FISHERIES SURVEY OF TANANA RIVER TRIBUTARIES ALONG THE ALCAN GAS PIPELINE ROUTE

TR-2-1

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

ABSTRACT

A fisheries survey was conducted of the proposed Alcan gas pipeline route between Delta Junction and the Alaska-Canada border. A total of 29 streams and 11 ponds were found or documented to support fish. The majority of these fishery streams originate as spring-fed or snowmelt waters. Many are formed by glacial runoff, although the large glacial rivers do not support fish in summer, and a few drain bogs and marshes. Although no commercial fishery exists in any of these Tanana River tributaries, small subsistence fisheries are known in some areas. The most significant use of the fishery is recreational, and that is only moderate.

The proposed Alcan route can be expected to impact the fishery of these streams only moderately. Since much of the gas line is proposed through an existing corridor, clearing of vegetation should remain minimal. The most dramatic impact is expected to come from gravel mining operations and construction of stream crossings, i.e., culverts, bridges, subriverine trenches. Wise monitoring of the construction activities can alleviate many irrecoverable environmental damages.

INTRODUCTION

This survey of streams and lakes along the proposed Alcan Gas Pipeline route was conducted for Northwest Pipeline Corporation. Its purpose is to assess existing fish populations in waters adjacent to, or traversed by, the pipeline corridor between Delta Junction, Alaska and the Alaska-Yukon Border (Figure 1). This report presents the findings of the survey in a station-by-station description and in a table of fish species found in each. It represents the biological baseline on which recommendations were made to the Federal Power Commission concerning pipeline route selection (BIO/WEST, 1976).

The survey was conducted during July 1976. Findings of field collections were supplemented by other reports and by interviews with local residents in an attempt to provide a characterization of some physical and chemical aspects of each area as well as a complete list of fish species and their relative abundances.

Quantitative information on the fishes of the Tanana River tributaries is sparse. The inventory and catalog reports by Pearse (1976), of the Alaska Department of Fish and Game (ADFG), were a principal source of information. These provide a good physical and chemical description of many of these streams and lakes, as well as a record of their fish populations. Also, just prior to this survey, Van Hyning (1976) conducted a reconnaissance of the fish resources along the discussed pipeline route. Interviews with local residents and with employees of ADFG provided us with much of the more recent and unpublished information.

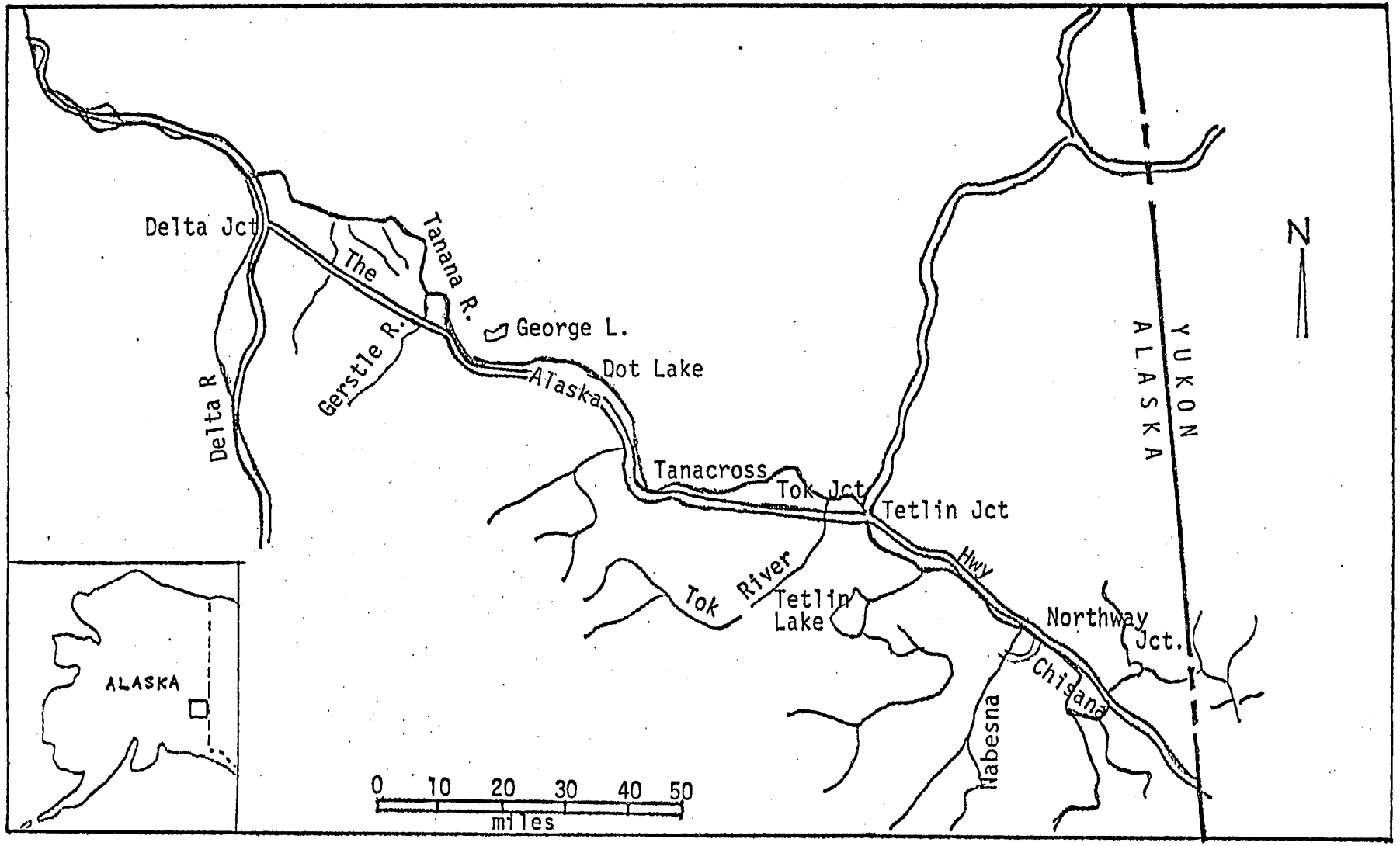

Figure 1. The Tanana River and its tributaries along the Alcan Highway and proposed Alcan gas pipeline in east-central Alaska.

GENERAL AREA DESCRIPTION

All waters surveyed drain into the Tanana River of east-central Alaska and flow perpendicular to the proposed Alcan route and the Alaska-Canada (Alcan) Highway. Most of the streams originate as glaciers or springs in the snowcapped Alaska Range and flow 30 to 40 miles northeast into the Tanana River, emptying not more than 5 miles below the highway. Others originate in lowland bogs and marshes and meander for their entirety into the river. The lakes are all small and shallow with muddy bottoms and dense stands of aquatic vegetation.

The significance in finding certain fish species in the restricted area of the pipeline corridor during our July survey is difficult to assess without adequate knowledge of specific fish life histories. A general description of the behavior of the more abundant fish species is warranted and will serve to introduce the reader to the area and its aquatic fauna. To do this, it is necessary to draw inferences from other studies of similar rivers in Alaska (Netsch, 1975; Vascotto and Morrow, 1973) and reveal something of the climatic conditions of the area.

The life history of these aquatic fishes is greatly influenced by the character of their environment; extremely cold, long winters and short, dry, hot summers. Annual air temperatures along the Tanana River system range from -70 to +90 F. Annual precipitation averages around 12 inches, with most occurring between June and September.

The severely cold Alaskan temperatures cause icing in streams and lakes from late September to mid-April. The smaller streams may freeze

solidly except in areas kept flowing by perennial springs. The large rivers often continue to flow, but only under several feet of surface ice. The small and shallow lakes frequently freeze solidly. Few lakes in this area are deep enough to stave off complete icing or anaerobic conditions to maintain perennial fish populations.

In the summer (June - September), all tributaries of the Tanana River are ice-free. All of the large rivers and many of the small streams are fed by glacial melt. The water from these is heavily laden with till and the rivers are highly turbid, quite in contrast to the crystal clear flow of winter.

Most of the fishes of the Tanana River watershed apparently overwinter in the clear riverine waters flowing beneath the thick surface ice. As early as mid-April, adult grayling (Thymallus arcticus) move upstream into the thawing streams. They are followed by immature grayling and perhaps some whitefish (Prosopium sp. and Coregonus sp.). The grayling spawn as soon as the streams are ice-free and the water temperatures rise, in May or June. The adults leave the small tributaries immediately after spawning, remaining in the more silt-free downstream waters. The immature fish remain in the small tributaries until late August or September. A general downstream movement occurs in fall, as glacial melting is retarded and silt load in the rivers is reduced.

