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FEDERAL AID IN FISH RESTORATION
AND
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INVENTORY AND CATALOGING

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STATE OF ALASKA

Bill Sheffield, Governor

Annual Performance Report for

INVENTORY AND CATALOGING OF ARCTIC AREA WATERS

by

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Volume 24 Study No. G-I

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Job No: G-I-I Job Title: Inventory and Cataloging of Arctic Area Waters

Cooperator: Terrence N. Bendock

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ABSTRACT

Information is presented on overwintering habitats of Arctic char, Salvelinus alpinus (Linnaeus) in spring-fed tributaries to the Sagavanirktok River. A study was initiated of overwintering areas in the main stem of the Sagavanirktok River using radio-tagged burbot, Lota lota (Linnaeus). Aerial surveys were conducted of Arctic char in index areas of the Sagavanirktok and Anaktuvuk Rivers, and sport fishing pressure was monitored along the Dalton Highway.

Sixteen Arctic char were radio-tagged in four tributaries of the Sagavanirktok River. Overwintering habitats were located in three of the four streams and information is presented on the physical and chemical characteristics as well as the fish sampled at each site. Char of all life history stages were captured, and length, weight, age and food habits data are presented. Most char were observed overwintering in confined under-ice habitats between open-water springs and large *aufeis* fields. Movements of radio-tagged char following spawning and freeze-up appeared to be minor adjustments to changes in flow and ice conditions, with a general downstream movement from spawning areas and tagging sites.

Eleven burbot, equipped with radio-tags were released within a 50 mile section of the main stem of the Sagavanirktok River. Information is presented on the lengths, weights and locations of the tagged burbot.

Aerial index counts of Arctic char in the Anaktuvuk and Sagavanirktok Rivers were conducted in 1982. The number of fish observed in the Sagavanirktok River was considerably higher than that observed in previous years, while numbers observed in the Anaktuvuk survey were down from previous years. High, turbid water in the Anaktuvuk River contributed to poor survey conditions and char were distributed over a much wider area than observed in past surveys.

Seven lakes in the vicinity of the Dalton highway were surveyed during 1982. The Nigu-Etivluk and Anaktuvuk Rivers were surveyed and information is presented on Arctic grayling, Thymallus arcticus (Pallas), and Arctic char sampled from these streams.

Sport fishing pressure along the Dalton Highway was monitored during the summer of 1982. Sport fishing pressure north of the Yukon River was light and was concentrated near Trans-Alaska Pipeline pump stations.

KEY WORDS

Keywords: North Slope; lake surveys; Sagavanirktok River; Anaktuvuk River; Etivluk River; Dalton Highway; Arctic char, Salvelinus alpinus; Arctic grayling, Thymallus arcticus; burbot, Lota lota; overwintering habitat; *aufeis;* radio telemetry; aerial surveys.

BACKGROUND

The Alaska Department of Fish and Game, Sport Fish Division, has conducted fisheries investigations on the North Slope since 1968. Emphasis of this work has varied between drainages and species in an effort to meet the changing patterns of use and activities within this region. Development at Prudhoe Bay, and construction of the Dalton Highway (North Slope Haul Road) has tied the North Slope into the existing State road network. Improved access has increased sport fishing activity as well as other recreational, municipal and commercial endeavors in this remote region of the State.

Petroleum exploration and development is a major force that is shaping the future on the North Slope; municipalities are viewing the newly-found State oil wealth as the key to funding capital improvement projects with costs that have long been out of reach. Many of these activities place increasing demands on the aquatic resources of the region and point to the need for more knowledge of the fish species inhabiting North Slope waters.

Figure 1 shows the study site locations in northern Alaska. The species of fish found along the Dalton Highway and North Slope are shown in Table 1.

The report findings for this study are presented in five sections, each treated as a separate phase of the project. The first section describes overwintering habitats of Arctic char in spring-fed tributaries to the

Sagavanirktok River. Char were located under the ice using radio transmitters in an effort similar to that conducted on the Anaktuvuk River (Bendock, 1982). Little is known about the winter life history of fish in North Slope streams, yet demands for gravel mining, water withdrawal, and road construction activities, which may harm overwintering fish or their habitat are increasing yearly.

The second section describes an overwintering investigation initiated on the Sagavanirktok River utilizing radio-tagged burbot to locate overwintering areas in the main stem of this stream.

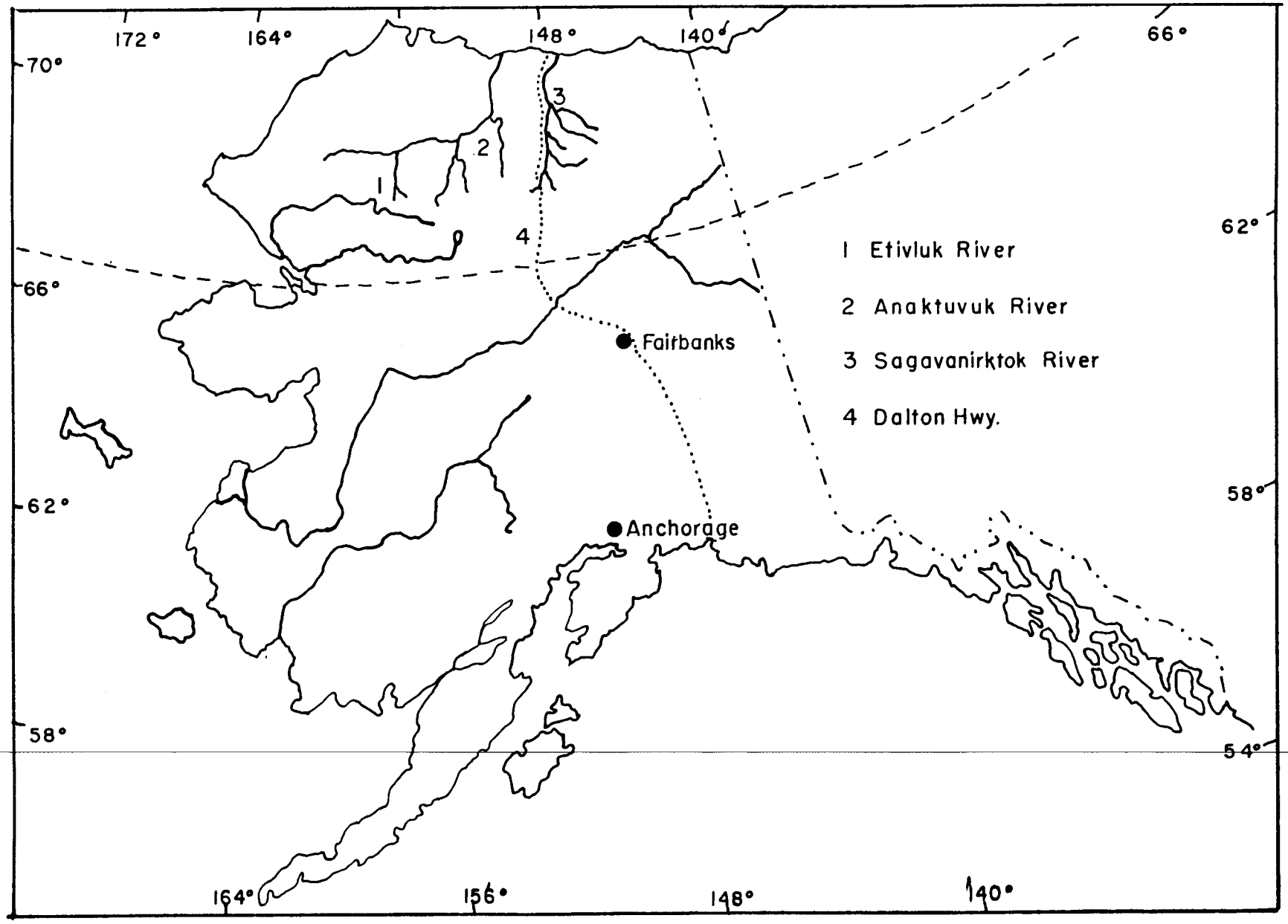

Figure 1. State of Alaska, showing study sites along the North Slope 1982.

