

STATE OF ALASKA

*William A. Egan, Governor*

Annual Progress Report for

MONITORING AND EVALUATION OF ARCTIC WATERS  
WITH EMPHASIS ON THE NORTH SLOPE DRAINAGES

*by*

*Eugene A. Roguski, Edwin Komarek, Jr., and*

*Dennis R. Kogl*

ALASKA DEPARTMENT OF FISH AND GAME

*Wallace H. Noerenberg, Commissioner*

DIVISION OF SPORT FISH

*Rupert E. Andrews, Director*

*Howard E. Metsker, Coordinator*

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100

ANNUAL REPORT OF PROGRESS

TABLE OF CONTENTS

	<u>Title</u>	<u>Page No.</u>
Job G-III-A	Monitoring and Evaluation of Arctic Waters With Emphasis on the North Slope Drainages: Arctic Wildlife Range Study. Eugene A. Roguski and Edwin Komarek, Jr.	1
	Monitoring and Evaluation of Arctic Waters With Emphasis on the North Slope Drainages: Colville River Study. Dennis R. Kogl.	23



RESEARCH PROJECT SEGMENT

*State:* Alaska

*Project No.:* F-9-3

*Name:* Sport Fish Investigations of Alaska.

*Study No.:* G-111

*Study Title:* Lake and Stream Investigations.

*Job No.:* G-111-A

*Job Title:* Monitoring and Evaluation of Arctic Waters with Emphasis on the North Slope Drainages: Arctic Wildlife Range Study.

*Period Covered:* July 1, 1970 to June 30, 1971.

ABSTRACT

As part of the Sport Fish Division's program to inventory and monitor Arctic waters, a cooperative project was initiated with the Bureau of Sport Fisheries and Wildlife to study the waters and fishes of the Arctic National Wildlife Range.

Studies during 1970 were limited to river mouths and lagoons along the Beaufort Sea coast. Observations were made on ice conditions, water depths, bottom types, currents, and salinities.

Arctic char, Salvelinus alpinus, and Arctic cisco, Coregonus autumnalis, were captured along the entire coast, and grayling, Thymallus arcticus, were found in lagoons having low salinity.

Data is presented on age and growth, length frequency, sexual maturity, and distribution of these and species of lesser importance in the study area.

## INTRODUCTION

A study of the fishes and waters of the Arctic National Wildlife Range was initiated in the summer, 1970, as part of the Monitoring and Evaluation Study of Arctic Waters conducted by the Division of Sport Fish, Alaska Department of Fish and Game. The Bureau of Sport Fisheries and Wildlife, administrators of the Wildlife Range, cooperated on the study and furnished transportation, housing, and logistic support.

The Arctic National Wildlife Range, in extreme northeast Alaska, has the Beaufort Sea coast as a northern boundary, and extends from the Canadian border westward to the Canning River, a straight-line distance of approximately 125 miles. The Range is drained by 10 major rivers flowing northward from the Brooks Range and numerous smaller streams draining the Arctic Slope and tundra.

Much of the coastline has low reefs and offshore islands that serve to keep the fresh water of the rivers from mixing rapidly with ocean water, and also to hold back the ice pack from the sea coast. Thus, the lagoons extending along much of the coast are not only largely ice free in summer, but also have salinities ranging from nearly fresh to only somewhat brackish.

## RECOMMENDATIONS

It is recommended that further surveys of the Arctic National Wildlife Range waters be conducted as soon as practicable with emphasis on the following:

1. surveys of the major streams and representative minor streams, including attempts to locate overwintering areas of char and grayling.
2. surveys of the major lakes and determination of possible anadromous char in Schrader and Peters lakes.
3. surveys of the lakes near the coast, with emphasis on lakes connected to the Canning River reported to contain whitefish populations.
4. tagging char near reefs and islands to determine their movements.

## OBJECTIVES

This study is part of a continuing Monitoring and Evaluation Study of Arctic Waters conducted by the Division of Sport Fish, Alaska Department of Fish and Game.

The objective of this phase of the overall Arctic study is assessment of environmental characteristics and fish species of waters in the Arctic National Wildlife Range for future comparisons of ecological changes due to oil development.

## TECHNIQUES USED

Fish were captured with dip net, hook and line, and gill nets of standard construction, or monofilament, 125' x 6', with five graduated mesh sizes ranging from 1/2-inch to 2 1/2-inch bar measure.

Fork length of fish was measured to the nearest millimeter. Male Arctic char exhibiting considerable kype development were measured from the upper jaw to the fork of the tail.

Age determinations were made from scale samples or otoliths. Scales were either impressed on cellulose acetate with an Ann Arbor roller press, or mounted between glass slides prior to reading. A Bausch and Lomb micro-projector was used for scale reading. Arctic char were aged using otoliths. The methods were similar to those described by Helser (1966), except xylene rather than water and household detergent was used to immerse the otoliths while they were being read. Fish that had not laid down a first annulus were termed age 0.

All sex and maturity determinations were made from examination of gonads. Fish containing gonads approaching sexual maturity were termed "potential spawners". Fish not in spawning condition were termed either "immature", "mature non-spawners", or as "having some development", according to gonad appearance.

Meristic counts made on Arctic char follow Hubbs and Lagler (1958).

Water salinities were measured by hydrometer and were standardized to 15°C.

Surveys were usually conducted using an outboard-powered sport canoe for transportation. A float plane was used to reach some of the more westerly locations.

## FINDINGS

### Rivermouth and Coastal Surveys

During 1970, all surveys were confined to the coastal areas and were conducted along the entire coast from the Canadian border westward to the Canning River. A base camp was maintained at Nuvagapak Point, Beaufort Lagoon.

TABLE 1 Fish Sampling, Beaufort Sea Coast - Arctic Wildlife Range, 1970.

Name*	Date	Species	No.	Length Range (mm)	Mean Length (mm)	Net** Hrs.
1. Pingokraluk Point Reef (inside)	7/ 8	AC	10	275 - 550	412	12
		ACI	24	355 - 445	396	
		GR	14	300 - 375	344	
		AF	15	185 - 260	228	
		FSC	12	180 - 310	250	
2. Raluk Reef (inside)	7/ 7	AC	2	365 - 387	---	17
		ACI	14	370 - 410	392	
		GR	5	345 - 380	358	
		AF	10	250 - 280	262	
		FSC	6	190 - 260	224	
3. Kongakut River (inside reef)	7/ 8	AC	9	370 - 545	419	46
		ACI	9	370 - 420	390	
		FSC	3	210 - 275	249	
4. Siku River at Siku Point (inside)	7/ 6	AC	13	265 - 475	389	46
		GR	87	225 - 385	340	
5. Egaksrak River mouth	6/26	AC	3	190 - 210	197	37
	6/27 7/ 3	GR	11	290 - 380	345	
		GR	7	245 - 370	293	
		GR	31	245 - 410	329	
6. Aichilik River mouth	6/20	AC	1	425	---	25
	6/21	AC	1	410	---	
	6/25	GR	2	340 - 345	343	30
		AC	3	125 - 150	133	
		GR	5	265 - 380	318	
		FSC	5	110 - 180	142	

TABLE 1 (Cont.) Fish Sampling, Beaufort Sea Coast - Arctic Wildlife Range, 1970.

<u>Name*</u>	<u>Date</u>	<u>Species</u>	<u>No.</u>	<u>Length Range (mm)</u>	<u>Mean Length (mm)</u>	<u>Net** Hrs.</u>
Aichilik River mouth (Cont.)	8/25	AC	3	208 - 268	247	36
	9/ 4	AC	29	---	---	89
		ACi	19	---	---	
		FSC	4	---	---	
7. Kogotpak River mouth	6/19	AC	1	506	---	70 (50' net)
		FSC	1	190	---	
	7/ 1	AC	17	340 - 458	404	Angling
	7/ 2	AC	11	368 - 540	457	Angling
8. Nuvagapak Point Reef (inside)	7/23	AC	5	322 - 528	374	15
		ACi	12	352 - 406	379	
9. Nuvagapak Point	8/20	AC	3	365 - 500	427	20
		ACi	30	115 - 420	372	
	9/ 7	AC	4	---	---	48
		ACi	9	---	---	
		FSC	2	---	---	
10. Small Creek and Lake at Nuvagapak Point	6/29	SB	9	55 - 69	62	Dip net
		FSC	45	11 - 42	20	
11. Unnamed creek one mile west of Nuvagapak Point	6/30	SB	12	48 - 70	58	Dip net
		FSC	1	52	---	
12. Angun Point	7/23	ACi	9	355 - 407	380	16
13. Reef at Angun Lagoon	7/24	AC	12	265 - 475	389	48
		ACi	16	361 - 411	383	

TABLE I (Cont.) Fish Sampling, Beaufort Sea Coast - Arctic Wildlife Range, 1970.

<u>Name*</u>	<u>Date</u>	<u>Species</u>	<u>No.</u>	<u>Length Range</u> (mm)	<u>Mean Length</u> (mm)	<u>Net**</u> <u>Hrs.</u>
14. Pokok Bay (west side)	7/25	AC ACi	5 3	336 - 437 376 - 396	381 385	25
15. Pokok Bay Reef (outside)	7/25	AC ACi	3 10	369 - 440 363 - 420	414 391	32 (50' net)
16. Oruktalik Lagoon (inside reef)	7/25	AC ACi	2 1	404 - 427 364	416 ---	24
17. Jago Spit (inside)	7/26	AC ACi	3 9	330 - 365 340 - 418	351 381	23
18. Barter Island (Float Plane Cove)	7/21	AC FSc FSc FSc	3 31 10 21	276 - 369 154 - 203 --- 18 - 40	325 --- --- 24	4.5 (15' net)  Angling Dip net
19. Anderson Point (outside)	7/29	AC ACi FSc	10 9 3	348 - 487 370 - 416 202 - 230	418 399 212	59
20. Simpson Cove (east side)	7/27	AC ACi	2 1	405 - 432 409	419 ---	20
21. Camden Bay (west end)	7/29	AC ACi FSc	2 6 59	325 - 355 375 - 405 150 - 252	340 386 190	70

TABLE 1 (Cont.) Fish Sampling, Beaufort Sea Coast - Arctic Wildlife Range, 1970.

<u>Name*</u>	<u>Date</u>	<u>Species</u>	<u>No.</u>	<u>Length Range</u> (mm)	<u>Mean Length</u> (mm)	<u>Net**</u> <u>Hrs.</u>
22. Konganevik Point	7/29	AC	21	174 - 511	368	7
		ACi	7	352 - 421	380	
		FSc	7	99 - 195	146	
23. Brownlow Reef (one mile east of Point, on inside)	7/29	AC	22	351 - 463	398	4
		ACi	9	370 - 415	394	
		FSc	1	175	---	
24. Brownlow Point (outside)	7/29	AC	6	326 - 480	430	3 (50' net)
		FSc	1	165	---	

\*Numbers correspond to locations in Figure 1.

\*\*Based on one, 125' net, or equivalent in multiple net sets.

AC - Arctic char  
ACi - Arctic cisco

AF - Arctic flounder  
FSc - Fourhorn sculpin

GR - Arctic grayling  
SB - Stickleback

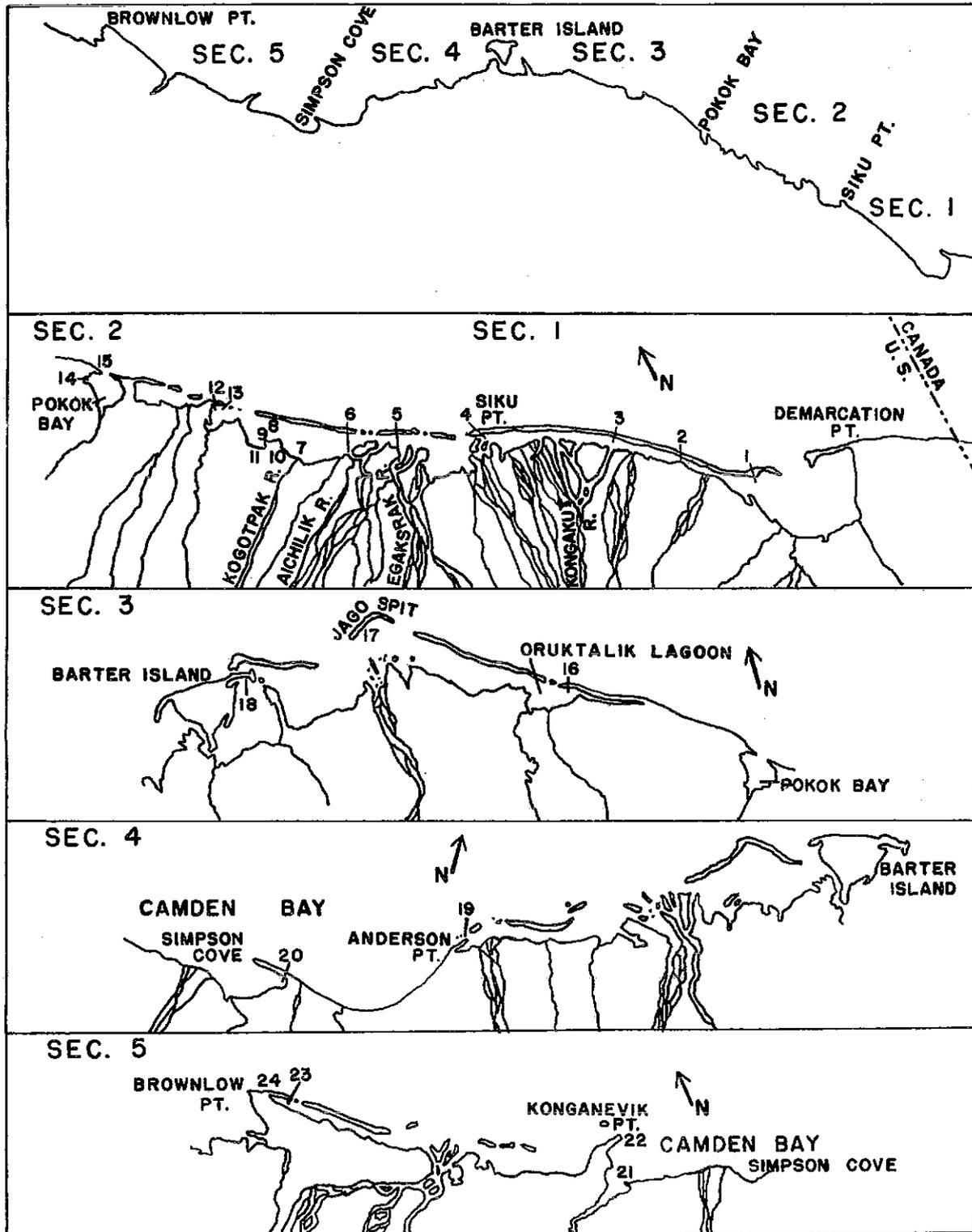


FIGURE 1 FISH SAMPLING LOCATIONS ON ARCTIC WILDLIFE RANGE COAST, 1970. LOCATION NUMBERS CORRESPOND TO TABLE 1.

Table 1 lists the locations, species, and numbers of fish captured during these surveys. Approximate locations of net sets are depicted in Figure 1.

Although stream surveys were not conducted in 1970 due to time and transportation limitations, it was noted that streams originating from the tundra and foothills had clear water and gravel bottoms, while major rivers draining the Brooks Range were laden with glacial silt, had silt bottoms, and were extensively braided.

Salinity measurements were made along the coast as listed in Table 2. Correlation between salinity and fish species captured is also defined in this table.

TABLE 2 Salinity, Beaufort Sea Coast - Arctic Wildlife Range, 1970.

