Fishery Management Report No. 93-1

Annual Management Report for Sport Fisheries in the Arctic-Yukon-Kuskokwim Region, 1991

by

William D. Arvey

November 1993

Alaska Department of Fish and Game

Division of Sport Fish

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[1] Some of the data included in this report were collected under various jobs of Projects F-10-7 and F-10-8 of the Federal Aid in Fish Restoration Act (16 U.S.C. 777-777K).

The fishery Management Reports series was established in 1989 for the publication of an overview of Division of Sport Fish management activities or management goals in a specific geographic area. Fishery Management Reports are intended for fishery and other technical professionals, as well as lay persons. Distribution is to state and local publication distribution centers, libraries and individuals and, on request, to other libraries, agencies, and individuals. This publication has undergone editorial and peer review.

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ABSTRACT

An estimated 21,962 angler-days of sport fishing effort occurred in the AYK Region in 1991, of which 155,662 angler-days were expended in the Tanana Area. An estimated 221,164 fish were reported harvested in the AYK Region sport fishery, of which 152,959 were reported harvested in the Tanana Area. The Salcha River harvest of 308 chinook salmon in 1991 was the greatest since 1986. The 1991 estimated sport harvest of 2,345 coho salmon in the Delta Clearwater River was the highest on record. The Arctic grayling fishery on the Chena River was closed by emergency order to harvest on July 1, 1991, and catch-and-release was instituted. The estimated harvest of 12,476 northern pike in the Tanana Area in 1991 was the highest since inception of the statewide harvest survey in 1977. The fall spear fishery for whitefish in the Chatanika River closed on July 1 by emergency order because of low stock abundance. Fishing effort at Piledriver Slough in 1991 exceeded 17,700 angler-days; the largest amount for any waterbody in the Tanana Area. Approximately 2.349 million fish of seven species were stocked in Tanana area waters. A total of four emergency orders were released, and 19 reports were published in the Sport Fish Division series. The Board of Fisheries did not consider changes in AYK Region sport fishing regulations in 1991.

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

PREFACE

This is the sixth Annual Management Report for sport fisheries in the Arctic-Yukon-Kuskokwim Region (AYK Region). Statistics pertinent to recreational fisheries in the AYK Region are presented, Alaska Department of Fish and Game (ADF&G) research and reporting activities are described, stock status information is introduced, regulatory changes in 1991 are documented, and other natural and man-influenced factors that may affect fish survival and production during the reporting period are briefly summarized. In addition, long term trends in abundance and/or exploitation are described. Arvey et al. (1990, 1991), Arvey and Parker (1991), and Arvey (1991, 1992) present similar information for the years 1986, 1987, 1988, 1989 and 1990. The reader is advised to consult other cited regional fisheries data reports for specific information. A brief summary of reports completed by regional staff during the reporting year, along with complete citations is included here under the section entitled "Synopses of Published Reports".

INTRODUCTION

The AYK Region encompasses the majority of the landmass of the state of Alaska (Figure 1). Included within the region are 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. Regional coastline boundaries extend from Cape Newenham in the southwest, around all of western, northwestern and northern Alaska to the Canadian border on the Arctic Ocean (Figure 1). The region as a whole is very sparsely populated, with one densely populated center located in the Tanana River valley. Fairbanks (population about 31,000) is the largest community. The Fairbanks North Star Borough Census Area contains about 78,000 people. Other population centers in the region include the Yukon-Koyukuk Census Area with 8,500 people, Nome Census Area with 8,300 people, Southeast Fairbanks Census Area with 6,000 people, Northwest Arctic Borough with 6,100 people, Wade Hampton Census Area with 5,800 people, and the North Slope Borough with 6,000 people (Alaska Department of Labor (ADL) 1991).

The State of Alaska sport fishery program divides the AYK Region into three separate fishery management areas; the Tanana Area, the Northwestern Area (Norton Sound and Kotzebue), and the AYK Area. The Tanana River drainage is a separate management area because it contains population centers that have greater impacts upon fishery resources. Intensive, stock specific studies have been required in the Tanana Area to provide needed biological information for fishery management because of higher fishery exploitation rates in this area. Since 1990, the Sport Fish Division has assigned separate management responsibility to the upper Tanana River Valley and to the Northwestern Area (Norton Sound/Kotzebue).

TANANA AREA DESCRIPTION

Prior to 1990, harvest reports for the Tanana Area included all southern drainages of the Yukon River from its confluence with the Tanana River near Tanana, east to the Canadian border. They also included the Alaskan portion of the Fortymile and Sixtymile River drainages, the entire Tanana River watershed, and the Alaskan portion of the White River drainage. Beginning in 1990, only the Tanana River watershed is considered to be part of the Tanana Area for the purpose of harvest reporting. Harvest reports from all other portions of the upper Yukon River are now included in the AYK Area.

Geographic and Geologic Setting

The Tanana River basin (Figures 2-6) is an area of approximately 113,900 km^2 (11.4 million ha). The main river is a large glacial stream formed at the confluence of the Chisana and Nebesna rivers near Tok. After flowing downstream in a general northwesterly direction for some 917 km, it joins the Yukon River at Tanana. It is the second largest tributary of the Yukon River; the drainage area of the Porcupine River is slightly larger. The Tanana River receives most of its water volume and sediment loads from streams draining the glaciers of the Alaska Range and the Wrangell Mountains. All major tributaries entering the north side of the Tanana River originate in the Tanana Hills uplands and are clear in both winter and summer except for relatively short periods after heavy rains and during the spring period of

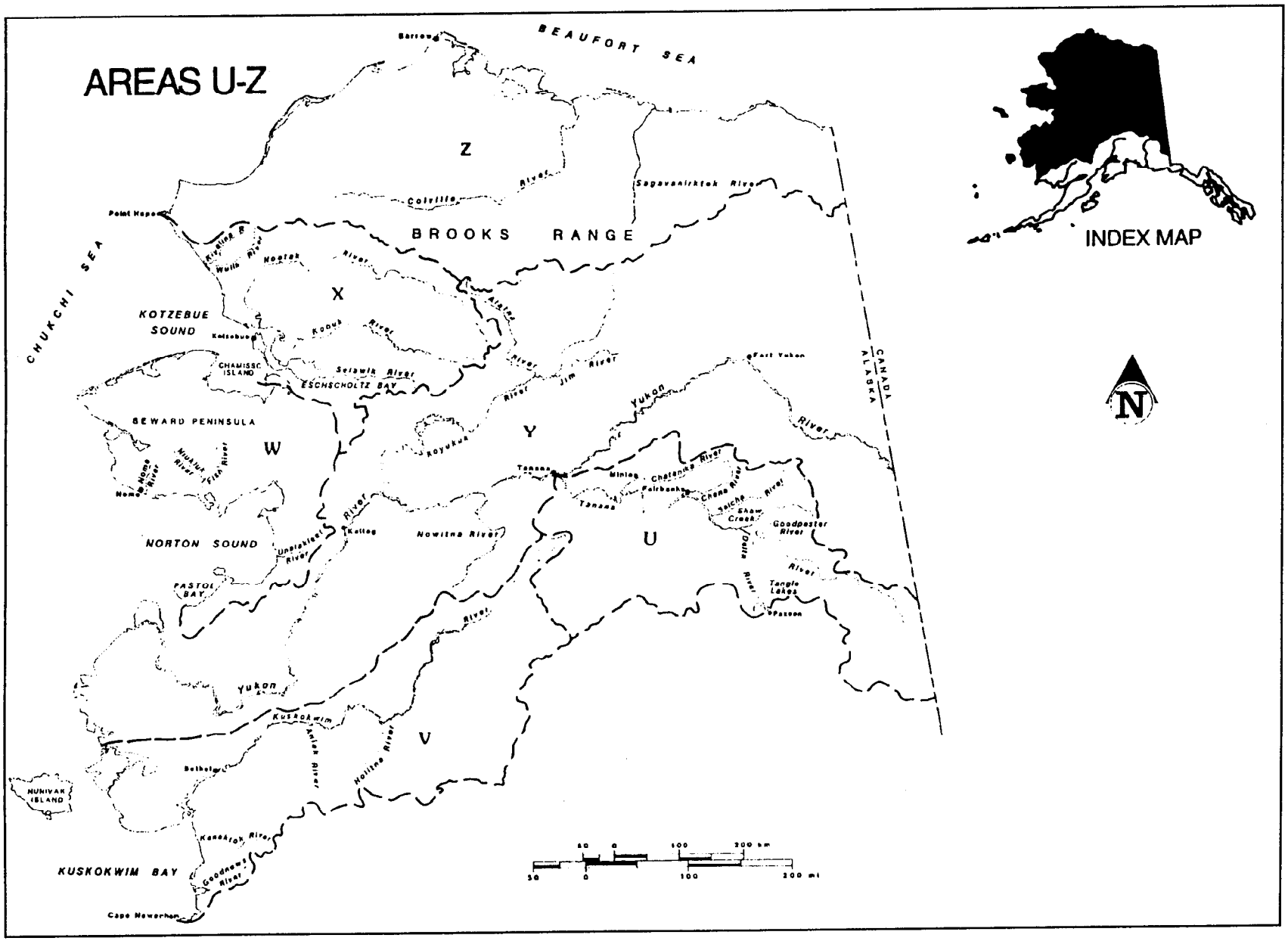

Figure 1. The Arctic-Yukon-Kuskokwim Region. Dashed lines indicate boundaries between harvest reporting areas U - Z.

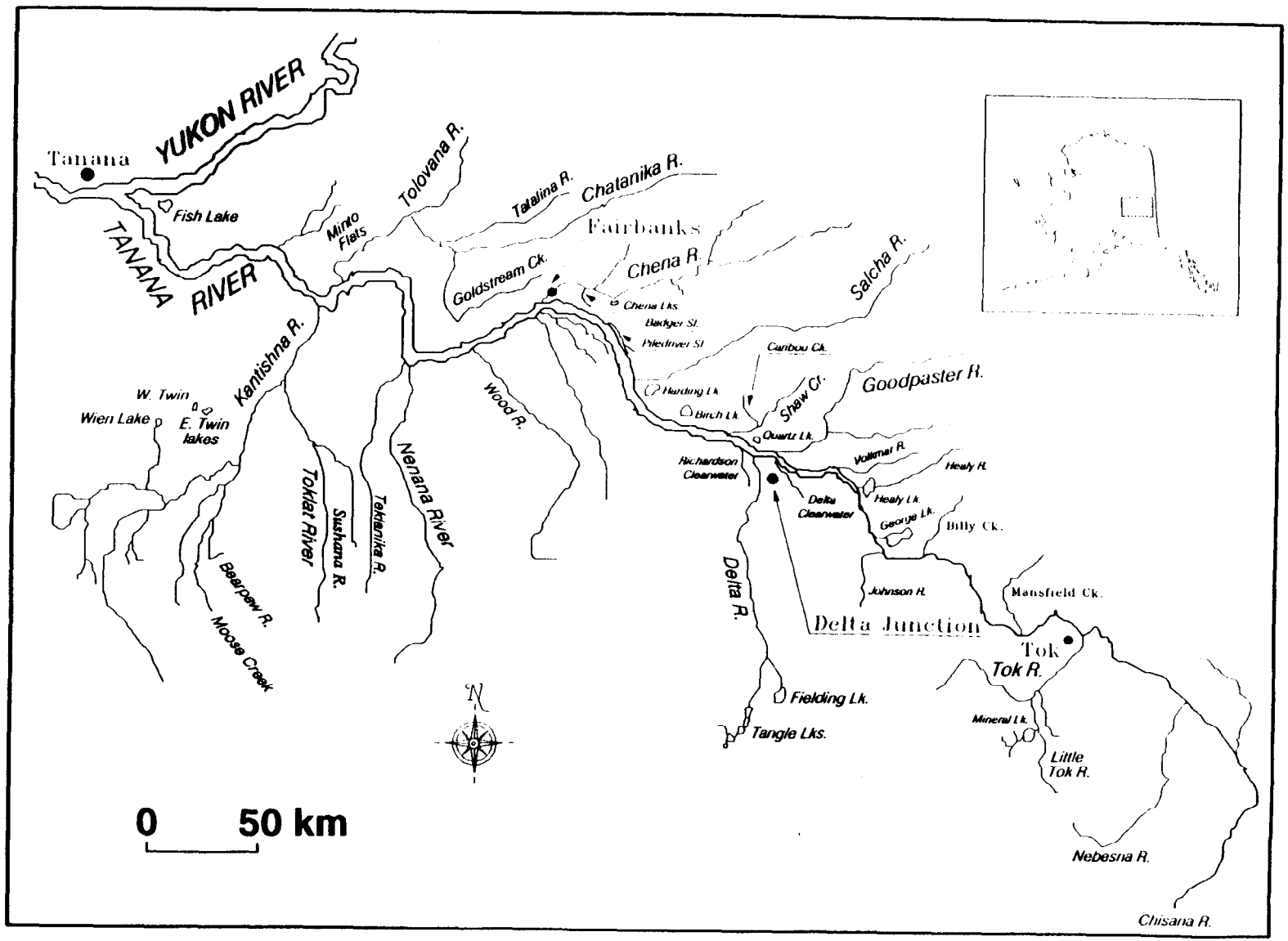

Figure 2. The Tanana River drainage.

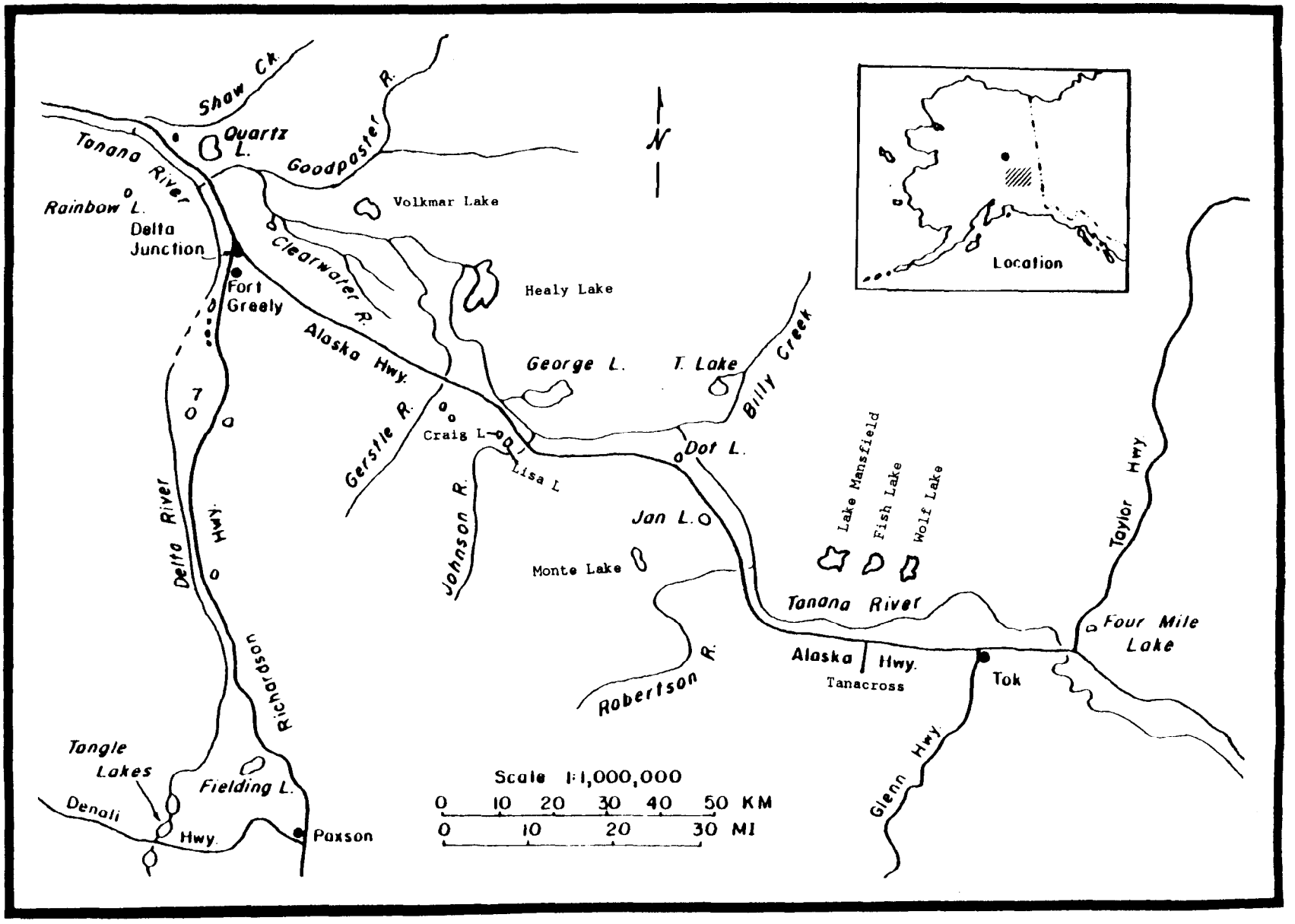

Figure 3. Waters and highways of the middle Tanana River valley.

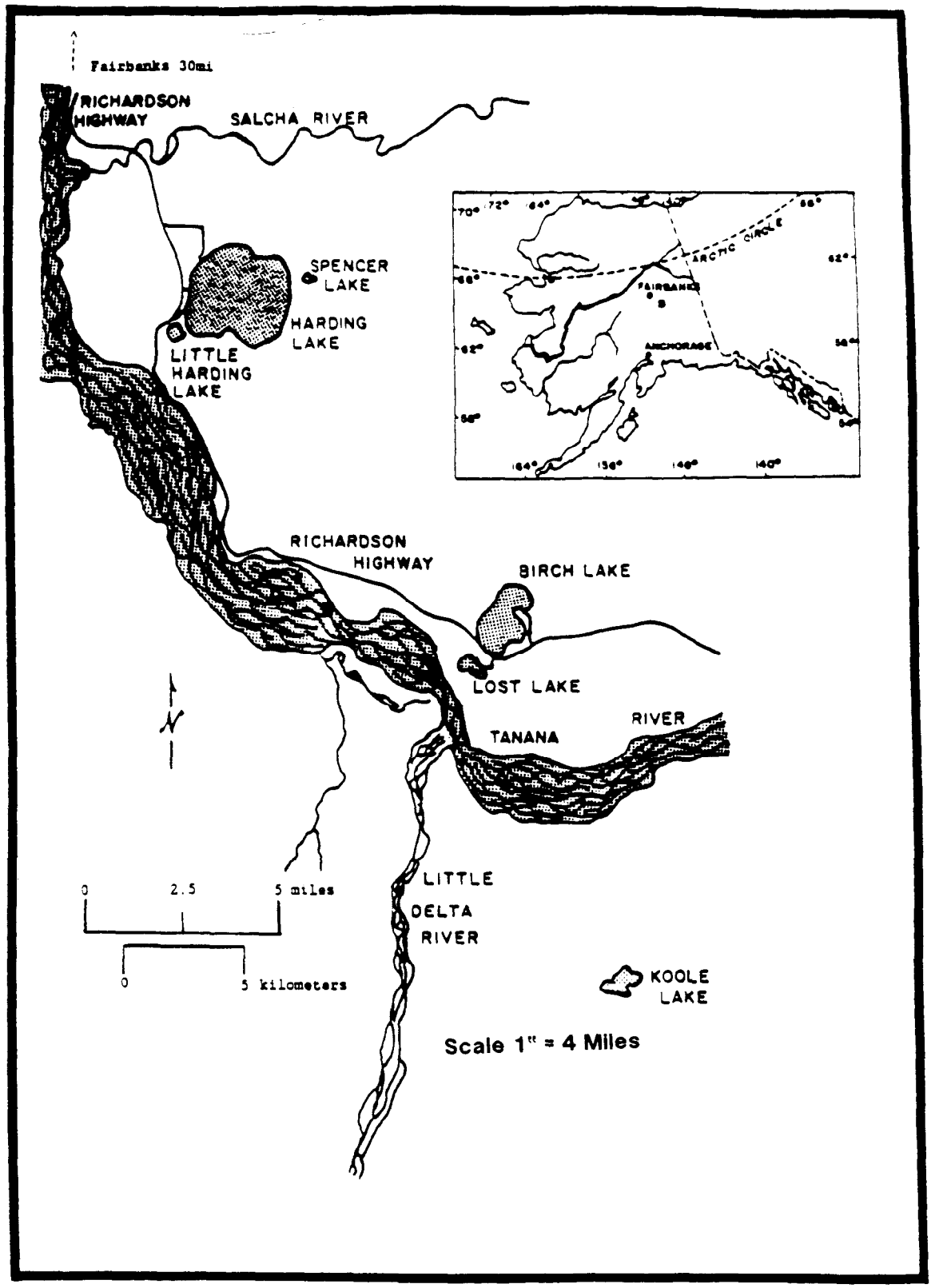

Figure 4. Tanana River waters near Fairbanks.

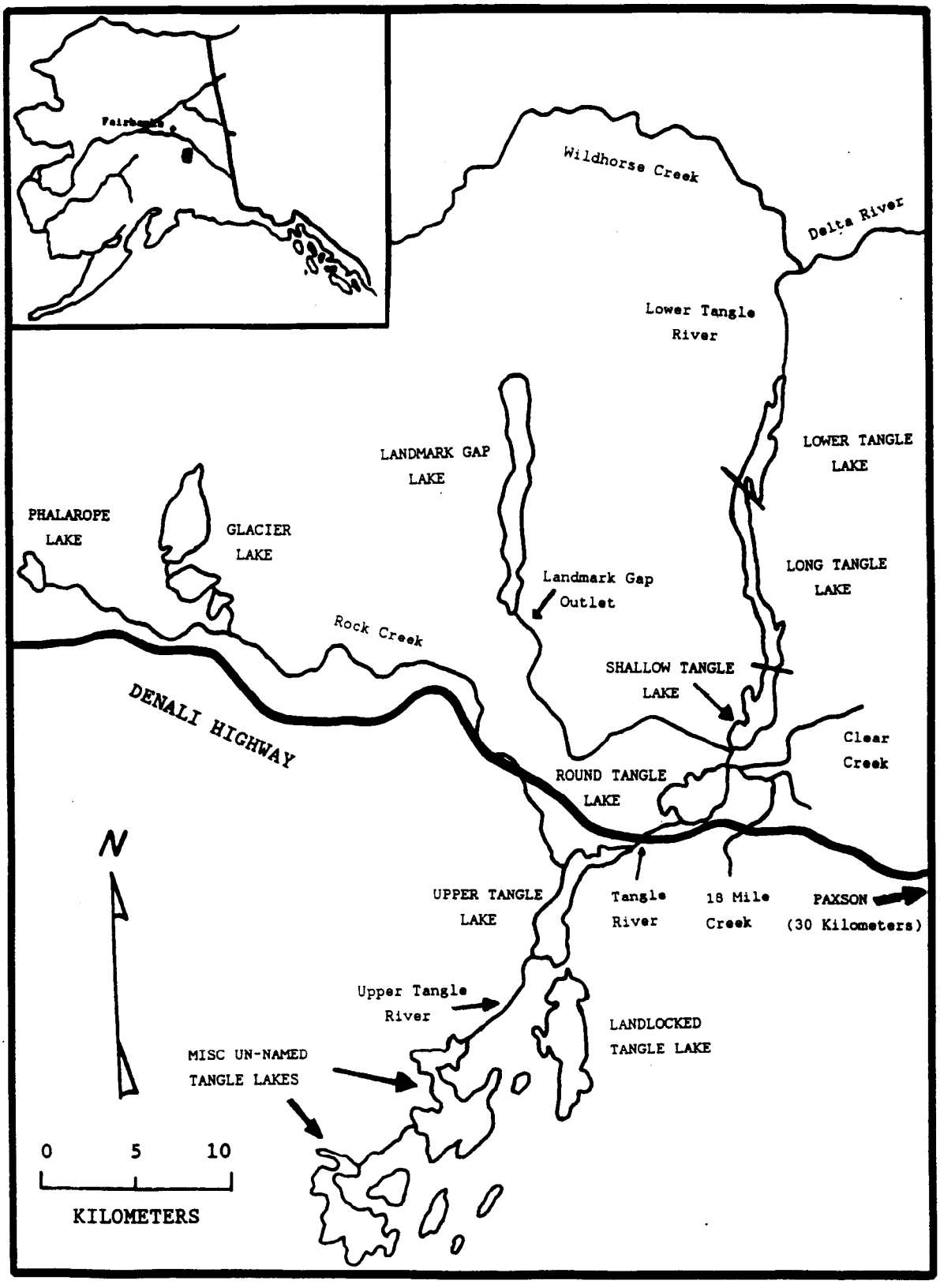

Figure 5. Map of the Tangle Lakes system.

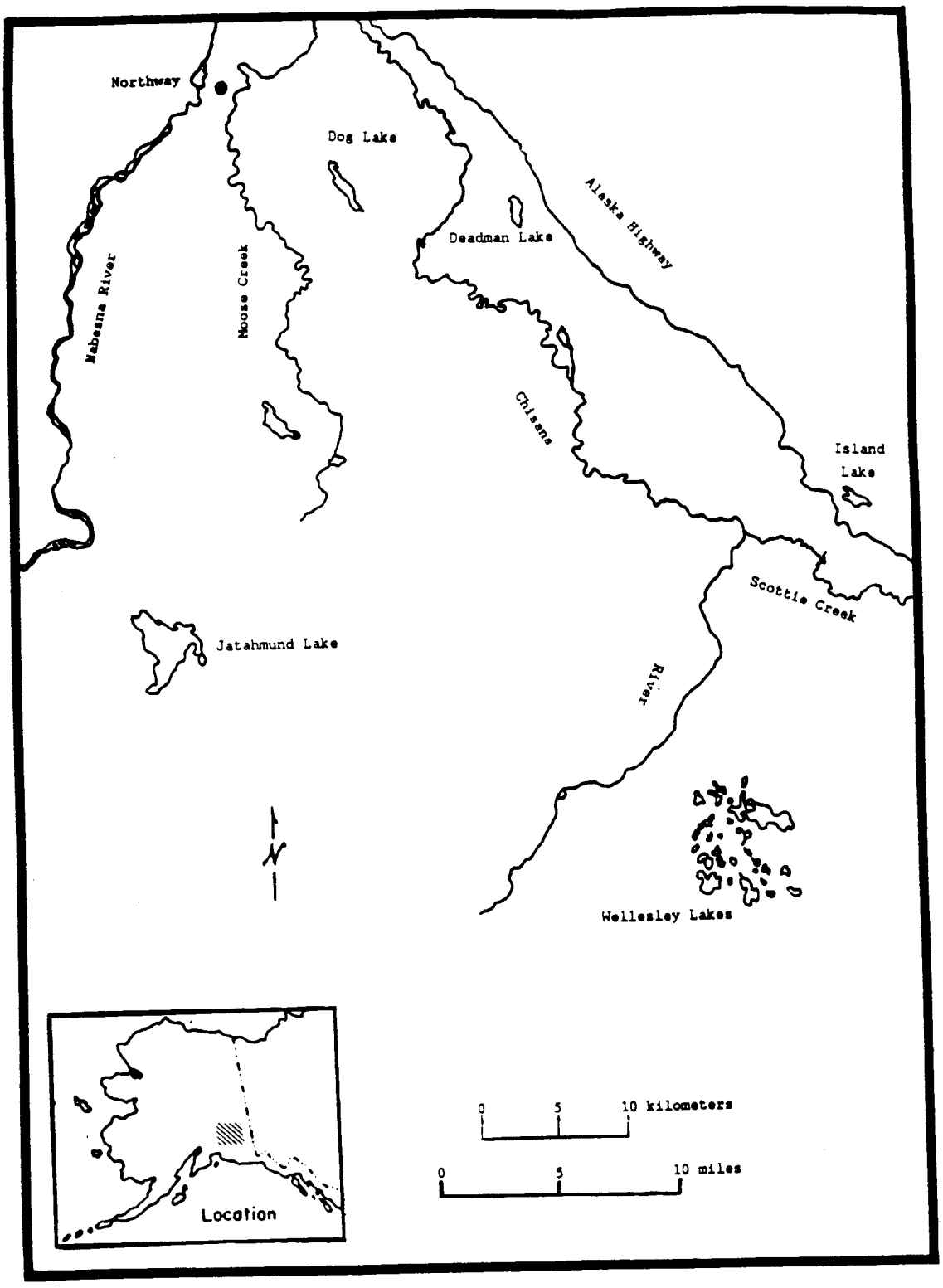

Figure 6. Tributaries of the upper Tanana River.

snowpack melt. They include the Goodpaster, Salcha, Chena, Chatanika, and Tolovana rivers. Rivers flowing from 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 rivers (Figure 2).

Lake and Stream Resources

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 sub-surface water flows from the north slope of the Alaska Range. The Delta Clearwater and Richardson Clearwater rivers (Figures 2 and 3) are the most important sport fishing streams (in terms of angler days and harvest) that originate from these aquifers. The few on-stream lakes present (lakes that drain into a stream tributary to the Tanana River or into the Tanana River itself) in the drainage are of insufficient volume to sustain flow in the Tanana River during winter or through dry summers. Headwater glaciers provide water storage that maintains 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 (Selkregg 1976). 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 present in the lakes. Primary lakes for sport fishing within the Tanana River drainage are Harding, Birch, Chena, Quartz, Volkmar, George, Fielding, and Tangle lakes (Figures 3 and 4). Volkmar and George lakes have no roadside access. Chena Lakes (Figure 2) in the lower Chena River basin were created by gravel removal to erect flood control structures during the 1970's.

Lakes are generally ice covered by late October and breakup can occur from May in low elevation lakes to late June or early July in lakes at higher elevation. By late winter, ice thickness typically ranges from 81 to 102 cm on interior Alaska lakes.

Lakes were formed in various ways. Some (e.g. Harding, Healy, and George lakes) were created by silt from the Tanana River damming streams draining the surrounding hills. The melting of buried ice masses can sometimes result 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-like conditions occurring as early as mid-April and snowfall, with sub-freezing temperatures, occurring as late as June. Summers are three months in duration and are characterized by long daylight hours and temperatures that occasionally exceed 32°C. The fall season may extend through early October, with snowfall and decreasing temperatures. Winter conditions last from mid-November until mid-

March, and during this time temperatures may fall to -57°C. Annual precipitation averages around 28 cm, the majority falling between June and September (U.S. Department of Agriculture (USDA) 1991).

Species of Importance to the Sport Fishery

There are 17 fish species known in the Tanana area of which 10 are important sport species. They include: chinook salmon *Oncorhynchus tshawytscha*, coho salmon *Oncorhynchus kisutch*, Arctic grayling *Thymallus arcticus*, burbot *Lota lota*, lake trout *Salvelinus namaycush*, inconnu (sheefish) *Stenodus leucichthys*, least cisco *Coregonus sardinella*, humpback whitefish *Coregonus pidschian*, and northern pike *Esox lucius*. Rainbow trout *Oncorhynchus mykiss* are not native to the drainage, but have been stocked in several locations.

Tanana Area Sport Fisheries

The statewide harvest survey (SHS), compiled annually since 1977 by Mills (1979-1992) serves as the basic reference of effort and harvest in AYK Region fisheries. Many fisheries in the Tanana Area are not monitored by ADF&G creel surveys, and several are monitored only to obtain CPUE (catch-per-unit-effort) and biological catch composition data, but not seasonal harvest totals. Because so few fisheries are monitored by creel survey, the SHS is the only source of harvest information. Only the Salcha River chinook salmon sport harvest was monitored with an on-site creel survey in 1991, in which a harvest of 308 salmon was estimated, the largest number since 1986 when 526 chinook salmon were estimated to have been taken. For comparison, the SHS harvest estimate for this fishery was 373 chinook salmon, indicating a difference of approximately 17% in the harvest estimates.

The harvest for 30 separate locations within the Tanana drainage was estimated using the SHS for the 1991 calendar year. These SHS estimates are 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 were surveyed annually until 1989, when the sample size was approximately doubled and 8.7% of all anglers received questionnaires. A total of 30,164 questionnaires was mailed in 1991, followed by two reminders to non-respondents. Responses were obtained from more than 52% of the individuals that received the first mailing.

Catch, as opposed to harvest was estimated and reported separately for the first time in 1990 for all areas statewide (Mills 1991).

Results of the 1991 SHS for the Tanana River drainage fisheries were based on responses received from several hundred people (Mills 1991). In 1991, the proportion of the total number of angler-days spent in the Tanana Area (155,662 AD) was 71% and 6% of the total number of all angler-days spent in the AYK Region and the entire state of Alaska, respectively (Table 1) Of the 1,282,541 fish harvested in freshwater (includes anadromous salmonids) in the state, 152,959 (12%) were taken from the Tanana River drainage, and 68,205 (5%) were taken from the AYK Area (Table 1).

An average of approximately 72% of the sport fish harvested in the AYK Region is taken from the Tanana Area (Mills 1979-1992). Effort in angler-days in the Tanana Area has increased from 100,000 in 1977 to about 155,600 in 1991.

Table 1. Number of sport anglers, fishing trips, angler days and total freshwater[a] fish harvested in the Tanana River drainage, the AYK area and the entire state of Alaska, 1991[b].

	Tanana Drainage	AYK[d]	Alaska
Number Sport Anglers[c]	34,672	14,320	425,025
Number Fishing Trips[c]	113,247	38,979	1,706,558
Number Angler Days	155,662	64,300	2,456,328
Total Fish Harvested[c]	152,959	68,205	1,282,541

[a] Includes anadromous salmonids.
[b] Mills 1992.
[c] Includes both marine and freshwater; harvest is freshwater only.
[d] Exclusive of Tanana River drainage.

