Volume 24 Study G-I-P-A

STATE OF ALASKA

Bill Sheffield, Governor

Annual Performance Report for

INVENTORY AND CATALOGING OF SPORT FISH AND SPORT FISH WATER OF WESTERN ALASKA

by

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Volume 24 Study No. G-I-"S"*

RESEARCH PROJECT SEGMENT

State: Alaska Name: Sport Fish Investigations of Alaska

Project: F-9-15

Study No: G-I Study Title: INVENTORY AND CATALOGING

Job No.: G-I-P-A Job Title: Inventory and Cataloging of Sport Fish Waters of Western Alaska

Cooperator: Alfred DeCicco

Period Covered: July 1, 1982 to June 30, 1983

ABSTRACT

This report presents data from the second year of a 4-year life history study of Arctic char, Salvelinus alpinus, in the Noatak, Wulik and Kivalina Rivers of northwestern Alaska.

Physical descriptions and fish distributions are presented for important spawning streams in the Noatak River system and for the Wulik and Kivalina Rivers. Chemical data are given for Noatak streams.

Aerial surveys showed a minimum of 10,664 char spawning in the Noatak River and 1,081 in the Wulik and Kivalina Rivers. In 1982 additional spawning areas were located in the Kugrak and Igning Rivers, 400 miles upstream on the Noatak.

A total of 3,309 char has been tagged in the study area. Recoveries indicate movement within the Noatak River and inter-system movement between spawning areas in the Noatak and wintering areas in both the Wulik and Kivalina Rivers.

Overwintering counts of 65,581 in the Wulik River and 10,032 in the Kivalina River were lower than those for the past 2 years which averaged 107,690 for the Wulik and 42,524 for the Kivalina. Winter sampling showed that char overwinter up to 197 miles upriver in the Noatak system.

The length frequency of Arctic char spawners tagged in the Noatak was greater in 1982 than in 1981. The sex ratio of spawning char in the Noatak River was one male to 1.87 females.

* "S" = 100% State funds

Ova counts for char from two spawning streams are given. Age and growth data are presented. Char from the study area grow faster than Sagavanirktok River char. Diptera larvae were the most frequently occurring food items in stomachs of rearing char.

The 1982 Kivalina fall subsistence harvest was 18,438 char. The area-wide char recreational, commercial and subsistence fisheries are discussed.

KEY WORDS

Arctic char, spawning, overwintering, movements, life history, Wulik River, Kivalina River, Noatak River, Kotzebue.

BACKGROUND

The Noatak, Wulik and Kivalina Rivers have long been known to support large populations of Arctic char which are important to the subsistence economy of the region and sustain a light sport fishery of recognized quality. The Wulik and Kivalina Rivers drain a 1,520 sq mi area of the western slopes of the Brooks Range and empty into the Chukchi Sea at lat. 67° 54' N, long. 160° 31' W near the village of Kivalina. The Noatak River, the ninth largest river in the State, drains a 12,597 sq mi area of northwestern Alaska and enters Kotzebue Sound at lat. 67° 00' N, long. 162° 30" W, about 5 mi north of Kotzebue.

The present study was begun in 1981 after preliminary survey work in 1980. During 1980 char spawning and rearing areas were located. Aerial surveys showed that Noatak River tributary streams supported more spawning activity than either the Wulik or Kivalina Rivers. Char were tagged in spawning areas on the Noatak system and in overwintering areas on the Kivalina River. Data on char movements, angling effort and harvest were collected as time permitted. A summary of existing information on Arctic char of the region was presented by DeCicco (1982).

Recent mineral exploration and development has prompted an increase in environmental studies and focused attention on the Wulik River system where the Red Dog heavy metals deposit is located. Environment Assessment work was being done by Environment Study (EVS) Consultants of Vancouver, Canada and Dames and Moore of Seattle environmental in this area in 1982.

The major foci of 1982 field work included physical surveys of spawning streams, tagging spawning char and collecting water chemical data on Noatak River tributary streams, conducting fall overwintering counts on the Wulik and Kivalina Rivers and conducting aerial surveys to enumerate spawning char.

A map of the study area is presented in Figure 1 and a list of fish species occurring in the study area is presented in Table 1.

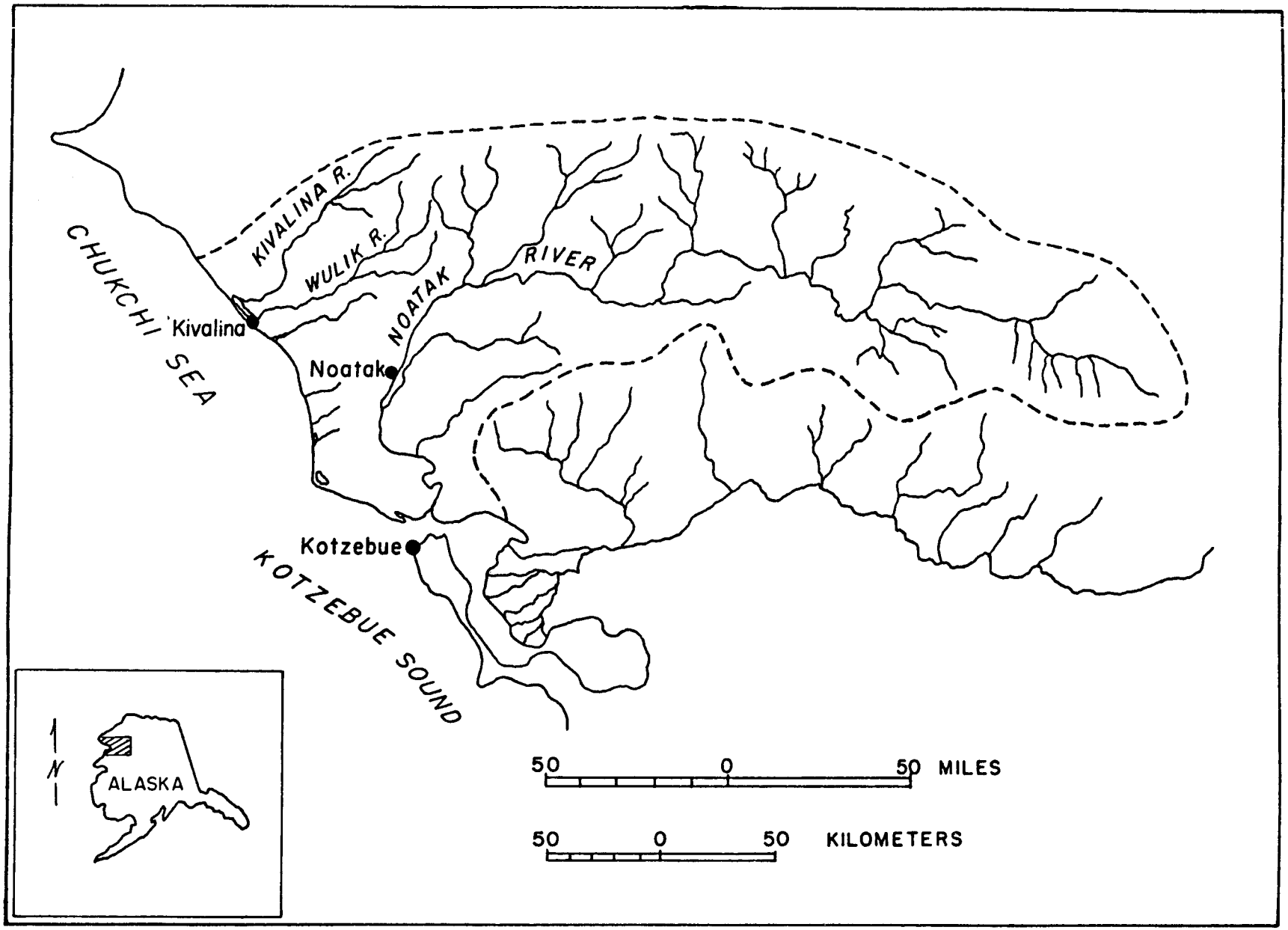

Figure 1. Study area.

Table 1. List of common names, scientific names and abbreviations of fish found in study area.