<u>Location</u>	<u>Salinity (ppt)</u>	<u>Date</u>	<u>Species Captured</u>
Raluk VABM in Pingokraluk Lagoon*	1.0	7/ 6	AC, ACi, GR, AF, FSc
Inside Siku Point Reef*	1.0	7/ 6	AC, GR
Near Kogotpak River mouth	3.0	7/22	AC, FSc
Point one mile east of Nuvagapak Point	3.0	7/22	
Nuvagapak Point	2.0	7/23	
Nuvagapak Point*	22.0	8/20	AC, ACi
Nuvagapak Point	19.0	8/28	
Inside of Reef at Nuvagapak Point*	1.0	7/22	AC, ACi
Inside of Reef at Nuvagapak Point	26.0	8/21	
Outside of Reef at Nuvagapak Point	1.0	7/22	
Outside of Reef at Nuvagapak Point	29.0	8/21	
Middle of bay between Nuvagapak Point and Reef	2.0	7/22	
One mile outside of Reef at Nuvagapak Point	2.0	7/22	
West tip of Reef at Nuvagapak Point	1.0	7/22	
Inside east end of Angun Point	2.0	7/22	
Off tip of Angun Point*	3.0	7/23	ACi
3/4 mile outside Angun Point	2.0	7/23	
Inside of west point at Pokok Bay*	4.0	7/24	AC, ACi
Outside of west point at Pokok Bay*	3.0	7/24	AC, ACi
1/4 mile outside Oruktalik Entrance	5.0	7/24	
Outside of reef one mile east of Tapkaurak Entrance	9.5	7/25	
Jago Spit - outside*	32.0	7/25	No fish
Jago Spit - inside*	8.0	7/25	AC, ACi
Float Plane Cove Barter Island*	14.0	7/21	AC, FSc
Narrows between Barter Island and Bernard Spit*	13.0	7/21	No fish

TABLE 2 (Cont.) Salinity, Beaufort Sea Coast - Arctic Wildlife Range, 1970.

<u>Location</u>	<u>Salinity (ppt)</u>	<u>Date</u>	<u>Species Captured</u>
Inside South Hook Pipsuk Point	8.0	7/21	
Off Pipsuk Point	16.0	7/21	
Outside west tip Barter Island	32.0	7/26	
Inside west tip Barter Island	15.0	7/26	
Outside middle Arey Island	29.0	7/26	
Outside reef at Kajutakrok Creek	25.0	7/26	
Anderson Point - outside*	17.0	7/26	AC, ACi, FSc
East end of Simpson Cove at DEW Line site*	15.5	7/27	AC, ACi
Camden Bay (west end)*	4.0	7/27	AC, ACi, FSc
Off Konganevik Point*	6.0	7/29	AC, ACi
Outside reef at East Branch, Canning River	5.0	7/29	
Inside middle of Brownlow Reef*	1.0	7/29	AC, ACi, FSc
Outside middle of Brownlow Reef	3.0	7/29	
Inside east tip, Brownlow Point	1.0	7/29	
Off Brownlow Point*	7.0	7/29	AC, FSc
One mile off east tip, Flaxman Island	9.5	7/29	

\*Gill net sampled on same date.

AC - Arctic char                      FSc - Fourhorn sculpin                      AF - Arctic flounder  
 GR - Arctic grayling                ACi - Arctic cisco

For convenience, the Arctic Wildlife Range coast has been arbitrarily divided into five sections. These sections are discussed in order from east to west.

Demarcation Point to Siku Point:

The Kongakut River, the only major river of this area, is extremely braided at its mouth. The entire mouth is an expanse of gravel with small streams flowing over it. Overflow ice remained all summer in places.

Icy Reef, a single continuous reef, extends over most of the coast with entrances at Siku Point and Demarcation Bay. The reef is relatively high and the Beaufort Sea rarely flows over it. Siku Lagoon contains a large amount of fresh water (1 ppt salinity on July 6) due to the damming of Kongakut River water by the reef.

Siku Lagoon is shallow, with depths averaging about five feet. Arctic char, Salvelinus alpinus; Arctic cisco, Coregonus autumnalis; grayling, Thymallus arcticus; Arctic flounder, Liopsetta glacialis; and fourhorn

sculpin, Myoxocephalus quadricornis, were captured in the lagoon; however, no grayling were captured after July 8, possibly due to increasing salinities.

Overflow ice from the Kongakut River mouth cut the lagoon in half for about one-half mile and some ice was still present in Demarcation Bay on July 8. Ice outside the reefs was breaking up and moving out in places along the whole coast in early July. By July 21, most ice outside the reefs had broken up and it was possible to travel by boat from Demarcation Point to Brownlow Point, across the entire Wildlife Range coast.

The water temperature at Raluk Reef had reached 46°F (7.8°C) on July 6.

#### Siku Point to Pokok Bay:

The two major rivers of this area are the Aichilik and Egaksrak rivers, both entering into the east end of the area. Their deltas extend out on all sides into Nuvagapak, Beaufort, and Egaksrak lagoons almost to the reefs. These deltas are very shallow with water depths as little as one foot out to the reefs. Egaksrak Lagoon has a maximum depth of eight feet. Reefs are low and composed mostly of sand and silt with some gravel. During fall storms, water washes across the reefs.

Nuvagapak, Angun, and Pokok bays average about six feet deep.

By June 12, small creeks in the area were beginning to open and water was running over the ice. By June 24, the Aichilik River temperature had risen to 50°F (10°C); on June 26, the Egaksrak River mouth had a temperature of 52°F (11.1°C).

Arctic char were captured throughout the area from June 20 to September 7, and grayling were captured as far west as the Aichilik River mouth on June 21 and 25, but not on September 4, when this river mouth was again sampled with gill nets. Salinities at nearby Nuvagapak Point increased from 2 ppt on July 23 to 22 ppt less than one month later, probably accounting for the absence of grayling in any coastal area after early July. Arctic cisco were not captured near the Egaksrak or Aichilik river mouths in July, but were present at the Aichilik River mouth in early September.

On July 1 and 2, char were readily taken by angling at the Kogotpak River mouth. By September 7, the water temperature at Nuvagapak Point had dropped to 34°F (1.1°C).

#### Pokok Bay to Barter Island:

This section of coast has only one principal stream, the Jago River, which empties to the Beaufort Sea approximately eight miles east of Barter Island. The shallow delta of this river extends seaward several miles, almost to Jago Spit and the west end of Tapkaurak Spit.

The coast from Pokok Bay to Pokok Lagoon has a gravel shore and a high dirt bank, in some places as high as 20 feet. This bank is sloughed off into the ocean periodically.

The reef from Pokok Lagoon to Griffin Point is high and rarely floods; but extending westward, the reef becomes lower, and at Jago Spit water covers the reef at times, especially in late fall. As elsewhere on the coast the lagoons are very shallow, seldom exceeding 10 feet deep.

Salinities in late July were low to intermediate inside the reefs, and on the outside of the Tapkaurak Reef, the salinity was only 9.5 ppt, probably due to the eastward flow of Jago River water. A short distance westward salinities indicated undiluted sea water on the outside of Jago Spit and Barter Island.

Both Arctic char and Arctic cisco were captured throughout this section of sea coast, and fourhorn sculpin were taken at Barter Island.

Subsistence fishing for char and cisco occurs both at the village of Kaktovik on Barter Island and at Griffin Point. Personnel at the Barter Island DEW Line Station fish extensively for char; Kaktovik Eskimos were observed angling for char.

#### Barter Island to Simpson Cove:

The principal rivers of this section are the Okpilak, Hulahula, and Sadlerochit rivers. The Okpilak and Hulahula rivers nearly connect at their mouths, just west of Arey Island. Arey Island is generally low, with some gravel, but is composed mainly of silt and sand and is inundated frequently by storms.

Unlike the rivers to the east of Barter Island, both the Okpilak and Hulahula rivers do not have reefs extending out from their mouths, except for Arey Island to the east.

The small islands between the Hulahula River and Anderson Point are low and often flooded. No reefs or islands exist between Anderson Point and Simpson Cove and water depths near shore drop off rapidly to 18 feet. Simpson Cove itself is shallow, probably no more than seven feet deep.

Salinities in this section were quite high in late July, ranging from 15.5 - 29 ppt, probably because of few islands and reefs.

Only two sites were sampled for fish in this section, Anderson Point off the mouth of the Sadlerochit River, and Simpson Cove. Arctic char and Arctic cisco were captured in both locations and fourhorn sculpin were taken at Anderson Point.

### Simpson Cove to Brownlow Point:

The Katakturuk and Canning rivers are the principal rivers of this westernmost section of the Arctic Wildlife Range coast. The Canning River is the largest river of the Wildlife Range and is highly braided near its mouth. Its mud flats extend to the small island off its mouth.

The spits between Konganevik Point and the Canning River are low and often flooded, but the almost continuous reef from the Canning River to Brownlow Point is quite high and composed largely of gravel.

Several large lakes at the Canning River mouth are connected to the river and are reported by Barter Island Eskimos to contain whitefish.

Arctic char, Arctic cisco, and fourhorn sculpin were captured throughout this section.

Salinities were quite low in this area (Table 2). Despite salinities as low as 1 ppt at some locations in late July, no grayling were captured. Thus, it was not demonstrated that grayling enter the offshore waters of this area as they do farther east, although the lateness of the season may account for their absence.

### Fish Species

#### Arctic Char:

The length frequency and mean length of 173 of 206 Arctic char captured during this study are presented in Figure 2. Table 3 lists the sex composition and maturity of these fish.

TABLE 3 Sex Composition and Maturity of 173 Arctic Char Captured at Arctic Wildlife Range - Beaufort Sea, 1970.

	<u>No.</u>	<u>%</u>	<u>Length Range</u> <u>(mm)</u>
Male:			
Immature	34	56.7	150 - 487
Some Development	18	30.0	210 - 462
Potential Spawner	<u>8</u>	13.3	388 - 535
Total	60		
Female:			
Immature	15	13.3	125 - 372
Some Development	45	39.8	190 - 463
Potential Spawner	<u>53</u>	46.9	365 - 550
Total	113		

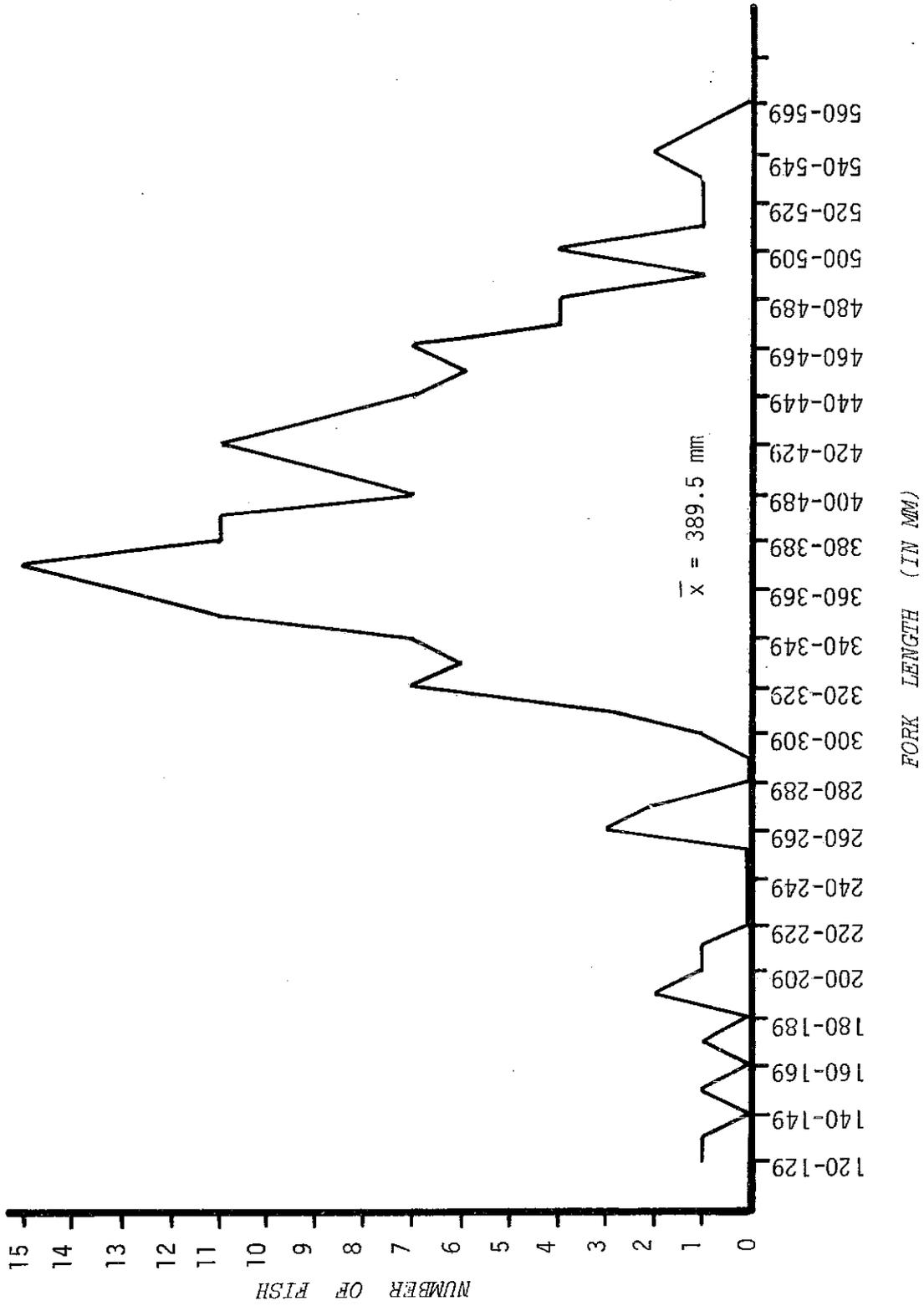


FIGURE 2 LENGTH FREQUENCY OF 173 ARCTIC CHAR, CAPTURED AT ARCTIC WILDLIFE RANGE, BEAUFORT SEA, 1970.

In 1969, an experimental char fishery was conducted at Thetis Island off the mouth of the Colville River and 148 char were sampled (Winslow and Roguski, 1970).

Comparison of Thetis Island and Wildlife Range char reveals many similarities, even though the graduated mesh nets used in 1970 allowed capture of smaller fish (120 mm) than did the standard nets used in 1969 (300 mm). The modes for both groups of fish were identical and the length frequencies similar. Sex compositions were also similar: 1969 there were 56% female to 44% male; in 1970, 65% were female and 35% were male.

Sexual development was unaccountably quite different in the two locations. In 1969, only two of the 148 Thetis Island char were potential spawners, with the rest exhibiting some gonadal development. In 1970, 53 female and 8 male char of the 173 fish sample were potential spawners. Many immature char were captured in 1970, although none were noted in 1969.

Immature or non-spawning char were found in a wide length range and some of the immature males were considerably larger than the smallest potential spawner.

The marked difference in sexual development between the two sexes in 1970 cannot be explained at present, but the sample size of 60 males and 113 females tends to reinforce its validity. Sexual development is probably obscured by non-consecutive spawning as is reported to occur in Canadian char (Hunter, 1966; Grainger, 1953).

The age-length composition of 67 char from the Wildlife Range coast is presented in Table 4. Females predominated in age groups VII and older, and no male char older than age IX were noted.

TABLE 4 Age-Length and Sex Composition of 67 Arctic Char\* Captured at Arctic Wildlife Range - Beaufort Sea, 1970.

Age Class	Length Range (mm)	Mean Length (mm)	No. in Sample	Sex	
				♂	♀
III	125 - 208	164	4	3	1
IV	265 - 268	267	2	2	-
V	210 - 415	329	9	4	5
VI	318 - 447	358	15	8	7
VII	358 - 500	418	9	4	5
VIII	409 - 500	444	13	4	9
IX	390 - 496	459	8	1	7
X	461 - 528	495	2	-	2
XI	406 - 511	459	2	-	2
XII	506 - 545	530	3	-	3

\*67 char selected to represent the various length classes nearly equally.

