Volume 23 Study No. G-I

RESEARCH PROJECT SEGMENT

State:	ALASKA	Name:	Sport Fish Investigations of Alaska
Project No.:	F-9-14		
Study No.:	G-I	Study Title:	INVENTORY AND CATALOGING
Job No.:	G-I-I	Job Title:	Inventory and Cataloging of Arctic Area Waters
Cooperator:	Terrence N. Bendock		
Period Covered:	July 1, 1981 to June 30, 1982		

ABSTRACT

This report presents baseline fisheries information on 23 lake surveys conducted on the North Slope, overwintering habitats of Arctic char, Salvelinus alpinus (Linnaeus) in the Anaktuvuk River, aerial index counts of char in the Sagavanirktok and Anaktuvuk River drainages, an experimental stocking of grayling Thymallus arcticus (Pallas) at Pt. Barrow and angling effort along the Dalton Highway.

Lake surveys were conducted on four mountain, and 19 coastal plain lakes during 1981. Seventeen (74%) of the waters investigated contained fish. Least cisco, Coregonus sardinella Valenciennes, and lake trout, Salvelinus namaycush (Walbaum), were the most frequently encountered species. A brief life history discussion of the predominant species is presented.

Radio telemetry was used to monitor the winter movements of 12 Arctic char in the Anaktuvuk River. Tagged char, under the Anaktuvuk River ice, were essentially sedentary for a period of time exceeding 8 months. There was some evidence that fish segregated by species and size within spring areas during the winter months. A description of the overwintering habitat is presented.

Aerial index counts of Arctic char in the Anaktuvuk and Sagavanirktok Rivers were conducted. Values obtained during the surveys compared favorably with previous estimates.

A freshwater lagoon at Pt. Barrow was investigated and approved for stocking with 50,000 grayling fry. An evaluation of the success of this stocking has not been completed at this time.

Sport fishing pressure along the Dalton Highway was monitored during the summer of 1981. Sport fishing pressure north of the Yukon River was light,

and concentrated near Alyeska Pump Stations. Unrestricted public access to the first 150 mi of highway north of the Yukon River did not appreciably affect sport fishing pressure and harvest.

KEY WORDS

Arctic char, Salvelinus alpinus (Linnaeus), interior Alaska, Anaktuvuk River, Arctic Grayling, Thymallus arcticus (Pallas), char tagging, winter movements, fishing pressure.

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. Construction of the Dalton Highway (North Slope haul road) has tied the North Slope into the existing state highway system. Improved access has increased the demand for sport fishing, as well as other recreational, municipal, and commercial endeavors in this remote region of the state.

Petroleum exploration and development is the overriding 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.

The Alaska National Interest Lands Conservation Act, in 1980, withdrew vast areas of the North Slope into the National Wildlife Refuge, National Park, and National Wild and Scenic Rivers systems which has heightened the area's scenic and wildlife values with a supplicatory advertising campaign.

The report findings for this study are presented in five sections, each treated as a separate phase of the project. The first section describes lake surveys conducted in both mountain and coastal plain waters of the North Slope. In a continuing effort to inventory the region's fresh water fish resources, four mountain lakes and 19 coastal plain lakes were surveyed. A brief life history discussion of the major species found in coastal plain waters follows in this section.

Section two describes winter habitats and movements of Anaktuvuk River Arctic char based on a study using radio-telemetry to track fish movements under the ice. To confirm these results and describe additional overwinter char habitats, 16 Arctic char were radio-tagged in four tributaries to the Sagavanirktok River during 1981.

Additional sections include discussions of Arctic char aerial surveys, an experimental lake stocking near Pt. Barrow and sport fishing pressure along the Dalton Highway.

Table 1 lists the species of fish inhabiting waters of the North Slope and found along the highway north of the Yukon River. A map of the study area is shown in Fig. 1.

Table 1. Fish species found along the haul road 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
Chinook 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

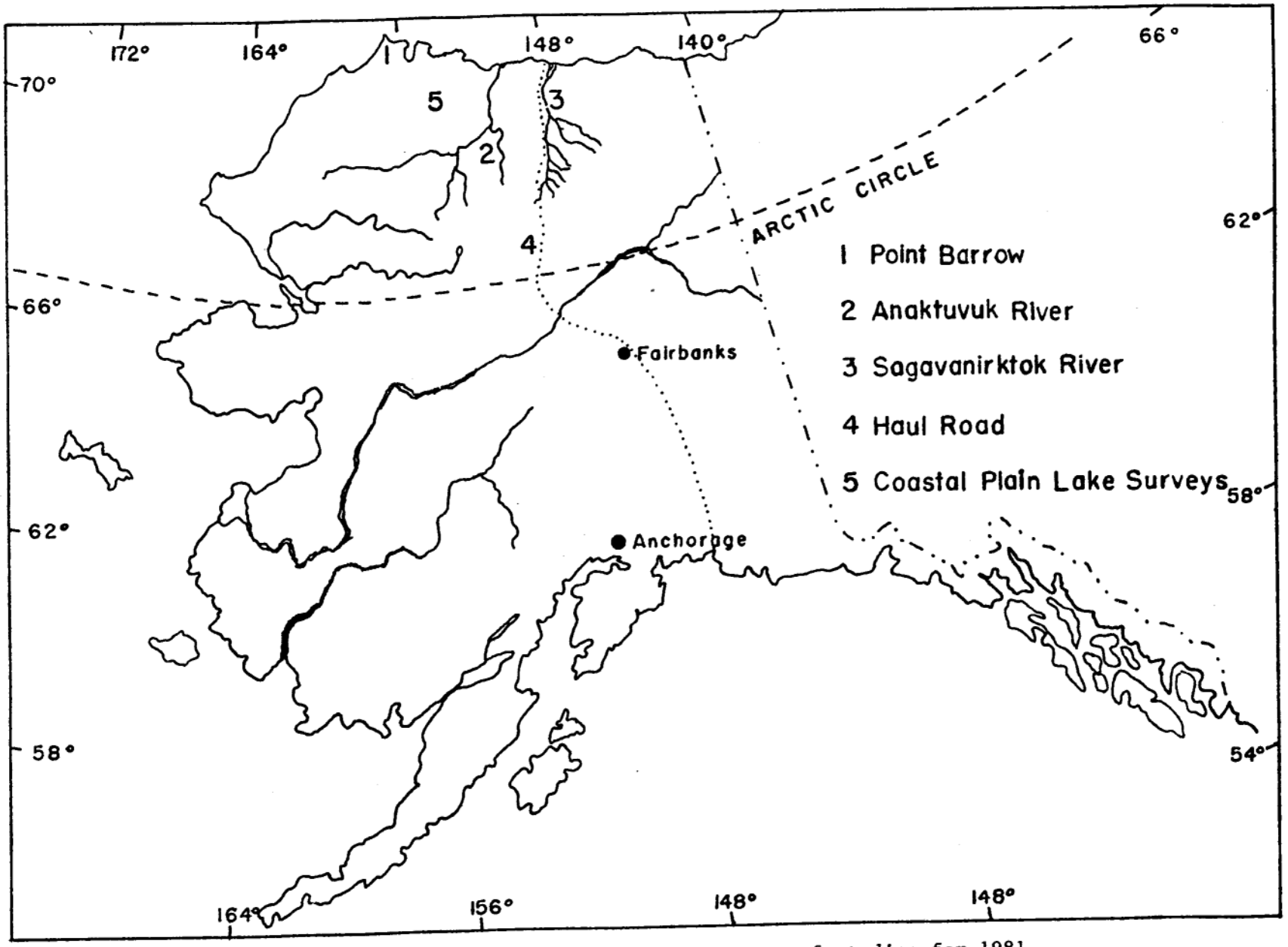

Figure 1. State of Alaska showing the North Slope and locations of studies for 1981.

RECOMMENDATIONS

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 spring-fed systems and the Sagavanirktok River.

3. Evaluation of grayling stocked at Pt. Barrow should continue.

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

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.

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 1956 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 or 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 and Arctic char.

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 Anaktuvuk River were determined using radio-telemetry. Ski-equipped aircraft 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 Anaktuvuk River 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

Sixteen Telonics RB-5 radio transmitters were inserted into the stomachs of Arctic char captured in four tributaries to the Sagavanirktok River. The implant and tracking procedures are discussed in Bendock (1981).

FINDINGS

Lake Surveys

During the report period, fisheries surveys were conducted on four mountain lakes and 19 coastal lakes. Surveys were brief, but included information on size, maximum depth, water chemistry and species present. A single experimental gill net was fished overnight in each of the lakes. Life history discussions, following the survey descriptions, refer only to fish captured in the coastal plain.

Mountain Lakes

Most of the large mountain lakes, lying north of the Brooks Range divide, have had preliminary fisheries surveys conducted on them. Bendock (1979, 1980) presented survey information on mountain lakes in the Colville drainage and in the vicinity of the "haul road" corridor. Mountain lakes in the Brooks Range are oligotrophic, usually glacial in origin, with relatively steep sides and rubble or boulder bottoms. Most mountain lakes have small, narrow basins. Chandler Lake, the largest, is 5 mi long and has a maximum depth of 62 ft. Large mountain lakes are ice covered from October through June. Typical fish associations include lake trout, burbot, grayling, round whitefish and slimy sculpin. Least cisco inhabit mountain lakes in the Colville and Sagavanirktok River drainages and Arctic char are widely scattered in lakes throughout the Brooks Range.

Mountain lakes on which fisheries surveys have not been conducted are predominantly small, unnamed and inaccessible; however, many of these waters contribute to the sport and subsistence fisheries of the region and are increasingly being used as temporary water sources for exploratory oil drilling operations. Mountain lakes surveyed during 1981 are shown in Figure 2.

Tulugak Lake

Tulugak Lake, lat. 68° 17'N, long. 151° 28'W., lies 12 mi northeast of Anaktuvuk village, surface elevation is 1,940 ft. It is 0.8 mi long with a maximum depth of 40 ft. Water color is green and the Secchi reading was 9 ft on July 23, 1981. Bottom material varies from sand to large gravel and aquatic vegetation is sparse. Tundra vegetation extends to the waterline along most of its perimeter. Tulugak Lake is fed by ground water springs which flow a short distance and enter the lake along the east shore. A single outlet drains into the Anaktuvuk River from the north shore. The springs provide a constant source of year-round water to Tulugak Lake, thus providing continuous flow in the outlet throughout the winter. Hardness was 85.5 ppm; pH 9 and water temperature 52°F during the survey period

A single 125' experimental gill net set overnight yielded a catch of 5 lake trout, 5 grayling, 7 round whitefish and 11 least cisco. While none were captured, burbot are reported to inhabit the lake. Large numbers of fish spawning in the outlet of Tulugak Lake have been observed from the air during September. Limited subsistence fishing by residents of Anaktuvuk village takes place in Tulugak Lake, primarily in the fall.

