FISHERY MANAGEMENT REPORT NO. 90-1

ANNUAL MANAGEMENT REPORT FOR ARCTIC-YUKON-KUSKOKWIM REGION, 1986[1]

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ABSTRACT

This report presents a compilation of information on the recreational fisheries of northern, northwestern, western, and interior Alaska, an area referred to as the Arctic-Yukon-Kuskokwim region. Important species to the sport fisheries in this region are identified, zoogeographic distribution of species is discussed, as is stock status and harvest data from the 1986 calendar year. Regulatory changes and proposed changes for 1986 are described. Management and research activities that occurred in 1986 are described. Stocking and enhancement activities are described. Climatic factors of importance to area fisheries are summarized. Federal land status within the region is described.

KEY WORDS: Arctic, Yukon, Kuskokwim, Tanana River, sport fishery, recreation, harvest, effort, abundance, regulations.

PREFACE

This report is the first of its kind for Sport Fisheries in the Arctic-Yukon-Kuskokwim Region. It is intended as an annual compilation of information not available elsewhere on sport fisheries activities including management, research, regulation changes and development, enhancement, and habitat monitoring occurring in the region during the reporting year. The reader is advised to consult other regional reports for specific project information, or, for more abbreviated fisheries summaries, the Alaska Board of Fisheries Reports. This report provides a brief summary of all reports completed by regional staff during the reporting year with information on how the reader may access them.

The report is designed to provide an historic record of the Region's fisheries, to document regulatory changes as they occur, and other natural-and man-influenced factors that may affect fish survival and production during the reporting period. Those factors may include such phenomena as unusual rain or snowfall patterns that affect stream flows, or instream disturbances that influence water turbidity and primary production. In addition, catch and effort statistics for the reporting year are presented along with any available information concerning stock status and long term trends in abundance or exploitation.

INTRODUCTION

The Arctic-Yukon-Kuskokwim Region (AYK Region), encompasses the majority of the landmass of the state of Alaska, (Figure 1). Within the region are included some 1,061,000 km^2, the state's largest river systems (Yukon, Kuskokwim, Colville, and Noatak), thousands of lakes, and thousands of miles of coastline and streams. It essentially includes all waters between Cape Newenham in the southwest, (excluding Kuskokwim Bay and the lower Kuskokwim River), the Alaska Range in the south, the Arctic Ocean in the north, and the Canadian border in the east (Figure 1). The region as a whole is very sparsely populated, with the exception of population centers located in the Tanana River valley. Fairbanks is the largest of these communities, containing approximately 72,000 people within the Fairbanks North Star Borough Census Area. The next largest census area is that of Bethel, (outside the AYK Region as defined here), containing approximately 12,000 people. Other population centers in the region include the Southeast Fairbanks Census Area with 6,900 people, the North Slope Borough with 5,500 people, Nome Census Area with 7,800 people, Northwest Arctic Borough with 5,800 people, Yukon-Koyukuk Census Area with 9,100 people, and the Wade Hampton Census Area with 5,600 people (Alaska Department of Labor 1987).

For management purposes, the regional sport fishery program is divided into the Tanana and AYK areas. The Tanana Area (also called Fairbanks Area) receives management area status because of the greater impact of its larger human population base upon local fishery resources and the need to conduct more intensive stock specific studies to provide managers with needed biological information.

TANANA AREA DESCRIPTION

The Tanana Area is also described as the Fairbanks Area in the statewide postal survey (Mills 1987), and it includes "all southern drainages of the Yukon River from its confluence with Tanana River near Tanana, east to the Canadian border and including the Alaskan portion of the Fortymile and Sixtymile River drainages as well as the entire Tanana River watershed. This area also includes the Alaskan portion of the White River drainage." Although the Tanana Area, for purposes of the statewide harvest report, includes more than just the Tanana River drainage, management responsibilities within the region are limited to the Tanana drainage for the Tanana Area staff.

Geographic and Geologic Setting

The Tanana River basin (Figures 2 - 6) is an area of approximately 113,900 km^2 (8.9 million ha). The main river is a large glacial stream that forms at the confluence of the Chisana and Nebesna rivers near Tok. After flowing downstream in a general northwesterly direction for some 917 km, it forms a confluence with the Yukon River at Tanana. It is the second largest tributary of the Yukon River; the Porcupine River is slightly larger. The Tanana River receives both the majority of its flow as well as its largest sediment loads from streams draining the glaciers of the Alaska Range and the Wrangell Mountains. All major tributaries flowing into the north side of the Tanana

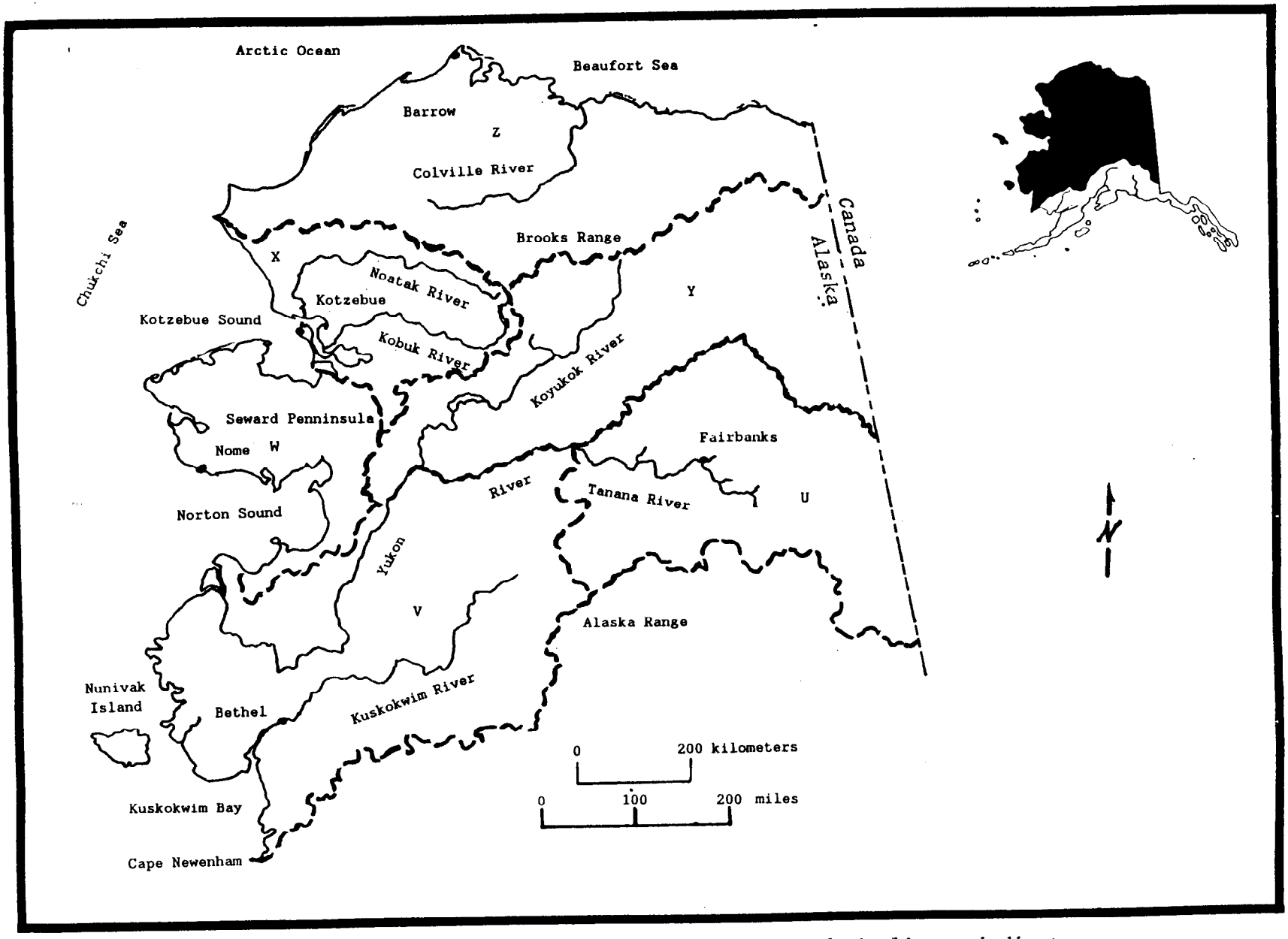

Figure 1. The Arctic Yukon Kuskokwim Region. Dashed lines indicate boundaries between harvest reporting areas U-Z.

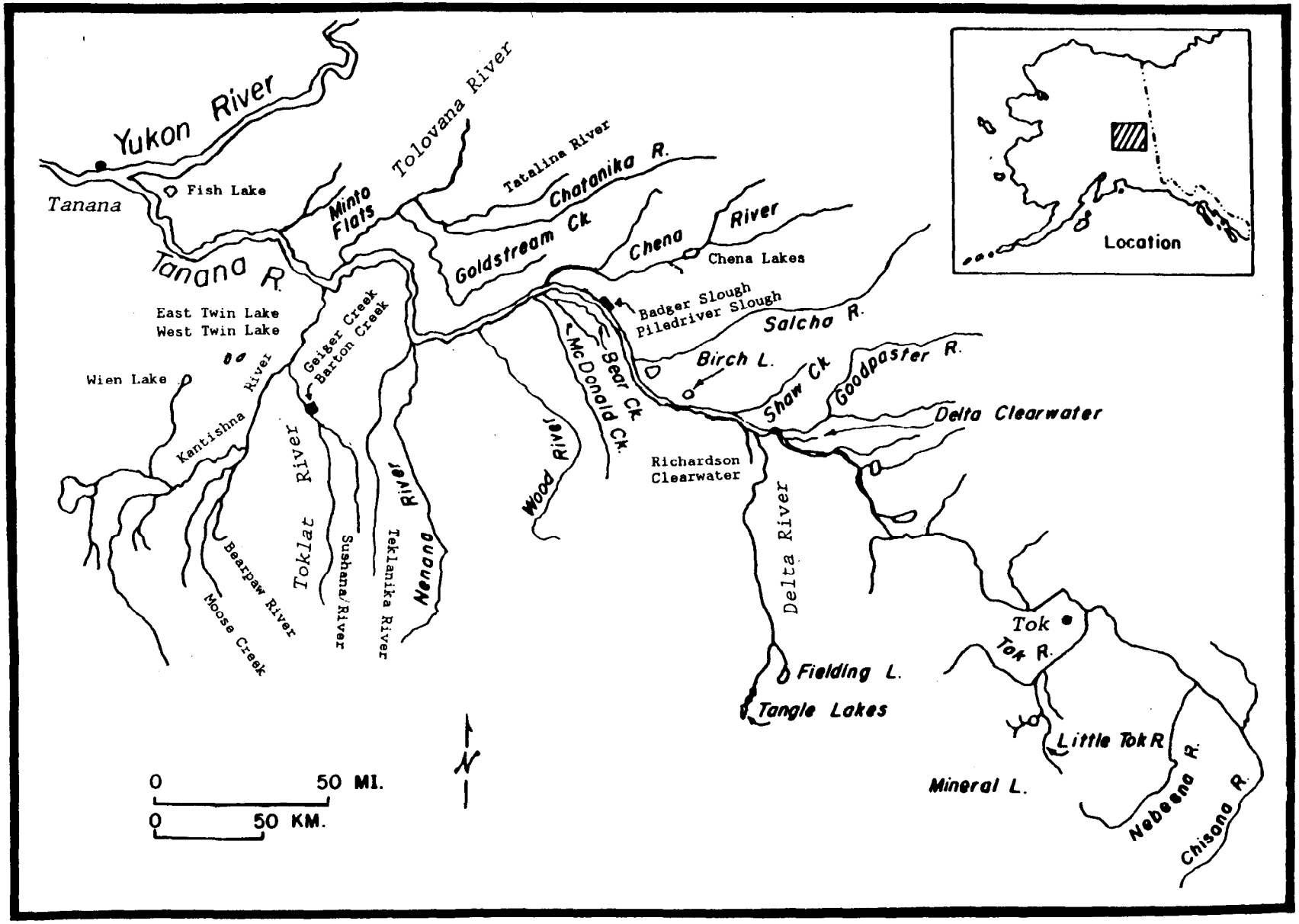

Figure 2. The Tanana River drainage.

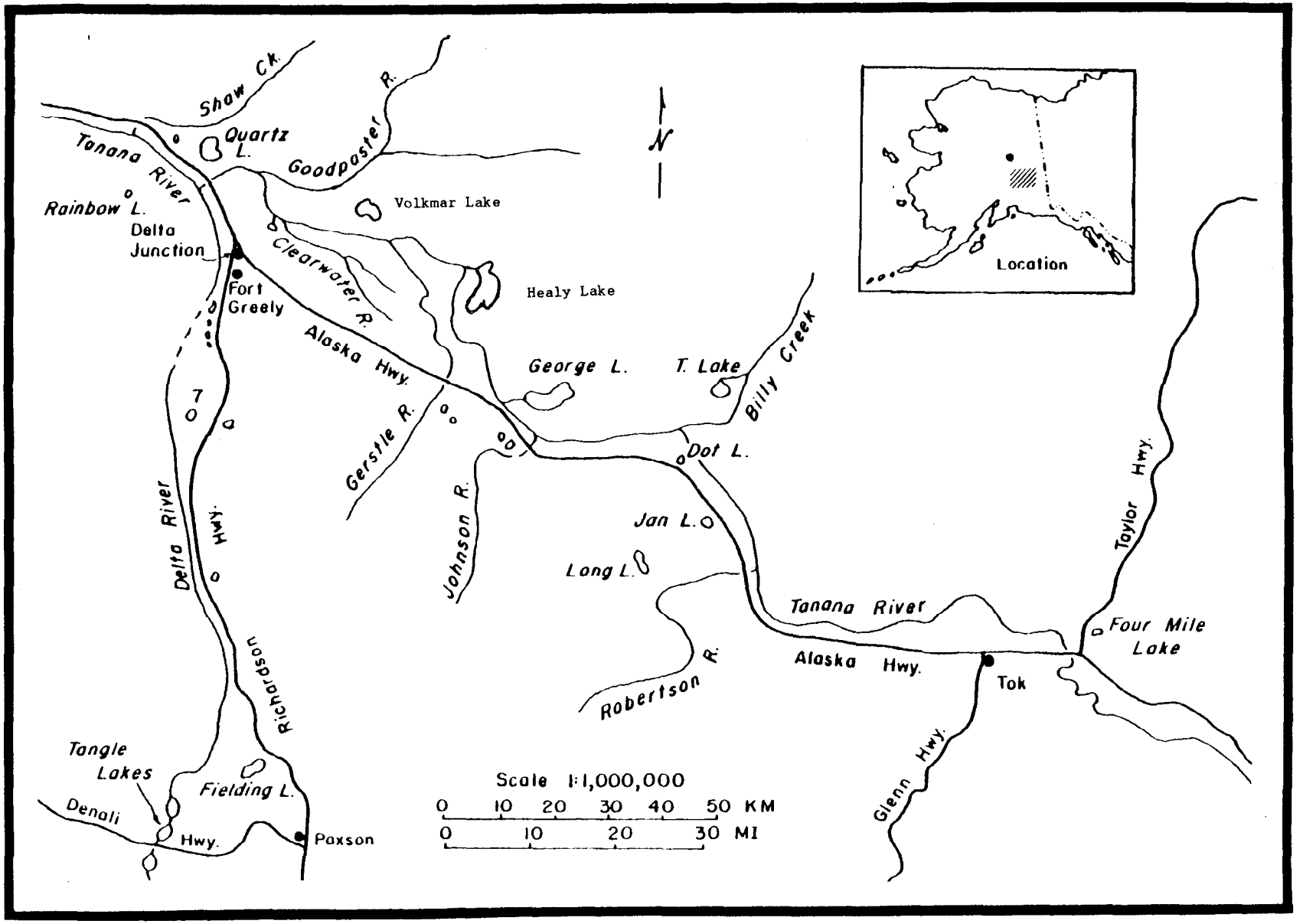

Figure 3. Waters and highways of the middle Tanana River valley.

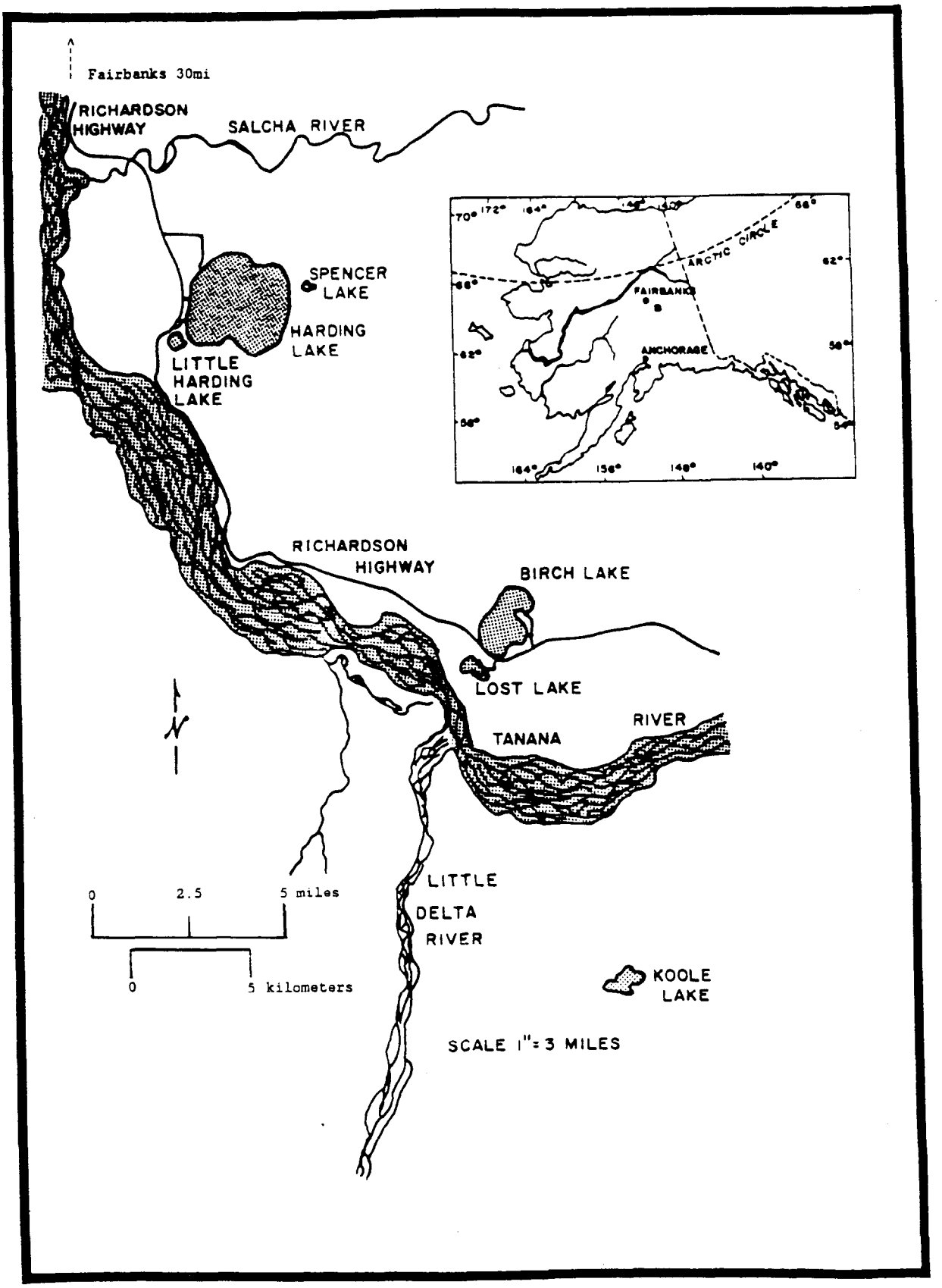

Figure 4. Tanana River waters near Fairbanks.

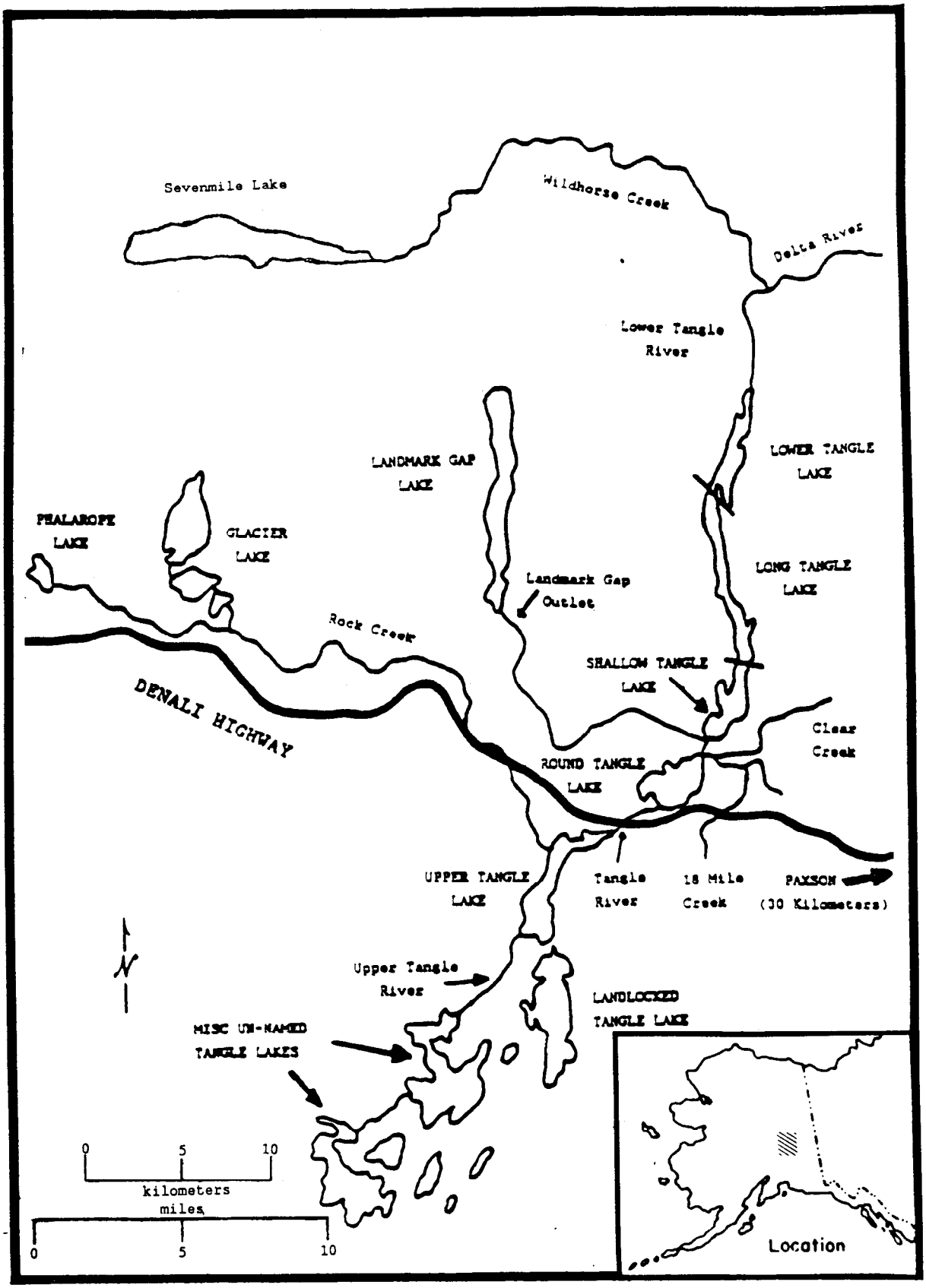

Figure 5. Tangle Lakes.

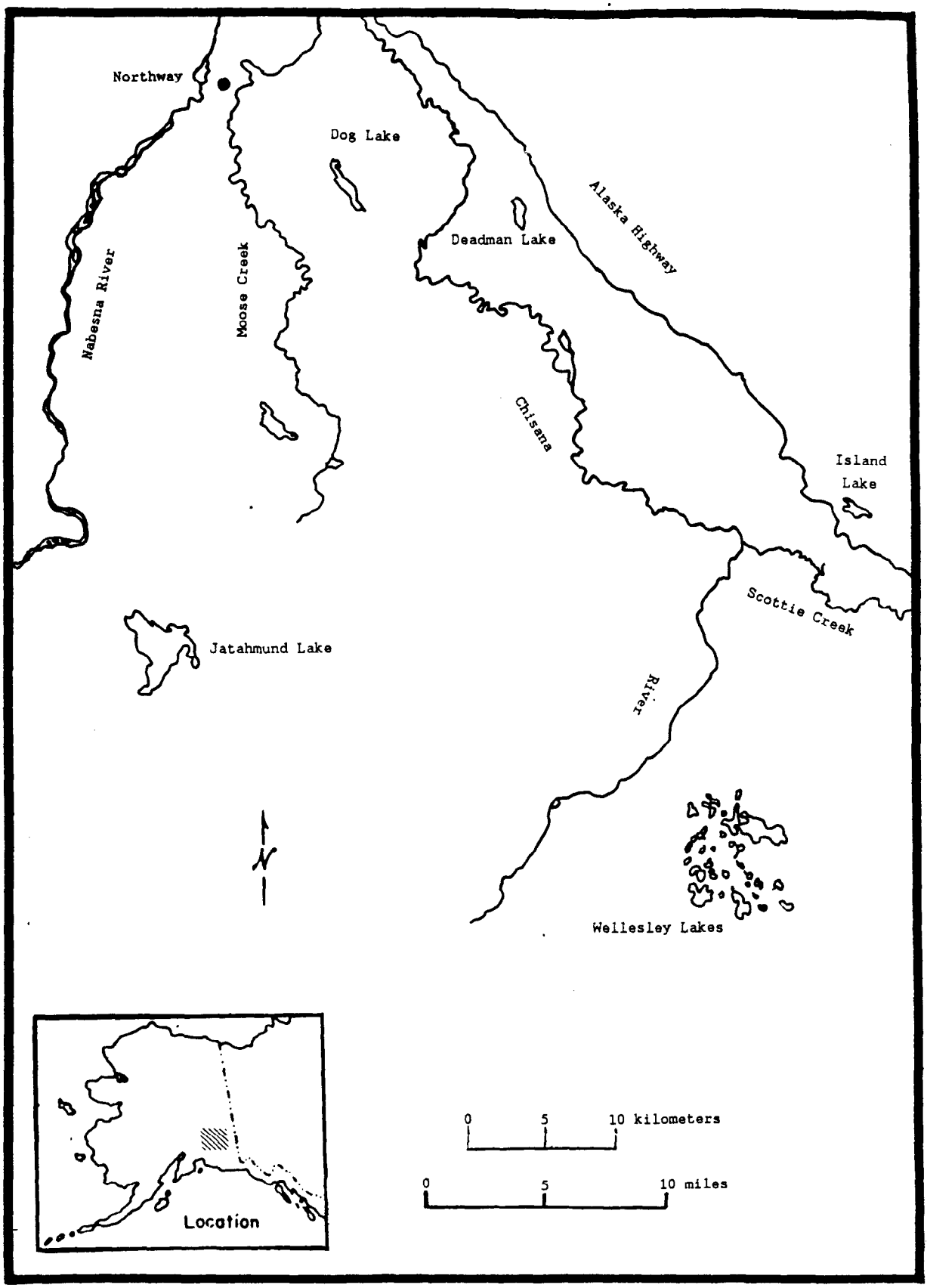

Figure 6. Tributaries of the upper Tanana River.

River originating from the Tanana Hills uplands are clear water streams. They include the Goodpaster, Salcha, Chena, Chatanika, and Tolovana rivers. The river systems flowing out of the Alaska Range and the Wrangell Mountains and entering the south side of the Tanana River are of glacial origin. They include the Chisana, Nabesna, Tok, Delta, Nenana and Kantishna, and Toklat rivers (Figure 2).

The Tanana Area (statewide harvest survey definition) also includes the north slope drainage of the White Mountains north of Fairbanks. Included are Birch Creek and its tributaries, and Beaver Creek, both of which empty into the Yukon Flats between Circle City and the Dalton Highway crossing of the Yukon River near Stevens Village (Figure 7). This area is contained within the Yukon Flats National Wildlife Refuge. Upstream from Circle City to the Canadian border the Charley, Seventymile, and Alaska portions of the Fortymile rivers are included in the area. The Yukon-Charley National Wildlife Preserve encompasses much of the Yukon drainage upstream of Circle City to the border, including the streams just listed (Figure 8).

Lake and Stream Development

Large alluvial aquifers associated with porous floodplain gravels influence fish production by storing water and providing more stable winter stream flows in the Upper Tanana River and some of its tributaries from Delta Junction upstream and in the Toklat River, tributary to the Kantishna River. All the large aquifers are located on the south side of the Tanana River and are associated with subterranean water flows from the north slope of the Alaska Range. The Delta Clearwater and Richardson Clearwater rivers (Figure 2) are the most important sport fishing streams that originate from these aquifers. The few on-stream lakes (lakes that are directly on stream to the Tanana or a major tributary) present in the Tanana River system do not provide sufficient storage to sustain stream flow during winter or through dry summers (Selkregg 1976). Most precipitation during the winter is retained in the snowpack and further restricts winter flows. Glaciers provide some storage of water that can enhance stream flows in dry summers (Selkregg 1976).

Lake development in the Tanana basin is not as extensive as in many other parts of Alaska. Some 20 lakes within the drainage exceed 26 km^2 in surface area. Most of the water bodies within the system do not contain sufficient volume to influence Tanana River flows, but many are important for sport fishing because of wild or stocked species residing in the lakes. Primary lakes for sport fishing within the Tanana River drainage are Harding, Birch, Quartz, Volkmar, George, Fielding, Tangle, and Chena lakes (Figures 3 and 4). Volkmar and George lakes do not have roadside access. Chena Lake (Figure 2) in the lower Chena River basin is man-made, resulting from gravel removal to erect flood control structures during the 1970's. Many of the waters listed are shown in Figures 3 and 4, and the lakes of the upper Delta River are shown in Figure 5.

Lakes are generally covered with ice by late October and breakup can occur as late as late June or early July. Typically, ice can range from 81 to 102 cm thick on interior Alaska lakes.

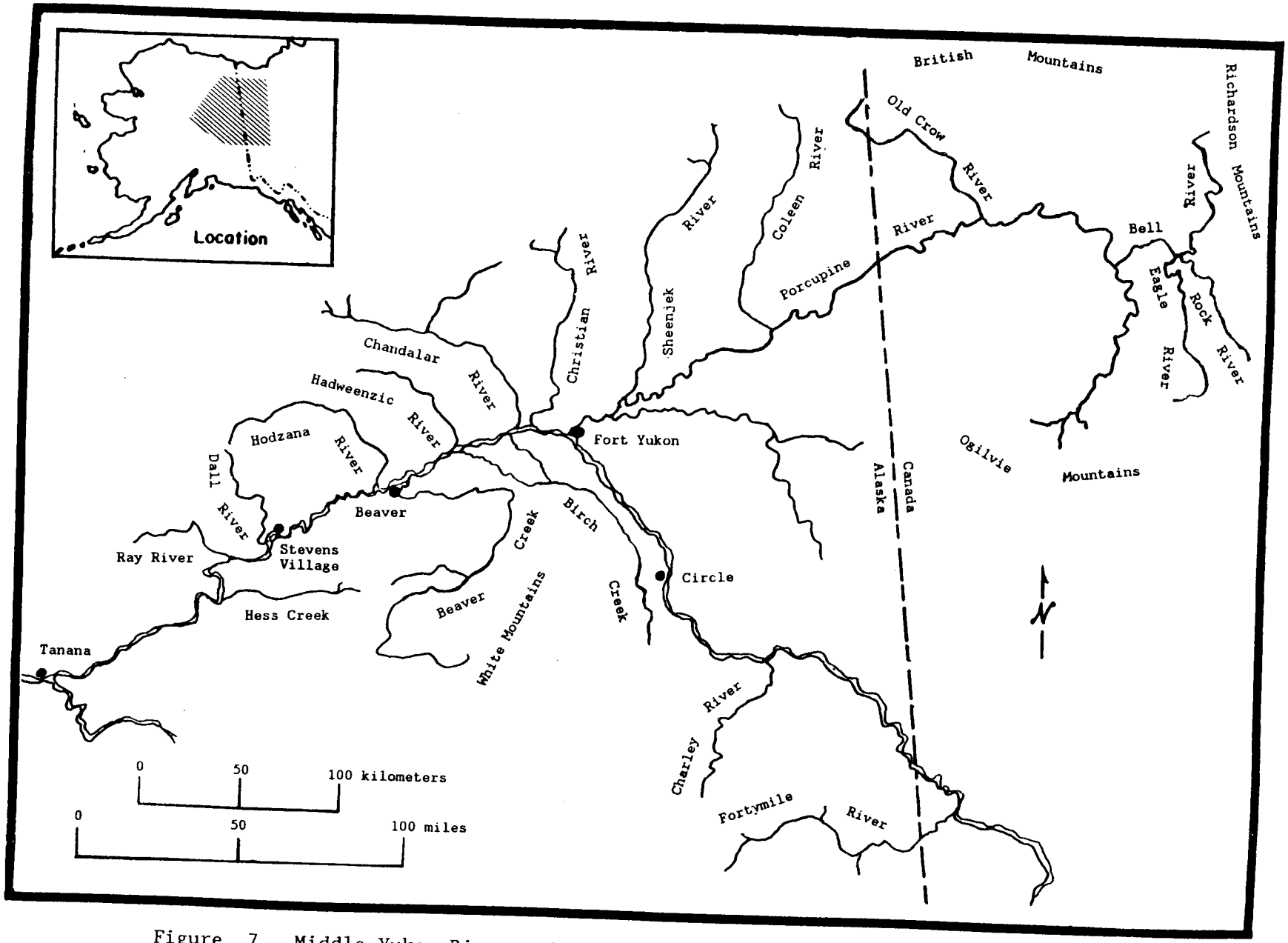

Figure 7. Middle Yukon River and Porcupine River drainages.

