angler hours 10,783, total harvest 7,883 grayling, and 0.70 total grayling caught and kept per hour. The angler hour and harvest estimates are similar to those of past years, but are appreciably lower than the estimates for the same period in 1980 (Hallberg 1981). The high water levels occurring in July and August probably account for the lower use and harvest in 1981.

Development Projects Affecting the Chena River

The only project of any significance that affected the Chena River in 1981 was the Chena River Lakes Flood Control Project. A complete history of the project, as well as an explanation of how it functions, appears in last year's annual report (Hallberg 1981).

The major components of the project have been completed, only the recreation area associated with the project remains uncompleted and due to Federal budget cuts its completion date is unknown.

The Army Corps of Engineers had planned to test the facility during the 1981 spring (breakup) flood, but due to the light snowfall that occurred the preceding winter, coupled with a slow melt-off, not enough water was available to conduct the test. However, due to the heavy rains in early July 1981 and the potential for possible flooding in low-lying areas in and around Fairbanks, the Corps elected to close the flood gates to offer protection and, at the same time, to test the facility.

With minor exceptions, operation of this facility during summer months should pose no serious threats to the fishery resource of the Chena River Basin. During the test, adult king and chum salmon were observed using the fish ladder. It was reported by Corps personnel that a few grayling and

Table 8. Summary of creel census results for the upper Chena River, 1970-1981.*

Year	Date	Days	Total Angler Hours	Total Grayling Harvest	Grayling Caught & Kept Per Angler Hour
1970	May 1-31 July 14-Aug. 29	78	12,518	6,770	0.54
1974	July 01-Aug. 31	62	11,680	18,049	1.55
1975	June 01-Aug. 31	92	22,657	14,067	0.62
1976	June 01-Aug. 31	92	10,762	4,161	0.39
1977	June 01-Aug. 31	92	13,536	9,406	0.69
1978**	May 29-Aug. 31	95	10,508	6,898	0.65
1979	June 01-Aug. 31	92	12,744	10,459	0.82
1980	May 08-Sept. 30	144	20,827	16,390	0.78
1981	May 01-Aug. 31	123	15,896	13,549	0.80

* Data before 1978 taken from Hallberg, 1978.
** Data taken from Kramer, 1979

round whitefish had also passed through the ladder. Velocities in the ladder were approximately 5 feet per second in the slots and 3 feet per second in the pools, which is considered excellent for fish passage. Based on these observations there dosen't appear to be any problem once a fish enters the ladder, however, the smaller, weaker swimming fish may have trouble reaching the ladder entrance due to strong water velocities in the tail water area. The Corps of Engineers maintains that, through the manipulation of the tail water near the fish ladder entrance, fish will be attracted to the ladder. Monitoring of future operations of the facility will be done to evaluate this.

Other problems occurred in the large inundated pool area above the control structure. Here the water was not confined to the cleared "floodway" as was predicted and flowed randomly throughout the vast, heavily vegetated areas which had numerous undrained low areas. Surveys of these areas after water levels had receded showed that only a few fish, mainly longnose suckers, were trapped. It is feared that if a spring flood did occur, out-migrating king and chum salmon smolts could be trapped in such areas. Also, the drawdown of the water in the reservoir area was very slow and caused some minor fish mortality to occur as flows back into the Chena River from the pool became sub-surface, leaving fish stranded or caught in the riprap bank areas near the river. The resource agencies are working with the Corps of Engineers on these problems. A more sculptured, well defined floodway to contain the floodwaters and a better draining structure to allow fish to safely find their way back into the Chena River have been recommended to the Corps. A post-test evaluation manual put out by the Corps will address these concerns and will outline the corrective measures the Corps will take to solve these problems.

Area Surveys

Area surveys were conducted on portions of the Chatanika and Salcha Rivers and Beaver Creek. The purpose of the surveys was to determine physical and chemical characteristics, collect graying life history information and assess the sport fishing potential for grayling. Index areas in the Salcha and Chatanika River were to be located for future studies to provide comparative data on grayling populations and trends. The following is a summary of those surveys.

Beaver Creek

Beaver Creek was surveyed in late June. Access to the Creek was gained by utilizing a primitive road which lead some 15 mi from the Steese Highway to placer mines along Nome Creek, a tributary to Beaver Creek. Nome Creek was then floated to its confluence with the main Beaver Creek, and it was floated some 300 mi to the Yukon River, near the village of Beaver.

