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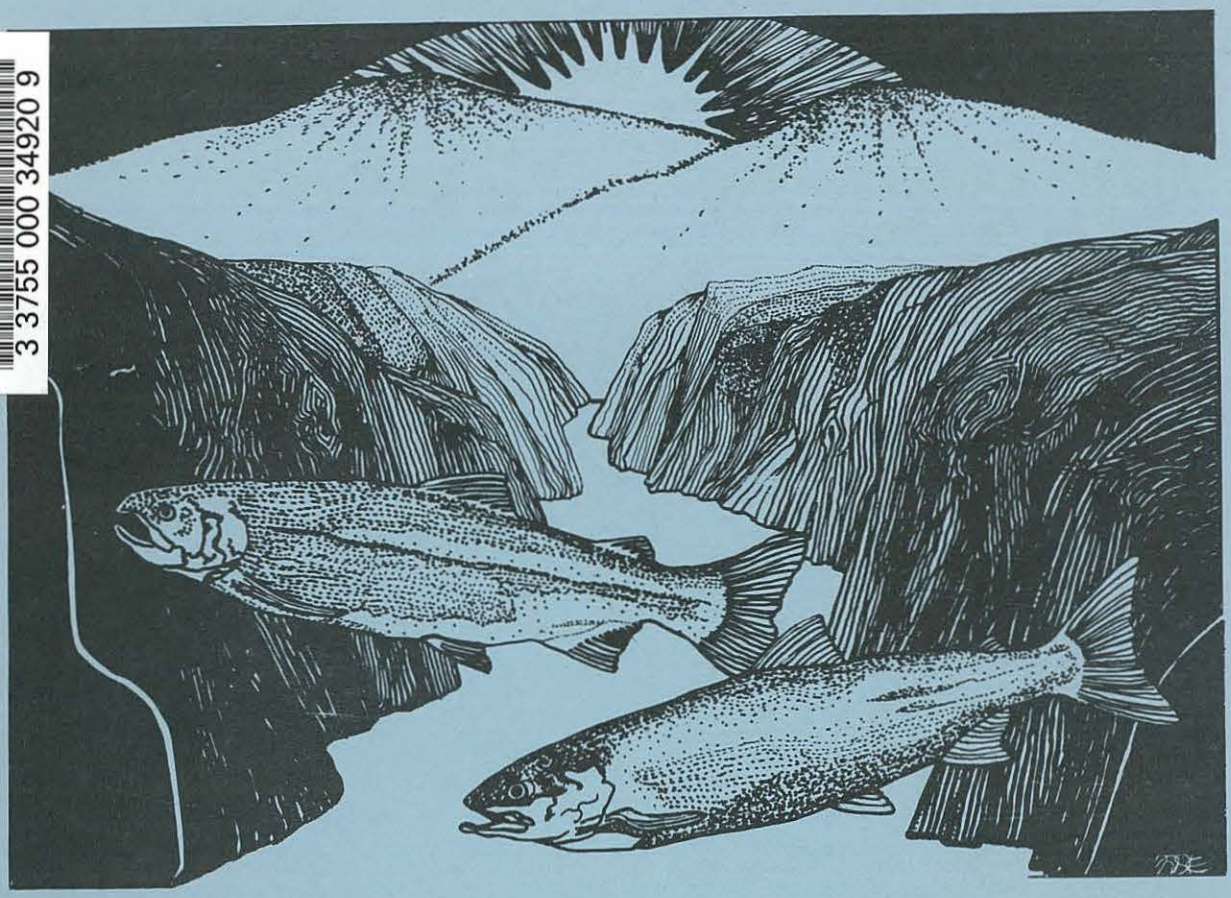

Subtask 7.10
Phase 1 Final Draft Report
Resident Fish Investigation on the Upper Susitna River
ADF&G / 1981

ALASKA DEPARTMENT OF FISH AND GAME

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

Subtask 7.10
Phase 1 Final Draft Report
Resident Fish Investigation on the Upper Susitna River ADF&G / 1981

by
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SUMMARY

1. Upper Susitna River studies had as its objectives for 1981 operations:

   Determine the seasonal distribution and relative abundance of selected resident and juvenile anadromous fish populations within the study area.

   Identify spawning and rearing locations of the resident species and the rearing locations of juvenile anadromous species to estimate their comparative importance.

   Record descriptive information on captured fish (species, location of capture site, age class), and discuss seasonal migration patterns of selected adult resident species.

2. A four man crew was utilized in the upper Susitna River basin fisheries studies. Transportation into the study area was provided by fixed wing aircraft, after which both helicopter and river rafts were used to reach the various habitat locations. On site operations began May 20 and extended through September 28.

3. For each stream habitat location within the confluence portion of site number 1, the following sampling gear was fished for two consecutive time periods ranging from 18 to 24 hours: five minnow traps, two trotlines, and one 30 foot variable mesh gillnet (panels of 1-1/2 to 2-1/2 inch bar mesh). At sites 1 through 5, hook and line, beach seines and backpack

electrofishing units were used to collect fish as stream conditions permitted. Selective fish habitat sites were sampled exclusively by rod and reel with the exception of Sally Lake where gillnets and minnow traps were also used.

4. Arctic grayling, burbot, round whitefish, and longnose suckers over 150 mm in length and in good condition after capture were tagged using Floy anchor tags inserted well above the lateral line just posterior of the dorsal fin.

5. Eight fish species were taken during 1981 sampling and included: Arctic grayling, burbot, cottid, Dolly Varden, Lake trout, longnose sucker, humpback whitefish, and round whitefish. No juvenile or adult salmon were either captured or observed in the upper river.

6. During upper Susitna River studies of 1981, a total of 3,303 Arctic grayling Thymallus arcticus greater than 135 mm of length were captured. Adult grayling were captured from all habitat location sites in the eight tributaries. Two hundred three angler hours fished within habitat locations produced 1,326 grayling for a catch per unit effort of 6.4. Highly significant differences were found in catch per unit effort by tributary of sampling.

Young of the year and juvenile grayling were captured through the summer in shallow, clearwater sloughs along the main Susitna and from quiet pools and side channels off Goose and Jay creeks.

The total number of grayling tagged during the season was 2,511. Recaptures amounted to 11% (268) of the total tagged.

Schnabel population estimates, based on the tag and recapture program, were generated by tributary and for the upper Susitna as a whole. The estimate for the upper Susitna was 10,279 (95% confidence limits 9,194 - 11,654). This population level would give an average of approximately 501 adult grayling per clearwater tributary mile or 121 per river mile including the main Susitna, to be inundated. Tagged grayling demonstrated interchange between tributaries using the main Susitna as a migratory corridor.

Age determination was made by scales taken from 381 grayling collected from the eight tributaries throughout the season. Fish age IV averaged 270 mm, age V averaged 303 mm, age VI averaged 329 mm and age VII averaged 352 mm (all length fork length).

Observations during May of 1981 indicate that grayling spawning takes in late April or early May under the ice or in early May flood waters immediately following ice out.

7. Eighty-eight adult burbot, Lota lota, were captured in the upper Susitna River. Catches were distributed over all tributary habitat locations. The catch per trotline day fished averaged 0.68 for all locations. One juvenile burbot of 15 mm FL was captured from lower Jay Creek on June 20.

The majority of the burbot aged were in the age classes IV, V, and VI. The mean lengths of burbot for these respective age classes were 357 mm, 382 mm, and 409 mm.

8. Thirty three adult round whitefish Prosopium cylindraceum were captured during 43 gillnet days fished at upper Susitna habitat locations. Six habitat location sites were productive for this species. Fish aged were VI to VIII with age VII fish the most numerous.

9. One hundred forty four longnose sucker, Catostomus catostomus, were captured during 43 gillnet days fished at upper Susitna habitat locations. Six of the eight habitat locations fished produced this species. Ninety longnose suckers were used for age determinations, Age VII suckers averaged 355 mm while Age VIII averaged 381 mm and Age IX averaged 405 mm.

10. Thirty eight slimy sculpin, Cottus cognatus, were collected at seven of eight habitat locations in the upper Susitna River.

11. Lake trout, Salvelinus namaycush, were taken from Sally and Deadman lakes. No lake trout were captured from the Susitna River or from the eight tributary stream habitat locations.

12. During 1981 operations, minnow traps produced minimal catches considering man hours expended in their use. The general use of this gear shall be discontinued in future upper main river and tributary sampling.

2. INTRODUCTION

The upper Susitna River basin is drained by the Susitna River from the proposed Devil Canyon dam site, River Mile (RM) 152, to the Susitna Glaciers (Figure E.2.1). the study area for summer 1981 field work was limited to those reaches of eight streams tributary to the upper Susitna River, beginning with Fog Creek (R.M. 173.9) and extending to the Oshetna River (R.M. 226.9), which will be permanently or seasonally inundated by the proposed Susitna dam impoundments (Figures E.2.2-E.2.9). The Denali Highway currently provides access to a portion of the upper Susitna Basin; however, the study area lies in a true wilderness setting where access is limited to foot travel, light aircraft, boat, snowmachine or helicopter.

Prior to initiation of the 1981 Susitna Hydroelectric Aquatic Studies, fisheries data pertaining to species composition, seasonal distribution, relative abundance, migrational movements and aspects of species life history within the upper Susitna River basin consisted of various preliminary environmental assessments (Andrews 1952, 1954, 1958, 1960, 1961, 1965; Riis and Friese 1978; Williams 1978). These studies define species composition and highlight habitat locations and issues of particular concern, but because of their limited scope were unable to quantitatively examine resident fish populations and their relationship to the aquatic environments.

2.1 Objectives

Determine the seasonal distribution and relative abundance of selected resident and juvenile anadromous fish populations within the study area.

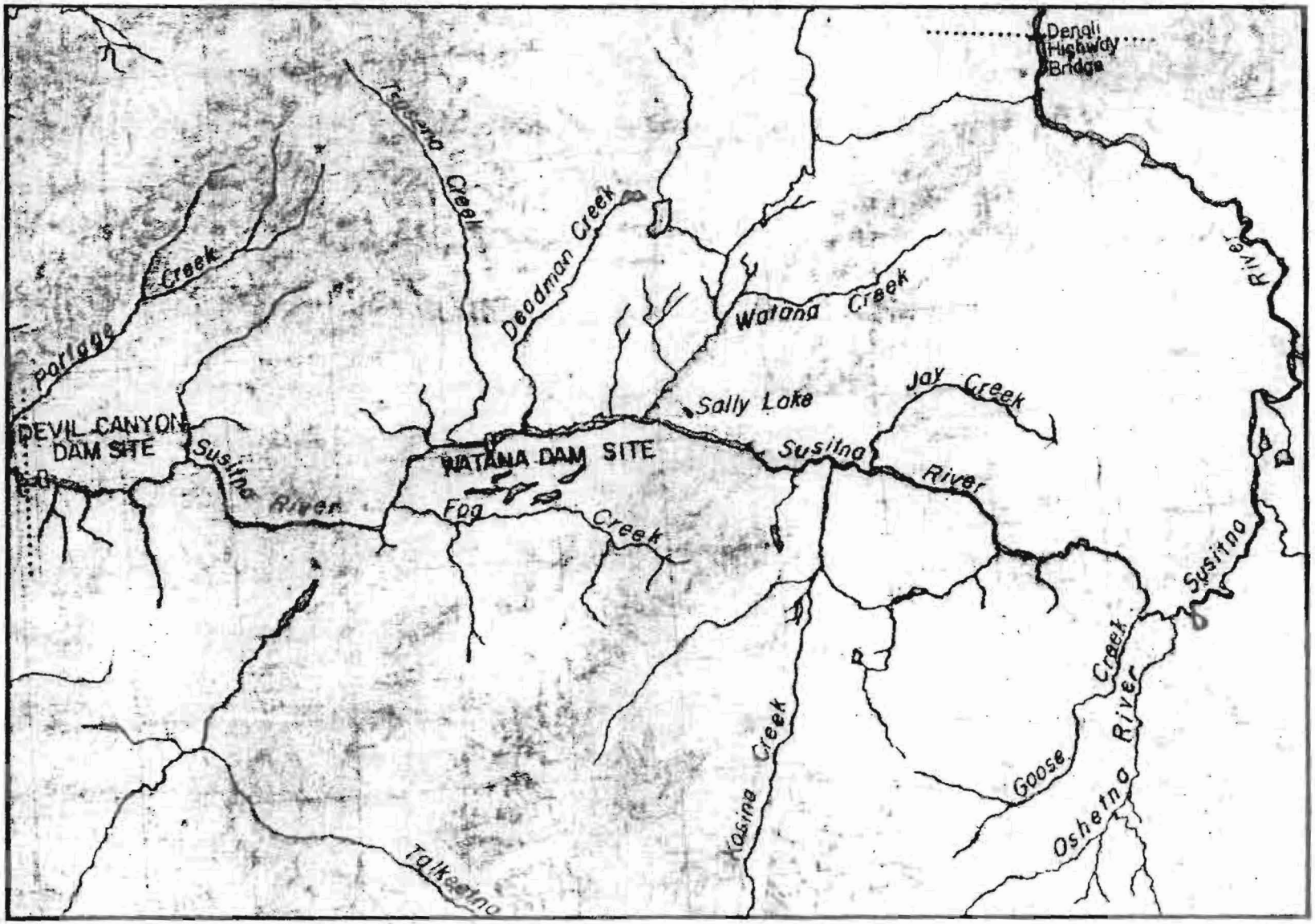

Figure E.2.1. Map of the upper Susitna River basin from the proposed Devil Canyon dam site to the Denali Highway.

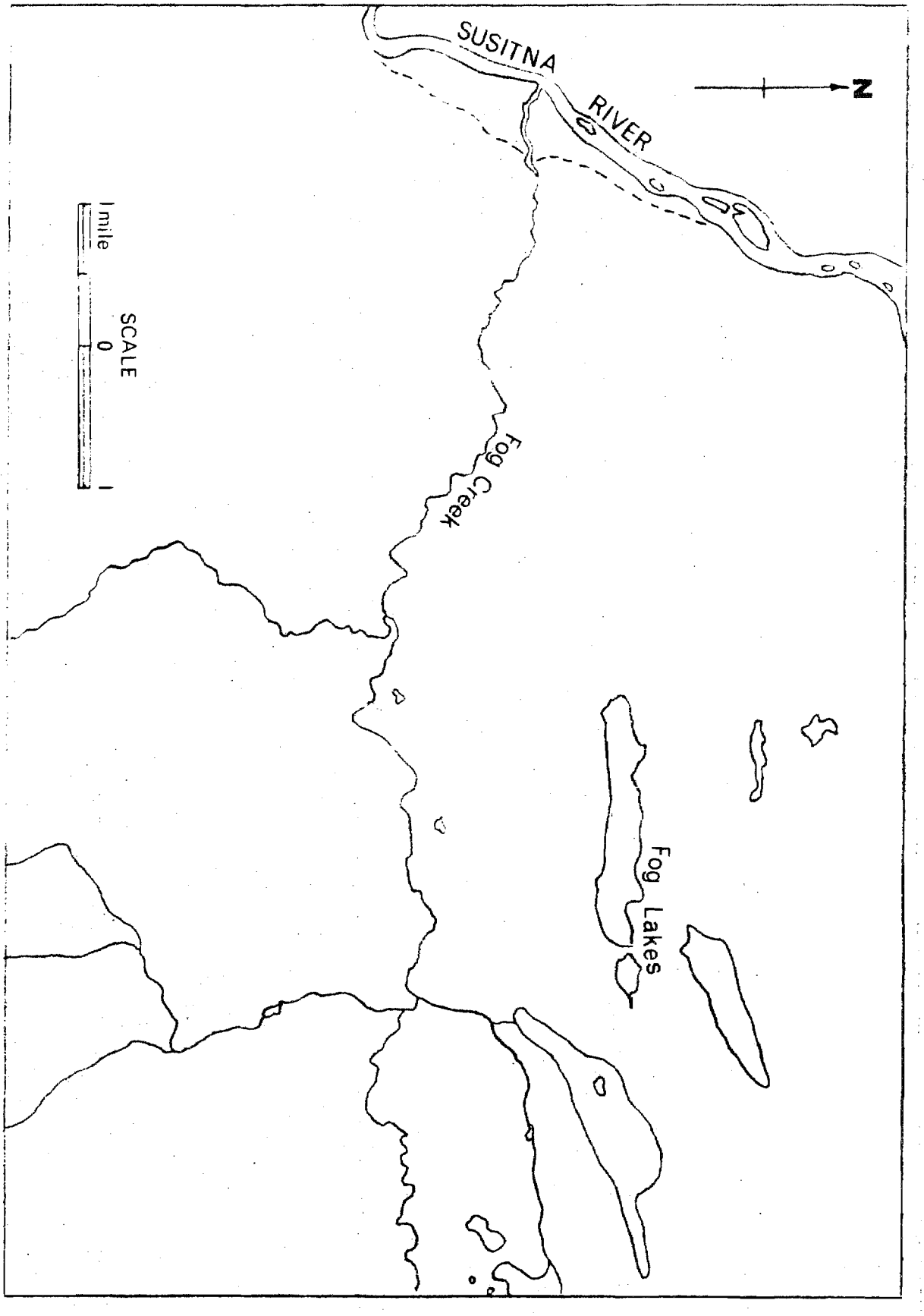

Figure E.2.2. Map of Fog Creek.

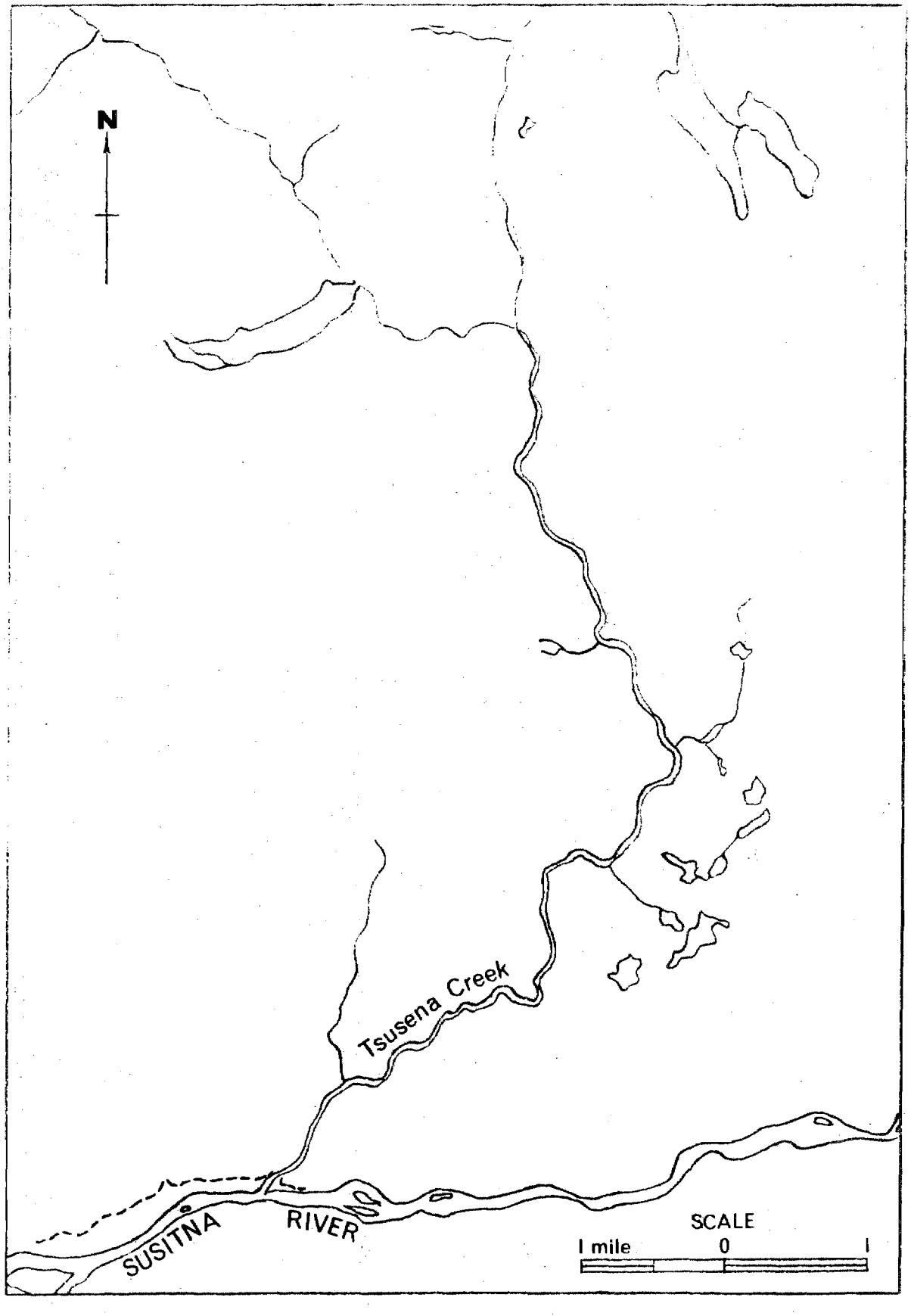

Figure E.2.3. Map of Tsusena Creek.

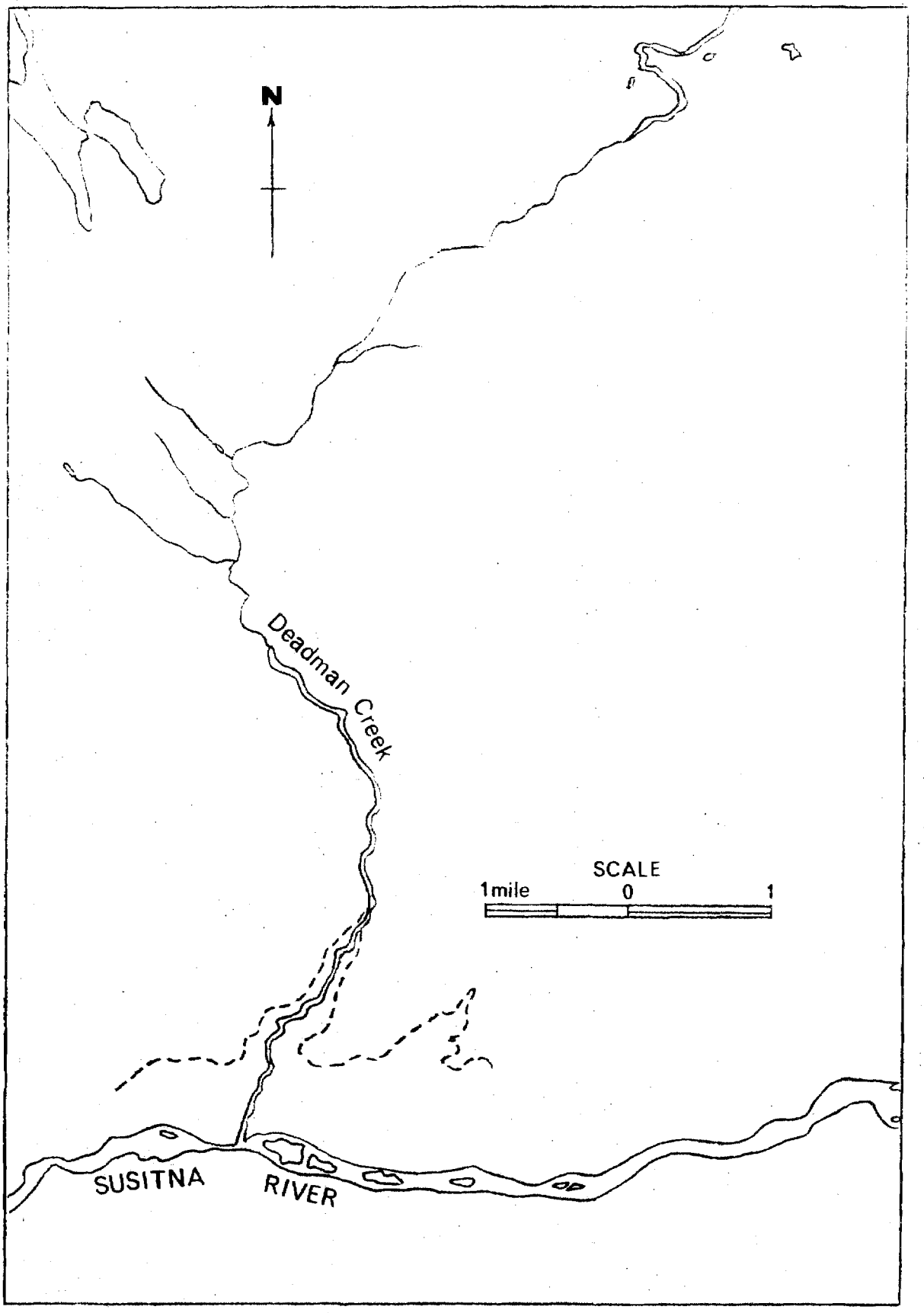

Figure E.2.4. Map of Deadman Creek.