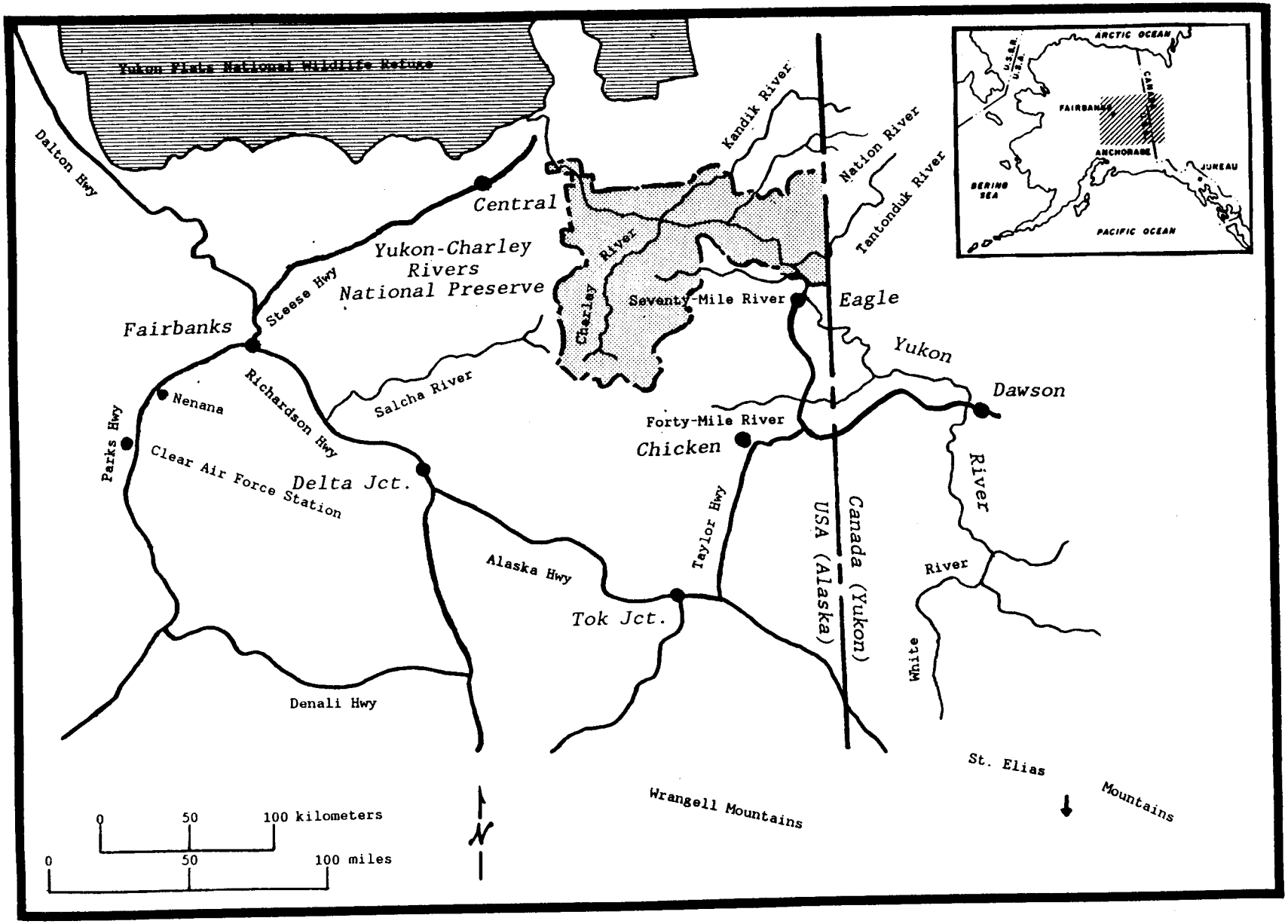

Figure 8. Major highways in interior Alaska.

Lake formation has occurred by several means. In some cases, (eg. Harding, Healy, George lakes) lakes are created by silt from the Tanana River damming streams draining the surrounding hills. Buried ice masses can melt, resulting in lake formation in the sub-glacial soil. Lakes also form when permafrost melts due to vegetative disturbance. Vegetation insulates permafrost soils, and melting can occur when it is removed (Selkregg 1976).

Climate

Climate in the area is one of harsh contrasts, with spring coming as early as mid-April and snowfall, with subfreezing temperatures, occurring as late as June. Summers are three months in duration and are characterized by long daylight hours and temperatures occasionally exceeding 32°C. The fall season may extend through early October, with snowfall and decreasing temperatures. Winter lasts from mid-November until mid-March when temperatures may fall to -57°C. Annual precipitation averages around 28 cm, with most falling between June and September.

Primary Species for Sport Fishing

There are 17 fish species known to occur in the Tanana area of which ten are important sport species. They include: chinook salmon *Onchorhynchus tshawytscha*, coho salmon *Onchorhynchus kisutch*, Arctic grayling *Thymallus arcticus*, burbot *Lota lota*, lake trout *Salvelinus namaycush*, inconnu (sheefish) *Stenodus leucichthys*, least cisco *Coregonus sardinella*, humpback whitefish *Coregonus pidscian*, northern pike *Esox lucius*, and rainbow trout *Onchorhynchus mykiss*.

Status and Harvest Trends of Wild Stocks

A brief description of the fisheries for the most prominent sport species in the Tanana River area follows.

Chinook Salmon:

Chinook salmon fisheries are limited to the lower sections of the Salcha and Chena Rivers and to some extent the Upper Chatanika River, since these are essentially the only road-accessible tributary stocks available in sufficient abundance to support recreational harvests. Sport harvests in the Salcha River since 1980 have ranged between 150 and 900 chinook salmon, while harvests from the Chena and Chatanika rivers are small but growing, especially in the Chena River, where angler awareness and salmon return abundance both seem to be increasing (Mills 1987).

Coho Salmon:

Coho salmon are taken in the Delta Clearwater River and from various creeks in the Nenana River drainage. Coho salmon occur in other tributaries to the Tanana River but little sport effort has occurred. The Kantishna River and Toklat River tributaries such as Moose, Barton, and Geiger creeks, and the Sushana River (Figure 2), where artesian waters are found, support coho salmon populations. The largest drainage harvest occurred in 1986 when an estimated

1,374 coho salmon were taken (Mills 1987). The vast majority of the harvest in the Tanana River drainage is taken from the Delta Clearwater River where more than 1,000 fish are estimated to have been taken in 1986.

Arctic Grayling:

Arctic grayling are perhaps the most ubiquitous and frequently sought-after sport species in the Tanana area. The species inhabits most of the flowing waters and many of the lakes of the drainage and is favored by anglers because of its trout-like characteristics. Essentially all the major clear water tributaries to the Tanana River support Arctic grayling populations. The major Arctic grayling fisheries in the Tanana drainage occur in the Chena, Salcha, Chatanika, and Goodpaster rivers; Badger and Piledriver sloughs; Shaw Creek; the Delta and Richardson Clearwater rivers; and Fielding and Tangle lakes. The Chena River supports the largest Arctic grayling fishery in the state, due to its proximity to Fairbanks and many miles of road access. Another important Tanana drainage Arctic grayling fishery takes place in the summer and fall in the Delta Clearwater River, a spring-fed system near Delta. Two important spring Arctic grayling fisheries occur at Shaw Creek and at Piledriver Slough.

The average annual harvest of Arctic grayling in the Chena River, exceeded 21,000 fish from 1977 to 1984. The harvest declined from a peak of 42,000 in 1980 to a low of about 8,000 in 1985 and 1986, while effort has remained relatively stable (Clark 1987). Declines in other important Tanana River drainage Arctic grayling fisheries have been noted in recent years and Shaw Creek, the Delta Clearwater River, Richardson Clearwater River and Chena River fisheries are examples of depleted stocks. In 1975, because of perceived increases in use with the construction of the trans-Alaska pipeline, the daily bag limit in the Tanana drainage was decreased from 10 to five Arctic grayling. The possession limit has been maintained at 10 Arctic grayling since 1962. The reduction in bag limit in 1975 to five fish daily and 10 in possession did not prevent the decline of major Arctic grayling stocks and neither has it increased nor stabilized fishing success. Declines in fishing success have been attributed to reductions in Arctic grayling abundance due to both reduced recruitment because of unfavorable environmental conditions (primarily high river discharge during the natal year) and to sport fishing overharvest of already declining stocks (Clark 1987).

Northern Pike:

Northern pike are harvested by sport fishermen using hook and line gear in summer and winter as well as with spears primarily during the winter. The majority of the Tanana area harvest comes from lakes which are easily accessed. Important fishing areas are found in Minto Flats, northwest of Fairbanks (Figure 2) and in George and Volkmar lakes southeast of Delta Junction (Figure 3). In fact, Minto Flats and George Lake support the largest recreational northern pike fisheries in Alaska. Additional lakes and streams utilized by sportsmen for this species include East and West Twin lakes and Wien Lake in the Kantishna River drainage, Fish Lake near the Tanana-Yukon confluence, Wellesley, Dog, Jatahmund, Island, and Deadman lakes, and Moose and Scotty creeks in the vicinity of Northway (Figures 2 and 6).

Harvest and effort on northern pike have increased in the past ten years. Angler surveys indicate that this species is the second most sought-after indigenous sport fish species in interior Alaska with over 45% of all anglers fishing for northern pike at least once in 1985. It is estimated that more than 20,000 anglers fished for northern pike during 1986 (Holmes and Pearse 1987). The total sport harvest of northern pike within the Tanana River drainage has remained relatively stable over the past ten years, from 8,000 to 12,000 fish annually. Because of the substantial increase in effort, however, the catch per angler day has decreased.

Recent studies of some northern pike populations within the Tanana River drainage have produced estimates of higher than sustainable exploitation rates. Even in populations where exploitation rates are not judged to be excessive (less than 20% per year) as in Volkmar Lake, the number of large fish has declined rapidly under only modest harvest pressure. Populations in the Minto Flats area have been of special concern due to high additive estimated rates of exploitation in summer and winter subsistence and sport fisheries.

Lake Trout:

Lake trout are found in many of the lakes and a number of the streams of the Delta and Upper Tanana River drainages (Burr 1987a). They are most frequently associated with deep, oligotrophic lakes in the mountains and are rarely found at lower elevations of the Tanana River drainage. Lakes of the Delta River drainage (Figure 5) including Fielding, Landmark Gap, Sevenmile, and the Tangle lakes contain significant populations of this species. Harding Lake (Figure 4) near Fairbanks contains small numbers of transplanted lake trout, but the lake does not support a significant population of the species. On average, 65% of the AYK Region lake trout harvest is taken from lakes in the Tanana drainage. The regional lake trout harvest increased at an annual average rate of 27% from 1978 to 1985. An apparent major decline in abundance was first observed in 1986 however, especially in waters of the Tanana drainage. Research on the species in both southcentral and interior Alaska indicates that most of the road accessible stocks have undergone overexploitation in recent years.

Lake trout are a long lived, slow growing and late maturing species, and the potential impact of even a modest fishery can be significant. Lake trout older than 25 years are not uncommon and individuals older than 50 years are recorded for Alaska, (Burr 1987a). Trophy lake trout weighing 8.7 kg (20 lbs) or more are typically 20 or more years old (Burr 1987a). The oldest lake trout sampled by Burr (1987b) was 36 years old from Summit Lake (Copper River drainage) in the Alaska Range.

Tanana drainage harvests peaked at about 3,100 lake trout (Table 1) but the 1986 harvest was only slightly more than 700 fish (Mills 1987). Research studies have shown that lake trout stocks have declined in abundance due to unsustainable exploitation levels.

Table 1. Tanana River drainages[1] sport fish harvest and effort by fisheries and species[2] 1986[3].

	Anglers	Trips	Days Fished	KS	SS	LL	CS	LT	DV AC	RT	GR	WF	SF	NP	BB	OTHER
Upper Chena River[4]	4,403	10,773	10,688	0	0	0	0	0	0	0	3,695	424	0	56	0	0
Lower Chena River[5]	5,259	15,804	18,669	212	22	0	11	0	0	0	4,167	1,394	16	224	889	122
Badger Slough[6]	1,932	4,607	5,673	0	0	0	0	0	0	0	1,347	136	8	384	0	0
Chatanika River	3,889	6,122	7,783	0	0	0	45	0	0	0	2,692	22,038	8	1,282	40	0
Salcha River	4,696	9,772	13,792	525	0	0	257	0	0	0	7,540	783	0	16	296	0
Delta Clearwater River	3,693	7,212	10,137	0	1,005	0	246	0	0	0	2,343	208	0	0	0	0
Goodpaster River	563	512	933	0	0	0	0	0	0	0	1,508	0	0	16	88	0
Shaw Creek	1,443	1,892	2,003	0	0	0	0	0	0	0	505	16	0	0	120	0
Brushkana Creek	514	645	550	0	0	0	0	0	16	0	748	0	0	0	0	0
Tanana River	3,645	8,970	9,449	11	179	0	112	0	8	0	2,692	1,272	8	617	2,948	0
Other Streams	2,808	5,250	7,378	33	168	0	22	0	176	0	9,283	147	0	528	441	49
Birch Lake	6,213	7,924	9,969	0	0	4,950	0	0	0	8,723	0	0	0	0	0	0
Quartz Lake	8,928	14,045	18,486	0	0	16,613	0	0	0	14,778	0	0	0	0	0	0
George Lake	1,321	1,091	1,957	0	0	0	0	0	0	0	134	0	0	3,076	32	0
Fielding Lake	1,052	1,158	1,682	0	0	0	0	136	0	0	1,329	98	0	0	32	0
Minto Flats	2,128	2,449	3,318	0	0	0	0	0	0	0	101	0	8	3,621	32	0
Tangle Lakes	3,742	2,270	5,122	0	0	0	0	409	0	0	4,781	294	0	0	104	0
Chena Lake (Lake only)	2,935	5,698	8,853	0	0	1,778	0	0	0	7,001	0	0	0	0	0	0
Harding Lake	1,590	1,758	2,064	0	0	0	0	24	0	0	0	0	0	673	0	0
Other Lakes	2,811	5,717	6,431	0	0	720	0	144	0	768	3,116	0	24	1,441	120	0
TOTAL	34,835[7]	113,669	144,937	781	1,374	24,061	693	713	200	31,270	45,981	26,810	72	11,934	5,142	171

1 Tanana River Drainages (Area U): All southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, to the Canadian border; including the entire Tanana River drainage, and the Alaskan portion of the White River drainage.

2 KS: chinook salmon; SS: coho salmon; LL: landlocked coho or chinook salmon; CS: chum salmon; LT: lake trout; DV/AC Dolly Varden or Arctic char; RT: rainbow trout; GR: grayling; WF: whitefish; SF: sheefish; NP: northern pike; BB: burbot

3 From Mills 1987.

4 The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

5 The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

6 All parts of Badger Slough (sometimes called Chena Slough).

7 Angler totals may not equal sum of sites due to some anglers fishing at more than one site.

Burbot:

Burbot have become a popular Alaskan sport fish in recent years. The majority of the AYK Region harvest occurs in waters of the Tanana Area. Participation is mostly by local residents using set lines although hand-held fishing gear is also used. Most fishing occurs during the winter months. Burbot fishing occurs in streams, primarily the Tanana River, and in lakes. The most heavily used lakes are Fielding and Harding lakes. The total burbot harvest for the Tanana drainage in 1986 is estimated at approximately 5,100 burbot, (Mills 1987; Table 1). The Tanana River supports one of the largest burbot fisheries in the state, surpassed only by the burbot fisheries in and around the Glennallen area. Although Tanana River burbot harvest rates are not currently excessive, studies of harvest rates and abundance in Tanana drainage lakes suggest high exploitation and low stock abundance in most of the lakes examined.

Whitefish:

The majority (60%) of the statewide whitefish harvest occurs in the AYK Region. The sport harvest of whitefish is almost entirely from the Chatanika River, tributary to the Tanana River, where an active and growing spear fishery occurs in the fall. In 1986, nearly 27,000 whitefish were harvested in the Tanana area, more than 19,000 of which were taken from the spear fishery in the Chatanika River (Table 1). Species composition of the harvest from the spear fishery was approximately 13% humpback whitefish, and 87% least cisco. The Chatanika River supports a large spawning population of both species. During late summer and fall, these fish migrate up the river from the Minto Flats to spawn. By the time of freeze-up in approximately mid-October, the adult whitefish have departed for wintering areas that have not been identified, possibly outside the Chatanika River. It is not known whether the Chatanika River provides habitat for whitefish other than during spawning and the egg-fry development stages.

Since 1977, harvest of whitefish from the Chatanika River has increased at an average annual rate of 34%, making it the fastest growing recreational fishery in the Tanana River drainage (Hallberg and Holmes 1987). Approximately 3,309 angler-hours of effort were expended in 1986 during the peak harvest period lasting from 26 September until 10 October. Harvest levels have increased steadily since 1981 when the total estimated harvest was approximately 5,000 whitefish.

Sheefish:

Spawning stocks of sheefish in the Tanana River drainage have only been documented in the Minto Flats area, spawning in the upper Chatanika River, (Alt 1987.) Tagging studies conducted between 1967 and 1971 indicated that sheefish that spawned in the Chatanika River were the same fish that spent the summer feeding in Minto Flats (Alt 1987). Recaptures of sheefish in the lower Chena River and at Nenana indicate widespread movement of sheefish in the areas adjacent to spawning. Sheefish are widespread in the Tanana River drainage during the open water season, from the Tanana River mouth to more than 300 km upstream of Fairbanks. They have been found at the mouths of the

Bearpaw and Toklat rivers in the Kantishna River drainage also (Alt 1987). Typically sheefish are taken in the lower reaches of clear water tributaries such as the Chena, Chatanika, Tolovana, and Tatalina rivers as well as others.

Rainbow Trout:

Rainbow trout are not indigenous to the Yukon River. They have been introduced in several of the area lakes. Since the 1950's, rainbow trout have been planted into 50 to 75 Tanana Area lakes. There is no evidence that natural reproduction has taken place.

A total of 703,905 rainbow trout was planted in 26 lakes of the Tanana Valley in 1986, all from broodstock originating from the Swanson River (Kenai Peninsula). These fish were reared to the fingerling stage or larger in the Clear Hatchery near Nenana, or in the Fort Richardson Hatchery near Anchorage.

ARCTIC, YUKON, AND KUSKOKWIM AREA DESCRIPTION

Excluding the Tanana River drainage which comprises a little over 10% of the land area of the AYK Region, the AYK Area consists of some 870,000 km^2 of extremely varied topography, climate, and zoogeography. Land ownership and jurisdictions fragment this huge area into a mosaic of patterns, some of which overlap. The federal government is the major land manager through its jurisdiction over the land withdrawals for National Parks and Preserves, National Wildlife Refuges, and Wild and Scenic Rivers. For purposes of reporting and organizing statistics in the statewide harvest survey, the area is subdivided into five subareas; Lower Yukon-Kuskokwim, Seward Peninsula-Norton Sound, Northwest Alaska, South Slope of the Brooks Range, and North Slope of the Brooks Range.

The Lower Yukon-Kuskokwim subarea (Sport Fish Postal Survey area V; Figure 1) includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, west to Kaltag; all north and south drainages of the Yukon River south of Kaltag to the Bering Sea; the Kuskokwim River watershed; all waters flowing into Kuskokwim Bay; and adjacent salt water and islands. This area does not include the Pastolik River drainage and waters flowing into Norton Sound northeast of the Pastolik River nor any portion of the Tanana River watershed[1]. The Lower Yukon-Kuskokwim subarea excludes the Koyukuk and Porcupine River drainages because they drain the south slope of the Brooks Range. It should also be noted that prior to 1984 the boundaries of the subarea were such that the Arctic Circle was utilized as a northern limit. Now the northern limit of the Lower Yukon-Kuskokwim subarea extends from Kaltag to the Canadian border along the Yukon River itself, (Mills 1985).

The Seward Peninsula-Norton Sound subarea (Sport Fish Postal Survey W; Figure 1) includes all waters north of the Yukon River drainage south of the

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[1] The Sport Fish Division assigns management responsibility for Kuskokwim Bay and Kuskokwim River waters upstream to Aniak to its Central Region which is headquartered in Anchorage. Responsibility for these areas is assigned to Sport Fisheries staff stationed in Dillingham.

Selawik River-Kotzebue Sound area and west of the Yukon-Koyukuk River drainages. This area includes Pastol Bay and all salt water north and west of it in Norton Sound as well as salt water adjacent to the Seward Peninsula, including Spafarief Bay in Kotzebue Sound and the southern half of Eschoscholtz Bay (ADFG 1984).

The Northwest Alaska Area (Postal Survey Area X; Figure 1) includes all waters and drainages of the Kotzebue area, including drainages of the Selawik, Kobuk, Noatak, Wulik, and Kivalina rivers. The area also includes all salt water in the northern half of Eschscholtz Bay, including the Chamisso Island area and the northern half of Kotzebue Sound to and including Point Hope (ADFG 1984). The eastward limit of the subarea extends to the Alatna River.

The south slope of the Brooks Range subarea (Sport Fish Postal Survey Area Y; Figure 1) includes all drainages south of the Brooks Range, west of and including the Koyukuk and Alatna River drainages, and north of the Yukon River, including all northern tributaries of the Yukon River from Kaltag to the Canadian border.

The north slope of the Brooks Range (Sport Fish Division Postal Survey Area Z; Figure 1) includes all waters north of the Brooks Range divide flowing into the Beaufort and Chukchi Seas from Point Hope on the west to the Canadian border on the east including adjacent saltwater areas.

Geographic and Geologic Setting

Dominant features of the huge landmass that lies north of the Alaska Range divide include the Alaska Range itself which provides water for streams in the Kuskokwim drainage and to the Tanana River and its tributaries. The Brooks Range and its drainages provide water to the Noatak, Kobuk, Colville, Koyukuk, and Porcupine rivers as well as to many other streams that drain directly into the Arctic Ocean and the Chukchi Sea.

The Yukon is the largest river in Alaska and its drainage constitutes the fifth largest in North America. The river originates in the basin and range domain of the southern Yukon Territories and northern British Columbia, and flows over 3,700 km northwest to its mouth on the Bering Sea coast. Additional Canadian flows to the upper Yukon River watershed are added from glacial streams such as the White River which originates in the Wrangell and St. Elias Mountain ranges. Approximately one-third of the Yukon River watershed is in Canada. The total drainage area of the Yukon River is approximately 855,000 km^2, including the area in Canada, which is approximately three-fourths of the land area of the AYK Region. The entire mainstem of the Yukon River up to the confluence of the White River (Figure 8) in Canada is turbid from glacial silt entrained in the waters draining the Alaska, St. Elias, and Wrangell Mountain ranges.

Lake and Stream Development

Sport-fishing waters and opportunities are extremely varied as could be expected in an area so large and diverse. In the following section the primary fishing waters and species of interest will be briefly characterized

for each of the five subareas within the AYK Area. It is recognized that not all streams, lakes, or fish stocks of importance will receive attention by this cursory treatment.

Lower Yukon and Kuskokwim River Subarea:

The primary flowing waters of the subarea are the mainstems of the Yukon and Kuskokwim rivers and their tributaries. For the Kuskokwim River (Figure 9) above the Aniak River confluence, the Holitna River represents the most productive sport fishing water because of the diversity and abundance of its resident and anadromous species. There are six fishing guides on the river currently who bring in about 75 clients per year (Rue et al. 1987). No permanent lodge or tourist structures are present on the river. The Holitna River supports populations of Arctic char *Salvelinus alpinus*, Dolly Varden *Salvelinus malma*, Arctic grayling, northern pike, burbot, sheefish, whitefish and all five pacific salmon species. Rainbow trout are not documented in the Kuskokwim River drainage upstream of the Aniak River. Dolly Varden, coho salmon, and chinook salmon are the primary sport fish species in the Holitna River, although feeding sheefish are present in the summer as far upstream as the Hoholitna River (Alt 1987) and are sought by many anglers. The Stony, Swift, Gagaryah, Tatlawiksuk, Cheeneetnuk, and Hoholitna rivers are some of the other important middle Kuskokwim River tributaries. All originate in the Alaska Range and its foothills (Figure 9). Fishery resources of these streams are poorly documented, and because of remoteness and limited access, they are thought to receive only light recreational use from sport anglers.

Above McGrath, (Figure 10) in the upper Kuskokwim drainage, there are many tributaries that originate in the Alaska Range, such as the Big River, the Middle, South, Windy, Big Salmon, Slow, and East forks of the Kuskokwim River, as well as the Tonsona and Little Tonsona rivers and Highpower Creek near Telida. The North Fork, Nixon Fork, and Takotna rivers do not head in the Alaska Range, but form in the Kuskokwim Mountains west of the Kuskokwim River. Chinook, coho, and chum salmon spawn in streams of the upper Kuskokwim drainage, as do sheefish. Sheefish spawning has been documented in Big River and in Highpower Creek (Alt 1987). Although most of the primary sport fish species occur in the middle and upper Kuskokwim, (with the exception of rainbow trout), sport fishing effort is extremely light on most streams and fish stocks. Most fisheries exploitation in the middle and upper part of the drainage is from local subsistence fisheries that target salmon and whitefish primarily.

Lake development in the Kuskokwim River drainage above the Aniak River is sparse, and there are few lakes documented which have good potential for recreational fisheries. The fisheries resources in two lakes (Telequana and Two; Figure 9) in the upper Stony River were surveyed by Russell (1980), and Whitefish Lake in the upper Hoholitna River was surveyed in 1977 by Baxter, (1977). Lake trout were found in all three lakes, as were Arctic grayling, northern pike, and various whitefish species. Dolly Varden were noted in Two and Telequana lakes but not in Whitefish Lake. Recreational angling occurs at Telequana and Two lakes, both by guided and unguided fishermen. Little information is available regarding sport fishing opportunities and species available in other lakes of the drainage. Most of the lakes in the upper

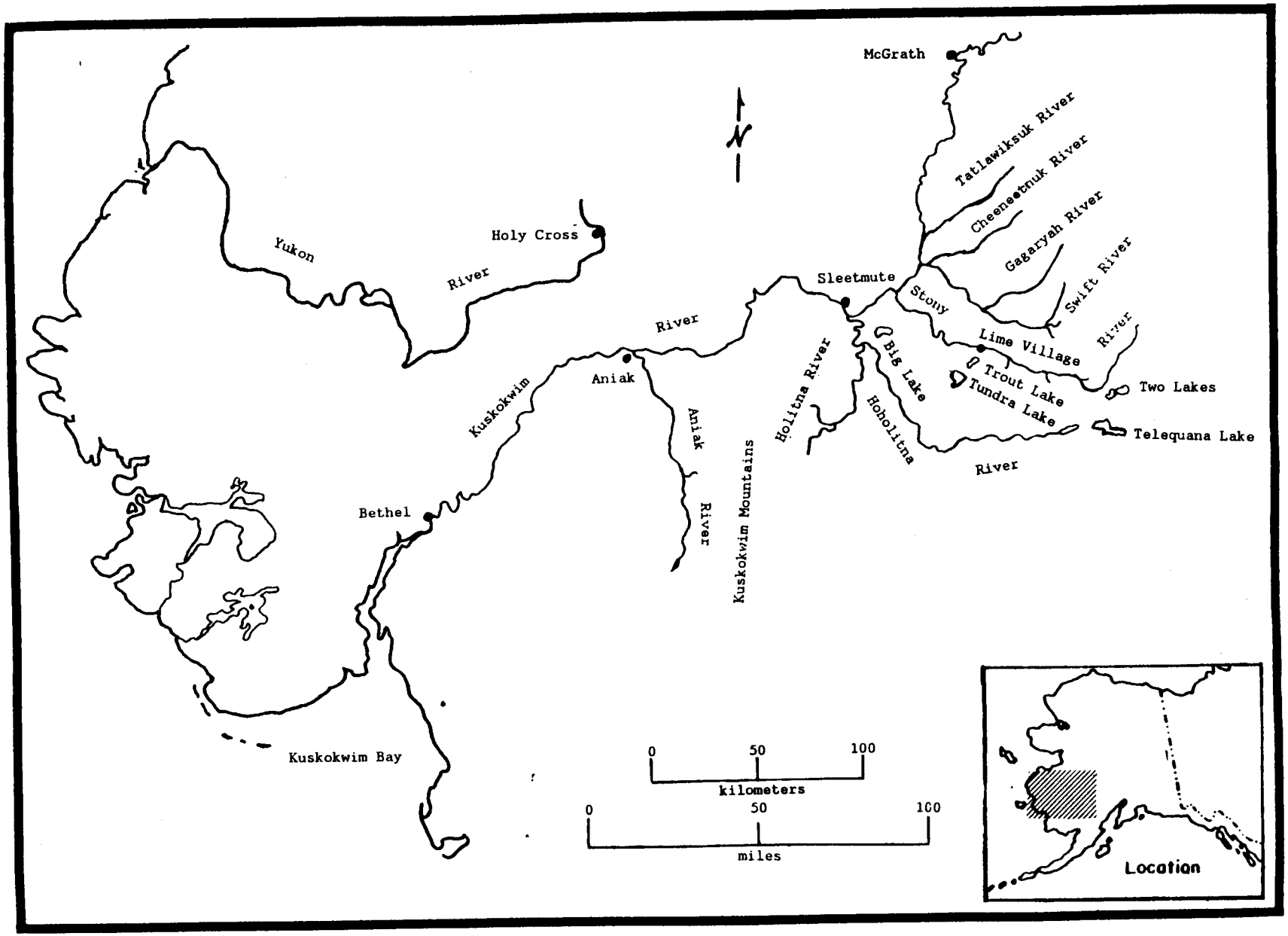

Figure 9. Waters of the lower Kuskokwim valley.