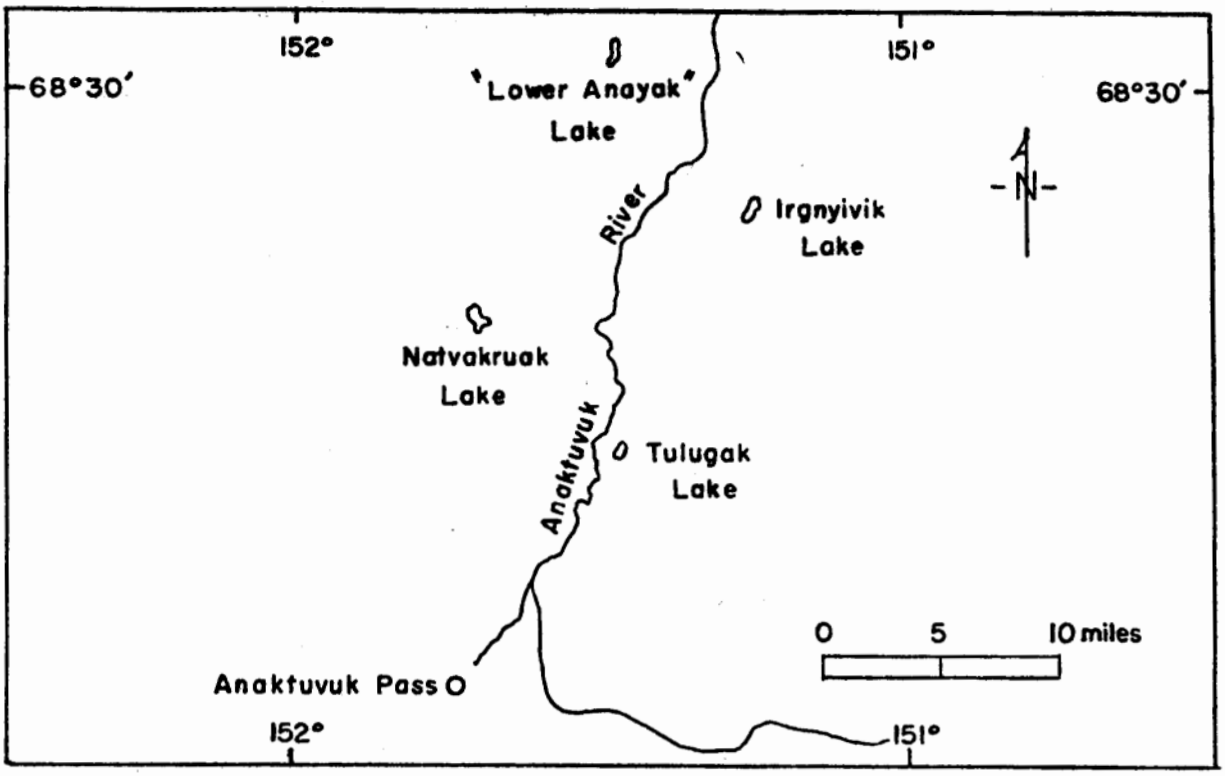

Figure 2. Map of Anaktuvuk Pass showing locations of four mountain lakes surveyed during 1981.

Irgnyivik Lake

Irgnyivik Lake, lat. 68° 26'N, long. 151° 16'W., lies 24 mi northeast of Anaktuvuk Pass. Surface elevation is 1,950 ft. It lies in a narrow basin and is 1.2 mi long with a maximum depth of 55 ft. There is a single inlet on the north end and an outlet on the south which flows into the Anaktuvuk River. The outlet may be discontinuous during midsummer and is marginal for fish passage. Aquatic vegetation is sparse and the lake bottom is comprised of sand, rubble and widely scattered large boulder reefs. Water color is green and the Secchi reading was 22 ft on July 23, 1981. Hardness was 103 ppm, pH 9 and water temperature was 58°F during the survey period.

A single 125-ft experimental gillnet set overnight yielded a catch of 19 lake trout, 6 round whitefish and 1 grayling. Slimy sculpins were observed in littoral areas. Access to the lake is limited to aircraft and snow machines and there was no evidence of recent sport or subsistence fishing activity.

"Lower Anayak Lake"

"Lower Anayak Lake," lat. 68° 32'N, long. 151° 29'W is an unnamed lake that lies in the lower Anayaknaurak Creek drainage, 27 mi north of Anaktuvuk Pass. Surface elevation is 2,520 ft. The lake has a narrow basin, is 1.0 mi long with a maximum depth of 22 ft. Tundra vegetation extends to the waterline, leaving no exposed beaches. Bottom material is soft peat with scattered rubble reefs. There is one inlet and a single outlet, both of which appear to maintain adequate flow for fish passage, and have gravel or boulder substrates. The water is tea colored with a Secchi reading of 6 ft. On July 23, 1981, hardness was 171 ppm, pH 7.5 and water temperature 61°F.

A single experimental gillnet set overnight yielded a catch of 9 lake trout, 4 round whitefish and 1 grayling. There was no evidence of recent sport or subsistence fishing activity.

Natvakruak Lake

Natvakruak Lake, lat 68° 22'N, long 151° 43'W lies at the head of Natvakruak Creek, in the Chandler River drainage approximately 16 mi north of Anaktuvuk Pass. Surface elevation is 2,460 ft. The lake has a rectangular basin, is 1.2 mi long, and is 60 ft deep. There are short, exposed beaches comprised of large boulders and rubble. The water is tea-colored and had a Secchi reading of 20 ft on July 23, 1981. Aquatic vegetation is sparse. There are a single inlet and outlet, both of which may seasonally provide passage for fish. Hardness was 68 ppm, pH 8.5 and water temperature 55°F.

One experimental gill net set overnight yielded a catch of five lake trout and one round whitefish. Slimy sculpin were observed in littoral areas. Considerable litter exists at several sites around the lake. There is also evidence of sport and subsistence fishing as well as past oil company activities at Natvakruak Lake.

Coastal Plain Lakes

The Arctic coastal plain on the north Slope extends from cape Lisburne to the Canadian Border. At its greatest depth south of Barrow, the coastal plain extends 115 mi inland, while on the eastern border it is less than 10 mi deep. The coastal plain is characterized by abundant lakes, wet tundra, meandering streams, low relief and thermokarst features. Precipitation is low (5" to 7"annually) and surface drainage is poor due to flatness of terrain, continuous permafrost and low rates of evaporation. Lakes within the region are "thaw lakes" and cover up to 50 percent of the total plain area. Four lakes within the region are greater than 10 sq mi in area. The largest, Teshekpuk Lake, is 25 mi long and covers 315 sq mi. Lakes within the region generally tend to be shallow; however, a significant number have deep basins and provide year-round habitat for fish. Deep basins, where they exist, are considerably smaller than the total surface area of the lake, thus surface area alone does not adequately indicate which lakes support populations of fish. The amount of basin area may also limit species diversity and population size within a lake. Shallow lakes usually do not support fish except where seasonal access is provided by inlet and outlet streams.

Species diversity and abundance varies throughout the coastal plain. Netsch et. al. (1977) surveyed several coastal lakes and streams north of the Colville River, in the northern half of the National Petroleum Reserve - Alaska. This and other studies indicate that species diversity is lowest on both the eastern and western margins of the coastal plain and greatest in the central region lying south of Teshekpuk Lake and west of the Colville River. During the report period, 16 lakes within this area were surveyed (Fig. 3). These waters were moderately deep, ranging from 8 ft to 50 ft, soft and slightly basic. Many of the lakes had extensive, unvegetated shoal areas on which ice remains grounded throughout the winter. Submerged aquatic vegetation is sparse and sand is the most common substrate in both lake basins and river beds within this area. Both sport and subsistence fishing pressures are minimal. Much of this region will be leased for oil and gas exploration in the near future. Three additional lakes near Prudhoe Bay were also surveyed during the report period. None of the lakes surveyed are named on USGS 1:250,000 maps. A single 125-ft experimental gill net was set overnight in each of the coastal plain lakes. Table 2 lists the locations, physical characteristics and species captured in each of the waters surveyed.

Life History Discussions of Coastal Plain Species

Of the 16 coastal plain lakes surveyed west of the Colville River, 13 (81%) contained populations of fish. The most common species occurring within the area in terms of frequency of occurrence and catch per unit effort included least cisco, broad whitefish and lake trout, followed by round whitefish, humpback whitefish, burbot and grayling. Burbot are not readily captured by gill net, and thus may be more abundant than indicated. Ninespine stickleback and slimy sculpins, while not captured, were found as food items in lake trout and burbot. The following discussions are based on fish captured in 1981, but also include samples from 1979 taken in Teshekpuk Lake.

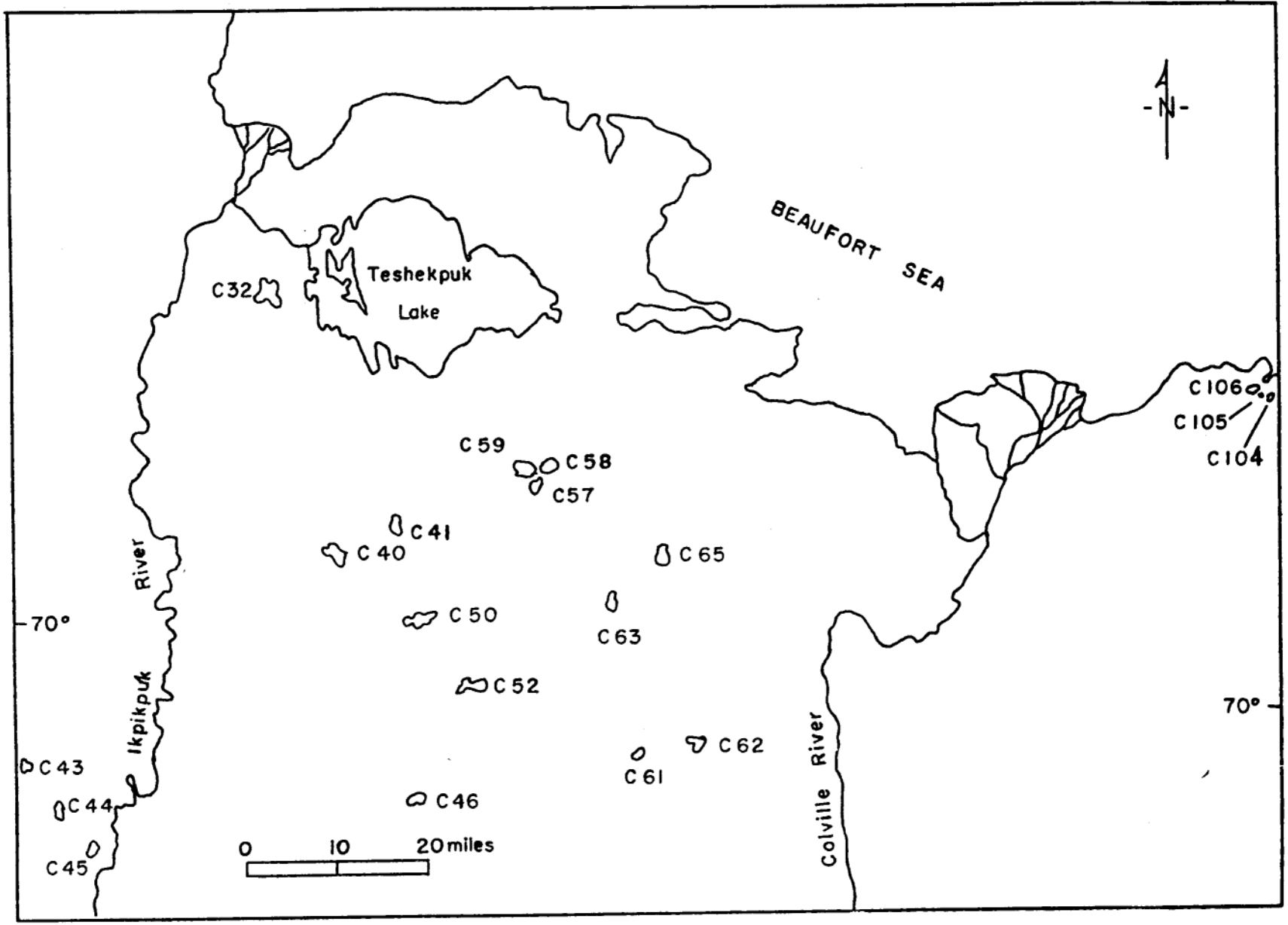

Figure 3. Coastal Plain Province of North Slope showing locations of lakes surveyed during 1981.

Table 2. Locations, physical characteristics and species captured in 19 coastal plain lakes during 1981.

