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STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

INVENTORY AND CATALOGING OF INTERIOR WATERS WITH EMPHASIS ON THE UPPER YUKON AND THE HAUL ROAD AREAS

by

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Job No. G-I-N Inventory and Cataloging of Interior Waters with Emphasis on the Upper Yukon and the Haul Road Areas

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ABSTRACT

This report summarizes preliminary fisheries surveys conducted during the years 1964 through 1978 in a 106,190 square kilometer (41,000 square mile) study area in Northeastern Alaska.

Area habitat, climate, and human activities are discussed, and sport and subsistence fishery uses are briefly described. A total of 20 fish species was either captured or reported present. General descriptions of the area's four major drainages, the Yukon, Koyukuk, Chandalar, and Porcupine rivers, are included as well as more detailed drainage by drainage descriptions that include habitat and climactic factors, human use, and land status. Past fisheries investigation publications, by drainage, are compiled and summarized. Specific recommendations for future work are included with each drainage description.

An Annotated Bibliography of the majority of available fisheries reports discussing their content and scope is presented.

BACKGROUND

During the years 1964 through 1978, lake and stream inventory and cataloging surveys have been conducted in an approximate 106,190 sq km (41,000 sq mi) study area, bordered on the south by the Yukon River, on the north by the Brooks Range, and extending east from the headwaters of the Alatna River to the Canadian border. The Arctic Circle bisects the study area which lies in Northeastern Alaska (Fig. 1).

The area encompasses a wide range of climatic and habitat types that vary primarily with altitude. Latitude, mountain barriers and wind are other contributing factors. Elevations range from approximately 2,400 m (8,000 ft) above sea level in the central Brooks Range to just over 90 m

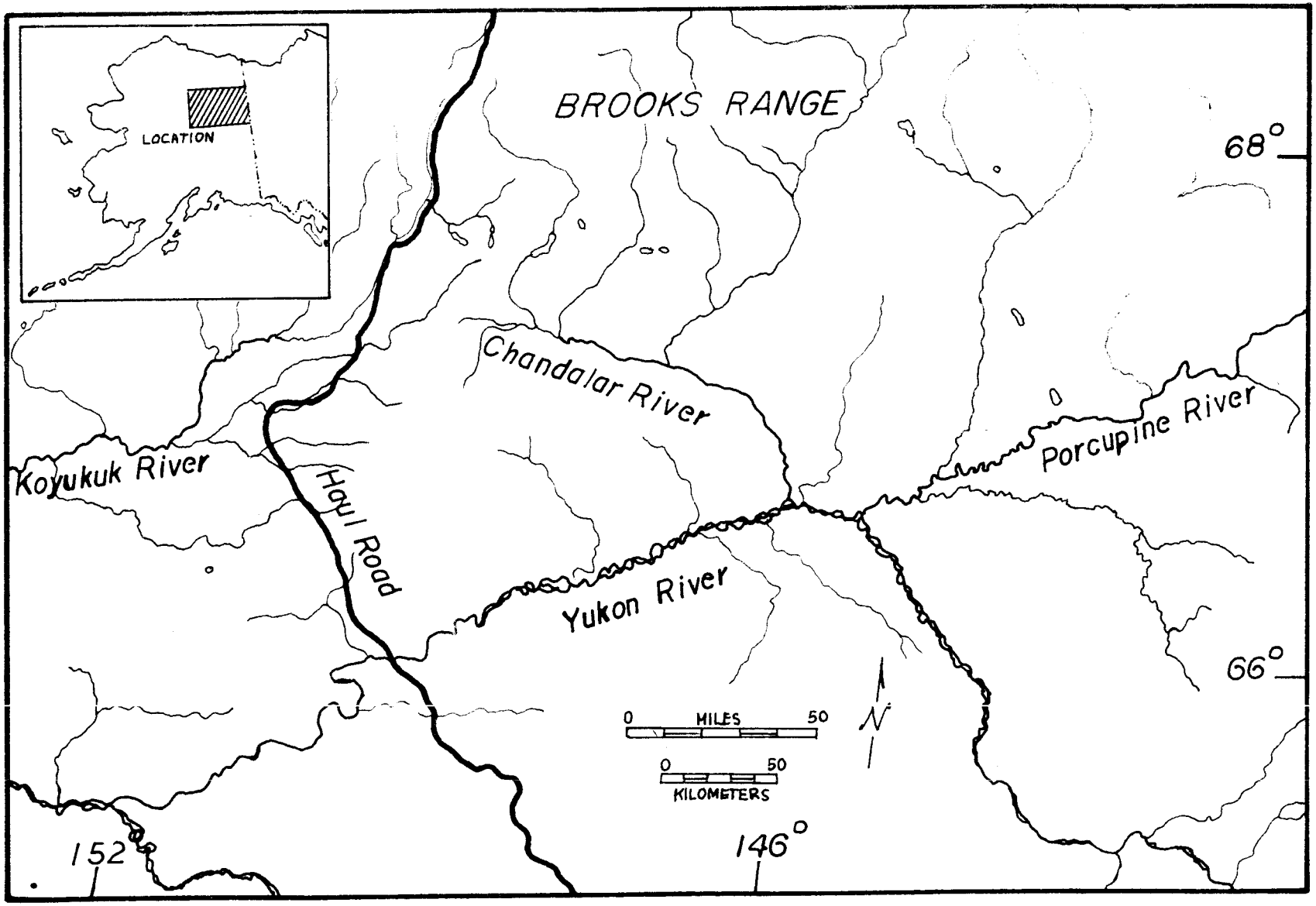

Figure 1. Study area in Northeastern Alaska.

(300 ft) along the Yukon River. Vegetation is scant at the higher elevations and tends to increase in both species and density below the 760 m (2,500 ft) level. Spruce, cottonwood, alder, and willow predominate at lower elevations when soil types permit. Low lands are characterized by poorly drained soils, standing water, ice-rich bases, and an abundance of shallow, seasonal ponds. Habitat also varies markedly with reference to north or south facing slopes. The south slope exhibits greater floral density and diversity due generally to warmer soils. Vegetative cover differs considerably within a given watershed and often affects nutrient input into adjacent lake systems and hence aquatic productivity.

The climate is one of harsh contrasts. Summer temperatures often reach 27°C (80°F) during the months of June, July, and early August. Fall temperatures usually show continual below freezing levels by late September. Midwinter extremes may fall below -57°C (-70°F). Springs are often long, and continual above freezing temperatures may not occur until late May. Mean annual temperatures average -6°C (20°F). Daylight varies from a nearly continual photoperiod in late June to almost complete darkness in December. Growing seasons for most flora and fauna are thus limited by the daylight extremes. Cloud cover varies but occurs most frequently during the long, warm summer days. Typical annual precipitation for the study area averages around 0.3 m (12 in) a year. Freezeup of the rivers that drain the southern Brooks Range occurs by early October and thaw is usually complete by early May. Lakes experience a similar freeze-thaw schedule, with ice cover present by early October and open water leads showing by late May.

The early people of the area consisted of Eskimos and Athapascan Indians. The Eskimo influence was seen primarily in the northwestern segment of the study area while various Athapascan groups populated and migrated through the central and eastern portions. Their lifestyle was nomadic and the majority of the time movements coincided with food availability and yearly climactic changes. Game species movements as well as fish migration and availability dictated the lifestyle and survial success. White traders, both Russian and North American, entered the area in search of valuable fur. The gold rush period of the late 1800's drew many adventurers into the area in search of the numerous gold deposits and other valuable minerals. World War II precipitated land mapping and airfield construction. With the discovery of oil and natural gas on Alaska's North Slope, portions of the study section have become an avenue for transportation.

Present development consists of the small villages of Allakaket, Arctic Village, Beaver, Bettles, Chalkyitsik, Hughes, Stevens Village, Venetie and Wiseman. Smaller mining camps have been created near mineral deposits, primarily in the central Brooks Range near Wiseman and Chandalar lakes. In the late 1960's the avenues for initial oil exploration and logistic transportation consisted of a winter road that ran through Bettles and northward. With the confirmation of commercial oil reserves on the North Slope, a haul road, oil pipeline, and several construction camps were built in the middle 1970's to allow for oil transportation to the port of Valdez. This represents the greatest development to date, although a planned natural gas line down the same corridor will again

lead to increased construction activity within the study area. Other major commercial resource uses consist of guiding operations that center on concentrations of game and fish and limited commercial fisheries along the main Yukon River.

The following fish species (Table 1) are generally distributed or reported throughout at least a portion of the lakes and rivers in the study area: Arctic char, Arctic grayling, Arctic lamprey, Bering cisco, burbot, broad whitefish, chum salmon, coho salmon, humpback whitefish, king salmon, lake chub, lake trout, least cisco, longnose sucker, ninespine stickleback, northern pike, round whitefish, sheefish, slimy sculpin, and trout-perch. The salmon are limited to the major rivers, while all others may be found in both lakes and streams. Lake trout generally dwell in the area's deep lakes.

Sport Fish Catch and Effort

The Department of Fish and Game, Sport Fish Division conducted a postal questionnaire survey of license holders for the year 1977. The results shown in Table 2 indicated the low catch and effort level. Arctic grayling were the highest catch reported, followed by lake trout and northern pike.

Documented subsistence use also remains at a low level (Fred Andersen, Division of Commercial Fisheries, 1978, pers. comm.). He relates that netting and line fishing occur near all villages and townsites. Chum, king, and silver salmon along with various whitefish species and northern pike are taken. In all lakes and in a majority of streams, permits and quotas have not been required or established. However, the majority of streams adjacent to the pipeline corridor were closed during the study and in others permits were required. Hand held lines are presently legal for subsistence purposes only when fishing through the ice.