Common Name	Scientific Name & Author	Abbreviation
Alaska blackfish	Dallia pectoralis Bean	BF
Arctic char	Salvelinus alpinus (Linnaeus)	AC
Arctic flounder	Liopsetta glacialis (Pallas)	AF
Arctic grayling	Thymallus arcticus (Pallas)	GR
Bering cisco	Coregonus laurettae Bean	BC
Broad whitefish	Coregonus nasus (Pallas)	BWF
Burbot	Lota lota (Linnaeus)	BB
Chinook salmon	Oncorhynchus tshawytscha (Walbaum)	KS
Chum salmon	Oncorhynchus keta (Walbaum)	CS
Coho salmon	Oncorhynchus kisutch (Walbaum)	SS
Fourhorn sculpin	Myoxocephalus quadricornis (Linnaeus)	FSC
Humpback whitefish	Coregonus pidschian (Gmelin)	HW
Inconnu (sheefish)	Stenodus leucichthys (Guldenstadt)	SF
Least cisco	Coregonus sardinella (Valenciennes)	LCI
Longnose sucker	Catostomus catostomus Forster	LNS
Ninespine stickleback	Pungitius pungitius (Linnaeus)	NSB
Northern pike	Esox lucius Linnaeus	NP
Pacific herring	Clupea harengus pallasi Valenciennes	PH
Pink salmon	Oncorhynchus gorbuscha (Walbaum)	PS
Rainbow smelt	Osmerus mordax (Mitchill)	RSM
Round whitefish	Prosopium cylindraceum (Pallas)	RWF
Saffron cod	Eleginus gracillis (Tilesius)	SC
Slimy sculpin	Cottus cognatus Richardson	SSC
Sockeye salmon	Oncorhynchus nerka (Walbaum)	RS

RECOMMENDATIONS

Management

1. Collect angler and subsistence use information in the study area.

2. Monitor the development of the Red Dog Mine Project and other mining activities in the area with emphasis on possible impacts on char and char habitat.

Research

1. Continue the physical-biological survey of the Wulik, Kivalina and Noatak Rivers.

2. Tag char in the Noatak, Wulik and Kivalina Rivers with emphasis on tag recovery.

3. Count overwintering and spawning char.

4. Collect life history information with emphasis on summer vs. fall spawning and early life history.

OBJECTIVES

1. To continue the physical-biological surveys of the Wulik, Kivalina and Noatak Rivers.

2. To determine movements and distribution of Arctic char in the waters of the study area.

3. To locate and describe Arctic char spawning and rearing areas in the waters of study area.

4. To survey overwintering and spawning populations of Arctic char within the study area.

5. To collect basic life history information on Arctic char including age and growth, spawning, and food habits from the Wulik, Kivalina and Noatak Rivers.

6. To collect angler and subsistence use information on Arctic char on the Wulik, Kivalina and Noatak Rivers.

Note: Objectives are not exactly as in Job Description because G-I-P Job Objectives cover Jobs G-I-P, parts A and B.

Those Objectives not referred to in part A are omitted.

TECHNIQUES

Float-equipped Cessna 185 and wheel-equipped Piper PA-18 aircraft were used to transport field personnel and equipment to and from a base camp near the mouth of the Kugururok River.

Surveys to locate spawning grounds and to enumerate spawning fish were conducted from a Piper PA-18 aircraft flying at low level. Spawning areas were delineated on U.S. Geological Survey 1:250,000 topographic maps. Numbers of fish were determined by counting individual fish and estimating larger concentrations by tens or hundreds. Surveys to enumerate summer spawners were flown in early August prior to the onset of spawning, and fall spawning surveys were flown at the end of September after completion of summer spawning. Because of budget constraints all spawning areas were not surveyed in both summer and fall.

Counts of overwintering char were conducted on the Wulik and Kivalina Rivers in late September using a PA-18 aircraft. Large concentrations of fish were estimated to the nearest thousand. Counts are given as minimum counts only.

Char were captured for tagging using hook and line, an 80' x 10' x 3/4" bar measure seine and a 90' x 6' x 1¼" bar measure seine. An inflatable boat equipped with an outboard jet motor was used on the Nimiuktuk, Kugururok, Kelly and Kivalina Rivers. The Eli River was surveyed using an inflatable raft. Char captured on spawning grounds in the Noatak drainage and in overwintering areas in the Kivalina River were tagged using Floy FD 67 internal anchor tags. Tags were numbered, color coded to major streams in the study area and inscribed with "ADF&G Kotz." A $2.00 reward for char tags was paid by the Division of Commercial Fisheries which staffs a permanent office in Kotzebue. Posters indicating the presence of tagged char in the area were circulated to all the villages in the study area and radio spots regarding tagged char were broadcast on the local Kotzebue radio station. All char tagged were measured to the nearest millimeter from the upper snout to the fork of the tail and weighed to the nearest 25 grams using a 6 kilogram Chatillion spring scale and a basket net. Tagged char were recovered by commercial fishermen in Kotzebue Sound, subsistence fishermen from Noatak and Kivalina, sport anglers, and ADF&G personnel. Additional tags were placed in char in the Wulik River by Dames and Moore personnel.

Ovaries were weighed to the nearest 0.1 gram in the field on an Ohaus Dial-a-gram balance and egg diameters were determined by measuring 10 eggs to the nearest millimeter. Ovaries were preserved in 10% formalin for later counting in the laboratory. The number of ova was determined gravimetically.

Water chemistry data were measured using a Hach AL 36 B field test kit.

Saggital otoliths were taken in the field, stored dry in coin envelopes and examined in the laboratory under a dissecting scope by immersing them in loess solution (51 parts 95% alcohol, 7 parts glycerin, 42 parts distilled water). Ages were determined by counting the translucent rings on the otolith.

Juvenile char were captured with a small mesh dip net and in minnow traps baited with fish eggs.

Use statistics on the Noatak River were acquired from the National Park Service in Kotzebue, and Kivalina subsistence harvest information was acquired from Stephen Braund and Associates and Ernest Burch Jr.

FINDINGS

Physical and Biological Surveys of Char Spawning Streams

Noatak River System:

Eli River. The Eli River is 78 mi long and drains a 514 sq mi area of the western slopes of the Baird Mountains (Fig. 2). It runs westward through a narrow mountain valley for about 24 mi until the confluence of Ahaliknak Creek at Lat. 67° 43' N, Long. 16° 59' W. Six miles past this point the Eli enters the broad flood plain of the Noatak. The river is mostly a single channel until this point where it begins to braid for the next 10 miles. Past this braided section the Eli again becomes a single channel stream and meanders through the Noatak floodplain, draining many small lakes. It roughly parallels the Noatak until their junction about 56 miles from the Noatak mouth. Bottom composition grades from large gravel, cobble and bedrock in the upper reaches through medium gravel where it enters the Noatak floodplain to mud, sand, and silt in its lower reaches. Bank vegetation runs from open spruce forest to willow, with tundra banks predominating in the higher areas of the flood plain. The lower river is forested with spruce.

Arctic char, Arctic grayling and slimy sculpin occur in the upper reaches of the Eli drainage. The lower Eli is an important chum salmon spawning area. Lakes drained by the lower Eli probably include a species composition similar to nearby lakes surveyed by Bureau of Land Management (BLM) fisheries biologists in 1980. These lakes contained northern pike, longnose suckers, broad whitefish, humpback whitefish, least cisco and grayling (Webb, 1980). Pink salmon probably spawn in the lower Eli.

Arctic char spawn in the lower 4 miles of Ahaliknak Creek, in the Eli River about 1/4 mi above its confluence with Ahaliknak Creek and for about 3 miles downstream. Spawning also occurs in the braided section of the Eli as it flows into the Noatak flats (Fig. 2). The greatest concentration of spawning char is in the vicinity of the confluence of the Eli River and Ahaliknak Creeks. Rearing juveniles and young-of-the-year char were present in lower Ahaliknak Creek and the mainstem of the Eli River during late July. Grayling are present throughout the river.

Water chemistry data and aerial counts of spawning char are given in Tables 2 and 3.

Kelly River. The Kelly River, draining a 582-sq-mi area of the south slope of the Delong Mountains, is 48 mi long and enters the Noatak River from the north at Mile 103. The Kelly River is moderately braided throughout most of its length, with most braiding occurring in the lower 15 mi. Bottom composition varies from fine to medium gravel in the lower reaches to a mix of medium gravel, cobble and boulders in the upper reaches. The lower 15 miles drains a broad valley of open spruce forest and muskeg with numerous small lakes. Fifteen miles upstream, the river valley becomes more confined as mountains rise to 3,000 ft on both sides of the valley. In this middle section of the river, spruce trees become more scattered and bank vegetation grades from willow to open gravel bars.