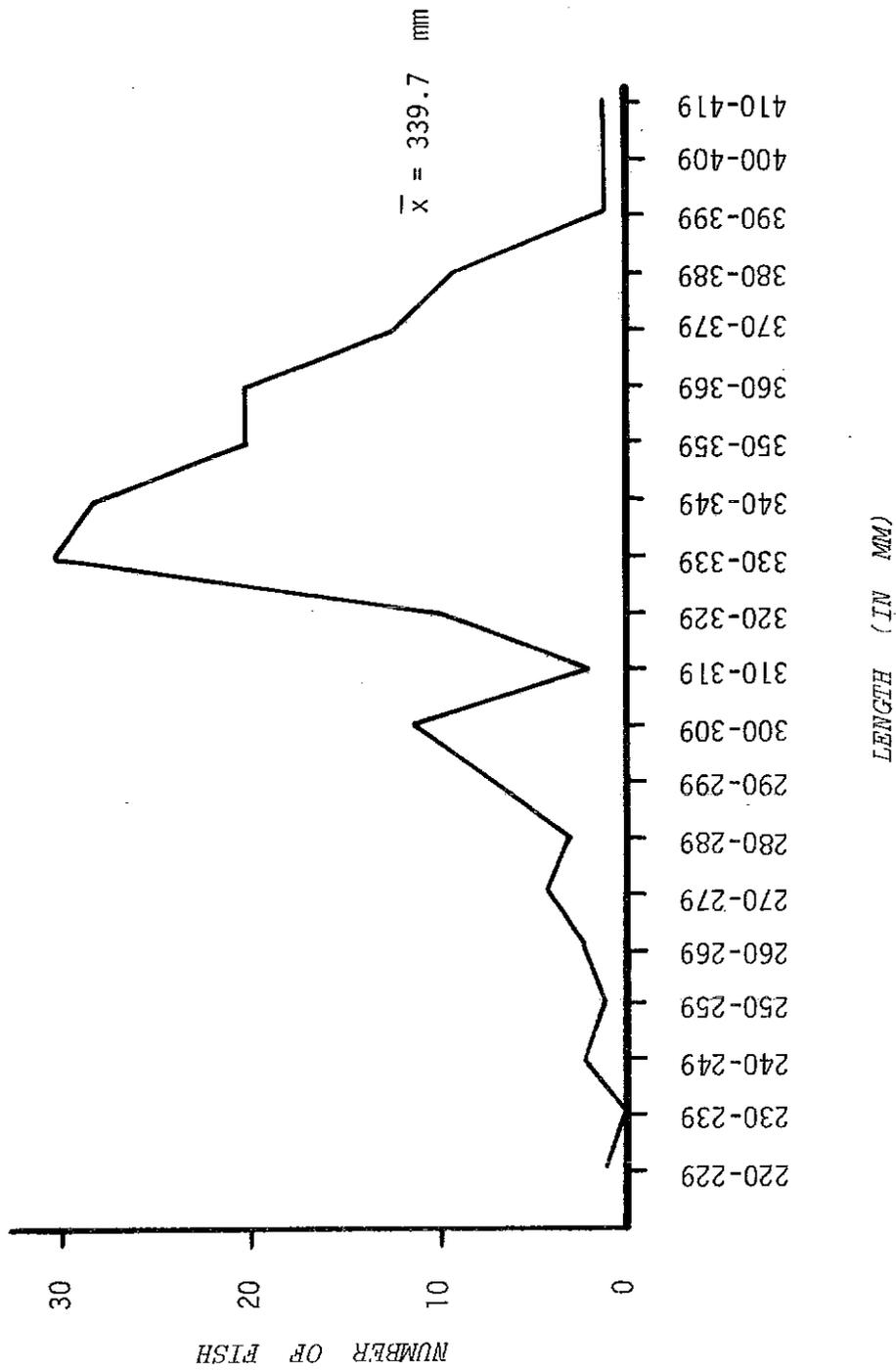


FIGURE 3 LENGTH FREQUENCY OF 167 ARCTIC GRAYLING CAPTURED AT ARCTIC WILDLIFE RANGE - BEAUFORT SEA, 1970.

Gill raker counts were made on 42 char to help delineate individual stocks of these fish (Table 5). The mean gill raker count of these fish (22.14) is nearly that of the 1969 Thetis Island area char (22.89); although the char in this study had a greater range (20 - 26) than the Thetis Island fish (21 - 25). Anadromous char captured in the Colville River system in 1970 (Kogl, 1971, in press) also had mean gill raker counts near 22, while resident char from Chandler Lake and Ikagiak Creek on the Colville system had mean gill raker counts of approximately 27.

TABLE 5 Gill Raker\* Counts of 42 Arctic Char Captured at Arctic Wildlife Range - Beaufort Sea, 1970.

---

Entire Arch:

No. rakers	20	21	22	23	24	25	26
No. fish	6	5	16	9	5	--	1

$$\bar{x} = 22.14$$

Upper Limb:

No. rakers	8	9	10	11	12	13
No. fish	1	2	15	21	2	1

$$\bar{x} = 10.57$$

Lower Limb:

No. rakers	9	10	11	12	13
No. fish	1	2	18	14	7

$$\bar{x} = 11.57$$

\*First left arch.

---

Arctic Grayling:

Grayling were captured along the Arctic Wildlife Range coast from Pingokraluk Point to the mouth of the Aichilik River (Table 1). In all locations of capture, the water was very fresh, with salinities not exceeding 1 ppt. It is likely that grayling venture into the offshore areas in the western part of the coastline soon after ice-out, but netting after July 8 failed to capture any grayling even in areas where they were abundant earlier.

Figure 3 depicts the length frequency and mean length of the 167 grayling captured during this survey. Table 6 lists the age-length and sex composition of 51 of these grayling selected to represent the various length classes nearly equally.

TABLE 6 Age-Length and Sex Composition of 51 Arctic Grayling\* Captured at Arctic Wildlife Range - Beaufort Sea, 1970.

Age Class	Length Range (mm)	Mean Length (mm)	No. in Sample	Sex	
				♂	♀
IV	225	225	1	1	-
V	245 - 265	253	5	2	3
VI	270 - 310	287	11	5	6
VII	290 - 355	330	15	7	8
VIII	325 - 380	359	14	8	6
IX	365 - 400	385	3	2	1
X	380	380	1	-	1
XI	410	410	1	1	-

\*51 grayling selected to represent the various length classes nearly equally.

The mean length of ages IV to VIII grayling compares closely with that of grayling taken from various North Slope waters (mostly Sagavanirktok River drainage) in 1969 (Winslow and Roguski, 1970). These fish lag approximately one year in linear growth when compared to grayling from the Chena River in Interior Alaska (Roguski and Winslow, 1969).

The sex composition of these grayling was 57.4% male to 42.6% female. One male 342 mm in length was judged a non-spawner and seven males ranging from 225 - 375 mm showed slight gonadal development. All other males were sexually mature. The mature fish ranged in length from 280 - 410 mm. Only five females ranging in length from 245 - 300 mm were not sexually mature and showed some gonadal development. The mature females ranged from 275 - 390 mm.

#### Arctic Cisco:

Like Arctic char, Arctic cisco were captured at locations along the entire Wildlife Range coast, both in nearly fresh water and in water with salinities up to 22 ppt (Table 2).

The length frequency and mean length of 169 Arctic cisco captured in this study are depicted in Figure 4. With the exception of one 115 mm fish, all cisco captured were 325 mm or larger. Because graduated mesh nets with small mesh panels were employed throughout the study, it is unlikely any significant number of small Arctic cisco were present in the sampling area.

Table 7 lists the sex composition and maturity of captured Arctic cisco. Only 6% of the males and 6.8% of the females were immature. The nearly equal numbers of fish of both sexes showing either some development or judged to be potential spawners may indicate that Arctic ciscoes are non-consecutive spawners.

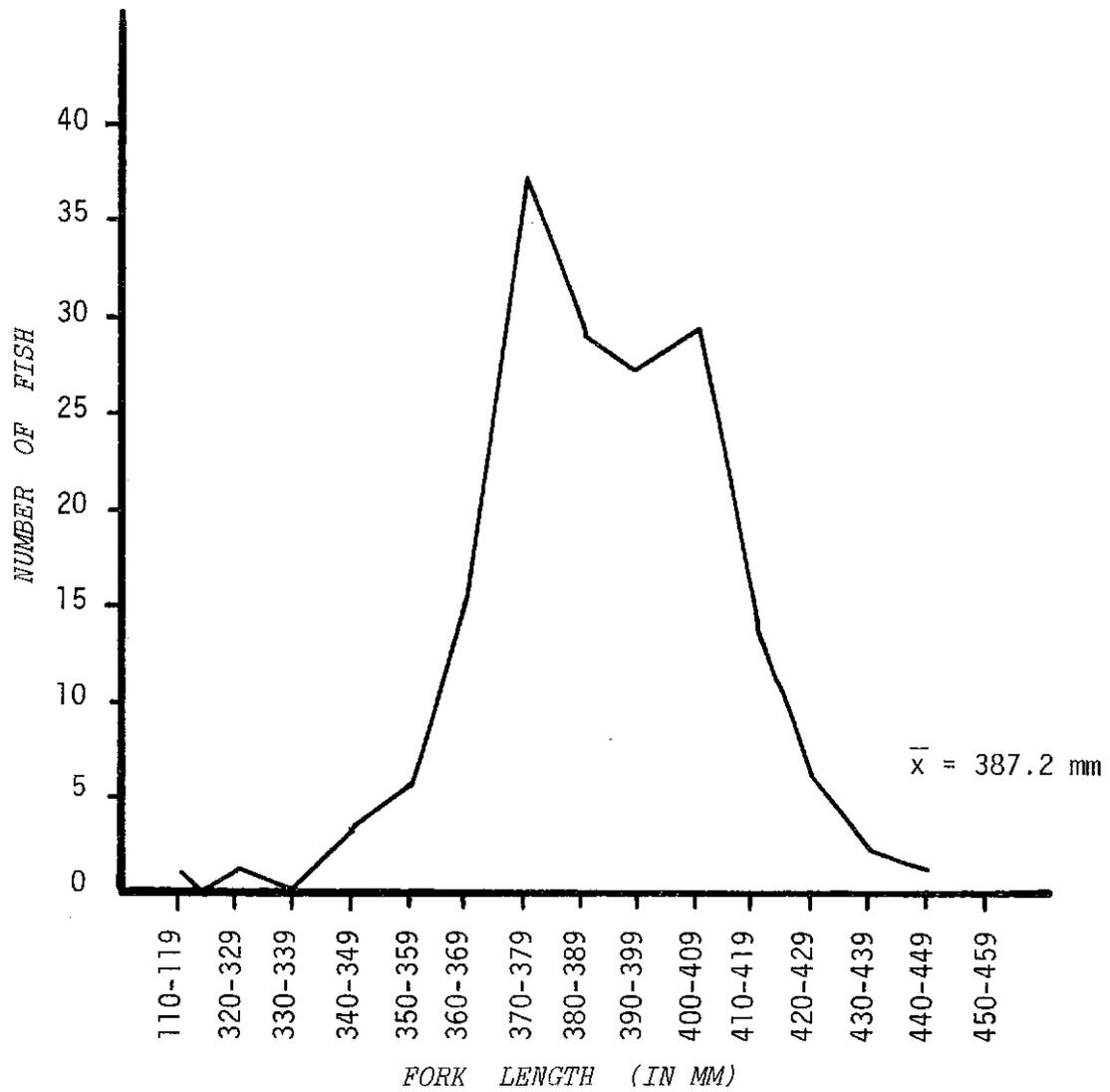


FIGURE 4 LENGTH FREQUENCY OF 169 ARCTIC CISCO CAPTURED AT ARCTIC NATIONAL WILDLIFE RANGE - BEAUFORT SEA, 1970.

TABLE 7 Sex Composition and Maturity of 169 Arctic Cisco Captured at Arctic Wildlife Range - Beaufort Sea, 1970.

	<u>No.</u>	<u>%</u>	<u>Length Range (mm)</u>
<b>Male:</b>			
Immature	4	6.0	115 - 384
Some Development	31	47.0	340 - 409
Potential Spawner	<u>31</u>	47.0	345 - 405
Total	66		
<b>Female:</b>			
Immature	7	6.8	370 - 414
Some Development	52	50.5	325 - 421
Potential Spawner	<u>44</u>	42.7	370 - 445
Total	103		

Age-length composition of 31 Arctic cisco was selected to represent the various length classes nearly equally (see Table 8). Again, with one exception, all cisco were of ages VI, VII, or VIII, possibly indicating this is the age of sexual maturity of this species in this area.

TABLE 8 Age-Length and Sex Composition of 31 Arctic Cisco\* Captured at Arctic Wildlife Range - Beaufort Sea, 1970.

<u>Age Class</u>	<u>Length Range (mm)</u>	<u>Mean Length (mm)</u>	<u>No. in Sample</u>	<u>Sex</u>	
				<u>♂</u>	<u>♀</u>
I	115	115	1	1	-
VI	325	325	1	-	1
VII	340 - 418	373	16	7	9
VIII	365 - 445	414	13	-	13

\*31 cisco selected to represent the various length classes nearly equally.

**Other Fish:**

Arctic flounder were captured at only two locations in the eastern end of the study area, at Pingokratuk Reef and Raluk Reef on July 7 and 8. The 25 fish captured ranged in length from 185 - 280 mm, with a mean of 242 mm. Of five flounder from Raluk Reef examined for sex, all were female ranging from 250 - 272 mm, and all contained eggs of approximately .25 mm diameter.

Fourhorn sculpin were captured throughout the area by gill net, by angling at Barter Island, and by dip net at Barter Island and two creeks near Nuvagapak Point. Sculpin captured in gill nets ranged in length from 99 - 310 mm, while the dip netted fish ranged from 11 - 52 mm. Fifty sculpin were examined for sex and maturity with results given in Table 9.

TABLE 9 Length and Maturity of 50 Fourhorn Sculpin Captured at Arctic Wildlife Range - Beaufort Sea, 1970.

	<u>No.</u>	<u>Length Range</u> <u>(mm)</u>
Males:		
Immature	2	99 - 108
Some Development	10	110 - 252
Females:		
Some Development	4	155 - 280
Potential Spawner	34	155 - 310

Eleven of the 12 sculpin captured at Pingokraluk were examined and all were female potential spawners.

Ninespine stickleback, Pungitius pungitius, were captured at two small streams near Nuvagapak Point. The 21 fish ranged in length from 48 - 70 mm.

Although no other fish species were encountered during this study, it is probable that had sampling been done at other times of the year, additional species would have been captured. Species likely to occur in this study area are least cisco, C. sardinella, humpback whitefish, C. pidschian, and broad whitefish, C. nasus.

It is recommended that stream surveys be conducted on the Arctic Wildlife Range as soon as practicable. Additional species likely to occur in the streams are round whitefish, Prosopium cylindraceum, and slimy sculpin, Cottus cognatus.

#### LITERATURE CITED

- Grainger, E. H. 1953. On the Age, Growth, Migration, Reproductive Potential and Feeding Habits of the Arctic Char, Salvelinus alpinus, of Frobisher Bay Baffin Island. Journal of the Fisheries Research Board of Canada. 10(6):325-370.

Heiser, David W. 1966. Age and Growth of Anadromous Dolly Varden Char, Salvelinus malma (Walbaum) in Eva Creek, Baranof Island, Southeastern Alaska. Alaska Department of Fish and Game. Research Report No. 5, 26 p.

Hubbs, Carl L. and Karl F. Lagler. 1958. Fishes of the Great Lakes Region. Cranbrook Inst. Sci. Bull No. 26. Revised Ed. 213 p.

Hunter, J. G. 1966. The Arctic Char Fish. Canada 19(3):17-19.

Kogl, Dennis. 1971. Monitoring and Evaluation of Arctic Waters With Emphasis on the North Slope Drainages: Colville River Study. Alaska Department of Fish and Game. Federal Aid In Fish Restoration, Annual Report of Progress, 1970-1971, Project F-9-3,

Roguski, Eugene A. and Peter C. Winslow. 1969. Investigations of the Tanana River and Tangle Lakes Grayling Fisheries: Migratory and Population Study. Alaska Department of Fish and Game. Federal Aid In Fish Restoration, Annual Report of Progress, 1968-1969, Project F-9-1, 10:333-351.

Winslow, Peter C. and Eugene A. Roguski. 1970. Monitoring and Evaluation of Arctic Waters With Emphasis on the North Slope Drainages. Alaska Department of Fish and Game. Federal Aid In Fish Restoration, Annual Report of Progress, 1969-1970, Project F-9-2, 11:279-301.