Selection for examination of the lakes in this survey by Department of Fish and Game personnel was done on the basis of their relation to various habitats within the area, as well as their relative importance and potential for fishery use. Data obtained from selected waters would be applicable at present to other systems possessing similar fish species composition, limnological qualities, and geographical location.

General Drainage Description

Four major drainages occur in the study section: the Yukon, Koyukuk, Chandalar, and Porcupine river systems and their tributaries. The major drainage, that of the largest river in Alaska, the Yukon, flows generally westward along the southern edge of the area. The other three rivers drain southward into it. They are, from the western study section eastward, the Koyukuk, Chandalar, and Porcupine systems. All drainages are adjoined by lake systems. The headwaters in the northern study section contain characteristic mountain lakes with their associated habitat types and fish populations, such as lake trout and grayling. The lower elevations along the Yukon River are dotted with numerous

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

Common Name	Scientific Name and Author	Abbreviation
Arctic char	*Salvelinus alpinus* (Linnaeus)	AC
Arctic grayling	*Thymallus arcticus* (Pallas)	AG
Arctic lamprey	*Lampetra japonica* (Martens)	AL
Bering cisco	*Coregonus laurettae* Bean	BCI
Burbot	*Lota lota* (Linnaeus)	BB
Broad whitefish	*Coregonus nasus* (Pallas)	BWF
Chinook salmon	*Oncorhynchus tshawytscha* (Walbaum)	KS
Chum salmon	*Oncorhynchus keta* (Walbaum)	CS
Coho salmon	*Oncorhynchus kisutch* (Walbaum)	SS
Humpback Whitefish	*Coregonus pidschian* (Gmelin)	HWF
Lake chub	*Couesius plumbeus* (Agassiz)	LC
Lake trout	*Salvelinus namaycush* (Walbaum)	LT
Least cisco	*Coregonus sardinella* Valenciennes	LCI
Longnose sucker	*Catostomus catostomus* (Forster)	LNS
Ninespine stickleback	*Pungitius pungitius* (Linnaeus)	NSB
Northern pike	*Esox lucius* Linnaeus	NP
Round whitefish	*Prosopium cylindraceum* (Pallas)	RWF
Sheefish	*Stenodus leucichthys* (Guldenstadt)	SF
Slimy sculpin	*Cottus cognatus* Richardson	SSC
Trout-perch	*Percopsis omiscomaycus* (Walbaum)	TP

Table 2. Postal census of sport fish catch south slope Brooks Range*, 1977.

	Days Fished	KS	CS	DV AC	LT	GR	NP	SF
Total	2,156	9	7	11	496	1,032	215	9

* All drainages from, and including, the Alatna River on the west, to the Canadian Border on the east, and from the Brooks Range south to the Arctic Circle.

shallow waters associated with low lying wetlands and marshes. Fish found in these waters include those normally associated with warm shallow systems, such as pike and whitefish. For the purposes of this report, only the Koyukuk, Chandalar, and Porcupine drainages will be discussed in detail. References to Yukon River studies are made in the Literature Cited Section.

1978 Field Studies

Creel Census:

Due to the continued sport fishing closure along the North Slope Haul Road, creel census programs in the study area were de-emphasized during the study period. Data relative to fishing catch and effort on waters outside of the closed corridor was obtained by the Sport Fish Division through a statewide postal survey. Information on 1977 data is presented earlier in this report. 1978 figures were in preparation at the time this report was written and should soon be made available.

Lake Surveys:

Monitoring of area waters consisted of two separate programs during the study period. A trip along the Haul Road was made in early June to assess breakup conditions and water flows through culverts. While the majority of waters appeared to allow adequate fish passage, those believed to have excessive velocities or other apparent fisheries impediments were so noted and the appropriate agencies notified. The second segment consisted of lake surveys and general drainage overwiew of the upper Yukon, Porcupine and Black rivers. Four lakes were initially surveyed while others were visually assessed as to their fisheries potential. Due to the continuing nature of these surveys, the data was put in files in Fairbanks for a future comprehensive write-up. Lakes surveyed included Graphite, Vindik, Ohtig and Tinkdhul.

Arctic Char Counts:

Mixed success was encountered while conducting the Arctic char spawning counts in early October. Due to the early onset of winter weather on the North Slope, we were unable to fly to the Ivishak and Echooka rivers, those streams traditionally used as char population index areas. However, the Anaktuvuk, Chandler and Killik rivers were flown under marginal flight conditions. Potential spawning areas were noted on the Anaktuvuk and Killik rivers. Excessive turbidity and flowing ice prevented a good assessment of the Chandler system. Counts will be attempted at an earlier date during the fall of 1979.

Therefore, the scope of this report was expanded to bring together fisheries data to date from a number of previous investigations in the study area. Extensive surveys of certain segments of the study area have been conducted by various biologists. Numerous portions, however, remain to be investigated.

Purpose and Intent of Report

The ultimate purpose of writing this report was to put into perspective the scope of past survey data and to suggest potential areas for future investigations.

Presented is a brief summary of each available fisheries report concerning the study area, with information on source documentation, author's topics, and areas of emphasis. Included for background and discussion are general descriptions of the study area and individual descriptions of each of the three major drainages. The reader should seek additional specific data and author intent from the source.

RECOMMENDATIONS

Koyukuk River Drainage

Management:

1. Unified sport fishing regulations regarding bag limit, gear and season should be established for the haul road.

2. Collection and filing of the area's fisheries data should be completed.

Research:

1. A sport fishery monitoring program should be established.

2. Drainage surveys should be completed on the following Koyukuk River tributaries: Kanuti, South Fork Koyukuk, North Fork Koyukuk, Wild, John, and Alatna rivers.

Chandalar River Drainage

Management:

Collection and filing of the area's fisheries data should be completed.

Research:

Drainage surveys should be completed on the following Chandalar River tributaries: West Fork Chandalar, North Fork Chandalar, lower East Fork Chandalar, Wind, and Junjik rivers.

Porcupine River Drainage

Management:

Collection and filing of the areas fisheries data should be completed.

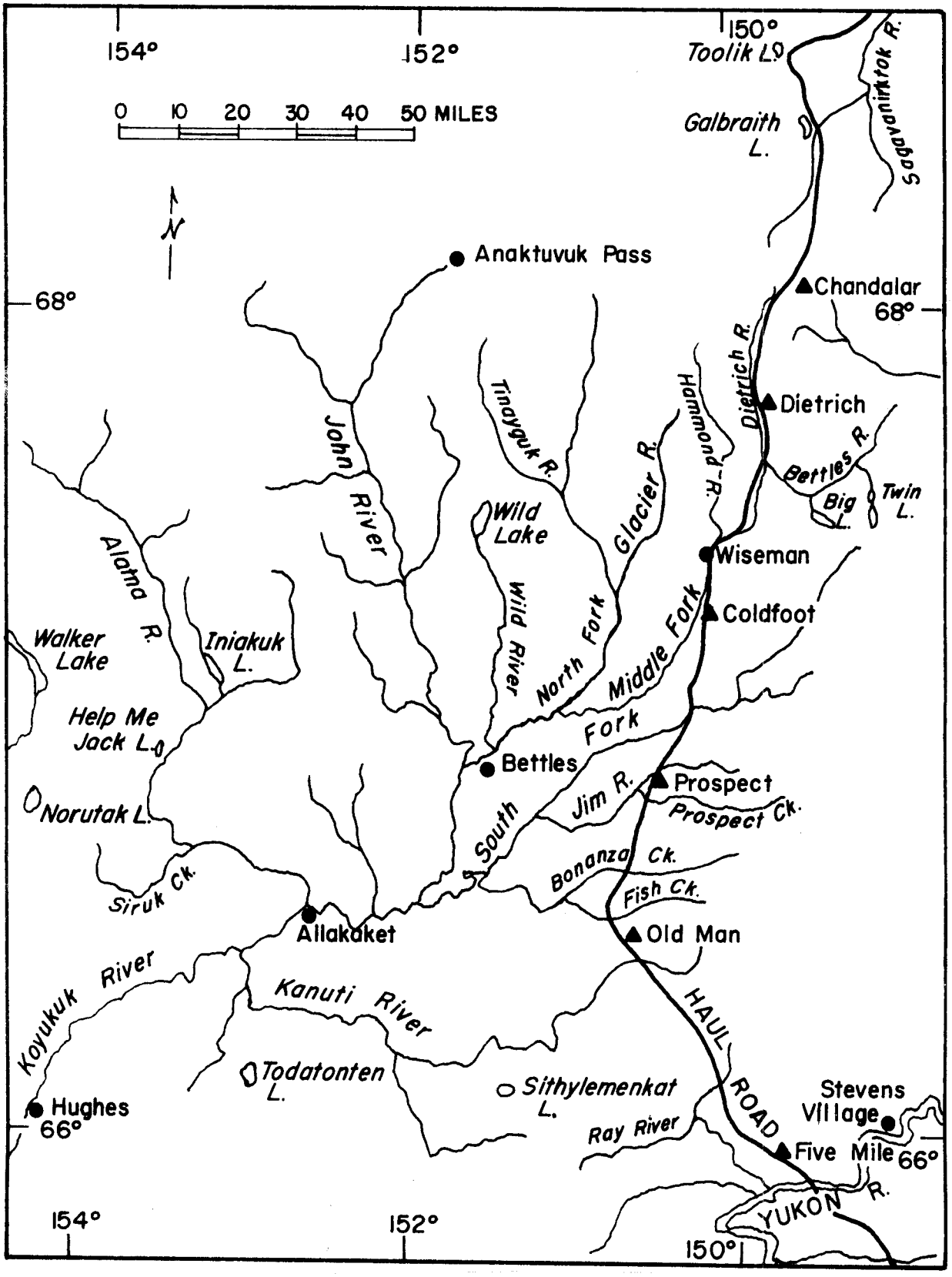

Figure 2. Koyukuk River drainage Middle and Upper.