Ref. #	Lat. °N.	Long. °W.	Surface Elevation (ft.)	Approx. Length (mi)	Max. Depth (ft)	Secchi Reading (ft)	Hardness (ppm)	pH	H_2O Temp (°F)	Species Captured
C-32	70° 34'	154° 18'	8	3.2	20	7	103	9	50	LCI, BWF
C-40	70° 09'	153° 55'	164	3.0	18	16	68	9	55	LT, BWF, LCI, RWF
C-41	70° 12'	153° 39'	160	2.1	22	20	86	9	53	LT, LCI
C-43	69° 46'	155° 18'	180	1.1	23	12	120	9	55	None
C-44	69° 42'	155° 08'	250	1.9	22	15	103	9	56	None
C-45	69° 39'	154° 58'	290	1.6	8	8	137	9	54	GR
C-46	69° 46'	153° 28'	280	2.0	10	8	68	9	57	None
C-50	70° 03'	153° 30'	145	3.6	45	20	86	9	54	LT, BWF
C-52	69° 57'	153° 15'	200	3.0	50	15	86	9	57	LT, BWF, LCI, RWF, BB NSB, SSC
C-57	70° 17'	153° 00'	120	2.5	37	22	103	9	51	LT, LCI, NSB
C-58	70° 18'	152° 56'	122	2.2	10	8	86	9	55	LT, BWF, NSB
C-59	70° 18'	153° 04'	123	2.3	44	20	103	9	55	LT, BWF, RWF, LCI, NSB
C-61	69° 51'	152° 27'	210	1.5	30	20	86	9	55	LCI
C-62	69° 53'	152° 11'	210	1.5	27	12	68	8.5	56	LCI, NSB
C-63	70° 06'	152° 37'	86	2.0	8	6	86	9	62	BWF, LCI, HWF, NSB
C-65	70° 10'	152° 23'	141	2.2	15	15	86	9	55	LCI, NSB
C-104*	70° 28'	149° 25'	28	0.6	5	...	205	7.5	32	None
C-105*	70° 28'	149° 27'	20	0.2	2.5	...	171	7.5	32	None
C-106*	70° 29'	149° 33'	7	0.8	7	7	103	8.0	32	None

* Surveys were conducted on October 22, 1981, all other waters were surveyed during the third week of July, 1981.

Least Cisco

Least cisco are distributed throughout the North Slope of Alaska, primarily inhabiting mountain and coastal lakes and the lower reaches of large rivers. Anadromous least cisco from the Colville River enter the Beaufort Sea and forage as far east as Barter Island during the summer months.

Least cisco were captured in 10 (63%) of the coastal plain lakes and were the most frequent and abundant species encountered. A total of 103 least cisco was captured in the coastal plain lakes and 26 were captured in Teshekpuk Lake. Of this total, 107 were sampled. The largest catches were taken from lakes C-62 (n=32) and C-32 (n=20).

Least cisco ranged from 127 mm to 436 mm in length and averaged 288 mm. The length frequency of 107 least cisco is shown in Figure 4. Weights ranged from 20 g to 1,100 g and averaged 274 g. The female to male sex ratio was 1:1.3. Ages ranged from III through XXI. The age at maturity was IV for a smaller least cisco morph found in Teshekpuk Lake and Age IX for ciscos taken in the remaining waters.

Least cisco are opportunistic feeders, utilizing a variety of prey found throughout the water column. Eighty percent of the least cisco stomachs examined contained food. The following food items were found in descending frequency of occurrence: aerial insects (primarily mosquitoes), snails, amphipods, clams, caddis larvae, ninespine stickleback, zooplankton and isopods. The first three categories represented 85% of the total food items.

Growth rates of coastal plain and anadromous least cisco from the North Slope are compared to cisco from Minto Flats (Interior Alaska) in Figure 5. Least cisco from the Arctic Slope coastal plain exhibit slower growth, greater age at maturity and greater longevity than those from Interior Alaska. On the North Slope, lake resident cisco attain a greater ultimate size and longevity than their anadromous counterparts. In coastal plain lakes, least cisco are an important forage fish for both lake trout and burbot.

Broad Whitefish

Broad whitefish are distributed in lakes and streams throughout the North Slope and are reported to be anadromous in the Colville and Sagavanirktok Rivers. Broad whitefish were captured in seven (44%) of the coastal plain lakes surveyed. Seventy-nine broad whitefish were captured from coastal plain lakes, including Teshekpuk Lake, and 66 of these were sampled. The largest catches occurred in Teshekpuk Lake and Lake C-63.

Broad whitefish ranged from 260 mm to 583 mm in length and averaged 463 mm. The length frequency of 66 broad whitefish is shown in Figure 6. Weights ranged from 190 g to 2,600 g and averaged 1,388 g. The female to male sex ratio was 1:1 and ages ranged from V to XX. The first age of maturity was X for both sexes of broad whitefish.

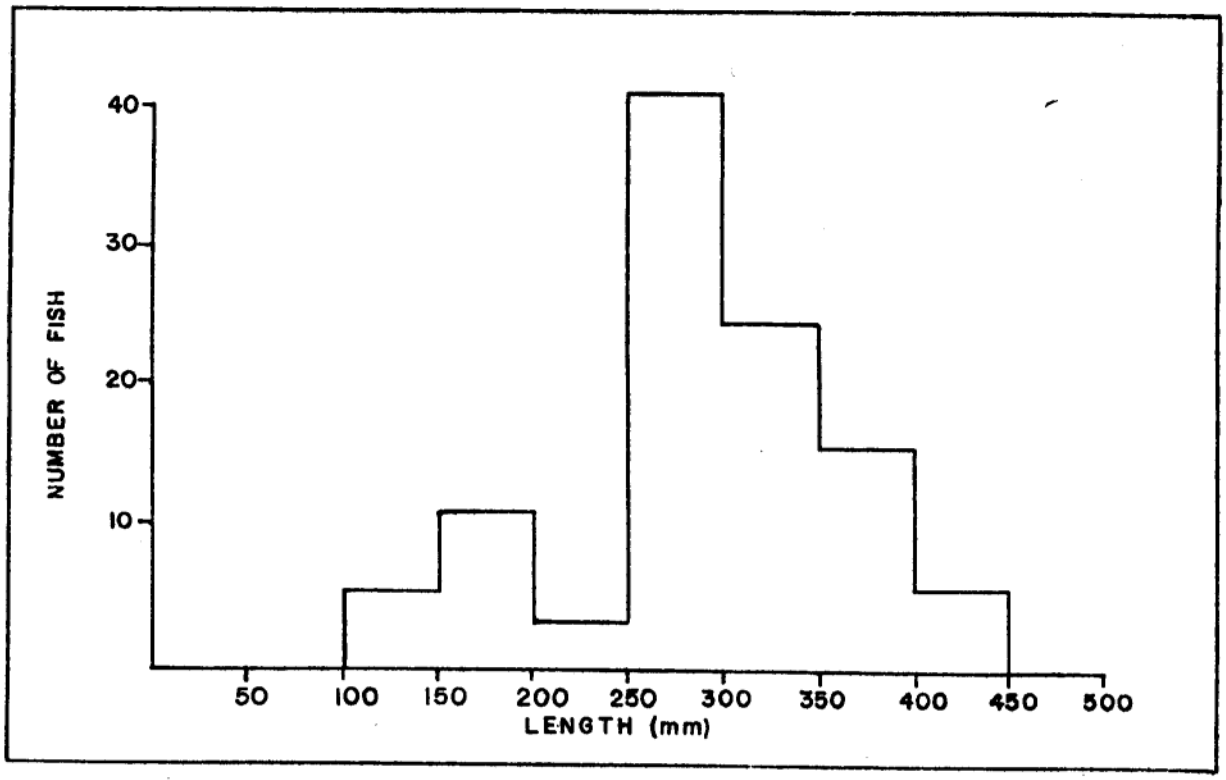

Figure 4. Length frequency of 107 least Cisco captured in Arctic coastal plain lakes.

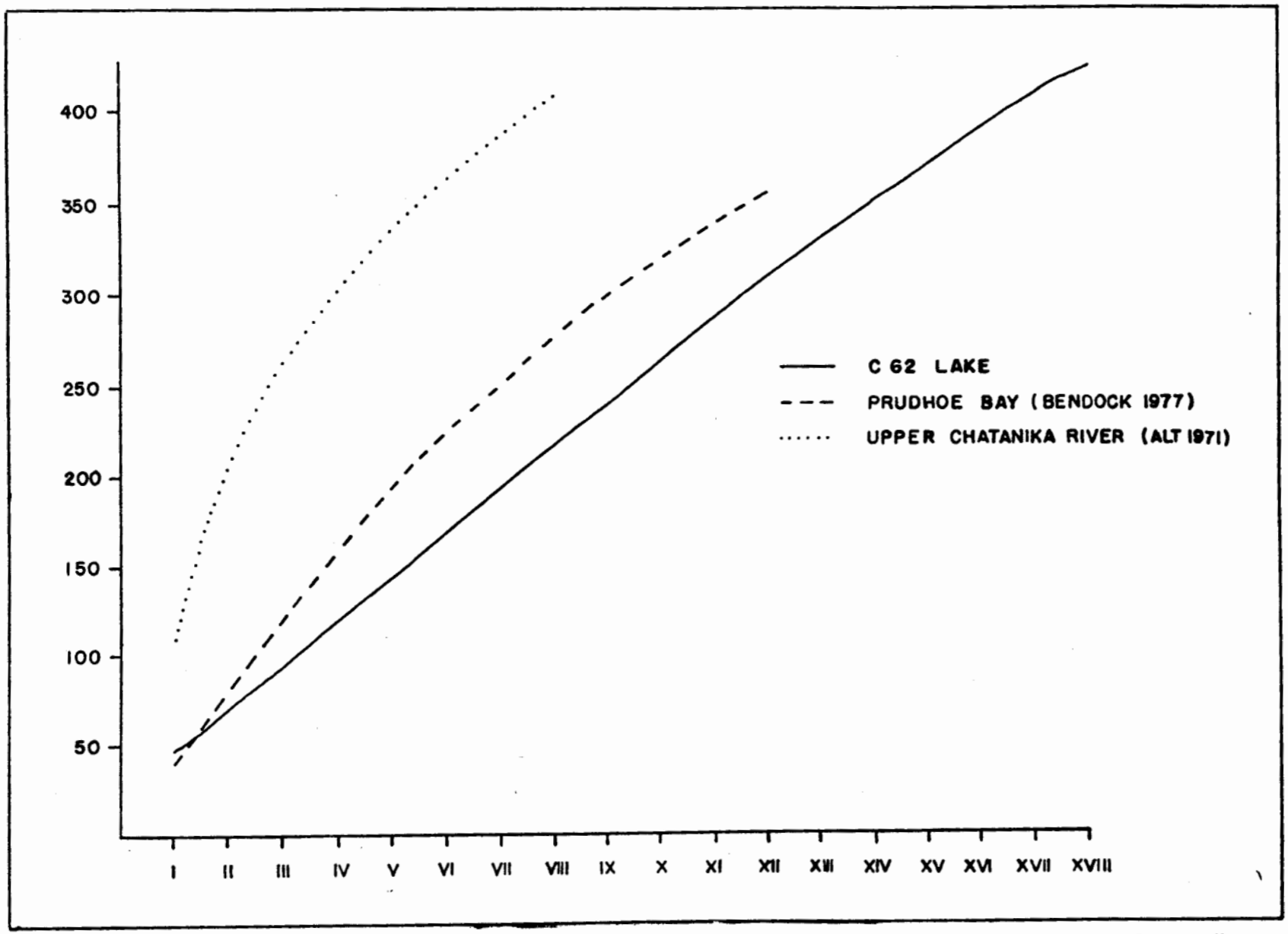

Figure 5. Back-calculated fork lengths of least cisco taken in C-62 Lake (coastal plain lake), Prudhoe Bay and Chatanika River (interior Alaska).

