SPORT FISH INVESTIGATIONS OF ALASKA

Annual Performance Report for

Study No. G-I

INVENTORY AND CATALOGING

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Volume 20 Study G-I-I

STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

INVENTORY AND CATALOGING OF ARCTIC AREA WATERS

by

Terrence N. Bendock

ALASKA DEPARTMENT OF FISH AND GAME
Ronald O. Skoog, Commissioner

SPORT FISH DIVISION
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RESEARCH PROJECT SEGMENT

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ABSTRACT

This report presents baseline fisheries information on lakes and streams of the western North Slope, with emphasis on the Colville River drainage. Data were collected on species composition, life histories, and migration patterns and timing. Chemical and physical characteristics of the waters examined are presented.

Sixteen species of fish were captured in the Colville River drainage. Species diversity and abundance in the Colville River decreases in an upstream direction. Arctic grayling, *Thymallus arcticus* (Pallas), have the widest distribution within the drainage and were found in all streams surveyed. An upstream spawning migration of humpback whitefish, *Coregonus pidschian* (Gmelin), and broad whitefish, *C. nasus* (Pallas), occurs in the Colville River during late August. Small runs of pink salmon, *Oncorhynchus gorbuscha* (Walbaum), and chum salmon, *O. keta* (Walbaum), enter the Colville, Utukok, Koklik, and Kukpowruk rivers in late July and early August. Anadromous Arctic char, *Salvelinus alpinus* (Linnaeus), were found in the Anaktuvuk and Chandler rivers.

Fish associations in mountain lakes included lake trout, *Salvelinus namaycush* (Walbaum), Arctic char, grayling, round whitefish, *Prosopium cylindraceum* (Pallas), and least cisco, *C. sardinella* Valenciennes, while thaw lakes along the foothills had populations of Arctic grayling. Northern pike, *Essox lucius* Linnaeus, were captured only in lakes within the Killik River valley.

Waters within the study area are characteristically soft, having low values for alkalinity and hardness and neutral pH. Rapid changes in water level and turbidity in response to precipitation on the watershed were observed throughout the open water season.

Overwintering habitat is abundant throughout the middle reaches of the Colville River but is less available or absent in the tributary streams. Seven species of fish were captured while netting under the ice in the Colville River during October 1977, and March and April of 1978.

BACKGROUND

Scope

Lakes and streams within the Colville River drainage contain populations of freshwater and anadromous fish (Table 1) that support light sport and subsistence fisheries and a commercial fishery for whitefish located in the Colville River delta. Past fishery research in the Colville River drainage is limited to a few projects conducted since 1970. Roguski (1970) reported on species composition, relative abundance, age, growth, and sexual maturity of broad whitefish, humpback whitefish, Arctic char, and several other species captured in the Colville Delta commercial fishery as well as preliminary surveys of two lakes in the Colville River drainage and the Itkillik River. Kogl (1971) presented additional information on the life history of several species from the lower Colville River and on preliminary surveys conducted on six lakes and ten streams within the drainage. Meristic counts for Colville River whitefish were reported on by Alt and Kogl (1973). Kogl and Schell (1975) reported on life history data for several species from the Colville delta and on a brief reconnaissance of overwintering conditions which was conducted with the aid of an underwater television camera. Furniss (1974) conducted surveys on three headwater lakes in the Colville River drainage.

The Sport Fish Division of the Alaska Department of Fish and Game is continuing its effort to inventory and catalog waters of the North Slope. This report presents data collected over a two-year period on waters of the Colville River drainage and was funded in part through a contract with the U. S. Fish and Wildlife Service to conduct fisheries surveys on waters within the National Petroleum Reserve - Alaska.

Additional survey data are presented on three streams of the Western North Slope, the Utukok, Koklik, and Kukpowruk rivers, as well as on Teshekpuk Lake, an 816 km^2 (315 mi^2) thaw lake located near the Beaufort Sea Coast at lat. 70°35'N, long. 153°30'W.

Study Area and Climate

The Colville River is the largest Arctic river in Alaska, draining approximately 62,160 km^2 (24,000 mi^2). Over 676 km (420 mi) long, the Colville River is the seventh largest drainage in Alaska. Tributaries entering from the south drain approximately 450 km (280 mi) of the Central Brooks Range and account for 26% of the drainage area. Sixty-four percent of the drainage lies within the Arctic Foothills and 10% drains the Arctic Coastal Plain (Selkregg, 1976).

The study area (Fig. 1) is in the zone of continuous permafrost, and thermokarst topography dominates the landscape. Tributaries originating in the Brooks Range are rapid run-off streams that contain coarse alluvial sands and gravel. They are heavily braided but confined to relatively narrow river valleys. Discharge peaks in June shortly after breakup and is greatly reduced by mid-summer. Extreme fluctuations in both discharge and turbidity in response to precipitation are common throughout the

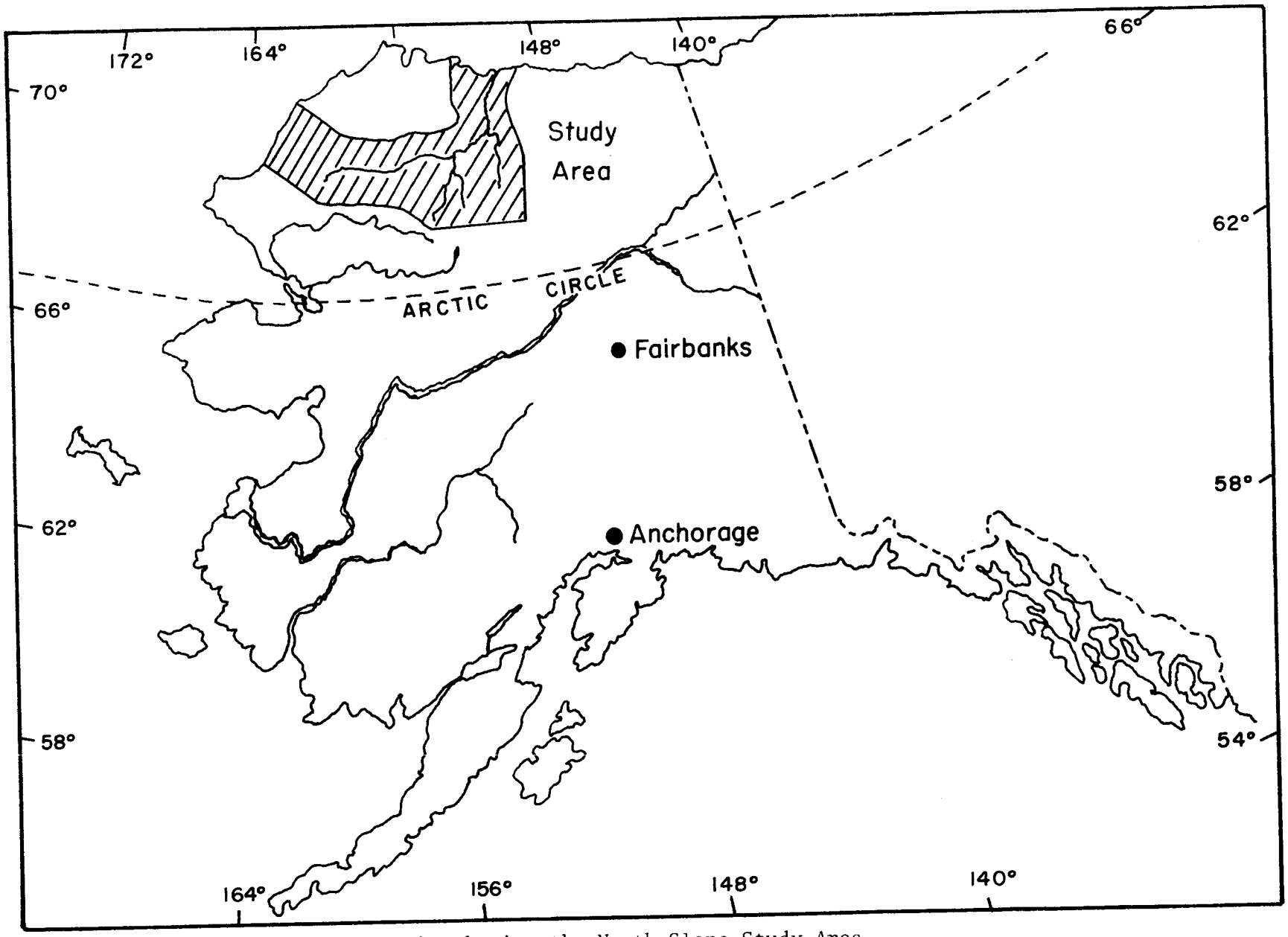


Fig. 1. Map of Alaska showing the North Slope Study Area.

Table 1. List of species captured in Colville River drainage in 1977-1978.

Common Name	Scientific Name and Author	Abbreviation
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
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
Slimy sculpin	*Cottus cognatus* Richardson	SSC

open water season, and many tributaries become discontinuous in mid-summer due to low precipitation.

Beaded streams are common throughout the study area and provide migration avenues for fish during run-off and periods of high water; however, most contain standing water during summer months and are of limited significance to fisheries.

For the purpose of this report, the mainstem of the Colville River was separated into four physiographic sections: (1) mouth to Itkillik River, (2) Itkillik River to Killik River, (3) Killik River to Etivluk River, and (4) Etivluk River to headwaters.

Three categories of lakes are found within the study area: (1) glacial, (2) thaw, and (3) overflow channels and oxbows within the floodplain of the Colville River. Thaw lakes and oxbows are characteristically shallow with neither inlets nor outlets and many do not contain fish. Glacial lakes are deep oligotrophic systems found widely scattered throughout the Brooks Range and represent only a small proportion of the total surface water within the study area.

The study area lies within the Arctic Climatic Zone. Waters within the study area are usually ice covered from October through June. Temperature extremes at Umiat 177 km (mile 110 on the Colville River) range from -54°C (-65°F) to 29°C (85°F) with a mean annual precipitation of 14.5 cm (5.7 in) (Selkregg, 1976). The Colville River freezes to the river bed in shallow areas and ceases to discharge during late winter.

Two village communities, Nuiqsut and Anaktuvuk Pass, are within the study area. Exploratory oil and gas work has been ongoing within the study area since 1944. Field studies for this report were based out of Umiat, a supply and operation base for oil exploration located on the Colville River, 121 km (75 mi) south of Harrision Bay.

RECOMMENDATIONS

Research

1. Lake and stream surveys should be completed on North Slope waters with emphasis on the central and eastern Brooks Range drainages.

2. Existing data should be reviewed to determine the locations and types of information necessary to complete a comprehensive life history assessment of North Slope fishes.

3. Fall populations of Arctic char in the Sagavanirktok and Kongakut river drainages should be enumerated.

4. Assessment of overwintering fish habitats in North Slope waters should continue.

Management

1. The sport fishing potential of area waters adjacent to the North Slope haul road should be determined.

2. The sport fishery for Arctic char in the Prudhoe Bay area should be monitored.

OBJECTIVES

1. To survey the Colville River and its principal tributaries as well as the lakes within the Colville watershed.

2. Determine fish species composition and relative abundance.

3. Determine life history parameters of these fish, including age, growth, and reproduction.

4. To identify important seasonal habitats, including spawning and overwintering areas.

5. To collect physical and chemical water data.

TECHNIQUES USED

Lake And Stream Surveys

Float equipped DeHavilland Beaver and Grumman Super Widgeon aircraft were used for transporting field crews and equipment between lakes and streams. Avon inflatable rafts and 4 1/2 hp outboard motors were used to conduct lake surveys and to float the Utukok, Kokolik, and Kukpowruk rivers.

An aluminum riverboat powered by twin 85 hp motors equipped with jet units was used to survey the Colville River and its tributaries.

Physiographic data, as well as longitude and latitude, were calculated from 1956 U. S. Geological Survey 1:250,000 maps and sectional aeronautical charts.

Water chemistry data were recorded using a Hach AL-36B field test kit. Water depths were recorded with a Lowrance fathometer. A standard 254 mm (10 in) Secchi disc was used to determine water clarity and a Yellow Springs Instruments salinity meter was used to determine salinity.

Multifilament graduated mesh sinking or floating gill nets measuring 38.1 x 1.8 m (125 x 6 ft) and consisting of five 7.6 m (25 ft) panels of 12.7 mm (1/2 in) through 63.5 mm (2 1/2 in) bar mesh were used to capture fish. Other sampling gear included 7.6 x 1.2 m (25 x 4 ft) beach seines, 7.6 x 1.8 m (25 x 6 ft) x 12.7 mm (1/2 in) mesh multifilament

gill nets and a Coffelt Model BP III backpack electroshocker. Hook and line sampling was used to capture fish as time allowed, and baited hooks were left overnight to capture burbot. A standard net night was considered 12 hours.

Estimates of flow (cfs) were made using the following formula:

$$R = \frac{W \times Da \times L}{T}$$

Where:

R = volume of flow in cfs
W = average width in feet
D = average depth in feet
a = constant for correction of stream velocity (.85)
L= length of stream section measured in feet
T = time in seconds for a float to traverse the distance L

A General ice auger with a 254 mm (10 in) bit was used to drill through winter ice. Monofilament graduated mesh sinking gill nets measuring 38.1 x 1.8 m (125 x 6 ft) or individual 7.6 m (25 ft) and 15.2 m (50 ft) panels from these nets were used to capture fish under the ice. Burbot were captured using large single hooks attached to lines set through the ice.

All data were recorded on standard Alaska Department of Fish and Game Stream and Lake Survey forms.

Biological Sampling

Fish samples were preserved in 10% formalin or frozen and sent to Fairbanks for laboratory analysis. All samples were grouped by date and location. Small fish were weighed to the nearest gram on a triple beam balance. Fish over 500 g were weighed on a Chatillon spring scale. Fork lengths were measured to the nearest millimeter, and sex and stage of maturity were determined by examining gonads.

A binocular microscope was used to determine ages of Arctic char, lake trout, and burbot from otoliths wetted in zylene. All other fish were aged by reading scales. Scales were cleaned and impressed on 20 mil acetate sheets. A Burning 200 microprojector was used to read the scales. Lengths at the end of each year of life for several species were back calculated using the direct proportion formula. Estimates of stomach fullness and contents were made in the field.

Fecundity was determined by displacing a volume of water with a known quantity of eggs. The total number of eggs was then calculated using the quantity of water displaced by the entire ova mass.

FINDINGS

Lake and Stream Surveys - Colville River System

A total of 16 species of fish representing six families was encountered within the study area. The main reaches of the Colville River offered the greatest diversity and abundance of fish. Three additional species, rainbow smelt, *Osmerus mordax* (Mitchill), fourhorn sculpin, *Myoxocephalus quadricornis* (Linnaeus), and Arctic flounder, *Liopsetta glacialis* (Pallas), are reported to occur in the Colville Delta (Kogl, 1971) which was not surveyed during this study. Alaska blackfish, *Dallia pectoralis* Bean, are also reported from North Slope waters, but were not captured in the study area. Species diversity and abundance in the Colville River decrease in an upstream direction.

Stream surveys and gill netting were conducted throughout the main stem of the Colville River between the Itkillik River (lat. 70°90'N, long. 50°56'W) and the Nuka River (lat. 69°01'N, long. 158°55'W) as well as for varying distances into the lower reaches of all major tributary streams. Much of the data on seasonal distribution and movements is based on net catches at Umiat.

Ice breakup in the Colville River progressed from the headwaters to the delta and occurred at Umiat on May 31, 1977 and June 1, 1978. The Colville River was free of ice by June 10, at which time gill net catches near Umiat consisted of grayling, round whitefish, broad whitefish, burbot, longnose sucker, slimy sculpin, and ninespine stickleback. Grayling, longnose sucker, and ninespine stickleback began spawning in the third week of June in 5° to 8°C (41° to 46°F) water. Small tributaries that by mid-summer may become discontinuous, such as Seabee, Rainy, and Fossil creeks are used extensively by grayling for spawning, as are the major tributaries to the Colville River. Most spawning by grayling was completed by the end of June, at which time large numbers of "spent" fish were captured near the confluence of minor tributaries in the Colville River. Grayling also utilize the main stem of the Colville River for spawning (most notably above the Etivluk River) and appear to prefer slow moving or slack water less than 0.9 m (3 ft) deep.

Longnose suckers spawn in the lower reaches of small tributaries, as well as in the main stem of the Colville and major tributaries. Spawning ninespine stickleback were captured in slow moving water in the lower portions of small tributaries.

The composition of net catches at Umiat throughout July and early August was similar to that following breakup. Arctic char and lake trout were captured infrequently at sites between the Anaktuvuk and Etivluk rivers throughout the open water season, and three mature Arctic cisco were captured at Umiat in early July, 1977.

A large run of mature humpback whitefish and immature and mature broad whitefish occurred at Umiat the third week of August, with peak numbers of fish captured in the last days of the month. Humpback and broad whitefish spawn during September throughout the lower and middle reaches of the Colville River; however, precise spawning locations within the drainage have not been delineated at this time.

A total of 64 pink, 29 chum, and 1 king salmon was captured in the Colville River between the Itkillik and Etivluk rivers during 1978. Pink salmon were spawning near the Itkillik River on August 11 and at Umiat on August 19. Chum salmon were moving upstream past Umiat on August 19 and were not yet ripe. A single king salmon that had not spawned was captured near the mouth of the Etivluk River on September 4, 1978.

Table 2 presents species composition of stream survey locations in the Colville River drainage. Preliminary information on the timing of instream migrations and spawning for several species is presented in Fig. 2. This information is based on net catches at Umiat. Data on the duration of spawning periods are incomplete at this time. The distribution of Colville River species is shown in Fig. 3.

Stream waters in the Colville River drainage are characteristically soft. Total hardness at stream survey locations ranged from 34 to 119 ppm and averaged 75 ppm. Alkalinity ranged from 17 to 103 ppm ($\bar{x}$ 62 ppm) and pH varied between 7 and 8.

Due to physiographic difference in stream morphology and discharge, the main stem of the Colville was divided into the four sections mentioned previously in this report. Most of the survey effort was in Sections II and III during 1977 and in Sections II and IV during 1978.

Section I:

Section I of the Colville River extends from Harrison Bay up to the confluence with the Itkillik River and consists of the two main channels of the Delta. Fishery values for this section of the Colville are described by Kogl (1971) and Kogl and Schell, 1975.

Section II:

Section II of the Colville River extends from the mouth of the Itkillik River to the confluence with the Killik River (Fig. 4). Section II is heavily braided, traversing a broad river valley that rises approximately 150 m (500 ft) in 402 km (250 miles). Much of this section is bordered by high bluffs on the west and north banks. Potential overwintering habitat is abundant in this section of the Colville, with the greatest number of deep holes (to 10.5 m [35 ft]) occurring along bluffs between the Itkillik and Anaktuvuk rivers. The river bed at several locations near the Itkillik River lies at or below sea level. In Section II, the Colville River is bordered by extensive gravel bars that are covered with thick stands of willow and alder. Following breakup, the water is turbid and clears up only for brief periods during mid-summer when precipitation on the watershed is low. A jet unit is required for boat travel throughout most of the open water season.

Table 2 lists the species of fish captured in Section II. All of the species captured appear to spawn, rear, and overwinter in this reach of the Colville or its tributaries. With the exception of late summer and fall migrations of whitefish and salmon, the seasonal distribution of species inhabiting Section II remains unchanged. Few Arctic char were

Table 2. Species composition of streams surveyed within the North Slope Study Area, 1977-1978.

	Species Present															
	LT	AC	GR	BWF	HWF	RWF	LCI	ACI	PS	CS	KS	BB	NP	LNS	SSC	NSB
Colville Section II	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Colville Section III	X	X	X	X		X				X	X	X		X	X	X
Colville Section IV			X	X		X						X		X	X	X
Anaktuvuk R.	X	X	X	X		X						X		X	X	X
Aupuk Cr.			X	X		X						X		X	X	X
Awuna R.			X	X		X								X	X	X
Chandler R.	X	X	X	X	X	X						X		X	X	X
Etivluk R.			X			X						X		X	X	X
Itkillik R.			X									X		X	X	X
Kiligwa R.			X											X	X	X
Killik R.	X		X			X	X					X	X	X	X	X
Kogosukruk R.			X			X						X		X	X	X
Kuna R.			X											X	X	X
Kurupa R.			X			X						X		X	X	X
Ipnavik R.			X												X	X

Table 2. (cont.) Species composition of streams surveyed within the North Slope Study Area, 1977-1978.

	Species Present															
	LT	AC	GR	BWF	HWF	RWF	LCI	ACI	PS	CS	KS	BB	NP	LNS	SSC	NSB
Mayuasanik R.			X			X									X	X
Nuka R.			X												X	X
Oolmnagavik R.			X	X		X									X	X
Seabe Cr.			X	X		X						X		X	X	X
Etivlik L. Outlet			X												X	X
Betty L. Inlet	X		X													X
Utukok R.			X						X	X					X	X
Kokolik R.		X	X					X	X	X					X	X
Kukpowruk R.			X						X	X					X	X

Fig. 2. Preliminary data on migration and spawning times of the principal salmonid species in the Colville River.

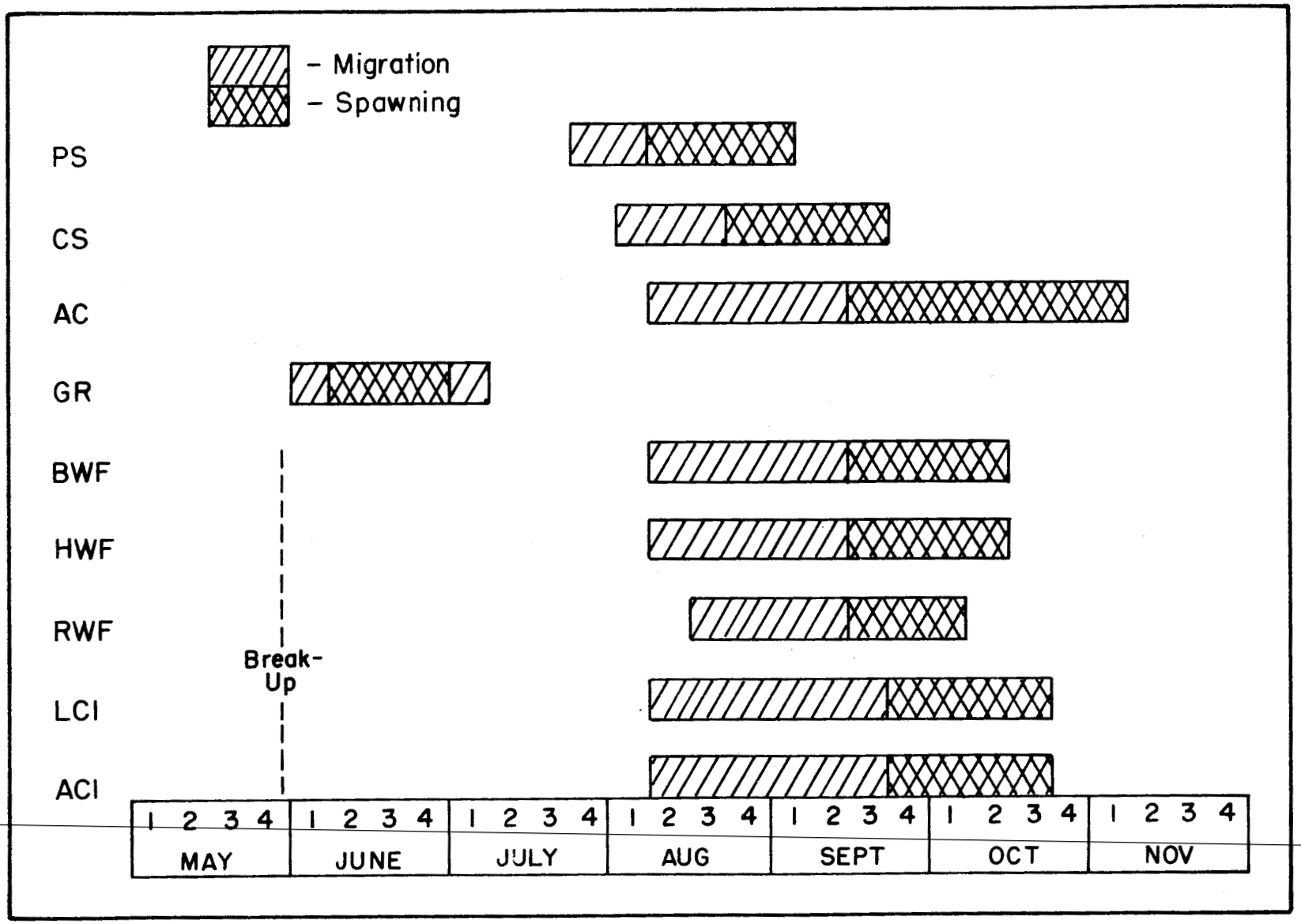
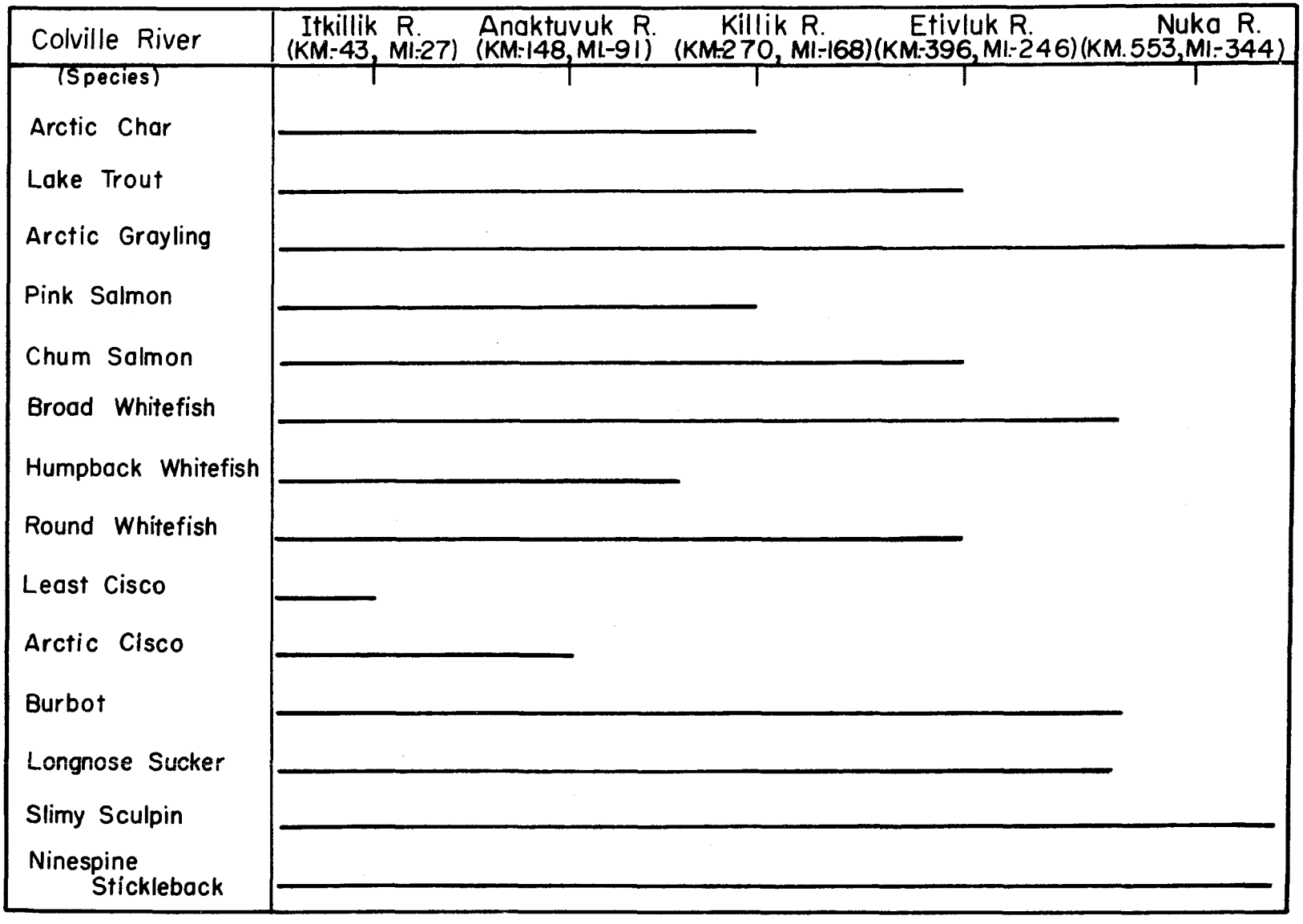


Fig. 3. Distribution of fish species throughout the main stem of the Colville River.