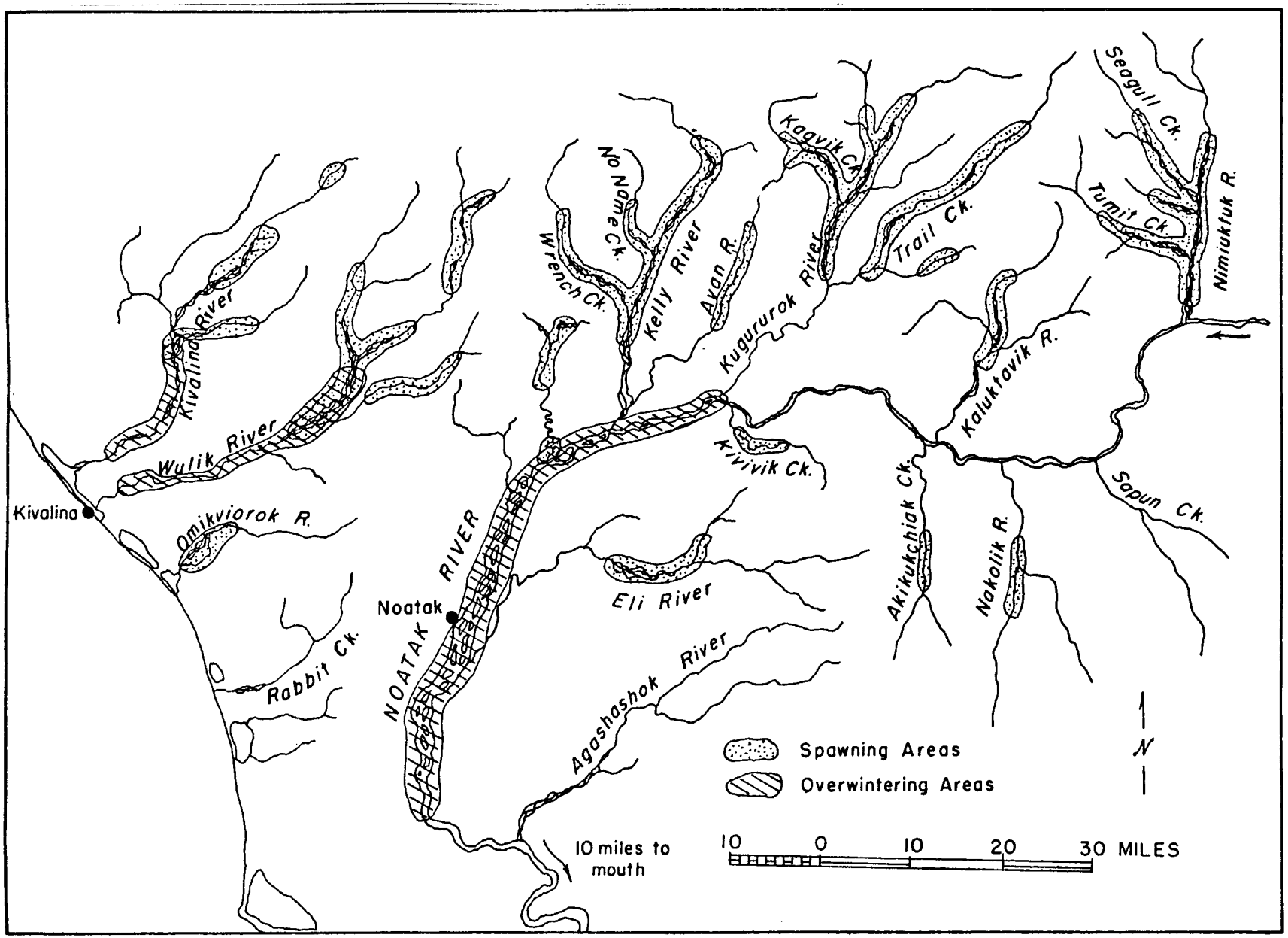

Figure 2. Lower Noatak, Wulik and Kivalina River char spawning and overwintering areas.

Table 2. Chemical data from Noatak River spawning streams, 1982.

Stream	Date	pH	Hardness	Alkalinity
Tumit Creek	July 09	7.7	76 ppm	43 ppm
Kukukpilak Creek	July 10	6.8	128 ppm	86 ppm
Seagull Creek	July 10	7.6	154 ppm	94 ppm
Nimiuktuk River	July 10	7.6	120 ppm	86 ppm
Kaluktavik River	July 13	7.9	86 ppm	86 ppm
Kugururok River (mouth)	July 14	7.9	154 ppm	120 ppm
Kugururok River (above Trail Cr.)	July 16	7.9	205 ppm	137 ppm
Kagvik Creek	July 18	7.6	205 ppm	137 ppm
Trail Creek	July 19	7.9	154 ppm	103 ppm
No Name Creek	July 22	7.8	154 ppm	137 ppm
Kelly River (above No Name Cr)	July 22	7.9	154 ppm	120 ppm
Avan River	July 23	7.9	120 ppm	137 ppm
Wrench Creek	July 23	7.9	145 ppm	128 ppm
Ahaliknak Creek	July 25	7.9	214 ppm	154 ppm
Eli R.-Main Fork	July 25	7.9	154 ppm	120 ppm
Kugrak River	Aug. 07	7.7	342 ppm	154 ppm
Igning River	Aug. 07	7.7	376 ppm	154 ppm

Table 3. Aerial observations of spawning char in the Noatak drainage, 1982.

Stream	Date	Conditions	No. Char Observed	River	Total
Ahaliknak Creek	8/03	good	57		
Eli River - Main Fork	8/03	good	180		
				Eli River	237
Avan River	8/04	good	341		
Wrench Creek	8/05	good	748		
No Name Creek	8/04	good	158		
Kelly R. Mainstem	8/03	good	1,079		
				Kelly River	2,326
Cairn Creek	8/04	good	10		
Nunaviksak Creek	8/04	good	257		
Kagvik Creek	8/04	good	620		
Okatak Creek	8/05	good	115		
Trail Creek	8/05	good	485		
Kugururok Mainstem	8/04	good	2,499		
				Kugururok R.	3,986
Seagull Creek	8/05	good	474		
Kukukpilak Creek	8/05	good	56		
Tumit Creek	8/05	good	783		
Nimiuktuk Mainstem	8/05	good	857		
				Nimiuktuk R.	2,170
Kaluktavik River	8/05	good	549		
				Kaluktavik R.	549
Kivivik Creek	8/07	good	15		
				Kivivik Creek	15
Akikukchiak Creek	8/07	good	25		
				Akikukchiak Cr.	25
Nikolik River	8/07	good	47		
				Nikolik River	47

Table 3. (Cont'd) Aerial observations of spawning char in the Noatak drainage, 1982.

Stream	Date	Conditions	No. Char Observed	River	Total
Spring Creek	8/07	good	10		
				Spring Creek	10
Kavachurak Creek	8/07	good	30		
				Kavachurak Cr.	30
Igning River	8/07	good	101		
				Igning River	101
Kugrak River	8/07	good	29		
				Kugrak River	29
Unnamed Creek	8/08	good	331		
				Unnamed Creek	331
Kagvik Creek	9/29	good	0		
Trail Creek	9/29	good	52		
Kugururok River	9/29	good	557		
				Kugururok R.	609
Tumit Creek	9/29	good	0		
Seagull Creek	9/29	good	0		
Nimiuktuk River	9/29	good	0		
				Nimiuktuk R.	0
Kaluktavik River	9/29	good	199		
				Kaluktavik R.	199
				Noatak River Total	10,664

The Avan River enters the Kelly River from the east about 1 mi from its mouth. The lower 10 mi of the Avan River meanders through open spruce forest and muskeg draining many small lakes. Above this area the river flows at a steep gradient, with many rapids, through boulder fields as it drains the mountains to the north. Water in the Avan River is stained a clear greenish brown.

Wrench Creek enters Kelly River from the west about 15 mi from its mouth. The lower 4 mi is mostly a meandering single channel through the spruce and willow of the Kelly River valley. Above this area Wrench Creek is heavily braided. Spring areas are abundant throughout this area and *aufeis* fields created by perennial ground water sources are present well into the summer.

No Name Creek enters the Kelly River from the west approximately 10 mi above Wrench Creek mouth. No Name Creek is a small stream approximately 25 mi in length with many spring areas. This creek represents the upper distribution of intermittent spruce stands on the Kelly River.

Moderate braiding continues on the Kelly River as it bends to the northwest about 12 mi above No Name Creek. There are numerous spring areas with associated aufeis fields in this part of the Kelly drainage. Above here the Kelly is quite small as it branches and drains mountain slopes to the North.

Arctic char, grayling, chum salmon, round whitefish, pink salmon and slimy sculpin inhabit the Kelly River, with northern pike having been reported from Tagakvik Lake in the lower Avan drainage. Chum salmon have been observed spawning in the lower reaches of Kelly River and the lower few miles of Wrench Creek and Avan River. Pink salmon spawning occurs in the lower Kelly River and Avan Rivers. Grayling are distributed throughout the Kelly River drainage.