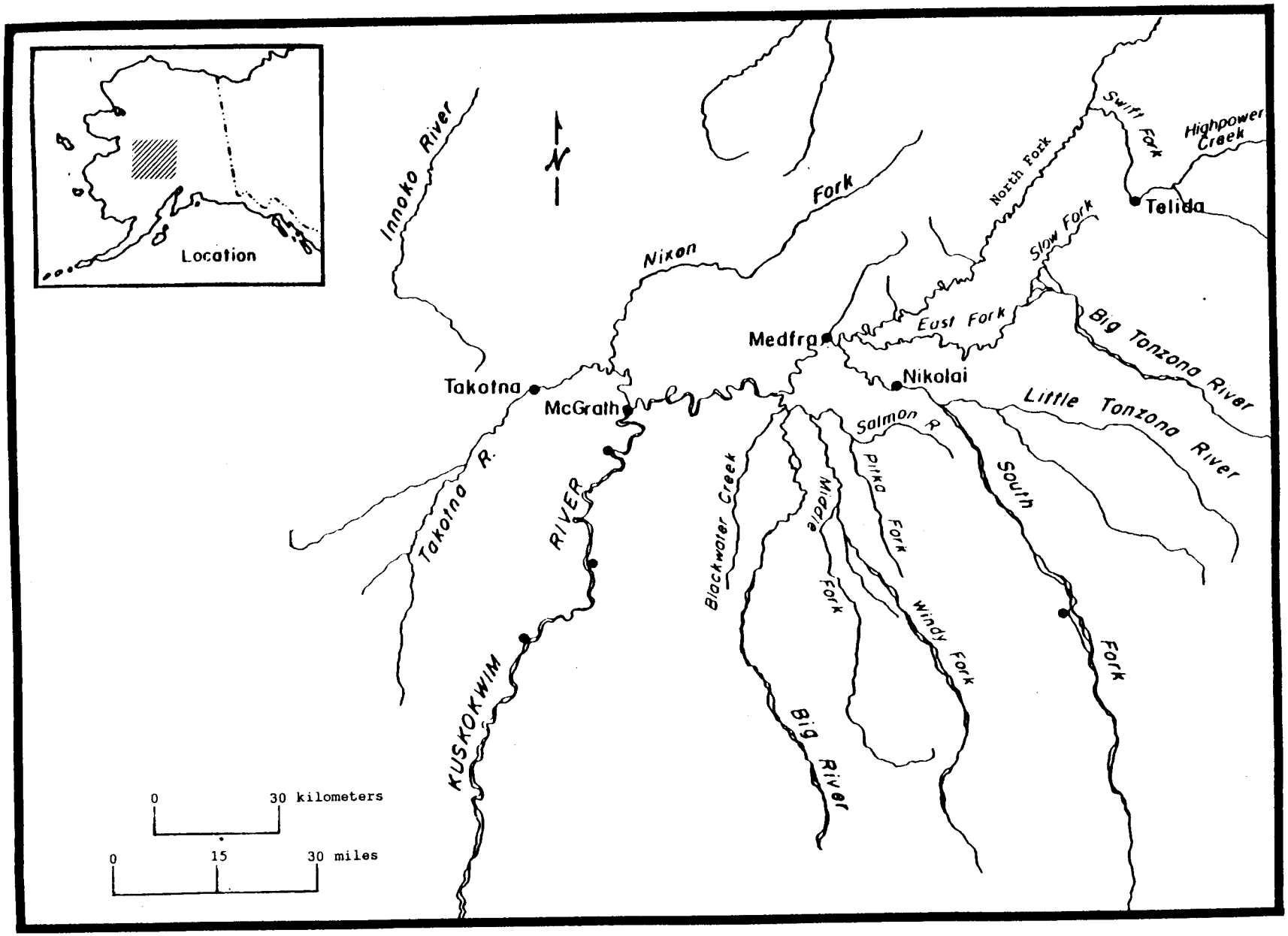

Figure 10. Waters of the upper Kuskokwim valley.

drainage are shallow tundra lakes, unsuitable for supporting year-round resident fish populations. Big Lake near Sleetmute, and Tundra and Trout lakes near Lime Village on the Stony River support year-round fisheries because of their size.

Clear water streams with sport fishing potential that are part of the Yukon River drainage are extremely numerous and extend to third and fourth order tributaries. Although the main stem of the river extends approximately 3,200 km, with the upper third of it in Canada, this report will include only Alaskan waters. Beginning near the Yukon mouth, (Figure 11) the east and west forks of the Andreafsky River are both high quality sport fishing streams and have been designated as part of the national Wild and Scenic River system. All the Pacific salmon species occur in the rivers with the exception of sockeye salmon *Oncorhynchus nerka*, as well as Arctic grayling, Dolly Varden, and northern pike in sloughs and lakes off the rivers. Each fork of this river is in itself a major stream and they drain extensive remote areas of the Nulato Hills between the Yukon River Delta and Norton Sound.

The Lower Yukon River provides a migratory corridor for all the species of resident, anadromous, and semi-anadromous fishes of the drainage. In addition, many species, such as sheefish, northern pike, several whitefish species, burbot and suckers utilize the mainstem lower river for rearing and feeding, particularly in winter months. For some species such as burbot, the mainstem provides year-round habitat.

The Innoko River and its tributaries drain a large area of flat wetlands and foothills of the Kuskokwim Mountains. The confluence of the Innoko River with the Yukon River is near the village of Holy Cross. The Innoko River system contains good populations of northern pike as well as other species. A vestigial sockeye salmon stock may spawn in the system, but at least in recent years, salmon production has been minimal.

The Anvik River, which enters the Yukon at the village of Anvik about 515 km upstream from the mouth, is a high quality fisheries stream. The river courses eastward from its drainage area in the Nulato Hills for about 130 km and although it is primarily a rapid runoff stream, a substantial amount of artesian upwelling helps stabilize winter flows and moderate water temperatures. Besides supporting the largest chum salmon *Oncorhynchus keta* spawning stock in the Yukon River drainage, with over a million individuals spawning in some years, the stream supports large numbers of chinook, coho, Arctic grayling, Dolly Varden, and northern pike. Fishing quality is excellent and there are few anglers using the stream in a summer season.

The Nulato River enters the Yukon River near Nulato, about 775 km from the mouth of the Yukon. Smaller and more difficult to navigate than the Anvik, the stream nevertheless has sport fishing potential for salmon, Arctic grayling and Dolly Varden.

The Koyukuk River, one of the largest first order tributaries of the Yukon, enters the Yukon River below Galena, about 820 km from the mouth (Figure 12). The main stem of the Koyukuk is turbid in its lower reaches from tannic stain, bank erosion and leaching. Lower Koyukuk River tributaries such as the

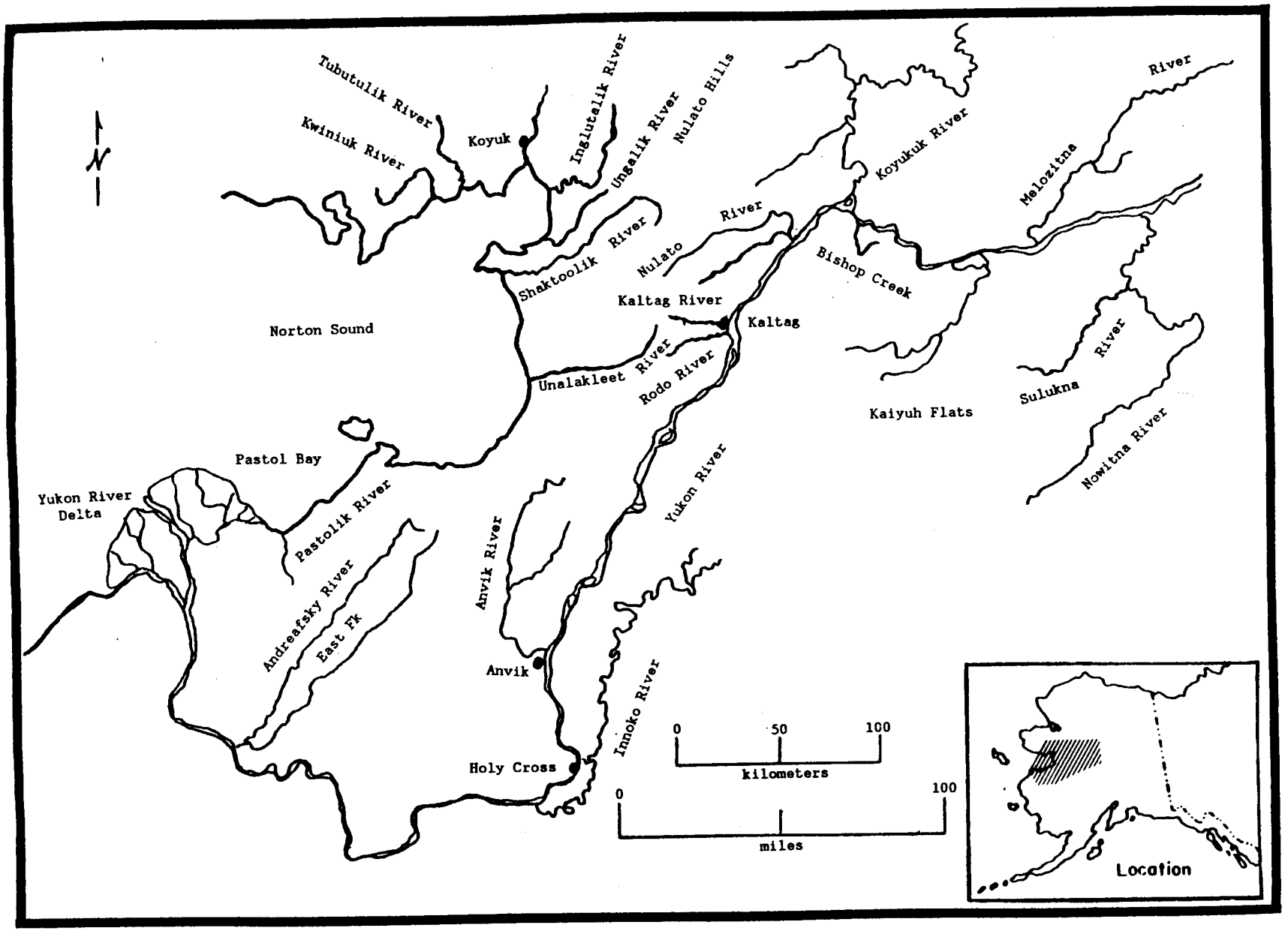

Figure 11. Lower Yukon River and eastern Norton Sound drainages.

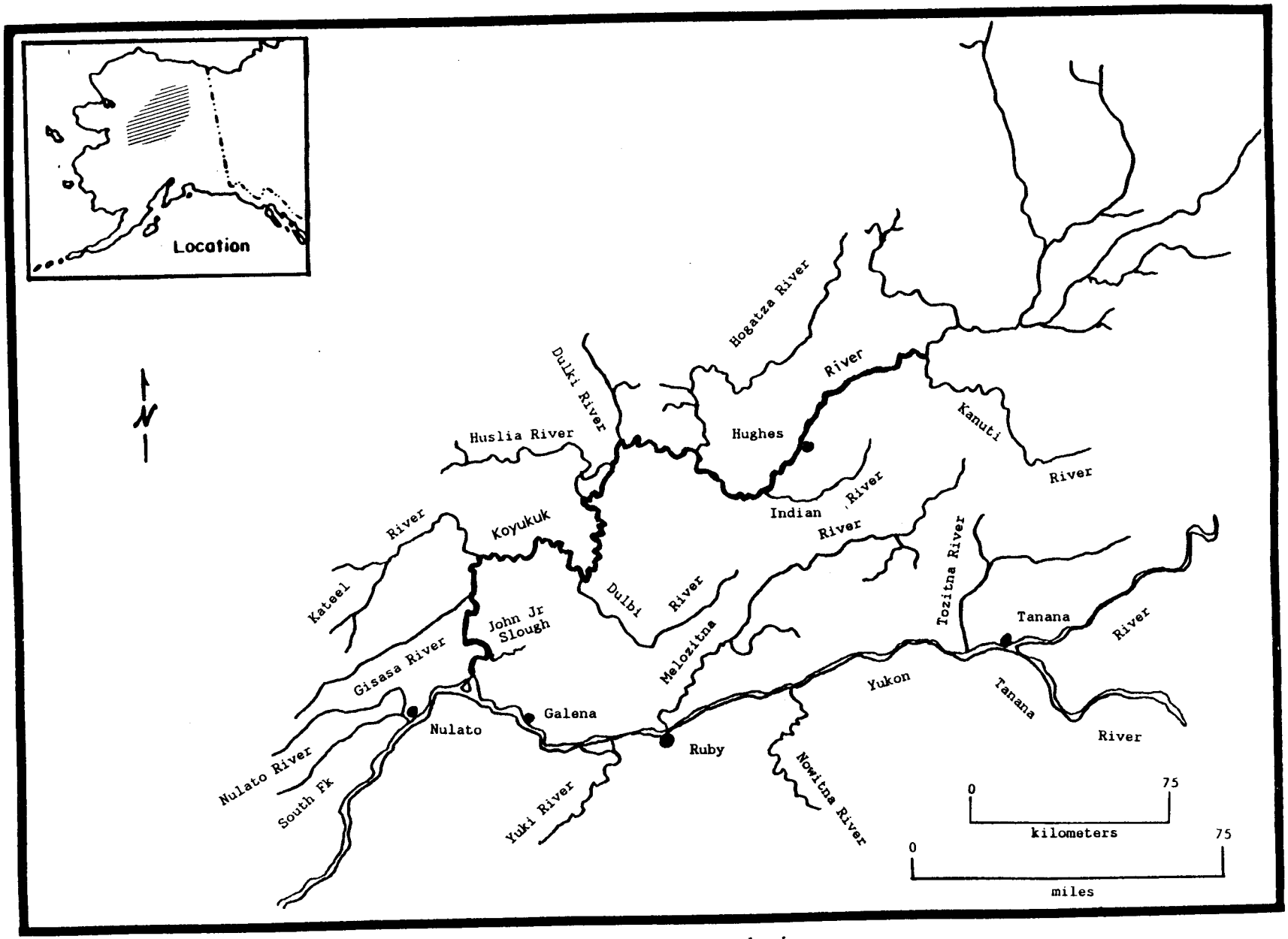

Figure 12. Middle Yukon River and Koyukuk River drainages.

Gisasa, Kateel, Dulbi, and Indian rivers are not well known outside of the local area but seasonally provide good sport fishing opportunities. Sheefish are taken at the mouths of several of the rivers including the Kateel and Dulbi and where John Junior Slough meets the Koyukuk River about 32 km upstream from the mouth[2]. Arctic grayling are common in all local streams and are heavily fished at times by local people from nearby villages as well as by military personnel stationed at the Galena Air Station. Sport fishing for northern pike is common in both sloughs and lakes near the main stems of the Yukon and Koyukuk rivers as well as in the extensive Kaiyuh Flats southeast of Galena. Since sheefish spawn annually in the main stem of the Koyukuk River near Hughes, there are both immature and adult mature prespawning individuals present in the lower Koyukuk River throughout the summer prior to the September spawning period. The best fishing for this species is near the mouths of tributary creeks and rivers where they enter the Yukon River main stem. Hook and line fishing for both recreation and for subsistence purposes is practiced by many local residents. Guided fishing for clients from outside the area occurs infrequently, but unguided "drop-off" fishing trips are more common.

The Kaltag and Rodo River mouths, Bishop Creek mouth, and the mouth of the Melozitna River all support fisheries for sheefish and Arctic grayling during summer and early fall months. Geothermal hot springs occur on one of the creeks of the Melozitna River, and a permanent lodge there caters to hunters and fishermen. The Melozitna River is also utilized frequently by local fishermen for Arctic grayling, particularly in the lower 16 km below rapids which effectively isolate the upper reaches of this stream.

The Nowitna River upstream from Ruby is a major clear water tributary which enters the Yukon from the south and drains the north slope of the Kuskokwim Mountains. It was included in the National Wild and Scenic River Act, and supports a significant amount of recreational fishing, much of it originating from the urban centers. Good angling for sheefish, northern pike and Arctic grayling can be found in the system, which consists of several branches. The river supports a population of spawning sheefish in its Sulukna River tributary (Alt 1987).

Other Yukon River tributaries below the Porcupine River confluence (Figures 7 and 12) that support sport fishing include the Tozitna River, Hess Creek, Ray River, Dall River, Hodzana River, Hadweenzic River, Beaver Creek, Birch Creek, Chandalar River, and Christian River. The area between Beaver Village and Fort Yukon on the Yukon River main stem is known to support sheefish spawning (Alt 1987). Upper Koyukuk River tributaries that cross the Dalton Highway (North Slope Haul Road) are illustrated in Figure 13.

The Yukon Flats is an extensive wilderness wetland between Circle and Stevens Village below the confluence of the Porcupine River in which thousands of shallow thaw lakes have been developed. Many of the lakes support fish populations at least seasonally, especially those with at least occasional connections to the sloughs and streams in the area. Northern pike and

[2] Tim Osborne. 1988. Personal Communication. ADFG, Division of Wildlife Conservation, PO Box 155, Galena, AK 99741.

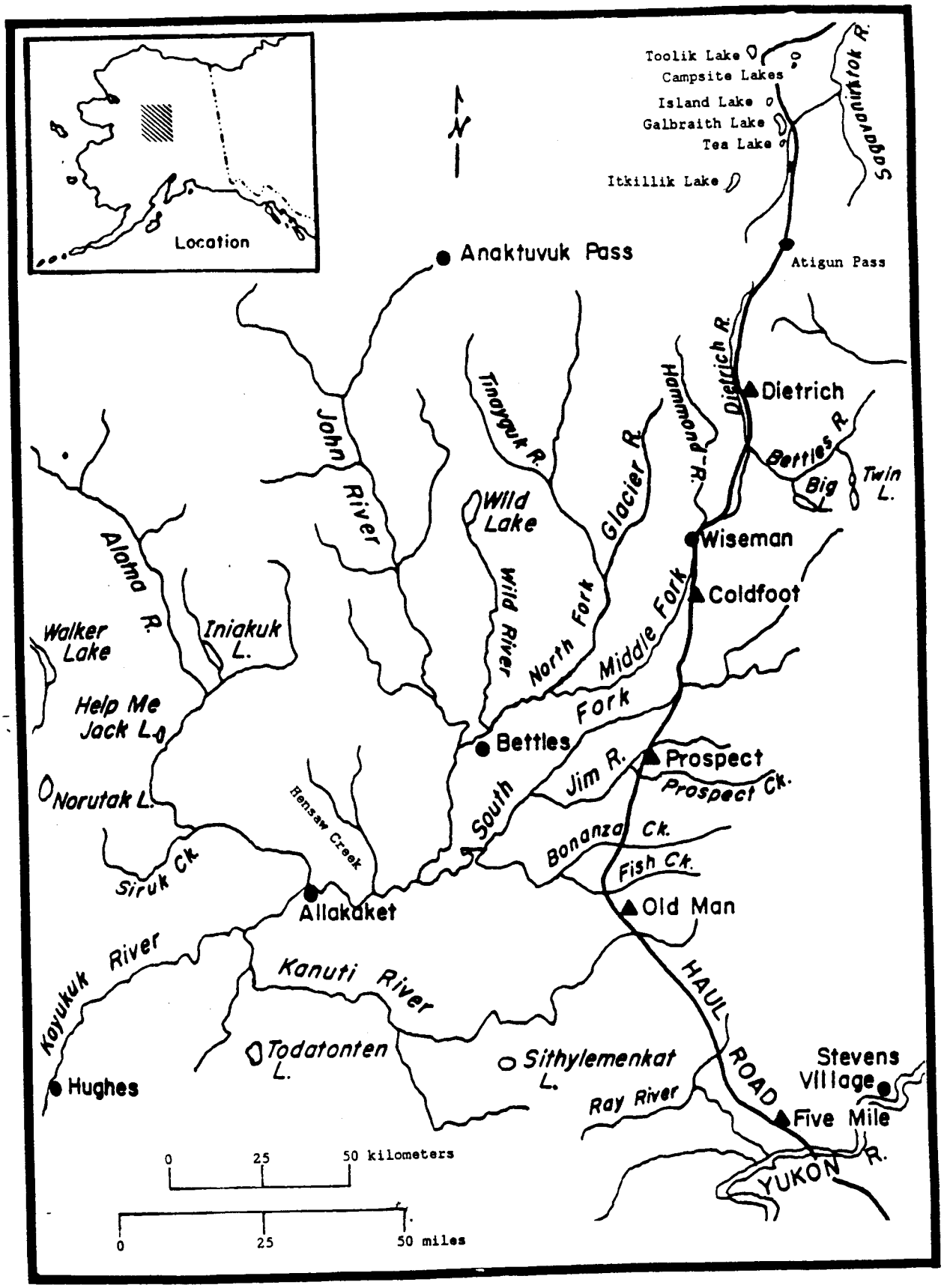

Figure 13. Upper Koyukuk River and North Slope Haul Road.

whitefish species are most common to this area, with sheefish and Arctic grayling also present in some waterways (USFWS 1985).

The Porcupine River (Figure 14) represents the largest tributary to the Yukon River, draining an immense area of the eastern Brooks Range through the Sheenjek and Coleen rivers, the British Mountains through the Old Crow River, the Richardson Mountains in Canada through the Bell, Eagle, and Rock rivers, and the northern Ogilvie Mountains in north-central Yukon Territories through the east Porcupine Fork and its tributaries. The Black River is one of the major Alaskan tributaries and drains the southeastern slopes of the Ogilvie Mountains. The Little Black River drains a lowland area south of the Black River parallel to the main stem of the Yukon River.

Other major tributaries between Fort Yukon and the Canadian border are all above Circle City, and include the Charley, Seventymile, and Fortymile rivers on the south side of the Yukon River and the Nation, Kandik, and Tatonduk rivers entering the north side of the Yukon River (Figure 8). Parts of Birch and Beaver creeks as well as parts of the Charley and Fortymile rivers are included in the National Wild and Scenic River Act (Appendix A). The major species for sport fishing on the rivers upstream of Fort Yukon are Arctic grayling in the upper stream reaches and northern pike in the lower slower sections.

Few large deep lakes sufficient to moderate flows or water temperatures are present in the interior subarea, in the Upper Kuskokwim River drainage and the Alaska Yukon River drainage. The majority of the lakes in the Yukon drainage developed as a result of thawing action on saturated permafrost soils and as a result, the lakes are mostly shallow and they are not supportive of primary sport species such as lake trout. There are thousands of such lakes in the deltas and flats of the drainage. Many of them provide summer feeding and rearing areas for various whitefish species, as well as for northern pike and occasionally, sheefish. Those fish utilizing the shallow thaw lakes for summer feeding habitat generally depart these lakes and move into primary tributaries and main stems of the major rivers prior to freeze-up in the fall.

Seward Peninsula/Norton Sound:

Primary sport streams in eastern Norton Sound (Figure 11) include several that drain the Nulato Hills which separate Norton Sound from the Yukon and Koyukuk River valleys. They include the Unalakleet, Shaktoolik, Inglutalik, and Ungalik rivers. The Unalakleet River is the largest and most heavily utilized of these, and it supports a substantial amount of sport fishing activity during summer months. A permanent lodge and guide service is established on the lower Unalakleet River. The river and its tributaries support populations of Arctic grayling and Dolly Varden as well as chinook and coho salmon. The other area streams also support those species, but are not as intensively fished, primarily because of the limited access and facilities available to nonlocal fishermen. The Koyuk River empties into Norton Bay in the extreme eastern corner of Norton Sound. Near its mouth it is a fairly large, low gradient, muddy stream. It offers little potential for sport fishing except for northern pike and Arctic grayling in some of the clear water tributaries.

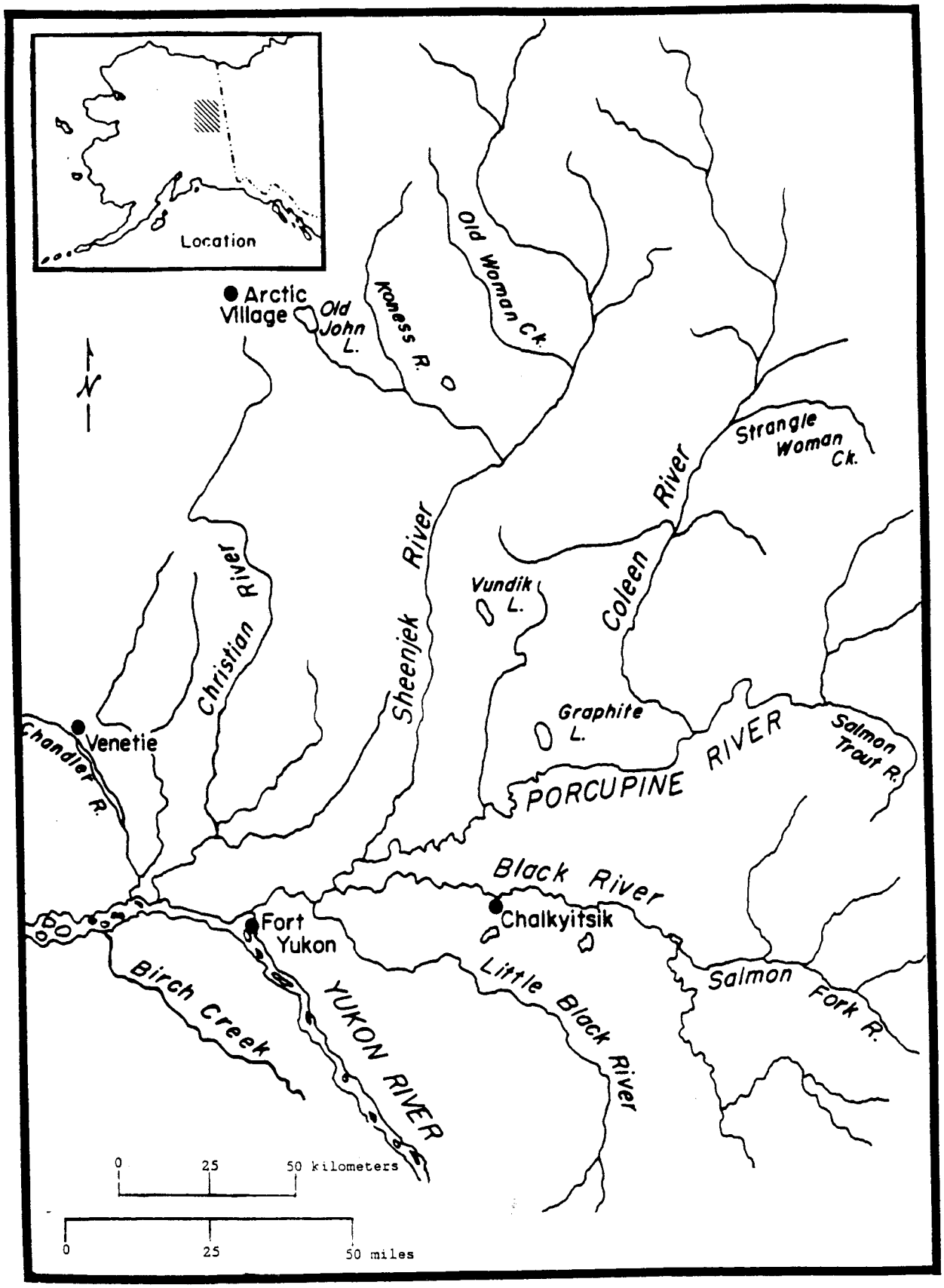

Figure 14. Porcupine River drainage.

Several high quality sport fishing streams are located along the southern half of the Seward Peninsula from Koyuk to Teller, (Figure 15) including the Tubutulik, Kwiniuk, Fish, Niukluk, Bonanza, Eldorado, Nome, Snake, Sinuk, Pilgrim, Agiapuk, and Kuzitrin rivers. Road access from Nome exists to all except the Kwiniuk and Tubutulik rivers, and all the streams are clear and swift flowing for most of their watercourses. Arctic grayling, Dolly Varden, and coho salmon are all present in these streams, and many contain chinook salmon, pink salmon *Oncorhynchus gorbuscha*, chum salmon, or northern pike. Small, perhaps remnant, sockeye stocks are also present in the Pilgrim and Sinuk rivers. Trophy Arctic grayling (larger than 1.4 kg or 3 lbs) are present in many streams on the Seward Peninsula, including the Sinuk, Tubutulik, Fish, and Kuzitrin rivers as well as others.

Streams draining the northern half of the Seward Peninsula are not noted for their sport fishing potential due to relatively small flow volumes, difficult access, poorer water quality and fisheries habitat.

Lake development on the Seward Peninsula consists of typical thaw lakes in the river floodplains and glacially created lakes in the mountains of the central and western Seward Peninsula. The largest inland body of water on the peninsula is Imuruk Lake (Figure 16) in the north-central portion of the peninsula. It is approximately 32 km^2 and was probably formed when volcanic lava originating in the nearby area cut off major drainage streams causing water to back up into a local depression. The lake presently drains northward to the Inmachuk River. Deering residents report that salmon (coho or chum) spawn at the lake outlet in the fall and that the lake supports whitefish and Dolly Varden[3].

Other lakes important for sport fisheries or which have recreational potential are smaller in size, and have been created by glacial action in the Imuruk Basin watershed and in the Kigluaik Mountains east of Nome. Many or most of these lakes contain populations of lake resident Arctic char (Kretsinger 1987) while other lakes and streams in this area contain anadromous Dolly Varden.

Northwest Alaska:

The most important streams of the Northwest Alaska subarea (Figures 16, 17 and 18) are the Noatak and Kobuk rivers, both of which drain large areas of the southern slope of the western Brooks Range. Each has a drainage area of approximately 31,000 km^2 and stream length of from 560 km (Kobuk) to 640 km (Noatak; U.S. Army Corps of Engineers 1967). The third largest stream by drainage area is the Selawik River, with an approximate area of 11,700 km^2. The Noatak River is slightly turbid at most times during the summer months from glacial silt entrained from mountain glaciers in the Brooks Range, while waters of the Kobuk and Selawik rivers are basically clear. Abundant groundwater resources are found in both the Noatak and Kobuk rivers as water-bearing gravel aquifers on the lower main stem of the Noatak River and in tributaries of the Kobuk River. These aquifers tend to stabilize flows and water temperature fluctuations and provide water storage within the systems.

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[3] Charles Lean. 1988. Personal Communication. ADFG, Division of Commercial Fisheries, PO Box 1148, Nome, AK 99762.

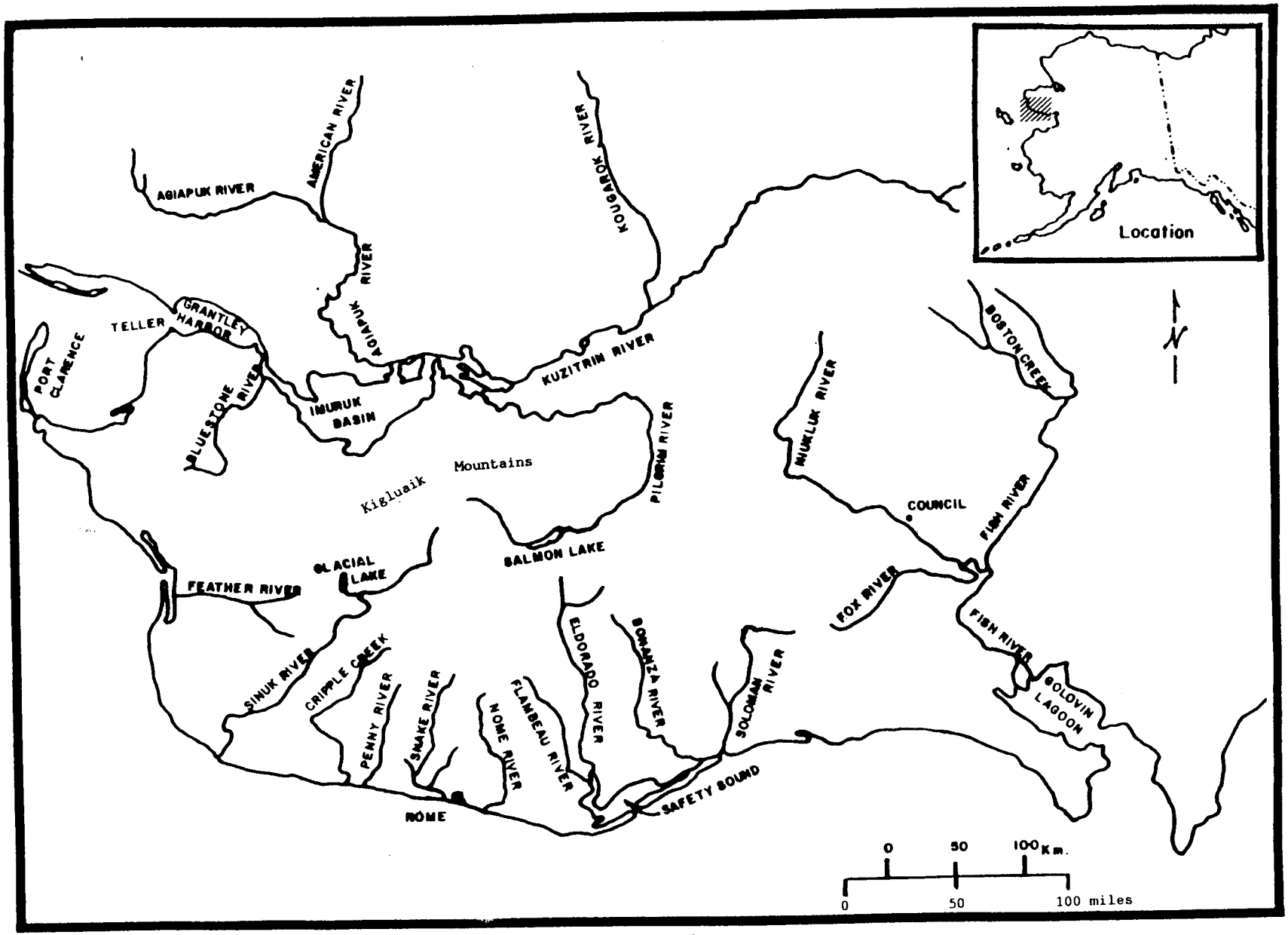

Figure 15. Waters of the Seward Peninsula.

