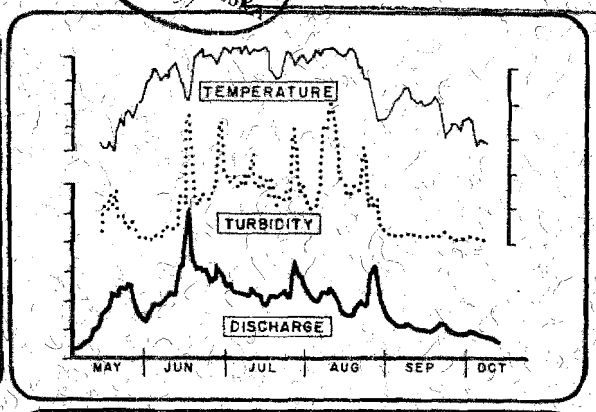

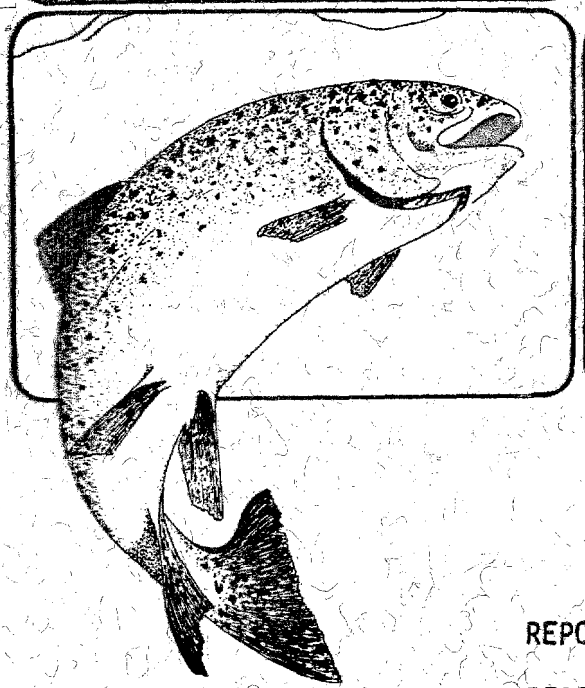

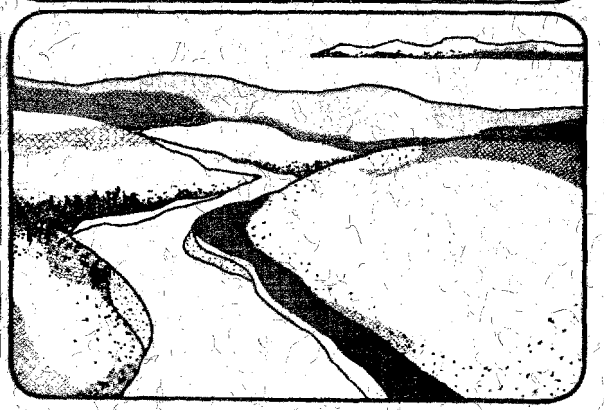

REPORT NO. 7

RESIDENT AND JUVENILE ANADROMOUS FISH INVESTIGATIONS (MAY - OCTOBER 1984)

PART 3

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

ALASKA DEPARTMENT OF FISH AND GAME

SUSITNA RIVER AQUATIC STUDIES PROGRAM

REPORT NO. 7

RESIDENT AND JUVENILE ANADROMOUS FISH INVESTIGATIONS (MAY - OCTOBER 1984)

PART 3

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Prepared for: Alaska Power Authority
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July 1985

PREFACE

This report is one of a series of reports prepared for the Alaska Power Authority (APA) by the Alaska Department of Fish and Game (ADF&G) to provide information to be used in evaluating the feasibility of the proposed Susitna Hydroelectric Project. The ADF&G Susitna River Aquatic Studies Program was initiated in November 1980.

The report covers studies conducted from May through October 1984 of juvenile salmon and resident fish species of the Susitna River. In addition, some information is included on overwintering of resident fish radio-tagged in 1983. The majority of the effort during the 1984 open-water season was on the lower river (from the mouth to the Chulitna River confluence). No studies were conducted this year in the area above Devil Canyon. This volume consists of three parts.

Part 1 (RSA Tasks 16A and 16B) covers the migration and growth of juvenile salmon. Coded wire tagging of chum and sockeye fry in the middle river (Chulitna River confluence to Devil Canyon) and collecting of all species of outmigrating fry at Talkeetna Station were similar to 1983 studies. In addition, a mark-and-recapture cold branding study was conducted in tributaries, sloughs, and side channels of the middle river to obtain estimates of chinook and coho juvenile salmon population size and residence time in these rearing areas. Also, outmigrant traps were operated near the mouth of the river at Flathorn Station (River Mile 22.4) to obtain a timing index of outmigration from the lower river. A statistical time series analysis of 1983 and 1984 discharge, turbidity, and juvenile salmon outmigration data from the middle river is included as an appendix.

Studies of the distribution and relative abundance of juvenile salmon and modelling of rearing habitat in the lower river are discussed in Part 2 (RSA Tasks 14 and 36). These studies were similar to those conducted in the middle river in 1983. Habitat suitability criteria developed for the middle river were used for the lower river unless evidence of different conditions in the lower river necessitated modifications. Results from habitat modelling at 14 RJHAB model sites and 6 IFIM model sites are presented. The RJHAB and IFIM models were compared by using both at two sites. IFIM model calibration is contained in Appendix D.

Part 3 (RSA Task 14) presents the results of resident fish studies in both the middle and lower river. Monitoring of fish movement through use of radio tags was continued. Index sites in the middle river were sampled as part of the long term monitoring effort. Population estimates for rainbow trout, Arctic grayling, round whitefish, and longnose suckers in the middle river were made from multiple year mark-recapture data.

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TITLES IN THIS SERIES

Report Number	Title	Publication Date
1	Adult Anadromous Fish Investigations: May - October 1983	April 1984
2	Resident and Juvenile Anadromous Fish Investigations: May - October 1983	July 1984
3	Aquatic Habitat and Instream Flow Investigations: May - October 1983	September 1984
4	Access and Transmission Corridor Aquatic Investigations: May - October 1983	September 1984
5	Winter Aquatic Investigations: September 1983 to May 1984	March 1985
6	Adult Anadromous Fish Investigations: May - October 1984	June 1985
7	Resident and Juvenile Anadromous Fish Investigations: May - October 1984	July 1985
8	Availability of Invertebrate Food Sources for Rearing Juvenile Chinook Salmon in Turbid Susitna River Habitats	1985
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PART 3

Resident Fish Distribution and Life History in the Susitna River below Devil Canyon

RESIDENT FISH DISTRIBUTION AND LIFE HISTORY IN THE SUSITNA RIVER BELOW DEVIL CANYON

Report No. 7, Part 3

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ABSTRACT

Studies of resident fish were conducted in both the lower (below Chulitna River confluence) and middle (Devil Canyon to Chulitna River confluence) Susitna River in 1984. The primary objectives in the middle river were to determine the seasonal distribution, timing of spawning, and spawning areas of rainbow trout, and to monitor 13 index sites as part of the long term monitoring effort. Most of the rainbow trout data was collected by use of radio telemetry. Results showed that rainbow trout are relatively few in numbers and that spawning occurs at selected areas which are influenced by lakes. Much of the rainbow trout population in the middle river probably originates in lakes which drain into middle river tributaries. Rainbow trout were abundant in lakes located at the headwaters of Fourth of July Creek and in the upper reaches of Portage Creek. Rainbow trout were also found to use Portage Creek more extensively than previously thought. Spawning occurred during the first week of June. All rainbow trout moved out of tributaries by early October (probably triggered by low fall discharges), and most overwintered in the mainstem Susitna River slightly downstream (0.1-4.0 miles) of the tributary where they were captured. Other middle river studies suggest Arctic grayling overwinter in the mainstem Susitna then ascend and spawn in tributaries in late May. Arctic grayling also outmigrated from tributaries at the same time as rainbow trout. Catch data at middle river index sites in 1984 were similar to 1982 and 1983 findings. Studies in the lower river reinforced the belief that some humpback whitefish are anadromous, and that rainbow trout and Arctic grayling outmigrate from most east side tributaries in September. Lower river studies also found that burbot move into the Deshka River in mid-September.

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1.0 INTRODUCTION

Since November 1980, Resident Fish Studies have been conducted in the Susitna River drainage to more accurately determine the distribution and relative abundance of resident fish. In 1982, resident fish abundance were compared at mainstem, slough, and tributary mouth macrohabitats (Suchanek and Hale 1983). In 1983, studies focused more on the middle reach of river because construction of the proposed hydroelectric dams would affect this reach of river most. Microhabitat suitability criteria and population estimates were developed for rainbow trout (Salmo gairdneri Richardson) and burbot (Lota lota Linnaeus) in selected areas during 1983 (Suchanek et al. 1984; Sundet and Wenger 1984). Rainbow trout and burbot movements were more clearly defined using radio telemetry in 1982 and 1983 (ADF&G 1983c; Sundet and Wenger 1984). Data from these studies and catch data has shown burbot most often reside in the mainstem in summer and in both mainstem and some tributaries in winter. These data also show rainbow trout migrate between tributaries and the mainstem during summer and all overwinter in the mainstem. During 1982 and 1983, information collected on spawning fish suggests that burbot and round whitefish (Prosopium cylindraceum Pallus) are mainstem spawners. Burbot were also suspected to spawn in some lower river tributaries during these years (ADF&G 1983c).

This report primarily addresses resident fish studies conducted during the 1984 open-water season. However, fish movements monitored by radio telemetry are presented from December 1, 1983 to the open-water season (for winter monitoring of 1983 radio tagged fish) and after the open-water season to December 1, 1984 (to show movement patterns of summer 1984 tagged fish during the transition period from open-water to winter conditions). Although sampling primarily occurred in the mainstem Susitna River between Cook Inlet and Devil Canyon, sampling also occurred at several tributaries in this reach of river.

The primary emphasis of Resident Fish Studies in 1984 was to further determine the seasonal distribution, timing of spawning, and locations of spawning for rainbow trout above Talkeetna using radio telemetry. Studies in 1984 also furthered our knowledge of resident fish distribution in the Susitna River below Talkeetna.

The radio telemetry program in the Susitna River below Talkeetna in 1984 monitored rainbow trout and burbot movements. Fish below Talkeetna as well as several fish in the middle river were radio tagged after August 1984. This report will include radio tagged fish monitoring data from December 1983 to December 1984. Since data from fish radio tagged after August are limited, these data will be presented in a report to be published in November 1985 covering winter 1984-85 studies.

In addition to radio telemetry studies, 13 resident fish index areas between Talkeetna and Devil Canyon were sampled regularly during 1984 to evaluate trends in abundance of resident fish. These 13 index areas, which have been sampled each year since 1982, encompass three macrohabitat types (tributary mouths, sloughs, and mainstem). By annually monitoring these sites where larger concentrations of resident fish have traditionally been found in comparison to other sites, the effects of the proposed hydroelectric dams to resident fish populations can be assessed.

2.0 METHODS

2.1 Study Locations

2.1.1 Relative abundance

Thirteen index sites between Talkeetna and Devil Canyon were sampled twice per month by boat electrofishing to monitor seasonal trends in relative abundance of resident fish (Figure 1). Site descriptions of Skull Creek (RM 124.7), Susitna Mainstem - West Bank (RM's 137.3-138.3), Susitna Mainstem (RM's 147.0-148.0), and Susitna Mainstem - Eddy (RM 150.1) are provided in Appendix E, while the remaining nine site descriptions are presented in Appendix F of Aquatic Instream Flow Studies, 1982 (ADF&G 1983d). In addition, other mainstem, side channel, slough, and tributary sites on the Susitna River between Cook Inlet and Devil Canyon were sampled intermittently.

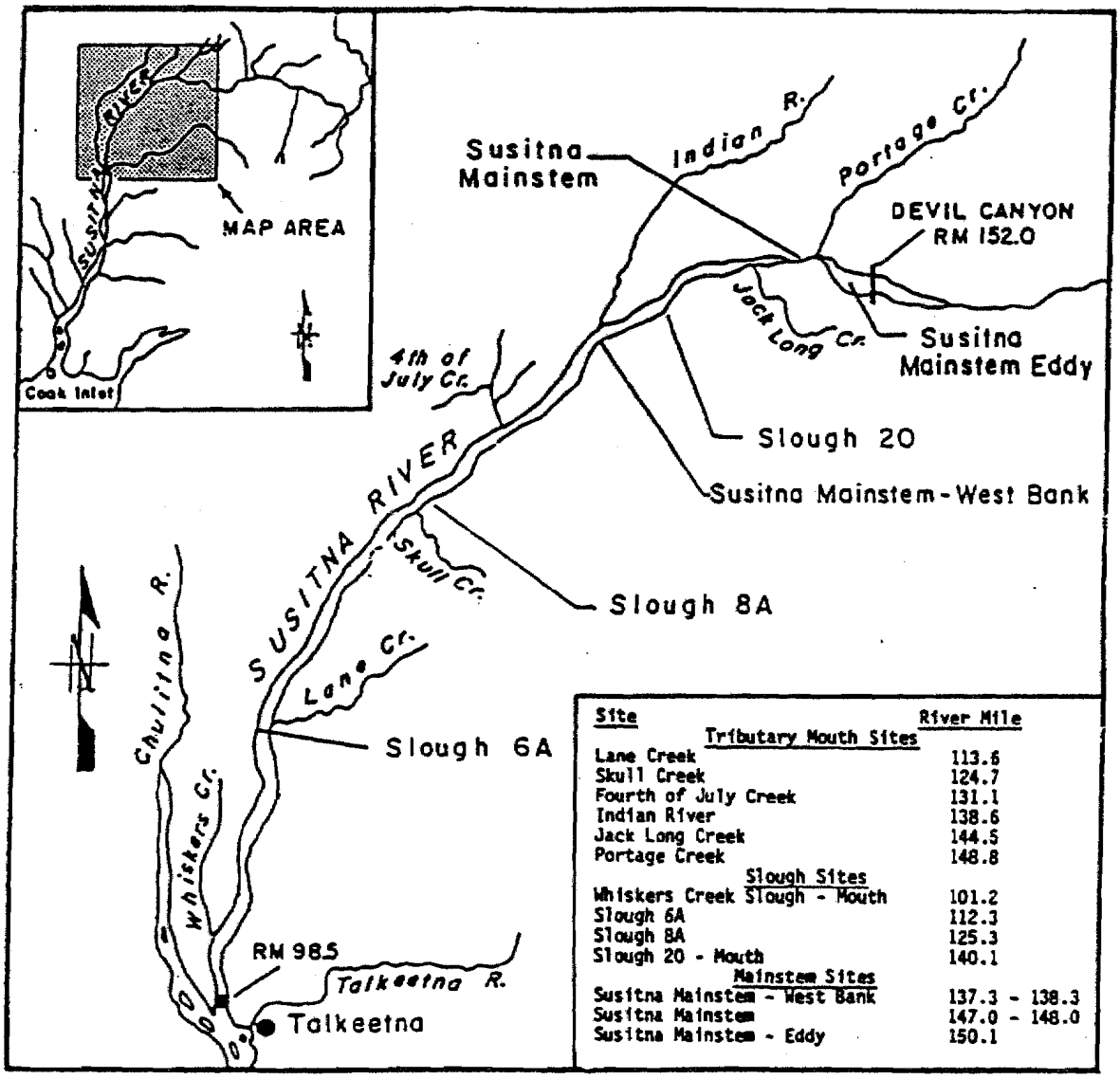
Several tributaries in the middle reach of the Susitna River were sampled during 1984 to determine the extent of rainbow trout and Arctic grayling (Thymallus arcticus Pallus) spawning and rearing (Table 1). These tributaries were selected because of their size, their proximity to Devil Canyon, or their relatively high abundance of these fish species.

Table 1. Resident fish sampling schedule at tributaries in the middle reach of the Susitna River, 1984.

	RM	TRM	May	Jun	Aug	Oct
Whiskers Creek	101.4	7.0		X		
Fourth of July Creek	131.1	0.1 - 3.5		X	X	X
Indian River	138.6	0.1 - 9.0	X	X		
Portage Creek	148.8	0.1 - 11.6	X	X		

In the lower Susitna river, the upper reaches of Kashwitna River (RM 61.0), Sheep Creek (RM 66.1), Goose Creek (RM 72.0), and Montana Creek (RM 77.0) were sampled during early September to determine the extent of rainbow trout and Arctic grayling rearing in these tributaries. Attempts were made to radio tag fish in these tributaries to determine the timing of their fall outmigration. Radio telemetry results from fish tagged in these areas will be presented in a later report.

Six lakes with outlets to the middle Susitna River were surveyed in 1984. These surveys were done to determine if rainbow trout populations existed in these lakes and if these fish migrate to or from the mainstem Susitna River. Surveys were conducted at four lakes at the headwaters



Site	River Mile
Tributary Mouth Sites	
Lane Creek	113.6
Skull Creek	124.7
Fourth of July Creek	131.1
Indian River	138.6
Jack Long Creek	144.5
Portage Creek	148.8
Slough Sites	
Whiskers Creek Slough - Mouth	101.2
Slough 6A	112.3
Slough 8A	125.3
Slough 20 - Mouth	140.1
Mainstem Sites	
Susitna Mainstem - West Bank	137.3 - 138.3
Susitna Mainstem	147.0 - 148.0
Susitna Mainstem - Eddy	150.1

Figure 1. Resident fish study sites on the Susitna River between the Chulitna River confluence and Devil Canyon, 1984.

of Fourth of July Creek [Lakes A, B, C, and D (Figure 2)], Miami Lake which outlets into Indian River at TRM 4.5, and an unnamed lake which outlets into Portage Creek at TRM 2.3 (Figure 3).

Resident fish catches recorded at five fishwheel sites, two outmigrant trap sites, a fyke net weir site, and 20 juvenile salmon rearing study sites (JAHS) were also examined to evaluate trends in relative abundance and seasonal movements. In addition, several east side tributaries such as Kashwitna River were monitored in April and May to determine timing of immigration of resident fish from the mainstem Susitna River.

2.1.2 Population estimates

Population esimates were made using multi-year data (1981-84) for four resident fish species tagged in the middle river (see Appendix D).

2.1.3 Radio telemetry

Selection of radio tagging sites in the mainstem Susitna between the Chulitna River confluence and Devil Canyon was based on resident fish distribution data collected during the 1981, 1982, and 1983 open-water seasons (ADF&G 1981b, 1983b; Sundet and Wenger 1984). Primary efforts to capture and radio tag rainbow trout and Arctic grayling in the mainstem were focused at the mouths of Whiskers Creek, Lane Creek (RM 113.6), Fourth of July Creek, Indian River, and Portage Creek. Fish were also caught and radio tagged in the upper reaches of Fourth of July Creek, Indian River, and Portage Creek at the same time the spawning studies were done.

2.2 Data Collection

2.2.1 Relative abundance

Resident fish were collected at mainstem and tributary sites primarily with a boat mounted electrofishing unit (Plate 1). A Coffelt Model VVP-3E boat electrofishing unit powered by a 2,500 watt Onan generator was used for boat electrofishing and using techniques described in ADF&G (1983a). Secondary gear types used included outmigrant traps at RM 22.4 and at RM 103.0, a fyke net weir at TRM 2.5 of the Deshka River, backpack electrofishing units, gill nets, hook and line, hoop nets, and trotlines.

Biological data (age, length, sex, and sexual maturity) were collected as outlined in ADF&G (1983a). Scales for age determination were taken from a representative sample of rainbow trout captured above the Chulitna River confluence. Scales were also taken from spawning Arctic grayling and round whitefish to determine ages of spawners for these species.

Survival rates were calculated for rainbow trout above the Chulitna River confluence in 1984 using catch and age data and methods presented in Everhart et al. (1975).

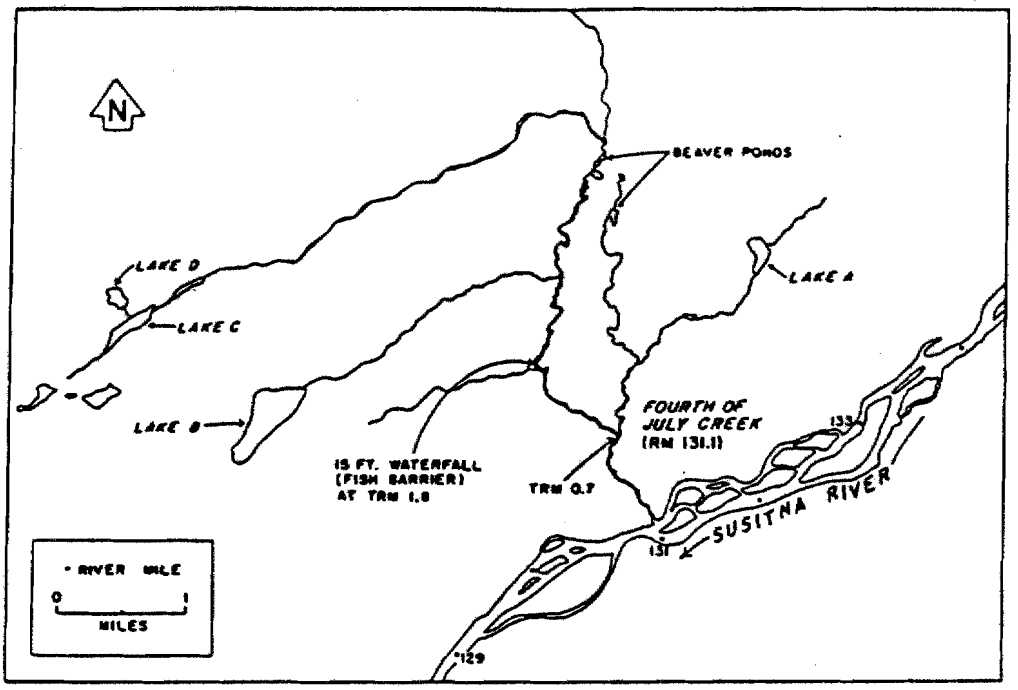


Figure 2. Fourth of July Creek drainage.

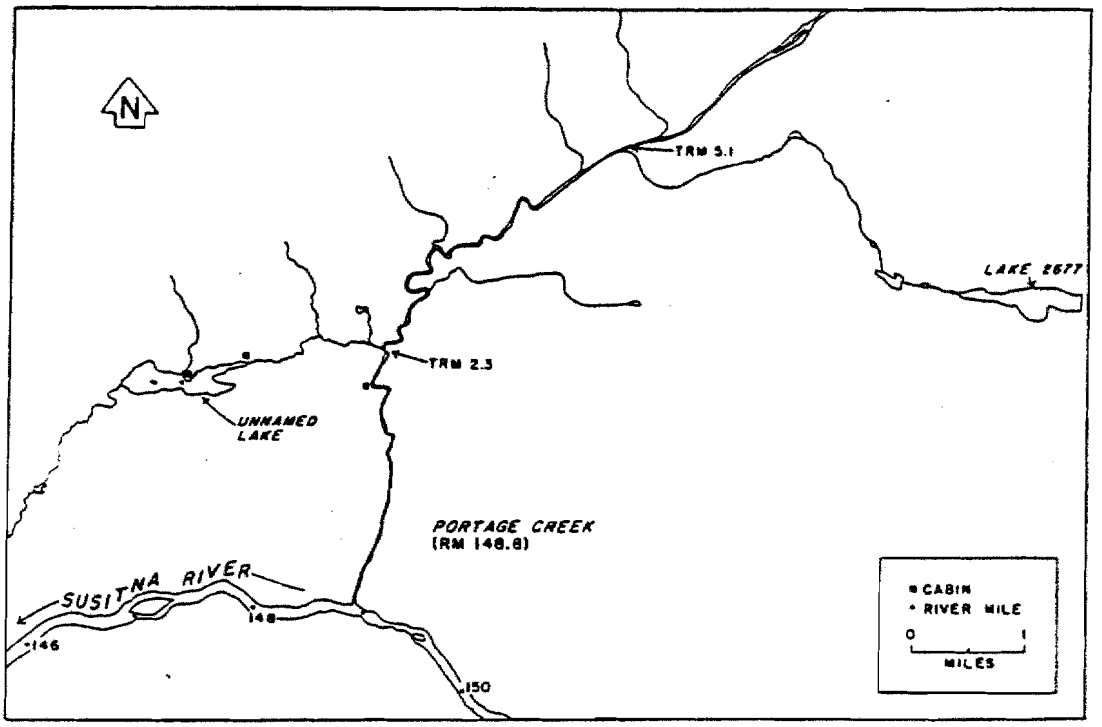


Figure 3. Lower Portage Creek drainage.