Arctic char spawn throughout most of the middle area of Kelly River, Wrench Creek, No Name Creek and the upper Avan (Fig. 2).

Young-of-the-year and juvenile char have been observed in small tributary streams, spring areas, side channels and along the main channel of the Kelly River system.

Water chemistry data for the Kelly River and its tributaries are presented in Table 2. Arctic char spawning counts are presented in Table 3.

Kugururok River. The Kugururok River is 61 mi in length, drains a 940 sq mi area of the south slope of the Delong Mountains, and enters the Noatak from the north, 119 mi from its mouth. The Kugururok River is confined to a single channel for its lower 20 mi. This section of the river is swift with a bottom composition varying from fine gravel to bedrock with many large boulders where it cuts through a steep walled canyon for several miles. The lower Kugururok drains several lakes, the largest of which is lake Narvakak near its confluence with the Noatak. Bank vegetation on the lower river is a mixture of open spruce forest, willow and tundra.

The Kugururok River is extensively braided for the next 27 mi upstream, with many spring areas, and *aufeis* is present well into summer. The stream

bottom is mostly small to medium-size gravel, with some larger rocks and cobble. Bank vegetation is willow, with many open gravel bars. Water flow measured in April 1978 showed a discharge rate of 12 cfs in the Kugururok above Trail Creek, and a discharge rate of 35 cfs near its mouth (Childers and Kernodle, 1981).

Entering from the east at Mile 20, Trail Creek, 47 mi long, is the largest tributary of the Kugururok. Its headwaters drain the south slope of Nucleus Mountain and its valley is confined by mountains for much of its length. The lower reaches drain Misheguk Mountain, and Okatak Creek enters below Misheguk Mountain from the east, where the valley broadens. Trail Creek then continues in a southeasterly direction, entering the Kugururok River near Lake Kaiyak.

Kagvik Creek enters the Kugururok from the west 10 mi above the confluence of Trail Creek and is its second largest tributary. Its lower 12 mi are extensively braided with many spring areas. Bank vegetation is mostly willow, with many open gravel bars. Kagvik Creek drains the south slopes of Inaccessible Ridge and is confined to a narrow mountain valley for much of its 23-mi length.

Nunaviksak Creek enters the Kugururok River 8 mi above Kagvik Creek, and drains the many small side valleys of Inaccessible Ridge and Copter Peak. Nunaviksak Creek is confined to a single channel for most of its length.

Nine miles above the mouth of Nunaviksak Creek, Cairn Creek enters the Kugururok from the North. Cairn Creek is a small, single channel stream about 7 mi long and is confined to a steep narrow valley.

Above the mouth of Nunaviksak Creek, the Kugururok is a small, mostly single channel stream with headwaters draining Echo Mountain and Mount Bastille.

Fish species present in the Kugururok include Arctic char, chum salmon, pink salmon, Arctic grayling, round whitefish and slimy sculpin. Chum salmon spawn in the lower river, with some having been observed as far 25 mi upstream. Pink salmon have been observed spawning in the lower 3 mi of the Kugururok. Arctic char spawn throughout the Kugururok from the mouth of Trail Creek to just above Cairn Creek during the summer spawning period. They also spawn in Cairn Creek, Nunaviksak Creek, Kagvik Creek, Trail Creek and Okatak Creek (Fig. 2). Fall spawning also occurs on the Kugururok, but is restricted to several spring areas near the mouth of Kagvik Creek and Kingaviksak Mountain. On Trail Creek fall spawning occurs in a small spring about 32 mi upstream from its mouth and in spring areas near Misheguk Mountain. Young-of-the-year and rearing juvenile char have been observed throughout most of the Kugururok and its tributaries. Grayling occur throughout the watershed.

Kaluktavik River. The Kaluktavik River enters the Noatak from the north, 36 mi upstream of the Kugururok River at Mile 155 (Fig. 2). The Kaluktavik River is 36 mi long and drains the western slopes of the Poktovik Mountains and the Imikneyak Mountains between the drainages of the Kugururok and the Nimiuktuk Rivers. The Kaluktavik has two major tributaries; Imikneyak Creek, entering from the east at Mile 12, and Analak Creek, entering from

the west at Mile 16. The Kaluktavik has not been surveyed on the ground, but water chemistry data have been collected at its mouth, and aerial spawning surveys were conducted in 1982. Arctic char spawn in the Kaluktavik in both summer and fall. Most char spawning occurs from the mouth of Analak Creek upstream for a distance of about 12 mi. A survey for fall spawning in 1982, showed that flow in the Kaluktavik stopped about 6 mi above Analak Creek and resumed again from a spring area about ½ mi below this interruption. Fall spawning was located downstream of this interruption. Chum salmon were seen spawning in the lower 12 mi of the river.

Nimiuktuk River. The Nimiuktuk River drains a 564-sq-mi area of the south slope of the Delong Mountains in the vicinity of Black Mountain. The Nimiuktuk is 41 mi in length and enters the Noatak from the north at Mile 197. The Nimiuktuk is extensively braided for most of its length, it is bordered on the west by mountains and open on the east for the lower half to its length to the central Noatak basin. The western mountains are interrupted by river valleys of the three major Nimiuktuk tributaries. Tumit Creek enters at Mile 8, Kukukpilak Creek at Mile 12.5 and Seagull Creek at Mile 15.5. Bottom composition of the Nimiuktuk is mainly small to medium gravel with some large cobble; bank vegetation is mainly willow. A large, braided spring area about 2 mi from the mouth builds an extensive *aufeis* field which is present throughout most of the summer. Several other *aufeis* areas occur on the main Nimiuktuk and on both Tumit and Seagull Creeks. The lower Nimiuktuk drains many lakes, of which Aniralik Lake is the largest.

Tumit Creek is approximately 25 mi long and flows through a narrow mountain valley for all but its lower 4 mi. The stream channel exhibits moderate braiding throughout most of its length with two extensively braided *aufeis* areas, one about 4 mi and the other about 10 mi from its mouth. Vegetation is mostly willow, with some tundra and open gravel bars.

Kukukpilak Creek is a small, spring fed stream which enters the Nimiuktuk from the west 4.5 mi above Tumit Creek. This drainage is only 15 mi long and during low rainfall years, such as 1982, is dry throughout its lower reaches, while maintaining flow in most of its upstream areas. During 1982 the lower 2 mi of this stream, while showing a strong flow in early July, were dry by the first week of August. Arctic char, which entered the stream to spawn during July, were isolated in upriver spawning areas in August.

Seagull Creek is 23 mi long and enters the Nimiuktuk from the west 3 mi above Kukukpilak Creek. Its valley is narrow and bordered by mountains for much of its length. In the upper 13 mi Seagull Creek is confined to a single channel with some slight braiding, while the lower 10 mi are extensively braided, with many spring areas creating two large *aufeis* fields. Bank vegetation is mostly willow, with many open gravel bars within the braided section.

Fish species present in the Nimiuktuk system include Arctic char, Arctic grayling, round whitefish, slimy sculpin, chum salmon and pink salmon. Aniralik Lake contains populations of round whitefish and grayling (Alt 1978).

Chum salmon spawn in the lower 13 miles of the Nimiuktuk River, and two were seen in lower Tumit Creek. About 3,500 chum salmon were observed in the Nimiuktuk during an early August aerial survey. Salmon were noted in the river as early as July 12, 1982. Pink salmon were also seen in the lower Nimiuktuk in August, but no estimate of numbers was made.

Arctic char spawn during the summer in the lower 21 mi of the Nimiuktuk River. Spawning also occurs in the lower 15 mi of Seagull Creek, the lower 16 mi of Tumit Creek and in Kakukpilak Creek (Fig. 2). No fall spawning was observed in the Nimiuktuk.

Young-of-the-year and juvenile char were seen in many areas throughout the Nimiuktuk mainstem and tributaries in 1982, and like other Noatak tributary rivers, char rearing seems to occur throughout the system.

Arctic grayling occur throughout the Nimiuktuk drainage and were captured in all areas.

Other Noatak Tributaries. Reports of Arctic char occurring near the mouths of Noatak river tributaries as far as 400 mi upstream have been received from sport anglers, river floaters and area guides. Overflights of the upper Noatak in late winter of 1980 and 1981 have shown extensive *aufeis* areas in the upper reaches of the river and some open water. These features indicate the possibilities of suitable overwintering habitat for juvenile fish and spawning areas. An aerial reconnaissance survey of many smaller tributary streams of the middle and upper Noatak River was flown in August to locate spawning fish in previously unsurveyed areas. Char were observed spawning in Kivivik Creek, Akikukchiak Creek, Nakolik Creek, Aklumayuak Creek, a small nameless spring creek to the south of the Noatak at about Mile 330, Kavachurak Creek, Igning River and Kugrak River. Char were located on the Anisak River in 1980. No fish were seen in Nakolikurok Creek, Sapun Creek, Makpik Creek, Cutler River or Imelyak Creek (Figs. 2 and 3).