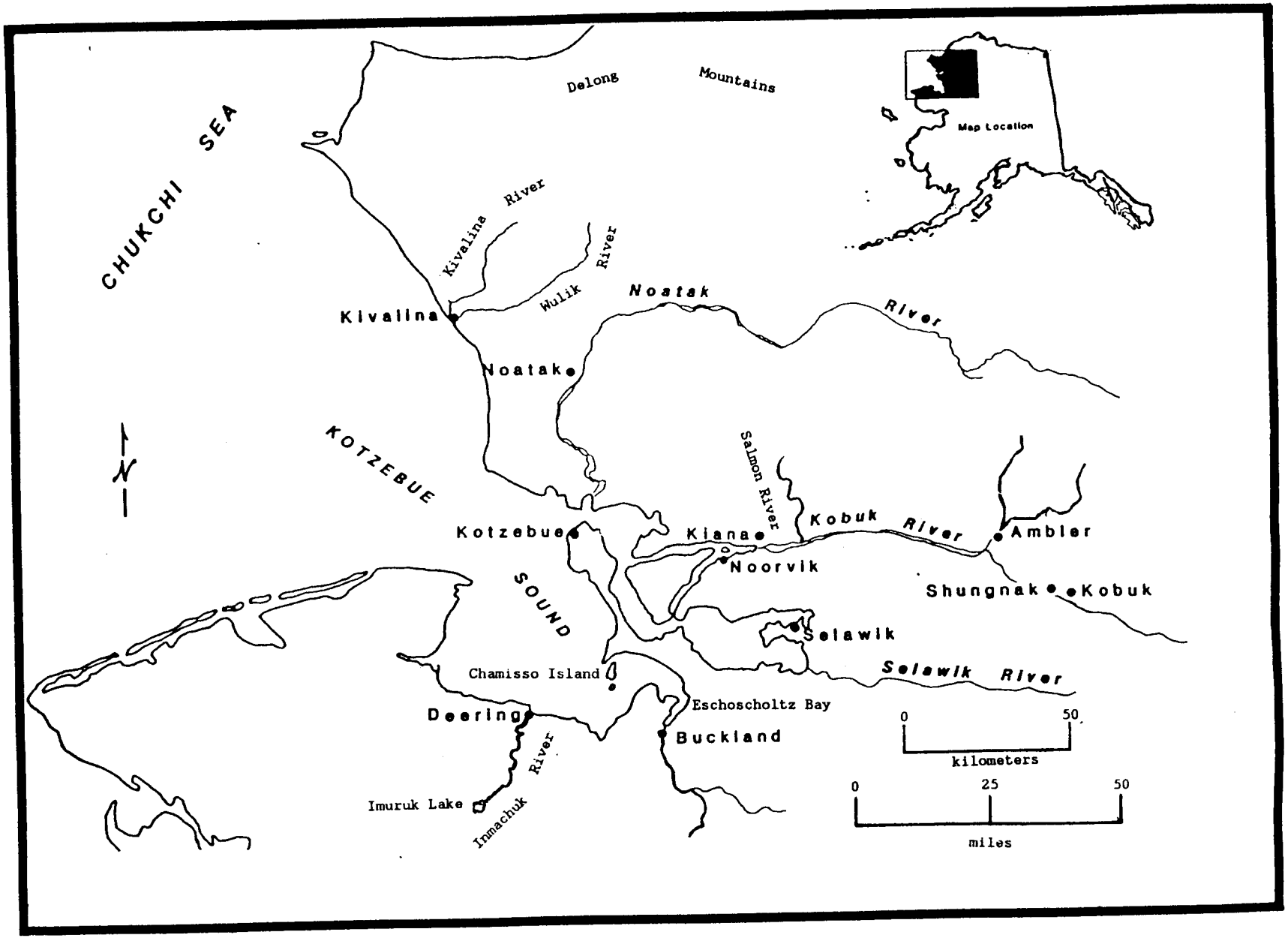

Figure 16. Kotzebue Sound and surrounding area.

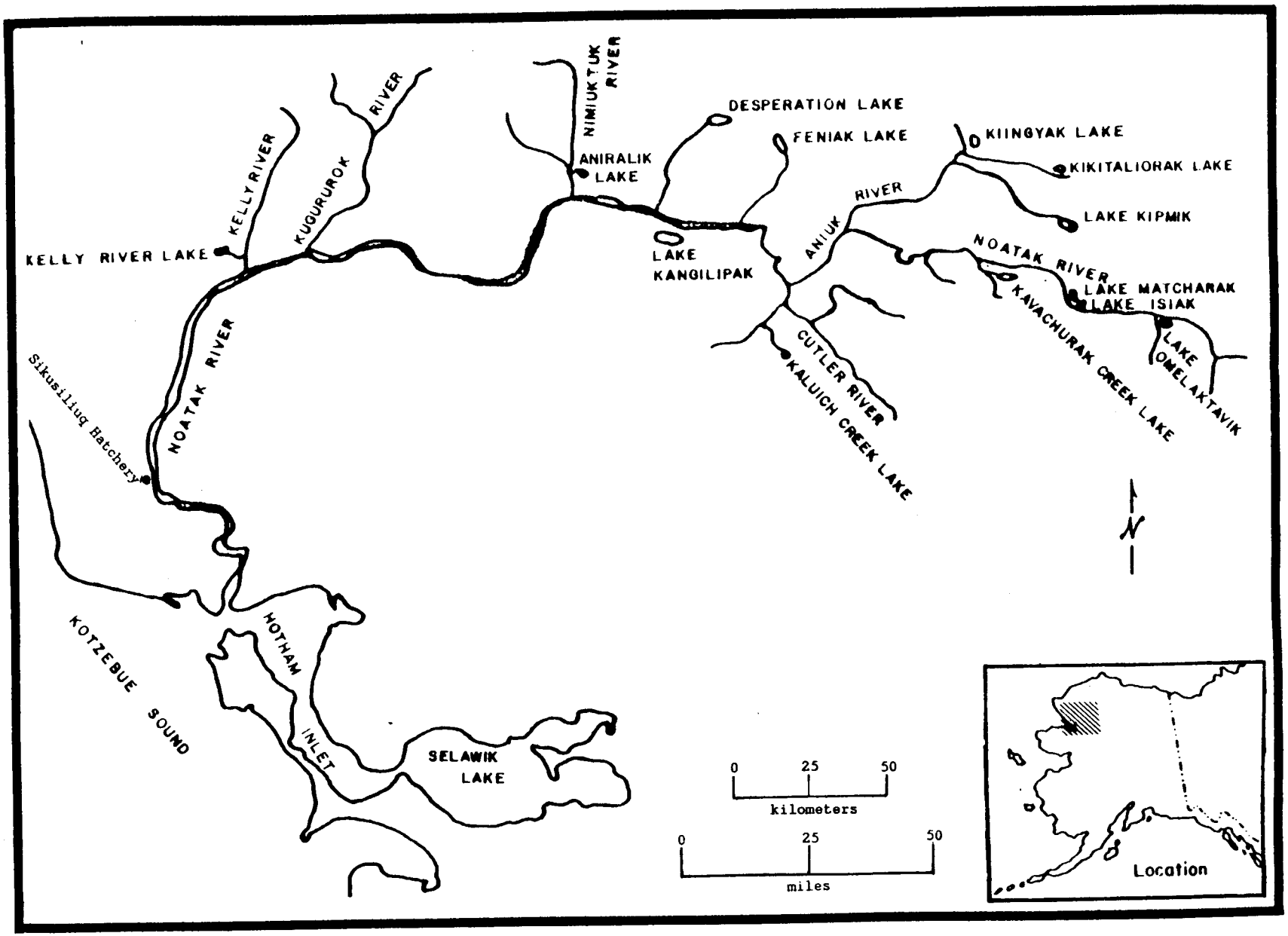

Figure 17. Waters of the Noatak River.

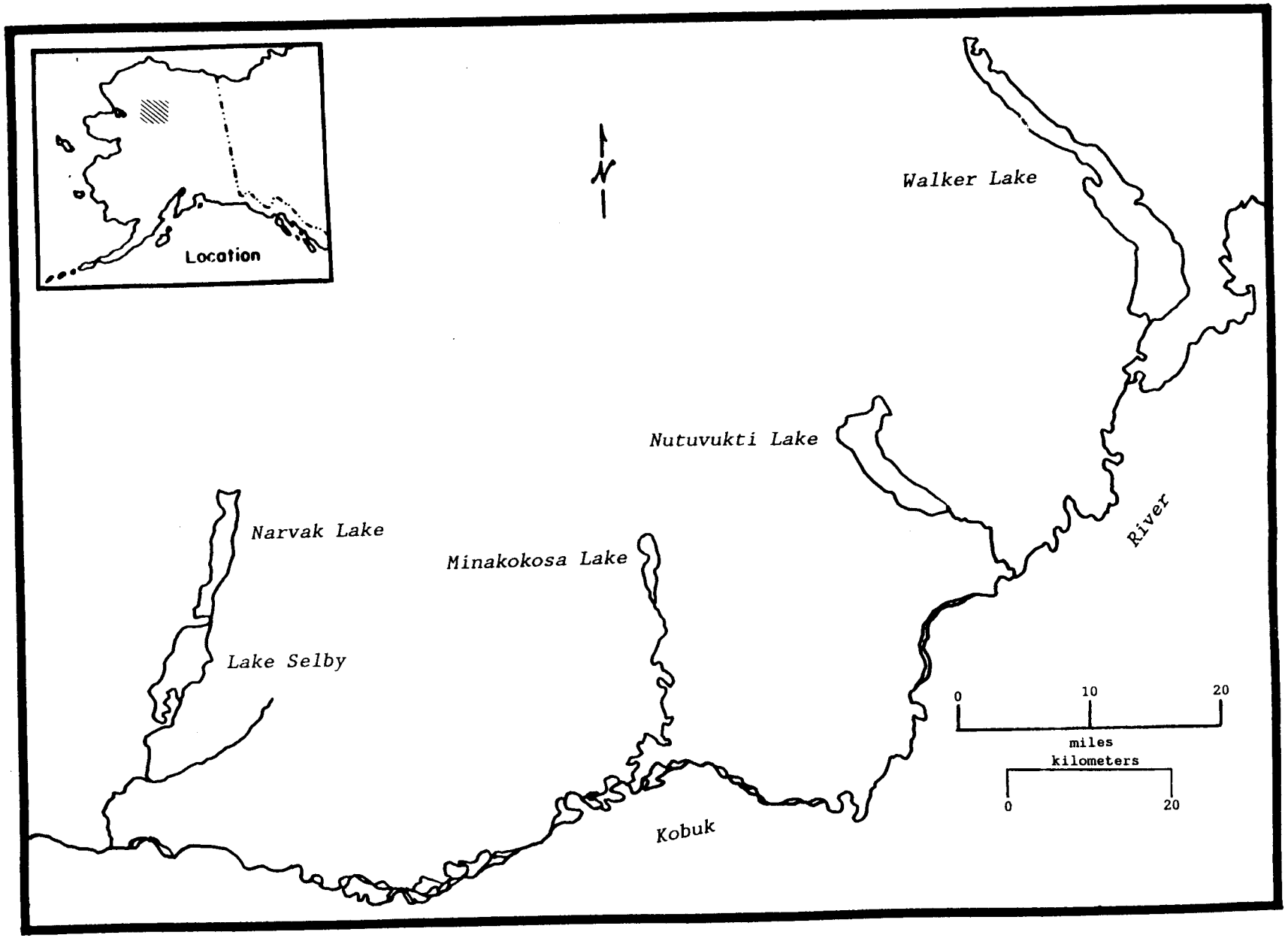

Figure 18. Waters of the upper Kobuk River.

The Noatak River is included in the National Wild and Scenic River Act, and most of the drainage is included in the Noatak National Preserve (Figure 19). The extreme upper headwaters of both the Noatak and Kobuk rivers are included in Gates of the Arctic National Park. A part of the lower Kobuk Valley between Kiana and Ambler is designated as Kobuk National Park, and the Salmon River tributary, as well as the upper main stem of the Kobuk River are included in the National Wild and Scenic River Act as is the Selawik River. Much of the Selawik River valley is part of the Selawik National Preserve.

The three large river systems contain abundant fisheries resources. The Noatak River produces a large run of late chum salmon that are the primary species for the Kotzebue-based commercial fishery. Many thousands of anadromous Dolly Varden overwinter and spawn in the river. Whitefish and northern pike are resident in the Noatak River but sheefish apparently use the river mainly for overwintering and feeding but not for spawning (Alt 1987).

Both the Selawik and Kobuk rivers support spawning populations of sheefish in their upper tributaries and main stems. The brackish delta systems which have formed at the river mouths serve as overwinter feeding areas for juvenile as well as adult sheefish. Trophy sheefish are taken from these waters especially during the fall when large mature spawners are available in the Upper Kobuk River and its tributaries. Abundant whitefish utilize the rivers and delta areas, including Selawik Lake and Hotham Inlet (Kobuk Lake). Dolly Varden are abundant in many of the tributaries to the Kobuk River, as are northern pike in sloughs and connecting lakes to the lower river and lake trout in deeper lakes of the upper Kobuk watershed. The Wulik River, which empties into the Chukchi Sea at the village of Kivalina, is well known as a trophy area for Dolly Varden that spawn in the river in the fall.

Sport fishing effort in Northwest Alaska is relatively light compared to most other areas in the state. Heaviest use occurs on the Noatak, Kobuk, and Wulik rivers. Many visitors to Gates of the Arctic National Park and Kobuk Valley National Park participate in float trips on the Kobuk River from Walker Lake to Kobuk village (Alt 1984; ADFG 1986; NPS 1984, 1985a). A lodge on Walker Lake promotes lake trout and Dolly Varden fishing. Summer hook and line fishing for sheefish from beaches in the vicinity of Kotzebue targets stocks from the Selawik and Kobuk River populations.

The Noatak River is utilized for fishing recreation by guided parties from outside the area as well as by unguided floating parties and Kotzebue residents who boat to different areas of the river to fish. The most popular fishing area is the Kelly River, but other tributaries such as the Nimiuktuk and Kugururok rivers receive occasional use also (Alt 1978, 1981).

One of the most popular recreational uses of the Noatak River is to raft or float with canoe or kayak. Many river parties put in at Matcharak Lake (Figure 17) and portage to the river, or land on gravel bars farther up the river (Alt 1978). Only Arctic grayling are available in the upper Noatak River, but below the Nimiuktuk River some Dolly Varden, chum salmon, and northern pike also occur (Alt 1978). Lake trout occur in Matcharak Lake and

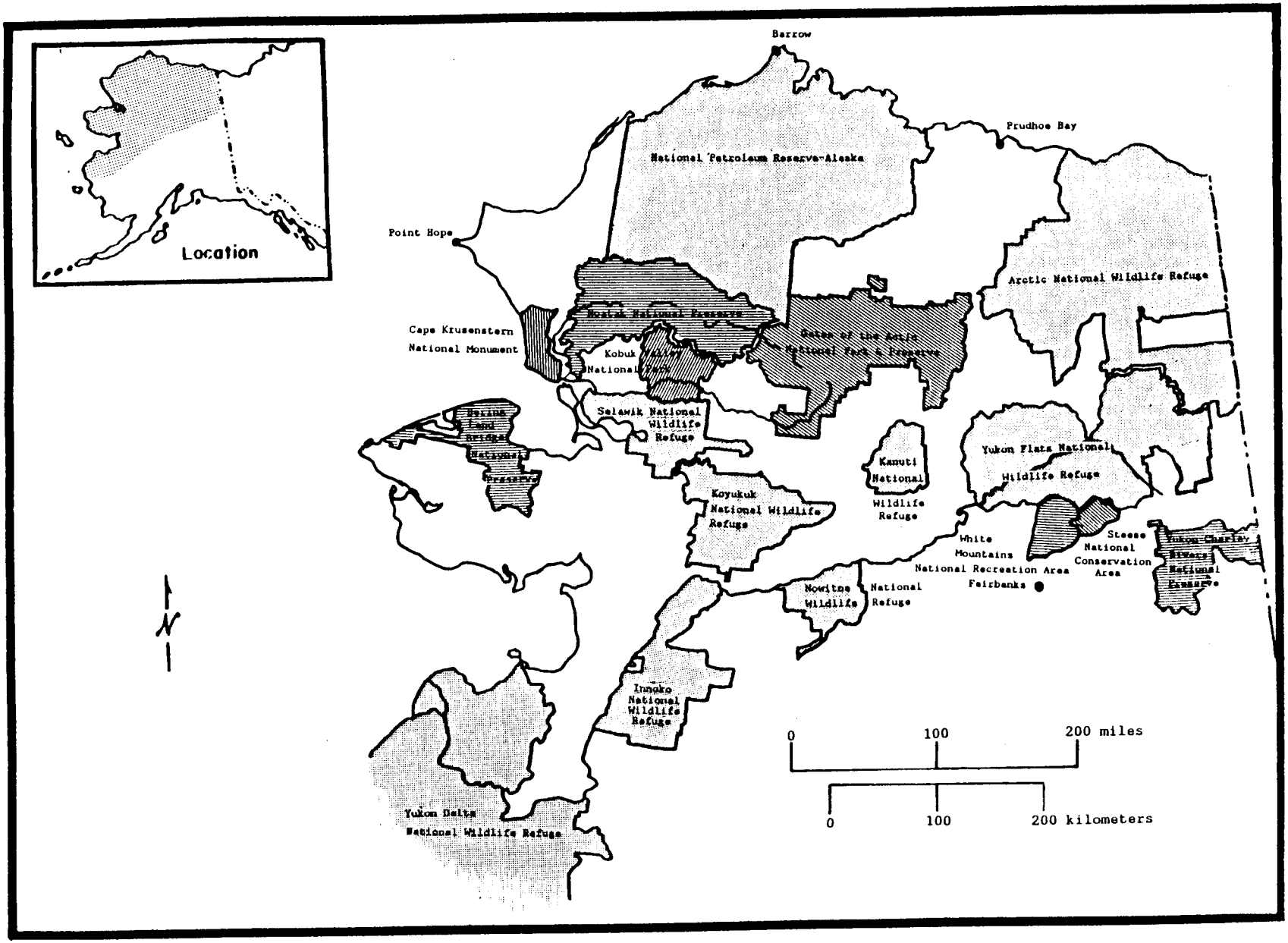

Figure 19. Federal land designations within the A-Y-K region.

in other lakes in the middle and upper Noatak drainage, however most lakes in the area are accessible only by airplane.

The lower floodplains of the Kobuk and Selawik rivers, especially in the vicinity of the Kobuk River delta, and the lower Noatak River (above the lower canyon of the Noatak) contain hundreds of shallow thaw lakes of various sizes. The lower Selawik River is particularly well supplied with numerous lakes. Most of the waters in this area are poorly inventoried, but are known to seasonally support large populations of whitefishes, northern pike, and sheefish. The mountains in the upper Kobuk River drainage (Figure 18) contain several relatively large, deep lakes which were formed by glacial action. Although complete fisheries inventories are not available, lake trout, Arctic grayling and perhaps one or two whitefish species are known to utilize these lakes. They include Walker Lake, Nutuvukti Lake, Minakokosa Lake, Lake Selby and Narvak Lake.

Lakes of the upper Noatak River (Figure 17) were surveyed by Alt (1978), with a brief inventory of 13 lakes in the upper drainage. Fish were present in all lakes surveyed, with round whitefish *Prosopium cylindraceum*, lake trout and Arctic grayling the most common species. Least cisco, northern pike, Dolly Varden, slimy sculpin *Cottus cognatus*, salmon (chum and sockeye), and ninespine stickleback *Pungitius pungitius* were also taken. Maximum depth in four of the lakes was greater than 10 m (Matcharak, Kipmik, Feniak, and Kavachurak Creek lakes).

South Slope Brooks Range:

A major portion of the South Slope Brooks Range subarea is contained within the boundaries of the Gates of the Arctic National Park and Preserve. Most of the streams in the area drain to the south from the Brooks Range into the Yukon River (Figures 13, 14 and 20). Significant flowing waters include the Alatna River, and other Koyukuk River tributaries such as the Gisasa, Kateel, Dulbi, Huslia, Indian, Kanuti, Hogatza, Dakli, Henshaw, John, Wild, North Fork, Tinayguk South Fork, Middle Fork, and Jim rivers. To the east are the Dall, Hodzana and Hadweenzic rivers, the Chandalar River with several tributaries and forks, the Christian River, and the Lower Porcupine River with tributaries such as the Sheenjek, Coleen, Black, and Little Black rivers. The Dalton Highway (North Slope Haul Road) bisects the subarea in a north-south direction (Figure 13), and provides access for recreational fishermen to several streams of the area, including the Ray River and the Middle Fork, South Fork, and Jim River of the upper Koyukuk River system.

Several large mountain lakes are present. They include Iniakuk, Wild, Big, Twin, Chandalar, Ackerman, and Old John lakes (Figures 13, 14 and 20). All these lakes are believed to contain lake trout populations as well as Arctic grayling and other species of whitefish and cisco in most cases.

This subarea contains approximately half of the Yukon Flats National Wildlife Refuge, (Figure 19) and there are literally thousands of lakes present of various sizes and origins. The lakes of the area are categorized roughly into 1) foothill lakes (formed from streams, with sufficient depth for fish habitation), 2) tundra lakes (which are shallow and often freeze to the

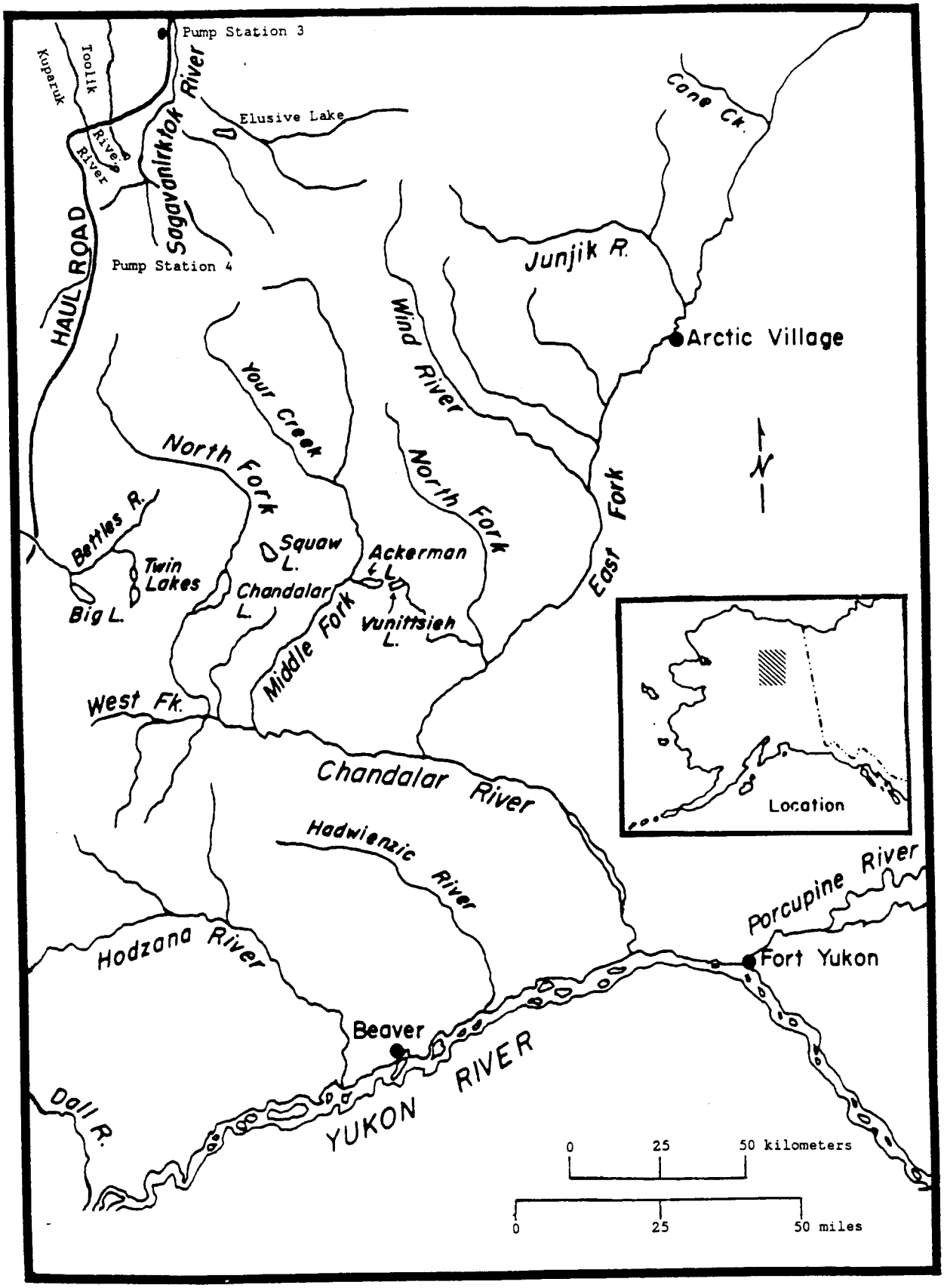

Figure 20. Chandalar River system.

bottom), and 3) lowland lakes of three types: oxbow lakes with river connections and deep enough to support fish, mud lakes (shallow, and suitable for only fish rearing), and lakes created from beaver activity (USFWS 1985). There is currently little documentation available on resident fishes that utilize these vast wetlands. Currently the U.S. Fish and Wildlife Service is conducting inventories and lake surveys in the waters of the Yukon Flats Refuge to provide information on this subject (USFWS 1985).

North Slope Brooks Range:

The northern-most part of Alaska is characterized by its broad arctic coastal plain, which abuts the Arctic Ocean and Beaufort Sea, and by the foothills and mountains which form the Brooks Range (Figure 21). The central and eastern Brooks Range consist of rugged, glaciated, east-trending ridges with summits rising to elevations of 4,350 to 5,000 m, (Selkregg 1976). The Delong Mountains on the western flank of the Brooks Range consist of glaciated ridges, 1,865 to 2,500 m in elevation, which drain northward into the Chukchi Sea (Selkregg 1976). No lakes or glaciers exist in the Delong Mountains although they were glaciated during the ice age. From the central and eastern Brooks Range, the mountain rivers flow northward to empty into the Beaufort Sea. As Selkregg (1976) points out, although several large rock basin lakes lie at the mouths of glaciated valleys on both sides of the range, there are surprisingly few lakes for a glaciated area. Although most of the streams that cross the foothills flow northward from their sources in the range, the region's largest stream, the Colville River flows eastward for more than 320 km before turning north onto the coastal plain (Figures 21 and 22). The drainage area of the Colville River is estimated to be about 62,000 km^2, a little more than half of the area drained by the Tanana River. Most streams east of the Colville River have braided courses across broad gravel flats which often become blocked in winter by aufeis (fields of ice that form continuously downstream from spring water sources) that causes local flooding (Selkregg 1976). The upper valleys of major rivers flowing from the Brooks Range often contain morainal lakes (Selkregg 1976).

The coastal plain is basically an area of low relief and very poor drainage due to underlying permafrost and a very shallow active layer, which tends to trap moisture near the surface. Rivers that cross the plain originate in the hills or mountains to the south. In the western part, more than 50% of the plain is covered by oriented thaw lakes that are aligned to the north-northwest on their long axes (Selkregg 1976). Ice-wedge polygons are found throughout the coastal plain section.

Major flowing waters of the coastal plain from west to east, include the Kukpowruk, Utukok, Kuk, Meade, and Itpikpuk rivers (Figure 21). The Colville River has several major tributaries, including the Killik, Chandler, Anaktuvuk, and Itkillik rivers (Figure 22). Other streams east of the Colville include the Kuparuk, Sagavanirktok, Canning, Hulahula, and Kongakut rivers (Figure 21).

Access to the North Slope area is either by plane or the Dalton Highway out of Fairbanks. The highway was originally built in 1974 to support construction of the trans-Alaska oil pipeline. Sport fishing was closed for 8 km (5 miles)

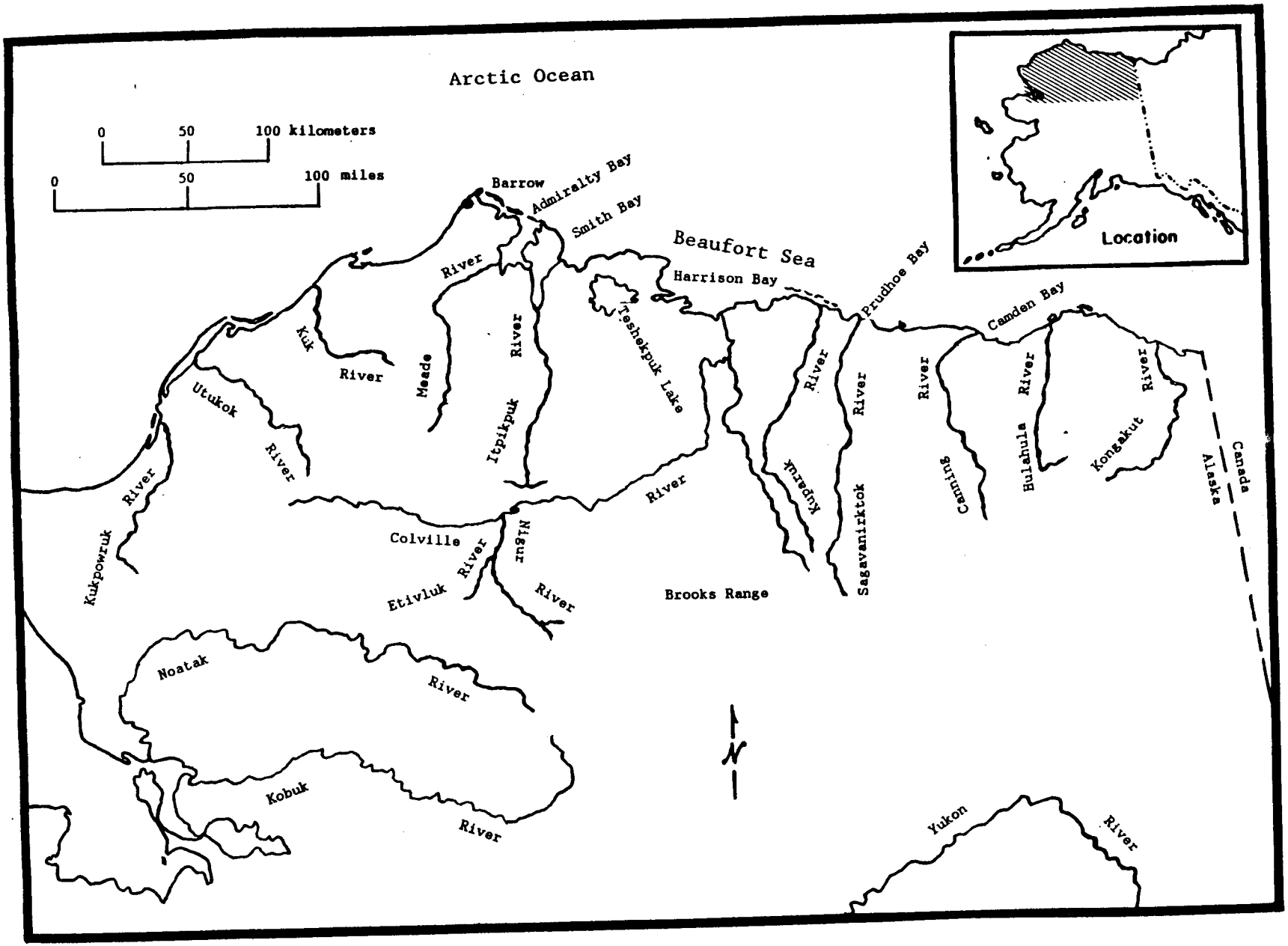

Figure 21. Waters of the Arctic Slope.