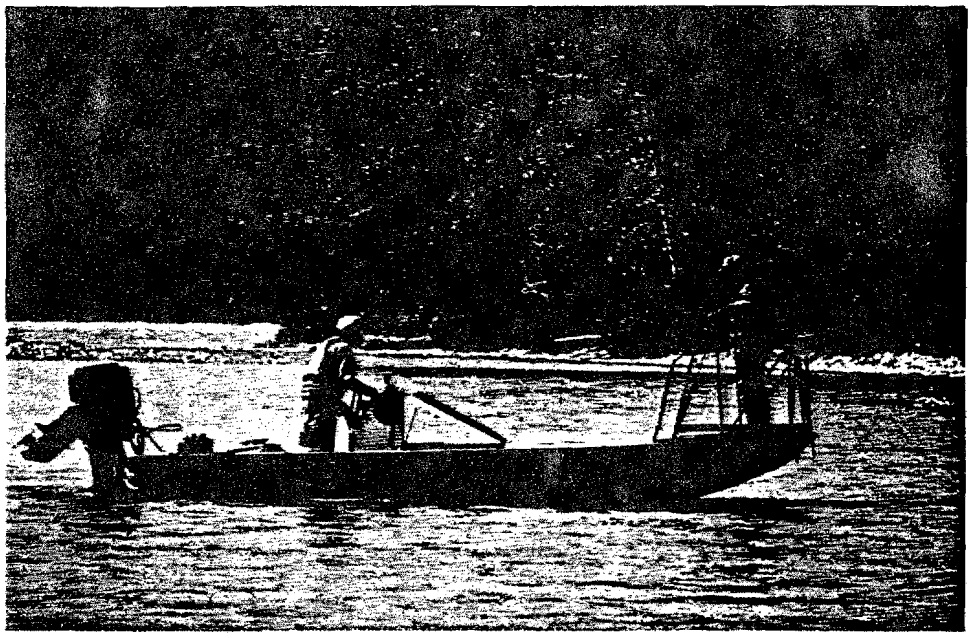


Plate 1. Boat electrofishing in the mainstem Susitna River at RM 147.8 and angling at TRM 2.3 of Portage Creek, June 1984.

Habitat parameters were measured at locations where spawning rainbow trout were found. These parameters included water velocity, water depths, substrate type, and general water quality. Specific habitat data collection methodology are summarized in ADF&G (1983a).

Habitat parameters were also measured at radio tagged fish relocation sites during the winter of 1983-84. During ground surveys in January and February, some radio tagged fish were located to within a four-foot-radius and habitat measurements were made as close to the signal as possible (Plate 2). Habitat parameters measured included those taken at fish spawning sites as well as ice thickness and the presence or absence of slush ice. In January and February the fate of each radio tagged fish surveyed was also determined.

A tag-and-recapture program was continued in 1984 to monitor the seasonal movements of adult resident fish. Floy anchor tags were used to tag seven species of adult resident fish: rainbow trout, Arctic grayling, humpback whitefish (Coregonus pidschian Gmelin), round whitefish, burbot, longnose suckers (Catostomus catostomus Forster), and Dolly Varden (Salvelinus malma Walbaum). All resident fish that appeared healthy after capture and were large enough to accommodate a tag were tagged. Burbot with a total length (TL) greater than 225 millimeters (mm) were tagged and other resident species with fork lengths (FL) greater than 225 mm were tagged.

Tag recoveries were made by the resident fish study group, the adult salmon fishwheel crews, and the angling public.

2.2.2 Population estimates

Population estimates were made for adult ($\geq$ 200 mm) rainbow trout, Arctic grayling, round whitefish, and longnose suckers in the middle river using the multiple-year (1981-84) tagging and recapture data (see Appendix D).

2.2.3 Radio telemetry

Most fish which were radio tagged were captured by boat electrofishing or by hook and line (Plate 1; Appendix Table B-1).

Equipment

Radio telemetry receiving equipment used in this study was developed by Smith-Root Incorporated in Vancouver, Washington. Receiving equipment consisted of a low frequency (40 MHz) radio tracking receiver (Model RF-40) and scanner (Model SR-40), and a loop antenna (Model LA-40).

Radio transmitters used in 1984 were manufactured by Advanced Telemetry Systems (ATS) of Bethel, Minnesota. Two types of radio tags were used: internal and external. Internal radio tags with 6-11 month life expectancies were implanted in rainbow trout. External radio tags were attached to several pre-spawning rainbow trout and one Arctic grayling.

Plate 2. Locating a radio tagged rainbow trout in the mainstem at RM 111.4 and measuring water velocities at this location, February 1984.

External tags were used on several pre-spawning rainbow trout since it was believed the condition of some of these fish would be unacceptable for internal implants. An external radio tag was used on the Arctic grayling since past efforts to internally radio tag this species have failed (ADF&G 1983c).

Radio tags used in rainbow trout and burbot tagged in 1983 and monitored during 1984 were somewhat different from those used in 1984. Refer to Suchanek et al. (1984) and Sundet and Wenger (1984) for methods of tagging, transmitter types, biological characteristics, and summer movement of fish tagged in 1983.

Advanced Telemetry Systems' internal transmitters (Model 10-35) used in 1984 were identical to those used in 1983 studies except pulse rates were slightly higher [between 1.0 and 2.5 pulses per second (pps)].

Advanced Telemetry Systems' external radio tags (Model RM 625) are rectangularly shaped, encapsulated in epoxy, and have slightly flexible 24.0 centimeter (cm) external antennas. The external transmitters are 0.9 cm high, 1.5 cm wide, 3.0 cm long, and have a dry weight of approximately 9.5 grams. The power source for the transmitters is a 1.4 volt mercury battery providing life expectancies of 90 days. The pulse rates for these tags are 2.4 pps.

The same transmitter frequencies (40.600-40.770 MHz) were used in 1984 as in 1983 studies. All radio tags were immersed in cold water (1.5°C) for 48 hours to ensure they were transmitting properly before they were implanted in fish.

Transmitter implantation

Based on personal communications with Carl Burger (USFWS) and experience gathered from the previous three years of radio telemetry studies, the minimum fork lengths of rainbow trout and Arctic grayling radio tagged was set at 380 mm (ADF&G 1983b, 1983c; Sundet and Wenger 1984).

Internal radio tags were implanted using the same procedures described in Ziebell (1973). Before surgery, fish were anesthetized with MS-222 (tricaine methane-sulfonate).

Prior to attaching external tags to fish, two Peterson disc needles were epoxied to one side of each radio tag so the needles were perpendicular to the length of the tag. Fish to be externally radio tagged were anesthetized and then the external tag was attached just below the dorsal fin (Plate 3). This method was similar as attaching Peterson disc needles described in the adult anadromous section of the 1983 procedures manual (ADF&G 1983a). This was accomplished by using pliers to push the two Peterson needles through the dorsal portion of the fish. After the needles were through the fish, one Peterson disc was attached to each needle. The radio tag and Peterson discs were then pushed tightly next to the fish and the excess needles (over 1.0 cm past the discs) were cut off with pliers. The remaining needles were then rolled with the tip of the pliers to tighten and secure the tag in place.

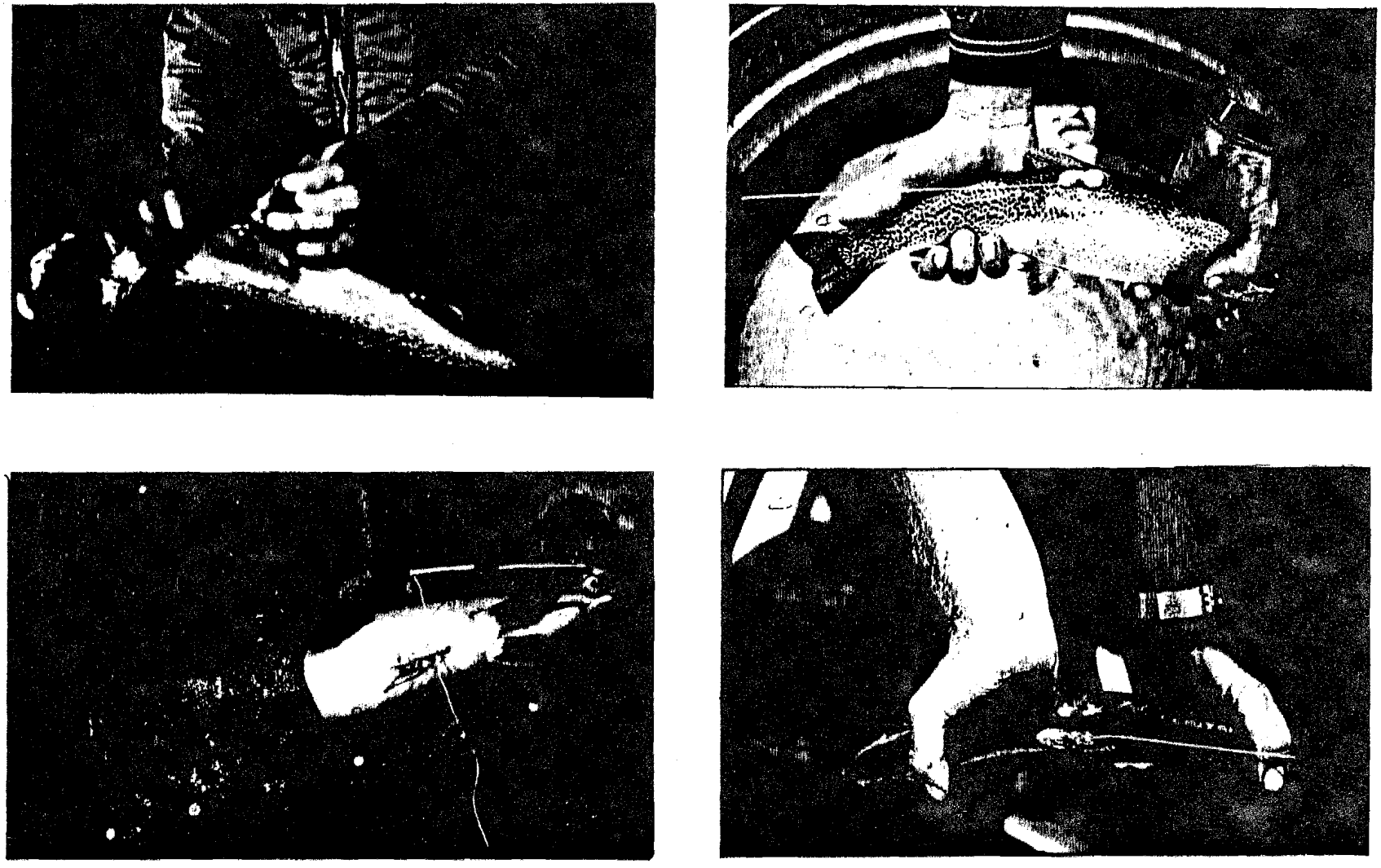


Plate 3. Implanting a radio tag into the abdomen of a rainbow trout (on left) and externally radio tagging a rainbow trout (on right).

After radio tagging, the fish were placed into a live box and held upright until they regained their equilibrium. The fish were then held overnight whenever possible for observation. The following day the sutures were checked on internally implanted fish and the transmitter's signal was tested before releasing each internally or externally radio tagged fish near their point of capture.

Tracking

Biologists radio tracked fish primarily by fixed wing aircraft and boat. Aerial radio tracking was done using methods described in Adult Anadromous Investigations 1981 (ADF&G 1981c). Radio tracking was conducted over the mainstem Susitna by fixed wing from December 1983 to December 1984. Between December 1, 1983 and May 1, 1984, radio tracking was done between RM 40.6 and RM 152.0 approximately every 20 days. From May 1 to August 30, 1984, radio tracking flights were made every 10-14 days between RM 97.0 (Talkeetna) and RM 152.0. From September 1 to December 1, 1984, radio tracking was conducted between RM 0.0 and RM 152.0 every 14 days. Fixed wing tracking was also done over various tributaries such as Fourth of July Creek and Portage Creek from May 1 to December 1, 1984.

Aerial tracking by helicopters was also done occasionally during winter 1983-84 and in May and June 1984. During the summer, radio tracking was also done by boat during each field trip to pinpoint radio tagged fish.

3.0 RESULTS

3.1 Distribution and Relative Abundance of Resident Fish on the Lower Susitna River

3.1.1 Rainbow trout

The first recorded rainbow trout catch of the 1984 open-water season occurred on May 6 at the Deshka River. Other early immigrations of rainbow trout into tributaries were reported by sport fishermen at Kashwitna River between May 16-19 (David James, pers. comm.). During this time, water temperatures were 6.0°C (on May 6) at the Deshka River and 8.2°C (on May 10) at Kashwitna River (TRM 1.5).

A total of 155 rainbow trout were captured by all methods in 1984. The highest rainbow trout catches (62 fish) occurred at the Deshka River. Relatively high catches were made by boat electrofishing sampling in the mainstem Susitna River between RM 30.0 and RM 98.5 in early September (31 fish) and at the mouth of Little Willow Creek (RM 50.3, 14 fish) during late September. Only nine rainbow trout were captured in the upper reaches of east side tributaries during early September.

In 1984, 73 rainbow trout were Floy anchor tagged in the lower river and four fish were recaptured. All four fish were tagged and recovered in the Deshka River. The maximum movement exhibited by these rainbow trout between capture and recapture was 3.5 miles.

3.1.2 Burbot

A total of 334 burbot were captured in 1984. Of these, 282 adult burbot ($\geq$ 200 mm) were caught at the Deshka River between TRM's 0.0 and 6.0. Adult catches at the Deshka River were high in May, September, and October, however, little sampling was done in the interim period.

Few juvenile burbot ($<$ 200 mm) were captured. Twenty-one juveniles were captured at JAHS and the Deshka River weir sites. No juvenile burbot were captured by outmigrant traps at RM 22.4.

In 1984, 197 burbot were Floy anchor tagged in the lower river. Most of these burbot (178) were captured at the Deshka River between TRM 0.0 and TRM 6.0. Twenty-five recoveries were made in September and October 1984 from 23 different fish. All 25 recoveries were made in the Deshka River between TRM 0.0 and TRM 6.0. Nearly all (23) of these recoveries were from burbot tagged in the Deshka River during September or October 1984. Another recovered burbot was tagged in the Deshka River in May 1984. The remaining recovery was from a burbot tagged at Anderson Creek (RM 23.8) on June 22, 1981 and recaptured on October 15, 1984 at the mouth of the Deshka River (RM 40.6). During the interim, it grew from 488 mm to 581 mm (TL).

3.1.3 Arctic grayling

In 1984, Arctic grayling immigration from the mainstem Susitna River were first reported by local fishermen at Grey's Creek (RM 59.5) on

April 28, and Rabideux Creek (RM 83.1) on May 1. Peak catches for Arctic grayling were reported at Grey's Creek on May 7 - 8 and at Kashwitna River (RM 61.0) from May 16-19 (David James pers. comm.).

A total of 271 Arctic grayling were captured in 1984. Most (60%) of the fish were captured during September and early October boat electrofishing efforts. The maximum catch of Arctic grayling during these efforts was 69 fish at mainstem sites between RM 60.1 and RM 98.5. Only two Arctic grayling were captured in upper reaches of east side tributaries during early September hook and line sampling.

Ninety-nine Arctic grayling were Floy anchor tagged in the lower river and no recaptures were made in 1984.

3.1.4 Round whitefish

A total of 1,195 round whitefish were captured in 1984. Round whitefish were most abundant at JAHS sites. Eight hundred three juvenile (<200 mm) and one adult round whitefish (≥ 200 mm) were captured at 20 regularly sampled sites and several opportunistic sites. Catches over 100 round whitefish were recorded at four side channel sites: Sucker (RM 84.5), Beaver Dam (RM 86.3), Sunset (RM 86.9), and Sunrise (RM 87.0). Most adult round whitefish catches (72 fish) were made by boat electrofishing in the mainstem between river miles 60.1 and 98.5.

In October, 19 sexually ripe round whitefish were captured at six sites. Eight spawning fish were found in the mainstem at RM 70.0. Several individual or pairs of spawning fish were also caught in the mainstem between RM 50.5 and RM 84.0.

In 1984, 113 round whitefish were tagged in the lower river and four round whitefish were recovered. Three of the fish (one tagged each year in 1981, 1982, and 1984) were recaptured less than 5.0 miles from their tagging site. The remaining fish moved from Montana Creek (RM 77.0) to TRM 1.5 of the Kashwitna River (RM 61.0) in two years.

3.1.5 Humpback whitefish

Six hundred eighty-seven humpback whitefish were captured in 1984. Most (94.2%) of the fish were captured by fishwheels or by outmigrant traps. Outmigrant traps located at Flathorn Station (RM 22.4) captured 71 juvenile humpback whitefish with 26.8% of the catch occurring in early September. No adult humpback whitefish (≥ 200 mm) were captured at the outmigrant trap site.

The largest fishwheel catches of humpback whitefish occurred at Flathorn Station (RM 22.4) where 369 adults were captured. Fishwheels at Sunshine (RM 79.0) and Yentna (RM 28.5, TRM 4.0) stations also captured over 70 humpback whitefish. The maximum seasonal catch at fishwheel sites was made during late August. Relatively high fishwheel catches also occurred from early July to early August.

Boat electrofishing humpback whitefish catches were the highest (16 of 27 fish) at mainstem sites between RM 30.0 and RM 98.5. No humpback whitefish catches were reported at JAHS sites, however some juvenile humpback whitefish catches may have been misidentified as round whitefish (Paul Suchanek, pers. comm.).

In 1984, 261 humpback whitefish were tagged in the lower river and three were subsequently recaptured by fishwheels. All three recaptures were tagged at Flathorn Station (RM 22.4). One fish was recovered at Flathorn Station eight days later. The other two were recovered at Yentna Station (RM 28.5, TRM 4.0). The time between tagging and recovery of these two fish was 2 and 30 days.

3.1.6 Longnose suckers

Eight hundred sixty-two longnose suckers were captured in 1984. Most longnose sucker catches (326 fish) were made at JAHS sites and all but a few were juveniles (<200 mm). Catches at JAHS sites were the highest at Sunrise Side Channel (RM 87.0, 53 fish). Catches over 40 fish were also made at Hooligan (RM 35.2) and Sucker (RM 84.5) side channels.

Higher boat electrofishing catches (145 of 191 fish) were recorded at mainstem sites between RM's 30.0 and 60.0 compared to other boat electrofishing sites. Relatively high catches were also made at the Deshka River and fishwheel sites (226 and 76 fish, respectively). Most (50%) fishwheel catches of longnose suckers occurred during early July or late August and most (87%) Deshka River catches were in May or September. Thirty-five juvenile longnose suckers were also captured by outmigrant traps at RM 22.4.

During 1984, 283 longnose suckers were tagged in the lower river and one longnose sucker was recaptured. After five months at large, it was recovered in the Deshka River (RM 40.6, TRM 1.0) only 0.7 miles from where it had been tagged.

3.1.7 Other Species

Dolly Varden

Thirty-one Dolly Varden were captured in the Susitna River during 1984; the highest catch (15 fish) occurred at fishwheel sites.

Dolly Varden were caught at the mouth of the Talkeetna River and at the Kashwitna River (TRM 1.2) between April 30 and May 6. After this time, sport fishermen's catches declined sharply indicating that the fish had moved elsewhere. Sport fishermen reported Dolly Varden catches at Clear Creek (TRM 6.0 of Talkeetna River) increased near May 6. Dolly Varden were the first observed resident species to immigrate into the Kashwitna River and Talkeetna River in 1984. At this time, the water in both of these glacial tributaries was still clear and much shelf ice was present. The mid-day water temperature at Talkeetna River was 3.5°C and 4.5°C on May 2 and on May 8, respectively. The mid-day water temperature at Kashwitna River on May 6 was 6.5°C.

During 1984, five Dolly Varden were tagged in the lower river and none were recovered.

Northern pike

In 1984, three northern pike (Esox lucius Linnaeus) were captured; all three fish were caught at Flathorn Station (RM 22.4). Two adult fish (≥ 200 mm) were captured in late August, one by a fishwheel and one by an outmigrant trap. The other fish was a juvenile (< 200 mm) captured by an outmigrant trap in mid-August.

Threespine stickleback

A total of 8,775 threespine stickleback (Gasterosterus aculeatus Linnaeus) were captured during 1984. Outmigrant traps at Flathorn Station captured 7,765 threespine stickleback. The highest seasonal outmigrant trap catches (37.1%) occurred during early August. Juvenile Anadromous Habitat Study (JAHS) crews captured the remaining fish. At JAHS sites, the maximum catch (915 of 1,010) of threespine stickleback was recorded at Beaver Dam Slough (RM 86.3). Over 95% of the catch at all sites were young-of-the-year stickleback (20-40mm).

Ninespine stickleback

In 1984, 50 ninespine sticklebacks (Pungitius pungitius Linnaeus) were captured by a JAHS crew sampling at an opportunistic site and another ten were caught by outmigrant traps at RM 22.4. Fish caught by the JAHS crew were beach seined at an unnamed upland slough on the west side of the Susitna River at RM 57.2. No lengths were recorded, but two age classes were observed. One age class was approximately 25 mm long and the other was approximately 50 mm (TL). A list of the habitat parameters at the site where the ninespine sticklebacks were captured are presented in Table 2.

Table 2. Habitat data collected at RM 57.2 where 50 ninespine stickleback were captured, August 5, 1984.

Water Measurements:	
Velocity	0.1 fps
Depth	3.5 ft
pH	6.6
Temperature	7.5°C
DO	6.5 mg/l
Conductivity	160 uhos/cm
Substrate Composition	Mud
Cover Characteristics:	
Type	emergent vegetation
% cover	96-100%

Arctic lamprey

A total of 425 Arctic lamprey (Lampetra japonica Martens) were captured in 1984. A fyke net weir on the Deshka River (RM 40.6, TRM 2.5) captured most of these Arctic lamprey (336 fish). Five of these fish were adults (310-600 mm) and the remainder were juveniles (< 200 mm). Arctic lamprey were caught at the Deshka River from late May to mid-August. However, the largest catches were made during mid-May (32.7%) and late July (66.9%).

Outmigrant traps at RM 22.4 captured 22 Arctic lamprey. In addition, 57 Arctic lamprey were captured by JAHS crews of which 55 were caught at Birch Creek Slough (RM 88.4). A few Arctic lamprey were also captured in the Deshka River by hoop nets.

3.2 Resident Fish Index Site Monitoring on Middle Susitna River

A total of 1,409 resident fish were captured by boat electrofishing at 13 index sites in 1984. Seven species of fish were captured: rainbow trout, burbot, Arctic grayling, round whitefish, humpback whitefish, longnose suckers, and Dolly Varden. Most of these fish (56.6%) were captured at tributary sites. Mainstem and slough sites accounted for 35.3% and 8.2% of the catch, respectively. Relatively high catches at the combined sites were recorded for rainbow trout, Arctic grayling, round whitefish, and longnose suckers. Catch data for these four species are presented by site in Appendix Table E-1 and by macrohabitat type in Table 3. Less than 20 fish of each of the other resident fish species were captured at index sites. Because these catches were so small, no further catch data will be presented for these other resident fish species.

3.2.1 Tributary mouth sites

Round whitefish and Arctic grayling were captured more frequently at tributary mouth sites (83.5%) in 1984 than rainbow trout or longnose suckers (Table 3). Round whitefish were captured in greatest numbers at Indian River (136 fish) (Appendix Table E-1). Arctic grayling were captured primarily at Indian River (104 fish) and Portage Creek (104 fish). Most rainbow trout were captured at Indian River (26 fish) and most longnose suckers were captured at Jack Long Creek (21 fish).

3.2.2 Slough Sites

In 1984, Arctic grayling (48.7%) were found more often at slough sites than other species. The percentage of other species captured at sloughs were as follows: round whitefish (20.7%), longnose suckers (18.0%), and rainbow trout (12.6%) (Table 3). Thirty-eight of 41 Arctic grayling captured were caught at Whiskers Creek Slough in late May (Appendix Table E-1).

3.2.3 Mainstem sites

Round whitefish (56.9%) and Arctic grayling (32.0%) were captured more often at mainstem sites than rainbow trout or longnose suckers (Table 3). Most round whitefish (178 fish) were captured between RM 147.0 and

Table 3. Boat electrofishing catch and catch per unit effort (CPUE) of four resident fish species in the middle Susitna River by three macrohabitat types. CPUE is in parenthesis, and the units are catch per minute.