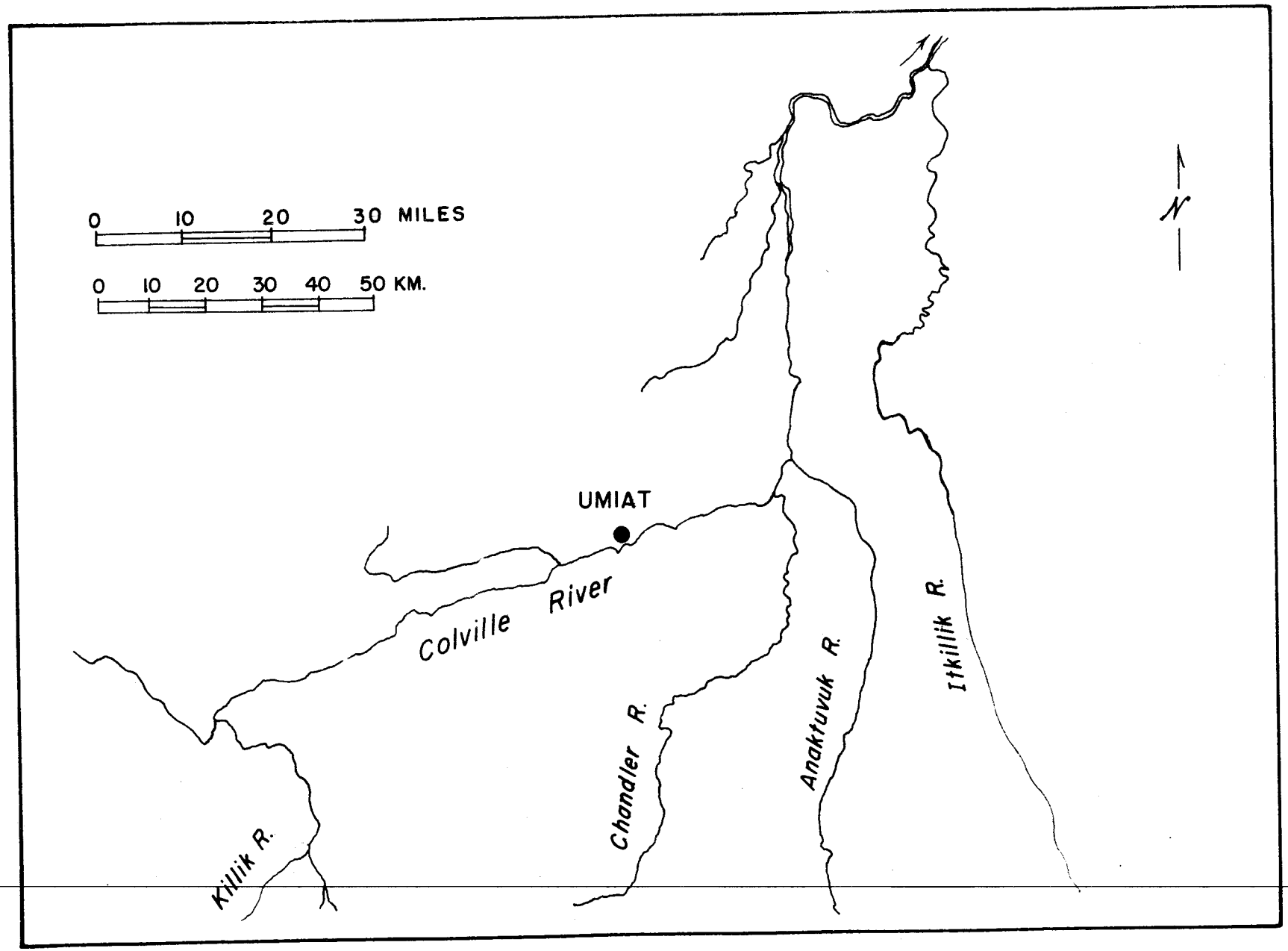


Fig. 4. Section II of the Colville River.

captured in Section II above the confluence with the Chandler River, and lake trout were only captured in low numbers throughout this section.

Grayling are the most widespread and abundant sport fish species inhabiting Section II of the Colville River. Minor tributaries that are important spawning or rearing habitats for grayling include: Kikiakrorak River, Kogosukruk River, Seabee Creek, Rainy Creek, Prince Creek, Fossil Creek, and Ninuluk Creek. The mouths of these tributaries are also important rearing areas for other species of fish including: broad whitefish, round whitefish, burbot, longnose sucker, and slimy sculpin.

Broad whitefish spawn, rear, and overwinter throughout Section II of the Colville River. Humpback whitefish migrate through Section II during August and September prior to spawning; however, they were not captured at other times of the year in this section of the river.

There were no subsistence or commercial fishermen observed in Section II of the Colville River during 1977 and 1978; however, there was evidence of fish camps at three locations below the Kikiakrorak River. Only light and occasional sport fishing (for grayling) by workers based at Umiat was observed during this study.

Four major tributaries, the Itkillik, Anaktuvuk, Chandler, and Killik rivers enter Section II of the Colville. Nine lakes within these drainages were surveyed.

Itkillik River. The Itkillik River heads near Oolah Pass in the Endicott Mountains. It flows northeast and then northwest for 354 km (220 mi) and enters the Colville 40 km (25 mi) southwest of Harrison Bay at lat. 70°09'N, long. 150°56'W. The middle and upper reaches of the Itkillik River are heavily braided and flow rapidly over large rocks and rubble. The lower one-third of the river meanders slowly through relatively flat terrain and is bordered by mud and sand bars. The water is blue-green and transparent throughout most of the open water season.

A survey was conducted by riverboat in the lower 8 km (5 mi) of the Itkillik River on August 13, 1978. The river is shallow throughout the area surveyed and the water temperature was 6°C (43°F). Fish species captured in the lower Itkillik River included pink and chum salmon, least cisco, round whitefish, humpback whitefish, and grayling. Additional species reported to occur in the Itkillik River are lake trout, Arctic char, broad whitefish, Arctic cisco, slimy sculpin, and rainbow smelt (Kogl, 1971).

Anaktuvuk River. The Anaktuvuk River heads in the Endicott Mountains and flows north for 217 km (135 mi) to the Colville River at lat. 69°34'N, long. 151°28'W (Fig. 5). The watershed area of the Anaktuvuk River is approximately 7,350 km^2 (2,839 mi^2).

The river is heavily braided throughout its length and has a bottom comprised of sand and large gravel. Several spring areas in the middle and upper reaches of the Anaktuvuk create large fields of aufeis that remain throughout most of the open water season. Spring areas also

Fig. 5. Anaktuvuk River drainage.

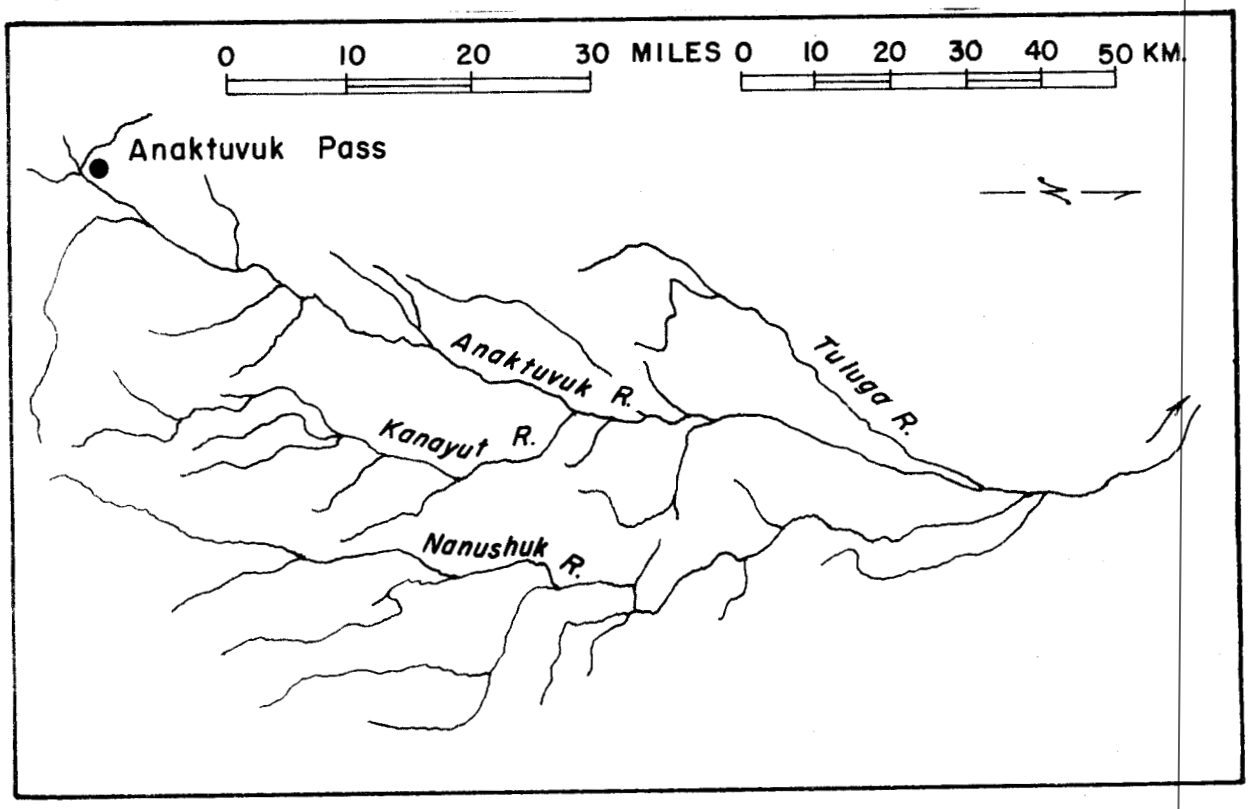
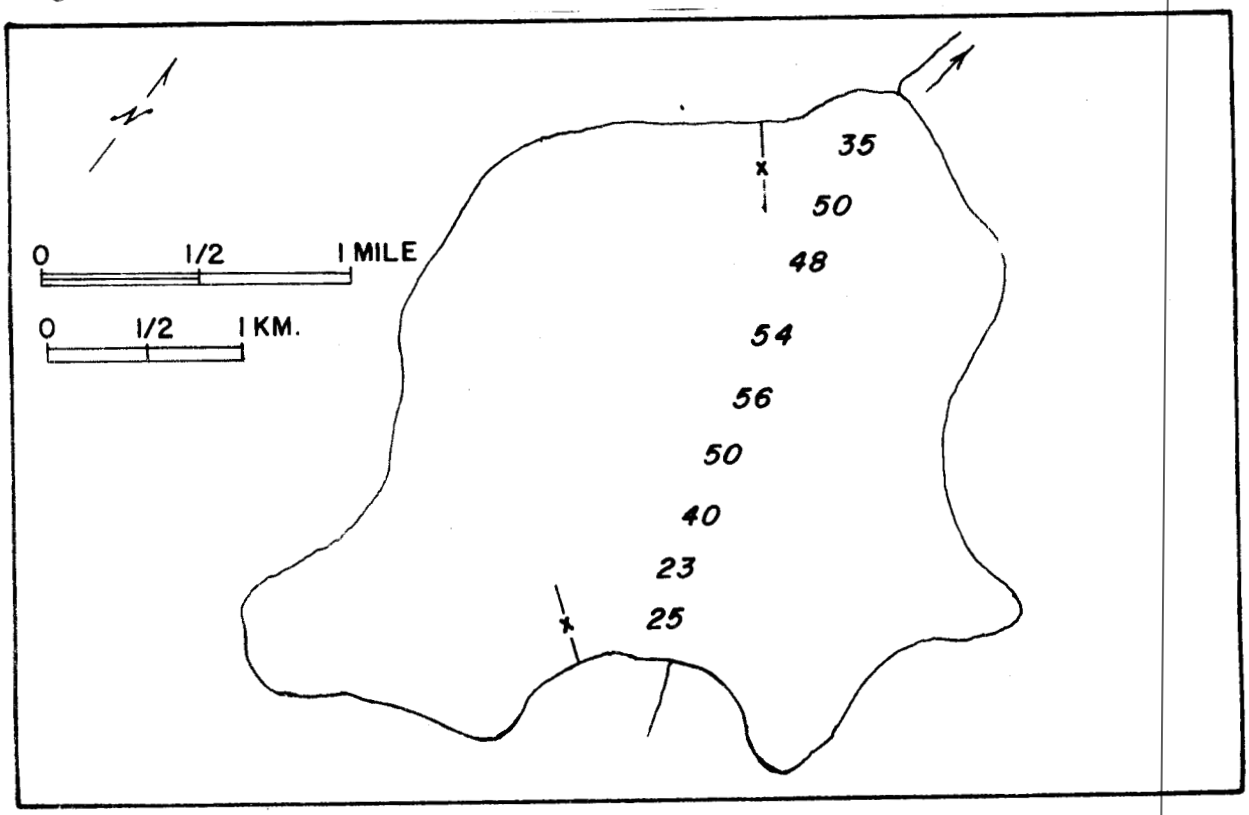


Fig. 6. Shainin Lake, depths are shown in feet.



maintain open leads during winter months and, presumably, some discharge occurs in the Anaktuvuk River year around. Gravel bars along the lower reaches of the Anaktuvuk River are vegetated with willows, alder, and dwarf birch and the upper reaches with alpine tundra. Aquatic vegetation throughout the system is sparse. Several small lakes lie within the floodplain of the upper Anaktuvuk River; however, these lakes were not surveyed due to their small size and apparently shallow depths. Three major tributaries, Nanushuk, Tulugak, and Kanayut rivers enter the Anaktuvuk River. Anaktuvuk Pass, a Nunamuit village of less than two hundred residents, lies at the head of the Anaktuvuk River. During the time of our investigation, two wildcat oil wells were being drilled along the upper and middle reaches of the river.

The lower 6.4 km (4 mi) of the Anaktuvuk River were surveyed by riverboat on July 7 to 9 and August 22 to 24, 1977. The lower Anaktuvuk River is shallow and approximately 60 m (200 ft) wide. Velocity was 1.58 m/sec (5.2 fps) and flow was estimated at 65.76 m^3/sec (2,322 cfs) on August 23. Water chemistry data were: Alkalinity 137 ppm, hardness 120 ppm, pH 8.5, and water temperature 13°C (55°F). The water is blue and transparent following high water during breakup; and angling for grayling, lake trout, and Arctic char is good throughout late summer and fall.

Arctic char, lake trout, grayling, round whitefish, broad whitefish, burbot, slimy sculpin, and ninespine stickleback were captured in the Anaktuvuk River. Spawning habitat is abundant for all species present; however, overwintering habitat provided by deep pools is limited. The extent to which spring areas contribute to overwintering habitat in the Anaktuvuk River is unknown at this time.

Anadromous Arctic char enter the Anaktuvuk River in August. Pink salmon, chum salmon, and humpback whitefish were captured at the mouth of the Anaktuvuk; however, it was not determined if these species utilize the main stem of the river. A large concentration of fish was observed adjacent to Rooftop Ridge during an aerial survey on October 1, 1978; however, landing areas were not available and identification of species was not made.

Shainin Lake (Fig. 6), lat. 68°20'N, long. 151°03'W, is a glacial lake located on the north side of the Brooks Range 35.4 km (22 mi) northeast of Anaktuvuk Pass. Shainin Lake is surrounded by alpine tundra, has a surface elevation of 823 m (2,700 ft) and a single inlet and outlet. It is 4.3 km (2.7 mi) long and has a maximum depth of 17 m (56 ft). Water color is dark green due to glacial silt and the Secchi disk reading was 0.9 m (3 ft). Bottom material varies from mud to coarse rubble. Shore material along the south bank is sand, while gravel and rubble cover the east and west shores. Aquatic vegetation is sparse. Water chemistry data were: Alkalinity 86 ppm, hardness 68 ppm, pH 8.0, and water temperature 13°C (55°F).

Gill netting conducted from August 17 to 19, 1977, yielded a catch of grayling, lake trout, round whitefish, and slimy sculpin. Kogl (1971) reported capturing a small Arctic char in Shainin Lake. Spawning and overwintering habitats are abundant. Shoals and submerged bars are not

common; however, the inlet and outlet streams provide additional spawning habitat for lake trout and grayling. Angling for lake trout and grayling in Shainin Lake is excellent.

Sitchiak Lake (Fig. 7), lat. 68°48'N, long. 150°47'W, lies 84 km (52 mi) north-northeast of Anaktuvuk Pass. Surface elevation is 396 m (1,300 ft) and the longest dimension of the lake is 1.6 km (1 mi). Sitchiak Lake is surrounded by low ridges and has a single outlet on the northeast corner with an estimated flow of .014 m^3/sec (0.5 cfs). A single inlet enters from the south. The maximum depth of Sitchiak Lake was 2.4 m (8 ft) and a Secchi disk reading measured 1.5 m (5 ft). Water color was light brown. Bottom material was unsorted rock and gravel, and submergent aquatic vegetation was abundant. Water chemistry data were: Alkalinity 6 ppm, hardness 17 ppm, pH 8, and water temperature 18°C (64°F).

On August 17 to 18, 1977, two gill nets set overnight yielded a catch of 32 grayling and 1 juvenile lake trout. Ninespine stickleback were observed in shallow water. Spawning habitat for grayling and lake trout is abundant; however, overwintering habitat is limited. Angling was excellent for grayling during the survey period.

Ahaliorak Lake (Fig. 8), lat. 68°54'N, long. 151°19'W, is a small thaw lake that lies between the Tuluga and Anaktuvuk rivers, 87 km (54 mi) north of Anaktuvuk Pass. The surface elevation is approximately 300 m (1,000 ft) and the longest dimension of the lake is 2.74 km (1.7 mi). The single outlet on the southwest corner is heavily vegetated and discharges only during periods of high water and runoff. The maximum depth of Ahaliorak Lake is 2.7 m (9 ft) and bottom material is mud and sand. The lake is usually turbid as a result of wind disturbance. Submergent and emergent aquatic vegetation is abundant. Water chemistry data were: Alkalinity 6 ppm, hardness 17 ppm, pH 7.5, and water temperature 18°C (64°F).

Three gill nets set overnight (August 15 to 16, 1977) yielded a catch of 16 grayling. Ninespine stickleback were found as a grayling food item. Overwintering and spawning habitat for grayling is limited throughout the lake. Angling was poor during the survey period.

Chandler River. The Chandler River (Fig. 9), heads in the Brooks Range from Chandler Lake and flows northeast for 201 km (125 mi) to the Colville River 27 km (17 mi) southwest of Umiat. The Chandler River enters the Colville approximately 4.8 km (3 mi) upstream from the mouth of the Anaktuvuk River. The upper one-half of the Chandler River (above Grandstand Ridge) is heavily braided and flows across a broad region of alpine tundra. Below Grandstand Ridge the Chandler meanders through a narrow river valley. River bars throughout the lower reaches are heavily vegetated with willow, alder, and cottonwood. Like the Anaktuvuk River, the Chandler has several spring areas that maintain open water throughout the year. Discharge in the Chandler River varies greatly in response to precipitation on the watershed. The water is brown and clears up only for brief periods during mid and late summer. On June 16, 1977, discharge was estimated to be 209.2 m^3/sec (7,387 cfs), and on August 24, 1977 it dropped to 44.6 m^3/sec (1,575 cfs). The

Fig. 7. Sitchiak Lake, depths are shown in feet.

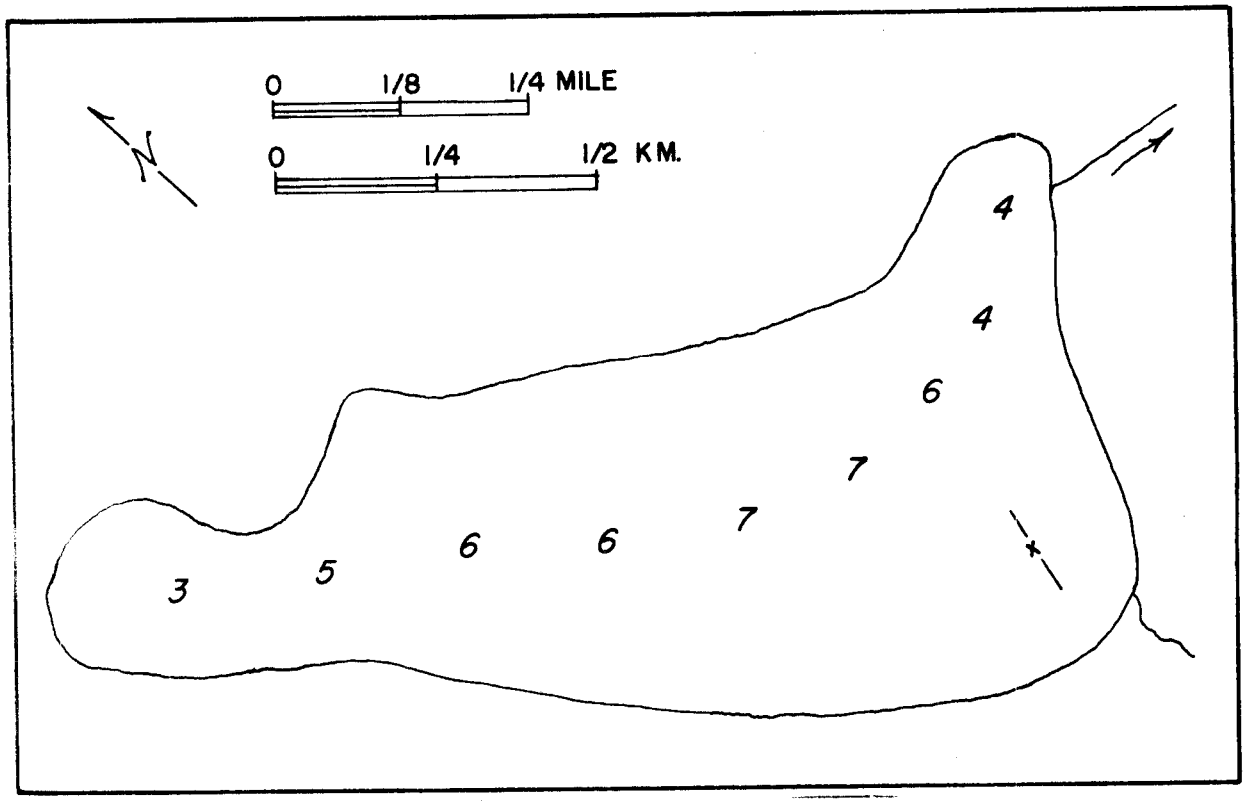


Fig. 8. Ahalioriak Lake, depths are shown in feet.

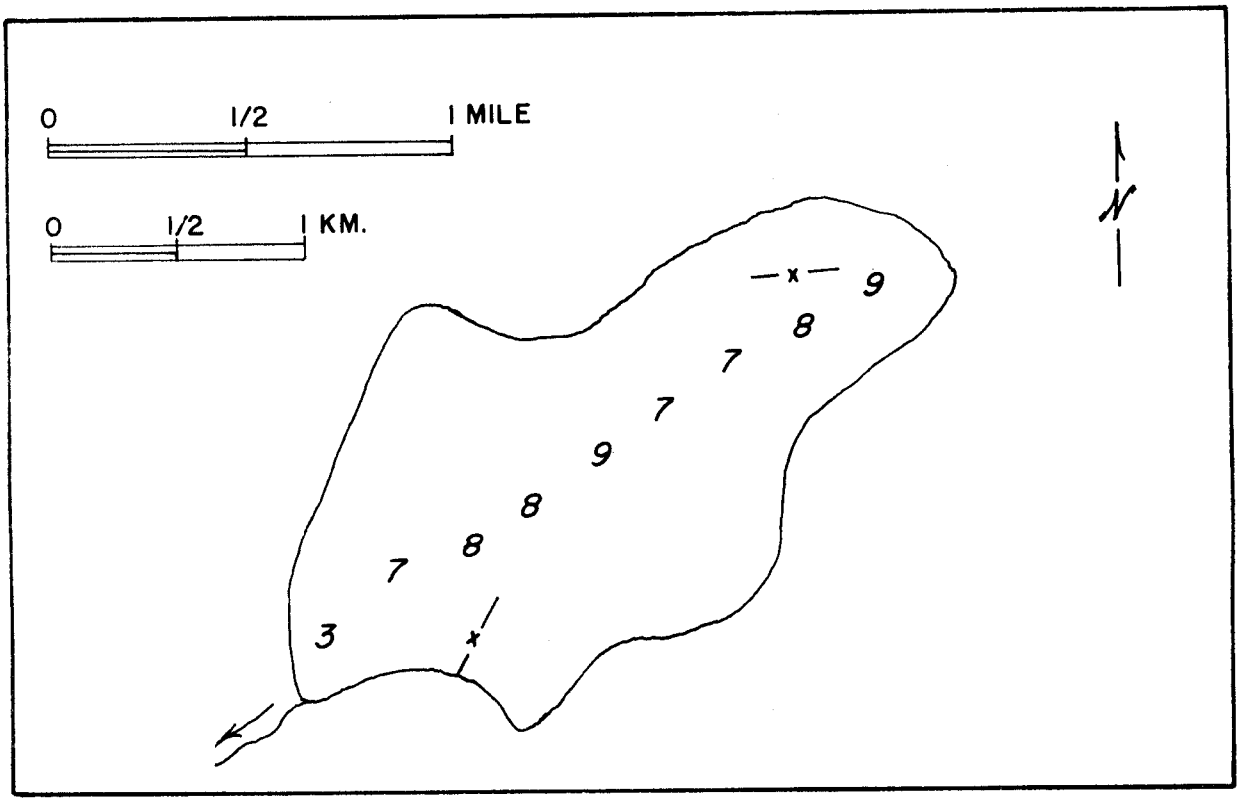


Fig. 9. Chandler River drainage.

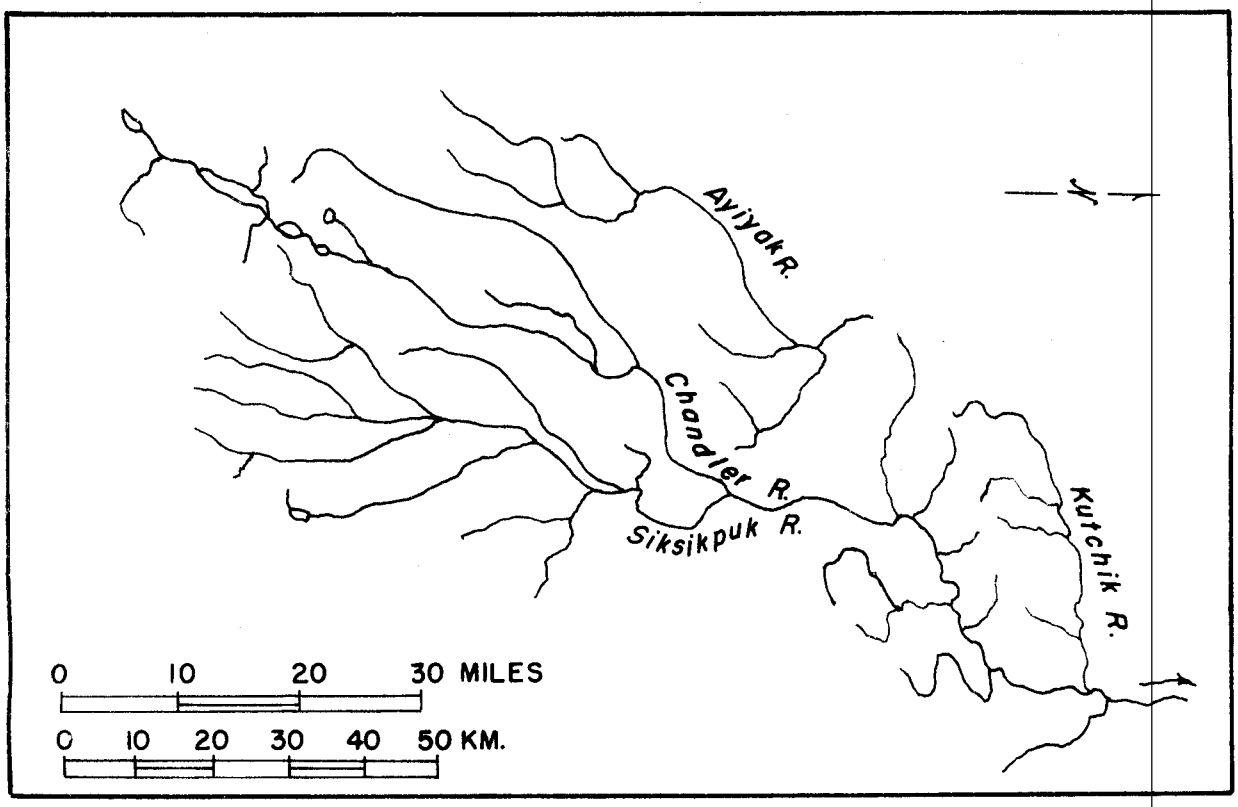
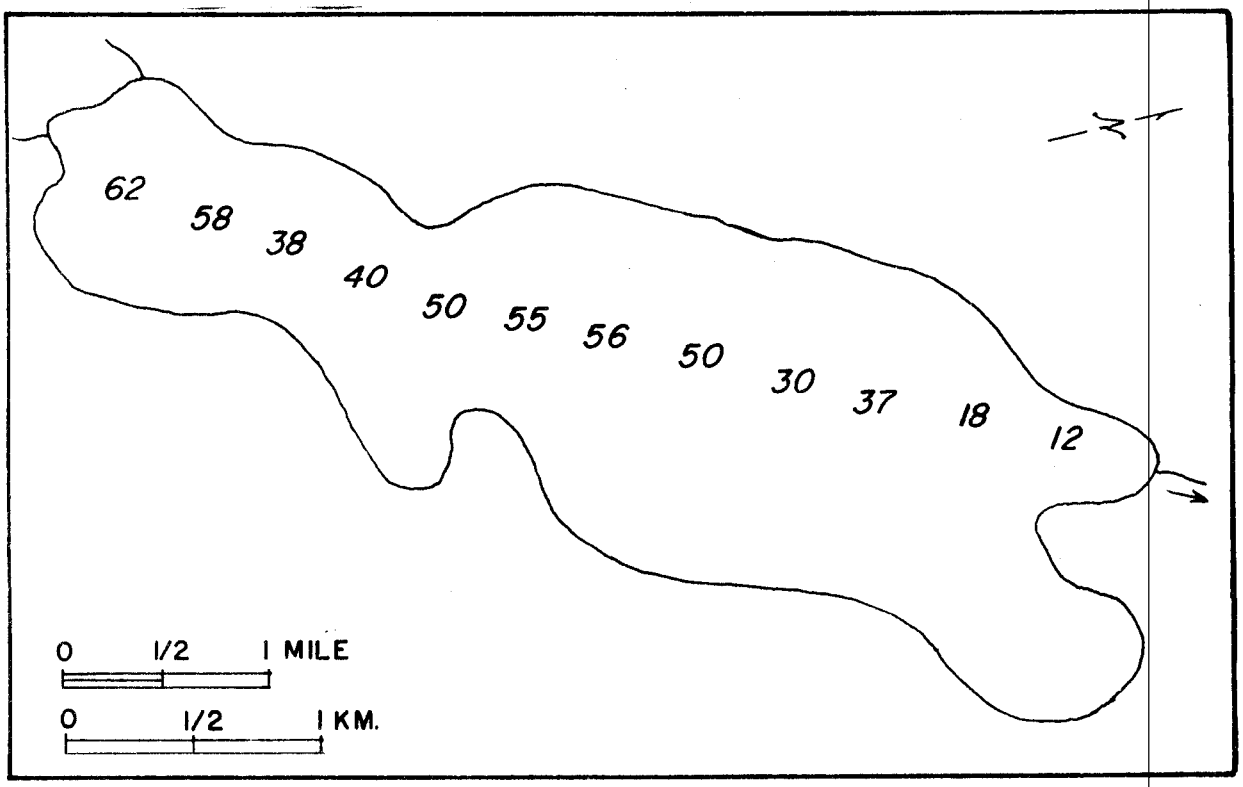


Fig. 10. Chandler Lake, depths are shown in feet.



average width of the lower river in August is approximately 30 m (100 ft) and average depth is 1.05 m (3.5 ft). Pool and riffle formations are common throughout the lower river and aquatic vegetation is sparse. Water chemistry data for the lower river were: alkalinity 103 ppm, hardness 103 ppm, pH 7.5, and water temperature 13°C (55°F).