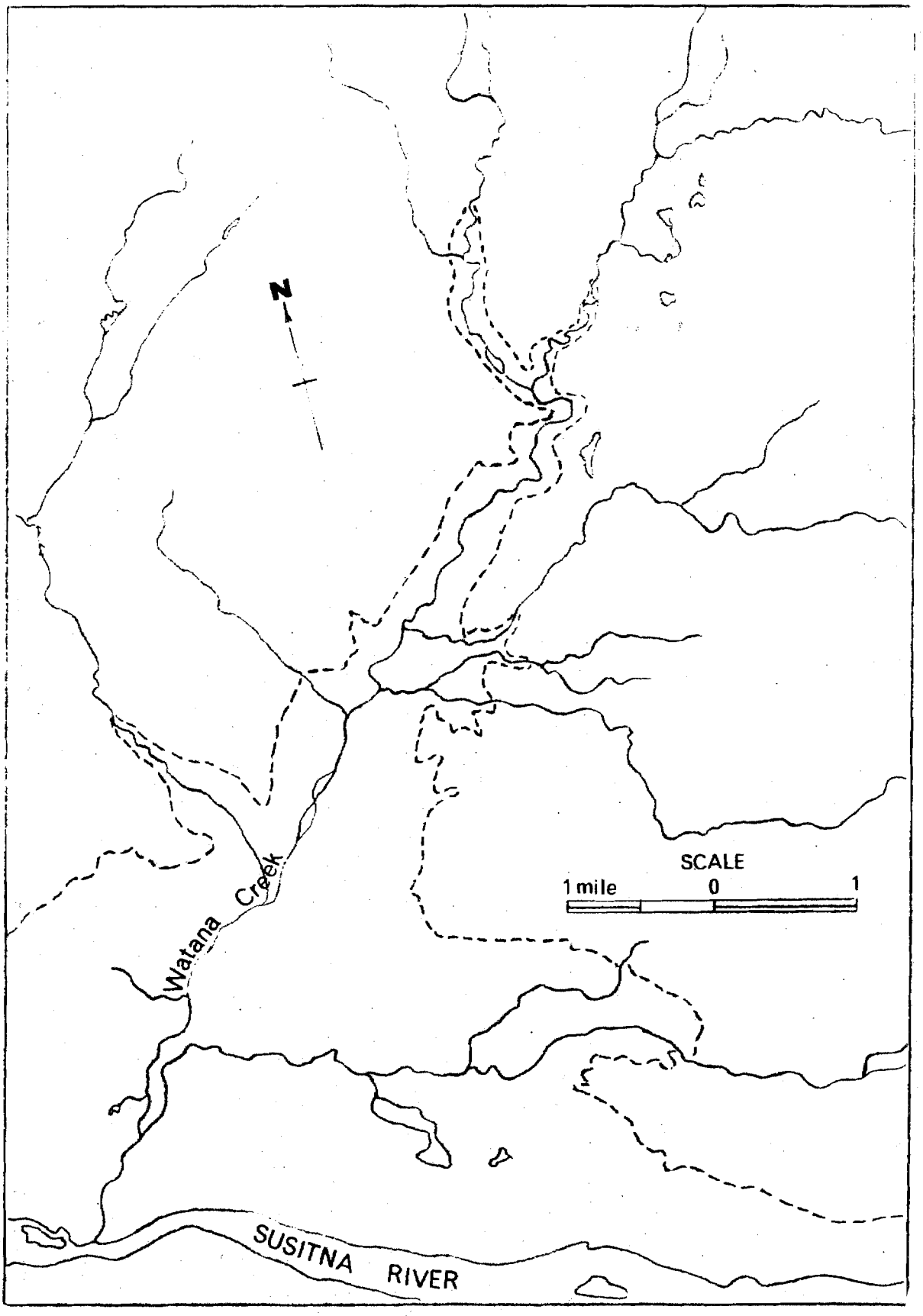

Figure E.2.5. Map of Watana Creek.

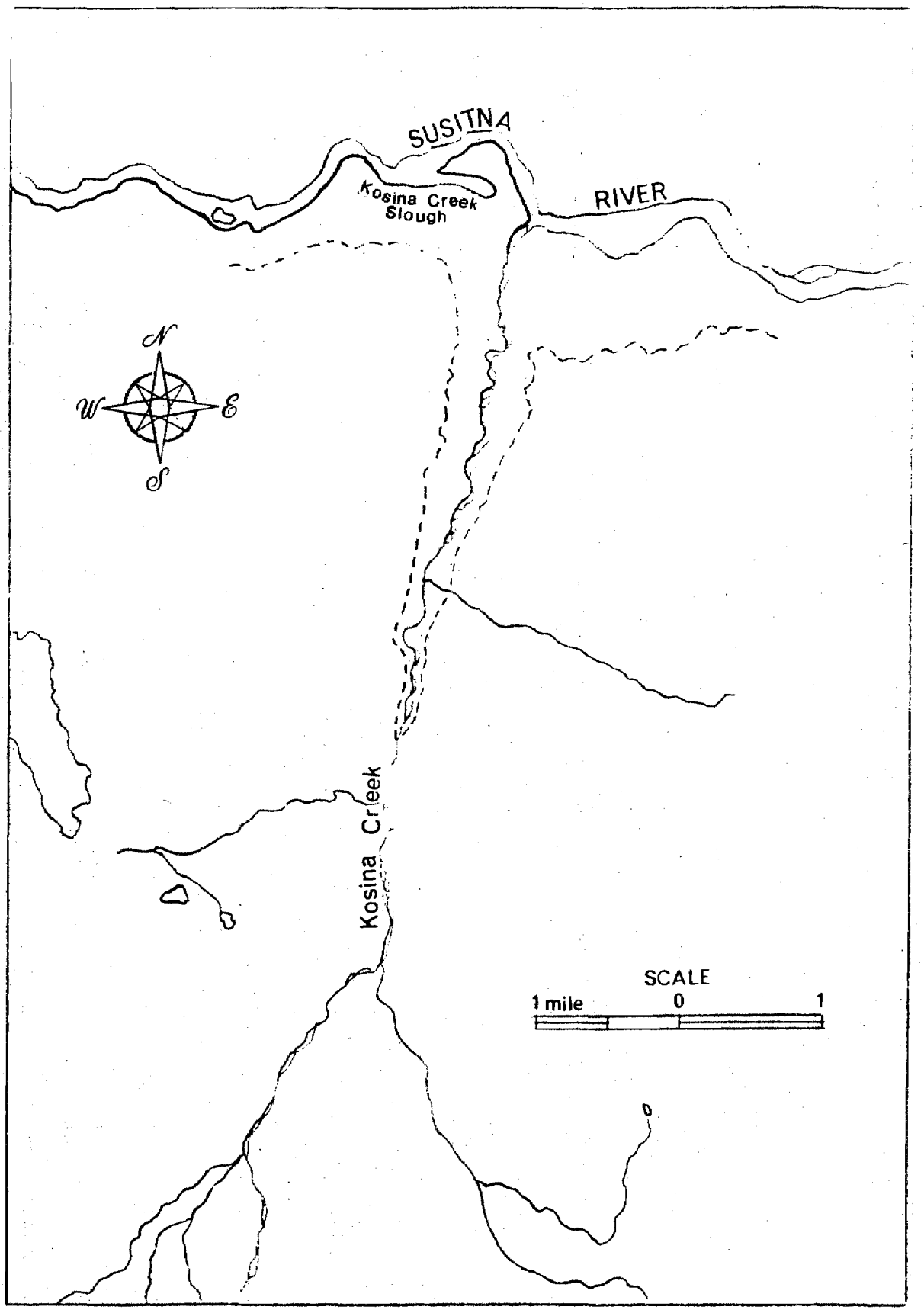

Figure E.2.6. Map of Kosina Creek.

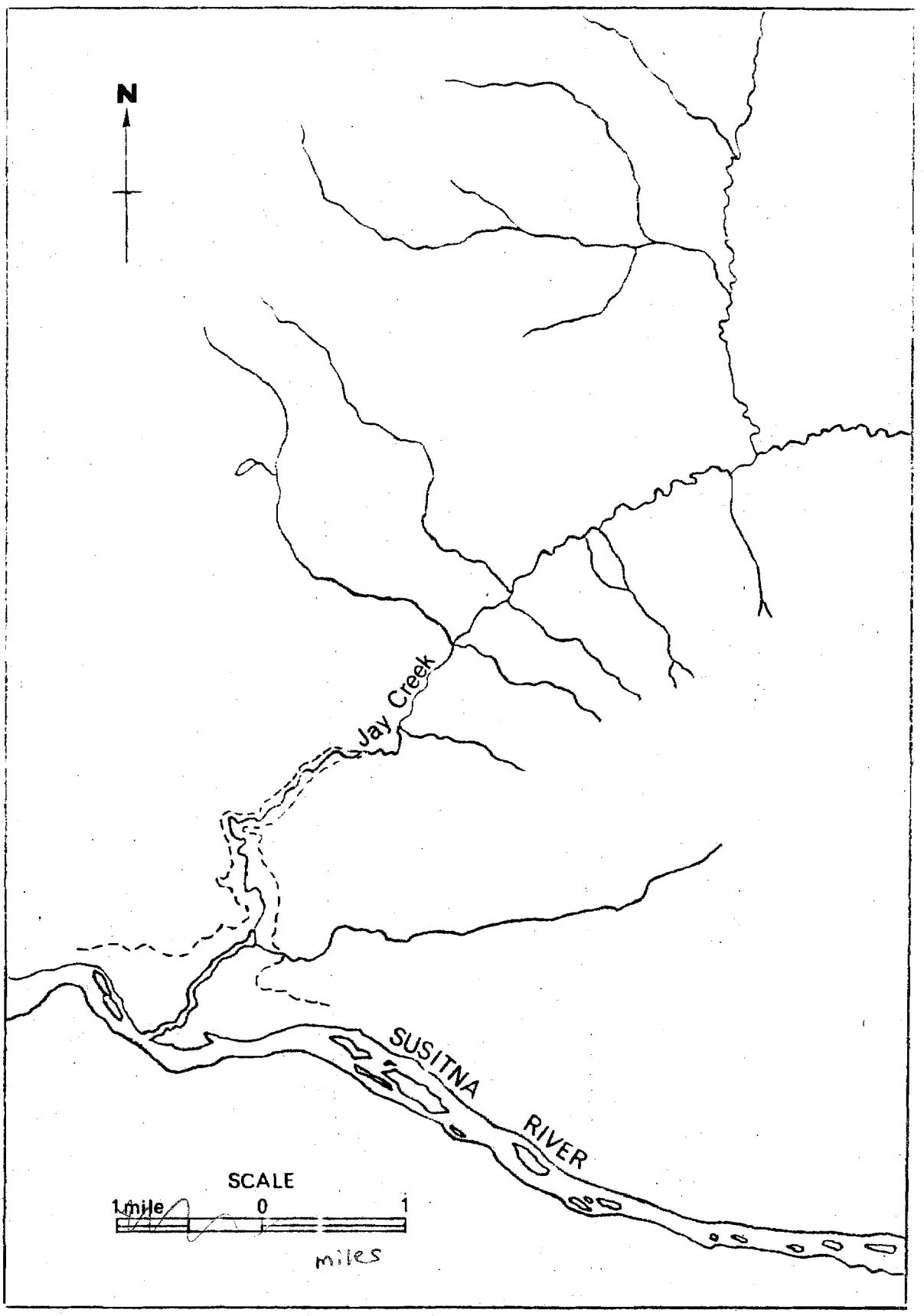

Figure E.2.7. Map of Jay Creek.

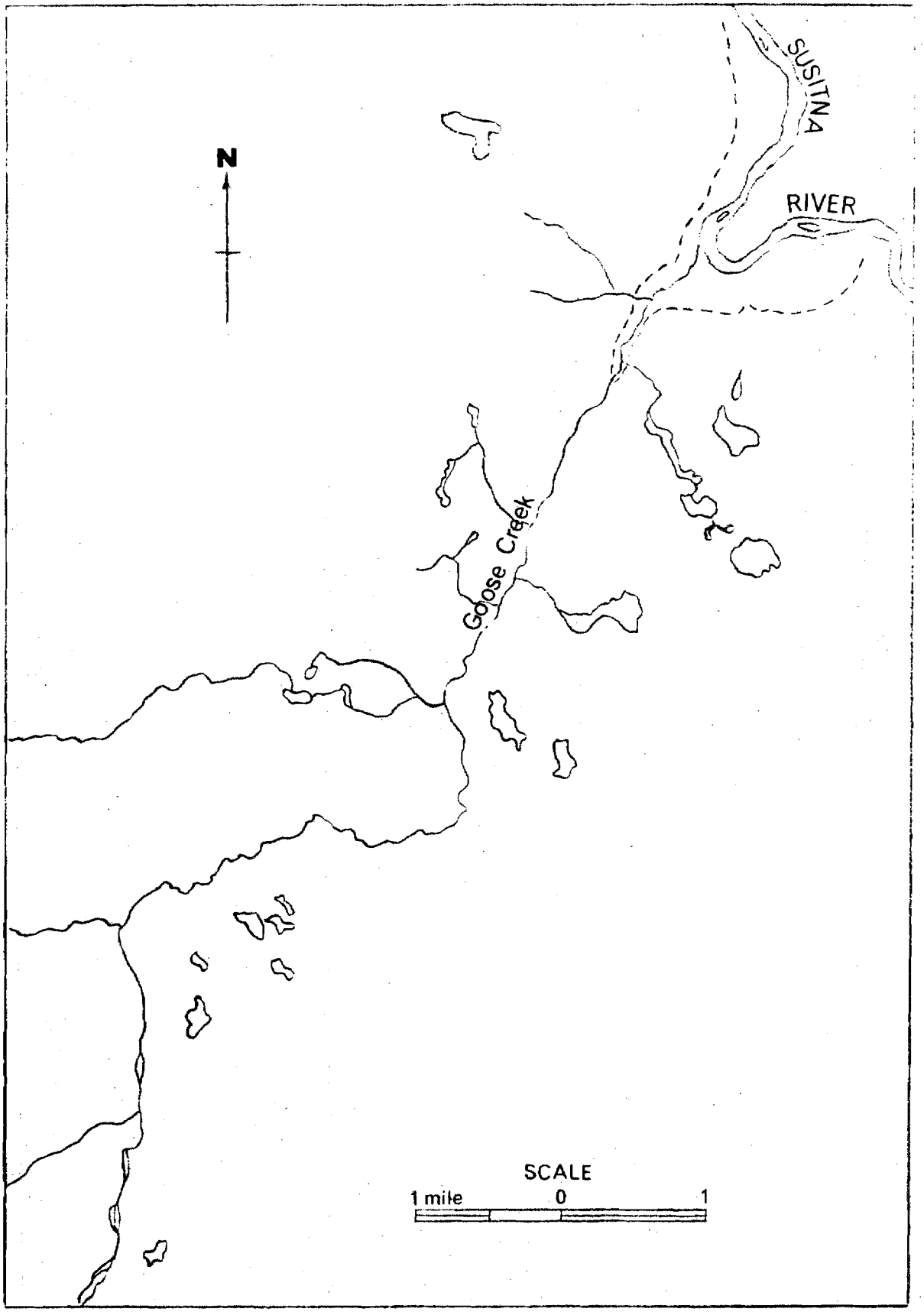

Figure E.2.8. Map of Goose Creek.

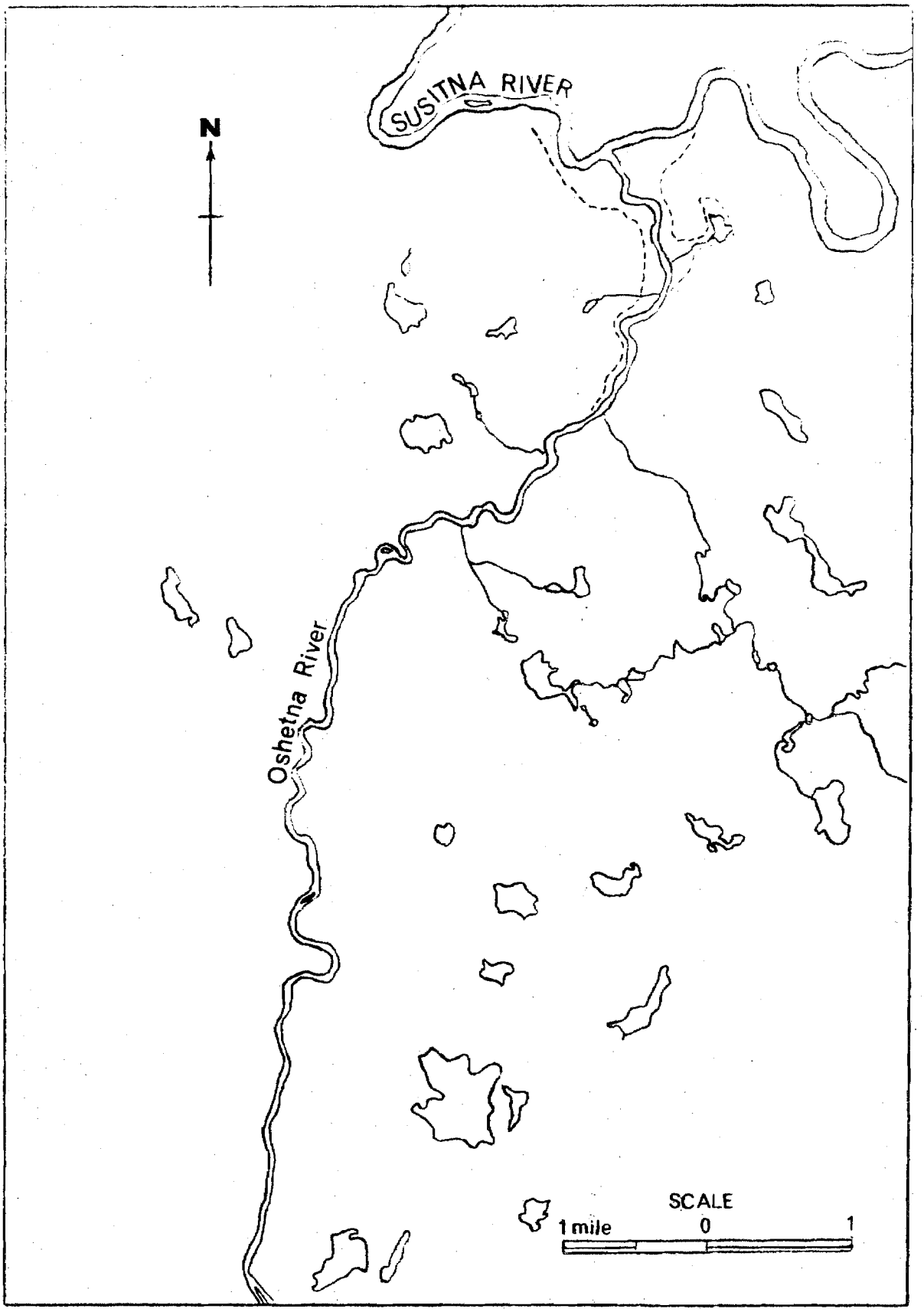

Figure E.2.9. Map of Oshetna River.

Task 2.1 Identify spawning and rearing locations of the resident species and the rearing locations of juvenile anadromous species to estimate their comparative importance.

Task 2.2 Record descriptive information on captured fish (species, location of capture site, age class), and discuss seasonal migration patterns of selected adult resident species.

2.2 Methods

Based on preliminary reconnaissance of the upper Susitna River basin, eight major tributaries were selected for in-depth indigenous fisheries and aquatic habitat studies. These streams are characterized by steep gradients, clear, cold, rapid flowing water, variously sized gravel substrates, and extreme fluctuations in discharge and turbidity.

Substantial resident fish populations are present in all eight tributary study streams. These streams, with their locations, proposed impoundment elevations, and miles which may be inundated, are listed in Table E.2.1. For the purpose of this study, the first mile of these streams from their confluence with the Susitna River are designated as the habitat locations.

A typical tributary stream habitat location with sampling sites defined is shown in Figure E.2.10. Preliminary ground and aerial surveys conducted in May 1981 indicated that prime representative fish habitat occurs in the lower one mile reach of each tributary stream. A sampling scheme was devised

Table E.2.1 Tributary habitat location streams and their proposed impoundment elevations, river miles, and elevation at their mouth.

Tributary	Susitna River Mile (above mouth)	Operational Level Proposed Impoundment Elevation (Ft.)	Elevation at Mouth	Miles in Impoundment
Fog	173.9	1477	1380	0.7
Tsusena	178.9	1477	1460	Mouth Only
Deadman	183.4	2185	1510	2.3
Watana	190.4	2185	1590	9.0
Kosina	202.4	2185	1690	4.0
Jay	203.9	2185	1710	3.0
Goose	224.9	2185	2030	1.5
Oshetna	226.9	2185	2050	2.0

Upper Susitna River tributary tagging locations (study sites) in river miles above confluence with the Susitna River.

Habitat Location Site Number	Feet Upstream From Confluence	Average Feet Above Mouth	Miles
1	0-500	250	0.0
2	1,000-1,500	1,250	0.2
3	2,000-2,500	2,250	0.4
4	2,500-3,000	2,750	0.5
5	4,000-4,500	4,250	0.8

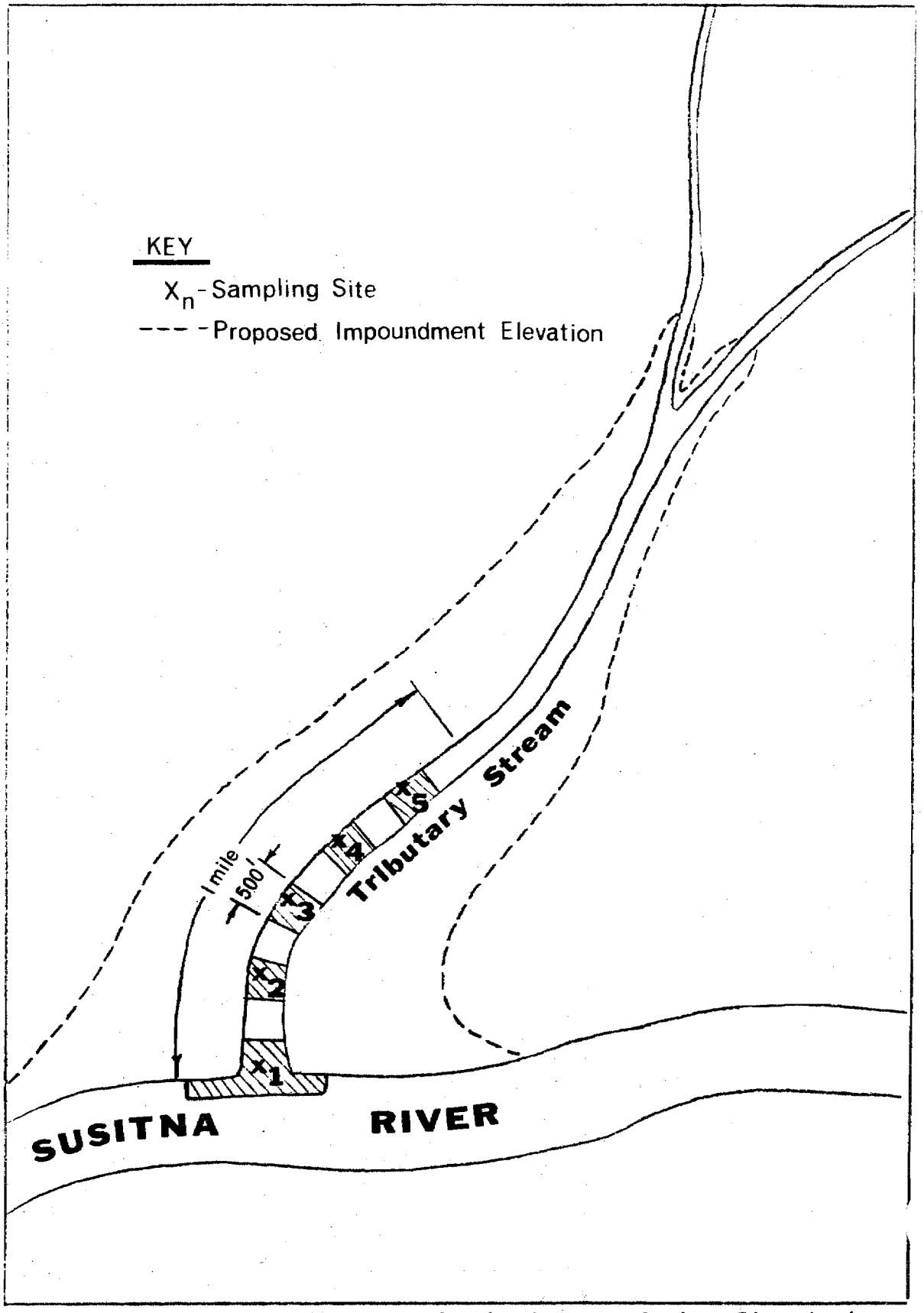

Figure E.2.10. A typical habitat location in the upper Susitna River basin with sampling sites defined.

involving systematic sampling of the first mile of the tributary. Five sampling sites, each 500 feet in length, separated from each other by a 500 foot interval, were marked off. The first 500 feet of the tributary upstream from its confluence with the Susitna was designated sampling site No. 1. Site No. 1 included the clear tailwaters, normally extending 300 feet downstream along the Susitna from the tributary confluence, and the turbid waters for 300 feet upstream. Table E.2.2 lists the tributary habitat locations with habitat sites and geographic location.

Selected fish habitat sites were chosen from Site No. 5 upstream to the high flood level of the proposed impoundment. Additional selected fish habitat sites were chosen from the 500 foot interval between study sites and form reaches of Kosina and Deadman creeks above the proposed impoundment elevation. The largest lake located within the proposed impoundment, known locally as Sally Lake, was also designated a selected fish habitat site. Criteria used for the selection of selected fish habitat sites included uniqueness, visual sightings of fish, large pools, cut banks, and relatively low water velocities.

Study sites were measured with a 100 foot length of rope and boundaries were blazed, spray painted and flagged on trees, rocks or other permanent land markers.

Although efforts to systematically sample each habitat location were made, it was not always possible because of geographical and impoundment limits and legal ramifications. Steep canyon walls on Deadman Creek limited access to habitat location sites 1 and 2 only. Tsusena Creek, located at the extreme

Table E.2.2. Upper Susitna River tributary habitat location sites and geographic locations.

HABITAT LOCATION	SITE	DESCRIPTION	RM	GEOGRAPHIC LOCATION
Fog Creek	1	Confluence	173.9	31N 04E 16DBB
	2			31N 04E 16DBB
				31N 04E 16DAD
Tsusena Creek	1	Confluence	178.9	32N 04E 36ADB
Deadman Creek	1	Confluence	183.4	32N 05E 26CDB
	2			32N 05E 26CAA
Watana Creek	1	Confluence	190.4	32N 06E 25CCA
	2			32N 06E 25CAB
	3			32N 06E 25BDC
	4			32N 06E 25ACB
	5			32N 06E 25ABC
Kosina Creek	1	Confluence	202.4	31N 08E 15BAB
	2			31N 08E 15BAC
	3			31N 08E 15BCA
	4			31N 08E 15CBA
	5			31N 08E 15CCA
Jay Creek	1	Confluence	203.9	31N 08E 13BCC
	2			31N 08E 13BCA
	3			31N 08E 13BAC
	4			31N 08E 13BAA
	5			31N 08E 12DCB
Goose Creek	1	Confluence	224.9	30N 11E 32DBC
	2			30N 11E 32COA
	3			30N 11E 32CDC
	4			29N 11E 05BBC
	5			29N 11E 05BCB
Oshetna River	1	Confluence	226.9	30N 11E 34CCD
	2			29N 11E 03BAB
	3			29N 11E 03BAC
	4			29N 11E 03ACB
	5			29N 11E 03ACC

upstream end of the proposed Devil Canyon dam impoundment, will not be inundated upstream of it's confluence with the Susitna River so only habitat location number 1 was sampled. Fog Creek study sites upstream of number 3 fell within private Native Corporation lands and permission to trespass was denied.

Sampling in the upper Susitna basin was conducted on a monthly basis with each of the eight habitat locations sampled for two days each month. Selected fish habitat sites were sampled as work load and transportation availability permitted.