Round whitefish (Prosopium cylindraceum) and humpback whitefish (Coregonus pidschian) behave similarly, but their upstream movement

occurs later. The downstream movement apparently is synchronized with that of the grayling.

Northern pike (Esox lucius) and burbot (Lota lota) also ascend the streams in spring, but their movement is not as extensive and many fish remain in the tributaries near the river or in adjacent sloughs.

Mystery still surrounds the life history of the Dolly Varden (Salvelinus malma) of the small tributaries. Since this species is a fall and winter spawner, its downstream migration may well occur under ice in winter. If the streams are completely frozen, however, this fish may be forced to overwinter in perennial springs. Some investigators believe that this often happens and that the Dolly Varden is sometimes accompanied by grayling and whitefish (Morrow, 1976).

Little is known of the other less abundant species in the Tanana River above Delta Junction. The chum salmon (Oncorhynchus keta) that spawn in the area are few and most are seen in late August and September.

Thus, the absence or presence of fish near the corridor at any one time of the year may be of little value in assessing the density and composition of the fish populations in a given stream or lake. For this reason, a reconnaissance of the upper watersheds was conducted by helicopter. The presence of fish in the upper watershed means that the stream is probably used as a migration avenue to and from the spawning areas. Interviews with ADFG personnel also aided interpretations of survey findings.

METHODS

All of the streams and lakes of interest were accessible by motor vehicle and by hiking, since the proposed pipeline corridor parallels the Alcan Highway and is never more than 1/2 mile away. A helicopter was used for 2 days to see and visit the upper watersheds of the streams and to provide a more complete picture of fish use in each.

A standard field data form, similar to those used by ADFG, was completed for each stream or lake visited. Included on this form are measures of water temperature, estimated flow, substrate type, and channel configuration, as well as numbers and kinds of fishes and macroinvertebrates encountered. A second form was used to record the species, length, and weight of each fish caught. Copies of these forms are available from BIO/WEST upon request.

Fish

Relative numbers of stream fishes were determined with seines and electro-fishing gear. The total number of each species caught from a measured section of stream was documented and individual fish weighed and measured. All fish were returned live to their place of capture. Visual counts of fish in the clear, slow-flowing streams were also made and expressed as numbers in linear stream distance. Abundance of each species was classified as abundant, numerous, or rare.

Macroinvertebrates

A qualitative survey of benthic macroinvertebrates was made in each stream visited. Organisms were collected with a kick screen and preserved in labelled vials with ethol alcohol for later identification. The more apparent taxa were classified in the field. Abundance was expressed in the same manner as the fishes.

SITE DESCRIPTIONS

A total of 29 streams (rivers and creeks) and 11 lakes and ponds along the Alcan corridor between Delta Junction and the Alaska-Canada border were found to support fish during this July survey (Appendix, Table 1). The eight major rivers all have summer flows in excess of 70 cubic feet per second (cfs). These rivers are heavily laden with glacial silt and flow through extensively braided channels of mud-silt and cobble.

There is considerable variation in the physical and chemical features of the 21 creeks examined. Summertime flows vary from 0.32 to 192 cfs. Some of these flow clear except during freshets, while others flow continually laden with mud and glacial silt. Still others have water darkened by humic stain. Many of these creeks vary in coloration inside a distance of 20 miles, flowing clear near their origin but becoming stained as they flow through stands of spruce, birch, and alder.

The waters along the proposed corridor are believed to support 14 species of fish, including 5 salmonids, 3 coregonids, and 1 each of the families cottidae, catostomidae, esocidae, cyprinidae, gadidae, and thymallidae (Appendix, Table 1). Common and scientific names are provided in Table 1 of the appendix, and only common names are used in the text.

A description of each water known to support fish is offered to provide detailed information on the known status of each population. Each station is located by use of the Alcan Highway roadside mileposts which begin at Dawson Creek, British Columbia and end in Delta Junction, Alaska.

Granite Creek

This creek drains the area of the Alaska Range north of the Granite Mountains and flows under the Alcan Highway about 12 miles southeast of Delta Junction. Granite Creek remained dry at the highway throughout July, even during heavy rainstorms that stimulated freshets in other nearby creeks. When observed via helicopter, Granite Creek was found to flow about 183 cfs some 19 miles upstream of the highway, becoming subterranean about 2-1/2 miles upstream. This creek is believed to flow entirely above ground during spring runoff and occasional summer freshets.

Although no fish were encountered at any of three sites surveyed (3-1/2, 19, and 24 miles above the highway), fish habitat and food

supply were considered very adequate. Mayflies, caddisflies, blackflies, stoneflies, and true flies were numerous to abundant in the clear pools and riffles of the stream, indicating that winter icing in the substrate is incomplete.

No previous fishery information is available for the area upstream of the highway. Pearse (1976) reports that the area of the Tanana near the outlet of Granite Creek is possibly used as a rearing site by silver salmon and grayling. It is highly probable that a few grayling and possibly some Dolly Varden gain access to Granite Creek in spring (April-June) and become stranded in the upper watershed during summer drought. These fish are able to survive only if they can escape the frozen stream conditions by emigrating in early winter (September-October) or by overwintering in perennial springs.

Rhoads Creek

Rhoads Creek is smaller, but similar physically and biologically to Granite Creek. It traverses the Alcan Highway at mile 1407.6, where it remained dry all of July. Flow about 5 miles above the highway was 25 cfs and, like Granite Creek, it flowed underground about 3 miles above the highway.

The fishery of this stream is unknown, but it is believed to periodically support a few grayling and Dolly Varden (Peckham, 1976), although the seasonal nature of its flow precludes the occurrence of large populations. Like Granite Creek, Rhoads Creek probably flows

entirely above ground in spring and during freshets, providing for movement by fishes.

Sawmill Creek

Like Granite and Rhoads creeks, Sawmill Creek became subterranean about 2-1/2 miles above the Alcan Highway. About 4 miles above the highway, Sawmill Creek flowed about 96 cfs in July. No fish were encountered at this site, although the pool-riffle situation was favorable and the macroinvertebrate fauna very adequate as a food supply; an abundance of mayflies, stoneflies, caddisflies, blackflies, and midges were found.

An estimated 50 cfs of muddy water flowed under the highway bridge after a rainstorm on July 25, 1976. Flow continued for about 5 days, with the water clearing after the second. No fish were observed in the stream at this time, although this phenomenon of a sudden increase in flow supports the hypothesis that Granite, Rhoads, and Sawmill creeks do exhibit summer freshets for access by fish. The presence of fish in Sawmill Creek is also probable from mid-April through June and September through mid-October.

Gerstle River

No fish were captured in this large, heavily silted, extensively braided glacial river. Pearse (1976) reports that "present fishery use is nonexistent." Mr. Bud Coiley (1976), owner and manager of George

Lake Lodge, believes that the Gerstle probably supports some grayling and Dolly Varden. These, Mr. Coiley suspects, spend the summer in clear upstream tributaries and overwinter in the river proper. The Gerstle River is part of Mr. Coiley's winter fur trap line. Mr. Coiley also reports seeing the phenomenon of aufeising on the Gerstle River. Piles of ice many feet high are created by continued supplies of super-cooled water to the existing ice surface. Since this usually occurs near perennial springs, it provides evidence that although the Gerstle River may freeze solidly, it is capable of supporting overwintering fish.

No clear habitable feeder streams were observed in the 30 miles between the Alcan Highway and the Gerstle Glacier when surveyed by helicopter. There are many streams, but all cascade too precipitously to allow access to fish and to provide adequate pool habitat. These streams usually flowed on bedrock substrate, precluding the existence of macroinvertebrates.

If fish ascend the Gerstle in the clear waters of springtime and spawn in clear tributaries unknown to us, then it is presumed that they return to the Gerstle River or Tanana River in fall. Based on these assumptions, fish may inhabit the Gerstle from mid-April through June, and September through mid-October, when the grayling and whitefish are moving through.

Little Gerstle River

This river at the highway is about 42 feet wide and flowed, heavily laden with glacial silt, at a rate of about 72 cfs in July. The Little Gerstle flows on a pebble-cobble-boulder channel.

A 1000-foot section of river upstream of the Alcan Highway yielded 2 grayling, 4 longnose suckers, 1 round whitefish, and 1 slimy sculpin to seining on July 5, 1976. Electrofishing in the same area yielded 5 grayling and 1 round whitefish on July 28, 1976.

At Pegmatite Creek, a tributary of the Little Gerstle River about 15 miles above the highway, 3 grayling were captured with electrofishing gear and many other fish were seen in the deep, slow-flowing channel. Other feeder streams with similar habitat were seen from the helicopter, giving the impression that grayling were abundant in the upper watershed of this small river in July.