*Data Collected By:*

Edwin Komarek, Jr.  
Fishery Technician

*Approved By:*

s/ Howard E. Metsker  
D-J Coordinator

*Report Prepared By:*

Eugene A. Roguski  
Fishery Biologist

s/ Rupert E. Andrews, Director  
Division of Sport Fish

*Date:* April 1, 1971

## RESEARCH PROJECT SEGMENT

*State:* Alaska

*Project No.:* F-9-3                      *Name:* Sport Fish Investigations of Alaska.

*Study No.:* G-III              *Study Title:* Lake and Stream Investigations.

*Job No.:* G-III-A              *Job Title:* Monitoring and Evaluation of Arctic Waters with Emphasis on the North Slope Drainages: Colville River Study.

*Period Covered:* July 1, 1970 to June 30, 1971.

## ABSTRACT

Preliminary findings on the investigations of fish populations of the Colville River drainage are presented.

Information on relative abundance, distribution, age, growth, and sexual maturity was obtained on fishes in the Colville River Delta.

Local and migratory fish populations were sampled by gill net throughout summer, 1970, on the Colville River at Umiat. Information is presented on the timing of migratory whitefish runs, and the age and growth of grayling, Thymallus arcticus, at Umiat.

Survey findings on 6 lakes and 10 streams are presented in addition to data on fish species present.

Results of rotenone sampling to determine fish productivity and general water quality data are presented.

Data from samples of Arctic char, Salvelinus alpinus, taken at several locations are compared.

Length, age, and sexual maturity information on grayling, Arctic char, and broad whitefish, Coregonus nasus, from the Sagavanirktok River are presented.

## RECOMMENDATIONS

1. Conduct a limnological study of the Sagavanirktok River and tributaries.
2. Initiate Arctic char life history studies in the Sagavanirktok River.
3. Continue the assessment of the existing and potential sport fish waters of the North Slope adjacent to oil drilling sites and the proposed Trans Alaska Pipeline.
4. Evaluate development projects involving water use and their effects on North Slope waters for the protection of the fishery resources.
5. Determine present utilization of fish populations by subsistence, sport, and commercial harvest on North Slope waters, with emphasis on the Sagavanirktok River drainage.

## OBJECTIVES

1. To assess the environmental characteristics of the existing and potential fishery waters of the North Slope adjacent to oil drilling sites and the proposed Trans Alaska Pipeline.
2. To evaluate multiple water use development projects and their effects on the North Slope streams and lakes for the proper protection of the fishery resources. Life history studies will be initiated.
3. To determine present utilization of fishery populations, subsistence, sport and commercial, of North Slope waters.
4. To conduct a limnological study of the Colville River.
5. To assess the environmental characteristics of the waters in Arctic National Wildlife Refuge for future comparisons of ecological changes due to oil development.

## TECHNIQUES USED

Fish were collected by beach seine, minnow trap, dip net, gill nets, and rotenone. Gill nets were 125' x 6' and composed of five monofilament panels ranging in size from 1/2-inch to 2 1/2 inches bar mesh.

To obtain standing crop estimates in streams a small mesh net or beach seine was stretched across the water course to prevent fish loss at the end of the rotenone-treated area. Treatment areas were carefully inspected to maximize fish recovery. The area of treated sections was estimated by direct measurement in the case of sloughs, or stream length was taken from a map. Liquid rotenone was diluted with water and applied in portions.

Fish samples captured by rotenone were counted and weighed by species.

Water quality determinations were made using a Hach chemical kit.

Stream surveys were made either at river mouths by river boat access or in headwater areas where access was by light aircraft or helicopter. A float aircraft was used during lake surveys. An inflatable rubber boat was used to set gill nets and make depth transects. Depth measurements were made with a Ross P-100 fathometer.

## FINDINGS

The Colville River is the largest waterway draining to the north coast of Alaska. It courses east and north approximately 450 miles from its origin on the western end of the Brooks Range to the Arctic Ocean.

The river undergoes ice breakup progressively from the headwaters to the mouth, beginning in early May, and is navigable about mid-June. The ice at Umiat began to move on May 19, 1970 (observed by an Umiat resident). Freezeup begins in the latter part of September.

The water warms rapidly during June and cools abruptly in the latter part of August. Water temperatures in the Colville River, a major tributary, the Anaktuvuk River, and in a small stream, Seabee Creek, are depicted in Figure 1.

The Colville River is clear but subject to rapid and large rises in water level resulting from widespread showers on the watershed. The river is extensively braided for much of its length and boat travel is difficult during summers with light rainfall.

Eight major streams enter the Colville River and a few of these can be navigated for varying distances. Seven of these streams originate in the Brooks Range and several have mountain lakes at their sources (Figure 2).

During summer, 1970, Sport Fish Division operations were based at Umiat.

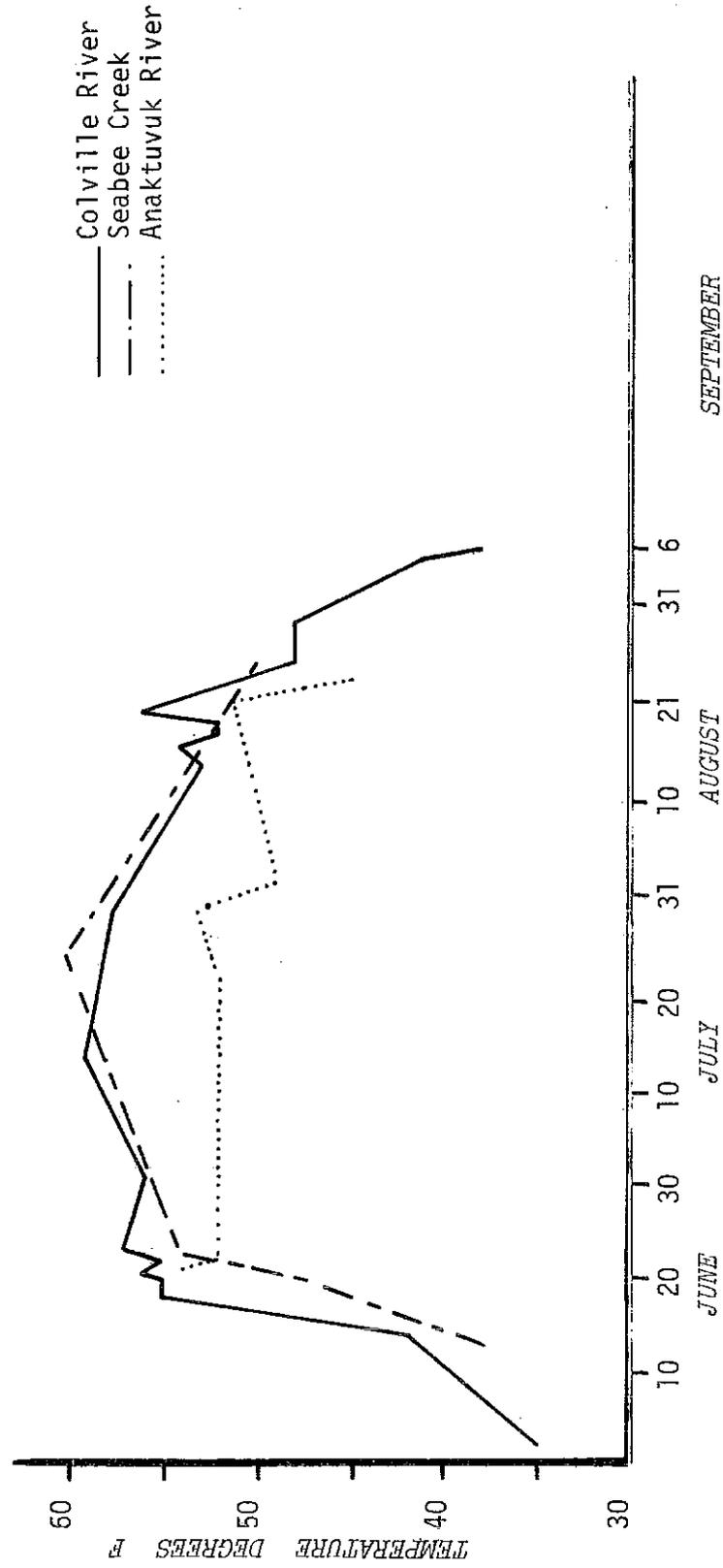


FIGURE 1 WATER TEMPERATURE OF THE COLVILLE RIVER AT UMIAT AND OF SELECTED TRIBUTARIES, 1970.

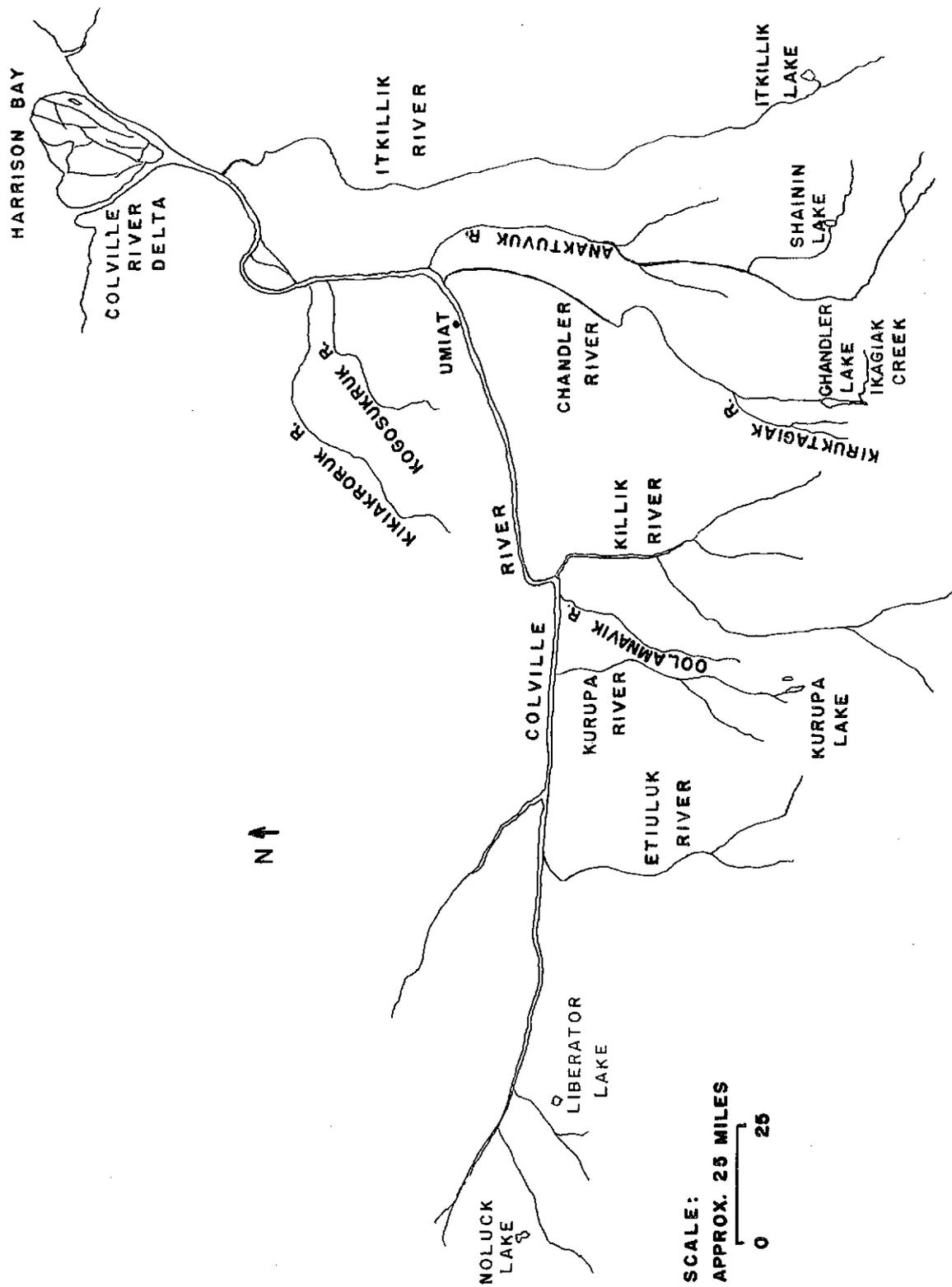


FIGURE 2 SCHEMATIC DRAWING OF THE COLVILLE RIVER SYSTEM.

TABLE 1 Gill Net Catch in Various Colville River Delta Locations, 1970.

Location	Date	No. Nets	Species Captured*													Total		
			BWF	HWF	RWF	ACI	LCI	GR	LT	AC	RSM	S	FSc	AF				
Colville River Mile 70	7/ 1	2	13						2									15
Colville River Mile 36	(1)** 7/ 2	1	5	1	1			9	10									26
Itkilik River (Mouth)	(2) 7/ 2	1	16	3	4	10	3	1										37
Itkilik River (Mouth)	(2) 7/11	1	2	1		5												8
Putu	(3) 7/ 2	1	1		9	2	1											13
Putu (2.4 hours)	(3) 7/11	1			3													3
Nanuk Lake	(4) 7/ 4	2	21	29	4	22	32	1			8	12	5					134
Tamayayak Channel	(5) 7/ 6	3	27	25	14	16		1		1			4					88
Kachemach River	(6) 7/ 7	3	3	4	1	1	3					1						18
Miluveach River (3 hours)	(7) 7/ 8	1	2	5		2	1						2					12
Colville at Miluveach (3 hours)	(7) 7/ 8	1	1														1	2

TABLE 1 (Cont.) Gill Net Catch in Various Colville River Delta Locations, 1970.

Location	Date	No. Nets	Species Captured*												Total		
			BWF	HWF	RWF	ACi	LCi	GR	LT	AC	RSM	S	FSc	AF			
Kalubik Creek (8)	7/ 9	1			3		1										4
Ocean off Kalubik Creek (9)	7/ 9	2	15	12		27	206				1				24	2	287
Oliktok (4 hours) (10)	7/ 9	1		2		11	10										23
East Branch 8 mile (11)	7/10	1		2		1	1					1					5
Kupigruak Channel (12)	7/10	1	10	3		1	2					6	3	3			28
Total			121	82	14	89	300	20	2	2	2	16	16	39	2		703

\*BWF - Broad Whitefish  
 HWF - Humpback Whitefish  
 RWF - Round Whitefish  
 ACi - Arctic Cisco  
 LCi - Least Cisco  
 GR - Grayling

LT - Lake Trout  
 AC - Arctic Char  
 RSM - Rainbow Smelt  
 S - Sucker  
 FSc - Fourhorn sculpin  
 AF - Arctic Flounder

\*\*Numbers correspond to map in Figure 3.