Since 1988 the harvest of stocked fish has exceeded that of wild stocks in the Tanana Area. A brief description of the sport fisheries in the Tanana Area follows.

Chinook Salmon:

Sport fishing for sea-run chinook salmon in the Tanana River drainage is largely limited to the lower sections of the Salcha and Chena rivers and to the upper Chatanika River, since these are essentially the only road-accessible stocks of sufficient size to support recreational harvests. Annual sport harvests in the Salcha River since 1980 have ranged between zero (1988) and 904 (1980) chinook salmon, while harvests in the Chena and Chatanika rivers are generally smaller. Harvest estimates by the SHS, of chinook salmon in the Salcha river, was similar in 1991 to that obtained by the creel survey study. The sport harvest estimated by creel survey for the Salcha River was 308 fish (Table 2), compared to 373 fish estimated by the SHS (Mills 1992).

The Salcha River spawning escapement in 1991 was estimated[1] to be less than desired by ADF&G for reproductive purposes (ADF&G 1991). Escapements estimated by aerial survey that equal or exceed 2,500 adult spawning fish are considered desirable, and the peak aerial escapement estimate of 2,212 chinook salmon in 1991 failed to reach the established goal. Since 1980, escapements have ranged from as few as 1,031 to as many as 6,757 chinook salmon under good survey conditions in the Salcha River. The average escapement from 1980 to 1990 (12 data points), is 2,656 chinook salmon. Chena River chinook salmon escapement in 1991 was estimated to be 1,276 fish. Estimates of escapement from aerial surveys conducted under good conditions have ranged from 1,276 to 2,553 fish during the 1980 to 1991 period, with an average (10 data points) of 1,902 fish per year. Escapement objectives (estimated by aerial survey) for the Chena River have been set at 1,500 chinook salmon, and the 1991 escapement estimate failed to meet the goal.

In addition to aerial survey estimates of escapement, mark-recapture experiments to estimate spawner abundance have been conducted since 1986 in the Chena River and 1987 in the Salcha River by the Sport Fish Division. Results of the abundance estimates in 1991 indicated that 5,608 adult chinook salmon returned to the Salcha River, compared to the peak aerial survey count of 2,212 fish (Skaugstad 1992). It was estimated that 3,025 adult chinook salmon returned to the Chena River in 1991, compared to the peak aerial survey count of 1,276 fish (Evenson 1992a).

Coho Salmon:

Anadromous coho salmon are taken in the Delta Clearwater River and from various creeks in the Nenana River drainage. Coho salmon spawn in other clear spring-fed tributaries of the Tanana River where little sport effort occurs.

The Kantishna River and Toklat River tributaries such as Moose, Barton, and Geiger creeks, and the Sushana River (Figure 2), where abundant groundwater is found, support coho salmon populations. The previous largest sport harvest in the Tanana Area occurred in 1988 when an estimated 2,237 anadromous coho

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[1] Estimated by fixed wing aerial survey.

Table 2. AYK Region creel surveys, 1991.

Water Body/Fishery	Species[a]	Date(s)	Effort (hours)	Harvest
Chatanika River	AG	16 May-31 Aug	3,349	ND
Chena River	AG	18 May- 31 Jul	3,201	ND
George Lake	NP	25 May- 27 May	ND	128
Piledriver Slough	RT	28 May- 27 Jul	ND	ND
Salcha River	KS	06 Jul- 28 Jul	7,337	308

[a] AG: Arctic grayling; KS: chinook salmon; RT: rainbow trout; NP: northern pike.

salmon were taken. The Delta Clearwater River supports both the largest coho spawning population and the largest recreational harvest in the Tanana Area, where an estimated 1,721 fish were harvested in 1991 (Table 3). The estimated sport harvest for the Tanana Area in 1991 exceeds the previous high harvest and is estimated to have been 2,345 fish (Table 4). The fishery in the Delta Clearwater River for coho salmon typically takes place from mid-September until the end of October.

Delta Clearwater River escapements have generally increased since 1985 when 5,358 coho salmon were estimated in the spawning population. Comparable escapement sizes for 1989, 1990 and 1991 were 11,000, 8,325 and 23,900 fish, respectively (Bergstrom et al. 1992; ADF&G 1991). The highest escapement recorded for this stream occurred in 1991. Escapement since 1977 has ranged from 3,946 fish in 1980 to 23,900 fish in 1991. Commercial fishing restrictions in the lower Yukon River salmon fisheries, combined with low natural mortality have apparently favored large escapements of this species to spawning grounds in drainages of the Yukon and Tanana rivers.

Stocking of landlocked coho salmon in Quartz, Birch, Chena and several smaller lakes has been popular with anglers in the Tanana River valley. An estimated 22,125 fish were harvested from stocked lakes in 1991, with 11,054 taken from Quartz Lake alone (Table 3).

Arctic Grayling:

Arctic grayling are widely distributed in streams and lakes of the Tanana Area and are a favorite of anglers. The largest Arctic grayling fisheries in the Tanana drainage occur in the Chatanika, Chena, Salcha, Goodpaster, Delta Clearwater and Richardson Clearwater rivers; Badger and Piledriver sloughs; and Fielding and Tangle lakes. The Tangle lakes in the headwaters of the Delta River support the largest lacustrine fishery for Arctic grayling in Alaska.

Historically, the Chena River supported the largest Arctic grayling fishery in the state, due to an abundant stock, proximity of the Chena River to Fairbanks, and the extensive road access available. The average annual harvest of Arctic grayling in the Chena River exceeded 21,000 fish during the eight years from 1977 to 1984. The harvest declined from a peak of 42,000 in 1980 to a low of 3,090 in 1987. Clark (1987) attributed declines in abundance and fishing success in the Chena River since 1984 to both sport fishing over-harvest and to reduced recruitment because of unfavorable environmental conditions (primarily high river discharge during the natal year). The estimated 1989 sport harvest in the Chena River and its tributaries was 13,737 Arctic grayling, and 4,507 fish in 1990. The harvest in 1991 was estimated at 3,719 fish (Table 3). Modest increases in survival and recruitment estimates over recent previous years for Chena River Arctic grayling were reported by Clark (1990) for 1988-1989. Clark (1991) also reported substantial increases in survival and recruitment in 1989-1990, exceeding the long term average.

Table 3. Tanana River area[a] sport fish harvest and effort by fisheries and species[b], 1991.

	Anglers	Trips	Days Fished	KS	SS	LL	KO	CS	LT	DV AC	RT	GR[c]	GR[d]	WF	SF	NP[e]	NP[f]	BB	OTHER
Upper Chena River	4,450	6,465	8,591	0	0	0	0	0	0	0	0	0	722	34	0	178	0	0	0
Lower Chena River[g]	4,345	11,300	12,547	110	0	0	0	39	0	0	0	1,370	1,627	0	68	1,398	74	225	0
Piledriver Slough	5,308	15,365	17,703	5	0	0	0	7	0	0	6,414	1,835	2,152	91	0	298	45	203	0
Nenana River Drainage	754	1,297	1,550	11	222	0	0	0	0	29	0	733	881	0	0	119	30	11	0
Chatanika River	4,345	5,431	8,085	82	21	0	0	59	0	0	0	1,015	1,627	0	0	297	104	0	0
Salcha River	4,958	8,252	11,242	373	0	0	0	156	0	0	0	0	1,688	0	0	59	59	23	0
Delta Clearwater River	3,171	4,765	5,594	0	1,721	0	0	98	0	0	0	0	2,165	91	0	0	0	0	89
Goodpaster River	350	543	786	0	0	0	0	0	0	0	0	196	440	0	0	0	0	0	0
Brushkana Creek	631	543	666	0	0	0	0	0	0	87	0	355	171	0	0	0	0	0	0
Lower Tanana River	456	648	1,279	0	0	0	0	0	0	0	0	0	12	11	45	372	104	113	0
Middle Tanana River	1,104	2,190	2,344	0	127	0	0	59	0	174	0	24	0	23	0	208	0	834	0
Upper Tanana River	385	841	1,492	0	11	0	0	0	0	0	0	0	294	0	0	0	0	654	0
Shaw Creek	578	701	773	0	0	0	0	13	0	0	0	0	453	0	0	0	0	45	0
Richardson Clearwater River	561	683	1,199	0	106	0	0	0	0	0	0	0	1,419	0	0	0	0	0	0
Delta River (below Tangle Lakes)	438	491	679	0	0	0	0	65	44	0	0	135	440	0	0	0	0	0	0
Other Streams	2,021	3,230	4,628	38	137	0	0	33	295	233	0	782	3,056	11	0	476	120	23	0
Birch Lake	7,341	9,145	13,893	0	0	6,098	0	0	0	0	17,625	0	0	0	0	0	0	0	0
Quartz Lake	9,899	11,388	15,478	0	0	11,054	0	0	0	0	28,238	0	0	0	0	0	0	0	0
Fielding Lake	1,174	964	1,572	0	0	0	0	0	295	0	0	379	905	0	0	0	0	0	0
Minto Flats	1,034	1,016	1,532	11	0	0	0	59	0	0	0	98	24	137	45	1,457	297	56	0
Tangle Lakes and Tangle River	4,082	3,136	6,407	0	0	0	0	0	472	0	0	2,385	2,532	23	0	0	0	23	36
Chena Lake (Lake only)	3,732	6,798	9,444	0	0	3,058	0	0	0	0	12,196	0	0	0	0	0	0	0	0
Harding Lake	3,241	4,292	5,155	0	0	0	185	0	133	450	246	86	0	68	0	1,487	401	45	0
Dune Lake	613	613	759	0	0	924	0	0	0	0	646	208	379	0	0	0	0	0	0
East Twin Lake	526	456	679	0	0	0	0	0	0	0	0	0	0	0	0	595	30	0	0
George Lake	788	999	1,931	0	0	0	0	0	0	0	0	24	0	182	0	1,086	178	11	0
Volkmar Lake	333	420	1,052	0	0	0	0	0	0	0	0	0	0	0	0	461	104	0	0
Steese Ponds	823	1,384	1,785	0	0	84	0	0	0	0	123	122	12	0	0	15	0	0	0

-continued-

Table 3. (Page 2 of 2).

	Anglers	Trips	Days Fished	KS	SS	LL	KO	CS	LT	DV AC	RT	GR[c]	GR[d]	WF	SF	NP[e]	NP[f]	BB	OTHER
Chena Hot Springs Road Ponds	1,121	1,454	2,224	0	0	34	0	0	44	15	954	367	122	0	0	238	45	0	0
Meadow Road Lakes	562	2,261	2,975	0	0	17	0	0	236	1,481	1,184	1,614	159	0	0	0	0	0	178
Coal Mine Road Lakes	631	614	1,230	0	0	336	0	0	103	378	477	147	24	0	0	0	0	0	0
Other Lakes	4,196	5,562	10,388	0	0	520	0	0	356	44	3,921	244	355	68	0	1,977	164	473	0
TOTAL	34,672[h]	113,247	155,662	630	2,345	22,125	185	588	1,978	2,891	72,024	12,119	21,659	739	158	10,721	1,755	2,739	303

[a] Tanana River Drainage (Area U): The entire Tanana River watershed, excluding all portions of the Yukon and Kuskokwim River watersheds.

[b] KS: king or chinook salmon; SS: silver or coho salmon; LL: landlocked silver salmon; KO: kokanee; CS: chum salmon; LT: lake trout; DV/AC: Dolly Varden or Arctic char; GR: Arctic grayling; WF: whitefish (any of several species); SF: sheefish; NP: northern pike; BB: burbot; PS: pink salmon; HA: halibut; SM: smelt;

[c] Arctic grayling less than 12 inches.

[d] Arctic grayling 12 inches and over.

[e] Northern pike 30 inches and under.

[f] Northern pike over 30 inches.

[g] All parts of Badger Slough (sometimes called Chena Slough).

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

Table 4. Arctic-Yukon-Kuskokwim Region sport fish harvest by species, 1979-1991[a].

Species	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Tanana Area:													
Chinook Salmon	515	941	763	984	1,048	338	1,356	781	502	853	963	439	630
Sea-Run Coho Salmon	25	67	45	52	147	831	796	1,374	1,231	2,237	1,596	1,719	2,345
Landlocked Coho/ Chinook Salmon	36,073	25,733	57,294	43,374	34,255	29,245	41,042	24,061	26,566	32,342	18,614	13,943	22,125
Sockeye Salmon	0	0	0	0	0	0	0	0	0	0	0	0	0
Pink Salmon	0	0	0	0	0	0	0	0	0	0	0	0	0
Chum Salmon	219	483	595	698	649	585	1,255	693	620	491	1,134	55	588
Rainbow Trout	5,186	19,584	24,571	26,186	20,664	34,022	33,432	31,270	31,824	78,345	74,675	64,143	72,024
Lake Trout	946	1,264	1,721	3,104	2,937	2,104	2,984	713	652	2,221	1,932	896	1,978
Dolly Varden/ Arctic Char	364	524	572	482	293	350	1,230	200	36	909	913	830	2,891
Arctic Grayling	70,243	80,150	75,288	81,753	92,363	83,626	63,560	45,981	38,480	52,659	54,823	28,414	33,778
Northern Pike	7,975	9,452	9,941	9,822	10,225	9,607	12,090	11,934	9,471	11,986	11,330	7,348	12,476
Whitefish	5,159	5,987	4,873	8,643	8,311	11,658	20,230	26,810	26,435	11,775	16,935	6,891	739
Burbot	1,979	2,700	4,122	3,887	5,040	5,556	4,795	5,142	3,855	3,733	4,357	3,799	2,739
Sheefish	279	96	93	127	157	338	420	72	235	982	643	169	158
Other Fish	79	0	108	10	21	39	0	171	0	0	130	34	303
Total	129,042	146,981	179,986	179,122	176,110	178,299	183,190	149,202	139,907	198,533	188,045	128,680	152,774

-continued-

Table 4. (Page 2 of 3).

Species	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AYK Area:													
Chinook Salmon	644	939	1,112	1,530	2,649	1,481	1,331	2,079	1,691	2,965	2,450	1,366	1,333
Sea-Run Coho Salmon	2,958	3,469	2,087	5,909	5,785	11,205	2,396	7,319	7,210	9,713	8,655	4,819	8,317
Landlocked Coho/ Chinook Salmon	0	0	0	0	0	0	0	0	58	0	0	0	0
Sockeye Salmon	126	112	117	430	261	650	169	439	1,364	1,528	456	818	631
Pink Salmon	2,918	7,844	3,118	14,214	5,286	8,712	1,206	3,404	1,322	3,859	3,765	7,994	1,865
Chum Salmon	1,482	2,290	3,045	5,083	4,049	2,689	1,781	3,643	2,148	3,201	4,748	2,091	2,570
Rainbow Trout	401	835	982	796	1,783	1,455	659	504	592	1,599	757	435	774
Lake Trout	655	1,025	1,100	2,023	1,157	1,520	2,370	2,537	461	509	1,955	847	1,055
Dolly Varden/ Arctic Char	8,144	8,273	8,176	13,647	20,324	12,882	13,430	10,173	12,333	11,238	13,359	7,431	16,880
Arctic Grayling	19,229	20,396	20,892	27,043	30,800	15,516	17,666	19,744	19,476	16,302	17,215	9,092	18,576
Northern Pike	4,004	6,190	5,184	7,435	8,609	4,610	3,613	7,062	4,751	7,838	5,853	4,982	8,295
Whitefish	855	1,705	576	3,708	4,746	234	630	4,960	724	1,855	1,997	810	2,197
Burbot	118	663	684	1,896	555	377	420	469	162	145	537	1,684	316
Sheefish	1,263	2,315	2,146	3,154	3,166	3,609	2,100	3,649	2,362	2,239	1,663	581	2,098
Smelt	0	0	0	0	0	0	8,750	464	7,080	2,476	2,424	1,709	1,818
Halibut	0	0	0	0	0	0	62	0	36	0	0	144	0
Other Fish	2,218	3,513	3,124	8,551	8,806	1,844	1,336	1,178	0	371	241	580	1,480
King crab	0	0	0	0	0	0	0	0	0	0	0	0	748
Total	45,015	59,569	52,343	95,419	97,976	66,784	57,919	67,624	61,770	65,838	66,075	45,383	68,953

-continued-

Table 4. (Page 3 of 3).

Species	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AYK Region (both management areas):													
Chinook Salmon	1,159	1,880	1,875	2,514	3,697	1,819	2,687	2,860	2,193	3,818	3,413	1,805	1,963
Sea-Run Coho Salmon	2,983	3,536	2,132	5,961	5,932	12,036	3,192	8,693	8,441	11,950	10,251	6,610	10,662
Landlocked Coho/ Chinook Salmon	36,073	25,733	57,294	43,374	34,255	29,245	41,042	24,061	26,624	32,342	18,614	13,943	22,125
Sockeye Salmon	126	112	117	430	261	650	169	439	1,364	1,528	456	818	631
Pink Salmon	2,918	7,844	3,118	14,214	5,286	8,712	1,206	3,404	1,322	3,859	3,765	7,994	1,865
Chum Salmon	1,701	2,773	3,640	5,781	4,698	3,274	3,036	4,336	2,768	3,692	5,882	2,146	3,158
Rainbow Trout	5,587	20,419	25,553	26,982	22,447	35,477	34,091	31,774	32,416	79,944	75,432	64,618	72,798
Lake Trout	1,601	2,289	2,821	5,127	4,094	3,624	5,354	3,250	1,113	2,730	3,605	1,743	3,033
Dolly Varden/ Arctic Char	8,508	8,797	8,748	14,129	20,617	13,232	14,660	10,373	12,369	12,147	14,272	8,261	19,771
Arctic Grayling	89,472	100,546	96,180	108,796	123,163	99,142	81,226	65,725	57,956	68,961	71,637	37,506	52,354
Northern Pike	11,979	15,642	15,125	17,257	18,834	14,217	15,703	18,996	14,222	19,824	17,183	12,330	20,771
Whitefish	6,014	7,692	5,449	12,351	13,057	11,892	20,860	31,770	27,159	13,630	18,932	7,701	2,936
Burbot	2,097	3,363	4,806	5,783	5,595	5,933	5,215	5,611	4,017	3,878	4,894	5,483	3,055
Sheefish	1,542	2,411	2,239	3,281	3,323	3,947	2,520	3,721	2,597	3,221	2,306	750	2,256
Smelt	0	0	0	0	0	0	8,750	464	7,080	2,476	2,424	1,709	1,818
Halibut	0	0	0	0	0	0	62	0	36	0	0	144	0
Other Fish	2,297	3,513	3,232	8,561	8,827	1,883	1,336	1,349	0	371	371	614	1,783
King Crab	0	0	0	0	0	0	0	0	0	0	0	0	748
Total	174,057	206,550	232,329	274,541	274,086	245,083	241,109	216,826	201,677	264,371	253,437	174,175	221,727

[a] From Mills 1992

However Clark (1993) reported a decline in abundance and recruitment for 1991. Abundance of fish 3 years old and older in the lower 152 km of the Chena River (estimated in July) was estimated to be 24,657 fish, compared to 29,130 fish estimated in 1990.

In 1991, sport harvest of Arctic grayling in the Chena River was completely curtailed on July 1 by an emergency order that reduced the bag and possession limit to zero for this stream. Prior to this, the fishery was regulated by a minimum length limit of 30.5 cm (12 in) and a bag and possession limit of two fish, among other restrictions. The small harvest reported for 1991 reflects adoption of the zero harvest regulation after July 1.

Concern for the conservation of several Tanana River drainage Arctic grayling stocks were identified from stock status studies conducted during the latter half of the 1980's decade. Shaw Creek, the Delta Clearwater River, Richardson Clearwater River and Chena River Arctic grayling stocks were considered in danger of over-exploitation. Since early assessments, stocks in all but the Chena River appear to have stabilized at healthy levels.

In 1975, because of increased fishing effort associated with the influx of people for the construction of the trans-Alaska pipeline, the daily bag limit in the Tanana River drainage was decreased from 10 to five Arctic grayling. The reduction in bag limit in 1975 to five fish daily and 10 in possession did not prevent the decline of important Arctic grayling stocks. Further restrictions were enacted in 1987, including a decrease in the possession limit to five Arctic grayling daily, and institution of a minimum length limit of 30.5 cm in the Chena River. Additional conservation measures were also enacted for other stocks in the Tanana River drainage. Further restrictions were imposed by the Alaska Board of Fisheries (BOF) in 1990, including a bag limit reduction to two fish daily and in possession, and use of un-baited, single-hook, artificial lures upstream of the Chena River flood control dam.

Harvest estimates of Arctic grayling in the Tanana Area for 1990 were the lowest recorded since the SHS was initiated in 1977, with a total of 28,414 fish, which is 10,000 fewer fish than the previous low recorderd in 1987. The estimated harvest in 1991 of 33,778 fish was slightly increased from the 1990 level. The largest harvests from single systems in 1991 were taken from the Chatanika and Chena rivers and from Piledriver Slough.

In spite of (or perhaps, because of) large historic annual harvests in the Tanana Area, there have been no trophy Arctic grayling (larger than 1.4 kg, 3.0 lb) registered since the inception of the trophy program in the mid-1960's, while 125 individuals have been recorded from rest of the state. Growth rates of individual Arctic grayling in the Tanana River drainage are considered to be typical for Alaska, however, growth rates of Arctic grayling in Bristol Bay, and the Seward Peninsula, where the majority of the trophy fish have been taken, are exceptionally high. It is also possible that Tanana River drainage populations have been maintained at smaller individual size from steady fishing and natural mortality, so that even though growth rates are normal, most individuals are removed before reaching minimum trophy size.

Northern Pike:

Northern pike are harvested by anglers using hook and line gear in summer and winter as well as with spears during the winter. The majority of the Tanana Area harvest comes from lakes that have relatively good access. Important fishing areas are found in Minto Flats, northwest of Fairbanks (Figure 2) and in Harding, George, Healy and East Twin lakes (Figures 3 and 4). Through-the-ice fisheries during the two months just prior to spring break-up, when northern pike have concentrated for spawning, account for a significant portion of the annual fishing mortality (Minto Flats is closed to fishing from October 15 through May 31).

In 1991, the estimated sport harvest of northern pike in Harding Lake, Minto Flats (including Chatanika River), George Lake, and East Twin Lake was 1,888, 2,155, 1,264 and 760 fish respectively, accounting for about 49% of the harvest of 12,476 northern pike in the Tanana River drainage (Table 3). The harvest estimate for 1991 is the highest since inception of the SHS in 1977.

Additional fisheries for northern pike include West Twin and Wien lakes in the Kantishna River drainage, Fish Lake near the Tanana-Yukon confluence, Volkmar and Healy lakes near Delta, Wellesley, Dog, Jatahmund, Island, and Deadman lakes, Moose and Scotty creeks in the vicinity of Northway (Figures 2 and 6), and other tributary streams of the Tanana River including the Chena River.

Generally harvest and effort have increased for northern pike in the past 11 years. Angler surveys indicate that this species is the second most sought-after indigenous sport fish species in interior Alaska (Holmes and Pearse 1987). The total sport harvest of northern pike within the Tanana River drainage has remained relatively stable, from 8,000 to 12,500 fish annually although the distribution of the harvest has varied among various fishing sites. Because of increased effort, the catch per angler day has decreased, and some stocks have been over-fished. The estimated harvest of northern pike in the Tanana River drainage in 1991 (12,476 fish) constituted about 42% of the estimated statewide harvest (29,611) of this species (Mills 1992).

Recent studies of northern pike populations within the Tanana River drainage indicated that exploitation rates are higher than sustainable in some populations. 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 under only moderate harvest pressure. The Minto Flats population has been of special concern due to high additive estimated rates of exploitation in summer and winter subsistence and sport fisheries. Concern for increased harvest in the Minto Flats (Tolovana River drainage) resulted in a winter closure of the sport fishery beginning in the winter of 1987. New regulations, including a reduction in the daily bag limit from 10 to five fish and a winter sport fishery closure, have helped reduce sport harvests of northern pike in the Minto Flats since 1987. Recent harvest estimates were 1,492 northern pike in 1988, 1,684 in 1989, 1,182 in 1990, and 2,155 fish in 1991. Historical harvests from this wetlands complex were much higher, with estimates exceeding 4,600 and 4,900 northern pike in 1985 and 1986. A total of 60 (32%) of the 188 statewide registered trophy northern pike (minimum weight of 6.8 kg, 15 lbs) through 1991 was taken from the Tanana River drainage. The Chatanika River, Tolovana River and Minto Flats (considered

parts of the Minto Flats complex) account for 24 (40%) of the Tanana River drainage trophy northern pike records, with 14 (23%) from East Twin Lake and eight (13%) from Volkmar Lake. The number of large pike taken from each area may be more reflective of relative fishing effort than of size and growth characteristics of the respective stock.

Lake Trout:

Lake trout occur in many lakes and some streams of the Delta River and upper Tanana River drainages (Burr 1987). They most frequently inhabit deep, oligotrophic mountain lakes and are rarely found at lower elevations of the Tanana River drainage. Lakes of the Delta River drainage (Figure 5) including Fielding, Landmark Gap, Glacier, Sevenmile, and the Tangle lakes contain lake trout. Transplanted lake trout occur in Harding Lake (Figure 4) near Fairbanks and although the small numbers do not support a large fishery, some large individuals have been taken. On average, 65% of the AYK Region lake trout harvest is from lakes in the Tanana River drainage. The regional lake trout harvest increased at an annual average rate of 27% from 1978 to 1985. An apparent major decline in abundance occurred and was first observed in 1986 in waters of the Tanana River drainage. Research in both southcentral and interior Alaska indicates that most of the road accessible stocks have been overharvested in recent years.

Lake trout are a long lived, slow growing and late maturing species, and the impact of even modest fishing pressure can be significant. Lake trout 25 years of age and older are not uncommon and individuals estimated to be older than 50 years are recorded for Alaska (Burr 1987). Trophy lake trout weighing 8.7 kg (20 lbs) or more are typically 20 or more years old (Burr 1987). Lake trout inhabiting high elevation lakes in the Alaska Range migrate into shallow rocky shoals to spawn in late fall. Lake trout spawn for the first time at ages ranging from 5 to 12 years of age, depending apparently on growth conditions. Alternate year spawning may be more normal than spawning in consecutive years in interior and northern Alaska.

The harvest of lake trout in the Tanana River drainage peaked at approximately 3,100 fish in 1982. Harvest declined to 713 and 652 in 1986 and 1987, after the bag limit was reduced from 12 to two lake trout per day (Table 4). After two years of reduced harvest, the 1988 harvest of lake trout increased to 2,221 fish (Table 4). However, further investigation of responses to the SHS showed that harvests of lake trout were reported from lakes known to contain only stocked rainbow trout and/or Arctic char, particularly from those lakes on Eielson Air Force and Fort Greely Army bases. Lake trout harvest estimates for the Tanana Area in 1989 totalled 1,932 fish. After eliminating some responses, a more accurate estimate of the 1989 native lake trout harvest in the Tanana River drainage is 1,498 fish. Lake trout harvest estimates for the Tanana Area in 1990 totalled 896 fish of which 253 were reported from unspecified lake locations. Responses to the SHS have not been examined to determine whether any harvest reports included in the unspecified category can be omitted from the Tanana Area total because of similar reporting errors. The estimated 1991 harvest of 1,978 lake trout includes all fish reported as lake trout taken from the Tanana Area.

Five trophy lake trout are recorded from the Tanana Area, three taken in Harding Lake, one each in Fielding and Upper Tangle lakes.

Burbot:

Participation in burbot fisheries has increased in recent years in the AYK Region. The majority of the AYK Region harvest has occurred in waters of the Tanana Area. Local residents using baited setlines or hand-held fishing gear are the primary participants. Most fishing in the Tanana River near Fairbanks occurs during the winter months while in the upper Tanana River drainage, a major portion of the annual harvest occurs in spring and summer. Burbot fishing occurs in streams, such as the Tanana, Chena and Tolovana rivers, and in lakes. In past years, the most heavily fished lakes were Fielding, Harding, and Tangle lakes. Since 1987, bag limits in these lakes were reduced to two fish daily, and use of set lines was eliminated. The Tanana River supports one of the largest burbot fisheries in the state, and only the burbot fisheries in the Copper Basin support comparable effort and harvest levels. Although exploitation rates of burbot in the Tanana River are not considered excessive, studies suggest low stock abundance in most of the lakes examined. Population density of burbot in lakes declined dramatically in the early 1980's due to unsustainable rates of sport fishing exploitation. Studies in Fielding Lake indicate that significant recovery of the population has taken place, probably due to minimum fishing pressure (Lafferty et al. 1991). Burbot stocks in the Tanana River are exploited most heavily near population centers such as Fairbanks, Delta Junction, and near Northway. Burbot movements within the Tanana River tend to minimize effects of concentrated local fishing effort, and stocks in the Tanana River appear to be lightly exploited (Evenson 1990, 1991, 1992b).

To prevent further declines in burbot populations in lakes of the Tanana drainage, the ADF&G implemented emergency regulations in 1987 that prohibited the use of set lines from 15 May to 15 October, and reduced the bag and possession limit in all Tanana drainage lakes to five fish. Also, a ban on the use of set lines throughout the entire year was enacted for Harding, Fielding, T, and Tangle lakes along with a further reduction in the bag and possession to two burbot daily in these waters. The estimated harvest of burbot in the Tanana River drainage by sport anglers in 1991 was 2,739 fish. The majority (2,093 fish) of the harvest was taken in the Tanana River and the lower Chena River (Table 3).

Of the 184 trophy burbot registered through 1991 in Alaska, (minimum size 3.6 kg, 8 lbs) 95 (52%) were taken in the Tanana Area, and the majority of those were taken near Fairbanks in the Tanana (59, 32%) and Chena (21, 11%) rivers.

Whitefish:

Most of the statewide recreational whitefish harvest occurs in the AYK Region. The Tanana Area sport harvest of whitefish is almost entirely from the Chatanika River, tributary to the Tolovana River, itself a tributary of the Tanana River, where an active spear fishery usually occurs in the fall. Hook and line techniques are also used here and in other places to capture whitefish, in which small baited hooks are drifted along the stream bottom. Harvest in 1991 from the Chatanika River was greatly curtailed because of early closure of the fall spear fishery.

The estimated (SHS) 1991 harvest of Tanana Area whitefish was 739 fish, with none reported taken from the Chatanika River (Table 3). The harvest reduction is the result of reduced stock abundance and an early closure of the Chatanika River spear fishery on July 1 by emergency order.

The Chatanika River supports spawning populations of humpback whitefish, least cisco, and round whitefish *Prosopium cylindraceum*. During late summer and fall, these fish migrate upstream from Minto Flats to spawn. By freeze-up in approximately mid-October, adult whitefish have departed for wintering areas that are as yet unidentified, and which may be located downstream of the Chatanika River. The importance of the Chatanika River as habitat for whitefish other than during spawning and the egg-fry development stages is not fully understood.

Harvest levels in the Tanana Area increased steadily during the 1981 to 1989 period, ranging from 5,449 fish in 1981 to 26,810 fish in 1986. From 1977 until 1989, harvest of whitefish from the Chatanika River increased at an average annual rate of 34%, the fastest growing recreational fishery in the Tanana River drainage (Hallberg and Holmes 1987). Approximately 4,894 angler-hours of effort were expended to spear whitefish in 1990, a decrease of about 18% from the 1989 level. Abundance estimates upon which the calculation of exploitation rates are based were restricted to a section of the Chatanika River near the location of the fishery, and consequently, the abundance estimate cannot be considered germane to the entire river and its stocks of whitefish (Timmons 1990). Since 1987 a daily bag limit of 15 whitefish for the waters of the Tanana River drainage was has been in effect. At the time of their implementation, it was hoped that the new regulations would not only reduce harvest but also limit exploitation rates to no more than 20%, a level thought to be sustainable for these species.

Sheefish:

Spawning stocks of sheefish in the Tanana River drainage have been documented only in the upper Chatanika River (Alt 1987). Tagging studies from 1967 to 1971 indicated that sheefish that spawned in the Chatanika River also spent the summer feeding in Minto Flats (Alt 1987). Recaptures in the lower Chena River and at Nenana, of fish that were tagged in the Chatanika River, showed that sheefish disperse widely in the areas adjacent to spawning. Sheefish are widely distributed 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 also been found at the mouths of the Bearpaw and Toklat rivers in the Kantishna River drainage. 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. Total sport harvest of sheefish in the Tanana River drainage in 1991 was estimated to be 158 fish (Table 3).

Attempts to stock lakes with sheefish in the Tanana River drainage to create new sport fisheries have met with little success. Harding Lake was stocked nearly annually from 1982 through 1989 (with the exception of 1984). No returns to the sport fishery were documented and stocking for the purpose of fisheries enhancement has discontinued following 1990 when there was a small stocking in Sansing Lake on Clear Air Force Base. While growth and survival of stocked sheefish in lakes has been generally disappointing, good growth and survival of stocked sheefish was reported from Four Mile Lake (Figure 3) along

the Taylor Highway from stocking events in 1968 and 1969 (Alt 1981) The appearance of new age classes led Peckham and Doxey (1983) to speculate that natural reproduction had occurred. Status of that stock since 1983 is unknown.

Rainbow Trout:

Rainbow trout are not indigenous to the Yukon River drainage but have been introduced in several locations, including about 75 Tanana Area lakes since the 1950's. There is evidence that successful natural reproduction has taken place in only one of the stocked locations, Fourteen Mile Lake, near Paxson. This landlocked lake, tributary to the Delta River, was last stocked in the 1960's by Federal Fishery Biologists, and there is evidence that young year classes are present (Burr pers. comm.[2]).

