

# **Local and Traditional Knowledge of Whitefish in the Upper Koyukuk River Drainage, Alaska**



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Traditional Ecological Knowledge Component**

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## ABSTRACT

Whitefish (*Coregonus sp.*) are widely distributed throughout the waters of the Koyukuk River drainage. Historically and today, whitefish constitute one of the more reliable and important subsistence resources for residents of the Koyukuk River area. Local fishers have accumulated knowledge pertaining to the efficient harvest and use of whitefish due to their long term residence in the area and reliance on these important fish. Exploitation of the whitefish resource requires knowing their patterns of seasonal movement, behavior, and habitat use. Western science is still in the early stages of documenting basic information on the distribution, life history, and critical habitats of whitefish throughout Alaska—a process that could benefit from an understanding of local and traditional knowledge (LTK). Based upon interviews with knowledgeable local residents in the communities of Allakaket and Hughes, this project involved the collection of LTK pertaining to whitefish in the upper Koyukuk River and the waters of the Kanuti National Wildlife Refuge. Analysis of this information reveals much about basic habits and behavior of whitefish in this region that might be of use to fisheries scientists. It also highlights some of the characteristics which distinguish LTK as a data type and presents an opportunity to assess both the strengths and limitations of using LTK in the western scientific context.

**Key Words:** broad whitefish (*Coregonus nasus*), humpback whitefish (*Coregonus pidschian*), Koyukuk River, Kanuti River, least cisco (*Coregonus sardinella*), whitefish (*Coregonus sp.*), traditional ecological knowledge

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## INTRODUCTION

Historically, residents of the Koyukuk River drainage have had a particularly strong reliance on fishery resources. Many of the resources one thinks of as cornerstones of subsistence cultures throughout interior Alaska were absent or scarce along the Koyukuk River. According to local residents, Moose, which are a subsistence mainstay in the region today, have only been present in the drainage since the 1930s. Small numbers of caribou are sporadically available in some portions of the drainage but cannot be counted on with any regularity. The Koyukuk River has modest runs of salmon (*Oncorhynchus sp.*), but their numbers are small relative to the runs that ascend the Yukon River mainstem and they decline in both number and quality in the upper reaches of the drainage. For the indigenous population of the Koyukuk, the traditional round of subsistence activities accentuated the use of seasonally abundant waterfowl, a variety of small game, and the year-round pursuit of various non-salmon fish species (Marcotte and Haynes 1985; Nelson et al.1982)

Among these resident fish, several species of whitefish are an especially important subsistence resource. Broad whitefish (*Coregonus nasus*), humpback whitefish (*Coregonus pidshian*), and least cisco (*Coregonus sardinella*) are widely distributed and seasonally abundant in Koyukuk waters. Today, as in the past, residents of the Koyukuk River expend significant effort each year to catch and preserve these fish as a source of food for both people and sled dogs. A house-to-house harvest survey of Koyukuk River communities conducted in 2003 estimated a drainage-wide harvest of more than 63,000 pounds of whitefish for calendar year 2002—twice that of all other non-salmon fish species combined (Andersen et al. 2004). Of this harvest total, approximately 37,600 pounds was attributed to fishers in the up-river communities of Hughes, Allakaket, and Alatna. This equates to approximately 400 pounds of whitefish per household (N=93 households) in these three small communities.

Relatively few scientific studies have been done to document the seasonal movements, life history, or critical habitats of whitefish in the Koyukuk River. Given their prominence as a subsistence resource and their status as one of the more ubiquitous fish species of the region, this

study was conducted with the thought that more information on this important group of fish needs to be collected and made available to fishery biologists and managers.

This project is closely affiliated with two other studies. Andersen et al. (2004) collected traditional ecological knowledge pertaining to all non-salmon fish species utilized for subsistence in the Koyukuk River drainage. One of the recommendations stemming from that research was to more closely examine some of the more important and widely used species, such as whitefish, and attempt to collect additional LTK with a more focused line of questioning and in a smaller geographic area. This project follows-up on that recommendation. In addition, FIS 04-269 was designed and funded with two components—the LTK component reported on here, and a biological component that followed the movements of radio-tagged whitefish in the upper Koyukuk. These two components were conducted by separate principle investigators, using very different methodologies, but applied to the same set of objectives. Results of the biological component will be reported on separately in Brown 2008 (in preparation). The juxtaposition of these two data sets presents a relatively rare opportunity to examine the utility, strengths, and limitations of these various approaches in fisheries research. These aspects are discussed in the concluding sections of this report.