Research:

Drainage surveys should be completed on the following Porcupine River tributaries: Lower Sheenjek, Coleen, and Porcupine rivers.

OBJECTIVES

1. To monitor the sport fishery in the study area.

2. To monitor area waters with emphasis on fishery problems.

3. To continue aerial index counts of Arctic char in the upper Sagavanirktok drainage.

TECHNIQUES USED

Data collected by Alaska Department of Fish and Game personnel for the reports discussed herein were obtained through standard lake and stream survey methods.

Map references and elevations were taken from U.S.G.S. 1:63,360 and 1:250,000 topographic maps, and U. S. Department of Commerce sectional and World Aeronautical charts. Lake locations were described in statute miles and magnetic compass bearings (°M) from the nearest major community. The Dictionary of Alaska Place Names, Geological Survey Professional Paper 567, was also used for location references. Acreages were determined by the use of a polar planimeter and the above maps. Secchi readings were taken using the standard black and white disc. Flows and discharges of inlet and outlet streams were computed by the drift method. Fish were captured with either experimental 38 x 1.8 m (125 x 6 ft) graduated mesh gill net 12.7 to 63.5 mm (1/2 to 2 1/2 in) bar in five panels or by the use of hand held or beach-set sport lines. Usually two nets were set for 18 hours on each lake. Fish so captured were measured for fork length to the nearest millimeter and weight to the nearest five grams, and a scale or otolith was taken for aging purposes. Most fish were autopsied to determine sex and maturity composition and classified to their year of maturity. When maturity or sex was uncertain (U), it was noted. Water quality measurements were obtained with the use of a Hach AL-36B drop titration and color comparator kit. Visual methods were used to collect the remainder of the field data. Scale samples were soaked, cleaned, and mounted on gummed cards, from which plastic impressions were taken. The scales were read on a microprojector. Ages were determined by totaling the scale annuli. Back-calculations were accomplished by comparing the relative distance from the scale focus to each annulus with the overall scale radius along the dorsal field.

The monitoring of the sport fishery was conducted by systematic angler interviews, usually conducted in conjunction with other studies or field

work. When possible, the man hours of effort and catch statistics were recorded. The aerial char index counts were conducted by two observers in a Bell 206 helicopter. Sampling by hook and line yielded data relative to maturity and spawning timing.

Techniques employed by non-department personnel often closely follow the brief outline presented above. However, the reader should satisfy himself by reading the respective techniques section in each report to determine the degree of conformity or variance.

FINDINGS

Koyukuk River Drainage

The majority of the following data regarding the Koyukuk River background section were either obtained from Selkregg (1977), from various topographic maps of the area, or from the author's experience.

The Koyukuk River drains an approximate 85,470 sq km (33,000 sq mi) portion in the western section of the study area (Fig. 2). The river originates in the Endicott Mountains of the central Brooks Range and then flows approximately 515 km (320 mi) southwest to its confluence with the Yukon River near the village of Koyukuk. Elevations in the headwaters range up to 2,320 m (7,610 ft) and are contrasted by deep glaciated valleys. The major tributaries originating in the Brooks Range include, from west to east, the Alatna, John, Wild, North Fork, Middle Fork, Dietrich, and Bettles rivers. Southward, the river descends through low mountainous terrain and uplands and finally ends in low marshlands. Major tributaries entering the mid to lower portion from the east include the South Fork, Kanuti, Indian, and Dulbi rivers. Lower western tributaries include the Hogatza, Huslia, Kateel and Gisasa rivers. Elevations lower to 35 m (115 ft) at the river's mouth. The climate of the drainage is essentially the same as described earlier for the study area. Temperatures have ranged from 34°C (94°F) in the village of Allakaket to a reported low of -58°C (-72°F). Yearly precipitation varies from 27.9 - 35.6 cm (11 to 14 in). Persistent winds in the Brooks Range are common. Freezeup of the main river occurs on the average in mid-October, with breakup taking place usually by mid-May. The area's larger lakes may exhibit a delay in both cycles by a few weeks.

Several major lake systems drain into or adjoin the Koyukuk River or its main tributaries. In the Brooks Range, going from west to east, they include Norutak, Helpmejack, Takahula, Tobuk, Iniakuk, Ernie, Wild, Delay Pass, Big (Bob Johnson) and Twin lakes. Numerous lowland lakes and sloughs dot the country in the middle-lower river stretches. They are too numerous to individually name, and most have had low use by sport fishermen to date.

Major settlements along the Koyukuk River include pipeline construction camps or pump stations and a few small villages. Townsites or villages

going north to south along the drainage with 1975 census data include Wiseman (24), Bettles/Evansville (57), Allakaket (164), Hughes (98), Huslia (207), and Koyukuk (124). Economics depend on local seasonal labor, trapping, and some limited commercial fishing.

Land status at present is confusing and in a constant state of flux. A large portion has been either filed for or transferred under the Alaska Native Claims Settlement Act. The Federal Government has withdrawn a sizeable portion of the eastern drainage for a utility (pipeline) corridor. The Brooks Range has largely been withdrawn by the Federal Government as national interest lands. Very little land is in state or private ownership.

In the past, fishery investigations have been concentrated in specific portions of the drainage. The lower main river stretches have been investigated and reported by Alt (1968, 1969, 1970, 1971, 1973, 1974, 1975, 1978(a), 1978(b)), and Nagata (1967). Their primary objectives were to determine various life history features of sheefish and obtain sheefish eggs for experimental rearing. However, a good deal of capture data on incidentally caught fish species is available, as is selected life history information and distribution. Alt (1969 and 1971) reported on fall sheefish investigations in the Alatna River. Pearse (1977) reported on limited grayling age growth data from the North Fork Koyukuk River. The majority of the drainage's major lakes located in the Brooks Range have been preliminarily surveyed. Heckart (1965), Roguski and Spetz (1968), and Pearse (1978), have reported on these surveys. Winslow (1969), reported on a limited sample of char in the headwaters of the John River.

Those Koyukuk River tributaries draining the eastern portion of the Koyukuk drainage have been investigated under several intensive studies conducted before, during, and after the construction of the Trans-Alaska Oil Pipeline and adjacent haul road. Early investigations were reported on by the Alaska Department of Fish and Game, 1969. Later studies include those reports by Hallberg (1975), Netsch (1975), and Pearse (1975 and 1977). The above dealt primarily with stream surveys, chemical and biological water parameters, and fish life history summaries.

While not in the Koyukuk drainage, a great deal of fishery survey data is available relating to those waters along the pipeline and haul road north of the Brooks Range which are associated with the Sagavanirktok River system. Those reports include Roguski (1970), McCart and Pepper (1970), Alaska Department of Fish and Game (1972), Yoshihara (1972 and 1973), Furniss (1974 and 1975), Craig and McCart (1974), Griffiths, et al. (1974), and McCart, et al., (1972). A comprehensive summary of stream survey briefs along the entire pipeline route has been compiled by Johnson and Rockwell (1978).

Data relative to commercial and subsistence fish species use and distribution are available from Geiger and Andersen (1977).