Wulik/Kivalina system:

Wulik River. The Wulik River is a clearwater system draining an 880-sq-mi area of the western slopes of the DeLong Mountains. It is 89 mi long and empties into Kivalina Lagoon and the Chukchi Sea near the village of Kivalina. For its lower 18 mi, the Wulik meanders through coastal tundra; it is fairly slow-moving and mostly confined to a single channel, with some sloughs and old river channels evident in its lower reaches. From Mile 18 to the forks at Mile 42 (lat. 68° 00' N, long. 163° 28' W), the river drains tundra uplands. The channel is extremely braided with a bottom composition of small to medium gravel and some larger cobble. Salmon spawning occurs sporadically throughout this section and Arctic char spawn in the upper 9 mi. Bank vegetation is mostly willow, with some tundra cut banks and open gravel bars.

Ikalakrok Creek enters the Wulik from the east 10 mi below the forks. This creek is 42 mi long and drains the mountains along the west boundary of Noatak National Monument north of the Noatak River. The headwaters of Ikalukrok Creek are heavily mineralized, and it is on Red Dog Creek, a tributary stream entering Ikalukrok Creek about 28 mi from its mouth, that

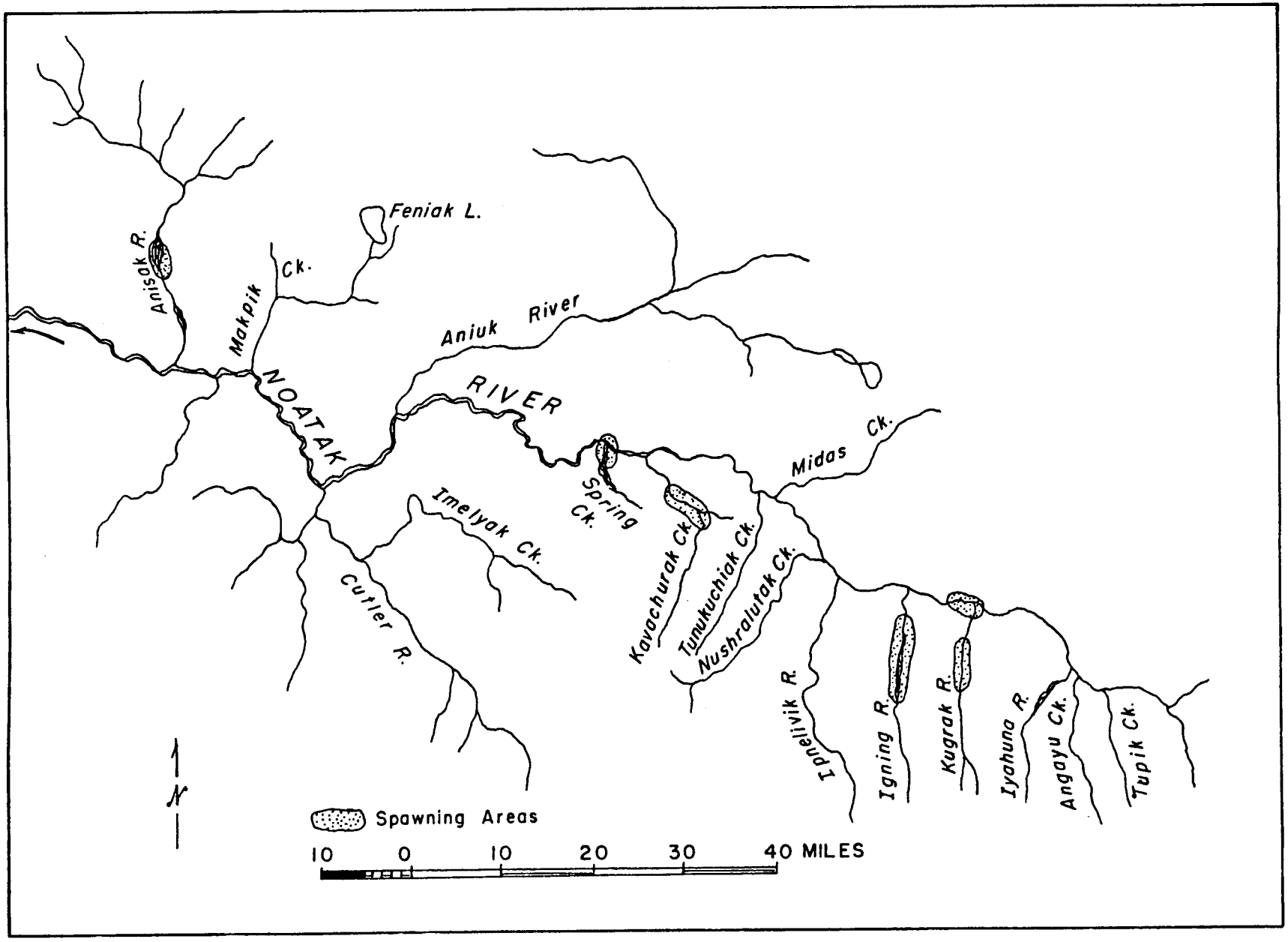

Figure 3. Upper Noatak River char spawning areas.

the Red Dog Mine will be located. The lower 20 mi of Ikalukrok Creek drains tundra uplands and contains several ground water sources. Bank vegetation is mostly tundra or willow and bottom composition is small to medium gravel. Above 20 Mile, the country drained by Ikalukrok Creek becomes mountainous.

The West Fork of the Wulik River drains the south slopes of the Wulik Peaks. Approximately 16 miles upstream it flows through a steep walled canyon cut into the bedrock. There are several falls in this area, which probably serve as a barrier to the upstream movement of fish.

The mainstem of the Wulik extends for 42 mi above the forks and drains an area of the Delong Mountains in the vicinity of Sheep Mountain. The lower 4 mi are quite braided as the Wulik flows out of the mountains. A canyon area with several rapids is located approximately 15 mi upstream from the forks where the Wulik cuts through a bedrock area. These rapids do not serve as a barrier to fish movement, as some important Arctic char spawning areas are located above this area on Sheep Creek and in the main river. Bank vegetation is willow and tundra. Above the canyons the Wulik again braids out for about 10 mi to the confluence of Sheep Creek, which enters from the east. Bottom composition is mostly small to medium-size gravel, with larger cobble in headwater areas.

Fish species present in the Wulik drainage include Arctic char, Arctic grayling, ninespine stickleback, king salmon, chum salmon, pink salmon, red salmon, coho salmon, humpback whitefish, Bering cisco and blackfish.

Salmon spawning occurs in the lower Ikalukrok and in the Wulik from the forks downstream. Char spawning occurs in Ikalukrok Creek, the west fork of the Wulik to below the falls, the main Wulik above the forks, Sheep Creek and the mainstem of the Wulik below the forks. The middle section of the Wulik from the forks downstream serves as important overwintering habitat for char (Fig. 2). Counts of spawning char are presented in Table 4.

Char rear throughout the Wulik and its tributaries and grayling occur throughout the system.

Whitefish and ciscos occur in to Kivalina Lagoon and the lower reaches of the Wulik.

Kivalina River. The Kivalina River is a clearwater system draining a 640-sq-mi area of the western slopes of the Delong Mountains. The river is 64 mi long and empties into the Chukchi Sea through Kivalina Lagoon. A breach in the beach barrier at lat. 67° 46' N, long. 164° 40' W serves as the primary entrance of Kivalina water to the sea. From its mouth upstream to Simik Hill, approximately 12 mi, the Kivalina River is slow and deep, with a bottom of medium-size gravel grading to fine sand and silt near its mouth. Above this point the river current is progressively faster and the channel becomes more braided to Mile 27, lat. 68° 1' N, long. 164° 15' W, where the three major forks forming the lower mainstem converge. Bottom composition through this area is mostly medium-size gravel, with some larger than fist-size cobble. Bank vegetation is willow or tundra, with some open gravel bars.

Table 4. Aerial observations of spawning char in the Wulik/Kivalina drainages, 1982.