For each stream habitat location within the confluence portion of site number 1, the following sampling gear was fished for two consecutive time periods ranging from 18 to 24 hours: five minnow traps, two trotlines, and one 30 foot variable mesh gillnet (panels of 1-1/2 to 2-1/2 inch bar mesh). At sites 1 through 5, hook and line, beach seines and backpack electrofishing units were used to collect fish as stream conditions permitted. Selective fish habitat sites were sampled exclusively by rod and reel with the exception of Sally Lake where gillnets and minnow traps were also used.

A four man crew was utilized in the upper Susitna River basin fisheries studies. Transportation into the study area was provided by fixed-wing aircraft, after wh ch both helicopter and river rafts (Plate E.2.1) were used to reach the various habitat locations. Sampling trips lasted from 14 to 18 days during which time the crew established spike camps at each of the habitat locations. Radio communications were accomplished with a Spilsbury Tindall

Plate E.2.1. Rafts used for transportation in the Impoundment study reach.

SX-11 mobile unit which allowed for a phone patch through an Anchorage based dispatch system.

Resident and Juvenile Anadromous field forms for collecting catch, effort and biological data are presented as Figures E.2.11, E.2.12, and E.2.13. The location, date, number of units of each specific sampling gear type, duration of effort, and catch by species was recorded for each day sampling was conducted. The biological data form was used for the collection of length, age, and sex data, where applicable, and provided a cross reference for fish scales taken and subsequently stored in scale envelopes. A more detailed discussion of methodology of biological data collection and sampling techniques is available in the procedures manual.

Tagging and recapture methods were used to study the seasonal migrations of selected resident fish species in the upper Susitna basin. All Arctic grayling, burbot, round whitefish, and longnose suckers over 200 mm in length and in good condition after capture were tagged using Floy anchor tags inserted well above the lateral line just posterior of the dorsal fin.

The data collected at the time of tagging included: tag number, date, species, fork length, method of capture and location. Information recorded at the time of tagged fish recovery included: tag number, date, method of capture, location recaptured and the fate of the fish. The standard tag and recaptured form is presented in Figure E.2.14.

File No. 03-81-7.10-2.74 Page 1 of ____

SUSITNA HYDRO RESIDENT & JUVENILE ANADROMOUS STUDY
MOBILE GEAR CATCH DATA RJ 81-04

Habitat Location _____ Sampling Site _____ River Mile _____ __/__/__/__/__

DATE: Gear Set _____ Gear Pulled _____ Collector(s) _____

gear type code	PSN	net length	mesh size	bait type	hook size	TIME set	TIME pulled	TIME total*	CATCH – SPECIES CODE NO.												REMARKS

* total time for beach seine haul, electroshock and hook & line

GEAR TYPE CODE

drift gillnet	1a
electroshock	2
beach seine	3
hook & line	9
other (specify)	0

SPECIES CODE

burbot	580	humpback whitefish	562
chinook 0+	410	lake trout	550
chinook 1+	411	longnose sucker	920
chum salmon	450	pink salmon	440
coho 0+	430	rainbow trout	541
coho 1+	431	round whitefish	566
coho 2+	432	smelt/eulachon	511
cottid	910	sockeye 0+	420
dolly varden	530	sockeye 1+	421
grayling	610	stickleback	660

BAIT TYPE CODE

artificial	1
fish	2
eggs	3
other	4

Figure E.2.11. Resident and Juvenile Anadromous study, catch and effort form, mobile gear, 1980-1981.

File No. 03-81-7.10-2.71 Page 1 of _____

SUSITNA HYDRO RESIDENT & JUVENILE ANADROMOUS STUDY
FIXED GEAR CATCH DATA RJ 81-01

Habitat Location _____ Sampling Site _____ River Mile _____ ___ ___ ___/___ ___ ___/___ ___/___ ___ ___/___

DATE: Gear Set _____ Gear Pulled _____ Collector(s) _____

gear type code	PSN	net length	mesh size	hook size	bait type	TIME set	TIME pulled	TIME total	CATCH - SPECIES CODE NO.	REMARKS
1										
5										
10										

GEAR TYPE CODE

gillnet	1
minnow trap	5
trot line	10
burbot set	10a

SPECIES CODE

burbot	590
chinook 0+	410
chinook 1+	411
chum salmon	450
coho 0+	430
coho 1+	431
coho 2+	432
cottid	910
dolly varden	630
grayling	610
humpback whitefish	562
lake trout	550
longnose sucker	920
pink salmon	440
rainbow trout	541
round whitefish	566
smelt/eulachon	511
sockeye 0+	420
sockeye 1+	421
stickleback	660

BAIT CODE

artificial	1
fish	2
eggs	3
other (specify in remarks)	4

Figure E.2.12. Resident and Juvenile Anadromous study, catch and effort form, fixed gear, 1980-1981.

Figure E.2.13. Resident and Juvenile Anadromous study, biological data form, 1980-1981.

File No. 03-81-7.10-2.72 Page ____ of ____

SUSITNA HYDRO RESIDENT & JUVENILE ANADROMOUS STUDY
BIOLOGICAL DATA RJ 81-02

Habitat Location _____ Sampling Site _____ River Mile _____ __/__/__/__/__/__/__

Date(s) Collected _____ Collector(s) _____

	species code	length (mm)	sex	age	scale card #	gear type code	PSN	mesh size	remark on back		species code	length (mm)	sex	age	scale card #	gear type code	PSN	mesh size	remark on back
1										26									
2										27									
3										28									
4										29									
5										30									
6										31									
7										32									
8										33									
9										34									
10										35									
11										36									
12										37									
13										38									
14										39									
15										40									
16										41									
17										42									
18										43									
19										44									
20										45									
21										46									
22										47									
23										48									
24										49									
25										50									

GEAR TYPE CODE

beach seine	3
burbot set	10a
drift gillnet	1a
electroshock	2
gillnet	1
hook & line	9
minnow trap	5
trot line	10

SPECIES CODE

burbot	580	humpback whitefish	582
chinook 0+	410	lake trout	550
chinook 1+	411	longnose sucker	920
chum salmon	450	pink salmon	440
coho 0+	430	rainbow trout	541
coho 1+	431	round whitefish	586
coho 2+	432	smelt/eulachon	511
cottid	910	sockeye 0+	420
dolly varden	530	sockeye 1+	421
grayling	610	stickleback	860

File No. 03-81-7.10-2.73

SUSITNA HYDRO RESIDENT & JUVENILE ANADROMOUS STUDY
TAG AND RECAPTURE DATA RJ 81-03

TAGGING DATA						RECAPTURE DATA					
tag no.	gear code	date	species code	length (mm)	Habitat Location	date	recap code	gear code	length (mm)	Habitat Location	released

SPECIES CODE

burbot	590
dolly varden	530
grayling	510
humpback whitefish	582
rainbow trout	541
round whitefish	586
lake trout	550

GEAR TYPE CODE

beach seine	3
burbot set	10a
drift gillnet	1a
electroshock	2
gillnet	1
hook & line	9
minnow trap	5
trot line	10

RECAPTURE CODE

Su Hydro staff	1
ADF&G (other)	2
Sport Fishermen	3

Figure E.2.14. Resident and Juvenile Anadromous study, tag and recapture form, 1980-1981.

3.1 ARCTIC GRAYLING

3.1.1 Abstract

During upper Susitna River studies of 1981, 3,303 Arctic Grayling (Thymallus arcticus) greater than 135 mm fork length were captured. Adult grayling were captured from all habitat location sites sampled in eight major tributaries including the Oshetna River, Goose, Jay, Kosina, Watana, Deadman, Tsusena, and Fog creeks. Highly significant differences were found in catch per unit effort by tributary of sampling. Kosina Creek was the most productive of the tributaries with a total habitat location site catch of 315 and a catch per unit effort of 8.6 grayling per angler hour fished. The total catch for this stream within the reach proposed to be impounded was 799.

Eighty-seven percent of adult grayling captured within habitat locations were taken by hook and line; 12% were taken by gillnet. Two-hundred and three angler hours fished at habitat locations produced 1,306 grayling for a catch rate of 6.4 grayling per angler hour. Forty-three gillnet days fished produced 120 grayling for a catch rate of 12.7 grayling per gillnet day fished.

Highly significant differences were found in the catch per angler hour fished by month. July was the most productive month with a total catch of 363 and a catch rate of 8.1 grayling per angler hour fished. The seasonal average catch rate for all eight streams was 6.4 grayling per angler hour.

Young of the year and juvenile grayling were captured through the summer in shallow, clearwater sloughs along the main Susitna and from quiet pools and side channels off Goose and Jay creeks.

The total number of grayling tagged during the season was 2,511. Recaptures amounted to 11% (268) of the total tagged. All but 6 tagged grayling recaptured, were recaptured by project personnel.

Schnabel population estimates, based on the tag and recapture program, were generated by tributary and for the upper Susitna as a whole. The estimate for the upper Susitna was 10,279 (95% confidence limits 9,194 - 11,654). This population level would give an average of approximately 501 adult grayling per clearwater tributary mile or 121 per river mile, including the main Susitna, to be inundated.

Tagged grayling demonstrated interchange between tributaries using the main Susitna as a migratory corridor. Interstream movement was documented for 9% of tagged fish recaptured. These recaptures were made at the mouth or within a tributary other than the tributary of initial tag and release.

Age determination was made by scales taken from 381 grayling collected from the eight tributaries throughout the season. Fish age IV averaged 270 mm (range 210-313), age V averaged 303 mm (range 260-335), age VI averaged 329 mm (range 275-385) and age VII averaged 352 mm (range 320-395 - all length fork length).

Lengths were taken for 2,673 Arctic grayling collected from the upper Susitna River from May through September 1981. Arctic grayling from 260 mm to 340 mm, age V, occurred most frequently in the catches. The mean fork length of Arctic grayling captured by hook and line and gillnet was 304 mm and the range was from 235 mm to 420 mm. Significant differences were found for fish lengths between streams.

3.1.2 Introduction

The distribution of the Arctic Grayling Thymallus arcticus (Pallas) is holarctic, encompassing much of northwestern North American and northeastern Siberia (Scott and Crossman, 1972). In Alaska, native populations of Arctic grayling are found in freshwater drainages throughout interior and Arctic Alaska and on the Alaska Peninsula south to approximately Port Heiden (McLean and Delaney, 1978).

Adult Arctic grayling have a strikingly large dorsal fin which is low anteriorly and disproportionately high posteriorly. The dorsal fin has irregular but distinct rows of dark spots and is often tinged with pink or white on the upper edge. The tail, pectoral and anal fins are usually a dusky, yellowish-green; the pelvics commonly have lengthwise stripes of pink and black which can be more or less obscure. The mouth is small and there are small teeth on both jaws. Juveniles are distinguished by the presence of narrow, vertically elongated parr marks.

Grayling are found in clear, cold, streams and lakes (Scott and Crossman, 1973). Silt laden glacial systems, such as the Susitna River, are believed to

support fewer grayling throughout their life histories; however, such systems are believed to provide essential migratory pathways and overwintering habitat (ADF&G et al., 1978). Grayling inhabit nearly all tributaries of the Susitna River; the greatest numbers are found in clearwater tributary systems such as the Deshka River, Indian River, Portage Creek, Kosina Creek and the Oshetna River.

Arctic grayling reach sexual maturity in Alaska at Age II to VII (McLean and Delaney, 1978) and are capable of spawning several times during their life.

The Arctic grayling is characterized by Reed (1964) as a migratory species. During spring break up, from April to June, adults migrate from ice-covered lakes and large rivers, such as the Susitna, into clear gravel-bottomed tributaries to spawn (Morrow, 1980). Pearse (1974) found Arctic grayling less than 200 mm fork length entering the Delta clearwater rivers in early April.

After spawning, the adults move away from the spawning areas into pools where they spend the rest of the summer feeding on aquatic and terrestrial insects taken from the drift (Vascotte, 1970). A downstream migration occurs in late August and mid-September back into overwintering areas in large rivers and deep lakes (Pearse, 1974).

The Arctic grayling is described by McClane (1965) as a fish highly prized for its beauty. The Arctic grayling is one of the most important sport fishes of Alaska and northern Canada. The grayling readily takes dry flies and is a favorite of the fly fisherman and are also taken on spinning tackle. Grayling

are excellent food fish and may be prepared in a variety of ways. Grayling are also utilized by subsistence fisherman in some areas for dog food and personal consumption.

3.1.3 Methods

Arctic grayling were collected at upper Susitna River habitat locations from Fog Creek (R.M. 173.9) to the Oshetna River (R.M. 226.9) from May to September 1981. Additional grayling were captured at selected fish habitat sites including the Tyone River and both Sally and Deadman Lakes.

Five types of sampling gear, variable mesh (1-1/2 to 2-1/2 inch bar mesh) gillnets, hook and line, beach seines, electrofishing and minnow traps were utilized to capture Arctic grayling. Fork length in millimeters (mm) of all fish collected was recorded and scales were taken from a representative subsample for age determination. Fish which were killed by collection gear were autopsied to determine sex composition and maturity.

Viable fish were tagged with Floy anchor tags and released.

3.1.4 Results and Discussion

3.1.4.1 Distribution and Relative Abundance

Three thousand three-hundred and thirteen adult Arctic grayling over 135 mm fork length were captured during 1981 studies of the upper Susitna River. Table E.3.1.1 lists grayling catch by tributary and month. This total

Table E.3.1.1. Arctic grayling total catch by tributary by month upper Susitna River, 1981.

TRIBUTARY	MAY	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL
Fog Creek	30	17	38	5	5	95
Tsusena Creek	35	75	133	53	9	305
Deadman Creek	53	86	110	23	15	287
Watana Creek	4	52	18	184	55	313
Kosina Creek	139	263	238	73	187	900
Jay Creek	84	181	74	21	68	428
Goose Creek	128	163	82	41	13	427
Oshetna River	24	93	157	73	167	514
Sally Lake	13	4	-	26	-	43
Deadman Lake	-	-	-	-	1	1
TOTAL	510	934	850	499	520	3,313

includes all catches by all gear from sampling within stream reaches proposed to be inundated and catches from limited hook and line sampling conducted upstream of proposed impoundment elevations.

The total catch to from within stream reaches proposed to be inundated was 2,667. With a total of 344 angler hours fished the catch per unit effort was 7.7 for angler hour of fishing.

Arctic grayling were collected at 100% of the habitat locations in the upper Susitna River during the 1981 season. Grayling catches and catch rates are listed in Tables E.3.1.2 and E.3.1.3 by tributary habitat location, selected fish habitat site and gear type. This data is illustrated in Figures E.3.1.1 and E.3.1.2. The total catch for habitat location sites was 1,501 of which eighty-seven percent were taken by hook and line and 12.7 percent by gillnet. Gillnets accounted for a substantial portion of catches in Watana and Jay creeks. Two hundred and three angler hours fished at habitat locations produced 1,306 grayling for a catch rate of 6.4 (Table E.3.1.4). Forty-three gillnet days fished produced 190 grayling for a catch rate of 12.7 grayling per gillnet day fished.

Chi square tests were run to determine significant differences in actual hook and line catch rates between tributary habitat locations and also between habitat locations and selected fish habitat sites within each individual tributary. These tests utilize hook and line catch and effort data for habitat locations and selected fish habitat sites by tributary by month, illustrated in Tables E.3.1.2, E.3.1.3, E.3.1.4, E.3.1.5, E.3.1.6 and E.3.1.7.

Table E.3.1.2. Arctic grayling catch and effort by gear type, upper Susitna River habitat location sites, 1981.

Tributary		Hook & Line Catch/hour	Gillnet Catch/day	Minnow Trap Catch/day	Trotline Catch/day	
Fog Creek	No. Caught	51	0	0	0	51
	Effort	12.4	4	36	12	--
	CPUE	4.0	0	0	0	--
Tsusena Creek	No. Caught	135	2	0	0	137
	Effort	22.6	4	40	5	--
	CPUE	6.0	0.5	0	0	--
Deadman Creek	No. Caught	153	0	0	0	153
	Effort	23.6	3	29	10	--
	CPUE	6.5	0	0	0	--
Watana Creek	No. Caught	59	31	0	1	92
	Effort	18.1	6	45	22	--
	CPUE	3.3	5.2	0	0.0	--
Kosina Creek	No. Caught	315	30	2	0	347
	Effort	36.4	8	50	20	--
	CPUE	8.6	3.75	0.0	0	--
Jay Creek	No. Caught	176	110	2	0	288
	Effort	23.3	8	50	28	
	CPUE	7.5	13.7	0.0	0	--
Goose Creek	No. Caught	267	11	0	0	278
	Effort	42.9	6	50	20	--
	CPUE	6.2	1.8	0	0	--
Oshetna River	No. Caught	150	6	1	0	157
	Effort	23.2	4	50	12	--
	CPUE	6.4	1.5	0.0	0	--
Total	No. Caught	1,306	190	5	1	1,501
	Effort	202.7	43	348	129	--
	CPUE	6.4	442	0.0	--	--
	% Total	87.0	12.7	0.3	0	100

[a] Additional juvenile fish specimens were taken by various methods including seine, electrofish, and dipping (Appendix Table 6).

Table E.3.1.3 Arctic grayling hook and line catch and effort for selected fish habitat sites by tributary, 1981

Tributary		Selected Fish Habitat Sites	
		1st Mile	Above Mile 1 to PIE*
Fog	Total Catch	21	a
	Man Hours	4.2	
	CPUE	5.0	
Tsusena	Total Catch		a
	Man Hours		
	CPUE		
Deadman	Total Catch	37	a
	Man Hours	5.1	
	CPUE	7.3	
Watana	Total Catch	21	186
	Man Hours	4.5	19.6
	CPUE	5.2	9.5
Kosina	Total Catch	57	427
	Man Hours	11.5	38.5
	CPUE	4.9	11.1
Jay	Total Catch	60	81
	Man Hours	6.5	7.4
	CPUE	9.5	10.9
Goose	Total Catch	64	51
	Man Hours	8.9	6.2
	CPUE	7.5	8.3
Oshetna	Total Catch	59	297
	Man Hours	7.91	22.1
	CPUE	7.46	14.0
Total	Total Catch	319	1042
	Man Hours	47.5	93.7
	CPUE	6.7	11.1

* Proposed impoundment elevation.

a not fished.

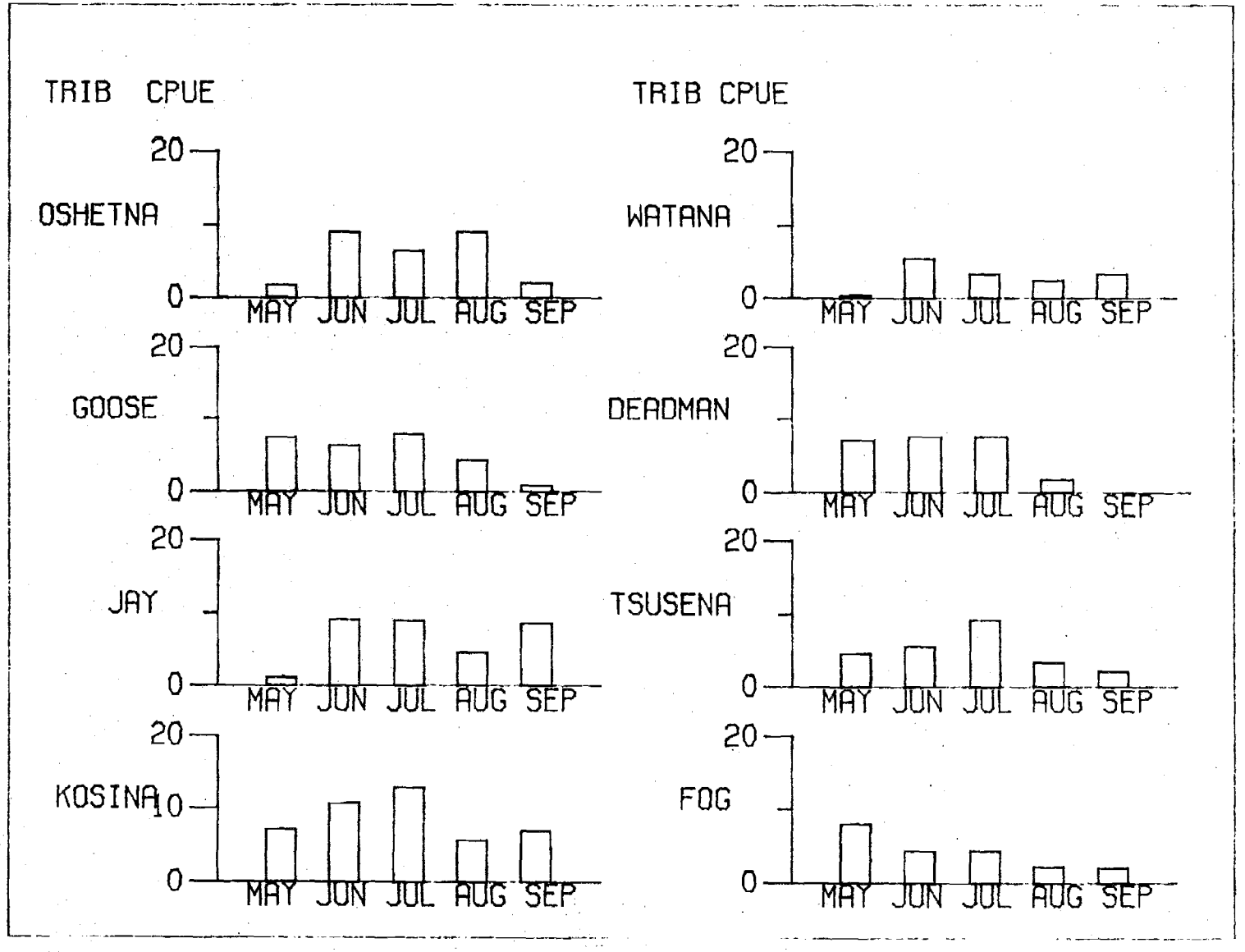

Figure E.3.1.1. Arctic grayling hook and line catch per hour. Upper Susitna River habitat location sites by month, 1981.

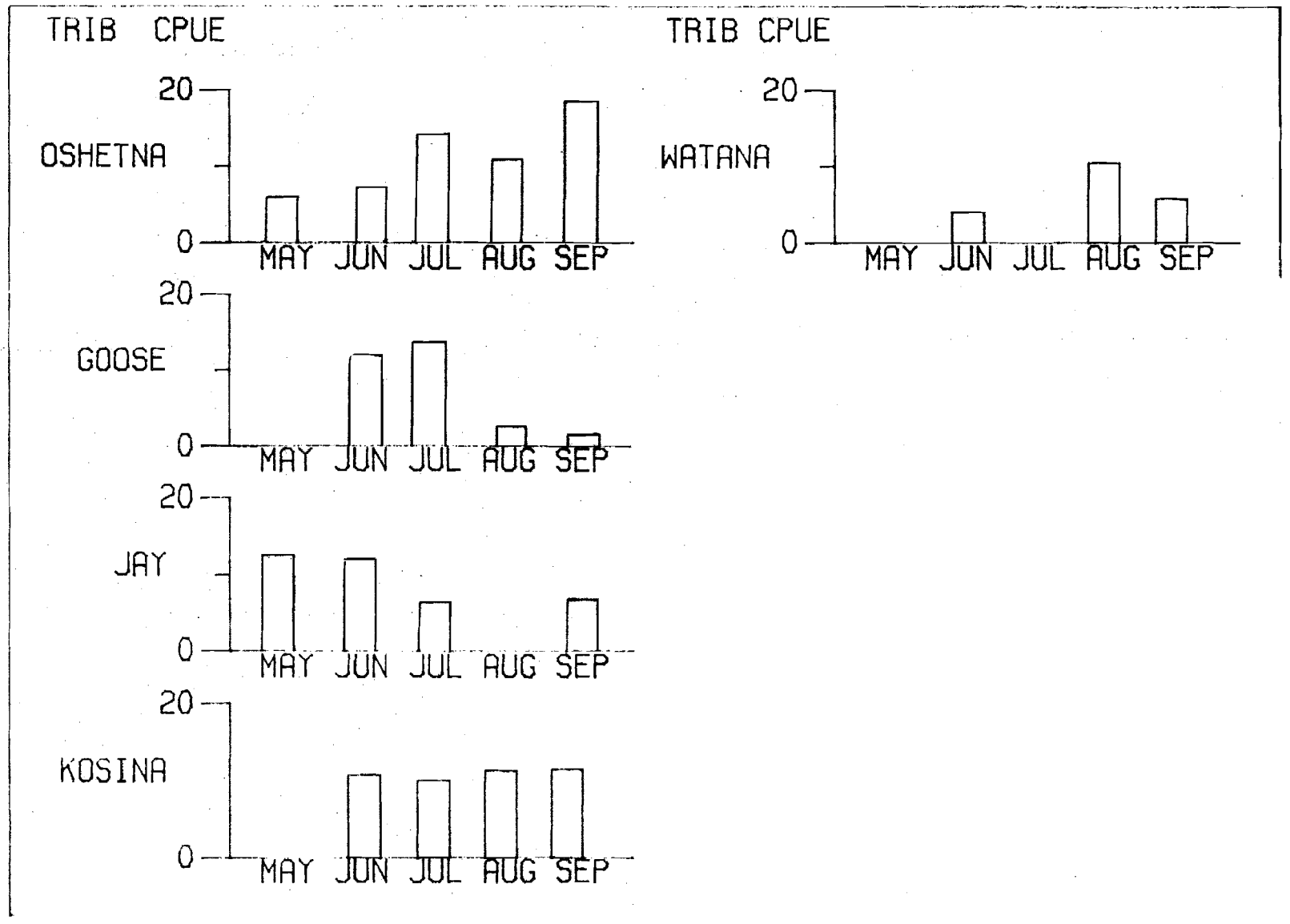

Figure E.3.1.2. Arctic grayling hook and line catch per hour by month for selected fish habitat sites upstream of stream mile one to the proposed impoundment elevation, 1981.

Table E.3.1.4. Arctic grayling hook and line catch and effort for habitat location sites by tributary and month, 1981.