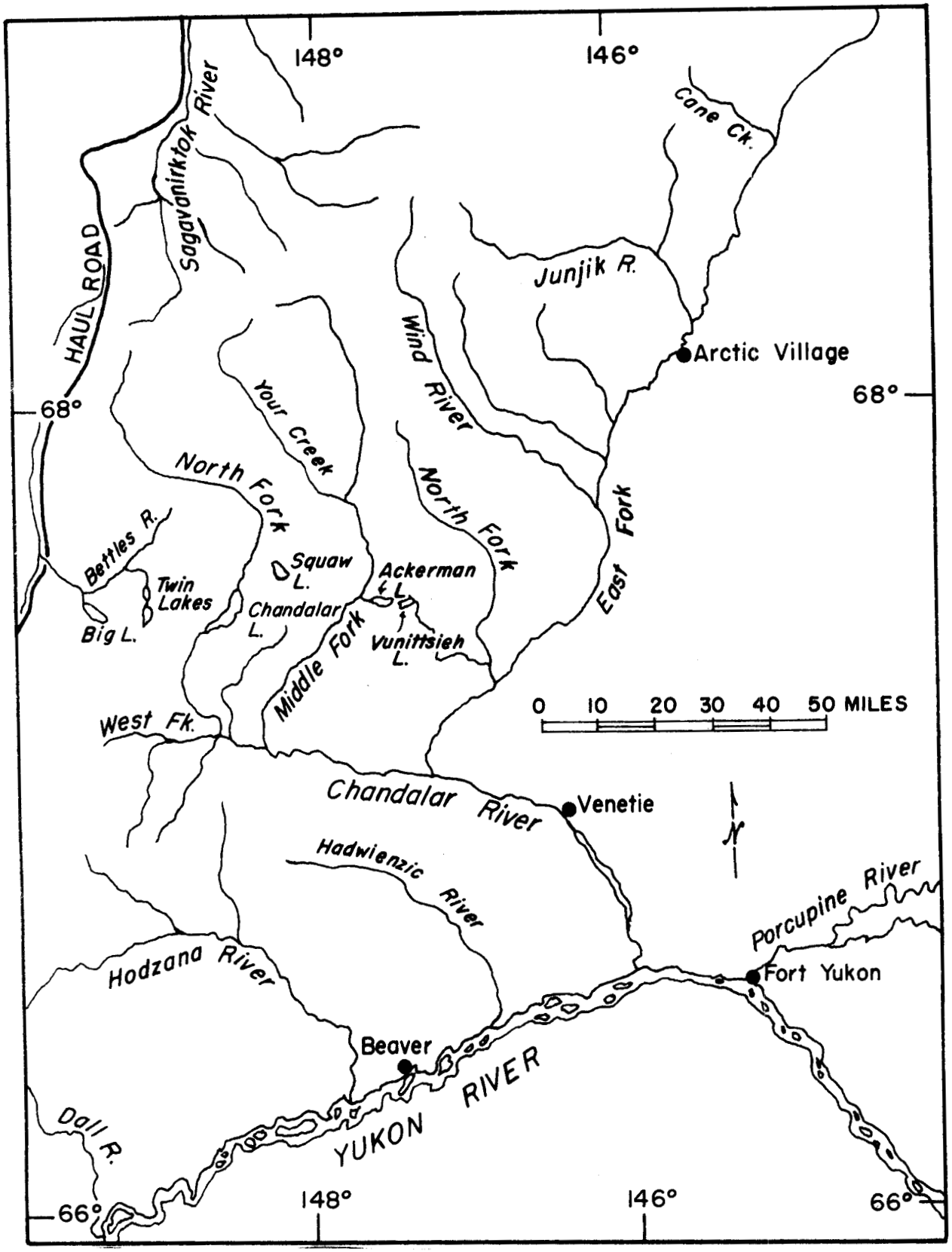

Figure 3. Chandalar River drainage.

Sources of a general fisheries nature that would apply to the Koyukuk drainage include fisheries life history texts by McPhail and Lindsey (1970), Scott and Crossman (1973), Morrow (1974), McLean and Delaney (1978). Selkregg (1977) discusses varied facets of a natural history nature for the region.

Considering the drainage as a whole versus those areas wherein fisheries and habitat investigations have been conducted, it is relatively easy to note those portions that have had adequate fisheries investigations at the present levels of development and exploitation. Those include the waters immediately adjacant to the haul road, the major lakes previously investigated in the Brooks Range, and the lower portion of the main Koyukuk River. Streams where further investigations are needed include the Kanuti, South Fork Koyukuk, North Fork Koyukuk, Wild, John, and Alatna rivers. Preliminary float trip surveys should yield data presently lacking on fish species distribution and habitat classification. Future lake investigations could center on preliminary studies of those smaller waters in the Brooks Range not previously surveyed. The low lying flats along the central and lower main river system have been only superficially investigated and further studies could be conducted at a lower need level than the above.

Chandalar River Drainage

The majority of the following facts comprising the Chandalar River background section were taken either from Selkregg (1977), from various topographic maps of the area, or the author's experience.

The Chandalar River drains an approximate 46,620 sq km (18,000 sq mi) portion in the central section of the study area (Fig. 3). The river orginates in the Philip Smith Mountains of the central Brooks Range and then flows approximately 241 km (150 mi) south and southeasterly to its confluence with the Yukon River near the old village site of Venetie Landing. Elevations in the headwaters range up to 2,555 m (8,048 ft) and are contrasted by deep glaciated valleys. The major tributaries and forks originating in the Brooks Range from west to east include; the West Fork Chandalar, North Fork Chandalar, Middle Fork Chandalar, Wind, Junjik, and the East Fork Chandalar rivers. Southward, the river descends through low foothill mountains and uplands finally ending in low wetlands adjacent to the Yukon River. Few tributaries enter the main river once it exits the Brooks Range foothills. Elevation descends to around 122 m (400 ft) at the river's mouth. The climate of the drainage is essentially the same as described earlier in the general background section. Temperatures at Chandalar Lake in the Brooks Range have ranged from 29°C (85°F) to a low of nearly -57°C (-70°F). Arctic Village on the East Fork Chandalar has shown similar extremes. At Fort Yukon, east of the river's mouth, highs of 38°C (100°F) and lows of -59°C (-75°F) have been recorded. Average annual precipitation in Fort Yukon is around 17.8 cm (7 in) including 114 cm (45 in) of snow. Persistent winds in the Brooks Range and associated mountain passes are common. Summers are characterized by long daylight hours, while little light is present in winter above the Arctic Circle. Freezeup of the main river occurs around early October with breakup taking place usually by mid-May. The area's larger lakes may exhibit a delay in both cycles by a few weeks.

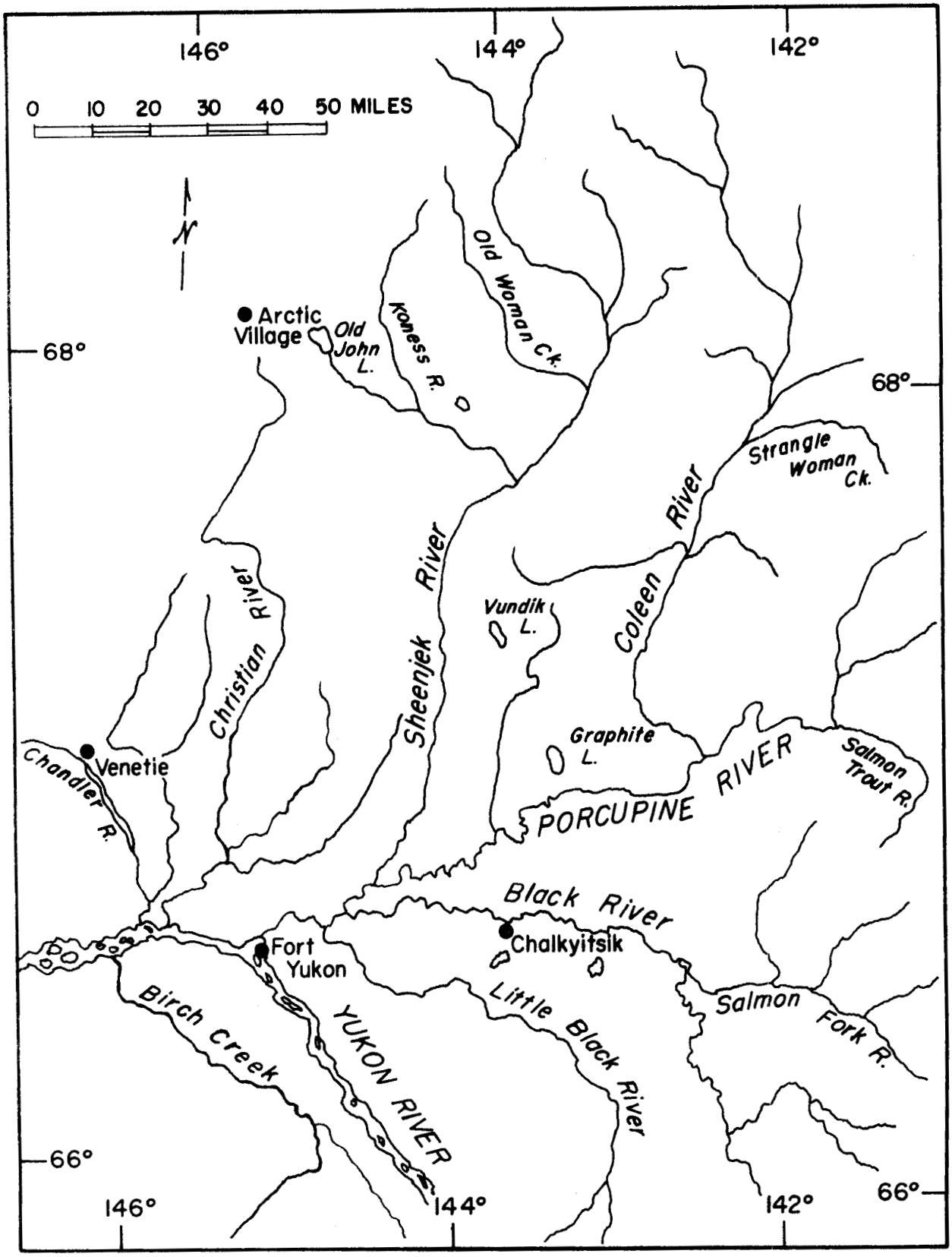

Figure 4. Porcupine River drainage.

Several major lake systems drain into or adjoin the Chandalar River or its main tributaries. In the Brooks Range headwater area, from west to east, they include Chandalar, Squaw, Ackerman, and Vunittsieh lakes. Numerous smaller systems, both within the Brooks Range and to the south along the lower river reaches have not been investigated.

Major population settlements and approximate resident numbers along the Chandalar River include Chandalar Lake (10), Venetie (112), and Arctic Village (85). Economics of the region depends largely on local seasonal labor, trapping, and some limited commercial fishing.

Land status at the time this report was written was at best confusing and subject to constant change. Several groups, including Native village and regional corporations, federal land managers and state interests were all vying for land shares.

As in the adjacent study habitats, past fishery investigations have been concentrated in specific portions of the drainage. Early surveys of Brooks Range lakes were conducted and reported on by Roguski and Spetz (1968). Later, updated Alaska Department of Fish and Game lake surveys were reported on by Pearse (1978). Research on lakes and streams in the upper Chandalar drainage adjacent to the then proposed Arctic gasline route has been reported on by numerous authors. Waters mainly associated with the East Fork Chandalar were investigated. The reports include Craig and McCart (1974), Craig and Wells (1975), McCart (1974), Ward and Craig (1974), and Griffiths, et al. (1974). Limited studies have been conducted on the lower river section. Alt (1973, 1974, 1978) reports on some test fishing and water quality for the main Chandalar River upstream from the Yukon River. Geiger and Andersen (1977), reported on commercial and subsistence use and fish species in the Chandalar system. Childers (1973), describes some limited hydrologic investigation conducted in the river's upper portion. Most waters important for spawning or rearing of anadromous fish species are listed in the Alaska Department of Fish and Game Anadromous Stream Catalog, (1975). Some references of general habitat and fisheries interest include McLean and Delaney (1978), McPhail and Lindsey (1970), Morrow (1974), and Scott and Crossman (1973).