SPECIES	MAY 16-31	JUN 1-15	JUN 16-30	JUL 1-15	JUL 16-31	AUG 1-15	AUG 16-31	SEP 1-15	SEP 16-30	OCT 1-15	TOTAL
MACROHABITAT TYPE											
Tributary Mouths											
RAINBOW TROUT	15(.07)	3(.08)	3(.06)	---(----)	4(.12)	---(----)	2(.06)	17(.25)	8(.16)	1(.04)	53(.11)
ROUND WHITEFISH	63(.31)	27(.70)	89(1.91)	---(----)	25(.74)	---(----)	18(.54)	46(.67)	83(1.64)	20(.74)	371(.74)
ARCTIC GRAYLING	61(.30)	14(.36)	27(.58)	---(----)	30(.88)	---(----)	31(.93)	75(1.09)	36(.71)	9(.33)	283(.56)
LONGNOSE SUCKER	0(0.00)	2(.05)	3(.06)	---(----)	3(.91)	---(----)	21(.63)	16(.23)	2(.04)	1(.04)	76(.15)
TOTAL	139(.68)	46(1.19)	122(2.62)	---(----)	90(2.65)	---(----)	72(2.15)	154(2.23)	129(2.55)	31(1.15)	783(1.55)
Sloughs											
RAINBOW TROUT	10(.20)	0(0.00)	0(0.00)	---(----)	1(.08)	---(----)	0(0.00)	2(.12)	1(.14)	---(----)	14(.11)
ROUND WHITEFISH	6(.12)	4(1.00)	5(.20)	---(----)	0(0.00)	---(----)	3(.21)	5(.30)	0(0.00)	---(----)	23(.18)
ARCTIC GRAYLING	42(.85)	2(.50)	0(0.00)	---(----)	1(.08)	---(----)	2(.14)	7(.42)	0(0.00)	---(----)	54(.42)
LONGNOSE SUCKER	2(.04)	1(.25)	5(.20)	---(----)	1(.08)	---(----)	6(.41)	5(.30)	0(0.00)	---(----)	20(.16)
TOTAL	60(1.21)	7(1.75)	10(.41)	---(----)	3(.25)	---(----)	11(.76)	19(1.15)	1(.14)	---(----)	111(.87)
Mainstem											
RAINBOW TROUT	3(.06)	0(0.00)	0(0.00)	---(----)	0(0.00)	---(----)	0(0.00)	5(.09)	11(.18)	5(.10)	24(.07)
ROUND WHITEFISH	36(.53)	65(1.49)	16(.82)	---(----)	3(.15)	---(----)	8(.50)	60(1.09)	64(1.08)	25(.49)	277(.84)
ARCTIC GRAYLING	27(.40)	20(.46)	24(1.23)	---(----)	21(1.24)	---(----)	6(.38)	40(.73)	14(.24)	4(.08)	156(.47)
LONGNOSE SUCKER	0(0.00)	3(.07)	5(.26)	---(----)	6(.35)	---(----)	0(0.00)	9(.16)	5(.08)	2(.04)	30(.09)
TOTAL	66(.98)	88(2.02)	45(2.31)	---(----)	30(1.76)	---(----)	14(.88)	114(2.07)	94(1.58)	36(.70)	487(1.48)

- - - = No effort.

RM 148.0 (Appendix Table E-1). Most (72 fish) Arctic grayling were captured between RM's 137.3 and 138.3. The highest mainstem catches of rainbow trout and longnose suckers occurred at RM 150.1 where 19 and 34 fish were captured, respectively.

3.3 Radio Telemetry Studies of Selected Resident Fish of the Middle Susitna River

3.3.1 Rainbow trout

Eighteen of 26 radio tagged rainbow trout tagged in 1983 were monitored during the winter of 1983-84 until their batteries expired. The remaining eight fish died or the battery-powered radio tag ceased functioning between July and early December 1983. Biological, tagging, and monitoring data collected between May and early December 1983 are presented in Suchanek et al. (1984) and Sundet and Wenger (1984).

Movements of the 1983 tagged fish from mid-December through late April were minimal with most (13 of 18 fish) moving less than 2.0 miles from where they were found in early December (Figures 4 and 5). The maximum winter movement was shown by rainbow trout 729-1.0 which moved 46.5 miles in 23 days. Because it moved downstream much more rapidly than the others, it was believed to have died between early January and early February. The remaining four fish moved from 2.8-8.1 miles between mid-December and late April. The maximum upstream movement of radio tagged rainbow trout during this time was 2.8 miles.

On January 11 and 12, fourteen of 17 fish whose transmitters were still functioning were located by helicopter in open-water areas of the mainstem Susitna. The open water prevented sampling and biologists were unable to determine the fate of these fish.

The other three rainbow trout were initially located by helicopter then pinpointed during ground surveys in areas of the mainstem covered by ice. Rainbow trout 670-1.4 was pinpointed at RM 101.1. This fish had stayed within a 0.5 mile radius during 1983-84 monitoring. It was in 2.5 feet of slush-free water with an estimated velocity of 1 to 2 feet per second (Appendix Table B-1). Rainbow trout 767-1.5 was pinpointed at RM 114.8, it had ranged 1.2 miles from its tagging location. Rainbow trout 767-1.5 was located in one foot of water with six inches of slush ice over the water. Since no movement was detected after ice augering in the areas where their transmitted signals were the strongest, the fate of fish (670-1.4 and 767-1.5) was not determined. The fate of the remaining rainbow trout (597-1.3) located during the ground survey was also not determined due to a peculiar null from its signal which prevented pinpointing the fish.

Surveys on February 15-17 found 15 fish whose transmitters were still functioning. All but five fish were found in areas of open water. Three (670-1.4, 709-1.5, and 729-1.3) of the five fish found under ice cover moved from 10-200 feet after drilling with an ice auger over them. These three fish were found in water depths averaging 6.2 feet and flows averaging 2.2 fps. Appendix Table B-1 lists habitat measurements taken at the three locations.

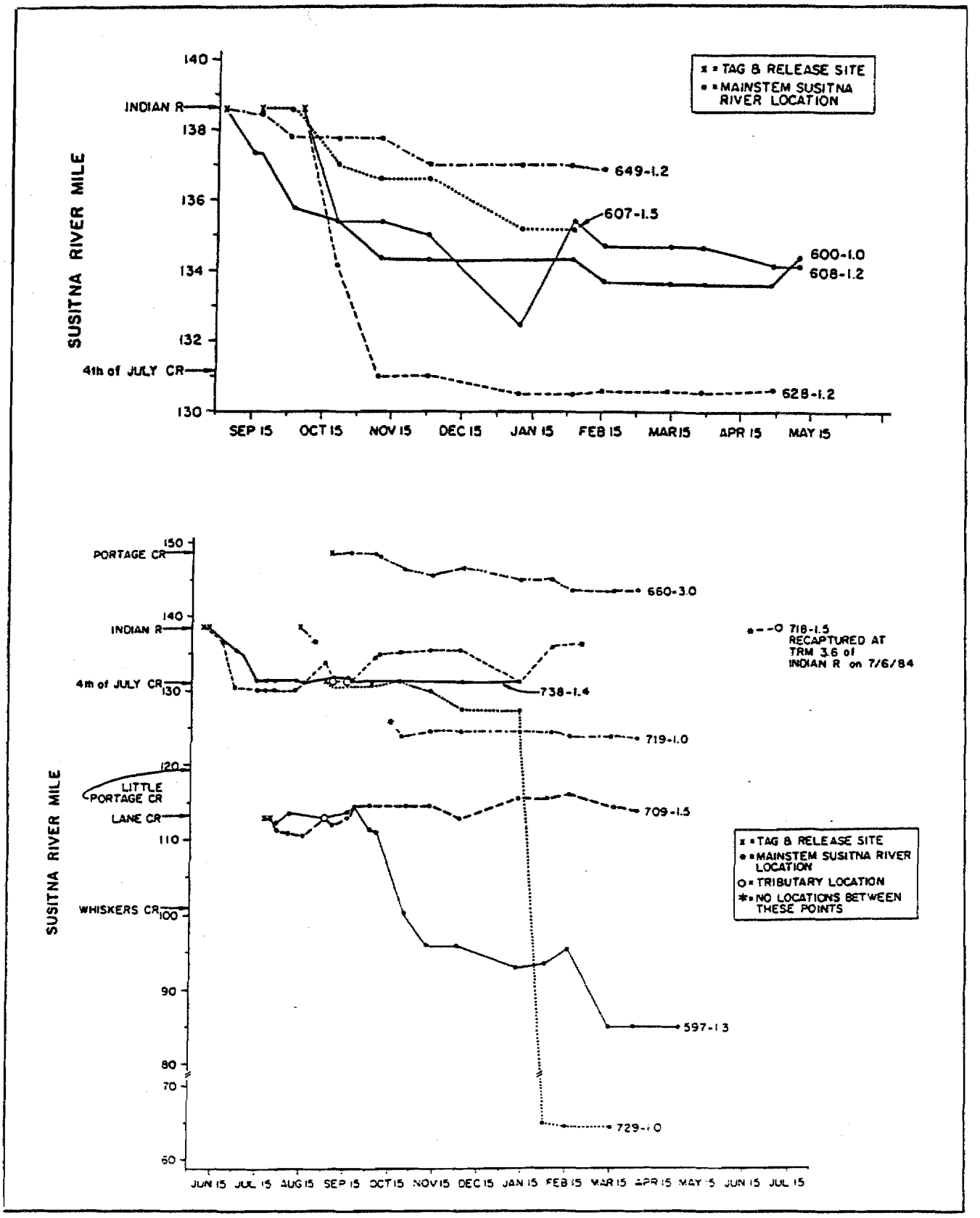


Figure 4. Movement of 12 radio tagged rainbow trout in the Susitna River below Devil Canyon, June 1983 to May 1984.

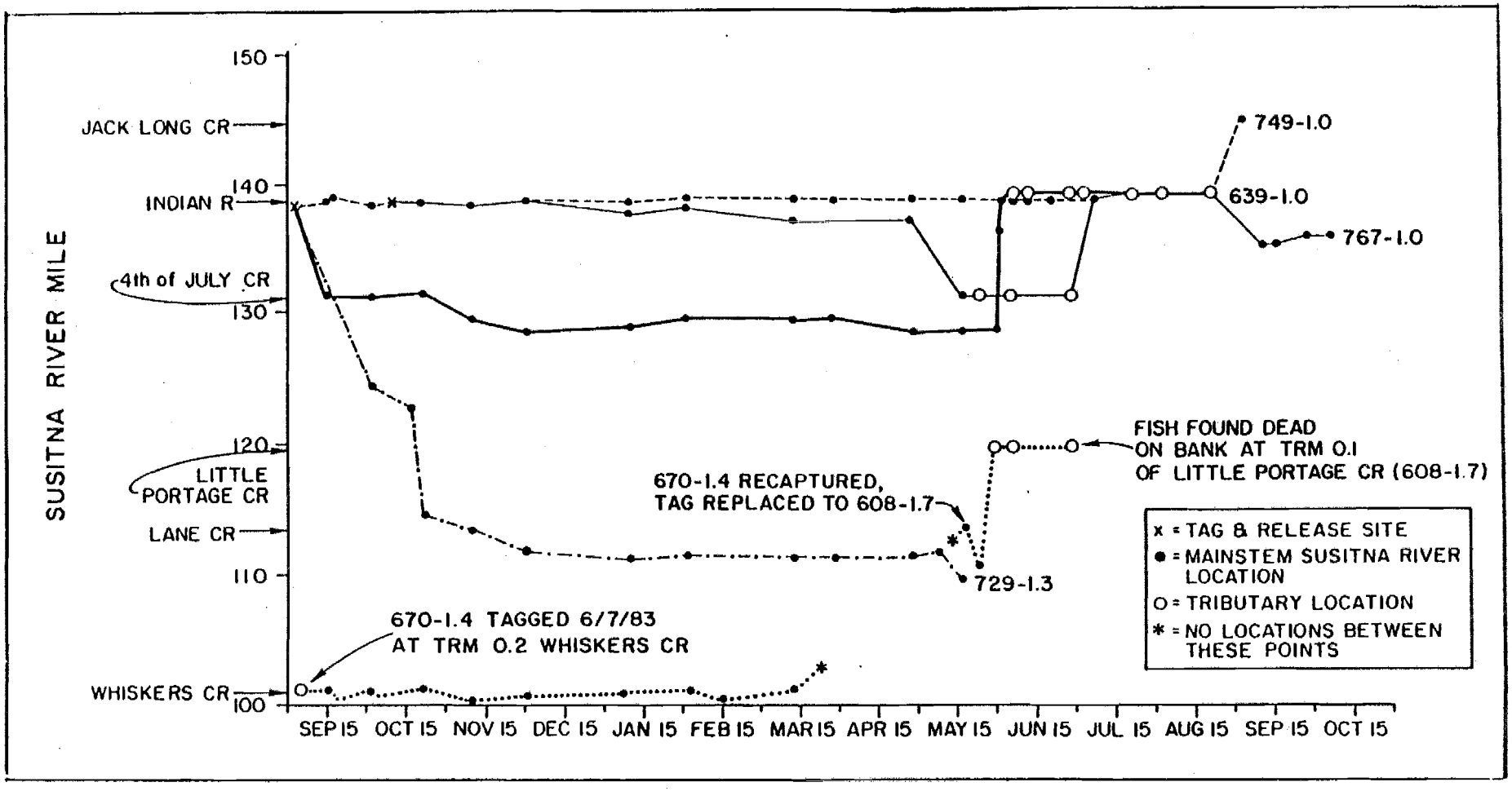


Figure 5. Movement of five radio tagged rainbow trout in the Susitna River below Devil Canyon, September 1983 to October 1984.

Two other fish found during ground surveys in mid-February were believed to be dead. No movement was detected for either rainbow trout 767-1.5 or 729-1.0. Rainbow trout 767-1.5 was found in only one foot of water and 729-1.0 in 1.5 feet of water. Water velocities near these two fish were less than 0.5 fps.

All ten fish found in open water during mid-February were in areas with no anchor ice. Three of these fish were in pools and the others were in riffles.

Six 1983 radio tagged rainbow trout were found after April but the transmitter batteries from three of their tags expired by mid-May. The remaining three fish (639-1.0, 749-1.0 and 767-1.0) were monitored until August or September 1984 (Figure 5). One of these fish (767-1.0) moved into Fourth of July Creek on May 24, then moved up and into Indian River in early July (Figure 6 and 7). The other two fish also moved into Indian River during the summer (Figure 7).

Two rainbow trout which had been radio tagged in 1983 were recovered in 1984. Transmitters in both fish had been dead for over one month. Rainbow trout 718-1.5 was recaptured at TRM 3.6 of Indian River by a sport fisherman on July 6. Rainbow trout 670-1.4 was recaptured at Lane Creek on May 18 by a boat electrofishing crew and the old transmitter was replaced with tag 608-1.7. On May 31, the fish was located at the mouth of Little Portage Creek (RM 119.0). On June 27 the tag was found along the bank at TRM 0.1 of the creek and the fish was suspected to have been eaten by a predator.

In 1984, 23 rainbow trout were radio tagged in the middle river between May 17 and July 23 with 82.6% being tagged by June 10. Fourteen of the radio tagged fish were pre-spawners. All but two of the fish were captured in tributaries or at tributary mouths. A breakdown of the radio tagged rainbow trout catch by tributary was as follows: Fourth of July Creek (9), Portage Creek (8), and Indian River (4). One fish tagged at Fourth of July Creek apparently died after it was tagged, therefore no tracking data is provided for this fish. Appendix Table B-2 presents a summary of capture and biological data for the other 22 radio tagged fish. Individual fish movements of these rainbow trout from the time they were tagged through November 30, 1984 are presented in Figures 6 to 11. Most (21 of 25) radio tagged fish monitored during the summer appear in two or more figures since they moved in the mainstem as well as in tributaries or between tributaries. Most (16) of the 1984 tagged fish showed large summer movements between 5.0-15.0 miles from where they were tagged. All but one fish showed an upstream movement of over 1.0 mile. The maximum movement by a rainbow trout (598-1.6) was 101.2 miles (Figure 8). Because it moved so much and so rapidly after August 13, it apparently died shortly thereafter. Another fish (670-1.2) may have died after spawning (Figure 9).

Only one of the 25 monitored radio tagged rainbow trout was not found in a tributary during the summer of 1984. Ten fish ascended Portage Creek, six ascended Fourth of July Creek, four ascended Indian River, two ascended both Fourth of July Creek and Indian River, one fish ascended

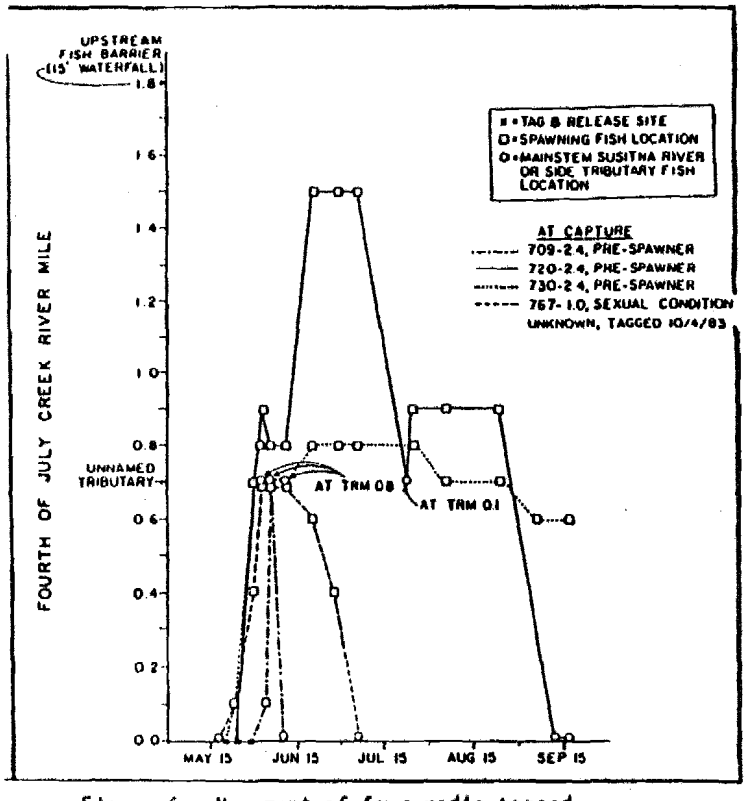


Figure 6. Movement of four radio tagged rainbow trout in Fourth of July Creek, May to October 1984.

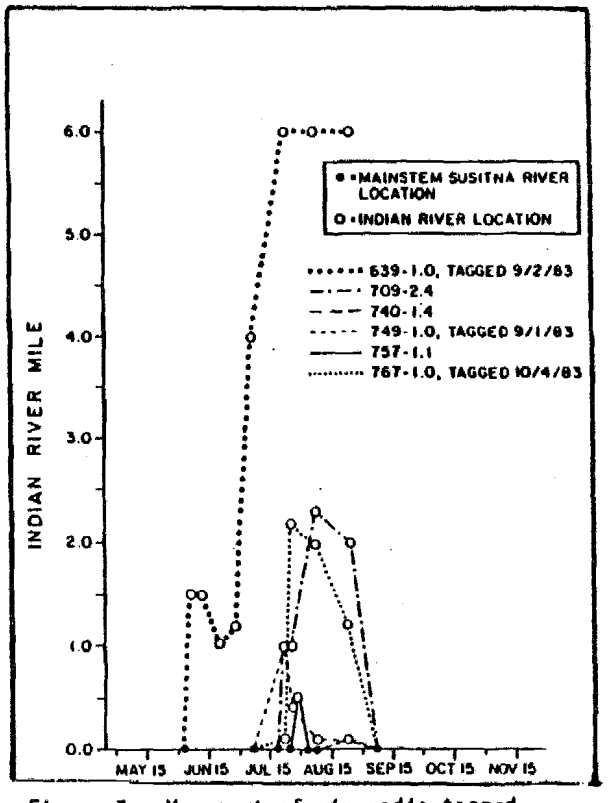


Figure 7. Movement of six radio tagged rainbow trout in Indian River, May to October 1984.

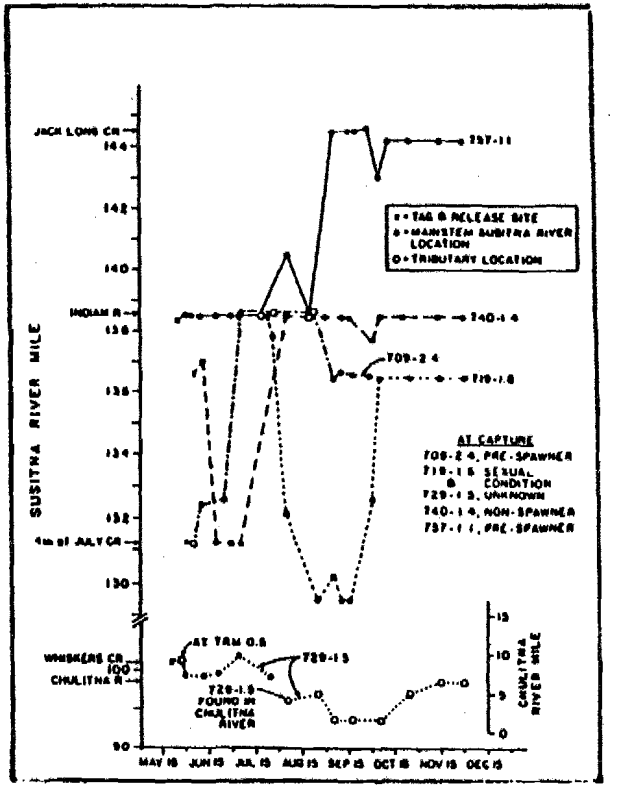


Figure 8. Movements of five radio tagged rainbow trout in the Susitna River, May to December 1984.

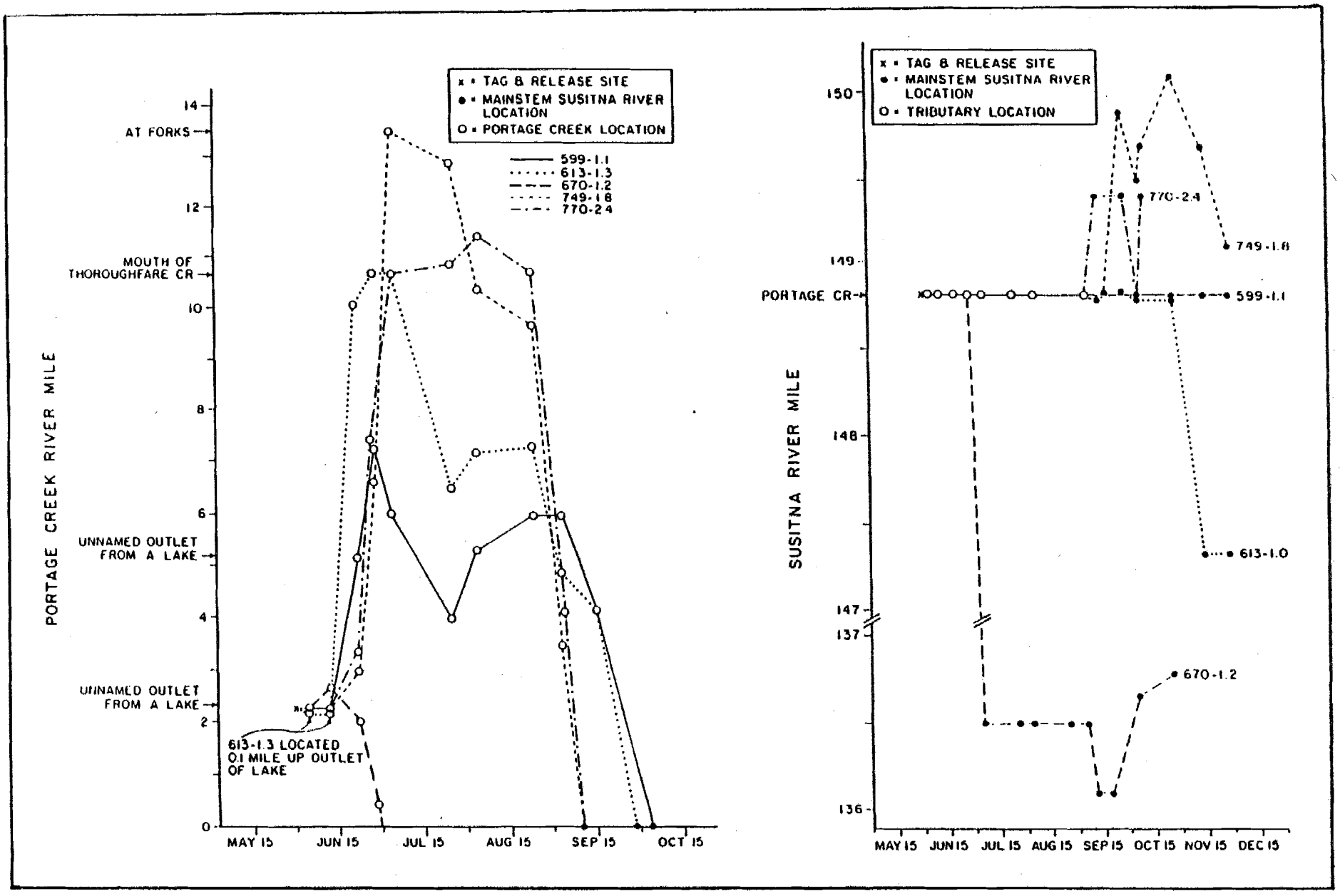


Figure 9. Movement of five spawning rainbow trout, tagged at TRM 2.3 Portage Creek, in Portage Creek and then in the mainstem Susitna River, May to December 1984. At capture, all five fish were pre-spawners.