Tributary Habitat Location		May	June	July	August	Sept.	Total
Fog	Catch Total	14	17	11	4	5	51
	Man Hours	1.8	3.9	2.6	1.8	2.5	12.5
	CPUE	8.0	4.4	4.3	2.3	2.0	4.1
Tsusena	Catch Total	23	19	74	18	1	135
	Man Hours	5.0	3.4	8.3	5.5	0.5	22.6
	CPUE	4.6	5.6	8.9	3.3	2.0	6.0
Deadman	Catch Total	53	69	27	4	0	153
	Man Hours	7.5	9.0	3.5	2.2	1.4	23.6
	CPUE	7.1	7.7	7.7	1.8	0	6.5
Watana	Catch Total	1	29	14	5	10	59
	Man Hours	3.3	5.4	4.3	2.0	3.1	18.1
	CPUE	0.3	5.4	3.3	2.5	3.3	3.3
Kosina	Catch Total	119	79	87	17	13	315
	Man Hours	16.6	7.3	6.8	3.0	2.8	36.5
	CPUE	7.2	10.8	12.8	5.7	4.6	8.6
Jay	Catch Total	3	49	64	13	47	176
	Man Hours	2.4	5.4	7.3	2.9	5.5	23.4
	CPUE	1.3	9.1	8.8	4.6	8.6	7.5
Goose	Catch Total	121	76	36	32	2	267
	Man Hours	16.3	12.3	4.5	7.4	2.4	42.9
	CPUE	7.4	6.2	8.0	4.3	0.8	6.2
Oshetna	Catch Total	4	43	50	46	7	150
	Man Hours	2.2	4.8	7.7	5.1	3.4	23.2
	CPUE	1.8	9.1	6.5	9.0	2.1	6.5
TOTAL	Catch Total	338	381	363	134	85	1,306
	Man Hours	55.1	51.3	45.0	29.9	21.6	202.8
	CPUE	6.1	7.4	8.1	4.5	4.0	6.4
	Man						

Table E.3.1.5. Arctic grayling hook and line catch and effort for habitat location site (1) by tributary and month, 1981.

Tributary Habitat Location		May	June	July	August	Sept.
Fog	Catch Total	14	13	3	3	5
	Man Hours	1.2	3.1	1.3	0.9	2.5
	CPUE	11.2	4.3	2.4	3.2	2.0
Tsusena	Catch Total	23	19	14	18	1
	Man Hours	5.0	3.4	8.3	5.5	0.5
	CPUE	4.6	5.6	9.0	3.3	2.0
Deadman	Catch Total	38	52	7	3	0
	Man Hours	6.0	7.0	1.5	1.4	1.1
	CPUE	6.3	7.4	4.7	2.1	0.0
Watana	Catch Total	0	8	1	2	10
	Man Hours	2.0	2.0	1.5	0.9	2.8
	CPUE	0.0	4.0	0.7	2.3	3.6
Kosina	Catch Total	30	38	79	15	11
	Man Hours	7.7	3.6	5.9	2.5	1.9
	CPUE	3.9	10.6	13.4	6.0	5.8
Jay	Catch Total	3	23	50	10	46
	Man Hours	2.0	2.5	5.1	2.0	4.4
	CPUE	1.5	9.2	9.9	5.0	10.5
Goose	Catch Total	121	34	20	27	1
	Man Hours	15.0	6.5	1.6	5.4	0.3
	CPUE	8.1	5.2	12.7	5.0	4.0
Oshetna	Catch Total	0	3	9	8	1
	Man Hours	1.0	1.0	1.0	1.0	0.8
	CPUE	0.0	3.0	9.4	8.0	1.3

Table E.3.1.6. Arctic grayling hook and line catch and effort for selected fish habitat sites above mile 1 to PEI by tributary and month, 1981.

Tributary Habitat Location		May	June	July	August	Sept.
Fog	Catch Total	-	-	-	-	-
	Man Hours	-	-	-	-	-
	CPUE	-	-	-	-	-
Tsusena	Catch Total	-	-	-	-	-
	Man Hours	-	-	-	-	-
	CPUE	-	-	-	-	-
Deadman	Catch Total	-	-	-	-	-
	Man Hours	-	-	-	-	-
	CPUE	-	-	-	-	-
Watana	Catch Total	-	2	-	167	17
	Man Hours	-	0.5	-	16.1	3.0
	CPUE	-	4.0	-	10.4	5.7
Kosina	Catch Total	-	142	92	50	143
	Man Hours	-	12.9	9.0	4.4	12.2
	CPUE	-	11.0	10.2	11.5	11.7
Jay	Catch Total	-	75	3	-	3
	Man Hours	6.2	0.6	-	0.6	
	CPUE	-	12.0	5.2	-	5.2
Goose	Catch Total	0	9	36	4	2
	Man Hours	0.3	0.8	3.0	1.2	0.8
	CPUE	0.0	11.5	12.2	3.2	2.4
Oshetna	Catch Total	3	33	93	8	160
	Man Hours	0.5	4.5	7.0	0.8	9.3
	CPUE	6.0	7.3	13.3	10.7	17.2

Table E.3.1.7. Arctic grayling hook and line catch and effort by tributary to be impounded for stream reach and month, 1981.

Tributary Habitat Location		May	June	July	August	Sept.
Fog	Catch Total	22	17	23	5	5
	Man Hours	3.3	4.4	3.4	3.1	2.5
	CPUE	6.8	3.9	6.7	1.6	2.0
Tsusena	Catch Total	23	19	74	18	1
	Man Hours	5.0	3.4	8.3	5.5	0.5
	CPUE	4.6	5.6	9.0	3.3	2.0
Deadman	Catch Total	53	86	42	6	3
	Man Hours	7.5	10.5	5.8	2.5	2.3
	CPUE	7.1	8.2	7.2	2.4	1.3
Watana	Catch Total	1	49	16	172	28
	Man Hours	3.3	8.1	5.3	18.4	6.6
	CPUE	0.3	6.1	3.0	9.3	4.2
Kosina	Catch Total	136	246	143	67	187
	Man Hours	18.9	56.5	17.7	7.5	15.8
	CPUE	7.2	9.3	10.9	8.9	11.8
Jay	Catch Total	3	178	70	16	50
	Man Hours	5.4	16.2	8.7	3.6	6.3
	CPUE	1.3	11.0	8.0	4.4	8.0
Goose	Catch Total	121	136	82	37	6
	Man Hours	16.2	18.3	7.8	10.0	4.8
	CPUE	7.3	7.4	10.6	3.7	1.2
Oshetna	Catch Total	19	92	155	72	167
	Man Hours	4.2	10.8	16.6	7.7	13.8
	CPUE	4.5	8.5	9.4	9.4	12.1

In Table E.3.1.8 actual versus expected hook and line catch based on effort expended for the habitat locations is compared. A highly significant difference in catch rate is found in the comparison. Kosina Creek with an average actual catch rate of 8.6 grayling per hour and Jay Creek with 7.5 grayling per hour both had higher actual catches than were expected while both Watana and Fog Creek catches were lower than expected.

Actual versus expected catches were compared between habitat locations and the selected fish habitat sites within the first mile of each tributary (Table E.3.1.9). Kosina Creek habitat location sites with a catch rate of 8.6 grayling per angler hour were found to have significantly higher catches than the selected fish habitat sites located within the first stream mile (5.0 per hour). This was the only tributary for which a difference was identified.

Actual versus expected catches for habitat location sites were compared to the selected fish habitat sites upstream from mile one to the proposed impoundment elevation for each tributary (Table E.3.1.10). The upstream selected fish habitat sites from Kosina, Watana, and Jay creeks and the Oshetna River proved more productive than the respective habitat location sites. Plate E.3.1 shows one of the very productive Kosina Creek pools located between stream mile 1 and 2 which was sampled by hook and line. Goose Creek selected fish habitat sites catch rates were similar to the habitat location catch rates. Tributaries not included in this test and reasons for their exclusion are: Fog Creek, access to the stream beyond one mile upstream from the mouth was denied by private landowners; Deadman Creek, waterfalls impassable to fish are located one-half mile upstream from the confluence; Tsusena Creek, only the mouth of the stream is proposed to be inundated.

Table E.3.1.8 Arctic Grayling actual versus expected hook and line catches for habitat locations

Tributary	Actual Catch	Expected Catch	Difference
Fog	51	81	-30
Tsusena	135	146	-11
Deadman	153	152	+1
Watana	59	116	-57
Kosina	315	235	80
Jay	176	151	+25
Goose	267	276	-9
Oshetna	150	149	+1
Total	1,306	1,306	0

Chi Square Value = 71.5[b] with 7df

[a] Expected catch based on man hours of effort exerted (See Table 4).

[b] Highly significant differences at 99% level.

Table E.3.1.9. Arctic Grayling actual versus expected hook and line catches compared for tributary study sites 1-5 and tributary habitat locations 1-5, May to September, 1981[a]

	Study Sites		Habitat Locations		
Tributary	Actual Catch	Expected Catch	Actual Catch	Expected Catch	Value (df)[e]
Fog[b]	51	54	21	18	0.67
Tsusena[c]					
Deadman[d]	153	156	37	34	0.32
Watana	59	65	21	15	2.95
Kosina	335	293	57	99	15.10[e]
Jay	176	185	60	51	2.0
Goose	267	275	64	54	2.13
Oshetna	150	156	59	53	0.91

[a] Expected catches based on catch per hour of combined study site and habitat location sampling.

[b] For Fog comparison is for study sites 1-3 and habitat locations 1 and 2.

[c] For Tsusena only study site 1 was fished. No comparison was applicable.

[d] For Deadman only study sites 1 and 2 were fished.

[e] Significant value.

Table E.3.1.10. Arctic Grayling actual versus expected hook and line catches compared for tributary study sites 1-5 and upstream selected habitat locations within the proposed impoundment, 1981[a]

Tributary	Study Sites 1-5		Tributary Upstream		Chi Square Value (1df)
	Actual Catch	Expected Catch	Actual Catch	Expected Catch	
Watana	59	116	186	128	54.30[b]
Kosina	335	361	427	381	6.4[b]
Jay	176	195	81	62	7.67[b]
Goose	267	278	51	40	3.47
Oshetna	150	229	297	218	44.47[b]

[a] Tributaries not included were sampled for fewer than 5 study sites.

[b] Chi Square Value of 6.64 is highly significant.

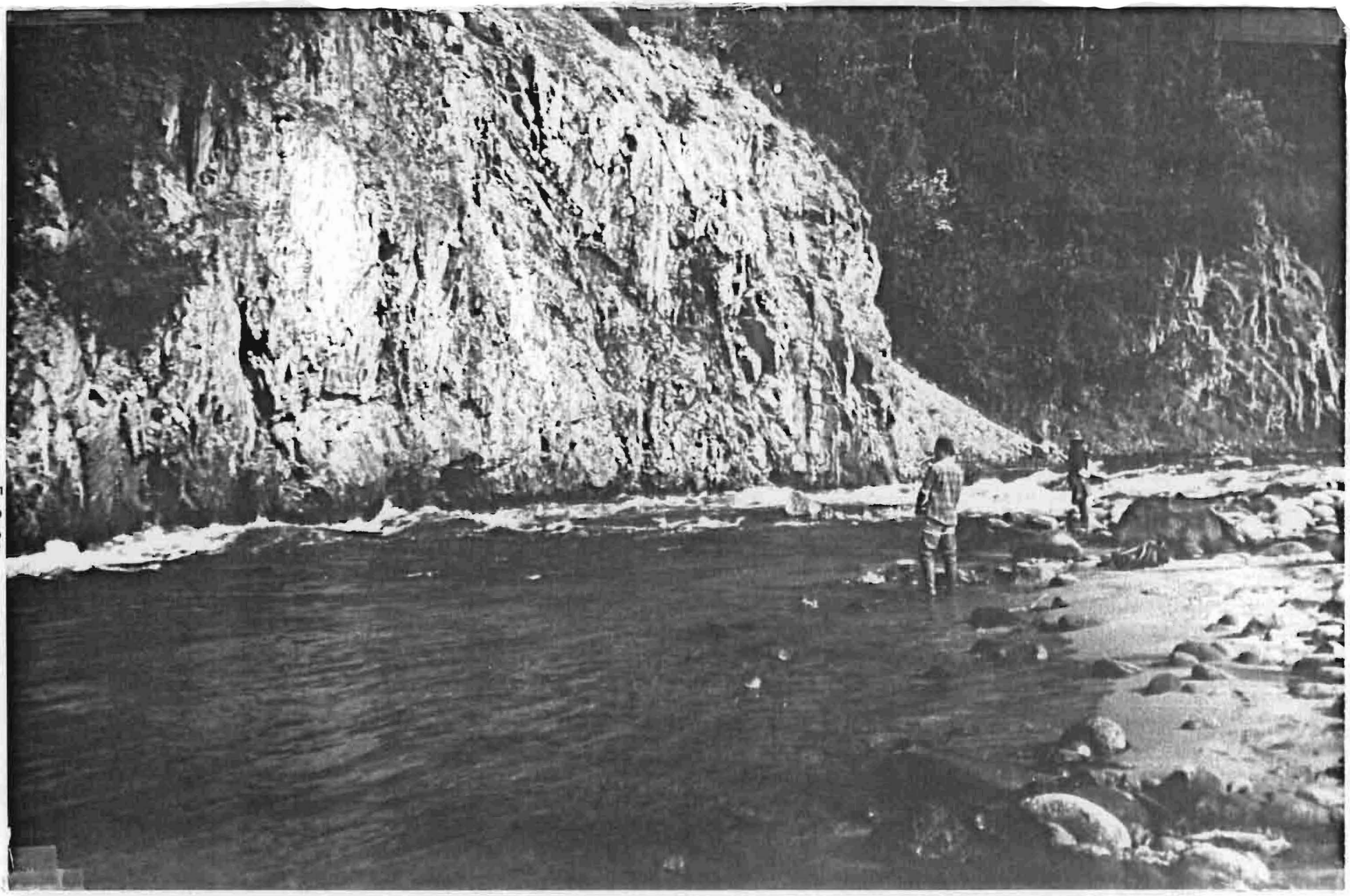

Plate E.3.1. High catches for angler hour fished were recorded in Kosina Creek pools such as the one pictured, Stream mile 1 to 2.

The actual versus expected Arctic grayling catch for tributary habitat locations was also compared by month (Table E.3.1.11). June and July had catches significantly higher than expected while August and September catches were lower than expected. The actual catch made during May was similar to what was expected. This test indicates that the catch rate for grayling varies by month and that the highest success rate was recorded in June and July.

An overall average of 6.4 grayling per hour was recorded for the tributary habitat location sites in the Upper Susitna River during 1981 sampling. Kosina Creek had the highest average catch rate at 8.6 grayling per hour while Watana was low with 3.3. The grayling catch rate observed in the Chena River, a heavily fished stream near Fairbanks, Alaska, has varied from 0.6 to 0.8 grayling per hour in recent years (Hallberg, 1981). Grayling catch rates of up to 4.0 fish per hour have been recorded at the Jims River, a lightly exploited stream along the Alaska Pipeline (Hallberg, personal communication).

3.1.4.2 Age, Length and Sex Composition

Three hundred eighty-one upper Susitna River Arctic grayling taken from hook and line, gillnet, and dipnet catches were aged using scale analysis. These fish ranged from Age I to Age VIII; age V and age VI were dominant, comprising 33.9% and 31.5% of the sample respectively (Table E.3.1.12 and Figure E.3.1.3).

Length determination was made for a total of 2,673 Arctic grayling collected from the upper Susitna River from May through September 1981. Figure E.3.1.4

Table E.3.1.11. Arctic Grayling actual versus expected hook and line catches by month for habitat location sites, 1981.

Month	Actual Catch	Expected Catch	Difference
May	338	355	-17
June	381	330	+51
July	139	289	+72
August	139	193	-54
September	85	134	-54
Total	1,306	1,306	0

Chi Square Value = 63.8 with 4df[b]

[a] Expected catch based on man hours of effort exerted (See Table 5). Average catch per man hour for all study sites = 6.44.

[b] Highly significant differences at 99% level.

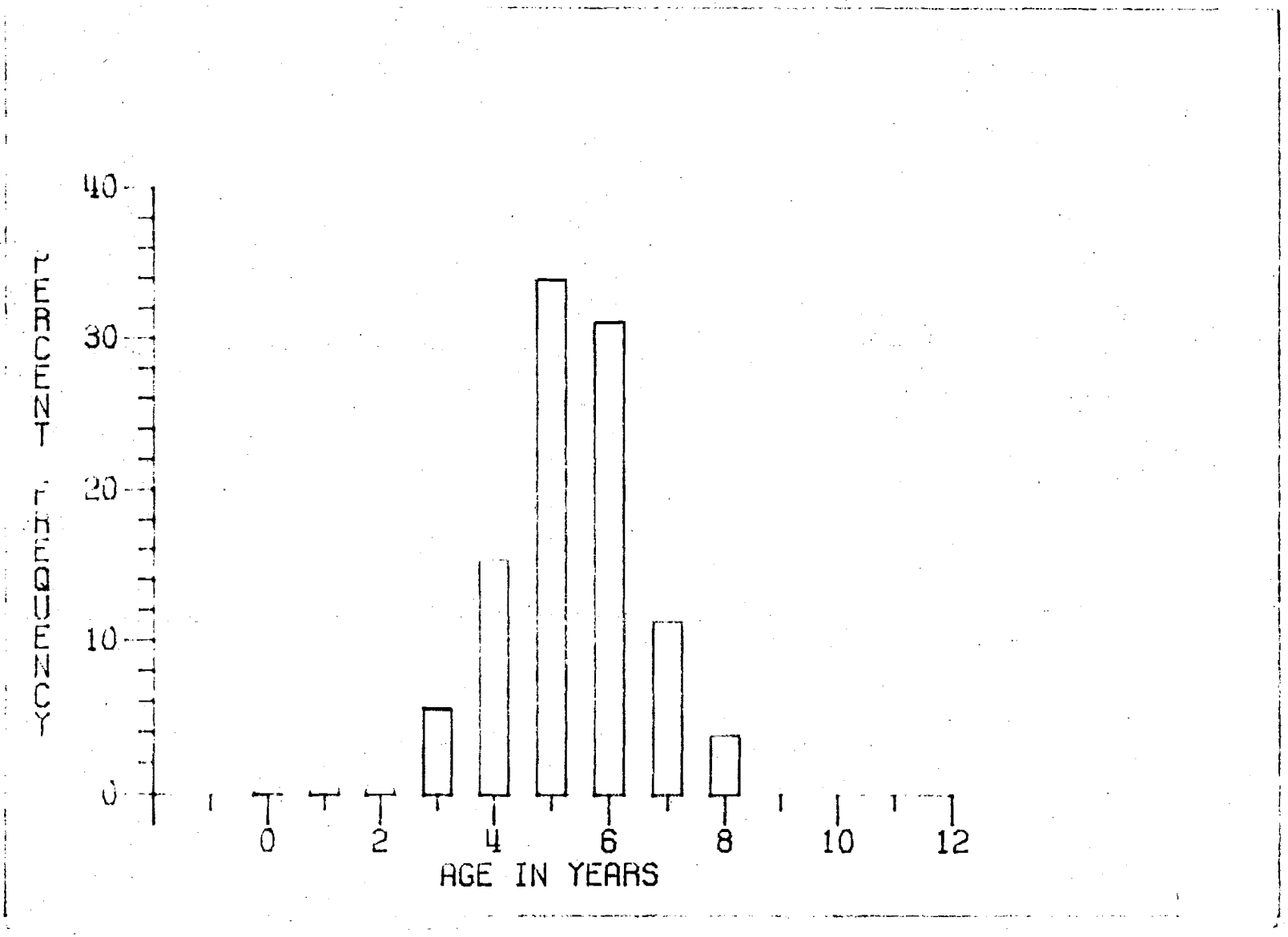

Figure E.3.1.3 Arctic grayling percent age-frequency, upper Susitna River, 1981.

illustrates the age-length distribution for upper Susitna River Arctic grayling. Of the Arctic grayling used for age determination age IV averaged 270 mm (range 210-313), age V averaged 303 mm (range 260-335), age VI averaged 329 mm (range 275-385) and age VII averaged 352 mm (range 320-395). Arctic grayling from 260 mm to 340 mm occurred most frequently in the catches. The mean fork length of Arctic grayling captured by hook and line and gillnet was 304 mm and the range was from 135 mm to 420 mm (Figure E.3.1.5). An Arctic grayling of 410 mm FL was taken in each Tsusena, Deadman and Jay creeks during the course of 1981 studies.

Table E.3.1.12 Arctic grayling, age-length frequency composition at habitat location sites on the upper Susitna River May to September, 1981.

AGE	TOTAL NO. OF FISH SAMPLED	MEAN LENGTH (MM)	RANGE OF LENGTHS (MM)	% OF SAMPLE
0				
I	1	140		0.3
II	2	138	115-160	0.5
III	13	229	200-260	3.0
IV	57	270	210-313	15.0
V	129	303	260-335	33.9
VI	120	329	275-385	31.5
VII	45	352	320-395	11.8
VIII	14	375	350-400	4.0
TOTAL	381		115-400	100

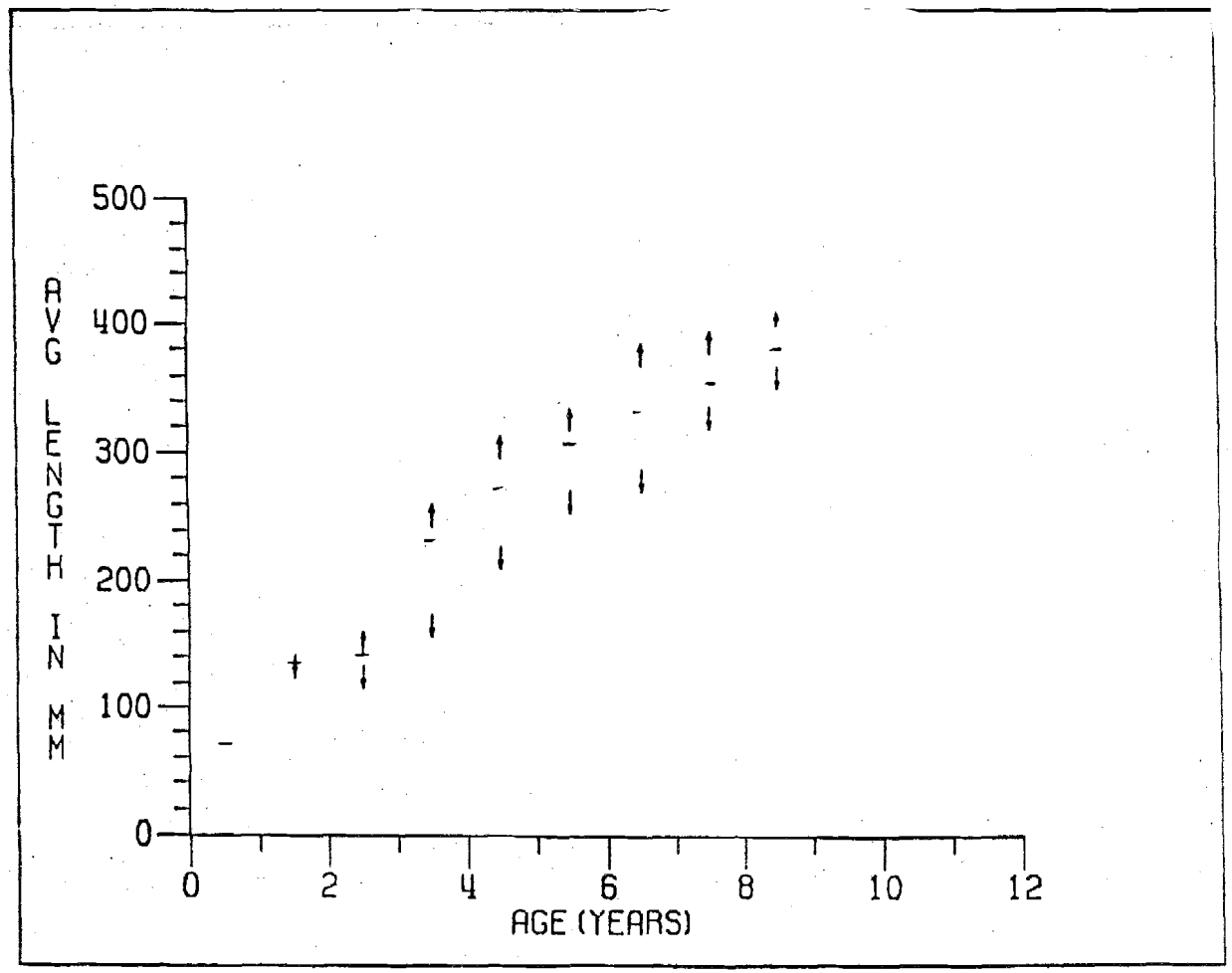

Figure E.3.1.4 Arctic grayling age-length relationship upper Susitna River, 1981. Range of lengths and mean length illustrated for each age encountered.

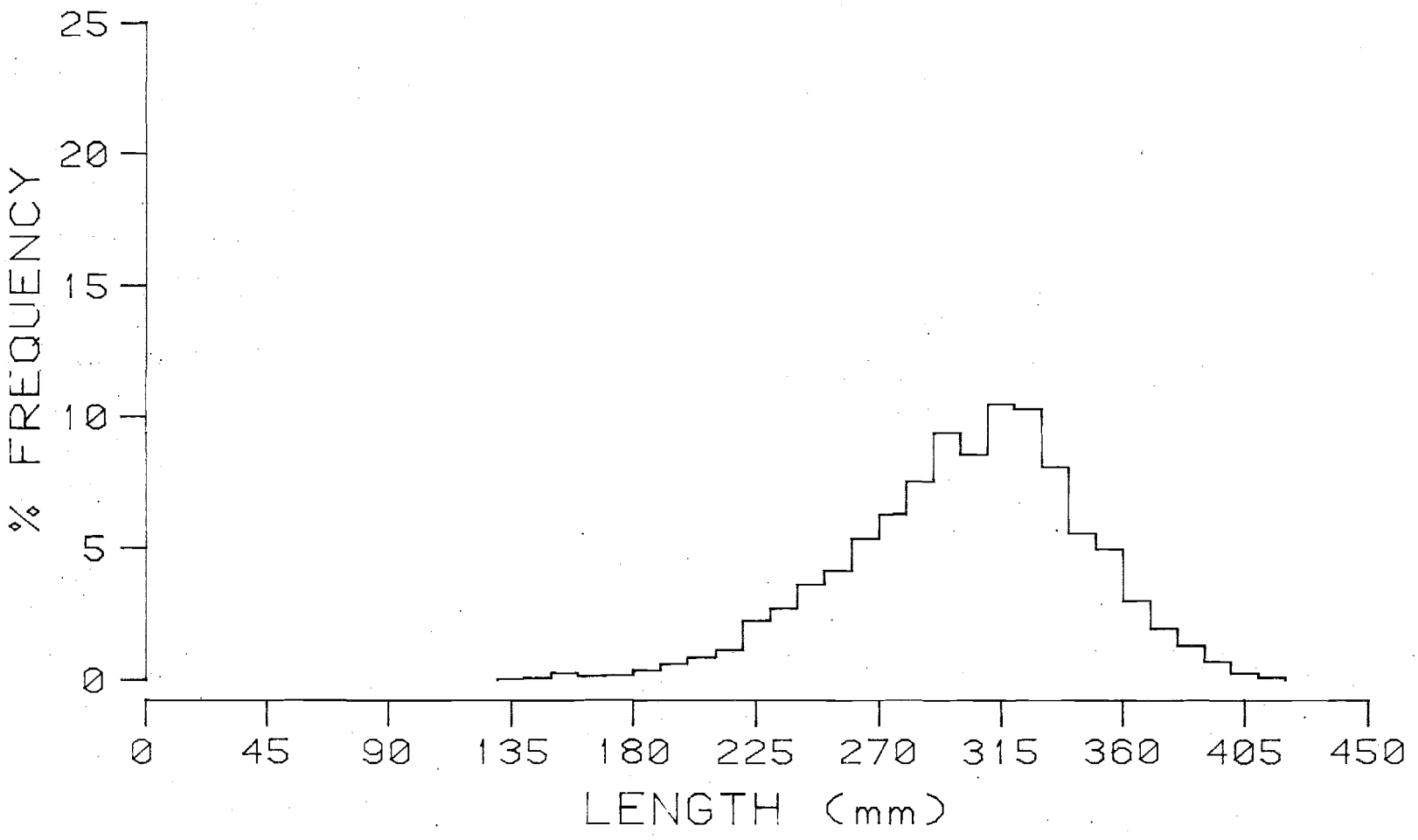

Figure E.3.1.5 Arctic grayling length frequency composition upper Susitna River study, 1981.