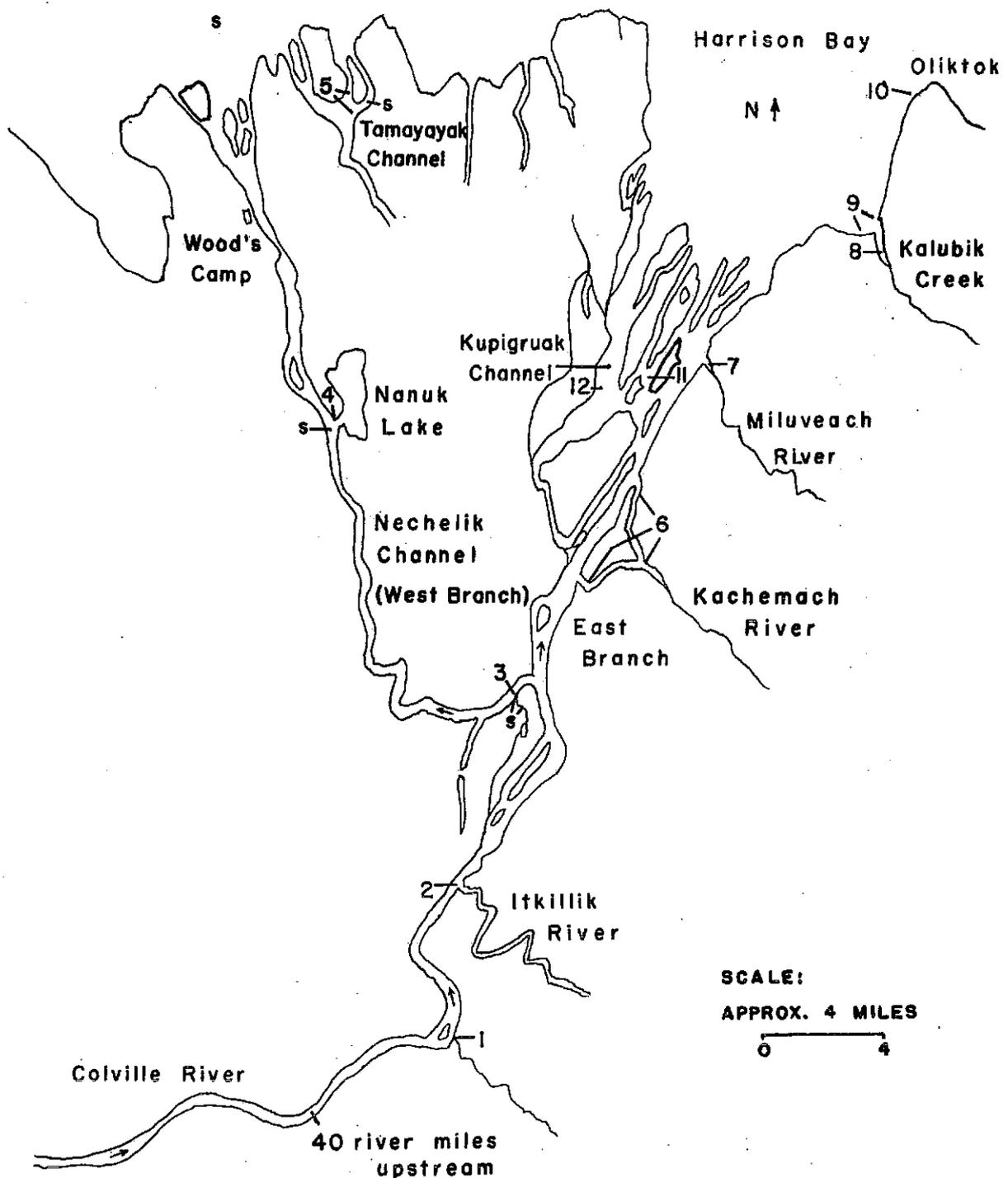


FIGURE 3 SCHEMATIC DRAWING OF THE COLVILLE RIVER DELTA  
 (Numbers refer to gill netting sites, Table 1.  
 Letter "S" refers to seining sites, Table 2.)

## Colville River Delta Survey

A preliminary survey of the Colville River Delta was made by river-boat in early July, 1970 (Figure 3).

Approximately 75 miles downstream from Umiat, the Colville River changes from a braided, fairly swift stream with gravel bottomed channels, to one of less velocity, contained in one or sometimes two channels with a sand or fine gravel bottom. Turbidity increases with the change in physical characteristics (from 2 ppm at Umiat to 15 ppm in the Delta).

Total river discharge above the Itkillik River mouth was approximately 16,000 cubic feet per second (cfs) on July 1. The Itkillik River discharged an additional 3,000 cfs. The West Branch of the Colville River, as measured at the upper end, had a discharge of approximately 7,000 cfs on July 10.

The Delta is a maze of shallow waterways which are navigable either at spring flood or when periodic onshore winds cause a general rise in water level throughout the area.

Fishing locations and the species and numbers of fish caught are presented in Table 1. Species taken by beach seine and gill net were broad whitefish, Coregonus nasus; humpback whitefish, C. pidschian; Arctic cisco, C. autumnalis; least cisco, C. sardinella; round whitefish, Prosopium cylindraceum; grayling, Thymallus arcticus; lake trout, Salvelinus namaycush; Arctic char, S. alpinus; rainbow smelt, Osmerus mordax; longnose sucker, Catostomus catostomus; fourhorn sculpin, Myoxocephalus quadricornis; and Arctic flounder, Liopsetta glacialis.

A total of 703 fish were caught at a rate of 2.4 fish per net hour. Least cisco was the most abundant species captured with broad whitefish representing the greatest biomass. The largest catch (144) was made in Harrison Bay off the mouth of Kalubik Creek during a standard 15-hour net-night. Least cisco constituted 72% of the catch. Another large catch was made at the mouth of Nanuk Lake on the West Branch of the Colville River. A catch of 67 fish composed of broad whitefish, humpback whitefish, Arctic cisco, and least cisco was made in a 15-hour gill-net night.

The catch per net hour was twice as great in the West Branch of the Colville as in the East Branch.

Seine catches made in the Delta were composed of rearing fish. A single 150-foot pass with a 50-foot beach seine, made opposite Nanuk Lake, captured a total of 269 fish (Table 2).

TABLE 2 Seining Results in the Colville River Delta, July, 1970 (50' bag seine, one 50-yard pass).

Location	Species Captured*								
	BWF	HWF	ACI	LCI	RWF	GR	S	RSM	Other
Mouth of Nanuk Lake	9**	2	10	73	50	--	6	119	--
Tamayyak Channel	-	--	--	15	1	--	--	--	9***
Sand Flats - flats off mouth of West Branch	1	--	5	3	--	--	14	--	--
Head of West Branch	-	--	--	--	9	--	--	--	--
New channel between West Branch and Main Colville	-	--	--	--	2	5	--	--	--

\*BWF - Broad Whitefish                      RWF - Round Whitefish  
 HWF - Humpback Whitefish                GR - Grayling  
 ACI - Arctic Cisco                         S - Sucker  
 LCI - Least Cisco                         RSM - Rainbow Smelt  
 \*\*Combination of Broad Whitefish and Humpback Whitefish.  
 \*\*\*Unidentified fry.

The Colville Delta is apparently an important rearing area for migratory whitefish since all young age groups were present.

#### Broad Whitefish:

Broad whitefish were taken at most fishing sites in the Delta. Sixty-nine of the 121 broad whitefish taken were sampled for biological data. The sample constituted 36% males and 64% females. Thirty-seven percent of the sample was composed of potential spawners. Two females of 526 mm and 560 mm, although apparently mature, were judged non-spawners. The Delta sample ranged in length from 103 - 632 mm with a mean of 376 mm.

In contrast to the above sample, 160 broad whitefish captured upstream at Umiat had a mean length of 532 mm with a range of 333 - 668 mm. A sample of 153 fish was composed of 56% males and 44% females. Eighty-six percent of these fish were judged potential spawners.

Broad whitefish apparently move upstream in small groups and the run is spread over several months. The largest catch of broad whitefish at Umiat occurred in July with a peak at the end of the month.

A comparison of age, length, and maturity of broad whitefish is presented in Table 3. This table is a composite of fish taken by beach seine and gill net in the Delta and at Umiat.

TABLE 3 Length, Age, and Maturity of 88 Broad Whitefish, Colville River Delta and Umiat, 1970.

Age Group	No. in Sample	Length Range (mm)	Mean Length (mm)	Sex Comp.		Potential Spawners	
				♂	♀	♂	♀
0	1	54	---	-	-	-	-
I	10	96 - 116	109	-	-	0	0
II	1	178	---	0	1	-	0
III	3	230 - 265	246	0	3	-	0
IV	2	257 - 272	265	1	1	0	0
V	-	---	---	-	-	-	-
VI	3	328 - 391	359	1	2	0	0
VII	10	308 - 588	434	4*	5	1	0
VIII	6	355 - 440	386	1**	3	0	1
IX	7	395 - 645	448	2	5	0	1
X	12	333 - 576	459	6*	5	2	4
XI	9	528 - 632	573	7	2	7	2
XII	12	474 - 665	544	5	7	5	7
XIII	9	558 - 668	609	3	6	3	6
XIV	3	592 - 654	616	1	2	1	2

\*One fish, sex and maturity not recorded.

\*\*Two fish, sex and maturity not recorded.

Sixty-six Delta broad whitefish sampled for stomach contents had the following incidence of food items: chironomids (20), snails (3), bivalves (3), and unidentified food remains (19). Twenty-five stomachs were empty. Six fish contained coelomic ascarids.

#### Humpback Whitefish:

Of 82 Delta humpback whitefish taken by gill net, 44 were sampled. The mean length of these fish was 343 mm with a range of 120 - 429 mm. This sample was 49% male and 51% female. Thirty-seven percent of these fish were considered potential spawners.

At Umiat, 121 humpback whitefish were captured, of which 105 were sampled. The mean length was 381 mm with a range of 344 - 418 mm. Their sex composition was 60% male and 40% female. Unlike the broad whitefish, no immature humpback whitefish were taken at Umiat. The spawning population was composed of fish in age groups VIII through X. The humpback whitefish run peaked at Umiat on August 14. Table 4 presents the age-length composition and state of maturity of 45 fish taken at various locations on the Colville.

TABLE 4 Length, Age, and Maturity of 45 Humpback Whitefish, Colville River, 1970.

Age Group	No. in Sample*	Length Range (mm)	Mean Length (mm)	Sex Comp.		Potential Spawners	
				♂	♀	♂	♀
I	2	120 - 121	121	-	--	-	-
II	2	143 - 150	147	0	2	-	2
III	2	214 - 215	215	1	1	0	0
IV	-	---	---	-	-	-	-
V	2	273 - 275	274	1	1	0	0
VI	4	297 - 351	311	1	3	0	0
VII	5	308 - 346	325	4	1	0	0
VIII	8	364 - 404	380	4	4	4	3
IX	14	350 - 418	383	11	3	10	3
X	6	371 - 429	401	3	3	3	3

\*Sample sizes do not reflect the numerical strength of the various age groups.

Forty-nine Delta humpback whitefish taken by beach seine and gill net contained the following incidence of food items: chironomids (8), snails (4), bivalves (2), zooplankters (6), mysid shrimp (2), unidentified food remains (14), empty (13). The occurrence of particular benthic organisms in stomachs of broad and humpback whitefish was apparently related to local availability. Stomachs sampled from the West Branch of the Colville contained chironomids almost exclusively. In the East Branch, chironomids, along with snails and bivalves, were eaten. The Kachemach and Miluveach rivers were probably the source of snails and bivalves. Only at Oliktok Point in Harrison Bay (Figure 3), did humpback whitefish stomachs contain mysid shrimp.

#### Arctic Cisco:

Eighty-nine Arctic cisco were captured in the Delta and 58 of these were sampled. The sex composition was 49% male and 51% female. No mature fish were taken. The mean length of these fish was 298 mm with a range of 123 - 353 mm. Table 5 presents the age-length composition of these fish. Arctic cisco were taken at most fishing locations although they apparently were not plentiful in the East Branch. They were more abundant at Oliktok Point where three fish per hour were taken in a four-hour net set.

TABLE 5 Age-Length Composition of 34 Arctic Cisco, Colville River Delta, 1970.

Age Group	No. in Sample*	Length Range (mm)	Mean Length (mm)
I	14	92 - 130	114
II	4	130 - 139	136
III	2	214 - 252	233
IV	1	297	---
V	13	282 - 336	317

\*Sample sizes do not reflect the numerical strength of the various age groups.

Twenty-four of 51 Arctic cisco sampled for food materials had empty stomachs. Of those that contained food, there was the following incidence of items: mysid shrimp (7), zooplankters (6), aerial insects (3), isopods (2), chironomids (2), and unidentified food remains (7).

#### Least Cisco:

One hundred Colville Delta least cisco were sampled from a gill net catch of 300 fish. Males comprised 33% of the sample and females comprised 67%; 75 fish were considered potential spawners. Nineteen percent of the females were judged mature non-spawners. The mean length of sampled fish was 278 mm with a range of 115 - 358 mm. Table 6 presents the age composition of 36 least cisco captured by gill net and beach seine.

TABLE 6 Length, Age, and Maturity of 36 Least Cisco, Colville River Delta, July, 1970.

Age Group	No. in Sample*	Length Range (mm)	Mean Length (mm)	Sex Comp.		Potential Spawners	
				♂	♀	♂	♀
0	9	48 - 65	56	-	-	-	-
I	4	83 - 116	102	-	-	-	-
II	2	137 - 142	140	-	-	-	-
III	4	176 - 183	180	0	4	-	0
IV	2	208 - 212	210	1	1	1	0
V	4	227 - 253	240	3	1	2	0
VI	3	278 - 300	289	1	2	1	1**
VII	2	269 - 299	284	1	1	1	1
VIII	6	286 - 358	325	1	5	1	4**

\*The sample numbers of the various age classes are not intended to represent the numerical strength of each age class.

\*\*One non-spawning mature fish.

Fifty-five least cisco were examined for stomach contents. Those with food had the following incidence of items: zooplankters (8), insect larvae (3), mysid shrimp (2), chironomids (1), and unidentified food remains (17).

Other Species:

Table 7 presents information on several species of fish taken during the survey. No char were reported in the commercial catch by native fishermen at Wood's Camp before July 7. Only two char were taken during the survey and both were caught in brackish water.

TABLE 7 Fish Species Taken in Incidental Numbers in the Colville River Delta, 1970.

Species*	No. in Sample	Length Range (mm)	Mean Length (mm)	Age Range	% Mature**	
					♂	♀
GR	17	127 - 394	288	III - X	100 SO	56 SO
RSM	9	202 - 268	246	---	100 PS	100 PS
AC	2	289 - 435	362	VI	---	100 IM
FSc	9	70 - 248	166	I - V	---	---
AF	1	166	---	---	---	---
LT	2	525 - 630	578	XII - XIV	100 PS	100 PS

\* GR - Grayling                      AC - Arctic char                      AF - Arctic flounder  
RSM - Rainbow smelt              FSc - Fourhorn sculpin              LT - Lake trout

\*\*IM - Immature                      SO - Spawned Out                      PS - Potential spawner

Gill Net Sampling at Umiat

Gill nets were fished intermittently at Umiat from June 2 through September 6. Nets were also frequently set at the mouths of the Anaktuvuk, Chandler, and Killik rivers.

Table 8 presents the fish species and numbers taken and the effort expended.

TABLE 8 Results of Gill Net Sampling in the Umiat Area, 1970.

Month	Net- Hrs. Fished	Species Caught*								Total	Fish/ Hr.
		GR	BWF	HWF	RWF	AC	LT	BB	S		
June	480	71	23	--	3	--	--	5	10	112	0.23
July	432	28	84	15	4	--	--	--	12	143	0.33
August	796	47	102	106	7	2	3	4	2	273	0.34
September	22	11	1	--	--	--	--	1	--	13	0.59
Totals	1,730	157	210	121	14	2	3	10	24	541	0.31

\* GR - Grayling  
 BWF - Broad Whitefish  
 HWF - Humpback Whitefish  
 RWF - Round Whitefish  
 AC - Arctic Char  
 LT - Lake Trout  
 BB - Burbot  
 S - Sucker

A total of 541 fish were caught in 1,730 hours, or a catch of 0.31 fish per hour. Fifty percent of the summer's catch was made in August, due in part to increased fishing effort. The catch per unit effort was 30% higher in July and August than June.

In the order of abundance, the catch consisted mainly of broad whitefish, humpback whitefish, and grayling. Broad whitefish and grayling were taken in all months while humpback whitefish were taken in July and August. Fishing was terminated the first week of September with the onset of freezeup.

One hundred seventy-two grayling were caught by gill net and hook and line in the Umiat area. The mean length of these fish was 293 mm with a range of 134 - 399 mm.

The sex composition of these grayling was 63% male and 37% female. The age composition of 59 grayling taken at Umiat both by gill net and rotenone is presented in Table 9. Grayling reached sexual maturity at ages VII and VIII.

TABLE 9 Length, Age, and Maturity of 59 Grayling Taken on the Colville River at Umiat, 1970.