Since a small population of grayling, whitefish, sculpin, and suckers was present in the river proper in July, the times in which fish are present in the Little Gerstle River probably extends from mid-April through September.

Craig Lake

Craig Lake was not visited during this survey since it lies about 1 mile from the proposed pipeline route and will probably not be directly impacted by construction activities.

This 17-acre lake is stocked by ADFG with rainbow trout and silver salmon, and is also known to support lake chub (Pearse, 1976).

Lisa Lake

Rainbow trout and silver salmon are stocked in Lisa Lake, producing excellent fishing until recent years. Reduced stocking is recommended by Pearse (1976) because of a decreasing water level. Increased human activity in the area could result in increased fishing pressure to both Lisa and Craig lakes.

Johnson River

The Johnson River originates with the Johnson Glacier near the Mount Kimball area of the Alaska Range and flows north and northeast between the Macomb Plateau and Independent Ridge. It is spanned by the Alcan Highway at mile 1380.3.

No fish were captured from this large, glacial, braided river when sampled in July. Presumably, the silty waters are incompatible to fish during summer.

Two feeder streams, 3 to 4 miles upstream of the highway, were found to contain numerous whitefish, Dolly Varden, and grayling. These fish probably summer in these clear, spring-fed streams and then move into the Johnson and Tanana rivers in fall and winter, before most of the streams freeze. These fish apparently use the Johnson River as an

avenue of migration to the Tanana River, or they may overwinter in unfrozen areas or perennial springs.

Sloughs formed by the Johnson River at its confluence with the Tanana probably support northern pike, lake chub, and burbot (Pearse, 1976).

Dry Creek

Dry Creek flows north from the Macomb Plateau into the Johnson Slough and then into the Tanana River. This creek remained dry at the highway during July, in spite of three heavy rainstorms that recharged flow in other nearby dry streams. Like Granite and Sawmill creeks, Dry Creek became subterranean about 1 mile upstream of the highway.

About 7 miles above the highway, Dry Creek flows through a deep, narrow gorge of the Macomb Plateau in a boulder and cobble channel lined with alder and low-growing tundra. There is some gravel and pebble in the substrate, but 80 percent is composed of boulders and cobble. The stream filled the entire channel at a rate of about 95 cfs on July 26. The macroinvertebrate fauna at this site consisted of an abundance of baetid and heptageniid mayfly nymphs, larvae of blackflies, and immature stoneflies. Although the pool-riffle situation presented a very favorable habitat for lotic fishes, none were encountered with electrofishing gear.

Further downstream, Dry Creek flows through alder, willow, and spruce stands in which the water is stained brown. A number of permanent

dwellings are located up to 4 miles upstream from the highway. According to these residents, an abundance of grayling, up to 16 inches long, ascend Dry Creek in May and June and numerous whitefish ascend in August. These fish descend to the Tanana River in September. Dolly Varden are found with the grayling and whitefish, although it is believed that these are permanent residents that overwinter in stream sections kept flowing by perennial springs. Dry Creek was electrofished adjacent to these dwellings but no fish were seen or captured. It is possible that the fishing pressure here keeps the local numbers of fish low.

The present number of inhabitants along Dry Creek probably does not constitute a severe pollution problem. Open-pit toilets and septic tank systems, situated away from the stream, are used exclusively. However, porosity and organic character of the soil and underlying substrate would have to be known to fully evaluate the potential of this problem. During our visit on July 26, 1976, we observed no physical evidence of gross pollution in Dry Creek, i.e., no nutrient enrichment that produced algal growth.

Sears Creek

Sears Creek drains the foothills of the Macomb Plateau and flows north into the Johnson Slough. It flows for its entirety as a small humic-stained stream through a channel overgrown with alders, birch, and spruce. Six grayling were captured with electrofishing gear near

the highway at mile 1374.5. The stream here is low gradient with a gravel-sand-mud bottom and a high density of benthic macroinvertebrates (mayflies, stoneflies, caddisflies, midges, blackflies, and nematodes). Dolly Varden are also reported in Sears Creek (Pearse, 1976).

Berry Creek

Berry Creek at the Alcan Highway (mile 1371.4) flowed about 90 cfs throughout July 1976. The creek flows a slight turbid and humic color over a substrate of gravel, pebble, and cobble. Streamside vegetation (spruce, alders, willows) is dense and provides some overhanging cover and undoubtedly an important fish food supply of aerial and arboreal insects in the summer.

The benthic macroinvertebrate fauna was the richest of any stream sampled on this survey. Heptageniid mayfly nymphs and chloroperlid stoneflies were very abundant, while baetid and ephemerlid mayflies, blackflies, and midges were numerous.

Berry Creek was clearly the most desirable fish stream of any visited during this survey. Three longnose sucker, 3 round whitefish, 5 slimy sculpin, and 1 grayling were captured near the highway with electrofishing gear July 11, 1976. On July 23, 10 longnose sucker, 2 round whitefish, 39 slimy sculpin, 7 grayling, 1 ling cod (burbot), and 2 Dolly Varden were captured in the same 1000-foot section. The majority of the fish, except for the sculpin, were found in the deep (4-8 feet) pools and undercut banks. Numerous small grayling and

whitefish were also encountered in the runs and riffles along with the sculpin.

Berry Creek near the highway is the only stream in which anglers were seen during this July survey. It is lined with dense vegetation and, according to locals, is frequented by grizzly bear. Tracks and dung of these were evident but no bears were sighted by our crew.

Berry Creek was also surveyed via helicopter at two other sites, about 5-1/2 and 14 miles above the highway. At the former site, the creek flowed about 100 cfs through a boulder-cobble-gravel channel with sand and gravel bars and lined with large spruce and birch trees. At this point, Berry Creek is joined by an unnamed clear side stream.

A total of 12 grayling, 2 round whitefish, 1 Dolly Varden, and 1 slimy sculpin were recovered from about 300 feet of Berry Creek. Many other fish were seen but not captured in the deep, swift, silty water. A section of about 200 feet of the clear side stream yielded 3 grayling, 5 Dolly Varden, and 1 round whitefish to electrofishing gear.

The stream supports an abundance of blackfly larvae and stonefly and mayfly nymphs. The diversity of deep and undercut pools and productive riffles characterizes this part of Berry Creek as excellent grayling, Dolly Varden, and whitefish habitat.

A second site of upper Berry Creek was surveyed about 14 miles above the Alcan Highway. Here Berry Creek flowed about 108 cfs on July 27, 1976. It is a swift, whitewater stream flowing through a wide scoured boulder-cobble channel. No trees grow at this elevation

(3600 feet) and the stream banks are barren or lined with sparse, low-growing vegetation.

Macroinvertebrate fauna was similar to that of the previously described site. However, electrofishing 300 feet of stream yielded only 2 Dolly Varden. No other fish were seen.

Pearse (1976) reports that a light grayling fishery exists during the spring and summer above and below the Alcan bridge. Van Hyning (1976) considered Berry Creek as "a good grayling stream--perhaps the best in the segment."

There is apparently little or no winter flow in Berry Creek, but it is suspected that grayling, whitefish, and perhaps Dolly Varden are present near the highway from about mid-April to late September. These fish were certainly abundant in Berry Creek further upstream during July.

Unnamed Creek

A small unnamed creek located at mile 1369.1 drains the north face of Knob Ridge. The water is a humic brown color and flows at a rate of about 3 cfs through a large wooden culvert under the highway. A large splash pool is formed by a 2 to 3-foot fall of water downstream of the highway. Small grayling and white fish were visibly abundant in this pool throughout July. One haul through the pool with a 20-foot seine on July 6, 1976, yielded 51 grayling, 6 round whitefish, 1 longnose sucker, and 1 slimy sculpin. On July 23, an estimated 60 percent

capture was accomplished with several seine hauls. These yielded 138 grayling, 91 round whitefish, 12 longnose sucker, and 34 slimy sculpin. Apparently, the elevated highway culvert is an effective barrier to fish movement during normal summer flow since none were found in the stream above the highway. However, the culvert is probably passable during spring runoff. Presumably these fish leave this area in winter and return from mid-April to about late September.

Neither Pearse (1976) nor Van Hyning (1976) make mention of this stream in their surveys of the area.

Sam Creek

Sam Creek in July was a dry stream bed where it crosses the Alcan Highway (mile 1365.9). However, it then parallels the highway and picks up a considerable amount of water from springs along the Tanana River. According to Pearse (1976), during high summer flood levels in the Tanana, silty water backs up Sam Creek and floods the upper stretches. The creek averages 3 feet in depth and the substrate is mainly sand and detritus. The gradient is so mild that this creek largely resembles a slough.