Non-parametric one-way analysis of variance tests (Kruskal-Wallis test) were made comparing median lengths of grayling collected from each of the eight streams for each month (Appendix Tables EA-1 through EA-5). For each month, test were run and significant differences were found for fish lengths between streams. The high-median lengths by stream and month were; May Jay - 343, June Tsusena - 341, July Tsusena - 325, August Tsusena - 329, September Tsusena - 356. Figure E.3.1.6 gives the age-length distribution by tributary.

Pearse (1974) found an average fork length of 355 mm for 422 grayling measured in the Delta Clearwater and 280 mm for 85 grayling measured in the Richardson Clearwater. These fish were captured by seine and electroshocker. Chena River studies by Hallberg (1979) showed an average fork length of 181 mm for 1,111 grayling captured by electrofishing. Fish as small as 100 mm were included in this sample.

In general fish of less than 150 mm fork length were not readily taken by hook and line sampling utilized in the upper Susitna. Fish of a smaller size than this could not easily take the metal type lures or flies used in much of the sampling. During sampling of upper Watana Creek (above mile 6) August 10-11, approximately 80 Arctic grayling of less than 150 mm fork length were taken using fly fishing gear.

A large school of young of the year and age I juvenile Arctic grayling were located in a slough near the mouth of Jay Creek in June and July 1981. Juvenile grayling were also taken from Goose Creek, the Oshetna River, Kosina Creek, Tsusena Creek and Watana Creek areas. Subsamples of these fish were measured to determine length. Age 0 ranged from 20 to 22 mm in June, from 24

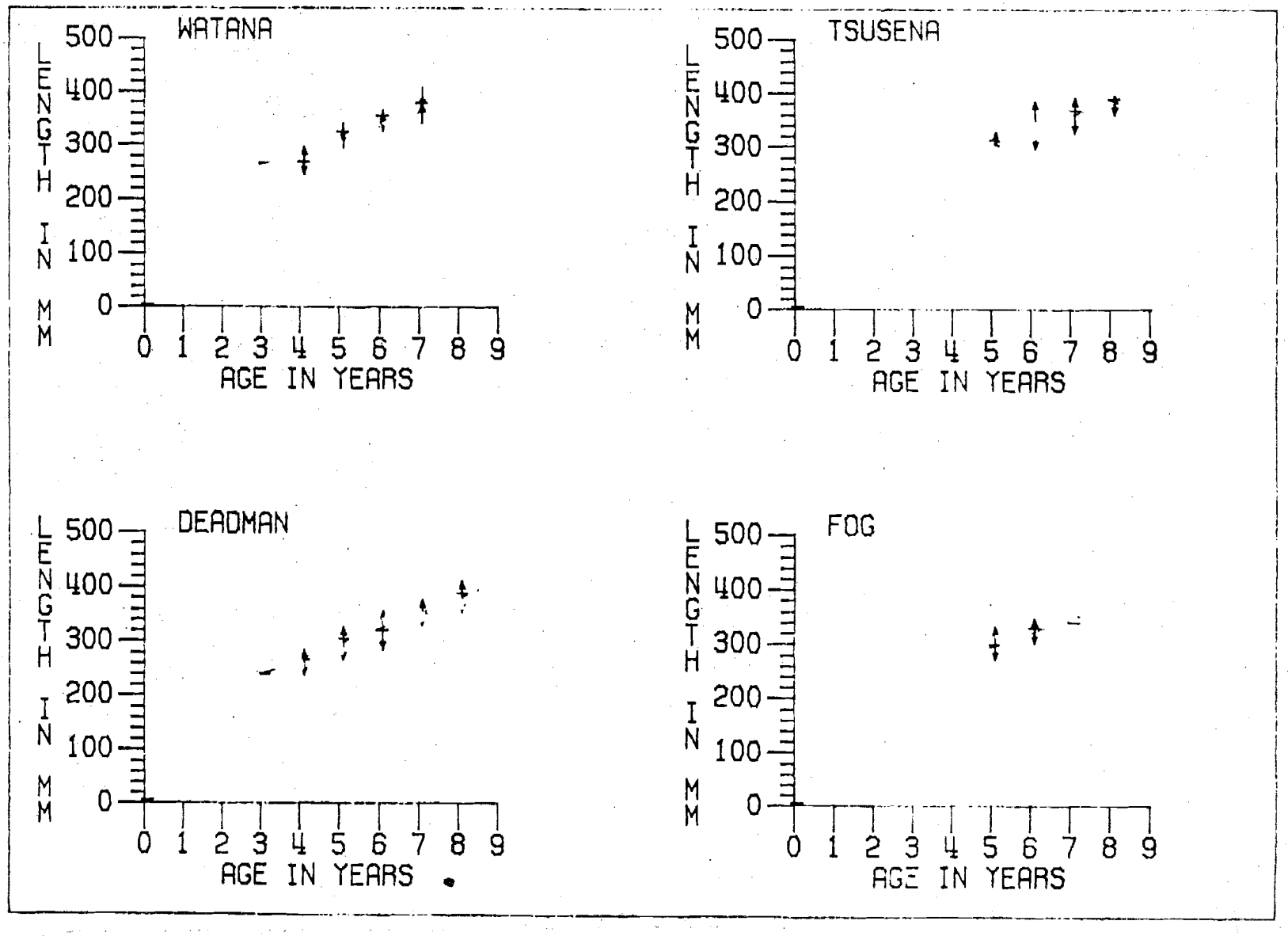

Figure E.3.1.6. Arctic grayling age-length distribution. Upper Susitna River tributary habitat locations May to September, 1981.

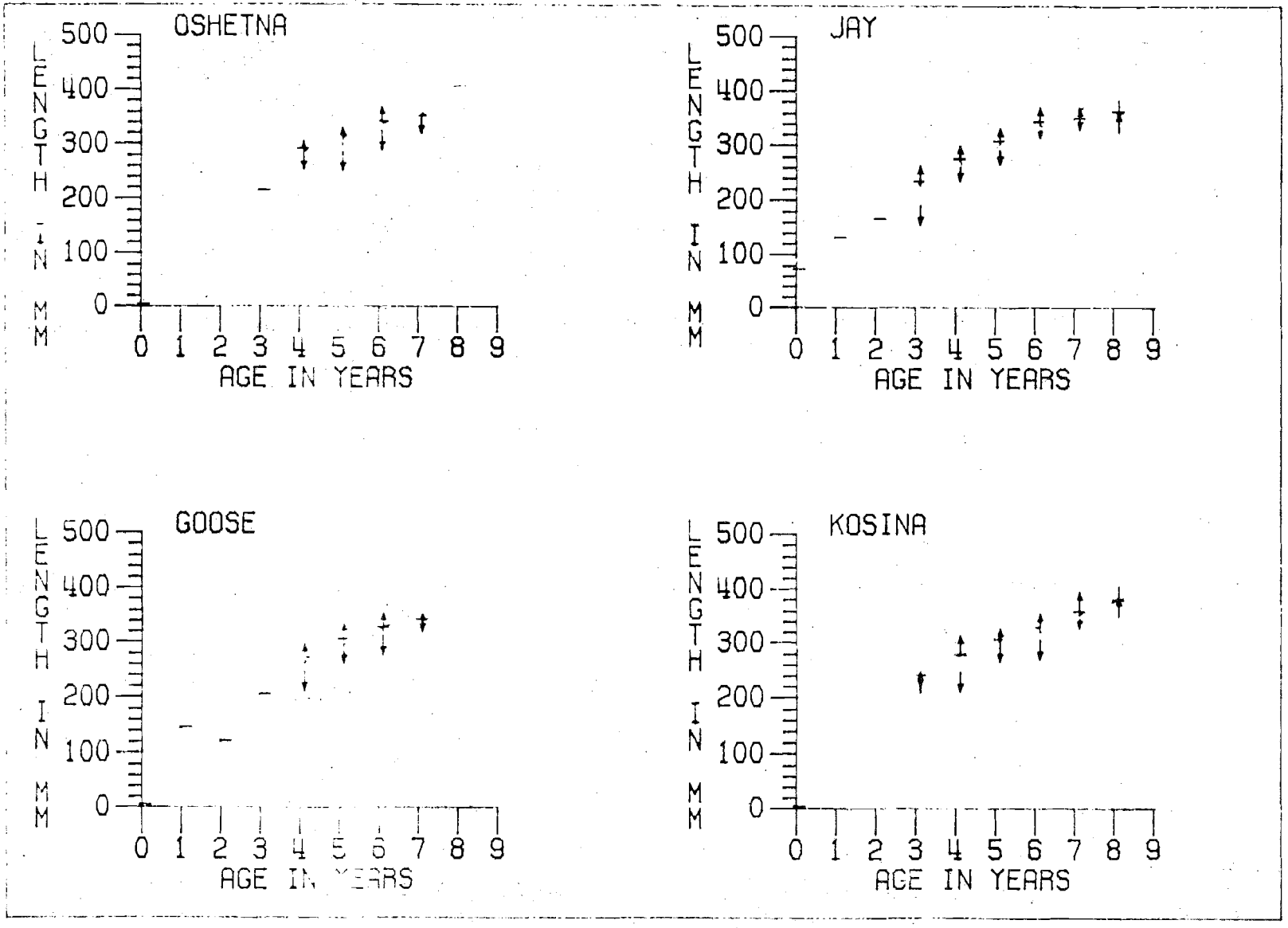

Figure E.3.1.6. (cont.)

to 45 mm in July, and from 47 to 60 mm in September. Age I juvenile Arctic grayling measured ranged from 54 mm in May, from 75-95 mm in June, and from 84-98 mm in July. Two Arctic grayling 54 mm and 115 mm FL were taken 3 miles up Goose Creek May 23. (Plate E.3.2 shows project staff in the pursuit of juvenile fish species. See Appendix Table EA-6 for a listing of juvenile grayling captured).

Two hundred and sixteen grayling were examined for sex composition. 59.7% were males and 40.3% were females for a ratio of 1.48 males:1.00 female. The sex ratio varied from 0.85 males:1.00 female in May to 2.45 males:1.0 female in June then remained at or near the 1.48 average for July, August and September (Table E.3.1.13). No explanation for this variance in sex ratio over time was determined by this study.

Table E.3.1.13 Arctic grayling sex composition by month upper Susitna River, habitat locations, May to September 1981.

	NO. MALE	NO. FEMALE	MALE:FEMALE
May	17	20	0.85:1
June	27	11	2.45:1
July	41	26	1.58:1
August	18	12	1.50:1
September	26	18	1.44:1
TOTAL	129	87	1.48:1

Plate E.3.2. Sampling for juvenile fish, Jay Creek habitat location, 1981.

The ratio of males to females was highly variable by stream (Table E.3.14). Only Fog Creek with a limited 14 fish sample had a plurality of females over males.

Table E.3.14. Grayling sex composition, upper Susitna River tributaries, May to September 1981.

	Male	%	Female	%	Sample Size
Oshetna	36	59	25	41	61
Goose	18	62	11	38	29
Jay	21	66	11	34	32
Kosina	29	62	18	38	47
Watana	5	56	4	44	9
Deadman	7	78	2	22	9
Tsusena	10	67	5	33	15
Fog	3	21	11	79	14
TOTAL	129	60	87	40	216

Total sample size was small for some months and tributaries to regard sample sex ratios as a true representation of population sex ratios. There is, however, an indication of changing sex ratios by season and differences between streams which may be real and due to differences in survival rates and migratory behavior of the sexes. Sampling of the Delta Clearwater in 1972-73 showed that of 57 grayling autopsied 44% were male and 56% were female.

3.1.4.3 Spawning

Based on known spawning behavior for other areas, project personnel believed that spawning in the upper Susitna River tributaries would occur after ice out following the peak of the spring breakup flood in late May. Aerial surveys of the tributaries were conducted by project personnel on May 11, 1981 for purposes of reconnaissance. Breakup had just occurred, streams were in high flood, and were extremely turbid. Personnel were on site by May 20 but this proved to be too late to document spawning. Arctic grayling examined during May and early June exhibited spent gonads and frayed dorsal and caudal fins indicating that they had already spawned. Fish in this condition were collected at the mouths of tributaries. Two ripe males were taken at the mouth of Goose Creek May 22. It is now believed that 1981 spawning in the upper Susitna River tributaries took place from late April through early May likely under the ice or during mid-May spring flood when documentation would have been most difficult. In the Yukon and Alaska North Slope regions, grayling have been known to spawn in turbid waters during spring flood periods (TES, 1981).

Young of the year and juvenile Arctic grayling were taken through the summer in shallow, clearwater pools off the main Susitna. These clearwater areas were formed by the isolation of clearwater runoff from tributaries such as Kosina and Jay Creeks in main river side channels and sloughs. Such areas generally had little current and were only connected to the main river at their outlet. Additional juvenile Arctic grayling were taken in quiet pools and side channels of Goose and Jay creeks. Spawning is believed to have occurred in nearby tributaries but may have occurred in these slough areas.

The preferred type of gravel spawning substrate occurs in pools throughout the various tributaries. The amount of such habitat is extremely variable with extensive occurrence in Oshetna, Kosina and Tsusena creeks; moderate occurrence in Goose, Jay, and Watana creeks and limited occurrence in areas surveyed in Deadman and Fog creeks.

3.1.4.4 Tagging

3.1.4.4.1 Introduction

A total of 2,511 Arctic grayling were tagged and released during 1981 operations. The numbers of Arctic grayling tagged by month for each tributary stream or lake within the confines of the proposed impoundment elevation are listed in Table E.3.1.15. Those Arctic grayling surviving recapture were subsequently released with tag intact.

Two hundred sixty-eight of the tagged Arctic grayling were recaptured. Table E.3.1.16 lists recaptures of Arctic grayling by tributary of tagging and month. Twenty-six fish were recaptured twice and two grayling were taken three times. Only recaptures which occurred in subsequent months or from different tributaries during the same month were included in the totals.

All tagging was with Floy Tagging Mark II tagging guns utilizing 2-5/8" international orange anchor tags. Plate E.3.3 shows an Arctic grayling with Floy tag in place. Tagged grayling were held upright in the current until respiratory function appeared normal. Fish deeply hooked or bleeding were not tagged and were sacrificed for biological sampling. A number of tagged

Table E.3.1.15. Arctic grayling tagged by month and tributary, upper Susitna River, 1981.[a]

TRIBUTARY	MONTH MAY	JUNE	JULY	AUG.	SEPT.	TOTAL
Fog	19	15	32	3	5	74
Tsusena	34	68	110	49	8	269
Deadman	50	68	32	6	4	160
Watana	2	48	12	105	42	209
Kosina	97	121	211	61	158	648
Jay	80	153	56	17	64	370
Goose	97	142	71	34	9	353
Oshetna	14	83	130	65	136	428
TOTAL	393	698	654	340	426	2,511

[a] 108 additional grayling were tagged during the field season outside the area proposed to be impounded. Numbers tagged by tributary were:

upper Deadman	60	17	10
upper Kosina			10
Sally Lake		10	
Deadman Lake			1

Table E.3.1.16. Arctic grayling recaptures by tributary of tagging and month of recapture, upper Susitna River, June to September, 1981.

TRIBUTARY	MONTH					TOTAL
	MAY	JUNE	JULY	AUGUST	SEPTEMBER	
Fog	0	3	7	2	0	12
Tsusena	0	3	15	15	2	35
Deadman	0	4	11	4	3	22
Watana	0	0	2	0	2	4
Kosina	0	21	12	15	17	65
Jay	0	11	17	12	13	53
Goose	0	10	13	11	2	36
Oshetna	1	0	19	12	9	41
TOTAL	1	52	96	71	48	268

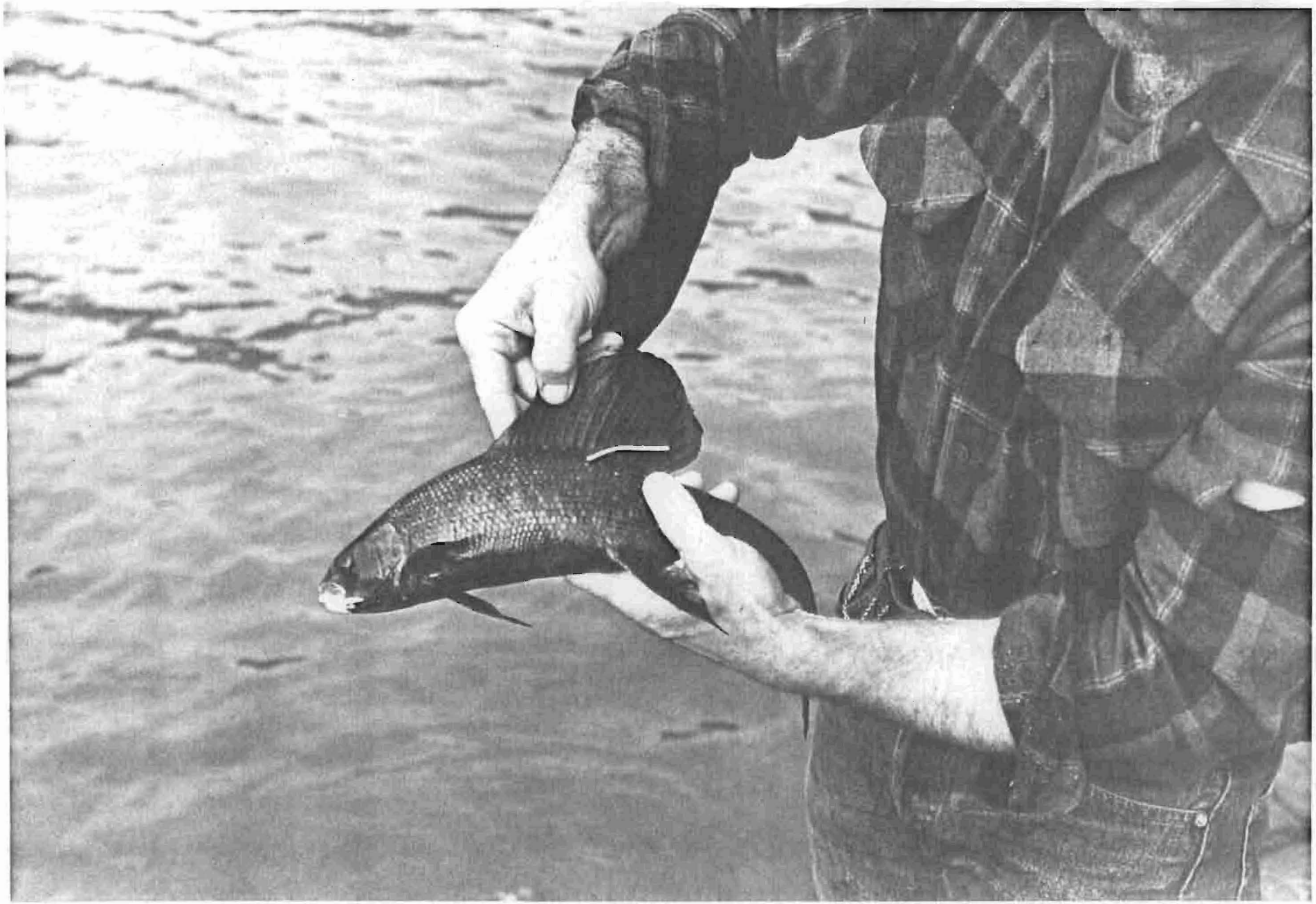

Plate E.3.3. Arctic Grayling with Floy anchor tag in place, Upper Susitna River, 1981.

grayling were marked by clipping the adipose fin. Recaptures of fish so marked should give an indication of tag shedding. Through the September sampling recaptures from fish so marked are too few in number for meaningful conclusions. With a relatively high overall recovery rate of 11% (273 recovered for 2,511 tagged), it would appear unlikely that there was much shedding of tags or mortality due to tagging. The bulk of grayling tagged--96%--were captured for tagging by rod and reel.

Of one group of 86 gillnet captured grayling tagged off the mouth of Jay Creek May 25-26, 14 or 16.3% were eventually recaptured. Thus there is no evidence of disproportionate mortality due to gillnet capture as compared to rod and reel. Gillnet tagged fish taken were tagged within 15 minutes following entrapment in the net. Fish gilled resulting in gill injury were not tagged.

Almost all tagged grayling recaptures were made by Fish and Game project personnel. A total of 6 tagged grayling were recaptured by non-project personnel: 4 at the mouth of Kosina Creek, and two in Goose Creek 12 miles upstream from its mouth.

3.1.4.4.2 Population Estimation

Arctic grayling population estimates were made for the upper Susitna River study area and the proposed inundated reach of each tributary. These estimates are based on tagging conducted from May through August and recoveries of tags from June through September and were produced using the Schnabel method (See Appendix Table EA-7 for formula and Appendix Table EA-8

for recaptures used in computations). The population estimate for Arctic grayling in the upper Susitna river study area calculated at the 95% confidence level ($4d_f$), is 10,279 with a range of 9,194 to 11,654. Kosina Creek has the highest estimate for an individual tributary at 2,787 (range 2,228 - 3,720) followed by the Oshetna River at 2,017 (range 1,525 - 2,976). Fog Creek had the lowest estimate at 176 (range 115 - 369), (Table E.3.1.17). No estimate is listed for Watana Creek, although Watana is included in the study area total estimate, because the low number of tagged fish recovered would have resulted in an estimate with an unacceptably wide range of values.

Table E.3.1.17 Arctic grayling population estimates, upper Susitna River tributaries, 1981. 1/

STREAM	POPULATION ESTIMATION	CONFIDENCE 2/ INTERVAL
Oshetna	2,017	1,525 - 2,976
Goose	1,327	1,016 - 1,913
Jay	1,089	868 - 1,462
Kosina	2,787	2,228 - 3,720
Deadman	979	604 - 2,575
Tsusena	1,000	743 - 1,530
Fog	176	115 - 369

1/ Watana Creek estimate is not included because too few recaptures were made.

2/ Based on June through September recoveries $d_f = 4$ at 95% level.

As illustrated in the discussion of tag return data, grayling interchange freely between tributaries using the main Susitna as a migratory corridor. Seasonal movement into and out of the clearwater tributaries has been demonstrated. Population estimates for a tributary with the emmigration of fish tagged or immigration of numbers of untagged fish would in effect result in a lower ratio of tagged to untagged fish. Population estimation resulting would be high. The upper Susitna study area would best be regarded as a whole with the total population estimation the most valid.

On numerous occasions during 1981 sampling tagged grayling were recaptured repeatedly during the same day of sampling from the pool of release. In many instances a fish captured initially on a spinner was recaptured on a fly; frequently, a fish captured on one lure type was recaptured on that same lure type. It appears that grayling do not easily learn to avoid lures making hook and line sampling a legitimate recovery method. Problems were experienced in covering west bank pools when encamped on the east bank or east bank pools when operating from the west. In the larger tributaries such as the Oshetna River, Kosina, Deadman, and Tsusena creeks sampling was limited to casting distance from the bank of helicopter dropoff. Monthly sampling on the Oshetna River alternated between the west and east banks.

The impoundment population estimation of 10,279 grayling over 150 mm fork length is for approximately 20.5 miles of clearwater tributaries and 85 miles of the main Susitna. This would give an average of approximately 501 adult grayling per clearwater tributary mile or 121 per river mile including the main Susitna to be inundated. Hallberg (1979) gave a population estimation of

495 grayling per mile for the upper Chena River Dam Site for a 1978 study for fish 150 mm or greater in length. Four sections of the Chena combined gave an estimation of 320 grayling per mile. Earlier studies of this system had given total population estimations as high as 1,824 per mile (including fish under 150 mm fl). In a 1974 study Pearse (1974) gave population estimations for the Delta Clearwater River as from 142 to 182 per mile.

3.1.4.4.3 Migration

Different patterns of movement and utilization by grayling in a drainage system may become apparent as a particular region is studied (T.E.S., 1981). Some tributaries may serve as spawning streams and rearing areas for fry, whearas other tributaries, mainstream regions, or lakes may be used by both immature and mature adult grayling as summer feeding grounds. The time of migration out of the spawning stream depends in part on size of the system with mature individuals carrying over after spawning in large systems until mid-summer or autumn.

Table E.3.1.18 summarizes grayling intrastream migration patterns as shown by tagging and tag recovery. A total of 243 tag returns are included in this data. Fifty tagged grayling recovered moved upstream, 69 moved downstream and 124 were recaptured at their point of release. The distance of movement recorded ranged from 2 miles downstream to 12 miles upstream within the various tributaries. The average length of time at large for within stream tags recovered was 39.6 days.