Piledriver Slough has been stocked with rainbow trout since 1987. The slough was formerly connected to the Tanana River and is located about 30 km south of Fairbanks (Figure 2). Water in the slough became clear when the Army Corps of Engineers blocked Tanana River water from entering the upper end at several locations in 1976. The slough was blocked in conjunction with the Army Corps of Engineers Chena Flood Control Project to prevent spillage of high water discharge from the Tanana River into the floodway channel during construction. The temporary dikes are still in place, although they have not been maintained. Piledriver Slough, fed by groundwater from the Tanana River valley, re-established itself as a clear-water tributary to Moose Creek which discharges directly into the Tanana River. Arctic grayling, whitefish and long-nose suckers *Catostomus catostomus* were found inhabiting Piledriver Slough within a year after its upper end was blocked. The objective of stocking was to create a stream rainbow trout fishery in Alaska's interior, thus providing more diversity of fishing opportunity for Interior anglers. This was the first documented time rainbow trout had been released into flowing waters in interior Alaska since statehood.

The harvest of rainbow trout in Piledriver Slough by sport anglers in 1991 was estimated to be 6,414 fish, while approximately 72,000 rainbow trout were taken in the Tanana Area including Piledriver Slough (Table 4). Angler effort (number of days fishing) on Piledriver Slough in 1991 exceeded 17,700 days, the largest amount of effort for any single water body in the Tanana Area (Table 3).

Substantial harvests of rainbow trout occur in Quartz, Birch, and Chena lakes. The largest harvest occurred in Quartz Lake, where an estimated 28,238 rainbow trout were taken (Table 3). The Tanana Area harvest of rainbow trout in 1988 of more than 78,000 fish represented an historical high value; the 1991 harvest estimate of 72,000 fish was about 8% smaller (Table 4). The steady rise in harvest of this species reflects the successful expansion of the stocking program in the Tanana River valley.

Trophy rainbow trout (minimum size 6.8 kg, 15 lbs) have not been recorded from interior Alaska streams or lakes, and most of the registered trophy fish are native anadromous rainbow trout (steelhead) taken in coastal streams.

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[2] Burr, John. 1993. Personal Communication. ADFG, Division of Sport Fish, 1300 College Road, Fairbanks, AK 99701.

Nevertheless, good growth rates and size have been achieved in some enhanced lake situations. The largest rainbow trout recorded in the Tanana Area was taken in 1980 from Quartz Lake at a size of 4.5 kg (9.8 lbs). Rainbow trout exceeding 2.3 kg (5 lbs) are commonly taken from area lakes.

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 (58% of the entire land area of Alaska) of extremely varied topography, climate, and zoogeography. Land ownership and jurisdictions fragment this huge area into a complex mosaic. The federal government is the major land manager through its jurisdiction over lands in National Parks and Preserves, National Wildlife Refuges, Wild and Scenic Rivers, as well as other classifications of federal lands. Native corporations, State of Alaska and private lands comprise the rest, approximately 40% of the landmass of the state. The State of Alaska, by virtue of the Statehood Act retains authority to manage fisheries and wildlife on all lands and waters of the state (approximately 42 million ha, compared to 88 million ha under federal jurisdiction). Since 1990 however, the Federal agencies have assumed management of subsistence hunting and fishing on Federal public lands and waters. For purposes of reporting and organizing statistics in the SHS, the AYK Area is subdivided into five sub-areas; Yukon (Y), Kuskokwim (V), Seward Peninsula-Norton Sound (W), Northwest Alaska (X), and North Slope of the Brooks Range (Z) (Figure 1).

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 supply water to the Noatak, Kobuk, Colville, Koyukuk, and Porcupine rivers as well as to many other streams that drain directly into the Yukon River or the Arctic Ocean and the Chukchi Sea.

Lake and Stream Resources

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 in each of the five sub-areas within the AYK Area. It is recognized that not all streams, lakes, or fish stocks of importance receive attention in this cursory treatment.

Yukon River Sub-area:

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. Map figures that include the Yukon River and major drainages include Figures 7 - 13. Approximately three quarters of the land area of the AYK Region is in the Yukon River drainage. 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.

The Yukon sub-area (statewide harvest Area Y; Figure 1) includes drainages of the Yukon River from the south slope of the Brooks Range to the Bering Sea, from Naskonat Peninsula north to Pastol Bay; from the Canadian border west to the Bering Sea. This sub-area does not include any portion of the Tanana or Kuskokwim river watersheds. Prior to 1990 the Lower Yukon and Kuskokwim rivers were combined into a single sub-area for Sport Fish Division reporting purposes. Separate harvest reporting for the two river drainages has been established since 1990.

Clear water streams with sport fishing potential are extremely numerous in the Yukon River drainage and extend to third and fourth order tributaries. Although the main stem of the river flows for approximately 3,200 km, (with the upper third in Canada) this report considers Alaska waters only.

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 longnose suckers utilize the mainstem lower river for rearing and feeding, particularly during winter months. For some species such as burbot, the Yukon River mainstem provides year-around habitat.

Near the Yukon River mouth, (Figure 9) the east and west forks of the Andreafsky River are both high quality sport fishing streams and have been designated as Wild and Scenic Rivers (Wild and Scenic Rivers Act 1968; Alaska National Interest Lands Conservation Act (ANILCA) 1980). All the Pacific salmon species, with the exception of sockeye salmon *Oncorhynchus nerka*, occur in the rivers as do Arctic grayling, Dolly Varden *Salvelinus malma*, and northern pike (in sloughs and lakes off the rivers). Each fork of the Andreafsky 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 Innoko River and its tributaries drain a large area of flat wetlands and foothills of the Kuskokwim Mountains. The Innoko River enters the Yukon River a few miles downstream of the village of Holy Cross. The Innoko River system of tributaries and wetlands contains numerous northern pike and whitefish as well as other species. A small sockeye salmon stock may spawn in the system, in addition to chum *Oncorhynchus keta*, chinook salmon and coho salmon, but there is no evidence that the Innoko River is important for salmon production when compared to other known productive streams in the Yukon River drainage. Much of the lower Innoko River is included in the southern unit of the Innoko National Wildlife Refuge.

The Anvik River, which enters the Yukon River near the village of Anvik about 515 km upstream from the mouth, is a highly productive stream. The river courses eastward from its drainage area in the Nulato Hills for about 130 km

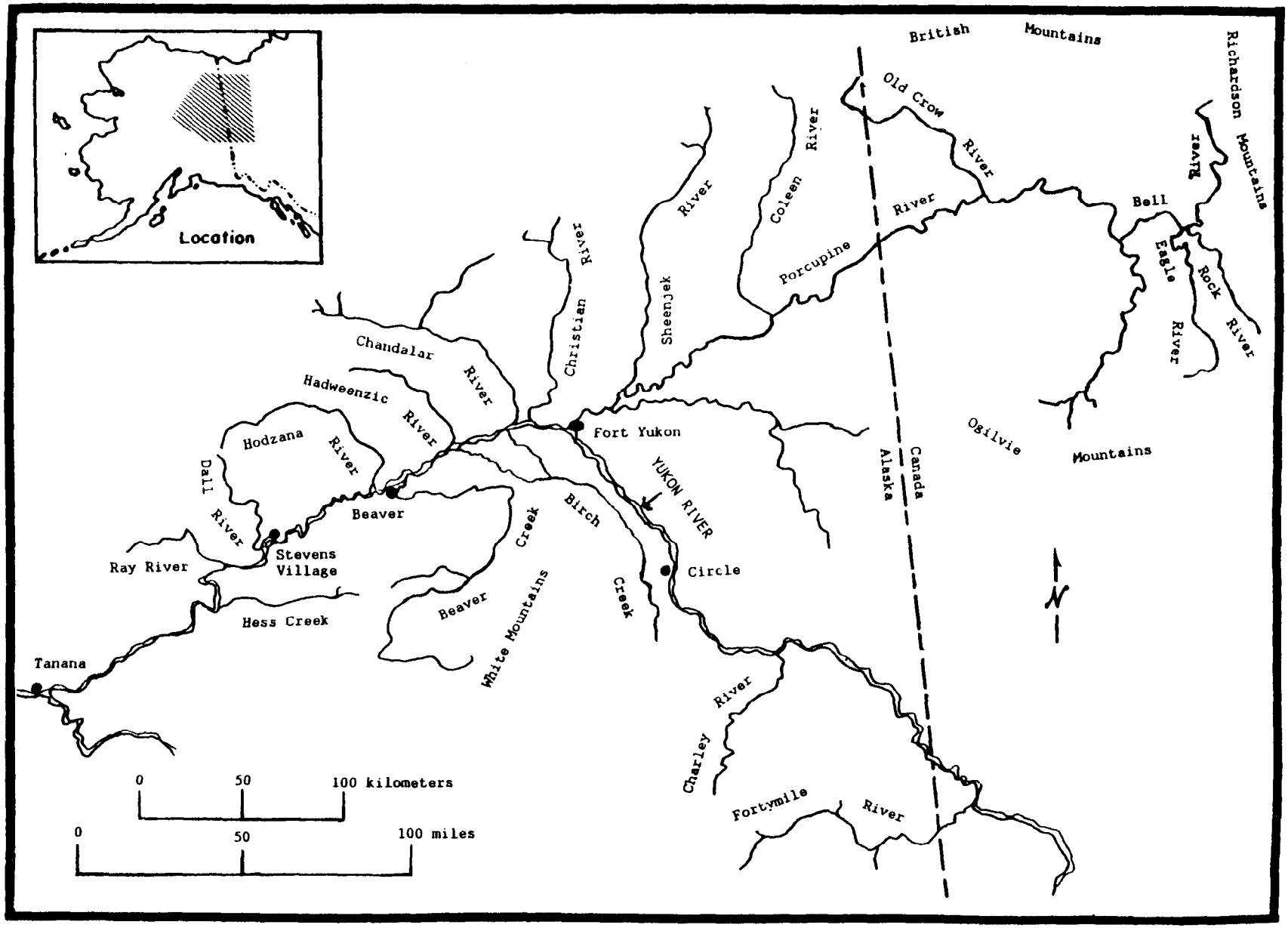

Figure 7. Middle Yukon River and Porcupine River drainages.

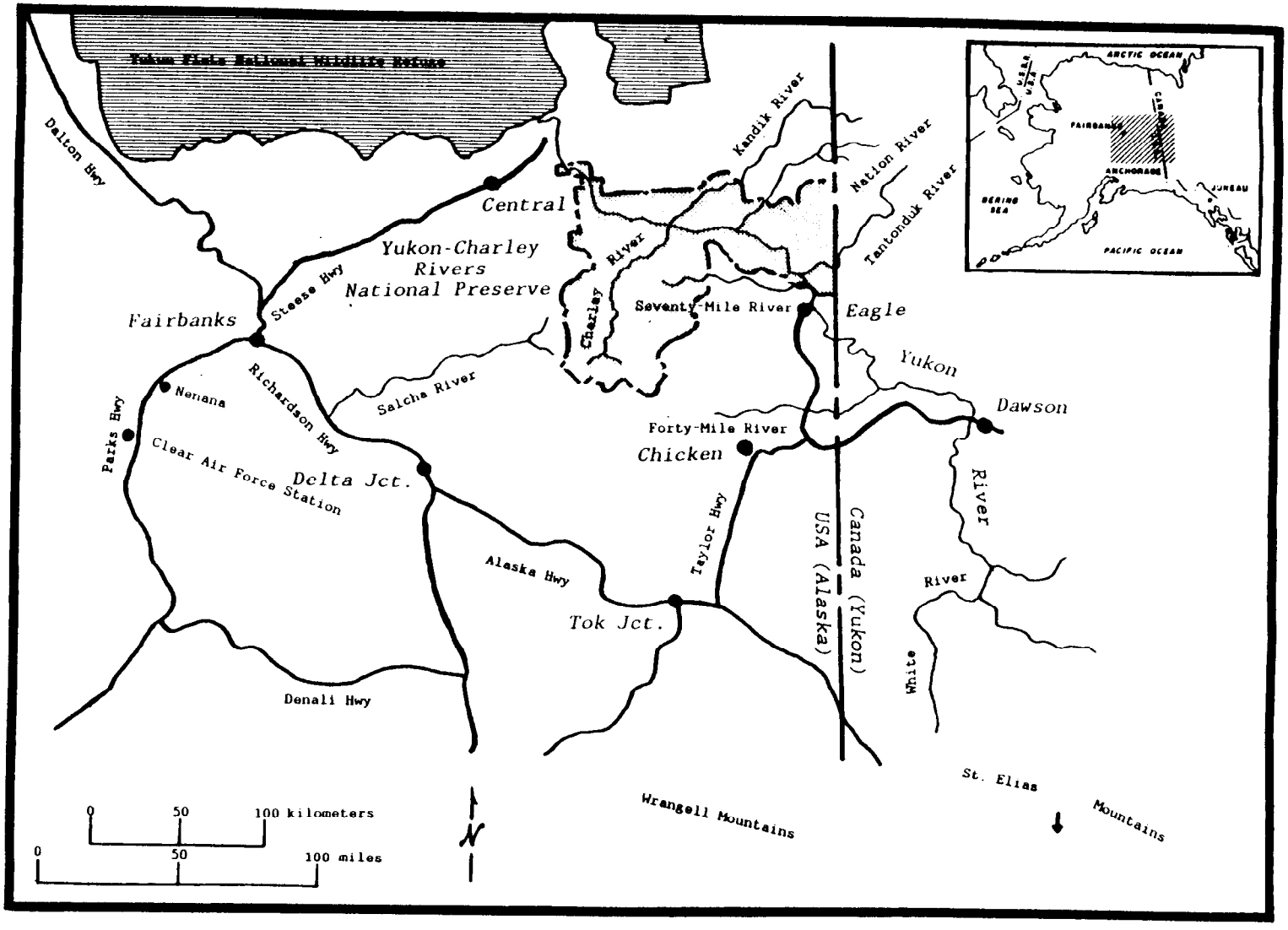

Figure 8. Major highways in interior Alaska.

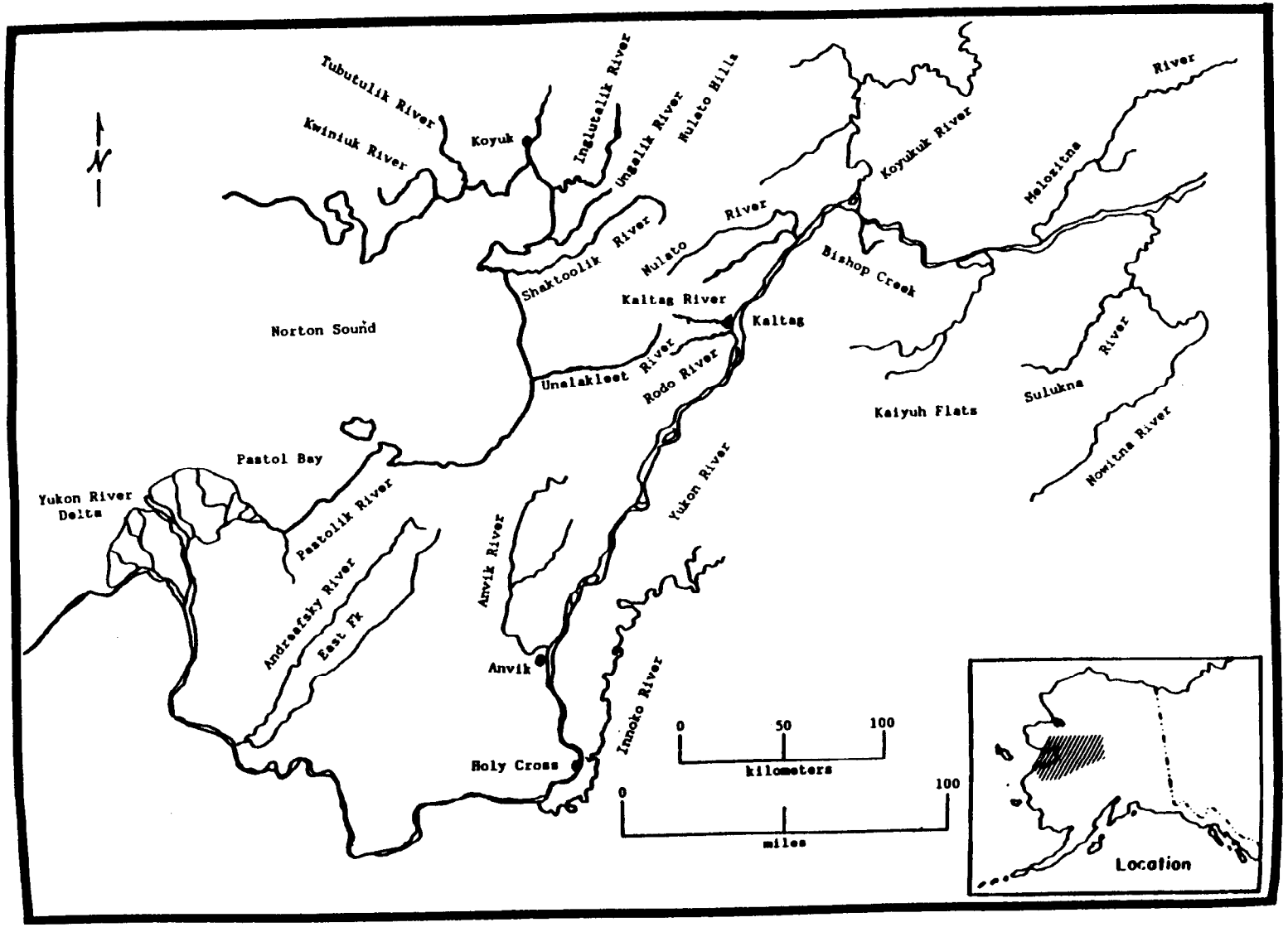

Figure 9. Lower Yukon River and eastern Norton Sound drainages.

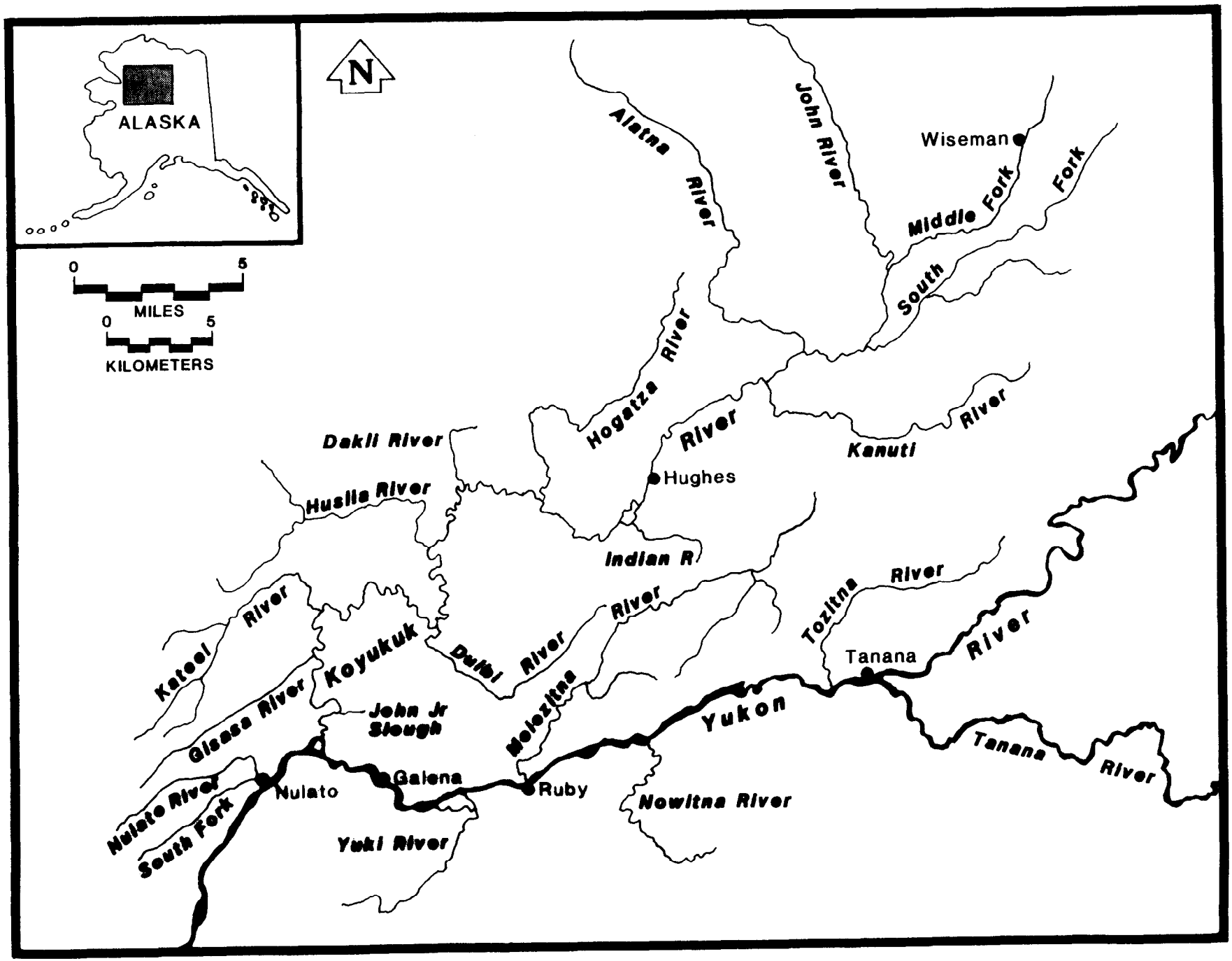

Figure 10. Middle Yukon River and Koyukuk River drainages.

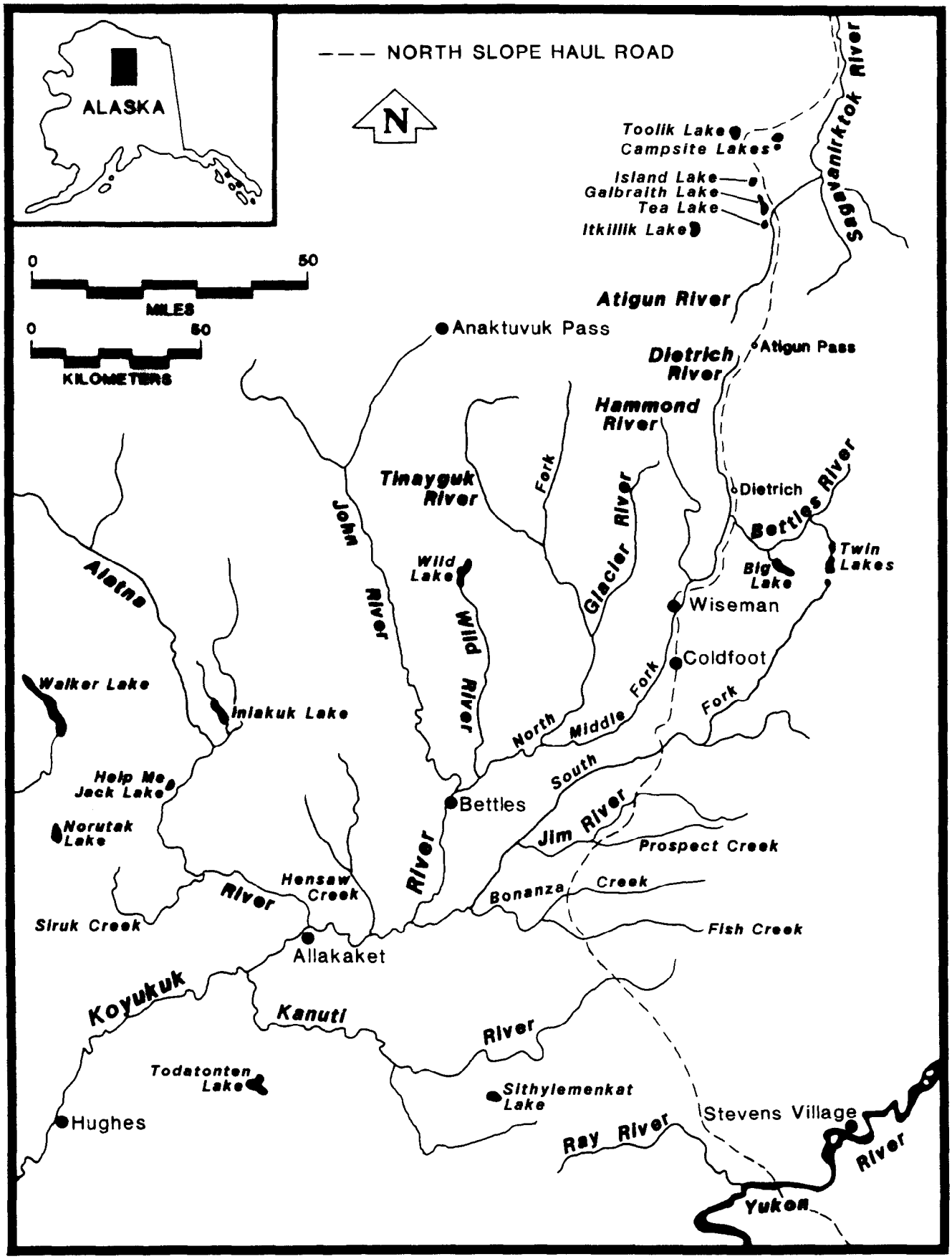

Figure 11. Upper Koyukuk River and North Slope Haul Road.

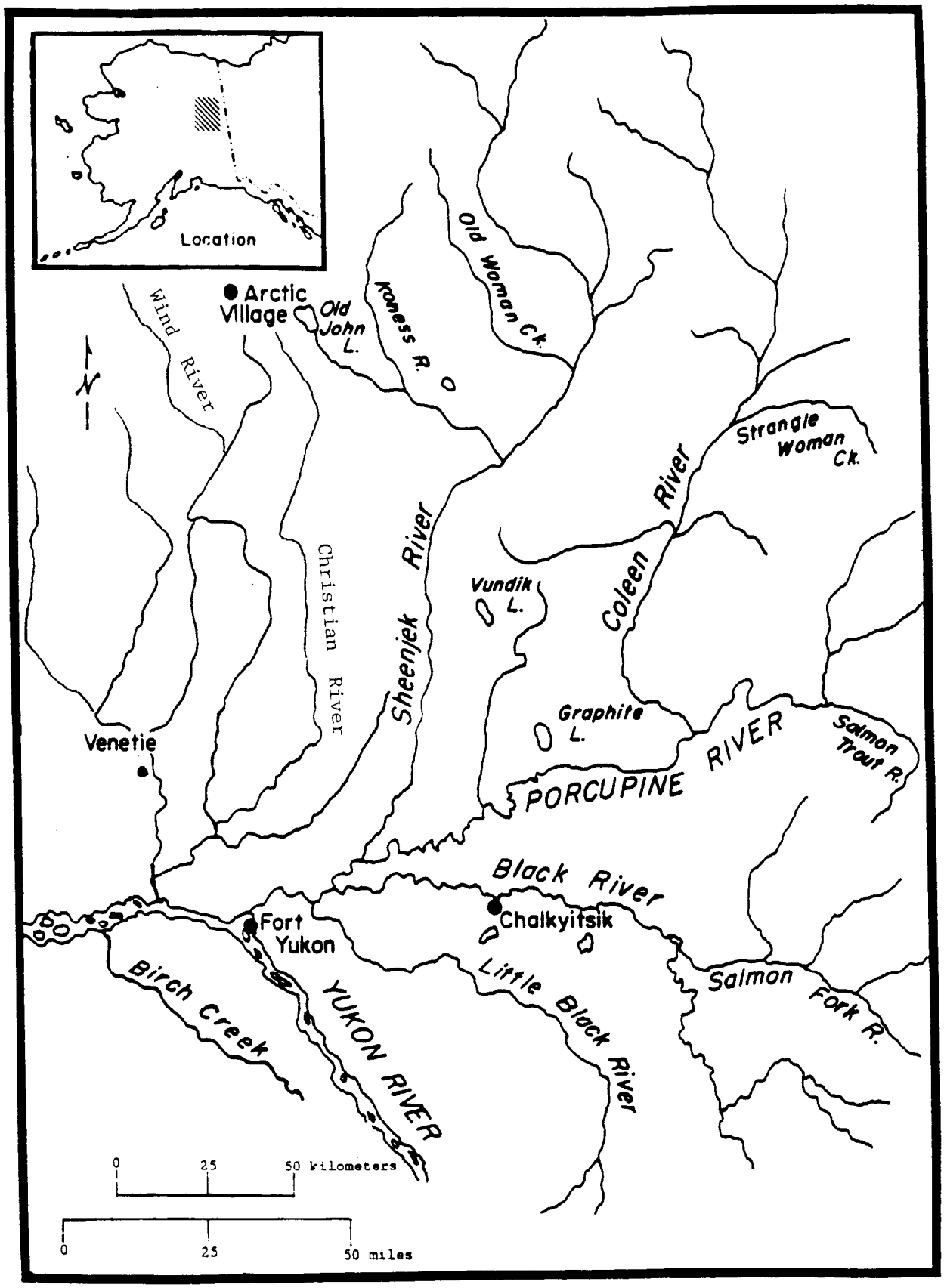

Figure 12. Porcupine River drainage.

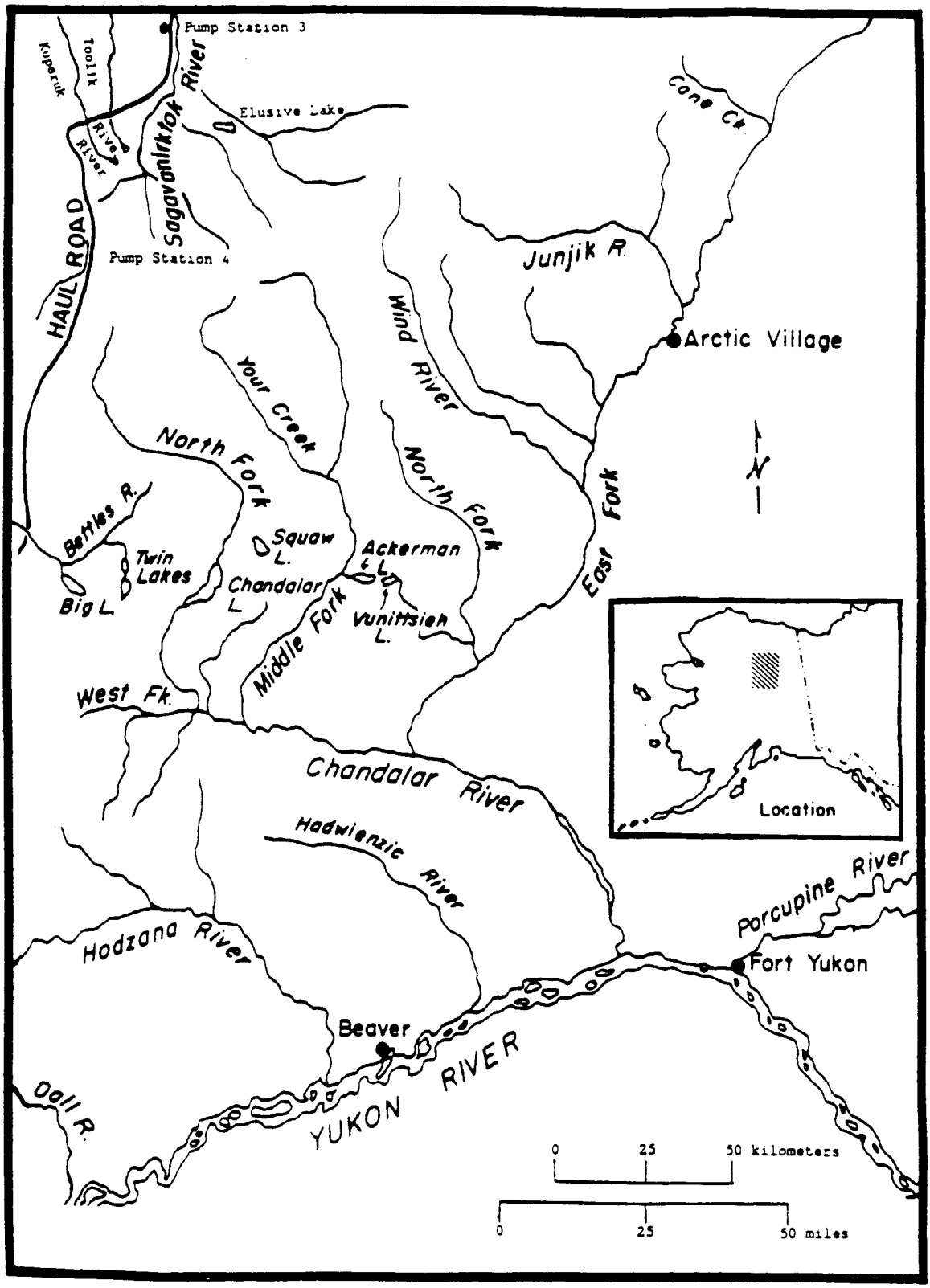

Figure 13. Chandalar River system.

and although it is primarily a rapid runoff stream, artesian upwelling helps stabilize winter flows and water temperatures. Besides supporting the largest chum salmon spawning stock in the Yukon River drainage, with over a million individuals spawning in some years (Whitmore et al. 1987), the stream supports healthy populations of chinook salmon, Arctic grayling, Dolly Varden, and northern pike. Coho salmon have been observed spawning in the Anvik River (Barton 1984) but the status of this population is not known. Quality of the angling experience is excellent, but few anglers use the stream during the summer season because of its remoteness and difficult access.