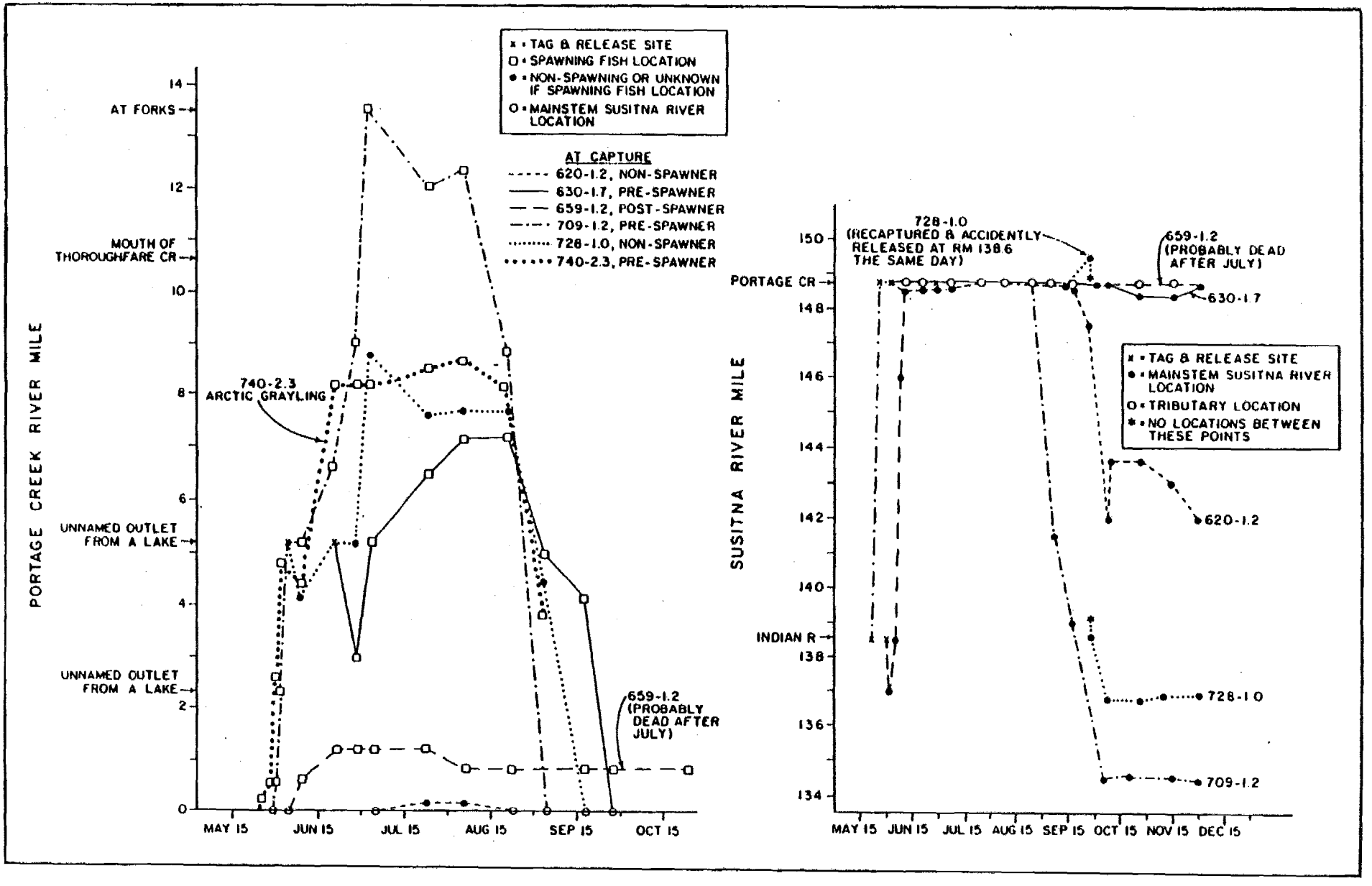


Figure 10. Movement of five rainbow trout and one Arctic grayling in Portage Creek and then in the mainstem Susitna River, May to December 1984.

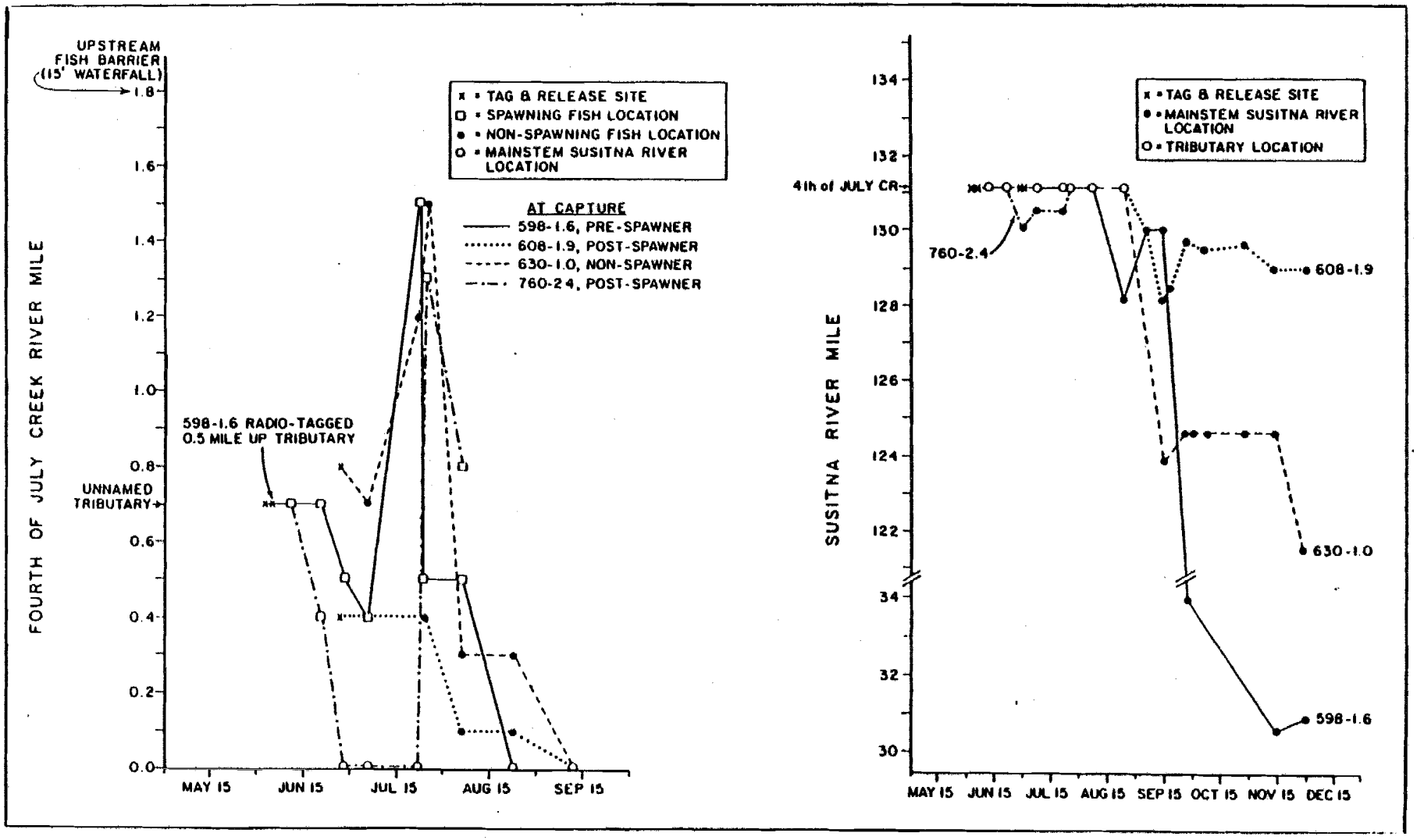


Figure 11. Movement of four radio tagged rainbow trout in Fourth of July Creek and then into the mainstem Susitna River, May to December 1984.

Little Portage Creek, and one ascended Whiskers Creek. The fish which moved into Whiskers Creek, later moved into the Chulitna River (Figure 8). In 1984, 434 locations of 39 different radio tagged rainbow trout were recorded. Movements of radio tagged rainbow trout monitored in 1984 can be placed into four major categories based on their annual life history: (1) those associated with overwintering (December - April), (2) those associated with spawning (May and June), (3) those associated with summer rearing (July - September), and (4) those associated with the transition period between fall and winter (October and November). The distribution of 1984 monitored fish changed by macrohabitat as the season changed. Between December and April, nearly all (90.7%) rainbow trout were found in the mainstem (Figure 12). During May and June, 62.2 percent of the radio tagged rainbow trout locations were in tributaries. The majority (58.9%) of fish locations from July to September were also in tributaries.

By October 6, all but one radio tagged rainbow trout had outmigrated from tributaries to their mouths or into the mainstem. The one rainbow trout (659-1.2) that remained in a tributary after September was believed dead because it exhibited no movement over an extended period of time (Figure 10). In October and November, 72.1% of the radio tagged rainbow trout locations were associated with the mainstem and the remainder were at tributary mouths.

3.3.2 Burbot

Sampling trips made in mid-January and mid-February 1984 to locate and determine the fate of burbot radio tagged during the summer of 1983 yielded limited data. In January, only one burbot was pinpointed during ground surveys. Two more radio tagged burbot were located in open-water areas of the mainstem during January. In February, only one radio tag was still functioning.

Burbot 670-3 was located in the mainstem at RM 87.0 in January. Biologists measured 6 inches of water with zero velocity and 2 feet of slush ice between the water and the ice at this location. This burbot did not move when ice augering was done in the vicinity of its strongest radio tag signal and therefore its fate was not determined. Two burbot sets made in the area overnight failed to catch any fish. Both this fish and the other two fish (639-3.0 and 720-3.0) located in mid-January moved downriver less than 1.0 mile from where they were found on December 1, 1983. Burbot 639-3.0 was located at RM 131.1 in waters approximately 4 feet deep and velocities of 1-2 fps. Habitat measurements taken near burbot 639-3.0 showed a water temperature of 0.2°C, conductivity of 247 umhos, pH of 7.9, and DO of 13.6 mg/l. In February, burbot 720-3.0 was found 0.2 miles downriver from where it had been pinpointed in January in an open-water channel off Slough 10 (RM 133.8) in water approximately 4 feet deep. Burbot 720-3.0 was last found on March 13, at RM 133.7.

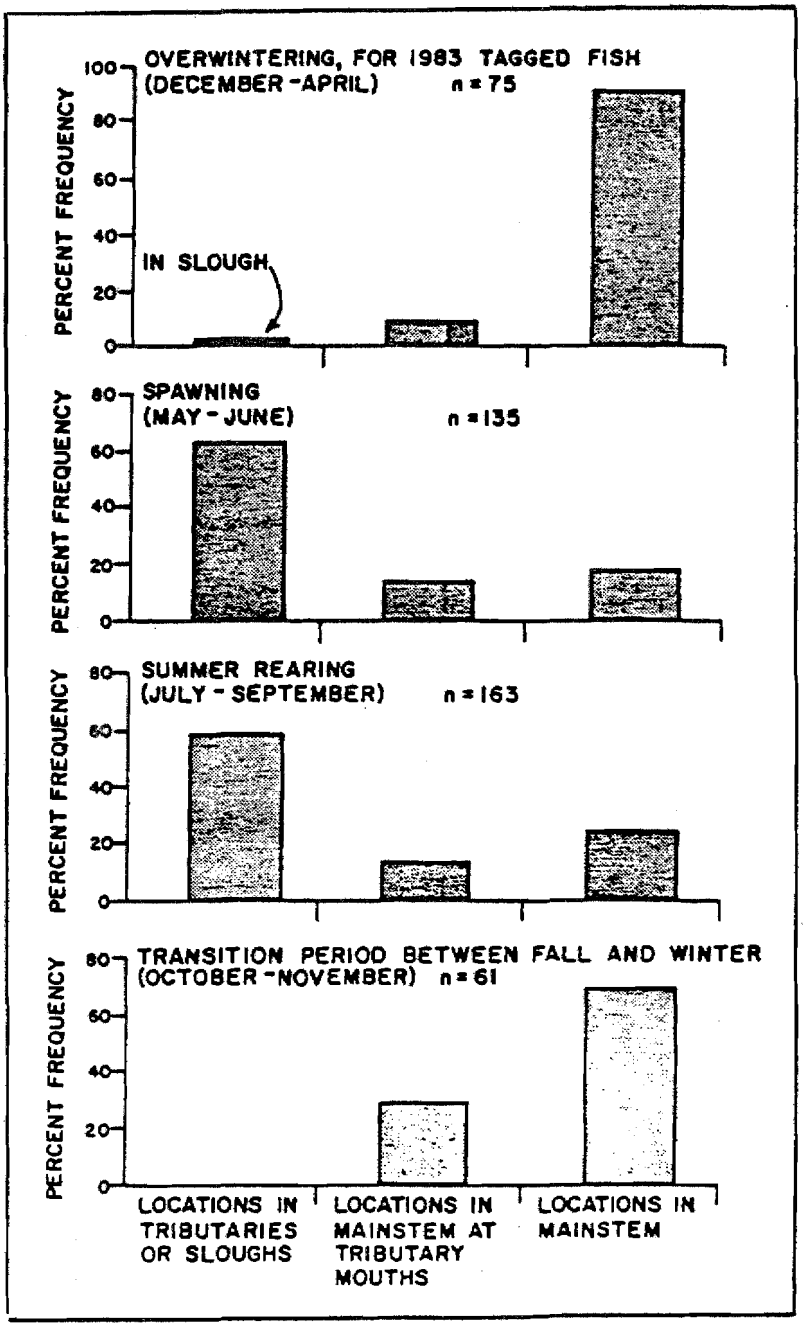


Figure 12. Frequency distribution of radio tagged rainbow trout locations in tributaries, at tributary mouths, and in the mainstem Susitna River during 1984.

3.3.3 Arctic grayling

One radio tagged Arctic grayling was monitored between May and September 1984. This fish was captured by boat electrofishing, tagged, and released at RM 150.1 on May 22. Biological data collected from this fish at the time of capture, indicated it was a pre-spawning male, 410 mm (FL) long, and 10 years old. Two days after tagging, it moved into Portage Creek (RM 148.8) for the summer (Figure 10). The maximum recorded upstream location of this fish was TRM 8.7 on August 6. Shortly thereafter, the fish began to move downstream in Portage Creek and it was last found on September 6 at TRM 3.8 of Portage Creek.

3.4 Other Resident Fish Studies on the Middle River

Table 4 provides catch data of resident fish captured in the middle river in 1984 at sites other than the 13 boat electrofishing index sites. Population estimates were made using 1981-84 data; numbers used and population estimates made are provided in Appendix D.

Four sites were located in 1984 where rainbow trout probably spawned. These sites were at Portage Creek TRM 2.3 and TRM 5.1, at Fourth of July Creek TRM 0.7, and at TRM 0.5 of an unnamed side tributary which has an outlet entering at TRM 0.7 of Fourth of July Creek. Appendix Table E-2 provides habitat measurements taken at these sites as well as general comments about each site.

3.4.1 Lake surveys

A total of 390 resident fish were captured in six lakes surveyed in 1984 (Table 4). Rainbow trout composed 86.1% of the catch at these lakes. Lake B was the only lake surveyed where no rainbow trout were captured. Effort was similar in all lakes except at the lake which has an outlet that enters Portage Creek at TRM 2.3. Much less effort was expended in this lake compared to the other five lakes. Less effort was expended at the one lake bacause sampling was done in each lake only to document if rainbow trout were present; in the Portage Creek lake, rainbow trout were captured immediately by hook and line after landing in a helicopter. In the other lakes, rainbow trout were not immediately captured or observed, therefore, gill nets had to be set overnight.

3.4.2 Tag-and-recapture studies

Rainbow trout

In 1984, 153 rainbow trout were Floy anchor tagged and 30 recoveries were made from rainbow trout tagged in the middle river. Seven recoveries were made at the tagging sites and 15 rainbow trout were recovered within 5.0 miles of their tagging sites. The remaining eight fish moved an average of 27.4 miles from where they were tagged. Most (63%) recoveries were from fish tagged in 1983. Eighty-seven percent of the recoveries were made in or at the mouths of tributaries such as Fourth of July Creek (14, RM 131.1), Indian River (6, RM 138.6), and

Table 4. Catch data of resident fish species in the middle river at opportunistic and lake sites, May to October 1984.

Species	Catch Data at Middle River Sites (Excluding Lakes)								Middle River Lake Catch Data						
									Lakes at Headwaters of Fourth of July Creek						
	Fishwheel Sites	Outmigrant Traps	Boat Electro-shocking Opportunistic Sites	Other Gear at Mainstem Influenced Opportunistic Sites	Indian River TRM 0.1-TRM 9.0	Portage Creek TRM 0.1-TRM 11.6	Fourth of July Creek TRM 0.1-TRM 1.8	Total Catch	A	B	C	D	Miami Lake	Lake Outletting at 2.3 of Portage Creek	Total Catch
Rainbow trout	9	50	12	39	1	13	54	178	64	0	192	59	11	10	336
Burbot	2	8	0	4	0	0	0	14	0	0	0	0	0	0	0
Arctic grayling	8	88	13	112	0	40	0	261	0	0	0	0	0	0	0
Round whitefish	16	2,173	31	32	0	0	0	2,252	0	0	0	0	0	0	0
Humpback whitefish	27	277	1	7	0	0	0	312	0	0	0	0	0	0	0
Longnose suckers	17	316	5	71	0	0	0	409	0	0	0	0	0	0	0
Dolly Varden	1	5	1	4	0	0	1	12	0	19	0	0	0	0	19
Lake trout (Salvelinus namaycush Walbaum)	0	0	0	0	0	0	0	0	0	33	0	0	2	0	35
Threespine stickleback	-	5,080	0	-	-	-	-	5,080	0	0	0	0	0	0	0
Arctic lamprey	-	93	0	-	-	-	-	93	0	0	0	0	0	0	0
TOTAL CATCH	80	8,090	63	270	1	53	55	8,611	64	52	192	59	13	10	390

- = Not applicable for this species.

Portage Creek (3, RM 148.8). The longest move recorded for a Floy anchor tagged rainbow trout in the Susitna River is 55.7 miles. This fish was tagged in Fourth of July Creek in 1983 and recovered in an unnamed tributary of the Chulitna River (TRM 23.1) during 1984.

Burbot

In 1984, six burbot were Floy anchor tagged in the middle Susitna River and there were no recaptures.

Arctic grayling

During 1984, 425 Arctic grayling were tagged and 44 recoveries of 43 different fish were made from fish tagged in the middle river. This included one fish tagged at Cheechako Creek (RM 152.4) in August 1982 and recovered in May 1984 at Portage Creek (RM 148.8). The 44 recoveries ranged 0.0 to 95.8 miles from their release sites. Eight fish were recaptured at the same site where they were originally tagged. Twenty-one Arctic grayling recaptured were caught within 5.0 miles of the site where they were tagged. The remaining 15 fish moved an average of 20.0 miles. The maximum movement for an Arctic grayling to date is 95.8 miles. This fish was tagged in Portage Creek (RM 148.8, TRM 6.0) in 1983 and recovered in Kashwitna River (RM 61.0, TRM 2.0) in 1984. Most (61.4%) recoveries were made from fish tagged in 1983. Twenty-one of the recoveries were made in tributaries or at tributary mouths with another 17 recaptured in the mainstem.

In addition to these recoveries, one Arctic grayling was recaptured at Portage Creek which had been tagged at Tsusena Creek (RM 181.3) in 1982.

Round whitefish

In 1984, 481 round whitefish were tagged and 76 recoveries of 72 different fish were made from fish tagged in the middle river. Most of the recoveries were made near the tagging sites with 25 at the tagging sites and 35 recoveries made within 5.0 miles of the tagging sites. The remaining 16 fish moved an average of 16.0 miles with a maximum movement of 55.7 miles. Sixty-one percent of the recoveries were made from fish tagged in 1983. Forty-two of the recoveries were made at tributary mouths and 32 recoveries were made in the mainstem.

Humpback whitefish

In 1984, a total of 25 humpback whitefish were tagged in the middle Susitna River. No humpback whitefish were recaptured in 1984.

Longnose suckers

A total of 158 longnose suckers were tagged in 1984. Thirteen longnose suckers that were tagged in the middle river were recaptured in 1984. Four fish were recaptured at their tagging sites, another four were recaptured within five miles of their tagging sites, and the

remaining five fish moved an average of 16.5 miles. Most of the fish recaptured were tagged in 1982 (five fish) or in 1983 (six fish).

Dolly Varden

During 1984, eight Dolly Varden were tagged in the middle river. Three recoveries of two different fish were made in 1984 with both fish being tagged in 1984. One fish was tagged at RM 139.4 and recaptured one month later at RM 136.7 and again three months later at Indian River (RM 138.6). The other fish was tagged and recaptured, 12 days later, at Indian River.

4.0 DISCUSSION

4.1 Lower Susitna River

4.1.1 Rainbow trout

Studies conducted in 1984 show that rainbow trout immigrate lower river tributaries up to 10 days earlier than middle river tributaries. Water temperatures taken at Deshka River and Kashwitna River in 1984 show that the immigration occurs at similar temperatures (6.0°C and 8.2°C, respectively) as Fourth of July Creek (7.7°C) in the middle river. Catch data from 1981 also shows rainbow trout immigrate lower river tributaries early in May (ADF&G 1981b).

It is believed that after rearing in tributaries during the summer, rainbow trout move out of most east side tributaries in September or October and overwinter in the mainstem Susitna River. The fall outmigration is probably triggered by discharge and/or temperature. In 1984, the outmigration was probably triggered by a flood in late August (refer to part 4.2.1 and Figure 14). Surveys conducted in the upper reaches of several of these tributaries in early September found very few rainbow trout. Sport fishermen have reported summer rainbow trout populations in these tributaries such as the North Fork of the Kashwitna River and Montana Creek to be high (Dave Watsjold, pers. comm.).

Radio tagging data from the winter of 1981-82 support the hypothesis that some rainbow trout overwinter in the lower mainstem Susitna River (ADF&G 1983b). Recoveries of Floy anchor tagged fish show some Talkeetna River rainbow trout also overwinter in the mainstem Susitna River (Sundet and Wenger 1984). Because few adult rainbow trout were captured in early spring or late fall in the lower Deshka River in 1981 or 1984, adult rainbow trout may overwinter in the upper reaches of the Deshka River. High rainbow trout catches at the mouths of other tributaries such as Indian River during these times show these populations move into tributaries for summer rearing and into the mainstem for overwintering. Because catch rates were relatively high for juvenile rainbow trout during these times on the lower Deshka River, it appears some upper Deshka River juveniles outmigrate to the mainstem or the lower Deshka River for overwintering.

4.1.2 Burbot

Susitna River burbot reside mostly in mainstem influenced areas (ADF&G 1981b, 1983b, 1983c, Suchanek and Hale 1983). This relationship is probably due to high turbidities which causes low light penetration in the mainstem, a condition the light sensitive burbot prefers (Hale 1983; Suchanek et al. 1984). Studies (1981-84) have shown that burbot are found in much higher concentrations below Talkeetna than above it (ADF&G 1981b, 1983b). This is probably due to a greater frequency of preferred habitat. Captured burbot and radio tagged burbot have been found most often in backwater areas of varying depths (ADF&G 1983c; Hale 1983; Suchanek et al. 1984).

Our data indicates that burbot readily use mainstem influenced areas in the lower river for spawning. Capture rates have been reported by sport fishermen to be high at the mouths of the Deshka River (RM 40.6) and Alexander River (RM 10.1) during mid-December to early February (ADF&G 1983b, 1983c). Radio tagged burbot data has also shown that all 11 burbot monitored during January and February 1982 and 1983 have remained in the mainstem between RM's 26.0 and 89.6. Since approximately 85% of burbot over 400 mm total length are spawners for a given year (ADF&G 1983c), it is likely that several of the radio tagged fish spawned in the mainstem Susitna.

Burbot spawning occurs in the Deshka River and it also probably occurs in the Alexander River. The pre-spawning movement into these tributaries has been reported to begin in November, but from studies done in 1984 this movement appears to begin slightly earlier (ADF&G 1981b, 1983b). During 1984, burbot were captured by hoop nets between TRM's 0.0-6.0 on the Deshka River with catch rates increasing substantially from mid-September to mid-October. The highest burbot catch rates during May, September, and October 1984 sampling were between October 11-15 which were the last days of the open-water field season. Local residents on the Deshka River reported that slush-ice flowed from October 16 to November 11 and on November 11 the river froze over (Leon Dick, pers. comm.).

While few burbot were captured at the farthest upriver Deshka River sites (between TRM's 5.0 to 6.0) in early September, by mid-September the catch and catch rates were much higher. This also suggests that Susitna burbot may spawn in the Deshka River further upriver than previously believed. Data from one burbot tagged and recovered in 1984, and catch data from 1981, also supports this hypothesis. The recaptured fish was tagged at TRM 1.5 on September 13 and recovered at TRM 6.0 on October 13. Catch data from 1981 at TRM 4.5 (site C) showed that there were no adult burbot caught until late August (ADF&G 1981b). From late August through mid-October burbot catch rates increased.

Young-of-the-year burbot have been seldom captured; however, during mid-June 1984 several thousand approximately 15 mm (TL) burbot were observed along the shoals of the Deshka River at TRM 1.9. A similar timing of hatching was reported in 1982 at Slough 9 (RM 129.2) where several dozen of the same size fish were captured (ADF&G 1983b).