Pearse (1976) reports that grayling probably spawn in the upper section during spring and are present during the entire open water period. Round whitefish and suckers are also found in the summer.

Sam Creek, known as Sand Creek to the locals, is used as a boat launch site to the Tanana River and nearby Sand Lake.

Dot Lake

Dot Lake is located at mile 1361.5 adjacent to a small settlement by the same name. It is 15 to 20 feet deep and inhabited by small northern pike (Charles, 1976). Grayling were introduced by ADFG in 1967, but these apparently did not survive since, according to Pearse (1976), the dissolved oxygen level drops to 0.0 milligrams per liter (mg/l) in winter. Apparently, the northern pike migrate to and from the Tanana River via a small outlet stream.

Chief Creek

Chief Creek at the Alcan Highway (mile 1358.7) was dry when first seen on July 4, 1976. It flowed very turbid (about 30 cfs) after a heavy rain July 8-9. Afterward, the stream continued to flow clear but at a rate which diminished daily. Apparently, as Pearse (1976) states, this creek is fed by an occasional spring but flows are seasonal. This creek experienced the most dramatic rain-induced increase in flow of any surveyed.

No fish or macroinvertebrates were found in Chief Creek, although Pearse (1976) states that "grayling are reportedly caught in the spring but the fishery is presently light."

Bear Creek

Bear Creek flows under the Alcan Highway at mile 1357.3. Its main tributary originates at Fish Lake, some 15 miles upstream, but the main creek is of glacial origin. Fish and macroinvertebrates were sampled at the highway crossing and at the confluence of the main tributary about 11 miles from the highway.

Near the highway, Bear Creek was slightly turbid from glacial silt and flowed about 77 cfs in July. The substrate is gravel, pebble, and cobble and an abundance of benthic periphyton (algae and diatoms) was noted on the rocks. The moss Mnium sp. was also abundant. Macroinvertebrates, however, were rare. Only three chloroperlid stonefly nymphs were recovered from several kick screen samples. The aerial and arboreal insects in the dense streamside vegetation probably supplement the food of fish in this stream.

About 1000 feet of stream near the Alcan Highway were seined on July 7, 1976. The catch included 4 grayling and 1 longnose sucker. Later, on July 9, the same area was electrofished and 7 grayling were captured.

The confluence of the Fish Lake tributary and Bear Creek, about 11 miles above the highway, was visited with the aid of a helicopter on July 27. Both Bear Creek and the tributary were sampled. Flow in Bear Creek at this site was 71 cfs. The glacially silted stream flowed over a boulder-cobble channel interrupted by small gravel bars. Spruce, birch, and alder provide an abundance of overhanging cover.

The macroinvertebrate fauna here consisted of an abundance of blackfly larvae, a few chloroperlid stonefly nymphs, and an occasional heptageniid mayfly nymph. Only 1 Dolly Varden was captured with electrofishing gear from about 300 feet of stream.

The tributary from Fish Lake was a slow-flowing, mud bottom stream, carrying about 20 cfs of slightly humic-stained water. There was no evidence of glacial silt here as was found in the main Bear Creek. Emergent vegetation such as mare's tail (Hippuris vulgaris) and potomogeton was abundant and the macroinvertebrate fauna was dominated by midge larvae and siphlonurid mayfly nymphs. A bank survey of the first 300 feet of this tributary revealed an average of 10 fish (Dolly Varden and grayling) for every 50 feet of stream. Electrofishing 100 feet of this stream yielded 15 Dolly Varden and 5 grayling.

Bear Creek, in the area of the highway crossing, is apparently an avenue for migrating grayling. According to Pearse (1976), grayling are seasonally available during spring and fall but few are caught. The tributary from Fish Lake is apparently an important summer stream for grayling and Dolly Varden.

Jan Lake

Jan Lake was not visited during this survey. According to Pearse (1976), the water in Jan Lake is clear and the bottom is composed of muck and detritus. No inlets or outlets are present. Rainbow trout were introduced in 1955 and later silver salmon were also stocked.

Van Hyning (1976) reports that Jan Lake "is considered excellent fishing for stocked rainbow trout and coho salmon."

Robertson River

The Robertson River is a large, glacial, braided river similar to the Gerstle and Johnson rivers. It is spanned by the Alcan Highway at mile 1347.5. The Robertson River drains the north face of the Alaska Range near Mt. Kimball, whence it flows northeast into the Tanana River.

No fish or macroinvertebrates were collected or observed from the Robertson in the area of the highway. High turbidity from glacial silt in the summer, no doubt, precludes residence by any aquatic life.

The entire river was surveyed via helicopter on July 27, 1976, with expressed interest in finding clear tributaries that might harbor fish. Turbidity in the main river became progressively higher as we approached the Robertson Glacier some 30 miles above the highway, and so no attempt was made to sample the main channel.

In a small, clear, slow-flowing (29 cfs) tributary about 6 miles above the highway, numerous fish were sighted from the helicopter. The stream was very clear, as though spring-fed, with a deep muddy channel and grassy banks. This unnamed stream drains two small unnamed lakes, as well as a series of beaver ponds in which several schools of 15 to 50 fish were sighted.

We landed and observed an average of 10 fish (grayling, whitefish, and Dolly Varden) for every 50 feet of stream. There was a great

abundance of fish, considering that the density remained about the same for the entire 2 miles of stream. These fish were actively feeding on surface insects while exhibiting little or no alarm to our presence. The lack of streamside bushes and trees and the slow, meandering nature of the water make this an excellent fly-fishing stream.

We electrofished about 100 feet of stream and captured 11 grayling, 2 Dolly Varden, and 2 round whitefish. The largest Dolly Varden was about 12 inches long.

A second similar stream, about 2 miles in length, was seen about 8 miles above the highway. Fish density appeared to be lower than the stream just described, but it was nevertheless occupied by numerous grayling, Dolly Varden, and whitefish. Except for these two streams, all other feeding the Robertson River cascade steeply from high granite walls and are probably uninhabitable because of the lack of resting pools and adequate substrate for macroinvertebrates.

The Robertson River apparently has a year around flow. It is probably used by grayling and whitefish as a migration route to and from adjacent feeder springs in spring and fall (Pearse, 1976) and as a holding area in winter. Some fish, especially Dolly Varden, probably reside in the spring-fed feeder streams year around.

Sheep Creek

Sheep Creek drains the north face of the Alaska Range and flows northeast into the Tanana River. Its flow is dependent upon snowmelt

and rain runoff (Pearse, 1976). This stream was dry when visited July 4, 1976, but flowed for about 1 day at about 1 cfs after a rainstorm on July 8. From the helicopter, Sheep Creek was observed to flow about 5 cfs before becoming subterranean about 1/2 mile above the highway.

No fish or macroinvertebrates were observed or captured in Sheep Creek. Pearse (1976) speculates that probably few fish, if any, ascend this stream due to its seasonal flow nature.

Unnamed Slough

This is a highly turbid canal-like slough that lies mainly downstream (northeast) of the highway at mile 1339.6. Upstream from the highway, it is a boggy marsh with very little humic-stained water and only seepage flow.

The slough below the highway extends from the Tanana River and is 2 to 5 feet deep with a silt-mud bottom. No macroinvertebrates were found in this slough, but numerous small (2 inches) lake chub, round whitefish, and longnose sucker were captured.

Electrofishing on July 9, 1976, yielded 1 northern pike about 18 inches long. Five other large fish, presumed to also be northern pike were sighted but not captured. The highly turbid water prevented any stunned fish below the surface from being seen.

On July 10, an attempt to electrofish the slough yielded only 2 northern pike between 18 and 20 inches long. Six days later, about

300 feet of the slough were sampled with an electric seine and 2 northern pike, 3 longnose sucker, and 1 grayling were captured. Numerous small chub, whitefish, and suckers were also seen.

This slough appears to be a nursery for lake chub, round whitefish, and longnose sucker from the Tanana River during the open-water season. It is productive northern pike water in the sense that these fish apparently frequent the slough and feed on the young chub, whitefish, and sucker.

Neither Pearse (1976) nor Van Hyning (1976) mention this slough in their work.

Yerrick Creek

Yerrick Creek is a small (33 cfs) very clear stream about 23 feet wide, flowing in a wide (200 feet) boulder-strewn channel lined with gravel berm. There is very little silt in the channel, and no benthic periphyton was noted where the creek is spanned by the Alcan Highway. This stream was sampled here and also about 6 miles upstream.

Benthic macroinvertebrate fauna near the highway was moderately rich. Heptageniid mayflies were abundant, while baetid mayflies, blackflies, midges, and nematodes were numerous.