Four main tributaries, Kutchik, Ayiyak, Siksikpuk, and Kiruktagiak rivers enter the Chandler River. The lower 64.3 km (40 mi) of the Chandler River were surveyed by riverboat June 13-17, 1977. Other sampling was conducted in August, 1977, and June and August, 1978.

The Chandler River has the greatest species diversity of the Colville River tributaries that were surveyed. Grayling, lake trout, Arctic char, broad whitefish, humpback whitefish, round whitefish, burbot, longnose sucker, slimy sculpin, and ninespine stickleback were captured in the lower reaches of the Chandler. Pink and chum salmon were captured at the confluence with the Colville. There is an abundance of spawning habitat for all species present. Grayling were observed spawning in the lower reaches as well as in tributary streams during June of 1977. Longnose suckers, slimy sculpin, and ninespine stickleback also spawn in the lower reaches of the river. Pre-spawning broad and humpback whitefish were captured while entering the Chandler in late August. Angling for grayling in the river is good throughout the summer.

Overwintering habitat is limited to a few holes up to 3 m (10 ft) deep, in the lower 64.3 km (40 mi) of river. As with the Anaktuvuk River, it is not known to what extent spring areas contribute to overwintering habitat in the Chandler River.

Chandler Lake (Fig. 10), lat. 68°14'N, long. 152°42'W, is a large glacial lake near the continental divide on the north side of the Brooks Range. It lies 42 km (26 mi) west of Anaktuvuk Pass at 853 m (2,800 ft altitude) and is the source of the Chandler River. Chandler Lake is 8 km (5 mi) in length and is surrounded on the east and west by steep hills. The maximum recorded depth is 18.9 m (62 ft) and the Secchi disk reading was 3.6 m (12 ft) on August 8, 1977. Water color is green, and shoals exist near the two inlets and single outlet. The remainder of the lake perimeter drops off sharply. Lake shores are covered by pea gravel on the north and south and large rubble on the east and west. Aquatic vegetation is sparse. Water chemistry data were: alkalinity 34 ppm, hardness 17 ppm, pH 7.5, and water temperature 15°C (59°F). Chandler Lake remains partially ice covered through the first half of July. A short, unimproved airstrip is located on the south end of the lake and a small cabin lies at the north end.

Lake trout, Arctic char, grayling, round whitefish, and slimy sculpin were captured during August 12-14, 1977. Eskimos report that burbot are in the lake (Furniss, 1974); however, none were captured on set lines during our survey. Overwintering and spawning habitats for the species present are abundant. Kogl (1971) determined that the lower reaches of inlet streams in the Chandler Lake area are important rearing areas for juvenile Arctic char, lake trout, round whitefish, and grayling. Sport fishing is excellent during the open water season.

Killik River. The Killik River (Fig. 11), heads in the Brooks Range at the junction of April and Kakivilak creeks and flows north 169 km (105 mi) to the Colville River, 83.6 km (52 mi) southwest of Umiat. The upper section of the Killik River from Easter Creek to Sunday Rapids is a broad meandering channel that cuts through the northern edge of the Brooks Range. The valley is 4.8 to 6.4 km (3 to 4 mi) wide and dozens of small lakes lie in the floodplain. Exposed and vegetated sand dunes border this stretch of the Killik, and the river bars are sand and assorted gravel. Below Sunday Rapids the Killik River is heavily braided and swift. River bars are composed of unconsolidated rock and gravel. Spring areas and aufeis fields are present from the mouth up to the Okokmilaga River. Turbidity varies with precipitation; however, the water is usually brown and clears up for only brief periods during mid and late summer. Velocity near the mouth was 3.6 m/sec (12 fps) on June 19, 1977. Water chemistry data were: alkalinity 34 ppm, hardness 51 ppm, pH 7.5, and water temperature 11°C (52°F). Three main tributaries, the Okokmilaga River, and Easter and April creeks, enter the Killik River. Surveys were conducted by riverboat in the lower 10 miles of the Killik River on June 19-20, 1977 and June 21-22, 1978.

Grayling, lake trout, round whitefish, burbot, longnose suckers, ninespine stickleback, and slimy sculpin were captured in the lower reaches of the Killik River. Northern pike and broad whitefish are abundant in several lakes of the upper Killik drainage; however, none were captured in the main stem of the river. Stream resident Arctic char have been reported in the Killik River (Morrow, 1973). Spawning habitat is abundant in the Killik drainage. Spawning grayling were captured in the main stem and in lesser tributaries during the third week of June. Overwintering habitat in the Killik River has not been adequately assessed.

Sport fishing was poor due to high, turbid water during our survey. The Killik River receives light sport fishing pressure from floaters and hunters from mid-summer through fall.

Udrivik Lake (Fig. 12), lat. 68°30'N, long. 154°00'W, is the largest lake in the upper Killik River valley. It is 2.9 km (1.8 mi) across and has a complex shoreline. The surface elevation of Udrivik Lake is 503 m (1,650 ft). It is bordered on the west by the Killik River and lies in an area of low hills and vegetated sand dunes. Approximately 30% of the surface is in shoal area and the water color is green. Maximum recorded depth is 9 m (30 ft) and the Secchi disk reading was 6 m (20 ft). Udrivik Lake has a sandy bottom and abundant submerged and emergent aquatic vegetation. There are no inlets and a single outlet that was discharging less than .028 m^3/sec (1 cfs) into a swampy area adjacent to the Killik River. There are no beaches around the perimeter of the lake. Water chemistry data were: alkalinity 68 ppm, hardness 34 ppm, pH 8, and water temperature 20°C (68°F).

Udrivik Lake was surveyed between July 19-20, 1977. Two gill nets set overnight yielded a catch of 26 northern pike and 5 least cisco. There is abundant spawning and overwintering habitat for both species. Large schools of least cisco were seen along the shore line. Angling for small pike is excellent.

Fig. 11. Killik River drainage.

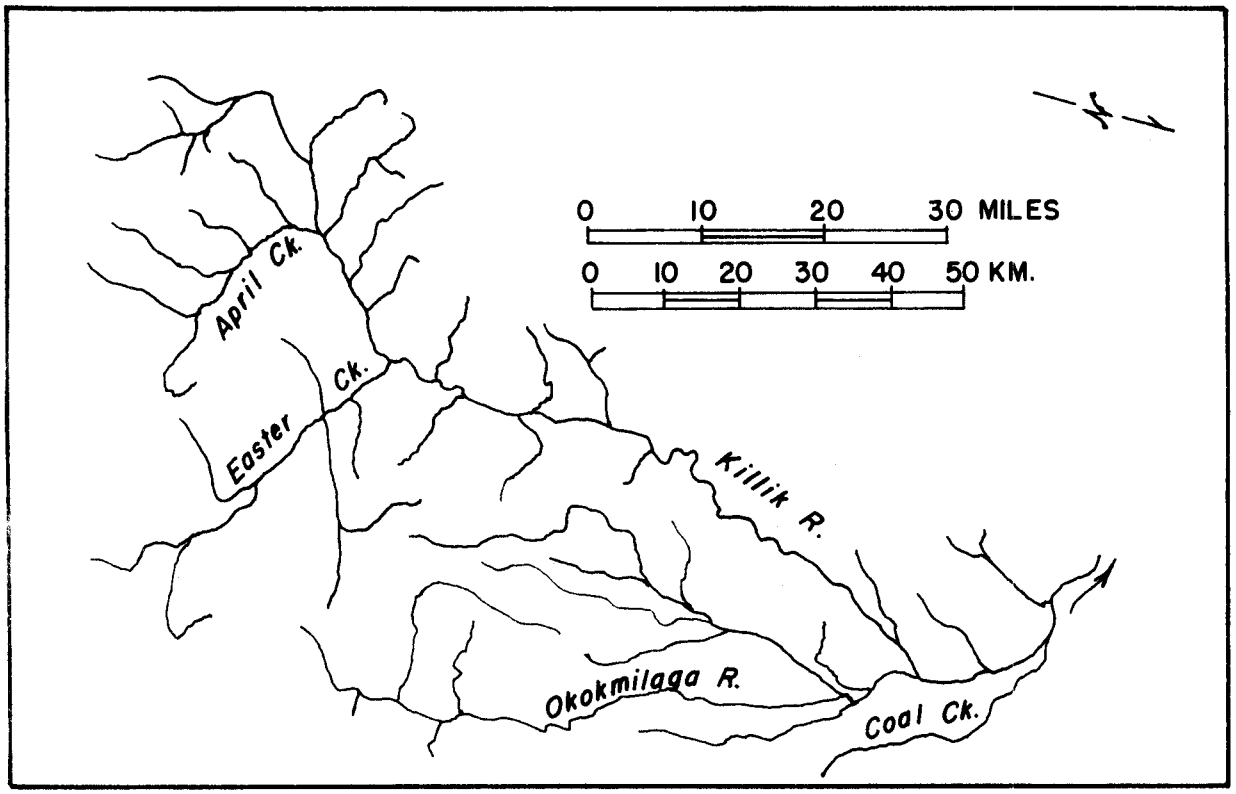
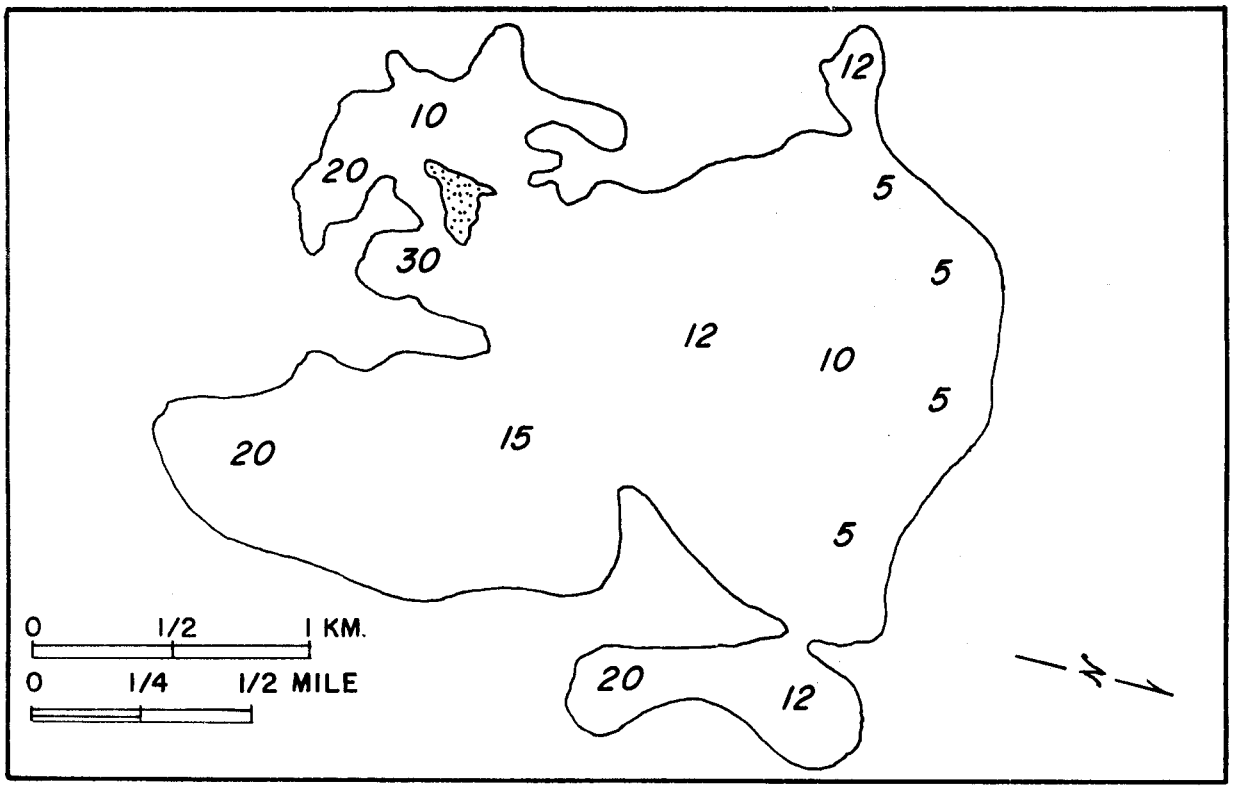


Fig. 12. Udrivik Lake, depths are shown in feet.



Imiaknikpak Lake (Fig. 13), lat. 68°29'N, long. 154°03'W, lies in the Killik River Valley approximately 3.2 km (2 mi) southwest of Udrivik Lake. It is roughly a circular lake 2.4 km (1.5 mi) across with no bays or projections. The surface elevation is approximately 480 m (1,600 ft). The water is light green, maximum recorded depth is 3.9 m (13 ft), and the Secchi disk reading was 1.2 m (4 ft). There is a moderate amount of submerged and emergent aquatic vegetation and extensive shoal areas surrounding the perimeter of the lake. The east shore is covered with pea gravel and a hard sandy beach covers the southwest shore. There are no inlets and a single outlet to the Killik river. The outlet was approximately 6 m (20 ft) wide and 0.6 m (2 ft) deep and was not measurably flowing at the time of our survey. Water chemistry data were: alkalinity 51 ppm, hardness 34 ppm, pH 8, and water temperature 21°C (70°F).

Northern pike, least cisco, broad whitefish, longnose suckers, slimy sculpin, and a single lake trout were captured in Imiaknikpak Lake on July 19-20, 1977. Spawning habitat is abundant in the lake. It is not known if the species present overwinter in Imiaknikpak Lake or migrate seasonally from the Killik River. There is good angling for small northern pike during the summer months.

Unnamed Lake (Fig. 14), lat. 68°25'N, long. 154°04'W, lies 4.8 km (3 mi) south of Imiaknikpuk Lake and has a surface elevation of 457 m (1,500 ft). It is 1.6 km (1 mi) across and has a complex shoreline as well as several small vegetated islands along the eastern shore. Maximum depth is 9 m (30 ft) and the Secchi disk reading was 9 m (30 ft). The water is blue and transparent. It has a mud and sand bottom that is almost entirely covered with dense growths of submerged vegetation. Shoal areas are extensive around the perimeter of the lake; however, there are no exposed beaches. There are no inlets or outlets to this lake. Water chemistry data were: alkalinity 120 ppm, hardness 103 ppm, pH 9, and water temperature 17°C (63°F).

Northern pike, broad whitefish, burbot, and slimy sculpin were captured in this lake between July 18-19, 1977. Spawning and overwintering habitat for the species present is abundant. Angling for small northern pike is excellent.

Kaniksrak Lake (Fig. 15), lat. 68°11'N, long. 154°09'W, lies adjacent to the Killik River three miles north of its junction with Easter Creek. The lake is 1.6 km (1 mi) across and has an irregular shoreline. The surface elevation of Kaniksrak Lake is 487 m (1,600 ft). Maximum recorded depth is 4.5 m (15 ft) and the Secchi disk reading was 3.3 m (11 ft). The water is blue-green, and the bottom material is sand and pea gravel that is covered with a moderate amount of submerged aquatic vegetation. Emergent vegetation is abundant around the perimeter of the lake and there are no exposed beaches. There is neither inlet nor outlet to Kaniksrak Lake. Water chemistry data were: alkalinity 120 ppm, hardness 120 ppm, pH 9, and water temperature 17°C (63°F). Grayling were the only fish captured on July 18-19, 1978.

Fig. 13. Imiaknikpak Lake, depths are shown in feet.

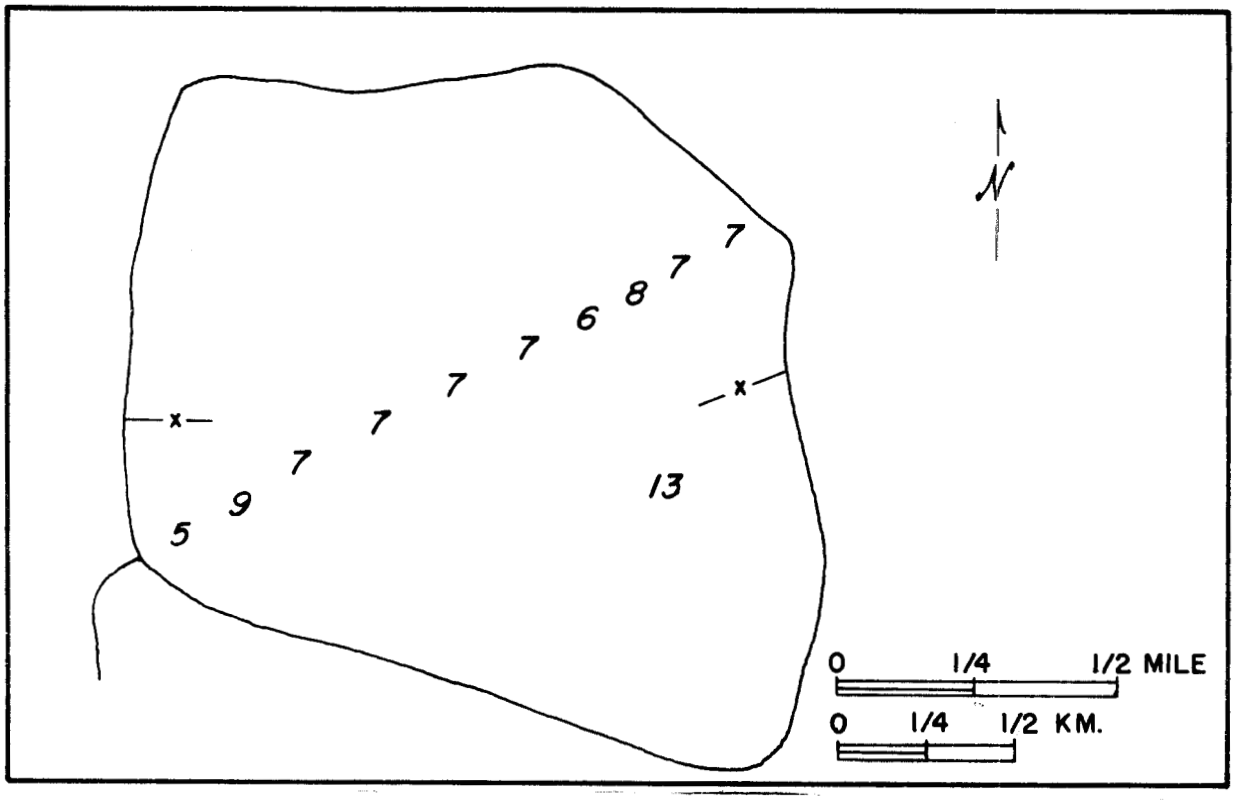


Fig. 14. Unnamed Lake, Killik River drainage. Depths are shown in feet. Latitude 68°25'N, Longitude 154°04'W.

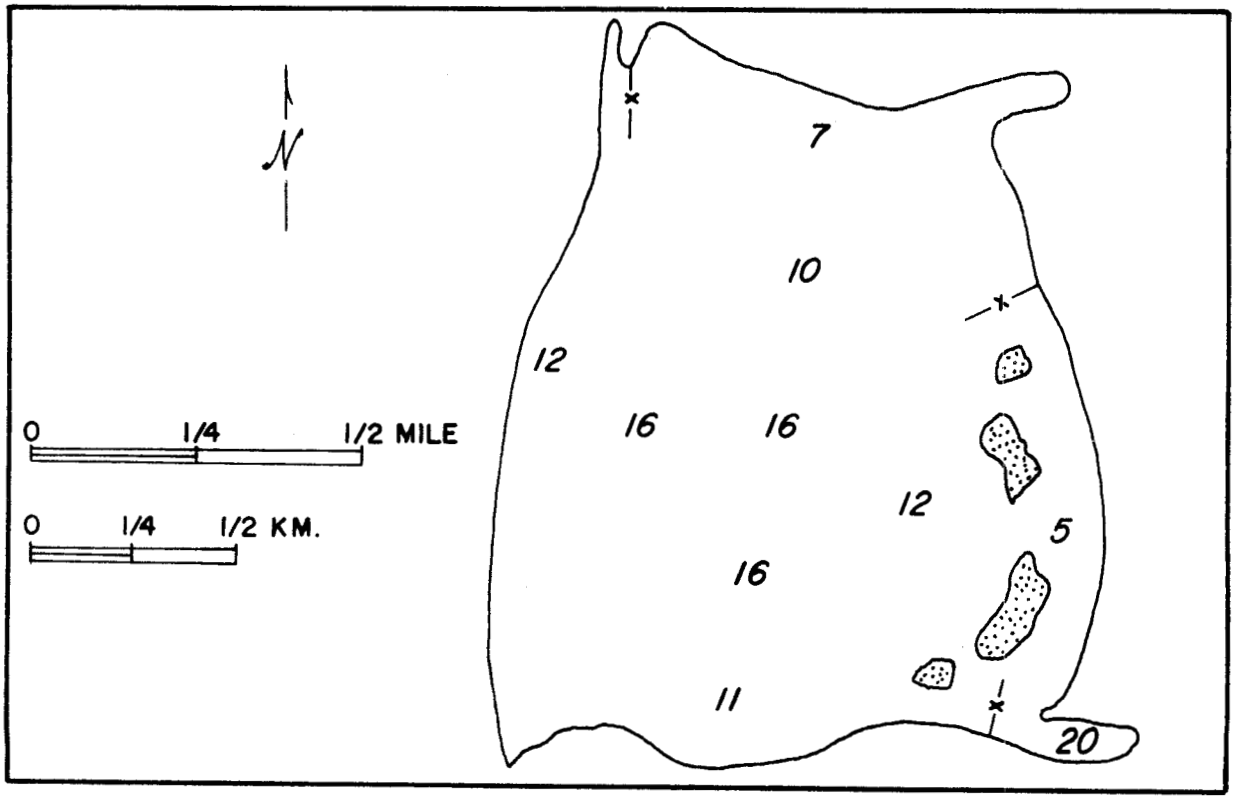


Fig. 15. Kaniksrak Lake, depths are shown in feet.

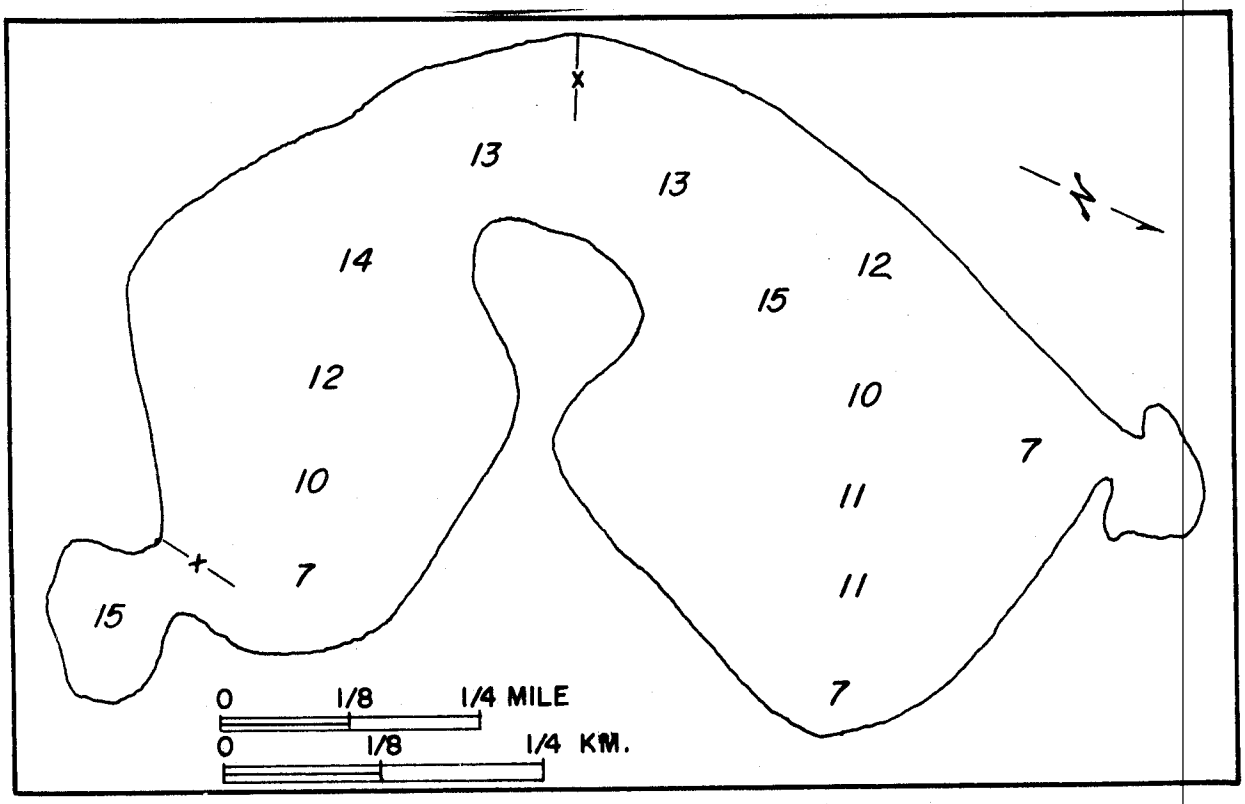
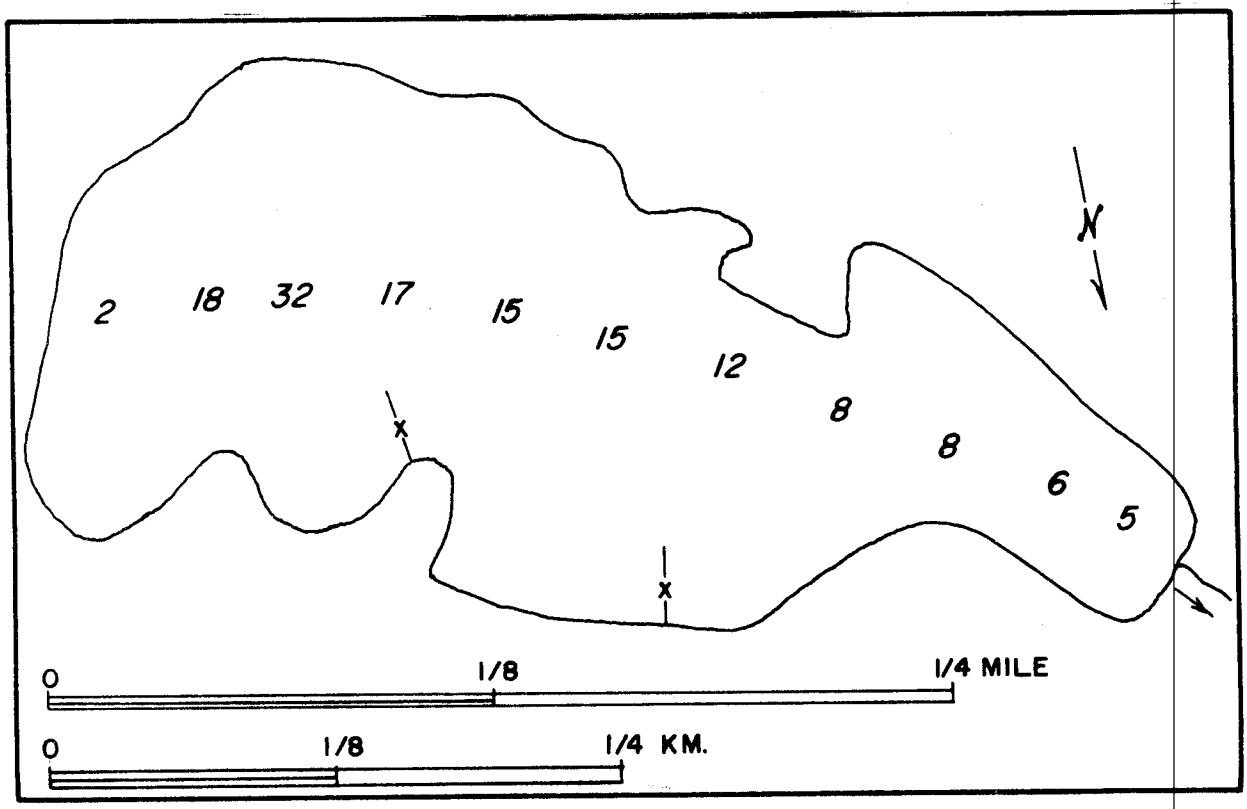


Fig. 16. Tululik Lake, depths are shown in feet.