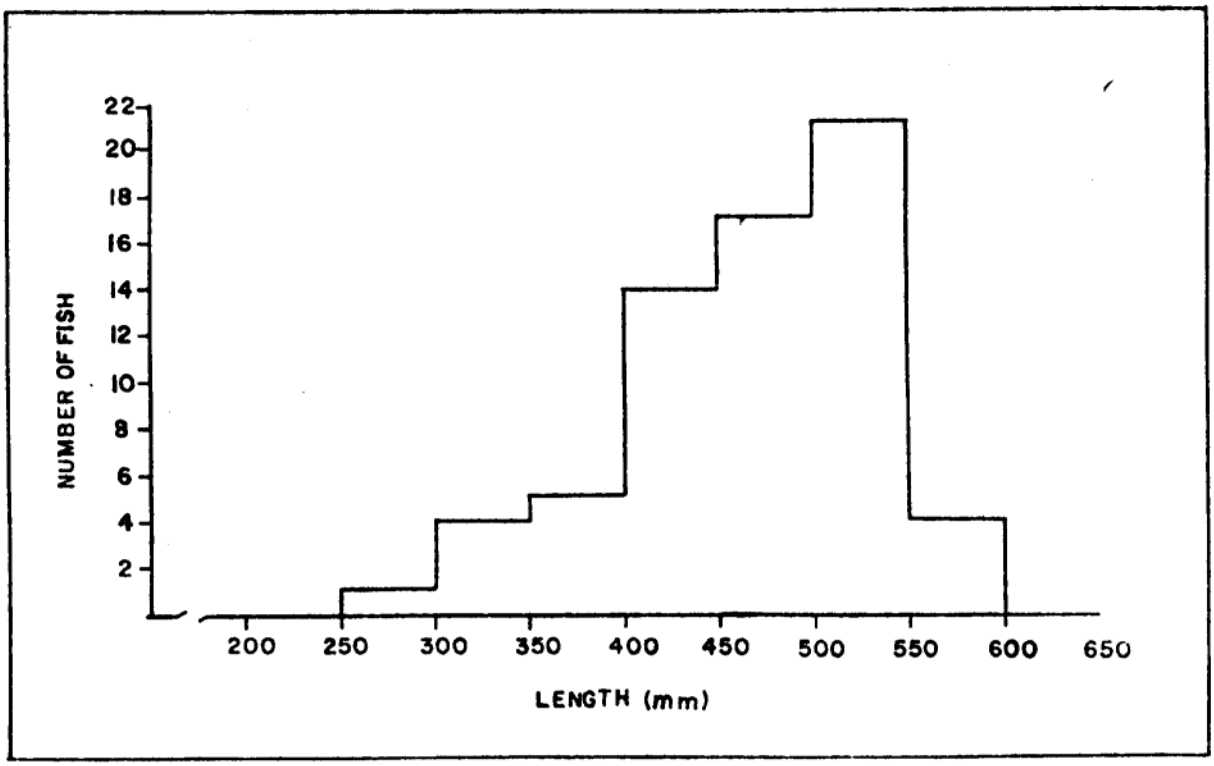

Figure 6. Length frequency of 66 broad whitefish captured in Arctic coastal plain lakes.

Forty-six percent of the broad whitefish stomachs examined contained food. Prey items in descending order of frequency included: clams, snails, chronomid larvae and zooplankton.

Broad whitefish from the coastal plain lakes attain a smaller maximum size than those reported for the Mackenzie River (Hatfield, et al., 1972) and Siberia (Berg, 1949), however, maximum lengths are similar to those reported for Prudhoe Bay (Bendock, 1977) and Interior Alaska (Alt, 1972). Longevity is greater for coastal plain broad whitefish than for both the anadromous counterparts (Prudhoe Bay) and interior Alaska fish. Figure 7 shows comparative growth rates for three populations of broad whitefish.

Lake Trout

Lake trout are widely distributed across the North Slope, primarily inhabiting lakes, but also occurring in streams within the Colville, Sagavanirktok and Canning River drainages. Waters within the foothills region and the western margin of the coastal plain have few lake trout; however, this species is well represented in the central coastal plain which marks the northern most distribution of this species in Alaska.

Twenty-six lake trout were sampled from eight (47%) of the coastal plain lakes surveyed, including Teshekpuk Lake. The largest catches were from Teshekpuk Lake and Lake C-52. Lake trout ranged from 370 mm to 890 mm in fork length and averaged 631 mm. Weights ranged from 580 g to 9,700 g and averaged 3,545 g. The length frequency of 26 lake trout from coastal plain lakes is shown in Figure 8. The female to male sex ratio was 1:1.3. Ages ranged from VII to XXXV. The age of maturity for lake trout was XI and spawning by most individuals, based on gonad examination, appears to be nonconsecutive.

Thirty-eight percent of the lake trout had empty stomachs. Of those that contained food, the following prey items were taken in descending order of frequency: ninespine stickleback; other fish including least cisco, slimy sculpin and lake trout; snails and clams.

Age and growth, maturity and longevity of lake trout from coastal plain lakes compare closely with lake trout inhabiting North Slope mountain lakes, despite major differences between the two habitats.

Other Species

Round whitefish are distributed throughout the North Slope in both lakes and streams. While common in streams throughout the region, they are less frequently encountered in coastal plain lakes than in foothill and mountain waters. Round whitefish were captured in four (24%) of the coastal plain lakes that were surveyed. Fork lengths ranged from 163 mm to 387 mm (n=5), weights ranged from 40 g to 600 g and ages ranged from III to XIII.

Humpback whitefish on the North Slope are primarily limited in distribution to the Colville River and other major streams across the coastal plain. One humpback whitefish was captured both in Teshekpuk Lake and in Lake C-63. Both of these lakes have large outlet streams which may be important

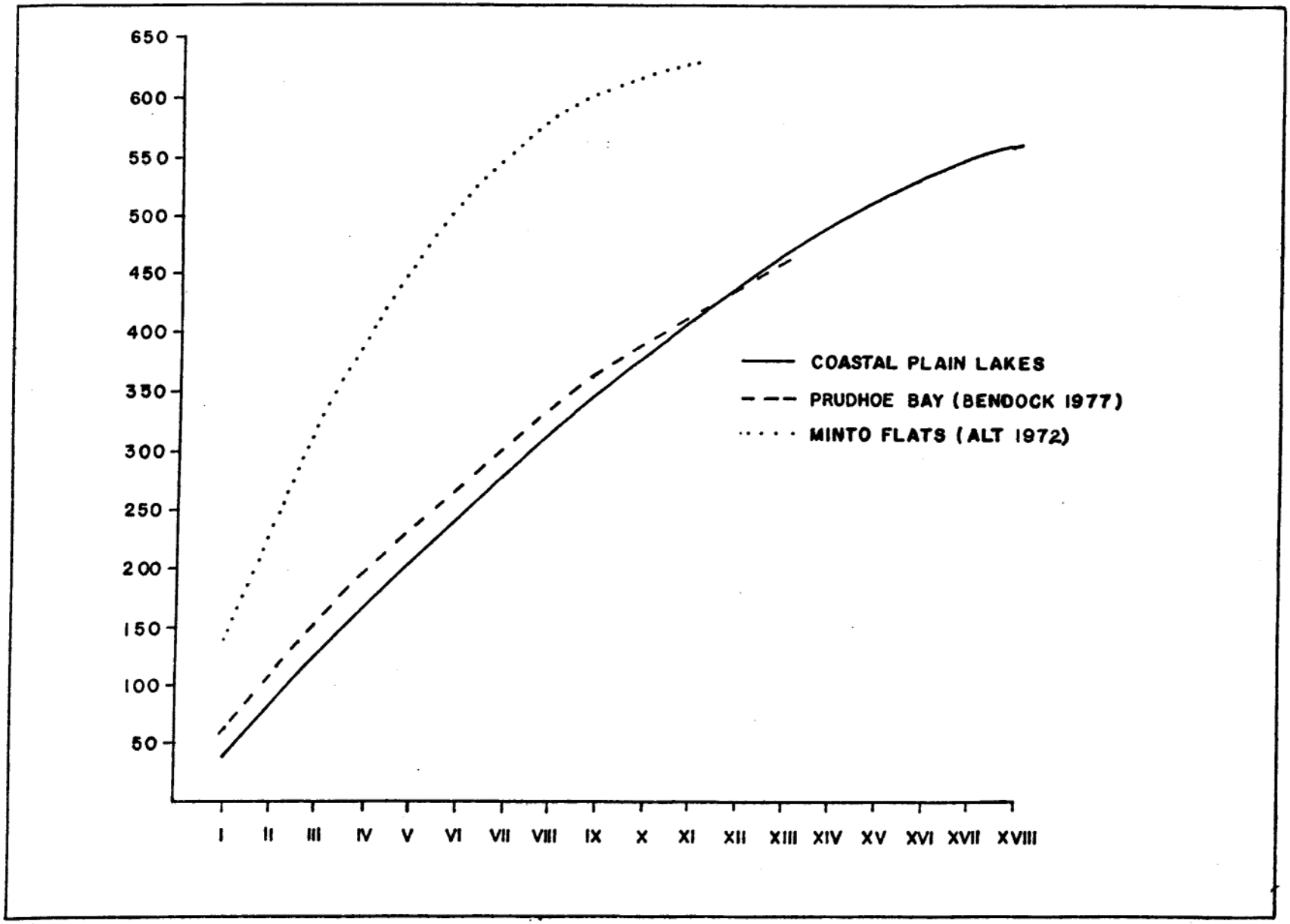

Figure 7. Back-calculated fork lengths of broad whitefish taken in coastal plain lakes, Prudhoe Bay and Minto Flats (interior Alaska).

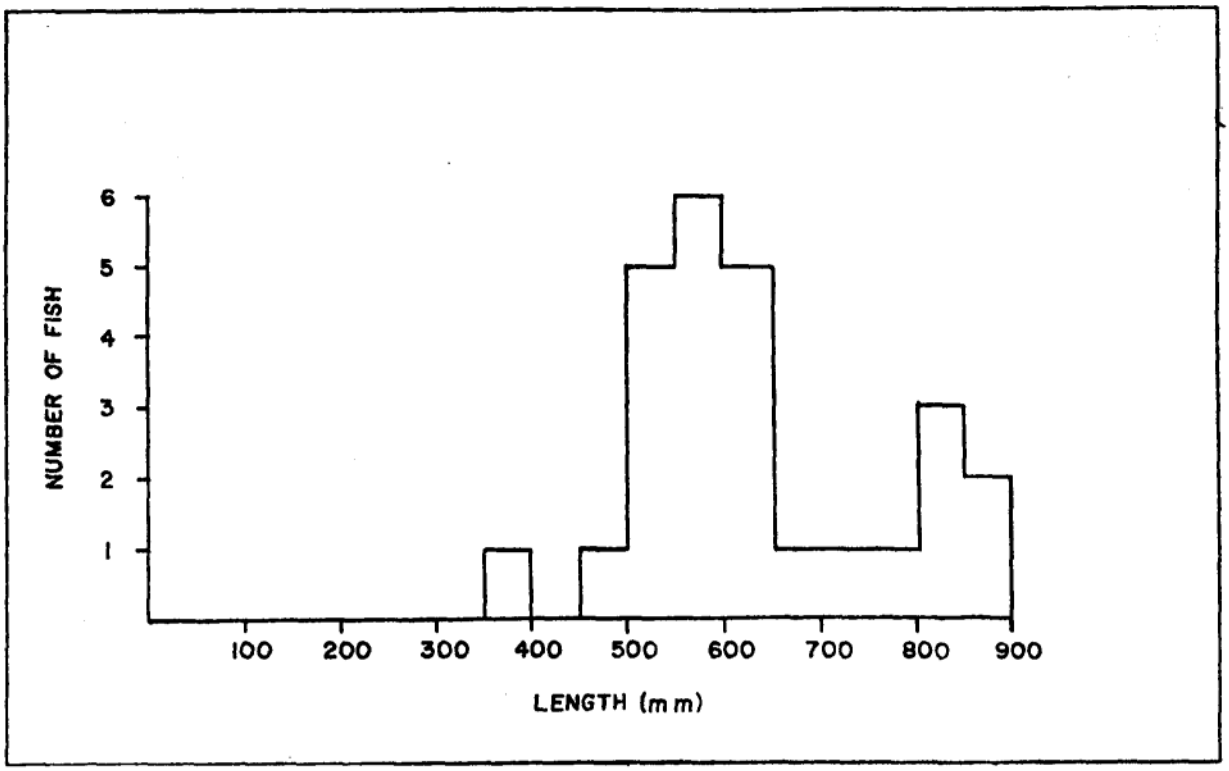

Figure 8. Length frequency of 26 lake trout captured in Arctic coastal plain lakes.

migration corridors for humpback whitefish. This species seldom inhabits foothill and mountain lakes on the North Slope.

Grayling are widespread in both lakes and streams across the North Slope. They are the principal species inhabiting foothill lakes and streams. While abundant in Teshekpuk Lake, only a single specimen was captured in another coastal plain lake (C-45).