Grayling and whitefish were evident in the clear pools near the highway, and a 300-foot section of stream yielded 12 grayling, 2 round whitefish, and 1 slimy sculpin to electrofishing gear on July 9. On July 22, a 1000-foot section near the corridor yielded 9 grayling, 2 round whitefish, and 1 Dolly Varden.

Additional sampling was conducted about 1 mile upstream of the corridor with fly-fishing gear. Flow and also pool size and depth were noticeably greater than at the highway, indicating that at least a part of Yerrick Creek is subterranean. Here, pools were 6 to 10 feet deep and 25-30 feet wide. Although many fish were visible, the majority were apparently hidden by the whitewater and depth. One man-hour of fly-fishing yielded 18 grayling, between 4 and 16 inches long. Nearly twice that number were hooked and lost with the barbless hook.

About 6 miles above the highway, Yerrick Creek flows precipitously through a deep, narrow gorge over a boulder-cobble bed. Flow rate on July 27 was 55 cfs. Pockets of gravel border the deep splash pools which appear favorable fish habitat. No trees grow at this 2800-foot elevation and the channel is lined with low-growing alders.

Nymphs of chloroperlid stoneflies and baetid, ephemerid and heptageniid mayflies were numerous in the stream substrate.

A total of 7 Dolly Varden and 1 grayling was captured with electrofishing gear from about 300 feet of stream. At least 1 Dolly Varden was seen or captured in nearly every whitewater pool.

Grayling, whitefish, and some Dolly Varden appear to occupy Yerrick Creek near the highway all summer long. Larger populations occur about 1 mile upstream where the pools are deeper. Their presence indicates that substantial movements of grayling occur in spring and fall through the corridor area. Pearse (1976) and Van Hyning (1976) apparently did not recognize the existence of large numbers of fish in upper Yerrick Creek, but note that northern pike, whitefish, chub, and longnose

sucker are probably present in sections immediately above the Tanana River about 2 miles downstream of the Alcan Highway. It is also believed that fish use the lower section as a migratory route between the Tanana River and Moon Lake, into which a small tributary of Yerrick Creek drains.

Pearse (1976) recognized the absence of suitable fish habitat because of the open nature of the stream channel. However, the pool-riffle ratio is very favorable and those pools with sufficient water and depth (6-10 feet) are capable of providing good cover for numerous grayling and whitefish.

Moon Lake

Moon Lake is located adjacent to the Alcan Highway about 18 miles west of Tok. It is an old oxbow of the Tanana River that is filled by backup and seepage from the river. It is also fed by an ephemeral stream of the nearby Alaska Range. Moon Lake is known to also receive water from Yerrick Creek during rainy periods (Pearse, 1976). The water is humic stained and the bottom is covered with mud and a dense layer of vegetation.

Moon Lake is used primarily as a recreational facility by Tok residents. A state campground is maintained on the south shore near the highway.

Sampling in Moon Lake during this survey was restricted to the shallow, littoral areas. There, macroinvertebrates were found to be

numerous to abundant, especially the characteristic lentic forms such as water boatmen (corixidae), damselflies and dragonflies, beetles (dytiscidae and hydrophilidae), midges, amphipods and cladocerans (Daphnia sp.).

Fishes were also numerous in the shallows. Several large schools of young longnose sucker and lake chub were seen during the warm, clear day of July 10, 1976. These small fish were schooled sympatrically in the shallow shoreline in numbers of 200 to 500 individuals. One seine haul of 20 feet yielded 179 longnose sucker and 67 lake chub. Each was about 2 inches long. Diving and surface feeding by seagulls on the open water indicated that these or other small bait fish were abundant throughout the lake. Two loons were also seen on the lake.

According to Pearse (1976), approximately 75,500 grayling fry were stocked in Moon Lake in 1975. Their survival is questionable since ADFG reports a dissolved oxygen level of 0.0 mg/l in May of 1971, demonstrating that the lake can become anaerobic in winter. Nevertheless, grayling, northern pike, whitefish, chub, and longnose sucker probably have access to Moon Lake from the Tanana River via Yerrick Creek.

Tok River

The Tok River is a semi-glacial river that originates in the Alaska Range and flows northeast into the Tanana River. It crosses the Alcan Highway about 5 miles east of Tok. Although the glacial

and snowmelt flows are supplemented by clear-water springs and tributaries, the river at the Alcan crossing dries completely by late winter. In the summer, the water is moderately silted by glacial till and mud. It flowed about 270 cfs during our visit July 13, 1976.

The banks of the Tok River are lined with willow, alder, and cottonwood. The substrate near the Alcan consists of gravel and cobble overlaid with silt and mud. Only nymphs of the stonefly chloroperlidae (Chloroperla sp.) were found in screen samples of this benthos, although these were numerous.

On July 22, electrofishing in 1000 feet of river yielded 5 round whitefish, 5 sculpin, 4 grayling, 1 longnose sucker, and 1 lake chub. Most were captured in a small, quiet side channel and not in the main river channel. Other fish found in the Tok but not captured during this survey include burbot and northern pike (Pearse, 1976).

Apparently, grayling, whitefish, and sucker occupy the Tok River near the highway most of the year, but the highest densities probably occur from mid-April through June and September through mid-October. Residents of the town of Tok actively fish for these migrants in spring and fall, although the favored fishing is in two tributaries, the Little Tok River and the Tok Overflow. An established state campground on the banks of the river attracts many Alcan Highway travelers and some transient anglers to the area.

Tanana River

This large, braided and heavily silted glacial river is spanned by the Alcan Highway at mile 1303.3, about 11 miles east of Tok. It has its origin in the Wrangell Mountains near the Yukon Border as the Nabesna and Chisana rivers. The Tanana flows northwest into the Yukon River in central Alaska.

No attempts were made to sample this deep, swift river during this survey. Little is known about the fishery resource of the Tanana except through inference of what is found in its tributaries. Fish species believed to inhabit the Tanana River are those already discussed as well as sheefish and chum, coho, and chinook salmon.

Sheefish or inconnu are caught occasionally in the Tanana River and have been introduced in some of the closed lake systems.

Chum salmon are known to spawn in substantial numbers at the confluence of the Tanana and Delta rivers near Delta Junction. The extent of spawning by this anadromous species upstream of this confluence is not well known. Mr. Bud Coiley (1976) claims that he captured a "net full of dog salmon" from a deep pool of the Tanana River near the George Lake outlet in late August of 1974. The "net full" of salmon included 30 to 40 chum captured in a "short period of time." Mr. Coiley has also seen chum salmon in the outlet stream of George Lake, a point about 40 miles upstream from Delta Junction. Mr. Kim Francisco (1976) of ADFG confirms the presence of chum salmon at this point. The ADFG also reported seeing 29 spawning chum salmon as far upstream as Sheep Creek

on the Chisana River (Geiger and Andersen, 1976), about 175 miles upstream from Delta Junction.

The possibility that coho and chinook salmon spawn in the area upstream of Delta Junction also exists, but the numbers are probably low (Francisco, 1976).

The Tanana River flows under surface ice in winter and probably supports large concentrations of grayling, whitefish, northern pike, and juvenile salmon. In the summer, few fish are able to tolerate its highly silted waters and the sloughs and tributaries are used extensively.

Bitters Creek

Bitters Creek is a small, humic-stained stream located in a deep, rocky gulley where it is traversed by the Alcan Highway at mile 1280.3. The stream flowed about 4.5 cfs exhibiting an excellent pool-riffle ratio when surveyed July 14, 1976. The stream flows beneath the highway through a 15-foot diameter sectional culvert pipe about 200 feet long. Water in the culvert is only about 6 inches deep and the gradient is about 10 degrees with a 1-1/2 foot spill at the outlet. This culvert appears to be an effective barrier to fish during normal summer flows since all fish captured were downstream of the culvert.

Electrofishing on July 14 yielded 5 grayling up to about 15 inches long from about 1000 feet of stream. Two others were seen and not captured. On July 21, 7 grayling and 6 sculpin were captured when the same area was electrofished.

The macroinvertebrate fauna of Bitters Creek is rich. Baetid and siphlonurid mayflies are abundant, while midges, heptageniid mayflies, and nemourid stoneflies are numerous. Cranefly (Dicronata sp.) and blackfly larvae are numerous to rare.

Bitters Creek probably supports grayling downstream of the highway during the open water period. Presumably, a migration occurs from mid-April through June and September through mid-October.

Beaver Creek

Beaver Creek is a gentle, humic-colored stream flowing through a deep, snag-filled channel. It drains a large bog north of the Tanana River and flows beneath the Alcan Highway at mile 1268.1 and into the confluence of the Chisana and Nabesna rivers. Alders, willows, and spruce are abundant on the banks and the substrate is mud and sand. Only siphlonurid mayflies were found in the benthos of Beaver Creek.