4.1.3 Arctic grayling

Spring movements of Arctic grayling into lower river tributaries usually begins in early May, up to 20 days earlier than in most middle river tributaries such as Portage Creek. The earlier immigration into tributaries below RM 98.5 than those above is probably due to warmer water temperatures. Daytime surface water temperatures in 1984 was 8.2°C at Kashwitna River on May 10 and 0.8°C at Portage Creek on May 9.

After rearing in tributaries during the summer, Arctic grayling apparently move out of most east side tributaries into the mainstem to overwinter. In larger west side tributaries such as the Deshka River, most adult Arctic grayling are believed to overwinter in the upper

reaches of those tributaries. Catch rates were only slightly higher in early spring and late fall compared to other times at the Deshka River (TRM's 1.5-6.0) in both 1981 and 1984. Two recaptures in 1981 indicate that some Arctic grayling in the lower river may overwinter far downriver in the mainstem from their summer rearing tributaries. These fish were tagged in May 1981 and were later recovered 9.9 and 32.5 miles upriver (ADF&G 1981b).

4.1.4 Round whitefish

Boat electrofishing catches in the lower river showed that the distribution of round whitefish in 1984 was similar to 1982 findings (ADF&G 1983b). Because a number of sexually ripe round whitefish have been found in the mainstem in October, round whitefish are thought to spawn in mainstem habitats at this time.

4.1.5 Humpback whitefish

Two stocks of humpback whitefish appear to be in the Susitna River below Devil Canyon. One stock is anadromous and the other remains in the river all year. Scale analysis of fish captured in 1983 at Yentna River fishwheels showed that 19.2% of the fish aged exhibited periods of high growth. Above the Chulitna River confluence only 4.9% of the humpback whitefish aged exhibited the same high growth periods. This suggests that a high percentage of humpback whitefish in the lower river overwinter in the estuary. Relatively high juvenile humpback whitefish catches at outmigrant traps at RM 22.4 in 1984 also lends support to this hypothesis.

Fishwheel catch data shows adult humpback whitefish begin their spawning run in July and it continues through September. With the addition of fishwheels at Flathorn Station (RM 22.4) in 1984 more knowledge was gathered on the timing and behavior of humpback whitefish during the spawning migration. As the season progressed, humpback whitefish catches similarly progressed up the river. Catches were high at Flathorn Station from early July to late August, at Yentna Station (RM 28.5, TRM 4.0) from early July to early September, and at Sunshine Station (RM 79.0) in late August and early September. During this time, fishwheel effort was approximately the same at all stations except during the spring. Comparison of catches between the three stations suggests many humpback whitefish migrate up the Yentna River and into areas between these stations to spawn. One of the suspected spawning areas between stations is Anderson Creek (RM 23.8). Large numbers of humpback whitefish were gill netted in this tributary in 1981 (ADF&G 1981b).

Tag-and-recapture data also support evidence of the spawning run originating from or near the estuary. Between late August and early September 1984, two fish were recovered at Yentna Station which had been tagged at Flathorn Station. The time between tagging and recapture for these two humpback whitefish was 2 days and 30 days, respectively.

Exact spawning locations for humpback whitefish have not been found, however it is believed that they spawn primarily in tributaries. Support for this hypothesis is provided by the small numbers of humpback

whitefish captured by boat electrofishing at mainstem influenced areas in 1982 and 1984. Large numbers of pre-spawners have been captured, however, at Anderson Creek. Spawning is presumed to occur from mid to late October.

4.1.6 Longnose Suckers

Longnose suckers are distributed widely throughout the Susitna River. Boat electrofishing catch data from 1982 and 1984 indicate that they are the most abundant resident fish species (except for sculpins and sticklebacks) in the lower river (ADF&G 1983b).

Recapture data from 1981 to 1984 suggests that most adult longnose suckers move little in the summer. Only one of 12 suckers recaptured from 1981 to 1984 moved over 5.0 miles from their tagging sites (ADF&G 1981b, 1983b).

Longnose sucker spawning has been documented during late May in tributaries as well as in the mainstem Susitna River (ADF&G 1983b). Although Morrow (1980) reports longnose suckers are only spring spawners, high numbers of male and several female pre-spawners have also been captured in the mainstem Susitna River during September and October. These fish have been captured throughout the lower river above RM 35.4 but are most numerous between RM 35.4 and RM 60.0. These data suggest that there may be two spawning periods for longnose suckers in the Susitna River with one in late May and the other in October or November. Because no effective means of sampling occurs during freeze-up (mid-October to December), this hypothesis will be difficult to prove.

4.1.7 Other Species

Dolly Varden

Dolly Varden are widely distributed in the Susitna River but few have been captured. They have been captured most frequently near the mouths of the Kashwitna River and Talkeetna River.

In tributaries which have sizable populations of Dolly Varden, studies done in 1984 show that this species is the first resident species to immigrate from the mainstem during spring. Limited data from 1984 suggests that this migration occurred at colder temperatures than for other species.

Northern pike

Northern pike are scarce in the Susitna River. Only five fish have been captured since 1981.[1] Since all of the northern pike have been captured between RM's 22.4 and 36.3, including Yentna fishwheels (RM 28.5, TRM 4.0), it is most probable that these fish have emigrated from the Yentna

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[1] The reference to the Susitna River includes only where fish have been collected for the past four years. Studies have been conducted at TRM 4.0 Yentna River but no further upriver than that.

River drainage. The northern pike population in the Yentna River system, particularly around Skwentna, has increased dramatically in the last decade (Kelly Hepler, pers. comm.). It is believed that northern pike were originally introduced into this drainage by illegal stocking (Stan Kubik, pers. comm.).

Threespine stickleback

The population of threespine stickleback in the Susitna River appears to be very variable. In 1981, large numbers of Age 3 stickleback were captured throughout the lower reach above RM 10.1. Although limited sampling was done in 1982, relatively few threespine sticklebacks (mostly Age I) were captured. Prior to the 1984 open-water season, we theorized that catches would be high for threespine stickleback if the offspring of the 1981 spawners returned in 1984 as Age 3 fish. However, there was no large increase in Age 3 stickleback catches in 1984. Over 95% of the 1984 catch was Age I fish. The cause of the decrease in threespine stickleback numbers is not known.

Capture data in 1981 and 1982 suggests that threespine stickleback are anadromous and that an upriver spring migration begins from the estuary in late May (ADF&G 1981b, 1983b).

Ninespine stickleback

Catch data from 1981-84 reflects the scarcity of this species in the lower river. In 1984, a small concentration of ninespine sticklebacks were captured in a low oxygen and heavily vegetated slough in the lower Susitna at RM 57.2. In 1981, only two fish were captured with both captures occurring in the Deshka River (unpublished data).

Arctic lamprey

Arctic lamprey are much more abundant in the lower river than the middle river. Most Arctic lampreys have been captured in tributaries such as Birch Creek or the Deshka River which drain from shallow lakes or muskeg.

Arctic lamprey populations can be anadromous or resident (Morrow 1980). Both forms have been reported to be parasitic, but the more blunt teeth found in the freshwater form suggests that it is nonparasitic. McPhail and Lindsey (1970) report that while the largest Alaskan Arctic lamprey found was 411 mm long, most adults of the nonparasitic form rarely exceeds 180 mm. In four years, only 16 adults over 180 mm have been captured. One fish captured in 1984 at the Deshka River may have been a Pacific lamprey. It measured approximately 600 mm in length and 90 mm in diameter. All other adults captured have been smaller in length and much less in diameter.

4.2 Middle Susitna River

4.2.1 Rainbow trout

In 1984, our knowledge of the seasonal distribution of rainbow trout in the middle river was greatly increased. Primary sampling emphasis was placed on radio tagging fish earlier in the year, May-June, to learn more about the timing and locations of spawning. Emphasis was also placed on tagging fish from the upper section of the middle river: Portage Creek, Indian River, and Fourth of July Creek. Previously few rainbow trout have been captured early in the season, however, 18 fish were successfully tagged in 1984 before June 16 of which 14 were pre-spawners. Several pre-spawners from a school of 30 probable spawners were captured in Portage Creek, a river which was previously believed to harbor few rainbow trout (Sundet and Wenger 1984). Previous success at capturing rainbow trout in Portage Creek may have failed because most of the adults move up into the creek before sampling normally occurs (after ice-out in the mainstem). Since sampling was done during this time from TRM 0.0 to TRM 11.6 and only these fish were observed or captured, it is probable that these fish represented the majority of spawning rainbow trout in Portage Creek. Four tagged fish apparently spawned at TRM 2.3 and another 0.5 miles up the small side tributary which enters at TRM 2.3 during early June 1984 (Figures 9). Movements of other pre-spawning radio tagged fish shows spawning also occurs at TRM 5.1 and at the same time (Figure 10).

Other pre-spawning radio tagged rainbow trout show that a similar timing of spawning occurs in Fourth of July Creek at TRM 0.7 and TRM 0.8, in a side tributary which enters at TRM 0.7 of Fourth of July Creek, and probably at Little Portage Creek during the same period as those in Portage Creek (Figure 6; Sundet and Wenger 1984; Figures 11 and 5).

Water surface temperatures correlated to movement of four radio tagged rainbow trout into Fourth of July Creek in 1984 shows spawning rainbow trout move into that tributary in late May when temperatures are 6.7°C to 8.5°C (Figure 13). A slightly cooler temperature (2.8°C) in this tributary was observed in mid-May 1983 during the immigration (Mark Wenger, pers. comm.).

Both TRM 2.3 and TRM 5.1 of Portage Creek, and TRM 0.7 of Fourth of July Creek are similar because all three have an outlet from a lake flowing into them. It is suspected that rainbow trout in Portage Creek and Fourth of July Creek spawn at the confluences of these lake outlets because of the warmer water temperatures found there. During the first week of June 1984, the mainstem of both Fourth of July Creek and Portage Creek were approximately 8°C, while the outlets at TRM 0.7 of Fourth of July and TRM 2.3 of Portage Creek were 12°C. Little Portage Creek is also influenced by lakes, however, no temperatures have been taken at this creek in June.

The 1984 studies showed that rainbow trout are abundant in the lakes that flow into Fourth of July Creek (Figure 2) and Portage Creek at TRM 2.3 (Figure 3). Since few juvenile (<200mm) rainbow trout have been

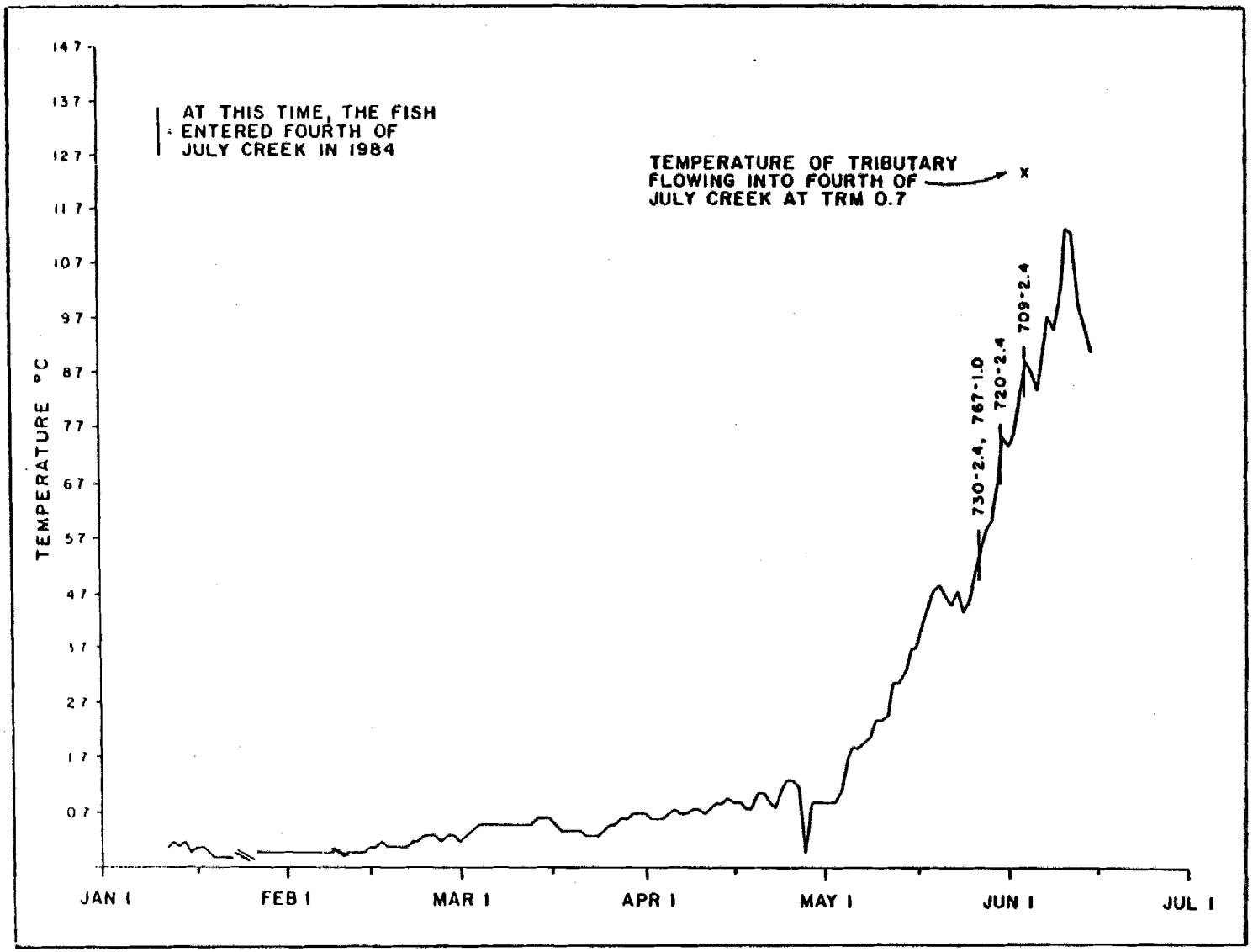

Figure 13. Mean surface water temperatures in Fourth of July Creek correlated to four spawning radio tagged rainbow trout's movement from the Susitna River into Fourth of July Creek, 1984.

captured in Portage Creek over the past four years, it is suspected that the lake which flows into Portage Creek at TRM 2.3 acts as a nursery. No rainbow trout, however, have been found in the lake which outlets at TRM 5.1 of Portage Creek (Sautner and Stratton 1984).

Although many juveniles have been captured in Fourth of July Creek, it is suspected that the lakes which outlet to this tributary contribute heavily to the rainbow trout population in Fourth of July Creek below TRM 1.8. Support for this hypothesis is provided by: (1) little spawning gravel has been found in Fourth of July Creek between TRM 0.0 and TRM 1.8, (2) several small adult rainbow trout were gill netted above the barrier at TRM 3.5 in 1984 and (3) better scale analysis of rainbow trout in 1984 showed that many fish captured below TRM 1.8 of Fourth of July Creek had the same stunting scale patterns as those captured in the lakes at its headwaters. Scale analysis of mainstem Fourth of July Creek fish also showed they were usually the smaller sized fish in each age class compared to other middle river stocks. For example, of 39 Age 5 fish, five fish from Fourth of July Creek were the smallest.

While spawning has been found to occur in both Fourth of July Creek and Portage Creek, little spawning evidence has been documented in Indian River. Only one pre-spawning radio tagged rainbow is believed to have spawned in Indian River (Fish 757-1.1 in Figure 8). Other pre-spawners captured at Indian River have moved elsewhere to spawn. Over 30,000 juvenile salmon and only one juvenile rainbow trout were captured in Indian River during the open-water season of 1984. The apparent low success of rainbow trout spawning in Indian River may be caused by the failure of rainbow trout to successfully migrate from Miami Lake or other streams which drain from lakes into Indian River.

The overall low number of juveniles found in the middle river infers that either egg or juvenile survival is extremely low. One reason for this low survival may be the cold temperatures of these tributaries.

After spawning in early to mid-June, fish in different systems show different behavior patterns for the rest of the summer. In Fourth of July Creek, most fish stay between TRM 0.4 and TRM 1.8. However, a number of fish have been found to move into other areas such as the mouth, nearby sloughs, or into Indian River (Figure 7, Sundet and Wenger 1984). In Portage Creek, most radio tagged rainbow trout move further upstream after spawning (Figures 9 and 10).

Fish tagged in 1984 showed a similar summer association with spawning salmon as did fish tagged in 1983, many of which were found close to spawning chum and pink salmon (Sundet and Wenger 1984). More fish were tagged earlier in 1984 than in 1983 and their movement coincides with the earlier adult chinook salmon movement. This movement was most evident at Indian River and Portage Creek which have the greatest number of spawning chinook salmon above Talkeetna; escapement in 1984 was over 1,500 chinook salmon in each river (Barrett et al. 1985). As in 1983, this close association with spawning salmon is probably due to rainbow trout utilizing salmon eggs as a primary summer food source. This was substantiated during a late June 1984 helicopter survey. At this time, fish were pinpointed exactly and, in all cases, the radio tagged fish

were within 100 feet of adult chinook salmon. Most rainbow trout in Portage Creek and Indian River remain in these tributaries through the peak salmon spawning periods. Peak chinook spawning occurs in late July and the peak pink and chum spawning occurs in late August. Apparently, however, rainbow trout do not rely on coho salmon eggs as a food source because most rainbow trout move out of the tributaries before coho spawning reaches its peak in late September.

In 1983 and 1984, all radio tagged rainbow trout had outmigrated from tributaries by October 6. Ground surveys conducted in early October 1984 between TRM's 0.1 and 1.0 of Fourth of July Creek also support radio tagged fish outmigration findings. At this time, no rainbow trout were captured and only one was observed.

Water surface temperatures and relative depths were correlated to the outmigration of seven radio tagged rainbow trout from Portage Creek to the mainstem in 1984. Water depths appeared to influence the outmigration more than temperature. A late season flood between August 20 and August 30 apparently triggered the final outmigration of six fish (Figure 14). Downstream movements had begun much earlier for most of the fish with the maximum upriver locations for four fish being on July 6. The slower downriver movement between then and late August is probably due to other reasons such as food supply more than temperature or water depths.

Winter monitoring of radio tagged fish over three years show that nearly all rainbow trout move slightly downstream (0.1-4.0 miles) after October before they hold up in their overwintering areas (ADF&G 1983b, 1983c; Sundet and Wenger 1984; Figures 4 and 5). This downstream movement is believed to be associated with the fish searching for acceptable overwintering areas. During all three years, however, several rainbow trout have remained all winter near the tributary where they were tagged. From 1984 taggings, it appears that fish from Portage Creek may overwinter near that tributary mouth.

During winter sampling in the lower river in 1981-82, although none of the radio tagged fish were captured, a high catch per unit effort was recorded for other rainbow trout in the vicinities of the tagged fish (ADF&G 1983b). Therefore, it is suspected that rainbow trout concentrate in small numbers and use specific areas of the lower mainstem Susitna for overwintering. A similar phenomenon probably occurs in the middle river.

Winter sampling at radio tagged fish relocation sites has provided little information to characterize rainbow trout overwintering areas. This is primarily due to the difficulties which are inherent to winter sampling. During the winter of 1983-84, most radio tagged fish were found in open-water leads. Habitat data collected at these areas varied considerably except for conductivity. In all cases, the conductivity measurements were relatively high (above 125.0 uhos/cm) indicating that rainbow trout seek out overwintering areas that are influenced by groundwater. Radio tagged rainbow trout also appear to prefer areas of moderate water velocities. Limited data from the winter of 1982-83 showed similar conclusions (ADF&G 1983c).

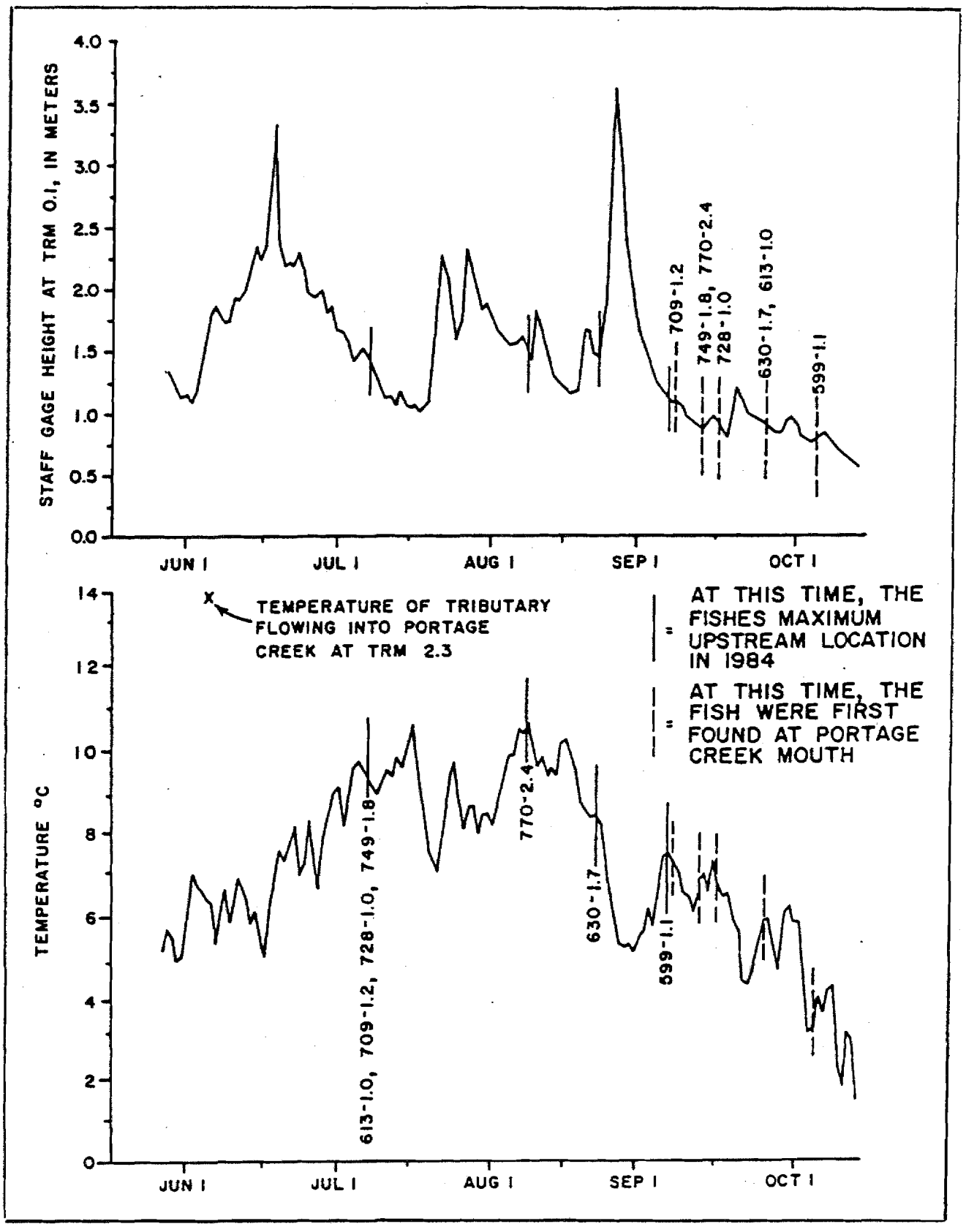

Figure 14. Mean surface water temperatures and relative depths in Portage Creek correlated to seven radio tagged rainbow trout's maximum movement and their outmigration into the mainstem Susitna River, 1984.

Radio tagged fish data reflects the low survival rate for rainbow trout. The middle river rainbow trout survival rate was 33.3% in 1983 and 42.7% in 1984.[1] In three years, sport fishermen have reported catching two radio tagged fish, three have been found eaten by predators, and one died after being trapped in a side channel which dewatered during the fall. Other mortalities include one attributable to post-spawning die-off and three to overwintering.[2] Needham and Jones (1959) and Needham and Slater (1945) report that rainbow trout overwintering mortalities are often high due to physical catastrophes such as dewatering, collapsed snow banks, and anchor ice formation.

4.2.2 Burbot

Catch data from 1981-83 indicate that burbot are much less abundant in the middle river than the lower river (ADF&G 1981b, 1983b, 1983c). Although food and rearing habitat may be limiting factors for burbot in the Susitna River between the Chulitna River confluence and Devil Canyon, during the winter of 1983-84 biologists observed another reason why there may be fewer burbot in this reach. During aerial tracking surveys in January, biologists noticed that a large section of the mainstem Susitna River (RM 123.0 to RM 150.0) had remained open. Approximately half of this open-water area had anchor ice on the substrate and occasionally the anchor ice would free itself and float to the top. Since burbot spawn from mid-January to early February in the Susitna River, the formation and movement of anchor ice could disrupt the success of burbot spawning. The several radio tagged burbot monitored in the winters of 1982-83 and 1983-84 have remained in the mainstem Susitna during the spawning period indicating spawning occurs there (ADF&G 1983c). Since most radio tagged burbot have not migrated far or frequently, several poor years of spawning might mean that no new individuals would be recruited to the existing population in this area.