Nome Creek is a small, narrow creek about 20-40 feet wide and averages about 10" deep, with extensive riffle areas and few pools. Grayling were observed in the deeper pools and slimy sculpins were found throughout Nome Creek. The bottom composition of Nome Creek was moderate to small-size gravel with some sandy areas. The watershed area is made up of dense stands of spruce, birch, aspen and willow. Extremely low water conditions made travel on Nome Creek very slow and difficult. Many times the creek was too shallow to float and the canoe had to be literally dragged downstream. While there was evidence of active mining operations on Nome Creek, the water remained clear. Water temperatures on Nome Creek changed from 46°F where we first put in, to 50°F near the main Beaver Creek. Aquatic vegetation on Nome Creek was mainly a brown algal growth found on the bottom rock throughout the creek. Caddis fly cases were also common on rock bottoms.

Upper Beaver Creek is a much larger stream than Nome Creek. Here the stream is from 75-100' wide and averages 3-4' deep, with many pools over 10' deep. The upper 100 mi of Beaver Creek is a moderately swift, youthful stream that meanders through the open, broad headwater valleys of the White Mountains. In contrast, the lower 200 mi is a contorted, heavily meandered mature stream that winds slowly through the Yukon Flats.

Grayling, representing Age Classes I-VIII were observed throughout the river. While no Age I grayling were sampled, they were observed in some of the quieter back-water areas. No young-of-the-year were found but it may have been too early for the emerging fry or perhaps they were just too small to be observed. Captured grayling ranged in length from 145mm to 360 mm. Age and length composition of grayling sampled in Beaver Creek appear in Table 9. Water chemistry in Beaver Creek was as follows, total alkalinity 68 ppm, hardness 80 ppm, pH = 7.7, CO_2 15 ppm.

Round whitefish and slimy sculpins were observed throughout the length of the stream, while suckers and northern pike began showing up more toward the flats area. Due to the low water, netting sites in the lower river were hard to find. One net was set near the confluence with the Yukon River for one night and caught no fish. However, stream surveys conducted on the lower 2 mi of Beaver Creek in June 1973 and September 1975 showed that sheefish, chum salmon, humpback whitefish, least cisco and chubs are present (Ken Alt, pers. comm.).

Chatanika River Survey

The 70-mi section of the Chatanika River from the Elliot Highway bridge to the confluence with Goldstream Creek was surveyed in early June, 1981.

For approximately the first 5 mi below the Elliot Highway the river is a gentle meandering, clear river with the characteristic pool-riffle configuration common to many Interior streams. The water here was clear and 52°F and the bottom composition was small to medium-size rubble covered with a thin layer of silt, apparently caused by placer mining activity further upstream. In the next 30 mi the river changed considerably as it became confined to a well-defined single channel with steep banks, void of any gravel bars and heavily meandered. The average depth here was 3 to 4 feet and bottom composition consisted of fine gravel, silt and mud. After flowing through this stretch of relatively slow flowing, flat watershed area, the Chatanika enters a steeper, more hilly shoreline area where, once again, the river takes on those characteristics found in the first 5 mi of our survey.

The river leaves the hills and enters the Minto Flats approximately 14 mi upstream of its confluence with Goldstream Creek. Bank cover in the upper

Table 9. Age-length relationship for Arctic grayling from Chatanika River, Beaver Creek and Salcha River, 1981.

		Age At Capture								
		1	2	3	4	5	6	7	8	9
Chatanika River	$\bar{x}$		169	204	233	264	286	290		
n=32	n		4	7	10	7	3	1		
	Range		145-195	190-215	210-260	245-280	285-290	290		
Beaver Creek	$\bar{x}$		164	218	231	271	293	313	348	
n=53	n		7	9	14	5	10	5	3	
	Range		145-180	205-235	205-260	255-280	275-320	295-330	340-360	
Salcha River	$\bar{x}$	126	162	197	224	254	272	302	335	353
n=91	n	20	25	11	9	7	5	8	5	1
	Range	98-146	135-196	158-212	200-247	233-265	265-285	281-322	315-348	353

Chatanika was predominately spruce, birch and aspen forest with a willow and alder understory. In the lower section (Minto Flats area) the shoreline was mostly willow, alder and meadow grasses. Water chemistry in the lower Chatanika River was as follows; hardness 4 ppm, total alkalinity 3 ppm, pH 7.7, CO_2 10 ppm and water temperature $55^{o}F$.