Numerous adult grayling were sighted near the highway, but electrofishing was difficult because of snags and deep water. Nevertheless, 1 round whitefish and 1 grayling were caught. One man hour of angling also yielded 3 grayling between 14 and 16 inches long. Although Beaver Creek appears to be excellent habitat for northern pike, none were captured or seen.

Since no additional fishery information is available, incidence of fish can only be inferred from our findings in July and from information of similar streams. Other nearby streams support sizable

runs of grayling and whitefish in the spring and fall. Reportedly, northern pike from the Tanana River also use these slow-flowing streams for spawning and rearing of young during the open water period.

Chisana River

The Chisana River meets the Nabesna River at about mile 1268 to form the Tanana River. Most of the same fish species noted for the upper Tanana River also inhabit the Chisana. Chum salmon are reported as far up as Sheep Creek (Geiger and Andersen, 1976), and northern pike, burbot, humpback whitefish, and grayling are found throughout. Burbot and humpback whitefish are actively sought near Northway Junction in spring (Van Hyning, 1976). Fishwheels were used until recently to capture these species.

Nabesna River

Much of the description of the Chisana River also applies to the Nabesna, except that no salmon have been reported there. Little quantitative information on the fishery of this area is available.

Silver Creek

Silver Creek is a very small, humic-colored stream that flows through a channel choked with rushes (*Scirpus* sp.), sedges (*Carex* sp.), and mare's tail (*Hippuris vulgaris*). This creek drains the area of

Cheneathda Hill north of Northway Junction and runs into Eliza Lake on the Chisana River. Flow on July 18 was about 1.5 cfs and the water temperature was 14 C.

An abundance of blackfly larvae was found in the sand and gravel substrate. Baetid and ephemerelid mayflies, chloroperlid stoneflies, and nematodes were numerous.

About 1000 feet of stream near the corridor yielded 6 young northern pike, each about 5 inches long. Two others were seen.

Mr. John Irvin (1976), who lives with his family on the banks of Silver Creek, claims that he has seen round whitefish and adult northern pike in the creek during high water. He feels that the fish move into either of two small, marshy ponds or a large lake in the upper watershed. No additional information is available on Silver Creek.

Based on our observations and those of Mr. Irvin, Silver Creek appears to support a very small fishery. It is probably important to a few whitefish and northern pike as a migration avenue in spring and fall, and as a nursery for the young pike in summer.

Eliza Lake

Eliza Lake is a shallow, muddy lake of about 500 surface acres dotted with small islands of vegetation. It is located near mile 1258, about 6 miles southeast of Northway Junction. Eliza Lake is fed by Silver Creek, but its principal source of water is overflow from the Chisana River.

Eliza Lake is inhabited by round and humpback whitefish, and northern pike. Since the lake freezes solidly in the winter, these fish apparently move into the Chisana River. During the open water period, the lake and its tributary, Silver Creek, are used as feeding, spawning, and nursery areas.

Yarger Lake

Yarger Lake is located about 1/2 mile southeast of Eliza Lake. Like Eliza Lake, it is shallow (about 10 feet maximum depth) and flooded seasonally by the Chisana River. Sedges and rushes are abundant along the shoreline and yellow pond lillies abound in the lake.

An abundance of dragonflies, damselflies, dytiscid beetles, backswimmers (Notonectidae), water boatmen (Corixidae), and amphipods were found in Yarger Lake.

According to Van Hyning (1976), ADFG netting in Yarger Lake has resulted in the capture of small pike, humpback whitefish, and suckers.

Tenmile Creek

Tenmile Creek is a small, humic-stained stream flowing through a mud channel choked with vegetation; mare's tail (Hippuris vulgaris), rushes (Scirpus sp.), sedges (Carex sp.) and potamogeton (Potamogeton sp.). The stream closely resembles Silver Creek, and although no fish were captured by electrofishing, it is likely to be a spawning and nursery area for northern pike from Tenmile Lake and the Chisana River.

Baetid mayflies, veliids, and amphipods were numerous in the stream.

Deadman Lake

Deadman Lake is a 350-acre body of water about 1-1/4 miles west of the Alcan Highway. It has a maximum depth of about 300 feet and is periodically flooded by the Chisana River. The shoreline is lined with emergent aquatic vegetation such as sedges and rushes, and these support an abundance of aquatic beetles (dytiscidae and gerridae), water boatmen (Corixidae), backswimmers (Notonectidae), damselflies, and dragonflies. Van Hyning (1976) reports that the lake has been stocked with rainbows and grayling without success and presently contains a small population of pike from 10-24 inches in length. During our visit to Deadman Lake, on July 18, 1976, we observed two anglers with grayling and northern pike.

An established campground is located on the northeast shore of Deadman Lake.

Gardiner Creek

Gardiner Creek drains an extensive bog and marsh area northeast of the Chisana River. It is a large humic-colored stream flowing in a deep, meandering channel with numerous abutting sloughs and lined with overhanging alders, willows, and spruce. There are many snags and falls in this deep, steep-banked mud channel and the many deep,

long pools provide excellent fish habitat. Flow on July 19, 1976, was estimated at 720 cfs.

The macroinvertebrate fauna of Gardiner Creek includes an abundance of siphlonurid mayflies and blackflies (simulidae). Crane-fly larva (tipulidae) were numerous.

Large schools of young sculpin (presumably slimy sculpin) were seen near the banks of the stream, indicating that a carnivorous food source is available for larger piscivores. Electrofishing and seining in the shallow backwaters did not yield any other fish. Nevertheless, Gardiner Creek is known to support a substantial run of grayling in late May and early July, as these fish migrate to spawn upstream (Greyhead, 1976). Northern pike and round and humpback whitefish are also believed to spawn in Gardiner Creek. The densities of these fish in midsummer are probably low near the Alcan Highway.

Unnamed Pond

An unnamed pond at mile 1239.5 is reported to support whitefish and northern pike (Greyhead, 1976; Thompson, 1976). Van Hyning (1976) reports that this 30-acre lake has a maximum depth of 19 feet and supports a sparse population of grayling which apparently survive low oxygen levels in winter (0.2 mg/l). Rainbow and sheefish introduced by ADFG have apparently failed to survive (Tearse, 1975). We seined the pond extensively during this survey and failed to capture any fish.

The invertebrate fauna of this pond, like that of most in the area, is rich. It includes beetles (dytiscidae), water boatmen (Corixidae), backswimmers (notonectidae), veliids, dragonflies, and damselflies.

Island Lake

Island Lake, appropriately named for a small island in its center, covers about 240 acres. It is about 1/2 mile northeast of the highway at mile 1230.2 and it drains east into Desper Creek. Shoreline vegetation is abundant and the macroinvertebrate fauna is quite diverse, including beetles (dytiscidae, hydrophilidae), water boatmen (corixidae), backswimmers (notonectidae), damselflies, dragonflies, waterstriders (gerridae, veliidae), amphipods, and snails.

Maximum depth of Island Lake is 40 feet, and ADFG reports oxygen levels of 8.0 ppm in July and 5.5 ppm in February (Van Hyning, 1976). Test netting by ADFG shows a fairly large population of northern pike. Seining during the present survey yielded no fish.

Desper Creek

Desper Creek is a deep, slow-flowing, humic-stained stream with a mud bottom and many tangles and falls. It drains Island Lake and meanders into Scottie Creek some 4 miles below the Alcan Highway.

Mr. Bud Greyhead (1976), who lives next to Desper Creek, reports that the creek supports a good population of northern pike. He also

reports moderate runs of round and humpback whitefish, as well as some grayling in spring and fall, presumably to and from Island Lake. Van Hyning (1976) reports similar findings. Electrofishing in Desper Creek yielded no fish, although the habitat looks very favorable for northern pike. Mr. Greyhead also reports that Desper Creek freezes solidly in winter.

Scottie Creek

Scottie Creek flows in a very deep, earthen channel with steep banks. It originates in several small lakes in Canada about 20 miles northeast of the highway and flows south and then west into the Chisana River. The water in Scottie Creek is strongly humic-stained and flows at a rate of about 190 cfs where it is spanned by the highway.

Mr. Stag Thompson (1976), who lives adjacent to Scottie Creek, reports large runs of humpback whitefish and grayling in spring and fall. Other fishes include a sizable population of various sizes of northern pike, burbot, longnose suckers, and sculpin. Thompson reports having caught northern pike of 10 to 15 pounds downstream of the highway. Van Hyning (1976) reports a similar species composition for this creek.

The macroinvertebrate fauna of Scottie Creek includes an abundance of siphlonurid mayflies and dytiscid beetles.