Tululik Lake (Fig. 16), lat. 68°07'N, long. 154°08'W, lies on a bench above Easter Creek 3.2 km (2 mi) south of its junction with the Killik River. The surface elevation is 579 m (1,900 ft). The lake is .54 km (1/3 mi) long and 12 m (40 ft) deep. The water is light brown and the Secchi disk reading was 7.6 m (25 ft). The bottom is composed of sand and assorted gravel, and a single outlet at the northwest corner of the lake discharged less than .028 m^3/sec (1 cfs). There are no inlets. The lake bottom is covered by a moderate amount of submerged vegetation, and emergent vegetation lines the perimeter of the lake. Water chemistry data were: alkalinity 68 ppm, hardness 103 ppm, pH 8, and water temperature 16°C (61°F).

Grayling, burbot, round whitefish, and slimy sculpin were captured on July 18-19, 1978. There is abundant spawning and overwintering habitat for the species present. Sport fishing for grayling is fair in Tulilik Lake.

Section III:

Section III of the Colville River (Fig. 17), extends from the mouth of the Killik River to the confluence with the Etivluk River. This section of the Colville is a single or split channel meander which traverses a narrow valley defined by bluffs on either side of the river throughout most of its length. It falls approximately 400 feet in 80 miles and is bordered by large river bars composed of well-sorted gravel. Riparian vegetation is less dense than in Section II of the Colville River. There are large pools of slow moving water adjacent to bluffs throughout Section III; however, overwintering habitat appears to be less abundant here than in the lower reaches of Section II. The deepest pool in this section was 7.5 m (25 ft) (measured on June 21, 1978), and is located approximately 21 km (13 mi) downstream from the confluence with the Etivluk River.

Five tributaries, Aupuk Creek and the Oolamnagavik, Kurupa, Awuna, and Etivluk rivers, enter Section III of the Colville River. Surveys were conducted on portions of the latter three streams. The Oolamnagavik River and Aupuk Creek are important spawning and summer habitats for grayling, slimy sculpin, and ninespine stickleback. Aupuk Creek, however, became discontinuous during the summer of 1977 following a prolonged period of low precipitation.

Table 2 lists the species of fish captured in this section of the Colville River. Grayling, broad whitefish, round whitefish, chum salmon, burbot, longnose suckers, slimy sculpin, and ninespine stickleback spawn and rear throughout Section III. Humpback whitefish, pink salmon, and both species of cisco were not captured above the mouth of the Killik River. Arctic char and lake trout were captured infrequently throughout this section, and a single king salmon was captured near the mouth of the Etivluk River.

There were no subsistence or commercial fisheries observed in this section of the river during our study. Sport fishing is good for grayling and occasional lake trout, particularly during periods when the river is low and clear.

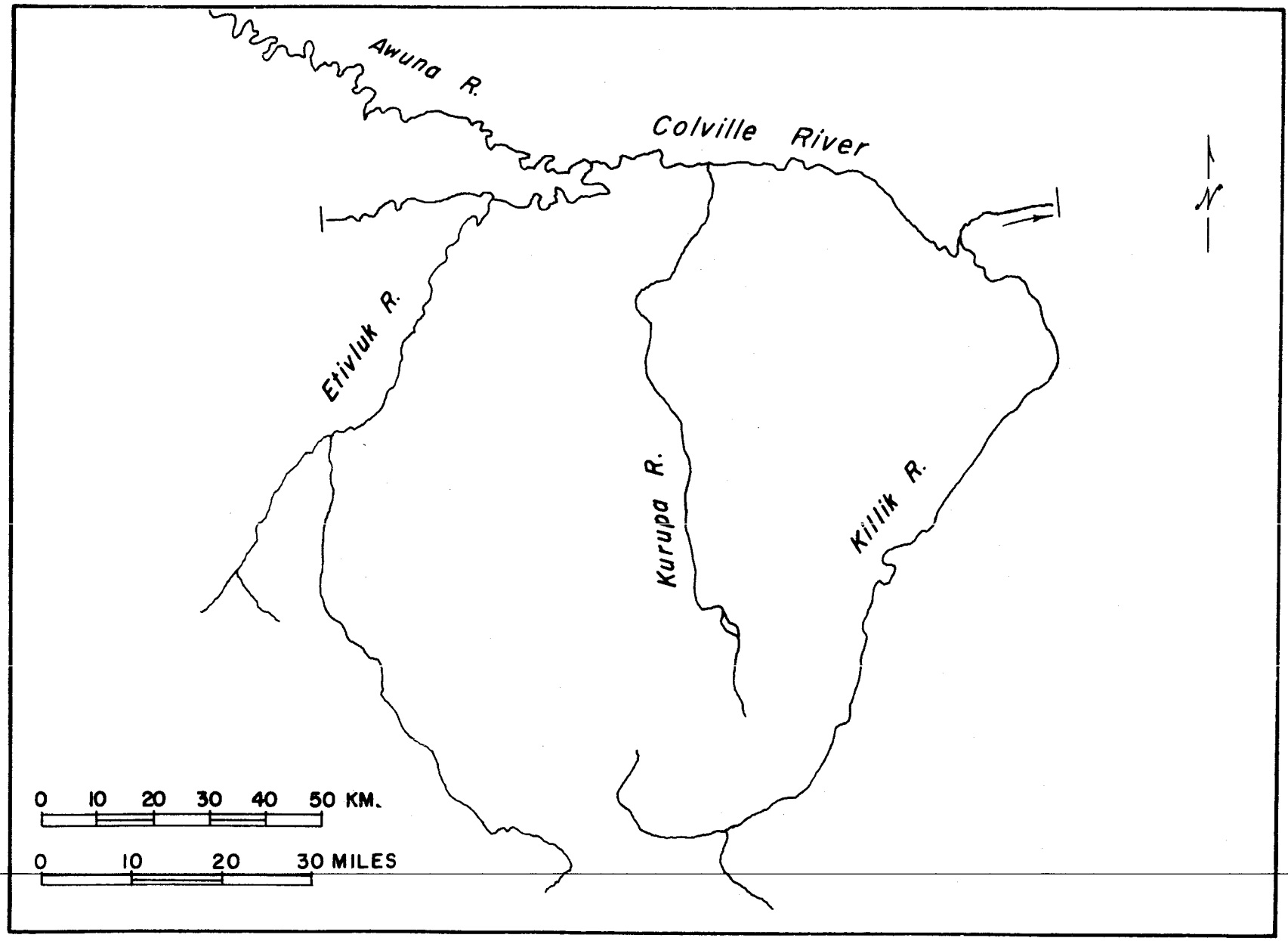


Fig. 17. Section III of the Colville River.

Kurupa River. The Kurupa River (Fig. 18) heads in the Brooks Range and flows north 129 km (80 mi) to the Colville River at lat. 69°04'N, long. 155°03'W. It is a single channel meander throughout most of its length. Braiding occurs most notably near the confluence with Outwash Creek. The drainage area is 2,810 km^2 (1,085 mi^2) and the estimated average annual flow is 15.29 m^3/sec (540 cfs). The Kurupa River valley is narrow and well defined by low ridges on either side. Pool and riffle formations are common throughout the lower reaches. River bars are narrow and composed of large rock and gravel. The Kurupa River clears up shortly after breakup and the water remains blue-green throughout most of the summer. The lower 30 miles of the Kurupa River were surveyed by riverboat from June 19 to 21, 1977. Aquatic vegetation is sparse. Water quality data were: alkalinity 51 ppm, hardness 86 ppm, pH 8, and water temperature 10°C (50°F).

Grayling, burbot, round whitefish, longnose suckers, slimy sculpin, and ninespine stickleback were captured in the lower reaches of the Kurupa River. Broad whitefish were taken at the confluence with the Colville. Grayling were spawning throughout the area surveyed. Pools sufficiently deep for overwintering fish were not found in the lower Kurupa. Angling was poor due to high, turbid water during our survey.

Karupa Lake (Fig. 19), lat. 69°22'N, long. 154°35'W, is a large glacial lake on the north side of the Brooks Range that lies in the course of the Kurupa River. It is 4.83 km (3 mi) long and has a maximum depth in excess of 36 m (120 ft). The surface elevation is 900 m (3,000 ft). Narrow beaches of angular gravel surround the perimeter of the lake. The water is green and the Secchi disk reading was 1.8 m (6 ft). Kurupa Lake has two principal inlets (one draining Cascade Lake) and a single outlet (Kurupa River). On July 23, 1977, the estimated combined discharge of both inlets was 2.18 m^3/sec (77 cfs) and the outlet was discharging 2.27 m^3/sec (80 cfs). The outlet gradient is steep and may be a barrier to fish passage. Aquatic vegetation in the lake and tributary streams is sparse. Water chemistry data were: alkalinity 60 ppm, hardness 60 ppm, pH 7.5, and water temperature 10°C (50°F). The lake may remain partially ice covered through mid-July.

Lake trout, Arctic char, and round whitefish were captured in Kurupa Lake between July 20 and 23, 1977. Kogl (1971) also captured grayling in the inlet streams. There is abundant spawning and overwintering habitat in Kurupa Lake. Sport fishing is excellent for lake trout and small Arctic char. Kurupa Lake recieves light sport fishing effort from fly-in hunters, hikers, and fishermen.

Cascade Lake (Fig. 20), lat. 68°20'N, long. 151°03'W, is a glacial lake that lies less than 1.6 km (1 mi) to the northeast and approximately 150 m (500 ft) higher in elevation than Kurupa Lake. It has shoreline projections, no inlets, and a single outlet that has a steep gradient and drains into Kurupa Lake. The outlet was discharging an estimated 0.10 m^3/sec (3.5 cfs) on July 23, 1977. Small beaches composed of angular gravel exist on the northern and southern shores. A submerged reef that rises to within 1.5 m (5 ft) of the surface exists at the narrowest part of the lake. Aquatic vegetation is sparse and the lake is surrounded by alpine tundra.

Fig. 18. Kurupa River drainage.

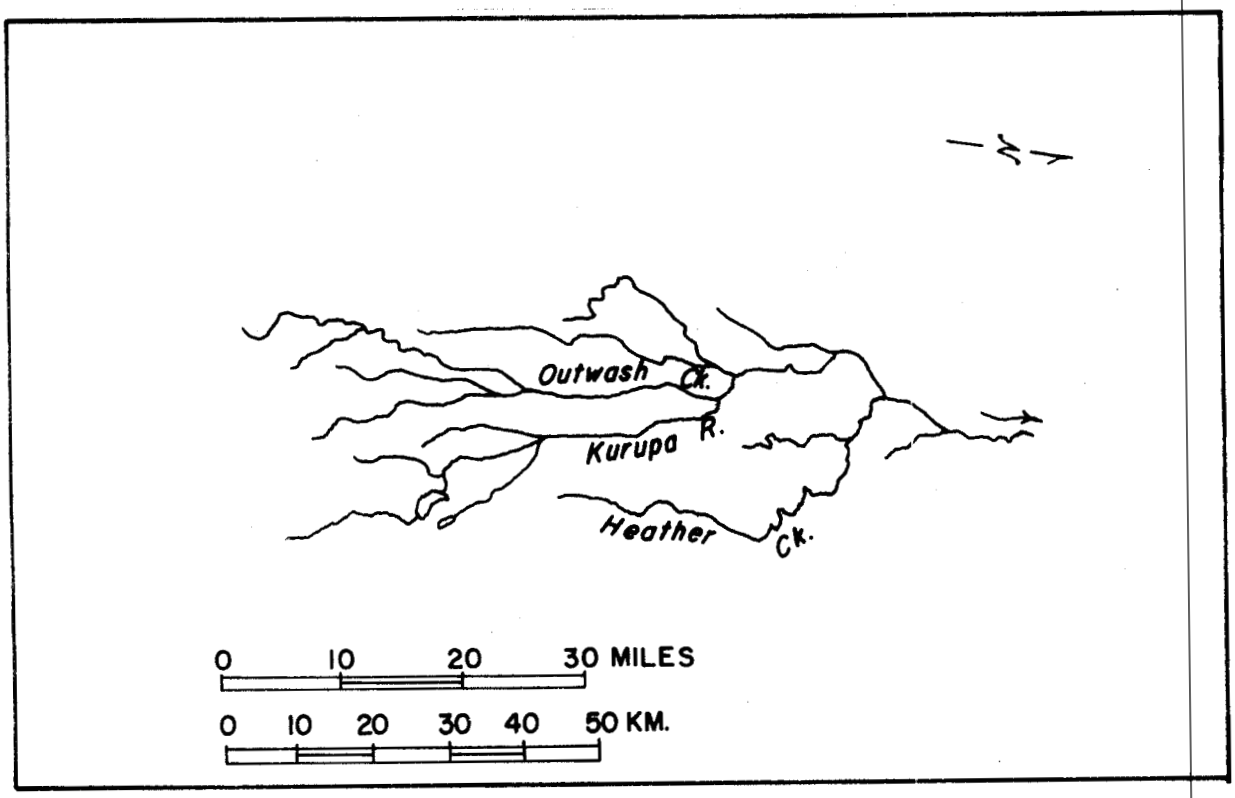
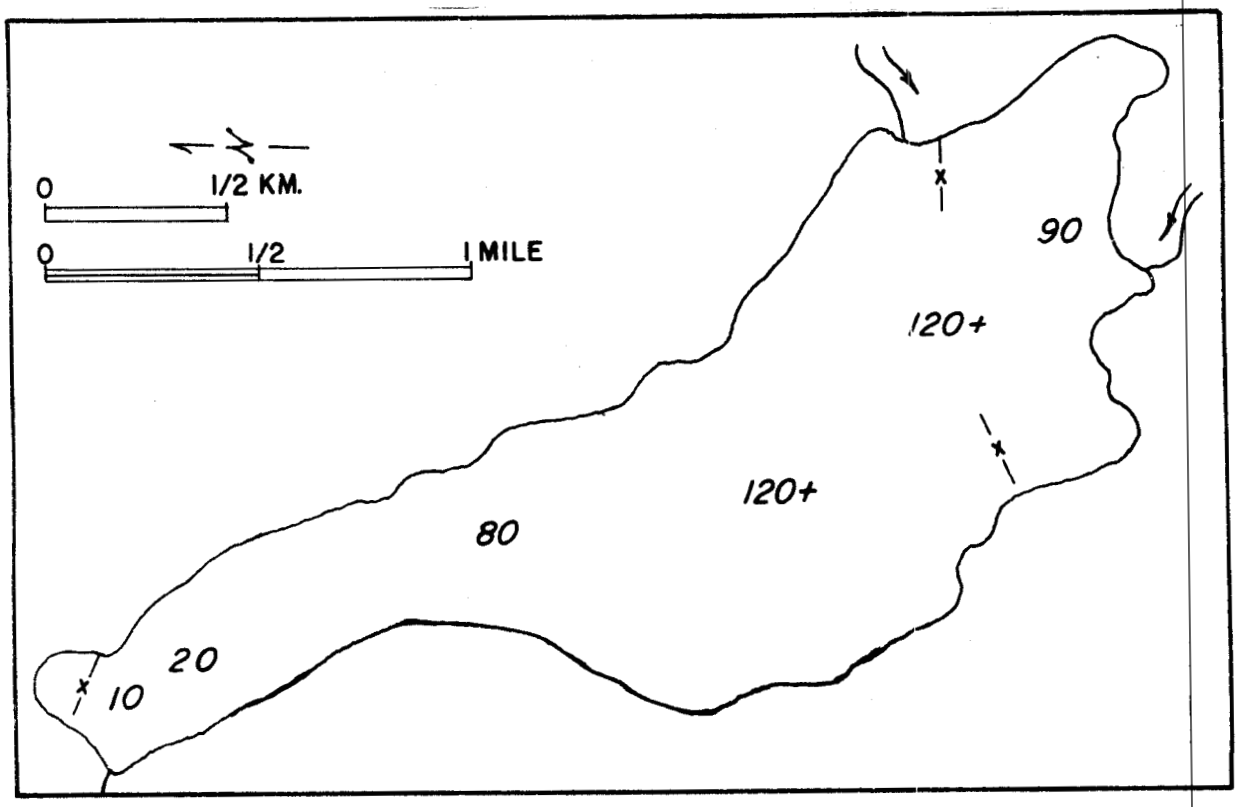


Fig. 19. Kurupa Lake, depths are shown in feet.



The maximum depth of Cascade Lake is 36 m (120 ft) and the Secchi disk reading was 5.10 m (17 ft). Water color is green. Water chemistry data were: alkalinity 34 ppm, hardness 34 ppm, pH 7.5, and water temperature 13°C (55°F).

Lake trout, Arctic char, and slimy sculpin were captured in Cascade Lake between July 21 and 23, 1977. Spawning and overwintering habitat for these species is abundant. Lake trout and char captured in Cascade Lake were smaller than these species taken in other alpine lakes in the Brooks Range and may result from the lack of a suitable forage species for these fish. Cascade Lake receives light sport fishing pressure from fly-in fishermen throughout the open water season.

Two additional lakes in the Kurupa River drainage were visited briefly on July 23, 1978. The uppermost lake in the Kurupa drainage (lat. 68°11'N, long. 154°30'W) has a surface elevation of 1,310 m (4,300 ft), milky blue water, and a depth in excess of 15 m (50 ft). The Secchi disk reading was 2.4 m (8 ft). This lake has two short inlets and a single outlet with a gradient that appears to be a barrier to fish passage. Water chemistry data were: alkalinity 34 ppm, hardness 17 ppm, pH 8, and water temperature 8°C (46°F). Angling for 1.5 hours near the inlet and outlet produced no fish.

The second lake visited is the lower of two headwater lakes of Outwash Creek (lat. 68°14'N, long. 154°49'W). Surface elevation is 1,310 m (4,300 ft). It has milky blue water, a depth in excess of 15 m (50 ft), and a Secchi disk reading of 1.5 m (5 ft). There is a single inlet and an outlet. Water chemistry data were: alkalinity 51 ppm, hardness 34 ppm, pH 8, and water temperature 10°C (50°F). One hour of angling near the inlet produced no fish.

Awuna River. The Awuna River (Fig. 21) heads on the north side of Lookout Ridge and flows east 176 miles to the Colville River at lat. 69°03'N, long. 155°28'W. It drains 3,445 km^2 (1,330 mi^2) and has an estimated average flow of 19 m^3/sec (670 cfs). The Awuna River drains an area of low hills and ridges and is confined to a single meandering channel throughout its length. During a prolonged dry period in 1977 the Awuna became discontinuous. The river bed is composed of small to medium size gravel, and long shallow pools are common. Gravel bars, where they exist, are short and narrow. There is a light bank cover composed of dwarf birch and willow. The water color is dark brown and transparent. Water chemistry data were: alkalinity 51 ppm, hardness 120 ppm, pH 7.5, and water temperature 12°C (54°F). On June 21, 1977, the estimated discharge was 25.5 m^3/sec (900 cfs) and riverboat travel was only possible in the lower 1.6 km (1 mi).

Grayling, broad whitefish, round whitefish, longnose suckers, slimy sculpin, and ninespine stickleback were captured in the lower Awuna on June 21 and 22, 1977. Spawning habitat for grayling is abundant in the Awuna River; however, overwintering habitat does not appear to be available. No lakes inhabitated by fish were found in the Awuna River drainage.

Fig. 20. Cascade Lake, depths are shown in feet.

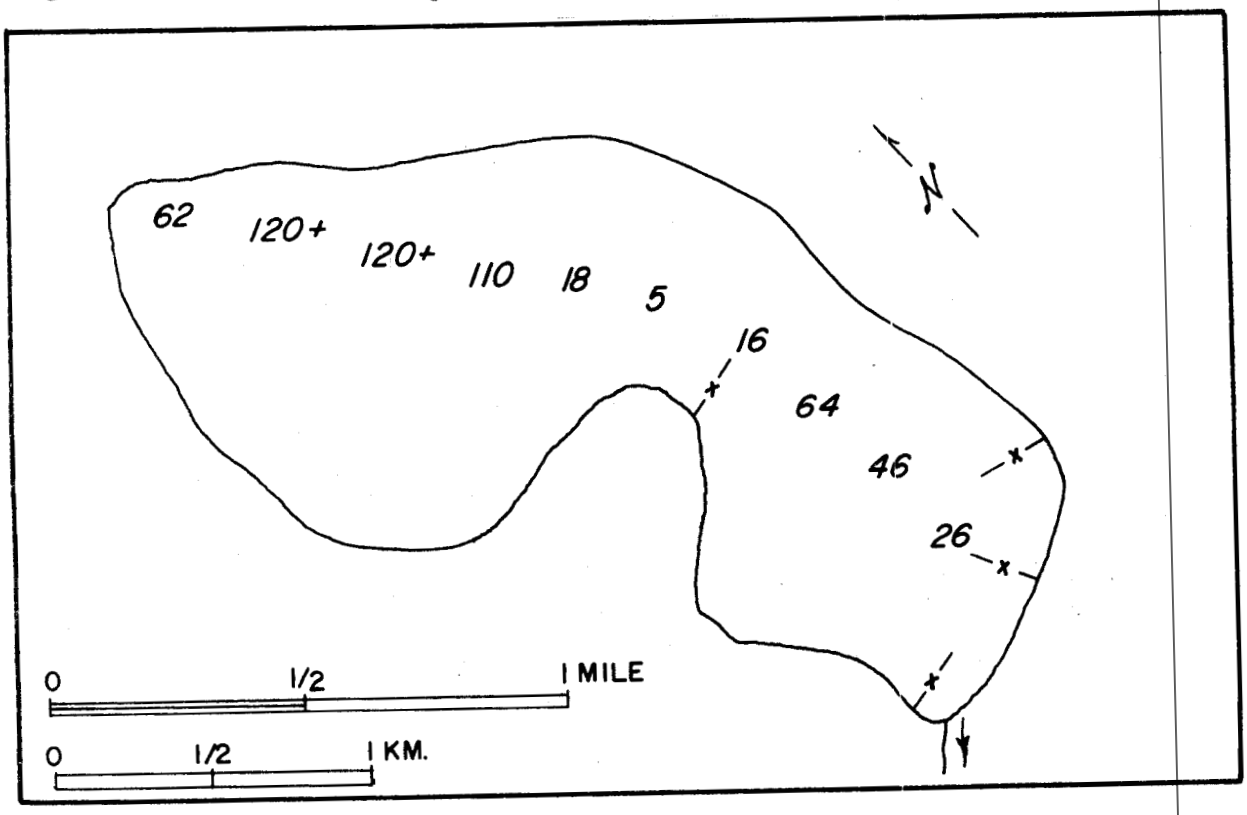
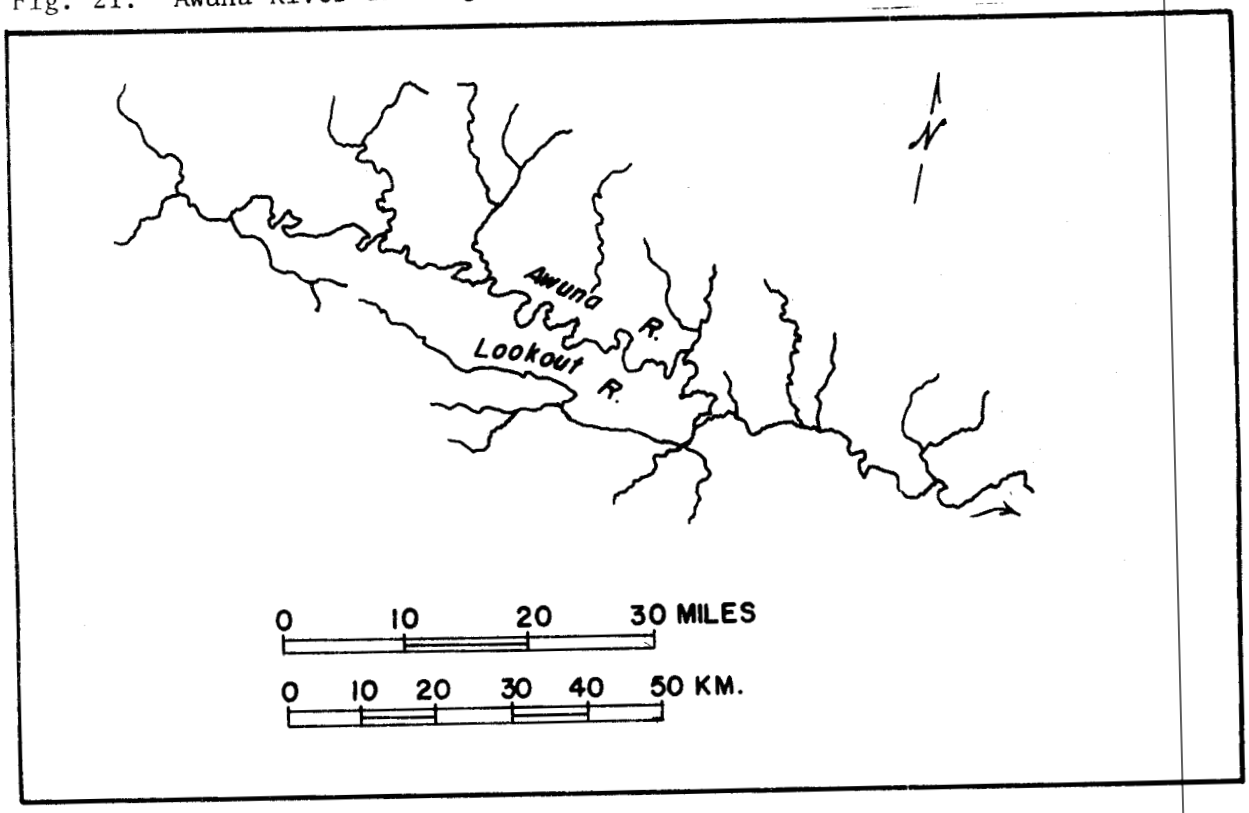


Fig. 21. Awuna River drainage.



Etivluk River. The Etivluk River (Fig. 22) heads at Nigtun Lake in Howard Pass and flows northeast 105 km (65 mi) to the Colville River at lat. 68°57'N, long. 155°57'W. The Etivluk River drains an area of 5,390 km^2 (2,081 mi^2) and has an estimated average annual flow of 29.5 m^3/sec (1,040 cfs). It has a broad river valley and two major tributaries, East Fork and the Nigu River, both of which enter from the east. The river channel is a single or split channel meander. River bars are abundant throughout the lower half of the Etivluk and are composed of well sorted medium and large gravel. Bars along the lower river are well vegetated with willow, alder, and dwarf birch. Water is light green in color, and transparent. Pool and riffle formations are common. Water chemistry data were: alkalinity 6 ppm, hardness 51 ppm, pH 8, and water temperature 10°C (50°F). The lower 24 km (15 mi) of the Etivluk River is accessible by riverboat during periods of high water.

Grayling, round whitefish, broad whitefish, lake trout, burbot, longnose suckers, slimy sculpin, and ninespine stickleback were captured in the lower Etivluk River on June 22 and 23, 1977. Stream resident Arctic char are reported for the Etivluk drainage (Morrow, 1973), but were not captured during our survey. Spawning habitat is abundant throughout the lower Etivluk and its tributary streams. Overwintering habitat appears to be limited to a few isolated pools in the lower river. Angling is good for grayling and lake trout.