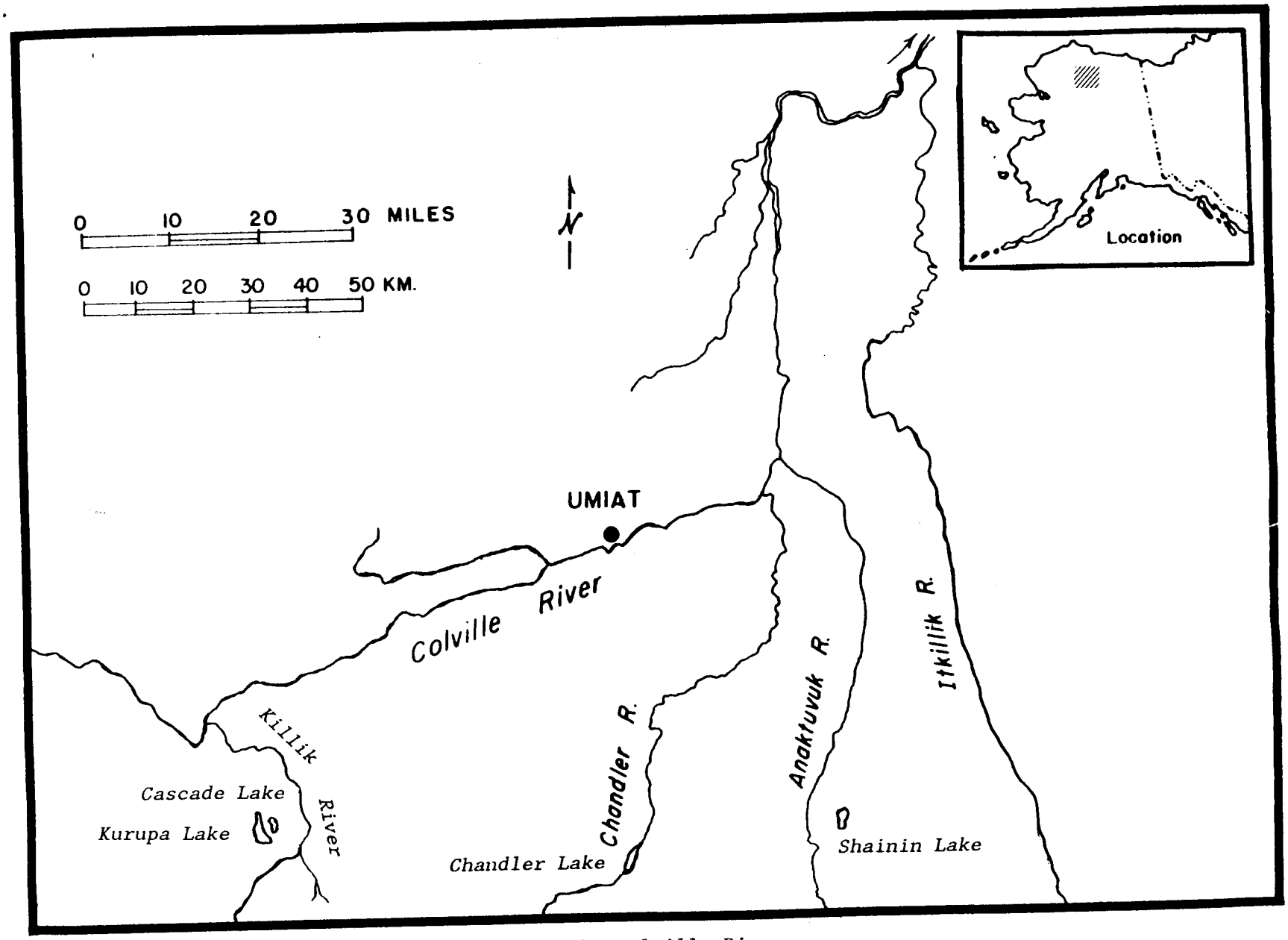

Figure 22. Principal tributaries of the Colville River.

on either side of the pipeline beginning in 1978. The closure was rescinded in 1980 by the Alaska Board of Fisheries, which opened the Haul Road Corridor for fishing for all species except sheefish and salmon, (Bendock 1980). Since June 1981 the highway south of Disaster Creek (near Dietrich, Figure 13) has been open to the general public (Bendock 1982).

The Dalton Highway crosses tributaries of the Sagavanirktok, Toolik, and Kuparuk rivers and parallels the Sagavanirktok River for about 160 km (100 miles) south of Prudhoe Bay, providing sportfishing opportunities for Arctic grayling, lake trout, and Arctic char (Figure 13; Bendock 1980). There are numerous small lakes between Ribdon River (tributary to the Sagavanirktok River) and Galbraith Lake that provide good opportunities for these species (Figure 23; Bendock 1980).

Sportfishing also takes place on the Colville, Kongakut, Canning, Ivishak, Echooka, Killik, and Anaktuvuk rivers (Bendock 1979; ADFG 1986). Some fishing may also be done by parties floating the Nigu and Etivluk rivers (Bendock 1983).

Lakes in the vicinity of Toolik Lake and the Upper Kuparuk and Sagavanirktok rivers are the most frequently fished areas north of Atigun Pass (Bendock and Burr 1984). Other popular lakes along the Haul Road include Galbraith, Island, and Tea lakes (Bendock 1980). Lakes outside the Dalton Highway Corridor that receive some sportfishing effort include Elusive, Shainin, Itkillik, and Chandler lakes (Figures 20 and 22; Furniss 1974; NPS 1985a). Lakes that receive occasional sportfishing effort within the Colville River drainage include Cascade and Kurupa lakes (Figure 22; Bendock 1982).

AYK Area Climate

Because the area is so immense and varied in topography there is extreme variation in average annual climate. Except for the immediate coastal areas, the majority of the area has a continental type of climate, with cool summers and cold winters. Annual precipitation varies a great deal but generally tends to be sparse except for the areas under coastal influence. In lower latitudes, the amount of precipitation generally received in the AYK Area would result in arid conditions similar to those found in many deserts of the world. Because of cooler temperatures in Alaska, and the fact that a great deal of moisture is trapped in permafrost soils, desertification has not occurred, and, in fact, much of the area appears as if it received abundant moisture. Typical summer weather lasts from mid-June until late August or early September in some areas, with rainy weather typical during August and September. Snowfall is usually light even in the coastal areas of AYK, compared to other areas of the state with more abundant precipitation.

Primary Species For Sport Fishing

In addition to the species listed for the Tanana Area, Dolly Varden and/or Arctic char are important to sport fishing in the area.

Rainbow trout stocks do not naturally occur north of the Kuskokwim River and the streams of Kuskokwim Bay. Wild stocks of rainbow trout occur upstream in

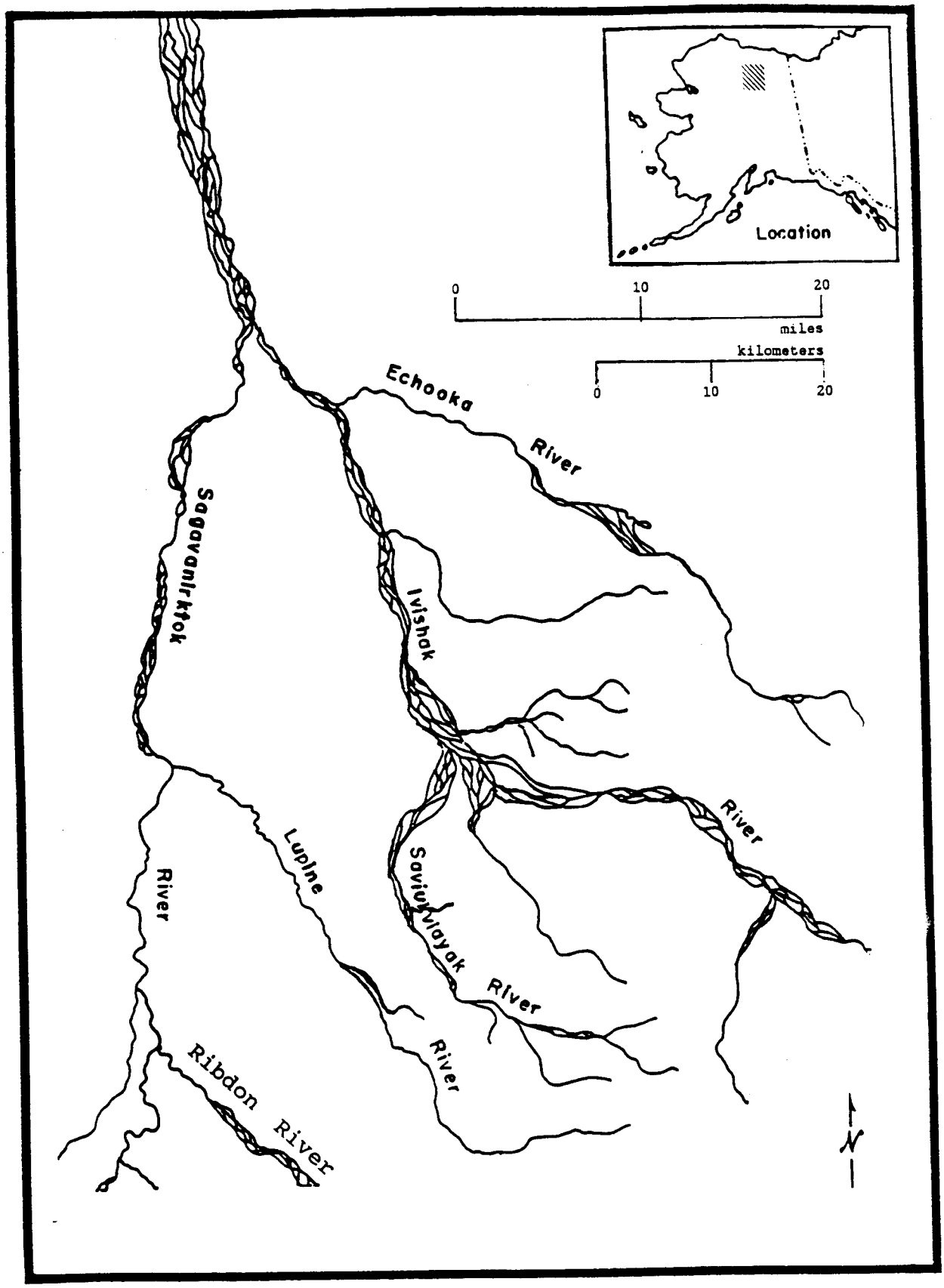

Figure 23. Principal tributaries of the Sagavanirktok River.

the Kuskokwim River drainage as far as the Aniak River and its tributaries. There have been no hatchery plantings of rainbow trout in the AYK Area.

Pink salmon are an important sport fish species in the Norton Sound and Seward Peninsula area. There is sport fishing effort in both freshwater and marine waters.

Additional species of whitefish that are of importance to fisheries in the AYK Area include the broad whitefish, *Coregonus nasus*, Arctic cisco, *Coregonus autumnalis*, and Bering cisco, *Coregonus laurettae*.

All other species listed under the Tanana Area are also found in the AYK Area.

Status and Harvest Trends of Wild Stocks

A brief description of the fisheries for the most prominent sport species in the AYK area follows.

Chinook Salmon:

Important stocks of chinook salmon spawn throughout the Kuskokwim and Yukon River drainages, and in the streams of eastern Norton Sound and the southern Seward Peninsula. While chinook salmon occur in streams north of the Seward Peninsula, no stocks yet identified are sufficiently abundant to support commercial or sport fisheries. Sport fishing is concentrated in only a few streams in the AYK Area, and the majority of the sport harvest is taken by local residents in remote areas. More intensive sport fishing has been observed in Norton Sound on the Unalakleet River and on the Seward Peninsula in parts of the Fish River system. In both these instances commercial guiding and lodging facilities have been developed in the area to promote sport fishing for salmon. Other areas of fishing pressure include the Holitna River in the Kuskokwim drainage where several guiding operations take sport fishermen into the drainage for salmon fishing. The Salmon River near Nikolai and McGrath also supports intensive sport fishing on a chinook salmon spawning stock by local people using rod and reel gear for subsistence purposes (Stokes 1985). An undocumented but substantial amount of angling for chinook salmon takes place on both the Andreafsky and Anvik rivers. Few chinook salmon are landed in the AYK and Tanana Areas compared to other management areas statewide (Mills 1987). Since 1980 the AYK chinook salmon sport harvest has ranged from about 2,000 to 4,000 fish, with the majority taken from non-Tanana, AYK Area streams (Mills 1987). The statewide postal survey indicates a modest increase in harvest since 1980, from levels of about 1,900 in 1980 to 1986 harvest estimates of about 2,900 chinook salmon (Table 2).

Coho Salmon:

While coho salmon are distributed widely south of the Brooks Range in the AYK Area, their abundance drops off markedly north of the Kuskokwim River. Kuskokwim River coho salmon returns may be the largest to a single river in Alaska. Approximately 660,000 coho salmon were harvested by commercial fishmen in the Kuskokwim River in 1986, the historic record high commerical harvest year for this system (Francisco et al. 1987). Coho salmon are

Table 2. Arctic-Yukon-Kuskokwim Alaska sport fish harvests by species, 1977-1986[1].

Species	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Chinook Salmon	499	1,095	1,159	1,880	1,875	2,514	3,697	1,819	2,687	2,860
Sea-Run Coho Salmon	973	1,447	2,983	3,536	2,132	5,961	5,932	12,036	3,192	8,693
Landlocked Coho/ Chinook Salmon	7,151	22,412	36,073	25,733	57,294	43,374	34,255	29,245	41,042	24,061
Sockeye Salmon	69	85	126	112	117	430	261	650	169	439
Kokanee Salmon	0	0	0	0	0	0	0	0	0	0
Pink Salmon	2,524	8,328	2,918	7,844	3,118	14,214	5,286	8,712	1,206	3,404
Chum Salmon	1,246	1,992	1,701	2,773	3,640	5,781	4,698	3,274	3,036	4,336
Steelhead	0	0	0	0	0	0	0	0	0	0
Rainbow Trout	6,215	6,768	5,587	20,419	25,553	26,982	22,447	35,477	34,091	31,774
Cutthroat Trout	0	0	0	0	0	0	0	0	0	0
Brook Trout	0	0	0	0	0	0	0	0	0	0
Lake Trout	2,269	1,100	1,601	2,289	2,821	5,127	4,094	3,624	5,354	3,250
Dolly Varden/ Arctic Char	4,908	4,538	8,508	8,797	8,748	14,129	20,617	13,232	14,660	10,373
Arctic Grayling	67,168	94,564	89,472	100,546	96,180	108,796	123,163	99,142	81,226	65,725
Northern Pike	11,661	11,753	11,979	15,642	15,125	17,257	18,834	14,217	15,703	18,996
Whitefish	4,154	7,482	6,014	7,692	5,449	12,351	13,057	11,892	20,860	31,770
Burbot	1,773	1,889	2,097	3,363	4,806	5,783	5,595	5,933	5,215	5,611
Sheefish	1,247	1,291	1,542	2,411	2,239	3,281	3,323	3,947	2,520	3,721
Smelt	0	0	0	0	0	0	0	0	8,750	464
Halibut	0	0	0	0	0	0	0	0	62	0
Rockfish	0	0	0	0	0	0	0	0	0	0
Razor Clams	0	0	0	0	0	0	0	0	0	0
Other Fish	3,214	1,293	2,297	3,513	3,232	8,561	8,827	1,883	1,336	1,349
Total	115,071	166,037	174,057	206,550	232,329	274,541	274,086	245,083	241,109	216,826

[1] From Mills 1987.

believed to spawn primarily in spring-fed streams in western Alaska. The upper Kuskokwim River and its tributaries that drain the northern slopes of the Alaska Range, is extensively underlain with alluvial gravels as a result of outwash from the Alaska Range. These gravel aquifers provide spawning and rearing waters for coho salmon in the Kuskokwim drainage and fall chum salmon in the Yukon and Tanana River drainages. Statewide creel census results in 1986 indicate that relatively few coho salmon were taken in streams of the Kuskokwim River and Yukon River exclusive of the Tanana River area (Mills 1987). The sport harvest of coho salmon from the interior area in 1986 was estimated at 3,378 fish, of which 2,010 were taken from the Kanektok River (Table 3).

Coho salmon are an important sport species north of the Yukon River in Norton Sound, where coastal and stream fisheries occur at least as far north as Teller. Several streams of eastern Norton Sound (Figures 11 and 15) including the Unalakleet, and Shaktoolik, Fish, and Niukluk rivers support runs of coho salmon, as do many of the streams in the Nome area, Port Clarence, and Safety Sound. Active sports fisheries occur in these areas for coho salmon. Statewide survey results for 1986 estimate the Norton Sound coho salmon harvest to be 3,926 fish, of which 1,605 were taken in the Unalakleet River (Table 4). Coho salmon occur north of Port Clarence, but as with other rearing salmon species, their abundance decreases markedly at higher latitudes.

Pink Salmon:

This species rarely undertakes extensive freshwater migrations (more than 160 km) and as a consequence, it is not an abundant species upstream of the lower main stems of the major river systems of the AYK Region. For example, pink salmon seldom ascend the Yukon River beyond the Anvik River, or the Kuskokwim River beyond the Holitna River. A harvest of fewer than 1,000 fish was estimated by the statewide harvest survey for all AYK census areas except Norton Sound (Mills 1987).

Pink salmon are an important sport species in Norton Sound where harvest estimates have ranged from 1,100 (1985) to more than 13,000 (1982). The ten year average sport harvest is 5,450. Pink salmon utilize a great many streams in Norton Sound for spawning, and in some years the returns are astoundingly large. Extremely large returns have been recorded for the Unalakleet River, the Kwiniuk River and Tubutulik River (Lean et al. 1986). For example more than 6 million pink salmon were estimated to have spawned in the Unalakleet River in 1984 (Lean 1985). Returns of this species are extremely variable even in more southerly latitudes. Cyclic dominance is not as evident in Norton Sound and in more northerly areas, although the magnitude of return variation is probably larger because (presumably) of the greater climatic variation at higher latitudes. Snow cover and depth and average monthly temperatures during the winter months have a profound effect on ice depth and the amount of frozen versus unfrozen ground water in local streams of the area. Salmon egg and fry survival rates are in turn directly affected by the amount of freezing in the groundwater and stream gravels where incubation takes place.

Table 3. Interior Alaska[1] sport fish harvest and effort by fisheries and species[2], 1986[3].

	Anglers	Trips	Days Fished	KS	SS	LL	RS	PS	CS	LT	DV AC	RT	GR	WF	SF	NP	BB	SM	HA	OTHER
SALTWATER:																				
Boat	26	45	31	0	0	0	0	0	0	0	245	0	0	0	0	0	0	0	0	0
SALTWATER TOTAL	26[4]	45	31	0	0	0	0	0	0	0	245	0	0	0	0	0	0	0	0	0
FRESHWATER:																				
Kanektok River	1,495	3,503	8,825	938	2,010	0	200	72	777	9	1,213	259	213	0	0	0	0	0	0	0
Other Streams	1,022	1,687	2,527	49	1,368	0	122	98	245	0	391	221	953	245	194	856	146	0	0	0
Lakes	73	90	459	0	0	0	98	0	0	1,101	0	24	73	0	0	0	0	0	0	0
FRESHWATER TOTAL	2,519[4]	5,280	11,811	987	3,378	0	420	170	1,022	1,110	1,604	504	1,239	245	194	856	146	0	0	0
GRAND TOTAL	2,539[4]	5,325	11,842	987	3,378	0	420	170	1,022	1,110	1,849	504	1,239	245	194	856	146	0	0	0

1 Interior Alaska (Area V): All southern drainages of the Yukon River from its confluence with the Tanana River to Kaltag; all drainages of the Yukon River south of Kaltag, including the Kuskokwim River and all waters flowing into Kuskokwim Bay; does not include the Tanana River and the Koyukuk River drainages.

2 KS: chinook salmon; SS: coho salmon; LL: landlocked coho or chinook salmon; RS: red salmon; PS: pink salmon; CS: chum salmon; LT: lake trout; DV/AC Dolly Varden or Arctic char; RT: rainbow trout; GR: grayling; WF: whitefish; SF: sheefish; NP: northern pike; BB: burbot; SM: smelt; HA: halibut.

3 From Mills 1987.

4 Angler totals may not equal sum of sites due to some anglers fishing at more than one site.

Table 4. Seward Peninsula-Norton Sound[1] sport fish harvest and effort by fisheries and species[2], 1986[3].

	Anglers	Trips	Days Fished	KS	SS	RS	PS	CS	DV AC	GR	WF	SF	NP	BB	SM	OTHER
SALTWATER:																
Boat	238	217	283	0	113	0	38	0	264	0	0	0	0	0	0	0
Shoreline	272	588	567	0	38	19	19	76	76	0	0	0	0	0	0	566
SALTWATER TOTAL	509[4]	805	850	0	151	19	57	76	340	0	0	0	0	0	0	566
FRESHWATER:																
Unalakleet River	782	2,814	6,457	850	1,605	0	1,208	982	2,284	1,227	510	0	0	0	189	0
Nome River	1,087	2,350	6,023	0	415	0	491	76	1,057	491	0	0	0	0	0	0
Other Streams	1,258	2,446	2,889	38	396	0	1,001	585	681	1,210	0	0	680	0	0	0
Systems	850	650	1,888	189	1,359	0	415	0	1,359	1,114	0	0	19	0	0	0
FRESHWATER TOTAL	2,872[4]	8,260	17,257	1,077	3,775	0	3,115	1,643	5,381	4,042	510	0	699	0	189	0
GRAND TOTAL	3,381[4]	9,065	18,107	1,077	3,926	19	3,172	1,719	5,721	4,042	510	0	699	0	189	566

1 Seward Peninsula-Norton Sound (Area W): All drainage area north of the Yukon River drainage, including all saltwater north and west of Pastol Bay in Norton Sound; and, south of the Selawik River drainage. Does not include the Selawik River.

2 KS: chinook salmon; SS: coho salmon; RS: red salmon; PS: pink salmon; CS: chum salmon; DV/AC Dolly Varden or Arctic char; RT: rainbow trout; GR: grayling; WF: whitefish; SF: sheefish; NP: northern pike; BB: burbot; SM: smelt.

3 From Mills 1987.

4 Angler totals may not equal sum of sites due to some anglers fishing at more than one site.

Non-rearing species such as pink and chum salmon may have an advantage in many of the AYK streams where freshwater productivity is much lower than in lower latitudes. Sport and subsistence fisheries in the Nome area for pink salmon in local streams such as the Nome, Snake and Sinuk rivers is particularly intense in late July and early August.

Arctic Grayling:

Arctic grayling occur throughout the entire AYK Area and may be the most ubiquitous and highly sought after sport fish species in northern, western and interior Alaska. Most of the freshwater drainages that have been surveyed along the arctic coast contain Arctic grayling (USFWS 1982). It is the principal species inhabiting foothill lakes and streams on the Seward Peninsula and they occur in lakes and streams emptying into the Chukchi Sea between Kotzebue and Barrow (ADFG 1978, 1986). Arctic grayling also occur throughout the main stems and tributaries of the largest rivers in the region, including the Yukon, Kuskokwim, Noatak, and Kobuk rivers.

Arctic grayling typically spawn in smaller, clear, headwater streams with gravel bottoms and low stream gradients, usually during May and early June. After spawning, the adults disperse throughout the streams for summer feeding and rearing. Overwintering occurs in lower stretches of tributaries where sufficient water and oxygen concentrations are present, as well as in lakes and spring fed portions of streams.

Summary descriptions of distribution, life history and abundance of Arctic grayling in the AYK Region are provided in the two volume Alaska Habitat Management Guides for the Interior, Western and Arctic Regions (ADFG 1986).

Statewide harvest survey results indicate that since 1977, the Arctic grayling harvest in the AYK region exclusive of the Tanana Area, has ranged from about 10,000 fish in 1977 to more than 30,000 in 1983. Since 1983, harvests have declined, ranging from 15,500 in 1984 to 19,700 in 1986 (Mills 1987). The Arctic grayling harvest is taken fairly evenly from the five sub-areas of the region, from 2,000 to 9,000 Arctic grayling in each sub-area (Tables 1 - 7). The largest harvests during 1983, (the historic high harvest year) were in the interior area (9,095), the Seward Peninsula/Norton Sound area (8,241), followed by the south slope of the Brooks Range area (6,181; Mills 1987).

Northern Pike:

Sloughs, interconnected lakes, and the lower sections of large rivers throughout much of the region are inhabitated by northern pike. Lowland areas of the Yukon and Kuskokwim rivers are particularly noted for large northern pike populations. Northern pike are abundant in all parts of the AYK region where appropriate habitat is present except the north slope of the Brooks Range, where their distribution is limited. Bendock and Burr (1985) reported the presence of northern pike on the arctic coastal plain west of the Colville River, in rivers and lakes draining into Admiralty and Smith Bays (Figure 21). Northern pike also occur in middle reaches of the Killik River, tributary to the Colville River (Bendock and Burr 1985).

Table 5. Northwest Alaska[1] sport fish harvest and effort by fisheries and species[2], 1986[3].

	Anglers	Trips	Days Fished	KS	SS	RS	PS	CS	LT	DV AC	GR	WF	SF	NP	BB	SM	OTHER
SALTWATER:																	
Boat	24	45	31	0	0	0	0	0	0	0	0	0	0	0	0	183	0
Shoreline	171	445	538	0	0	0	0	0	0	229	0	0	168	0	0	92	612
SALTWATER TOTAL	131[4]	490	569	0	0	0	0	0	0	229	0	0	168	0	0	275	612
FRESHWATER:																	
Noatak River	391	601	1,116	0	0	0	31	566	229	520	1,238	168	0	1,009	0	0	0
Kobuk River	587	668	2,508	0	0	0	0	107	107	153	2,875	31	1,590	872	0	0	0
Other Streams	709	1,269	1,890	0	0	0	31	76	0	627	917	0	1,605	856	107	0	0
Lakes	121	133	230	0	0	0	0	0	168	0	91	0	0	15	0	0	0
FRESHWATER TOTAL	1,570[4]	2,671	5,744	0	0	0	62	749	504	1,300	5,121	199	3,195	2,752	107	0	0
GRAND TOTAL	1,649[4]	3,161	6,313	0	0	0	62	749	504	1,529	5,121	199	3,363	2,752	107	275	612

1 Northwest Alaska (Area X): Kotzebue area including drainages of Selawik, Kobuk, Noatak, Wulik, and Kivalina Rivers. All saltwater in the northern half of Kotzebue Sound to and including Point Hope.

2 KS: chinook salmon; SS: coho salmon; RS: red salmon; PS: pink salmon; CS: chum salmon; LT: lake trout; DV/AC Dolly Varden or Arctic char; GR: grayling; WF: whitefish; SF: sheefish; NP: northern pike; BB: burbot.

3 From Mills 1987.

4 Angler totals may not equal sum of sites due to some anglers fishing at more than one site.

Table 6. South Slope Brooks Range[1] sport fish harvest and effort by fisheries and species[2], 1986[3].

	Anglers	Trips	Days Fished	KS	SS	CS	LT	DV AC	GR	WF	SF	NP	BB	OTHER
Haul Road Streams	929	1,468	5,507	0	0	0	0	0	2,783	153	31	275	0	0
Other Streams	1,291	1,423	2,286	15	15	153	15	91	2,201	31	61	2,323	91	0
Haul Road Lakes	98	111	98	0	0	0	0	0	76	0	0	92	0	0
Other Lakes	425	453	844	0	0	0	493	0	183	46	0	46	31	0
TOTAL	2,408[4]	3,455	8,735	15	15	153	508	91	5,243	230	92	2,736	122	0

1 South Slope Brooks Range (Area Y): All drainages south of the Brooks Range and north of the Yukon River; including all northern drainages of the Yukon River from Kaltag to the Canadian Border, and, all drainages of the Koyukuk River and Alatna Rivers.

2 KS: chinook salmon; SS: coho salmon; CS: chum salmon; LT: lake trout; DV/AC Dolly Varden or Arctic char; GR: grayling; WF: whitefish; SF: sheefish; NP: northern pike; BB: burbot.

3 From Mills 1987.

4 Angler totals may not equal sum of sites due to some anglers fishing at more than one site.

Table 7. North Slope Brooks Range[1] sport fish harvest and effort by fisheries and species[2], 1986[3].

	Anglers	Trips	Days Fished	PS	CS	LT	DV AC	GR	WF	SF	NP	BB	SM	OTHER
SALTWATER:														
Shoreline	374	1,052	955	0	0	0	435	472	0	0	0	0	0	0
SALTWATER TOTAL	327[4]	1,052	955	0	0	0	435	472	0	0	0	0	0	0
FRESHWATER:														
Haul Road Streams	612	1,083	793	0	0	0	95	1,284	0	0	0	0	0	0
Other Streams	646	1,208	1,634	0	0	19	302	1,795	3,776	0	0	94	0	0
Haul Road Lakes	170	124	170	0	0	0	0	0	0	0	0	0	0	0
Other Lakes	340	465	1,227	0	0	396	151	548	0	0	19	0	0	0
FRESHWATER TOTAL	1,527[4]	2,880	3,824	0	0	415	548	3,627	3,776	0	19	94	0	0
GRAND TOTAL	1,854[4]	3,932	4,779	0	0	415	983	4,099	3,776	0	19	94	0	0

1 North Slope Brooks Range (Area Z): All Alaskan waters, including drainages, north of the Brooks Range and flowing into the Beaufort and Chukchi Seas to the north and east of Point Hope. Does not include Point Hope.

2 PS: pink salmon; CS: chum salmon; LT: lake trout; DV/AC Dolly Varden or Arctic char; GR: grayling; WF: whitefish; SF: sheefish; NP: northern pike; BB: burbot.

3 From Mills 1987.

4 Angler totals may not equal sum of sites due to some anglers fishing at more than one site.

During summer, northern pike are generally distributed near shore in shallow aquatic habitats with aquatic vegetation and a mud bottom. Northern pike have some tolerance for salinity since they are taken frequently in brackish waters of the Yukon-Kuskokwim Delta. They are not known to feed or travel extensively in marine or coastal waters outside the major rivers. During winter, northern pike congregate in deep, well-oxygenated waters found in the lower reaches of tributaries or other areas of sufficient water flow (Hallberg 1984).

The majority of the recreational harvest of northern pike is by rod and reel, although some spearing and hand jigging occurs. Productive northern pike fishing takes place in the Kuskokwim River drainage from McGrath downstream to below Bethel, including the Takotna, Nixon Fork, Holitna, and Johnson rivers. Most recreational fishing for northern pike on the Yukon River takes place in the middle and upper reaches, from Galena upstream. Popular areas include the Yukon Flats near Fort Yukon, Koyukuk River, Beaver Creek, Birch Creek, Dall River, Hess Creek, Tozitna River, Melozitna River, and Nowitna River. The Pilgrim River, as well as the Fish-Niukluk system in the Nome area are popular as well.

Major use of northern pike in the AYK area is probably for subsistence. Although harvest levels are largely undocumented they are thought to exceed recreational harvests. Much of the recreational and subsistence harvest is taken during winter months through the ice with hook and line gear.

Sport fishing for northern pike has gained in popularity since the early 1960's. In recent years public regard for the species has been enhanced (at least in urban areas) as more people have become aware that northern pike possess excellent qualities for food and angling. Northern pike are now eagerly sought by fishermen in areas that have good boat access. They are often fished for in the fall in combination with hunting activities.

The estimated sport harvest of northern pike in the AYK Area has ranged from about 2,000 fish in 1977 to more than 8,600 fish in 1983 (Mills 1979-1987). The estimated harvest in 1986 was 7,062 fish (Tables 3 - 7). The largest harvests have consistently been taken in the Interior subarea which contains the Yukon and Kuskokwim River drainages. Estimated 1986 harvests from the Northwest and south slope Brooks Range subareas were exceptionally strong however, compared to prior years, while the estimated catch from the Interior subarea was smaller than in past years (Tables 1 - 7).

Little is known concerning the status of northern pike stocks in the AYK Area but because of absence of a large human population, fishing effort is thought to be light to moderate except for stocks close to towns and villages that may receive more angling and subsistence gill netting effort. Northern pike populations close to the Yukon River Haul Road Bridge may have experienced more angling pressure because the recent opening of the road has allowed easy boat access to people living in the Fairbanks area. Northern pike population studies conducted in the Tanana River drainage have indicated that abundance and stock composition parameters such as age/size respond negatively and rather quickly when annual harvest exploitation rates exceed 20%.