## **OBJECTIVES**

The primary objective of this project was as follows:

to describe the seasonal movements of whitefish and identify important seasonal habitats (spawning, over-wintering, and feeding areas) of humpback and broad whitefish in the upper Koyukuk River drainage based on the observations and knowledge of local residents.

While information on seasonal movements and important habitats of whitefish was the primary focus of the work, local residents generally approached these topics through discussions of whitefish fishing and whitefish in general. As a result, the narrative below attempts to document a larger body of local knowledge surrounding whitefish in the upper Koyukuk, including seasonal movements and habitats but also including things such as Native names and taxonomy pertaining to whitefish, fishing methods, preservation and preparation methods, and the health and population status of local whitefish populations.

## METHODOLOGY

Local and traditional knowledge (LTK) of whitefish was collected through semi-directed interviews with key respondents. The methodology used to select respondents on this project fell generally into the category of nonprobability or judgment sampling (Honigman 1970) whereby the researchers use prior knowledge of the potential pool of respondents to select individuals with certain specific qualifications or traits. In this case, criteria considered in the selection process included long-term residency in the upper Koyukuk region and a history of participation in whitefish fishing activities.

An interview guide (Appendix) provides a list of interview topics covered. All interview sessions were pre-arranged and took place in the home of the respondent. With the knowledge and consent of respondents, interview sessions were recorded on audio tape. Photographs depicting the various whitefish species were shown to respondents to confirm the species being discussed. USGS topographic maps of the upper Koyukuk region were utilized to identify fishing locations and significant places mentioned during the interview. Together, photos and maps served as effective visual prompts to stimulate the discussion of whitefish and whitefish fishing activities. A local assistant was present at each interview to facilitate introductions, serve as translator as needed, and map fishing sites and fish habitats discussed during the course of the interview.

During the period April 2004 through June 2006, seven data collection trips were made to the upper Koyukuk communities of Allakaket and Hughes. During those trips, interviews were conducted with a total of 13 individuals. Respondents included a mix of knowledgeable elders whose fishing days are largely behind them, and middle-aged individuals who are currently among the most active fishers in each community. The list of respondents includes eight men and five women ranging in age from 55 to 92 years old. All are of Athabascan descent. The average age of respondents is 76.5 years. Table 1 below lists the name, community of residence, interview date, and age of each respondent at the time of the interview.

**Table 1. Key Respondents, Age, and Interview Dates.**

<b>Respondent Name</b>	<b>Community</b>	<b>Interview Date</b>	<b>Year Born</b>	<b>Age</b>
Joe Beetus	Hughes	May 15, 2004	1915	89
Celia Beetus	Hughes	May 15, 2004	1922	82
Martha Oldman	Hughes	May 15, 2004	1920	84
Lindberg Bergman	Allakaket	June 26, 2004	1929	75
Lydia Bergman	Allakaket	June 26, 2004	1930	74
Sarah Simon	Allakaket	June 26, 2004	1912	92
Steven Bergman	Allakaket	June 27, 2004	1949	55
Effie Williams	Allakaket	September 11, 2004	1919	85
Pollock Simon	Allakaket	November 26, 2004	1939	65
Lester Sam	Hughes	January 14, 2005	1942	63
Andy Simon	Allakaket	March 7, 2005	1937	68
Henry Beatus	Hughes	May 7, 2005	1932	73
William Williams	Allakaket	June 7, 2006	1916	90

Mapped information collected during interview sessions was marked on acetate map overlay sheets at a scale of 1:250,000 and/or 1:63,360. About one half of the respondents contributed mapped information. These data have been compiled and are presented and discussed in a later section of the report. In addition to interview data and mapped information, additional insights and contextual information surrounding aspects of fish and fishing were collected through participant observation, visits to fishing sites, and observation of fishing activities.

## **OVERVIEW OF THE PHYSICAL AND HUMAN ENVIRONMENT**

### ***The Physical Environment***

The upper Koyukuk region is depicted in Figure 1. The Kanuti National Wildlife Refuge was created by an act of Congress in 1980 and consists of approximately 1.6 million acres of land and

water in the upper Koyukuk River drainage (USFWS 1987). The Kanuti Flats is a prominent physical feature of the refuge--a broad expanse of lake-dotted lowlands that represents important habitat for migratory waterfowl, fish, and other Alaskan wildlife. These lowlands are rimmed on all sides by hills and highlands. Major rivers draining the northern one-half of the refuge include the Koyukuk, South Fork Koyukuk and Fish Creek. The southern portion of the Refuge is drained by the Kanuti River and its tributaries, most notably the Kanuti-Chalutna, and Kilolitna Rivers.