Burbot also have a widespread distribution, inhabiting both lakes and streams across the North Slope. Gill nets, the primary capture method, do not readily capture and hold burbot, thus catches in the coastal plain may not adequately define the distribution within this area. Burbot are reported to be present in Teshekpuk Lake and were captured in Lake C-52.

Ninespine stickleback and slimy sculpin inhabit all major waters on the North Slope. While not captured in gill nets, these species were frequently observed and were found as prey items in larger fish inhabiting the coastal plain waters.

Other species reported to occur in coastal plain lakes (Netsch et al, 1977), but not encountered during our surveys include: Northern pike, Arctic cisco, Alaska blackfish, and fourhorn sculpin.

Winter Char Habitats In The Anaktuvuk River

Background:

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 covers an area of 2,839 sq mi and the river's estimated mean annual flow rate 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 in 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, grayling and round whitefish.

The Anaktuvuk River is heavily braided throughout most of its length and has bottom material ranging from fine sand in the upper and foothills region to large gravel and boulders in the middle and lower reaches. Spring areas, perennial sources of ground water, are abundant adjacent to and within the river valley, creating large fields of aufeis that remain throughout most of the open water season. Spring areas also maintain open leads in the river throughout the winter months. The largest springs occur in the main stem of the Anaktuvuk River, May Creek, as well as in the Nanushuk and the lower Kanayut Rivers.

Anaktuvuk Pass, a small Nunamiut village, is located at the head of the Anaktuvuk River. There are two gravel air strips constructed for exploratory oil drilling adjacent to the Anaktuvuk River. 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 and humpback whitefish have been captured at the mouth of the Anaktuvuk River. Bendock (1979) presented survey information obtained in the lower reaches of the river.

Arctic char were first reported in the Anaktuvuk River by Roguski and Winslow (1970). Kogl (1971) reported capturing anadromous char in the Colville River and rearing char in the upper Anaktuvuk River. Bendock (1980) reported on two fall concentrations of Arctic char in the Anaktuvuk River and estimated (by aerial survey) the largest group to contain over 15,000 fish, comprised of both spawning and non-spawning individuals. Following these earlier observations, the Sport Fish Division initiated an investigation to examine the distribution, migration timing and patterns, and overwintering habitats of Arctic char in the Anaktuvuk River.

Bendock (1981) presented information on the age and growth, distribution, spawning and migration timing of Anaktuvuk River char. This report presents findings on the winter habitats of char based on a telemetry study of 12 radio-tagged char.

Tagging Site Characteristics:

The radio tagging site (Fig. 9) adjacent to Rooftop Ridge contains the largest fall concentration of both spawning and non-spawning anadromous char. The site is heavily braided, with several channels of flowing water traversing the flood plain during the summer months. Gravel bars within the flood plain are sparsely vegetated due to thick winter ice cover and scouring at breakup. River bed material is medium sized (2 to 5 in) smooth gravel interposed with small areas of finer material. During breakup the flood plain is bank-full with water. Peak discharge decreases rapidly in June; however, the river usually remains turbid throughout most of the summer. By late August the water becomes low and clear as discharge is further reduced by freezing near the headwaters.

The Anaktuvuk River begins running ice by late September and freeze up commences shortly thereafter. Located within the riverbed and in adjacent arms of the river are ground water springs that discharge either directly into the Anaktuvuk or provide the only source of water for short side channels. Ground waters enter the system at 36°F to 39°F, thus areas in the vicinity of larger ground water sources remain ice-free for a limited distance throughout the winter. The remainder of the Anaktuvuk River that is not influenced by ground water freezes to the bottom and thus does not provide suitable habitat for fall spawning or overwintering fish.

The spring water cools rapidly as it travels from the source and at variable distances downstream is blocked by existing river ice. Water then flows through or around the blockage and freezes on the surface of the river bed or existing ice. In this manner, ice accretion occurs downstream from perennial water sources throughout the winter when air temperatures are below freezing, creating large aufeis fields. By late winter, aufeis up to 10 ft thick covers approximately 20 sq mi of riverbed immediately downstream from the Rooftop Ridge tagging site. The aufeis field below Rooftop Ridge remained through the summer of 1981 to form the nucleus of

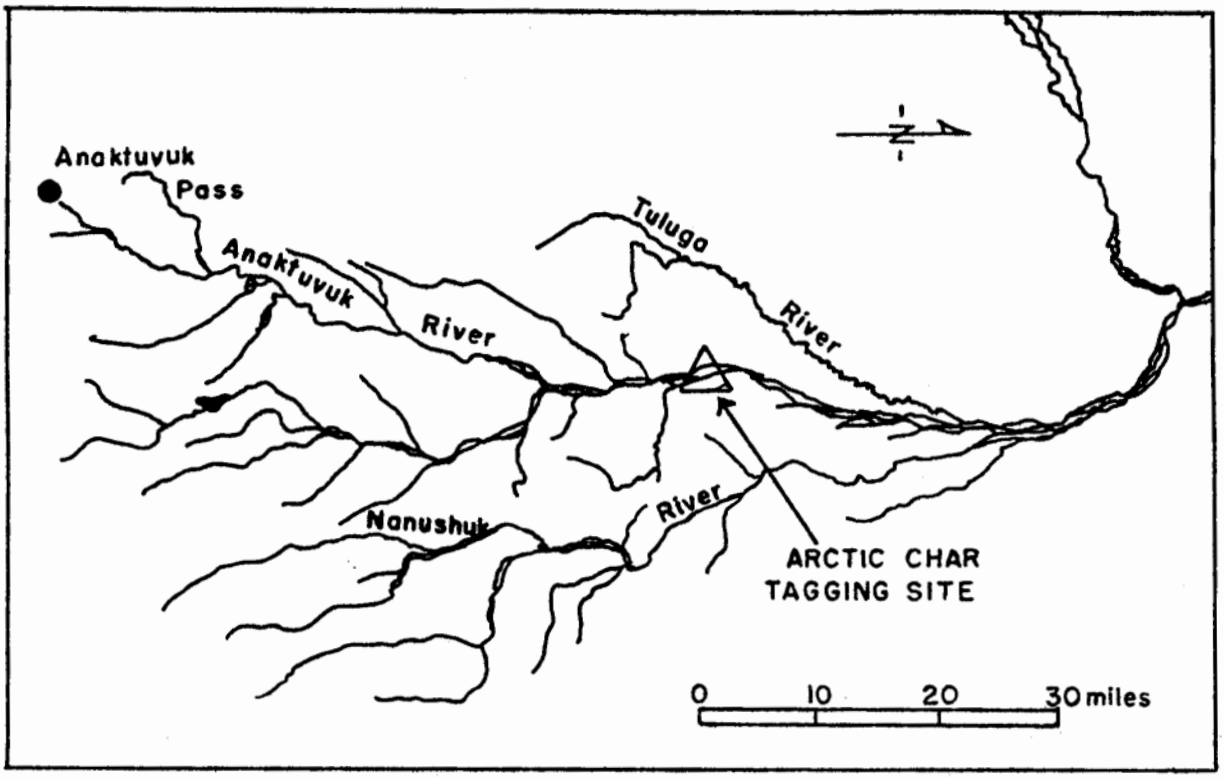

Figure 9. Anaktuvuk River showing the location of capture and release of twelve radio-tagged Arctic Char, 1980-1981.

the present season's field. The effects of aufeis on permafrost and river morphology in northern Alaska are discussed by Harden et al. (1976). Smaller spring areas and aufeis fields occur intermittently throughout the Anaktuvuk drainage.

Anadromous char first arrive at the Rooftop Ridge spring area in mid August. Adult non-spawners concentrate in dense schools in the main stem of the Anaktuvuk River while spawners occupy the spring-fed side channels adjacent to the main drainage. Spawning takes place in spring channels from early September through October. Following spawning, spent fish move to the main river and enter schools of non-spawners. The entire concentration of char is distributed within a 4-mi stretch of the Anaktuvuk River by late September. Following freeze-up, little is known about char habitats or movements until fall concentrations again appear the following year.

Winter Movements:

Due to the inaccessibility of the Anaktuvuk River, radio-telemetry was used as a method for monitoring the winter movements of char and to locate overwintering habitats under the ice. The techniques section of this report describes the equipment and procedure for implanting the radio transmitters. Twelve char were radio-tagged, of which six were spawners and six were non-spawners. Of the spawners, three were male and three were female. The sex of non-spawners could not be determined by examining external sex characteristics. The tagged fish ranged from 560 mm to 820 mm in fork length and averaged 662 mm. Weights ranged from 2,100 g to 5,000 g and averaged 2,750 g (6.1 lbs). All of the char were tagged and released in the Anaktuvuk River adjacent to Rooftop Ridge on Sept. 20-21, 1980 (Fig. 10). Table 3 shows the length, weight, sex and radio frequency of the tagged char.

An attempt was made to locate the radio-tagged fish at 2-week intervals using a fixed-wing aircraft. This procedure worked well until late March to early April, at which time the overwintering locations were sampled under the ice. Following the spring sampling period, the tags that remained functional were monitored at irregular intervals until the spring outmigration in June. Table 4 lists the dates when tracking was conducted and the number of tags functioning on each date.

Radio tracking results indicate that char are "confined" residents of the limited overwintering habitat and that movement throughout the ice-covered months (October through May) is minimal. All of the char that were tagged in the spawning channel departed that location and occupied adjacent stretches of the main river, even though the spawning channel remained slightly warmer, and ice-free near its source, throughout the winter. There was a net upstream movement of both spawners and non-spawners throughout the winter. Figure 11 shows the distribution of tagged char in April, 7 months after their release. Movement was slight and variable during the winter tracking periods, resulting in minor shifts in position of tagged fish. The average distance traveled between the tagging location (September) and locations identified in April was 0.9 mi and ranged from a few feet to 1.6 mi (Table 5).

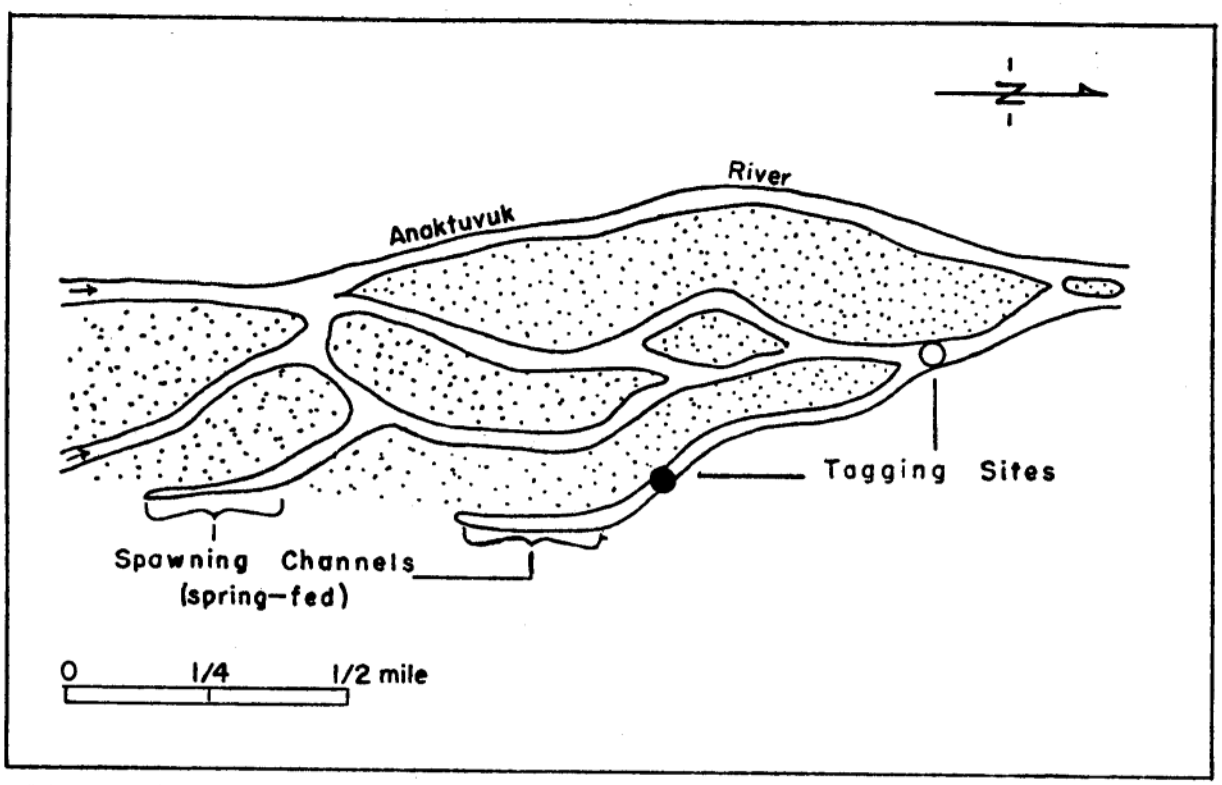

Figure 10. Location of tagging sites in Anaktuvuk River, September, 1980.