Grayling, longnose suckers, round whitefish and slimy sculpins were common throughout the surveyed area. Northern pike and sheefish were sampled in the lower section of the river. Grayling were sampled throughout the survey with hook and line. The catch per unit effort was highest in faster waters with 10 gr/hr. Age and fork length data are presented in Table 9.

No Age I grayling were sampled in the Chatanika River, as they would have been too small to catch on hook and line; also, because the survey was done in early June, no young-of-the-year grayling were sampled.

Salcha River

An attempt to conduct a population estimate on Arctic grayling within a 3-mi section of the Salcha River met with little success. The area selected was near the crossing of the Trans-Alaska oil pipeline below Redmond Creek from River Mile 11 to 14. Tack (1973) was able to obtain a population estimate in this area utilizing an electrofishing boat, but warned that due to the very low numbers of fish marked and recaptured (163 and 5, respectively) that the estimate should be regarded with caution. Extremely clear, swift and poorly conductive water conditions were given as reasons why sampling was difficult. After 3 successive days of sampling, a total of 202 grayling was captured, measured, finclipped and released. No marked fish were recaptured; consequently, no estimate was obtained.

The age-length relationship of those grayling sampled appears in Table 9. It should be pointed out that in Table 9 these grayling sampled in Beaver Creek and the Chatanika River were captured with hook and line, while the Salcha River fish were captured with the electrofishing boat. Grayling sampled on the Salcha River ranged from 98 to 353 mm fork length and had a mean of 202 mm. The wide range and smaller mean fork length is thought to be a function of the methods used in sampling. Hook and line would bias toward larger fish, while the electrofishing boat would have a tendency to sample the entire population more randomly.

Surveys of Spring-fed Streams

Fivemile Clearwater. One trip was made to the Fivemile Clearwater River on May 21. The water level was about 10-12" lower than normal and riverboating was quite difficult. The lower 3 mi of river was somewhat silted by a mudflow coming from the tundra.

As in 1979, large schools of round whitefish were present in the lower 5 mi of river. However, many more grayling were observed this year than were seen in mid-May of 1979. Twenty mature grayling averaging about 300 mm were sampled by hook and line. All the fish were spawned out.

High water levels in the Chena River resulted in the testing of the Chena River Flood control structure. Monitoring of this operation and the subsequent test netting and rehabilitation of Chena Lake precluded further surveys of clearwater streams in 1981.

Tagging Study

A tagging study on Arctic grayling in the Chena River was initiated in June of 1980 (Hallberg 1981). During that field season a total of 3,000 grayling was tagged using numbered Floy internal anchor tags. Through recaptured tag returns from anglers and staff personnel, we hoped to learn more about the movements of grayling within the river. More specifically we hoped to learn if those fish utilizing the lower river move into the upper, more heavily utilized areas of the Chena, replacing the thousands of grayling that are harvested during the summer months.

In 1981 only 485 additional tags were placed on fish. Heavy rains in July and expanded work programs elsewhere were the reasons for the reduced tagging efforts. However, during the 1981 field season 171 previously tagged fish were recaptured. Of these, 105 were recaptured by Department personnel who were conducting population estimates on index areas within the Chena, and only two of these fish exhibited any significant movement from where they were tagged. Both fish had moved downstream approximately 25 miles.

The remaining 66 tag returns were from angler-caught fish. Here 43 fish showed no movement, 12 moved downstream, and 11 moved upstream. The data at this point show no strong tendency of fish moving in either direction and perhaps indicate only random movements. However, those fish which had moved downstream may exhibit some migration patterns. Two of the 12 moved downstream 6 mi each and were caught in Badger Slough, a known spawning stream. Both were caught in early May and both were of spawning size, around 285 mm. Eight of the remaining 10 were caught in May and early June and had moved an average of 30 miles downstream. These movements could be the result of fish that had moved downstream to an overwintering area in late fall and were caught early the following spring prior to or during their upstream migration. The other two angler-caught fish moved downstream in July and August and moved 10 and 5 mi.

Those individuals that moved upstream showed a more random movement. Seven of the 11 were caught in May and early June from 5 to 80 mi from where they were tagged. They may be considered part of an upstream spring migration; however, they were caught throughout the lower 100 mi of the Chena River. The remaining four tag returns were from fish captured in August and September, they moved and average of 22 mi.

Because of the small sample of angler-caught tagged fish, any hypotheses as to their movements should be reguarded with caution until more data are available.

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