Age Group	No. in Sample	Length Range (mm)	Mean Length (mm)	Sex Comp.		Maturity*	
				♂	♀	♂	♀
0	7	34 - 45	40	-	-	-	7 IM -
I	5	80 - 95	88	-	-	-	5 IM -
II	4	129 - 148	139	2	2	2	2 IM 2 IM
III	6	171 - 207	189	5	1	5	5 IM 1 IM
IV	2	211 - 217	214	1	1	1	1 IM 1 IM
V	7	211 - 277	231	3	4	1	1 SO 2 IM 4 IM
VI	7	212 - 287	249	6	1	6	6 IM 1 IM
VII	7	239 - 333	289	3	4	3	3 SO 2 SO 2 IM
VIII	6	270 - 333	302	3	3	3	3 SO 3 SO
IX	6	281 - 365	319	4	2	4	4 SO 2 SO
X	2	350 - 389	370	2	0	2	2 SO --

\*IM - Immature  
SO - Spawned Out

According to Umiat residents, Seabee Creek opened on May 30, 1970. On June 2, an experimental gill net was set approximately 1/4-mile up Seabee Creek from its confluence with the Colville River. Several grayling in spawning condition moving into Seabee Creek were taken. The

first spent female was collected on June 16. Creek temperature during the previous week was 38° - 41°F (3° - 5°C) (Figure 1). The discharge of Seabee Creek at the time was approximately 30 cfs.

On July 25 rotenone was used to sample a small section of the stream. The discharge had fallen to less than 1 cfs and the temperature was approximately 58°F (14°C). The catch consisted of grayling in age groups 0 and 1, and rearing burbot. The length range of age 0 grayling was 23 - 38 mm with a mean length of 32 mm.

Nine anadromous Arctic char were taken in the vicinity of Umiat (Table 10). Only one was a male and all were potential spawners. The age range was VII to XII and the length range 440 - 569 mm. Two char contained small amounts of insect remains and the others had empty stomachs. The largest catch of char (four) was made at the mouth of the Chandler River on August 17.

TABLE 10 Length, Age, and Maturity of 9 Arctic Char, Colville River at Umiat\*, 1970.

<u>Fork Length (mm)</u>	<u>Sex</u>	<u>Maturity</u>	<u>Age Group</u>
440	♀	PS	VII
470*	♀	PS	VII
470	♀	PS	VII
470	♀	PS	VII
476	♂	PS	IX
478	♀	PS	IX
502	♀	PS	X
536	♀	PS	X
569	♀	PS	XII

$\bar{x}$  = 491 mm

PS - Potential Spawner

\*Chandler River mouth catch included.

Assuming that migration routes were adequately sampled, and that no late fall run occurs, few char ascend the Colville River beyond Umiat.

Rearing char were found only in upper reaches of tributaries. More sampling will be necessary to evaluate the Colville system for char production.

Five lake trout were taken at the Killik River mouth, four at the mouth of the Chandler River, and two at Umiat. Three were considered immature and three were considered non-spawners although this determination was difficult to make. The length, age, and maturity of lake trout is shown in Table II.

TABLE II Length, Age, and Maturity of 11 Lake Trout, Colville River in the Umiat Area, 1970.

<u>Fork Length (mm)</u>	<u>Sex</u>	<u>Maturity*</u>	<u>Age Group</u>
452	♀	IM	XIII
470	♀	IM	IX
482	♂	IM	XIII
493	♀	NS	XVIII
583	♂	SD	XVI
611	♀	NS	XII
619	♀	SO	XI
619	♀	SO	XIII
679	♀	NS	XVIII
702	♂	PS	XIX
740	♀	PS	XXV

$\bar{x}$  = 577 mm

Mean age = XV+

\*IM - Immature

NS - Non-spawner

SD - Some Development

SO - Spawned Out

Of 11 lake trout stomachs examined, there was the following incidence of food items: grayling (2), decomposed fish remains (6), plant debris (1), and empty (2).

Noteworthy was the presence of a 359 mm grayling in the stomach of a 702 mm lake trout.

Ten burbot, *Lota lota*, taken by gill net and set-line, had a length range of 378 - 837 mm and a mean length of 655 mm.

### Stream Surveys

Ten stream surveys were made in 1970.

Colville River:

70°03'N 151°10'W  
70°13'N 150°52'W

The Colville River was surveyed at a site 41 river miles from the Arctic Ocean and at the upper end of the Nechelik Channel (Figure 3).

The first location was a broad channel averaging 600 feet wide with an average depth of 16 feet and a maximum depth of 27 feet. Water velocity was approximately 2.8 feet per second (fps) and the calculated flow was 16,000 cfs. Turbidity was estimated at 10 ppm and water temperature was 58°F (14°C) on July 1. The gradient was four feet per mile. Bottom materials were sand, mud, and fine gravel although there was coarse gravel at the base of an 18-foot high-cut bank. The banks undergo continuous erosion that may account for increased turbidity in this section of the river.

Grayling; broad, humpback, and round whitefish; Arctic and least cisco; burbot; slimy sculpin, Cottus cognatus; and suckers were taken by beach seine and gill net.

Physical characteristics of the Colville River at the Nechelik Channel were similar to those of the first site, 41 miles above the mouth. The Nechelik Channel had a width in excess of 200 feet, and an average depth of 17 feet. Velocity was estimated at 2.0 fps and the flow at 7,000 cfs. Pools in this section of the channel were one-half to three miles in length and were separated by riffles of 100 yards or longer. Onshore wind in Harrison Bay has an effect on water level at this location.

Itkillik River:

70°10'N 150°57'W

This river was surveyed on July 10 from the mouth to approximately 10 miles upstream. The Itkillik River is about 175 miles long and drains an area of approximately 2,000 square miles. The river has broad, sweeping curves with midstream shoals about eight miles above the mouth. Shore materials were mud, sand, and fine gravel on broad bars.

Maximum depth near the mouth was nine feet and the average depth was seven feet. The water was about four feet lower than it was on July 1. On the survey date, velocity was in excess of 2 fps and the flow was about 2,000 cfs.

All five species of whitefish common to the Colville Delta, in addition to lake trout, grayling, slimy sculpin, and smelt, were collected in the Itkillik River by beach seine and gill net. Arctic char have been reported from the Itkillik River (Winslow and Roguski, 1970).

Anaktuvuk River:

69°31'N 151°28'W

The mouth and a short distance upstream on the Anaktuvuk River was surveyed. This is a clear, rapid stream about 123 miles in length. The present mouth is a recent break-through across a large gravel bar. The mouth has four or more outfalls on the Colville River. The most prominent outfalls are about 70 feet wide. The average depth was 2.5 feet with pool depths to five feet. One channel had eight pools in the first 1/8-mile from the mouth. Velocity was 9 fps and the flow of the entire river was estimated at 2,000 cfs. Water temperature was 55°F (13°C) on June 30.

Six 300+ mm grayling were taken on hook and line in less than one hour. Arctic char, burbot, lake trout, and round whitefish were also present.

Grayling Creek:

68°06'N 151°04'W

Grayling Creek is an eight-mile-long headwaters tributary of the Anaktuvuk River directly east of Anaktuvuk Pass. This stream was briefly surveyed by helicopter on August 22. Grayling Creek had a rapid velocity, a turbidity of 15 ppm, and averaged 80 feet in width. Water temperature was 38°F (3°C). Bottom materials were gravel and coarse rubble, and the gradient was 75 feet per mile. Rearing char were captured.

The Anaktuvuk River was also surveyed briefly by helicopter at 68°37'N 151°15'W. A slough was treated with rotenone which produced grayling, rearing char, round whitefish, and sculpin.

Chandler River:

69°26'N 151°30'W

The Chandler River enters the Colville River about two miles upstream from the Anaktuvuk River. Unlike the Anaktuvuk River, the Chandler River had about 5 ppm turbidity, was warmer (61°F [16°C] on June 30), and had less velocity (6 fps). The Chandler River discharged an estimated 2,000 cfs in one channel 150 feet wide. The Chandler River has long pools in the lower river area with frequent short braided sections farther upstream.

Average depth at the mouth was 2.5 feet, with pools to four feet. Bottom materials were fine sand and mud on shore, with cobbles to large broken boulders in the main current.

The Chandler River was strongly affected by rainfall in the Brooks Range, which greatly increased its silt load.

There were remains of an oil exploration camp and a large cache of oil drums about one mile above the mouth.

Arctic char; lake trout, broad, humpback, and round whitefish; slimy sculpin; and grayling were taken at the Chandler River mouth.

Ikagiak Creek:

68°16'N 152°35'W

Ikagiak Creek was reached by helicopter on July 27. This stream is eight miles in length and enters Chandler Lake from the east. It falls 800 feet but is much reduced in velocity near the mouth. The average width near the mouth was 50 feet, the depth 1 foot, and the flow an estimated 32 cfs. Pools ranged in depth to six feet and there was slight turbidity. Bottom materials consisted of sand, coarse gravel and boulders. The water temperature was 49°F (9°C).

Rotenone was applied to a section of the stream which produced a large sample of grayling, rearing char, lake trout, round whitefish, and slimy sculpin.

Kiruktagiak River:

68°25'N 152°50'W

This river was surveyed on July 27 using a helicopter for transportation. It has a length of approximately 54 miles and a gradient of 50 feet per mile at the sampling location. In this vicinity the Kiruktagiak River had an average width of 30 feet, an average depth of 0.8 foot, and velocity and flow were 2.8 fps and 61 cfs, respectively. Water temperature was 45°F (7°C) and there was negligible turbidity. Bottom materials consisted of algae-covered rocks and boulders with some in excess of four feet in diameter.

Pools were short for the most part (20 - 30 feet) and riffles were numerous. A large sample of grayling, char, and round whitefish was collected with rotenone.

Seabee Creek:

69°22'N 152°06'W

Seabee Creek, located at Umiat, is about 12 miles long with an average gradient of 29 feet per mile. In spring, flow was in excess of 30 cfs but fell to less than 1 cfs by mid-July. Seabee Creek drains an area of approximately 60 square miles which consists mainly of boggy tundra with numerous ponds. On July 25, 1970, the average width and depth of this stream were six feet and one foot, with pool depths to two feet. No turbidity was noted but the water was brownish in color. Water velocity was not detectable in pools. Bottom materials were gravel, sand, and silt. Grayling burbot, round whitefish, slimy sculpin, and suckers were captured.

TABLE 12 General Water Quality Data from the Colville River System, 1970.

Date	Location	Temperature F	Temperature (C)	Turbidity	D.O. (ppm)	pH	Tot. Alk. (ppm)	Net Uptake C <sup>14</sup> mg-at/l
6/13	Seabee Creek	39°	( 4°)			6.5	51.3	
6/22	Anaktuvuk River (mouth)	51°	(11°)	none	--	8.5	102.6	
6/22	Chandler River (mouth)	55°	(13°)	5 ppm	--	8.0	102.6	
6/25	Itkillik River (mouth)	60°	(16°)	15 ppm	--	8.0	85.5	
6/25	Kikiakroruk River	64°	(18°)	moderate	--	8.0	85.5	
6/25	Kogosukruk River	62°	(17°)	moderate	--	7.5	85.5	
6/27	Kurupa River (30 miles upstream)	53°	(12°)	none				
7/ 1	Colville River (Sent. Hill)	56°	(13°)	5 ppm				
7/ 1	Colville River (mile 41)	58°	(14°)	10 ppm	--	8.0	85.5	
7/ 4	Nanuk Lake (mouth)	61°	(16°)	20 ppm	--		--	
7/ 6	Tamayyak Channel (one mile northwest)	45°	( 7°)	15 ppm	--	8.5	68.4	
7/ 6	Tamayyak Channel	47°	( 8°)	--	--		--	
7/ 7	Kachemach River	43°	( 6°)	none	--	7.5	68.4	
7/ 8	Miluveach River	41°	( 5°)	none	--	7.5	68.4	
7/ 9	Oliktok	40°	( 4°)	10 ppm	--	9.0	68.4	
7/14	Killik River (mouth)	58°	(14°)	5 ppm	8.4	8.0	68.4	.056
7/14	Colville River at Killik River	59°	(15°)	none	7.9	8.0	68.4	
7/17	Chandler River (mouth)	63°	(17°)	5 ppm	8.2	8.0	119.7	.112
7/17	Umiat Lake	64°	(18°)	5 ppm	8.4	8.0	68.4	1.696
7/21	Seabee Creek	59°	(15°)	none	8.2	7.0	85.5	1.180
7/22	Anaktuvuk River	52°	(11°)	none	8.6			
7/27	Ikagiak Creek	48°	( 9°)	none	--	7.5	51.3	
7/27	Kuruktagiak River	45°	( 7°)	none	--	8.5	171.0	
7/29	Colville River (mile 142)	58°	(14°)	2 ppm	--	8.0	85.5	
7/30	Anaktuvuk River (mouth)	53°	(12°)	none	10.6	8.5	136.8	
7/30	Chandler River (mouth)	57°	(14°)	2 ppm	9.1	8.5	119.7	
7/31	Clear Slough of Etivluk River	54°	(12°)	2 ppm	9.5	7.7	62.5	
8/ 2	Anaktuvuk River (mouth)	49°	( 9°)	5 ppm	9.5	7.9	123.1	

TABLE 12 (Cont.) General Water Quality Data from the Colville River System, 1970.

Date	Location	Temperature		Turbidity	D.O. (ppm)	pH	Tot. Alk. (ppm)	Net Uptake Cl <sup>-</sup> mg-at/l
		F	(C)					
8/ 3	Itkillik River (69°10'N)	48°	( 9°)	5 ppm	9.6	8.5	119.7	
8/ 6	Fossil Creek (mouth)	57°	(14°)	2 ppm	10.0	8.5	119.7	1.867
8/ 6	Prince Creek	50°	(10°)	2 ppm	9.0	7.5	56.4	
8/ 9	"Tatigak" Lake (near Umiat)	52°	(11°)	none	9.0	7.5	68.4	13.068
8/18	Oolamnavik River	49°	( 9°)	none	9.5	7.5	68.4	
8/19	Colville River (69°00'N 154°03'W)	53°	(12°)	1 ppm	8.9	7.7	48.9	
8/19	Killik River (mouth)	53°	(12°)	5 ppm	9.5	7.7	50.8	
8/19	Colville River at Umiat	56°	(13°)	5 ppm	9.2	7.9	63.0	
8/20	Anaktuvuk River (69°08'N)	51°	(11°)	none	9.9	7.9	114.2	
8/22	Creek entering Anaktuvuk Tabletop Bluff	43°	( 6°)	none	10.9	7.9	136.8	
8/22	Anaktuvuk River (Tabletop)	45°	( 7°)	2 ppm				
8/22	Grayling Creek	38°	( 3°)	15 ppm	10.3	8.0	84.6	
8/22	Creek at Tulugak Lake	40°	( 4°)	none	11.8	7.8	78.0	
8/24	Killik River (opposite Sinuk Creek)	42°	( 6°)	5 ppm	--	7.5	68.4	
8/24	Colville River at Umiat	48°	( 9°)	2 ppm	--	7.5	102.6	
8/24	Seabee Creek	50°	(10°)	none	--	8.0	119.7	
8/25	Bog Creek (near mouth of Kurupa River)	43°	( 6°)	none	--	6.5	34.2	
8/31	Shainin Lake	48°	( 9°)	2 ppm	--	8.5	102.6	--
8/31	Itkillik Lake	47°	( 8°)	none	--	9.0	136.8	--
9/ 3	Kurupa Lake	44°	( 7°)	2 ppm	--	8.0	68.4	--
9/ 4	Creek on Kurupa Lake	42°	( 6°)	none	--	7.0	51.3	--
9/ 5	Noluck Lake	37°	( 3°)	10 ppm	--	7.0	68.4	--
9/ 5	Creek at ARL Building, Noluck Lake	33°	( 1°)	none	--	7.5	102.6	
9/6	Liberator Lake	39°	( 4°)	2 ppm	--	7.0	51.3	

TABLE 13 Standing Crop of Fishes in Streams, Colville River Drainage, 1970.