Table 1. Fish species found along the Dalton Highway and North Slope.

Common Name	Scientific Name and Author	Abbreviation
Alaska blackfish	Dallia pectoralis (Bean)	AB
Arctic char	Salvelinus alpinus (Linnaeus)	AC
Arctic cisco	Coregonus autumnalis (Pallas)	ACI
Arctic grayling	Thymallus arcticus (Pallas)	GR
Broad whitefish	Coregonus nasus (Pallas)	BWF
Burbot	Lota lota (Linnaeus)	BB
Chum salmon	Oncorhynchus keta (Walbaum)	CS
Fourhorn sculpin	Myoxocephalus quadricornis (Linnaeus)	FSC
Humpback whitefish	Coregonus pidschian (Gmelin)	HWF
King salmon	Oncorhynchus tshawytscha (Walbaum)	KS
Lake trout	Salvelinus namaycush (Walbaum)	LT
Least cisco	Coregonus sardinella Valenciennes	LCI
Longnose sucker	Catostomus catostomus Forster	LNS
Ninespine stickleback	Pungitius pungitius (Linnaeus)	NSB
Northern pike	Esox lucius Linnaeus	NP
Pink salmon	Oncorhynchus gorbuscha (Walbaum)	PS
Round whitefish	Prosopium cylindraceum (Pallas)	RWF
Sheefish	Stenodus leucichthys (Güldenstadt)	SF
Slimy sculpin	Cottus cognatus Richardson	SSC

Additional sections include information on Arctic char annual index counts, lake and stream surveys and sport fishing pressure along the Dalton Highway.

RECOMMENDATIONS

Management

1. Assessment of the fishing potential of area waters adjacent to the Dalton Highway should continue.

2. Sport fishing pressure on area waters should be monitored.

Research

1. Lake and stream surveys should continue on North Slope waters with emphasis on NPR-A and coastal plain lakes.

2. Assessment of overwintering fish habitats in North Slope waters should continue with emphasis on the Sagavanirktok and Colville River drainages.

3. Fall aerial surveys of Arctic char in the Sagavanirktok and Anaktuvuk Rivers should continue.

OBJECTIVES

1. To conduct fall aerial surveys of selected waters on the North Slope to determine locations and estimate the abundance of Arctic char stocks with emphasis on the Sagavanirktok and Colville River drainages.

2. To continue monitoring sport fishing pressure on selected waters of the North Slope with emphasis on the North Slope Haul Road corridor.

3. To determine the availability and use of overwintering fish habitat in lakes and streams of the North Slope with emphasis on the Sagavanirktok and Colville River drainages.

4. To continue inventory and cataloging of potential sport fish waters on the North Slope.

5. To provide recommendations for the management of sport fish resources of the job area.

TECHNIQUES USED

Lake Surveys

A float-equipped Cessna 185 aircraft was used to transport field crews and equipment to remote lakes within the study area.

Physiographic data, as well as latitude and longitude, were calculated from U.S. Geological Survey (USGS) 1:250,000 maps and sectional aeronautical charts.

Water chemistry data were measured using a Hach AL-36B field test kit. Water depths were determined with a Lowrance fathometer, and a standard 10-in Secchi disc was used for water clarity.

Multifilament and monofiliment graduated mesh sinking and floating gill nets, measuring 125 x 6 ft and consisting of five 25 ft panels of 1/2 in through 2-1/2 in bar mesh, were used to capture fish. Other sampling gear included 25 x 4 ft beach seines, and 25 x 6 ft x 1/2 in mesh multifilament gill nets. Hook and line sampling was used to capture burbot, Arctic char and lake trout.

All data were recorded on standard Alaska Department of Fish and Game stream and lake survey forms.

All fish samples were grouped by date and location. Weights were recorded to the nearest gram using a Chatillon spring scale. Fork lengths were measured to the nearest millimeter, and sex and stage of maturity were determined by examining gonads.

Ages of Arctic char, lake trout and burbot were determined from otoliths wetted in glycerine and alcohol and viewed under a binocular microscope.

All other fish were aged by reading scales. Scales were cleaned and impressed on 20 mil acetate sheets. A Bruning 200 microprojector was used to read scales.

Winter Sampling

Locations of overwintering char in the Sagavanirktok River were determined using radio telemetry. Snow machines were then used to transport personnel and equipment to these sites during the sampling period.

Ice, water and snow depths were measured to the nearest inch. Dissolved oxygen levels were measured using a Hach AL-36B field test kit and the low range titration procedure.

Holes were drilled through ice using a gasoline-powered portable digger with a 10-in bit. Monofilament graduated mesh sinking gill nets, measuring 125 x 6 ft (or individual 50 ft and 25 ft panels from these nets), were used to capture fish under the ice. A "Murphy Stick" (Bendock, 1980) was used to string net lines under the ice.

Angling was used to capture both char and lake trout under the ice and a 25 ft x 4 ft beach seine was used to capture fish in open-water spring areas.

Radio Telemetry

Eleven Telonics RB-5 radio transmitters were surgically implanted into the peritoneal cavity of burbot using the shielded-needle technique described by Ross and Kleiner (1982).

FINDINGS

Winter Habitats of Arctic Char in the Sagavanirktok River

Background:

The Sagavanirktok River originates in the Philip Smith Mountains at lat. 68° 10' N, long. 149° 04' W and flows north 180 mi where it enters the Beaufort Sea, adjacent to Prudhoe Bay. It has an estimated annual flow of 2,770 cfs and a drainage area of 5,546 sq mi. The Dalton Highway, build in 1974 to serve construction of the Trans-Alaska Pipeline and Prudhoe Bay oil field parallels the Sagavanirktok River along its western shore. The river has been, and continues to be, a source of gravel and freshwater obtained for construction and domestic uses.

The Sagavanirktok River has a large run of anadromous Arctic char. Studies detailing the distribution, migrations, age and growth and spawning behavior of char inhabiting the Sagavanirktok River have been conducted since 1971 (Yoshihara 1971, 1972; Furniss, 1974; and McCart, Craig and Bain, 1972). Previous studies, however, have reported on information obtained during the open-water season, thus little is known about the overwintering movements or habitats of char in the Sagavanirktok drainage. In addition to char, the Sagavanirktok River is inhabited by grayling, lake trout, broad whitefish, humpback whitefish, round whitefish, least cisco, Arctic cisco, burbot, pink salmon, chum salmon, ninespine stickleback and slimy sculpin.

Following the autumn migration into the Sagavanirktok River char enter tributaries flowing from the east to spawn and overwinter. These tributaries are characterized by having broad valley floors, braided drainage patterns and perennial springs. The springs, which are associated with faults in the limestone of the region, supply the only source of winter flow, and thus provide small areas of habitat for fish spawning, rearing and overwintering.