Unnamed Pond

A small, shallow unnamed pond below the hill of the Alaska-Canada border station and north of the highway at mile 1222.3 is reported to support northern pike and humpback whitefish that move to and from Scottie Creek (Thompson, 1976). Seining efforts yielded no fish during this survey.

SUMMARY OF WATERS SURVEYED

The tributaries of the upper Tanana River can be classified into four types of streams, according to their origin, flow volume, substrate type, and apparent water quality. These include:

1. large glacial rivers,
2. small glacial rivers,
3. spring-fed or snowmelt creeks, and
4. marsh or bog-fed streams.

Large Glacial Rivers

The Gerstle, Johnson, Robertson, Tanana, Chisana, and Nabesna rivers are considered the large glacial rivers in the area surveyed. These flow high in summer months and tend to be heavily silted by glacial till. In the winter, heavy surface ice forms and flow is either low and clear (since the release of glacial till is halted by refreezing of the glacier) or completely impeded by freezeup. Aufeising,

especially near springs, produces massive billows of ice on some river sections. These large glacial rivers almost always flow in reticulate channels on substrates of heavily silted sand, gravel, and cobble. The turbid waters of summer and their resultant scouring effect preclude habitation by any form of aquatic life. Fish thus tend to use these rivers only as overwintering areas when all other tributaries are solidly frozen.

Small Glacial Rivers

Small glacial rivers in this survey area include the Little Gerstle River, Berry Creek, Bear Creek, and the Tok River. These have many of the same features as the large glacial rivers, except that the channels tend to reticulate less and summertime silt loads are not as high. Glacial water laden with till appears to be diluted by springs and clear tributaries in the summer and the main channel is often inhabited by numerous fish and macroinvertebrates. Flow in winter is reduced substantially and most tend to freeze completely, except in areas of perennial springs.

Substantial runs of grayling and whitefish occur in spring and fall in these rivers, and sizable populations of grayling, whitefish, burbot, longnose suckers, and sculpin are supported in summer. Dolly Varden are numerous in the upstream portions of these small rivers in summer and, perhaps, near perennial springs in winter. Most fish, however, leave these frozen channels to overwinter in the large glacial rivers.

While all four streams exhibited the characteristic silt load from glacial till, Berry Creek and Bear Creek were noted to also have a brown or coffee color. This is apparently the manifestation of dissolved organic matter leeched by the water during surface and subsurface runoff. Since the pH of both of these streams is 7.5 (Pearse, 1976), this brown color is hardly the result of acid dissolutions as is the case in most humic-stained streams (Hynes, 1970). Since the water source for these rivers is non-calcareous, carbon dioxide appears to be lost rapidly, pH increases, and oxygen is acquired in a short distance. Ferrous bicarbonate, which may be contained in the runoff from the muskeg and tundra, is deposited as ferric hydroxide. Small sections of these streams, especially near the headwaters, are coated with rust-colored masses of iron bacteria as evidence of this process. Since the waters are soft (alkalinities of 34 and 51 mg/l $CaCO_3$) and the content of inorganic ions low, the brown dissolved organic matter is likely to remain in solution.

Spring-fed or Snowmelt Creeks

The majority of the streams surveyed are classified under this category. These include Granite, Rhoads, Sawmill, Dry, Sears, Unnamed, Sam, Chief, Sheep, Unnamed, and Yerrick creeks.

These streams originate either in snowfields in the high, steep valleys of the Alaska range or in springs along the foothills. Except for Sears, Sam, Yerrick, and one unnamed creek, all of these streams

are either ephemeral (dry in summer) or partly subterranean. Most flow clear and well near their source but go underground before reaching the Alcan route.

This seasonal flow precludes the existence of any sizable fish populations. Fish that gain access during freshets or spring runoff may be stranded during winter freezeup. Most of these streams are devoid of macroinvertebrates as well, indicating that freezeup in many is complete.

Spring runoff from these and other similar streams that drain the Alaska Range is apparently violent. Many of these channels are filled with large boulders and lined with gravel berm to attest to this. The channels, especially above the highway, are steep gradient beds of gravel, cobble, and boulders.

Yerrick Creek is unique among these streams. It usually flows above ground for its entirety and supports a sizable population of grayling and whitefish. Its clear, cold waters fail to become stained because of its open and plantless channel.

Marsh or Bog-fed Streams

All of these streams originate in the lowlands northeast of the Tanana River. Bitters, Beaver, Silver, Tenmile, Gardiner, Desper, and Scottie creeks all fall under this category. All are low gradient, stained streams that flow in meandering, mud channels lined with dense stands of willow, birch, and alder. Except for Scottie Creek, these streams freeze solidly in winter.

Northern pike, grayling, and whitefish are numerous in most of these vegetation-choked streams. Most are used as avenues of migration to and from other tributaries or small lakes in spring and fall.

DISCUSSION AND RECOMMENDATIONS

The proposed Alcan gas pipeline route between Delta Junction and the Alaska-Canada border is a reasonable choice which reflects good environmental consciousness on behalf of Northwest Pipeline Corporation. Since the proposed route follows the existing corridor of the old military Haines pipeline, extensive clearing of vegetation is not likely. The entire corridor can be readily accessed from the Alcan Highway with addition of discretely placed access roads.

Although this survey focused on the fishery of the area, we neither observed nor heard of any extensive caribou use of the area. Moose sign, however, was abundant, and grizzly bear are reported in the Dot Lake area. Caution in placement of work camps and in construction will alleviate serious encounters with the large mammals. Furthermore, proper pipeline construction will reduce long-term conflicts with wildlife.

The fishery resources of the area are of sports value only. No commercial fishery is directly dependent on this part of the Tanana watershed, except, perhaps, for a subsistence fishery in the area of Northway Junction. The possible exception is that some chum salmon may spawn in the area and their progeny migrate to sea via the Yukon River.

The majority of the fishery streams support primarily grayling, whitefish, and northern pike. These are sought principally by local residents during upstream spawning migrations in spring and also during downstream movement to overwintering areas in fall. Most fishing occurs over a 1 or 2 week period when the fish are in the area of the Alcan Highway and most accessible.

Although these tributaries of the Tanana River are of little commercial fishery importance, pipeline construction activity in the area will have to be sensitive to preserving the recreational needs of area residents. With this in mind, monitoring of the pipeline construction by knowledgeable biologists is advised. Two areas of concern should be given particular attention: gravel mining and stream crossings.

Gravel Mining

One of the most critical needs for constructing the proposed Alcan gas line will be sources of materials and gravel for workpads and roadbeds. The experiences with borrow methods used on the Alyeska Pipeline (Tape and Craig, 1975; Wilson et al., 1977) will be valuable in reducing environmental damage to the corridor region. Planning and mitigation between construction workers and biologists can alleviate damages to wildlife and habitat and ensure rapid recovery of affected areas. It is not premature to develop these plans well before construction and identify potentially sensitive areas.

The majority of the streams that drain the Alaska Range between Delta Junction and Tok flow in gravel-filled channels. Many flow low in summer, exposing extensive gravel deltas and berms. Also, gravel deposits appear to be present along the foothills, not far from the proposed route.

Mining of gravel deltas, berms, and deposits can be an acceptable practice when habitat requirements of fish and wildlife are considered. Each major fish stream or wildlife habitat must, therefore, receive individual attention. A knowledgeable biologist should monitor the construction activities in order to avoid misunderstandings and irrecoverable damages to a valuable resource.

In the case of those streams surveyed herein, gravel appears to be most available in the large reticulate glacial rivers--the Gerstle, Johnson, Robertson, Tanana, Chisana, and Nabesna. All are traversed by the proposed route at 10 to 15 mile intervals and can provide ready sources of material. However, much of this gravel is heavily silted and will require extensive piling for draining and drying. Shallow mining is recommended to alleviate problems encountered with borrow pits in construction of the Alyeska Pipeline (Wilson et al., 1977). Borrow mining, especially of berms, will be particularly damaging in these glacial rivers in winter, since overwintering fish may become trapped and stranded in the newly created ponds. Surface mining in these large glacial rivers will be most practical in summer, when the silt and mud loosened from these operations will hardly be a detriment to the already heavily silted rivers.

The small glacial rivers and spring-fed or snowmelt creeks may also serve as available sources of gravel. In addition to those described in this survey, there are many ephemeral streams, with gravel-lined channels, such as the Cathedral Creeks near Moon Lake. Mining in all of these must proceed with caution, particularly in spring and fall, when these streams may be important avenues of migration to fish. During the summer months (June-August), mining is feasible in those streams occupied by few fish near or below the corridor (although an abundance of spawners and juveniles may be present further upstream), and those streams that are seasonally dry. Although many of these streams are frozen solidly in winter, areas near perennial springs should be avoided to prevent destroying overwintering habitat.