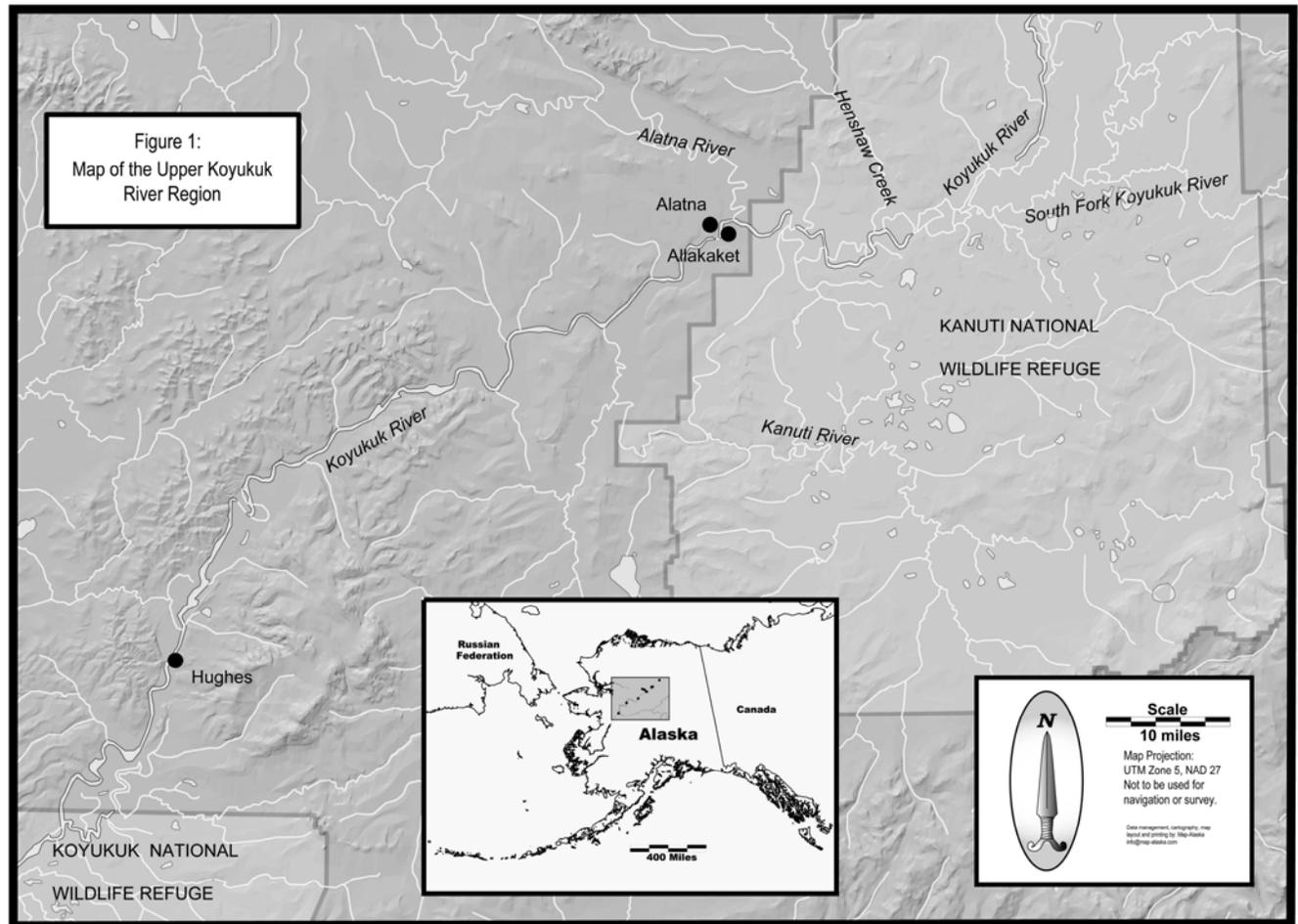
Apart from the whitefish species focused on here, a variety of other freshwater and anadromous fish species utilize refuge waters on a year-round or seasonal basis. Other resident fish species that are important from a human use standpoint include: Alaska blackfish (*Dallia pectoralis*), arctic grayling (*Thymallus arcticus*), burbot (*Lota lota*), longnose sucker (*Catostomus catostomus*), and northern pike (*Esox lucius*). Important seasonal migrants through the waters of the upper Koyukuk include chum salmon (*Onchorhynchus keta*), king salmon (*Onchorhynchus tshawytscha*), silver salmon (*Onchorhynchus kisutch*) and sheefish (*Stenodus leucichthys*).