Table E.3.1.18. Arctic Grayling movement as demonstrated by tagged fish recovered within stream of tagging by month of tagging

Tagging		Number Different	Movement			Miles Traveled	Days at Large
Stream	Month	Recaptures	No. Up	No. Down	No. 0	Range	Range
Oshetna	June	23	10	9	4	-0.4 +0.2	29-54
	July	12	0	7	5	-1.1 0	30-54
	Sept.	4	0	0	4	-1.1 0	
	Total	39	10	16	13	-0.4 +0.2	29-59
Goose	May	17	5	0	12	0.0 +12.0	27-85
	June	14	2	2	10	-0.3 +1.2	27-81
	July	3	0	1	2	-0.3 0.0	
	Aug.	1	0	1	0	-0.1	
	Total	35	7	4	24	-0.3 +12.0	27-85
Jay	May	10	4	0	6	-0.5 +1.4	26-55
	June	24	1	8	15	-1.3 +1.7	27-93
	July	8	0	0	8	0	31-64
	Aug.	6	0	1	5	-0.1	31-34
	Total	48	5	9	34	-0.5 +1.7	26-93
Kosina	May	23	5	6	12	-0.2 +2.9	37-110
	June	13	0	5	8	-0.5	27-93
	July	17	6	5	6	-1.0 +2.3	27-60

Table E.3.1.18. (Continued)

Tagging Stream	Tagging Month	Number Different Recaptures	Movement No. Up	Movement No. Down	Movement No. 0	Miles Traveled Range	Days at Large Range
	Aug.	3	0	3	0	-0.3	33-34
	Sept.	3	0	3	0	-2.0 -1.5	1-2
	Total	59	11	22	26	-2.0 +2.9	27-93
Watana	June	1	0	1	0	-0.6	92
	July	1	0	1	0	-0.2	1
	August	1	1	0	0	+1.0	42
	Total	3	1	2	0	-0.6 +1.0	1-92
Deadman	May	6	1	0	5	0 +0.2	2-85
	June	3	2	0	1	0 +0.1	26-27
	July	4	0	0	4	0	1-63
	Aug.	1	0	1	0	-.3	30
	Total	14	3	1	10	-1.3 +0.2	1-63
Tsusena	June	17	3	4	10	+-0.3 -1.0	27-119
	July	16	8	6	2	-0.2 +0.3	1-29
	Total	33	11	10	12	-1.0 +0.3	1-119
Fog	June	11	2	4	5	-0.9 +0.4	27-56
	July	1	0	1	0	+0.3	26
	Total	12	2	5	5	-0.9 +0.4	26-56

Interstream movement was significant for tagged grayling recaptured (Table E.3.1.19). Twenty-five or 9% of tagged fish recaptured were recaptured at the mouth of or in a stream other than the stream of initial tagging. The number of grayling moving upstream in the main Susitna was 2, downstream 19, and downstream in the main Susitna then upstream in a tributary was 4. The average days at large was 44.2 with a range of 3-117. The average distance moved was 8.3 miles (range 0.5-34.5 miles). The maximum rate of documented movement was 4.7 miles/day.

Migration patterns as shown by tag returns and/or catch rates will be discussed by tributary. Catch success was greatly affected in some tributaries for some months by extremely turbid water conditions resulting from heavy rains, runoff and by land slides. Under such conditions, grayling could not feed readily by sight and did not readily take lures.

Oshetna River

May:

No grayling were taken by hook and line and only 3 were captured by gillnet at the mouth of the Oshetna River (habitat location site 1) during the May sampling, however, a catch rate of 1.8 grayling per angler hour was recorded for habitat location sites 1-5 combined. In contrast, a catch rate of 8.0 per angler hour was recorded for the selected fish habitat sites in the lower mile of the Oshetna River. More pools and fishable water were found between the habitat location sites than within them. The grayling catch rate for selected

Table E.3.1.19. Arctic grayling movement from initial tributary of tagging as indicated by tag recoveries, 1981.

Tributary	Tributary Mile of Tagging	Tag No.	Date Tagged	Days at Large	Recovery Location	Tributary Mile of Recapture	Total Miles Traveled
Oshetna	0.9	3012	5/24	3	Goose	0.0	-2.9
Oshetna	0.6	3496	6/17	29	Goose	0.1	-2.7
Goose	0.0	3025	5/22	33	Watana	0.0	-34.5
Jay	0.0	3193	5/26	57	Kosina Slough	201.9[a]	-2.0
Jay	1.5	3802	6/21	36	Fog	0.0	-31.5
Jay	0.1	3741	6/21	2	Kosina	0.7	2.3 (-1.6-+0.7)
Jay	0.1	3716	6/20	93	Kosina	0.7	2.3 (-1.6-+0.7)
Jay	0.0	3742	6/25	4	Watana	0.0	-13.6
Kosina	0.2	3240	6/29	33	Tsusena	0.0	-23.5
Kosina	0.2	3963	6/22	4	Watana	0.0	-12.0
Kosina	0.0	3299	5/26	27	Jay	0.0	+1.5
Kosina	0.0	3214	5/26	117	Jay	0.0	+1.5
Kosina	0.1	3283	5/27	55	Kosina Slough	201.9[a]	-0.5
Kosina	0.0	3258	5/27	5	Tsusena	0.0	-23.5
Watana	0.5	2234	6/25	28	Deadman	0.2	-7.7
Deadman	0.0	3339	5/30	85	Tsusena	1.8	-6.3
Deadman	0.2	3348	5/30	56	Tsusena	0.8	+5.5 (-4.9-+0.8)
Deadman	0.0	3331	5/30	57	Tsusena	0.0	4.5
Deadman	0.0	3357	5/30	56	Tsusena	0.0	-4.5
Deadman	0.0	3373	5/30	55	Tsusena	0.0	-4.5
Deadman	0.2	3351	5/30	56	Tsusena	1.5	6.2 (-4.7-+1.5)
Deadman	0.0	3361	5/30	56	Tsusena	0.0	-4.5
Deadman	0.0	3366	5/30	56	Tsusena	0.0	-4.5
Tsusena	0.0	3385	6/1	56	Crk.	178.4[a]	-0.5
Tsusena	0.0	3397	6/1	56	Fog	0.1	-5.1

[a] Susitna River mile upstream of mouth.

fish habitat sites above mile one to approximately mile 2 during May was 6.0 grayling per hour. Limited hook and line sampling above Mile 2 produced no grayling. The stream total catch rate for May was 6.0 grayling per angler hour. A single grayling tagged at Oshetna River mile 0.9 May 24 moved downstream 3.6 miles to be recovered at Goose Creek mouth 3 days later on May 27.

June:

The numbers of grayling found at the mouth and in the other habitat location sites increased from the May sampling as evidenced by catch rates of 3.0 and 9.1 grayling per angler hour for habitat location site 1 and sites 1-5 combined respectively. The catch rate recorded for selected fish habitat sites in the lower mile increased to 10.6 as did the catch rate for selected sites above mile one to the proposed impoundment elevation (7.3). Grayling appeared to be moving into the Oshetna River from the Susitna River and actively migrating upstream.

Twenty-three grayling tagged during June in the Oshetna River were later recaptured. Twenty five of these fish were subsequently recaptured in the Oshetna within one half mile of their release point. One grayling was recaptured 29 days later at 0.1 mile up Goose Creek.

July:

Large numbers of grayling were again found at the mouth, in the lower mile and above mile one to the proposed impoundment elevation with catch rates of 9.4, 6.5 and 13.3 respectively. The greatest increase was observed in that reach

of Oshetna from mile one to the proposed impoundment elevation where the catch rate during July was 13.3 grayling per angler hour. The highest stream total catch rate, 9.4 grayling per angler hour was also recorded during July.

Twelve grayling tagged during July in the Oshetna were recaptured. Of the 12 fish recaptured in the Oshetna 7 moved downstream from their point of release and 7 remained at or near their point of release.

August:

Relatively large numbers of grayling remained present at the mouth, in the lower mile and above mile one to the proposed impoundment elevation. A catch rage of 9.0 grayling per angler hour was recorded in the habitat location sites and a stream catch rate for August of 9.4 grayling per hour. No grayling tagged in the Oshetna River during August were recaptured in the September sampling. One hundred sixty-seven fish were captured in upriver sampling. The lack of tagged fish would seem to indicate that earlier tagged fish had moved out of the study area and were no longer available in the lower Oshetna River for recovery.

September:

Grayling catch rates in the Oshetna River habitat locations decreased to 2.1 fish per angler hour in September, with only 1.3 grayling per hour being captured at the mouth. With the exception of one relatively deep pool located approximately 2.0 miles up the Oshetna, catch rates throughout the stream were

consistently low. This single cobble bottom pool, 3 to 5 feet deep, 125 feet long and lying along the outside of a bend, was fished extensively to determine the presence of any tagged grayling. A catch rage of 17.2 grayling per angler hour was recorded. None of the 167 grayling collected from this pool carried tags. It appears that this pool provides potential wintering habitat for grayling and that those fish occupying it in September were likely to have moved downstream from areas not previously sampled.

Goose Creek

May:

Grayling were present at the mouth and in the lower one mile of Goose Creek during May as a catch rate of 7.4 grayling per angler hour was recorded in the habitat location sites. All of these grayling were collected at the mouth of Goose Creek. No grayling were captured from Goose Creek above stream mile one; one adult was observed in a pool three miles upstream. A single juvenile grayling 54 mm total length was collected in a shallow side channel. Although grayling were present at the mouth and in the lower mile of Goose Creek the extent of their upstream distribution appears very limited.

Five grayling tagged in the lower mile of Goose Creek were subsequently recaptured upstream. Two of these fish were captured by sport fishermen approximately 12 miles up Goose Creek. These sport fishermen reported observing 10 additional tagged grayling in the same area. Fourteen grayling tagged during May in the lower mile of Goose Creek were captured 27 to 85 days

later in that same area. One grayling tagged May 22 at the mouth of Goose Creek was recaptured 33 days later, 34.5 miles down the Susitna River at the mouth of Watana Creek.

June:

Grayling were present at the mouth and in the lower mile of Goose Creek where the habitat location catch rate during June was 6.2 grayling per angler hour. A significant increase was observed in the numbers of grayling above stream mile one. The catch rate at selected fish habitat sites from mile one to the proposed impoundment elevation was 11.5 grayling per angler hour. Grayling previously schooled at the mouth Goose Creek had distributed in an upstream direction.

Fourteen of the fish tagged at Goose Creek in June were later recovered in Goose Creek within 1.2 miles of their release point. It appears that by the end of June the general upstream movement of grayling has ceased and random movements by individual fish predominates.

July:

Relatively large numbers of grayling were collected over the entire reach of Goose Creek sampled. The habitat location catch rate was 8.0 grayling per angler hour while the catch rate for the selected fish habitat sites reach was 12.2 grayling per hour.

Three grayling tagged during July were subsequently recaptured near their release point.

August:

Fewer grayling were taken at the Goose Creek habitat location and at the selected fish habitat sites during August. The habitat location catch rate was 4.3 grayling per angler hour. Sampling efforts upstream from mile one to the proposed impoundment elevation resulted in a grayling catch rate of only 3.2 per angler hour. Grayling appear to have begun to move out of Goose Creek by the August sampling.

Only one fish tagged a Goose Creek in August was later recaptured, that in September one tenth of a mile downstream from its point of release.

September:

A majority of the grayling present in Goose Creek through the summer months had moved out of the habitat location and upstream selected fish habitat sites by September. The habitat location catch rate was 0.8 grayling per angler hour; the selected fish habitat site catch above mile 1 was 2.4.

No tagged grayling were recaptured in September.

Jay Creek

May:

Small numbers of grayling were collected by hook and line in the Jay Creek habitat location or in selected fish habitat sites because of high and turbid water conditions; however, 125 grayling were captured by gillnet at the Jay Creek Susitna River confluence.

Four grayling tagged at the mouth of Jay Creek in May were later recaptured upstream in Jay Creek, and six were recaptured at their point of release and one was captured 57 days later two miles downstream in a slough off the mainstem Susitna River.

June:

Relatively large numbers of grayling were present at the mouth, in the lower mile and upstream from mile one to the proposed impoundment elevation. The habitat location catch rate was 6.2 grayling per angler hour while the stream total catch rate was 7.4 per hour. Grayling appear to have moved into Jay Creek and distributed themselves within the system.

A total of twenty-eight grayling tagged during June in Jay Creek were later recaptured; 15 at their point of release, 8 upstream in Jay Creek, 1 downstream in Jay Creek and 4 in downstream tributaries. Of the latter recoveries two were in Kosina Creek, one was in Watana Creek and one was in Fog Creek.

July:

Relatively high catch rates were recorded in the Jay Creek habitat location and in selected fish habitat sites during July. The habitat location catch rate was 8.8 grayling per angler hour while, the stream total catch rate was 10.9 per hour.

Eight grayling tagged during July in Jay Creek were later recovered near their point of release.

August:

High turbid water conditions prevailed during August in Jay Creek precluding any hook and line sampling above mile one. The habitat location catch rate was 4.1 grayling per angler hour, and a gillnet place at the Susitna River Jay Creek confluence captured only five additional grayling.

Six August tagged grayling were later recaptured in Jay Creek near their point of release.

September:

Relatively large numbers of grayling were captured in the habitat location particularly at the mouth of Jay Creek. The grayling catch rate at the mouth (habitat location site No. 1) was 10.5 per hour while the habitat location overall had a catch rate of 8.6 per hour. It appeared that the grayling were

moving downstream in Jay Creek toward the mouth, however fish were still present in the lower reach of Jay Creek.

Kosina Creek

May:

Catch rates for habitat location site 1 and sites 1-5 combined were 3.9 and 7.2 grayling per angler hour respectively. Due to high water, that section of Kosina Creek above habitat location site 3 was not sampled. The stream total catch rate for May was 7.2 grayling per angler hour.

Twenty-three grayling tagged during May in Kosina Creek were later recaptured at or near their point of release, six downstream and twelve (were recovered) upstream from their point of release. Two grayling tagged May 26 at the mouth of Kosina Creek were recaptured 27 and 117 days later at the mouth of Jay Creek, a distance of 1.5 miles up stream in the Susitna. Two grayling tagged May 27 at 0.0 and 0.1 mile Kosina Creek was recaptured 5 and 55 days later in Tsusena and Kosina Slough, distances of 23.5 and 0.5 miles down the Susitna respectively.

June:

The numbers of grayling found at the habitat location sites increased during June as evidenced by a catch rate of 10.8 grayling per angler hour. The catch rates for selected fish habitat sites in the lower mile and above mile one to the proposed impoundment level, sampled for the first time in June, were 3.97

and 11.0 grayling per angler hour respectively. With the exception of a small pool located between habitat location sites 1 and 2, all the fishable water was found within the habitat location sites in the lower mile of Kosina Creek. The stretch of Kosina Creek between mile 1 and 3 was found to contain some very large, deep pools. These pools averaged 150 to 300 feet in length, 20 to 40 feet in width, and 4 to 8 feet in depth. All were located below very turbulent rapids. It is very possible that these pools provide an in stream over wintering habitat area for Kosina Creek grayling as evidenced by the continuous presence of large numbers of grayling. The stream total catch rate for June was 9.3 grayling per angler hour, with the majority of the 246 grayling captured coming form the selected fish habitat sites between mile 1 and 3.

Thirteen grayling tagged during June in Kosina Creek were later recaptured, eight at or near their release point and five within 0.5 miles downstream. One fish tagged June 22 was recaptured 4 days later at the mouth of Watana Creek, a distance of 12.0 miles; and another tagged at mile 0.2 of Kosina Creek on June 19 was recaptured at the mouth of Tsusena Creek, a distance of 23.7 miles.

July:

A large increase in the numbers of grayling found at the mouth of Kosina Creek occurred during July, with the catch rate reaching 13.4 grayling per angler hour. The formation of a large pool at the confluence with the Susitna caused by extremely high water conditions resulted in an increase in desirable habitat greater numbers of grayling and increased CPUE. The catch rate at the

habitat location increased to 12.8 grayling per angler hour. Selective fish habitat sites between mile 1 and 3 continued to have a high catch rate of 10.2 grayling per angler hour. High water conditions during July seemed to have little effect on the sampling conducted. The highest stream monthly total catch rate, 10.9 grayling per angler hour, was recorded in July.

Seventeen grayling tagged during July in Kosina Creek were recaptured. All 17 of these fish were recaptured in Kosina Creek. Six were recaptured at or near their point of release, six moved upstream and five moved downstream.

August:

A large decrease in the numbers of grayling and in the catch rate at the habitat location of Kosina Creek occurred in August. The catch rate was 5.7 grayling per angler hour. The catch rate in the selected fish habitat sites between mile 1 and 3 remained high at 11.5 grayling per angler hour. High water and turbid conditions occurred in the lower mile of Kosina Creek probably hampering success rates. The stream total catch rate was 8.9 grayling per angler hour for August.

Three grayling tagged in Kosina Creek during August were recaptured. All three of these fish were recaptured in Kosina Creek and all had moved downstream 0.3 miles from their point of release.

September:

Grayling catch rates in the habitat location of Kosina Creek dropped 4.7 grayling per angler hour. A total of only 13 grayling were captured during September in this area. With the exception of the large pool selective fish habitat sites between mile 1 and 3, grayling had migrated out of Kosina Creek. The large pools in upper Kosina Creek produced the highest catch and catch rates recorded during the season running 143 grayling and 11.7 grayling per angler hour respectively. This would indicate migration of grayling into these pools from surroundirg areas, possibly for overwintering.

Three grayling tagged in Kosina Creek during September were later recaptured. All three of these grayling were recaptured in Kosina Creek 1.5 to 2.0 miles downstream one day after being tagged.

Watana Creek

May:

Watana Creek was high and turbid during May making sampling efforts particularly inefficient. A catch rate of only 0.3 grayling per angler hour was recorded at the habitat location. No sampling was conducted upstream of mile one. No grayling tagged in Watana Creek in May were later recovered.

June:

Increased numbers of grayling appeared to be present in the Watana Creek habitat location where the catch rate was 5.4 grayling per angler hour. Water condition had improved from the May sampling and hook and line sampling was effective throughout the stream.

Two grayling tagged during June in Watana Creek were later recaptured, one 92 days later only 0.2 miles from its release and the other 28 days later at the mouth of Deadman Creek.

July:

Watana Creek catch rates for July were relatively low. The habitat location catch rate was 3.3 grayling per hour while the stream total was 3.1 per hour. A total of only 16 grayling were captured during the two day period although water condition was moderately clear. The lower mile of Watana Creek does not appear to provide high quality habitat for summer feeding grayling.

Approximately eight miles of Watana Creek will be inundated by the proposed Susitna Dams; and through July, sampling efforts had been limited to the lowest two miles of this reach.

A single grayling tagged in Watana during July was later recaptured a short distance downstream in Watana.

August:

Catch rate remained relatively low at the habitat location and in the lower mile of Watana Creek in August. Hook and line sampling was conducted at the confluence of east and west forks of Watana Creek approximately six stream miles from the mouth. The east fork, similar to lower Watana was turbid much of the summer of 1981; in contrast, the west fork was clear a majority of the time. This west fork of Watana is excellent grayling habitat with numerous cobble bottomed pools 5-10 feet deep and up to 100 feet in length and 60 feet in width. The catch rate in the west fork and confluence west fork-east fork area was 10.4 grayling per angler hour. A high percentage of the grayling collected by hook and line were 120 to 150 mm fork length or predominately Age II and III.

Although 95 of these small grayling were tagged, none were recaptured at downstream locations in the September sampling. One grayling tagged during August in the lower mile of Watana Creek was recaptured in September in the upper reach of Watana Creek.

September:

The Watana Creek habitat location catch rate remained relatively low but consistent with July and August staying at 3.3 grayling per angler hour. Sampling in upper Watana yielded a catch rate of 5.7 grayling per angler hour.

It is important to determine in 1982 the relationship of upper Watana Creek to lower Watana, other nearby Susitna tributaries and to the upland lakes draining into this system.

Deadman Creek

May:

Grayling were found at the mouth and immediately upstream during May. Only the first 2000 feet up from the mouth of that section of Deadman Creek below the 100-150 foot waterfall was accessible for sampling purposes. The section of Deadman Creek below the falls is an extremely torrential with boulder strewn rapids containing very poor spawning and juvenile rearing habitat. The majority of the grayling captured and observed were at the mouth. The catch rate for the habitat location was 7.1 grayling per angler hour.

Fourteen grayling tagged at Deadman Creek in May were later recaptured, six in Deadman Creek with one moving upstream and 5 remaining at the point of release. Eight grayling tagged at Deadman Creek mouth on May 30 were recaptured at Tsusena Creek Mile 0.0 to 1.8 56 to 85 days later.

June:

The numbers of grayling found at Deadman Creek increased from the May levels. The highest catch rate for the season was recorded at the habitat location during June, 7.7 grayling per angler hour. Large numbers of grayling do not

appear to enter Deadman Creek to feed during the summer; however, schools of grayling are occasionally present off the mouth and in the lower one half mile.

Three grayling tagged at Deadman Creek in June were later recaptured. All three of these fish were recaptured in Deadman Creek one moving 0.1 mile upstream and two remaining at or near the point of release.

July:

Seven grayling were captured at the mouth, with a catch rate of 4.7 grayling per angler hour. A slight increase in catch rate was observed upstream of the mouth with a catch of 35 grayling. The stream total catch rate for July was 7.2 grayling per angler hour.

Sixty-eight grayling were captured in upper Deadman approximately 2 miles upstream from the falls. The majority of these fish were tagged and released. Upper Deadman from Deadman Lake to approximately a mile above the falls impassible to downstream, fish has many pools and extensive productive fish habitat.

Four grayling tagged at lower Deadman Creek in July were later recaptured. All four of these fish were recaptured in Deadman Creek at or near the point of release.

August:

Small numbers of grayling were present in Deadman Creek during August. A catch rate of 1.82 grayling per angler hour was recorded at the habitat location and the total stream catch and catch rate was 6 grayling and 2.4 grayling per angler hour, respectively. High and turbid water conditions slightly hampered sampling success; but, as evidenced by the drop in catch and catch rates, large numbers of grayling were not present in Deadman Creek.

A single grayling tagged during August was later recaptured in Deadman Creek having moved downstream.

September:

With only three grayling taken, grayling catch rates in lower Deadman Creek habitat location decreased to 0.0 grayling per angler hour.

Recovery efforts in upper Deadman selected fish habitat sites 2 miles above the falls from which 68 grayling had been captured in July produced only 8 fish. The fish had either ceased to feed or emmigration had occurred out of the upper stream possibly into Deadman Lake for the winter.

Tsusena Creek

May:

The catch rate for the mouth of Tsusena Creek, the only portion of Tsusena Creek proposed to be inundated was 4.6 grayling per angler hour. The fish that were present were at the confluence with the Susitna River. Limited sampling was conducted upstream; but during May, few grayling had moved into the available habitat.

None of the grayling tagged in Tsusena Creek during May were later recaptured.

June:

The catch rate for June increased slightly to 5.6 grayling per angler hour. Limited sampling upstream evidenced that grayling had migrated up into the available habitat.

Nineteen grayling tagged in Tsusena Creek during June were later recaptured. Seventeen of these fish were recaptured in Tsusena Creek, ten at or near the point of release, four upstream, and three downstream from the point of release. Two tagged grayling were recaptured June 1: one at the mouth of a small creek at RM 178.4 and the other 0.1 mile up Fog Creek.

July:

The total catch and catch rates for the mouth were the highest recorded during the season, 74 grayling and 9.0 grayling per angler hour respectively. High water conditions created a long, clear water pool extending approximately 1000 yards down the Susitna River. A relatively large number of grayling occupied this entire area of good habitat.

Sixteen grayling tagged at Tsusena Creek during July were later recaptured. All sixteen of these were recaptured in Tsusena Creek, two at or near the point of release, eight moved upstream and six moved downstream.

August:

The numbers of grayling at the mouth decreased substantially compared to the preceding months with a catch rate of 3.3 grayling per angler hour. Catches upstream also declined as the grayling started migrating out of Tsusena Creek.

No grayling tagged at Tsusena Creek in August have been recaptured.

September:

The grayling catch rate in Tsusena Creek dropped to 2.0 grayling per angler hour with a catch of only one grayling at the mouth. Limited upstream sampling indicated the majority of grayling had outmigrated.

No grayling tagged at Tsusena Creek in September have been recaptured.

Fog Creek

May:

Fourteen grayling were taken at the mouth, the only area within the habitat location that grayling were collected. Water was high and discolored during much of May sampling. Catch rates for the mouth and habitat location sites 1-3 combined were 11.2 and 8.0 grayling per angler hour respectively.

No grayling tagged at Fog Creek in May have been recaptured.

June:

The highest numbers of grayling were again found at the mouth, with a catch of 13 and rate of 4.3 grayling per angler hour. Upstream sampling showed no real increase with 4 grayling caught. The stream total catch rate was 3.9 grayling per angler hour.

Eleven grayling tagged at Fog Creek were later recaptured in Fog Creek, five at or near their point of release, two moved upstream as much as 0.4 mile and four moved downstream a maximum of 0.9 mile.

The total stream catch rate was 6.8 grayling per angler hour.

July:

Only three grayling were captured at the mouth with a catch rate of 2.4 grayling per angler hour. The highest total number of grayling captured during the season of 20 was recorded in July. The total stream catch rate was 6.8 grayling per angler hour. Lower Fog Creek has a limited amount of grayling habitat.

A single grayling tagged at Fog Creek in July was recaptured 0.3 miles downstream from its point of release 26 days later.

August:

The number of grayling in Fog Creek habitat location apparently decreased as evidenced by a catch rate of 1.6 grayling per angler hour. Small, shallow side channels were found to contain young of the year grayling proving some grayling use Fog Creek as a spawning stream.

No fish tagged at Fog Creek in August have been recaptured.

September:

Five grayling were captured at the mouth of Fog Creek for a catch rate of 2.0 grayling per angler hour. No other areas of Fog Creek were sampled because of freezing conditions.

No grayling tagged at Fog Creek during September have been recaptured.

Generally, it is believed that by the time of arrival of project personnel on site, May 20, the upstream spawning run and following downstream migration was essentially over. Sampling in June found grayling had moved back upstream into the tributaries where relatively high numbers remained through July and early August. Late August and September catch rates and tag return data suggests that large numbers of grayling had moved out of the tributaries, particularly the upstream reaches. Large numbers of untagged fish were captured in habitat locations sampled which were likely moving through from upstream unsampled areas. Many tributary fish appear to move into the main Susitna for wintering. The lower reaches of some tributaries such as Kosina and Tsusena have large deep pool habitat where overwintering would be possible.

3.2 BURBOT

3.2.1 Abstract

Eighty-eight adult burbot, Lota lota, were captured in the upper Susitna River. Catches were distributed over all tributary habitat locations with Jay and Watana Creek showing the most consistent catches and highest catch rates for the season of 1.14 and 1.09 burbot per trotline day fished respectively. The catch rate for all tributaries for the season was 0.68 burbot per trotline day fished. One juvenile burbot of 15 mm TL was captured from lower Jay Creek on June 20; one young of the year burbot of 102 mm TL was taken from Jay Creek slough on August 19.