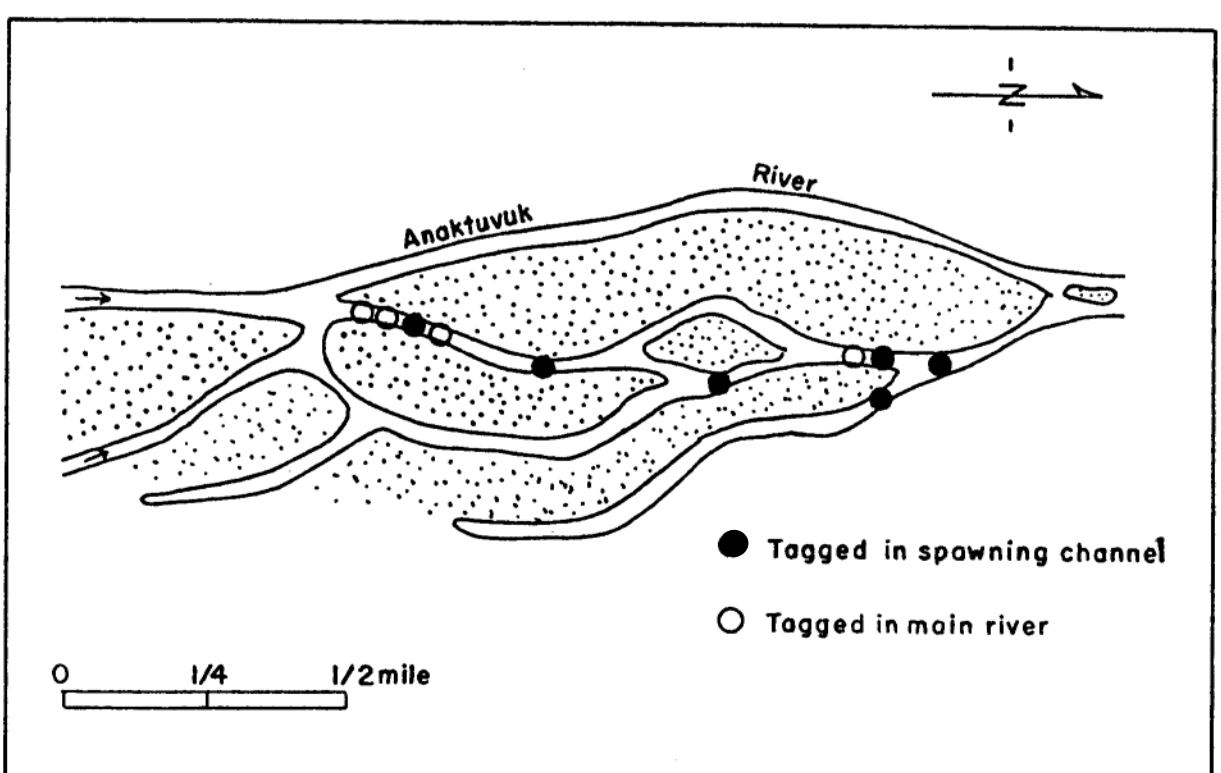

Figure 11. April distribution of tagged Arctic Char, seven months after release.

Table 3. Fork length, weight, sex and spawning conditions of twelve char radio-tagged in the Anaktuvuk River, 1980.

No.	Date	(MHz) Frequency	Fork Length (mm)	Weight (g)	sex	Spawning Condition
1	9/21	151.000	575	2,100	...	Non-spawner
2	9/21	151.020	660	2,500	...	Non-spawner
3	9/20	151.040	586	2,200	...	Non-spawner
4	9/20	151.060	600	2,500	...	Non-spawner
5	9/20	151.080	740	3,800	...	Non-spawner
6	9/20	151.100	630	2,100	Fem	Spent
7	9/20	151.120	645	2,100	Fem	Spent
8	9/20	151.140	560	2,100	...	Non-spawner
9	9/21	151.160	820	5,000	Male	Spent
10	9/21	151.180	740	3,500	Male	Spent
11	9/21	151.200	710	3,000	Male	Spent
12	9/21	151.220	678	2,100	Fem	Spent

Table 4. Number of tags functioning on each radio tracking date.

Date	# Tags	Operating Life (Mos.)
9-22-80	12	0
10-14-80	12	1
11-04-80	12	2
11-19-80	12	2
12-09-80	12	3
01-29-81	12	4
03-05-81	11	6
04-02-81	10	7
04-22-81	10	7
05-12-81	4	8
06-08-81	2	9
06-17-81	2	9

Table 5. Distance travelled by radio tagged Arctic char in the Anaktuvuk River between 9/21/80 and 4/1/81.

Fish #	Tag Site	Sex	Distance Traveled (mi)
1	Spawning Channel	...	1.6
2	Spawning Channel	...	0.8
3	Main River	...	0.8
4	Main River	...	0.9
8	Main River	...	0.07
7	Main River	female	1.0
9	Spawning Channel	male	0.7
10	Spawning Channel	male	1.1
11	Spawning Channel	male	1.3
12	Spawning Channel	female	0.7

It was assumed that char depart the overwinter location and begin a seaward migration at breakup. Continued monitoring of tagged fish, however, indicated that the char remained concentrated at the overwintering site through mid-June, which in 1981 was approximately one month after breakup occurred in the middle and upper Anaktuvuk River. On June 8, the Anaktuvuk River cleared up temporarily and an aerial survey confirmed the presence of large numbers of char still concentrated at the overwinter site. No fish, however, were observed above, or below the site. By this date, breakup had occurred throughout the length of the Anaktuvuk and Colville Rivers. Later monitoring of char concentrations by aerial survey was hampered by turbid water conditions. On June 17th, the only remaining char with a functioning transmitter (#3) was located at the mouth of the Anaktuvuk River, approximately 55 mi below the overwintering site. The following day, a thorough search of the lower Anaktuvuk and Colville Rivers failed to locate the char and it was assumed that the fish had completed the seaward migration through the remaining 90 mi of the Colville River.

Gill netting in the lower Anaktuvuk River during the spring of 1980 showed large numbers of char out-migrating on June 10, which is 1 week earlier than the radio-tagged individual departed in 1981. It appears, however, that the departure from overwintering habitats more closely coincides with breakup along the Beaufort Sea coast than with breakup near the wintering locations more than 100 mi to the south. It further appeared that any foraging or wandering away from the overwintering site prior to the out-migration was minimal. Arctic char radio-tagged in the Anaktuvuk River were confined to a small stretch of river and essentially sedentary for a period of time exceeding 8 months.

Overwintering Habitat and Sampling

The overwintering site and sampling locations at Rooftop Ridge is shown in Figure 12. Descriptions of the habitat and under-ice sampling were conducted in late March through early April 1981. The entire overwintering site was less than 3 mi in length, consisting primarily of two short channels of water flowing under the ice. Water originated in spring areas that were ice-free at the source. As the water traveled away from the source, it cooled rapidly and was soon flowing under a layer of surface ice. The largest open water area was approximately 1/2 mi long. Downstream from the open water, an air space separated the flowing water from the surface ice and the ice had a rough, irregular bottom. Further downstream the ice increased rapidly in thickness and within 2 mi of the spring area, water was blocked by aufeis and was incorporated in the field. Fish inhabited all locations with flowing water. Table 6 lists the physical and chemical characteristics of each sample location. Figure 13 shows a diagramatic cross-sectional view of the habitat.

Monofiliment gill nets were set for 4 hours at sites 2 and 3. A gill net was used as a seine to sample fish from site 1. Table 7 lists the species and numbers of fish captured at each site.

All of the char captured at site 1 (open water) were subadults ranging from 4 to 5 years of age. Char ranging from 5 through 9 years of age were captured at sites 2 and 3. The combined female to male sex ratio of 24 captured char was 1:0.4. All of the char had empty stomachs.

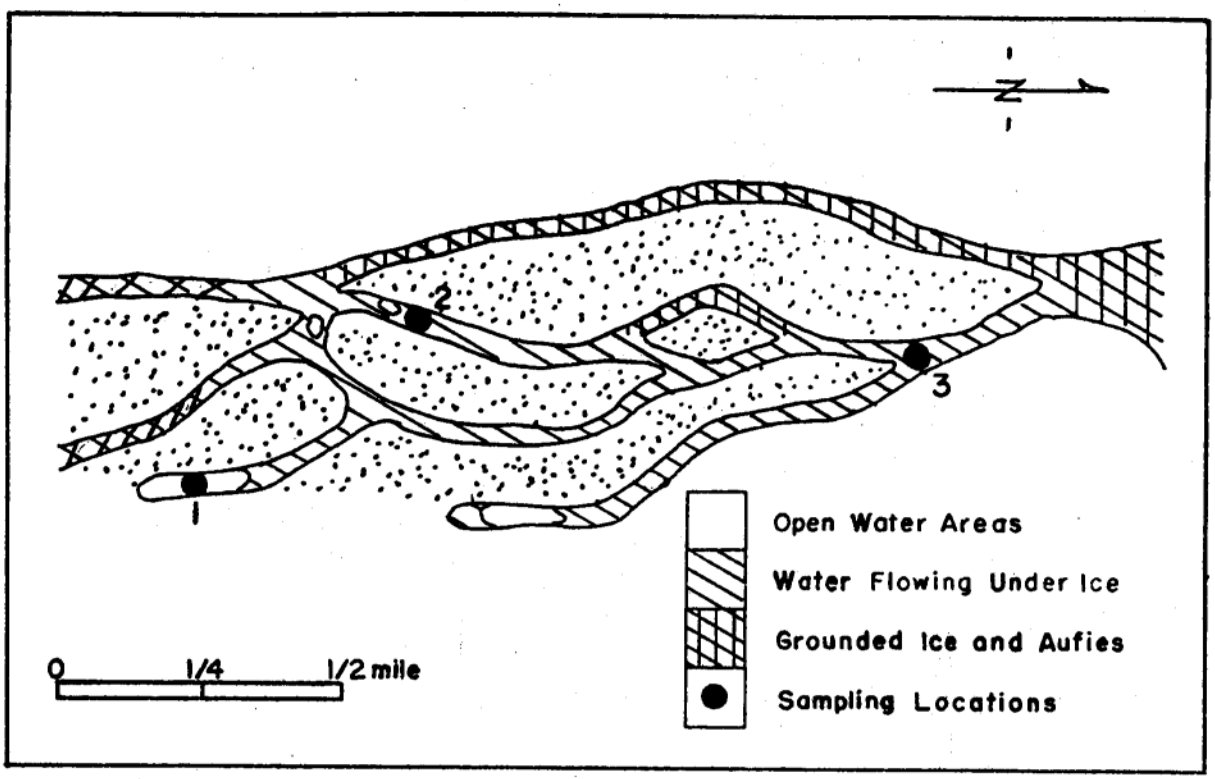

Figure 12. Anaktuvuk River overwintering site and sampling locations, April, 1981.

Table 6. Physical and chemical characteristics of three sampling sites in the Anaktuvuk River April, 1981.