The Kaltag and Rodo river mouths, and Bishop Creek mouth support sheefish and Arctic grayling fisheries during summer and early fall months. Sport fishing for northern pike is common in sloughs and lakes near the main stems of the Yukon and Koyukuk rivers as well as in the extensive Kaiyuh Flats southeast of Galena.

The Nowitna River, whose confluence with the Yukon River is upstream from Ruby, is a major clear tributary which enters the Yukon from the south and drains the north slope of the Kuskokwim Mountains. It was designated as a Wild and Scenic River in 1980 (Alaska National Interest Lands Conservation Act, P.L. 96-487), and supports a significant amount of recreational fishing. Most sport fishing is done by Fairbanks residents using personal riverboats or aircraft to reach the river. Good angling for sheefish, northern pike and Arctic grayling can be found in the system, which consists of several branches. Most of the main stem and major tributaries are included in the Nowitna National Wildlife Refuge (U.S. Fish and Wildlife Service (USFWS) 1987b). Sheefish spawn in the Sulukna River tributary (Alt 1987).

Few lakes of sufficient area or depth to influence winter flow volume or temperature are present in the Alaska Yukon River drainage. The majority of the lakes in the lower Yukon drainage developed when saturated permafrost soils thawed and as a result, these lakes are mostly shallow and not supportive of primary sport species such as lake trout. There are thousands of such lakes throughout the deltas and floodplains of the drainage. Many provide summer feeding and rearing for various whitefish species, as well as for northern pike and occasionally, sheefish. Fish utilizing shallow thaw lakes for summer feeding generally move into primary tributaries and main stems of larger rivers prior to freeze-up.

A significant portion of the Yukon River drainage along the south slope of the Brooks Range is within the boundaries of the Gates of the Arctic National Park and Preserve. Most of the streams in the sub-area drain to the south from the Brooks Range into the Porcupine, Koyukuk, and Yukon rivers (Figures 10, 11, 12, and 13). 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 sub-area in a north-south direction (Figure 11), and provides access for recreational fishermen to several streams of the area, including the Ray River, the Middle Fork and South Fork of the Koyukuk River, as well as Prospect Creek and Jim River of the upper Koyukuk River system.

The Nulato River enters the Yukon River near Nulato, about 775 km from the mouth of the Yukon River. Smaller and more difficult to navigate than the Anvik River, the stream nevertheless has sport fishing potential for salmon, Arctic grayling, Dolly Varden and northern pike. The stream receives some seasonal sport fishing use at the present time from anglers stationed at a U.S. Air Force station in Galena.

Sport fisheries for sheefish and Arctic grayling during summer and early fall occur at or near the mouth of the Melozitna River, which enters the Yukon River at Ruby. Geothermal hot springs occur on one of the creeks of the Melozitna River. The Melozitna River is 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 from boating access.

The Koyukuk River, one of the largest first order tributaries of the Yukon, enters the Yukon River downstream from Galena, about 820 km upstream from the Yukon River mouth (Figures 10 and 11). The main stem of the Koyukuk River is turbid in its lower reaches from tannic stain, and entrained sediments from bank erosion. Lower Koyukuk River tributaries such as the Gisasa, Kateel, Dulbi, and Indian rivers are little known outside of the local area but seasonally provide good sport fishing opportunities. Sheefish are taken at the mouths of several streams including the Kateel and Dulbi rivers and where John Junior Slough meets the Koyukuk River about 32 km upstream from the mouth. Sheefish have been found to spawn in the Koyukuk River in the reach between Hughes and Allakaket and in the Alatna River (Alt 1987). Arctic grayling are common in clear tributary streams and local residents of nearby villages as well as military personnel stationed at the Galena Air Station fish for them. Sport fishing for northern pike takes place in 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 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 (Alt 1987).

Other Yukon River tributaries below the Porcupine River confluence that support sport fishing include the Tozitna River, Ray River, Dall River, Hodzana River, Hadweenzic River, Chandalar River (Figures 7 and 13), and Christian River (Figure 12). Upper Koyukuk River tributaries that cross the Dalton Highway (North Slope Haul Road) are illustrated in Figure 11.

The Yukon Flats is an extensive wilderness wetland between Circle and Stevens Village below the confluence of the Porcupine River. Thousands of shallow thaw lakes have developed throughout the flats. Many of the lakes support fish populations, at least seasonally, especially those with occasional connections to the sloughs and streams in the area. Northern pike and whitefish species are most common to this area, but sheefish and Arctic grayling also occur in some waterways (USFWS 1985). Salmon production is very limited in the Yukon Flats proper. The area between Beaver Village and Fort Yukon on the Yukon River main stem may support sheefish spawning (Alt 1987). This sub-area contains approximately half of the Yukon Flats National Wildlife Refuge, (Figure 13) and there are literally thousands of lakes present of various sizes and origins. The lakes of the area are categorized roughly

(USFWS 1985) into: (1) foothill lakes (formed from streams, with sufficient depth for fish habitation); (2) tundra lakes (which are shallow and often freeze to the bottom); and (3) lowland lakes of three types: oxbow lakes with river connections and deep enough to support fish, mud lakes (shallow, and suitable only for fish rearing), and lakes created from beaver activity. There is currently little documentation available on resident fishes that utilize these vast wetlands. 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.

The Porcupine River (Figure 12) is the largest Yukon River tributary, 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 which drains the southeastern slopes of the Ogilvie Mountains is one of it's major Alaskan tributaries. 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 upstream of Fort Yukon into Canada 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 designated as National Wild and Scenic Rivers (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 sections and sheefish near the river mouths.

Several large mountain lakes are present. They include Iniakuk, Wild, Big, Twin, Chandalar, Ackerman, and Old John lakes (Figures 11, 12 and 13). All are believed to contain lake trout populations as well as Arctic grayling and other species of whitefish and cisco in most cases.

Kuskokwim River Sub-area:

The Kuskokwim River sub-area (Statewide harvest area V, Figure 1) includes the Kuskokwim River watershed and all waters flowing into Kuskokwim Bay; adjacent salt water from Cape Newenham north to the Naskonat Peninsula (north of Nelson Island) and Nunivak Island[3].

The Holitna River is the most productive stream for sport fishing in the Kuskokwim River drainage (Figure 14) above the Aniak River confluence, because of the diversity and abundance of its resident and anadromous species. Approximately six fishing guides provide services on the river to about 75 clients per year (Rue et al. 1987). No permanent lodge or tourist structures exist on the river. The Holitna River supports populations of Dolly Varden, Arctic grayling, northern pike, burbot, sheefish, various whitefish species and all five pacific salmon species. Rainbow trout do not occur upstream of

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

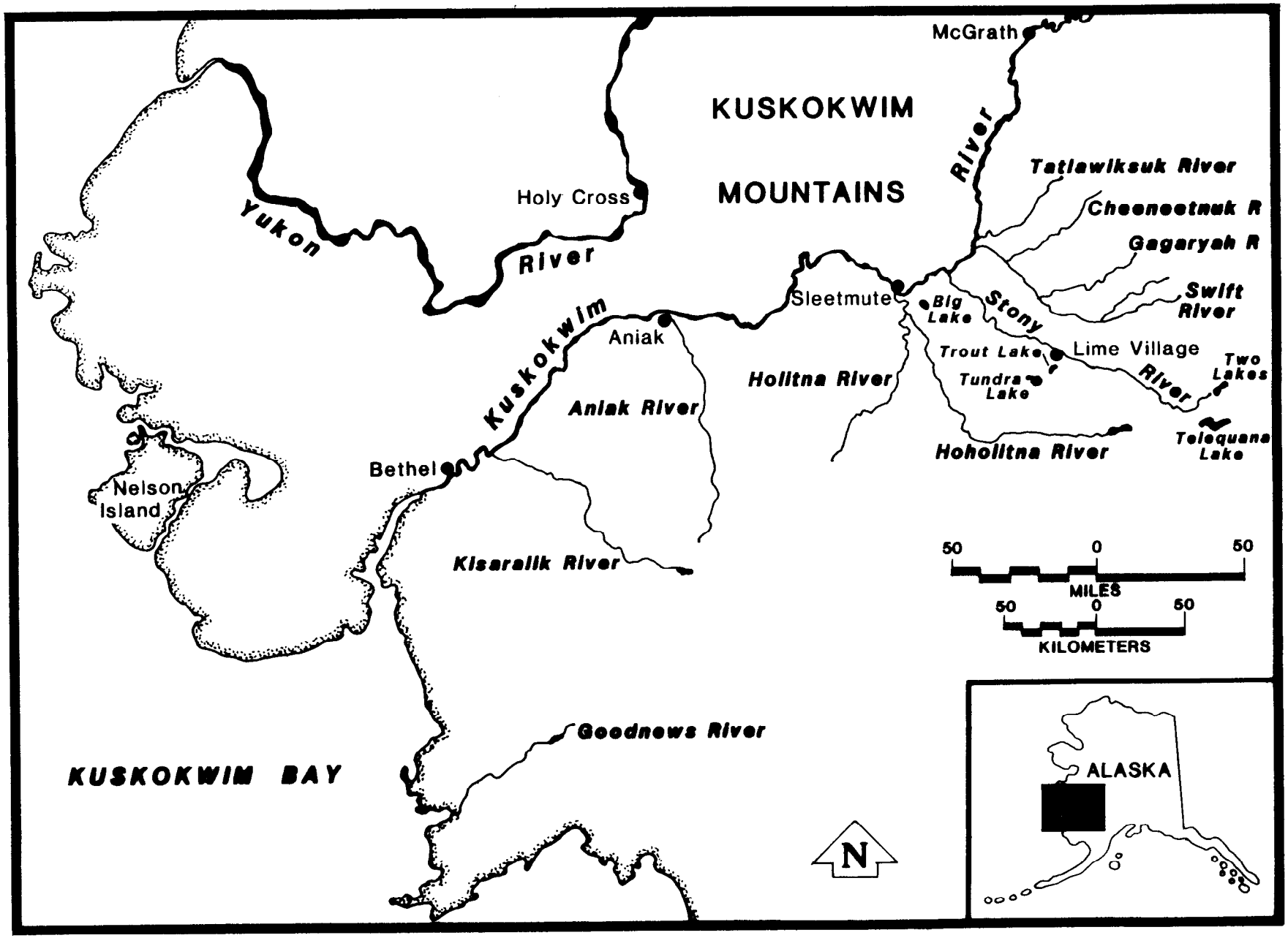

Figure 14. Waters of the lower Kuskokwim River valley.

the Aniak River in the Kuskokwim River drainage. 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 some anglers. The Stony, Swift, Gagaryah, Tatlawiksuk, Cheeneetnuk, and Hoholitna rivers represent some of the other important middle Kuskokwim River tributaries. All originate in the Alaska Range and its foothills (Figure 14). Fishery resources of these streams have not been fully documented, and because of remoteness and limited access, receive only light use by anglers.

Upstream of McGrath (Figure 15) 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 originate 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 River drainage, (with the exception of rainbow trout), sport fishing effort is extremely light on most streams. Most fishing exploitation in the middle and upper part of the drainage occurs in local subsistence fisheries that mainly target salmon and whitefish.

The few lakes found in the Kuskokwim River drainage above the Aniak River have limited potential for recreational fisheries. The fisheries resources in two lakes (Telequana and Two lakes; Figure 14) 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, Arctic grayling, northern pike, and various whitefish species were present in all lakes surveyed. Dolly Varden were noted in Two and Telequana lakes but not in Whitefish Lake. Recreational angling occurs in 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 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 fish populations because of their larger size.

Seward Peninsula/Norton Sound Sub-area:

The Seward Peninsula-Norton Sound sub-area (statewide harvest Area W; Figure 1) includes all waters north of the Yukon River drainage and south of the 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 Eschscholtz Bay (ADF&G 1984).

Primary sport fishing streams in eastern Norton Sound (Figure 9) 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

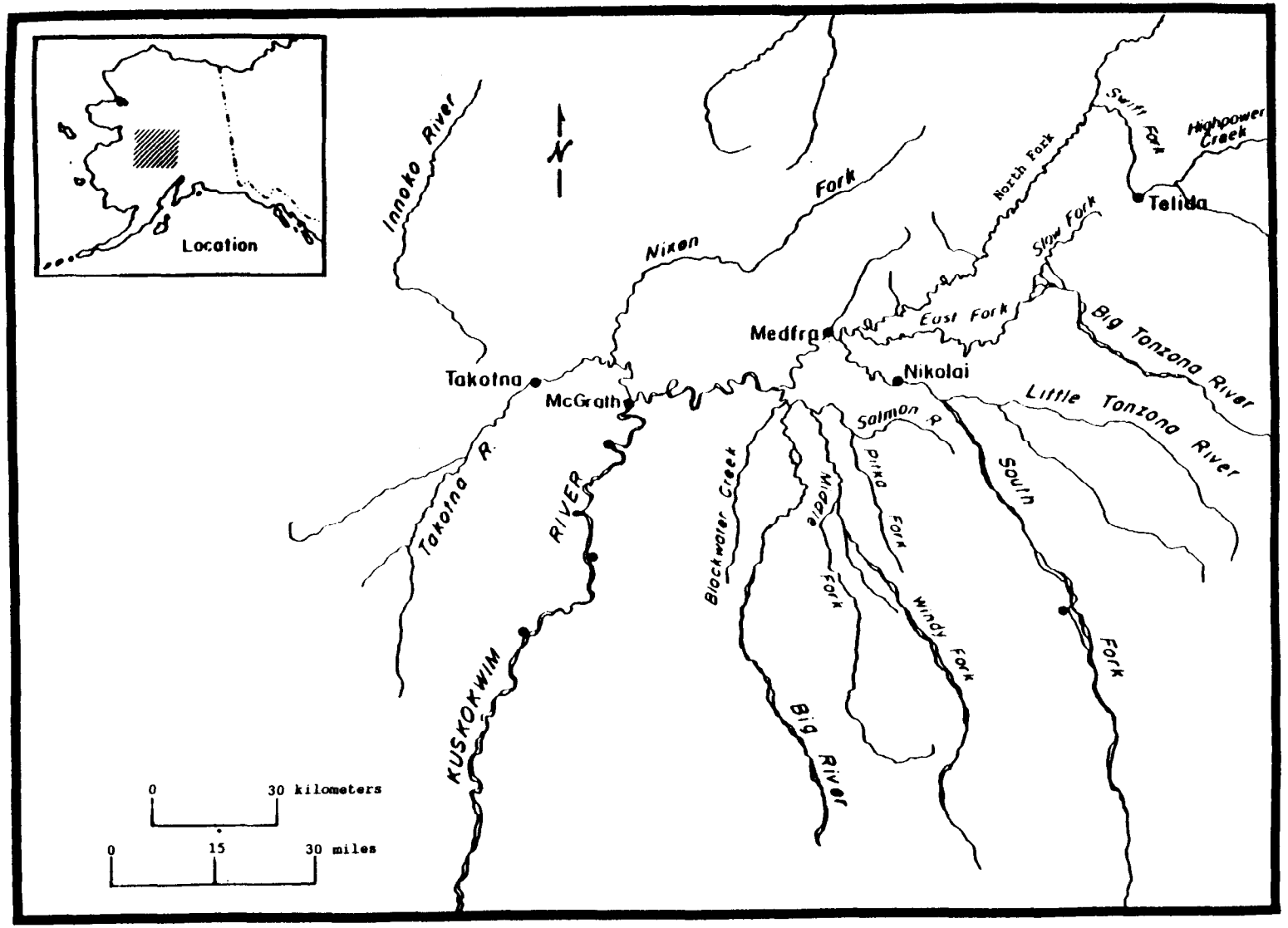

Figure 15. Waters of the upper Kuskokwim River valley.

heavily utilized of these, and it supports a sport fishery during summer months. A permanent lodge established on the lower Unalakleet River offers guide services to the Unalakleet River and to other streams in Norton Sound. The river and its tributaries support populations of Arctic grayling and Dolly Varden as well as chinook, coho, and pink salmon *Oncorhynchus gorbuscha*. Other area streams also support those species, but are not as intensively fished, primarily because of the limited access and facilities available to non-local fishermen. The Koyuk River main stem carries an abundance of entrained material, including tannic stain, reducing water clarity. The stream terminates in Norton Bay at the extreme eastern corner of Norton Sound. It offers little potential for sport fishing except for northern pike and Arctic grayling in some clear water tributaries.

Several high quality sport fishing streams are located along the southern half of the Seward Peninsula from Koyuk to Teller, (Figure 16) including the Tubutulik, Kwiniuk, Fish, Niukluk, Bonanza, Eldorado, Nome, Snake, Sinuk, Pilgrim, Agiapuk, and Kuzitrin rivers. Road access from Nome exists to many of these streams. Arctic grayling, Dolly Varden, and coho salmon occur in these streams, and chinook salmon, pink salmon, chum salmon, burbot or northern pike are found in many others. Small, perhaps remnant, sockeye salmon stocks are also present in the Pilgrim and Sinuk rivers. Trophy Arctic grayling, larger than 1.4 kg (3 lbs) are present in many streams on the Seward Peninsula, including the Sinuk, Nome, American, Tubutulik, Fish, Pilgrim and Kuzitrin rivers as well as others. Many of the largest Arctic grayling recorded as trophies for Alaska have been taken from streams on the Seward Peninsula. Of the 145 largest fish registered from 1967 to 1991 in the ADF&G trophy fish program, 33 were taken in waters of the Seward Peninsula. Nineteen of the 33 registered trophy Arctic grayling from the Seward Peninsula were taken from the Sinuk River.

Most of the streams draining the northern half of the Seward Peninsula have low sport fishing potential due to relatively small flow volumes, difficult access, and poorer quality of water and fisheries habitat.

Most of the lakes on the Seward Peninsula were created either by thaw action in river floodplains or by glaciers in the mountains of the central and western Seward Peninsula. The largest inland body of water on the Seward Peninsula is Imuruk Lake (Figure 17) in the north-central portion of the peninsula. It is approximately 32 km^2 in area, and was probably formed when volcanic lava originating in the nearby area cut off drainage streams causing water to back up into a local depression. The lake presently drains northward through the Inmachuk River. Salmon spawn at the outlet in the fall and the lake supports whitefish and Dolly Varden.

Smaller glacial lakes in the Imuruk Basin watershed and in the Kigluaik Mountains east of Nome contain populations of game fish. Some contain populations of lake resident Arctic char *Salvelinus alpinus*, (Kretsinger 1987) while other lakes and streams in this area contain anadromous Dolly Varden. Salmon Lake, located about 150 km northeast of Nome in the headwaters of the Pilgrim River, contains Dolly Varden, Arctic grayling, round whitefish and a remnant stock of sockeye salmon. Since the lake can be reached by road from the town of Nome, it receives use for sport fishing, and during the first half of the century was an important recreation and fishing area for gold miners in the area. Subsistence fishing for salmon in Salmon Lake has been prohibited

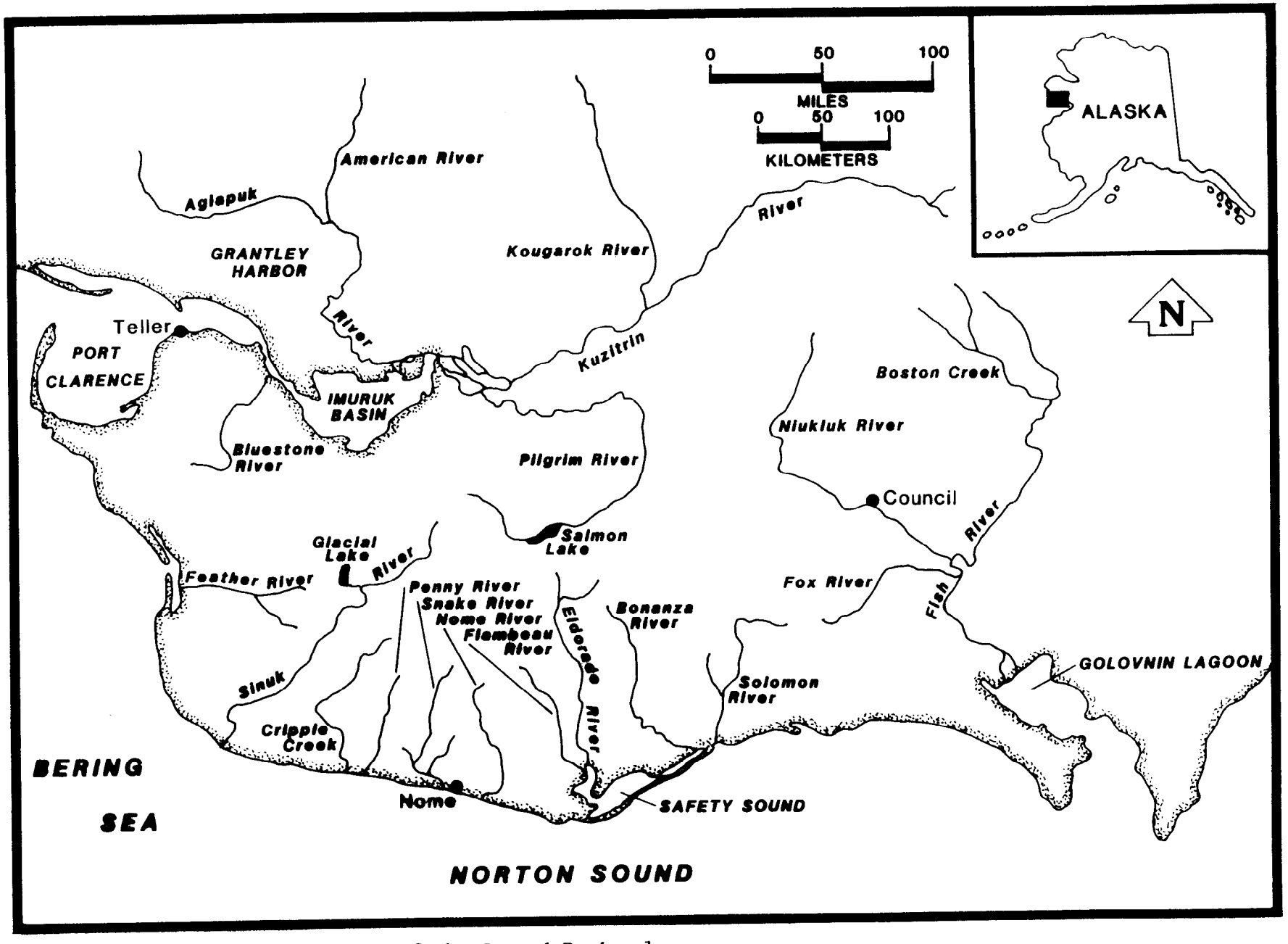

Figure 16. Waters of the Seward Peninsula.

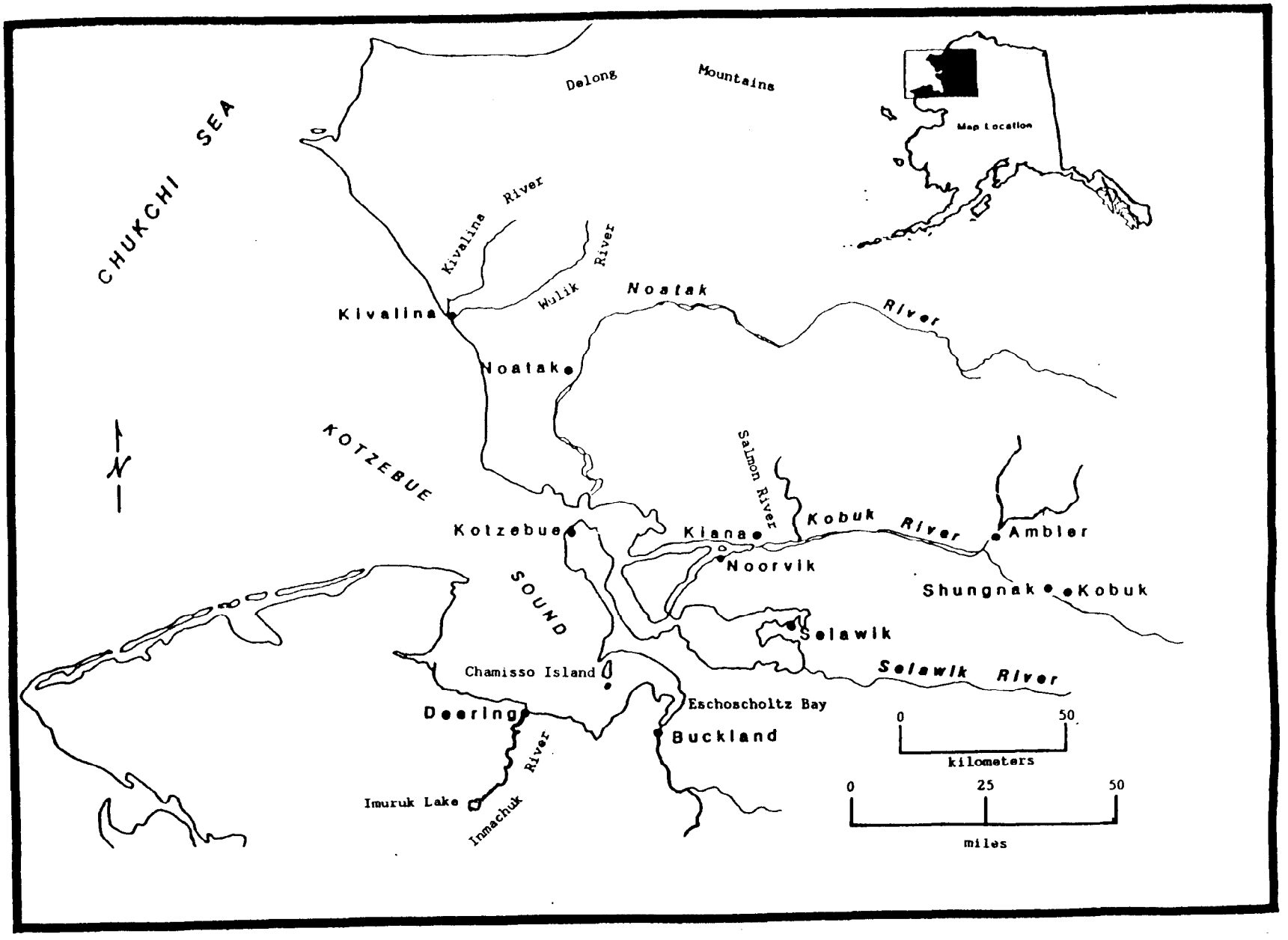

Figure 17. Kotzebue Sound and surrounding area.

for many years because the stock was practically eliminated by early fisheries. Sport fishery for salmon in the lake and it's tributaries is presently prohibited.

Northwest Alaska Sub-area:

The Northwest Alaska Area (statewide harvest 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 (ADF&G 1984). The eastward limit of the sub-area extends to (but does not include) the Alatna River.

The most important streams of the Northwest Alaska sub-area (Figures 17, 18 and 19) 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 drainage is that of 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 entrained glacial silt carried from mountain glaciers in the Brooks Range, while waters of the Kobuk and Selawik rivers are more clear. Abundant groundwater is present 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.

The Noatak River is designated as a National Wild and Scenic River, and most of the drainage is included in the Noatak National Preserve (Figure 18). The extreme upper headwaters of both the Noatak and Kobuk rivers are included in the Gates of the Arctic National Park. A part of the lower Kobuk Valley between Kiana and Ambler is included in the Kobuk National Park, and the Salmon River tributary, as well as the upper main stem of the Kobuk River are National Wild and Scenic Rivers as is the Selawik River. Much of the Selawik River valley is part of the Selawik National Preserve.

These 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, and during the commercial salmon fishery in August a significant incidental harvest of adult Dolly Varden is taken in gillnets. Whitefish and northern pike are resident in the Noatak River. Alt (1987) reports that sheefish use the river for feeding but do not spawn there.

Both the Selawik and Kobuk rivers support spawning populations of sheefish in their upper 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 in the upper Kobuk River during the fall when large mature spawners congregate near spawning areas in the main stem. The Alaska state record sheefish was taken in 1986 from the upper Kobuk River (mouth of the Pah River) and weighed 24 kg (53 lbs). Abundant whitefish utilize the rivers and delta areas, including

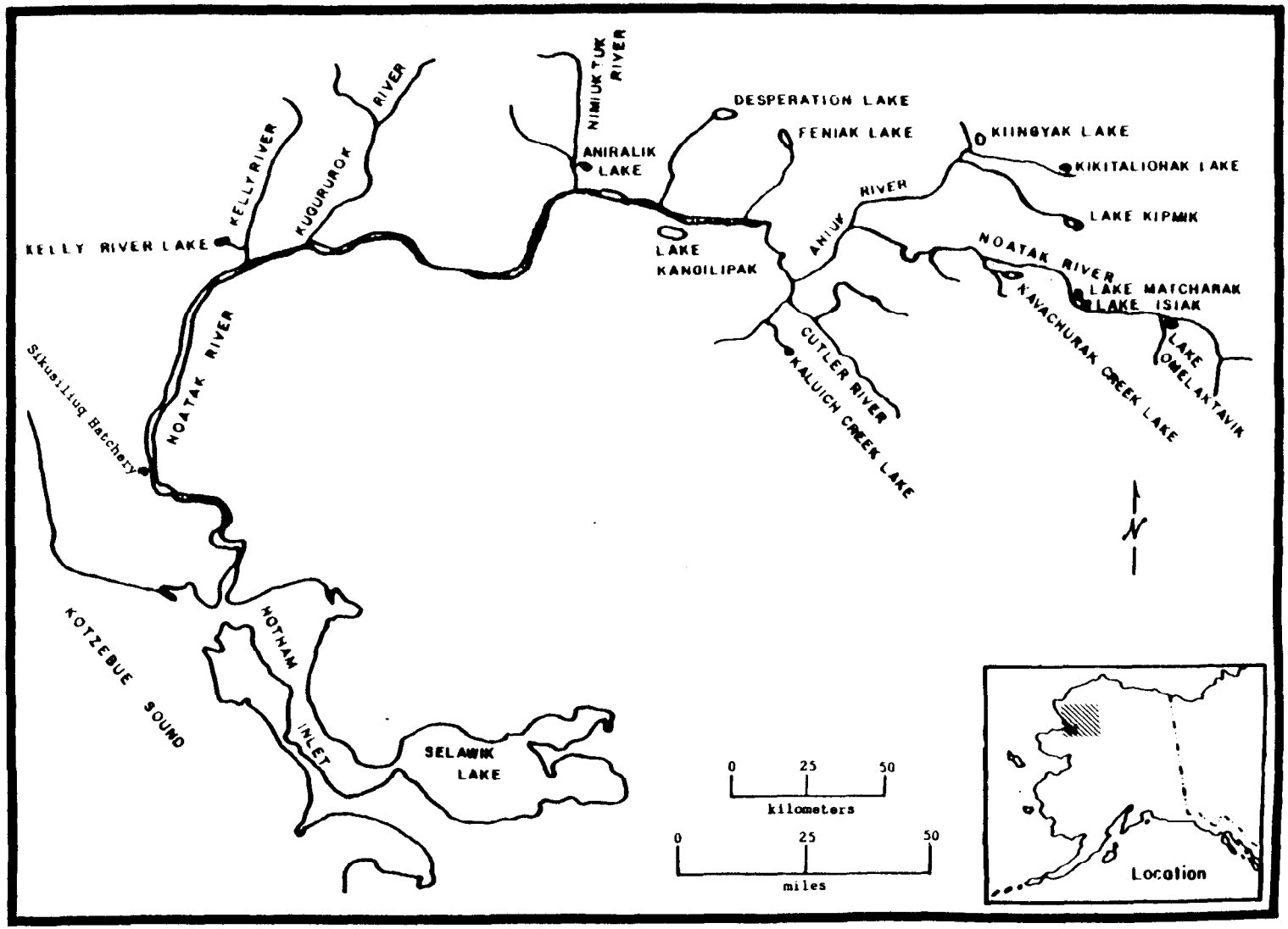

Figure 18. Waters of the Noatak River.