All of the larger eastern tributaries to the Sagavanirktok River having spring areas are used for spawning and rearing by char. In addition, the Ivishak River is used for overwintering by sub-adult migrant char and non-spawning adult char. The schools of migrant char wintering in the Ivishak River are comprised of individuals from all of the major spawning tributaries. While large numbers of char can be observed in these streams prior to freeze-up, little is known about the winter movement, distribution or overwintering site characteristics during the 8 month ice-covered period. Previous investigations of overwintering char in spring-fed

streams have included aerial surveys with supporting data obtained from angling, seining and gill netting in open-water areas (Craig and McCart, 1974). Bendock (1981, 1982) investigated overwintering sites of char in the Anaktuvuk River using radio-tagged fish to locate the sampling sites.

Radio-Tagging:

Radio telemetry was used as a method for monitoring the winter movements of char and to locate overwintering habitats under the ice. Sixteen char were equipped with radio transmitters and released between September 15 to 17, 1981. Transmitter frequency ranged from 150 to 151 MHz. Four fish were tagged in each of the following streams: Echooka, Ivishak, Saviukviayak and Lupine Rivers (Fig. 2). Char spawning occurs in each of these streams, however migrant nonspawning char were only found in the lower Ivishak River.

Fourteen of the radio-tagged char were in spawning condition, while two were adult, nonconsecutive spawners. Of the spawners, six were female and eight were male. The sex of the nonconsecutive spawners could not be determined by examining external characteristics. The radio-tagged char ranged from 520 mm to 730 mm and averaged 616 mm in fork length. Weights ranged from 1,500 g to 4,100 g and averaged 2,244 g. Physical characteristics of the tagged char and capture site characteristics are listed in Table 2.

Fall and Winter Movements:

The radio-tagged char were located by aerial reconnaissance on three occasions between their release in September and the spring sampling period in April. Table 3 summarizes the direction and distances moved by the various tagged char on the three reconnaissance flights. The average distance from the tagging site traveled by char on January 26 (the last date on which most of the tags were located) was 2.1 miles. Of the eleven fish for which travel was noted, the majority (8%) moved downstream from the tagging site, however, the greatest distance traveled (average of 6.3 mi) was by those fish moving upstream from the site.

There was no interstream movement of tagged char following spawning and freeze-up. The nonspawners (fish #3 and 4) tagged in the Ivishak River moved upstream to the confluence of the Saviukviayak River by late January. They were subsequently not located, however sampling in April confirmed the presence of nonspawning char in the Saviukviayak River which were not noted during the fall. Thus, it was assumed that some fish from the Ivishak River do move into the Saviukviayak River under the cover of ice.

Char tagged from similar schools undertook similar directions and distances of movement. This was particularly evident during the January flight when all individuals from each site had moved the same direction for approximately the same distance.

It appears that winter movements at all of the sites except the Ivishak River represented minor adjustments to changes in flow and ice conditions, with a general downstream movement as the ice formed in the fall. In all

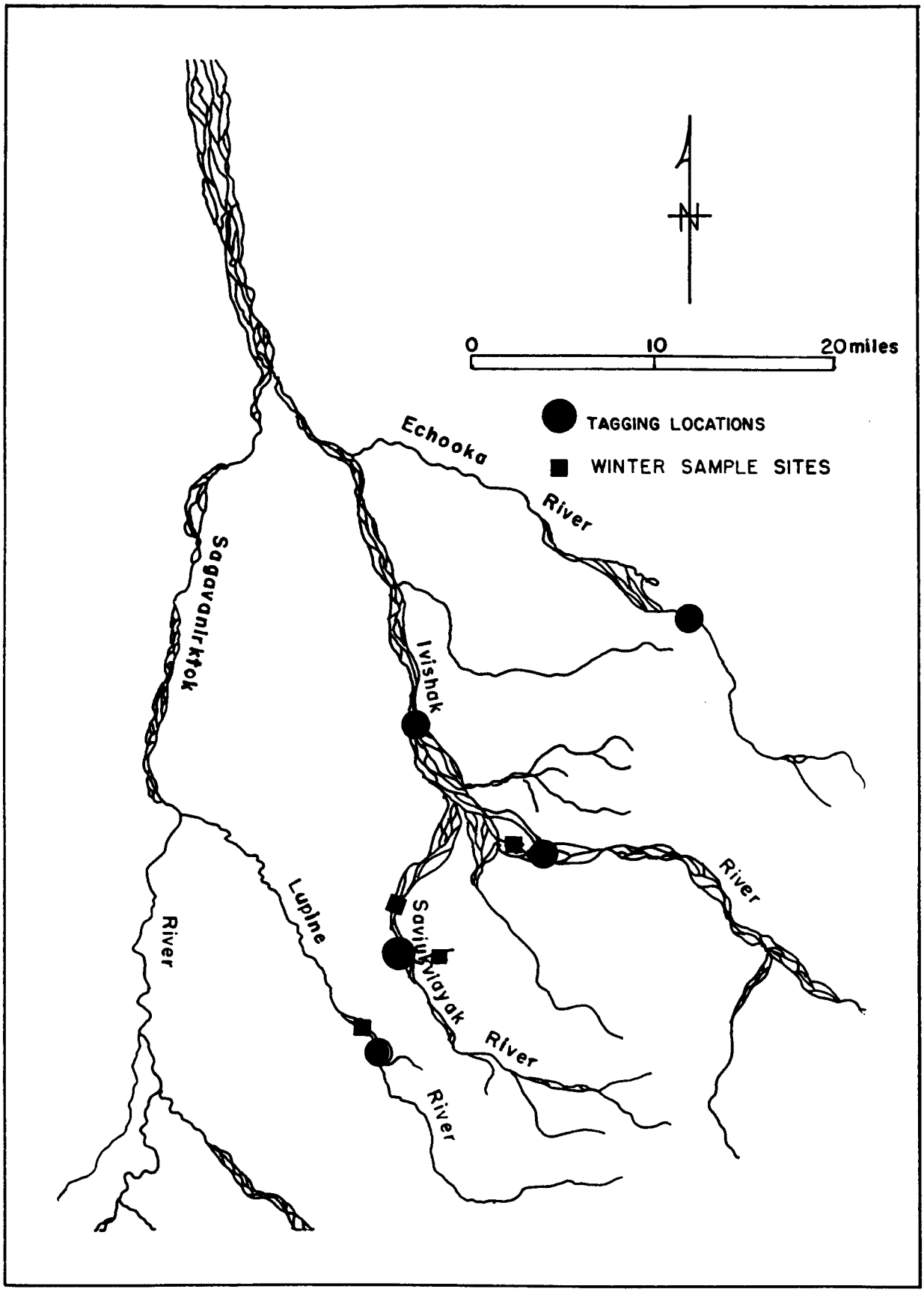

Figure 2. Sagavanirktok River drainage showing Arctic char radio-tagging locations and overwintering sites sampled in 1982.

Table 2. Physical characteristics of tagging sites and Arctic char radio tagged in the Sagavanirktok River drainage, 1981.

Location	#	Sex	Mat*	F.L. (mm)	Wt. (g)	H_2O Temp.	pH	Hardness ppm
Lupine R.	1	M	Sp	585	1,800	40°F	8.5	188
	2	F	Sp	600	1,500			
	3	F	Sp	610	2,000			
	4	M	Sp	580	2,000			
Saviukviayak R.	1	F	Sp	635	2,200	39°F	8.5	154
	2	M	Sp	535	1,500			
	3	F	Sp	650	2,700			
	4	M	Sp	570	1,800			
Ivishak R.	1	M	Sp	670	2,800	39°F	8.5	137
	2	M	Sp	730	4,100			
	3	-	Ns	535	1,800			
	4	-	Ns	520	1,500			
Echooka R.	1	F	Sp	600	2,100	40°F	8	154
	2	M	Sp	710	3,000			
	3	M	Sp	655	2,500			
	4	F	Sp	665	2,600			

* Ns Nonspawner
Sp Spawner

Table 3. Summary of radio-tagged char movements from their site of release on Sept. 15-17, 1981.