Tukuto Lake (Fig. 23), lat. 68°30'N, long. 157°02'W, is a glacial lake lying at the head of Tukuto Creek, 32 km (20 mi) north of Howard Pass. The surface elevation is 488 m (1,600 ft) and the lake is surrounded by low tundra hills. Tukuto Lake is 3.2 km (2 mi) long and has a maximum depth of 7 m (23 ft). The Secchi disk reading was 3.3 m (11 ft). The lake bottom is composed of sand and gravel and is covered with a moderate amount of submerged vegetation. Several narrow beaches intermittantly line the perimeter of the lake. There are two inlets and a single outlet. The water is brown and transparent. Water chemistry data were: alkalinity 34 ppm, hardness 17 ppm, pH 7.5, and water temperature 16°C (61°F).

Lake trout, grayling, round whitefish, least cisco, slimy sculpin, and ninespine stickleback were captured in Tukuto Lake between August 5 and 7, 1977. There is abundant spawning and overwintering habitat for the species present. Angling is fair for lake trout and grayling.

Unnamed Lake (Fig. 24), lat. 68°28'N, long. 156°30'W, lies between the Etivluk River and Tukuto Creek. It is less than 1.6 km (1 mi) across and has a maximum depth of 1.5 m (5 ft). The surface elevation is 420 m (1,400 ft). The water is dark brown and the Secchi disk reading was 1.2 m (4 ft). The lake bottom is covered with gravel and there are no exposed beaches. There are no inlets and a single (beaded stream) outlet that was not flowing at the time of our survey. Water chemistry data were: alkalinity 17 ppm, hardness 17 ppm, pH 7.5, and water temperature 8°C (46°F).

Grayling and ninespine stickleback were captured at this site on August 7 and 8, 1977. Spawning habitat is abundant; however, overwintering may be limited due to the absence of any deep areas in the lake.

Fig. 22. Etivluk River drainage.

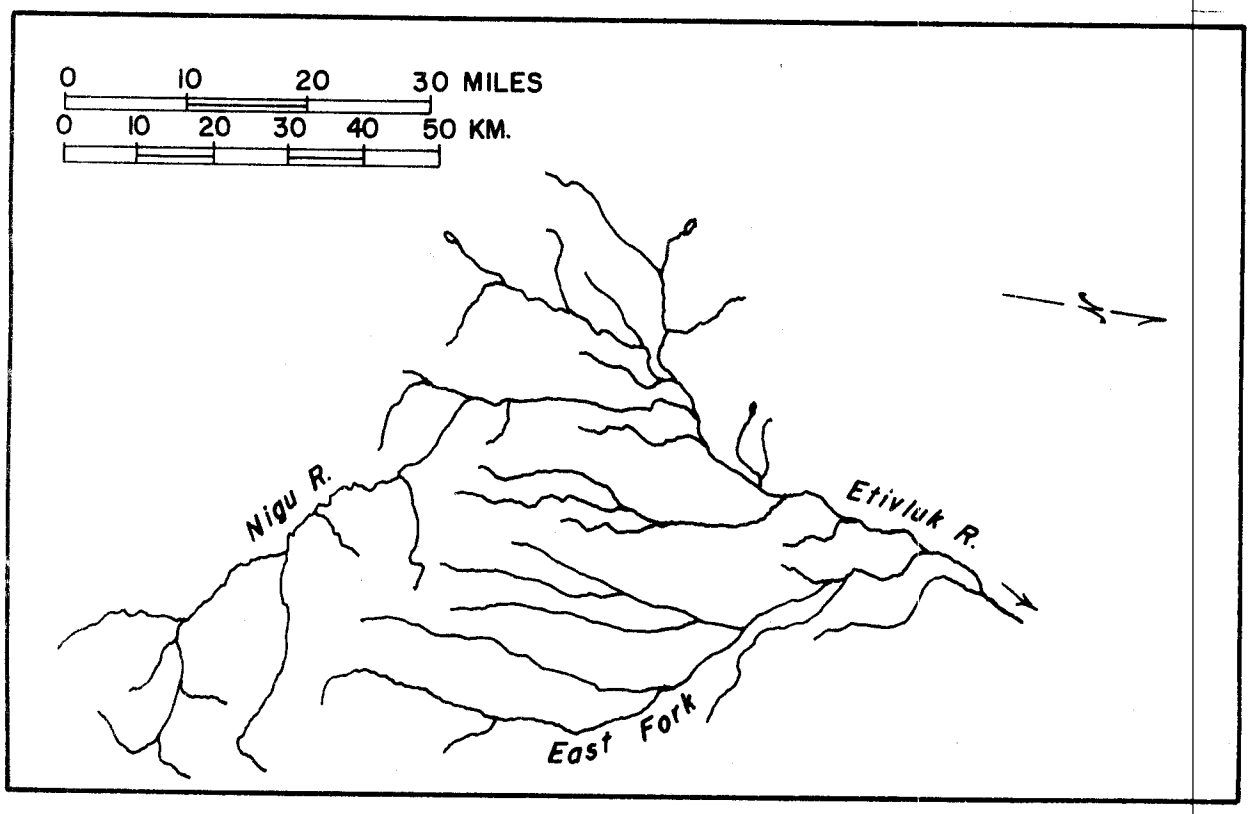


Fig. 23. Tukuto Lake, depths are shown in feet.

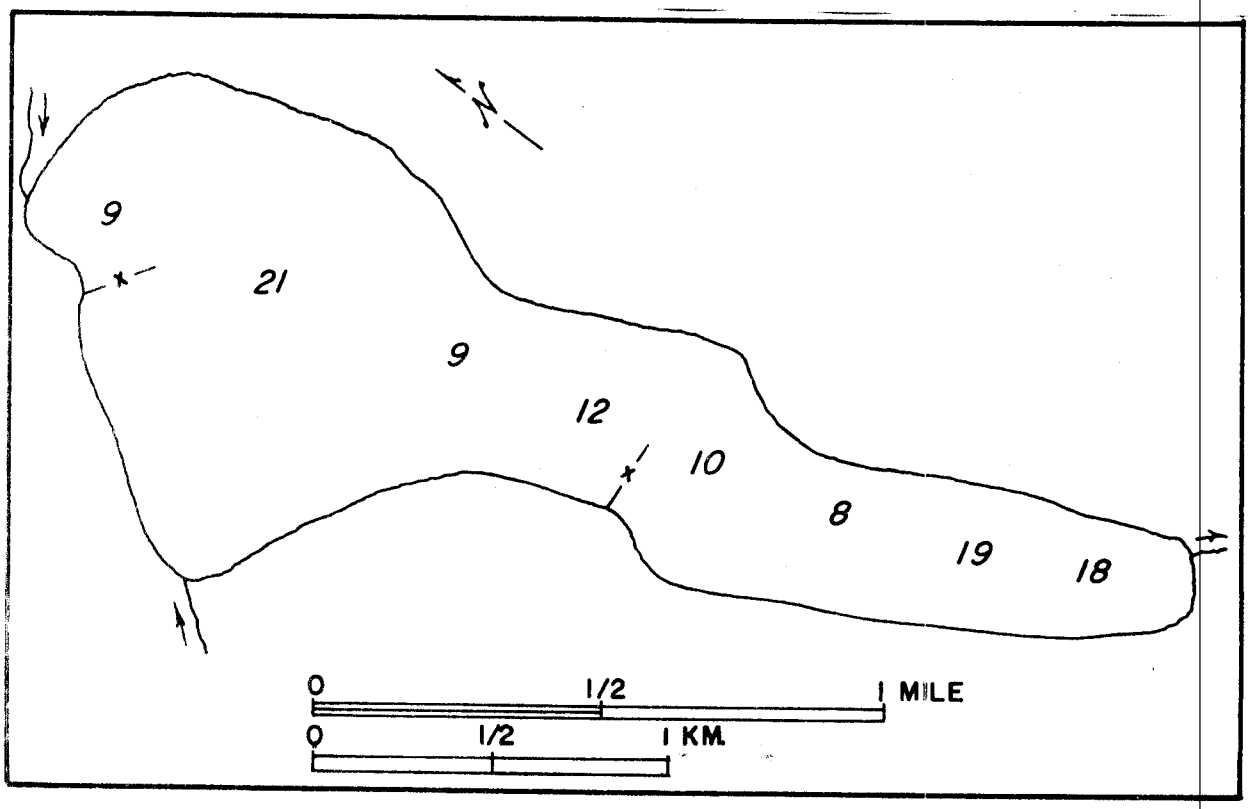
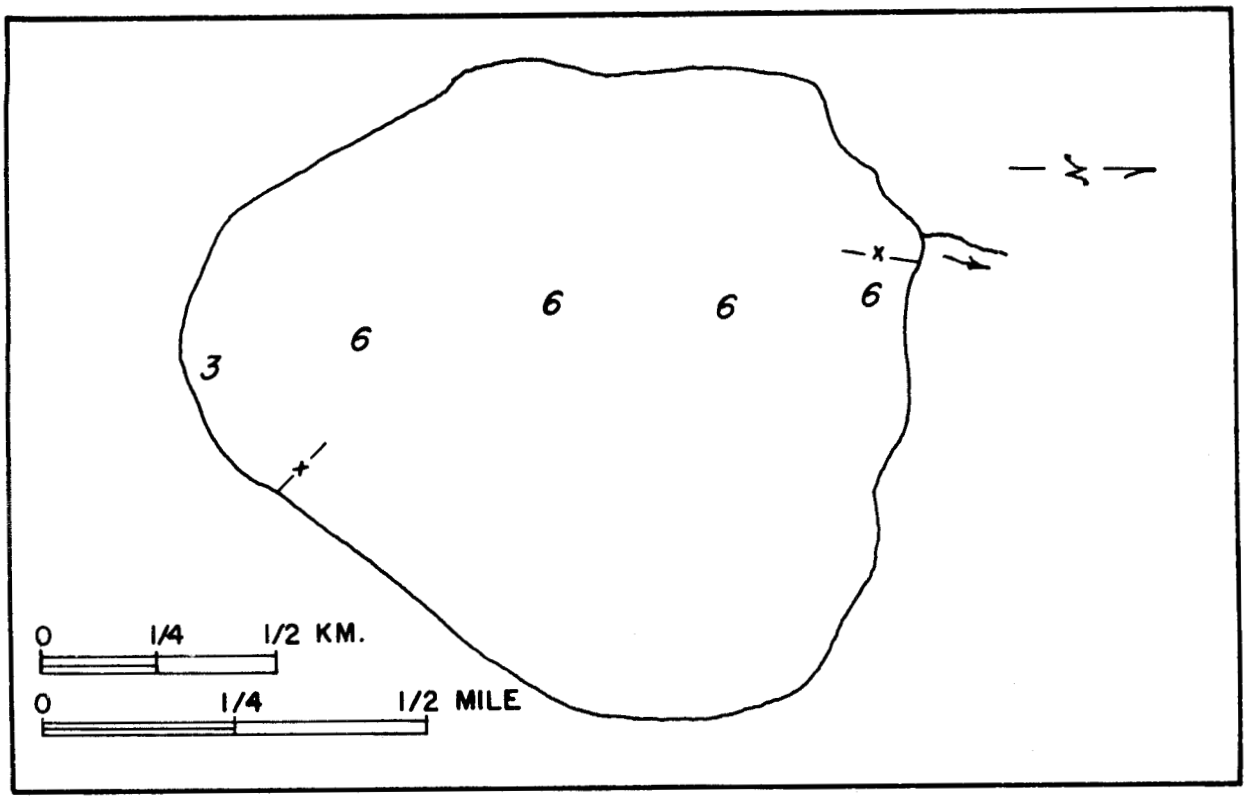


Fig. 24. Unnamed Lake in Etivluk River drainage. Depths are shown in feet. Latitude 68°28'N, Longitude 156°30'W.



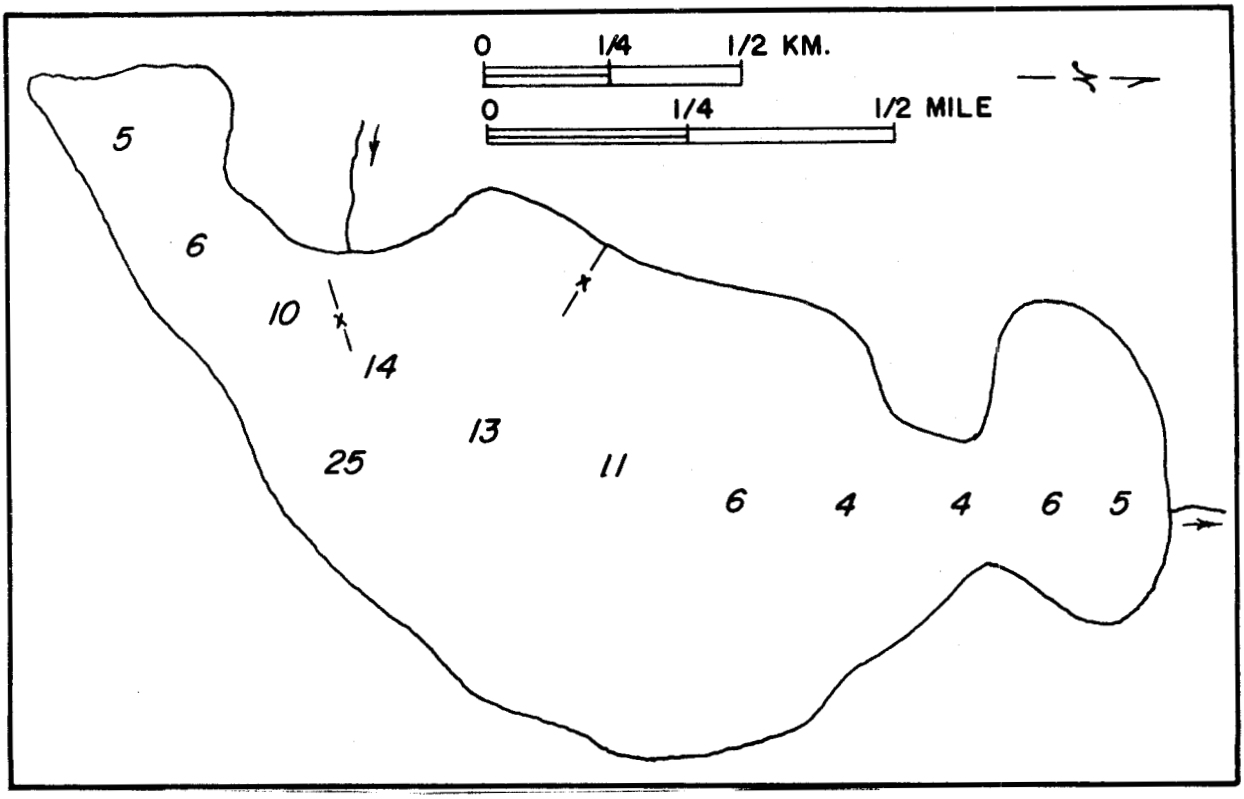


Fig. 25. Betty Lake, depths are shown in feet.

Betty Lake (Fig. 25), lat. 68°29'N, long. 156°30'W, lies 6.4 km (4 mi) south of the junction of the Nigu and Etivluk rivers. Surface elevation is 427 m (1,400 ft) and the surrounding terrain is relatively featureless. Betty Lake is 2.41 km (1.5 mi) long, has a maximum depth of 7.5 m (25 ft) and had a Secchi disk reading of 1.5 m (5 ft). Water color is dark brown. The perimeter of the lake is lined with tundra cutbanks and the lake bottom is composed of sand, gravel, and peat. There is a single inlet on the southwest end of the lake and an outlet on the north end that drains into the Etivluk River. Aquatic vegetation is sparse. Water chemistry data were: alkalinity 17 ppm, hardness 34 ppm, pH 7.5, and water temperature 10°C (50°F).

Lake trout, grayling, and a broad whitefish were captured at Betty Lake between August 7 and 9, 1977. Spawning and overwintering habitat is abundant. The inlet and outlet streams are used by grayling and lake trout for rearing and feeding. Sport fishing is excellent for both species.

Akuliak Lake (Fig. 26), lat. 68°15'N, long. 156°47'W, lies adjacent to the Etivluk River in Howard Pass. The surface elevation is 488 m (1,600 ft) and the lake is 2.4 km (1.5 mi) long. There are no inlets or outlets. The maximum depth is 3.3 m (11 ft) and the Secchi disk reading was 3 m (10 ft). The water color is light brown. Emergent vegetation is dense along the north end of the lake and there are no exposed beaches around the perimeter. The bottom is composed of medium size smooth gravel. Water chemistry data were: alkalinity 34 ppm, hardness 17 ppm, pH 7.5, and water temperature 10°C (50°F).

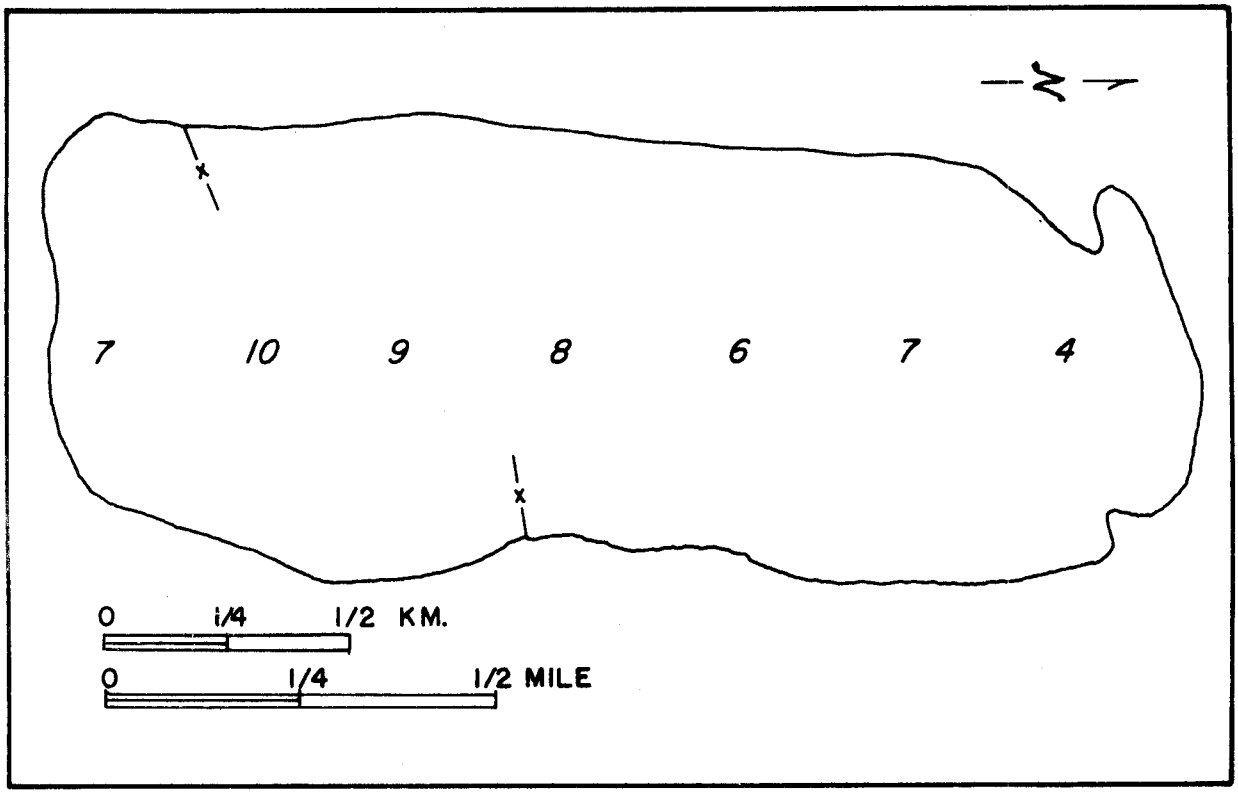
Grayling, round whitefish, and least cisco were captured in Akuliak Lake on August 9 and 10, 1977. Spawning and overwintering habitat is abundant.

Unnamed Lake (Fig. 27), lat. 68°12'N, long. 156°25'W, lies at 549 m (1,800 ft) in Inyorurak Pass, approximately 19 km (12 mi) east of Howard Pass. It is 1.6 km (1 mi) long and has a single outlet to the Nigu River. The outlet is heavily vegetated and discontinuous during summer months. The maximum depth is 6.7 m (22 ft), the water is brown and the Secchi disk reading was 3 m (10 ft). Tundra extends to the shoreline and the lake bottom is composed of silt and gravel. The southern third of the lake is shallow with moderate amounts of emergent vegetation. Water chemistry data were: alkalinity 17 ppm, hardness 17 ppm, pH 7.5, and water temperature 15°C (59°F).

Lake trout, grayling, least cisco, and slimy sculpin were captured at this site on August 9 and 10, 1977. Spawning and overwintering habitat is abundant and sport fishing for lake trout and grayling is excellent.

Etivlik Lake (Fig. 28), lat. 68°07'N, long. 156°04'W, lies near the head waters of the Nigu River, 34 km (21 mi) southeast of Howard Pass. The surface elevation is 610 m (2,000 ft), and the lake is 3.2 km (2 mi) long. It has an irregular shoreline and a maximum depth of 13.7 m (45 ft). The water is brown and the Secchi disk reading was 6 m (20 ft). There are few exposed beaches and the lake bottom is composed of sand, gravel, and boulders. Aquatic vegetation is sparse. There are two

Fig. 26. Akuliak Lake, depths are shown in feet.



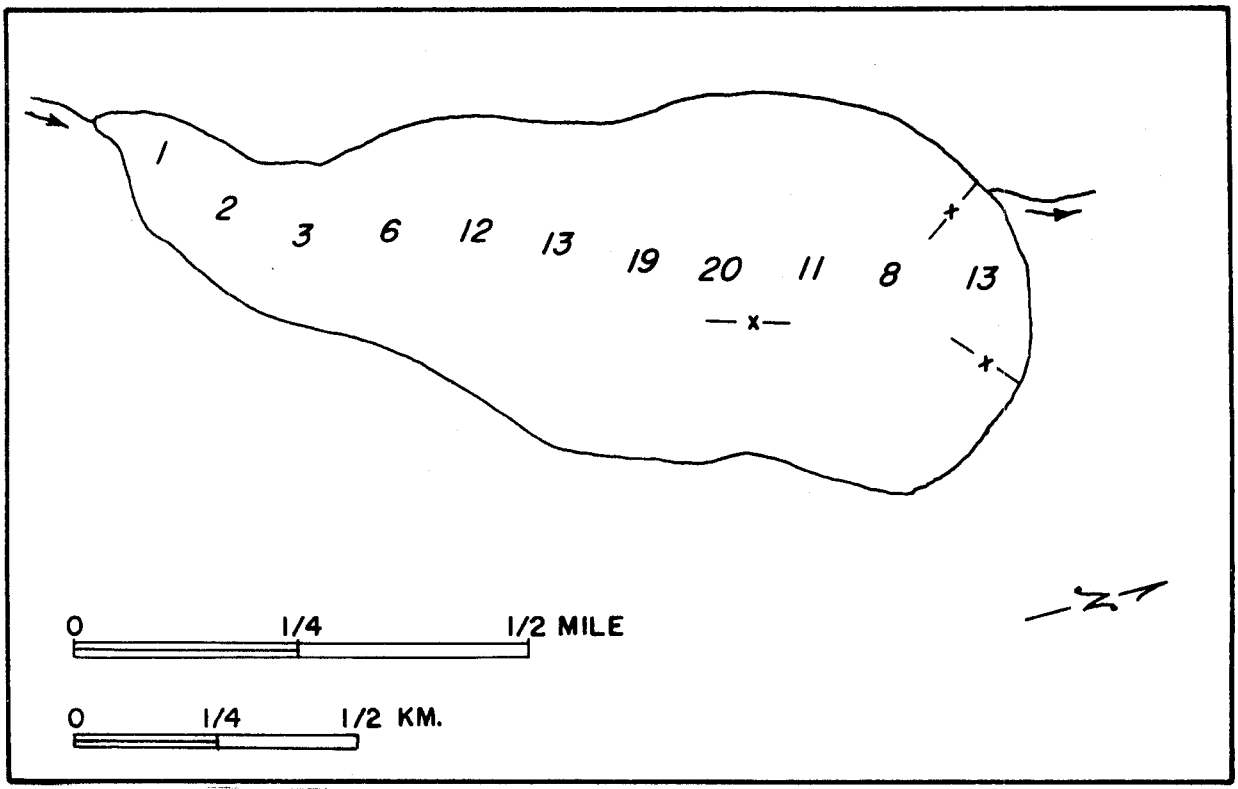


Fig. 27. Unnamed Lake in Etivluk River drainage, Depths are shown in feet. Latitude 68°12'N, Longitude 156°25'W.

Fig. 28. Etivlik Lake, depths are shown in feet.

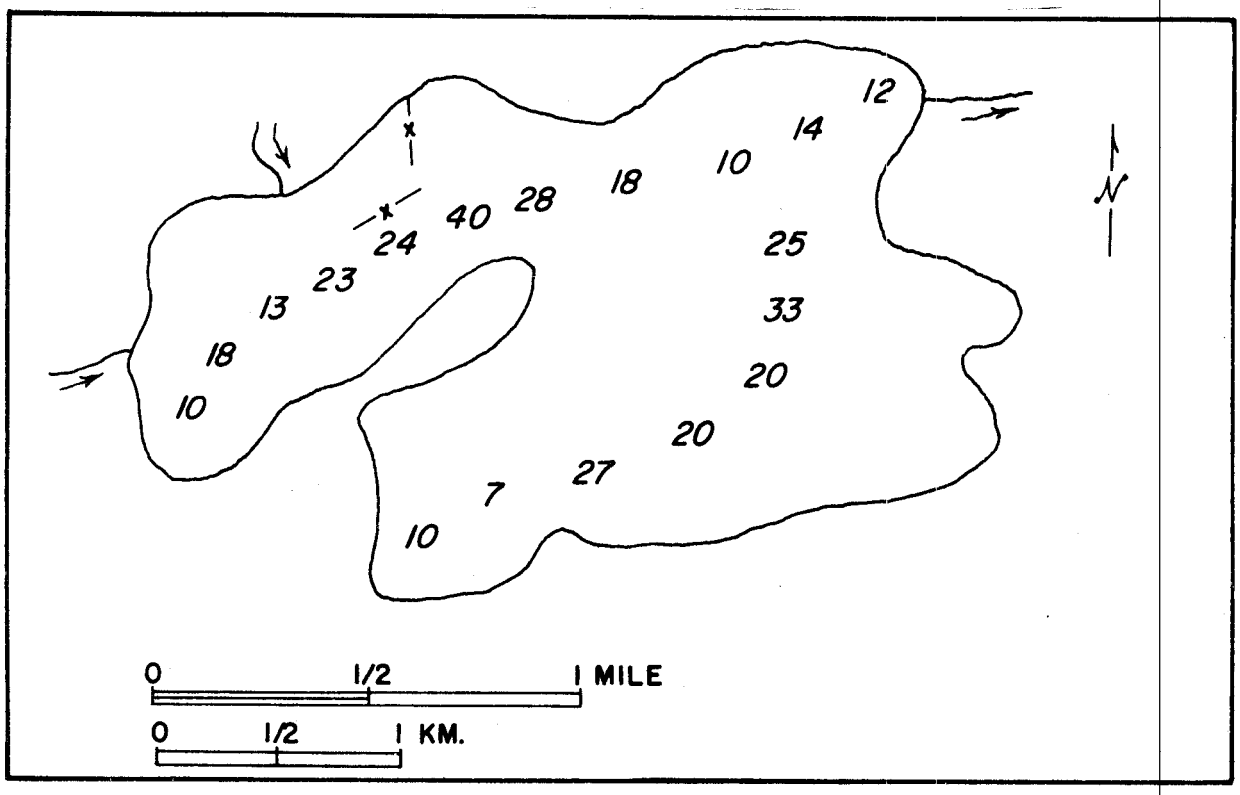
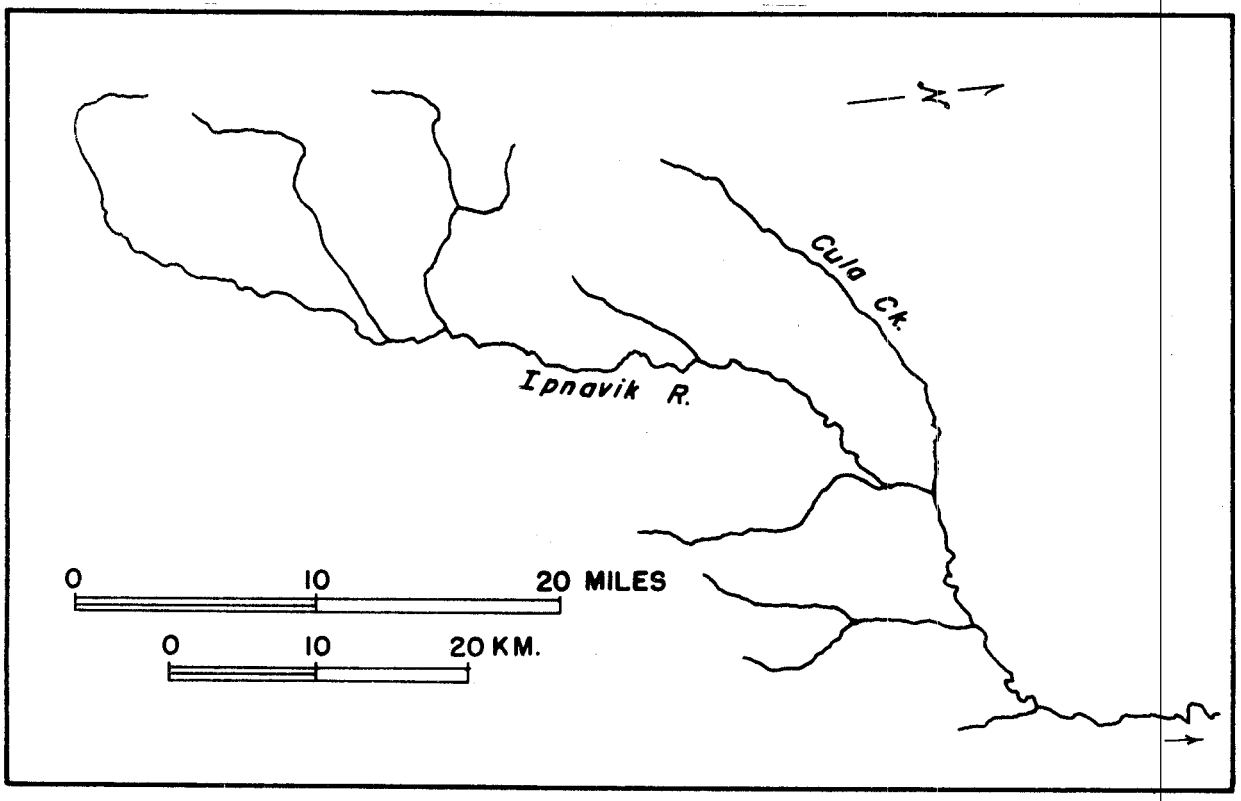


Fig. 29. Ipnavik River drainage.



inlets, each discharging less than .028 m^3/sec (1 cfs) on the northwest corner of the lake and a single outlet on the northeast corner that was discharging an estimated 0.11 m^3/sec (4 cfs). Water chemistry data were: alkalinity 17 ppm, hardness 17 ppm, pH 7.5, and water temperature 17°C (63°F).