Four major types of fish habitat have been identified on the refuge (USFWS 1993):

- 1) Koyukuk River mainstem
- 2) sloughs and backwaters adjacent to the Koyukuk
- 3) Koyukuk River tributary streams
- 4) thousands of area lakes, ponds, and marshes

These habitats are variously used by different species of fish as feeding, spawning, rearing and over-wintering areas, and as travel corridors between these habitat types. For residents of the Koyukuk drainage, past and present, an important part of the subsistence strategy has been to observe and understand how and when the various fish species utilized these habitats, and to identify movements and concentrations of fish that could be utilized for food.

**Figure 1. Map of the Upper Koyukuk River Region.**



It is important to acknowledge and briefly describe several hydrologic characteristics of the region as they figure prominently in the seasonal movements of fish between habitats and how and when local fishers utilize fishery resources. The seasonal freeze-up of area waters typically occurs during the month of October accompanied by a general lowering of water levels in rivers and streams. Winter temperatures are extreme enough that shallow lakes, stream pools and ponds typically freeze to the bottom. The long winter period of freeze-up and snow cover allows local residents to have more generalized access to area lands and waters for subsistence activities using winter transportation methods such as snowmobiles and dog teams. The seasonal thaw or breakup of area waters typically occurs in May and is accompanied by generally rising water levels in area streams. Water levels during the summer open-water period can fluctuate substantially with the occurrence of rain events locally or in distant headwater portions of the drainage. Weather during the month of August typically features rain events that cause local rivers to rise. The processes of freeze-up and break-up are described in a bit more detail in narrative sections describing the seasonal movements of fish and fishing activities.

### ***Human History***

The upper Koyukuk/Kanuti region has been the traditional home of the Koyukon Athabascan people for millennia. The Koyukon Athabascan language group occupied the largest land area of any Alaska Athabascan group and includes several major dialects and subdialects (Krauss 1982). The Upper Koyukuk and Kanuti River drainage represents only a fraction of the land area occupied by the Koyukon but it is a linguistic and cultural crossroads of sorts, marking a region where several subgroups and dialects converge. Clark (1981) described nine recognized subdivisions of the Koyukon based largely on dialectic and socio-political affiliation. Four of these subdivisions had homelands within the Koyukuk River drainage: 1) Yukon Kateel, 2) Huslia-Dulbi-Hogatza, 3) Todatonten-Kanuti, and 4) South Fork. The upper Koyukuk region, which is the focus of this study, is primarily concerned with these last two subgroups.

While there is general agreement that the word “Kanuti” is a westernization of the Koyukon term *Koonootena* or *Kk’oonootne*, there is some uncertainty regarding the meaning of this traditional name. The dictionary of Alaska place names ascribes it to mean “old man’s river” (Orth 1971).

Most local residents, to this day, do refer to the Kanuti River as “Oldman,” and Oldman is a common surname in the upper Koyukuk region. Jetté and Jones (2000) suggest that the term *Kk’oonootne* has two other possible interpretations—one being “a river well traveled by man and animals,” and another being “roe river,” based on the Koyukon term for fish eggs-- “*kk’oon*”. While one cannot be certain what species of fish the reference to “roe” might pertain to or the exact context of the reference, the “roe river” interpretation of the name does imply regional connotations with fish, important fishing activities that might have taken place there, or critical fish habitats present in the drainage that should at least be contemplated within the context of this narrative and the human use of the region.

### **The Traditional Subsistence Cycle**

Understanding the traditional seasonal round of subsistence activities is important because it is the lens through which the Koyukon have viewed the natural world and thus the vantage point from which LTK emanates. It is also important because certain elements of the traditional round are still practiced today in a slightly modified and modernized form.