Although spawning is probably limited in the middle river, one radio tagged fish monitored during the winter of 1983-84 stayed near Slough 10 indicating that some spawning may occur there. The capture of juveniles near Slough 9 in 1982, suggests spawning may also occur there (ADF&G 1983b).

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[1] The higher survival rate is somewhat biased because in 1984 we sought out more large adults to radio tag. Therefore the survival rate is probably closer to 1983 findings.

[2] Although effects of radio tagging may have contributed to the fate of the three fish which died during the winter, it is more likely they died because of effects of overwintering. These three fish were known to be alive between August and October and any fatal post-effect of radio tagging has been apparent in other radio tagged fish within two weeks after tagging.

4.2.3 Arctic grayling

The general distribution and abundance of Arctic grayling in the middle Susitna River in 1984 was similar to 1981-83 findings. Population estimates using multiple-year data show Arctic grayling are the third most abundant resident fish species in the middle river (other than sculpins and sticklebacks). During all four years, Arctic grayling were most numerous at Indian River (RM 138.6) and Portage Creek (RM 148.8). High catches at Whiskers Creek Slough (RM 101.2), Lane Creek (RM 113.6), Fourth of July Creek (RM 131.1), and a mainstem site at RM 150.1 are recorded only in May, June, or September. Catches at all sites over all four years have generally been the highest in the spring and fall.

Until 1984, our knowledge of Arctic grayling immigration and outmigration from tributaries to the mainstem was based on tag-and-recapture and catch per unit effort data. These data show Arctic grayling move into tributaries in May and early June to spawn, then begin to outmigrate in mid-September (ADF&G 1981b, 1983b; Sundet and Wenger 1984). In 1984, the monitoring of one pre-spawning radio tagged Arctic grayling provided additional information on movement and spawning. This fish was tagged and released in the mainstem Susitna on May 22 and it ascended Portage Creek two days later. Other studies done in 1984 also show the spring immigration into Portage Creek occurs at this time. No fish were observed or captured in Portage Creek between TRM 1.5 and TRM 3.2 from May 9 to 25, but surveys conducted in early to mid-June in the upper reaches of Portage Creek showed Arctic grayling were found upriver as far as TRM 11.6. During this time, catch rates became higher in the upper reaches indicating Arctic grayling were ascending Portage Creek.

The radio tagged fish apparently spawned at TRM 0.4 of Portage Creek between May 22 and 30. A similar timing of spawning was shown by 82 other Arctic grayling in 1984 which were captured and examined for sexual conditions above RM 125.0. Other fish examined in 1984 below RM 125.0 shows timing of spawning there is about seven to ten days earlier than above RM 125.0 (Appendix Figure C-7). The difference in timing of spawning between these two sections is probably due to the warmer tributaries water temperatures below RM 125.0 than above. The earliest spawning Arctic grayling were found in 1984 was May 9 at the mouth of Whisker's Creek (RM 101.4). A similar timing of spawning occurred in 1983 (Sundet and Wenger 1984).

Mean surface water temperatures in Portage Creek during late May 1984, when Arctic grayling began to immigrate and spawn, were slightly higher than those reported elsewhere in Alaska. Water temperatures in Whisker's Creek, at the time of spawning in mid-May 1984, however, were similar as reported elsewhere. Water temperatures at Portage Creek were 5.1°C on May 26 and at Whisker's Creek were 3.8°C on May 9. Tack (1980, 1973) reports the spawning runs begin when water temperatures are 1°C and spawning occurs at 4°C in Interior Alaska.

Catch and recapture data from 1981-84 and radio telemetry data shows that most large adult Arctic grayling remain in tributaries through early September. Smaller adults and juvenile Arctic grayling have been

captured at tributary mouths during the summer, probably because they were displaced in the upper reaches as a result of territorialism (ADF&G 1983b). Recaptures of Floy anchor tagged fish show adults move little during the summer.

It was speculated in 1983 that some adult Arctic grayling may overwinter in Portage Creek, however, evidence from the radio tagged fish suggests that this may not be true. After early August, the radio tagged Arctic grayling began to move rapidly downstream along with radio tagged rainbow trout. Unfortunately, the battery of the Arctic grayling's radio tag expired before the fish reached the mainstem. The radio tagged rainbow trout, which were outmigrating at the same time, had all outmigrated from Portage Creek into the mainstem Susitna by October 6. The outmigration of the radio tagged Arctic grayling and rainbow trout was apparently triggered by a late season flood which occurred between August 20 and 30 (Figure 14).

Data on the winter distribution of Arctic grayling in the mainstem is limited. Several Floy anchor tag recoveries in 1983 and 1984 suggest that some Arctic grayling may overwinter far downriver in the mainstem from their summer rearing tributaries. Several fish tagged at Portage Creek between late May and July have been recovered 10 to 20 miles downriver. Three fish were recovered in late May 1984, 25 to 37 miles downriver from where they were tagged in 1982 or 1983. It is possible these three fish were recovered before they returned upriver or that they had simply relocated during the interim. It appears most fish tagged at Portage Creek or nearby, however, indicate they may overwinter between RM 146.0 and RM 148.0 or at RM 150.1. Boat electrofishing, gill net, and hoop net catch rates were very high at these areas during mid-late May and at RM 146.0 to RM 148.0 in late September 1983 and 1984.

In 1984, two Arctic grayling were recovered which were tagged in or above Devil Canyon. While no recoveries have been made above the canyon from those fish tagged below, this is the first evidence that Arctic grayling can successfully migrate downriver through Devil Canyon.

4.2.4 Round whitefish

Population estimates made in 1984 using multiple-year data show that round whitefish are the most abundant resident fish species in the middle river. Catch data from 1982-84 show the highest concentrations of round whitefish occurs between RM 132.6 and RM 150.1, and round whitefish are much more abundant in the middle river than in the lower river.

Pooled CPUE rates based on boat electrofishing data from 1982-83 shows that round whitefish CPUE's at tributary or slough sites are much higher than at mainstem sites. Relatively high CPUE's at mainstem sites, however, are in June and September of those years and also overall in 1984. Juvenile round whitefish captured at JAHS sites have been found more often at turbid mainstem and slough sites than at tributary sites (Suchanek et al. 1984). Juvenile round whitefish prefer these areas

because of lower water velocities and higher turbidities which they use as cover.

While a definite fall downriver movement was shown by recaptured round whitefish in 1981 and 1982, only a slight downstream movement throughout the summer was shown by recovered fish in 1983 and 1984.

Sexually ripe round whitefish have been captured in the mainstem Susitna or at the mouths of several middle river tributaries during early October from 1981-84. This suggests that round whitefish use mainstem influenced areas for spawning. Peak spawning probably occurs from mid to late October. Specific round whitefish spawning areas found since 1981 include the mouths of Lane Creek, Indian River, and Portage Creek, and in the mainstem Susitna at RM 147.0. Other round whitefish close to spawning have also been found scattered throughout the middle river in pairs or small groups.

While it is unknown where adult round whitefish overwinter, early spring catch and recapture data suggests they may overwinter near their summer rearing areas which is primarily in the mainstem above RM 132.0 (ADF&G 1983b; Sundet and Wenger 1984).

4.2.5 Humpback whitefish

Catch data from 1981-84 shows humpback whitefish are relatively scarce in the middle river. Most humpback whitefish in the middle river probably overwinter in that reach. However, increased outmigrant trap catches of humpback whitefish at RM 103.0 in the fall and high growth rates shown in scales of several adults suggests that some humpback whitefish may outmigrate from the middle river to overwinter in the estuary (Sundet and Wenger 1984).

4.2.6 Longnose suckers

Catch data shows little differences in distribution or abundance of longnose suckers between 1982, 1983, and 1984. Recapture data from these years show longnose suckers generally move little in summer, but a spring upriver and a fall downriver migration may occur. Several 1984 recaptured fish also shows some fish move upriver during June through August.

4.2.7 Other species

Dolly Varden

Dolly Varden have been found mostly at Lane Creek, Indian River, and Portage Creek. Catch data suggests Dolly Varden move into tributaries before late June (ADF&G 1983b, 1984b). It is believed that they stay in the tributaries through October at which time they spawn and then outmigrate to overwinter in the mainstem.

Dwarf populations of Dolly Varden are found in the upper reaches of several tributaries (ADF&G 1983b). These populations are believed to remain in these tributaries year-round.

Lake trout

Two populations of lake trout were found in the middle river drainage during lake surveys for rainbow trout in 1984. Although lake trout were known to occur in Miami Lake, no information was previously known on the lake which drains into Fourth of July Creek (Lake B in Figure 2). Although only juveniles were captured, Lake B may harbor a sizeable population of adult lake trout. A steep shoreline and the lack of a boat prevented proper setting of gill nets in this lake. No depths were measured, however, the lake was extremely clear and appeared to be over 50 feet deep.

Threespine stickleback

Threespine stickleback are less numerous in the middle reach of the Susitna River than the lower reach. However, they have been caught in relatively large numbers between the Chulitna River confluence and RM 120.0 (ADF&G 1981b).

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APPENDIX A

Floy Anchor Tag Retention Rates

METHODS

The external Floy anchor tag (model FD-67) has been used to tag resident fish since January 1981 to determine seasonal and yearly movements. The dimensions of the tag and tagging procedure are explained in the 1981 procedures manual (ADF&G 1981a). Disc dangler tags were used to tag burbot for several months during 1981 and the spring of 1982.

Floy anchor tag retention rates were evaluated for Arctic grayling, round whitefish, and longnose suckers by comparing the number of fish with tag scars to the total number of fish with tag scars and Floy anchor tags of that species recaptured in 1983.[1] By subtracting this ratio from 1.00, Floy anchor tag retention rates were determined. Tag retention rates for rainbow trout were not determined because the smaller scales of this species regenerate rapidly and make it difficult to detect tag scars. In 1983, no captured longnose suckers showed a tag scar.

RESULTS

The Floy anchor tag retention rate for Arctic grayling during 1984 was 75.9% with 15 of 58 recaptures showing a tag scar. The 1984 tag retention rates for round whitefish and longnose suckers were 83.7% and 92.9% respectively, with 15 of 92 round whitefish and one of 14 longnose suckers showing a tag scar.

DISCUSSION

We believe that improper tag placement has been the primary cause of tag loss in our studies. In 1982, tags were injected into the dorsal musculature. After 1982, tags were anchored at the base of the dorsal fin through the interneural rays. We have noticed increased tag retention rates each year thereafter. Tag retention rates for Arctic grayling increased from 69.4% in 1983 to 75.9% in 1984. Tag retention rates for round whitefish showed similar improvement, increasing from 77.5% in 1983 to 83.7% in 1984.

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[1] Only those fish recaptured by a resident study crew were used. Other groups such as sport fishermen or fishwheel crews did not look for scarred fish.

APPENDIX B

Radio Tagged Fish Capture, Biological, and Winter Habitat Data

Appendix Table B-1. Summary of tagging data for radio tagged rainbow trout captured on the Susitna River between the Chulitna River confluence and Devil Canyon, May to July 1984.

Radio Frequency/ Fork Lengths (mm)	Type of Implant: Internal or External	Floy Tag Number	Age/ Sex	Spawning Condition	Method Captured	Location Captured and Released	River Mile	Date Captured	Date Released
599-1.1/485	Internal	17457	-/M	pre-spawning	HL	Portage Creek	TRM 2.3	6/1	6/1
598-1.6/410	Internal	---	6/M	pre-spawning	HL	Tributary Mouth at TRM 0.7 of Fourth of July Creek	TRM 0.5	6/5	6/5
613-1.0/475	Internal	17453	8/M	pre-spawning	HL	Portage Creek	TRM 2.3	6/1	6/1
608-1.7/391 (recap was 670-1.4)	Internal	11948	8/F	pre-spawning	EF	Lane Creek	113.6	5/17	5/18
608-1.9/400	Internal	17757	6/F	post-spawned	HL	Fourth of July Cr.	TRM 0.4	6/27	6/27
620-1.2/390	Internal	17492	6/M	non-spawner	EF	Portage Creek	148.8	6/4	6/4
630-1.0/450	Internal	17761	-/-	non-spawner	HL	Fourth of July Cr.	TRM 0.8	6/27	6/27
630-1.7/495	Internal	17753	-/M	pre-spawning	HL	Portage Creek	TRM 5.1	6/20	6/20
659-1.2/435	Internal	12615	7/-	post-spawned	EF	Indian River	138.6	5/26	5/27
670-1.2/450	Internal	17456	-/F	pre-spawning	HL	Portage Creek	TRM 2.3	6/1	6/1
709-1.2/433	Internal	5825	6/F	pre-spawning	EF	Indian River	138.6	5/22	5/24
709-2.4/450	External	17598	-/F	pre-spawning	EF	Fourth of July Cr.	131.1	5/28	5/31
719-1.6/405	Internal	1243	6/-	--	EF	Indian River	138.6	7/23	7/23
720-2.4/400	External	5823	7/F	pre-spawning	HL	Fourth of July Cr.	131.1	5/23	5/24
728-1.0/392	Internal	5091	-/M	non-spawner	HL	Portage Creek	TRM 5.1	6/5	6/5

-- = not sexed or not aged
EF = Electrofishing
HL = Hook and Line
HN = Hoop net
TRM = Tributary River Mile

Appendix Table B-1 (Continued).

Radio Frequency Fork Lengths (mm)	Type of Implant: Internal or External	Floy Tag Number	Age/ Sex	Spawning Condition	Method Captured	Location Captured and Released	River Mile	Date Captured	Date Released
729-1.5/420	Internal	5107	7/-	--	EF	Whiskers Creek Slough	101.2	5/21	5/21
730-2.4/485	External	15464	-/M	pre-spawning	HL	Fourth of July Cr.	131.1	5/18	5/18
740-1.4/425	Internal	5867	7/-	non-spawner	HN	Mainstem	136.7	6/5	6/5
749-1.8/418	Internal	5092	7/M	pre-spawning	HL	Portage Creek	2.3	6/5	6/5
757-1.1/424	Internal	5817	7/M	pre-spawning	EF	Indian River	138.6	5/22	5/24
760-2.4/400	External	16066	7/M	post-spawned	HL	Fourth of July Cr.	0.7	6/3	6/3
770-2.4/462	External	17454	8/F	pre-spawning	HL	Portage Creek	2.3	6/1	6/1

Total = 22 Fish

-- = not sexed or not aged
EF = Electrofishing
HL = Hook and Line
HN = Hoop net
TRM = Tributary River Mile

Appendix Table B-2. Radio tagged rainbow trout habitat measurements taken at their relocations in January and February 1984. Fish were tagged in 1983.

Radio Frequency	Date	RM	Ice Open (0) Covered (c)	Fish Movement (in ft)	Depths (ft)			Velocity	Substrate	Water Quality			
					Water	Ice	Slush	(fps)		Temp °C	DO mg/l	umhos/cm	pH
670-1.4	1/11	101.1	c	0.0	2.5	2.5	0.0	*1-2	rubble/cobble	--	--	--	--
	2/14	100.7	c	-50.0	5.7	2.5	0.0	2.5	rubble/cobble	+0.1	14.0	236.0	7.6
709-1.5	2/15	116.5	c	-10.0	3.0	2.0	0.0	1.5	rubble/cobble	-0.1	13.1	256.0	7.5
718-1.5	1/11	131.1	0	--	*4.0	0	0	--	rubble/cobble	+0.2	13.6	247.0	7.9
729-1.0[a]	2/16	64.8	c	0	1.5	2.5	3.0	0.0	cobble	--	--	--	--
729-1.3	2/15	111.4	c	-200.0	10.0	2.0	0.0	2.5	cobble	-0.1	13.0	212.0	7.5
767-1.5[a]	1/11	114.8	c	0	1.0	2.0	0.5	0	--	--	--	--	--
	2/15	114.5	c	0	2.0	2.0	0.5	0.5	--	--	--	--	--

[a] Fish believed dead
* Estimated measurement because meter did not work or too deep
-- No movement or no measurements taken

APPENDIX C

Population and Biological Characteristics

A total of 6,941 resident fish of eleven species were measured for length on the Susitna River from May to October 1984. Appendix Table C-1 presents the range and means of fish measured and Appendix Figures C-1 to C-6 present length frequency compositions of six of these species.

Sexual maturities of four resident fish species were determined in 1984. Appendix Table C-2 presents lengths of fish examined for sexual condition and Appendix Figure C-7 illustrate the timing of spawning for two of these species: rainbow trout and Arctic grayling.

Ages were determined for spawners of three species in 1984 (Appendix Figures C-8 to C-10). Ages were also determined for spawning and non-spawning rainbow trout captured in lakes C and D at the headwaters of Fourth of July Creek (Figure C-11).

The ages of 147 rainbow trout captured on the Susitna River between the Chulitna River confluence and Devil Canyon in 1984 were determined by scale analysis. These rainbow trout ranged in age from Age 1 to Age 9. Ages 4 (17.0%), 5 (26.5%), 6 (23.1%), and 7 (20.4%) were sampled most often (Appendix Table C-3). The ages of thirty-five rainbow trout captured in lakes A, C, and D ranged from Age 2 to Age 7. In these lakes, ages 3 and 4 were sampled more frequently than others. A graphical representation of age-length data shows rainbow trout captured in the mainstem Susitna and its tributaries are approximately 60 mm larger at a given age class than fish captured in Lakes A, C, and D (Appendix Figure C-12).

One hundred forty-three of the 147 rainbow trout aged in the middle river were captured by hook and line or by boat electrofishing.[1] The instantaneous survival rate for rainbow trout in this reach of river captured by these two methods was calculated at 42.7% (Appendix Figure C-13).

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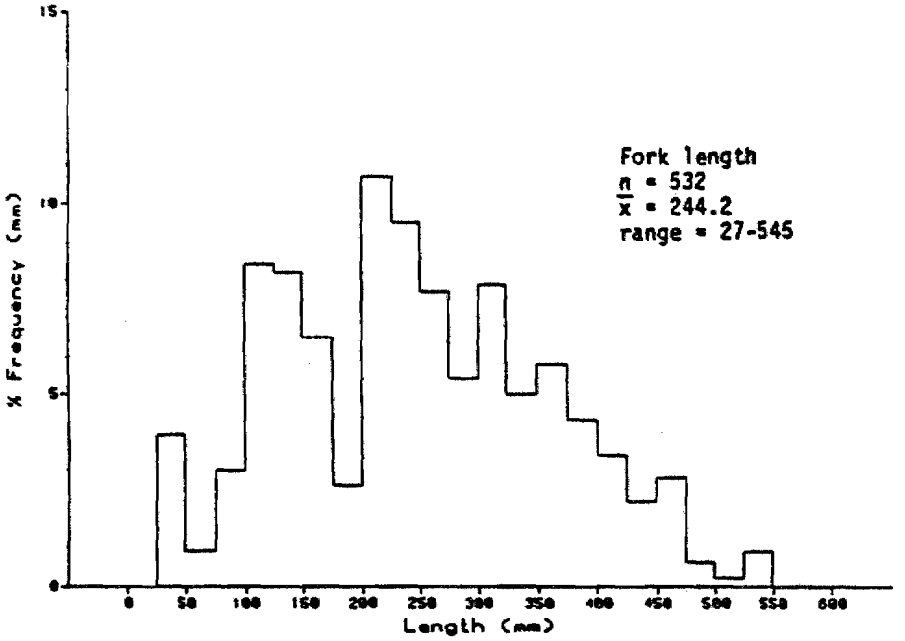
[1] To be consistent with 1983 instantaneous survival rate calculations, one Age 6 and three Age 7 fish were not used in 1984 calculations because they were captured by gear other than boat electrofishing and hook and line. Fish used in 1983 calculations were only used if they were captured by boat electrofishing or by hook and line.

Appendix Table C-1. Length data for resident fish captured on the Susitna River, 1984.

Species	Sampling Period	n	Length (mm) Range	Mean
Rainbow Trout (FL)	Lower Susitna	105	27 - 530	281.9
	Middle Susitna	227	27 - 545	282.7
	Lakes in Middle Susitna	200	70 - 360	180.7
	Combined Total	532	27 - 545	244.2
Burbot (TL)	Lower Susitna	217	209 - 701	406.9
	Middle Susitna	15	42 - 475	241.2
	Combined Total	232	42 - 701	396.2
Arctic Grayling (FL)	Lower Susitna	197	89 - 392	251.2
	Middle Susitna	641	40 - 427	255.4
	Combined Total	838	40 - 427	254.5
Round Whitefish (FL)	Lower Susitna	301	40 - 469	222.8
	Middle Susitna	1729	20 - 410	140.8
	Combined Total	2030	20 - 469	153.0
Humpback Whitefish (FL)	Lower Susitna	348	30 - 510	286.2
	Middle Susitna	298	25 - 410	87.6
	Combined Total	646	25 - 510	194.2
Longnose Suckers (FL)	Lower Susitna	377	30 - 447	297.3
	Middle Susitna	490	24 - 392	148.8
	Combined Total	867	24 - 447	213.4
Dolly Varden (FL)	Lower Susitna	6	163 - 366	247.3
	Middle Susitna	16	119 - 457	249.5
	Lakes in Middle Susitna	20	92 - 190	125.9
	Combined Total	42	92 - 457	190.3
Lake Trout (FL)	Lakes in Middle Susitna	35	60 - 468	109.6
Threespine Stickleback (TL)	Lower Susitna	1271	20 - 90	28.8
	Middle Susitna	337	15 - 74	32.0
	Combined Total	1608	15 - 90	29.5
Northern Pike (FL)	Lower Susitna	3	83 - 713	433.7
Arctic Lamprey (TL)	Lower Susitna	21	113 - 162	134.7
	Middle Susitna	87	74 - 290	126.1
	Combined Total	108	74 - 290	127.8

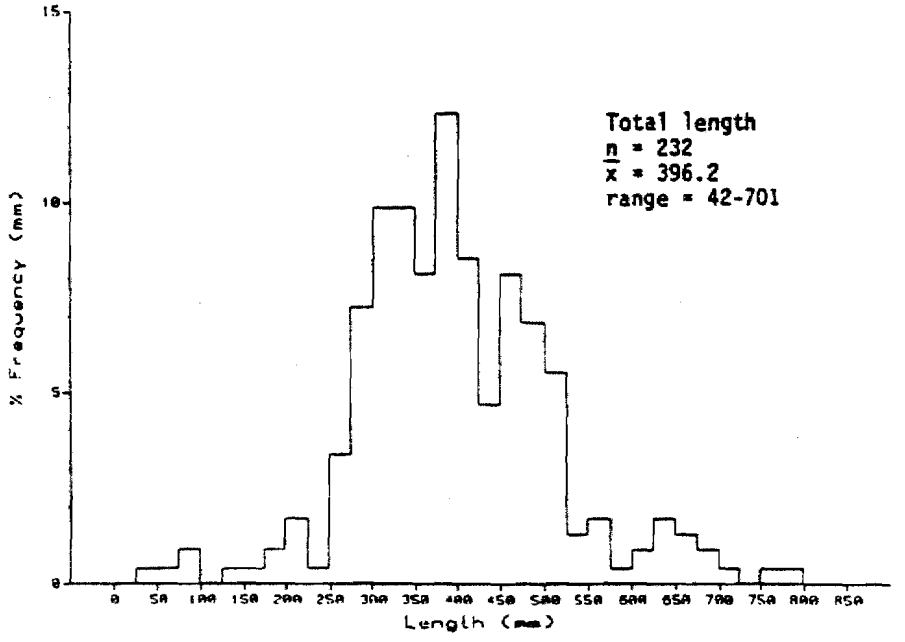
FL = Fork Length
TL = Total Length

RAINBOW TROUT



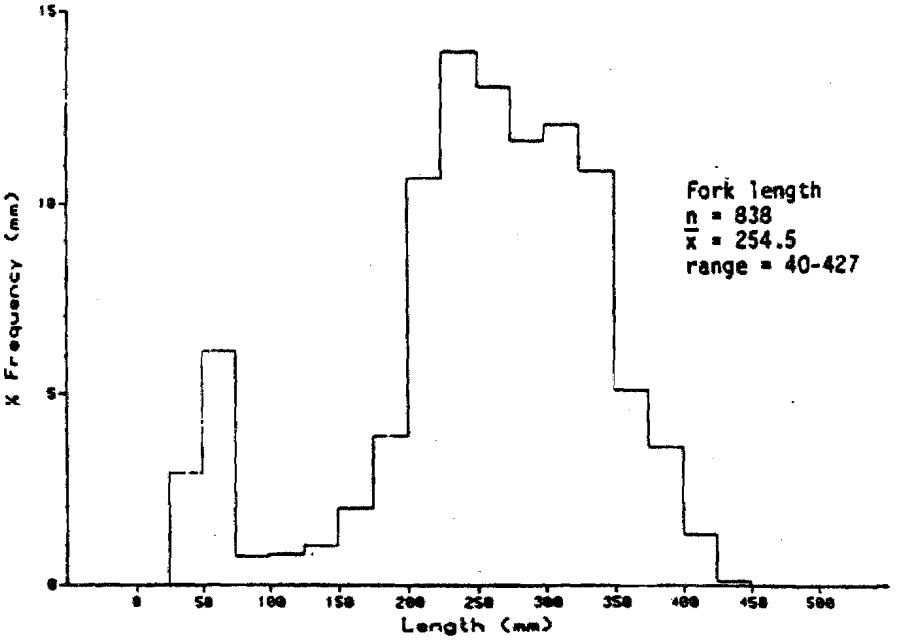
Appendix Figure C-1. Length frequency composition of rainbow trout captured in the Susitna River between Cook Inlet and Devil Canyon by all gear types, May to October 1984.