Stream	Date	Conditions	No. Char Observed	River	Total
Sheep Creek	8/08	good	28		
Wulik Main Fork	8/08	good	73		
Wulik West Fork	8/08	good	133		
Wulik R. Mainstem	8/08	good	184		
Ikalukrok River	8/06	good	60		
				Wulik River	478
Kivalina River	8/06	good	299		
Little River	8/06	good	7		
Grayling Creek	8/06	good	146		
				Kivalina R.	452
Little River	9/30	good	0		
Kivalina River	9/30	good	40		
				Kivalina R.	40
Sheep Creek	9/30	good	59		
Main Fork Wulik R.	9/30	good	2		
West Fork Wulik R.	9/30	good	30		
Wulik River (mainstem)	9/30	good	20		
				Wulik River	111
				Total for Wulik/Kivalina	1,081

Grayling Creek, the most easterly of the forks, drains the south slope of the Wulik Peaks and flows for 24 mi through tundra before entering the Kivalina. Grayling Creek has many spring areas located in its lower 10 mi, with a bottom composition of small to medium-size gravel.

The Main Fork of the Kivalina River is 34 mi long and drains the northwest slopes of the Wulik Peaks. It is extremely braided in its lower 12 mi and has extensive ground water sources near the upper end of this braided section. Above Mile 12 the main fork is mostly a single channel, with bank vegetation consisting of willow, alpine tundra and open gravel bars.

The West Fork of the Kivalina River, or Little River, is a slower-moving, single channel, meandering tundra stream. Its bottom is stained a dark brown and its tea-colored waters drain an alpine tundra area between the Kukpuk River and the Main Fork of the Kivalina.

Fish species present in the Kivalina River include: Arctic char, Arctic grayling, chum salmon, red salmon, coho salmon, king salmon, pink salmon and slimy sculpin. Bering cisco, least cisco and humpback whitefish occur in Kivalina lagoon and probably in the lower river.

Char spawning occurs in Grayling Creek, the main fork of the Kivalina and in the mainstem below the forks (Fig. 2, Table 4). Spawning has also been reported in Kisimilot Creek, a small tributary entering from the east downstream of Grayling Creek (Houghton, and Hilgert, 1982).

Grayling are abundant throughout all areas of the Kivalina River and show a general movement out of tributaries into the main river in September.

Most salmon spawning occurs downstream of the forks in the mainstem. In August 1982, over 26,000 pink salmon were seen spawning in the Kivalina River.

Movements of Arctic Char

Movements between and within river systems as well as movements to and from the sea have been indicated by 59 tag recoveries from 3,309 marked char in the study area (Table 5).

Intra-system Movement:

Char move from tributary streams used for summer spawning to the main Noatak in late fall. Sixteen tag recoveries from lower Noatak overwintering areas in late September were from fish tagged in July on spawning grounds. Movements as far as 115 mi to overwintering areas were found. An April recovery from the lower Noatak indicates that spent char remain in that area throughout the winter.

Fish then migrate from Noatak overwintering areas to the sea in the spring. Six June recoveries from Kotzebue Sound and Sheshalik Spit were from fish tagged the previous summer spawning in Noatak tributaries.

Some char move seaward later in late summer immediately after spawning. Two fish tagged in summer spawning areas were recaptured in Kotzebue Sound later the same summer.

Table 5. Numbers of Arctic char tagged by year, sex and location.

River	Year	Male	Female	Unknown	Total
Eli River	1982	35	96	0	131
	Total	35	96	0	131
Kelly River	1982	120	193	0	313
	1981	93	265	0	358
	1980	21	76	1	98
	Total	234	534	1	769
Kugururok River	1982	186	316	0	502
	1981	83	210	0	293
	Total	269	526	0	795
Nimiuktuk River	1982	91	203	0	294
	1981	112	229	0	341
	Total	203	432	0	635
Kugrak River	1982	4	3	0	7
	Total	4	3	0	7
Wulik River	1981	6	15	0	21
	1980	10	18	0	28
	Total	16	33	0	49
Kivalina River	1982	150	452	31	633
	1981	78	136	62	276
	1980	4	5	0	9
	Total	232	593	93	918
Total	1982	586	1,263	31	1,880
	1981	372	855	62	1,289
	1980	37	102	1	140
	Total	995	2,220	94	3,309

The concepts of homing and alternate year spawning are supported by two fish recovered from the same spawning ground location, as they were tagged 2 years before in the Noatak System.

A spring seaward migration has also been shown on the Wulik River. Two char tagged during late May and early June in the Wulik River were recovered in late June near Kivalina lagoon.

That some char return to the same stream for overwintering in consecutive years has been shown by recoveries on the Wulik and the Kivalina Rivers.

Inter-system Movements:

Some char which spawn in the Noatak use the Wulik/Kivalina system for overwintering the year after spawning. Two September recoveries from the Wulik and one from the Kivalina of Noatak spawners tagged 15 months earlier support this.

A spring spawning movement from overwintering areas on the Wulik to spawning grounds on the Noatak was shown by the July recovery from a Noatak spawning stream of a char tagged during late May in the Wulik River.

Tag recoveries indicate that complex patterns of char movements exist. To fully understand these movements and how they relate to spawning, feeding and overwintering, more tag recovery data are needed.

Aerial Surveys of Overwintering Char:

A survey on September 28, 1982, after a documented subsistence harvest of 16,797 char from the Wulik River and 2,337 from the Kivalina River (pers. comm. Steve Brand, 1982), showed 65,581 char in the Wulik River and 10,932 in the Kivalina River (Table 6). Figures determined from this survey should be considered minimum numbers of char using these rivers. In 1982 substantially fewer fish were seen than in surveys of the past 2 years, which averaged 107,690 for the Wulik and 42,524 for the Kivalina. Counts for the past 3 years are directly comparable, as they were done using the same methods by the same surveyor under good to excellent light and wind conditions.

It is not known if the low numbers of overwintering fish present in the Wulik and Kivalina Rivers in 1982 indicate a decline in the char population of the area. Armstrong and Morrow (1980) found that Dolly Varden char in southeast Alaska were not stream-specific for overwintering in all cases. If the same is found to be true for char in northwestern Alaska, it may be that more fish than normal used the Noatak in 1982. The Noatak River was flooding in late September 1982 due to heavy rains in its headwaters. This infusion of fresh water into Kotzebue Sound may have attracted more char into the Noatak. The only data on numbers of char wintering in the Noatak are from surveys by Commercial Fisheries Division, Alaska Department of Fish and Game. In 1969, 21,000 char were counted, but it was noted that they were as abundant in the Noatak as they were in the Wulik. In 1980 Frand Bird (pers. comm.) counted 45,185 char in a partial survey of the Noatak.

Table 6. Overwintering char counts on the Noatak, Wulik and Kivalina Rivers.

Year	Noatak	Wulik	Kivalina
1968		90,236	27,640
1969	21,000	297,257	
1976		68,300	12,600
1979		55,030	15,744
1980	45,185	113,553	39,692
1981		101,826	45,355
1982		65,581	10,932