Lake Trout:

Historically, approximately 35% of the total AYK Region harvest of lake trout has occurred in the AYK Area. In 1986, the percentage taken outside the Tanana River drainage was much larger (88%) due to declines in catch and perhaps abundance within the Tanana River drainage. Harvest values for the AYK Area since 1977 have ranged from about 500 fish in 1977 to about 2,500 in 1986 (Mills 1979-1987).

Recent research indicates that lake trout resources have been overharvested in many of the more accessible waters of south-central and interior Alaska, (Burr 1987b). Specific life history features (slow growth, delayed maturity, and non-consecutive spawning) combined with the shortened growing season at higher latitudes make the species more vulnerable to overharvest than other species in *Salvelinus*.

Burr (1987a) described the distribution of lake trout in Alaska. Lake trout are most frequently associated with deep, oligotrophic lakes in the mountains and are rarely found at lower elevations of the Yukon or Kuskokwim basins (Redick 1967; Morrow 1980). In northwest Alaska, lake trout occur in lakes and streams of the Brooks Range in the Noatak and Kobuk River drainages. Lake trout are found in most drainages that flow into the Yukon River from the Brooks Range. Lake trout distribution is primarily restricted to lakes at higher elevations in these drainages. Lake trout are widely distributed on the north slope of the Brooks Range. They occur most frequently in mountain and foothill lakes, but they also occur in streams of the Colville, Sagavanirktok, and Canning River drainages. Lake trout generally do not occur in the lowland lakes of the Arctic coastal plain, but they are common in central coastal plain lakes between the Ikpikpuk and Colville rivers.

The Department of Fish and Game has conducted little population research on this species outside of the Alaska Range area in the Tanana Valley and near Glennallen. Lake trout research is being conducted by federal agencies, such as USFWS, NPS (National Park Service), and BLM (Bureau of Land Management) in National Wildlife Refuges, National Parks, National Preserves and other unclassified lands.

Dolly Varden/Arctic Char:

Most of the harvest of Arctic char or Dolly Varden (collectively referred to as char in this section) in the region occurs in the AYK Area since only the dwarfed stream resident form is found in the upper Yukon and Tanana River systems. Char occur in most of the waters of western and arctic Alaska, either in the anadromous, river resident, lake resident, or stream dwarf forms. Char are a target species for subsistence and sport fisheries in waters of the Arctic, Kotzebue vicinity, Seward Peninsula, and Norton Sound.

Two species are recognized within the AYK Area based upon meristic characters, (gill raker and pyloric caecae counts), life history features and the occurrence of anadromy (Behnke 1980). Dolly Varden are the dominant species from Bristol Bay north to the arctic plain, and occur in either the anadromous, stream resident or stream dwarf form, while the Arctic char occurs

only as a lake resident form in foothills of the North Slope (Chandler Lake Figure 22), the Kobuk River drainage (Walker and Selby lakes Figure 18), the Seward Peninsula (lakes of the Kigluaik Mountains Figure 15), and the Kuskokwim Mountains (Aniak Lake and others, Figure 9). The majority of char in the AYK Area are Dolly Varden of either the stream resident or anadromous type. They occur throughout the area but are most abundant in tributaries of the lower Yukon and Kuskokwim rivers, Norton Sound, Northwest Alaska, and along the north slope of the Brooks Range and the arctic plain. Morrow (1980) distinguishes two distinct forms of Alaska Dolly Varden (*S. malma*) based upon gill raker and vertebral counts. Generally the southern form occurs only south of the Alaska range, however examination of specimens collected in the upper reaches of the Copper, Tanana, Nenana, and Susitna Rivers indicates the presence of southern and northern forms on both sides of the passes in the stream resident or stream dwarf forms. Morrow (1980) argues that headwater transfer, which may still be occurring, is responsible for the mixing of the southern and northern forms in these areas.

Sport harvests of char from 1977 to 1986 have ranged from approximately 4,000 fish to more than 20,000 fish in the AYK Area. This represents from less than 5% to about 20% of the statewide total harvest (Mills 1979-1987). High quality sport fishing for char is available in northwest Alaska, particularly in the Wulik River near Kotzebue where trophy Dolly Varden can be taken with hook and line in the fall when large adults move into the stream for either overwintering or spawning.

Burbot:

Burbot are distributed throughout the AYK Area in all major rivers and many of the lakes and minor waterways. It is an important fisheries resource for both the subsistence economy in rural Alaska and for sport fisheries throughout the area. Burbot are members of the cod family, *Gadidae*, and spawn in midwinter under the ice of rivers and lakes. Sport fishing interest and intensity has increased for the species in recent years, particularly near settlements where burbot fishing provides an outdoor wintertime activity for many people. Reported annual sport harvests of burbot in the AYK area since 1977 have ranged from just over 100 fish to approximatlely 2,000 (Mills 1979-1987). The majority of the harvest effort occurs in the winter with lines set through the ice, although hand lines with rod and reel are also used in summer and winter months.

Whitefish:

Although members of the whitefish family, *Coregonidae*, are seldom considered to have substantial recreational value, as a group they constitute an extremely important fisheries resource in the AYK area. They are taken year around by subsistence fisheries and are utilized both for human consumption as well as for dog food. In addition various whitefish species form a forage base for many of the predatory fishes such as northern pike, burbot, and sheefish. The most important species in northern, western and interior Alaska include the humpback whitefish, broad whitefish, round whitefish, Arctic cisco, least cisco, and Bering cisco.

Recreational fisheries throughout the area account for a very small portion of the total harvest of all species of whitefish. The magnitude of the subsistence harvest is not well documented, but is believed to be substantial. In some areas where salmon are not available, the whitefish harvest is the major source of fish for subsistence use. Such a situation prevails over the entire north slope, and in many of the remote villages of interior Alaska located beyond the extent of the majority of the salmon runs. Limited commercial fisheries for whitefish exist in the AYK Area. Further discussion of these is found in the Land Use, Habitat and Water Quality section, page 59.

Sheefish:

Sheefish (also known as Inconnu), are large, predacious whitefish found throughout western, interior, and northwestern Alaska. They do not occur in north slope streams nor in Norton Sound north of the Koyuk River. Alt (1987) recognized nine stocks of sheefish, with anadromous-estuarine stocks occurring in the Kuskokwim, Lower Yukon, Koyuk, Kobuk-Selawik rivers, and resident non-anadromous stocks in Yukon River tributaries of the Nowitna, Tanana River (Minto Flats), Porcupine, and Salmon Fork of the Black River, as well as the main stem of the upper Yukon River. The distribution of this species in Alaska is limited to the AYK Region.

Sheefish are harvested by subsistence, commercial, and recreational users with subsistence harvests exceeding all others. The major commercial fishery (Kotzebue Sound) is limited by a harvest quota of 11,350 kg or approximately 3,300 fish annually (Lean 1985). Reported sales of sheefish from this commerical fishery have only once (in 1977-78) reached the allowed quota (Lean et al. 1986). During the period from 1977-1986, the recreational harvest in the AYK Region ranged from about 1,250 to about 3,950 fish (Table 2). Kobuk and Selawik River sheefish are the most abundant and heavily fished stocks. Harvest pressure takes place on a year-round basis from subsistence, commercial and sport fishermen, from spawning grounds in the upper Kobuk River to Kotzebue and Selawik located on the large brackish inlets, Hotham Inlet and Selawik Lake. The data base for sheefish stocks of the Kobuk and Selawik Rivers is small and deficient in critical information which would allow the determination of sustainable yields for the stocks (Alt 1987). The size of the spawning stocks have been poorly documented in the past 20 years, as has the harvest and biological composition of the harvest. Because of the late sexual maturation (five to seven years) of the species, suspected non-consecutive spawning, and probable decrease in average adult size in the past 20 years, there is concern that the stocks may be experiencing harvests beyond sustainable levels. The question cannot be addressed until further biological information becomes available.

Sheefish generally overwinter in lower reaches of rivers and estuarine waters, migrate upstream in summer to feeding grounds, and migrate further upstream to spawning grounds in the late summer and fall. Migrations of over 1,650 km have been documented. Sheefish spawn in late September and early October at water temperatures of 0 - 5°C. They are broadcast spawners and spawn only in late afternoon and evening. Numbers of spawners have been estimated to range from 100 in the Chatanika River to 3,700 in the Kobuk River (Alt 1987). Spawning grounds have probably been identified for all major sheefish stocks.

Availability of spawning habitat with desired current (2 m per sec), water depth (2 m), and bottom substrate of differentially-sized gravels may the most critical factor limiting sheefish distribution and abundance (Alt 1987).

Alt (1987) presents evidence that a spawning population of sheefish exists in the main stem of the Yukon River in the section between Beaver Village and Fort Yukon, and notes that attempts to find spawning in the tributaries in this section of the Yukon failed to detect the presence of spawning fish.

STAFF ORGANIZATION

Regional Staff Responsibilities

Regional staff members during 1986 are outlined in the staffing flow chart (Figure 24). All activities were supervised under the overall direction of the Regional Supervisor (J. Clark) who delegated to the Administrative Assistant (E. Nielsen) and the following Fishery Biologist III's: R Holmes, R. Peckham, K. Alt, and M. Kramer. Lake stocking and enhancement activities were the responsibility of M. Doxey. Area management responsibility and emergency order authority was vested with three positions, K. Alt (AYK area), R. Peckham (Upper Tanana River Area), and J. Hallberg (Lower Tanana River Area). Each of the area managers was also responsible for research projects in the respective areas. The AYK Area biologist was responsible for char and sheefish projects, the Upper Tanana River Area biologist for pike and burbot research projects, and the Lower Tanana River biologist for burbot and whitefish projects. Special research was conducted by W. Ridder on Arctic grayling in Shaw Creek, the Delta Clearwater River, Richardson Clearwater River, Goodpaster River, Fielding Lake, and Tangle lakes, all in the upper Tanana Valley. Arctic grayling research in the Salcha and Chena rivers near Fairbanks was conducted by R. Holmes and R. Clark. Heavy research emphasis was dedicated to the high-use Arctic grayling fisheries near the urban centers. Char research was conducted in northwest Alaska by A. DeCicco. Lake trout research in the Tanana River drainage was conducted primarily by J. Burr. Burbot research in lakes of the upper Tanana Valley was conducted by F. Parker. Sheefish research in the AYK area was conducted by K. Alt. Information and education were the duties of M. Kramer.

Synopsis of Major Sport Fisheries Research in 1986

The intent of the following section is to provide a brief overview of AYK Region fisheries studies that were completed during the reporting year. Since virtually all activities were documented with reports at the end of the year, the report itself will be cited, followed by a brief synopsis.

Alt, K. T. 1987. Review of Sheefish *Stenodus leucichthys* in Alaska. Alaska Department of Fish and Game, Fisheries Manuscript Number 3. 69 pp.

The paper is a summary of knowledge from more than 20 years of study of sheefish in Alaska. Nine stocks of sheefish are recognized in Alaska from the Kuskokwim River system north to the Kobuk-Selawik River. The Kuskokwim, Lower Yukon, Koyuk, and Kobuk-Selawik stocks are considered to be estuarine-

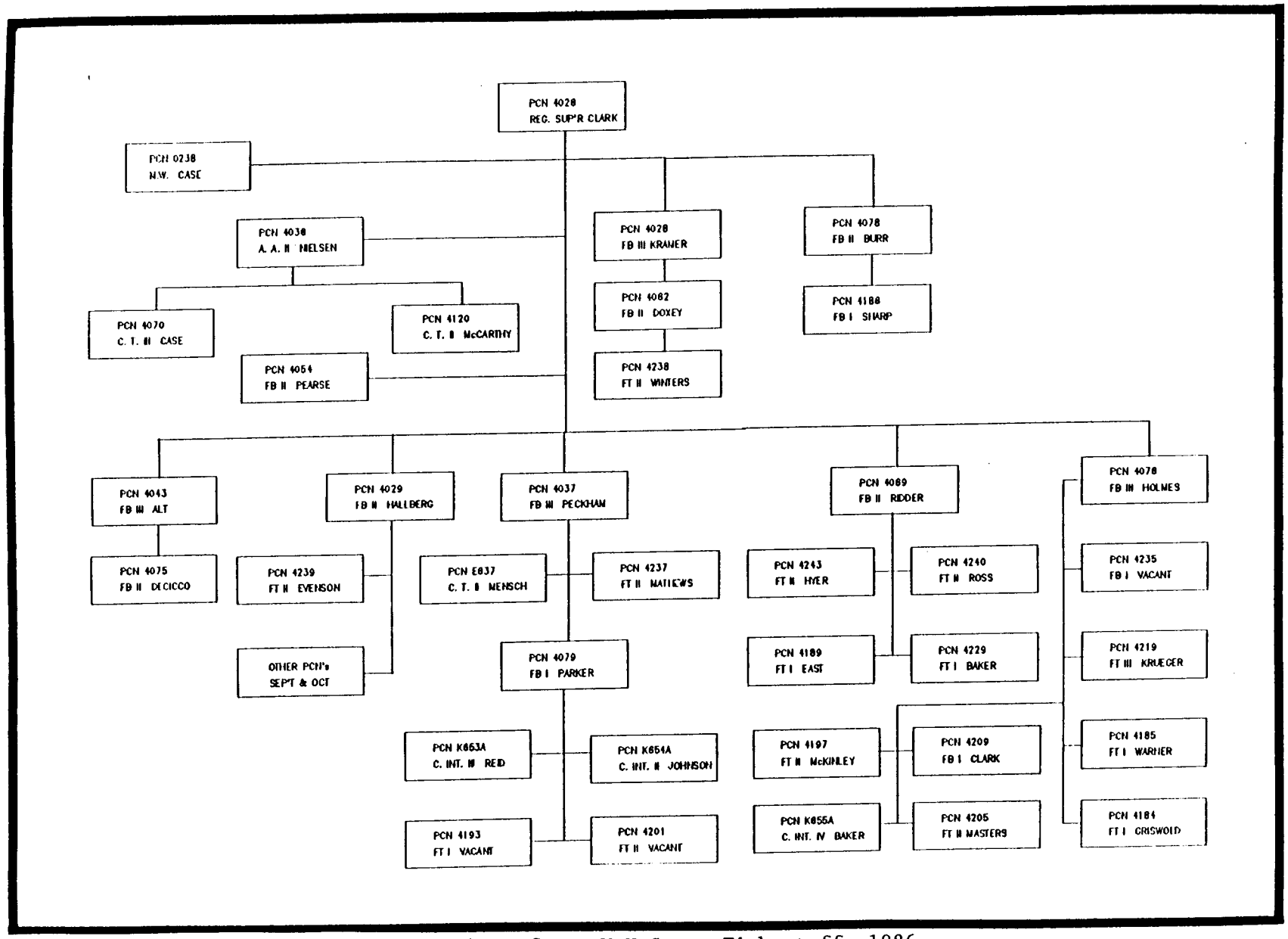

Figure 24. Organizational chart for A-Y-K Sport Fish staff, 1986.

anadromous, while resident non-anadromous stocks occur in Yukon River tributaries; Nowitna, Tanana, Porcupine, Salmon Fork of the Black, and the Upper Yukon River itself. Life history, size at age, growth, migratory behaviour, population size and distributuion, harvest history and enhancement efforts are described.

Bernard, D. R. and A. L. DeCicco. 1987. Stock assessment of the Dolly Varden Char of Kotzebue Sound. Alaska Department of Fish and Game. Fishery Data Series Number 19. 28 pp.

Spawning and overwintering stock abundance and age, sex, and size composition of commercial and subsistence catches are described. Studied stocks include those of the Kivalina, Wulik, and Noatak rivers.

Burr, J. M. 1987a. Synopsis and bibliography of Lake trout, *Salvelinus namaycush* in Alaska. Alaska Department of Fish and Game. Fishery Manuscript No. 5. 50 pp.

The report reviews literature from studies conducted on late trout in Alaska. Distribution, age, growth, age at maturity, and the sport harvest are discussed.

Burr, J. M. 1987b. Stock assessment and biological characteristics of lake trout populations in interior Alaska, 1986. Alaska Department of Fish and Game. Fishery Data Series No. 35. 65 pp.

The study was designed to evaluate and monitor the structure of lake trout populations in interior Alaska and determine the effects of sport fisheries on lake trout stocks. Although lake trout greater than 20 years old were not uncommon, the majority of lake trout sampled were between 4 and 20 years old. Age and length at maturity of lake trout was examined in the study lakes.

Clark, R. A. and W. P. Ridder. 1987a. Abundance and length composition of selected Arctic grayling stocks in the Tanana Drainage during 1986. Alaska Department of Fish and Game. Fishery Data Series No. 26. 55 pp.

Arctic grayling were captured in seven river systems and two lake systems of the Tanana drainage of interior Alaska in 1986. In four of these systems, population abundance was estimated for a whole system or sections of a system. Population estimates ranged from 61,581 Arctic grayling greater than 150 mm (FL) in the Chena River to 410 Arctic grayling greater than 150 mm (FL) in a 4.8 km section of the Goodpaster River. There was a continuing trend towards declining population size of Arctic grayling in the river systems of the Tanana River drainage. Age compositions in river systems of the Tanana River drainage are compared and predictions of year class strength from observed river discharge during the natal year are discussed in relation to implementation of special sport fishing regulations.

Clark, R. A. and W. P. Ridder. 1987b. Tanana drainage creel census and harvest surveys, 1986. Alaska Department of Fish and Game. Fishery Data Series No. 12. 91 pp.

Creel surveys were conducted on sixteen of the major Tanana Drainage fisheries from the spring of 1986 to spring of 1987. Angler effort, catch rates, and harvests were estimated for ten of these fisheries. Catch rates were estimated for the other six fisheries. While harvests of Arctic grayling in the two major fisheries (upper Chena River and Delta Clearwater River) were at historic lows in 1986, relatively high harvests and catch rates were estimated for the major stocked lake fisheries of the Tanana Drainage.

Doxey, M. 1987. Tanana drainage lake stocking evaluations, 1986. Alaska Department of Fish and Game. Fishery Data Series No. 31. 32 pp.

In 1986, a combined total of 1,453,655 rainbow trout, Arctic grayling, coho salmon, chinook salmon, sheefish and Arctic char was stocked into 55 lakes and ponds in interior Alaska. A mark-recapture population estimate of rainbow trout stocked as subcatchables in Birch Lake indicated that 57% had survived to catchable size. A mark-recapture estimate of rainbow trout and coho salmon abundance was completed in Quartz Lake. The total abundance of rainbow trout greater than 170 mm was estimated at only 10,479 fish, and the abundance of coho salmon estimated at 21,503 fish. Netting was performed in some stocked lakes and ponds to evaluate stocking success and growth of stocked fish. Most stocking attempts were successful and sport fishing potential was judged to be increased. No sheefish that were stocked into Harding Lake in 1982 and 1984 were caught during sampling.

Hallberg, J. E., R. A. Holmes, and R. D. Peckham. 1987. Movement, abundance and length composition of 1986 Tanana River burbot stocks. Alaska Department of Fish and Game. Fisheries Data Series No. 13. 21 pp.

A total of 3,541 burbot were tagged and released in the Tanana River in 1986. Tag returns since 1983 indicated that burbot tended to move upstream after release. The greatest movement recorded was a 256 km upstream movement by a burbot over a period of 1,244 days. Sampling was conducted using baited hoop traps during 1986 in 11 study sections of the Tanana River. Catch-per-unit of effort (CPUE) data were collected for an index of burbot abundance. Average CPUE ranged from a low of 1.16 burbot per net-night near Fairbanks to a high of 20.0 burbot per net night near Healy Lake outlet. A mark-recapture population estimate of the number of burbot 300 mm and greater in length was conducted in a 6.4 km subsection of the Tanana River near Rosie Creek. The estimated abundance was 2,892 burbot. Only slight differences in length frequency of burbot between river sections was documented and no clear segregations of burbot by size to specific areas was noted. Growth rates by sex were similar.

Hallberg, J. E. and R. A. Holmes. 1987. Abundance and size composition of Chatanika River least cisco and humpback whitefish with estimates of exploitation by recreational spear fishermen. Alaska Department of Fish and Game. Fishery Data Series No. 25. 26 pp.

Mark-recapture experiments, side-scan sonar, and visual counts of passing fish were methods used to estimate abundance of whitefish in the fall spawning migration in the Chatanika River during 1986. Estimates were 87,912 and 92,038 whitefish from mark-recapture and tower count expansion, respectively.

The run was composed of 83% least cisco and 17% humpback whitefish. Estimated rates of exploitation by the recreational spear fishery were 0.218 to 0.227 for least cisco and 0.159 to 0.170 for humpback whitefish.

Holmes, R. A. 1987. Profiles and regulatory preferences of Tanana River drainage sport fishermen. Alaska Department of Fish and Game. Fishery Manuscipt No. 2. 44 pp.

Motives for fishing, angler descriptions, and angler preferences for a variety of fishery management and regulation options were evaluated using a postal questionnaire of Tanana drainage sport fishermen. Differences found in angler group preferences demonstrate the need for fishery managers to provide a variety of fishing opportunities to meet the needs of a diverse angling public.

Parker, J. F., W. D. Potterville, and D. R. Bernard. 1987. Stock assessment and biological characteristics of burbot in lakes of interior Alaska during 1986. Alaska Department of Fish and Game. Fishery Data Series No. 14. 58 pp.

Abundance and/or indices of abundance of burbot were estimated for populations in 20 Alaskan lakes. Burbot were not fully recruited to hoop traps until greater than 450 mm in length. Abundance of large burbot estimated with mark-recapture was greatest in Paxson (9,111), Louise (6,990), Moose (2,027), and Tolsona (1,901) lakes. Mean CPUE for large burbot was high in June and July, dropped in August and September, and rose in October in most lakes. Size composition of burbot populations varied widely among lakes with some having no large burbot at all. No differences in the growth and age of male and female burbot were found.

Pearse, G. 1987. An annotated bibliography of burbot (*Lota lota*) with emphasis on studies conducted on northern and Alaskan burbot stocks. Alaska Department of Fish and Game. Fisheries Manuscript No. 4. 134 pp.

A worldwide literature search on the genus *Lota* was completed to clarify the status of current knowledge of burbot biology. A total of 599 primary and secondary references were obtained using several computer literature search facilities as well as library searches. Key words are listed for each reference, and a key word index is presented. A short annotation is also provided for each article that the author reviewed.

Peckham, R. D. and D. R. Bernard. 1987. Northern pike abundance and composition study. Alaska Department of Fish and Game. Fishery Data Series No. 27. 41 pp.

Northern pike populations in Volkmar, T, and George lakes near Delta Junction, Alaska were sampled in 1986, with gill nets, trap nets and seines. Estimates of abundance from Petersen mark-recapture experiments were 4,026 and 454 northern pike $\geq$ 450 mm fork length in Volkmar and T lakes respectively. Gill nets selected larger northern pike. Catchability coefficients for different-size mesh panels, parameters for length-weight, length-at-age, and weight-at-age relationships were calculated. Estimates of sex composition and average

growth by individual fish are given. Capture rates of northern pike dropped dramatically after early June.

Skaugstad, C. and W. Ridder. 1987. Evaluation of Arctic grayling enhancement in the Tanana drainage during 1986. Alaska Department of Fish and Game. Fisheries Data Series No. 9. 14 pp.

Release timing and rearing methods for Arctic grayling fingerlings stocked in the Delta Clearwater River since 1983 are compared for relative survival and contribution to the sport fishery. Although the results are somewhat inconclusive, Arctic grayling stocked in late September and early October returned to the river in greater proportions than those stocked earlier in the summer. Two roadside ponds near Fairbanks were stocked with Arctic grayling fingerlings in September 1985. Estimated survival in June 1986 of stocked Arctic grayling in one pond was 0.33. Mean growth in length over a 10 month period in the two ponds was 40 and 43 mm, respectively.

AREA FISHERY REPORT

Harvest and Effort in 1986

Harvest information for Region III (AYK) sport fisheries, was obtained from either the "Alaska Statewide Sport Fisheries Harvest Report" (Mills 1987) or from creel census studies on specific AYK fisheries, conducted by area personnel, and summarized by Clark and Ridder (1987b).

Creel censuses provide information on both the harvest and exploitation rates associated with selected sport fisheries. Estimates of catch, effort, CPUE and biological characteristics of the catch are obtained from a creel census. Creel census studies may solicit angler opinion such as ratings of fishing quality, or choice of regulatory and management options being considered for a particular fishery. Also, demographic profiles of fishermen utilizing a fishery are often obtained during the creel interview process. Methods consist of on-site interviews of random samples of sport fishermen in the selected fishery. The creel census program is designed to monitor both the fishery and the fish populations, develop regulations that insure sustained yield, reflect the desires of the angling public, and determine the effect of management regulations on the fishery and affected fish stocks. All creel census information collected in 1986 is summarized and reported by Clark and Ridder (1987b).

In summary, Arctic grayling harvests in the two largest fisheries of the Tanana drainage (upper Chena River and the Delta Clearwater River) were at historic lows in 1986 with catches of 3,326 and 1,701 Arctic grayling, respectively. Catch rates of Arctic grayling spring fisheries were also at record lows in 1986, ranging from 0.65 fish harvested per hour in Piledriver Slough to 0.09 fish harvested per hour in Badger Slough. Catch rates in two major lake trout fisheries (Fielding Lake and Tangle lakes; Table 8) averaged from 0.06 fish harvested per hour to 0.11 fish harvested per hour. Relatively high harvests and catch rates were estimated for the major stocked lake fisheries. Above average catch rates and harvest occurred for least cisco

Table 8. Tanana drainage creel surveys, 1986.

Water Body/Fishery	Date	Effort (hours)	CPUE	Harvest
Upper Chena River Grayling	May-Sept	10,716	0.31	3,326
Delta Clearwater Grayling	May-Sept	5,481	0.31	1,701
Badger Slough Grayling	1 May-8 Jun	ND	0.09	ND
Piledriver Sl. Grayling	1 May-8 Jun	ND	0.65	ND
Chena River Dam Grayling	1 May-8 Jun	ND	ND	ND
Shaw Creek Grayling	24 Apr-4 May	1,003	0.27	270
Fielding Lake Grayling	24 Jun-31 Aug	1,866	0.31	573
Fielding Lk Outlet Grayling	24 Jun-31 Aug	508	0.45	228
Fielding Lake Lake Trout	24 Jun-31 Aug	1,283	0.06	72
Lower Tangle Lk Grayling	24 Jun-31 Aug	ND	0.43	ND
Upper Tangle Lk Grayling	24 Jun-31 Aug	ND	1.18	ND
Tangle River Grayling	24 Jun-31 Aug	ND	1.24	ND
Lower Tangle Lake Trout	24 Jun-31 Aug	ND	0.11	ND
Upper Tangle Lake Trout	24 Jun-31 Aug	ND	ND	ND
Tangle River Lake Trout	24 Jun-31 Aug	ND	0.11	ND
Chena Lake Rainbow Trout	1 Jun-31 Aug	7,312	0.93	6,743
Chena Lake Coho	1 Jun-31 Aug	7,312	0.14	1,043
Birch Lake Rainbow Trout	19 May-31 Aug	15,746	0.16	2,534
Birch Lake Coho	19 May-31 Aug	15,746	0.03	466
Quartz Lake Rainbow Trout	19 May-31 Aug	27,008	0.30	8,088
Quartz Lake Coho	19 May-31 Aug	27,008	0.29	7,906
Chena Lake Rainbow Trout	15 Nov-29 Apr	ND	0.56	ND
Chena Lake Coho	15 Nov-29 Apr	ND	0.77	ND
Birch Lake Rainbow Trout	15 Nov-29 Apr	ND	1.12	ND
Birch Lake Coho	15 Nov-29 Apr	ND	0.53	ND
Quartz Lake Rainbow Trout	15 Nov-29 Apr	ND	0.35	ND
Quartz Lake Coho	15 Nov-29 Apr	ND	0.81	ND
Salcha River Chinook	7 Jul-28 Jul	11,242	0.05	526
Chatanika River Least Cisco	14 Sep-14 Oct	3,309	5.01	16,575
Chatanika River Humpback WF	14 Sep-14 Oct	3,309	0.76	2,528

during the whitefish spear fishery on the Chatanika River, and the harvest of chinook salmon on the Salcha River (525) was considered average.

The statewide postal survey, compiled annually since 1977 by Mills (1979-1987) serves as the basic reference of effort and harvest in those fisheries not censused by on-site surveys. Many important Tanana drainage fisheries have not received intense monitoring effort by Department creel censuses, and several fisheries are currently monitored only on a cursory basis whereby CPUE and biological catch composition data are collected, but not seasonal harvest totals. In cases where creel surveys are incomplete or not done at all, the statewide survey is a useful source of information. It is also instructive to compare harvest estimates derived from creel surveys, where available, with those from the statewide survey, as in Table 9. Fisheries within the Tanana Area for which data from the statewide harvest and regional creel census are comparable, yield estimates of harvest that are within 5% of each other (Table 9). While no established protocol exists to determine which harvest estimate should be accepted if results from the two survey methods differ substantially, common practice is to use the most reasonable of the estimates based upon prior information, observation, and common sense.

Harvest and effort data presented are obtained primarily from the Alaska Statewide Sport Fish Harvest report published by the Sport Fisheries Division of the Alaska Department of Fish and Game. This report is based upon responses to postal surveys sent to a random sample of resident and nonresident Sport Fish license holders. Approximately 4% of all sport fishing license holders are surveyed annually for the harvest survey, and in 1986 a total of 13,545 questionnaires were mailed out, followed by two reminders to non-respondents. Responses were obtained from more than 57% of the individuals that received the first mailing.

Results of the 1986 harvest report for the Tanana River drainage fisheries are based on a total of 1,499 respondents (Mills 1987). In 1986, Tanana Area anglers accounted for 77% and 10% of the total number of all anglers in AYK and the entire state of Alaska, respectively (Table 10). Of the 1.2 million freshwater fish harvested (excludes anadromous salmonids) in the state, 146,354 or 12% were taken from the Tanana drainage (Table 10).

Harvest data were obtained and reported for a total of 20 fisheries within the Tanana Drainage. A summary of harvest by fishery and species for the Tanana Area is presented in Table 1.

Postal survey results for 1986 for the subareas within the AYK Area are summarized in Tables 3 through 7. The AYK sport fish harvest by species by year (1977-1986) is presented in Table 2.

MANAGEMENT ACTIVITIES

1986 In-Season Regulatory Measures

Studies initiated in 1984 and 1985 identified a number of conservation problems that needed to be addressed through the regulation process.

Table 9. Comparison of 1986 Alaska Sport Fish Survey and Tanana River drainage creel census harvest estimates.

Fishery	Creel survey	Harvest survey
Upper Chena River		
Arctic grayling	3,326	3,695
Chatanika River		
Whitefish	19,686	22,038
Salcha River		
Chinook salmon	526	525
Chena Lake		
Landlocked salmon	1,043	1,778
Rainbow Trout	6,743	7,001

Table 10. Number of sport anglers, fishing trips, angler days and total freshwater[1] fish harvested in the Tanana River drainage, AYK and the entire state of Alaska, 1986[2].

	Tanana Drainage	AYK[3]	Alaska
Number Sport Anglers	34,835	45,248	359,383
Number Fishing Trips	113,669	138,607	1,650,299
Number Angler Days	144,937	194,713	2,071,412
Total Fish Harvested	146,354	197,094	1,245,380

[1] Excludes anadromous salmonids.
[2] Mills 1987.
[3] Inclusive of Tanana Drainage.

Substantial changes in Region III sport fisheries regulations were thereby initiated in 1986 as a result of those studies. Lake trout, Arctic grayling and lake burbot populations in lakes and streams of the Tanana Area were the subject of many of the proposed new regulations.

Emergency Orders:

The Alaska State Legislature, in enacting AS 16.05.060, delegated to the Commissioner and his authorized designees the power to control certain aspects of public utilization of fish and game. Statuatory authority for emergency orders is limited to changes in time and area regulations only, so that seasons or areas may be opened or closed and weekly closed periods may be changed. Emergency orders may not be used to establish or change quotas, bag limits, size limits or gear restrictions among other things. Emergency orders have the same force and effect as regulations of the Boards of Fisheries and Game, and statutes enacted by the Legislature, and they carry the same criminal penalties if violated. Issuance of emergency orders during the fishing season may be thought of as a fine tuning process in implementing a general management plan already approved by the Alaska Board of Fisheries. Emergency orders are much more prevalent in the day to day regulation of commercial fisheries, which tend to be more dynamic and fast developing, and which carry a higher degree of risk to constituent fish stocks than do sport fisheries, with the possible exception of the anadromous salmonid fisheries. Sport fisheries management in the AYK Region generally proceeds with basic regulations and a minimum of in-season emergency order changes due to the generally slower pace of the fisheries and the fact that it is more difficult to properly notify the public of changes in regulations than with commercial fisheries which are much more tuned to emergency order management. Consequently, during 1986, there were no emergency orders processed in the AYK Region. All fisheries proceeded as provided by 1986 sport fishing regulations.