Otoliths were collected from 54 burbot and used for age determination. The majority of the burbot aged were in the age classes IV, V, and VI. The mean lengths of burbot for these respective age classes were 357 mm, 382 mm, and 409 mm. Of the 54 burbot examined for sex 44 percent were males and 56 percent were females.

A total of 23 burbot were tagged and released; to date none have been recaptured.

3.2.2 Introduction

Burbot, Lota lota Linnaeus, known as lawyer, ling cod, lush, and mud shark, is the only species of the cod family (Gadidae) that lives in fresh water. Their distribution is circumpolar in the northern hemisphere being found in

all suitable fresh water habitats in continental Eurasia and North America southward to approximately 40° N (Scott and Crossman, 1973). In Alaska, burbot are found in the Copper and Susitna Rivers, Bristol Bay drainages and throughout the Interior, and the Arctic (McLean and Delaney, 1978).

Burbot are elongate, robust and nearly rounded anteriorly while tapering posteriorly with the caudal fin flared out and rounded. The mouth is terminal with the upper jaw reaching to just below the eye. A single barbel hangs from the chin. Coloration on the dorsal side ranges from a blotchy yellow to dark olive green while the ventral parts are pale yellow or white (Chen, 1969, Morrow, 1980).

In Alaska, burbot mature between Age III and VI and may live a total of 15 to 20 years of age. Spawning occurs as early as mid December and may extend through April, taking place at night under the ice in moderately shallow water over a substrate of sand or gravel. Female burbot can deposit up to 1 million eggs. Depending on the temperature, incubation time ranges from 30 to 70 days (Morrow, 1980).

Little is known concerning the movements or migration of burbot, although burbot have been observed migrating during spawning and feeding periods (MacCrimmon, 1959). Burbot are a nocturnal bottom feeding fish. Young burbot (Age I-II) prefer insect larvae (Hensen & Qudri, 1979), while adults will feed on whatever is available but prefer small fish (Hewson, 1955).

Burbot support a substantial sport fishery in the lakes of the upper Susitna River drainages, particularly the Lake Louise, Lake Susitna and Lake Tyone

chain of lakes where 6,612 burbot were estimated take in 1980 (Mills, 1980). The burbot population in the study area is subject to very little exploitation at the present time.

3.2.3 Methods

Burbot were collected from May to September, 1981 on trotlines baited with strips of round whitefish, grayling and longnose sucker.

All burbot captured were measured for total length. Otoliths were extracted from a representative sample of captured burbot for age determination. Sex was determined by necropsy.

All burbot uninjured by the sampling gear were tagged with Floy anchor tags.

3.2.4 Results and Discussion

3.2.4.1 Distribution and Relative Abundance

Burbot were collected at all eight Upper Susitna River habitat locations during May to September, 1981 for a total catch of 88. The percent incidence in sampling catches ranged from 50% of the locations sampled in May to 6 out of 7 sampled in July and 5 out of 5 sampled in September (Figure E.3.2.1).

Catch rates for all streams combined varied from 0.53 in May to 0.95 in September. The second highest catch rate, 0.73 burbot per trotline day, was recorded in July (Table E.3.2.1).

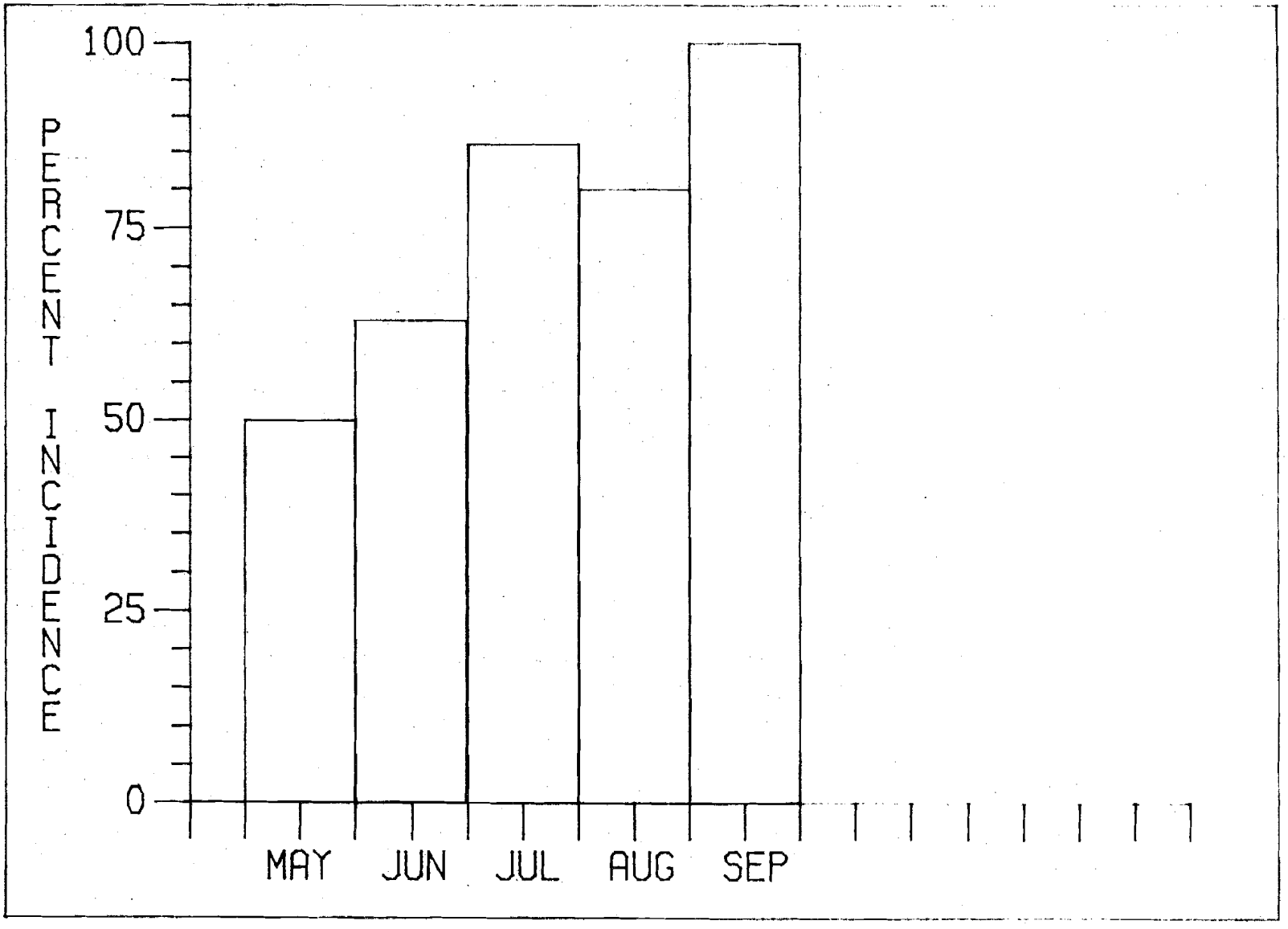

Figure E.3.2.1. Percent incidence of burbot at habitat locations, upper Susitna River, 1981.

Table E.3.2.1. Burbot captured by month and tributary upper Susitna River, 1981.

Tributary	May	June	July	Aug.	Sept.	Total
Fog	2	0	0	-	-	2
Tsusena	0	2	-	-	-	2
Deadman	1	0	1	-	-	2
Watana	5	6	6	4	3	24
Kosina	0	1	2	1	2	6
Jay	10	5	4	4	9	32
Goose	0	3	5	3	7	18
Oshetna	0	0	1	0	1	2
TOTAL	18	17	19	12	22	88
Trotline Days	27	32	26	22	22	129
Catch/ trotline day	0.62	0.53	0.73	0.54	0.95	0.68

All burbot catches were made immediately up or downstream from the tributary confluence with the Susitna. Jay Creek, with a May to September average catch rate of 1.14 burbot per trot line day, and total catch of 32 burbot was the most consistently productive habitat location followed closely by Watana and Goose creeks (Table E.3.2.2).

3.2.4.2 Age, Length and Sex Composition

Otoliths were removed and analyzed from 54 burbot for age determination. Age classes IV, V, and VI made up the majority of burbot, comprising 24%, 20%, and 35% respectively (Table E.3.2.3).

Of the dominant age classes found, Age IV averaged 357 mm (range 300-398), Age V averaged 382 mm (range 345-420 mm), and Age VI averaged 409 mm (range 325-500 mm). The age-length relationship for burbot is shown in Figure E.3.2.2.

Length determinations were made for a total of 88 burbot. Lengths ranged from 260 mm to 740 mm with a mean of 406 mm (Figure E.3.2.3). Of the 54 burbot examined for sex composition, 24 (44%) were males and 30 (56%) were females. Males comprised 38% of the Age IV burbot and 73% and 37% of the Age V and VI fish respectively.

A single burbot of 15 mm TL was taken in Jay Creek June 20. It is believed that this fish had been hatched for no more than a few days. Assuming a 70 day incubation time for spawned eggs given in the literature for Alaska

Table E.3.2.2. Burbot catch per trotline day fished and by tributary, upper Susitna River, 1981.[a]

	No. Burbot	No. Trotline Days	Catch per Trotline Day Fished
Fog Creek	2	12	0.17
Tsusena Creek	2	5	0.40
Deadman Creek	2	10	0.20
Watana Creek	24	22	1.09
Kosina Creek	6	20	.25
Jay Creek	32	28	1.14
Goose Creek	18	20	.90
Oshetna River	2	12	0.17
TOTAL	88	129	0.68

[a] One additional burbot was taken at the mouth of Kosina Creek by gillnet; one young of the year burbot 15 mm TL was taken in Jay Creek by minnow trap.

Table E.3.2.3. Age, length and sex frequency composition of burbot, upper Susitna River basin, 1981.

Age	Total No. of Fish Sampled	Mean Length (mm)	Range of Lengths	Male No/%	Female No/%	Total
I						
II						
III	2	295	260-330	1	1	2
IV	13	357	300-398	5	8	13
V	11	382	345-420	8	3	11
VI	19	409	325-500	7	12	19
VII	4	445	385-490	1	3	4
VIII	3	528	510-540	1	2	3
IX						
X	2	667	595-740	1/50	1/50	2
XI						
TOTAL	54	406	260-740	24	30	54

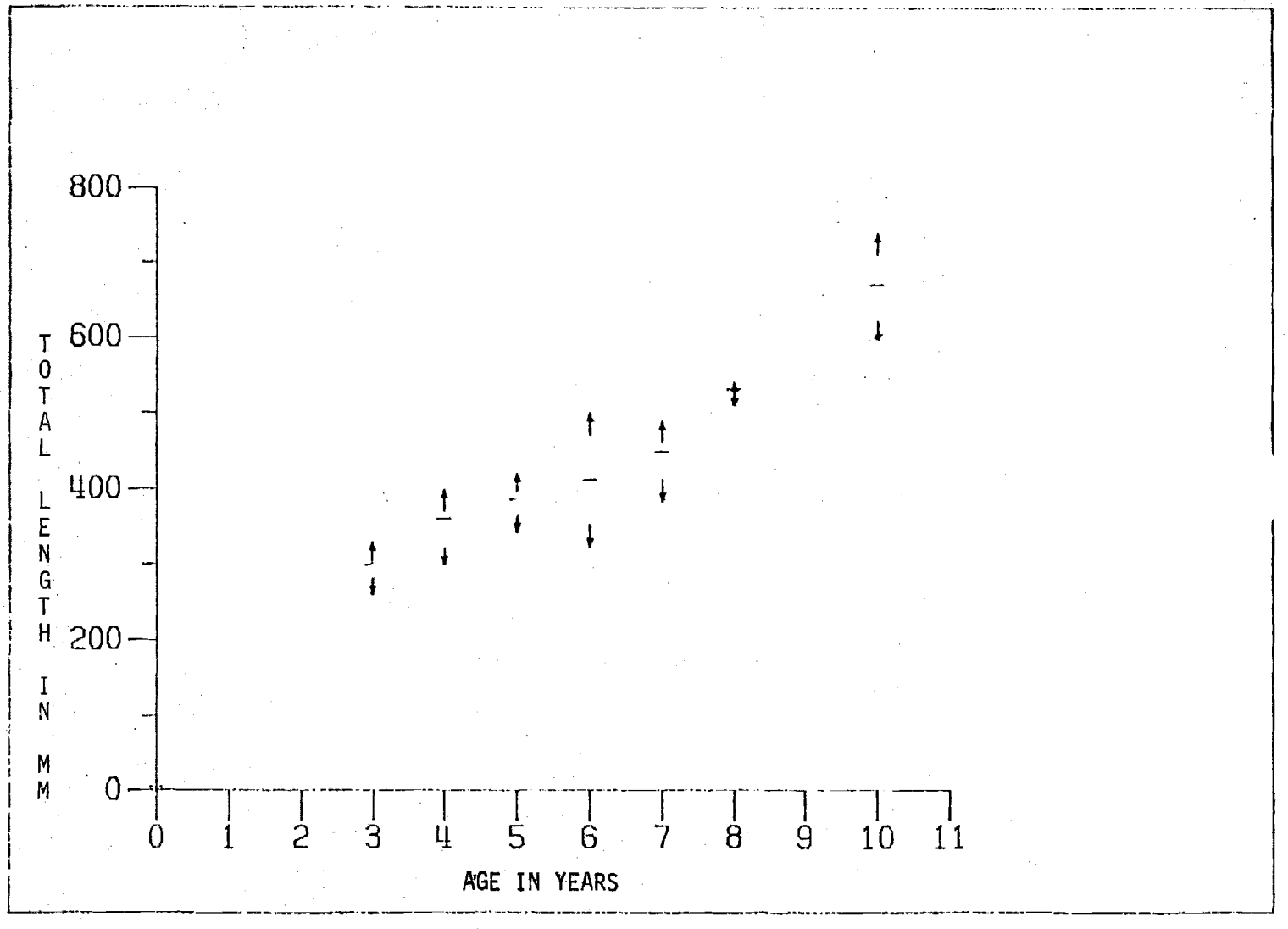

Figure E.3.2.2. Burbot age-length relationship, upper Susitna River, 1981.

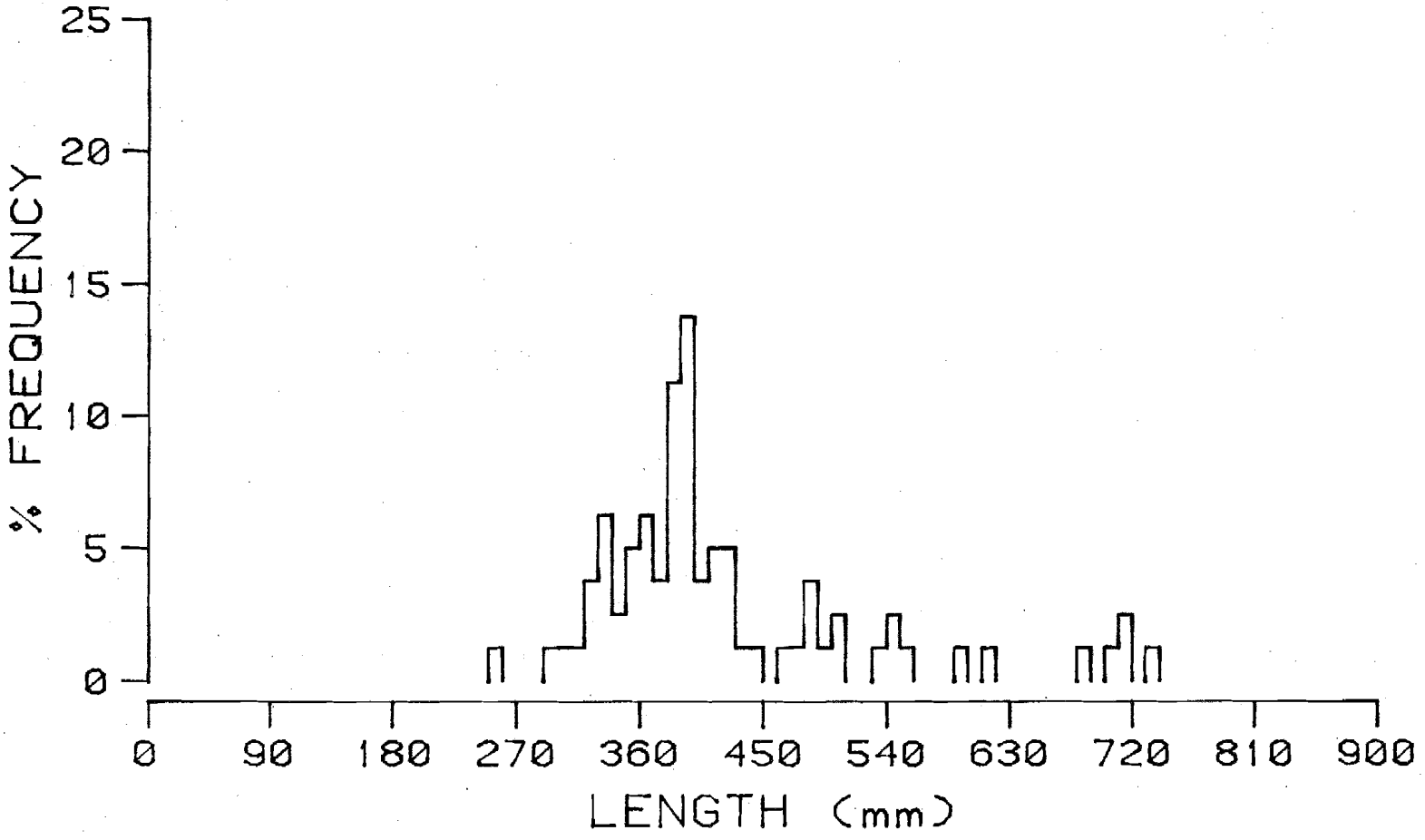

Figure E.3.2.3. Length frequency composition of burbot captured at habitat location sites on the upper Susitna River, May - September, 1981.

temperature regimes, this would put spawning time about mid to late March. All specimens captured during late May field work were spent or sexually immature. Observations by sport anglers for burbot in Paxson Lake are that both ripe and spent burbot have been taken in mid-March (Stratton, 1981 personal communication). On the basis of the foregoing it is likely that spawning for this species in the upper Susitna occurs during March. A burbot of 102 mm was taken from Jay Creek Slough on August 19.

3.2.4.3 Tagging and Recapture

A total of 23 burbot were tagged (Table E.3.2.4). To date no tagged burbot have been recovered.

Table E.3.2.4. Burbot tagged by month and tributary, upper Susitna River, May - September, 1981.

	May	June	July	Aug.	Sept.	Total
Fog	0	0	0	0	0	0
Tsusena	0	0	0	0	0	0
Deadman	0	0	0	0	0	0
Watana	2	0	3	4	1	10
Kosina	0	0	1	1	2	4
Jay	2	0	0	2	1	5
Goose	1	0	0	3	0	4
Oshetna	0	0	0	0	0	0
TOTAL	5	0	4	10	4	23

3.3 ROUND WHITEFISH

3.3.1 Abstract

Thirty-three adult round whitefish, Prosopium cylindraceum, were captured during 43 gillnet days fished at upper Susitna habitat locations. This species was captured from the Oshetna River, Jay, Kosina, Watana, and Tsusena creeks. Jay and Kosina creeks were the most productive with total catches of 13 and 9 respectively. Twenty-two whitefish were aged by scale analysis. Ages ranged from VI to VIII with age VII fish the most numerous. The fork length of age VI round whitefish averaged 323 mm (range 315-370 mm) age VII averaged 364 mm (range 340-440 mm) and age VIII averaged 414 mm (range 387-440 mm).

3.3.2 Introduction

Round whitefish, Prosopium cylindraceum Pallus, are distributed across all of the Arctic and Interior Alaska. Rivers of occurrence in southcentral Alaska include the Copper, Kenai and the Susitna. This species also occur in the large rivers draining into southeast Alaska from British Columbia. Round whitefish are abundant in clearwater streams with gravel-cobble substrate but the species is also found in large glacial rivers and lakes. Round whitefish prefer freshwater and are not normally found in an estuarine environment.

Round whitefish are identifiable by their round, cigar-shaped body and small mouth. Adults may reach a length of up to 20 inches and weigh up to four pounds. There are no obvious external differences between the sexes.

Spawning occurs in late September through October over gravel substrate in the shallows of rivers and the inshore areas of lakes (Furniss, 1974). For Alaskan round whitefish, consecutive year spawning appears to be the rule even in Arctic populations (McCart et al., 1972). Upstream migrations associated with spawning were also observed by McCart and are probably characteristic.

Alaskan subsistence fishermen harvest round whitefish with gill nets for human consumption and as dog food. Round whitefish also support limited hook and line and spear sport fisheries in the Tanana River drainage.

3.3.3 Methods

Round whitefish were collected from upper Susitna River habitat locations during May to September 1981 with variable mesh gill nets. Catches were limited to the area immediately up or downstream of the tributary confluence with the Susitna.

All fish captured were measured for fork length in millimeters (mm) and, where survival was likely, the fish were tagged with Floy anchor tags and released. Age determinations were made using scale analysis. Sex was determined by necropsy and by abdominal manipulation to obtain the discharge of eggs or milt.

3.3.4 Results and Discussion

3.3.4.1 Distribution and Relative Abundance

Round whitefish were captured at all habitat locations in the upper Susitna River except Fog, Deadman and Goose Creeks. Catches of round whitefish per gill net day fished by habitat location are given in Table E.3.3.1. Jay and Kosina Creeks were the most productive with total catches of 13 and 9 respectively. The percent incidence of round whitefish at habitat locations ranged from 33% in July to 75% in September (Figure E.3.3.1).

Forty-seven juvenile round whitefish (18-52 mm) were captured using seines and electroshockers at Jay Creek.

3.3.4.2 Age, Length and Sex Composition

Twenty-two upper Susitna River round whitefish from gill net catches were aged by scale analysis. Table E.3.3.2 illustrates that ages ranged from VI to VIII with age VII being encountered most frequently.

The fork length of age VI round whitefish averaged 323 mm (range 315-370 mm) age VII averaged 364 mm (range 340-440 mm) and age VIII averaged 414 mm (range 387-440 mm). Age VII fish dominated the sample.

All round whitefish captured were measured for fork length in millimeters. Lengths for adults ranged from 315 mm to 440 mm and the mean was 366 mm.

Table E.3.3.1. Round whitefish catch per gillnet day at habitat location sites, upper Susitna River, May to September, 1981.

Tributary	Number Caught	Gillnet Days	Catch per Gillnet Day
Fog Creek	0	4	0
Tsusena Creek	3	4	0.75
Deadman Creek	0	3	0
Watana Creek	5	6	0.83
Kosina Creek	9	8	1.13
Jay Creek[a]	13	8	1.63
Goose Creek	0	6	0
Oshetna River	3	4	0.75
Total	33	43	0.77

[a] A total of 47 juvenile round whitefish 18-52 mm were taken by seine and electroshocker.

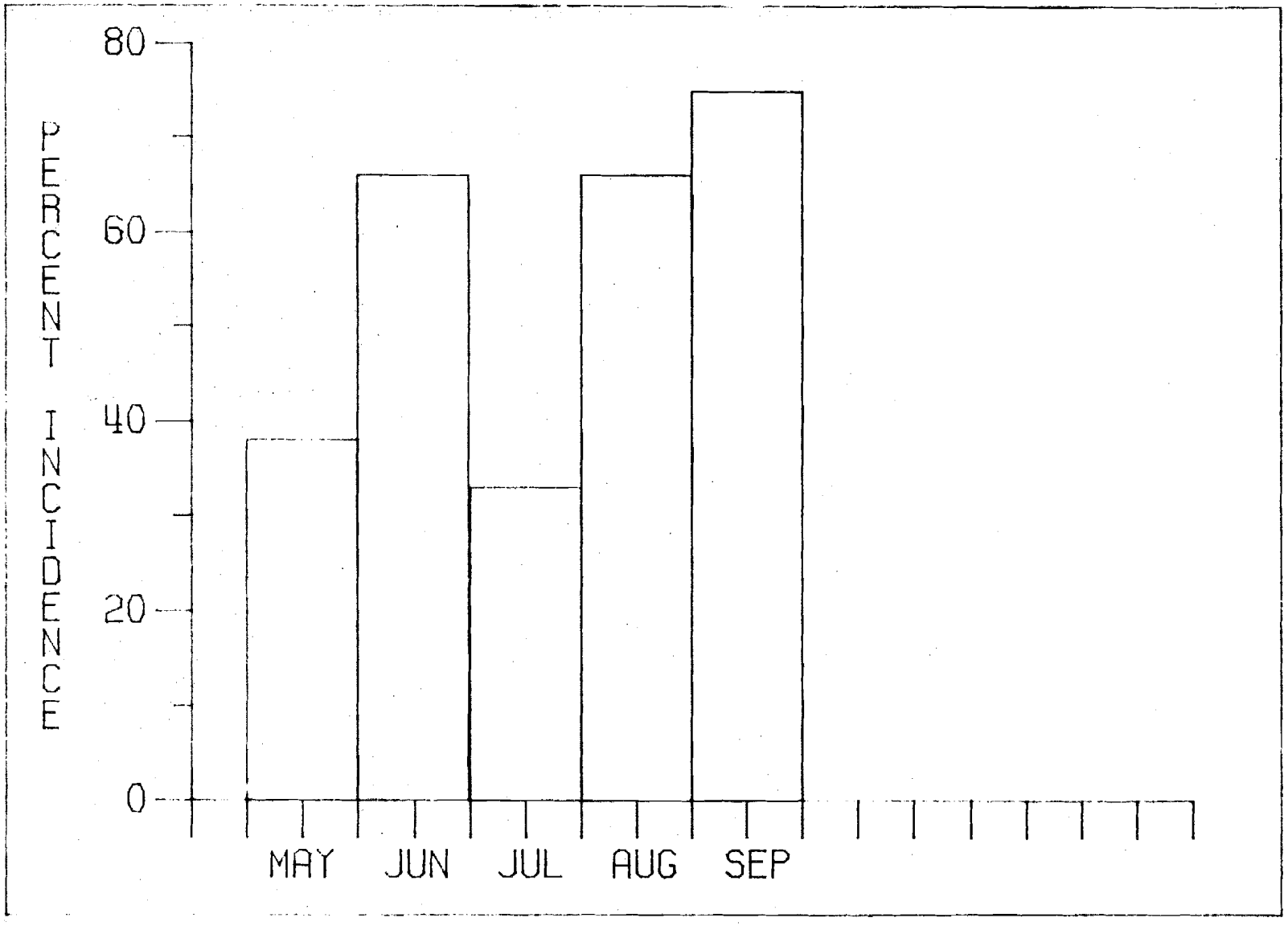

Figure E.3.3.1. Percent incidence of round whitefish at habitat locations, upper Susitna River, 1981.