Gravel appears to be much less available in the streams between Tok and the Alaska-Canada border. Except for the Tanana and Nabesna rivers, which parallel the corridor, between 1/4 and 1 mile away, the streams in this area drain small lakes, bogs, and marshes and meander slowly in mud and silt channels. Unless gravel deposits are found nearby, access roads will have to be built to the Tanana River for these gravel deposits.

Stream Crossings

The proposed Alcan gas pipeline will have to traverse over 100 stream channels between Delta Junction and the Canadian Border. Most of these are not believed to support fish. They are less than 6 feet

across and 2 feet deep with flow ephemeral in nature (usually dry in summer and winter). Many are large and deeper, but exhibit a similar flow regime. Few of these streams support fish populations or contribute directly to a fishery, except for runoff into the Tanana River.

The 29 fishery streams in this area are even more variable in size. Some flow in channels only 12 feet across and 3 feet deep. Others, such as the Robertson and Johnson rivers, measure nearly 3/4 mile from bank to bank and 15 to 20 feet in depth. By far, the majority of fishery streams (channels) in this area are 25 to 30 feet across and 6 to 8 deep.

The gas pipeline might traverse these streams in four different ways:

1. atop sectional culvert pipe,
2. buried beneath the stream bed,
3. attached to the scaffolding of existing bridges,
4. atop a specially built bridge spanning the stream.

Sectional culvert pipe is likely to be used for crossing the smaller, shallower channels. The bottom lip of the culvert pipe should be placed slightly below the existing stream substrate level to permit movement of fish through the area. Existing culvert crossings along the Alcan Highway exemplify the problems of placing the pipe too high from the downstream end or at a gradient too steep for fish. Upstream passage of fish is presently blocked in several streams along the Alcan because of this elevated culvert pipe that has created splash pools

downstream. The culvert pipe should be large enough to accommodate spring runoff and winter ice blocks.

Many stream crossings are more feasible if the pipe is buried beneath the stream substrate. Any stream selected for this approach will have to be monitored to avoid interference with migrating or residing fish during trenching. The pipeline will also have to be adequately insulated to reduce icing of subterranean flow that could alter flow regime and even heave the pipe out of alignment. Also, the entrenched banks will have to be adequately stabilized to prevent excessive cutting during spring runoff.

All of the large glacial rivers (Gerstle, Johnson, Robertson, Tanana) are spanned by large steel bridges with scaffolding on which rests the old military Haines pipeline. Many of the smaller and more significant fishery streams (Little Gerstle River, Dry Creek, Sears Creek, Berry Creek, Chief Creek, Bear Creek, Sheep Creek, Yerrick Creek, Tok River, Beaver Creek, Gardiner Creek, Scottie Creek) are also spanned by metal bridges and provide the opportunity for crossing the stream on an existing structure. This approach is advantageous and should be considered whenever possible, since it reduces direct physical disturbance to the stream and channel.

Assuming that the proposed Alcan route will follow closely the old Haines pipeline, the gas line will rarely be more than 1/2 mile from the Alcan Highway. It may be most practical in some stream crossings, particularly of large rivers, to build a bridge-like

structure for the pipeline rather than use the existing highway bridge. This may be particularly true when the existing bridge is inadequate or the corridor is too far from the bridge. In most cases, spanning a stream aerially will be much less damaging to a fishery than a buried crossing.

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APPENDIX A

List of Streams Crossed by the Proposed Alcan Route and Fish Species in Each

Table 1. Fishes in waters traversed by or adjacent to the proposed Northwest Pipeline Corridor between Delta Junction and the Canadian Border. The survey was conducted on creeks, rivers, ponds, and lakes July 5-21, 1976. Numbers are fish captured in 1000 feet of stream (500 ft. above, 500 ft. below crossing). X's and ?'s indicate presence and questionable presence, respectively, based on ADFG reports and interviews with residents.

WATER	MILEPOST	FISH SPECIES[a]													
		AG	RW	HW	SSc	LS	NP	LC	BB	DV	RT	CS	SS	KS	SF
Granite Creek[b]	1409.6	?								?			?		
Rhoads Creek[b]	1407.6	?								?			?		
Sawmill Creek[b]	1403.8	?								?					
Gerstle River[c,d]	1392.8	?	?							?			?		
Little Gerstle River	1388.4	5	1		X	X				?					
Craig Lake[c]	1383.0							?			X		X		
Lisa Lake[c]	1381.0										X		X		
Johnson River[c,d]	1380.3	X	X				?	X	X	X					
Dry Creek[c,e]	1378.0	X	X		?					X					
Sears Creek	1374.5	6								?					
Berry Creek	1371.4	7	3		39	10			1	2					
Unnamed Creek	1369.1	138	91		34	12									

Table 1. Continued

WATER	MILEPOST	FISH SPECIES[a]													
		AG	RW	HW	SSc	LS	NP	LC	BB	DV	RT	CS	SS	KS	SF
Sam Creek[c,f]	1365.9	X	X			X	X								
Dot Lake[c,f]	1361.5	X					X								
Chief Creek[c]	1358.7	X													
Bear Creek	1357.3	5			1					X					
Jan Lake[c]	1353.5										X		X		
Robertson River[c]	1347.5	X	X							X					
Sheep Creek[c]	1342.2	?	?												
Unnamed Creek	1339.6	1				3	2	2							
Yerrick Creek[c]	1333.6	9	2			?	?	?		1					
Moon Lake[c]	1331.8	?				X	X	X							
Tok River[b,c]	1309.5	4	5		5	1	X	1	X			?			?
Tanana River	1303.3	X	X	X	X	X	X		X	?		X			?
Bitters Creek	1280.3	7			7										
Beaver Creek[b]	1268.1	3	1												?

Table 1. Continued

WATER	MILEPOST	FISH SPECIES[a]													
		AG	RW	HW	SSc	LS	NP	LC	BB	DV	RT	CS	SS	KS	SF
Chisana River	1267.0	X	X	X	?	X	?		X	?		X			
Nabesna River	1267.0	X	X	X	?	X	?		X	?					
Silver Creek[g]	1258.7		X	X			6								
Eliza Lake[g]	1258.7		X	X			X								
Yarger Lake	1257.0	X					?								
Tenmile Creek	1252.8						?								
Deadman Lake	1250.0	X					?								
Gardiner Creek	1246.6	X	X	?	X		X								
Unnamed Pond[h,i]	1239.5		X	X			X								
Island Lake[h,i]	1230.2		?				X								
Desper Creek[b,h]	1225.6	?	?	?			X								
Scottie Creek[b,i]	1223.3	X	?	X	X	X	X		X						
Unnamed Pond[i]	1222.3						X								

[a] Code for fishes in Table 1.

GR	AG	arctic grayling	(Thymallus arcticus)
RW	RW	round whitefish	(Prosopium cylindraceum)
HW	HW	humpback whitefish	(Coregonus pidschian)
SD	SSc	slimy sculpin	(Cottus cognatus)
LS	LS	longnose sucker	(Catostomus catostomus)
NP	NP	northern pike	(Esox lucius)
LC	LC	lake chub	(Couesius plumbeus)
BB	BB	burbot (ling cod)	(Lota lota)
DV	DV	Dolly Varden	(Salvelinus malma)
RB	RT	rainbow trout	(Salmo gairdneri)
DS	CS	chum (dog) salmon	(Oncorhynchus keta)
SS	SS	coho (silver) salmon	(Oncorhynchus kisutch)
KS	KS	chinook (king) salmon	(Oncorhynchus tshawytscha)
IN	SF	Inconnu (sheefish)	(Stenodus leucichthys)

[b] Personal communication between Dr. Paul Holden and Mr. Gary Pearse, Alaska Dept. Fish and Game, Fairbanks, June 1976.

[c] Pearse, G. A. 1976. Inventory and cataloging of the sport fish and sport fish waters of interior Alaska, Tanana River Drainage between Tok and Little Delta Rivers.

[d] Personal communication with Mr. Bud Coiley, George Lake Lodge, milepost 1385, Alaska Highway, July 17, 1976.

[e] Personal communication with Mr. Bill Lowe, Dot Lake, milepost 1361, Alaska Highway, July 6, 9, 1976.

[f] Personal communication with Mr. Carl Charles, former Chairman, Dot Lake Tribal Council, milepost 1361, Alaska Highway, July 7, 1976.

[g] Personal communication with Mr. John Irvin, milepost 1258, Alaska Highway, July 18, 1976.

[h] Personal communication with Mr. Bud Greyhead, milepost 1225, Alaska Highway, July 20, 1976.

[i] Personal communication with Mr. Stag Thompson, Scottie Creek, milepost 1223, Alaska Highway, July 20, 1976.