Lake trout, grayling, round whitefish, and slimy sculpin were captured at Etivlik Lake between August 9 and 11, 1977. Spawning and overwintering habitat is abundant for the species present and angling is excellent for lake trout and grayling.

Section IV:

Section IV (Fig. 30) of the Colville River is the upper 293 km (182 mi) that extends from the Etivluk River to the headwaters near Thunder Mountain. Above the confluence with the Kiligwa river, the Colville is confined to a narrow channel that has few gravel bars and sparse riparian vegetation. Aquatic vegetation is sparse and riverbed material is medium to large gravel and broken bedrock. Below the Kiligwa River, the Colville splits and meanders across a narrow flood plain that has many small ponds and oxbows. Gravel bars composed of fine to medium size material are common along the lower reaches of Section IV. Deep pools are infrequent and widely scattered in this section. The deepest pool, located near the mouth of Mitten Creek, was 9 m (30 ft) deep.

The species diversity in Section IV is less than half of that present in the lower river. Table 2 lists the species of fish captured. Grayling, slimy sculpin, and ninespine stickleback were distributed throughout the Section IV. Broad whitefish, burbot, and longnose suckers were only taken in the lower reaches below the confluence with the Ipnavik River. Grayling spawn throughout the main stem of the Colville and in the tributary streams of Section IV. Overwintering habitat appears to be limited to a few pools in the main stem, downstream from the confluence with the Nuka River. There were no sport, commercial, or subsistence fishermen observed in Section IV during 1977 or 1978.

Four major tributaries, the Ipnavik, Kuna, Kiligwa, and Nuka rivers enter Section IV and six lakes were surveyed within these watersheds.

Ipnavik River. The Ipnavik River (Fig. 29) heads in the Brooks Range and flows northeast 109 km (68 mi) to the Colville River at lat. 68°54'N, long. 156°27'W. It has a drainage area of 1,525 km^2 (591 mi^2) and an estimated average annual flow of 6.9 m^3/sec (245 cfs). The upper Ipnavik is swift and confined to a single channel. The lower river is braided and has short, narrow bars. Aquatic vegetation is sparse. The Ipnavik flows clear throughout most of the summer. Water chemistry data were: hardness 34 ppm, pH 7, and water temperature 8°C (46°F).

Grayling were the only species captured in the Ipnavik on June 20 and 21, 1978. Spawning habitat exists throughout the lower river; however, overwintering habitat does not appear to be available.

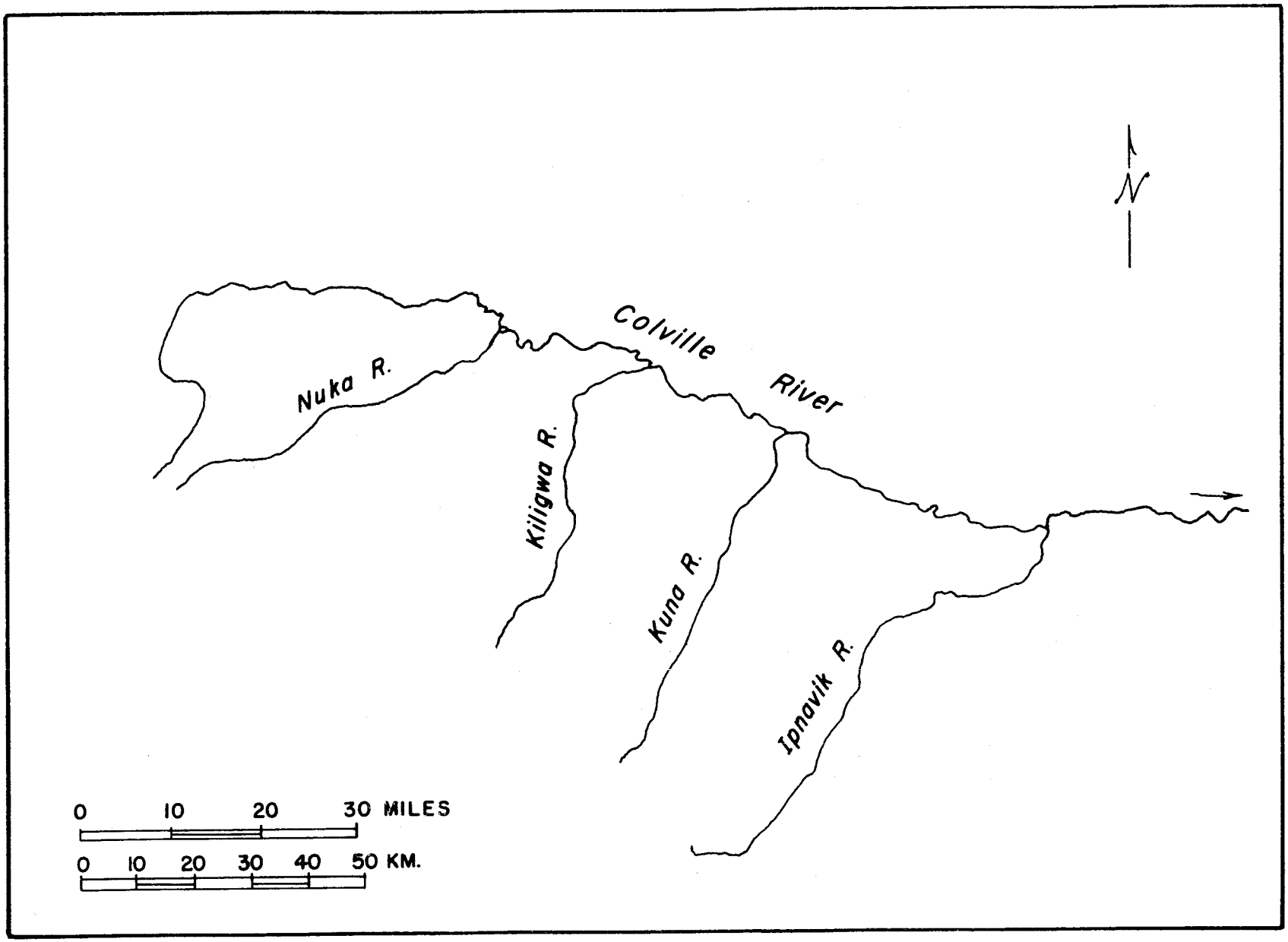


Fig. 30. Section IV of the Colville River.

West Smith Mt. Lake (Fig. 31), lat. 68°45'N, long. 156°24'W, lies 4.8 km (3 mi) north of Smith Mountain at an elevation of 305 m (1,000 ft). It is 1.6 km (1 mi) across, has a maximum depth of 2.1 m (7 ft), and a Secchi disk reading of 2.1 m (7 ft). The water is brown. There are no inlets, and a single outlet that drains into the Ipnavik River becomes discontinuous during mid-summer. Tundra extends to the lake shore except where a small gravel beach exists on the northeast side. The lake bottom is nearly entirely covered with vegetation. Water chemistry data were: alkalinity 51 ppm, hardness 51 ppm, pH 8, and water temperature 18°C (64°F).

Grayling were the only fish captured in West Smith Mountain Lake on July 27 and 28, 1977. Spawning habitat exists for grayling; however, overwintering may be marginal during years of extreme ice thickness.

Kuna River. The Kuna River (Fig. 32) heads in the Brooks Range and flows north for 80 km (50 mi) to the Colville River at lat. 68°57'N, long. 156°27'W. It drains 1,950 km^2 (753 mi^2) and has an estimated average annual flow of 10.6 m^3/sec (375 cfs). The river is a single or split channel meander throughout its length and pool-riffle formations are abundant. Aquatic vegetation is sparse. Moderate stands of willow, alder, and dwarf birch line the banks of the lower river. The water is clear throughout most of the summer. Cutaway, Swayback, and Stony creeks, major tributaries to the Kuna River, provide good summer and rearing habitats for grayling. Water chemistry data were: alkalinity 119 ppm, hardness 68 ppm, pH 7.5, and water temperature 9°C (48°F).

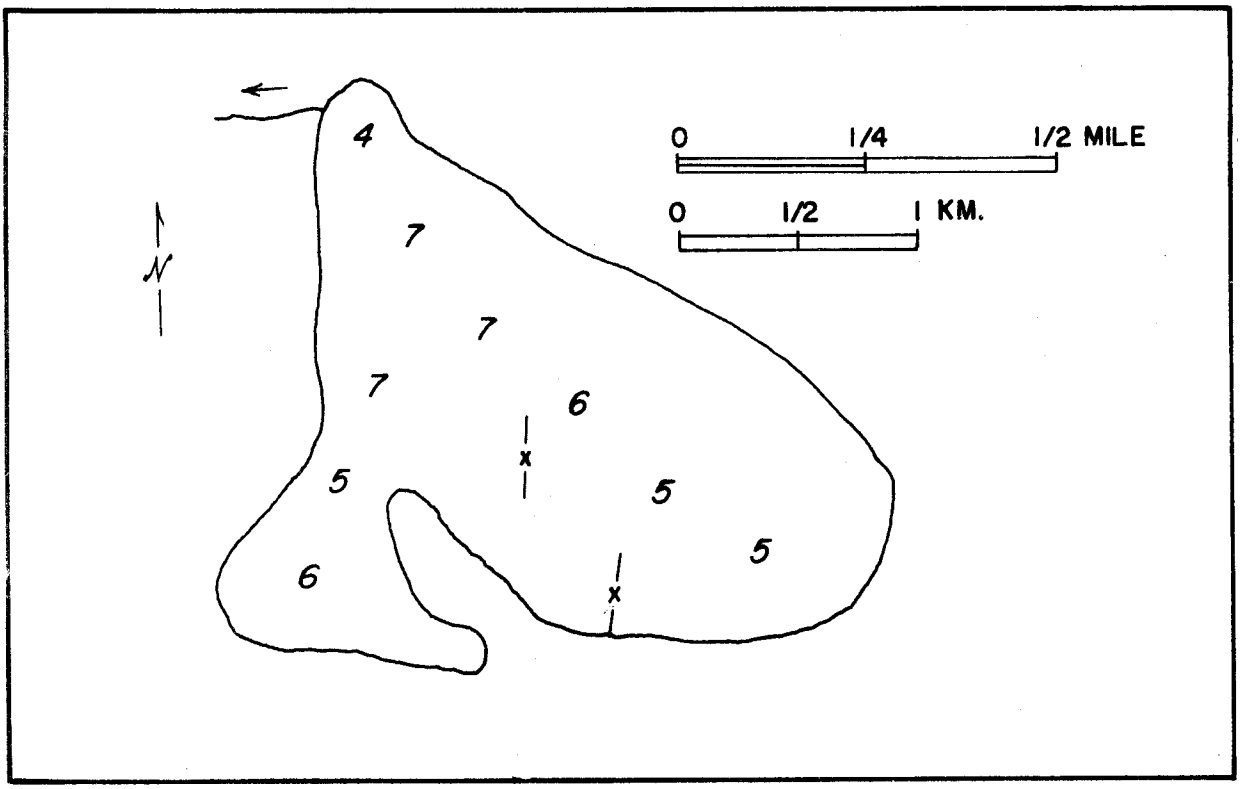
The Kuna River was surveyed by riverboat to a distance 8 km (5 mi) above Swayback Creek on June 17 and 18, 1978. Grayling were the only fish captured. Spawning habitat is abundant; however, overwintering habitat does not appear to exist.

Swayback Lake (Fig. 33), lat. 68°42'N, long. 157°51'W, lies between Swayback Creek and the Kuna River. The lake is less than 1.6 km (1 mi) across and has a maximum depth of 3.6 m (12 ft). Water color is brown and the Secchi disk reading was 1.5 m (5 ft). There are no inlets or outlets and the bottom is covered with small gravel and aquatic vegetation. Tundra extends to the lake shore around its perimeter. Water chemistry data were: alkalinity 68 ppm, hardness 17 ppm, and pH 7.5.

Grayling, ninespine stickleback, and slimy sculpin were captured on August 12 and 13, 1977. Spawning and overwintering habitat is abundant.

Liberator Lake (Fig. 34), lat. 68°52'N, long. 158°22'W, is a thaw lake that lies in the foothills of the Brooks Range 93 km (58 mi) northwest of Howard Pass. It is 2.45 km (1.5 mi) across, has a maximum depth of 3 m (9 ft) and a Secchi disk reading of 1.2 m (4 ft). The water is brown, and the surrounding country is relatively flat. There are no inlets to the lake; single outlet at the northern end discharges to the Colville River, but becomes discontinuous during mid-summer. The lake bottom is composed of mud, sand, and small gravel. Aquatic vegetation is sparse. Hardness was 51 ppm, and pH was 7.5.

Fig. 31. West Smith Mt. Lake, depths are shown in feet.



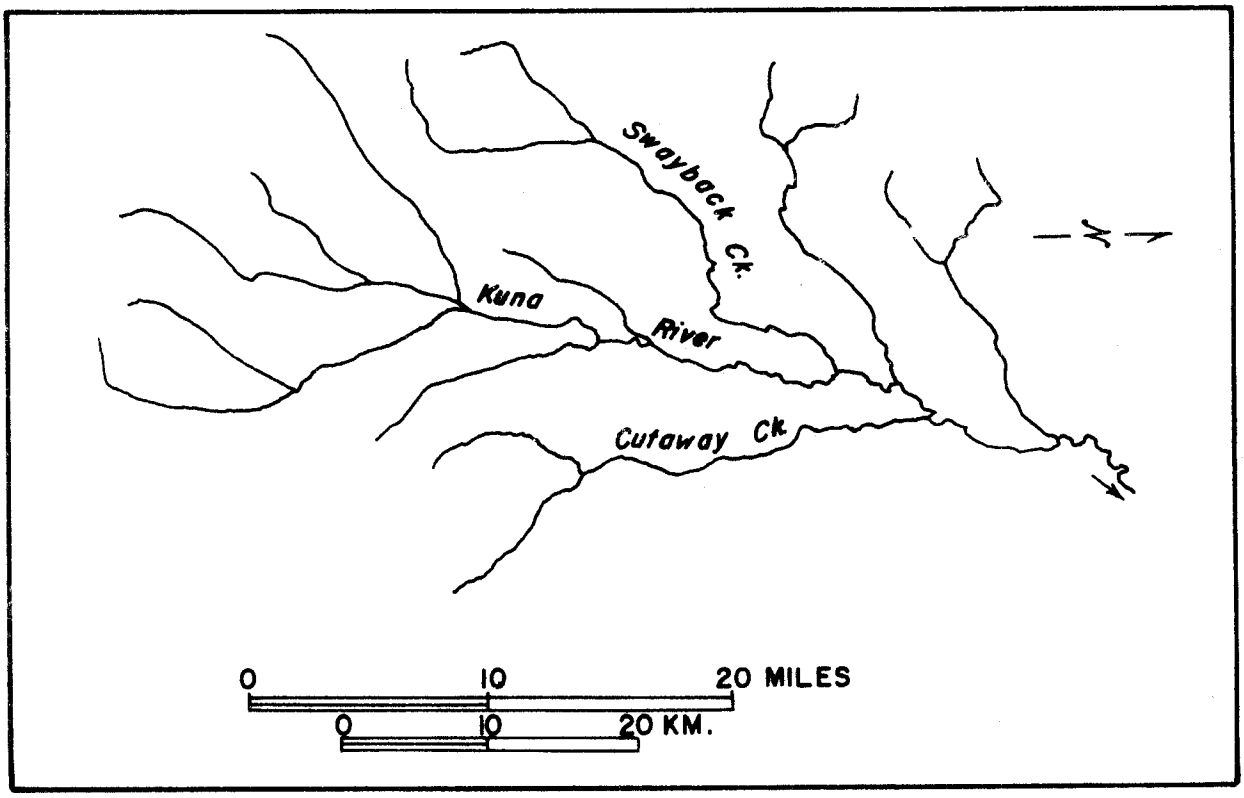


Fig. 32. Kuna River drainage.

Fig. 33. Swayback Lake, depth is in feet.

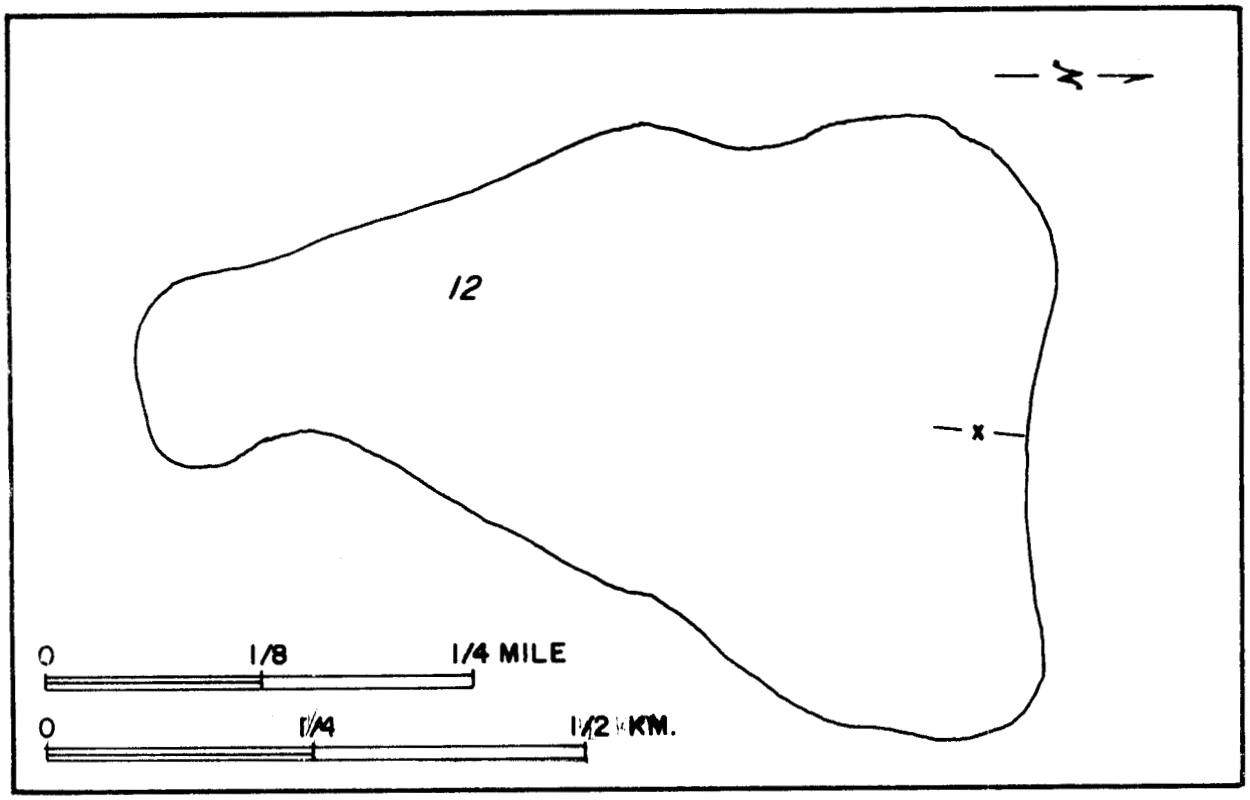
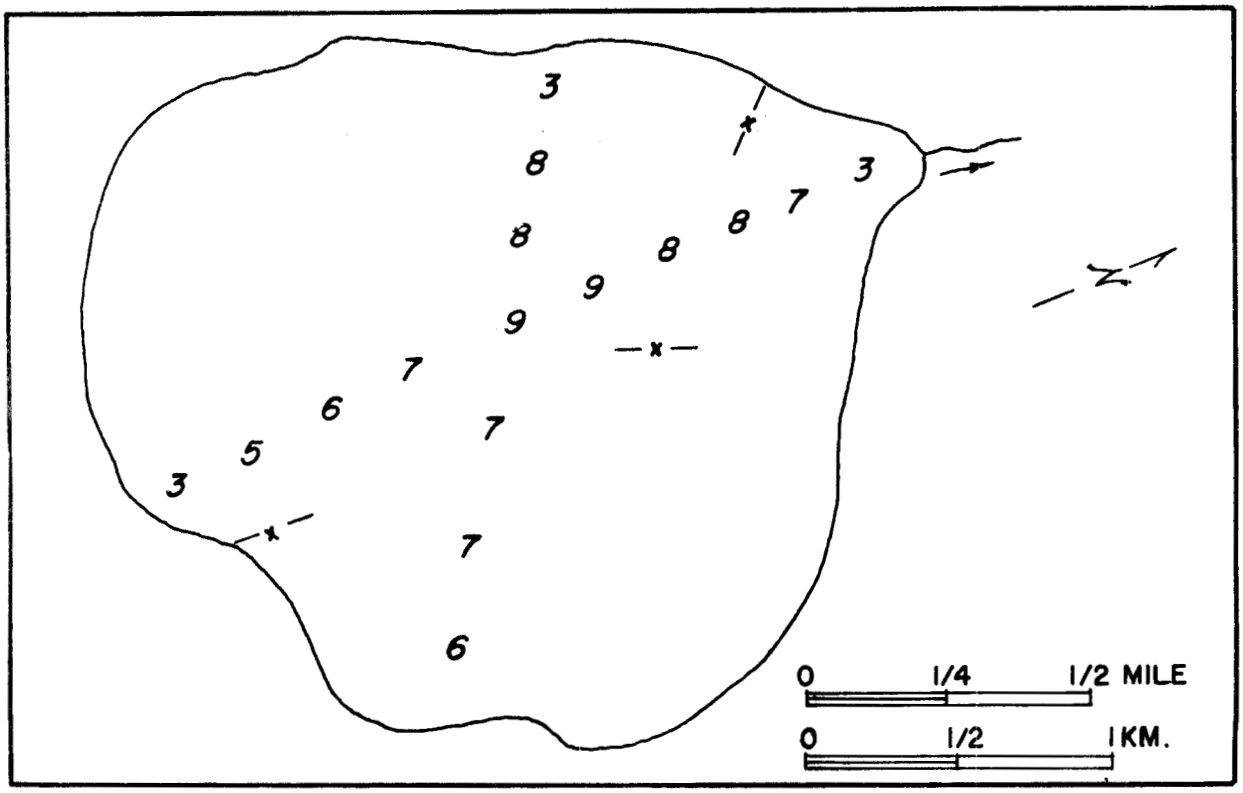


Fig. 34. Liberator Lake, depths are shown in feet.



Grayling, ninespine stickleback, and slimy sculpin were captured on August 1 and 2, 1977. Spawning and overwintering habitat is abundant.

Kiligwa River. The Kiligwa River (Fig. 35) heads in the Brooks Range and flows north 76 km (47 mi) to the Colville River at lat. 59°01'N, long. 158 16'W. It has a drainage area of 1,489 km^2 (575 mi^2) and an estimated average annual flow of 8.2 m^3/sec (290 cfs). The Kiligwa is confined to a single incised channel that is bordered by small rocky cliffs on either side throughout much of its length. The river flows over tilted bedrock in many areas, and otherwise has a bottom composed of boulders and broken bedrock. There are few gravel bars and aquatic vegetation is sparse. The Kiligwa has the steepest gradient of the tributaries that were surveyed. The water is clear throughout most of the summer. Water chemistry data were: hardness 34 ppm, pH 7.5, and water temperature 3°C (37°F). There is an abandoned oil exploration camp at Brady, located approximately 13 km (8 mi) upstream on the west bank. A small air strip and storage area for seismic equipment was located near the mouth on the east bank.

The Kiligwa River was surveyed by riverboat up to the mouth of Jubilee Creek. Grayling were the only fish captured on June 19 and 20, 1978. Spawning habitat is abundant throughout the Kiligwa and in the lower reaches of Jubilee Creek. There are a few pools up to 4.5 m (15 ft) deep along bluffs in the lower river during high water; however, overwintering habitat probably does not exist in the Kiligwa River.

Two unnamed lakes in the Kiligwa River drainage that did not contain fish were surveyed. The first lake is at the head of Query Creek lat. 68°39'N, long. 158°22'W. It is approximately 0.8 km (1/2 mi) long, has a maximum depth of 2.1 m (7 ft), and a Secchi disk reading of 0.9 m (3 ft). It has a smooth shoreline, sparse aquatic vegetation, and brown water. Water chemistry data were: alkalinity 34 ppm, hardness 34 ppm, and pH 9. There is no inlet or outlet.

The second lake is located in the Jubilee Creek drainage at lat. 68°44'N, long. 158°41'W. It has a maximum depth of 1.8 m (6 ft), brown water, and a Secchi disk reading of 0.9 m (3 ft). There is no inlet or outlet and sparse aquatic vegetation. Water chemistry data were: alkalinity 51 ppm, hardness 17 ppm, and pH 7.5.

Nuka River. The Nuka River (Fig. 36) heads in the Delong Mountains and flows northeast 80 km (50 mi) to the Colville River at lat. 69°01'N, long. 158°54'W. It is the uppermost named tributary to the Colville River and nearly equal in size to the remainder of the Colville. It has a drainage area of 1,572 km^2 (607 mi^2) and an estimated average annual flow of 8.5 m^3/sec (300 cfs). The Nuka River has a narrow incised channel throughout most of its length and very little flood plain. Gravel bars and aquatic vegetation are sparse. Water chemistry data were: hardness 34 ppm, pH 7.5, and water temperature 5°C (41°F).

Grayling were the only fish captured in the Nuka River on June 19 and 20, 1978. Grayling were spawning in slow moving water within the lower reaches. Overwintering habitat is probably not available in the Nuka River.

Fig. 35. Kiligwa River drainage.