Sample Location	1	2	3
Snow Depth (in)	0	12	15
Ice Depth (in)	0	16	77
Air Space (in)	0	15	0
Water Depth (in)	24	10	39
Water Temp. (^{o}F)	34	33	0
DO (ppm)	11	8	11
pH	8	8	8
Hardness (ppm)	137	171	137
Velocity (fps)	1.0	1.5	0.7
Species Present	AC, GR, RWF, SSC	AC	AC, LT, RWF, SSC

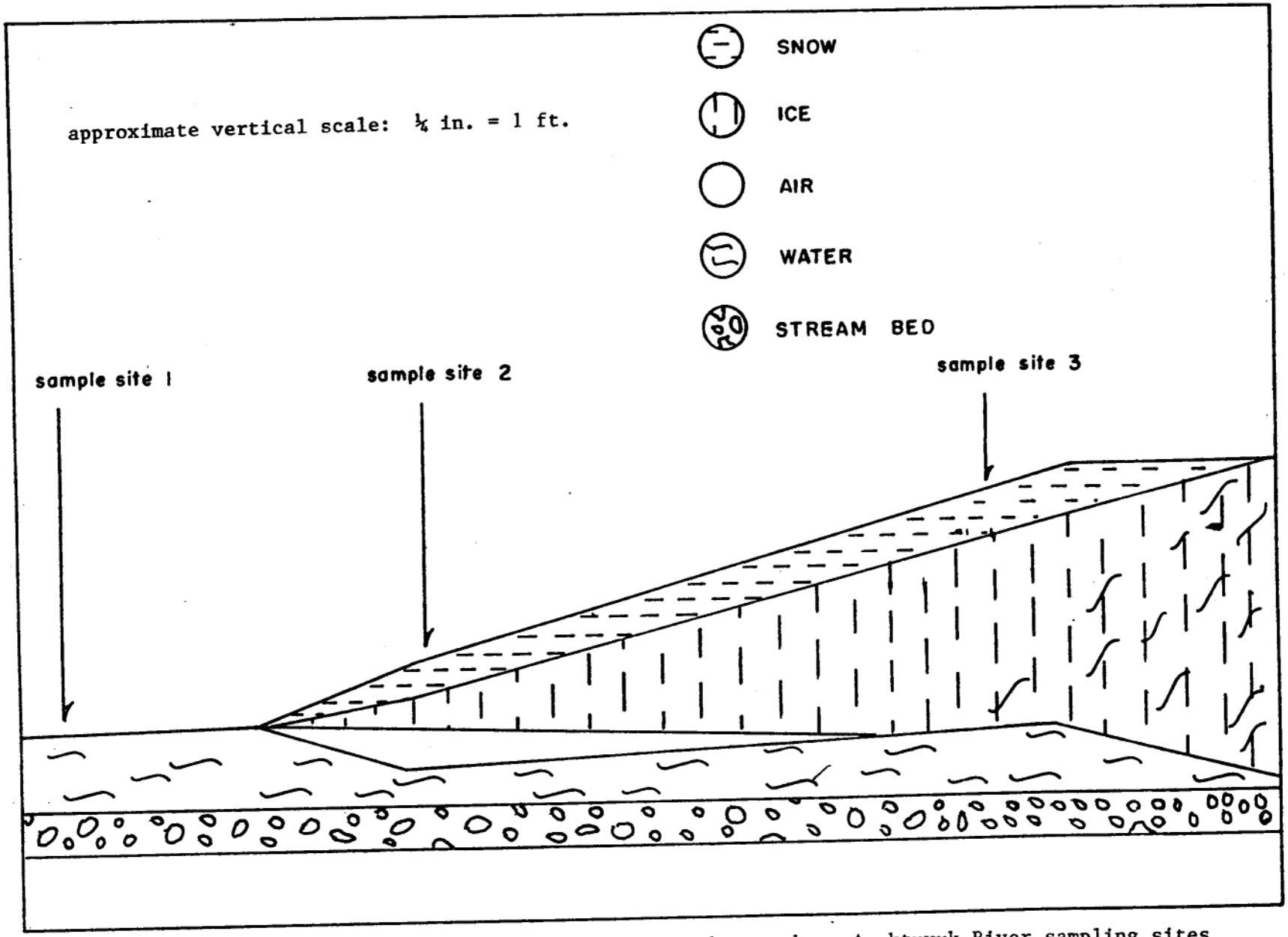

Figure 13. Schematic drawing of snow, ice and water depths at three Anaktuvuk River sampling sites April, 1981.

Table 7. Species, and numbers of fish captured at three over wintering sites in the Anaktuvuk River, 1981.

Sample Location	Species Captured					Total
	AC	LT	GR	RWF	SSC	
1	19	0	34	7	3	63
2	6	0	0	0	0	6
3	8	1	0	1	2	12
Total	33	1	34	8	5	81

Densities of char in the overwintering location appeared higher than the limited sampling indicates. At net site 2, an observer could look across the under-ice air space and see the backs of fish protruding above the water surface, as well as hear fish swim away from a disturbance. The water at this location was a maximum of 10 in deep. The schools of fish reacted strongly to disturbances on the ice and along the shore of open water. It was apparent that, while open water areas are available to the larger char, the preferred habitat was in ice-covered water.

Additional Sampling of Spring Areas

Four additional spring areas in the Anaktuvuk River drainage were sampled for water chemistry and fish presence during April 1981 All of the sites had open water, terminating in aufeis fields. Both sites on the Nanushuk River have fall concentrations of char, while the sites adjacent to the Kanayut River do not have char. Table 8 lists the site characteristics and fish captured at these locations on April 2, 1981.

The site characteristics were measured at the spring sources in open water and sampling for fish was conducted only in the ice-free areas. Thus, if these sites are similar to those sites sampled at Rooftop Ridge, large numbers of overwintering fish may have occupied the under-ice habitats between the open leads and the aufeis fields. Juvenile grayling were the only species captured at these additional sites.

Segregation of Fish

Little is known about the organization of fish by species and size in limited overwintering habitats. Bendock (1980) sampled several species, comprised of all age groups, inhabiting overwintering pools in the Colville River where segregation by size or species was not apparent. There is some evidence that fish overwintering in the Anaktuvuk River segregate either by size or species. Site 1 at Rooftop Ridge had only adult grayling while the Nanushuk had only juvenile grayling. Site 1 also had only subadult char, while sites 2 and 3 had larger char. Adult round whitefish were captured in Site 1, but no juveniles were present. Further sampling is necessary to determine the significance of this feature.

Radio Telemetry of Char in the Sagavanirktok River Drainage

To confirm the winter movement and habitat findings from Anaktuvuk River char and to describe additional overwintering habitats of Arctic char, 16 char were equipped with radio tags in the Sagavanirktok River drainage during September 1981. Four fish were tagged in each of the following streams: Echooka, Ivishak, Saviukviayak and Lupine Rivers (Fig. 14). Char spawning occurs in each of these streams; however, it is not known if overwintering takes place at a single location or at several sites within the drainage.

Fourteen of the radio-tagged char were in spawning condition while two were adult, nonconsecutive spawners in bright condition. Of the spawners, six were female and eight were male. The sex of the bright char could not be determined by examining external characteristics. The radio-tagged char ranged from 520 mm to 730 mm and averaged 616 mm. Weights ranged from

Table 8. Site characteristics and species present in four spring areas in the Anaktuvuk River drainage April , 1981.

Location	H_2O Temp ^oF	Snow (in.)	Ice (in.)	Water (in.)	D. (ppm)	pH	Hardness (ppm)	Velocity fps	Species
Nanushuk R.	36	0	0	10	8	8	171	1.0	GR
May Creek	36	0	0	8	7	8	205	1.0	Ø
Anak. above Kanayut	34	0	0	10	9	7.5	205	4.0	Ø
Anak. below Kayayut	34	0	0	12	9	8	154	1.5	Ø

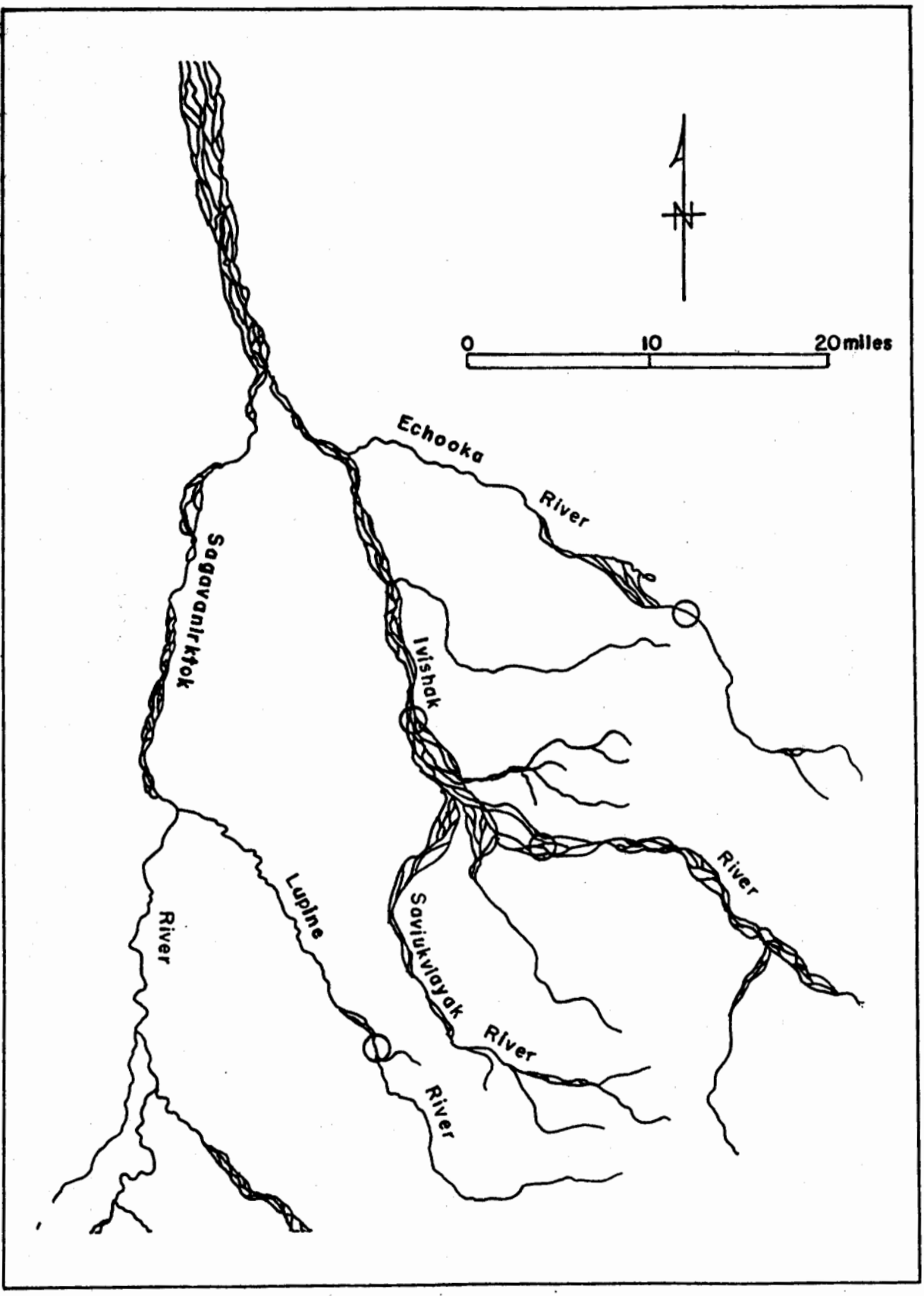

Figure 14. Locations of Radio-Tagged Arctic Char in the Sagavanivktok River Drainage, September, 1981.

1,500 g to 4,100 g and averaged 2,244 g. Physical characteristics of the tagged char, radio frequencies and capture site characteristics are listed in Table 9. All fish were tagged and released during the second week of September, 1981.

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

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 inexpensive means of annually indexing both the distribution and general abundance of char. Securing 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 in two locations in the Anaktuvuk River drainage have been counted since 1979; however, only the "Tuluga" group will be counted as an index area in future years. Table 10 lists the values for previous estimates in the Sagavanirktok and Anaktuvuk drainages.