Location Tagged	Fish #	Movement From Release Site		
		Oct. 12	Jan. 26	March 21
Echooka R.	1	none	downstream 0.8 mi	downstream 1.5 mi
	2	none	downstream 1.0 mi	downstream 1.5 mi
	3	upstream 1 mi	downstream 1.0 mi	could not locate
	4	upstream 0.5 mi	downstream 0.3 mi	could not locate
Ivishak R.	1	upstream 5.0 mi	upstream 5.5 mi	could not locate
	2	upstream 5.0 mi	could not locate	could not locate
	3	none	upstream 7.0 mi	could not locate
	4	none	upstream 6.5 mi	could not locate
Saviukviayak R.	1	downstream 1.0 mi	downstream 2.5 mi	downstream 3.0 mi
	2	downstream 2.0 mi	downstream 3.0 mi	downstream 3.0 mi
	3	downstream 1.0 mi	downstream 3.0 mi	could not locate
	4	downstream 1.0 mi	downstream 1.5 mi	downstream 1.0 mi
Lupine R.	1	upstream 0.5 mi	none	could not locate
	2	upstream 0.5 mi	none	could not locate
	3	upstream 0.5 mi	none	none
	4	none	none	could not locate

cases the tagged char avoided open-water spring areas, preferring the under-ice habitat and peripheral fields of *aufeis* forming downstream from open leads.

Overwintering Site Characteristics:

Sampling at each of the overwintering sites was accomplished between April 15-23, 1982. Surveys at each site consisted of an examination of water chemistry, physical descriptions of the habitat and fish sampling. Sample sites were located using the radio transmitters that were still functioning. In locations where tags were not functioning, the most recent "fix" from aerial reconnaissance was used to locate a site. In addition, examining under-ice habitat in the *aufeis* fields below open-water leads proved successful for locating overwintering char. Samples of char were taken from the Lupine, Saviukviayak, and Ivishak Rivers. "Warm Springs Creek", which is the source of winter flow in the Saviukviayak River, was also sampled. Weather and snow conditions precluded travel to the Echooka River; however, the positions of radio-tagged fish suggest that they occupy habitat similar to that found at other locations. Table 4 lists the chemical and physical characteristics, as well as the life history stage, of char taken at each site.

Each of the overwintering sites originated in a perennial spring. Water entered the systems at temperatures ranging from 36°F (Lupine River) to 54°F (Warm Springs Creek) and remained ice-free for variable distances downstream. The warmest site flowed approximately 3 miles before ice completely covered the stream. Water continues to flow under the ice for a variable distance until a barrier to the flow of water forces it to the surface. Beyond this point, large *aufeis* fields blanket the entire flood plain. During periods of extremely cold weather, large amounts of water are stored as shelf ice in the open water stretches. As the temperature moderates, this water is released, creating a surge in flow downstream from the open leads. In the ice-covered portion of the stream an airspace large enough to accommodate the variable flow rates exists between the water surface and ice cover. The air space weakens the ice and large areas that had collapsed were normally evident. A diurnal variation in flow, resulting from the difference between night and daytime temperatures, occurred during the sampling period. The variable rates of discharge also accounted for changes in water depth and velocity at the under-ice sample sites.

Pre-migrant char (Ages I to IV) and stream resident males (non-migrant, sexually mature males) were the only life history forms of char captured in the open-water portions of the streams. The remainder of the char were captured in ice covered habitat between the open-water leads and the *aufeis* fields. The overwintering habitat extended into the upstream boundary of the *aufeis* fields where large numbers of fish were captured and observed in water that was flowing between layers of ice. Figure 3 shows a schematic drawing of the overwintering habitats examined in the Sagavanirktok River drainage.

Analysis of Overwinter Samples:

Thirty char were captured in the Lupine River on April 18, 1982. Pre-migrant and resident char were taken in ice-free habitats, while

Table 4. Site characteristics and life history stages of Arctic char captured at overwintering locations in the Sagavanirktok River drainage.

Location	H_2O Temp. (°F)	D.O. (ppm)	Conductivity (μMHO)	Hardness (ppm)	pH	Snow Depth (in.)	Ice Thickness (in.)	Water Depth (in.)	* Approx. Velocity (f.p.s.)	Species Captured	Char Life - ** History Stage
Lupine River	0	9	300	171	8.0	10	29	16	sl	AC, GR	psm, sp
Saviukviayak R.	0	10	135	188	8.0	12	34	33	sw	AC	psm, sam, adm, sp
Ivishak River	0	11	80	154	8.0	6	20	48	mo	AC, WF	psm, sam, adm, sp
"Warm Springs Cr."	4.5	10	220	171	8.5	...	...	36	mo	AC	psm