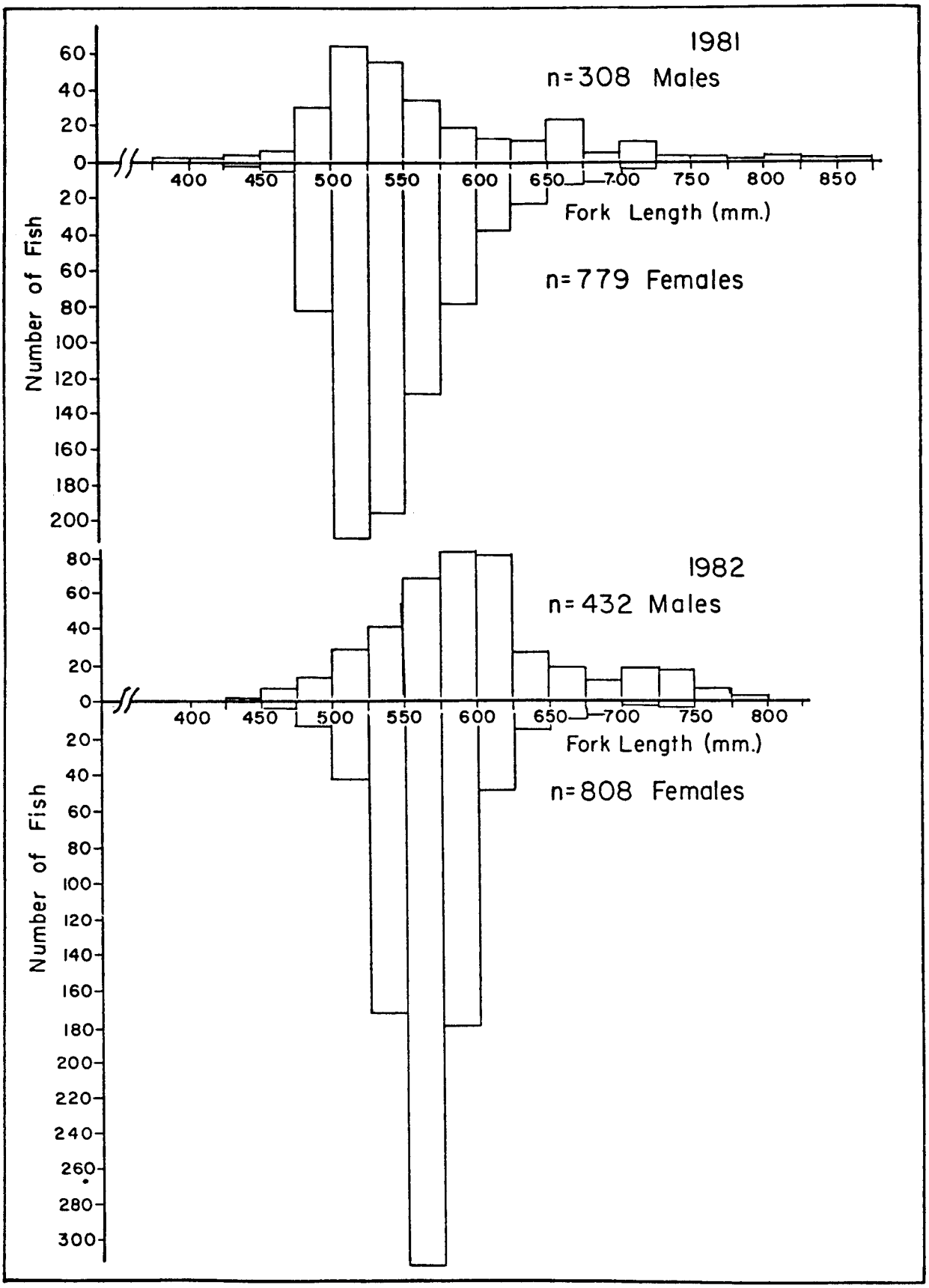

Figure 4. Comparative length frequency of char tagged in 1981 and 1982.

Noatak River Winter Sampling:

In mid April four char, ranging in fork length from 510 mm to 636 mm and in weight from 950g to 2800g, were collected by angling through the ice just downstream of the Kugururok River mouth. Egg diameters of three females varied between 1 and 1.5 mm and all had empty stomachs. Ice thickness varied from 5 to 6 ft and water depth from 0 to 18 inches.

Bendock (1982) found that Arctic char radio-tagged in the Anaktuvuk River in September remained in the same vicinity throughout the winter. Since nonspawning adult char were captured near the mouth of the Kugururok River in September, 1979, it is speculated that they overwintered at least that far upriver on the Noatak.

Length Frequency of Spawners

The modal size of spawners was similar for each of the Noatak tributary rivers sampled, with female char most common in the 550-574 mm range and males most common in the 575-599 mm range (Table 7). The only exception was the Kelly River where the modal size of males was larger at 600 to 624 mm.

The combined length frequency of 1981 and 1982 Noatak River spawners is compared in Figure 4. The modal size of female spawners increased by approximately 60 mm and that of male spawners by approximately 75 mm in 1982. This may indicate a strong year class of char, some of which entered the spawning population in 1981, the remainder of which spawned for the first time in 1982 at a larger size.

Sex Ratio of Spawners

The combined sex ratio for 1,240 Arctic char spawners tagged on the Noatak River in 1982 was 1 male to 1.87 females (Table 8).

These data contrast with 1981 data where a male to female ratio of 1:2.53 was found in a sample of 1,088 spawners (DeCicco, 1982). The sex ratio of 49 char taken in the Kotzebue commercial salmon fishery was 2 males to 1 female. This fishery selects for large char and may help to skew the sex ratio of spawning char. Yoshihara (1973) found a sex ratio of 1 male to 1.29 females for all spawning char in an unexploited population in the Sagavanirktok River.

Fecundity

Ova counts ranging from 4,134 to 7,543 ($\bar{x}$ = 5,847) were obtained from eight Kelly River char ranging in length from 512 mm to 604 mm ($\bar{x}$ = 551 mm). Eli River char ranging in length from 478 mm to 575 mm ($\bar{x}$ = 531 mm) had ova counts from 3,556 to 7,220 ($\bar{x}$ = 5,588) (Table 9).

These counts compare with fecundity of fish from other Noatak tributaries where char from the Kugururok and Nimiuktuk Rivers with average lengths of 510 mm and 556 mm contained 5,261 and 6,131 ova/female, respectively (DeCicco, 1982).

Table 7. Length frequency of spawning Arctic char tagged in major tributaries of the Noatak River system in 1982.

Fork Length (mm)	Kelly River		Kugururok River		Nimiuktuk River		Eli River	
	Male	Female	Male	Female	Male	Female	Male	Female
425-449					2			
450-474	2	1	2		3	1	1	2
475-499	3	3	4	3	6	2	1	5
500-524	6	13	12	15	11	9	1	5
525-549	19	42	15	61	6	40	2	28
550-574	19	71	32	129	15	80	4	36
575-599	21	46	41	72	18	45	10	14
600-624	23	13	34	18	15	13	8	4
625-649	4	1	12	7	5	6	2	4
650-674	6	1	5	5	5	3	1	1
675-699	4	2	6	3	1	3		
700-724	9		8	1	1		2	
725-749	4		9	2	2	1		1
750-774			6					
775-799					1			
Total	120	193	186	316	91	203	35	96

Total Male = 432
Total Female = 808

Table 8. Sex ratio of Arctic char spawners tagged in the Noatak River by stream.

Sex	Kelly River	Kugururok River	Nimiuktuk River	Eli River	Total
Male	120	186	91	35	432
Female	193	316	203	96	808
M:F	1:1.61	1:1.70	1:2.23	1:2.74	1:1.87

Table 9. Ova counts from female char spawning in the Kelly and Eli Rivers in July and August, 1982.

River	Fork Length (mm)	Weight (gm)	Ovary Weight (g)			Ovum Diameter (mm)	Number of Ova
			Left	Right	Combined		
Kelly River:							
	512	1,675	71.1	57.6	128.7	3.6	4,143
	515	1,325	28.3	38.3	66.6	2.7	4,567
	537	1,750	75.7	90.8	166.5	3.2	5,916
	541	1,450	110.7	105.7	216.4	3.6	5,789
	545	1,725	80.6	78.7	159.3	3.6	5,825
	567	1,900	82.5	93.0	175.5	3.3	6,675
	588	1,900	113.4	126.0	239.4	3.4	7,543
	604	2,050	119.4	116.4	235.8	3.8	6,317
Eli River:							
	478	1,100	38.7	52.4	91.1	3.1	3,556
	540	1,575	126.6	111.6	238.2	3.9	5,988
	575	1,975	128.7	108.8	237.5	3.8	7,220

Age and Growth

Arctic char from the study area ranging in fork length from 36 mm to 785 mm were aged from 0 to 12 years (Table 10).

Because of the difficulty in obtaining char of a known stock, variability in spawning movements (DeCicco, 1982), variability in age at first seaward migration (Yoshihara 1973, DeCicco 1982), and the lack of knowledge concerning movements and feeding at sea, it may be appropriate to combine samples from all systems and treat them as one area-wide population for age and growth data until a method for selective sampling of all age classes from known stocks is devised. Combined age and growth data are presented in Table 10 and Fig. 5. These combined data include age and growth information from Winslow (1969). A 785-mm char is the largest in this sample but, larger fish occur in the study area and fish over 850-mm in fork length have been tagged in the present study. None of these very large char have yet been aged. Winslow (1969) aged an 835-mm char at 16 years. He also captured a 915-mm male for which no age determination was made.

Growth rates of Kotzebue Sound/Chukchi Sea char are faster than those found by Yoshihara (1973) in the Sagavanirktok River (Fig. 5).

Food Habits of Rearing Char

During 1981 and 1982 stomachs of 58 rearing char from the Noatak and Wulik Rivers were examined for food items. Diptera, Ephemeroptera and Plecoptera larvae were the most frequently encountered food organisms in order of occurrence (Table 11). Tricoptera, Diptera (Tipulididae), and Hydracarina were also present but in low frequency. Fish examined varied in Age from 0 to II and in length from 30 to 127 mm. No correlation between fish size and food item preference was noted but larger fish often contained larger Plecoptera or Ephemeroptea larvae than did smaller fish. Of 40 fish examined from the Noatak system, 34 (85%) contained Diptera larvae. Of 18 fish examined from the Wulik River 16 (89%) contained Diptera (Chironomid) larvae. Of the 58 stomachs examined 11 contained only one type of food organism and only one was empty.

The Char Fishery and Harvest

Subsistence Fishery:

The major use of Kotzebue Sound/Chukchi Sea char stocks is for subsistence. Residents of Kivalina, Noatak and Kotzebue fish for char at various times and locations. The migratory habits of char cause them to be seasonally abundant in the localities where they are harvested.