News Releases, Announcements, and Articles:

A total of two official Department news releases were issued in 1986 that concerned Region III sport fisheries. They are listed below.

1. March 28, 1986. Shaw Creek Arctic grayling fishery. This news release announced that the Shaw Creek Arctic grayling fishery would open as per the normal schedule. In prior years the Department had closed the spring fishery to protect spawning Arctic grayling.

2. December 24, 1986. Fish and Game closes lakes to protect fish. This announcement described the pending closure of four interior lakes to burbot fishing, and also that two of the lakes would be closed to lake trout fishing. The closures were planned for emergency order after January 1, 1987.

A total of three articles concerned with Region III sport fisheries appeared in major Alaska newspapers in 1986. They are listed below.

1. November-December, 1986. Tangle lakes fishery threatened. By: Craig Medred. Anchorage Daily News. This article examines the reasons used by the Department to close popular interior lakes to burbot and lake trout fishing in 1987. Region II and III sport fisheries staff are quoted.

2. November 6, 1986. Public offered look at fishing proposals. By: Cathy Berry. Fairbanks Daily News Miner. The article announces the public availability of the 1986 Board of Fisheries regulation proposals, and deadlines for public comments to the Board of Fisheries. In addition the article discusses staff proposals for interior sport fisheries.

3. December 18, 1986. Record low Arctic grayling count threatens '87 sportfishing. By: Christopher Batin. Fairbanks Daily News Miner. A thorough discussion, with staff data and interviews, of Interior Arctic grayling stock status and proposed means of restoring heavily impacted stocks.

Preseason and Postseason Regulatory Activities

Regulatory activities begin with the development of staff proposals, and review of public proposals, to the Board of Fisheries. Board of Fisheries actions on proposals result in regulatory changes.

Advisory Committees:

Public input concerning regulation changes is provided by several means, including direct testimony to the Board of Fisheries and by participation in local fish and game advisory committees. Local advisory committees have been established in most rural areas of the state to assist the Boards of Fish and Game in assessing public sentiment regarding proposed regulation changes. Most active committees meet at least once a year, usually in the fall prior to the Board of Fisheries meeting. Advisory meetings are important also in allowing direct public interaction with Department staff who are expected to attend, answer questions, and provide clarification concerning proposed regulatory changes.

Advisory committees established for the AYK Region during 1986 included the following: Central Bering Sea, Lower Kuskokwim, Central Kuskokwim, Lower Yukon, Western Arctic, Eastern Arctic, Norton Sound, Southern Norton Sound, Kotzebue, Northern Seward Peninsula, Upper Kobuk, Lower Kobuk, Noatak/Kivalina, McGrath, Tok Cutoff/Nabesna Road, Clear/Healy, Delta, Denali, Upper Tanana/Fortymile, Yukon Flats, Fairbanks, Tanana, Ruby, Middle Yukon, Koyukuk, Grayling/Anvik/Shageluk/Holy Cross, and Eagle.

Several of the committees did not meet to discuss fisheries issues in 1986. Sport Fisheries Division staff only participated in meetings of the Fairbanks and Delta advisory committees in 1986. Sport Fisheries issues in Norton Sound, Kotzebue, and in the lower Yukon and Kuskokwim River areas were handled by Division of Commercial Fisheries staff attending those respective meetings.

Alaska Board of Fisheries:

The Board of Fisheries scheduled their annual finfish meeting for early December 1986. A total of 34 sport fish related proposals had been submitted by the public and Department staff from Region III. The meeting began on schedule but was adjourned after only a few days due to controversy among board members on certain salmon allocation issues. At the time of adjournment, none of the sport fish proposals had been considered, including the entire package of staff proposals that had been developed to address some of the outstanding conservation problems identified over the previous two years. These problems were addressed by the Department staff in early 1987 with a series of emergency orders and emergency regulations persuant to the Administrative Procedures Act. These actions will be further documented in the 1987 Annual Management Report.

The following is a summary of proposals submitted by the staff for Board of Fisheries consideration during 1986.

Proposal # 1). Consolidate and clarify the bag limit for stocked fish in Tanana drainage lakes for rainbow trout, salmon, sheefish, and Arctic char, as follows: "Tanana drainage lakes: 15 in combination daily and in possession of rainbow trout, salmon, sheefish, and Arctic char, only two of which can be rainbow or sheefish over 20 inches (51 cm)."

Proposal # 2). Clarify northern pike bag limit and provide that northern pike over 30 inches be part of the daily bag and possession limit, as follows." Northern pike, entire year, 10 per day and in possession, of which only two may be over 30 inches."

Proposal # 3). Lower the Arctic grayling possession limit from 10 to five in the waters of the Tanana River drainage.

Proposal # 4). Establish a catch and release fishery for Arctic grayling on a section of the Chena River, as follows: "In the Chena River and its tributaries, upstream from the bridge at 38 mile Chena Hot Springs Road, Arctic grayling may not be possessed or retained; all Arctic grayling caught must be released immediately."

Proposal # 5). Establish a 12" (30.5 cm) minimum length limit on Arctic grayling in selected waters of the Tanana River drainage, as follows: "In the following waters Arctic grayling less than 12 inches (30.5 cm) in length may not be possessed or retained; all Arctic grayling less than 12 inches (30.5 cm) in length must be released immediately; the Chena River and its tributaries upstream of its confluence with the Tanana river, except Badger Slough; Piledriver slough upstream of its confluence with Moose Creek; Delta River upstream from the confluence of Eureka Creek to the outlet of lower Tangle Lake; Richardson Clearwater and the Delta Clearwater rivers upstream from their confluence with the Tanana River."

Proposal # 6). Shorten the spear season for northern pike by one month, as follows: "Spears may be used to take northern pike from October 1 through April 30."

Proposal # 7). Prohibit the taking of Arctic grayling by means of baited hook or lure in selected waters of the Tanana River drainage, as follows: "Sport fishing for Arctic grayling is limited to unbaited artificial lures or flys in the waters listed below; the Chena River upstream from the bridge at 38 mile Chena Hot Springs Road; Piledriver Slough upstream of its confluence with Moose Creek; Delta River upstream from the confluence of Eureka Creek to the outlet of Lower Tangle Lake; Richardson Clearwater and the Delta Clearwater rivers upstream from their confluence with the Tanana River."

Proposal # 8). This proposal would allow for the legal harvest of longnose suckers, as follows: "Spears and bow and arrow may be used to take suckers. A permit specifying time and location issued by the Sport Fish Division of the Alaska Department of Fish and Game is required."

Proposal # 9). Change the set line season for burbot, as follows: "In all lakes, burbot may be taken by set line from October 15 to April 30."

Proposal # 10). Eliminate the use of spears as legal gear for harvesting burbot in lakes within the Tanana River drainage, as follows: "Spears may be used to take burbot from September 1 through December 31 in rivers in the Tanana River drainage. Burbot may not be speared in lakes in the Tanana River drainage."

Proposal # 11). Exempt temporary ice fishing shelters from Department registration, as follows: "All ice houses not removed from the ice at the end of the day's fishing must be registered and a permit secured from the department."

Proposal # 12). Close the Tangle lakes drainage and T Lake to the taking of burbot.

Proposal # 13). Close Shaw Creek and a portion of the Tanana River above and below the Shaw Creek mouth to all sport fishing to protect pre-spawning Arctic grayling from overharvest as follows: "Between April 1 and May 10, Shaw Creek will be managed by emergency order through sport fishing closures if necessary to insure that the Arctic grayling harvest does not exceed 500 fish."

Proposal # 14). Reduce the amount of area available on the Salcha River area for chinook salmon sport fishing as follows: "The Salcha River upstream from a marker placed 2.5 miles above the Richardson Highway Bridge on the Salcha River is closed to the taking of chinook salmon."

Proposal # 15). "Establish a two per day, two in possession, 18 inch (46 cm) minimum length limit for lake trout in the Tanana drainage. Except for Two Bit Lake and Monte Lake for which the length limit would not apply."

Development of AYK Sport Fishing Regulations:

Regulations in place for 1986 are reproduced as Appendix B. No Board of Fisheries action was taken in 1986 to modify existing 1985 regulations. Some substantial changes occurred in 1985, however. Major 1985 and 1986 changes in

regulations from the 1984 book included a reduction in the general area bag limit for salmon from 15 per day for all species (except for special regulations in certain areas) down to 10 per day except for chinook salmon which were limited to five daily and in possession. Under special regulations in 1985 and 1986, which pertain to the Tanana drainage and to the Chena and Salcha rivers, one chinook salmon was allowed daily and in possession, whereas in 1984, one chinook salmon over 41 cm (16 inches) was allowed in addition to 10 chinook salmon, less than 51 cm (20 inches).

Regulations governing the harvest of other sport fishing species remained much the same from 1984 to 1985-86 with the exception of the general bag limit for Arctic grayling, trout and char, which in 1984 was a combination for all species of 15 per day and 30 in possession for fish less than 51 cm (20 inches) in length. In 1985 this was changed to eliminate trout from the general combination limit, while leaving the bag limit for Arctic grayling and char at 15 with 30 in possession for fish less than 51 cm in length. The 1985 combination limit did not include trout. Rainbow and lake trout both had specific bag limits established for each species following the 1984 season.

AYK SPORT FISHERIES ENHANCEMENT

Interior Alaska Lake Stocking Program

Many lakes and ponds of the Tanana River Valley are stocked on a continuing basis with rainbow trout, coho salmon, Arctic grayling, or chinook salmon. Resulting fisheries comprise an important component of the total area harvest, and support over one-third of the recreational angling effort in the Tanana River drainage (Doxey 1987).

ADFG stocks lakes in an approximate 130,000 km^2 area, bordered on the west by the Kantishna River drainage, on the east by the area near Tok, on the south by the Delta River drainage, and on the north by the Steese Highway to Central. Most of the stocked lakes in the area are near communities or along road systems, but there are also a number of remote stocked lakes accessible only by off-road vehicle (ORV), dog team, or airplane. About half of the yearly sport effort on stocked lakes takes place on the larger accessible lakes in the winter.

ADFG stocking in the Interior began in the mid-1950's when barren lakes along the road system were stocked with rainbow trout or salmon. Lakes with indigenous fish populations that provided little or no sport fishing were chemically treated to eliminate competitor and predator species, and stocked with desirable species. Since 1968, 15 of the 50 regularly stocked lakes (including Birch and Quartz lakes) have been chemically treated to accelerate growth rates of stocked fish and to increase returns of target fish to the creel (Doxey 1987).

Throughout the 1970's, hatchery ability to provide stocked fingerlings steadily increased as fisheries enhancement received growing emphasis. Native Alaska rainbow trout brood stocks were developed when the importation of eggs from outside the state was discontinued in the late 1970's. As suitable brood

stocks were developed and new hatcheries were put into production, numbers of available stocked fish increased so that by 1985, average annual harvest and effort levels for stocked waters had risen by more than 40% and 20%, respectively (Doxey 1987).

The growth and success of the interior Alaska stocking program has been largely due to the development of, and production from, Alaska state hatcheries, particularly the Clear Hatchery, located about 145 km south of Fairbanks at the Clear Air Force Station (Figure 8). Hatchery production began in 1977, with an initial mission to experimentally incubate, rear and release chum salmon to determine whether large scale enhancement of salmon would be feasible under conditions found in the Interior. In recent years, production of sport fish species has taken precedence over anadromous salmonids, and a large proportion of its output consists of fingerling and subcatchable rainbow trout, coho salmon, and Arctic grayling. The facility presently has a capacity of about 9.0 million eggs.

Success of the stocking program is evaluated annually. The level of evaluation varies according to the size and accessibility of the lake and the importance and intensity of the sport fishery. Minimal evaluations address the question of whether the stocked fish survived and are providing sport fishing. More comprehensive evaluations provide limnological data, growth rate data, and fishery statistics such as CPUE, population estimates, comparison of performance between species, and other parameters.

1986 Stocking Results

Approximately 1.45 million fish of six species were stocked in area lakes in 1986, of which almost 700,000 were rainbow trout. Most of the rainbow trout were fingerling-and subcatchable-sized fish reared at Clear Hatchery, but 29,000 were of catchable size reared at the Fort Richardson Hatchery in Anchorage (Table 11). All of the rainbow trout were of the Swanson River (Kenai Peninsula) strain.

Approximately 321,000 fingerling-and fry-sized Arctic grayling were stocked in area lakes, ponds and pits in 1986, all of Moose Lake (Susitna River drainage) brood stock. These fish were incubated and reared at the Clear Hatchery (Table 12).

Sheefish have been experimentally stocked in Tanana Area lakes and ponds for several years to determine whether such an enhancement effort would be feasible for this species. About 90,000 sheefish were stocked in 1986 (Table 13) in five separate locations, all of fingerling size (about 8 g).

Arctic char were stocked in Trap Lake in the Kantishna River drainage in 1986. This was the first time that Arctic char have been stocked anywhere in the state. About 13,000, 4 g fingerling Arctic char of Amiloyak Lake (Headwaters of Chandler River) stock were planted (Table 14).

Chinook salmon fingerlings (36,000 at 9 g) were stocked in 1986 in lakes of the Tanana Area (Table 14). The fry, (which were of Crooked Creek, Kenai

Table 11. Number and size of rainbow trout stocked in AYK lakes in 1986.

Lake	Number Stocked	Size[1]
Four Mile	20,000	Fingerling
31 Mile Pit	500	Fingerling
45.5 Mi. CHSR Pit	1,000	Fingerling
Bathing Beauty Pond	500	Fingerling
Chet	1,000	Fingerling
Grayling	500	Fingerling
Hidden	4,000	Fingerling
Hidden	500	Fingerling
Jan	8,800	Fingerling
JRP #1	500	Fingerling
Koole	30,000	Fingerling
Lisa	1,000	Fingerling
Manchu	10,000	Fingerling
Nickle	1,000	Fingerling
North Twin	4,000	Fingerling
Rapids	2,000	Fingerling
Robertson #2	3,000	Fingerling
Sansing	450	Subcatchable
South Twin	4,000	Fingerling
Spencer	1,500	Fingerling
Quartz	300,000	Fingerling
Birch	83,368	Subcatchable
Chena	29,102	Catchable
Harding	187,485	Fingerling
Total	694,205	

[1] Fish sizes were as follows: Fingerling 2 g
Subcatchable 20 g
Catchable 65 g

Table 12. Number and size of Arctic grayling stocked in AYK lakes in 1986.

Lake	Number Stocked	Size[1]
Harding	79,412	Fingerling (4g)
West Pond	25,000	Fry
Left O.P. Pond	25,000	Fry
Sheefish	10,000	Fry
Sheefish	500	Fingerling (4 g)
Sheefish	500	Fingerling (8 g)
Delta Unnamed	10,000	Fry
Delta Unnamed	500	Fingerling (4 g)
Delta Unnamed	500	Fingerling (8 g)
Bathing Beauty Pond	10,000	Fry
Grayling	10,000	Fry
Hidden	10,000	Fry
Johnson Road #2	10,000	Fry
Walden Pond	1,500	Fingerling (4 g)
Engineer Hill	25,000	Fry
Steese Hwy Pits:		
Mi. 29.5	10,000	Fry
" 30.6	10,000	Fry
" 31.6	4,000	Fry
" 31.6	200	Fingerling (4 g)
" 31.6	200	Fingerling (8 g)
" 33.5	10,000	Fry
" 34.6	8,000	Fry
" 34.6	400	Fingerling (4 g)
" 34.6	400	Fingerling (8 g)
" 35.8	10,000	Fry
" 36.6	10,000	Fry
Chena Hot Springs Rd Pits:		
Mi. 32.9	10,000	Fry
" 42.8	10,000	Fry
" 45.5	10,000	Fry
" 47.9	10,000	Fry
Totals: Fry	237,000	
Fingerlings (4 g)	82,512	
Fingerlings (8 g)	1,600	

[1] Multiple sizes were stocked into some ponds in conjunction with an experiment being conducted by another project.

Table 13. Number and size of sheefish stocked in AYK lakes in 1986.

Lake	Number Stocked	Size[1]
Harding	88,460	Fingerling
Silver Fox Pit	200	Fingerling
Weigh Station Pond #1	200	Fingerling
Weigh Station Pond #2	400	Fingerling
Earthmover Pit	300	Fingerling
Total	89,560	

[1] Sheefish fingerlings were 8 g.

Table 14. Number and size of Arctic char and chinook salmon stocked in AYK lakes in 1986.

Lake	Number Stocked	Size
Arctic char		
Trap	12,778	Fingerling[1]
Chinook salmon		
Bolio	20,000	Fingerling[2]
Donnelly	6,000	Fingerling
Little Harding	10,000	Fingerling
Subtotal chinook	36,000	

[1] Arctic char fingerlings were 4 g.
[2] Chinook salmon fingerlings were 9 g.

Peninsula stock) were reared in the Elmendorf Hatchery and subsequently released in the Interior.

A total of 300,000 coho salmon was stocked in Tanana Area lakes and ponds in 1986 (Table 15). All stocked coho salmon were of fingerling size (about 4 g). All were of Wood Creek (Nenana River system) stock, and all were reared at the Clear Hatchery.

Anadromous Fish Releases by State Hatcheries

In addition to anadromous species stocked to landlocked lakes in the Tanana drainage, the Clear Hatchery stocked salmonids into waters of the Tanana River with the intent of enhancing anadromous returns. Species released in this manner included chinook, coho, and chum salmon. Numbers released by species and location are listed below.

A total of 1,043,007 chum salmon of Nenana River drainage (Wood Creek) stock were released into Wood Creek in early May, 1986. The salmon were all fry at about 50 mm in length and 1 g in weight.

A total of 202,991 chinook salmon of Clear Creek (Nenana River system) stock were released into Wood Creek in early May, 1986. Released salmon were from the 1985 brood year; average length was 70 mm, and weight averaged 3.9 g.

A total of 159,992 coho salmon of Wood Creek stock were released into Wood Creek in late April, 1986 with an average length of 56 mm and weight of 2.0 g. The released fry were from the 1985 brood year.

The other state operated hatchery of importance in the AYK Region was initiated in 1980 in the Kotzebue area at Sikusuilaq Creek, approximately 50 km upstream from the mouth of the Noatak River (Figure 17). The main purpose of this facility has been to examine the feasibility of large-scale chum salmon enhancement in a far northern environment. Enhanced hatchery returns are intended to benefit the salmon gill net fishery which operates near Kotzebue in marine waters. To date the scale of salmon releases has been small, less than two million chum salmon fry, and returns have been identified both in the commercial fishery and at the hatchery.

Releases of chum salmon fry in 1986 totalled 1,441,000 fish at an average size of approximately 0.5 g. Returns of about 3,620 adult chum salmon were identified from hatchery releases in 1981-1983.

LAND USE, HABITAT AND WATER QUALITY

Habitat-Related Fisheries Issues

Commercial development of minerals and timber, and construction of highways, associated with watersheds can have significant impacts on fish. A brief description of the types of commercial development in the Tanana and AYK areas, and known impacts to fisheries follows.

Table 15. Number and size of coho salmon stocked in AYK lakes in 1986.

Lake	Number Stocked	Size[1]
28 Mile Pit	500	Fingerling
31 Mile Pit	500	Fingerling
Birch	40,000	Fingerling
Chena	30,000	Fingerling
Dune	15,000	Fingerling
Geskakmina	20,000	Fingerling
JRP #1	500	Fingerling
Lost	10,000	Fingerling
Manchu	10,000	Fingerling
Moose	5,000	Fingerling
Quartz	168,500	Fingerling
Total	300,000	

[1] Average weight of coho salmon fingerlings was 4 g.

Placer Mining:

The majority of the placer mining activity which takes place in the state of Alaska occurs in the AYK region. Uncontrolled placer mining has the potential to significantly alter stream habitats and to impact fish populations. Increased stream turbidity and sediment loads may adversely affect oxygen exchange in fish through abrasion of gill tissues, prevent sight feeding fishes from foraging, limit aquatic plant growth by displacement or smothering, and generally reduce biological productivity. Placer mining may also increase the toxic metal content (arsenic, mercury) of stream water (ADEC 1986). In addition to changes in water quality, placer mining can affect the physical characteristics of the streambed by altering channel flow and modifying riparian habitat. Tailing deposits can inhibit fish passage and decrease overwintering habitat. Approximately 3,300 km of streams in Alaska in 1986 were affected by changes brought about by placer mining, primarily through the stripping of overburden and sluicing in streams (ADEC 1986).

In Alaska in 1986, 512 placer mining permits (on state, private and federal lands) were issued by the Alaska Department of Natural Resources (ADNR), a receiving agency for state and federal mining permits[4]. The ADFG issues permits for mining in streams supporting anadromous and resident fish. In some cases, where the development is within a resident fish stream and will not block fish passage, or where fish no longer exist, permits may not be required[5].

The volume of gold production decreased 16%, and the number of mechanized placer mines, which are the main producers of gold bullion, decreased 27% in 1986 over 1985 levels (Bundtzen et al. 1987). The largest decline in mining activity occurred in the eastern Interior region, specifically in the Circle mining district (Bundtzen et al. 1987). Reasons for the decline included uncertainties about state water quality regulations and federal lawsuits related to mining on federal lands. Alaska has a turbidity requirement for mine discharge water and since 1986, settling ponds have been required to reduce turbidity. Bundtzen et al. (1987) reported that in 1986 most miners were not in compliance with state law. A lawsuit (Sierra Club vs. National Park Service) settled in late 1985 prohibits mining in three parks and preserves, including Yukon-Charley Rivers Preserve, until environmental impact statements (EIS) can be prepared. In February 1986 a lawsuit filed by a coalition of native groups and the Sierra Club curtailed mining on Bureau of Land Management lands (specifically in Birch Creek near Fairbanks) until EIS are prepared.

The Alaska Department of Environmental Conservation (ADEC) (1986) includes the following specific examples where placer mining has adversely impacted stream water quality or streambed characteristics:

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[4] Bruce Campbell. 1988. Personal Communication. ADNR, Division of Mining, 3700 Airport Way, Fairbanks, AK 99709.

[5] Alan Townsend. 1988. Personal Communication. ADFG, Division of Habitat, 1300 College Rd., Fairbanks, AK 99701.

1) Birch Creek near Fairbanks;
2) Ungalik River (Norton Sound) streambed is so destabilized as to require over 10 years to return to normal (ADEC 1986);
3) Glacier Creek (Seward Peninsula) is assessed as above;
4) Tuluksak River (Kuskokwim tributary) rainbow trout populations may have been eliminated by placer mining (USFWS 1987a).

For a listing of streams impacted to some extent by placer mining, see ADEC (1986). See Bundtzen et al. (1987) for a complete listing of mining activity initiated in 1986.

Gravel Mining:

There are few documented instances where gravel mining in AYK has affected fish populations, but those instances have had a significant impact. Gravel mining of a streambed causes instream fanning, erosion, and deteriorates water quality and fish habitat (ADEC 1986). Specific cases of adverse impacts to fish populations in AYK due to streambed gravel mining include:

1) Sinuk and Tisuk Rivers (Seward Peninsula). Floodplain gravel was excavated from about 1983-1986, causing instream fanning and possible freezing to riverbed. Since 1986, ADFG has denied continuance of gravel mining at these rivers[6].
2) Putuligayuk River (North Slope). This river is expected to require 10 years to recover (ADEC 1986);
3) Birch Tree Crossing, Kuskokwim River. This area has been heavily mined for gravel and has experienced reduced water quality and fish habitat (ADNR 1988).

A complete listing of gravel mining sites and impacts is available in ADEC (1986) and Bundtzen et al. (1987) contains a listing of gravel mine operations in 1986. Reclamation of 19 gravel mine pits on the North Slope has increased overwintering habitat for fish inhabiting connecting streams, and increased fish production (Hemming 1988).

Industrial Metals Development:

Large-scale industrial metals operations did not significantly impact sport fishery resources in AYK in 1986. Specific developments initiated in 1986 included the offshore dredging for gold in Norton Sound by the 'Bima' (world's largest bucketline dredge owned by Inspiration Gold Inc.) and the initiation of construction of the Red Dog Mine near Kotzebue. In October 1986 the COMINCO Board approved development of the zinc-lead-silver mine, with production scheduled for 1991, following road and port development. During the construction phase, workers were prohibited by contract with NANA from participating in sport or subsistence fishing and hunting. Thus, the influx of workers did not impact the harvest of fish near the construction area. Road and culvert construction was closely monitored by ADFG Habitat Division

[6] Robert McLean. 1988. Personal Communication. ADFG, Division of Habitat, 1300 College Rd., Fairbanks, AK 99701.

personnel, and no lasting impacts to fish are believed to have occurred[7]. The only possible impact to fish populations in the area would occur if containment of the mine tailings pond failed and heavy metals washed into the Wulik River drainage.

Coal:

Coal mining did not significantly impact the sport fish resource in AYK in 1986. Usibelli mine near Nenana is currently the only operating coal mine in AYK. However, in 1986 state personnel assessed coal reserves at Chicago Creek on the Seward Peninsula and recommended strip mining development (Bundtzen et al. 1987). In addition, coal reserves near the North Slope were judged sufficient to meet the energy demands of the Red Dog Mine, and these reserves may be tapped in the future.

Oil and Gas Development:

Oil and gas development in AYK is presently restricted to the North Slope. Significant impacts of oil and gas development affected fish populations on the North Slope with regard to transportation corridors (such as the Dalton Highway and the Alyeska Pipeline) and extraction of gravel for road and building construction and maintenance. Dredging in estuarine lagoons near Point Lay in 1983 and 1984 was found to increase turbidity and depth, but did not significantly impact fish populations (Craig and Schmidt 1985). Investigation of impacts from a waterflood seawater treatment plant on the Kuparuk River by Dames and Moore (1987) in 1986 did not reveal significant effects on fish populations. There is evidence that construction of Prudhoe Bay's West Dock Causeway has disrupted east and west migratory movements as well as recruitment of Arctic cisco in the Colville and Sagavanirkok rivers (Gallaway et al. 1987; Moulton et al. 1986). No documentation has been found discussing adverse effects to fish populations from oil spill contamination.

Timberland Development:

Logging did not significantly impact the sport fishery resource in AYK in 1986. Few instances of commercial logging presently occur in AYK. In Galena a limited commercial harvest of spruce for domestic markets takes place (USFWS 1987b). The largest commercial timber harvests in the Kuskokwim Basin occur from McGrath to Stony River (ADNR 1988). Some commercial logging of spruce currently occurs in the Tanana River basin, primarily on state owned land along the Tanana River.

Road construction associated with logging could impact fish populations by soil erosion and sedimentation in streams, however this possibility is deemed small and effects would be localized, considering the minimal level of industry development at the present time.

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[7] Matt Robus. 1988. Personal Communication. ADFG, Division of Habitat, 1300 College Rd., Fairbanks, AK 99701.

Highway Development:

Road and culvert construction significantly affected fish populations in AYK in 1986. Road construction allows increased access to streams and lakes, thereby increasing the utilization of sport fishery resources. Improperly designed or constructed culverts can create a partial or complete barrier to fish migration. Major highways in the AYK region include the Steese Highway which accesses the Yukon River and Birch Creek; the Taylor Highway leading to the Forty-Mile and Yukon rivers; the Parks and Richardson Highways which provide access to the Tanana River and many of its tributaries and lakes; the Dalton Highway to the North Slope which crosses the Yukon River, upper tributaries to the Koyukuk River and the Sagavanirktok and Kuparak rivers on the North Slope. A newly-constructed road north of Kotzebue near the Wulik River leads to the Red Dog Mine. The Seward Peninsula has three major roads which cross more than a dozen significant rivers for sport fishing.

Culvert construction is frequently reviewed by ADFG's Habitat Division for effects on migrating fish. Of the road systems in AYK, three were discussed with Habitat Division personnel regarding adverse effects on fish populations: the Dalton, Red Dog Mine and Seward Peninsula Highways. A total of six of the 11 culverts examined on the Dalton Highway by Ott and Shideler (1986) posed barriers to migrating fish:

1) Old Wiseman Road crossing blocked Arctic grayling from spawning areas;
2) Nutirwik Creek crossing blocked Arctic grayling and Arctic char migration;
3) Dietrich River crossing blocked Arctic grayling, Arctic char and whitefish overwintering areas;
4) Char Lake crossing partially blocked Arctic grayling and Arctic char migration;
5) Milke Creek culvert was a barrier to the Sagavanirktok River; and,
6) Stout Creek crossing blocked Arctic grayling and Arctic char migration.

There are 40 - 50 culverts on the Seward Peninsula built in the 1950's of which many constitute partial barriers to tributary spawning and rearing. Habitat Division personnel are working with the Alaska Department of Transportation to improve stream habitat, for example, by removing gravel berms in the Nome and Pilgrim rivers which will provide more rearing habitat for young Arctic grayling.

Commercial Utilization of Fisheries Resources

Commercial sport fishing activities, through establishment of lodges and guiding services, offers a source of revenue to residents in the Tanana and AYK areas. A brief description of known commercial uses of sport fish species follows.

Wilderness Lodges and Guiding:

Lodges and sport fish guiding operations (including outfitters) are significant factors in the utilization of sport fishery resources in AYK, although the extent of this influence has yet to be fully determined. More information regarding the location and operation of lodges and guiding and outfitting operations is needed. A partial list of the type of operation at various locations can be found in Appendix C. The number of resident or nonresident clients served, species targeted, or types of fishing experiences offered at these locations is presently unknown.

Commercial Fisheries:

Commercial fisheries for finfish species other than salmon, or herring, are sometimes allowed under authority of a permit issued by the Commissioner of the Department of Fish and Game or his designee, usually an area manager of the Division of Commercial Fisheries. Permits to commercially harvest whitefish, sheefish, northern pike, blackfish, lamprey, Dolly Varden and burbot have been issued at various times for limited (usually local) commercial markets. In many cases, permits are issued by the Department, but harvests are either not made or are not reported. Few instances of commercial fish harvest of non-anadromous species were reported for the AYK Region in 1986. The Division of Commercial Fisheries maintains data records of such harvests.

Permits to harvest up to 6,800 kg (15,000 lbs) of whitefish and 1,360 kg (3,000 lbs) each of northern pike and burbot (total quota for the village) were issued to nine individuals of the Selawik Fish Project in 1986 (Lean et al. 1986). A total of 546 northern pike (approximately 1,980 kg) and no burbot were sold (Lean et al. 1986). A total of 65 burbot (133 kg) were sold by catcher-sellers on the Noatak River (Lean et al. 1986). No freshwater fishery permits for northern pike and burbot were requested in 1986 in either the Norton Sound or Port Clarence districts (Lean et al. 1986).

A fishery has taken place on the Colville River since 1964 for broad whitefish, humpback whitefish, Arctic cisco and least cisco. Reported harvests for this fishery in 1986 include: 18 humpback whitefish, 29,895 Arctic cisco, and 9,444 least cisco (Whitmore et al. 1986).

Freshwater fishery permits have been issued in various years for whitefish at Healy Lake, whitefish in Lake Minchumina, and burbot in the Tanana River. The only reported harvest in 1986 occurred on the Tanana River where 72 whitefish are recorded as being sold (Whitmore et al. 1986).

Reported sales of freshwater species in the lower Yukon River in 1986 include 1,533 whitefish (2,650 kg) and 36 kg of lamprey, *Lampetra japonica* (Whitmore et al. 1986).

Land Withdrawals, Status, and Planning

Land use designation by private, state, and federal agencies affects the management philosophy of sport fish within a given parcel of land. A brief

description of various national land designations in the Tanana and AYK areas and known influences on the use of sport fish within land units follows.

ANILCA:

The Alaska National Interest Lands Conservation Act (ANILCA), enacted into law in 1980, completed the implementation of the Alaska Native Claims Settlement Act (ANCSA) and addressed outstanding issues such as subsistence opportunity, energy development, economic growth and transportation planning. Legislative solutions to these issues included the creation or expansion of five national conservation systems in Alaska: national parks, wildlife refuges, wild and scenic rivers, wilderness preservation lands and national forests.