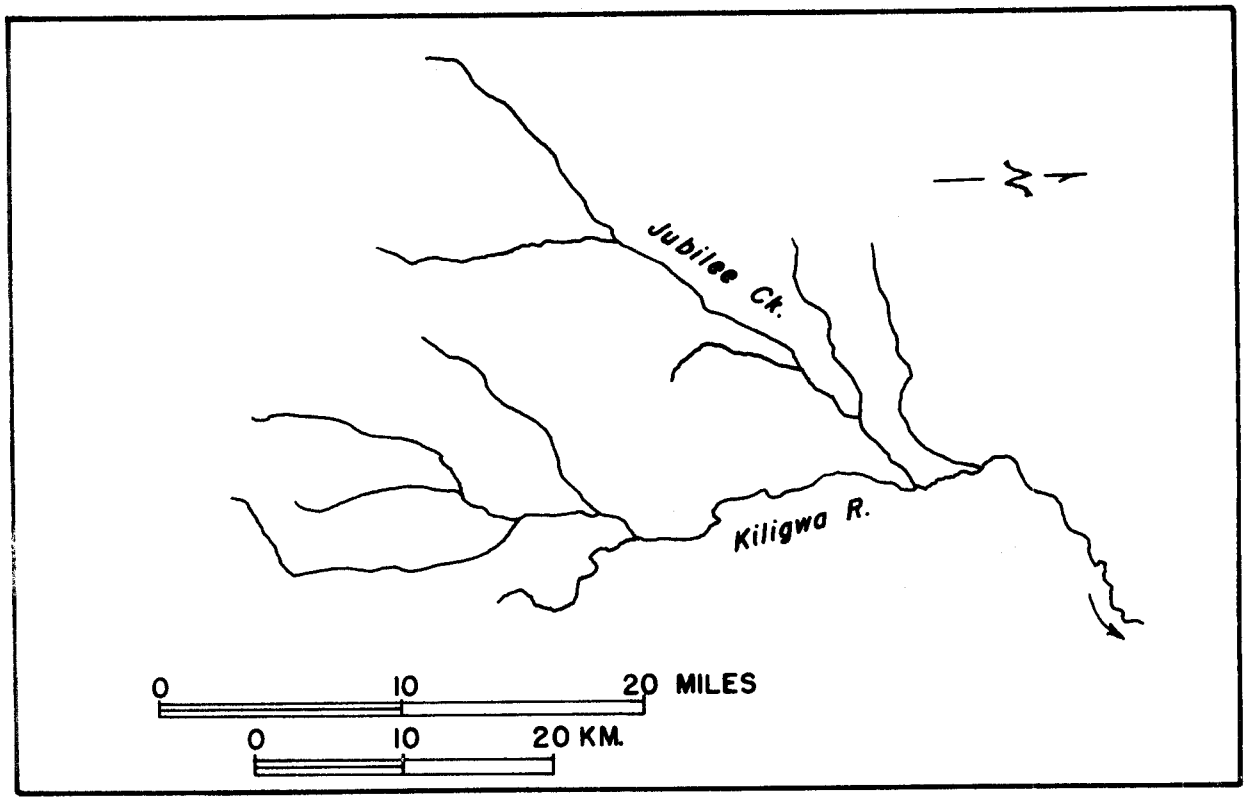
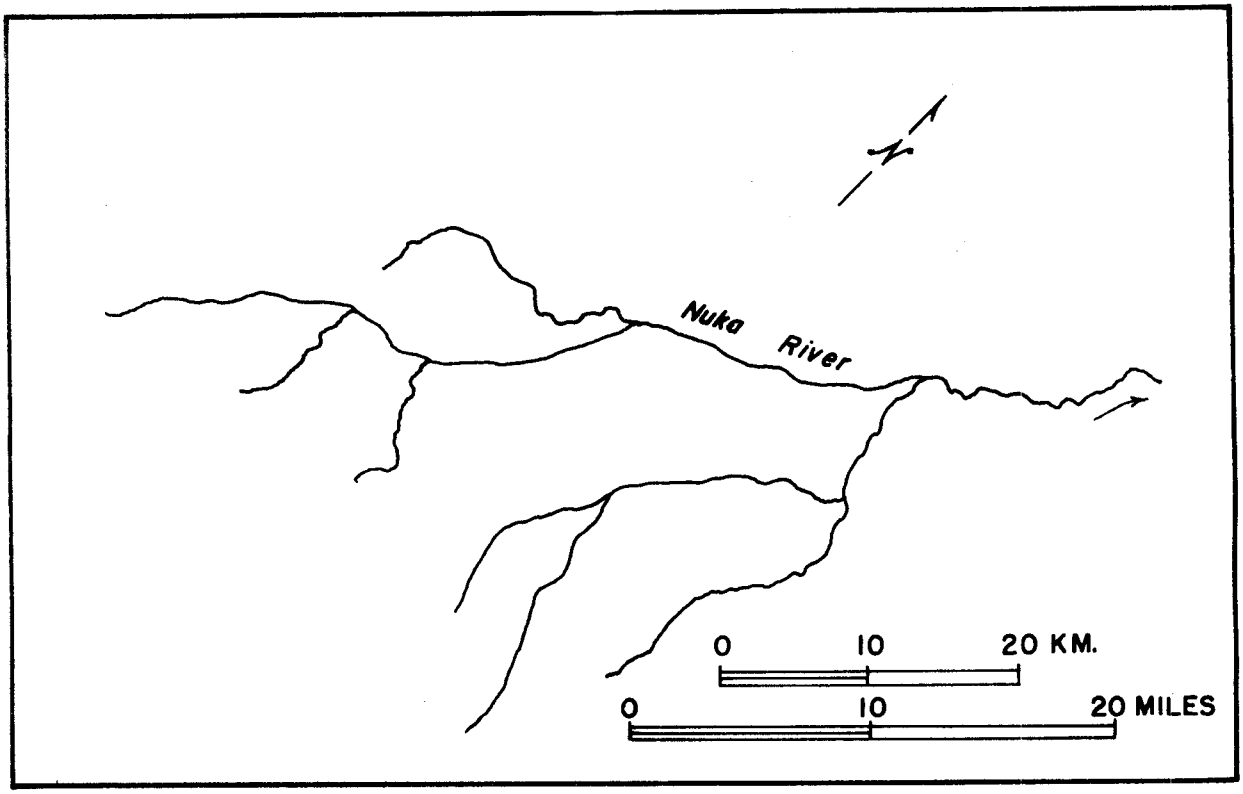


Fig. 36. Nuka River drainage.



Noluck Lake (Fig. 37), lat. 68°47'N, long. 160°00'W, lies in the foothills of the Brooks Range 27 km (17 mi) northeast of Thunder Mountain. It is 4 km (2.5 mi) across, has a maximum depth of 2.7 m (9 ft), and Secchi disk reading of 2.4 m (8 ft). The water is brown. Sand and pea gravel cover the lake bottom and several beaches along the perimeter of the lake. Aquatic vegetation is sparse. There is a single inlet located on the south side of the lake, that was dry during our survey. An outlet on the north end was discharging less than .028 m^3/sec (1 cfs). Water chemistry data were: alkalinity 51 ppm, hardness 34 ppm, and pH 7.5. There is a wrecked airplane, a Naval Arctic Research Lab cabin, and a considerable amount of debris on the south side of the lake.

Grayling were the only fish captured in Noluck Lake on August 2 and 3, 1977. Spawning and overwintering habitat is abundant.

Stream Surveys, Western North Slope

Utukok River:

The Utukok River (Fig. 38) flows in a northwesterly direction for approximately 341 km (212 mi) before entering the Arctic Ocean southwest of Icy Cape. Based on the estimated annual flow of 39 m^3/sec (1,380 cfs) the Utukok is the ninth largest river on the North Slope. The survey of the Utukok River began on July 5, 1978, at the Driftwood airstrip and was completed on July 12, approximately 40 km (25 mi) from the delta.

Above the confluence with Carbon Creek, the channel of the Utukok alternates between braided stretches of about 24 km (15 mi) in length and incised stretches that cut through ridges and foothills that lay in an east-west direction. Below Carbon Creek, the riverbed becomes a single channel meander with numerous gravel bars and few tributaries that contribute significant amounts of water to the Utukok River. In the foothill reaches of the Utukok River, the riverbed and bars consist of large angular gravel; the braided reaches, as well as the lower river bars, consist of well sorted fine and medium size gravel.

Carbon and Disappointment creeks were discharging turbid water during the time of our survey and the Utukok remained turbid throughout the remainder of the trip. Above the confluence with Disappointment Creek, water in the Utukok was colorless and transparent. Values for hardness in the Utukok River and Carbon Creek were moderately low (68-85 ppm) and pH was slightly basic. Emergent and submergent aquatic vegetation was very sparse throughout the survey. Coleopterans were the only aquatic insects that appeared to be abundant and, along with aerial insects, were major food items found in grayling stomachs.

Five species of fish were either captured or observed in the Utukok River. Low numbers of grayling were widely distributed throughout the river, and young-of-the-year fry were first observed in shallow water near our first campsite. Slimy sculpin were captured in seines and ninespine stickleback were found as food items in grayling. A single Arctic cisco, a prespawning adult male, was captured at our last campsite, along with grayling and two pink salmon. It is likely that some

Fig. 37. Noluck Lake, depths are shown in feet.

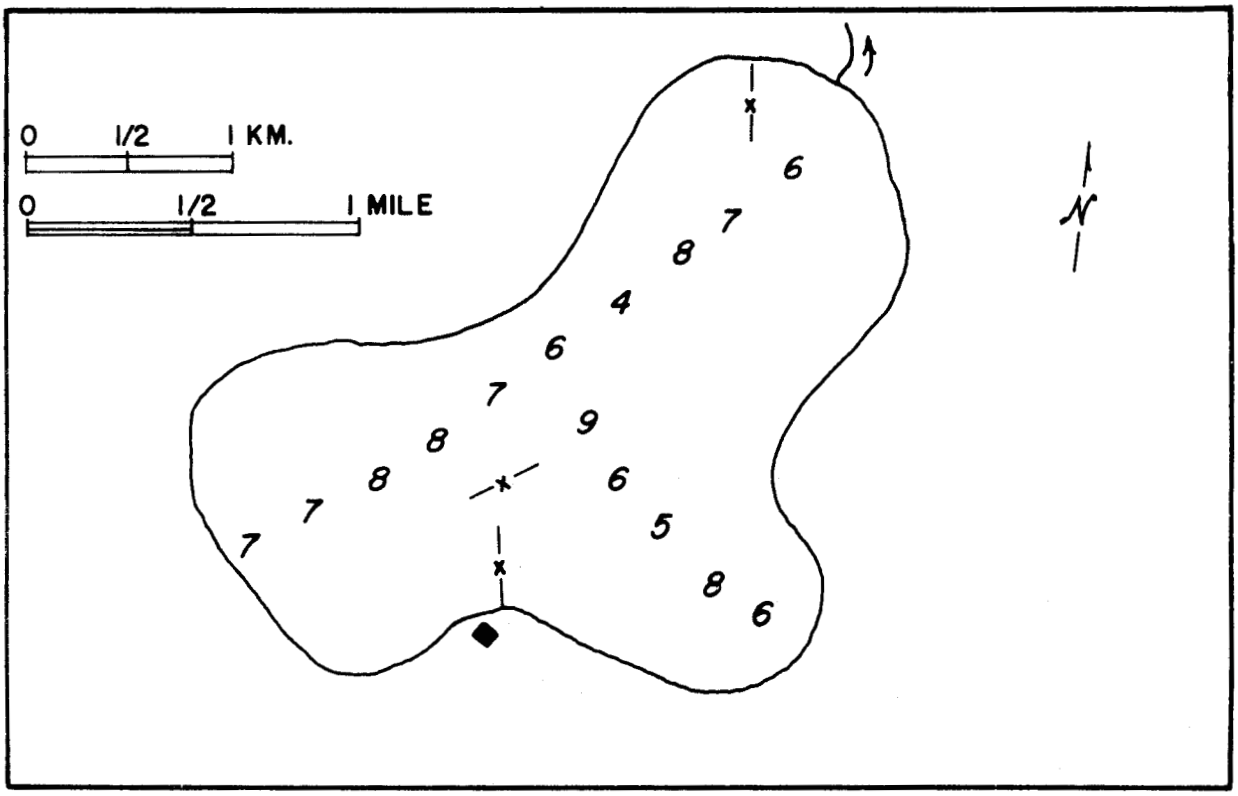
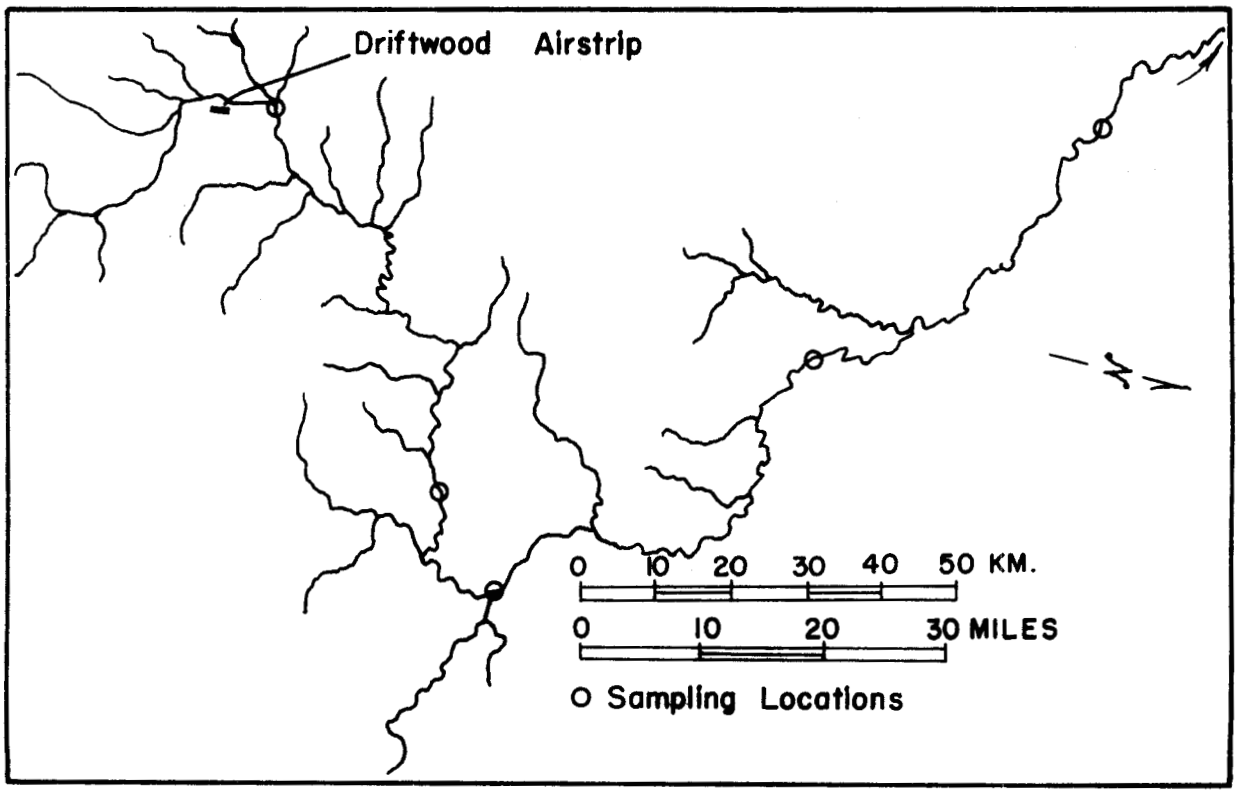


Fig. 38. Utukok River drainage.



overwintering of fish takes place in the Utukok River, most likely below the confluence with Carbon Creek. Tributaries to the Utukok other than Carbon Creek appear to be poor or unsuitable habitat for the fish species present. Figure 38 shows the locations of campsites and net sets on the Utukok River.

Kokolik River:

The Kokolik River flows in a northerly and westerly direction for approximately 298 km (185 mi). It headwaters in the western Brooks Range and enters the Chukchi Sea of the Arctic Ocean at Point Lay. The Kokolik is the 12th largest stream on the North Slope; with an average annual estimated flow of 33.3 m^3/sec (1,175 cfs).

The survey of the Kokolik River began on July 13, 1978, at a point approximately 16 km (10 mi) north of Kokolik Lake, and was completed on July 20 approximately 56 km (35 mi) from the coast.

Above Avingak Creek, the Kokolik flows alternately through a series of small valleys and three sets of ridges and hills. Braided channels are relatively less frequent than in other North Slope rivers. The gravel bars in the valleys consist of large, angular stones at the upper ends, grading to large gravel where the river enters the next section of incised channels and ridges. In the incised channels, the riverbed consists of large, angular rubble and boulders, many of which protrude at low water. The river flows over several low bedrock ledges, which are usually evidenced by a line of broken rock extending across the stream. From Avingak Creek down, the river comes out of the ridges and hills and meanders through flat tundra to the coast. Gravel size gets progressively smaller and there are many long, shallow straight stretches.

The greatest water depth was observed in the incised channels of the upper reaches, where some pools against rock faces were up to 4.8 m (16 ft) deep. Water depths in the lower reaches and in the upper valleys rarely exceeded 2.1 m (7 ft) where measured.

The water was a transparent green during most of the trip and for a short time it became turbid green in response to local thundershowers. There is little aquatic vegetation. Water beetles and stonefly larvae were abundant in some stretches of the river.

Five species of fish were captured or observed in the river. Grayling were distributed throughout the section surveyed. They were captured in low to moderate numbers in the upper reaches. Relative abundance cannot be speculated upon in the lower reaches, where pink salmon probably impaired the net's ability to take other species.

Pink salmon were taken in increasing abundance from Avingak Creek down stream. None of the pinks were yet spawning. Many young-of-the-year slimy sculpin were observed in sections of ridges and incised channels.

One chum salmon was taken below Avingak Creek and one small Arctic char was taken at the lowest net set.

Fig. 39. Kokolik River drainage.

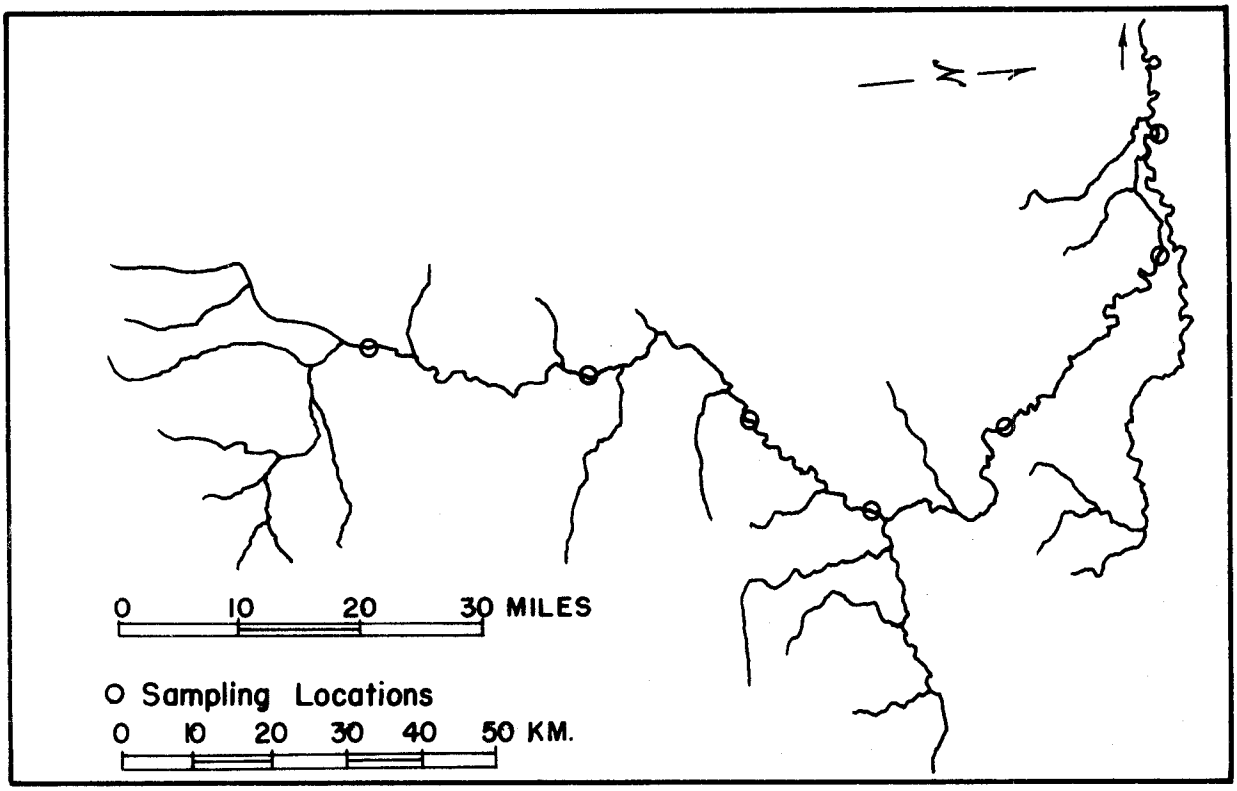
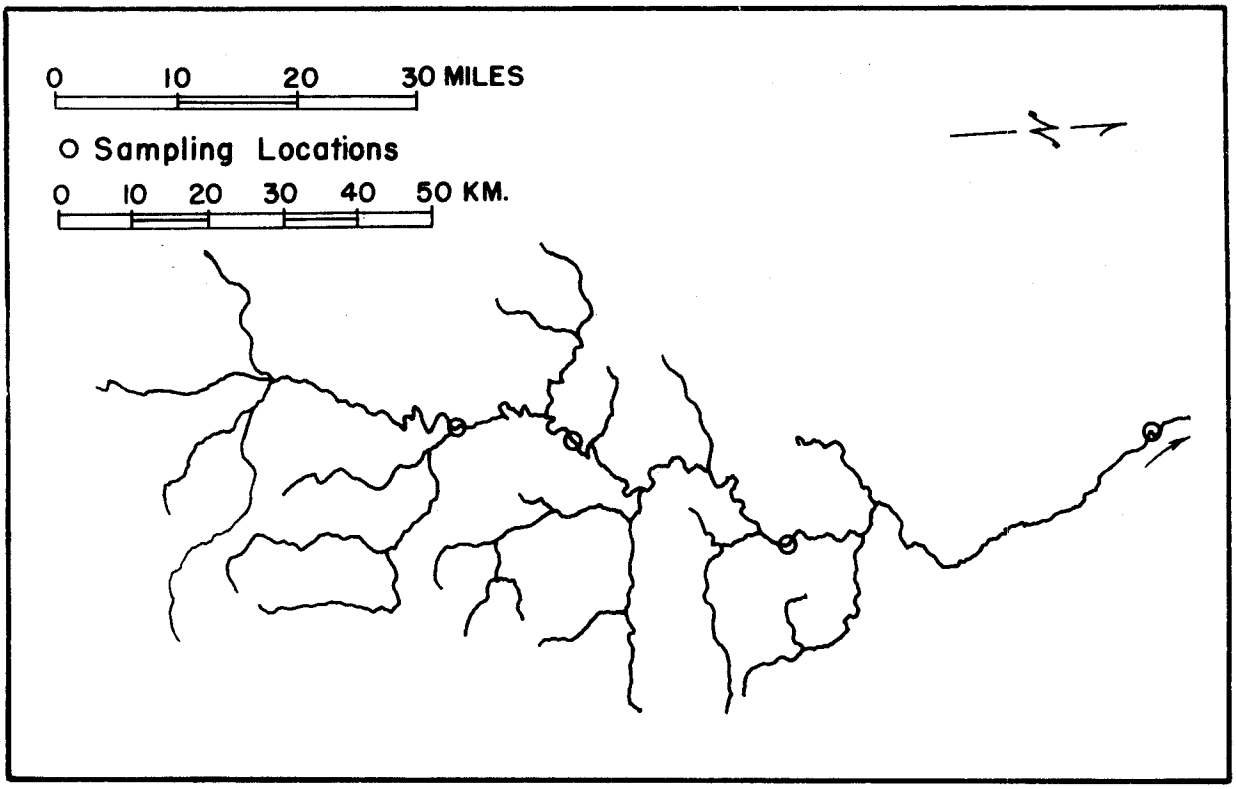


Fig. 40. Kukpowruk River drainage.



Stickleback were probably present but were not captured in the Kokolik. Figure 39 shows the locations of campsites and net sets on the Kokolik River.

Kukpowruk River:

The Kukpowruk River survey was conducted between July 13 and 20, 1978. The float trip began from a small oxbow adjacent to the Kukpowruk River, approximately 4.8 km (3 mi) above the confluence with Eagle Creek. The Kukpowruk River flows northward through broken foothills less than 600 m (2,000 ft) high, for about three-quarters of its length and enters the Chukchi Sea just south of Point Lay. Based on its estimated annual flow 26.9 m^3/sec (950 cfs), the Kukpowruk River is the 14th largest stream flowing north from the Brooks Range in Alaska, making it slightly smaller than the Etivluk River. There are four major tributaries to the Kukpowruk entering the stretch of river that was surveyed. Eagle, Turbid, Tupikchak, and Deadfall creeks all appeared to be poor or unsuitable fish habitat and were not large enough for either rafting or boating.

The Kukpowruk River is transparent and emerald green. It drops approximately 540 m (1,800 ft) in elevation over 241 km (150 mi). Pools and riffles are abundant throughout the distance surveyed. Maximum depths of pools in the upper half of the survey were 3.6 m (12 ft), and 6 m (20 ft) holes were found in the lower reaches. Suitable overwintering habitat for the species of fish present appears to exist throughout the lower one-half of the river. July water temperatures were warm (17° to 19°C) (63° to 66°F) and values for hardness were moderately high (102-136 ppm) compared to other North Slope streams.

The channel of the Kukpowruk River is incised throughout most of its length and meanders across the coastal plain over the lower 40 km (25 mi). With the exception of the lower 19 km (12 mi), gravel along bars was consistently large and angular.

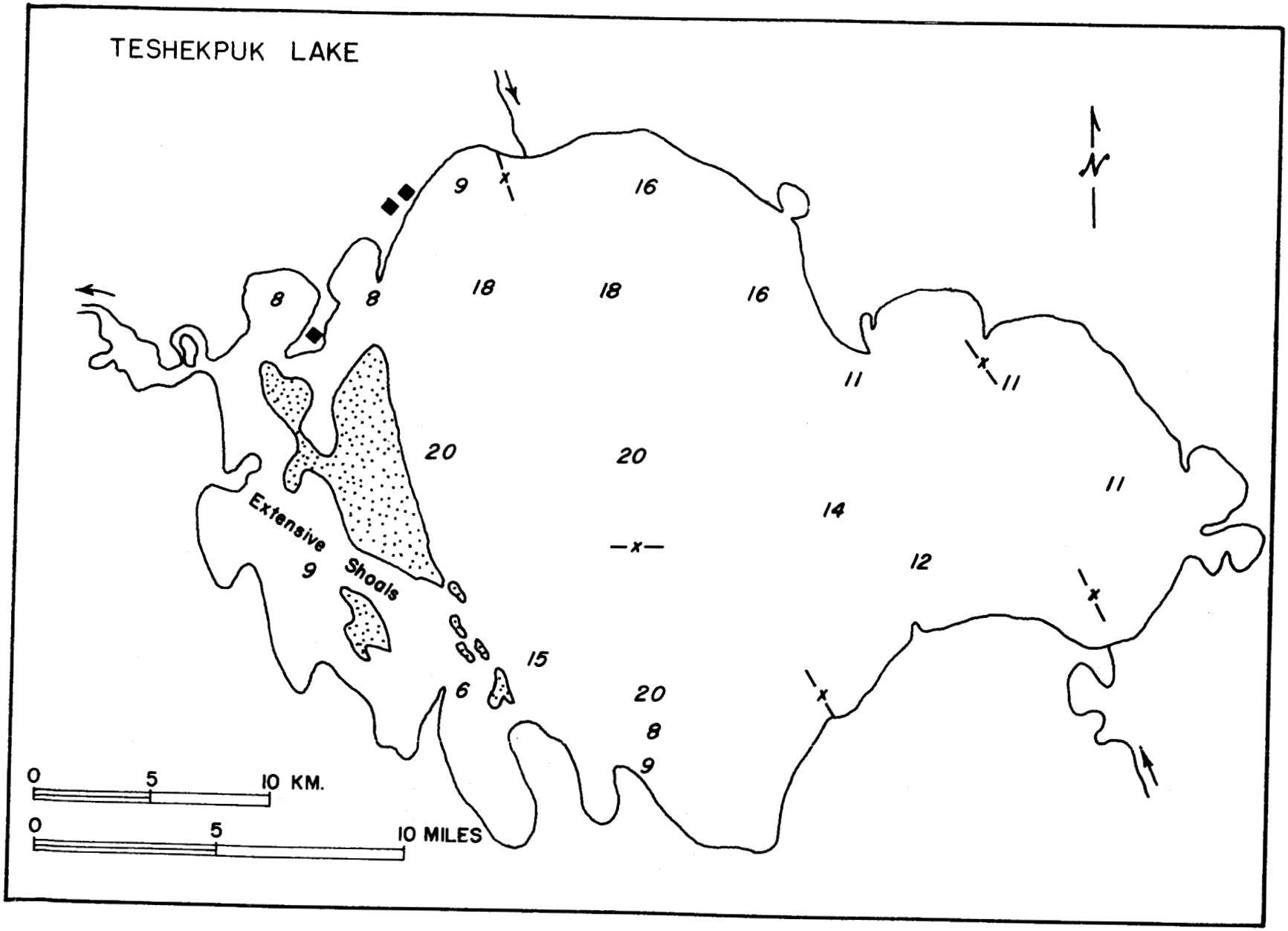
Grayling were the most widely distributed fish captured in the Kukpowruk. The abundance of grayling appears to be low to moderate, and suitable spawning habitat as well as young-of-the-year fry were observed throughout the section surveyed. A small run of pink salmon was in the Kukpowruk River during the time of our survey. Pink salmon were distributed from the mouth to Raven Basin near the confluence of Eagle Creek. The pink salmon were still migrating upstream and had not begun spawning by July 20. Slimy sculpin and ninespine stickleback were observed but not captured. There were no subsistence, commercial, or sport fisheries on the Kukpowruk River during the time of our survey. Figure 40 shows the locations of campsites and net sets on the Kukpowruk River.