Counts in 1981 were conducted on September 14, which is 1 week earlier than in previous years. The low numbers of spawners in the Echooka River in 1981 is a result of the count period preceding the peak of spawning activity. An overflight of the Echooka River in October 1981 showed large numbers of spawning char in traditional areas. Counts from other areas in 1981 compared favorably with previous estimates.

Experimental Fish Stocking - Pt. Barrow

Isatkoak Lagoon located at Pt. Barrow, Alaska is a series of three interconnected waters that formerly were a salt water lagoon (Fig. 15). Following the construction of three impoundment structures and dredging, the upper two impoundments are now fresh and potable. The lower lagoon (Tasigarook Lagoon) is the municipal sewage lagoon and contains the outfall from Barrow's water treatment facility. A concrete dike has been constructed between the lower lagoon and the middle lagoon, and a gravel dike with 11 arched culverts separates the middle from the upper lagoon. In past years, the middle lagoon has served as the municipal water source for Barrow. Dredging has occurred in the middle and upper lagoon and has created maximum depths of 12 ft and 25 ft respectively. The upper lagoon is the proposed future water source for Barrow due to its greater depth, and limited dredging is expected to continue in the future.

Table 9. Physical characteristics of tagging sites and Arctic char radio tagged in the Sagavanirktok River drainage, 1981.

Location	#	Sex	Mat*	F.L. (mm)	Wt. (g)	Freq. 151. (MHZ)	H_2O Temp.	pH	ppm Hardness
Lupine R.	1	M	Sp	585	1800	520.5	40°F	8.5	188
	2	F	Sp	600	1500	561.5			
	3	F	Sp	610	2000	460.8			
	4	M	Sp	580	2000	480.6			
Saviukviayak River	1	F	Sp	635	2200	610.9	39°F	8.5	154
	2	M	Sp	535	1500	682.9+			
	3	F	Sp	650	2700	651.7			
	4	M	Sp	570	1800	710.6			
Ivishak (Hi)	1	M	Sp	670	2800	830.5	39°F	8.5	137
	2	M	Sp	730	4100	870.9++			
Ivishak (Low)	1	-	NS	535	1800	790.9+			
	2	-	NS	520	1500	750.9+			
Echooka River	1	F	Sp	600	2100	890.8	40°F	8	154
	2	M	Sp	710	3000	910.8			
	3	M	Sp	655	2500	950.4			
	4	F	Sp	665	2600	990.7			

NS Non Spawner
* Spawner

Table 10. Aerial estimates of anadromous char in index areas of the Sagavanirktok and Anaktuvuk Rivers, 1971-1981.

Year	LOCATION			
	Sagavanirktok R.		Anaktuvuk R.	
	Ivishak	Echooka	"Tuluga"	Nanushuk
1971	12,470	1,137		
1972	11,937	1,688		
1973	8,992	1,883		
1974	11,000	2,160		
1975	8,306	852		
1976	8,570	2,254		
1979	24,403	814	15,717	934
1981	24,873	316	10,563	1,005

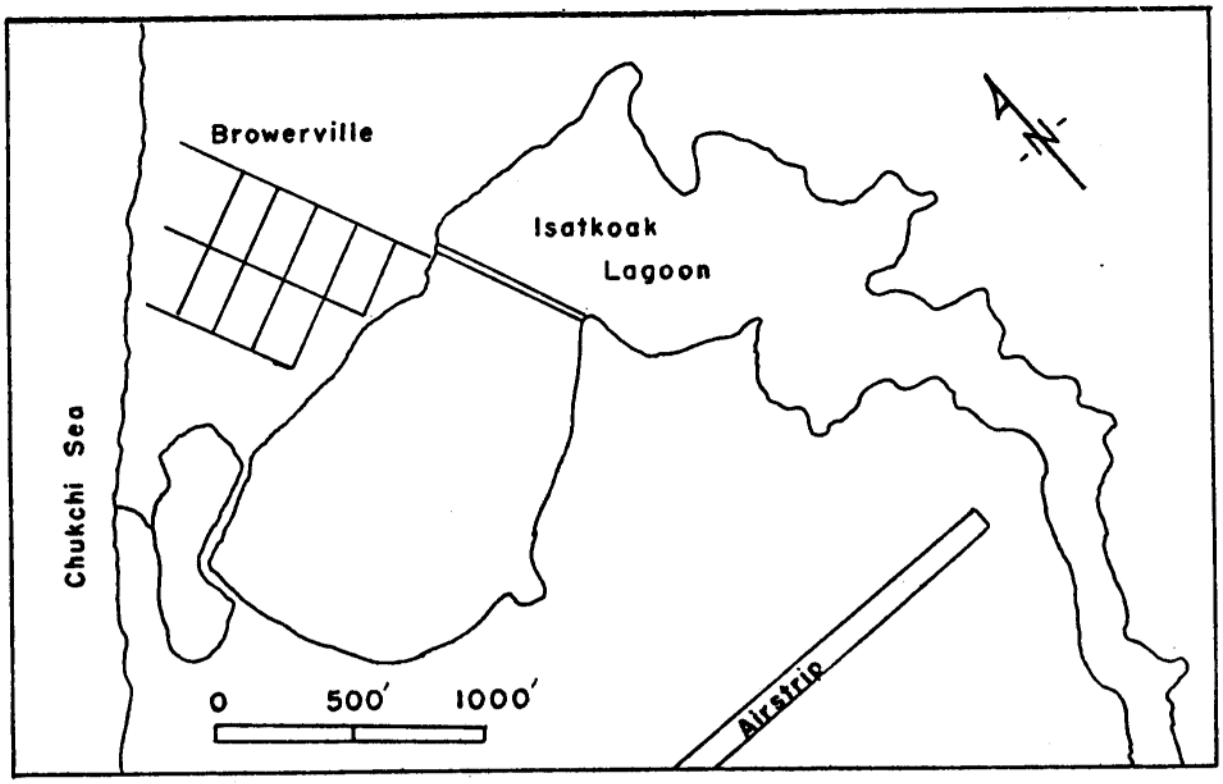

Figure 15. Isatkoak Lagoon Complex at Point Barrow, Alaska.

Following a request from the city of Pt. Barrow, Isatkoak Lagoon system was evaluated for an experimental stocking program to enhance recreational fishing opportunities for local residents. In April 1980, late winter dissolved oxygen values were obtained from the middle and upper lagoons (Table 11). In July 1980, a more complete water analysis was made (Table 12) and both waters were sampled overnight using experimental gill nets. Local residents reported that native fish were not present in the lagoon and gillnetting confirmed that observation. However, a single ninespine stickleback carcass was found on the shore of the dike separating the middle and upper lagoons.

Isatkoak Lagoon remains ice-covered throughout much of the year. Breakup is usually a slow process beginning in June, and patches of ice may still be present through July. Freeze-up usually occurs by October. The lagoon has a soft, muck bottom with isolated patches of gravel that have been exposed by dredging. Aquatic vegetation is sparse and exposed beaches are composed of peat and tundra. The middle lagoon has a nearly rectangular shoreline, while the upper lagoon has an irregular shoreline terminating in two forks that describe the small (less than 5 sq mi) drainage basin of the lake.

In June 1981, 50,000 (newly hatched) grayling fry were stocked in the upper lagoon near the confluence of the two drainage forks. At the time of stocking, the lagoon was ice-covered, with only a small amount of open water in the arm of the lagoon south of the Barrow air strip. An evaluation of the stocking success will be conducted in the future.

Dalton Highway

The Dalton Highway, built in 1974 and transferred to the State in 1978, was re-opened to sport fishing by Board of Fisheries action in 1979. Access during 1979 was limited to permitted commercial users which limited sport fishing opportunities primarily to truckers and employees of Alyeska and the State Department of Transportation. During June, July and August of 1981 the highway was opened for travel by the general public from the Yukon River to Disaster Creek, approximately 150 mi north of the Yukon River.

During the summer of 1981 sport fishing pressure was monitored to determine the effects of increased access to this section of road. The Sport Fish Division made 12 vehicle trips covering 35 days of this open period, observing fishermen and conducting creel census interviews enroute. Additional information on the location and intensity of fishing pressure was obtained from overflights in fixed-winged aircraft.

Information gathered in summer 1981 suggests that opening the lower end of the haul road to public access has had no appreciable effect on sport fishing pressure and harvest. The area opened to the public excludes many of the best fishing waters along the road and it appears that sport fishing was an activity not planned for by many travellers. Some of the factors contributing to the low fishing and tourist activity during 1981 included: 1) cool and wet weather throughout most of July and August, 2) extremely rough road conditions culminating in a general walk-out by the commercial trucking industry, 3) poorly situated and infrequent camping facilities, 4) placer mining on several streams creating turbid water throughout the

Table 11. Late winter dissolved oxygen values obtained at Isatkoak Lagoon.

Lagoon	Est. Surface Acreage	Snow Depth (in)	Ice Depth (in)	Water Depth (in)	Dissolved Oxygen (ppm)
Middle	120	10	78	60	7.2
Upper	170	6	84	120	7.0

Table 12. Water quality values obtained from Isatkoak Lagoon in July, 1980.

	Middle Lagoon	Upper Lagoon
Date	7-14-80	7-15-80
Max Depth	12'	25'
Water Color	Gray-Green	Gray-Green
Secchi Depth	3'	3'
H_2O Temp (^oF)	39	45
Hardness ($CaCO_3$)	222 mg/L	51 ppm
Alkalinity (M-O, $CaCO_3$)	51 mg/L	51 ppm
Co_2	20 mg/L	15 ppm
pH	7.5	9

summer, and 5) the long distance and travel time required from the nearest towns and villages. Some of the above factors may improve with time; however, others such as rough and dusty road conditions are an expected part of the haul road experience. While angler interest appears to remain high, most fishing is conducted by area residents and employees, and the Department does not anticipate dramatically increased fishing pressure with eased public access until conditions improve substantially. Future efforts to monitor sport fishing are expected to continue at a similar level.

LITERATURE CITED

Alt, K. T. 1971. A Life History Study of Sheefish and Whitefish in Alaska. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1970-1971. Project F-9-3, 15(R-I-A): 31p.

_____ 1972. A Life History Study of Sheefish and Whitefish in Alaska. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1971-1972. Project F-9-4, 34p.

Bendock, T. N. 1977. Beaufort Sea estuarine fishery study. In: Alaskan OCS Principal Investigators Annual Reports, U.S. Dept. of Commerce, NOAA Research Unit 233.

_____ 1979. Inventory and cataloging of Arctic area waters. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1978-1979, Project F-9-11, 20(G-I-I-): 64p.

_____ 1980. Inventory and cataloging of Arctic area waters. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1979-1980, Project F-9-12, 21(G-I-I-): 1-31p.

_____ 1981. Inventory and Cataloging of Arctic area waters. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1980-1981, Project F-9-13, 22(G-I-I): 1-33.

Berg, L. S. 1949. Freshwater fishes of the USSR and adjacent countries (translation). Zool. Inst. Akad. Nauk. 27, 39, 30.

Harden, D., P. Barnes, and E. Reimnitz, 1976. Distribution and character of Naleds in Northeastern Alaska. U.S. Geological Survey, Open File Report 77-91. Menlo Park, Calif. 20p.

Hatfield, C. T., J. N. Stein, M. R. Falk, and C. S. Jessop. 1972. Fish resources of the Mackenzie River Valley. Fisheries Service, Environment Canada, Interim Report I, Vol. I., II, 247p.

Kogl, D. 1971. Monitoring and evaluation of Arctic area waters with emphasis on the North Slope drainages: Colville River Study. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1970-1971, Project F-9-3, 12(G-III-A): 23-61.

Netsch, N., E. Crateau, G. Love, and N. Swanton. 1977. Freshwater fisheries reconnaissance of the coastal plain of the National Petroleum reserve-Alaska (NPR-A), July and August 1977, preliminary report. U.S. Fish and Wildlife Service, Anchorage, Alaska. 214p.

Roguski, E. and P. Winslow. 1970. Monitoring and evaluation of Arctic waters with emphasis on the North Slope drainages. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1969-1970. Project F-9-2, 11(15-C): 279-301.

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