* Water velocity: sl, sluggish; mo, moderate; sw, swift

** Char life-history stages: psm, pre-smolt; sam, sub-adult migrant; adm, adult migrant; sp, spawner from previous fall.

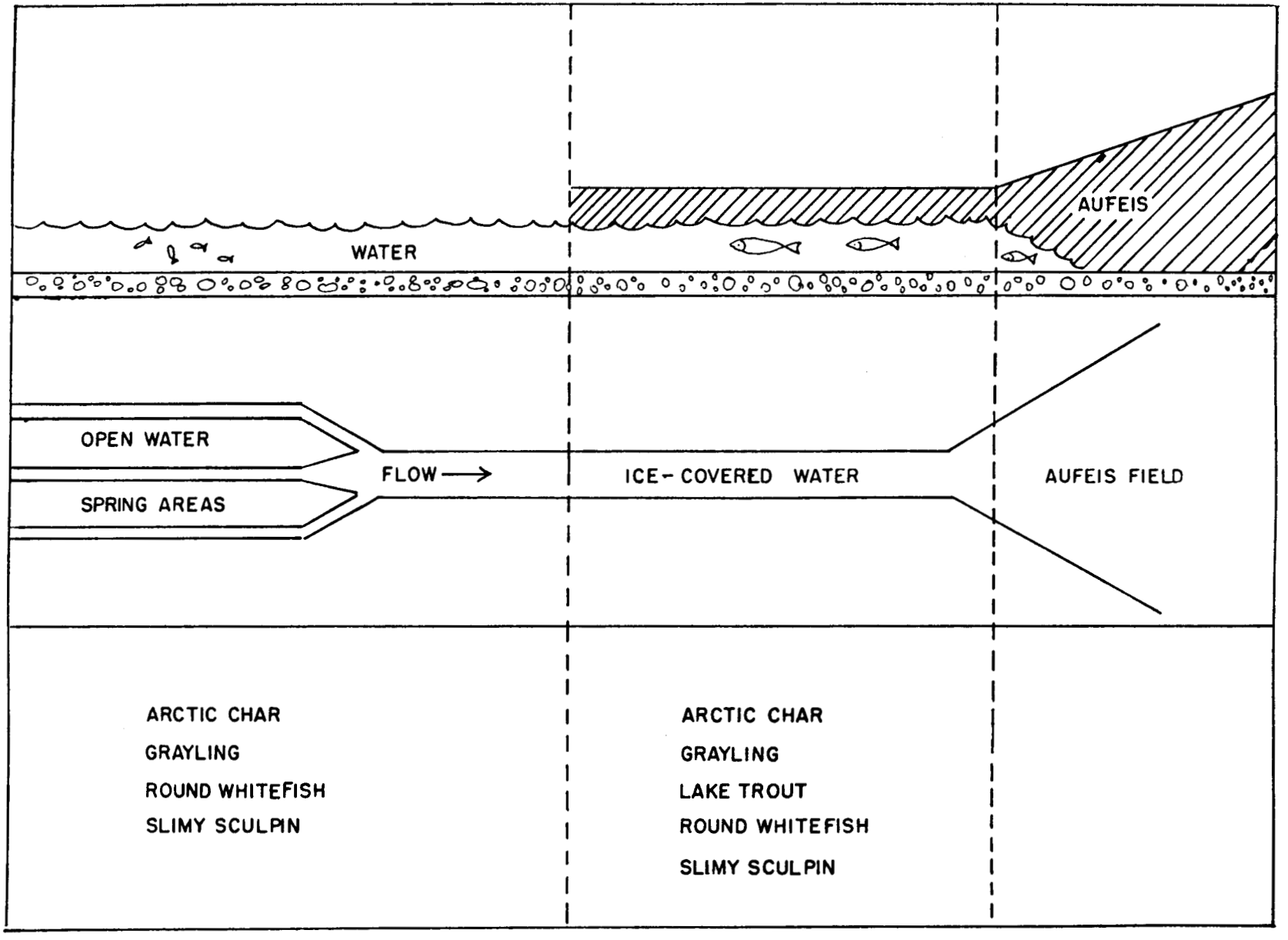

Figure 3. Schematic drawing of Arctic char overwintering habitat in the Sagavanirktok River drainage.

spawners from the previous fall, as well as pre-migrant and resident char, were captured from a single ice-covered pool below the springs. The under-ice pool measured approximately 15 ft x 2,000 ft and averaged 16 in deep. There were no non-spawning migrant char captured or seen in the Lupine River.

Seventy-one pre-migrant and resident char were captured in "Warm Springs Creek" on April 15-16, 1982. "Warm Springs Creek" remains ice-free throughout its length to the confluence with the Saviukviayak River and, again, no sub-adult or adult migrant char were observed or captured in the open water.

Twenty-eight char representing all life-history stages were captured in the Saviukviayak River in an ice-covered pool below "Warm Springs Creek." The presence of non-spawning adult char at the overwintering site suggests that these fish arrive from the Ivishak River following freeze-up. Previous observations have indicated that only spawners and non-migrant char utilize the Saviukviayak River during the open water season (Yoshihara, 1972). The overwintering channel in the Saviukviayak measured approximately 30 ft by 1.5 miles and had a maximum depth of 4 ft. It was not possible to determine the downstream extent of the overwintering habitat due to ice depths that exceeded our auger drilling capacity.

One hundred-four char representing all life history stages were captured at a single overwintering site in the Ivishak River. Premigrant char were captured in open-water areas while adult and juvenile fish were taken in under-ice habitats. The Ivishak River has numerous spring areas that combine to form a single large *aufeis* field that exceeds 10 sq mi in surface area. It is likely that there are several discrete overwintering areas within the Ivishak River.

Table 5 shows the size and age range of Arctic char taken during the sampling period. The male to female sex ratio of the combined sample was 1:1.4, Fig. 4 shows the length frequency distribution for the combined sample.

Forty-three percent of the char contained food in their stomachs. Insect larvae including stone flies, caddis flies and midzes were the major food items. Only non-migrant char including pre-smolts and resident males were feeding while overwintering migrant char had empty stomachs.

Char densities in the overwintering areas appeared high but were difficult to quantify. Char were easily seen through holes in the ice. Minnow traps set in open water areas caught an average of 1.1 fish per trap hour, with the highest catches exceeding six fish per hour. Angling for larger fish through the ice yielded a maximum catch rate of 33 fish per man-hour. Char were segregated by size at the overwintering sites, with the length of fish generally increasing with distance from the spring.

Nineteen (8%) of the char sampled were judged to be resident males, i.e. male char that do not include a seaward migration in their life history. They are characterized by having dark pigmentation, sexual maturity at an early age and parr marks that are retained throughout life. Resident males were captured at all sample sites. They ranged from 138 to 339 mm in fork length and averaged 212 mm. All were sexually mature and ranged from Age II to Age VII.

Table 5. Size and age range of Arctic char sampled under the ice in the Sagavanirktok River tributaries, April 1982.

Location	Sample Size	Length Range (mm)	Mean Length (mm)	Age Range (yrs)
"Warmsprings Creek"	71	80-154	117	0-IV
Saviukviayak River	28	149-633	383	II-IX
Lupine River	30	105-517	206	I-VIII
Ivishak River	104	122-468	254	I-VI

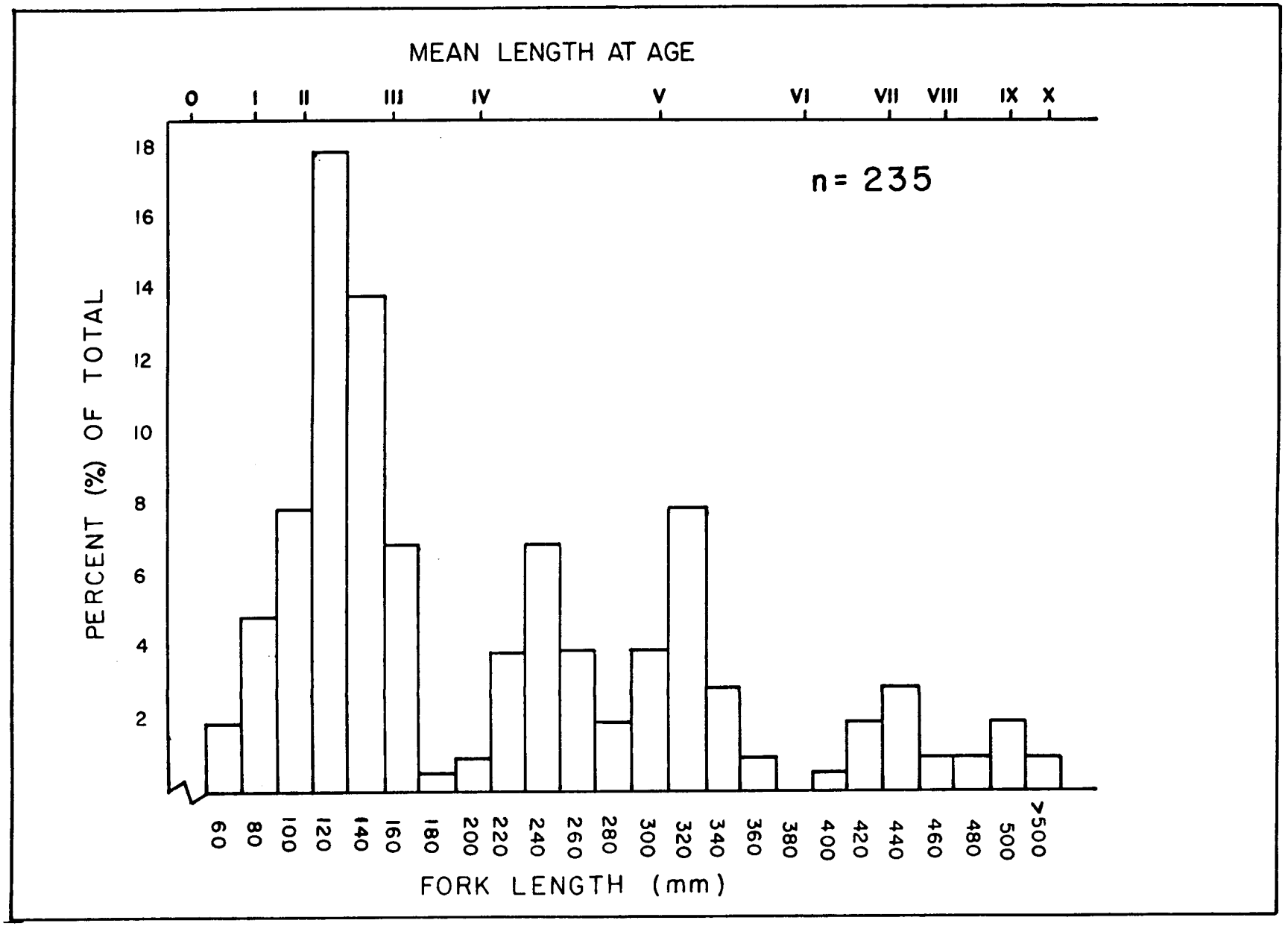

Figure 4. Length frequency, showing the mean length at age of Arctic char captured at four overwintering sites in the Sagavanirktok River drainage in April, 1982.