Coastal Plain Survey

Teshekpuk Lake:

Teshekpuk Lake (Fig. 41), lat. 70°35'N, long. 153°30'W, is the largest lake on the North Slope and is located 19 km (12 mi) west of Harrison Bay. It is 40.23 km (25 mi) across and covers 813 km^2 (315 mi^2). The lake has a complex

Fig. 41. Teshekpuk Lake. Depths shown in feet are taken from Mohr (1961).



shoreline with features including bays, spits, lagoons, vegetated and unvegetated islands, mud, sand and gravel beaches, and extensive shoal areas. It is reported to have a maximum depth of 15 m (50 ft). Extensive shoal areas exist at the east and west ends of the lake and, to a lesser degree, around the remaining perimeter. There is a single outlet on the west end, the Miguakiak River, that enters the lower Ikpikpuk River. Gastropod and bivalve shells are common in the beach sediments of the north shore and Saduria sp., a large isopod, as well as several species of amphipods, common along the Beaufort Sea coast, were observed in shallow water.

Salinities were taken at the surface in five different locations around the lake and all readings were 0. Teshekpuk Lake is usually turbid due to strong surface winds and disturbed sediments. The water is grey-green, and water chemistry data were: alkalinity 103 ppm, hardness 103 ppm, and pH 8.5. Surface temperature varied from 8° to 12°C (47° to 54°F).

Teshekpuk Lake was surveyed on August 17 and 18, 1977. Five gill nets set overnight yielded a catch of 60 least cisco, 48 broad whitefish, 43 grayling, 4 Arctic cisco, 2 lake trout, and 1 humpback whitefish. Netsch et al, (1977) reported capturing burbot and ninespine stickleback in the outlet of Teshekpuk Lake. Spawning and overwintering habitats are abundant.

Under-Ice Netting

During the fall of 1977 and 1978, water depths in the Colville River were surveyed using a boat mounted fathometer. Areas thought to be potential overwintering habitat in the lower river, based on water depths, are shown in Figure 42.

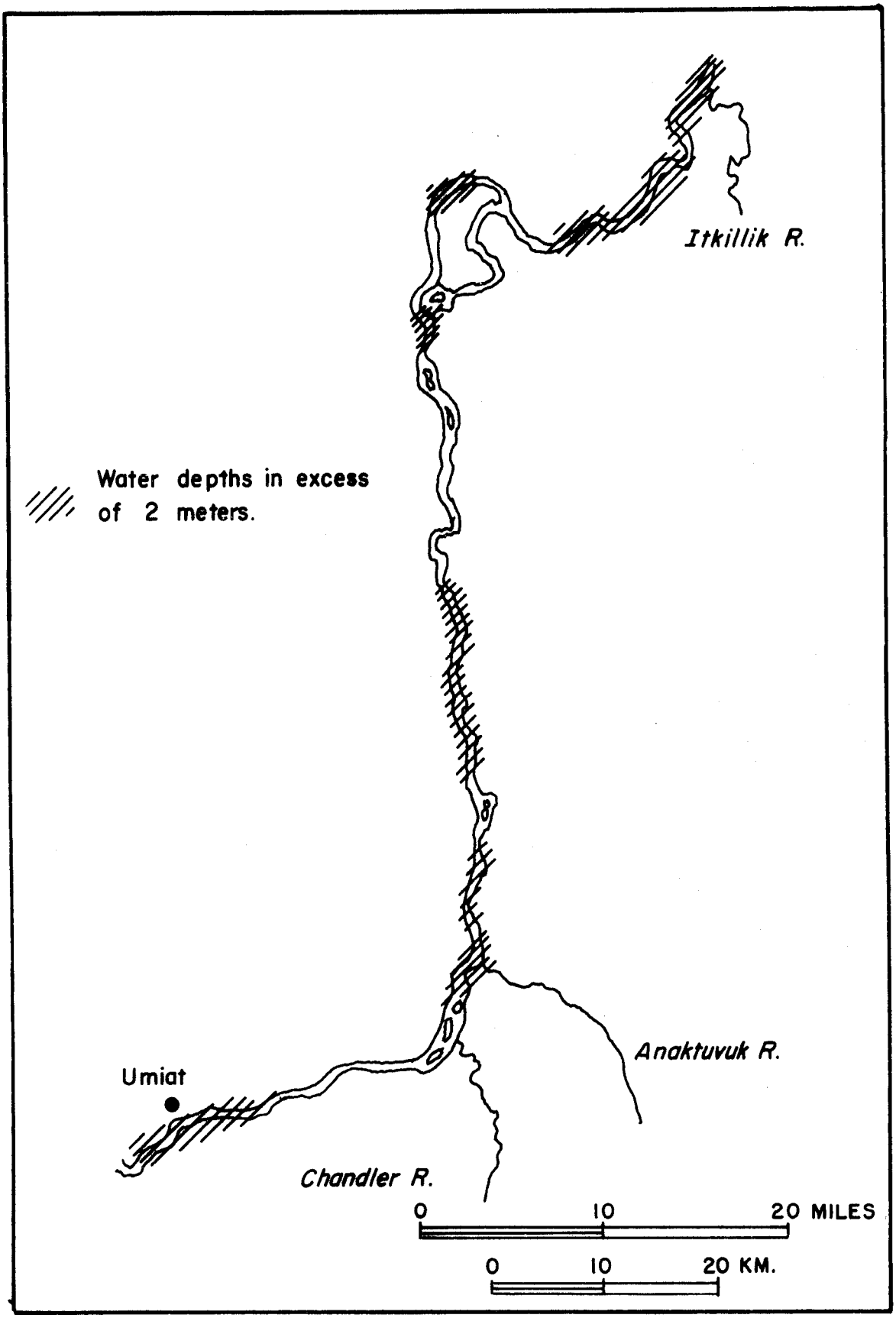
Under-ice netting was conducted in a 145 km (90 mi) reach of the Colville River during October, March, and April of 1977 and 1978 (Fig. 43). Nets were checked once or twice daily and measurements of snow depth, ice depth, water depth, water temperature, dissolved oxygen, and bottom type (when possible) were recorded at each site (Table 3).

Plastic flagging tape was suspended in the water column and observed to detect any under-ice flow of water.

A total of 1,476 net hours of fishing yielded a catch of 441 fish or 0.3 fish per hour. During the month of October the Colville River at Umiat began freezing, but had not completed freezing over its entire length by the end of the month. There was a considerable flow of water both in open areas and under the ice. Ice and snow depths were shallow and there was no indication at that time that the movements of fish were impaired by physical obstructions created by freezing.

In March and April, the entire length of the Colville River was ice covered. Snow depths ranged from 25 cm (10 in) to 58 cm (23 in), and ice depths ranged from 91 cm (36 in) to 157 cm (62 in). Levels of dissolved oxygen were low (1.4 ppm to 4.6 ppm) and there was no discernible flow or current under the ice. There was an abundance of under-ice habitat throughout the area surveyed.

Fig. 42. Potential overwintering areas in the lower Colville River.



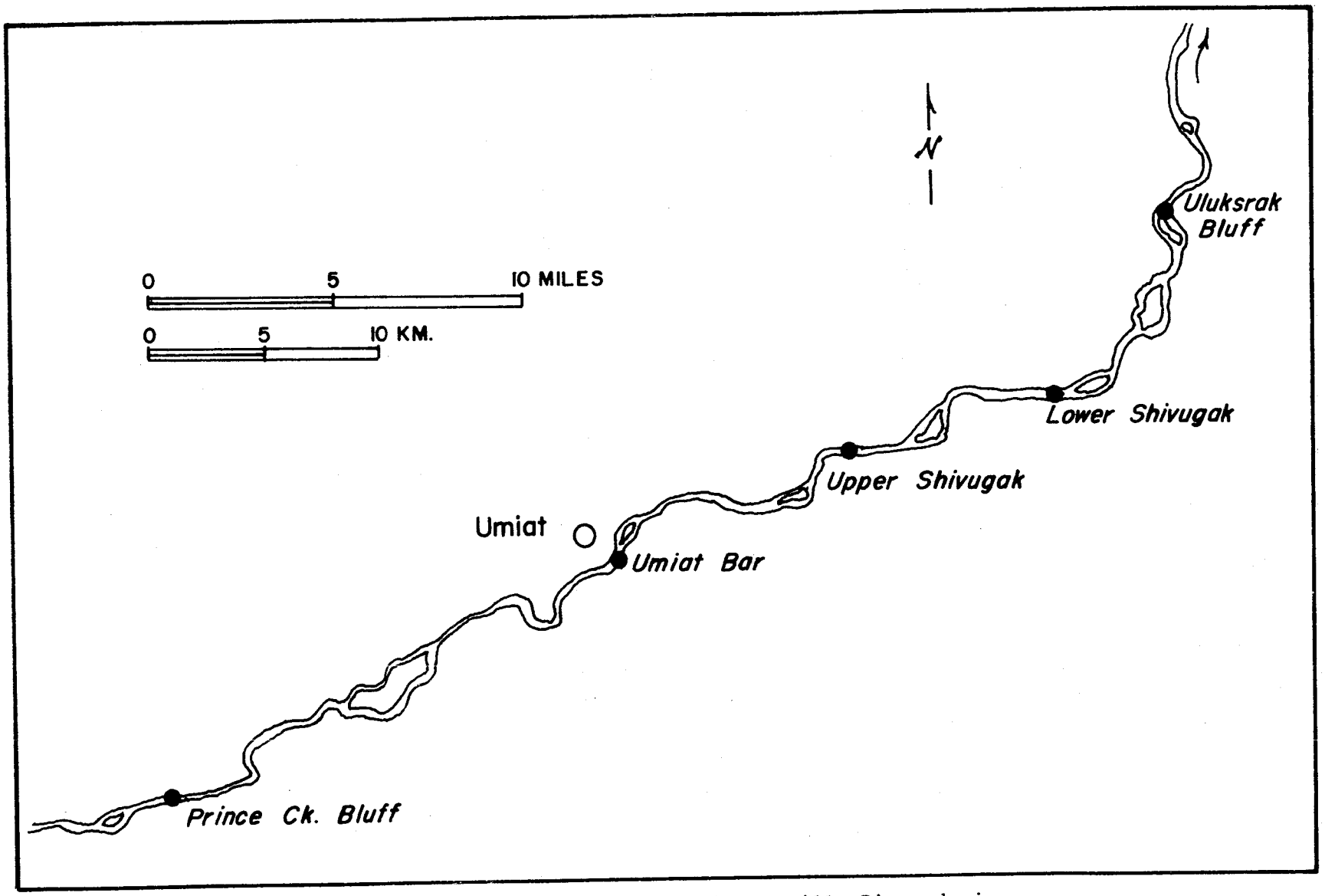


Fig. 43. Locations of under-ice net sets in the Colville River during October, March, and April of 1977-1978.

Table 3. Physical characteristics of under-ice net sites in the Colville River near Umiat.

Location	Date	Snow Depth cm (in)	Ice Depth cm (in)	Water Depth cm (in)	Water Temp. °C	DO (ppm)	Bottom Type	Species Present
Umiat Bar	Oct. 16, 1977	5 (2)	10 (4)	396 (156)	1		Medium gravel	GR, RWF, BWF, BB, LNS, SSC, NSB
Umiat Bar	March 21, 1978	58 (23)	91 (36)	304 (120)	1	1.4	Medium gravel	GR, BWF, LNS, NSB
Shivugak Bluff	March 21, 1978	46 (18)	99 (39)	487 (192)	1	1.6	Rubble	GR, BB, LNS, NSB
Shivugak Bluff	April 13, 1978	40 (16)	93 (37)	457 (180)	1	2.4	Rubble	GR, BB, LNS, NSB
Lower Shivugak Bluff	April 14, 1978	36 (14)	106 (42)	121 (48)	1	2.8	Medium gravel	Did not set net
Uluksrak Bluff	April 14, 1978	25 (10)	157 (62)	284 (112)	1	2.6	Large gravel	GR, RWF
Prince Cr. Bluff	April 16, 1978	30 (12)	121 (48)	365 (144)	1	4.6	Large gravel	GR, BWF, RWF, LNS

The species composition of fish inhabiting the Colville River near Umiat remains the same throughout the year. The dominant fish species captured during the summer of 1977 (grayling, broad whitefish, round whitefish, burbot, longnose sucker, ninespine stickleback, and slimy sculpin) were also taken during the three under-ice periods. Humpback whitefish, which migrate upstream past Umiat in August and September, were not taken during the winter netting. The relative abundance of grayling, as evidenced by the catch per unit effort, increased during the winter netting as a result of wintering fish moving out of summer habitats that freeze to the bottom. Ninespine stickleback and slimy sculpin were taken only as food items from burbot in spring but were observed in shallow water during October. Table 4 shows the numbers of principal fish species captured during the fall and spring netting periods. There was a decrease in average length and weight of grayling captured between fall and spring. Grayling averaged 295 mm and 271 mm in length and 316 g and 229 g in weight during October and March, respectively.

All of the principal species except broad whitefish contained food in their stomachs throughout the sampling periods. Whitefish eggs were a dominant grayling food item during October; however, mayfly and stonefly larvae predominated as grayling food items in March and April.

Burbot spawn in the main reaches of the Colville River during late winter and had completed spawning prior to our March test netting. The greatest catches of burbot occurred in areas with rubble or boulder bottoms; however, none of the fish appeared to segregate by species into separate overwintering locations.

Life History Data

Arctic Char:

Arctic char are distributed throughout the lower Colville, Anaktuvuk, and Chandler rivers. They are also found in the large glacial lakes of the Brooks Range in the Kurupa, Chandler, and Anaktuvuk drainages. The present taxonomy of Arctic char inhabitating waters of the North Slope is in question; however, for the purposes of this report, all char were considered to be *Salvelinus alpinus* as described by McPhail (1961).

Three life history patterns of Arctic char inhabitating the study area appear to exist. Isolated populations inhabit several alpine lakes in the study area where fish passage into or out of these systems is prevented by steep gradient and velocity barriers at their outlets. A second form of char is a year-round resident of streams within the study area and is characterized by its small size and dark spawning colors. Morrow (1973) describes stream resident char from the Etivluk, Killik, and Anaktuvuk rivers. The third form of char is anadromous and exibits a life history pattern similiar to Sagavanirktok River char described by Yoshihara (1972, 1973).

The Anaktuvuk and Chandler rivers support the greatest number of char in the study area. Char migrate out of these streams at breakup and forage in the lower Colville River and along the Beaufort Sea coast

Table 4. Numbers of principal fish species captured in the Colville River during fall and spring of 1977 and 1978.

Species	Numbers of fish Captured		
	October	March-April	Total
Grayling	187	169	356
Broad whitefish	25	7	32
Round whitefish	15	3	18
Burbot	12	9	21
Longnose sucker	2	12	14
Total	241	200	441

during the summer months. They return to spawn and overwinter in these streams during mid-August.

Arctic char captured in the Colville River drainage ranged in length from 354 to 610 mm and averaged 488 mm (n=46). Weights ranged from 410 to 2,400 g and average 1,369 g. The male to female sex ratio was 1:2.3. Ages ranged from IV to XV and age a maturity was between VII and IX. Twenty percent of the fish captured had mature gonads. Char captured while migrating through the Colville River were not feeding.

Arctic char from Cascade, Kurupa and Chandler lakes combined, averaged 364 mm in length and 786 g in weight. Ages ranged from III to XVI Predominent food items included zooplankton, aerial insects, and fish.

Lake Trout:

Lake trout inhabit the larger glacial lakes within the study area and a small number were captured in the main reaches of the Colville River as far upstream as the confluence with the Etivluk River and in Teshekpuk Lake.

Lake trout from the Colville River drainage exhibit a slightly slower growth rate, similar age at maturity, and greater longevity than lake trout from the Kuskokwim River drainage in Alaska (Alt, 1977). Ten percent of the lake trout sampled (n=126) were greater than 30 years old. The oldest fish aged was 42 years old. The male to female sex ratio was 1.8:1.

Lake trout ranged in length from 155 to 944 mm. Weights ranged from 90 g to 10.05 kg. Growth rates are similar for lake trout throughout the drainage.

Fifty-one percent of the lake trout stomachs examined were empty. Of those stomachs that contained food, the following items in descending order of frequency were found: least cisco, snails, aerial insects, round whitefish, slimy sculpin, and voles.

Arctic Grayling:

Arctic grayling are the most widespread and abundant species within the study area; they inhabit both lake and stream systems. Grayling captured in the Colville River exhibited a slower growth rate and smaller ultimate size than grayling inhabitating lake systems within the watershed.

Fork lengths ranged from 46 to 470 mm and averaged 311 mm (n=122). Ages ranged from young-of-the-year through XI years. Grayling ranged in weight from 1.1 g to 1.3 kg and averaged 465 g. Immature grayling accounted for 10% of the total catch, developing fish accounted for 30% of the catch, and mature fish with redeveloping gonads accounted for 60% of the catch. The male to female sex ratio of 118 grayling was 0.5:1.

Grayling spawn in a variety of habitats throughout the study area including the main stem of the Colville River, large and small tributaries,

beaded streams, and lakes with substrates varying from large rubble to vegetated silt. Spawning was first noted in the lower Colville during the second week of June and may not be completed in the higher tributaries until the end of the month. Many spawning areas that become unsuitable summer habitat when water levels recede are abandoned by adult grayling shortly after spawning, and most overwintering within the drainage takes place in the main stem of the Colville River. There was no evidence of alternate year spawning by grayling inhabiting the study area.

Throughout the study area, grayling are opportunistic feeders. Of 122 grayling stomachs examined, the average "fullness" was one-half. The following food items were found in descending order of abundance: caddis fly larvae, chironomid larvae, terrestrial and aquatic beetles, aerial insects, snails, bivalves, amphipods, and ninespine stickleback.

Broad Whitefish:

Broad whitefish range throughout the Colville River drainage and were found in several lakes within the watershed. Small numbers of broad whitefish were captured throughout the summer and winter in the main reaches of the Colville River, and a large spawning run passes Umiat during mid-August.

Broad whitefish from the Colville River drainage exhibit a faster growth rate than Seward Penninsula populations but slower than Yukon River drainage populations in Interior Alaska (Alt, 1976). Teshekpuk Lake broad whitefish were also slower growing than fish from the Colville drainage.

Broad whitefish ranged in length from 60 to 674 mm and average 491 mm. Weights ranged from 0.5 g to 4.85 kg and averaged 1.68 kg. Ages ranged from young-of-the-year to XVI years in the Colville drainage (N=85) and from V to XII years in Teshekpuk Lake (N=42). The male to female sex ratio of 72 broad whitefish was 1:1.

Seventy-six percent of the broad whitefish sampled has empty stomachs. Food items included: Dipteran larvae, snails, aerial insects, and phytoplankton.

Humpback Whitefish:

Humpback whitefish range throughout the lower Colville River and were found in Teshekpuk Lake. They were absent from all lakes surveyed in the Colville watershed.

Humpback whitefish first appeared at Umiat during the second week of August. At this time an upstream migration of mature fish began and continued through early September. Humpback whitefish spawning presumably takes place upstream from Umiat during September and October. Eighty-one percent of the humpback whitefish sampled during the run were mature prespawners.

Humpback whitefish ranged in length from 258 to 520 mm and averaged 409 mm. Weights ranged from 170 g to 2.15 kg with an average of 836 g. The male

to female sex ratio of 50 fish was 1:1. Ages ranged from IV to XIII. All of the humpback whitefish sampled had empty stomachs.

Least Cisco:

Least cisco are distributed throughout the lower Colville River, Teshekpuk Lake, and lakes in the Killik and Etivluk drainages. Least cisco growth is variable throughout the study area. Populations in Teshekpuk Lake and the lower Colville are probably anadromous while populations in the Killik and Etivluk drainages are lake residents and exhibit slower growth rates and smaller adult size.

Anadromous least cisco constitute a large portion of the commercial catch in the Colville delta. Doxey (1977) describes summer movements of least cisco between Prudhoe Bay and the Colville River based on tagging data.

Least cisco captured in the Killik River drainage ranged in length from 130 to 197 mm and in weight from 23 to 95 g (n=8). Ages ranged from II to VI and all fish were mature by Age IV.

Least cisco in the Etivluk drainage ranged in length from 138 to 360 mm and in weight from 30 to 500 g (n=30). Ages varied from young-of-the-year to Age VIII and sexual maturity was reached at Age IV.

In Teshekpuk Lake, least cisco ranged in length from 165 to 405 mm and in weight from 26 to 600 g (n=6). Ages ranged from III to VIII.

Arctic Cisco:

Three Arctic cisco were captured in the Colville River during 1977 and 1978. Their distribution in the Colville River drainage is limited to the delta area, and apparently only small numbers range above the confluence with the Itkillik River during the open water season. Arctic cisco are anadromous in the Colville River and are a target species in the delta commercial fishery as well as in subsistence fisheries near Nuiqsut and along the Beaufort Sea coast. Some aspects of Arctic cisco life history in arctic waters are discussed by Craig and McCart (1976) and Bendock (1977). Doxey (1977) reported on Arctic cisco timing and movements between Prudhoe Bay and the Colville River based on tagging data.

Arctic cisco captured in the Colville River ranged in weight from 540 to 640 g ($\bar{x}$ 590 g) and in length from 355 to 361 mm ($\bar{x}$ 359 mm). All three Arctic cisco were mature males and had empty stomachs.

Arctic cisco captured in Teshekpuk Lake averaged 370 mm in length and 505 g in weight (n=4).

Round Whitefish:

Round whitefish are common in both lakes and streams in the study area. They are an important forage species in lakes that contain lake trout.

Round whitefish taken in lakes were considerable heavier at the same length than those taken in streams. They have similar growth rates but smaller maximum size than round whitefish from the Kuskokwim drainage (Alt, 1977).

Round whitefish ranged in length from 38 to 422 mm and averaged 266 mm (n=172). Weights ranged from 0.5 to 800 g. The male to female sex ratio of 112 round whitefish was 1.4:1. Ages ranged from I through XI, with the majority of fish captured at Age VIII. Sexual maturity was first noted at Age VI and by Age VIII nearly all round whitefish were mature. Spawning in the Colville River occurs from late September through mid-October.

Thirty-one percent of the sample had empty stomachs. The following food items were taken by round whitefish: dipteran larvae, caddis fly larvae, snails, clams, phytoplankton, and aerial insects.

Burbot:

Burbot range throughout the Colville River to a distance above the mouth of the Etivluk River and in the lower reaches of tributary streams. The greatest abundance of burbot was found in the middle and lower reaches of the Colville River. Burbot also inhabit several lakes within the watershed; however, they are not readily caught by gill nets, which were our principal sampling gear, and thus they were not captured at several sites.

Burbot ranged in length from 55 mm to 1.019 mm and averaged 608 mm (n=50). Weights ranged from 2 g to 5.6 kg and averaged 1.636 kg. The growth rate and longevity of Colville River burbot is similar to that described for Yukon River burbot (Chen, 1969). Ages ranged from I through XXII and sexual maturity is first reached at Age VII. Seven percent of the burbot captured were immature, 39% had developing gonads, and 54% were mature. The male to female sex ratio of 33 burbot was 1:2. Spawning in the Colville River occurs under the ice in mid-winter and was completed by March.

Burbot are largely piscivorous feeders. Fifteen percent of the stomachs examined were empty and the remainder averaged one-fourth full. The following food items were taken by burbot: slimy sculpin, ninespine stickleback, round whitefish, grayling, snails, caddis fly larvae, small mammals, and carrion.

Northern Pike:

Northern pike were found in three lakes in the Killik River drainage; however, none were captured in the Killik or Colville rivers. Other North Slope drainages that have northern pike populations are the Oumalik and Ikpikpuk drainages (Netsch, 1977).

A total of 94 pike was captured in Udrivik Lake, Imiaknikpak Lake, and an unnamed lake at lat 68°24'N, long. 154°04'W. Pike from these lakes exhibit a slower growth rate, similar longevity, and later age at maturity

than pike from Interior Alaska. Lengths ranged from 160 to 870 mm and weights ranged from 50 g to 5.0 kg. Ages ranged from I to XXII. The first maturity was at Age X. Food items included burbot, least cisco, broad whitefish, and slimy sculpin.

Salmon:

Small numbers of pink and chum salmon and a single king salmon were captured in the Colville River during 1977 and 1978. Salmon numbers and distribution appear to vary considerable in the drainage from year to year.

Sixty-four pink salmon were captured in the Colville River downstream from Umiat. Lengths ranged from 371 to 460 mm and averaged 408 mm. Weights ranged from 750 g to 1.5 kg and averaged 1.06 kg. Pink salmon enter the Colville River in mid-August and spawning takes place in the main stem of the river as well as in the lower reaches of the Itkillik and possibly the Chandler and Anaktuvuk rivers. Pink salmon appear to have the widest distribution on the North Slope. In 1978, they were captured as far east as Barter Island.

Thirty-five chum salmon were captured in the Colville River. They were distributed from the mouth up to the confluence with the Etivluk River. Chum salmon ranged in length from 548 to 648 mm and average 602 mm. Weights ranged from 2.6 to 5.4 kg and average 3.86 kg. Spawning takes place in the mainstem of the Colville river from mid-August through mid-September.

A single king salmon was captured near the mouth of the Etivluk River on September 6, 1978. It was a male that had not spawned. King salmon appear to be rare in streams of the North Slope.

Other Species:

Longnose suckers are abundant throughout the Colville River and its major tributaries. Spawning takes place during June in the main reaches of the Colville as well as in tributary streams. Minor tributaries and overflow channels are important rearing areas for longnose suckers.

Ninespine stickleback are widely distributed throughout the study area, inhabiting both lake and stream systems. They are an important forage species for lake trout, char, and burbot. Ninespine stickleback spawning takes place in June.

Slimy sculpin are also widely distributed throughout lakes and streams within the study area. As with ninespine stickleback, they are an important forage species for larger fish.

LITERATURE CITED

Alt, K. T. 1976. Age and growth of Alaskan broad whitefish, Coregonus nasus. Trans. Amer. Fish Soc. 105(4): 526-528.

_____. 1977. Inventory and cataloging western Alaskan waters. Federal Aid in Fish Restoration, Completion Report, 1976-1977, Project F-9-9, 18(G-I-P): 128 pp.

Alt, K. T. and D. Kogl. 1973. Notes on the whitefish of the Colville River, Alaska. Journal Fisheries Research Board Canada. 30: 554-556.

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

Chen, L. 1969. The biology and taxonomy of the burbot, Lota lota leptura, in Interior Alaska. Biol. Pap. University Alaska. No. 11 53 pp.

Craig, P. and P. J. McCart. 1976. Fish use of nearshore coastal waters in the Western Arctic: emphasis on anadromous species. IN: Assessment of Arctic Marine Environment: Selected topics. Institute of Marine Sciences, University of Alaska, Fairbanks. 361-388.

Doxey, M. 1977. Fishery impact survey of the Atlantic Richfield Company causseway at Prudhoe Bay. Alaska Dept. of Fish and Game, Sport Fish Division, Fairbanks. 36 pp.

Furniss, R. 1974. Inventory and cataloging of Arctic area waters. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1973-1974, Project F-9-6, 15(G-I-I): 45 pp.

Kogl, D. 1971. Monitoring and evaluation of Arctic 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.

Kogl, D. and D. Schell. 1975. Colville River delta fisheries research. In: Environmental Studies of an Arctic Estuarine System, Final Report. Institute of Marine Science, University of Alaska, Fairbanks. Chapter 10. 483-504.

McPhail, J.D. 1961. A systematic study of the Salvelinus alpinus complex in North America. Journal Fisheries Research Board Canada, Vol. 18, No. 5. 793-816.

Mohr, C.L. et al. 1961. The marine nature of Nuwuk Lake and small ponds of the peninsula at Point Barrow, Alaska Arctic. 14(4): 211-223.

Morrow, J. E. 1973. A new species of Salvelinus from the Brooks Range, Northern Alaska in Studies of Alaskan Fishes. University of Alaska, Biological Paper 13. 1-9.

Netsch, N., E. Crateau, G. Love, and N. Swanton. 1977. Freshwater fisheries reconnaissance of the coastal plain of national petroleum reserve - Alaska (NPR-A), July and August 1977, Preliminary Report. U.S. Fish and Wildlife Service, Anchorage, Alaska. 214 pp.

Roguski, E. and Winslow, P. 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.

Selkregg, L. L. 1976. Alaska regional profiles - Arctic region. University of Alaska, Arctic Environmental Information and Data Center, Anchorage. 218 pp.

Yoshihara, H. 1972. Monitoring and evluation of Arctic waters with emphasis on the North Slope drainges. Alaska Dept. Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1971-1972. Project F-9-4, 13(G-III-A): 49 pp.

_____. 1973. Monitoring and evaluation of Arctic waters with emphasis on the North Slope drainages; Part A: Some Life History aspects of Arctic char. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1972-1973, 14(G-III-A): 63 pp.

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