A review of the available literature on the Chandalar River drainage indicates areas where exiting data are adequate for present use levels and population situations. Preliminary lake surveys have been conducted on the largest systems in the drainage. Unless fish population exploitation significantly increases, the data available for those waters should suffice. Numerous smaller lakes in the upper river sections, those found in the Brooks Range, have not been surveyed and could be planned for in the future. Except for the upper East Fork and lower main river, little is known of the river sections concerning their water, habitat, and fish qualities. None of the lakes associated with the lowlands adjacent to the Yukon River have been surveyed.

Porcupine River Drainage

The majority of the following data regarding the Porcupine River background section was taken either from Selkregg (1977), from various topographic maps of the area, or from the author's experience.

The Porcupine River drains an approximate 62,160 sq km (24,000 sq mi) section in the eastern portion of the study area (Fig. 4). The main Porcupine extends into Canada to the east, where it drains an equal amount of country. While originating in Canada, the main northerly American tributaries head in the Davidson Mountains of the Eastern Brooks Range. The southern tributaries originate in foothills along the Eastern Alaska - Canada Border. Flows are generally southwesterly to the confluence with the Yukon River near the village of Fort Yukon. Elevations in the headwaters range up to 2,318 m (7,600 ft) and are contrasted by deep glaciated valleys. The major tributaries orginating in the Brooks Range include from west to east, the Christian, Sheenjek, and Coleen rivers. The Black and the Little Black rivers enter from the southeast. Elevations descend to around 122 m (400 ft) at the river's mouth. The climate of the drainage is essentially the same as described earlier in the general background section.

Recorded temperature extremes at Arctic Village range from a 26.7°C (80°F) to a -55°C (-68°F). The yearly average of 25.4 cm (10 in) of precipitation includes 150 cm (58 in) of snow. At Fort Yukon, near the river's mouth, highs of 38°C (100°F) and lows of -59°C (-75°F) have been recorded. Average annual precipitation in Fort Yukon is around 18 cm (7 in) including 115 cm (45 in) of snow. Winds are persistent and common in the Brooks Range and associated mountain passes. Freezeup of the main Porcupine River occurs around early October, with breakup taking place usually by mid-May. As in adjacent drainages, the area's larger lakes may exhibit a delay in both cycles by a few weeks.

The drainage has fewer major lake systems associated with the Brooks Range than adjoining rivers, Old John and Big Fish lakes being the largest. Numerous smaller waters are distributed throughout the upper Porcupine River tributaries. In the lowlands associated with the middle and lower river stretches, Vundik, Graphite, Ohtig, and Tiinkdhul lakes are the major waters. Also present are numerous shallow lakes and sloughs associated with the low relief and wet terrain. Major populated settlements and approximate population numbers include Arctic Village (85), Chalkyitsik (90), and Fort Yukon (637). The economy of the region depends largely on local seasonal labor, trapping, and limited commercial fishing.

Land status at the time this report was written was at best confusing and subject to constant change. Several groups including, Native village and regional corporations, federal land managers, and state interests were all competing for land shares.

As in adjacent drainages, past fishery investigations have been conducted in specific sections usually in anticipation of, or in response to,

environmental data needs. The main Porcupine River, lower Coleen, Sheenjik, and Black rivers have been investigated and reported on by Alt (1971, 1972, 1973, 1974, 1975, and 1978) as part of Alaska Department of Fish and Game, Sport Fish surveys. The upper Sheenjek and Coleen rivers were investigated by Craig and McCart (1974), Craig and Wells (1975), Griffiths et al. (1974), McCart (1974), and Ward and Craig (1974), under contract to the Arctic gas companies. Geiger and Andersen (1977), present escapement and subsistence records for various salmon species in the main Porcupine River and adjoining tributaries. Some limited hydrologic data have been published by Childers (1973). The majority of waters important for spawning or rearing of anadromous fish species are listed in the Alaska Department of Fish and Game Anadromous Stream Catalog, 1975. Some lake surveys in the middle and upper river sections have been conducted and reported on by Pearse (1978 and 1979 unpublished). All data are in the Department of Fish and Game, Sport Fish Division files in Fairbanks. Some references of general fisheries or habitat interest include Mclean and Delaney (1978), McPhail and Lindsey (1970), Morrow (1974), and Scott and Crossman (1973).

A review of the available literature and survey data on the Porcupine River drainage denotes areas where existing data are adequate for present use levels and fish population situations. Surveys to date on the Coleen, Sheenjek, Porcupine, and Black rivers have yielded sufficient data to answer present and immediate future resource questions. In-depth stream surveys could be planned for the future and the major lakes in the area have only been superficially surveyed. More work could be expended to gather up-to-date information on the largest waters and their fish populations. The low-lying lakes and ponds along the lower main river have not been investigated. Fishery use levels are believed low at present yet surveys giving overall habitat information would be valuable. Most of the smaller lakes along the northern tributaries have been adequately investigated.

ANNOTATED BIBLIOGRAPHY

Alt, K. T. 1968. Sheefish and pike investigations of the upper Yukon and Kuskokwim drainages with emphasis on Minto Flats Drainages. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-5-R-9, 10(17-B): 307-322.

This report discusses early studies conducted on sheefish in the Koyukuk River drainage, primarily in the vicinity of the villages of Hughes and Allakaket. Timing of movements and tagging data are presented. Age and growth is discussed. The results of spawning timing and an experimental egg take are described.

Alt, K. T. 1969. Sheefish and pike investigations of the upper Yukon and Kuskokwim drainages with emphasis on Minto Flats drainage. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration. Annual Report of Progress, Project F-9-1, 11(17-B): 353-368.

Sheefish movements and spawning migrations in the Koyukuk and Alatna rivers are discussed. Age and growth data are analyzed. Tagging data along the Yukon River and several upper tributaries are summarized. A small section on local sport fisheries is included.

Alt, K. T. 1970. Sheefish and pike investigations of the upper Yukon and Kuskokwim drainages with emphasis on Minto Flats drainages. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-9-2, 12(17-B): 321-330.

Discussed in this report are sheefish tagging study results from the lower Yukon and Koyukuk rivers. Population parameter and stock hypotheses are evaluated for sheefish. Spawning observations of sheefish were conducted on the middle Koyukuk and Alatna rivers and spawning populations were enumerated. The results of an egg take are presented.

Alt, K. T. 1971. A life history of sheefish and whitefish in Alaska. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-9-3. 13(R-II).

Job R-II-B. Spawning habits of sheefish in Alaska. 9-10.

This report documents attempts to aerially enumerate spawning sheefish in the Koyukuk and Alatna rivers.

Job R-II-C. Movements, age and growth, and population dynamics of sheefish in the upper Yukon River, Seward Peninsula - Norton Sound streams. 11-16.

This report discusses the results of fisheries surveys in several upper Yukon River tributaries. The Charley, Kandik, Nation, Totonduk, and Seventymile rivers were surveyed. Several sheefish, the study species, were netted. Potential upstream spawning areas were also investigated. Data on incidentally captured species are presented. Results of surveys of the Porcupine and Black rivers are also discussed. Data on fish species captured by river location are tabulated.

Job R-II-F. Distribution, movements, age and growth, and taxonomic status of whitefish *Coregonus sp.* in the Tanana - Yukon drainage and North Slope. 19-31.

The author discusses several taxonomic features of whitefish in Alaska, including those from the upper Yukon River. Distribution, as well as age and growth data, is discussed.

Alt, K. T. 1972. A life history study of sheefish and whitefish in Alaska. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-9-4, 13(R-11).

Job R-II-C. Movements, age and growth, and population dynamics of sheefish in upper Yukon River and Seward Peninsula - Norton Sound streams. 13-15.

The author reports on sheefish studies in several middle and upper Yukon River tributaries. Sampling occurred in the Porcupine, Black, Hodzana, Dall, and Ray rivers, plus Hess, Birch, and Minook creeks.

Sheefish spawning stocks in the Porcupine River are evaluated. Test netting data for all fish species captured are tabulated and a brief section on sheefish migration is presented.

Job R-II-G. Distribution, movements, age and growth, and taxonomic status of whitefish *Coregonus sp.* in the Arctic-Yukon-Kuskokwim area. 23-34.

The author discusses the distribution of Bering cisco, in the vicinity of Hess Creek and the Ray River. Comparative age and growth of broad whitefish is presented; those sampled from the Porcupine River were the fastest growing fish of the systems studied. Taxonomic notes of humpback whitefish from the Dall River, a tributary to the middle Yukon are presented.

Alt, K. T. 1973. A life history study of sheefish and whitefish in Alaska. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-9-5, 14(R-II):

Job R-II-A. Sheefish lake and river adaptability study. 4-10.

The author traces the disposition of one million sheefish eggs taken from the Koyukuk River near Hughes in late 1972. The results of three lake stockings are presented. The paper then discusses various literature searches, water chemistry data, and spawning ground studies that may lend insight into sheefish adaptability in the study area. The author discusses rearing areas for sheefish in the Porcupine and Koyukuk rivers. Water chemistry data from several locations in the Porcupine and upper Yukon river drainages are tabulated. A section on the mechanism of sheefish range extension is presented. The Yukon, Porcupine, and Koyukuk rivers are discussed.