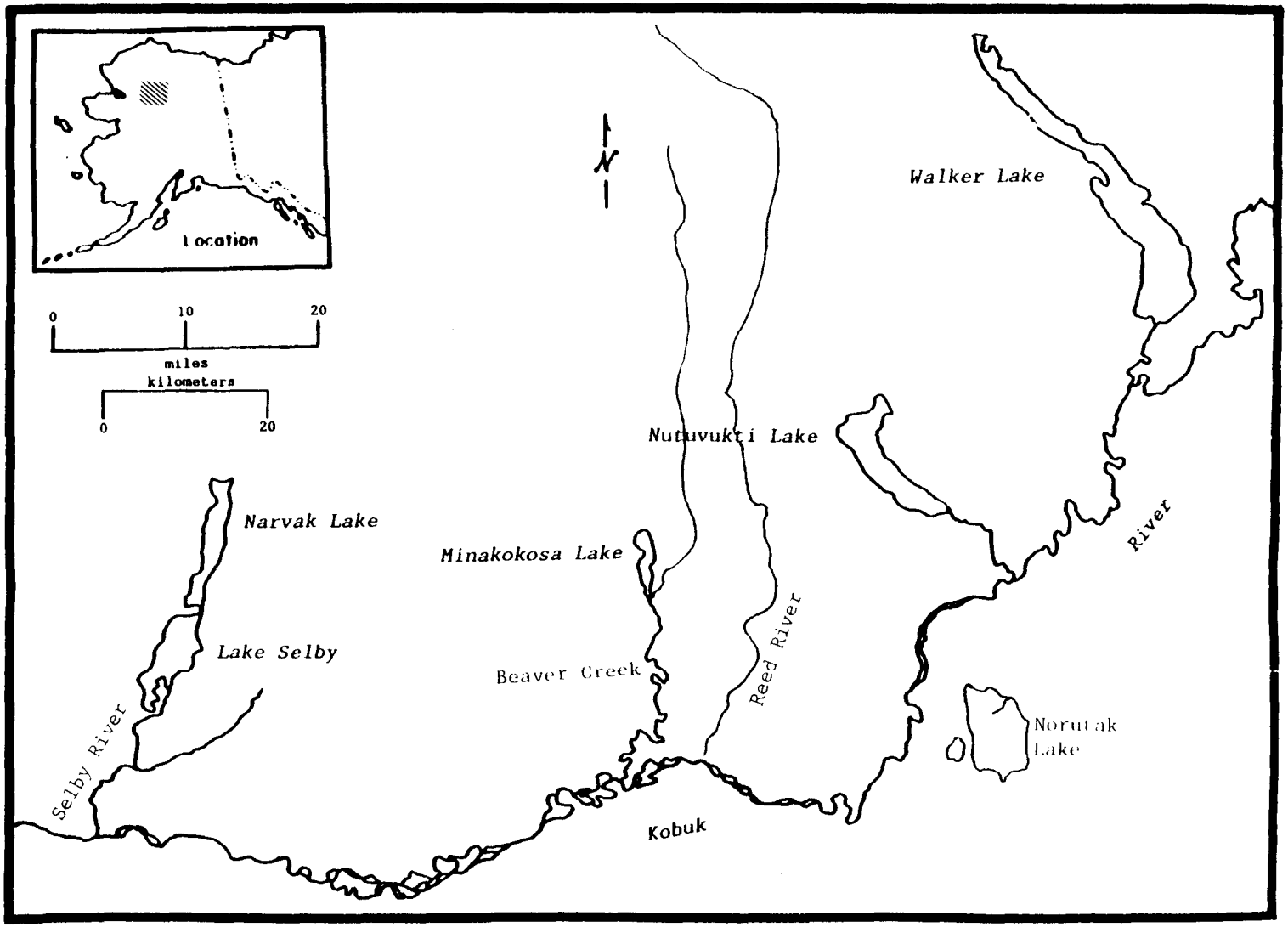

Figure 19. Waters of the upper Kobuk River.

Selawik Lake and Hotham Inlet (Kobuk Lake). Dolly Varden occur in some tributaries to the Kobuk River, as do northern pike in sloughs and connecting lakes to the lower river. Lake trout inhabit deeper lakes of the upper Kobuk River watershed. The Wulik and Kivalina rivers, which empty into the Chukchi Sea near the village of Kivalina, are well known as trophy streams for Dolly Varden.

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; ADF&G 1986; National Park Service (NPS) 1984, 1985a). A lodge on Walker Lake promotes lake trout and Arctic char fishing. A small amount of shore fishing with hook and line for sheefish takes place near Kotzebue in the summer.

Guided and unguided anglers and river floaters use the Noatak River as do Kotzebue area residents who boat to different parts of the river to fish. The most popular fishing area is the Kelly River, but other tributaries such as the Nimiuktuk and Kugururok rivers are also used occasionally for Dolly Varden fishing (Alt 1978).

Raft, canoe, and kayak trips are increasingly popular recreational uses on the Noatak River. Many parties put in at Matcharak Lake (Figure 18) and portage to the river, or land wheel aircraft on gravel bars farther upstream. Arctic grayling, Dolly Varden and lake trout are available in the upper Noatak River, and downstream from the Nimiuktuk River, chum salmon and northern pike also occur. Lake trout occur in Matcharak, Feniak, and Desperation lakes and in other lakes in the middle and upper Noatak drainage. Most lakes in the area are accessible only by floatplane during the summer.

The lower floodplains of the Kobuk and Selawik rivers, especially in the vicinity of the Kobuk River delta, and the lower Noatak River (upstream of the lower canyon of the Noatak) contain hundreds of shallow thaw lakes of various sizes. Fisheries resources in this area are poorly inventoried, but large populations of whitefish, northern pike, and sheefish are known to be seasonally present. The mountains in the upper Kobuk River drainage (Figure 19) contain several relatively large, deep lakes which were formed by glacial action. Lake trout, Arctic grayling, Arctic char and perhaps one or two whitefish species inhabit these lakes. They include Walker Lake, Nutuvukti Lake, Minakokosa Lake, Lake Selby and Narvak Lake.

Lakes of the upper Noatak River (Figure 18) were surveyed by Alt (1978), with a brief inventory of 13 lakes in the upper drainage. Fish were present in all lakes surveyed, and round whitefish lake trout and Arctic grayling were 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 found.

North Slope Brooks Range Sub-area:

The north slope of the Brooks Range sub-area (statewide harvest 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.

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 20). The central and eastern Brooks Range consist of rugged, glaciered, east-trending ridges with summits rising to elevations of 4,350 to 5,000 m. The Delong Mountains on the western flank of the Brooks Range consist of glaciered ridges, 1,865 to 2,500 m in elevation, which drain northward into the Chukchi Sea. Only a few small lakes and no glaciers exist in the Delong Mountains although they were glaciered during the ice age. From the central and eastern Brooks Range, the mountain rivers flow northward to the Beaufort Sea. As Selkregg (1976) points out, although several large rock basin lakes lie at the mouths of glaciered valleys on both sides of the range, there are surprisingly few lakes for a glaciered 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 20 and 21). The drainage area of the Colville River is 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 are braided and cross broad gravel flats that are often blocked in winter by aufeis (fields of ice that form continuously downstream from spring water sources) that cause local flooding (Selkregg 1976). The upper valleys of major rivers flowing from the Brooks Range often contain morainal lakes.

The coastal plain is an area of low relief and poor drainage due to underlying permafrost and a shallow active layer, factors that lead to moisture entrapment near the surface. Rivers that cross the plain originate in the hills or mountains to the south. In the west, more than half of the plain is covered by ~~orlente~~d thaw lakes aligned to the north-northwest on their long axes. 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 20). The Colville River has several major tributaries, including the Killik, Chandler, Anaktuvuk, and Itkillik rivers (Figure 21). Streams east of the Colville River include the Kuparuk, Sagavanirktok (Figure 22), Canning, Hulahula, and Kongakut rivers (Figure 20).

The North Slope is accessible by air travel or from the Dalton Highway, which extends north from Livengood to Prudhoe Bay. 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) on either side of the pipeline beginning in 1978 to prevent ~~rapid~~ fisheries depletion by construction workers along the Trans-Alaska Pipeline. The closure was rescinded in 1980 when the Alaska BOF opened the Haul Road Corridor to fishing for all species except sheefish and salmon (Bendock 1980). Since June 1981, highway travel south of Disaster Creek (near Dietrich, Figure 11) has been open to the general public (Bendock 1982). The Alaska BOF opened the Haul Road Corridor for sheefish fishing in 1987, but salmon fishing remains closed.

The Dalton Highway crosses tributaries of the Sagavanirktok, Toolik, and Kuparuk rivers and parallels the Sagavanirktok River for about 160 km (100

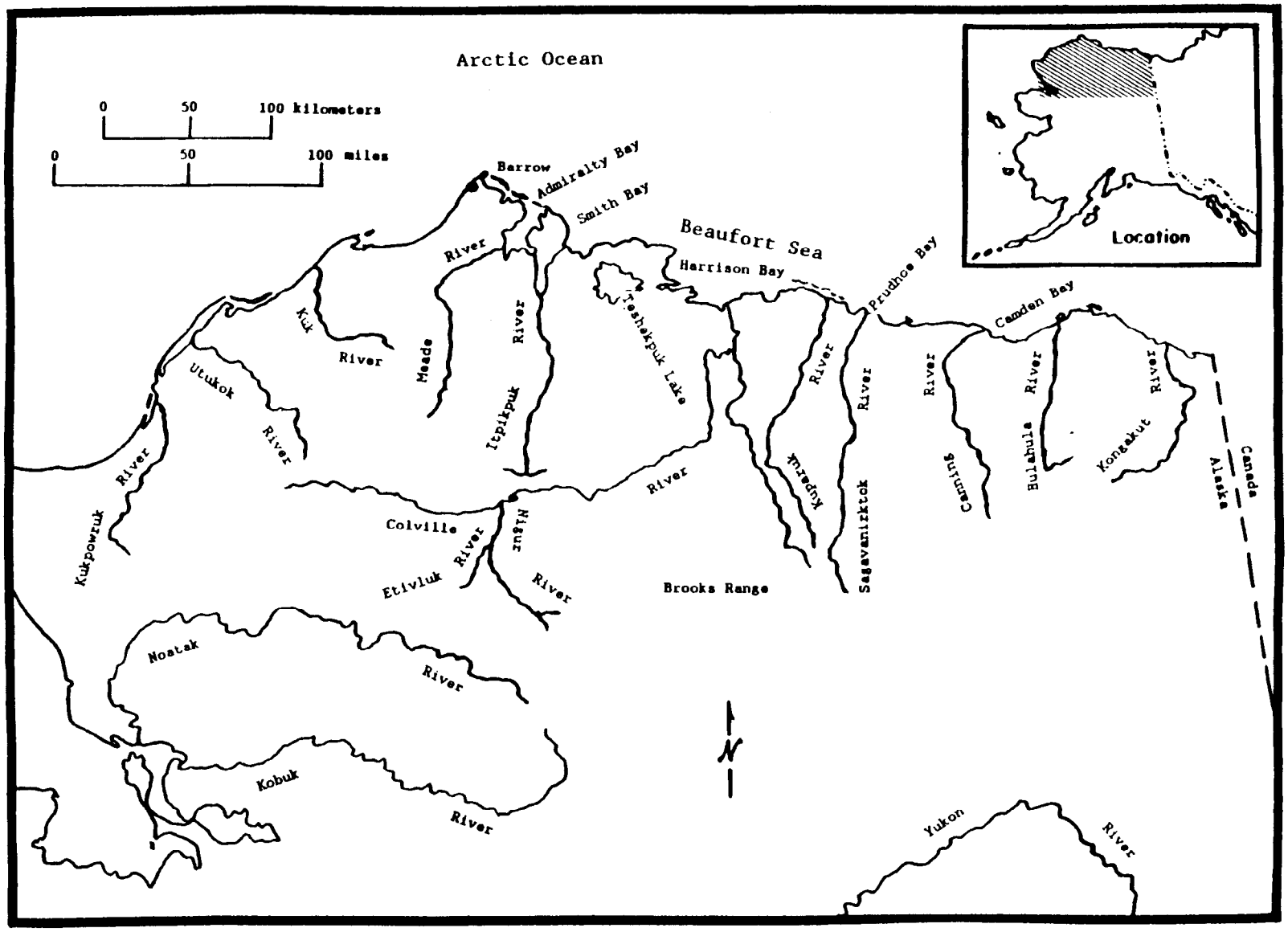

Figure 20. Waters of the Arctic Slope.

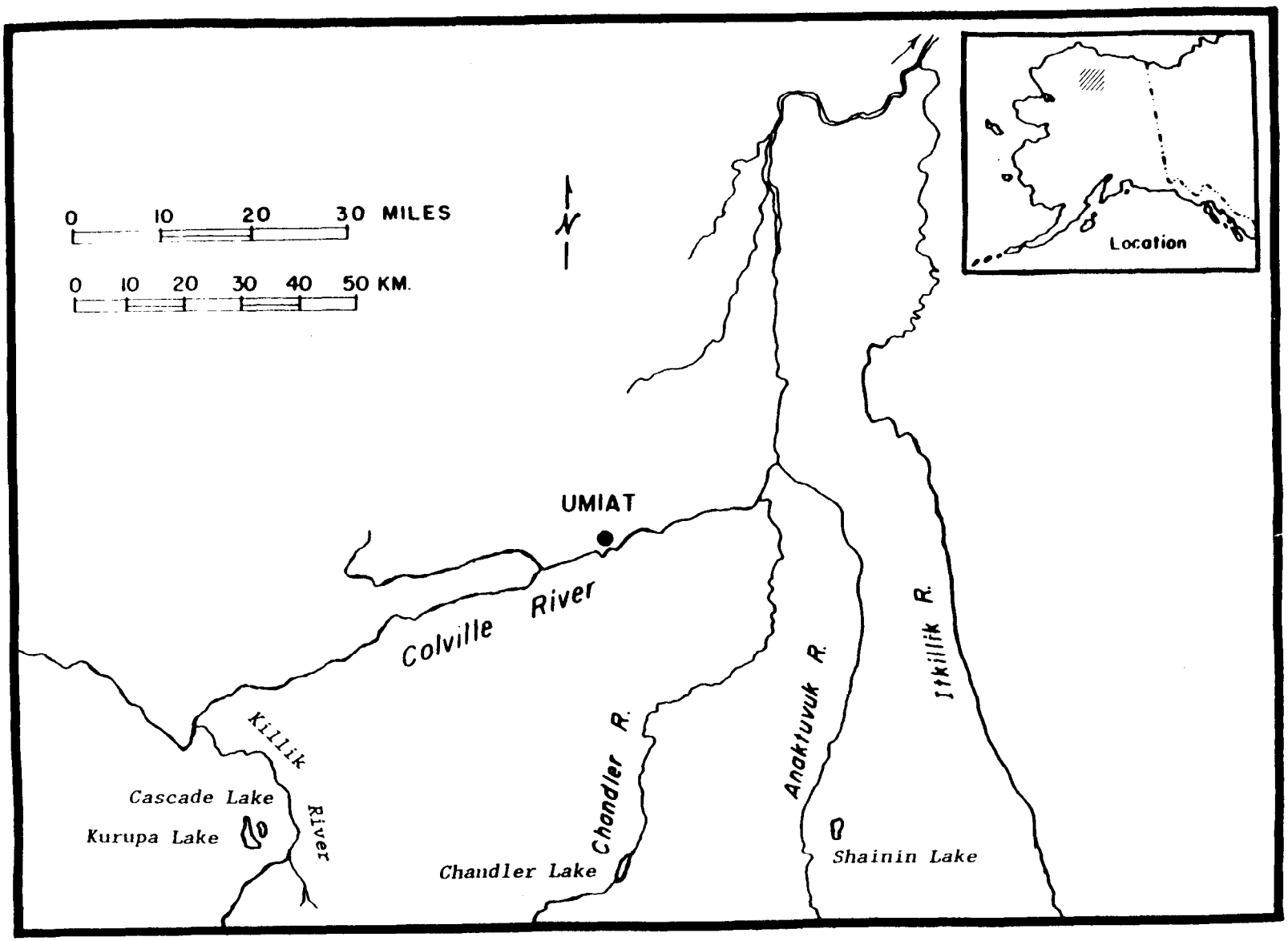

Figure 21. Principal tributaries of the Colville River.

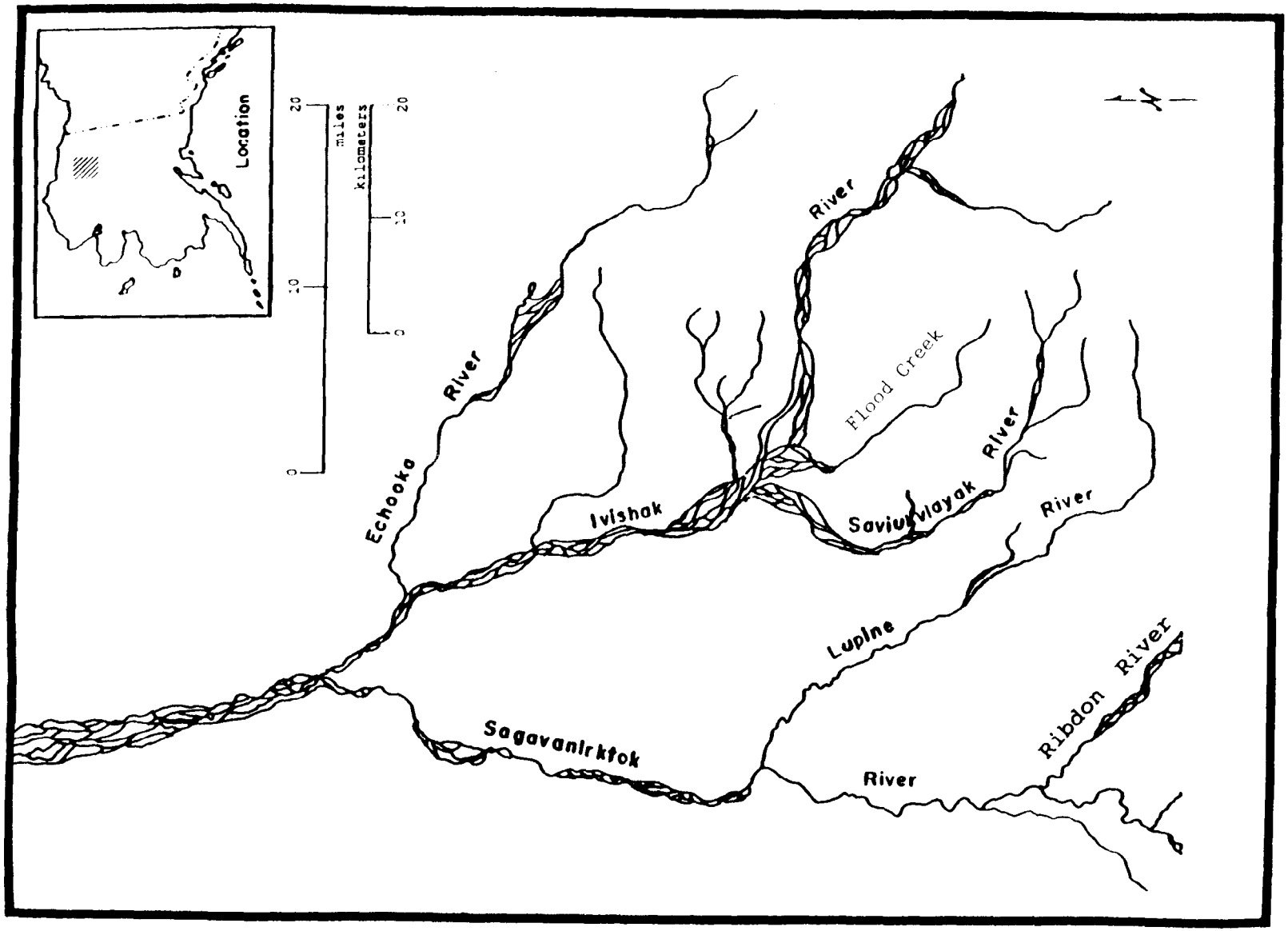

Figure 22. Principal tributaries of the Sagavanirktok River.

miles) south of Prudhoe Bay, providing access to sportfishing opportunities for Arctic grayling, lake trout, Dolly Varden and Arctic char (Figure 11). There are numerous small lakes between Ribdon River (Figure 22) (tributary to the Sagavanirktok River) and Galbraith Lake (Figure 11) that provide good fishing opportunities for these species .

Light sportfishing effort also takes place on the Colville, Kongakut, Canning, Ivishak, Echooka, Killik, Anaktuvuk and the Hulahula rivers (ADF&G 1986). Some fishing may also be done by parties floating the Nigu and Etivluk rivers (Bendock 1983). A significant proportion of the sport fishing in this sub-area is believed to take place by persons engaged in hunting activities as their main pursuit.

Lakes such as Toolik Lake in the upper Kuparuk River and Galbraith Lake in the upper Sagavanirktok River are two of the most frequently fished lakes north of Atigun Pass (Bendock and Burr 1984). Other popular lakes along the Haul Road include Island, Campsite, and Tea lakes. Lakes outside the Dalton Highway Corridor that receive sportfishing effort include Elusive, Shainin, Itkillik, Cascade, Kurupa, and Chandler lakes (Figures 11, 13, and 21; Furniss 1974; NPS 1985a).

AYK Area Climate

Because of geographic and topographic diversity and size, annual climatic parameters vary considerably throughout the area. Except for the immediate coastal areas, a continental type of climate prevails over much of the AYK Area, with warm summers, cold winters and little precipitation. Annual precipitation is usually 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 gives the appearance of having received abundant moisture. Typical summer weather lasts from mid-June until late August or early September, with rainy weather typical during August and September. Snowfall is usually light even in the coastal areas of the AYK Area, as compared to other areas of the state.

Species of Importance to the Sport Fishery

In addition to the species listed for the Tanana Area, Dolly Varden and Arctic char are important to sport fishing in many waters of the AYK Area. Wild stocks of rainbow trout occur as far upstream in the Kuskokwim River drainage as the Aniak River and its tributaries. Rainbow trout do not occur naturally north of the Kuskokwim River, although they have been stocked in two lakes of the AYK Area. Pink salmon are an important sport fish species in the Norton Sound and Seward Peninsula sub-area where 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.

AYK Area Sport Fisheries

A brief description of AYK Area sport fisheries follows.

Chinook Salmon:

Chinook salmon spawn throughout the Kuskokwim and Yukon River drainages and in streams of eastern Norton Sound and the southern Seward Peninsula. Chinook salmon occur in streams north of the Seward Peninsula, but no stocks identified are sufficiently abundant to support commercial or sport fisheries. Concentrated sport fishing occurs in only a few streams in the AYK Area, and the majority of the sport harvest is by local residents. More intensive sport fishing occurs in Norton Sound on the Unalakleet River and on the Seward Peninsula in parts of the Fish River system where commercial guiding and lodging facilities have been developed for salmon sport fishing. Guided fishing for chinook salmon also takes place on the Holitna River in the Kuskokwim drainage. The Salmon River (Kuskokwim River tributary) near Nikolai and McGrath also supports a sport fishery on a chinook salmon spawning stock by local residents (Stokes 1985). An undocumented amount of angling for chinook salmon takes place on both the Andreafsky and Anvik rivers. Few chinook salmon are harvested in the AYK and Tanana Areas compared to other management areas in Alaska (Arvey and Mills 1993; Mills 1992). Since 1980 the AYK Area chinook salmon sport harvest has ranged from about 1,000 to 3,000 fish, (combined large and small sea-run chinook salmon) with the majority taken from streams in the Yukon and Kuskokwim sub-areas (Mills 1991)[4]. An estimated total of 1,333 sea-run chinook salmon were harvested in 1991 in the AYK Area (Tables 4 - 9). Since 1990, separate estimates of small and large sea-run chinook salmon have been discontinued in the AYK Area. The estimated catch of chinook salmon by sport anglers in 1991 is 3,449 fish, approximately 2.5 fish for every one harvested.

Coho Salmon:

Coho salmon are distributed widely south of the Brooks Range in the AYK Area, however, they are more abundant in the Kuskokwim River drainage and in drainages to the south than in drainages north of the Kuskokwim River. Returns of coho salmon to the Kuskokwim River may be the largest to a single river in Alaska. Approximately 660,000 coho salmon were harvested in the 1986 Kuskokwim River commercial fishery, historically the largest commercial harvest for this system (Francisco et al. 1987). Western Alaska coho salmon are thought to spawn primarily in spring-fed portions of streams. The upper Kuskokwim River and its tributaries that drain the northern slopes of the Alaska Range are extensively underlain with alluvial gravels as a result of outwash from the Alaska Range. The resulting gravel aquifers provide high quality spring water for spawning and rearing of coho salmon in the Kuskokwim drainage, and fall chum salmon in the Yukon and Tanana River drainages. In 1991, the majority of the coho salmon recreational harvest in the AYK Area (8,317 fish) was from streams in the Seward Peninsula-Norton Sound sub-area (5,800 fish), followed by harvests in the Kuskokwim River sub-area (2,087

[4] Reported harvest figures include fish taken from lower Kuskokwim River and Kuskokwim Bay streams.

Table 5. Yukon River sub-area[a] sport fish harvest and effort by fisheries and species[b], 1991.

	Anglers	Trips	Days Fished	KS	SS	RS	CS	LT	DV/ AC	GR	WF	SF	NP	BB	OTHER
SALTWATER:															
Boat	37	18	50	0	0	0	0	0	0	0	0	0	0	0	0
SALTWATER TOTAL	37[c]	18	50	0	0	0	0	0	0	0	0	0	0	0	0
FRESHWATER:															
Yukon River Drainages (Downstream from Koyukuk River)	1,026	1,263	3,001	93	341	96	428	64	331	708	129	61	515	0	0
Koyukuk River Drainage	1,135	1,244	2,029	0	0	0	0	16	252	1,582	18	46	485	0	0
Yukon River Drainages (Koyukuk River to Fort Yukon)	1,797	3,020	4,198	10	0	60	21	338	0	2,624	92	1,188	3,102	128	0
Yukon River Drainages (Fort Yukon to Canadian Border)	531	421	1,059	30	0	24	0	0	46	553	183	46	0	32	0
Other Lakes	111	201	210	0	0	0	0	16	0	0	0	0	176	0	0
Other Streams	92	110	92	10	89	0	0	0	46	103	0	0	0	0	0
Non Yukon River Drainages	110	55	110	0	0	0	0	0	0	0	0	0	176	0	0
FRESHWATER TOTAL	4,047[c]	6,314	10,699	143	430	180	449	434	675	5,570	422	1,341	4,454	160	0
GRAND TOTAL	4,047[c]	6,332	10,749	143	430	180	449	434	675	5,570	422	1,341	4,454	160	0

[a] Yukon River Drainage (Area Y): All Yukon River drainages (including the Alaska portion of the White River drainage but excluding the Tanana River drainage), from the south side of the Brooks Range to the Bering Sea, and from the Canadian border to the Bering Sea; and all drainages of the Koyukuk River and Alatna Rivers.

[b] Refer to Table 3 for common names and species abbreviations.

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

Table 6. Kuskokwim River sub-area[a] sport fish harvest and effort by fisheries and species[b], 1991.

			Days	DV												
	Anglers	Trips	Fished	KS	SS	RS	PS	CS	LT	AC	RT	GR	WF	SF	NP	BB	OTHER
SALTWATER:																	
Boat	55	111	154	26	327	0	0	0	0	590	0	0	0	0	0	0	0
Shoreline	36	147	102	17	20	0	0	0	0	72	0	0	0	0	0	0	0
SALTWATER TOTAL	55[c]	258	256	43	347	0	0	0	0	662	0	0	0	0	0	0	0
FRESHWATER:																	
Kanektok River	736	1,398	3,078	316	358	88	0	80	0	389	182	54	24	0	0	0	95
Aniak River	662	1,086	3,078	214	327	38	0	169	0	547	76	1,085	0	13	244	0	0
Goodnews River	460	221	1,328	26	297	63	12	189	0	605	258	122	0	0	0	0	0
Other Streams	1,248	3,494	4,529	187	676	25	24	209	71	534	258	1,342	134	141	1,741	40	0
Lakes	348	274	786	0	82	0	0	0	201	187	0	0	0	0	33	0	0
FRESHWATER TOTAL	3,128[c]	6,473	12,799	743	1,740	214	36	647	272	2,262	774	2,603	158	154	2,018	40	95
GRAND TOTAL	3,146[c]	6,731	13,055	786	2,087	214	36	647	272	2,924	774	2,603	158	154	2,018	40	95

[a] Kuskokwim River Drainage (Area V): The Kuskokwim River drainage and all waters flowing into Kuskokwim Bay; adjacent saltwater from Cape Newenham north to the Naskonat Peninsula (north of Nelson Island). Does not include the Yukon, Tanana or Koyukuk River drainages.

[b] Refer to Table 3 for common names and species abbreviations.

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

Table 7. Seward Peninsula-Norton Sound sub-area[a] sport fish harvest and effort by fisheries and species[b], 1991.

	Anglers	Trips	Days Fished	KS	SS	RS	PS	CS	DV AC	GR[c]	GR[d]	WF	SF	NP	BB	SM	KC	OTHER
SALTWATER:																		
Boat	324	324	325	0	167	0	30	0	0	0	0	0	0	0	0	0	0	538
Shoreline	683	1,331	1,179	0	428	0	41	0	0	0	0	0	0	0	0	891	748	605
SALTWATER TOTAL	899[e]	1,655	1,504	0	595	0	71	0	0	0	0	0	0	0	0	891	748	1,143
FRESHWATER:																		
Nome River	1,241	3,848	4,609	22	417	0	356	241	1,220	129	57	13	0	0	0	0	0	13
Pilgrim River	1,133	2,158	3,085	51	310	124	81	85	856	158	287	13	0	608	0	0	0	0
Unalakleet River	845	3,164	5,518	296	2,156	0	437	497	1,474	703	1,005	1,318	0	0	0	808	0	202
Fish-Niukluk River System	827	1,295	2,470	14	977	0	356	272	1,474	933	387	13	0	283	35	0	0	0
Sinuk River	557	953	885	0	71	41	51	47	729	72	57	0	0	0	0	0	0	0
Snake River	647	2,158	2,384	7	798	62	71	93	1,252	316	86	0	0	0	0	0	0	0
Solomon River	593	1,115	1,057	7	83	0	173	0	2,219	144	14	0	0	0	0	0	0	27
Kuzitrin River	396	575	750	0	0	10	10	0	222	129	0	0	0	481	0	0	0	0
Other Streams	720	1,152	1,342	7	393	0	132	180	919	429	215	0	0	57	81	0	0	0
Lakes	18	18	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRESHWATER TOTAL	3,236[e]	16,436	22,118	404	5,205	237	1,667	1,415	10,365	3,013	2,108	1,357	0	1,429	116	808	0	242
GRAND TOTAL	3,776[e]	18,091	23,622	404	5,800	237	1,738	1,415	10,365	3,013	2,108	1,357	0	1,429	116	1,699	748	1,385

[a] 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.

[b] KS: king or chinook salmon; SS: silver or coho salmon; RS: red or sockeye salmon; PS: pink salmon; CS: chum salmon; LT: lake trout; DV/AC: Dolly Varden or Arctic char; GR: Arctic grayling; WF: whitefish (any of several species); SF: sheefish; NP: northern pike; BB: burbot; SM; smelt; KC: King crab.

[c] Arctic grayling 15 inches and under.

[d] Arctic grayling over 15 inches.

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

Table 8. Northwest Alaska sub-area[a] sport fish harvest and effort by fisheries and species[b], 1991.

	Anglers	Trips	Days Fished	KS	SS	RS	PS	CS	LT	DV[c] AC	DV[d] AC	GR	WF	SF	NP	BB	SM	OTHER
SALTWATER:																		
Boat	76	113	186	0	0	0	0	0	0	142	0	0	0	0	0	0	0	0
Shoreline	340	661	1,248	0	0	0	0	0	0	57	0	0	0	0	0	0	119	0
SALTWATER TOTAL	264[e]	774	1,434	0	0	0	0	0	0	199	0	0	0	0	0	0	119	0
FRESHWATER:																		
Kobuk River	567	831	2,206	0	0	0	64	27	32	57	113	446	122	579	163	0	0	0
Noatak River	642	1,058	3,708	0	0	0	9	32	22	128	808	817	107	0	163	0	0	0
Other Streams	568	926	1,889	0	0	0	18	0	32	184	228	631	31	24	68	0	0	0
Lakes	190	152	306	0	0	0	0	0	87	0	0	87	0	0	0	0	0	0
FRESHWATER TOTAL	1,606[e]	2,967	8,109	0	0	0	91	59	173	369	1,149	1,981	260	603	394	0	0	0
GRAND TOTAL	1,795[e]	3,741	9,543	0	0	0	91	59	173	568	1,149	1,981	260	603	394	0	119	0

[a] 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.

[b] KS: king or chinook salmon; SS: silver or coho salmon; RS: red or sockeye salmon; PS: pink salmon; CS: chum salmon; LT: lake trout; DV/AC: Dolly Varden or Arctic char; GR: Arctic grayling; WF: whitefish (any of several species); SF: sheefish; NP: northern pike; BB: burbot; SM; smelt.

[c] Dolly Varden and Arctic char 20 inches and under.

[d] Dolly Varden and Arctic char over 20 inches.

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

Table 9. North Slope Brooks Range sub-area[a] sport fish harvest and effort by fisheries and species[b], 1991.

	Anglers	Trips	Days Fished	KS	PS	CS	LT	DV/ AC	GR	WF	NP	BB	SM	OTHER
SALTWATER:														
Boat	53	88	231	0	0	0	0	204	0	0	0	0	0	0
Shoreline	246	512	523	0	0	0	0	436	0	0	0	0	0	0
SALTWATER TOTAL	299[c]	600	754	0	0	0	0	640	0	0	0	0	0	0
FRESHWATER:														
Sagavanirktok River	548	2,228	2,282	0	0	0	0	286	1,096	0	0	0	0	0
Other Haul Road Streams	283	300	602	0	0	0	0	136	893	0	0	0	0	0
Other Streams	355	478	2,383	0	0	0	0	54	716	0	0	0	0	0
Haul Road Lakes	159	176	343	0	0	0	0	0	81	0	0	0	0	0
Other Lakes	320	302	927	0	0	0	176	83	515	0	0	0	0	0
FRESHWATER TOTAL	1,379[c]	3,484	6,537	0	0	0	176	559	3,301	0	0	0	0	0
GRAND TOTAL	1,556[c]	4,084	7,291	0	0	0	176	1,199	3,301	0	0	0	0	0

[a] 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.

[b] KS: king or chinook salmon; PS: pink salmon; CS: chum salmon; LT: lake trout; DV/AC: Dolly Varden or Arctic char; GR: Arctic grayling; WF: whitefish (any of several species); SF: sheefish; NP: northern pike; BB: burbot; SM; smelt.