BURBOT



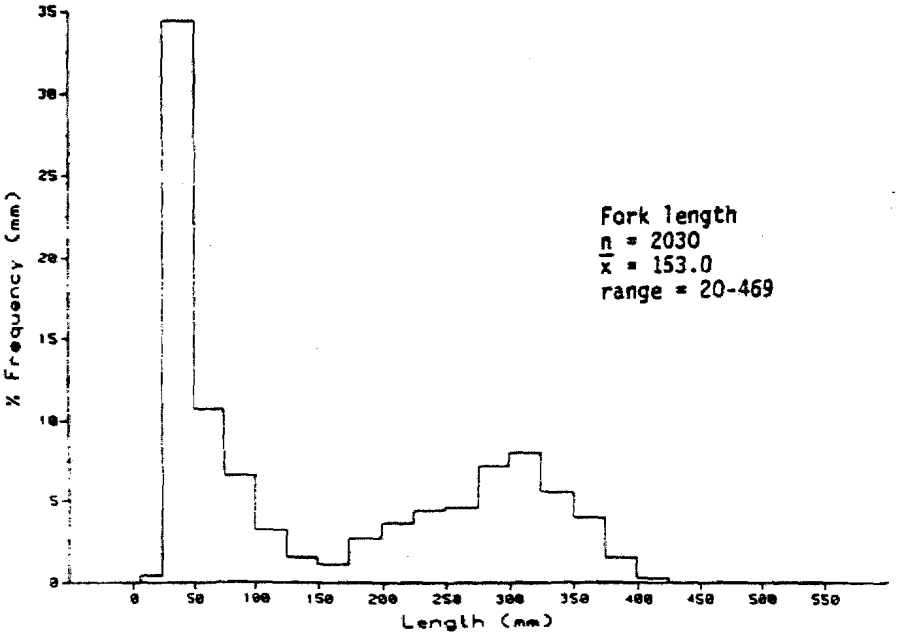
Appendix Figure C-2. Length frequency composition of burbot captured in the Susitna River between Cook Inlet and Devil Canyon by all gear types, May to October 1984.

ARCTIC GRAYLING



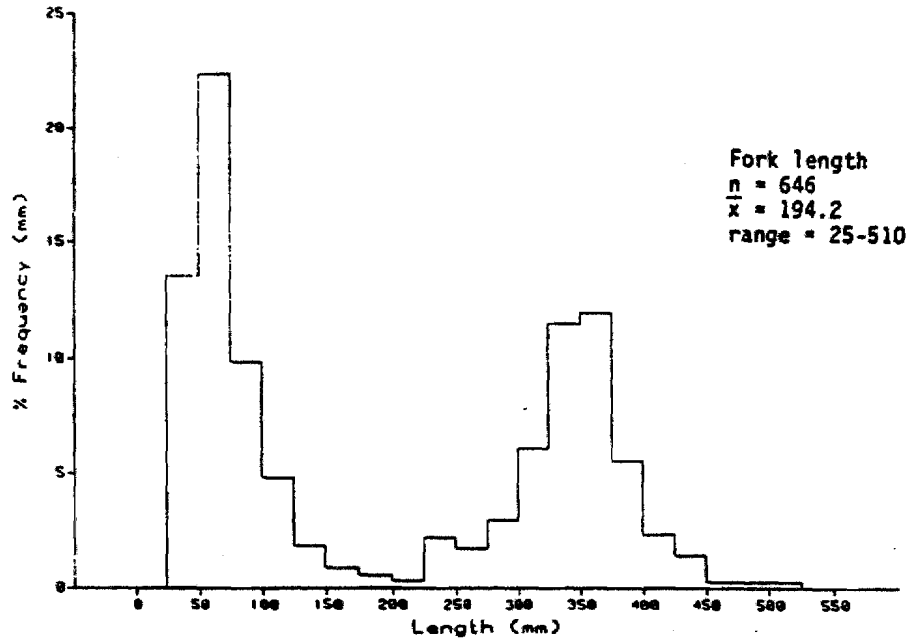
Appendix Figure C-3. Length frequency composition of Arctic grayling captured in the Susitna River between Cook Inlet and Devil Canyon by all gear types, May to October 1984.

ROUND WHITEFISH



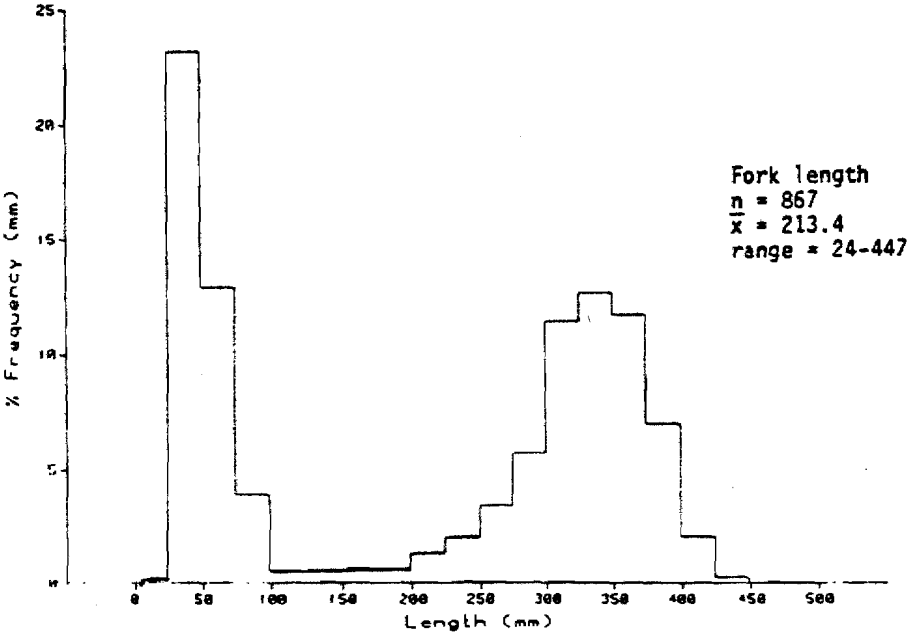
Appendix Figure C-4. Length frequency composition of round whitefish captured in the Susitna River between Cook Inlet and Devil Canyon by all gear types, May to October 1984.

HUMPBACK WHITEFISH



Appendix Figure C-5. Length frequency composition of humpback whitefish captured in the Susitna River between Cook Inlet and Devil Canyon by all gear types, May to October 1984.

LONGNOSE SUCKER

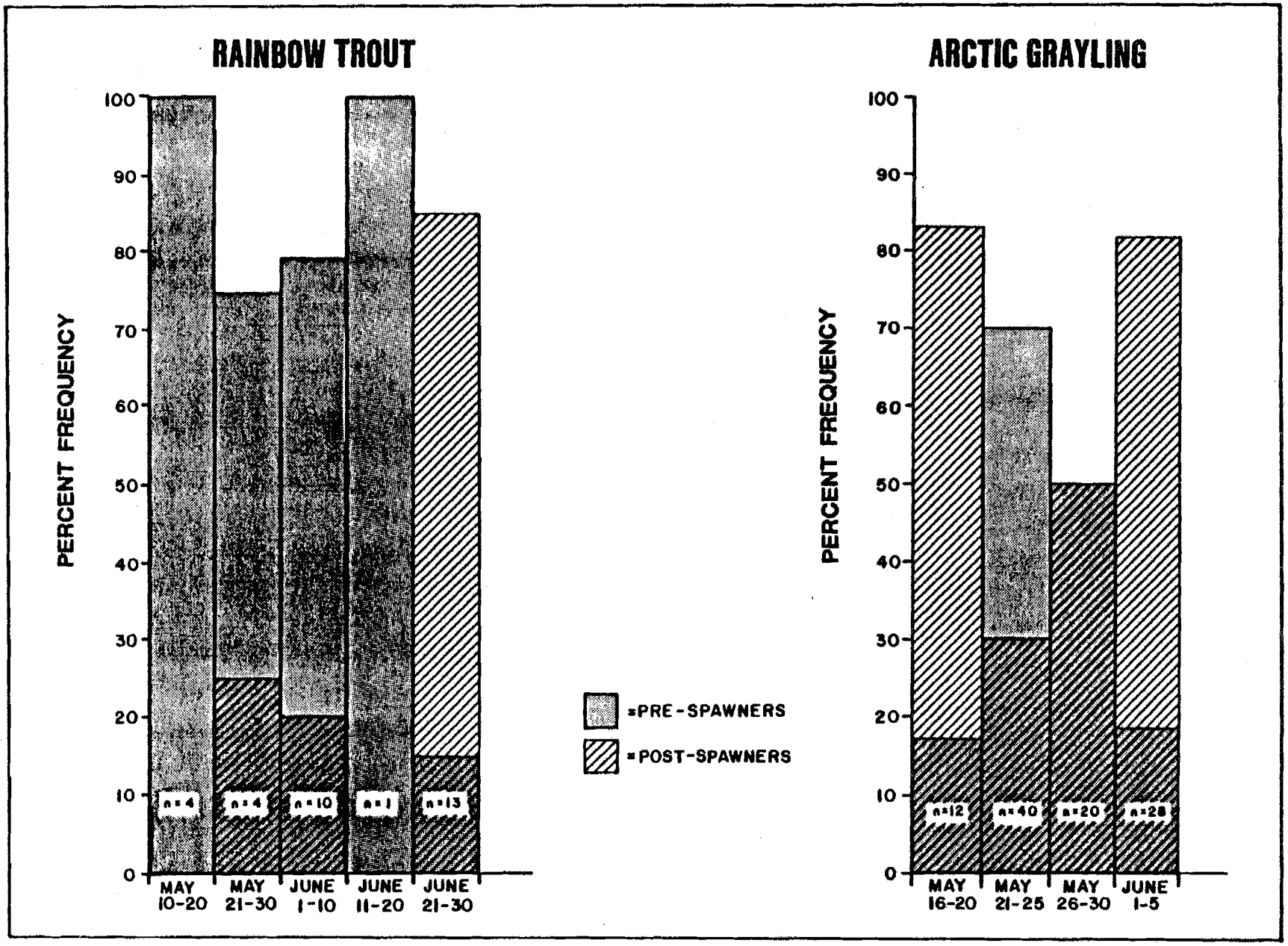


Appendix Figure C-6. Length frequency composition of longnose suckers captured in the Susitna River between Cook Inlet and Devil Canyon by all gear types, May to October 1984.

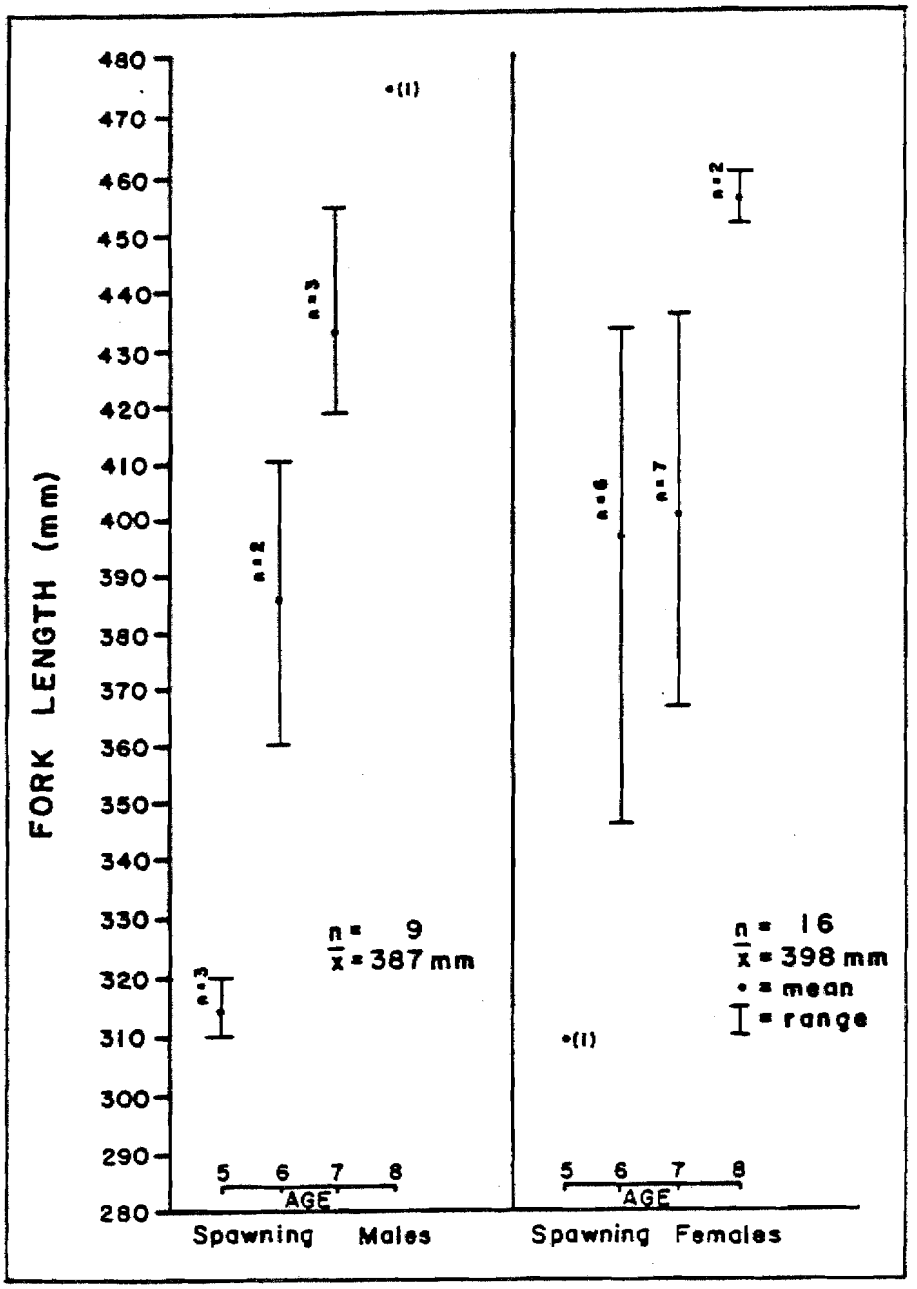
Appendix Table C-2. Fork lengths (mm) of sexually mature and immature resident fish captured on the Susitna River, 1984.

Species	Sampling Area	Dates	Spawning Condition	Males			Females			Combined Sexes		
				n	Range	x	n	Range	x	n	Range	x
Rainbow trout	Middle Susitna reach	5/17-6/27	1	7	320-495	428	11	345-462	406	18	320-495	415
		5/26-6/27	2	5	306-370	332	9	310-450	404	14	306-450	378
		5/17-6/27	3	12	306-495	388	20	310-462	405	32	306-495	399
		6/5-6/28	4	--	--	--	--	--	--	9	255-392	332
	Fourth of July	9/14	1	29	160-310	217	20	173-270	222	49	160-310	219
	Lakes C and D	9/14	4	--	--	--	--	--	--	15	95-240	155
Arctic grayling	Middle Susitna reach	5/17-6/2	1	19	322-417	370	26	265-395	321	45	265-417	341
		5/19-6/28	2	27	302-427	355	29	305-405	352	56	302-427	353
		5/17-6/28	3	46	302-427	361	55	265-405	337	101	265-427	348
		5/27-5/28	4	--	--	--	--	--	--	4	276-290	283
Round whitefish	Combined lower and	9/26-10/15	1	13	244-390	324	20	292-425	334	33	244-425	330
	middle Susitna	10/13-10/15	2	--	--	--	4	305-394	349	4	305-394	349
	reaches	9/26-10/15	3	13	244-390	324	24	292-425	336	37	244-425	332
Longnose suckers	Combined lower and	5/19-10/15	1	57	273-390	333	1	--	345	58	273-390	333
	middle Susitna	6/28-6/29	2	2	322-330	326	--	--	--	2	322-330	326
	reaches	5/17-10/15	3	59	273-390	333	1	--	345	60	273-390	333

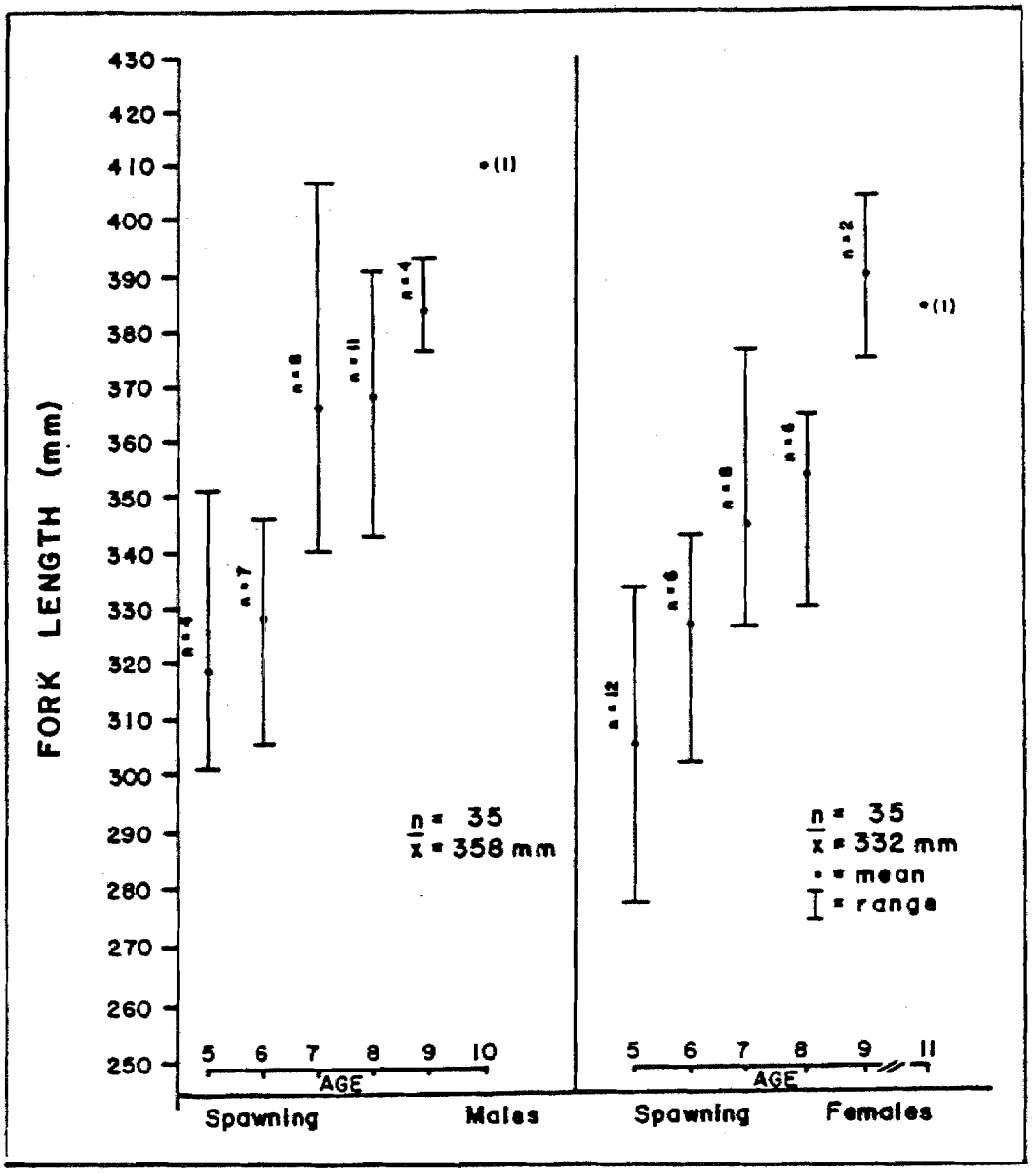
1 Pre-spawners
2 Post-spawners
3 Combined pre- and post-spawners
4 Non-spawners
-- No sample or sex undetermined



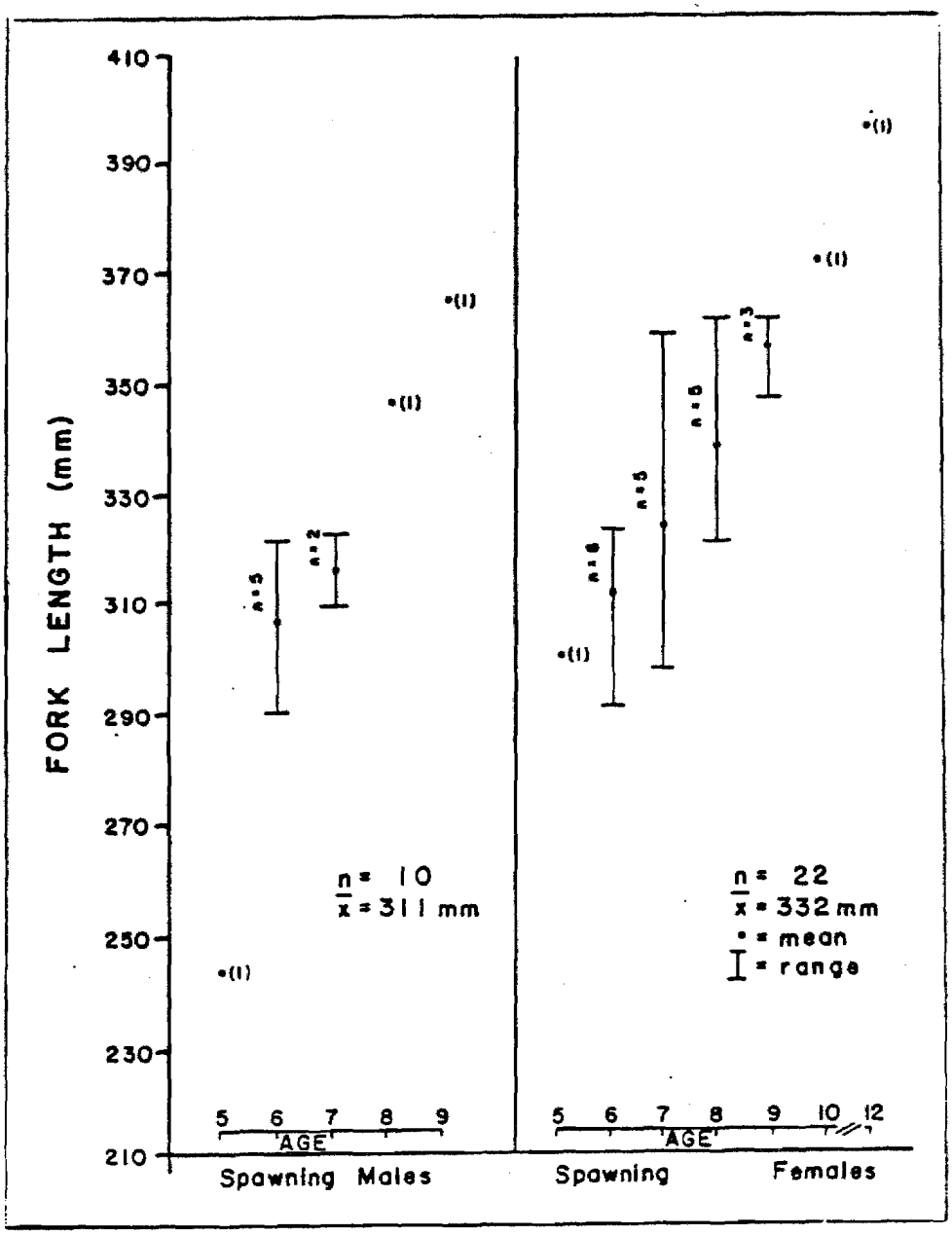
Appendix Figure C-7. Timing of 1984 rainbow trout and Arctic grayling spawning in the middle Susitna River determined by the incidence of pre- to post-spawners.



Appendix Figure C-8. Age and length relationship for spawning rainbow trout captured in the Susitna River between the Chulitna River confluence and Devil Canyon, May 17 through June 27, 1984.



Appendix Figure C-9. Age and length relationships for spawning Arctic grayling captured in the Susitna River between the Chulitna River confluence and Devil Canyon, May 17 through June 5, 1984.



Appendix Figure C-10. Age and length relationships for spawning round whitefish in the Susitna River between Cook Inlet and Devil Canyon, October 9 to to October 15, 1984.