Date	Location	Acres Sampled	Flow (cfs)	Temperature		GR	AC	RWF	No. Captured			Lbs./ Acres
				F	(C)				BB	SC	SM	
7/ 8	Kalubik Creek 70°25'N 150°03'W	0.14	5	38°	( 3°)	0	0	0	0	0	0	0.0
7/25	Seabee Creek 69°22'N 152°06'W	0.02	1	60°	(16°)	89	0	2	2	29	7	40.4
7/27	Ikagiak Creek 68°16'N 152°35'W	10.24	36	48°	( 9°)	263	28	92	0	88	0	8.5
7/27	Kiruktagiak River 68°25'N 152°50'W	2.55	67	45°	( 7°)	969	8	136	0	0	0	70.5
7/29	Colville River 152°25'W	0.49	27	58°	(14°)	67	0	8	0	19	42	2.6
7/30	Chandler River 69°26'N 151°30'W	1.04	53	48°	(14°)	526	0	42	3	70	4	6.1
7/31	Etivluk River 68°57'N 155°57'W	0.98	36	54°	(12°)	22	0	0	0	14	0	0.4
8/ 2	Anaktuvuk River 69°31'N	0.49	17	49°	( 9°)	93	0	10	0	8	0	1.9
8/ 3	Itkiilik River 69°10'N 151°28'W	1.62	44	48°	( 9°)	293	0	54	0	17	0	3.5
8/ 6	Colville River 152°25'W	1.35	38	50°	(10°)	117	0	108	0	53	4	5.6

TABLE 13 (Cont.) Standing Crop of Fishes in Streams, Colville River Drainage, 1970.

Date	Location	Acres Sampled	Flow (cfs)	Temperature		GR	AC	No. Captured			Lbs./ Acre	
				F	(C)			RWF	BB	Sc		
								SM	LT			
8/18	Oolamnavik River 68°59'N 154°02'W	1.46	15	49°	( 9°)	907	0	32	4	170	0	2.6
8/22	Anaktuvuk River 68°17'N	0.57	24	45°	( 7°)	59	10	0	0	43	0	16.8
8/22	Creek entering Anaktuvuk River 68°17'N	0.24	6	43°	( 6°)	23	0	0	0	19	0	3.9
8/22	Grayling Crèek 68°06'N 151°05'W	0.28	8	38°	( 3°)	0	17	0	0	0	0	7.6
8/24	Kilik River 68°06'N 154°15'W	0.83	125	43°	( 6°)	232	0	0	0	0	0	0.5
9/ 4	Creek entering Kurupa Lake 68°22'N 154°40'W	0.08	6	42°	( 6°)	1	14	0	0	10	0	11.2
9/5	Creek entering Noluck Lake 68°48'N 160°00'W	0.02	1	33°	( 1°)	7	0	0	0	0	0	31.4

#### Killik River:

The Killik River, sampled by use of rotenone at 68°06'N 154°15'W on August 24 produced rearing grayling and slimy sculpin. At that point the river was braided, the water temperature was 42°F (6°C), and a slight amount of glacial silt was present in the water.

Northern pike, Esox lucius, have been reported from lakes on the main Killik River.

#### Oolamnavik River:

68°59'N 154°02'W

The Oolamnavik River was reached by riverboat on August 18. This river is about 60 miles long and has a gradient of about five feet per mile at the mouth. The river mouth consisted of three channels with an estimated combined discharge of 100 cfs. The water was clear and the bottom was coarse gravel with pool depths to four feet. The average width of one channel, which was later sampled by rotenone, was 42 feet and average depth and velocity were 0.6-foot and 0.8 fps, respectively. Fish species taken were grayling, burbot, round whitefish, and slimy sculpin.

#### Other Streams:

A number of other streams were sampled using rotenone. Kalubik Creek (70°25'N 150°03'W) was cold (38°F) and clear on July 8, and had only slight flow. No fish were captured but one slimy sculpin was observed.

A clearwater slough of the Etivluk River (68°57'N 155°57'W) produced grayling and slimy sculpin.

A small bog water creek entering the Colville River near the mouth of the Kurupa River (Figure 2) produced grayling, slimy sculpin, and one whitefish (probably humpback), age 0.

General water quality data was gathered at fish sampling sites on the Colville system. In addition, in cooperation with the Institute of Marine Science, University of Alaska, limited primary productivity information (carbon-14 uptake by phytoplankton) was obtained (Table 12).

#### Standing Crop of Fishes in Streams

Standing crop of fishes per unit area and related physical characteristics of treated waters are presented in Table 13. Rotenone application in sloughs did not generally result in capturing adult grayling, so fish samples from sloughs are not considered representative of fish populations in rivers. However, the catch in sloughs apparently indicates abundance of rearing fishes. Due to small sample sizes, it was not considered meaningful to make generalizations between rivers.

Fish samples from Ikagiak Creek and Kiruktagiak River, which are composed of most age groups, are considered representative of these streams in the locations of treatment. Of the 70.5 pounds of fish per acre in the Kiruktagiak River samples, 63% were grayling and Arctic char combined, with round whitefish comprising the balance of the standing crop.

In Ikagiak Creek, 8.5 pounds of fish per acre were captured, principally composed of grayling and round whitefish.

The total alkalinity (in terms of CaCO<sub>3</sub>) of Kiruktagiak water (171 mg/l) was more than three times greater than Ikagiak water (51 mg/l) and was the highest found on the Colville drainage.

The difference between the standing crop of fishes on Kiruktagiak River and Ikagiak Creek could possibly be higher. In fluvial conditions slimy sculpin are probably less susceptible to rotenone, due to their benthic habits, than other species. The fact that sculpin are taken may serve as an indication of the effectiveness of the kill. Since it was likely that sculpin were present in the Kiruktagiak River, although none were taken, it is possible the standing crop of fish was somewhat higher than observed. This aspect of rotenone sampling requires further study.

TABLE 14 Age, Length, and Maturity of 45 Kiruktagiak River Grayling, 1970.

Age Group	No. in Sample	Length Range (mm)	Mean Length (mm)	Sex Comp		Maturity*	
				♂	♀	♂	♀
I	3	82 - 85	84	-	-	IM	IM
II	8	105 - 146	128	-	-	IM	IM
III	4	153 - 164	159	2	2	2 IM	2 IM
IV	4	174 - 192	185	3	1	3 IM	1 IM
V	4	186 - 201	194	2	2	2 IM	2 IM
VI	7	190 - 243	205	3	4	3 IM	2 IM
							2 SO
VII	10	219 - 270	242	8	2	5 IM	2 SO
						3 SO	
VIII	2	289 - 302	296	2	0	2 SO	--
IX	3	304 - 325	314	3	0	3 SO	--

\*IM - Immature  
SO - Spawnd Out

Length frequency and mean length of Kiruktagiak River grayling and round whitefish, and Ikagiak Creek grayling are presented in Figure 4. Tables 14, 15, and 16 show data on length, age, and maturity of grayling from both streams and Arctic char from Ikagiak Creek.

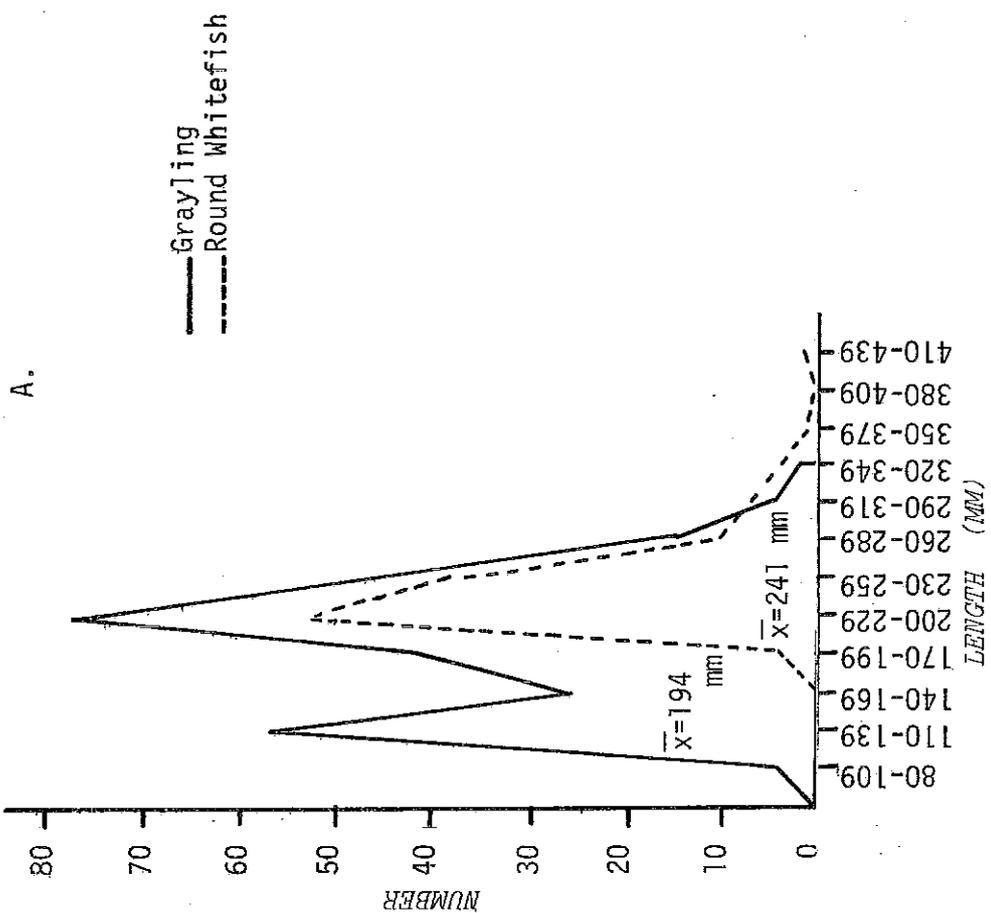
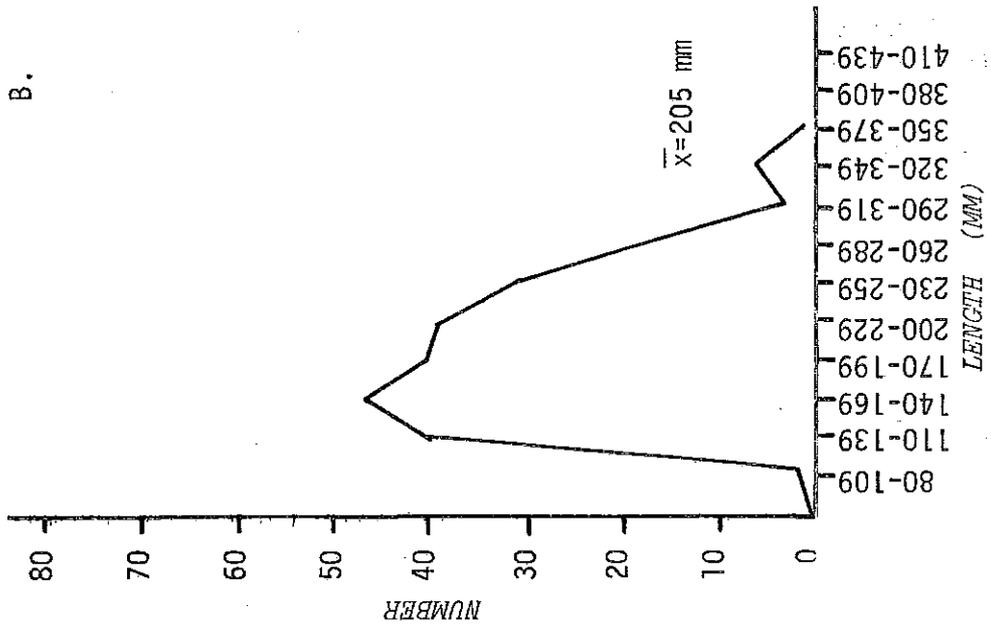


FIGURE 4 A. LENGTH FREQUENCY OF 269 GRAYLING AND 119 ROUND WHITEFISH, KIRUKTAGIAK RIVER, JULY 27, 1970.  
 B. LENGTH FREQUENCY OF 224 GRAYLING, IKAGIAK CREEK, JULY 27, 1970.

TABLE 15 Age, Length, and Maturity of 45 Ikagiak Creek Grayling, 1970.

Age Group	No. in Sample	Length Range (mm)	Mean Length (mm)	Sex Comp.		Maturity*	
				♂	♀	♂	♀
II	9	114 - 147	127	-	-	1M	1M
III	5	152 - 174	165	-	-	1M	1M
IV	5	183 - 194	185	2	3	2 IM	3 IM
V	3	201 - 221	209	2	**	2 IM	
VI	4	219 - 237	225	1**	2	1 IM	2 IM
VII	4	240 - 268	256	2	2	2 IM	2 IM
VIII	8	234 - 292	266	6	2	5 IM	1 IM
						1 SO	1 SO
IX	4	303 - 333	320	3	1	3 SO	1 SO
X	3	345 - 360	350	3	-	3 SO	--

\*IM - Immature

SO - Spawmed Out

\*\*Sex not recorded, one fish.

The sex composition of 75 Kiruktagiak River grayling was 68% male and 32% female. Twenty-eight percent of the fish were spawned out.

TABLE 16 Length and Age of 27\* Arctic Char, Ikagiak Creek, July 27, 1970.

Age Group	No. in Sample	Length Range (mm)	Mean Length (mm)
II	14	91 - 112	101
III	5	114 - 132	122
IV	4	139 - 170	159
V	3	181 - 187	185
VI	1	202	---

Mean total gill raker count, first arch, left side, 27.2 (N=27).

\*One char of the total catch (28) was damaged and not included in this table.

The sex composition of 53 Ikagiak Creek grayling was 55% male and 45% female. Twenty-eight percent of the fish were spawned out.

Grayling mature at ages VII and VIII in Kiruktagiak River and at ages VIII and IX in Ikagiak Creek. The age:length relationship of grayling is comparable between streams but both populations have an initially slower growth rate than grayling sampled on the Colville River at Umiat (Table 9). Age groups IX and X have a similar mean length in the three locations.

Ikagiak Creek Arctic char are apparently rearing forms of the Chandler Lake resident population. The mean total gill raker count on the first arch, left side (27.2) is the same for both samples.

Four rearing char in the Kiruktagiak River sample had a length range of 127 - 185 mm. These fish were in age groups II, III, and IV. The mean gill raker count was 22.3. These char are probably of anadromous stock.

Table 17 presents length, age, and sex information on Anaktuvuk River char. Adult anadromous char were reportedly present in the Anaktuvuk River near Grayling Creek during the survey, but none were captured. The Grayling Creek sample had a mean total gill raker count of 21.3. This sample, and the sample taken downstream on the Anaktuvuk River (68°37'N 151°15'W) are similar in growth rate and gill raker count and are considered to be of the same anadromous stock. No potential spawners or fish that had gonadal development were captured among these fish.

TABLE 17 Length and Age of 27 Rearing Char, Grayling Creek and Anaktuvuk River, August 22, 1970.

Age Group	No. in Sample	Length Range (mm)	Mean Length (mm)	Sex Comp.	
				♂	♀
Grayling Creek (68°06'N 151°04'W):					
II	2	132 - 141	137	1	1
III	5	146 - 166	160	2	3
IV	6	173 - 196	183	4	2
V	1	200	---	0	1
VI	1	219	---	1	0
VII	2	247 - 249	248	2	0
Anaktuvuk River (68°37'N 151°15'W):					
0	1	74	---		
I	5	99 - 118	108		
II	4	126 - 150	135		
Mean total gill raker count, first arch, left side, both samples 21.6 (N=27).					

A comparison of rearing char growth rates is presented in Figure 5. Ikagiak Creek char lag a full year behind Anaktuvuk River char in growth. This parameter in addition to the difference in mean total gill raker counts indicates they are distinct groups of char.

Sagavanirktok River Survey:

Little sampling was done on the Sagavanirktok River system during 1970 since major emphasis was placed on the Colville River survey.

Arctic char, broad whitefish, and grayling specimens were received by the Alaska Department of Fish and Game from an Atlantic-Richfield Corporation ecologist, Angus Gavin.

Length, age, and state of sexual maturity of Mr. Gavin's samples are presented in Table 18.

TABLE 18 Length, Age, and Maturity of Fishes Taken on the Sagavanirktok River, 1970.