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

fish) (Tables 4, 6 and 7). The sport harvest of coho salmon from the Seward Peninsula-Norton Sound sub-area in 1991 was composed of 2,156 fish from the Unalakleet River (Table 7).

Coho salmon are locally abundant 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 9 and 16) including the Unalakleet, Shaktoolik, Fish, and Niukluk rivers support spawning stocks of coho salmon, as do many of the streams in the Nome area, Port Clarence, and Safety Sound. Active sport fisheries occur in these areas for coho salmon. The Nome and Unalakleet rivers accounted for the majority of the harvest. Coho salmon occur north of Port Clarence, but as with other freshwater rearing salmon species, 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 abundant upstream of the lower main stems of the major river systems of the AYK Area. For example, few pink salmon ascend the Yukon River beyond the Anvik River (513 km), or the Kuskokwim River beyond the Holitna River (540 km). Estimated 1991 harvest of AYK Area pink salmon was 1,865 fish, of which all but 127 were taken in the Seward Peninsula/Norton Sound sub-area (Tables 4 and 7).

Pink salmon are a target species in Norton Sound sport fisheries where harvest estimates have ranged from 1,100 (1985) to more than 13,000 (1982). The recent (1982-1991) ten year average sport harvest is 4,812 fish. Even-year harvests for the five years of this period averaged 7,159 fish, while harvests during odd years averaged 2,465 fish. Pink salmon utilize numerous streams in Norton Sound for spawning, and in some years large returns are documented. Extremely large returns have been recorded for the Unalakleet River, the Kwiniuk River and Tubutulik River (Lean et al. 1986). More than 6 million pink salmon are estimated to have spawned in the Unalakleet River in 1984 (Lean 1985). Returns of this species are extremely variable even in more southerly latitudes. The common two-year cycle of pink salmon return abundance is not as pronounced in Norton Sound and in more northerly areas, although the magnitude of return variation is large because of climatic variation at higher latitudes. Snow cover, depth, and mean monthly temperatures during the winter months all affect ice thickness and the amount of frozen versus unfrozen groundwater in local streams of the area. Salmon egg and fry survival rates are directly affected by the amount of freezing in the stream gravels where incubation takes place.

Non-rearing species such as pink and chum salmon may have an advantage in northern 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 are active in late July and early August.

Arctic Grayling:

Arctic grayling inhabit waters throughout the AYK Area where they are perhaps the most popular and ubiquitous sport fish species. 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. Arctic grayling occur in lakes and streams emptying into the Chukchi Sea between Kotzebue and Barrow (ADF&G 1978, 1986). Arctic grayling also migrate through, or inhabit during parts of the year, main stems and tributaries of the largest rivers such as the Yukon, Kuskokwim, Porcupine, Koyukuk, Kuskokwim, Noatak, Kobuk and Colville rivers.

Arctic grayling typically spawn in smaller, clear headwater streams with gravel bottoms and low stream gradients, usually during May and early June as water temperatures warm. After spawning, the adults disperse throughout the streams for summer feeding. Juveniles and sub-adults frequently feed during summer months in far upstream reaches that become dewatered in winter. They overwinter in lower stretches of tributaries where water and oxygen concentrations are adequate, 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 Alaska Habitat Management Guides for the Interior, Western and Arctic Regions (ADF&G 1986).

Statewide harvest survey results indicate that since 1977, the Arctic grayling harvest in the AYK Area has ranged from about 9,000 fish in 1990 to more than 30,000 in 1983. Since 1983, estimated harvests have declined, and have ranged from 15,500 in 1984 to 18,576 in 1991, the high year (Table 4). Harvest distribution of Arctic grayling in the five sub-areas was somewhat weighted toward Yukon River and Seward Peninsula/Norton Sound sub-areas in 1991 (Tables 5 - 9). The largest harvest estimate in 1991 (5,570 fish) was from the Yukon River sub-area (Table 5).

Northern Pike:

Sloughs, interconnected lakes, and the lower sections of large rivers throughout most of the AYK Area are inhabited by northern pike. Lowland areas of the Yukon and Kuskokwim rivers are particularly noted for large northern pike. Northern pike are abundant in all parts of the AYK Area containing appropriate habitat except on 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 20) and in middle reaches of the Killik River, tributary to the Colville River.

During summer, northern pike are generally distributed near shore in shallow water containing aquatic vegetation and a mud bottom. Northern pike have some tolerance for salinity and 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).

Most of the recreational harvest of northern pike is taken with hook and line. Spearing, bow and arrow, and hand jigging techniques are also legal means and account for a small proportion of the total harvest. Northern pike sport fishing occurs in the Kuskokwim River drainage from McGrath to downstream of Bethel, including the Takotna, Nixon Fork, Holitna, and Johnson rivers. Most recreational fishing for northern pike along the Yukon River takes place upstream from Galena. 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, Kuzitrin, and Fish rivers in the Nome area are popular as well.

Much of the recreational and some of the subsistence harvest in the AYK Area 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. Northern pike are eagerly sought by fishermen in areas that have good boat access. They are often fished 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 1979-1992). The estimated harvest in 1991 was 8,295 fish (Table 4). Generally, the largest harvests have been taken in the Yukon and Kuskokwim river sub-areas. Estimated 1991 harvests from these sub-areas were 4,454 and 2,018 northern pike respectively. In 1991, an estimated harvest of 1,429 northern pike was taken in the Seward Peninsula/Norton Sound sub-area. (Tables 5 - 9).

Little is known concerning the status of northern pike stocks in the AYK Area, but because of remoteness and restricted access, fishing effort is light except on those stocks near towns and villages where angling and subsistence gill netting effort may be more intense. Northern pike populations close to the Yukon River Haul Road Bridge have experienced more angling pressure because the recent opening of the road has allowed easy boat access for Fairbanks area residents. Northern pike population studies conducted in the Tanana River drainage suggest that abundance and stock composition parameters such as age and size composition respond negatively and rapidly when annual harvest exploitation rates exceed 16%.

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 in 1991 for the entire region totalled 3,033 fish[5], of which 1,055 fish (35%) were taken from the AYK Area (Table 4). Harvests for the AYK Area since 1977 have ranged from about 500 fish in 1977 to about 2,500 in 1986 (Table 4).

Studies conducted by ADF&G indicate that lake trout resources have been overharvested in many of the more accessible waters of south-central and interior Alaska. Specific life history features (slow growth, delayed maturity, and non-consecutive spawning) combined with the short growing season at higher latitudes and altitudes increases the vulnerability of the species to overharvest.

Burr (1987) 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

[5] See remarks on harvest estimate accuracy for the Tanana Area, page 56.

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 occur commonly in central coastal plain lakes between the Ikpikpuk and Colville rivers.

The Alaska Department of Fish and Game has conducted little research on this species in areas outside of the Tanana Valley and near Glennallen. Limited lake trout assessment has been 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:

The majority 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 dwarf 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 coast, and occur in either the anadromous, stream resident or stream dwarf form, while Arctic char occur only as residents in foothill lakes of the North Slope (Chandler Lake Campsite Lakes, etc; Figures 11 and 21), the Kobuk River drainage (Walker and Selby lakes; Figure 18), the Seward Peninsula (lakes of the Kigluaik Mountains; Figure 16), and the Kuskokwim Mountains (Aniak, Kisaralik, Kagati, and Goodnews lakes; Figure 14). 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 coastal plain. Morrow (1980) distinguishes two distinct forms of Dolly Varden in Alaska based upon gill raker and vertebral counts. The southern form usually 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 that non-anadromous southern and northern forms occur on both sides of the Alaska Range passes. Morrow (1980) argues that headwater transfer, which may still be occurring, is responsible for the mixing of southern and northern forms in these areas.

Sport harvests of char in the AYK Area between 1977 and 1991 have ranged from approximately 4,000 fish to more than 20,000 fish (Table 4). This represents from less than 5% to about 20% of the statewide total harvest (Mills 1979-1992). The estimated harvest in 1991 was 16,880 fish from the AYK Area, the largest estimated harvest since 1983. The majority of the harvest was taken

in the Seward Peninsula-Norton Sound sub-area Tables 5 - 9). Typically, the largest percentage of the harvest is taken in the Seward Peninsula-Norton Sound sub-area. High quality sport fishing for char is available in northwest Alaska, particularly in the Wulik, Kivalina, and Noatak rivers north of Kotzebue, when trophy Dolly Varden move into the streams for either overwintering or spawning in the fall. The Noatak River in northwest Alaska supports populations of spawning char in its tributaries. Important spawning tributaries include the Kelly River, Kogururok River, and the Nimiuktuk River (DeCicco 1985). Incidental commercial harvest as well as directed subsistence harvests account for the highest proportion of the annual fishing mortality in northwest Alaska in most years (Bernard and DeCicco 1987).

During the period from 1967 to 1991, 30 trophy char (30% of the Alaska total) were registered from the AYK Area, including the state record char, (8.98 kg; 19 lbs 12.5 oz) taken from the Noatak River in 1991. All except one of the trophy char taken in the AYK Area came from northwest Alaska.

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 subsistence economies of rural Alaska and for sport fisheries as well. 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 1978 have ranged from just over 100 fish to approximately 2,000 fish (Table 4). The majority of the harvest and fishing effort occurs in the winter with lines set through the ice, although hand-held lines with rod and reel are also used in summer and winter months. The majority of the burbot sport harvest in the AYK Region takes place in the Tanana River drainage. The estimated AYK Area harvest of burbot in 1991 was 316 fish (Table 4).

Only three of the 184 Alaska trophy burbot registered from 1967 to 1991 were taken in the AYK Area, a fact that no doubt reflects lack of sport fishing effort in much of the area.

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 for human consumption as well as for dog food. In addition, various whitefish species provide a forage base for many of the predatory fishes that support important sport fisheries such as northern pike, burbot, and sheefish. The most important whitefish 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 proportion of the total harvest of all species of whitefish. An estimated harvest of 682 whitefish was taken by sport anglers in 1991 in the AYK Area (Table 4). The magnitude of the whitefish subsistence harvest is not well documented except

in a few specific instances, but is believed to be orders of magnitude greater than the sport harvest in the AYK Area. Where salmon are not available, and during the winter months, whitefish are 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 upstream limits of the salmon runs. Limited commercial fisheries for whitefish exist in the AYK Area.

Sheefish:

Sheefish are large, predatory whitefish found throughout western, interior, and northwestern Alaska. They do not occur in streams of the North Slope 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 commercial fishery have only once (in 1977-78) reached the allowed quota (Lean et al. 1986). During the period from 1978-1991, estimates of the recreational harvest in the AYK Area ranged from about 600 to about 3,600 fish (Table 4). The harvest estimate for the AYK Area in 1991 was 2,098 sheefish with over 1,300 harvested in the Yukon River sub-area (Tables 5 - 9). Alt (1975 and 1977) reported that the most abundant stocks of sheefish in Alaska occur in the lower Yukon River, Koyukuk River, and in the mainstem middle Yukon River, and that these Yukon River stocks make the longest migrations of any sheefish in Alaska.

Harvest of Kobuk and Selawik river sheefish occurs on a year-round basis from subsistence, commercial and sport fishers, from spawning grounds in the upper Kobuk River to the coastal inlets, Hotham Inlet and Selawik Lake near Kotzebue and Selawik villages. The data base for sheefish stocks of the Kobuk and Selawik rivers is not adequate to allow precise estimates of sustainable yields for the stocks. The size of the spawning stocks has been poorly documented as has the harvest and biological composition of the harvest. Because of life history features that favor late maturation, slow growth, nonconsecutive spawning, and the existing harvest pressure on major stocks, there is concern that the Kobuk and Selawik river stocks may be experiencing harvests from all uses that are beyond sustainable levels. The question cannot be addressed until further biological information becomes available.

Sheefish generally overwinter in lower reaches of rivers and in 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. Aerial survey estimates of the number of spawning sheefish on the Kobuk and Selawik rivers are available for seven years between 1966 and 1979. The highest aerial survey count for the

Kobuk River was 8,166 spawning sheefish in 1971 (Alt 1987). A total of 1,243 spawners was observed in the Selawik River in 1968, one of two years when surveys were made on this stream. It is not certain that spawning grounds have 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 be the most critical factor limiting sheefish distribution and abundance (Alt 1987).

Rainbow trout:

In only two known instances have rainbow trout been introduced into waters of the AYK Area. Approximately 3,000 fingerling were released into a man-made, landlocked reservoir known as Webster Reservoir in Prudhoe Bay in 1977. Fate of the transplanted fish was not assessed in subsequent years. Since the reservoir is used as an industrial water source in the winter, water levels are often drawn down severely, increasing the likelihood of winter kill from hypoxia or freeze-out. It is assumed that the transplant failed and that no fish remain.

In a second instance, rainbow trout were released into Roy's Pond near Central in 1987. The pond is a 15.38 ha (38 ac) waterbody with an outlet stream that does not flow except at extreme high water, into Crooked Creek, tributary to Birch Creek in the Yukon River drainage. The 1987 release consisted of 10,000 fingerling rainbow trout. The success of the stocking in producing catchable rainbow trout in the pond in subsequent years has not been assessed. During an ADF&G fisheries survey of Mammoth Creek, tributary to Crooked Creek, in 1990, a rainbow trout adult of about 235 mm in fork length was captured (Townsend 1991). There are anecdotal reports that other rainbow trout were captured in Crooked Creek also. There is therefore strong evidence that the rainbow trout planted in Roy's Pond have escaped into the Birch Creek drainage of the Yukon River.

In addition to authorized releases of rainbow trout, there may have been accidental or purposeful, but unauthorized stockings taking place. An anecdotal report from a trapper (Cheney pers. comm. [6]) in the Farewell area, near McGrath, indicates that rainbow trout may inhabit portions of the South Fork of the Kuskokwim River near Farewell. The lower Jones River and the South Fork above the confluence with the Jones River are reported to contain the species. These fish may represent escaped fish from an unauthorized stocking into Farewell Lake.

STAFF ORGANIZATION

Regional Staff Responsibilities

Organization of the region staff is outlined in Figure 23. All activities were directed by the Regional Supervisor (J. Clark) who delegated appropriate tasks to the Administrative Assistant (E. Nielsen), the Research Supervisor (P. Merritt), the management supervisor (F. Andersen) and the following Fishery Biologist III's: W. Arvey, J. Hallberg, F. Parker, F. DeCicco, and C.

[6] Cheney, Lee. 1991. Personal Communication. ADF&G, F.R.E.D. Division, Big Lake Hatchery, P.O. Box 520509, Big Lake, AK 99652.

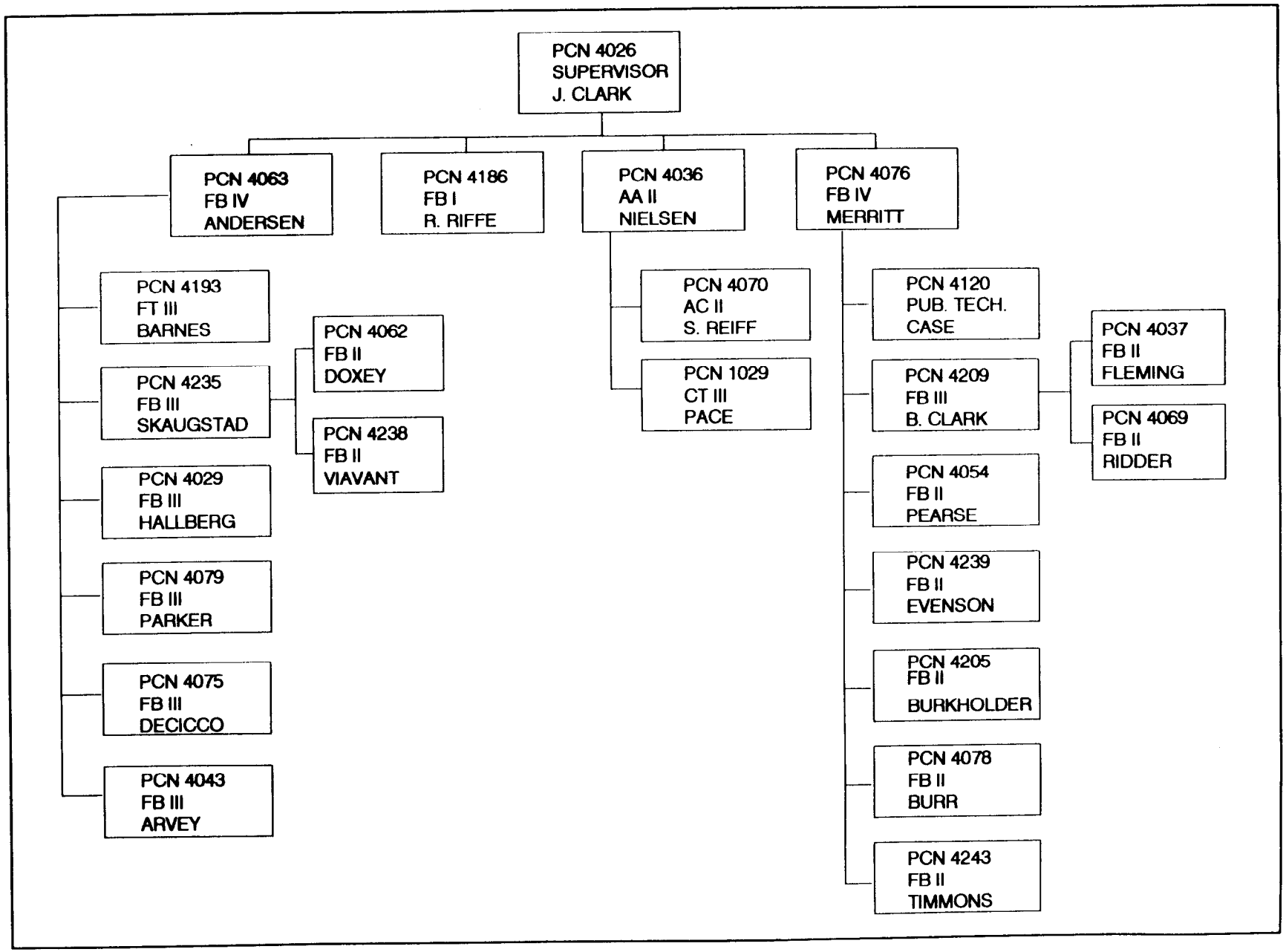

Figure 23. Organizational chart for A-Y-K Sport Fish staff, January, 1991.

Skagstad. Lake stocking activities were the responsibility of M. Doxey. Area management responsibility and emergency order authority was vested with four positions, W. Arvey (AYK Area), J. Hallberg (Lower Tanana Area), F. Parker (Upper Tanana Area), and F. DeCicco (Northwest Alaska Area). Each area manager conducted fisheries research projects in the respective areas. The AYK Area biologist was responsible for a study of Dolly Varden near the North Slope Haul Road; the Lower Tanana River Area biologist conducted creel survey studies in the Fairbanks area; the Upper Tanana Area biologist conducted studies of lake burbot, and northern pike; and the Northwest Area biologist conducted studies on Arctic grayling and Dolly Varden. Special research was conducted by W. Ridder on stock assessment of Arctic grayling in the Salcha, Chatanika and Goodpaster rivers, and in the Tangle lakes, all in the upper Tanana Valley. Arctic grayling research in the Salcha, Chena, and Chatanika rivers near Fairbanks, and in Fielding Lake near Delta was conducted by R. Clark. Char research was conducted in northwest Alaska by A. DeCicco, who also directed Arctic grayling studies on the Seward Peninsula. Lake trout research in the Tanana River drainage and Copper River was conducted by J. Burr. Burbot research in rivers of the upper Tanana Valley was conducted by M. Evenson. F. Parker conducted a study of burbot in lakes of interior Alaska. Northern pike studies were conducted by G. Pearse and A. Burkholder in the Tanana River drainage. Evaluation of the fish stocking program was conducted by C. Skaugstad, M. Doxey, and J. Clark. Adult chinook salmon abundance in the Salcha and Chena rivers was estimated by A. Burkholder and M. Evenson.

Synopses of Published Reports

The intent of the following section is to provide a brief overview of AYK Region fisheries studies completed during the reporting year, however some of the reports are from work completed in other years. Since the majority of AYK Region activities are documented by technical reports following each field season, the report itself is cited, followed by a brief synopsis.

Arvey, W. D. 1992. Annual management report for sport fisheries in the Arctic-Yukon-Kuskokwim Region, 1990. Alaska Department of Fish and Game, Fishery Management Report No. 92-2. Anchorage. 131 pp.

Sport fisheries in northern, western, and interior Alaska are described and reviewed for the calendar year 1990. Species important to the sport fisheries are identified, species distribution is discussed, as is stock status and sport fishing harvest. Regulatory actions affecting the regional sport fishery in 1990 are described along with other management, research, and enhancement activities. Climatic factors of importance to area fisheries are summarized, and federal land status within the region is described.

Burkholder, A. 1992. Mortality of northern pike captured and released with sport fishing gear. Alaska Department of Fish and Game, Fishery Data Series No. 92-3. Anchorage. 29 pp.

Mortality was estimated to be less than 10% for multiple captures and among tackle types. No fish died in the multiple capture experiment. Likelihood of bleeding was greater for fish captured with small treble hooks than with other hook configurations.

Burr, J. M. 1992. Studies of lake trout in Sevenmile Lake and the Tangle Lakes during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-8. Anchorage. 47 pp.

Size composition, growth and abundance in 1990 and 1991 is estimated.

DeCicco, A. L. 1992a. Assessment of overwintering populations of Dolly Varden in selected streams of the Seward Peninsula, Alaska, during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-11. Anchorage. 34 pp.

Populations of Dolly Varden overwintering in the Nome and Solomon rivers of the Seward Peninsula were sampled during the fall of 1991. Population abundance and length composition were estimated. Estimated abundance of Dolly Varden larger than 199 mm overwintering in a 24 km section of the Nome River was 3,006 fish, or 125 fish/km. Length of these fish ranged from 270 to 600 mm fork length. Abundance of fish overwintering in a 15 km section of the Solomon River was estimated at 3,972 fish; 265 fish/km. Fork length of these fish ranged from 227 to 600 mm. Fish measuring between 301 and 400 mm accounted for 55% of the population in the Nome River and 35% of the population in the Solomon River.

DeCicco, A. L. 1992b. Assessment of selected stocks of Arctic grayling in streams of the Seward Peninsula, Alaska, during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-13. Anchorage. 60 pp.

Stock status was investigated in the Fish, Nome, Pilgrim, Sinuk and Snake rivers during 1991. The estimated number of fish per kilometer, ranked from high to low was Fish River (121/km), Pilgrim River (92/km), Snake River (40/km), Sinuk River (36/km), and Nome River (18/km). Fork length of captured Arctic grayling ranged from 21 mm to 511 mm.

Doxey, M. 1992. Abundance of rainbow trout in Birch and Quartz lakes, Alaska Department of Fish and Game, Fishery Data Series No. 92-10. Anchorage. 50 pp.

Total abundance in August 1991 was 18,839 fish in Birch Lake, and 22,650 in Quartz Lake. Indicated costs to produce adults in the lakes ranged from $1.18/fish to $1.73/fish.

Evenson, M. J. 1992b. Abundance size composition of burbot in rivers of interior Alaska during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-12 Anchorage. 39 pp.

Abundance or an index of abundance was estimated in one section each of the Tolovana, Tanana, Chena, Nenana, and Yukon rivers and in Goldstream Creek. Mean length of fully recruited burbot was estimated in all six river sections and ranged from 534 mm in the Tanana River section to 750 mm in the Yukon River section.

Evenson, M. J. 1992a. Abundance, egg production, and age-sex-size composition of the chinook salmon escapement in the Chena River, 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-4. Anchorage. 36 pp.

Abundance of spawning chinook salmon was estimated by mark and recapture methods. In late July 612 chinook salmon were captured using electrofishing techniques. In early August, 389 carcasses were collected, of which 78 had been marked. The abundance estimate was 3,025 chinook salmon, of which 954 were female, and 2,071 male. Estimated egg production for the 1991 escapement was 8.5 million eggs. During aerial surveys, the highest count of live and dead chinook salmon was 1,276, or about 42% of the mark-recapture point estimate.

Fleming, D. F., R. A. Clark, and W. P. Ridder. 1992. Stock assessment of Arctic grayling in the Salcha, Chatanika, Goodpaster, and Delta Clearwater Rivers during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-17 Anchorage. 108 pp.

Abundance of fish larger than 149 mm fork length was estimated in the Salcha River, in three separate sections of the Chatanika River, in a 50 km section of the Goodpaster River, while age and size composition was measured in the Delta Clearwater River. Density of grayling in the Chatanika River was estimated to be greater than most other lotic populations under study in interior Alaska.

Hallberg J. E. and A. E. Bingham. 1992. Creel surveys conducted in interior Alaska during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-7 Anchorage. 73 pp.

Creel surveys were conducted on the Upper Chatanika River for Arctic grayling, the Upper Chena River for Arctic grayling, George Lake for northern pike, the Salcha River for chinook salmon, and Piledriver Slough for rainbow trout. Effort levels were measured on the Chena and Chatanika rivers, Memorial Day weekend harvest was estimated on George Lake, total harvest and catch was estimated on the Salcha River and angler interviews were conducted on Piledriver Slough.

Lafferty, R., J. F. Parker, and D. R. Bernard. 1992. Stock assessment and biological characteristics of burbot in lakes of interior Alaska during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-20. Anchorage. 71 pp.

Abundance, and/or indices of abundance were estimated in 16 lakes of interior Alaska. Abundance of fully recruited burbot was greatest in Paxson Lake (7,435) and lowest in T Lake (134 fish)

Pearse, G. A. and P. A. Hansen. 1992. Evaluations of age determination in Alaskan northern pike. Alaska Department of Fish and Game, Fishery Manuscript No. 92-4. Anchorage. 28 pp.

The validity of using scales to assess age of northern pike was studied. For fish less than 450 mm fork length, scales were the most precise structure. Cleithra had the highest precision for fish larger than 450 mm in length.

Pearse, G. A. and J. H. Clark. 1992. Movements and distributions of radio tagged northern pike in Volkmar Lake. Alaska Department of Fish and Game, Fishery Data Series No. 92-28. Anchorage. 111 pp.

Movements and distributions in relation to various habitat characteristics during and after spawning were investigated during 1991. Fourteen mature fish were fitted with externally-attached radio transmitters and were relocated 3 times per day during a 25 day period and once per day during an additional 8 day period. Rate of movement was greatest during 11 days following ice breakup, with males more active than females. Both sexes preferred vegetated habitat throughout the study.

Ridder, W. P. 1992. Abundance, composition, and exploitation of selected Arctic grayling spawning stocks in the Tangle Lakes system, 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-6. Anchorage. 56 pp.

The population above the Delta River falls was assessed. The study was designed to estimate the angler exploitation rate of three spawning aggregations in the Tangle River. Only one stock, Tundra Pond was found to be exploited at detectable levels.

Riffe, R. R. 1992. Abundance, length, and age composition of Chatanika River round whitefish, 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-19. Anchorage. 28 pp.

Abundance was estimated in a 124 km section between the Elliott Highway Bridge and the Murphy Dome extension road with a Petersen mark-recapture experiment. Abundance was estimated at 7,913 fish over 239 mm fork length. Dominant year class was age 3, followed by ages 4 and 5.

Skaugstad, C. 1992. Abundance, egg production, and age-sex-length composition of the chinook salmon escapement in the Salcha River, 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-2. Anchorage. 33 pp.

Abundance of spawning chinook salmon was estimated by mark and recapture methods. In late July, 475 chinook salmon were captured using electrofishing techniques. In early August, 706 carcasses were collected, of which 59 were marked. The estimate of abundance for males was 3,084, and for females, 2524, for a total escapement estimate of 5,608 salmon. An estimated 23 million eggs were produced by the escapement in 1991. During aerial surveys, the highest count of live and dead chinook salmon was 2,212, about 39% of the mark-recapture point estimate.

Skaugstad, C. and A. Burkholder. 1992. Abundance and age-length composition of northern pike in Harding Lake, 1991-92. Alaska Department of Fish and Game, Fishery Data Series No. 92-54. Anchorage. 62 pp.

Abundance in 1991 of fish larger than 300 mm fork length was estimated to be 2,086, about 2.1 fish/ha.

Timmons, L. S. 1992. Evaluation of the rainbow trout stocking program for Piledriver Slough, 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-5. Anchorage. 22 pp.

Survival in 1990 was estimated to be 0.021. Growth between years averaged 30 mm. Abundance of rainbow trout larger than 149 mm fork length in May 1991 was estimated to be 651 fish. No young-of-the-year trout were captured in 1991. A total of 25,143 triploid rainbow trout, including 9,048 catchable-sized fish were stocked in 1991.

Viavant, T. 1992. Comparative abundance of resident and stocked species of fish in Harding Lake, Alaska, 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-9. Anchorage. 32 pp.

The littoral, benthic and pelagic zones of the lake were sampled with different types of fishing gear in 1991. Catches of stocked species (Arctic char, rainbow trout and Arctic grayling) were greater than those of resident species (northern pike, least cisco, burbot and lake trout).

MANAGEMENT ACTIVITIES

1991 In-Season Regulatory Measures

The ADF&G has limited authority to rapidly enact changes in regulations without formal hearings and passage by the Alaska BOF. Such authority is normally reserved for situations in which immediate conservation measures are needed to protect fishery resources, or when opportunities to harvest an unusually abundant resource, surplus to reproductive needs, would be lost if no action was taken to modify existing regulations.

Emergency Orders and Regulations:

The Alaska State Legislature, in enacting AS 16.05.060, delegated to the Commissioner and his authorized designees power to control certain aspects of public utilization of fish and game. In 1990, ADF&G authority for emergency orders was expanded to include bag limits, and methods and means modifications as well as the usual authority for opening and closing fishing seasons or areas. Emergency regulations, via the Administrative Procedures Act [7], were required to change quotas, bag limits, size limits or gear restrictions prior to BOF action in the spring of 1990, which gave ADF&G expanded authority. Authority to change size limits by emergency order was not granted by the BOF however. Emergency orders and regulations have the same force and effect as regulations of the Boards of Fisheries and Game, or statutes enacted by the Legislature, and they carry the same criminal penalties if violated. An emergency order remains effective until rescinded, superseded by a subsequent emergency, and/or unless an expiration date is specified (ADF&G 1983). Use of emergency order authority allows ADF&G to take regulatory action in response to unexpected resource scarcity or abundance. Sport fisheries in the AYK Region generally proceed under published basic regulations. Emergency regulations expire after 120 days unless made permanent via the process outlined in the Administrative Procedures Act.

A number of regulatory changes were enacted during the 1987 calendar year, some by the emergency regulation process, the majority through action by the Alaska BOF. A full discussion of regulation development in 1987 may be found

[7] Alaska Statute 44.62.180(3)

in Arvey et al. (1991). Action by the BOF on finfish proposals for the AYK Region is scheduled to occur every three years. The Alaska BOF did not consider changes in AYK Region sport fish regulations at their meeting in 1991. Four emergency orders (Appendix B) were issued in 1991 for the AYK Region.

3-W-01-91. Closed eight rivers in the Nome area to the retention of chum and pink salmon by sport anglers, from June 16 to July 31, 1991.

3-AG-02-91. Closed the Chena River and its tributaries to the retention of Arctic grayling on July 1, 1991.

3-W-02-91. Opened several of the rivers closed to retention of salmon in Nome area streams (previously closed by Emergency Order 3-W-01-91).

3-WF-03-91. Closed the Chatanika River and its tributaries to the taking of whitefish by sport fishermen.

News Releases, Announcements, and Articles:

Four news releases (also called field announcements) concerning AYK Region sport fisheries were issued by the Department in 1991. They are listed below.

1. May 3, 1991. Spring fishing report. This news release announced the spring stocking of rainbow trout into Piledriver Slough, and provided reminders of bag and possession limits.

2. May 16, 1991. Local fishing conditions on Piledriver Slough, stocking report, and regulations update are included.

3. June 26, 1991. Chena River Arctic Grayling Sport Fishing Restriction. The news release announced closure of the Chena River and tributaries to retention of Arctic grayling.

4. September 6, 1991. Fishery Closure. The closure of the Chatanika River to sport fishing for whitefish on September 8, 1991 is announced in this new release. Reason for the emergency closure is the decline in abundance of humpback whitefish and least cisco.

5. Harding Lake Fishery Restrictions. This news release announced that the northern pike fishery was being restricted by ADF&G emergency order.

Preseason and Post-Season Regulatory Activities

The process of developing appropriate fishing regulations continues each year both during the primary fishing seasons, as well as before and after. The following section describes the salient features of that process in 1991.

Advisory Committees:

Public input concerning regulation changes is provided by several means, including direct testimony to the BOF and by participation in local fish and game advisory committees. Local advisory committees have been established throughout the state to assist the Boards of Fish and Game in assessing fisheries and wildlife issues and proposed regulation changes in the areas that will be affected. Most active committees meet at least once a year, usually in the fall prior to Board meetings. Advisory meetings allow opportunity for direct public interaction with Department staff who are expected to attend, answer questions, and provide clarification concerning proposed regulatory changes.