Job R-II-B. Movements, age and growth, spawning ecology, population dynamics, and utilization of sheefish in the middle Yukon River and Norton Sound Streams. 11-22.

This report details fisheries surveys and sheefish studies conducted along the middle Yukon River. That is the portion from the mouth of the Koyukuk River upstream to the town of Fort Yukon, approximately 795 km (494 river mi). The author discusses various aspects of Yukon River sheefish stocks based on data converted from comparative age and growth, tagging, meristics and morphometrics, capture location, and electrophoretic protein studies. A section on test netting results is presented. A tagging program for sheefish is discussed, as are subsequent recapture locations, mainly Yukon tributaries such as the Ray, Dall, and Porcupine rivers. The results of age and growth studies on sheefish from the Porcupine and Black rivers showed their growth rates to be slower than other Alaskan populations except those from the upper Yukon. The data are compared with other Yukon River locations.

Age and growth studies conducted on Rampart sheefish showed their growth to be different from those captured in the Porcupine River.

The known sport and subsistence utilization of middle Yukon River sheefish is discussed. Use levels were low.

Job R-II-C. Distribution, movements, age and growth, and taxonomic status of whitefish in the Arctic-Yukon-Kuskokwim Area. 23-31.

This paper documents whitefish presence in the Hess Creek, Ray, Dall, and Porcupine rivers. Bering cisco meristics from the Yukon and Porcupine rivers are presented. Movements, age and growth, maturity, and food habit statistics are noted.

Alt, K. T. 1974. A life history study of sheefish and whitefish in Alaska. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-9-6, 15(R-II):

R-II-A. A sheefish lake and river adaptability study. p 5.

This segment documents the numbers and fate of sheefish eggs taken near Hughes in October, 1973, from the Koyukuk River.

R-II-C. Movements, age and growth, spawning ecology, population dynamics, and utilization of sheefish in the middle Yukon River and Norton Sound streams. 6-13.

The author summarizes work conducted in 1973, on tagging sheefish in the Ray, Porcupine, and Yukon rivers (Rampart) as well as Hess Creek. Recoveries from previous years were made generally in the same location where tagged. Test netting in the main Yukon and several tributaries was also conducted. Sampled were the Porcupine, Black, Coleen, Ray, Hess, and Dall rivers. No spawning concentrations of sheefish were found and the results of incidental fish captures are noted. The results of tagging at Rampart are summarized. Main Porcupine River and tributary surveys are discussed, as are netting results and population hypotheses. Sheefish taxonomic studies are evaluated. Age and growth of sheefish from the middle Yukon River and major tributaries is tabulated and analyzed. The results of a sheefish electrophoretic study showed no evidence for or against the existence of different populations in the Yukon River.

R-II-G. Distribution, movements, age and growth, and taxonomic status of whitefish in the Tanana drainage. 14-19.

This report discusses test netting results conducted in Beaver Creek, Chandalar River, and Coleen River during 1973. Taxonomic data for humpback whitefish from various Alaska waters, including the Porcupine and Kandik rivers are discussed. Their age and growth from various locations, including the Kandik, Porcupine, Dall, and Ray rivers, as well as Hess Creek, is presented.

Alt, K. T. 1975. A life history study of sheefish and whitefish in Alaska. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-9-7, 16(R-II):

R-II-A. Sheefish lake and river adaptability study. 5-6.

Egg take success of sheefish eggs taken in the Koyukuk River at Hughes, and in the Yukon River at Rampart is discussed. Mortality was 100%, possibly due to egg take or hatchery techniques.

R-II-C. Movements, age and growth, spawning ecology, population dynamics, and utilization of sheefish in the middle Yukon River and Norton Sound streams. 7-19.

This report summarizes the results of the previous four years tagging study in the middle Yukon River. Of the 1,257 sheefish tagged between 1971 and 1974, 83 (6.6%) were recovered. Length and weight data are presented for sheefish. Stock separation hypotheses are discussed. Two populations, lower-middle Yukon and Porcupine rivers are tentatively defined. Yearly sheefish movements are analyzed. Spawning locations were sought through standard mark and recapture methods and radio tagging. The success of the latter is discussed. Other fish species captured in the middle Yukon River tributaries are tabulated. Taxonomic and age and growth data for sheefish are referred to. The food habits of middle Yukon River sheefish are analyzed; the stomach contents are tabulated. The utilization and conservation of sheefish are discussed. Subsistence fishermen are believed to take over 1,000 sheefish, with the sport harvest running less than 500 per year for the middle Yukon River and its tributaries.

Alt, K. T. 1978. A life history of sheefish and whitefish in Alaska. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-9-10, 19(R-II):

Job R-II-A. A sheefish lake and river adaptability study. 5-8.

The numbers and disposition of sheefish eggs taken from the Koyukuk River near Hughes in October, 1977 are described. Sheefish captured near Rampart on the Yukon River were transferred to a lake near Fairbanks for ripening and an egg take. The results of subsequent hatching and lake rearing are explained.

Job R-II-B. Movements, abundance, and spawning ecology of sheefish in the middle Yukon River and lower Yukon River. 8-22.

Test netting results from the lower 145 km (90 mi) of the Koyukuk River are presented. Sheefish were sought but capture data for other species is also presented. Fecundity was determined and discussed for sheefish from the Yukon River near Rampart and from the Salmon Fork of the Black River.

The search for spawning grounds of sheefish passing through the Rampart area of the Yukon River failed to locate spawning grounds or large concentration of spawning fish. The surveys were conducted between Rampart and Fort Yukon during mid-September. Other rivers netted included the Porcupine, Hodzana, and Chandalar rivers and the main Yukon and associated side sloughs.

Two tributaries of the Porcupine River, the Black and Salmon Fork rivers, were also investigated during September, 1977. Movement and fish presence are documented for sheefish and other species. Stock theories are discussed. Age and growth is evaluated as are sex and maturity data.

Alt, K. T. 1978. Summary of success and failures of past egg takes, hatchery success, stocking results, 1967-1978. In-house memo. 10 pp.

The author discusses and evaluates 12 years of an experimental sheefish lake and river adaptability study. Survival success is discussed in relation to egg takes, hatchery conditions, and subsequent pond rearing. The Koyukuk and Yukon rivers were major egg sources.

Childers, J. M., C. E. Sloan, and J. P. Meckel. 1973. Hydrologic reconnaissance of streams and springs in eastern Brooks Range, Alaska during July 1972. United States Dept. of the Interior, Geological Survey. Water Resources Division, Alaska District. Boni-Data Report. 25 pp.

This report contains the results of reconnaissance hydrologic observations on selected Brooks Range streams. Included are data on flood peak and bankfull discharge, drainage basin and channel descriptions, photographs of selected stream sections, plus physical and chemical characteristics of selected spring areas. Of interest in this report are studies of the East Fork Chandalar River, Monument Creek, Sheenjek, and Coleen rivers, plus Strangle Woman Creek.

Craig, P. and P. J. McCart. 1974. Fall spawning and overwintering areas of fish populations along routes of proposed pipeline between Prudhoe Bay and the Mackenzie Delta. Canadian Arctic Gas Study Limited Biological Report Series. 1972-1973. 15: 21-34.

The authors report this study was undertaken to identify areas that are critical to fish populations in streams, in Alaska and the Yukon territory, lying close to the alternate routes of the natural gas pipelines that were proposed by the Canadian Arctic Gas Study Limited. Overwintering areas and spawning grounds of the fall spawning species were considered as a possible means of formulating winter construction recommendations. A background section includes Arctic char life history data and notes on groundwater sources. Descriptions of each system investigated included physical, chemical, and fishery observations. Areas identified as having potential overwintering habitat near the proposed pipeline route include Strangle Woman Creek, Pass Creek, Sheenjek River, East Fork Chandalar River, and Deadman Creek. Streams without known overwintering

areas included the Coleen River, Old Woman Creek, Monument Creek, and Cave Creek. Maps are included. A section is presented defining "critical areas" and the relationships of the environment to fish overwintering needs.

Craig, P. and P. J. McCart. 1974. Classification of stream types in Beaufort Sea drainages between Prudhoe Bay, Alaska, and the Mackenzie Delta. Canadian Arctic Gas Study Limited, Biological Report Series, 17(1): 1-47.

This paper is a description, classification, and analysis of Arctic streams in Beaufort Sea drainages from Prudhoe Bay to the Mackenzie River Delta. The author classifies the northerly flowing streams, including the Saganvirktok River, according to their area of origin. Mountain, spring, and tundra streams are the author's classification. Flow patterns, temperature regimes, water qualities benthic densities, and fish species present are somewhat unique to each classification. The data were collected during 1971 through 1973 and information on the above variables is presented in table form for each stream.

Craig, P. C. and J. Wells. 1975. Fisheries investigations in the Chandalar River region, Northeast Alaska. Canadian Arctic Gas Study Limited (Calgary, Alberta), Biological Report Series. 105 pp.

This report presents the results of fisheries investigations conducted in the headwaters of three major tributaries to the Yukon River. Studies were conducted in the East Fork Chandalar, Sheenjek, and Coleen rivers. All originate in the Brooks Range in Northeastern Alaska and all flows are southerly.

A total of 11 fish species was studied during 1972 and 1973. Aquatic habitats, physical and chemical water data, and associated benthos are described. Fish distribution is extensively analyzed. The life history information section presents species collected in the study area. The species captured included grayling, slimy sculpin, round whitefish, lake trout, Arctic char, broad and humpback whitefish, pike, longnose suckers, burbot, and least cisco. The first three were the most abundant. Discussed in depth for most species were meristic characteristics, spawning areas and timing, age and growth, maturity and spawning frequency, weight relationships, fecundity and egg size, sex ratios, and food habits.