Age Group	No. in Sample	Length Range (mm)	Mean Length (mm)	Sex Comp.		Maturity*	
				♂	♀	♂	♀
Arctic Char:							
VI	1	433	---	0	1	--	1 PS
VII	4	390 - 455	425	0	4	--	3 PS 1 IM
VIII	5	448 - 570	499	2	3	2 PS	3 PS
IX	-	---	---	-	-	--	--
X	1	529	---	0	1	--	1 PS
XI	4	512 - 568	543	0	4	--	4 PS
(Caeca: $\bar{x} = 30.6$ , N=15)			(Gill rakers: $\bar{x} = 21.7$ , N=15)				
Broad Whitefish:							
VII	3	344 - 349	347	1	2	1 IM	2 IM
VIII	4	396 - 427	410	4	0	3 PS 1 IM	--
Grayling:							
VIII	1	308	---	-	-	--	1 SO
IX	1	326	---	-	-	--	1 SO
*IM - Immature		PS - Potential Spawner		SO - Spawned Out			

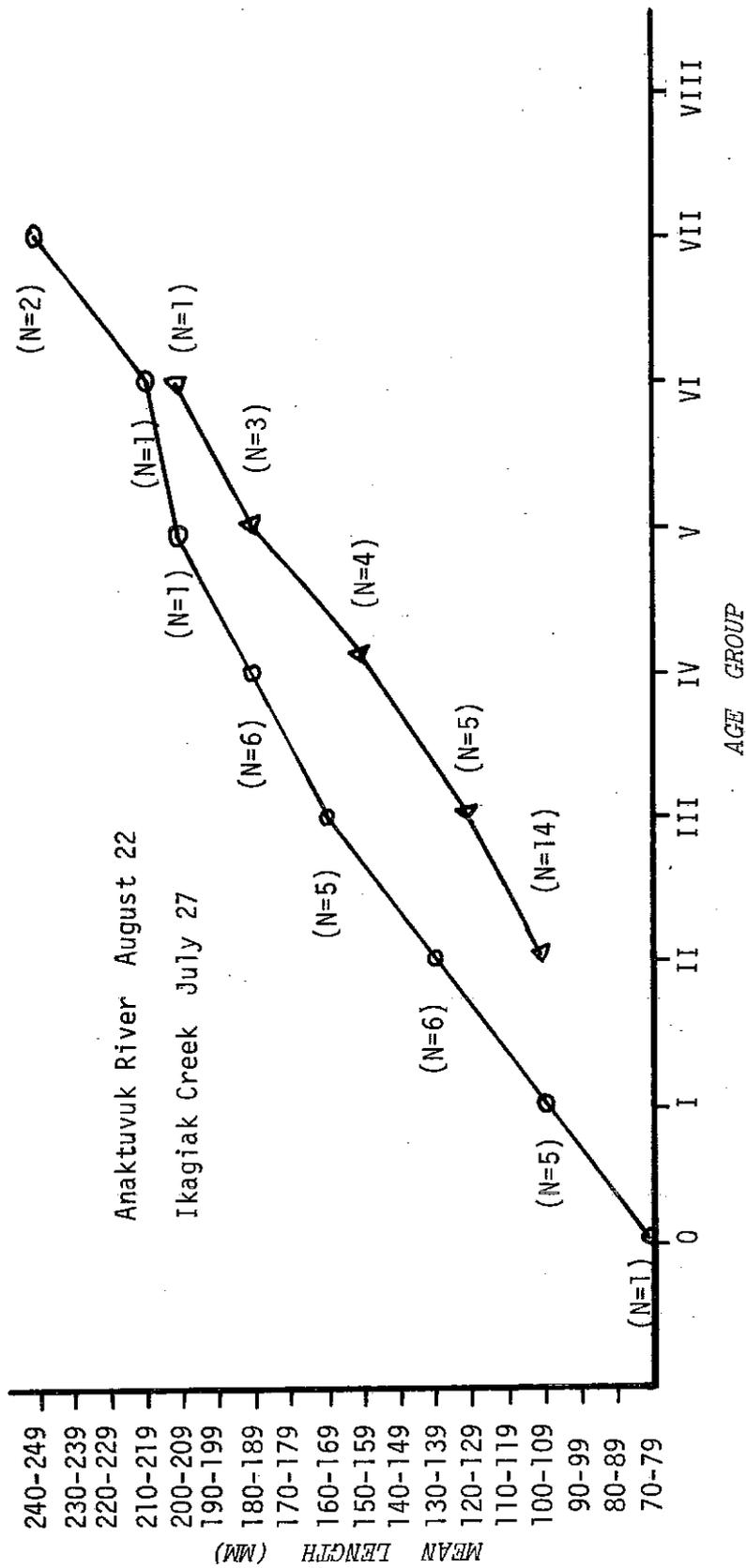


FIGURE 5 COMPARISON OF LENGTH AND AGE FOR REARING ARCTIC CHAR IN TWO NORTH SLOPE STREAMS, 1970.

## Lake Surveys

Six lakes were surveyed and several other lakes were briefly sampled in 1970.

Length, age, and maturity information on fishes taken by gill net, hook and line, and rotenone are presented in Tables 19, 20, 21, 22, and 23.

TABLE 19 Length, Age, and Maturity of Lake Trout from Various Lakes of the Colville River Drainage, 1970.

	<u>Fork Length (mm)</u>	<u>Sex</u>	<u>Maturity*</u>	<u>Age Group</u>
Shainin Lake	411	♂	S	VIII
(68°20'N 151°03'W)	451	♀	PS	IX
Mean Length 538 mm	453	♂	SD	XI
Mean Age XII	457	♂	SD	XIII
	509	♂	NS	XVII
	510	♀	SO	XIV
	545	♂	NS	VIII
	641	♂	PS	XIV
	673	♂	PS	XVII
	726	♀	SO	XIII
Tulugak Lake	421	♂	PS	X
(68°17'N 151°29'W)	441	♂	PS	--
Mean Length 470 mm	448	♀	PS	XIII
Mean Age XII	460	♂	PS	X
	510	♂	PS	XIV
	541	♂	PS	XVII
Chandler Lake	55	-	IM	I
(68°15'N 152°45'W)	471	♀	SO	XIII
Mean Length 566 mm	476	♂	PS	XVI
Mean Age XIV	751	♂	PS	XIII
Kurupa Lake	65	-	IM	I
(68°22'N 154°40'W)	95	♀	IM	II
Mean Length 590 mm	130	-	IM	III
Mean Age XVIII	137	♀	IM	IV
	165	♂	IM	V
	403	♂	IM	XIII
	473	♀	SO	XIX
	526	♀	SO	XIII

TABLE 19 (Cont.) Length, Age, and Maturity of Lake Trout from Various Lakes of the Colville River Drainage, 1970.

	<u>Fork Length (mm)</u>	<u>Sex</u>	<u>Maturity*</u>	<u>Age Group</u>
Kurupa Lake (Cont.)	572	♂	SO	XIX
	676	♀	SO	XVII
	722	♂	SO	XXII
	755	♀	SO	XXI

\*IM - Immature                      SD - Some Development  
 NS - Non-Spawner                SO - Spawner Out  
 PS - Potential Spawner

TABLE 20 Length and Age of 37 Lake Trout, Itkillik Lake, 1970.

<u>Age Group</u>	<u>No. in Sample</u>	<u>Fork Length Range (mm)</u>	<u>Mean Fork Length (mm)</u>
V	6	248 - 337	296
VI	1	266	---
VII	1	374	---
VIII	2	472 - 440	431
IX	3	412 - 469	442
X	6	405 - 493	440
XI	3	452 - 465	457
XII	5	422 - 509	477
XIII	2	541 - 543	542
XIV	2	455 - 558	507
XV	-	---	---
XVI	2	524 - 692	608
XVII	-	---	---
XVIII	2	449 - 697	573
XIX	-	---	---
XX	1	430	---
XXI	1	778	---

Mean Length 424 mm  
 Mean Age XI

TABLE 21 Length, Age, and Maturity of Arctic Char from Various Lakes in the Colville River Drainage, 1970.

	<u>Fork Length (mm)</u>	<u>Sex</u>	<u>Maturity*</u>	<u>Age Group</u>
Shainin Lake	185	-	IM	IV
Chandler Lake	445	♀	SO	IX
Mean Length 518 mm	480	♀	NS**	XI
Mean Age XI	532	♀	NS**	X
	534	♂	SD	XI
	597	♂	SD	XV

\*IM - Immature

NS - Non-Spawner

SD - Some Development

\*\*Females contained residual eggs and the gonad showed little development.

TABLE 22 Length, Age, and Maturity of 30 Arctic Char, Kurupa Lake, 1970.

<u>Age Group</u>	<u>No. in Sample</u>	<u>Length Range (mm)</u>	<u>Mean Fork Length (mm)</u>	<u>Sex Comp.</u>		<u>Maturity*</u>
				<u>♂</u>	<u>♀</u>	
0	8	42 - 53	47	-	-	8 IM
I	4	71 - 81	77	-	-	4 IM
II	5	105 - 138	116	3	2	5 IM
III	1	172	---	1	0	1 IM
IV	-	---	---	-	-	--
V	1	314	---	1	0	1 SD
VI	1	304	---	1	0	1 SD
VII	2	343 - 393	368	0	2	2 NS
VIII	3	363 - 386	378	0	3	3 NS
IX	1	401	---	0	1	1 PS
X	1	394	---	0	1	1 NS
XI	3	419 - 446	435	2	1	2 NS, 1 PS

\*IM - Immature

NS - Non-Spawner

PS - Potential Spawner

TABLE 23 Length and Age of 13 Itkillik Lake Grayling, 1970.

Age Group	No. in Sample	Length Range (mm)	Mean Fork Length (mm)	Sex Comp.	
				♂	♀
V	3	332 - 392	354	1	2
VI	2	295 - 336	316	1	1
VII	3	344 - 356	352	2	1
VIII	2	358 - 408	383	2	0
IX	2	369 - 371	370	2	0
X	1	368	---	0	1

"Tatigak" Lake:

69°02'N 152°15'W

This lake lies at the base of a ridge southwest of Tatigak Bluff near Umiat. It has a surface area of approximately 80 acres and the elevation is approximately 280 feet. The water was dark brown and there was very little turbidity. A large number of gammarids and copepods were present but no fish were taken by gill net or hook and line. Fish probably cannot overwinter because its maximum depth is only seven feet. This lake appears typical of a number of lakes which lie on the flood plain of the Colville River.

Itkillik Lake:

68°25'N 149°55'W

Itkillik Lake is a moderately high mountain lake on the Colville Drainage. The surface area is 1,330 acres, the maximum depth found was 29 feet, and the average depth was 18 feet. A depth of 41 feet has been reported.

The lake is clear and large snails are very numerous on the bottom. Aquatic vegetation (possibly Potamogeton) densely covers the bottom in several sectors.

Several small inlets with an aggregate discharge of 1 cfs, were found on the eastern hillside. A single outlet on the south end discharged 5 cfs on August 31. Itkillik Lake drains to the Itkillik River which enters the Colville near the delta.

Lake trout, grayling, and round whitefish were present in good numbers. Peter Craig (Alyeska Pipeline Service Company Fish Survey) estimates that 500 lake trout were harvested from Itkillik Lake in 1970 (viva voca).

Shainin Lake:

69°20'N 15°03'W

Shainin Lake was surveyed on August 31 and September 1. Shainin Lake lies at an elevation of 2,756 feet and has approximately 1,400 surface acres. A depth transect indicated an average depth of 37 feet and a maximum depth of 46 feet. A sample of snails, bivalves, and chironomids was taken from the lake bottom.

The outlet was not measured; however, the inlet on the south end had a discharge of 146 cfs. Shainin Lake drains to the Kanayut River which is a tributary to the Anaktuvuk River.

The water is a milky blue when seen from the air. The color is apparently due to suspended glacial material. The bottom could not be seen beyond a depth of five feet. Bottom materials were sand, pea-sized gravel, or coarse rock overlain with silt or algae. Sand shoals exist in the vicinity of the inlet but are not extensive. The water temperature was 48°F (9°C).

A good hook-and-line catch of lake trout was made at the inlet and outlet. A gill net set at the outlet took six lake trout, four round whitefish, and one small char.

This lake, as well as Itkillik and Tulugak lakes, is a former summer fishing site of Nunamiut Eskimo.

Chandler Lake:

68°15'N 152°45'W

Chandler Lake was briefly sampled by hook and line on July 26. Five char and two lake trout were taken by two anglers in 90 minutes. Chandler has a milky blue color. The surface temperature was 50°F (10°C).

Kurupa Lake:

68°22'N 154°40'W

This lake lies in a mountainous bowl about the 3,020-foot elevation and is 16 miles west of the Killik River valley. There are approximately 1,000 surface acres, two inlets, and one outlet. The inlets discharged approximately 36 cfs and the outlet discharged about 106 cfs. There was substantial runoff from the hillsides. This lake drains to the Kurupa River.

The average depth of Kurupa Lake was 32 feet and the maximum depth 46 feet; however, the transect was not made across the widest part of the lake because of high wind.

Kurupa Lake is similar in color and turbidity to Shainin Lake. The shores on the east and west sides consist of algae covered rocks, while the outlet is strewn with large boulders. Water temperature was 44°F (7°C) on September 4, 1970.

Kurupa Lake has a good fish population as indicated by a combined gill net and hook-and-line catch of 8 lake trout and 12 Arctic char. Rotenone sampling of the stream entering Kurupa Lake on the east side near the main inlet produced rearing char, lake trout, round whitefish, and grayling. All char had a high total gill raker count on the first arch, left side ( $\bar{x} = 27.7$ ) and were considered lake residents.

Kurupa Lake was the most rugged and attractive of the lakes surveyed, marred only by a partially submerged cache of aviation fuel. The lake's appeal may be correlated with its remoteness from common air routes through the Brooks Range.

Liberator Lake:

68°51'N 158°20'W

Liberator Lake lies in the foothills of the Brooks Range far upstream in the Colville drainage. It has one outlet to the Colville River which was discharging 5 cfs on September 6. Surface water temperature was 39°F (4°C).

The surface elevation is approximately 1,600 feet and there are approximately 1,200 surface acres. From the air Liberator Lake appeared very dark, having muskeg-water coloration. Bottom materials were mud and sand. A maximum depth of nine feet was found.

Grayling are present (two per 18-hour net set) but their abundance is not known. An Ekman dredge sample yielded bivalves.

Noluck Lake:

68°48'N 160°00'W

Noluck Lake is west of Liberator Lake and has a similar muskeg-water appearance. It was sampled on September 5, 1970.

Noluck Lake is at an elevation of 1,980 feet, and has an approximate surface acreage of 1,100, a maximum depth of 10 feet, and an average depth of 9 feet. The bottom lies at a fairly constant depth after falling abruptly from shore. Water temperature was 37°F (3°C). One inlet discharging less than 1 cfs was found on the south side. The bottom consists of mud, pea gravel, and rock ships. Turbidity estimated at 10 ppm<sup>u</sup> was partially due to a heavy zooplankton bloom.

Noluck Lake has a good population of grayling. One hundred fifty-eight fish were taken in a 15-hour gill net set. The estimated weight of this catch was 150 pounds, with the largest fish weighing 2.2 pounds. The length range was 113 - 469 mm with a mean length of 270 mm. No other species were taken although a small creek entering the lake was sampled with rotenone. The stomachs of the largest grayling were packed with Daphnia sp., tadpole shrimp, chironomids, copepods, adult caddis flies, and assorted dipteran larvae. The bulk of food material was Daphnia.

A Naval Arctic Research Laboratory cabin is located at the south end of the lake. There is much debris on shore and in the water from an abandoned Interior Airways camp.

#### ACKNOWLEDGEMENTS

Through the efforts of Mr. Angus Gavin, an Atlantic-Richfield Corporation ecologist, a helicopter was made available for work on the Colville River.

#### LITERATURE CITED

Winslow, Peter C. and Eugene A. Roguski. 1970. Monitoring and Evaluation of Arctic Waters with Emphasis on the North Slope Drainages. Alaska Department of Fish and Game. Federal Aid In Fish Restoration, Annual Report of Progress, 1969-1970, Project F-9-2, 11:279-302.

*Prepared by:*

Dennis R. Kogl  
Fishery Biologist

*Date:* April 1, 1971

*Approved by:*

s/Howard E. Metsker  
D-J Coordinator

s/Rupert E. Andrews, Director  
Division of Sport Fish