Several local advisory committees are active throughout the AYK Region : (1) in Western Alaska: Central Bering Sea, Lower Kuskokwim, Central Kuskokwim, Lower Yukon; (2) in Arctic Alaska: Norton Sound, Kotzebue, Northern Seward Peninsula, Upper Kobuk, Lower Kobuk, Noatak/Kivalina, Western Arctic, Eastern Arctic, St. Lawrence Island, Southern Norton Sound, and; (3) in Interior Alaska: Middle Nenana River, Delta, Eagle, Fairbanks, Lake Minchumina, Middle Yukon, Grayling/Anvik/Holy Cross, Koyukuk, McGrath, Ruby, Tanana/Rampart/Manley, Minto/Nenana, Upper Tanana/Forty Mile, Yukon Flats.

Several of the committees did not meet to discuss fisheries issues in 1991. Sport Fisheries Division staff participated in meetings of the Fairbanks and Delta committees in 1991. Sport fisheries issues in Nome, 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 Alaska BOF did not consider changes in AYK Region sport fish regulations at their meeting in 1991. Proposals for the region were taken in February 1992 at the meeting held in Bethel.

AYK Sport Fishing Regulations:

Published regulations for 1991 are reproduced as Appendix C.

AYK SPORT FISHERIES ENHANCEMENT

Interior Alaska Lake Stocking Program

Selected waters (lakes, ponds and Piledriver Slough) of the Tanana River Valley are stocked on a continuing basis with rainbow trout, coho salmon, Arctic grayling, chinook salmon, lake trout, sockeye salmon, and Arctic char. Resulting fisheries composed a minimum of 45% of the recreational angling effort and 65% of the fish harvested in the Tanana River drainage in 1991 (Table 4). By providing stocked fish in the Tanana River valley, the ADF&G hopes to:

1. ease harvest pressure on wild stocks;
2. provide angling opportunity for increasing numbers of anglers; and,
3. diversify angling opportunity.

Lake stocking in the Tanana River valley takes place over an approximate 130,000 km^2 area, mostly near communities and along the road system, but also in a number of remote locations accessible only by off-road vehicle (ORV), dog team, or airplane. About half of the yearly sport effort on stocked lakes takes place during the winter on larger accessible lakes.

The ADF&G stocking in the Interior began in the mid-1950's when barren lakes along the road system were stocked with rainbow trout or salmon. Between 1968 and the early 1980's, 15 lakes (including Birch and Quartz lakes) were chemically treated to eradicate endemic fish populations (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 came on line, 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) and the Fort Richardson hatchery near Anchorage. The Clear Hatchery program 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 interior Alaska. 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 sub-catchable 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.

1991 Stocking Results

Approximately 2.349 million fish of seven species were stocked in different locations in 1991, of which 702,740 were rainbow trout. Similar numbers of fish were stocked in 1989 and 1990.

Most of the stocked rainbow trout in 1991 were fingerling (approximately 1.0 to 2.0 g) or sub-catchable (20 to 30 g) sized fish but about 55,000 were of catchable size (65 to 680 g). All rainbow trout released in 1991 were reared at the Fort Richardson Hatchery in Anchorage (Table 10), and were of the Swanson River (Kenai Peninsula) strain.

Table 10. Number and size of rainbow trout stocked in AYK Region waters in 1991.

Receiving Water	Number Stocked	Release Date	Size (g)
Backdown Lake	600	7/31	1.7
Birch Lake	25,153	6/4	22.9
Bluff Cabin Lake	14,400	8/6	2.0
Bolio Lake	3,000	7/31	1.7
Bullwinkle Lake	800	7/31	1.7
Chena Lake	16,010	6/17	96.8
Chena Lake	10,966	7/15	109.0
Chena Hot Sp. Rd # 45.5	1,000	7/24	1.8
Chena Hot Sp. R. # 47.9	600	7/24	1.8
Chet Lake	1,000	7/31	1.7
Craig Lake	4,086	8/6	2.0
Doc Lake	600	7/31	1.7
Donna Lake	11,600	8/6	2.0
Donnelly Lake	3,000	7/31	1.7
Dune Lake	10,000	7/25	1.6
Forest Lake	7,000	7/29	1.9
Four Mile Lake	19,983	8/2	1.7
Fun Fish Day	270	6/7	85.0
Fun Fish Day	6	6/7	681.0
Fun Fish Day	246	6/7	225.0
Geskakmina Lake	20,000	7/25	1.6
Ghost Lake	1,000	7/31	1.7
Hanger Pit	1,300	7/25	1.6
Harding Lake	173,800	7/24	1.7
Harding Lake	10,530	6/11	20.0
Hidden Lake (EAFB)	4,000	8/2	1.9
Jan Lake	4,348	8/2	1.7
Kens Pond	1,000	7/29	1.7
Koole Lake	30,047	7/29	1.9
L. Donna Lake	9,400	8/6	2.0
L. Harding Lake	3,600	7/24	1.8
Les's Lake	750	10/10	10.1
Lisa Lake	10,000	8/6	2.0
Mark Lake	4,000	7/31	1.7
Monte Lake	15,000	7/29	1.9
N. Twin Lake	4,000	7/31	1.7
Nickel Lake	1,000	7/31	1.7
No Mercy Lake	1,500	7/31	1.7
Olnes Pond	1,600	7/24	1.8
Outboard Pit	16,000	8/8	2.2
Piledriver Slough	6,568	5/17	57.0
Piledriver Slough	6,525	6/11	64.0
Piledriver Slough	4,932	7/15	88.0
Piledriver Slough	7,118	7/15	88.0
Quartz Lake	25,005	5/17	20.3
Quartz Lake	17,711	6/17	24.9

- continued -

Table 10. (Page 2 of 2).

Receiving Water	Number Stocked	Release Date	Size (g)
Quartz Lake	152,000	7/31	2.0
Rainbow Lake	15,000	7/29	1.9
Rapids Lake	2,839	8/8	2.2
Red Dog Mine	100	4/8	60.0
Robertson Lake #2	1,600	8/2	1.7
Rockhound Lake	300	7/31	1.7
S. Johnson Lake	681	8/6	2.0
S. Twin Lake	8,000	7/31	1.7
Spenser Lake	5,000	7/24	1.8
Steese Hwy 29.5	1,000	7/24	1.8
Steese Hwy 33.0	800	7/24	1.8
Steese Hwy 34.6	350	7/24	1.8
Steese Hwy 36.6	1,000	7/24	1.8
Steese Hwy 39.2	1,000	7/24	1.8
Walden Pond	2,016	6/20	93.0
Total rainbow trout	702,740		

Rainbow trout were stocked into Piledriver Slough for the first time in 1987, and subsequent observations and catch returns in 1988 indicated that at least some large rainbow trout stocked in 1987 overwintered in, or returned to Piledriver Slough (Doxey 1989). Natural reproduction in the slough was not documented. Stockings of only the catchable size cohort continued in 1991 when 25,000 were released at sizes ranging from 57 to 88 g.

A single stocking of rainbow trout took place in Harding Lake in 1991, when 173,800 sub-catchable 1.7 g fish were released in late July. Net pen rearing, which had been tried in 1990 for rainbow trout was not done in 1991.

Approximately 950,000 fry, fingerling and adult-size Arctic grayling were stocked in area lakes, ponds, and gravel pits in 1991, all of Moose Lake (Susitna River drainage) brood stock. These fish were incubated and reared at the Clear Hatchery (Table 11).

Lake trout were released in 10 locations in 1991, for a total of approximately 43,000 fish (Table 12). All fish were reared at Clear Hatchery and were of Paxson Lake stock. All were released at a size of about 4.0 g.

About 200,000 fingerling coho salmon were released in three landlocked lakes (Birch, Chena, and Quartz) in 1991 (Table 12). All were reared at the Big Lake hatchery and were of Big Lake stock.

Approximately 450,000 Arctic char were stocked in 20 separate water bodies in the Tanana drainage in 1991 (Table 13). Fourteen stockings of Arctic char in Harding Lake occurred in 1991. All char were reared at Clear Hatchery and were of Aleknagik River (Bristol Bay) stock.

Anadromous Fish Releases by State Hatcheries

All anadromous fish hatched and/or reared at Clear Hatchery in 1991 were stocked into landlocked lakes in the Tanana River drainage. No anadromous species were stocked into flowing waters of the drainage in 1991.

The other state operated hatchery 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 18). The initial purpose of the facility was to examine the feasibility of large-scale chum salmon enhancement in a far northern environment. Hatchery expansion starting in 1987 was intended to bring the facility into larger scale production than in prior years of feasibility testing. Enhanced hatchery returns are intended to benefit the salmon gill net fishery which operates near Kotzebue in marine waters. The scale of salmon releases was relatively small, less than two million chum salmon fry prior to 1988. Returns from prior year releases have been identified both in the commercial fishery and at the hatchery. Releases of chum salmon fry in the lower Noatak River in 1991 totalled 7,365,874 fish, an increase of about 1,000,000 fry over the 1990 release. All fry were released on June 11 at an average size of 0.408 g. Returns in 1991 of about 32,000 adult chum salmon were identified in the commercial fishery harvest and at the hatchery site from hatchery releases in 1986-1988. Expanded hatchery capability was initiated in 1987 with the installation of new egg and fry incubators in order to increase rearing capacity to 10 million eggs. In

Table 11. Number and size of Arctic grayling stocked in AYK Region waters in 1991.

Receiving Water	Number Stocked	Release Date	Size (g)
Arctic grayling			
Bathing Beauty Pond	1,000	9/16	4.93
Big Lake	1,000	9/27	5.40
Birch Lake	40,000	9/16	4.93
Bolio Lake	1,000	9/16	4.93
Chena HS # 30.9	650	9/26	5.42
Chena HS # 32.9	5,000	7/17	0.46
Chena HS # 32.9	600	9/26	5.42
Chena HS # 45.5	550	9/26	5.42
Chena HS # 47.9	550	9/26	5.42
Chena Lake	13,000	9/16	4.93
Duck Pond # 1 (Ft. Wain)	100	6/3	117.00
Duck Pond # 2 (Ft. Wain)	130	6/3	117.00
Fun Fish Day[a]	25	6/8	252.00
Grayling Lake	500	5/28	117.00
Grayling Lake	1,000	9/17	4.93
Harding Lake	160	5/28	117.00
Harding Lake	322,178	6/7	0.02
Harding Lake	375,000	6/10	0.02
Harding Lake	20,000	9/16	4.93
Harding Lake	23,397	9/23	5.63
Hidden Lake (FAI)	3,600	9/27	5.40
"J" Lake	3,000	9/27	5.40
Johnson Road Pit # 1	1,000	9/16	4.93
Long Pond (Nenana)	400	9/21	5.20
Long Pond (")	95,900	6/22	0.02
Luke Lake	600	9/27	5.40
Plack Road Pit	255	6/3	117.00
Richardson Hwy # 31	10,000	6/5	0.02
Richardson Hwy # 81	600	9/16	4.93
Round Pond (Nenana)	15,000	6/20	0.02
Round Pond (Nenana)	700	9/21	5.20
Sheefish Lake (Ft Greely)	800	9/16	4.93
Steese Hwy 29.5	950	9/26	5.42
Steese Hwy 30.6	250	9/26	5.42
Steese Hwy 31.6	400	9/26	5.42
Steese Hwy 33.0	700	9/26	5.42
Steese Hwy 33.5	500	9/26	5.42
Steese Hwy 34.6	600	9/26	5.42
Steese Hwy 35.8	250	9/26	5.42
Steese Hwy 36.6	950	9/26	5.42
Steese Hwy 39.2	1,000	9/26	5.42
Walden Pond (Chena HS rd)	4,000	9/24	5.38
Wainwright # 6	154	6/3	117.00
Total Arctic grayling	947,449		

[a] Not released into wild waters.

Table 12. Number, size and release date of lake trout and coho salmon stocked in AYK Region waters in 1991.

Receiving Water	Number Stocked	Release Date	Size (g)
Lake Trout			
Chet Lake	1,800	5/29	3.6
Coal Mine # 5	2,600	5/29	3.6
Craig Lake	3,500	5/31	3.9
Four Mile Lake	20,000	5/31	3.9
Long Lake	7,677	5/30	3.9
N Twin Lake	2,000	5/29	3.8
Nickel Lake	1,000	5/29	3.6
Old Beaver Lake	2,000	5/29	3.9
Pauls Pond	1,000	5/29	3.6
Rapids Lake	1,000	5/29	3.9
Subtotal lake trout	42,577		
Coho Salmon			
Birch Lake	40,303	7/11	0.99
Chena Lake	16,364	7/11	0.99
Quartz Lake	105,825	7/8	1.03
Quartz Lake	45,960	7/11	0.99
Subtotal lake trout	208,452		

Table 13. Number, size and release date of Arctic char stocked in AYK Region waters in 1991.

Receiving Water	Number Stocked	Release Date	Size (g)
Backdown Lake	600	6/27	9.42
Bathing Beauty Pond	217	5/28	316.00
Bathing Beauty Pond	700	7/1	7.44
Birch Lake	13,365	7/19	11.03
Birch Lake	5,235	7/23	11.06
Bolio Lake	14,000	7/23	11.06
Brodie Lake	500	6/27	9.42
Chena Lake	250	5/30	761.00
Chena Lake	330	5/30	738.00
Chena Lake	36	6/3	2134.00
Chena Lake	364	6/3	761.00
Chena Lake	16,900	9/10	35.60
Dicks Pond	1,000	6/27	9.42
Duck Pond #1 (Ft Wain.)	100	6/3	761.00
Duck Pond #2 (Ft Wan.)	120	6/3	761.00
Fun Fish Day [a]	18	6/8	761.00
Grayling Lake	434	5/28	761.00
Harding Lake	1,044	5/29	761.00
Harding Lake	522	5/30	761.00
Harding Lake	49,296	7/18	11.06
Harding Lake	49,095	7/19	11.03
Harding Lake	7,659	7/23	11.06
Harding Lake	22,967	8/21	31.59
Harding Lake	24,030	8/22	34.60
Harding Lake	20,452	8/23	35.36
Harding Lake	22,888	9/3	43.60
Harding Lake	23,386	9/4	42.67
Harding Lake	7,992	9/5	42.90
Harding Lake	29,967	9/9	33.30
Harding Lake	7,010	9/10	35.60
Harding Lake	12,684	9/11	40.73
Hidden Lake	1,800	7/1	7.44
Kens Pond	1,000	6/27	9.42
Last Lake	400	6/27	9.42
Lost Lake	30,800	6/27	8.04
Manchu Lake	2,900	7/1	7.44
Old Beaver Lake	1,000	6/27	9.42
Plack Road Pit	100	6/3	761.00
Quartz Lake	75,000	7/16	10.55
Rangeview Lake	900	6/27	9.42
Red Dog Mine	1,000	5/31	3.95
Sansing Lake	300	10/2	100.26
Wainwright #6	81	6/3	761.00
Total Arctic Char	448,442		

[a] Not released to the wild

addition, new raceways were installed to allow short term rearing of fry before release.

LAND USE, HABITAT AND WATER QUALITY

Habitat-Related Fisheries Issues

Commercial development of minerals and timber, and construction of highways, can have significant impacts on watersheds as well as fish. The following is a brief description of the types of commercial development in the Tanana and AYK Areas, and known fisheries impacts.

Placer Mining:

The majority of Alaska's placer mining takes place in the AYK Region. Placer mining effluents, if not controlled, have the potential to significantly alter stream habitats and to impact fish populations. Elevated stream turbidity and sediment loads may reduce oxygen exchange rates through abrasion of gill tissues, prevent foraging by sight feeding fishes, limit aquatic plant growth by displacement or smothering, and generally reduce abundance and/or diversity of aquatic macroinvertebrates important for fish production (Weber 1986). Placer mining activities 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.

In the AYK Region, in 1991, 3,127 new mining claims (on state and federal lands) were recorded by the Alaska Department of Natural Resources (ADNR), a receiving agency for state and federal mining permits (Bundtzen et al. 1991). The number of new claims recorded in 1991 increased by 8% from the number recorded in 1990. However, the total number of active claims on file in 1991 (38,177) was fewer than the number of claims on file in 1990 (40,149). The ADF&G issues permits for mining in streams supporting anadromous and resident fish per its Alaska State Statute Title 16 authority. In some cases, where development is within a stream supporting only non-anadromous fish and will not block fish passage, or where fish are not present, permits may not be required.

Gold production increased in 1991, from 7,205 kg (231,700 troy oz) in 1990 to 7,585 kg (243,900 troy oz) in 1991 for the entire state (Bundtzen et al. 1991). Increased production was due to the resumption of one mine at Valdez Creek, but statewide, there was a net loss of 16 placer mine operations. The majority of the gold produced was from placer mines, with the remainder (15%) from lode operations.

The U.S. Environmental Protection Agency (EPA) issued placer mining effluent guidelines in 1988. Guidelines for water discharge permits went into effect in 1989 requiring 100% recycling of mine process waters, in addition to placing certain restrictions on the use of hydraulic mining technologies. Certain "best practice" mining methods are recommended in the guidelines. An NPDES (National Pollutant Discharge Elimination System) permit is required for discharge of mine waste into receiving streams. There were 30 such permits issued in 1991 (ADEC 1992).

The Alaska legislature implemented rental and royalty fees from all mining on state land in response to an Alaska Supreme Court decision that the Alaska Statehood Act required collection of these fees from mining activity on state lands.

Gravel Mining:

There are few documented instances where gravel mining in AYK has affected fish populations. Gravel mining of a streambed has the potential to cause instream fanning, erosion, and deterioration of water quality and fish habitat (ADEC 1986). A complete listing of gravel mining sites and impacted streams is available in ADEC (1986). Bundtzen et al. (1991) contains a listing of gravel mine operations in 1991.

Statewide production of sand and gravel in 1989 and 1990 was at the lowest level since the early 1970's due to declines in major construction activities.

Industrial Metals Development:

Cominco Alaska Inc. mined 2,19,000 tons of zinc-lead-silver concentrate from the Red Dog deposit north of Kotzebue in its second year of operation (Bundtzen et al. 1991). There has been concern that heavy metal contamination of Red Dog and Ikalukrok creeks would occur both from natural leaching of the ore body as it was stripped for ore production and from discharge of impounded waters that were not treated to remove contaminants. Such contamination would affect fish resident to, and migrating through, the lower Wulik River, resulting in public health concerns for the river fisheries for Dolly Varden, Arctic grayling and salmon. Regulatory enforcement by the Alaska Department of Environmental Conservation (ADEC), including fines imposed, in conjunction with mitigative and preventative measures taken by Cominco Inc. reduced danger of fish contamination in the Wulik River.

Oil and Gas Development:

Oil and gas extraction activities in the AYK Region are presently restricted to the North Slope. North Slope development has affected fish habitat on and near transportation corridors (such as the Dalton Highway and the Trans-Alaska Pipeline) and by the extraction of gravel for road and building construction and maintenance. 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 Sagavanirktok rivers (Gallaway et al. 1987; Moulton et al. 1986). Documentation of oil spills and resulting adverse impacts (if any) on fish populations from contamination is lacking in the AYK Area. A number of studies throughout the 1980's have attempted to determine or predict impacts from offshore gravel causeways, such as the Endicott Causeway, in the Beaufort Sea to fish, fisheries and fisheries habitat.

Timberland Development:

Logging had no significant impact to fisheries resources in the AYK Region in 1991. Little commercial logging presently occurs in the region. 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 accelerating the rate of soil erosion and sedimentation in streams, however, because of the minimal level of industry development at the present time, no such problems have been identified in the region.

Highway Development:

Roads allow increased access to streams and lakes, thereby increasing the utilization of sport fishery resources. Improperly designed or constructed road culverts can create partial or complete barriers to fish migration. Major highways in the AYK Region include the Steese Highway which provided road access via Fairbanks to 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 of the Koyukuk River and the Sagavanirktok and Kuparak rivers on the North Slope. A newly-constructed road north of Kotzebue connects the Red Dog Mine in the headwaters of the Wulik River to the Chukchi Sea coast south of Kivalina. Its purpose is to serve the Red Dog Mine site, and for transport of ore to the port facility on the coast. The Seward Peninsula has three major roads which cross more than a dozen rivers important for sport fishing. Of the road systems in the AYK Region, culvert crossing on the Dalton, Red Dog Mine and Seward Peninsula Highways have been of most concern to the Department. 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, the Alaska Department of Transportation, and Bureau of Land Management (BLM) personnel have worked cooperatively to improve stream habitat 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, offer 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 the AYK Region, and an increasing number and variety of services is available. More information regarding the location and operation of lodges and guiding and outfitting operations can be obtained from DeCicco and Barnes (1992) in which lodge and guiding services for the region are listed. A total of 93 separate guide services operating in the Tanana and AYK Areas have been compiled to date.

Commercial Fisheries:

Important commercial fisheries exist for finfish and shellfish species in the AYK Region. The largest is the commercial salmon fishery, followed by the herring and shellfish fisheries. Estimated wholesale values of the fisheries in 1991, were approximately $15.3 million for salmon, $8.9 million for herring and $16.0 thousand for halibut (Savikko pers. comm.[8]).

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 *Dallia pectoralis*, lamprey *Lampetra japonica*, Dolly Varden and burbot are issued occasionally 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. Only a small commercial harvest of non-anadromous freshwater finfish was reported for the AYK Region in 1991. The Division of Commercial Fisheries maintains data records of such harvests.

Commercial harvests of freshwater species in the Norton Sound and Kotzebue Area in 1991 are reported by Lean et al. (1992), which also includes a summary of historical harvests. The harvest of sheefish from Hotham Inlet near Kotzebue takes place during winter months of two calendar years (October 1990-October 1991). Commercial harvest of sheefish during this period is estimated to total 852 fish. Five catcher-sellers participated in the fishery, harvesting 3,734 kg (8,224 lbs). This fishery is limited by quota to 11,350 kg. Adult Dolly Varden taken incidentally in the Kotzebue commercial chum salmon fishery are sometimes sold to commercial fish processors. A total of 6,136 such fish were harvested and sold in 1991. The mean weight of the commercially sold Dolly Varden was 3.0 kg (6.64 lbs) in 1991. Virtually no fishing activity under the authority of a freshwater fishing permit took place in either the Norton Sound or Kotzebue Areas in 1991 for the harvest of whitefish or other freshwater species such as burbot or northern pike.

Francisco et al. (1992) reports that in 1991, five fishermen harvested and sold 1,413 whitefish and 41 burbot in the Kuskokwim Area.

A fishery has taken place in the Colville River since 1964 for broad whitefish, humpback whitefish, Arctic cisco and least cisco. Reported harvests (Bergstrom et al. 1992) in this fishery in 1991 include: 1,240 humpback whitefish, 13,805 Arctic cisco, and 5,697 least cisco.

Freshwater fishery permits have been issued in various years for whitefish at Healy Lake, whitefish in Lake Minchumina, and whitefish and burbot in the Yukon and Tanana rivers. Although several permits for commercial harvest of freshwater finfish were issued in 1990 for the Yukon River drainage, no permits were requested or issued in 1991, and no harvest was reported for any locations within the drainage.

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[8] Savikko, Herman. 1993. Personal Communication. ADF&G, Division of Commercial Fish, P.O. Box 25526, Juneau, AK 99802.

Land Withdrawals, Status, and Planning

Land use designations by private owners, state, or federal agencies may affect fisheries management considerations within given land parcels. 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, ANILCA required the state to distinguish between user groups and assign priority opportunities for subsistence uses of fish and game resources.

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 between the State of Alaska and the NPS stipulates that State fish and game regulations apply on NPS 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.

National park land designation has some influence on utilization of the sport fishery resource by restricting types of development within the parks. Large scale commercial development (e.g. 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, but has been the subject of dispute with NPS. 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 1985a, 1986a). 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 are depicted in Figure 24. Arvey et al. (1990, 1991), Arvey and Parker (1991), and Arvey (1991, 1992) provide brief descriptions of the federal units.

A General Management Plan for each unit (except the Yukon-Charley River National Preserve which was completed in 1985) was completed by the NPS in 1987 after taking public and state agency input. General Management plans are intended to establish management direction, determine public access policies, and allowable public uses including priorities for fisheries research within each park unit. It is intended that supplemental plans will be developed in subsequent years to deal with specific fisheries projects, public uses, and access problems. Many such planning efforts were underway in 1991.

National Wildlife Refuges:

Refuges (Figure 24) 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. The Alaska Supreme Court in 1989 decided the McDowell case and found that allowing a priority for rural residents for subsistence was unconstitutional. In 1990, as a result of this decision, and the fact that Alaska's fish and game regulations were out of compliance with ANILCA, the management of subsistence hunting and fishing on federal lands was transferred to federal authority. In practice, this has meant that subsistence hunting on federal land is managed by the federal government, under the auspices of a federal subsistence board, while subsistence fishing has largely remained a state responsibility because submerged lands that are deemed navigable are considered to be state lands under the Statehood Act. Refuge managers review and adopt ADF&G 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 eight National Wildlife Refuges (NWR) in the AYK Region. Comprehensive Conservation Plans (available from U.S. Fish and Wildlife Service) were completed for all refuges except the Yukon Delta NWR and Arctic NWR in 1987. The plans contain detailed information on the environment, management alternatives, environmental consequences as well as maps for each unit. Step-down plans, more specific plans for fisheries, river management and other public uses of the lands and their resources, are scheduled for completion in subsequent years. Some refuge step-down plans were initiated in 1991, and a fisheries management plan for the Nowitna NWR was completed in 1991.

1. Selawik NWR is 890,327 ha (2,200,000 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 in-holdings, oil and gas studies and recreational opportunities would be allowed. Recreational use levels are extremely low, with most sport

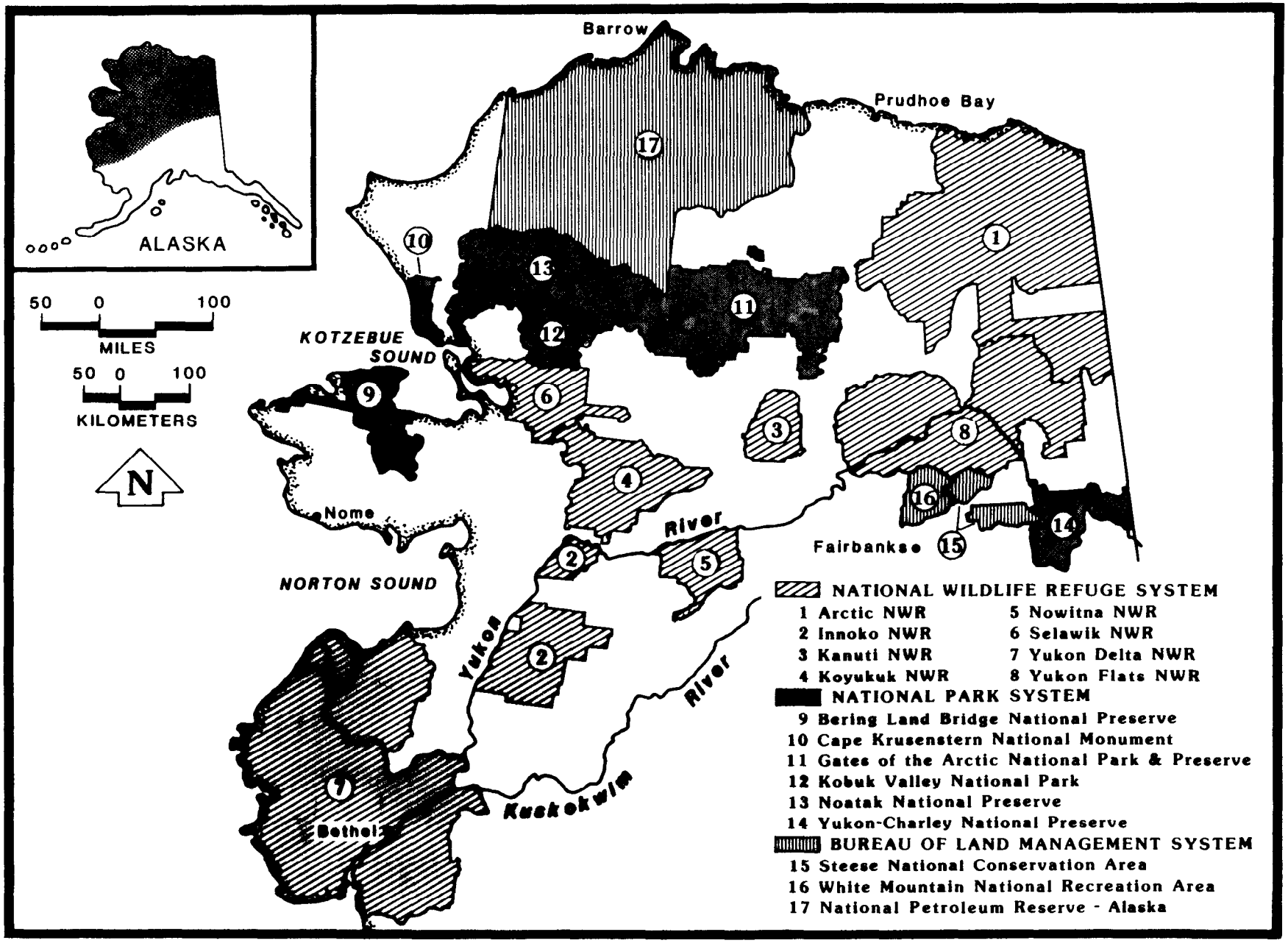

Figure 24. Federal land designations within the A-Y-K region.

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 (26,000,000 ac) including two Wild and Scenic Rivers and 769,000 ha (1,900,000 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 River 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 4,530,000 ha (11,200,000 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). A fisheries management plan was published in April, 1990.

4. Koyukuk and Innoko NWR are 1,820,000 and 283,000 ha (4,500,000 and 700,000 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). A fisheries management plan was in preparation in 1990.

5. Nowitna NWR consists of 809,389 ha (2,000,000 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). A fisheries management plan was inalized in 1991.

6. Kanuti NWR is 647,511 ha (1,600,000 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). A fisheries management plan was in preparation in 1990.

7. Arctic NWR consists of 7,900,000 ha (19,500,000 ac), four Wild and Scenic Rivers and 3,240,000 ha (8,000,000 ac) of wilderness lands. Section 1002 set aside 607,000 ha (1,500,000 ac) of land on the coastal plain of ANWR for future oil and gas exploration and development pending authorization by the U.S. Congress. 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, Dolly Varden, Arctic char, lake trout and northern pike occurs in conjunction with river trips and hunting (USFWS 1988). A fisheries management plan was in preparation in 1990, as was a river management plan.

8. Tetlin NWR, in the upper Tanana River valley is 284,000 ha (700,000 ac) in size. Under the management plan, fisheries would continue to be managed for harvests supported almost entirely by naturally reproducing stocks (USFWS 1987). Only subsistence and sport fishing will be allowed on the refuge. A fishery management plan was published in April 1990.

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 rivers on the Brooks Range south slope for recreation (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 among other uses. Wild and scenic rivers in the AYK Area 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. Depending upon interpretation of the wilderness modifications in ANILCA, land managers may restrict the use of power chain saws, generators, and other similar motors. Stream clearance, weir construction, and field camp operations in wilderness areas in support of fisheries field research may be restricted, depending upon circumstances (Cunning pers. comm.[9]).

Natural Factors Affecting Sport Fisheries

The timing and severity of natural catastrophic events may affect sport fish habitat and life history. Known natural occurrences in 1990 are described and their impacts on sport fish are estimated in the following paragraphs.

[9] Cunning, Artina. 1988. Personal Communication. ADF&G, Division of Wildlife Conservation, 333 Raspberry Rd., Anchorage, AK 99502.

Fires:

Fires and fire suppression measures by agencies such as the BLM and State of Alaska, Division of Forestry, are common during the summer months; and, during particularly dry and warm years, forest and tundra fires are a major feature in interior and northern Alaska. Fires in Alaska generally do not penetrate the duff layer to mineral soil and thus may not represent a great potential erosion problem. In addition, frozen ground in large areas of the Arctic and interior assists in curtailing fire-induced soil erosion. Major impacts of fire on fisheries can occur with the use of earth moving equipment by fire-fighters to prevent enlargement of a blaze, and aerial deployment of fire retardant. The BLM has strict guidelines regarding fire retardant use near water bodies. Retardants presently in use are biodegradable and if mistakenly introduced into a water body, are thought to have minimal and short-lived impact on fish populations (Jones pers. comm.[10]). Thus, it is the BLM position that fire retardant use in Alaska does not directly threaten fish populations.

The 1991 fire season was severe, with 760 unique fires was recognized by the Alaska Fire Service (AFS) (U.S. Department of Interior/Bureau of Land Management Alaska Fire Service, 1992). All of the largest fires started during the period from June 22 to July 3 from lightning causes. The drying trend noted in the past several summers, especially in the northern interior continued in the 1991 season despite a heavy snowpack in many areas. A total of 1.7 million acres (675,000 ha) burned in 1991, compared to the five-year average (1983-1988) of 253,964 ha. Lightning was the primary cause of all fires reported. The largest fire of the season was estimated to have consumed nearly 100,000 ha and was not declared out until September 30.

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 1991) provided snowpack summaries for Water Year 1991 by region. (Water year 1991, hereafter referred to as WR 91, is the period of time from 1 October 1990 through September 30, 1991).

In the Arctic, winter snow accumulation was slightly below average as of May 1991. In the Central Yukon Basin, the snowpack was above average for the year. Maximum snow water equivalent (SWE) was reached in April at about 11.4 cm. Breakup was earlier than normal in the Tanana Basin, where the SWE was about 20.3 cm in April compared to the average of about 10 cm. Record snowfalls were experienced at many stations in the basin. In the Western Interior Basins of the Koyukuk and upper Kuskokwim rivers, SWE was above average. Above average snowfall was recorded in Norton Sound also.