Management Considerations:

Arctic char overwintering areas are limited refuges in spring fed systems that support high densities of all life history stages of char. In smaller tributaries such as the Lupine River, a single confined overwintering site may support the spawning segment and pre-migrant recruitment of an entire stock of char. Spawning and overwintering sites in the smaller tributaries may be accurately delineated in order to avoid conflicting habitat uses. However, those areas in the larger, more complex systems such as the Ivishak River may contain several overwintering sites, the locations of which may change yearly due to alterations in ice accretion, erosion and stream bed displacement. Thus, in some streams, larger areas of habitat must be considered when protecting overwintering sites of fish. Locations where high densities of char are observed during the fall are not necessarily the sites used for overwintering. The location examined in the Saviukviayak River is a site where aerial observation did not reveal the presence of any char during the spawning period in 1982.

Industrial activity at overwintering sites should be avoided whenever possible. Damaging effects of gravel and water extraction or siltation during winter months may jeopardize an entire population of char that are confined to a very small stretch of river. Heavy equipment operating near *aufeis* fields may collapse sections of river ice that bridge the overwintering sites. Collapsed ice in Saviukviayak River appeared to affect the sedimentation, discharge and drainage pattern of water entering the overwintering areas. Because the stream beds are frozen solid both above and below overwintering sites, Arctic char as well as other species of fish cannot avoid either man-made or natural sources of disturbance in winter habitats.

Arctic Char Aerial Counts

Aerial counts of Arctic char have been attempted annually in the Sagavanirktok River drainage since 1971. All of the major tributaries to the Sagavanirktok River determined to be char spawning areas were counted between 1971 and 1975. Since 1976, only the Ivishak and Echooka Rivers have been counted. The Ivishak River contains the largest aggregation of char in the system and is considered an index to overall population levels. Prior to 1977, counts were conducted by helicopter; however, subsequent counts have been made using fixed wing (Piper PA-18) aircraft. All of the estimates have been made during mid-September. Aerial counts are not considered to be estimates of the char populations, but rather are a means of annually indexing both the distribution and general abundance of char. Safe flying weather has been a continual problem when conducting the char counts and poor weather has resulted in the loss of several years' counts.

Arctic char at two locations in the Anaktuvuk River drainage have been counted since 1979. At present, however, the counts in both drainages have been reduced to a single index area for each stream. Table 6 shows the estimates of anadromous Arctic char at index areas in the Sagavanirktok and Anaktuvuk River drainages. All of the counts have been conducted during the third week of September.

Table 6. Comparative aerial estimates of Arctic char on the North Slope, 1971-1983.

Year	Location	
	Ivishak River	Anaktuvuk River
1971	12,470	
1972	11,937	
1973	8,992	
1974	11,000	
1975	8,306	
1976	8,570	
*1977		
*1978		
1979	24,403	15,717
*1980		
1981	24,873	10,536
1982	36,432	6,222

* Count not conducted due to poor weather.

The 1982 estimate for the Ivishak River was considerably higher than in any previous year, although the distribution of fish was similar to that observed in earlier counts. The estimate for the Anaktuvuk River was low in 1982. The Anaktuvuk River was high and turbid during the count period. In addition, the char in the Anaktuvuk River had not aggregated into dense schools but were more widely distributed than noted in previous years. These circumstances contributed to poor counting conditions and a later count was precluded by inclement weather.

Radio Telemetry of Burbot in the Sagavanirktok River

In a continuing investigation of fresh water fish overwintering habitats on the North Slope, 11 burbot were equipped with radio-transmitters and released in a 50 mile stretch of the Sagavanirktok River. Figure 5 shows the locations of radio-tagged burbot.

Fish in the Sagavanirktok drainage have been found to overwinter in deep, under-ice pools (Bendock, 1977) and spring areas (Bendock, 1982); however, the middle stretches of the river are characterized by having neither large sources of ground water nor deep pools, yet probably support large numbers of overwintering fish. Grayling and round whitefish, the predominant summer species, undertake migrations into the smaller tributaries to the Sagavanirktok River at spring break-up and return to the river in the fall at freeze-up. Previous investigations have shown that burbot overwinter in conjunction with grayling, round whitefish and other species common to a drainage (Bendock, 1977, 1981). Due to their size and abundance, burbot were therefore chosen as a species to radio-tag in effort to identify fish overwintering habitats in the middle reaches of the Sagavanirktok River.

The 11 burbot were radio-tagged and released in the Sagavanirktok River on September 18-21, 1982. Lengths ranged from 535 mm to 910 mm, with an average of 703 mm. Weights ranged from 750 g to 5,000 g and averaged 1,977 g.

Results of this study will be reported on at a later date.

Lake And Stream Surveys

During the report period, fisheries surveys were conducted on seven unnamed lakes in the vicinity of the Dalton Highway along the North Slope. Surveys were brief, but included information on size, depth, water chemistry and species present. Fig. 6 shows the location of each of the lakes surveyed. All of the surveys were conducted during April and May, when the lakes were still ice covered. Fish were sampled at lakes 1 and 5 by angling through the ice. Graduated mesh gill nets were set under the ice for 24-hour intervals in the remaining lakes. Table 7 lists the surface elevation, water chemistry and species captured at each of the sites.

Fish were captured in two of the seven lakes. Those lakes without fish had low dissolved oxygen, shallow depths and lacked substantial outlets for accommodating seasonal migrations of fish. Two mature grayling were captured in lake #5.