Furniss, R. A. 1974. Inventory and cataloging of Arctic area waters. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-9-6, 16(G-I-I): 45 pp.

The author reports on work accomplished since 1971 on Arctic char in the Sagavanirktok River adjacent to the North Slope Haul Road. Emphasis was placed on recovery of tagged char in the Sagavanirktok River as well as aerial spawning ground enumeration. Data on tagged fish recoveries is tabulated. Sex ratios, spawning condition, and length data are discussed.

Furniss, R. A. 1975. Inventory and cataloging of Arctic area waters. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-9-7, 17(G-I-I): 1-30.

The author discusses final results of a four year Arctic char tagging study initiated in 1971 in the Sagavanirktok River drainage. The results indicated highly specific reproductive homing. Aerial index counts of spawning char showed stable numbers. Spawning frequencies and sex ratios are discussed. Data on inter-river system exchange of anadromous char is presented. Information on other fish species is included. Reference is made to monitoring and technical advisory functioning related to Arctic oil development and pipeline construction.

Geiger, M. F. and F. M. Andersen. 1978. Annual management report, Yukon area. Alaska Dept. of Fish and Game. Division of Commercial Fisheries. 91 pp. plus attachments.

This report, an annual product of the Department of Fish and Game, Commercial Fish Division, summarizes catch, use, and escapement data in salmon stocks subject to commercial and subsistence exploitation. The report opens with an area introduction and background description. District boundaries, commercial fishery history, and subsistence utilization are discussed. Management objectives and schemes are outlined as are notes on special studies directed towards stock and life history analysis. Summaries of 1977 commercial and subsistence catches plus subsequent escapement are included. Outlook and predictions for the 1978 season were presented. The 1978 report was still in preparation when this paper was written. Also included are summaries of data from several years when available. An attachment outlines various commercial and subsistence regulations including appropriate management plans.

Griffiths, W., A. Sekerak, and M. Jones. 1974. Distribution of fish species along alternative gas pipeline corridors in Alaska, the Yukon territory and Northwest territories. Canadian Arctic Gas Study Limited, Biological Report Series, 17(2): 176 pp.

This report represents a synthesis of fish distribution data collected as part of environmental studies conducted by resource consultants for the Arctic Gasline Company. The study is divided into three sections. Section I, lists of drainages and associated fish species; section 2, lists by species, distribution in the various drainages, section 3, consists of maps showing major drainages, the locations of the proposed alternative gasline corridors, the locations of major drainages, and the distribution by drainage of various fish species. Drainages considered include the Koyukuk, Yukon, Sagavanirktok, Chandalar, and Porcupine.

Hallberg, J. E. 1975. Fisheries habitat evaluation along the Trans-Alaska Pipeline Route from Dietrich Pass to the Yukon River, with emphasis on the middle fork Koyukuk River drainage . . . Preliminary Findings. Second Interim Report of the Sport Fish Technical Evaluation Study. Joint State/Federal Fish and Wildlife Advisory Team. 36 pp.

Preliminary results are presented on a study that began in August, 1975, to assess the effects of pipeline construction on fish and fish habitat along the Trans-Alaska Pipeline route from the Yukon River north to Dietrich Pass, with emphasis on the Middle Fork Koyukuk River drainage.

A total of 27 streams was surveyed during August and September, 1975. Completed survey forms and water quality data are presented.

Downstream movements of grayling, began in mid-August. The heaviest concentration occurred between August 25 and September 4, when 298 (of the total of 343) fish passed through weirs on three streams.

Observations of fish in small tundra streams indicated that these streams are utilized for feeding and rearing during the summer months. Side channels and meanders of the Middle Fork Koyukuk River; however, appeared to be used mainly as interstream movement routes. The presence of grayling fry in both areas indicate possible spawning activity.

Analysis of length and age composition of 498 grayling captured within the study area shows a predominance of immatures; 80% of the sample were less than 250 mm in length and 73% were Age V or less.

Heckart, L. 1965. Inventory and cataloging of the sport fish and sport fish waters in the Interior of Alaska. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-5-R-6, 6(15-A): 291-305.

Nine lakes were surveyed in the central Brooks Range, six on the north side and three draining the south slope. Lake trout, Arctic char, grayling, and round whitefish were captured on the north side. Lake trout and northern pike were captured in the three south slope lakes of interest; Walker, Helpmejack, and Iniakuk. General survey data were recorded and filed.

Johnson, R. L. and J. R. Rockwell. 1978. List of streams and other water bodies along the Trans-Alaska Oil Pipeline route. U. S. Dept. of the Interior Alaska Pipeline Office. Fourth Revision. Draft.

The author's purpose in preparing this report is to identify water bodies and locations of stream crossings along the Trans-Alaska Pipeline and associated access roads. Included are physical and biological descriptions, plus references to data sources. This stream catalogue is probably the most exhaustive single source of data briefs for the pipeline route from Valdez to Prudhoe Bay. While not biologically complete on each system, it does allow the reader to potentially identify water body locations and partially reference past studies.

McCart, P. 1974. Late winter surveys of lakes and streams in Canada and Alaska along the Gas Pipeline routes under consideration by Canadian Arctic Gas Study Limited. 1972-1973. Canadian Arctic Gas Study Limited, Biological Report Series, 15(1): 58-90.

This report is a compilation of data gathered during late winter stream surveys along gas pipeline routes at one time proposed by Canadian Arctic Gas Pipeline Limited and Alaska Arctic Gas Pipeline Company. The surveys were conducted during April, 1973. The objectives were to determine water quantity, quality, overwintering potential, and fish presence in lakes and streams along the route. The investigators looked at the East Fork Chandalar River, Old Woman Creek, Monument Creek, Sheenjek River, Grayling Lake, Ross Creek, Coleen River, Strangle Woman Creek, and Blackfish and Redfish lakes. Maps of the routes and systems studied are included.

McCart, P., and V. Pepper. 1970. Report on fish investigations along part of proposed route of Trans-Alaska Pipeline, June to August, 1969. Preliminary report on the ecology survey along the proposed pipeline route June through October, 1969. 22-64. Trans-Alaska Pipeline System, Anchorage, Alaska.

This report presents results of early fisheries surveys along the proposed Trans-Alaska Pipeline route between Hess Creek and Prudhoe Bay. The report consists of descriptions of a few of the major lakes and streams lying along the pipeline route. Fisheries data are general in nature and limited to presence notation. Associated environmental observations are included. Additionally, comments relating to possible effects of the pipeline on specific systems are dated by the time context.

McCart, P., P. Craig, and H. Bain. 1972. Report on fisheries investigation in the Sagavanirktok River and neighboring drainages. Report to Alyeska Pipeline Service Company. 170 pp.

In preparation for construction of the Trans-Alaska Oil Pipeline, the Alyeska Pipeline Service Company undertook a study of the ecology of the fishes of the area north of the Brooks Range. This report is a summary of the author's findings relative to waters along and adjacent to the proposed pipeline route. The report is lengthy and only major topics selected for discussion will be mentioned here. The authors discuss environmental factors unique to the North Slope and review descriptions of the area's lakes and streams. The results of benthic studies are presented and compared to other areas. The fisheries section is presented by species, with data on Arctic char, lake trout, round whitefish, and grayling being discussed. Age and growth, sex and maturity, spawning factors, and food preferences are touched upon for each species. Numerous tables and figures outline pertinent data and fish distribution.

McLean, R. F., and K. J. Delaney. 1978. Alaska's Fisheries Atlas. State of Alaska, Dept. of Fish and Game.

This two volume atlas is the result of an effort to bring together an overview of distributions and critical habitat of Alaska's finfish and shellfish. According to the authors, "past surveys and research have resulted in a certain amount of fisheries information, the need to make land, water, and fisheries management decisions led to the publishing of a great portion of that data." It should be noted that, in this author's opinion, not all available data have been included and that appropriate

departmental divisions should be contacted for specific information. The format for each atlas consists of three parts: fish species accounts, area accounts, and fish distribution maps. The fish species accounts relate general life history facts, distribution, and general habitat requirements of each species. The area accounts describe each regulatory area and include data on distribution, timing and exploitive uses of each species within the area. The fish distribution maps are marked to illustrate most known species distributions, and areas of special life history or uses. Volume I, treats commercial fisheries management areas and species, while Volume II is concerned with sport fish regulatory areas.

McPhail, J. D. and C. C. Lindsey. 1970. Freshwater fishes of Northwestern Canada and Alaska. Fisheries Research Board of Canada, Bulletin 173. 381 pp.

This publication is a compilation of general information on approximately 60 species of freshwater fishes found in Alaska and Northwestern Canada. Background information in part consists of the history of previous publications on northern freshwater fishes and an outline of geological history and fishery dispersal routes. Classification and nomenclature, species descriptions and methods of fish identification, plus family keys are also discussed. Species accounts typically include distinguishing characteristics, physical descriptions, distribution, taxonomic notes, post glacial dispersal, and general life history biology.

Morrow, J. E. 1974. Illustrated keys to the freshwater fishes of Alaska. 78 pp.

The author states that "this booklet includes all the fishes so far known to inhabit or to occur occasionally in fresh waters of Alaska". The intent of the book is to provide identification keys down to the species level. Included are brief discussions of range as well as sketches of each fish.

Nagata, T. 1967. Sheefish investigations in the Minto Lake drainages. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-5-R-8, 8(17-B): 275-264.

The author discusses results of sheefish studies on the Koyukuk River in the western study area. Age and growth, spawning, and food habits are presented.