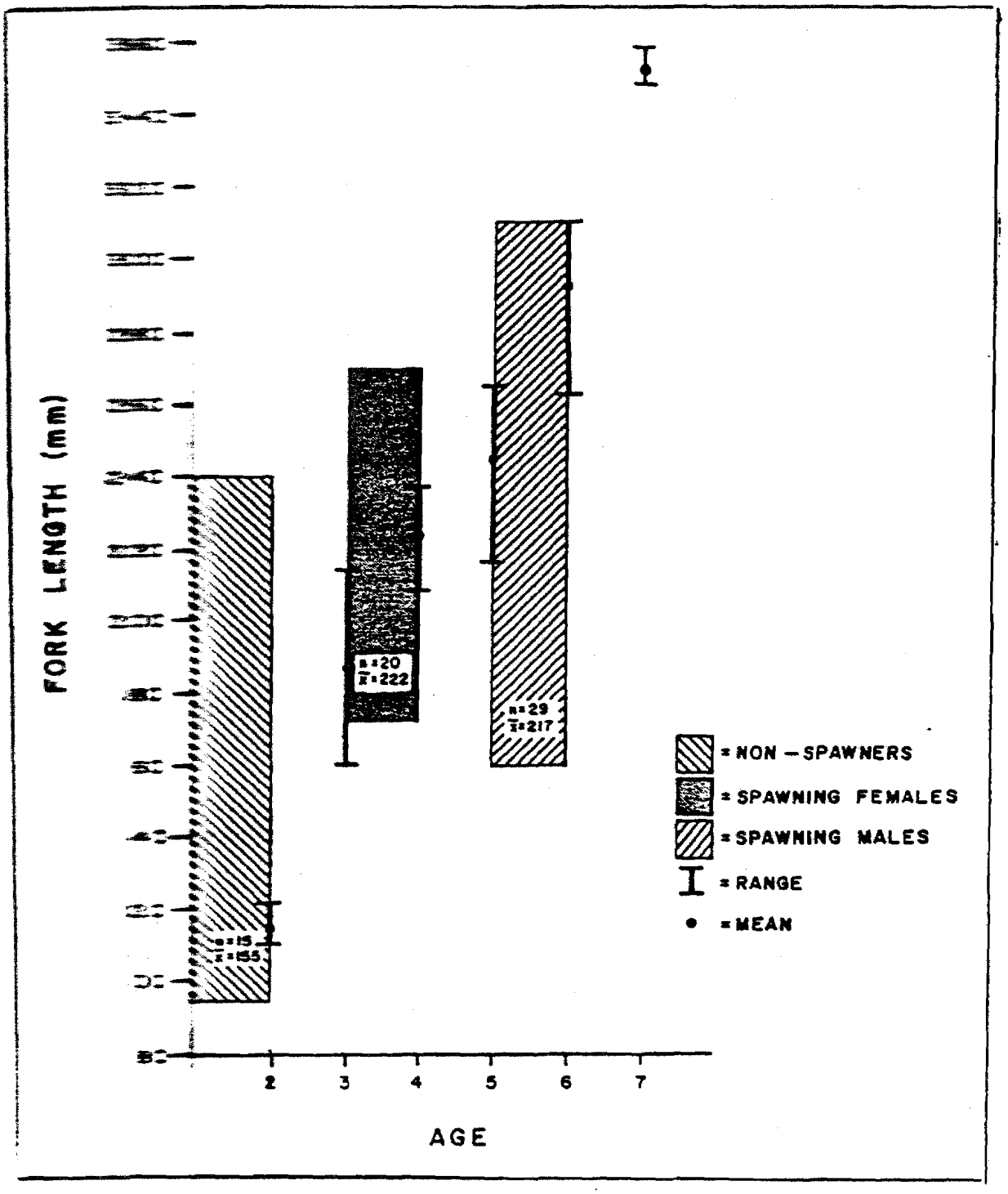
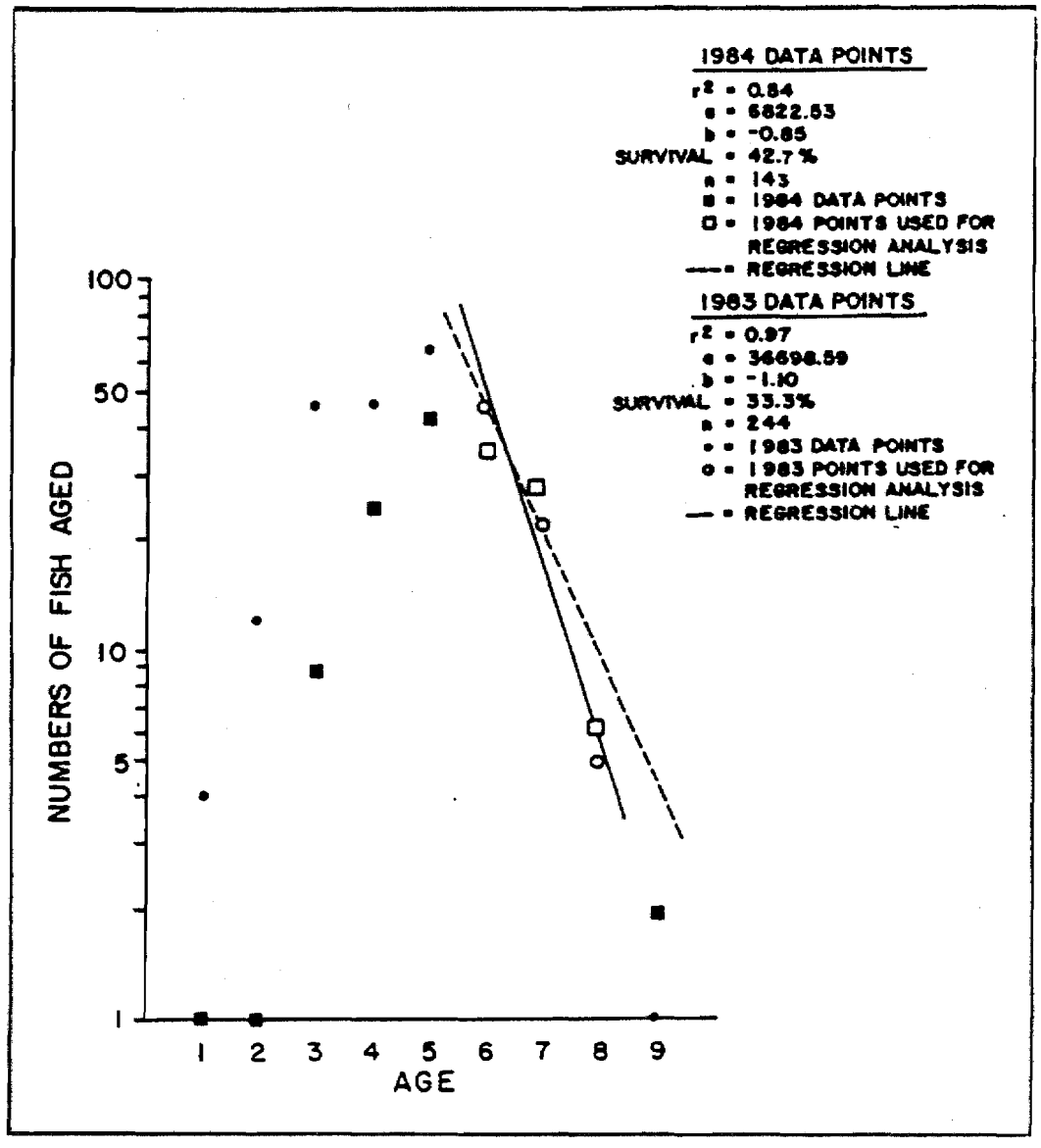


Figure C-11. Age and length relationships for pre-spawning rainbow trout captured in lakes C and D at the headwaters of Fourth of July Creek, September 14, 1984.



Appendix Figure C-13. Survival rate curves for rainbow trout captured in the Susitna River between the Chulitna River confluence and Devil Canyon, 1983 and 1984.

APPENDIX D

Population Estimates

Methods

Population estimates were made of adult rainbow trout, Arctic grayling, round whitefish, and longnose sucker populations in the middle river using the multiple-year (1981-1984) tagging and recapture data. Since only adult fish have been tagged, population estimates are applicable only for fish above 199 mm fork length. The Jolly-Seber and Bailey methods (Ricker 1975) were set up on a commercial microcomputer spreadsheet program. The 95% confidence interval for the Jolly-Seber population estimate was developed using the method of Manly (1984).

The number of recaptures of each species was adjusted by the tag retention rate for that species (Appendix A; Appendix Table D-2). Floy anchor tag retention rates were calculated in 1983 and 1984 for several resident fish species. This was done by comparing the number of fish recaptured with tags to the number of fish recaptured which showed a tag scar. Tag scars were not recorded for fish captured in 1982 so actual tag retention rates are unavailable for that year. However, since retention rates are known for 1983 and assuming there was little change in retention rates between years, 1983 retention rates were applied to recaptures made in 1982.

Results and Discussion

Population estimates presented in Appendix Table D-1 from the Jolly-Seber method and Bailey's method must be considered tentative at this time. The numbers of recaptures were low, leading to large confidence intervals on the population estimates using the Jolly-Seber method. One of the main problems was that there was a high mortality on the fish marked in 1981; hence, the recapture rate of these fish was low in comparison to 1982 and 1983. The high mortality was caused by the use of gill nets in 1981; we changed in 1982 to boat electrofishing as the primary capture method. Round whitefish are particularly sensitive to gill nets; only one of the 48 fish marked in 1981 was ever recaptured. Because the Jolly-Seber method requires three marking periods, the 1981 data cannot be discarded from the estimate presented here. However, we will be able to discard the 1981 data after the 1985 field season, and use the 1982 to 1985 data.

Note that several of the confidence intervals (particularly in 1982, which was affected by the 1981 mortality) are so wide as to be meaningless. The 1983 estimates, however, give a general idea of the magnitude of the populations. We can conclude, for example, that it is unlikely that there are more than 15,000 Arctic grayling larger than 200 mm in the middle reach of the Susitna River, and that the true number is closer to 7,000. A similar type of conclusion can be made for round whitefish and longnose suckers.

For the long term monitoring program, efforts will be redirected so that we can get higher recapture rates and therefore better population estimates.

Appendix Table D-1. Population estimates, using the Jolly-Seber and Bailey methods, for four species of resident fish in the middle river, 1981-84.

Date	Population Estimates: Jolly-Seber[a]	95% Confidence Interval[d]	Bailey[b]	S.D.	Bailey[c]	S.D.	Fish Newly Marked	Fish Checked for Marks	Recaptures of Fish Marked at: 1981	1982	1983	Total Recaptures
Rainbow Trout												
1981	NA	-	NA	-	-	-	92	NA	NA	NA	NA	NA
1982	1,408	548 - 6,661	1,450	1,148	NA	-	151	191	7	NA	NA	7
1983	1,036	312 - 29,667	NA	-	1,009	-	274	312	2	4	NA	6
1984	NA	-	-	-	NA	1,009	NA	204	0	1	16	17
Total Recaptures		-					NA	NA	9	5	16	30
Arctic Grayling												
1981	NA	-	NA	-	-	-	49	NA	NA	NA	NA	NA
1982	2,866	783 - 28,192	2,356	1,551	NA	-	400	425	6	NA	NA	6
1983	6,783	4,070 - 15,152	NA	-	5,787	-	765	911	3	30	NA	33
1984	NA	-	-	-	NA	2,329	NA	563	1	9	34	44
Total Recaptures							NA	NA	10	39	34	83
Round Whitefish												
1981	NA	-	NA	-	-	-	48	NA	NA	NA	NA	NA
1982	9,529	-	11,125	11,125	NA	-	720	787	0	NA	NA	0
1983	7,264	4,829 - 13,806	NA	-	6,204	2,006	1,079	1,172	1	50	NA	51
1984	NA	-	-	-	NA	-	NA	642	0	14	55	69
Total Recaptures							NA	NA	1	64	55	120
Longnose Suckers												
1981	NA	-	NA	-	-	-	80	NA	NA	NA	NA	NA
1982	6,930	837 - 261,062	8,602	6,922	NA	-	418	462	2	NA	NA	2
1983	7,613	4,003 - 20,439	NA	-	8,101	4,667	434	447	2	14	NA	16
1984	NA	-	-	-	NA	-	NA	223	0	5	7	12
Total Recaptures							NA	NA	4	19	7	30

[a] Population estimates made using 1981-84 data.
[b] Population estimates made using 1981-83 data.
[c] Population estimates made using 1982-84 data.
[d] See text for explanation.
NA = Not applicable.
S.D. = Standard deviation.

Appendix Table D-2. Tag retention rates.

Rainbow trout: 100% tag retention rates for years 1981-1984.

Arctic grayling: 69.4% tag retention rate for year 1982

Year Tagged	Actual No. Recaps	Adjusted No. Recaps
1981	4	6
1982	31	44
Total	35	50

Arctic grayling: 69.4% tag retention rate for year 1983

Year Tagged	Actual No. Recaps	Adjusted No. Recaps
1981	2	3
1982	21	30
1983	14	20
Total	37	53

Arctic grayling: 75.9% tag retention rate for year 1984.

Year Tagged	Actual No. Recaps	Adjusted No. Recaps
1981	1	1
1982	7	9
1983	26	34
1984	8	11
Total	42	55

Round whitefish: 77.5% tag retention rate for year 1982.

Year Tagged	Actual No. Recaps	Adjusted No. Recaps
1981	0	0
1982	32	41
Total	32	41

Round whitefish: 77.5% tag retention rate for year 1983.

Year Tagged	Actual No. Recaps	Adjusted No. Recaps
1981	1	1
1982	39	50
1983	32	42
Total	72	93

Appendix Table D-2. Tag retention rates.

Round whitefish: 83% tag retention rate for year 1984

Year Tagged	Actual No. Recaps	Adjusted No. Recaps
1981	0	0
1982	12	14
1983	46	55
1984	18	22
Total	76	91

Longnose suckers: 100.0% tag retention rate for years 1982 and 1983.

Year Tagged	Actual No. Recaps	Adjusted No. Recaps
1981	0	0
1982	5	5
1983	6	7
1984	2	2
Total	13	14

APPENDIX E

Middle River Index Site Catch Data and Descriptions, and Spawning Rainbow Trout Habitat Data

INDEX SITE DESCRIPTIONS

(the other nine site descriptions are provided in ADF&G 1983d)

Skull Creek - Mouth

Skull Creek is a small clear-water tributary with a summer discharge of approximately 50 cfs which empties into the east side of the Susitna River at RM 124.7 (R&M 1982). The mouth of the creek is characterized by shallow water depths, low water velocities, and small cobble substrate. No object cover other than the substrate usually occurs.

Susitna Mainstem - West Bank

The index site Susitna Mainstem - West Bank is along the west bank of the mainstem Susitna River between RM 137.3 and RM 138.3. This site is characterized by low to moderate water depths and velocities, and has large cobble substrate. No object cover other than the substrate usually occurs.

Susitna Mainstem

This mainstem index site is between RM 147.0 and RM 148.0 and includes both sides of a large island. The area along the east and west banks of the mainstem river is characterized by steep banks and moderate water depths and velocities. Along the island, the shorelines are gently sloping and water velocities are low to moderate. The substrate at this site is predominately large cobble which acts as the only object cover.

Susitna Mainstem - Eddy

This site is a back eddy along the east bank of the mainstem Susitna River at RM 150.1. The area is characterized by steep banks, moderate water depths, and low velocity. The substrate is sand and rock.

Appendix Table E-1 Boat electrofishing catch and catch per unit effort (CPUE) of four resident fish species at 13 index sites in the midddle reach of the Susitna River in 1984. CPUE is in parentheses, and the units are catch per minute.

Location	River Mile	Species	MAY 16-31	JUN 1-15	JUN 16-30	JUL 1-15	JUL 16-31	AUG 1-15	AUG 16-31	SEP 1-15	SEP 16-30	OCT 1-15	TOTAL CATCH
Tributary Mouth Sites													
Lane Creek	113.6	Rainbow trout	5 (0.2)	0	0	-	0	-	0	1 (0.3)	-	-	6
		Arctic grayling	16 (0.5)	4 (0.7)	3 (0.4)	-	3 (0.8)	-	0	2 (0.6)	-	-	28
		Round whitefish	5 (0.2)	5 (0.8)	2 (0.3)	-	2 (0.5)	-	1 (0.3)	2 (0.6)	-	-	17
		Longnose sucker	0	2 (0.3)	0	-	8 (2.0)	-	9 (3.0)	2 (0.6)	-	-	21
Skull Creek	124.7	Rainbow trout	1 (0.3)	-	0	-	0	-	0	-	-	-	1
		Arctic grayling	5 (1.4)	-	3 (0.6)	-	2 (0.7)	-	6 (3.0)	-	-	-	16
		Round whitefish	1 (0.3)	-	2 (0.4)	-	0	-	1 (0.5)	-	-	-	4
		Longnose sucker	0	-	0	-	3 (1.0)	-	1 (0.5)	-	-	-	4
Fourth of July Creek	131.1	Rainbow trout	2 (0.1)	1 (0.1)	2 (0.3)	-	1 (0.2)	-	1 (0.2)	1 (0.1)	1 (0.1)	-	9
		Arctic grayling	0	0	1 (0.1)	-	2 (0.4)	-	1 (0.2)	7 (0.5)	1 (0.1)	-	12
		Round whitefish	4 (0.1)	4 (0.5)	6 (0.8)	-	7 (1.3)	-	5 (0.9)	10 (0.8)	1 (0.1)	-	37
		Longnose sucker	0	0	0	-	3 (0.5)	-	2 (0.4)	11 (0.8)	0	-	16
Indian River	138.6	Rainbow trout	6 (0.1)	1 (0.1)	0	-	3 (0.4)	-	1 (0.1)	9 (0.3)	6 (0.3)	0	26
		Arctic grayling	10 (0.2)	1 (0.1)	7 (0.6)	-	6 (0.8)	-	5 (0.6)	47 (1.4)	28 (1.6)	0	104
		Round whitefish	21 (0.3)	2 (0.3)	33 (3.0)	-	6 (0.8)	-	2 (0.3)	16 (0.5)	45 (2.5)	11 (0.9)	136
		Longnose sucker	0	0	1 (0.1)	-	6 (0.8)	-	4 (0.4)	0	1 (0.1)	1 (0.1)	13
Jack Long Creek	144.5	Rainbow trout	0	0	0	-	0	-	0	0	0	0	0
		Arctic grayling	2 (0.1)	1 (0.2)	5 (1.0)	-	10 (2.9)	-	0	1 (0.1)	0	0	19
		Round whitefish	7 (0.3)	7 (1.3)	25 (5.0)	-	5 (1.4)	-	2 (1.3)	12 (1.6)	18 (3.3)	0	76
		Longnose sucker	0	0	2 (0.4)	-	0	-	0	1 (0.1)	0	0	3
Portage Creek	148.8	Rainbow trout	1 (0.0)	1 (0.1)	1 (0.1)	-	0	-	0	6 (0.5)	1 (0.1)	1 (0.1)	11
		Arctic grayling	28 (0.6)	8 (0.7)	8 (0.8)	-	7 (0.7)	-	19 (1.0)	18 (1.6)	7 (0.4)	9 (0.9)	104
		Round whitefish	25 (0.5)	9 (0.8)	21 (2.1)	-	5 (0.5)	-	7 (0.7)	6 (0.5)	19 (1.0)	9 (0.9)	101
		Longnose sucker	0	0	0	-	11 (1.1)	-	5 (0.5)	2 (0.2)	1 (0.1)	0	19
Slough Sites													
Whiskers Creek Slough Mouth	101.2	Rainbow trout	3 (0.1)	-	0	-	1 (0.3)	-	0	1 (0.2)	-	-	5
		Arctic grayling	38 (1.2)	-	0	-	1 (0.3)	-	1 (0.3)	1 (0.2)	-	-	41
		Round whitefish	3 (0.1)	-	0	-	0	-	1 (0.3)	2 (0.3)	-	-	6
		Longnose sucker	1 (0.0)	-	1 (0.1)	-	1 (0.3)	-	5 (1.4)	0	-	-	8
Slough 6A	112.3	Rainbow trout	0	-	0	-	0	-	0	-	-	-	0
		Arctic grayling	4 (0.3)	-	0	-	0	-	0	-	-	-	4
		Round whitefish	3 (0.2)	-	3 (0.3)	-	0	-	1 (0.2)	-	-	-	7
		Longnose sucker	1 (0.1)	-	3 (0.3)	-	0	-	0	-	-	-	4

Appendix Table E-1 (Continued).

Location	River Mile	Species	MAY 16-31	JUN 1-15	JUN 16-30	JUL 1-15	JUL 16-31	AUG 1-15	AUG 16-31	SEP 1-15	SEP 16-30	OCT 1-15	TOTAL CATCH
Slough 8A	125.3	Rainbow trout	7 (2.0)	-	0	-	0	-	0	1 (0.2)	-	-	8
		Arctic grayling	0	-	0	-	0	-	1 (0.3)	0	-	-	1
		Round whitefish	0	-	0	-	0	-	1 (0.3)	3 (0.5)	-	-	4
		Longnose sucker	0	-	1 (0.2)	-	0	-	0	0	-	-	1
Slough 20 Mouth	140.1	Rainbow trout	-	0	0	-	0	-	0	0	1 (0.1)	-	1
		Arctic grayling	-	2 (0.5)	0	-	0	-	0	6 (1.2)	0	-	8
		Round whitefish	-	4 (1.0)	2 (0.6)	-	0	-	0	0	0	-	6
		Longnose sucker	-	1 (0.3)	0	-	0	-	1 (0.5)	5 (1.0)	0	-	7
Mainstem Sites													
Susitna Mainstem West Bank	137.3-138.3	Rainbow trout	2 (0.2)	0	0	-	0	-	0	0	0	-	2
		Arctic grayling	2 (0.2)	1 (0.1)	22 (1.8)	-	21 (2.0)	-	6 (0.6)	13 (1.2)	7 (0.6)	-	72
		Round whitefish	2 (0.2)	8 (0.7)	7 (0.6)	-	2 (0.2)	-	4 (0.4)	7 (0.6)	17 (1.4)	-	47
		Longnose sucker	0	0	4 (0.3)	-	4 (0.4)	-	0	2 (0.2)	1 (0.1)	-	11
Susitna Mainstem	147.0-148.0	Rainbow trout	0	0	0	-	0	-	0	2 (0.1)	0	1 (0.0)	3
		Arctic grayling	9 (0.2)	17 (0.6)	2 (0.3)	-	0	-	0	23 (0.9)	5 (0.2)	4 (0.1)	60
		Round whitefish	34 (0.9)	56 (2.0)	9 (1.2)	-	1 (0.2)	-	4 (0.8)	33 (1.3)	25 (1.1)	16 (0.5)	178
		Longnose sucker	0	3 (0.1)	1 (0.1)	-	2 (0.3)	-	0	5 (0.2)	4 (0.2)	2 (0.1)	17
Mainstem	150.1	Rainbow trout	1 (0.1)	0	-	-	-	-	-	3 (0.2)	11 (0.5)	4 (0.2)	19
		Arctic grayling	16 (1.0)	2 (0.4)	-	-	-	-	-	4 (0.2)	2 (0.1)	0	24
		Round whitefish	0	1 (0.2)	-	-	-	-	-	20 (1.0)	22 (0.9)	9 (0.5)	52
		Longnose sucker	0	0	-	-	-	-	-	2 (0.1)	0	0	2

0.0 = Trace.

Appendix Table E-2. Habitat characteristics and measurements taken at spawning rainbow trout sites in 1984.

Location	RM	TRM	Date	Water		Water Quality				Substrate	Comments
				Depth (ft)	Mean Velocity (ft per sec)	Temp °C	pH	DO mg/l	Conductivity umhos/cm		
Portage Creek	148.8	2.3	6/2	--	--	4	7.6	12.4	96.0	large gravel 70% small cobble 25% bedrock 5%	Seven spawning fish were captured on June 1 and 5 from a school of approximately 30 adult rainbow trout. Five of these fish were radio tagged. This site is characterized by a pool with a tributary outletting from the west. The pool's maximum depth was estimated at 20 ft. Most spawning probably occurred in the pool near the side tributary's outlet where estimated water velocities were 0.5-1.5 fps and depths 1.5-2.5 ft.
Portage Creek (along the east shore)	148.8	5.1	6/20	4.5	0.2	6.4	7.1	11.8	66.0	large gravel 90% boulders 10%	One spawning fish was captured and radio tagged on June 20. One other spawning radio tagged fish was located at this site during this time. This site is characterized by low velocities due to large boulders and by a small tributary flowing into it. Most spawning probably occurred along the east side versus the west side. Water velocities were much greater along the west side.
Fourth of July Creek	131.1	0.7	6/3	2.8	2.5	9.3	6.8	11.4	21.0	large gravel 10% small cobble 60% large cobble 20%	One post-spawned fish was captured and radio tagged on June 3. Two spawning radio tagged fish were also located at this site during this time. This site is characterized by a side tributary outletting into it on the east side.
Unnamed side tributary outletting at TRM 0.7 of Fourth of July Creek		0.5	6/5	1.4	0.5	12.2	--	--	--	small gravel 60% large gravel 40%	One pair of spawning fish were observed. The male was captured and radio tagged. Other fish were observed but it was unknown if they were spawners. This side tributary was 10-15 feet wide. Limited undercut banks provided primary cover.

-- = No measurements taken.