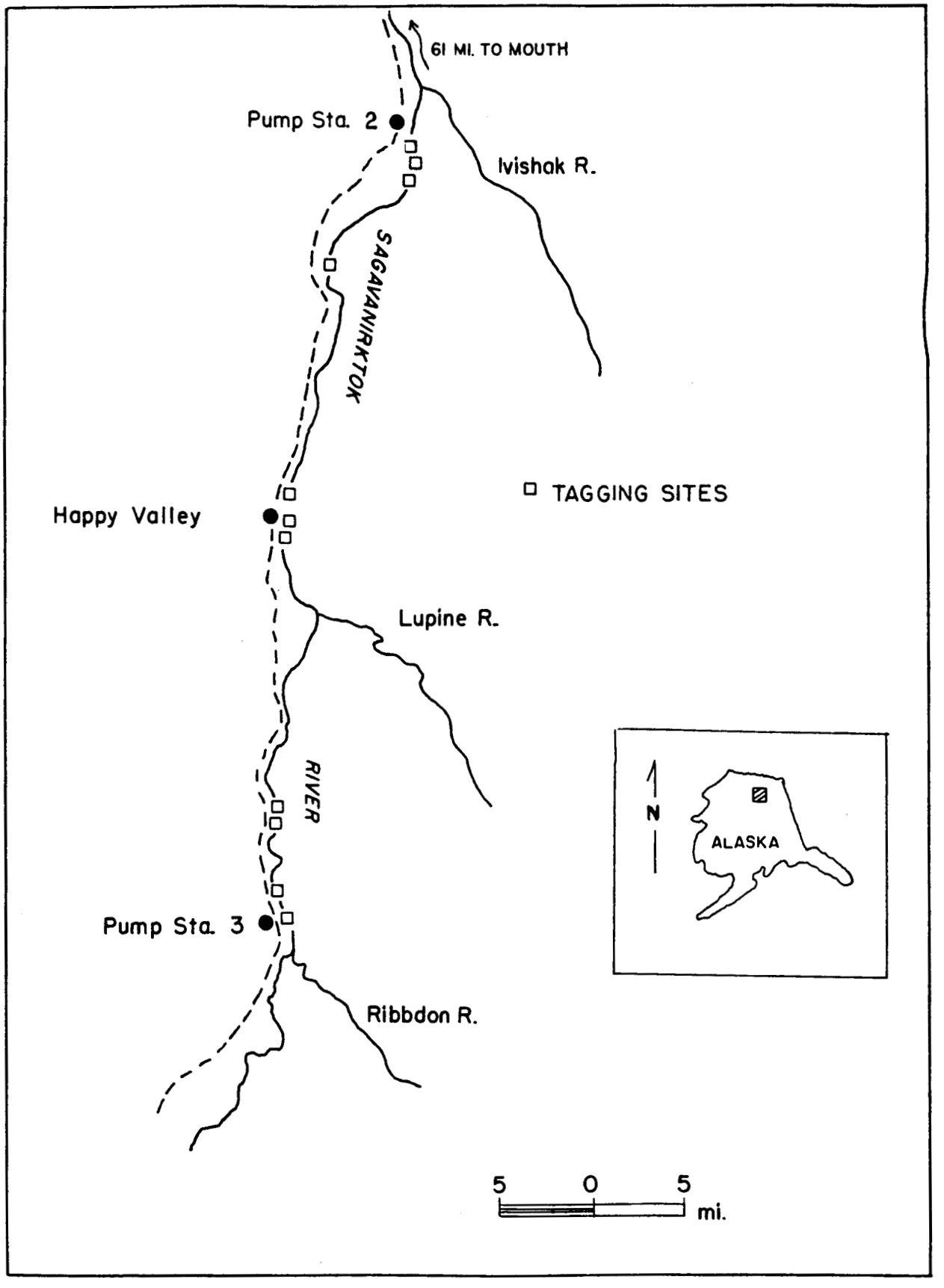

Figure 5. Sagavanirktok River showing locations of eleven radio-tagged burbot, 1982.

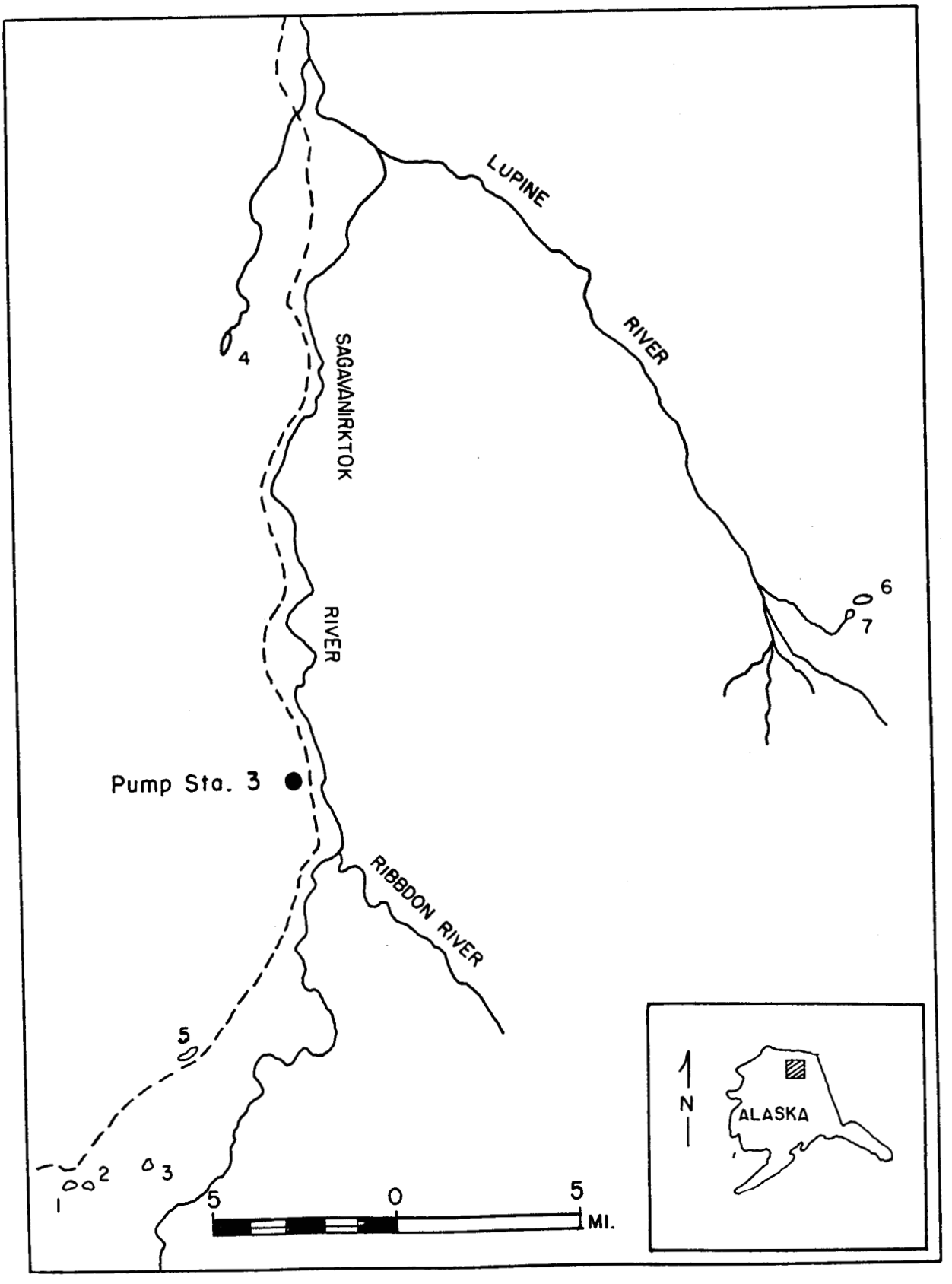

Figure 6. Sagavanirktok River drainage showing locations of seven lakes surveyed in 1982.

Table 7. Surface elevation, water chemistry and species captured in seven lakes surveyed during 1982.

Lake	#	Surface Elev. (ft)	Depth (ft)	D.O. (ppm)	Hardness (ppm)	pH	Species
"Cutoff"	1	2,500	20	10.0	120	7.5	AC, SSC
"Below Little Taho"	2	2,400	7	1.8	308	7.0	0
"Little Taho Drain"	3	1,900	4	1.6	239	7.0	0
"Seven Gear"	4	1,400	18	1.4	172	7.5	0
"Slope Mtn. Lake"	5	2,000	15	...	103	7.5	GR
"North Lupine"	6	1,550	12	6.0	137	7.0	0
"South Lupine"	7	1,550	13	2.0	154	7.0	0

Thirteen Arctic char were captured in lake #1. Char ranged from 149 mm to 472 mm in fork length and averaged 342 mm. Weights ranged from 20 g to 850 g, with an average of 401 g. The male to female sex ratio was 1:1.2 Ages ranged from Age V to Age XII. All but one fish contained food in their stomachs and snails were the predominant food item.