Netsch, N. F. 1975. Fishery resources of waters along the route of the Trans-Alaska Pipeline between Yukon River and Atigun Pass in North Central Alaska. U. S. Fish and Wildlife Service. Resource Publication 124. 45 pp.

Pre-construction investigations of fishery resources along the 185-mile segment of the Trans-Alaska Pipeline route between the Yukon River and Atigun Pass are described. The major initial objective was to compile a list of waters that supported fish and to note basic water quality data. A total of 209 waters was surveyed in 1971 and 1972, 100 of which supported

fish. Nineteen fish species are reported. Physical and chemical data for selected systems are presented. A section is written summarizing winter observations of the major river systems. Fisheries of the survey area are described. Commercial and subsistence catches are summarized and records of sport success by survey crew members are noted. Movements, populations, and growth of grayling and other fish species are discussed in depth. Results of tagging studies are included. A sampling techniques comparison section is presented, as is a discussion of gear efficiency.

Pearse, G. A. 1976. Fisheries habitat evaluation along the Trans-Alaska Pipeline route from Dietrich Pass to the Yukon River, with emphasis on the Middle Fork Koyukuk River drainage. Final Report of the Sport Fish Technical Evaluation Study. Joint State/Federal Fish and Wildlife Advisory Team. 66 pp. Unpublished.

This report presents baseline fisheries data collected on the Middle Fork Koyukuk River and its tributaries. The work was conducted under contract to the Joint Federal/State Federal Fish and Wildlife Advisory Team by the Alaska Dept. of Fish and Game, Sport Fish Division. Detailed descriptions drawn from data collected over several years on major tributaries to, and including, the Middle Fork Koyukuk River are presented. Water temperatures, chemistry, flows, physical description, and fish presence are documented. The results of age and growth studies are presented for key fish species, along with comparative data from other populations. Movement and migration trends and the results of weir operations conducted during 1975 and 1976 are summarized. An assessment of the visible effects and implications of spur dike (river training structure) construction on the Middle Fork Koyukuk River is discussed.

Pearse, G. A. 1977. Inventory and cataloging of Arctic area waters. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-9-9, 18((G-I-I): 55-93.

Data and discussions centering on a three part survey program in Arctic Alaska are presented.

The first phase centered on sport fishery monitoring in the Prudhoe Bay area during 1975. Arctic char and grayling are the sought after species. Catch levels were low.

The second phase consisted of conducting aerial index counts of spawning Arctic char in the upper Sagavanirktok River drainage. The counts, conducted since 1971, showed stable population levels in the surveyed sections.

The third phase focused on fishery studies in the upper Middle Fork Koyukuk River adjacent to and concurrent with construction of the Trans-Alaska Oil Pipeline. Studies on habitat types, major tributaries to the Middle Fork Koyukuk, fish movements and migrations, visible effects of pipeline construction, and age and growth of selected fish species were conducted and are analyzed in the report.

Pearse, G. A. 1978. Inventory and cataloging of Interior waters with emphasis on the upper Yukon and Haul Road areas. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-9-10, 19(G-I-N): 1-35

The report summarizes lake surveys conducted in an approximate 41,000 sq mi area of northeastern Alaska during 1977. Fifteen key lakes were selected for survey based on representative habitat and fishery types. Seventeen fish species were either captured in 1977 or reported present from previous surveys.

Standard Alaska Department of Fish and Game lake surveys were conducted and are summarized with a narrative. Length, weight, and condition factors are discussed. Both calculated lengths and ages are presented.

Documented sport use levels were low and are discussed along with a background description of the area. Detailed survey forms and life history data are on file in the Fairbanks office.

Roguski, E. A. and C. Spetz. 1968. Inventory and cataloging of the sport fish and sport fish waters in the Interior of Alaska. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-5-R-9, 9(15-A): 265-285.

This report presents the results of preliminary lake surveys of 12 waters on the south slope of the Brooks Range. Test netting for fish species present was limited to one-night sets. Data relative to captured fish species composition, length, weight and age ranges, plus limnological features are presented. Observations of the recording biologist are also included.

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

Preliminary lake and stream surveys of 7 lakes and 11 rivers and creeks along the haul road are presented. Fish species composition plus some limited age and growth data are tabulated.

Scott, W. B. and E. J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Bulletin 184. 966 pp.

This monograph on the freshwater fishes of Canada presents written accounts of 24 families and 177 freshwater species that are found in Canada. A typical species account might consist of a physical description, color variations, systematic notes, range and distribution, biology and life history, plus relationship to man. Many species found in Canada are distributed through portions of Alaska and the data relative to each species should also apply.

Selkregg, L. 1977. Alaska regional profiles: Yukon Region. University of Alaska, Arctic Environmental Information and Data Center, Vol. VI. 346 pp.

This volume, the last in the series of Alaska Regional Profiles prepared by the University of Alaska, presents basic comprehensive facts relative to the nature and man made environment of central Interior Alaska. In all, 528,360 km^2 (204,000 sq mi) or 35% of Alaska's 1,517,740 km^2 (586,000 sq mi) are discussed in this volume. Included are the lowlands and plains of Central and Western Alaska and the Interior highlands drained by the Yukon River and its tributaries. The volume is divided into several segments; typically each section contains general facts and factors common to similar natural settings. Additional environmental topics discussed include climatological and setting descriptions, topography, geology, water, and soils data. Discussion of the biotic communities include forest resources, terrestrial and aquatic vegetation, terrestrial animals, aquatic animals including fish data, plus utilization of the various resources. The man-made environment is also reviewed, including facts on the people, land status, and community facilities.

Ward, P. and P. Craig. 1974. Catalogue of streams, lakes and coastal areas in Alaska along routes of the proposed Gas Pipeline from Prudhoe Bay, Alaska to the Alaskan/Canadian Border. Canadian Arctic Gas Study Limited Biological Report Series, 19: 291-371.

This stream catalog is a compilation of information on streams in northeast Alaska within a broadly defined corridor on either side of the major routes then under construction by the Arctic Gas Study Company. A portion of the volume that deals with South Slope lakes and streams is of pertinence here. Described in the text are surveys of several tributaries of the Yukon and Porcupine River drainages, as well as surveys of the few large lakes and several smaller lakes and ponds. The major streams include the Chandalar, Sheenjek, and Coleen rivers, the smaller streams studied were Junjik River, and Cane, Old Woman, Spring, Deadman, Monument, Pass, Red Sheep, and Strangle Woman creeks. Several unnamed systems are also discussed. Grayling were the predominant species in both lakes and streams. In general, the surveys present assessments of overall habitat type, fishing pressure, winter conditions, water chemistries, and benthic invertebrate study results. Maps are included.

Winslow, P. C. 1969. Investigations and cataloging of sport fish and sport fish waters in Interior Alaska - char in Northwestern Alaska. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Progress Report, Project F-9-1, 10(15-A): 319-332.

Age, growth, and meristics of char sampled from the upper John River in the vicinity of Anaktuvuk Village are discussed.

Yoshihara, H. T. 1973. Monitoring and Evaluation of Arctic waters with emphasis on the North Slope drainages. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-9-5, (G-III-A): 83 pp.

Part A: Some Life History Aspect of Arctic Char

Areas of study were centered in the vicinity of oil development projects on the North Slope and directly along the then proposed alignment of the Trans-Alaska Oil Pipeline and adjacent haul road. The author studied early life histroy aspects of Arctic char. Migratory patterns are described. Age and growth plus length and weight data are extensively reported on. The preliminary results of tagging studies are referenced. Spawning observations are made and fecundity is analyzed.

Part B: Pipeline and Haul Road Crossing Surveys

The author presents data from surveys conducted on waterways scheduled, at that time, to be traversed by the pipeline and Haul Road. Twenty-six streams in addition to the 14 then proposed crossing sites of the Sagavanirktok River were surveyed. Information relative to fish species present, migration timing, survey status, and fish productively are presented by the author. Information describing chemical, physical, and biological characteristics are discussed. Fishery use data are presented. No commercial or subsistence use occurred at that time (1973). Capture rate during test sport fishing by department employees on the Ivishak River varied from 1.5 char per man-hour in July to 16.4 per man-hour in September.

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

The author reports on investigations directed toward the Sagavanirktok River drainage between the Brooks Range and Prudhoe Bay adjacent to the North Slope Haul Road. Areas of study were centered in the vicinity of oil-related development projects and directly along the then proposed alignment of the Trans-Alaska Oil Pipeline and the adjacent Haul Road. Attempts were made to ascertain the magnitude of problem areas where fishery resources may have been disrupted due to construction. Survey data of lakes and streams crossed by or adjacent to the Haul Road and pipeline are presented. Discussed are fish presence, estimated productivity, water quality measurements, and migration timing. Aerial surveys to determine distribution and relative abundance of anadromous Arctic char are included. Some observations on ice conditions of possible over-wintering areas are described. Arctic char life history aspects are included concerning movements, spawning, plus age and growth. Results of fish movements through an experimental weir on the Lupine River are discussed.

Anonymous. 1969. Pre-construction fishery surveys along the Haul Road corridor. State of Alaska, Department of Fish and Game Joint Fish and Wildlife Advisory Team. Unpublished.

Included in this in-house survey data file are initial stream surveys from the Brooks Range south to the Chatanika River. Narrative summaries of the survey forms are included.

Anonymous. 1972. Pre-construction fishery surveys. North Slope Haul Road and Pipeline Crossings. State of Alaska, Dept. of Fish and Game. Unpublished.

This in-house report is a collection of fish survey data collected during pre-construction fishery surveys along the Haul Road north of the Brooks Range. Survey forms and map references are included. A portion of the data was presented by Yoshihara (1972 and 1973).

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