Table E.3.3.2. Round whitefish, age-length-sex frequency composition at habitat location sites, upper Susitna River, May to September, 1981.

	Length			Sex		
Age	Total No. Fish Sampled	Mean Length (mm)	Range of Lengths	Male No	Female No	Total
1						
2						
3						
4						
5						
6	4	323	315-370	2	1	3
7	14	364	340-410	4	1	5
8	4	414	387-440	3		3
9						
10						
11						
	22	366	315-370	9	2	11

Eleven round whitefish examined for sex composition, 9 (82%) were male and 2 (18%) were female, for a male to female ratio of 4.5:1.

A total of 63 juvenile whitefish were taken during 1981 operations. Young of the year whitefish taken in June ranged from 18-37 mm, in July from 38-52 mm and in August from 49-77 mm.

3.3.4.3 Tagging and Recapture

A total of 17 round whitefish were tagged during May to September 1981 in the upper Susitna River (Table E.3.3.3). No recaptures have been recorded.

Table E.3.3.3. Round whitefish, summary of tagging data, upper Susitna River, May to September, 1981.

Tributary	May	June	July	Aug.	Sept.	Total
Fog	0	0	0	0	0	0
Tsusena	0	0	0	0	0	0
Deadman	0	0	0	0	0	0
Watana	0	0	0	0	2	2
Kosina	0	0	0	0	5	5
Jay	0	1	0	6	0	7
Goose	0	0	0	0	0	0
Oshetna	0	0	0	3	0	3
Total	0	1	0	9	7	17

3.4 LONGNOSE SUCKER

3.4.1 Abstract

One hundred forty-four adult longnose sucker, Catostomus catostomus, were captured during 43 gillnet days fished at upper Susitna habitat locations. This species was collected from the Oshetna River, Goose, Jay, Kosina, Watana, and Deadman creeks. Gillnet sets at Watana Creek mouth produced 52 percent of suckers caught.

Scales were removed and analyzed from 90 upper Susitna River longnose suckers. Age classes VII, VIII, and IX made up the majority of longnose suckers comprising 27%, 36%, and 20% respectively. Of the longnose suckers used for age determinations, Age VII suckers averaged 355 mm (range 325-405 mm) while Age VIII averaged 381 mm (range 340-430 mm) and Age IX averaged 405 mm (range 380-485 mm).

Ninety-seven longnose suckers were tagged. One tagged at the mouth of Watana Creek May 26 was recaptured at the same location on June 24.

3.4.2 Introduction

The longnose sucker, Catostomus catostomus Forster, is widely distributed from Alaska to Labrador and extends south into the Mississippi-Missouri River systems. It is ubiquitous throughout most of the drainages of mainland Alaska; it is not found on the islands along the Pacific, Bering and Arctic coasts (Morrow, 1980).

The longnose sucker is the only representative species of the sucker family found in Alaska. It can be easily distinguished from other Alaskan fishes by its ventrally located sucking mouth and large papillose lips. There are no obvious external differences between the sexes except during spawning periods when breeding males have well-developed tubercles on the head, anal and caudal fins, and are more vividly colored than the female. Sexual maturity occurs between the ages of V and VII. Spawning usually takes place in spring shortly after ice out in shallow gravel-bottomed portions of streams. Post spawning mortality of between 10-30 percent may occur. Many fish spawn consecutively for two or three years while others may skip years between spawning (Green, et al., 1966). The eggs hatch in about two weeks, depending on temperature, and the fry remain in the gravel an additional 1-2 weeks after hatching.

3.4.3 Results and Discussion

3.4.3.1 Distribution and Relative Abundance

Longnose suckers were found in all habitat locations except Fog and Tsusena creeks (Table E.3.4.1). All adult suckers were captured in gill nets set immediately upstream or downstream of the confluence of the tributary streams. A total of 144 suckers were captured during May-September. The mouth of Watana Creek produced consistent catches of suckers with a total of 75.

The percent incidence of longnose sucker at tributary habitat locations is shown in Figure E.3.4.1. For July all locations fished produced suckers

Table E.3.4.1. Longnose sucker catch per gill net day fished by tributary, 1981[a]

Tributary	No. Caught	Effort	Catch per Gillnet Day
Fog Creek	0	4	0
Tsusena Creek	0	4	0
Deadman Creek	3	3	1.0
Watana Creek	75	6	1.0
Kosina Creek	8	8	1.0
Jay Creek	28	8	3.5
Goose Creek	14	6	2.3
Oshetna River	16	4	4.0
Total	144	43	3.45

[a] A total of 24 juvenile longnose suckers 24-84 mm age I+ were captured by seine, electric shocker, and minnow trap.

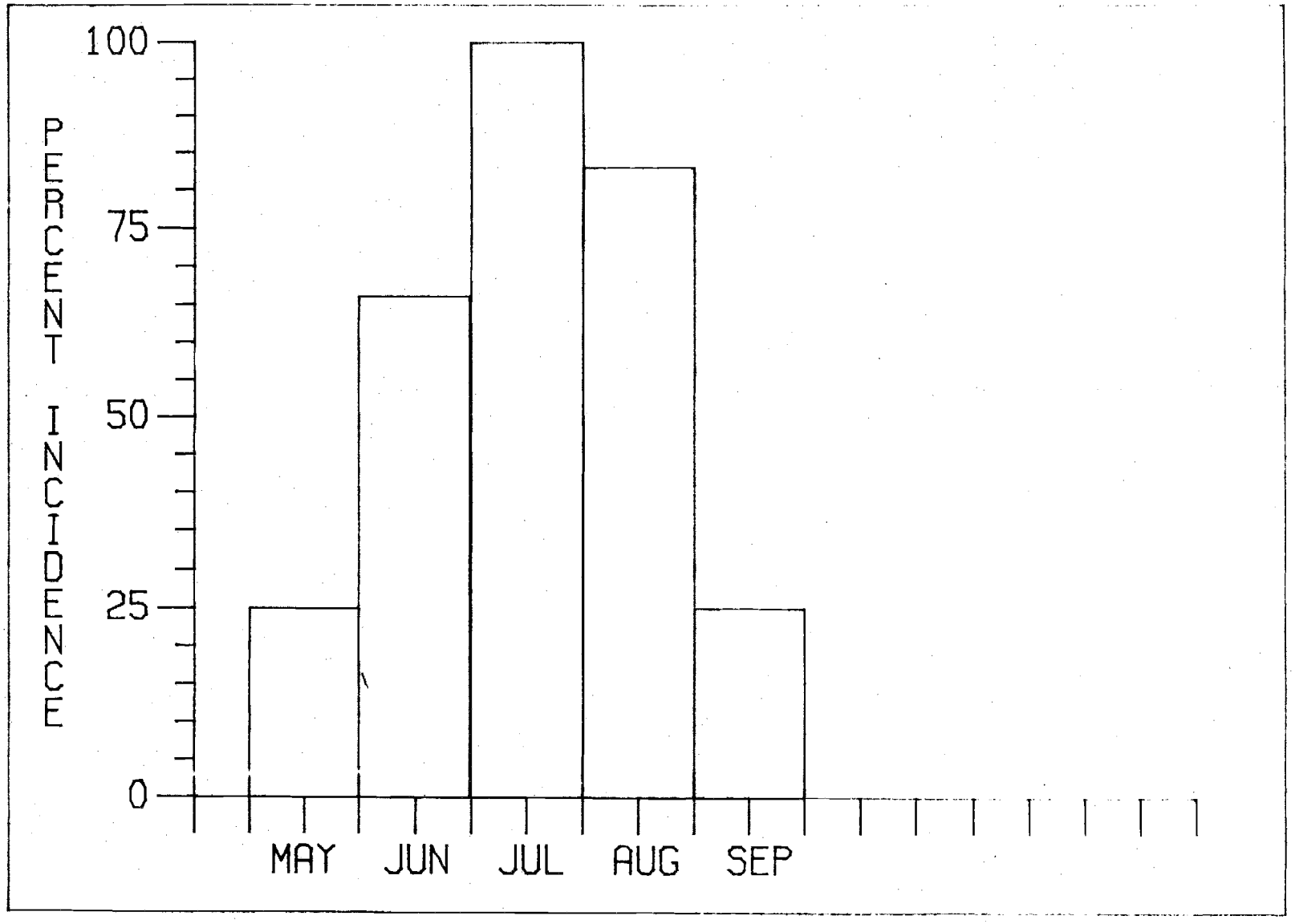

Figure E.3.4.1. Percent incidence of longnose sucker at habitat locations, upper Susitna River, May to September, 1981.

(Kosina and Fog were not fished). Twenty-five percent of habitat locations fished in May and in September produced this species.

Twenty-seven juvenile longnose suckers ranging from 28-105 mm were captured by seine, electroshocker, and minnow traps in sloughs and backwater areas of the Susitna River at Jay, Kosina, and Watana creeks.

3.4.3.2 Age, Length and Sex Composition

Scales were removed and analyzed from 90 upper Susitna River longnose suckers. Age classes VII, VIII, and IX made up the majority of longnose suckers comprising 27%, 36%, and 20% respectively.

Of the longnose suckers used for age determinations, Age VII suckers averaged 355 mm (range 325-405 mm) while Age VIII averaged 381 mm (range 340-430 mm) and Age IX averaged 405 mm (range 380-485 mm). Gill net captured longnose sucker lengths ranged from 320-505 mm with a mean of 384 mm (Table E.3.4.2).

Eight suckers were examined for sex composition. Three (38%) were males and 5 (62%) were females.

3.4.3.3 Tagging and Recapture

A total of 97 longnose suckers were tagged (Table E.3.4.3). One recapture of a tagged sucker occurred June 24 at the mouth of Watana Creek also its tagging location on May 26.

Table E.3.4.2. Longnose sucker, age-length-sex frequency composition at habitat location sites, upper Susitna River, May to September, 1981.

	Length			Sex		
Age	Total No. Fish Sampled	Mean Length (mm)	Range of Lengths	Male No	Female No	Total
1	1	105	105			
2						
3						
4						
5						
6	2	340	320-360			
7	24	355	325-405	1	3	4
8	32	381	340-430		1	1
9	18	405	380-485	2	1	3
10	8	440	405-475			
11	5	468	407-505			
	90	384	105-505	3	5	8

Table E.3.4.3. Longnose Sucker tagged by month and tributary, upper Susitna River, May to September, 1981.

Tributary	May	June	July	Aug.	Sept.	Total
Fog	0	0	0	0	0	0
Tsusena	0	0	0	0	0	0
Deadman	0	0	3	0	0	3
Watana	13	25	0	4	1	43
Kosina	0	0	0	1	0	1
Jay	0	7	1	17	0	25
Goose	0	9	0	3	0	3
Oshetna	0	0	1	12	0	13
Total	13	41	5	37	1	97

3.5 COTTIDS

3.5.1 Abstract

Slimy sculpins, Cottus cognatus, were collected at seven of eight habitat locations in the upper Susitna River. A total of 38 cottids were captured giving an overall catch per minnow trap day of 0.11. Oshetna River, Fog, and Tsusena Creek showed the highest catch per unit of effort of 0.20, 0.22, and 0.23 respectively. The length range for the season catch was 37-95 mm.

3.5.2 Introduction

The slimy sculpin, Cottus cognatus Richardson, ranges over all of Alaska, most of Canada, and is found as far south as Virginia. It also extends to the extreme northeast of Siberia (Scott and Crossman, 1978).

Slimy sculpin are a small bottom-dwelling fish. They are tadpole shaped with a rounded caudal fin, and they very in color from solid brown to a mottled gray-green (Morrow, 1980). Two distinguishing species characteristics are double chinpores and a short lateral line ending midway under the second dorsal fin.

Slimy sculpin mature between Age II and IV and can live to Age VII (Craig and Wells, 1976). Spawning occurs in spring at breakup. The male picks the nest site which is usually in shallow water with a sandy substrate. The female lays an average of 150 to 600 eggs. More than one female may lay her eggs in

a nest but only one male will fertilize the eggs (Koster 1936; Van Vliet, 1964). Incubation time requires about 30 days.

Sculpin feed mostly on insect larvae, nymphs, and fish larvae. The sculpin may serve as a forage species for lake trout, burbot and grayling (Morrow, 1980).

3.5.3 Methods

Cottids were collected in the upper Susitna River with baited minnow traps. All cottids captured were measured for total length in millimeters (mm).

3.5.4 Results and Discussion

3.5.4.1 Distribution and Relative Abundance

Thirty-eight cottids were taken during 352 minnow trap days from upper Susitna River habitat locations and selected fish habitat sites (Table E.3.5.1). The catch rate during May to September, 1981 for habitat locations was 0.11/trap day. The high cottid catches were recorded for Fog Creek, Tsusena Creek and the Oshetna River with total catches of 8, 9 and 10 respectively. Tsusena Creek had the highest catch rate at 0.23, while no cottids were captured at Jay Creek during this study. Sally Lake, a selected fish habitat site, was minnow trapped only during May resulting in 4 cottids collected.

Table E.3.5.1. Cottid catch per minnow trap day at fish habitat location sites on the upper Susitna River, May to September, 1981.

Habitat Location Site	No. Caught	Minnow Trap Days	Catch/ Trap Day
Fog Creek	8	36	0.22
Tsusena Creek	9	40	0.23
Deadman Creek	2	29	0.07
Watana Creek	6	45	0.13
Kosina Creek	1	50	0.02
Jay Creek	0	50	0
Goose Creek	2	50	0.04
Oshetna River	10	50	0.20
Sally Lake	4	2	2.0
Total[a]	38	350	0.11

[a] Total does not include Sally Lake.

3.5.4.2 Age, Length, and Sex Composition

Thirty-eight cottids were measured for total lengths. Lengths ranged from 37-95 mm. No data for age determination or sex composition was recorded.

3.6 LAKE TROUT

3.6.1 Abstract

Lake trout, Salvelinus namaycush were taken from Sally and Deadman Lakes. Seventeen days of gillnet effort in Sally Lake produced 30 lake trout. Limited hook and line sampling in Sally and Deadman lakes produced 2 and 3 trout respectively. Fork lengths of lake trout captured ranged from 305 to 505 mm. No lake trout were captured from the Susitna River or from the eight tributary stream habitat locations.

3.6.2 Introduction

The lake trout, Salvelinus namaycush, is also known as lake char, grey trout, and togue. Distribution ranges from the Alaska Peninsula east to Nova Scotia, south to New York, Pennsylvania, and the Great Lakes, and north to the islands of the Canadian arctic (Morrow, 1980). It almost always inhabits deep, clear lakes, although stream-dwelling populations sometimes occur where the rivers are connected to lakes; the latter situation is most common in Labrador, northern Quebec, and Alaska. There is considerable variation in color for this species, but the body is generally blue-gray or bronze-green, with pale spots on sides and back and with pale spots on the dorsal, adipose, and caudal fins (McLain, 1965).

Spawning occurs in the fall from early August to December. Virtually all lake trout spawn in lakes over clean, rocky bottoms at depths of five feet or less.

Sexual maturity usually occurs between age V and VII. Young emerge between early February and late March usually preceding breakup. Studies of Alaskan lake trout have been conducted by Roguski and Spetz, 1968, Van Wyhe and Pelk, 1969, and Furniss, 1974. The Alaska state record lake trout came from Clarence Lake in the Kosina Creek drainage and weighed 44 pounds.

3.6.3 Results and Discussion

3.6.3.1 Distribution and Relative Abundance

Lake trout were found in Sally Lake and Deadman Lake, two selected fish habitat sites in the upper Susitna River basin. Of these two sites, only Sally Lake will be inundated by the proposed Watana Dam. Sally Lake sampling was by gillnet and hook and line fished at various depths of up to 40 feet. All lake trout caught were within 100 feet of the shoreline in less than 6 feet of water. A total of 32 trout were captured in this lake, thirty were captured by gillnet and 2 by hook and line. Three Deadman Lake trout were captured all by hook and line. Catch per rod and reel hour was highest in Deadman Lake where it ran 0.75/hour (Table E.3.6.1). A limited sport fishery exists on Deadman and Sally Lakes for lake trout and grayling.

3.6.3.2 Age, Length and Sex Composition

Scales were taken from 19 lake trout collected in Sally Lake. Only seven scales were readable, and all of these were Age V.

Table E.3.6.1. Lake trout catch and effort, upper Susitna River basin lakes May to September, 1981.

Sally Lake
May - September 1981

Gear	No. Caught	Effort	Catch / Unit effort	No. Tagged
Gill Net	30	17 Days	1.74/Day	10
Rod & Reel	2	12 Hours	0.17/Hour	2
TOTAL	32			12

Deadman Lake
September 1981

Gear	No. Caught	Effort	Catch / Unit effort	No. Tagged
Rod & Reel	3	4 Hours	0.75/Hour	0

Lengths were recorded from 32 Sally Lake lake trout. Lengths ranged from 305 to 508 mm and the mean was 410 mm.

Sixteen lake trout were examined for sex composition. Equal numbers (8) of each sex were found.

During mid-August, both prespawning and post spawning lake trout were captured in Sally Lake.

3.6.3.3 Tagging and Recapture

A total of twelve lake trout were tagged at Sally lake. No recaptures have been recorded.

3.7 MISCELLANEOUS SPECIES

During the course of 1981 field studies, a single specimen each of humpback whitefish and Dolly Varden was captured. The life history and background for these species has been presented in the RJ report submitted on the lower Susitna River and will not be reviewed in detail here.

The humpback whitefish taken was a male 347 mm fork length taken at the mouth of Kosina Creek on September 24. This whitefish has been documented by Fish and Game personnel to occur in lakes Susitna and Louise.

The single Dolly Varden was taken at the mouth of Fog Creek August 25. This fish was a male, 235 mm in fork length. The only prior known occurrence of this species in the upper Susitna system was from Lake Louise.

No juvenile or adult salmon were captured or observed in the upper River during 1981 field operations. It is believed that effort exerted was adequate to detect salmon species if present in any numbers. A total of 348 minnow trap days were fished in possible juvenile salmon habitat. Electrofishing and seine hauls were also carried out in prime habitat. Most of the 22.5 miles of clearwater tributary to be impounded were surveyed by foot and from helicopters monthly.

4. RECOMMENDATIONS

During 1981 operations, gillnets, minnow traps and seines produced minimal catches considering man hours expended in their use. The torrential water and boulder strewn channels of the tributary streams minimized the successful utilization of seines and gillnets. Minnow trap production was largely limited to sculpin, and their use confirmed the absence of juvenile salmon species. It is recommended that the general use of this gear should be discontinued in future main river and tributary studies.

Operations in 1982 should be planned to emphasize the recovery of grayling tagged in 1981. Sampling will be largely by hook and line. Further testing of portable electroshocking units in select habitat sites is recommended. It would be desirable to use an electroshocking equipped boat to sample at tributary mouths, side sloughs and channels, and main river habitat locations below Vee Canyon.

Investigations should endeavor to reach key streams prior to and immediately following ice-out to determine timing and location of spawning. Such determination will be accomplished largely by catching spawning specimens with rod and reel.

The upper reaches of streams and lakes into which grayling now move seasonally and will move following impoundment should be investigated by helicopter. Specimens caught should be tagged to evaluate interchange with lower reaches of tributaries and the mainstem Susitna River.

It may be desirable to initiate a population study of lake trout in Sally lake. Trout could be captured for tagging through the use of Fyke type nets. Subsequently recovery would give an indication of population numbers.

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Appendix Table EA-1. Arctic grayling fork length comparisons by tributary for May, 1981 (95% C.I.)

Tributaries	Number of Observations	Mean	L.L.	U.L.	Median
Oshetna	19	319	302	335	325
Goose	107	297	288	306	290
Jay	88	343	336	349	340
Kosina	97	309	301	316	310
Watana	3	278	-----	-----	250
Deadman	51	301	289	311	300
Tsusena	34	334	324	344	331
Fog	30	319	308	330	323
Combined	429	315	311	319	320

Kruskal-Wallis Test

H_0: All medians the same

H_1: At least one median different

Test statistic = H_c = 81.140

Critical table value = $X^2.025,7$ = 16.013

Reject H_0

Appendix Table EA-2. Arctic grayling fork length comparisons by tributary for June, 1981 (95% C.I.)

Tributaries	Number of Observations	Mean	L.L.	U.L.	Median
Oshetna	85	301	293	309	295
Goose	144	296	289	302	300
Jay	179	294	286	303	300
Kosina	246	305	299	311	310
Watana	48	303	290	316	310
Deadman	71	283	274	293	290
Tsusena	72	341	333	349	345
Fog	17	325	309	340	320
Combined	862	302	299	306	305

Kruskal-Wallis Test

H_0: All medians the same

H_1: At least one median different

Test statistic = H_c = 84.599

Critical table value = $X^2.025,7$ = 16.013

Reject H_0

Appendix Table EA-3. Arctic grayling fork length comparisons by tributary for July, 1981 (95% C.I.)

Tributaries	Number of Observations	Mean	L.L.	U.L.	Median
Oshetna	150	295	289	302	299
Goose	81	294	285	304	300
Jay	67	287	276	299	290
Kosina	130	290	283	298	295
Watana	14	302	281	323	298
Deadman	38	287	272	303	293
Tsusena	125	325	317	332	325
Fog	33	303	289	316	305
Combined	638	299	296	303	300

Kruskal-Wallis Test

H_0: All medians the same

H_1: At least one median different

Test statistic = H_c = 58.610

Critical table value = $X^2.025,7$ = 16.013

Reject H_0

Appendix Table EA-4. Arctic grayling fork length comparisons by tributary for August, 1981 (95% C.I.)

Tributaries	Number of Observations	Mean	L.L.	U.L.	Median
Oshetna	73	301	292	311	300
Goose	40	307	299	315	305
Jay	19	314	298	329	315
Kosina	72	314	293	311	305
Watana	15	340	290	339	323
Deadman	6	245	-----	-----	233
Tsusena	50	330	321	338	325
Fog	4	276	-----	-----	315
Combined	279	307	303	312	315

Kruskal-Wallis Test

H_0: All medians the same

H_1: At least one median different

Test statistic = H_c = 35.253

Critical table value = $X^2.025,7$ = 16.013

Reject H_0

Appendix Table EA-5. Arctic grayling fork length compraisons by tributary for September, 1981

Tributaries	Number of Observations	Mean	L.L.	U.L.	Median
Oshetna	161	331	327	335	330
Goose	15	306	277	335	318
Jay	69	301	292	308	300
Kosina	176	327	324	331	325
Watana	19	350	338	362	355
Deadman	7	317	-----	-----	315
Tsusena	8	356	-----	-----	355
Fog	5	355	-----	-----	352
Combined	460	325	323	328	325

Kruskal-Wallis Test

H_0: All medians the same

H_1: At least one median different

Test statistic = H_c = 83.1920

Critical table value = $X^2.025,7$ = 16.013

Reject H_0

Appendix Table EA-6. Juvenile fish species captured by date, location, and size groupings, upper Susitna River, 1981.

Date	Location Captured	Number Captured	Length Size Range
	ARCTIC GRAYLING		
5/23	Goose Creek; shallow side channel 3 miles upstream from mouth	2	54-115
6/17	Oshetna River	1	64
6/22	Susitna River 1/2 mile below confluence with Jay Creek	5	20-22
6/24	Kosina Creek	3	75-95
7/18	Jay Creek lower mile	1	37
7/19	Susitna River Slough upstream of confluence with Jay Creek	9 3 1	24-48 84-95 114
7/25	Tsusena Creek	1	51
8/19	Jay Creek Slough	2 1	47-68 125
8/24	Fog Creek habitat location 2	21	50-150
9/25	Watana Pond	10 1	47-60 100
	BURBOT		
6/20	Jay Creek Lower	1	15
8/19	Jay Creek Slough	1	102
	ROUND WHITEFISH		
6/22	Susitna River 1/2 mile below Jay Creek	16	18-31
6/25	Watana Creek Mouth	20	27-32 fl
7/18	Jay Creek lower one mile	1	45
7/19	Slough above Jay Creek	10	38-52

[a] Length measurement in mm for total length unless stated otherwise.

Appendix Table EA-6. (Continued)

Date	Location Captured	Number Capture	Size Range
8/19	Jay Creek Slough	4	120-150
8/24	Fog Creek habitat location site 2	3	49-77
9/25	Watana Pond	8	52-68
	LONGNOSE SUCKER		
6/22	Jay Creek isolated pool, north bank	15 4	35-55 60-84
6/24	Kosina Creek	1	28
6/25	Watana Pond	7	35-80
	SLIMY SCULPIN		
6/22	Jay Creek isolated pool north bank	2	30-46

a Length in millimeters for total length unless stated otherwise.

Appendix Table EA-7. Model of Upper Susitna River population estimation for Arctic Grayling.

Schnabel method for Multiple Census

M_t the total marked fish at large at the start of the th day (or other interval), i.e., the number previously marked less any accidentally killed at previous recaptures.

M ΣM_t, the total number marked.

C_t the total sample taken on day t.

R_t the number of recaptures in the sample C_t.

R ΣR_t, the total recaptures during the experiment.

N the population present throughout the experiment.

Population estimation $\hat{N} = \frac{\Sigma[C_t M_t]}{\Sigma R_t} = \frac{\Sigma[C_t M_t]}{R}$

Confidence limits $V(1/\hat{N}) = \frac{\Sigma R_t}{[\Sigma(C_t M_t)]^2}$

$$\frac{1}{\hat{N}} - 1.96 \sqrt{V(1/\hat{N})} \leq \frac{1}{N} \leq \frac{1}{\hat{N}} + 1.96 \sqrt{V(1/\hat{N})}$$

df = 4

Appendix Table EA-8. Arctic grayling within tributary recaptures by tributary of tagging and month of recapture, upper Susitna River, June to September, 1981.

TRIBUTARY	MONTH				TOTAL
	JUNE	JULY	AUGUST	SEPTEMBER	
Fog	4	7	3	0	14
Tsusena	3	12	15	2	32
Deadman	4	3	2	0	9
Watana	0	0	0	2	2
Kosina	17	13	15	20	65
Jay	9	19	15	16	59
Goose	10	12	17	2	41
Oshetna	0	18	14	5	37
Total	47	84	81	47	259