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

Table 14. Gaging station records[a] of mean and maximum discharge[b] for 1991, and mean and maximum discharge for the period of record, for 11 rivers in the AYK Region.

River	1991		Period of Record		
	Mean	Max	Mean	Max	Years
Kuskokwim at Crooked Cr	49.9	165.0	41.9	392.0	1951-91
Yukon at Eagle	95.2	250.0	84.2	545.0	1950-91
Yukon at Pilot Station	249.8	1,050.0	225.9	1,100.0	1975-91
Tanana at Fairbanks	20.7	70.2	20.1	96.4[c]	1973-91
Chena at Fairbanks	1.8	11.4	1.4	74.4	1948-91
Salcha near Salchaket	2.0	14.9	1.6	97.0	1948-91
Snake near Nome	0.2	2.0	0.2	4.2	1965-91
Kobuk near Kiana	15.8	120.0	15.2	152.0	1976-91
Wulik near Kivalina	0.9	10.2	1.0	31.4	1984-91
Kuparuk near Deadhorse	1.0	37.1	1.3	118.0	1971-91
Sagavanirktok, Pump 3	1.3	13.0	1.3	23.0	1982-91

[a] Data from Lamke et al. 1992.
[b] Cubic feet per second x 1,000.
[c] Flood of Aug. 16, 1967 reached an approximate discharge of 125,000 ft^3.

Stream Discharge Assessment:

Stream flows have a significant impact on fish life history, especially maximum stream discharge events. Stream discharge records obtained from the U.S. Geological Survey (Lamke et al. 1992) provide monthly and annual mean and extreme discharge values by river (Table 14). Of the streams in the AYK Region for which discharge data are collected, most of the sites throughout the region recorded mean discharge rates in WR 91 that exceeded the annual mean discharge of all years of record (Table 14). However, only at Pilot Station on the lower Yukon River did maximum discharges approach the maximum recorded flows. Maximum discharges at all sites in WR 91 did not exceed maximum flow in the years of record. No serious flooding and streambed disruption was noted during the summer of 1991 in any AYK Region drainage.

Mean Air Temperature and Precipitation:

Average annual temperature and precipitation regimes influence the timing of stream freeze-up and break-up occurrences, and by affecting the duration and severity of the seasons, plays a major role in the annual water budget. Climatological data for four cities in the AYK Region (Fairbanks, Nome, Kotzebue and Barrow) were obtained from the US Weather Service (National Oceanic Atmospheric Administration 1991). The mean monthly and yearly temperature (F) and precipitation (inches) for the period of record (1958-1991) are provided by this source. Climatological data from only four locations may not adequately represent micro-climatic conditions throughout the region, but may provide an indication of seasonal weather patterns in the AYK Region.

Mean monthly air temperatures in WY 1991 for the four cities were generally close to the historic means, except for fall dips in December for three stations (Figure 25). Midwinter temperatures were somewhat elevated in Fairbanks.

Mean monthly precipitation values for WY 1991 for the four cities are more variable than temperature means. The interior, as judged from the precipitation records from Fairbanks, experienced below average moisture in all months except December, January, and March during the October 1990 to September 1991 period. Below normal levels of precipitation were recorded throughout WY 1991 in Barrow, but in Kotzebue and Nome levels were at or above means for much of the year (Figure 26).

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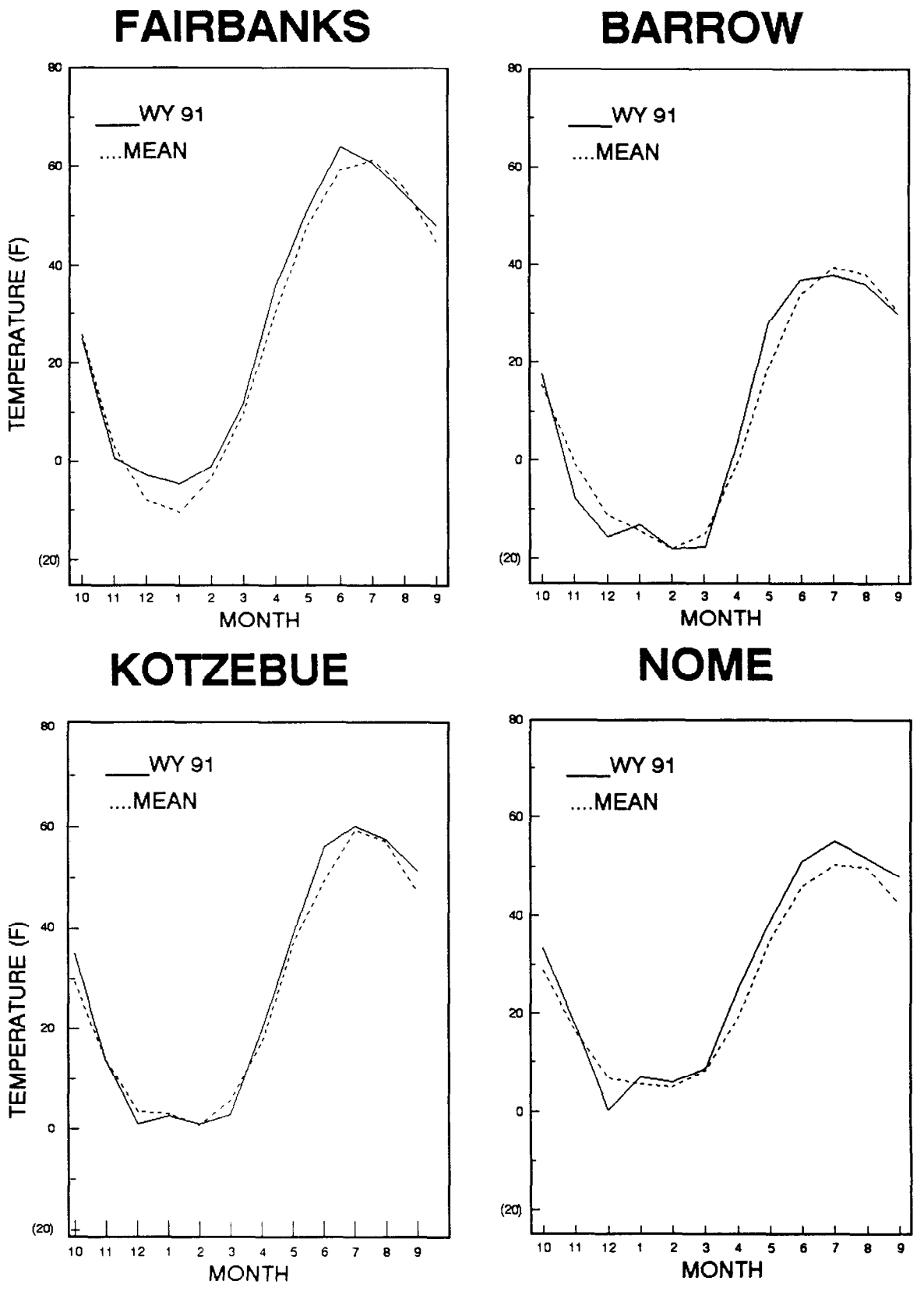

Figure 25. Monthly mean air temperature for the 1991 water year compared to monthly mean air temperature, 1958-1991, in four AYK locations.

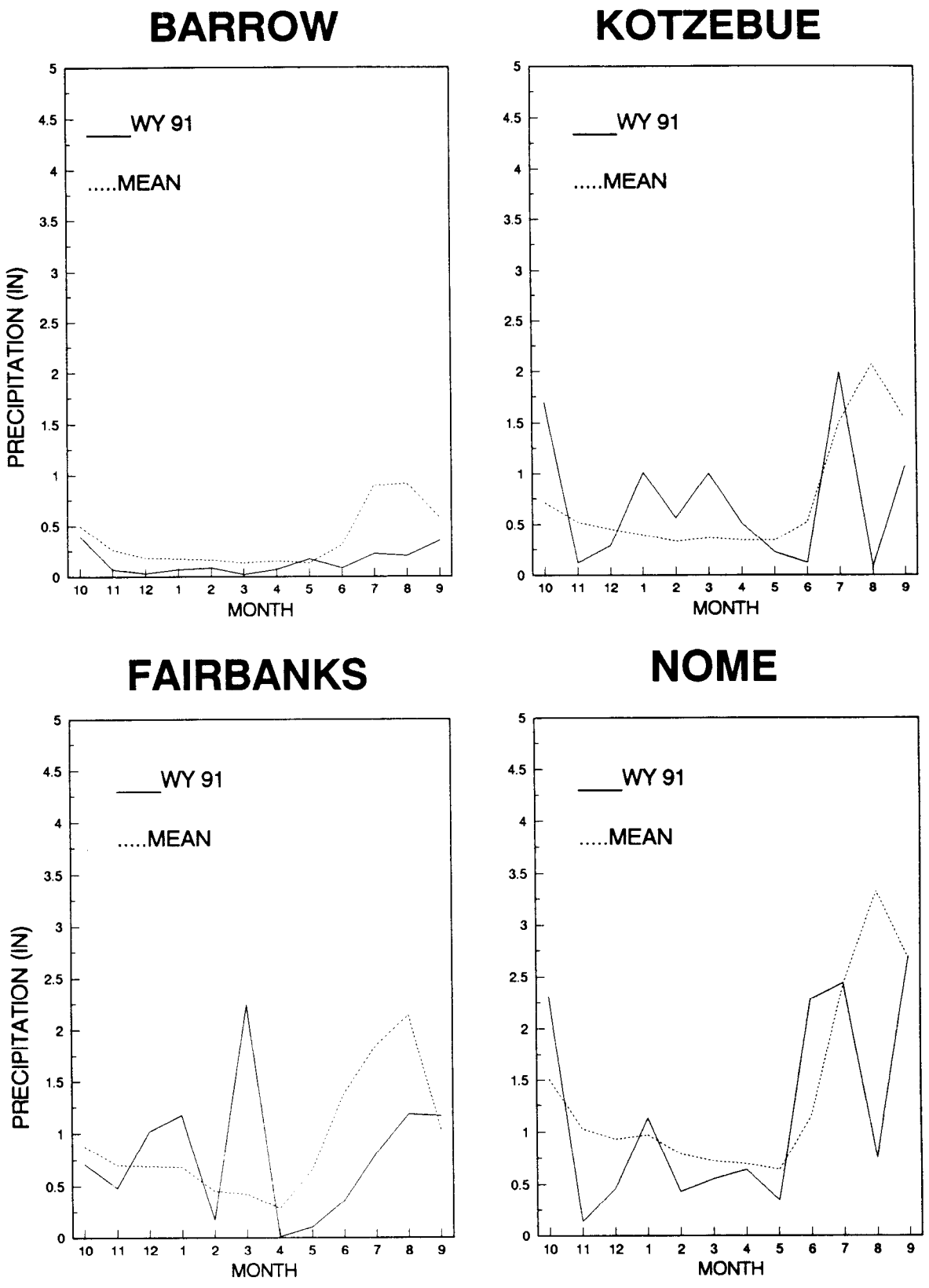

Figure 26. Mean monthly precipitation for water year 1991 compared to mean monthly precipitation, 1958-1991, in four AYK locations.

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APPENDIX A

Appendix A. National Wild and Scenic Rivers in the Arctic Yukon Kuskokwim Region.

Streams Within The National Park System
Alatna River. The main stem within the Gates of Arctic National Park.
John River. The portion of the river within the Gates of the Arctic National Park.
Kobuk River. The portion within the Gates of the Arctic National Park and Preserve.
Noatak River. The river from its source in the Gates of the Arctic National Park to its confluence with the Kelly River in the Noatak National Preserve.
North Fork of the Koyukuk River. The portion within the Gates of the Arctic National Park.
Tinayguk River. The portion within the Gates of the Arctic National Park.
Salmon River. The portion with the Kobuk Valley National Park.
Charley River. The entire river, including its major tributaries, Copper Creek, Bonanza Creek, Hosford Creek, Derwent Creek, Flat-Orthmer Creek, Crescent Creek, and Moraine Creek, within the Yukon-Charley Rivers National Preserve.

Streams Within The National Wildlife Refuge System
Andreafsky River. The portion from its source, including all headwaters, and the East Fork, within the boundary of the Yukon Delta National Wildlife Refuge.
Ivishak River. The portion from its source, including all headwaters and an unnamed tributary from Porcupine Lake with the boundary of the Arctic National Wildlife Range.
Nowitna River. The portion from the point where the river crosses the west limit of township 18S, Range 22E, Kateel River meridian, to its confluence with the Yukon River within the boundaries of the Nowitna National Wildlife Refuge.
Selawik River. The portion from a fork of the headwaters in township 12N, Range 10E, Kateel River meridian to the confluence of the Kugarak River; within the Selawik National Wildlife Refuge .
Sheenjek River. The segment within the Arctic National Wildlife Refuge.
Wind River. The portion from its source, including all headwaters and one unnamed tributary in township 13 S, within the boundaries of the Arctic National Wildlife Refuge.

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Streams Located Outside National Parks and Refuges

Fortymile River. The mainstem within the State of Alaska; O'Brien Creek; South Fork; Napoleon Creek, Franklin Creek, Uhler Creek, Walker Fork downstream from the confluence of Liberty Creek; Wade Creek; Mosquito Fork downstream from the vicinity of Ketchumstuk; West Fork Dennison Fork downstream from the confluence of Logging Cabin Creek; Dennison Fork downstream from the confluence of West Fork Dennison Fork; Logging Cabin Creek; North Fork; Hutchison Creek; Champion Creek; the Middle Fork downstream from the confluence of Joseph Creek; and Joseph Creek.

Delta River. The segment from and including all of the Tangle Lakes to a point one-half mile north of Black Rapids.

Beaver Creek. The segment of the main stem from the vicinity of the confluence of the Bear and Champion Creeks downstream to its exit from the northeast corner of township 12N, Range 6E, Fairbanks meridian within the White Mountains National Recreation Area, and the Yukon Flats National Wildlife Refuge.

Birch Creek. The segment of the main stem from the south side of Steese Highway in township 7N, Range 10E, Fairbanks meridian, downstream to the south side of the Steese Highway in township 10N, Range 16E,.

Unalakleet River. The segment of the main stem from the headwaters in township 12S, Range 3W, Kateel River meridian extending downstream approximately 65 miles to the western boundary of township 18S, range 8W.

APPENDIX B

Appendix B. Emergency orders issued in 1990 for the AYK Region.

SPORT FISHING
Emergency Order

ALASKA DEPARTMENT OF FISH AND GAME

Under Authority of AS 16.05.060

Emergency Order No. 3-W-01-91

Issued at Nome, Alaska
June 6, 1991

Effective Date: 11:59 p.m. ADT
Saturday, June 15, 1991

Expiration Date: July 31, 1991 unless superseded by subsequent emergency order.

EXPLANATION:

This emergency order closes the following waters to the retention of chum salmon and pink salmon from June 16, 1991 through July 31, 1991: the Sinuk, Cripple, Penny, Snake, Nome, Flambeau, Bonanza and Solomon Rivers, the waters of Safety Sound and Bonanza Channel inside the barrier spit and Safety Bridge, and ocean waters from Cape Nome jetty west to include the Sinuk River. For conservation reasons, these are specified as catch and release waters for chum and pink salmon from June 16 through July 31, 1991. All chum or pink salmon caught in these waters must be immediately released.

REGULATION:

5AAC 70.020. BAG LIMITS, POSSESSION LIMITS, AND SIZE LIMITS. (e) is amended by adding:

in the Sinuk, cripple, Penny, Snake, Nome, Flambeau, Bonanza and Solomon rivers, the waters of Safety Sound and Bonanza Channel inside the barrier spit and Safety Bridge, and ocean waters from Cape Nome Jetty west to include the Sinuk River, chum salmon or pink salmon caught from June 16, 1991 through July 31, 1991 may not be retained or possessed.

Carl L. Rosier
Commissioner

By delegation to: Alfred L DeCicco

Alfred L. DeCicco
Area Management Biologist

JUSTIFICATION:

During the last four years, chum salmon and odd year pink salmon escapements in the Nome area have been well below historic levels and the levels the department staff believes are needed to maintain the salmon runs.

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Over the past seven years, increasingly restrictive measures have been taken on the Nome River in an attempt to encourage increased escapement. The measures have not been effective. Heavy fishing effort in the Nome area combined with various natural and other influences have caused local salmon stocks to reach dangerously low levels. If the salmon stocks are not allowed to rebound soon, it is feared that some will cease to exist.

The staff will be flying frequent surveys and boating some rivers to track the salmon run strengths and progress. If a stream appears to have adequate escapement, restrictions will be lifted in that area, otherwise, the restrictions will remain in place until they no longer benefit the species of concern.

DISTRIBUTION:

The distribution list of this emergency order is available from the Department of Fish and Game office in Fairbanks.

SPORT FISHING
Emergency Order

ALASKA DEPARTMENT OF FISH AND GAME

Under Authority of AS 16.05.060

Emergency Order No. 3-AG-02-91

Issued at Fairbanks, Alaska June 27, 1991.

Effective Date: 12:01 a.m. Monday, July 1, 1991

Expiration Date: In effect until superseded by regulation or by subsequent emergency order.

EXPLANATION:

This emergency order closes the Chena River and its tributaries to the retention of Arctic grayling from 12:01 a.m. July 1, 1991 until further notice. All Arctic grayling caught in these waters must be released immediately.

REGULATION:

5 AAC 70.020. BAG LIMITS, POSSESSION LIMITS, AND SIZE LIMITS: is amended by adding:

(s) In the Chena River and its tributaries, Arctic grayling caught after July 1, 1991 may not be retained or possessed until further notice.

Carl L. Rosier
Commissioner

By delegation to: Jerome E. Hallberg
Jerome E. Hallberg
Area Management Biologist

JUSTIFICATION:

Available harvest information and biological data indicates that the Chena River Arctic grayling population is being over-harvested and recent exploitation rates of grayling larger than 12 inches in length have exceeded 50%. Harvest of Arctic grayling in the Chena River has increased annually from 3,000 in 1987 to 5,000 in 1988 to nearly 14,000 in 1989. The population abundance of Arctic grayling in 1990 was estimated to be 31,000 fish. The predicted recruitment (new fish entering the population) of 6,500 in 1991 and 9,000 in 1992 is well below the historical level of 13,000 grayling recruited annually.

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Therefore, a catch and release regulation on the entire Chena River Arctic grayling fishery is required to prevent continuing over-harvest, and to allow continuation of a limited recreational fishery.

DISTRIBUTION:

The distribution list of this emergency order is available from the Department of Fish and Game office in Fairbanks.

* * *

SPORT FISHING

Emergency Order

ALASKA DEPARTMENT OF FISH AND GAME

Under Authority of AS 16.05.060

Emergency Order No. 3-W-02-01

Issued at Nome, Alaska
July 25, 1991

Effective Date: 11:59 p.m. ADT
Thursday, July 25, 1991

Expiration Date: December 31, 1991 or until superseded by subsequent emergency order.

EXPLANATION:

This emergency order reopens the following waters to the retention and possession of chum and pink salmon: the Sinuk, Cripple, Nome, Bonanza and Solomon Rivers, the waters of Safety Sound and Bonanza Channel inside the barrier spit and Safety Bridge, and ocean waters from Cape Nome jetty west to include the Sinuk River mouth. Chum and pink salmon caught in these waters may be retained and possessed in accordance with Sport Fishing bag and possession limits of 10 salmon (other than king salmon) per day of which only three may be chum or coho salmon. Restrictions remain in effect on the Snake, Penny and Flambeau Rivers.

REGULATION:

5AAC 70.020. BAG LIMITS, POSSESSION LIMITS, AND SIZE LIMITS. (e) is amended by repealing chum and pink salmon catch and release restrictions on the Sinuk, Cripple, Nome, Bonanza and Solomon Rivers, the waters of Safety Sound and Bonanza Channel inside the barrier spit and Safety Bridge and the ocean waters from Cape Nome jetty west to include the Sinuk River. Through July 31, 1991 chum and pink salmon caught in the Penny, Snake and Flambeau Rivers may not be possessed or retained.

Carl L. Rosier
Commissioner

By delegation to: Alfred L. DeLucia
Area Management Biologist

JUSTIFICATION:

Recent aerial surveys have indicated that chum salmon escapement goals have been met or exceeded in the Nome, Sinuk, Cripple, Solomon and Bonanza Rivers. The previous closure would have expired on July 31, 1991. This emergency order allows sport fish harvest of salmon in waters where conservation problems do not currently exist and is in accordance with guidelines set forth in the emergency order which closed these waters to the retention of chum and pink salmon.

SPORT FISHING

Emergency Order

ALASKA DEPARTMENT OF FISH AND GAME

Emergency Order No. 3-WF-03-91
Under Authority of AS 16.05.060

Issued at Fairbanks, Alaska
September 6, 1991

Effective Date: 12:01 a.m.
Monday, September 9, 1991

Expiration Date:
December 31, 1991 or until superseded by subsequent regulatory action.

EXPLANATION:

This emergency order closes the Chatanika River and its tributaries to the taking of whitefish by sport fishermen.

REGULATION:

5 AAC 70.010. FISHING SEASONS, is amended to read:

(d) the Chatanika River and its tributaries are closed to the taking of whitefish from midnight Sunday, September 8, 1991 until December 31, 1991 unless superseded by a subsequent emergency order.

Carl L. Rosier
Commissioner

By delegation to: Fred M. Andersen

Fred M. Andersen
Management Supervisor

JUSTIFICATION:

Abundance of both least cisco and humpback whitefish has decreased dramatically in recent years. In addition, weak year classes of age 4 and 5 humpback whitefish and age four least cisco have been documented in the Chatanika River. These year classes typically make up the majority of the harvest in the spear fishery and represent the bulk of the spawning humpback whitefish and least cisco populations. For humpback whitefish, these age classes are estimated to have decreased from more than 60 percent of the population in 1986 to less than 10% in 1991.

For these reasons, an emergency closure of the Chatanika River whitefish sport fishery is necessary to provide for conservation of the spawning stock and to prevent further depletion of whitefish stocks in the Chatanika River.

APPENDIX C

Arctic-Yukon-Kuskokwim Area

OTHER ARCTIC-YUKON-KUSKOKWIM AREA REGULATIONS

METHODS AND MEANS.

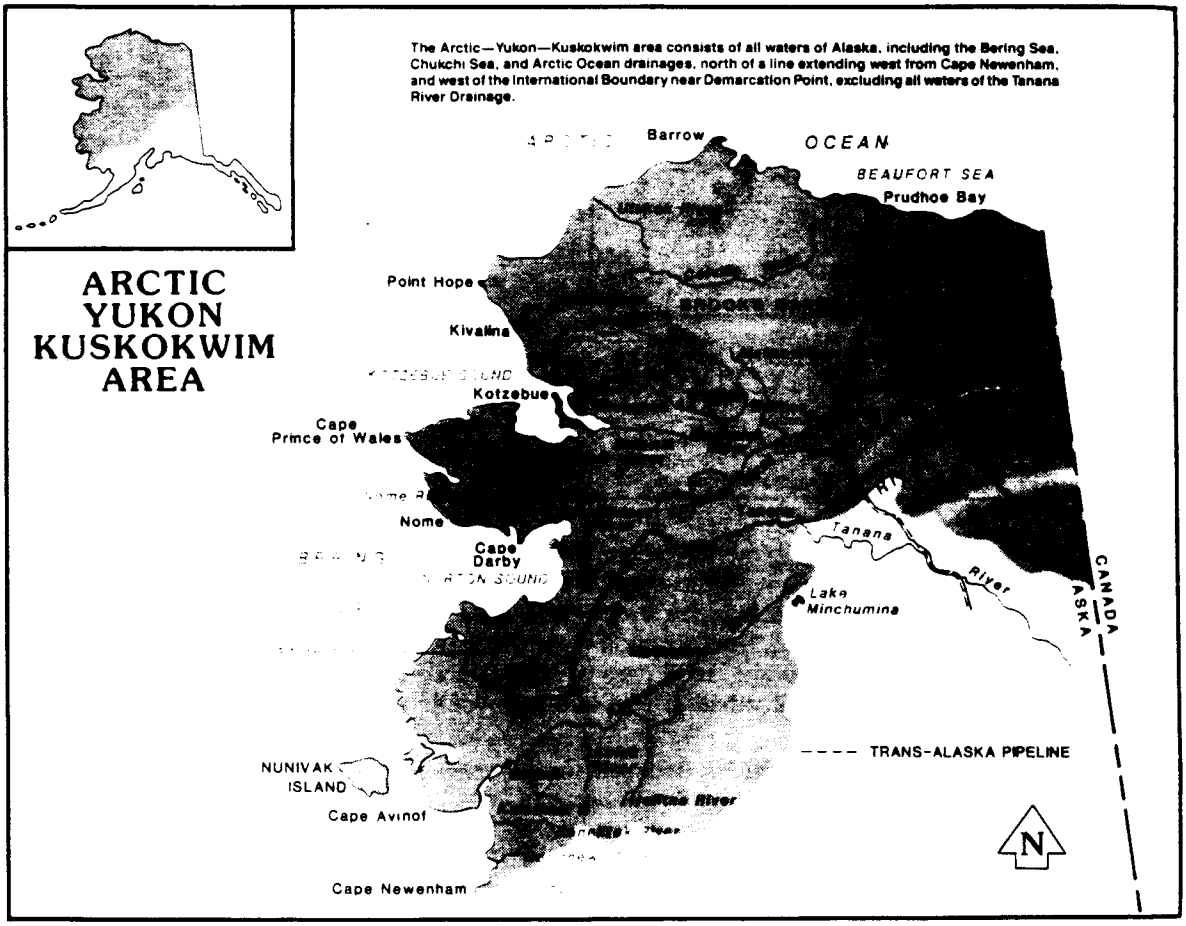
1. In all lakes, multiple hooks with gap between point and shank greater than one-half inch may be used for taking fish other than salmon.
2. Sucker and Burbot, may be taken by spear or bow and arrow from January 1 through December 31.
3. Northern Pike and Whitefish (excluding sheefish) may be taken by spear or bow and arrow from September 1 through April 30 and may be speared by persons completely submerged from January 1 through December 31.

SHELLFISH METHODS AND MEANS.

1. Shellfish may be taken only as follows:
   a. shrimp may be taken with pots and ring nets;
   b. crab may be taken with pots, ring nets, diving gear, dipnets, hooked or hookless lines either operated by hand or attached to a pole or rod, or by hand;
   c. clams may be taken with rakes, shovels, and manually operated clam guns.
2. No more than five pots per person, regardless of type, and a maximum of ten pots per vessel, regardless of type, may be used to take shellfish at any time.
3. Each sport fisherman shall plainly and legibly inscribe his or her first initial, last name, and home address on a keg or buoy attached to each pot. A keg or buoy attached to a pot must also be inscribed with the name or the Coast Guard number of the vessel used to operate the pot.
4. Escape mechanisms as described in the Personal Use Shellfish Regulations (page 91) must be provided for each pot.
5. The bag, possession, and pot limits for shellfish in this chapter are not in addition to those allowed under subsistence fishing regulations, nor to those allowed under personal use fishing regulations.
6. No person may mutilate or otherwise disfigure any crab in any manner which would prevent the determination of the minimum size restrictions until the crab has been processed for human consumption. No person may take or possess shellfish smaller than the minimum legal size limits.
7. The operator of a commercially licensed and registered shrimp fishing vessel used in the sport fish taking of shrimp during a closed commercial shrimp season or within a closed commercial shrimp district, section, or subsection may not possess more than 500 pounds on board the vessel.

HARVEST RECORDING FORM.

A person must obtain a harvest recording form from the department prior to fishing for king crab in the Norton Sound section of the Northern District.



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Arctic-Yukon-Kuskokwim Area

WATER	SEASON & CATCH LIMIT						SPECIAL REGULATIONS
	Salmon	Dolly Varden/ Arctic Char Lake Trout/ Rainbow Grayling	Sheefish	Northern Pike/ Burbot	Halibut	Other Fish Shellfish	
TRANS-ALASKA PIPELINE a corridor 5 miles wide on each side of the alignment.)	Closed	G,J,I	L	N,P		U	
UNALAKLEET RIVER drainage	B,C	H,J		N,P		U	
WULIK RIVER drainage	A,C	G,K	L	N,P		U	
YUKON RIVER drainage: from the mouth of the Tanana River upstream to, and including, the Hodzana River remainder of the drainage	A,C A,C	G,J,I G,J,I	L L	O,P N,P		U U	

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	3 per day, 3 in possession, only 1 may be greater than 28 inches
B	KING SALMON	Entire Year	1 per day, 1 in possession, no size limit
C	OTHER SALMON	Entire Year	10 per day, 10 in possession, no size limit
D	OTHER SALMON	Entire Year	10 per day, 10 in possession, only 3 which may be chum salmon and coho salmon, in combination
E	OTHER SALMON	Entire Year	5 per day, 5 in possession, no size limit
F	RAINBOW TROUT	Entire Year	2 per day, 2 in possession, only 1 over 20 inches
G	GRAYLING	Entire Year	10 per day, 10 in possession, no size limit
H	GRAYLING	Entire Year	5 per day, 5 in possession, only 1 over 15 inches
I	LAKE TROUT	Entire Year	4 per day, 4 in possession, no size limit
J	ARCTIC CHAR/ DOLLY VARDEN	Entire Year	10 per day, 10 in possession, no size limit
K	ARCTIC CHAR/ DOLLY VARDEN	Entire Year	10 per day, 10 in possession, no size limit
L	SHEEFISH	Entire Year	10 per day, 10 in possession, no size limit
M	SHEEFISH	Entire Year	2 per day, 2 in possession, no size limit
N	NORTHERN PIKE	Entire Year	10 per day, 10 in possession, no size limit
O	NORTHERN PIKE	Entire Year	5 per day, 5 in possession, no size limit
P	BURBOT	Entire Year	15 per day, 15 in possession, no size limit
Q	HALIBUT	Feb. 1 - Dec. 31	2 per day, 4 in possession, no size limit
R	KING CRAB (Red & blue in combination)	in waters south of 60° north latitude: June 1 - Jan. 31 In waters north of 60° north latitude: Entire Year	6 per day, 6 in possession, males only: Red King Crab 4 3/4 inches or more; Blue King Crab 5 1/2 inches or more 6 per day, 6 in possession, males only Red King Crab 4 3/4 inches or more; Blue King Crab 5 1/2 inches or more
S	DUNGENESS CRAB	Entire Year	6 1/2 inches or wider, 12 per day, 12 in possession, males only
T	TANNER CRAB (C. Bairdi and C. Opilio combination)	Entire Year	12 per day, 12 in possession, males only: C. Bairdi – 5 1/2 inches or more C. Opilio – 3 1/8 inches or more
U	OTHER FISH/ SHELLFISH	Entire Year	No bag, possession or size limit

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

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** (at the end of this section) to determine open season, catch, and length limits.

   Read **Special Regulations.**
3. An asterisk (*) denotes **Special Regulations** apply.

WATER	SEASON & CATCH LIMIT						SPECIAL REGULATIONS
	Salmon	Dolly Varden/ Arctic Char/ Lake Trout/ Rainbow/ Grayling	Blackfish	Northern Pike/ Burbot	Halibut	Other Fish/ Shellfish	
ALL WATERS not listed below	**A,C**	**F,G,J,I**	**L**	**N,P**	**Q**	**R,S, T,U**	
ANIAK RIVER drainage	B,E	*F,G,J,I	L	N,P		U	1. *In all flowing waters of the Aniak River drainage upstream of its confluence with Doestock Creek only unbaited, single-hook artificial lures may be used. Rainbow trout may not be possessed or retained; all rainbow trout caught must be released immediately.
GOODNEWS RIVER drainage	A,E	F,G,J,I	L	N,P		U	1. In all flowing waters of the Goodnews River drainage upstream of the Togiak National Wildlife Refuge wilderness area boundary only unbaited, singlehook artificial lures may be used. 2. No person may sport fish from a boat or the river bank within 300 feet of a legally operating subsistence set gillnet downstream of the Togiak National Wildlife Refuge Wilderness area boundary.
KANEKTOK RIVER drainage	A,E	F,G,J,I	L	N,P		U	1. In all flowing waters of the Kanektok River drainage upstream of the Togiak National Wildlife Refuge wilderness area boundary only unbaited, single-hook lures may be used. 2. No person may sport fish from a boat or the river bank within 300 feet of a legally operating subsistence set gillnet downstream of the Togiak National Wildlife Refuge Wilderness area boundary.
KIVALINA RIVER drainage	A,C	G,K		N,P		U	
KOBUK RIVER drainage upstream of the mouth of Mauneluk River remainder of the Kobuk River	A,C A,C	G,J,I G,J,I	M L	N,P N,P		U U	
KUSKOKWIM BAY drainages: All waters that drain into Kuskokwim Bay (excluding the Kuskokwim River) from Cape Avinof to Cape Newenham	A,E	F,G,J,I	L	N,P		U	
KUSKOKWIM RIVER drainage	B,E	F,G,J,I	L	N,P		U	
NOATAK RIVER drainage	A,C	G,K,I	L	N,P		U	
NORTH SLOPE waters: (All waters drainage into the Arctic Ocean and all waters draining into the Chukchi Sea north of Point Hope)	A,C	G,K,I	L	N,P		U	
SEWARD PENINSULA waters: (All waters draining into the Bering Sea from Cape Darby to Cape Prince of Wales on the Seward Peninsula)	B* D*	H,J		N,P		U	* Salmon Lake, its tributaries, and the outlet stream 300 feet downstream from the lake outlet are closed to salmon fishing.