Nigu-Etivluk River:

The Nigu River, an upper tributary to the Colville River, heads in Imakturok Pass and flows northwest 70 miles. It enters the Etivluk River 37 miles above the Colville. The Nigu River drains an area of 694 sq mi and has an estimated mean annual flow of 350 cfs. The river is inaccessible by boat from the Colville River; however, it has become a popular raft trip for visitors to the North Slope.

A fisheries survey of the Nigu and lower Etivluk Rivers was conducted by raft between August 11-16, 1982. A float plane was taken to a small unnamed lake east of Kivliktort Mountain, from which the equipment was packed to the river. Adjacent to Kivlitort Mountain, the Nigu is approximately 100 ft wide with broad riffle areas and had a velocity of 5 fps. Water temperature was 48°F. The lower river descends at a rate of approximately 20 ft. per mile. The streambed is large unconsolidated till, and aquatic vegetation is sparse. The drainage is a single or split channel meander throughout most of its length. The Etivluk River is similar in character, with a broader valley and short pools up to 10 ft deep.

The lower 15 miles of the Etivluk River are accessible by riverboat during periods of high water. Grayling and ninespine stickleback were the only species captured during the survey. Grayling were distributed throughout the Etivluk and Nigu Rivers. Young-of-the-year grayling ($\bar{x}$ 44 mm) were captured or observed from Nigu Bluff downstream to the mouth of the Etivluk. Spawning habitat appears abundant in the mainstem of both streams. East Fork and Kutchaurak Creek, the two largest tributaries on the lower Etivluk were discontinuous or extremely low due to the lack of recent precipitation. Overwintering habitat in both the Nigu and Etivluk Rivers appears to be limited due to the lack of deep pools or ground-water sources. Other species of fish captured at the mouth of the Etivluk include round whitefish, broad whitefish, lake trout, burbot, longnose suckers and slimy sculpin (Bendock, 1979). Most of these species, however, appear to be limited to the lower Etivluk River and its confluence with the Colville. An additional species, least cisco, inhabits lakes within the Etivluk drainage and resident Arctic char are reported to inhabit the river (Morrow, 1973).

Thirty-four grayling were sampled during the survey of the the Nigu and Etivluk Rivers. The male to female sex ratio of sampled fish was 1:0.32. All of the grayling were mature. Fork lengths ranged from 295 mm to 432 mm and averaged 343 mm. Weights ranged from 300 g. to 825 g. and averaged 423 g. Ages ranged from Age VI through Age XI. of the grayling were feeding on adult insects. There were no subadult (rearing) grayling taken in the sample.

Anaktuvuk River:

The Anaktuvuk River, second largest tributary to the Colville River, heads in the Endicott Mountains and flows north northwest for 132 mi. It enters the Colville River 91 mi inland from Harrison Bay. The Anaktuvuk River drainage is 2,839 sq mi and the estimated mean annual flow is 1,420 cfs. The Nanushuk River, largest of three main tributaries entering the Anaktuvuk River, flows north for 94 mi and drains an area of 896 sq mi. There are numerous lakes within the Anaktuvuk River drainage. Shainin Lake, the largest, is 2.7 mi long and has a maximum depth of 56 ft. Deep lakes within the drainage are typically inhabited by lake trout, Arctic char, grayling, round whitefish and least cisco.

The Anaktuvuk River is heavily braided throughout most of its length and has bottom material ranging from fine sand in the upper valley to large gravel and boulders in the middle and lower reaches. Tundra vegetation extends to the active floodplain in the upper valley, while larger willow communities and occasional cottonwood stands flourish along the river downstream from Table Mountain. Spring areas, perennial sources of ground water, are abundant within the river valley, creating fields of *aufeis* that remain throughout most of the open water season. Areas of the stream bed associated with retreating *aufeis* fields may be extremely braided and difficult to navigate with a raft during periods of low flow.

Anaktuvuk Pass, a small Nunamiut village, is located at the head of the Anaktuvuk River. Downstream there are two gravel airstrips constructed for exploratory oil drilling adjacent to the river. Access to both airstrips is presently controlled by the Arctic Slope Regional Corporation. The upper ten miles of the Anaktuvuk River fall within the boundaries of the Gates of the Arctic National Park. Fishing pressure within the drainage is light.

Arctic char, lake trout, grayling, round whitefish, broad whitefish, burbot, slimy sculpin and ninespine stickleback inhabit the Anaktuvuk River. Pink salmon, chum salmon, humpback whitefish and longnose suckers have been captured at the confluence with the Colville River. Bendock (1979) presented information from a riverboat survey of the lower 4 mi of the river. The lower 15 mi of the river is navigable by riverboat during the spring flood.

A fisheries survey of the Anaktuvuk River was conducted by raft between July 23-27, 1982. The trip began at Tulugak Lake and ended at the confluence with the Colville River. Several life history aspects of anadromous Arctic char inhabiting the Anaktuvuk River have been investigated by Bendock (1981, 1982). One of the object of the present survey was to determine whether some pre-spawning adult char remain in the Anaktuvuk River during the summer prior to spawning. Observations of char in the stream were unsuccessful during several low-level aerial surveys, thus an effort was made to capture fish using gill nets and angling gear during a float trip.

Eight Arctic char were captured between July 24-27, 1982. Three of the char were captured at the confluence with the Colville River and were presumed to be early-return migrants. Two char were captured adjacent to

Rooftop Ridge in a stretch of river used for fall spawning and overwintering and three char were captured at the mouth of the Kanayut River, 61 mi above the Colville River. All of the char were mature and in pre-spawning condition. The fish ranged from 555 mm to 700 mm fork length and averaged 638 mm. Weights ranged from 1,650 g to 2,850 g and averaged 2,436 g. All of the char had empty stomachs. The male to female sex ratio was 1:1.3. Female egg diameters averaged 3.0 mm. Ages ranged from Age II to Age IX years.

It was not possible to conclude that the char captured in the Anaktuvuk River had not undergone a seaward migration due to the presence of migrants captured at the mouth during the same time period. The spring migration in the Anaktuvuk River usually occurs during the middle of June, (Bendock, 1982). Thus, some pre-spawning individuals may migrate to sea for as little as 4 weeks prior to returning to spawn.

A total of 22 grayling was sampled during the Anaktuvuk River Survey. They ranged in fork length from 315 mm to 405 mm and averaged 360 mm. Weights ranged from 310 g to 775 g and averaged 456 g. The male to female sex ratio was 1:0.46. All of the grayling were mature and ages ranged from Age VII to Age XI. All of the grayling had been feeding on adult and larval insects.

Dalton Highway Sport Fishing

The Dalton Highway (North Slope Haul Road), build in 1974 and transferred to the State in 1978, was reopened to Sport fishing in 1979. Access during 1979 was limited to permitted commercial users which restricted sport fishing opportunities primarily to truckers and employees of Alyeska and the State Department of Transportation. During the summer of 1981, the highway was opened for public travel from the Yukon River to Disaster Creek, approximately 150 mi north of the Yukon.

Sport fishing pressure along the haul road has been monitored by observing fishermen, conducting creel census interviews and by observing the location and intensity of fishing from overflights in fixed wing aircraft.

Sport fishing pressure continues to be light throughout the Dalton Highway corridor north of the Yukon River. Effort remains concentrated near Alyeska Co. pump stations. The most frequently fished locations south of Atigun Pass are Prospect Creek, Jim River and Grayling Lake. North of Atigun Pass the lakes in the vicinity of Toolik Lake and the upper Kuparuk River are most frequently fished. Grayling are the principal species taken along the highway, while lake trout and Arctic char are taken in small numbers north of the Brooks Range.

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