The purpose of ANILCA is to preserve for future generations certain lands and waters in Alaska, protect resources related to subsistence needs and the subsistence lifestyle for rural residents, and to protect those resources related to recreational opportunities, such as sport fishing and hunting (ANILCA 1980). The Act directs specific management guidelines for conservation system units within Alaska.

To maintain state responsibility for fish and game management on newly designated conservation system units, the ANILCA required the state to distinguish between user groups and assign priority opportunities for subsistence uses of fish and game resources. This resulted in increased divisiveness among user groups in some instances.

National Parks, Monuments and Preserves:

All National Park Service (NPS) managed lands in the AYK Region are discussed under the following section.

A memorandum of understanding exists between the State of Alaska and the NPS which allows state fish and game regulations to apply on park lands except when a more restrictive harvest approach is desired by NPS. NPS may promulgate regulations concerning consumptive uses of resources which are more restrictive than state laws. The ANILCA intends for NPS to provide opportunities for continued subsistence and traditional activities.

Park land designation has some influence on utilization of the sport fish resource by restricting types of development within the parks. Large scale commercial development (ie. fishing lodges) is not allowed, but small lodge facilities for a few guests have been allowed in Kobuk National Park. Construction of temporary facilities (such as fish camps or tents) on park lands in Alaska was granted under ANILCA, however the National Park Servive attempted to prohibit these facilities. The state entered in a lawsuit in 1986 regarding cabins on park lands, to preserve temporary facility privileges. NPS goals include minimizing the sport fish take by encouraging release of captured fish or the taking of only small individuals of the more abundant species (NPS 1986a, 1985a). Motorized boat, snow machine, and airplane access is allowed for sport fishing on park lands in Alaska. Fish stocking or enhancement activities can be allowed if the purpose is to restore fish populations to "natural or healthy" levels.

Conservation system units within AYK (Figure 19) are as follows:

1. Kobuk Valley National Park is 688,000 ha (1.7 million ac) in size and includes one wild and scenic river and 77,000 ha (190,000 ac) of wilderness. NPS has proposed an additional 168,000 ha (414,720 ac) be set aside as wilderness. Regional residents account for more than 90% of park use. NPS estimates that out-of-region recreational use is limited to about 25-75 users per year. Most out-of region visitors fly in their own planes to sport fish at the mouth of the Salmon River and other tributaries of the Kobuk River. Local boats can be chartered for fishing. Lodges in Ambler and Shungnak accomodate a small number of visitors. There are reported instances of subsistence and sport fish user conflicts on the Kobuk River (see NPS 1986a).

2. Gates of the Arctic National Park and Preserve consists of 2.939 million ha (7.263 million ac) of combined park and wilderness lands and 42,000 ha (103,932 ac) of park lands only. The park also includes six wild and scenic rivers. Recreational fishing is mostly for Arctic grayling, Dolly Varden char and lake trout, with the most heavily used areas being Walker and Chandler lakes[8]. Two lodges on Walker Lake, at the headwaters of the Alatna River, advertise sport fishing opportunities, and local air-taxi operators drop off anglers at other areas. Sport fishing mostly occurs in conjunction with other activities such as river running, hunting and backpacking (see NPS 1985a).

3. Cape Krusenstern National Monument was created in 1980 to protect archeological sites, preserve prehistoric and historic Native cultures, protect habitat for fish and wildlife and protect the viability of subsistence resources. The NPS directs management of the monument which is 267,000 ha (659,807 ac) in size. Access and development restrictions of park lands apply to monument lands. Fishing for whitefish, ciscos, Arctic char, chum salmon and northern pike is primarily by subsistence users. Recreational use of the monument is extremely limited and occurs mostly in conjunction with subsistence activities (NPS 1985b).

4. Noatak National Preserve is 2.63 million ha (6.5 million ac) in size, and includes one Wild and Scenic River and 2.35 million ha (5.8 million ac) of designated wilderness land. It is also a UNESCO Bioshpere Reserve, designed to maintain genetic pools. Recreational use is estimated at 2,000 to 2,500 visitors per year, who participate river running, hunting and sport fishing. Arctic grayling and Dolly Varden char are the most common sport fish. About 25 commercial operators provide air and guiding service. Popular drop off points for sport fishing include the Kelly and Cutler Rivers. Construction of a State hatchery (Sikusuilaq Creek)

[8] Rodney Simmons. 1988. Personal Communication. USFWS, Fisheries Services, 101 12th Ave., Box 20, Fairbanks, AK 99701.

in the Lower Noatak River has caused some concern on the part of NPS regarding maintenance of the chum salmon gene pool as expressed in the Biosphere Preserve philosophy (NPS 1986b).

5. Bering Land Bridge National Preserve consists of 1.127 million ha (2.8 million ac), with 90% of use related to subsistence and local use activities. NPS has proposed that an additional 121,000 ha (299,520 ac) of the Preserve be designated as Wilderness. Very little sport fishing occurs in the Preserve because better fishing opportunities are available on the Seward Peninsula outside of the Preserve (NPS 1986c).

6. Yukon-Charley Rivers National Preserve is 1.023 million ha (2.53 million ac) in size and includes the Charley River and its main tributaries as a Wild and Scenic River. NPS has proposed that 442,380 ha (1,093,120 ac) be designated as Wilderness. Sport fishing is primarily for Arctic grayling, with northern pike found in lower tributary streams and Dolly Varden char found in one tributary (NPS 1985c).

National Wildlife Refuges:

Refuges are mandated to conserve fish and wildlife habitat, fulfill international treaty obligations, provide for continued subsistence opportunities and ensure water quality. Each refuge has specific legislative purposes and although each is regulated by federal law, the USFWS recognizes a master memorandum of understanding with the State of Alaska which vests primary responsibility for fish and wildlife management with the state, unless subsistence opportunities are compromised. Refuge managers review and adopt ADFG management plans unless the plans are formally determined to be incompatible with the purposes of the refuge. Different management goals exist for each refuge. Policy ranges from that of minimal interference with human use, to that of promotion of increased Wilderness and Wild and Scenic River designations. All guides and outfitters are required to have special use permits in addition to state licenses (for big game guides). There are seven National Wildlife Refuges (NWR) in AYK, and a summary of each follows. Note: readers are advised to consult most recent Comprehensive Management Plans (available from U.S. Fish and Wildlife Service) for each refuge to obtain detailed information and maps for each unit.

1. Selawik NWR is 890,327 ha (2.2 million ac) in size and includes one Wild and Scenic River and 97,126 ha (240,000 ac) of Wilderness lands. The preferred management alternative is for minimal interference. Mechanized travel to any inholdings, oil and gas studies and recreational opportunities would be allowed. Recreational use levels are extremely low, with most sport fishing targeting on sheefish in the Kobuk River, adjacent to the NWR (USFWS 1986).

2. Yukon Delta NWR is the largest of Alaska's 16 refuges and consists of 10.52 million ha (26 million ac) including two Wild and Scenic Rivers and 769,000 ha (1.9 million ac) of Wilderness lands. The

management plan permits oil and gas leasing on only 3% of the refuge. Habitat and population manipulation may be conducted on some of the lands. Most sport fishing occurs on the Kisaralik River, but increasing interest from Togiak fishing guides in establishing commercial guiding on the Andreafsky and Kwethluk rivers and other refuge rivers has been expressed. Rainbow trout are found in the Kwethluk, Kasigluk, Kisaralik, Tuluksak, and Aniak rivers. Sport harvest of sheefish has increased and large numbers of northern pike are caught by locals in the winter. If sport fish guiding increases, the refuge staff envisions conflicts with subsistence users and plans to launch an extensive monitoring program (USFWS 1987a).

3. Yukon Flats NWR is 4.53 million ha (11.2 million ac) in size, has two Wild and Scenic Rivers, and borders the Trans-Alaska pipeline. The management plan directs minimal disturbance of habitat and increased wilderness land designations. Limited fly-in sport fishing exists and is mostly incidental to hunting and river running. The Dall River receives the heaviest sport fishing pressure, due to access from the Dalton Highway (USFWS 1985).

4. Koyukuk and Innoko NWR are 1.82 and .283 million ha (4.5 and .7 million ac) in size, respectively. The management plan calls for minimal management. Staff has little information on sport fishing, but believes some occurs in conjunction with hunting and river running (USFWS 1987c).

5. Nowitna NWR consists of 809,389 ha (2 million ac) and one Wild and Scenic River. The management plan is for minimal management. Sport fishing for trophy sheefish is an established activity on the Nowitna River. Northern pike are also sought by anglers. It is believed that most sport fishing occurs in conjunction with hunting (USFWS 1987b).

6. Kanuti NWR is 647,511 ha (1.6 million ac) in size. The management plan emphasizes the restoration of fish populations to natural and healthy levels. The plan also strives to increase fishing opportunities, but would designate no wilderness areas, and would allow some oil and gas studies (USFWS 1987d).

7. Arctic NWR consists of 7.9 million ha (19.5 million ac), four Wild and Scenic Rivers and 3.24 million ha (8 million ac) of wilderness lands. The management plan maintains the existing range and intensity of management and recreational economic uses. Opportunities for fishing and other public uses would be maintained, as would scientific research. Most sport fishing for Arctic grayling, Arctic char, lake trout and northern pike occur in conjunction with river trips and hunting (USFWS 1988).

Float trips on refuge rivers of both the north and south slope are a recognized and growing popular use. The Kongakut River on the north slope is considered most popular, followed by the Hulahula and Canning rivers. The

Ivishak and Sagavanirktok rivers are also sometimes used by float parties. The Sheenjek and Porcupine rivers are the most popular south slope rivers for this purpose (USFWS 1988).

Wild and Scenic Rivers:

In the AYK Region, 23 rivers in national parks, preserves and refuges have been placed within the national wild and scenic river system. The Wild and Scenic Rivers Act of 1968 stipulates that these rivers shall be preserved in free flowing condition, generally free of impoundments, and have primitive shorelines and watersheds. The wild and scenic river designation positively impacts utilization of the sport fish resource by affording anglers the possibility of a pristine and uncrowded fishing experience. Access to rivers is controlled and facilities are restricted, thus potentially precluding the development of fishing lodges. Wild and scenic rivers are listed in Appendix A.

Wilderness Land Designations:

The Wilderness Act of 1964 restricts modes of access and development on designated parcels of land. Wilderness land designation is intended to promote solitude and primitive recreational opportunities. However, depending upon interpretation of the wilderness modifications in ANILCA, land managers may restrict the use of power chain saw or generators, etc. This can hinder stream clearance, weir construction, and field camp operations in wilderness areas[9].

Natural Factors Affecting Sport Fisheries

Natural catastrophic events, and timing and severity of natural phenomena, affect sport fish habitat and life history. Known natural occurrences in 1986 are described and their impacts on sport fish are estimated in the following paragraphs.

Fires:

Fires in Alaska generally do not penetrate the duff layer to mineral soil and thus do not present a great problem of erosion. In addition, frozen ground in large areas of the Arctic and Interior assist in curtailing fire-induced soil erosion[10]. Major impacts of fire on fisheries can occur with the use of earth moving equipment by firefighters to prevent enlargement of a blaze, and aerial deployment of fire retardant. The Bureau of Land Management (BLM) reports that no bulldozers were used to fight fires in 1986. BLM has strict guidelines regarding fire retardant use near water bodies. BLM personnel state that the retardant presently in use is biodegradeable and if mistakenly introduced into a water body, would have minimal and short-lived impact on

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[9] Artina Cunning. 1988. Personal Communication. ADFG, Division of Wildlife Conservation, PO Box 1148, Nome, AK 99762.

[10] Dale Haggstrom. 1988. Personal Communication. ADFG, Divison of Wildlife Conservation, 1300 College Rd., Fairbanks, AK 99701.

fish populations[11]. Thus, it is the BLM position that fires in Alaska pose no significant direct impacts to fish populations.

Snow Pack Assessment:

Snowpack depth and duration impacts fish life history by influencing such factors as water level, sunlight penetration, and insulation of water bodies in periods of extreme cold. Snow survey data obtained from the Soil Conservation Service (USDA 1986) provided snowpack summaries for water year 1986 by region. (Water year 1986, hereafter referred to as WR 1986, is the period of time from 1 October 1985 through September, 1986).

In the Arctic, Barrow and Prudhoe Bay received below average snowcover water equivalent (hereafter referred to as SWE) of 6.86 and 9.14 cm, respectively, as of May, 1986. In the Upper Yukon Basin, the snowpack at the headwaters of the Yukon River was the maximum of record (1958-1986), with a SWE of greater than 15.2 cm. In contrast, SWE in the Central Yukon averaged 7.11 cm and was below average. In 1986 the eastern interior remained the coldest part of the state in relation to normal, and delayed river breakup in that region. Breakup was also late in the Tanana Basin, where the average SWE was 4.6 cm. In the Koyukuk and Lower Yukon River areas SWE was 10.1 cm and considered far below normal. In the Kotzebue, Norton Sound and Kuskokwim regions, SWE was about 10.4, 22.1 and 17.3 cm, respectively, and considered normal.

Stream Discharge Assessment:

Stream flows have a significant impact on fish life history, especially maximum stream discharge events. The incidence of "flooding" is defined by the probability the investigator is willing to accept that a flood will occur. For example, a 50 year flood will constitute less stream discharge and occur more frequently than a 100 year flood. Records of stream discharge were obtained from the U.S. Geological Survey (Van Maanen et al. 1988) which give monthly and yearly mean and extreme discharge data by river (Table 16).

Of the streams in AYK for which discharge data is collected, the Tanana River at Fairbanks, Chena River below Moose Creek Dam, Snake River near Nome and the Putuligayuk River at Deadhorse in Prudhoe Bay reported maximum discharges in WY 1986 similiar to maximum discharges for the period of record (at least five previous years). These maxima may not constitute a "flood" at a given probability, but do indicate higher than average discharge events. Tanana River streams such as the Salcha River experienced considerable amounts of flooding and streambed disruption during the summer of 1986 with probable, but undocumented and unmeasured, severe fisheries impacts in those streams, particularly to young of the year Arctic grayling and to chinook salmon eggs and fry.

[11] Mark Jones. 1988. Personal Communication. BLM, Alaska Fire Service, PO Box 35005, Ft. Wainwright, AK 99703.

Table 16. Gaging station records of mean and maximum discharge[1] for 1986, and mean and maximum discharge for the period of record, for ten rivers in AYK.

River	1986		Period of Record		
	Mean	Max	Mean	Max	Years
Kuskokwim at Crooked Cr	35.2	141.0	40.9	392.0	1951-86
Yukon at Eagle	90.3	303.0	82.9	545.0	1950-86
Tanana at Fairbanks	19.7	96.4	19.5	96.4	1973-86
Chena at Fairbanks	1.4	8.3	1.4	74.4	1948-86
Salcha near Salchaket	1.8	37.1	1.7	97.0	1948-86
Koyukuk:					
Middle Fk near Wiseman[2]	1.0	11.1	0.8	19.1	1970-86
Snake near Nome	0.3	3.5	0.2	4.2	1965-86
Kobuk near Kiana	17.1	141.0	15.2	152.0	1976-86
Wulik near Kivalina	0.9	15.0	--	15.6	1984-86
Kuparuk near Deadhorse	1.5	38.0	1.3	118.0	1971-86
Sagavanirktok, Pump 3	1.3	11.6	--	23.0	1982-86

1 Cubic feet per second x 1,000.
2 Excluding year 1979-1982.

Mean Air Temperature and Precipitation:

Mean monthly temperature impacts fish life history by timing stream freeze up and break up occurrences, influencing the duration and severity of the seasons, and acting in conjunction with precipitation, affecting water level. Climatological data for four major cities in AYK (Fairbanks, Nome, Kotzebue and Barrow) were obtained from the US Weather Service (NOAA 1987), which give the mean monthly and yearly temperature (F) and precipitation (inches) for the period of record (1958-1987). Climatological data for these cities may not represent the microclimatic conditions present at a given stream, but the data give an indication of regional seasonal weather patterns.

Mean monthly air temperatures in WY 1986 for the four cities followed a similiar pattern to the period of record, except that all cities exhibited slightly higher temperatures in the winter months of 1985-1986 than the period of record. In addition, mean monthly air temperatures in July for three of the four cities exceeded those means for the period of record (Figure 25).

Mean monthly precipitation in WY 1986 for the four cities from about January through June was less than the mean for the period of record. In contrast, mean monthly precipitation in August for Kotzebue, Nome and Barrow significantly exceeded the mean for the period of record (Figure 26).

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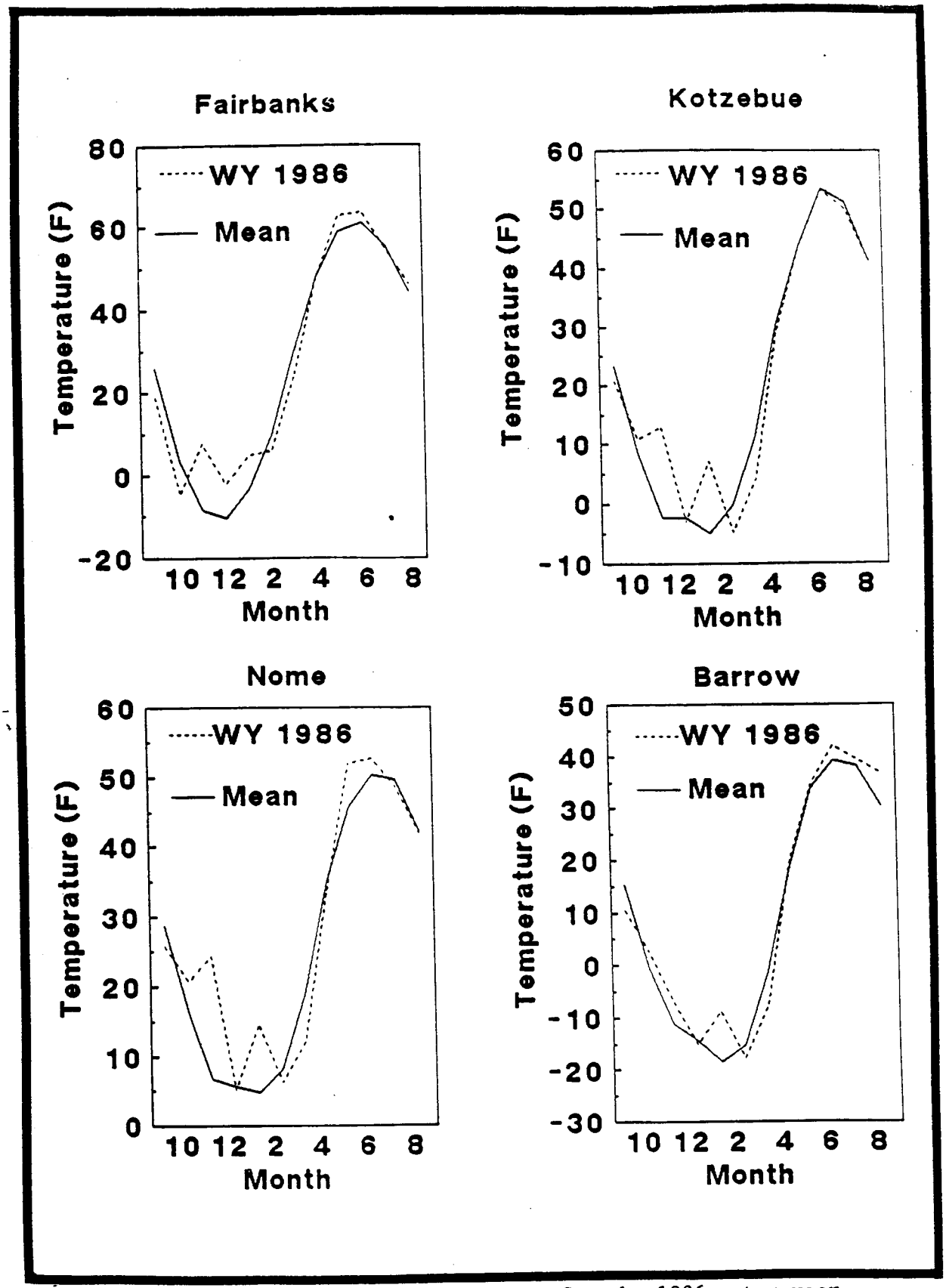

Figure 25. Monthly mean water temperature for the 1986 water year compared to monthly mean air temperature, 1958-1986, in four AYK locations.

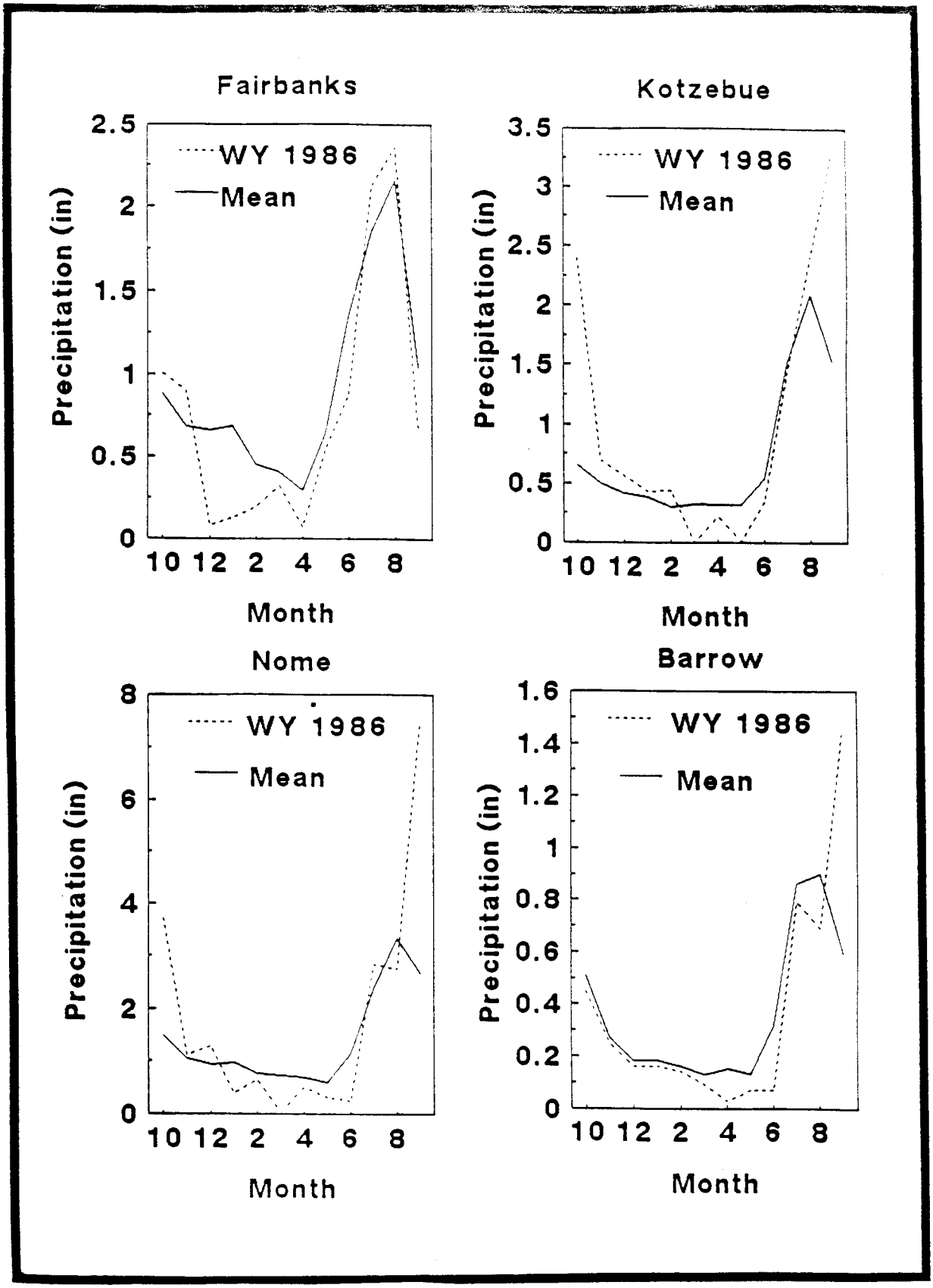

Figure 26. Mean monthly precipitation for the 1986 water year compared to mean monthly precipitation, 1958-1986, in four AYK locations.

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APPENDICES

Appendix A. List of wild and scenic rivers on national park, preserve and refuge lands in AYK.

River	Area
Upper Selawik	Kotzebue
Andreafsky and East Fork	Tributary of Yukon R.
Upper Beaver Cr.	Interior
Birch Cr.[1]	Interior
Nowitna (a 223 mi section)	Interior
Ivishak	Arctic NWR
Upper Sheenjek	Arctic NWR
Wind	Arctic NWR
Alatna	Gates of the Arctic NP
John	Gates of the Arctic NP
Kobuk	Gates of the Arctic NP
Upper Noatak	Gates of the Arctic NP
North Fork of the Koyukuk	Gates of the Arctic NP
Tinayguk	Gates of the Arctic NP
Salmon	Kobuk Valley NP
Charley	Yukon-Charley Preserve
Copper	Yukon-Charley Preserve
Bonanza	Yukon Charley Preserve
Hosford	Yukon-Charley Preserve
Derwent	Yukon-Charley Preserve
Flat-Orthmer	Yukon-Charley Preserve
Crescent	Yukon-Charley Preserve
Moraine	Yukon-Charley Preserve

[1] Placer mining occurs in the headwaters of this creek, outside of refuge authority, and has been the focus of some controversy.

Appendix B. AYK Area sport fishing regulations summary for 1986.

ARCTIC—YUKON—KUSKOKWIM AREA

This is a summary of the official regulations codified in 5 AAC 70.001-050 which are available for inspection at libraries, department offices, and Department of Public Safety offices throughout the state.

The Arctic—Yukon—Kuskokwim area consists of all waters of Alaska, including the Bering Sea, Chukchi Sea, and Arctic Ocean drainages, north of a line extending west from Cape Newenham, and west of the International Boundary near Demarcation Point.

INSTRUCTIONS:

1. Find the water (alphabetically listed) that you intend to fish. If the water, or any portion of it, is not listed, the regulations in the shaded entry apply.
2. Use the Code Key to determine open season, catch, and length limits. Read Special Regulations.
3. An asterisk(*) denotes Special Regulations apply.

WATER AND SPECIAL REGULATIONS	SEASON AND CATCH LIMIT					
	SALMON	RAINBOW TROUT/ GRAYLING/CHAR	SHEEFISH	PIKE	HALIBUT	OTHER
All waters not listed below	A,B	F,H	L	O	P	R
All waters between Paxson and Cantwell: (see also page 11)						
south of the Denali Highway, and the Summit and Paxson Lake drainages		I,K,Q				R*
north of the Denali Highway and south of the Tanana River, excluding Summit and Paxson Lake drainages		G,I,J,Q				R
Special Regulations: *Only 15 burbot daily and in possession.						
Beaufort Sea drainages between Point Barrow and Demarcation Point	E	E	L	O		R
Chena River drainage:						
upstream from a department marker 300 feet downstream from the Chena River flood control structure	Closed	J	M	N		R
remainder of drainage	C,D	J	M	N		R
Special Regulations: See Tanana River drainage Special Regulations.						
Fielding Lake		I,J				R*
Special Regulations: *Burbot may be taken by set line from October 15 through May 15.						
Goodpaster River drainage	Closed	J	M	N		R
Special Regulations: See Tanana River drainage Special Regulations.						
Nome River	A,B*	F				R
Special Regulations: *For salmon other than king salmon, the bag and possession limit is 15, only 5 of which may be chum and coho salmon, in combination.						

ARCTIC—YUKON-KUSKOKWIM AREA WATER AND SPECIAL REGULATIONS	SEASON AND CATCH LIMIT SALMON	RAINBOW TROUT/ GRAYLING/CHAR	SHEEFISH	PIKE	HALIBUT	OTHER
Salcha River: downstream from the confluence with Redmond Creek upstream from the confluence with Redmond Creek **Special Regulations:** Fishing from the Richardson Highway bridge over the Salcha River is prohibited. See Tanana River drainage Special Regulations.	C,D Closed	J J	M M	N N		R R
Salmon Lake (Seward Peninsula), its tributaries, and the outlet stream 300 feet downstream from the lake outlet	Closed	F				R
Snake River (near Nome) **Special Regulations:** *For salmon other than king salmon the bag and possession limit is 15, only 5 of which may be chum and coho salmon, in combination.	A,B*	F				R
Tanana River drainage: (excluding the waters between Paxson and Cantwell south of the Denali Highway which are specified elsewhere in this list) **Special Regulations:** Spears may be used to take pike from October 1 through May 31 and to take burbot from September 1 through December 31. Spears and bow and arrow may be used to take whitefish from September 1 through March 31. All ice houses must be registered and a permit secured from the department. Each house must have permit numbers displayed on its side and roof in distinguishable numbers not less than 12 inches in height.	C,D	G,I,J,Q	M	N		R
Trans-Alaska Pipeline (a corridor 5 miles wide on each side of the alignment): Yukon River to Brooks Range Divide Brooks Range Divide to Prudhoe Bay **Special Regulations:** *Closed to salmon fishing.	Closed Closed	F *E	Closed Closed	0 0		R R

OTHER ARCTIC—YUKON—KUSKOKWIM AREA REGULATIONS

METHODS AND MEANS. In all lakes, multiple hooks with gap between point and shank greater than one-half inch may be used for taking fish other than salmon. Burbot, pike and whitefish may be taken by underwater spear in all lakes by persons completely submerged.

CODE KEY: ARCTIC-YUKON-KUSKOKWIM AREA Use these codes to determine open season, catch and length limits.

CODE		OPEN SEASON	BAG, POSSESSION, AND SIZE LIMITS
A	KING SALMON	Entire Year	5 per day, 5 in possession, no size limit
B	OTHER SALMON	Entire Year	10 per day, 10 in possession, no size limit
C	KING SALMON	Entire Year	1 per day, 1 in possession, no size limit
D	OTHER SALMON 16 inches or more less than 16 inches	 Entire Year Entire Year	 3 per day, 3 in possession 10 per day, 10 in possession
E	SALMON, CHAR, GRAYLING	Entire Year	10 per day in any combination, 10 in possession only 2 over 20 inches
F	GRAYLING & CHAR	Entire Year	15 per day in combination, 30 in possession, only 3 per day and 6 in possession over 20 inches
G	RAINBOW TROUT	Entire Year	20 inches or more, 2 per day, 2 in possession Less than 20 inches, 10 per day, 10 in possession
H	RAINBOW TROUT	Entire Year	2 per day, 2 in possession, no size limit
I	LAKE TROUT	Entire Year	20 inches or more, 2 per day, 2 in possession Less than 20 inches, 10 per day, 10 in possession
J	GRAYLING	Entire Year	5 per day, 10 in possession, no size limit
K	GRAYLING	Entire Year	10 per day, 10 in possession, no size limit
L	SHEEFISH	Entire Year	10 per day, no possession limit, no size limit
M	SHEEFISH	Entire Year	2 per day, 2 in possession, no size limit
N	NORTHERN PIKE	Entire Year	30 inches or more, 2 per day, 2 in possession Less than 30 inches, 10 per day, 10 in possession
O	NORTHERN PIKE	Entire Year	No bag, possession or size limit
P	HALIBUT	February 1 - December 31	2 per day, 2 in possession, no size limit
Q	ARCTIC CHAR	Entire Year	10 per day, 10 in possession, no size limit
R	OTHER FISH	Entire Year	No bag, possession or size limit

NOTE: Unless indicated more specifically, char means all char including Dolly Varden, Arctic char and lake trout.

Appendix C. Partial listing of wilderness lodges, guiding and outfitting operations in AYK.

Location	Operation	Remarks
Seward Peninsula/Norton Sound:		
White Mtn.	Fishing lodge, guiding	Opened in 1986
Niukluk, Fish R.	Outfitters	
Unalakleet R.	1 lodge	
Kuskokwim:		
Tonzona R.	2 lodges	Includes hunting
Holitna R.	2 lodges, 6 guides	Includes hunting
Hoholitna R.	1 lodge	
Aniak R.	6 guides, misc. outfitters	
Arctic:		
Kobuk R.	a few small lodges (20 guests)[1]	
Walker Lk.	1 lodge	
Alatna R.	1 lodge	

[1] NPS encourages nonconsumptive use of Kobuk Valley Park, so these lodges may offer more for the sightseer than the angler.