Kivalina residents seine during late September in the upper Wulik and Kivalina Rivers, use hook and line through the ice during the winter, and gill net in the spring and fall in the Kivalina lagoon area to capture char for subsistence use.

In 1982, 35 out of 50 households participated in the fall seine fishery, harvesting 17,260 char (46,960 pounds). An additional 1,178 char were

Table 10. Age length relationships of Arctic char. Lengths are in mm.

	Age												
	0	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Noatak River													
$\bar{x}$	42	81	118	173	423	497	543	562	574	655	655	631	
n	22	26	16	14	4	14	27	18	7	3	4	1	
Range	36-62	60-98	91-266	110-324	378-495	443-539	420-605	486-628	522-659	600-724	624-677	631	
Kotzebue Sound													
$\bar{x}$				266	404	541	552	613	643	666	674	675	
n				4	3	9	9	29	18	22	10	2	
Range				250-302	367-455	382-624	513-646	531-680	462-707	567-751	595-739	622-728	
Kivalina River													
$\bar{x}$					387	449	451	544	621	521	648		
n					6	54	47	14	3	2	1		
Range					323-456	364-513	311-588	437-701	562-702	444-597	648		
Wulik River													
$\bar{x}$	56	93	121	244	347	438	540	553	593				772
n	91	31	6	9	7	17	34	19	6				1
Range	42-67	56-124	107-142	164-330	235-465	260-545	325-610	395-689	505-718				772
Combined (includes Winslow, 1969)													
$\bar{x}$	53	87	119	243	355	441	503	574	621	652	660	663	686
n	113	57	22	42	58	117	130	94	46	36	17	4	2
Range	36-67	56-124	91-266	110-370	235-495	260-624	284-646	354-735	462-785	444-745	595-739	622-728	600-772

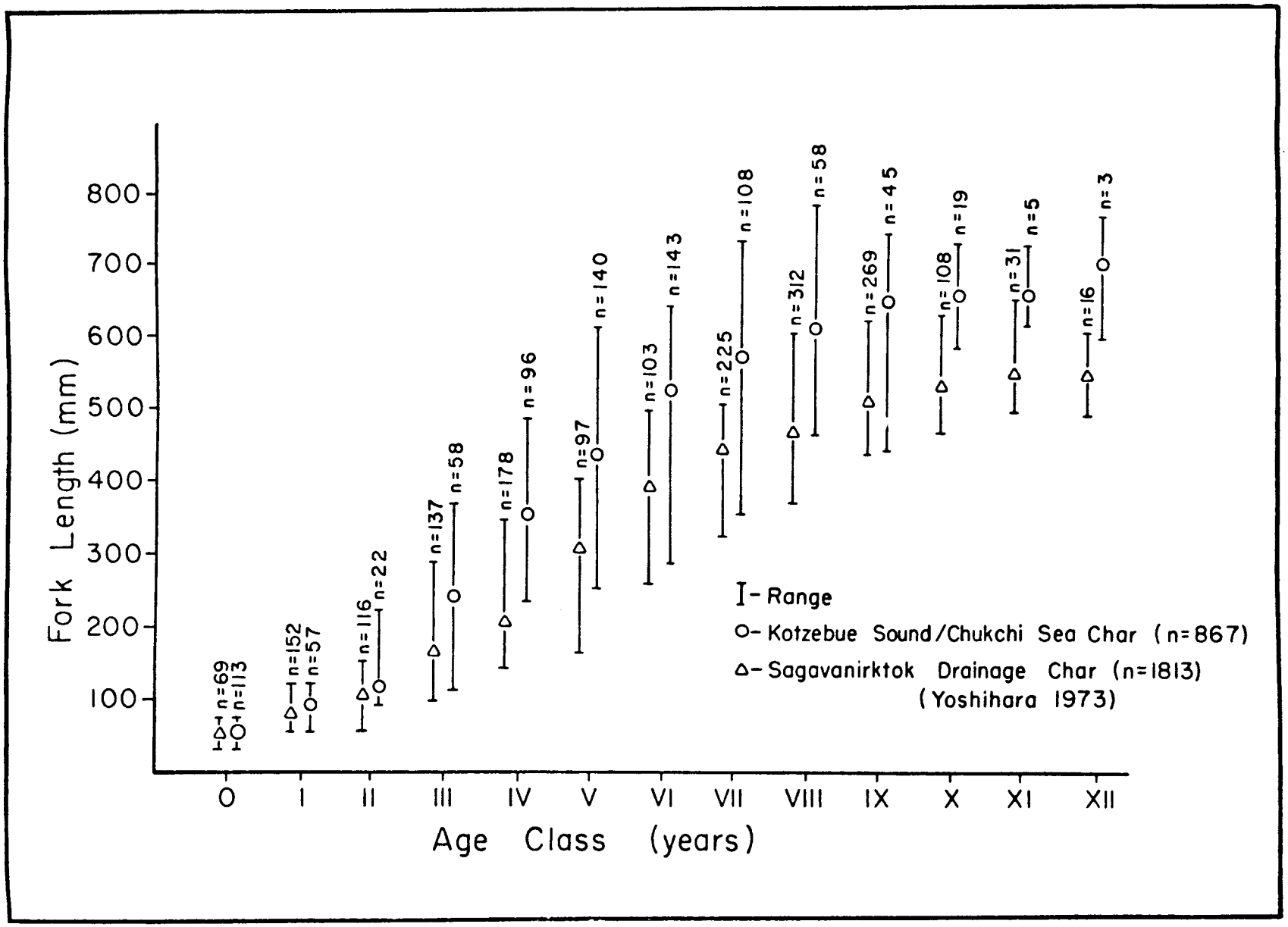

Figure 5. Comparative age and growth of Kotzebue Sound/Chukchi Sea char and Sagavanirktok River char.

Table 11. Frequency of food item occurence in rearing Arctic char.

River	Diptera		Ephemeroptera	Plecoptera	Other
	Chironomid	Simulidae			
Noatak n=40	32 (80%)	2 (5%)	11 (28%)	10 (25%)	Tricoptera 1 Tipulidae 1 Hydnacarina 1 (7.5%)
Wulik n=18	12 (67%)	4 (23%)	13 (73%)	3 (17%)	Empty 1 (6%)
Total	44 (76%)	24 (42%)	13 (23%)	6 (11%)	4 (7%)

harvested in gill nets (Braund and Burnham, 1982). From December through February 1,161 char were taken through the ice (Burch, 1983). No harvest data are available for the spring fishery.

Noatak villagers seine char in the Noatak River prior to freeze-up in early October and fish through the ice during the winter in the Noatak and Wulik Rivers. The major part of their catch is taken in the winter ice fishery.

In 1982 very little fall seining was done because of high water conditions on the Noatak. A house-to-house survey in late October showed that 21 families had harvested 2,403 char. (Joe Dinnocenzo, pers. comm.). Additional harvest data are not available for Noatak.

People from Kotzebue harvest char in the spring and fall in the vicinity of Sheshalik Spit and near the month of the Noatak River. Fish are captured in gill nets as they leave Noatak River wintering areas in June and as they enter Kotzebue Sound from the sea in August. Some people from Kotzebue travel to Noatak and Wulik River over-wintering areas to seine char in the fall. No harvest data are available from these fisheries.

Recreational Fishery:

Recreational angling pressure on the Noatak, Wulik and Kivalina Rivers is generated by three main groups, guides, Kotzebue residents and other Alaskans. Four guides operate in the area, bringing in a small number of anglers. Kotzebue residents fly to the Kelly River in summer and to the Wulik in the fall for char fishing. Some people from other parts of Alaska come to these rivers especially to catch char. The overall use of these rivers by sport anglers is low. The 1981 harvest was estimated at 1,069 char by a statewide sport fish creel census (Mills, 1982).

People attracted to the Noatak River for its wilderness float trip opportunities constitute another user group. In 1982 the National Park Service estimates that 100 persons floated the Noatak and it is assumed that most of them fished to augment their food supplies. No harvest data are available (Gil Hall, pers. comm.).
Some sport fishing is done by personnel working at mineral exploration camps on the Wulik River. Dan Delauder, Red Dog Camp Manager, indicated that fishing from that camp was very limited in 1982 because of an accelerated work schedule, and only a few fish were killed for consumption.

Commercial Fishing:

There is no commercial fishery for Arctic char in the study area; however, char are harvested incidentally in the Kotzebue Sound salmon fishery and sold to commercial buyers in Kotzebue. During the 1982 season 3,447 char were sold in this fishery (Joe Dinnocenzo, pers. comm.).

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