Traditionally, the Koyukon were dispersed on the land in scattered familial bands consisting of several households that utilized a relatively defined territory surrounding a semi permanent settlement or village (Clark 1981). According to Clark (1981:588), the Koyukon seasonal round of subsistence activities was characterized as being:

“distinctly structured in terms of time, place, type of activity, and type of interacting units. These units at various appropriate times consisted of families, households, fishing encampments, and hunting-foraging groups that comprised major portions of a band, entire bands, joint hunting groups from two major hunting bands and, for trading festivals, various aggregates of Koyukon as well as other Athabascan and sometimes Eskimo groups”

Clark summarized the seasonal round as follows: In May and June, Koyukon families vacated spring hunting and trapping camps and gathered at the mouths of major tributary streams to hold communal feasts of spring-caught foods such as muskrat, waterfowl, and fish. The summer months were focused primarily on salmon fishing followed by late-summer and fall hunting activities. With the onset of colder temperatures families gathered at fall camp locations adjacent to large lakes where “Men set grayling and whitefish traps in the streams and continued

to hunt locally, while women and children dried fish and snared small game” (1981:588). Winter’s focus was on the hunting of big game, particularly caribou and den hunting for black bear, interspersed with under-ice fishing for burbot and blackfish. Warming temperatures in March and April signaled a move back to spring camp locations where families would engage in a variety of hunting, trapping, and fishing activities. With the break-up of river ice, families traveled by river back to summer camp locations located along the major rivers.

The seasonal round described by Clark is somewhat generalized to fit the Koyukon region as a whole. Within this area there were variations. Specific locations might have more or less access to certain resources and the seasonal round would be slightly modified to make maximum use of the resources that were available. But Clark’s characterization of the seasonal round as “distinctly structured” is an important one. While the general land use pattern could certainly be fine-tuned to fit local circumstances, major departures from the seasonal round that had evolved over generations as the way to survive in the Koyukuk River region were probably rare. This placed people at certain locations, doing certain activities at specific times of the year—year after year. One of the consequences of this land use pattern is that LTK of specific places and specific resources is often grounded in, or restricted to, a specific season of the year. This aspect will be discussed in more detail in concluding sections of the report.

As described previously, ecological circumstances in the upper Koyukuk made resident fish species one of the more reliable sources of food. The generalized seasonal round, described above, was slightly modified and region-specific technologies were developed to enable residents of the region to harvest various resident fish species in virtually every month of the year (Andersen et al. 2004).

In the context of fishing, the movements to and from spring camp locations are particularly pertinent and are detailed by Clark (1981:589) as follows:

“In April people began moving to muskrat camps located near ponds and lakes. Snow was still on the ground, but soon the lakes thawed sufficiently around the edges for canoeing. Men hunted muskrat, beaver, and waterfowl while women set nets for pike, small whitefish, and suckers. Women too trapped muskrats, sometimes at camps separate from the men. Spring break-up comes during middle to late May.

When the rivers were clear, people went back to their summer locations along the rivers.”

Contact and settlement brought other gradual modifications to the seasonal round as well. But even as the dispersed population of the upper Koyukuk became more centralized into year-round settlements during the early decades of the 20th century, local residents continued to adhere to many of the major tenants of the traditional round. Basing out of newly formed year-round communities, many families continued to spend significant portions of the year out on the land, with hunters, trappers, and fishers making extended trips at key times of the year to access traditional areas their families had used for generations. Many elderly respondents spoke of being raised substantially out on the land into the middle decades of the 20th century, participating in what can only be described as a modified traditional round of subsistence activities. Several elderly respondents, for example, recalled the use of fish traps at fall fish camps located off the main rivers to catch the fall out-migration of resident fish. This practice continued at some upper Koyukuk locations, such as Lake Creek, into the 1940s.

Several respondents also had fond recollections of the spring camp era--traveling to spring camps at inland locations, as described above by Clark, and then floating downstream with the ice to reach the main Koyukuk where they would spend the summers in fish camps catching salmon and sheefish. According to these respondents, the Kanuti River flats and Chelatna River drainage were particularly popular locations for spring camps and could be accessed by winter trails from the Allakaket vicinity. The traditional practice of “springing out” continued into the 1960s for many local residents. One Hughes elder said when she was growing up her family always spent the month of May at their spring camp up the Kanuti River, traveling overland on spring snows to reach it. Fishing, as well as waterfowl and muskrat hunting, were the primary activities. Following breakup they would float out with the ice to the main Koyukuk. It was then a 3 day trip by row boat to travel the short distance from the mouth of the Kanuti River or “Oldman” to Allakaket against the swift current. She remembered seeing the first “kicker or outboard motor in 1927, a 2 ½ horse.

“Every spring we would spring out in Oldman River with my parents. We go down Oldman River and my mom would set fishnet. We want fish, so they caught all suckers. I don’t know why lots of suckers.....and they cook the head so we could find everything in his head what he took long ago. Every spring we spring-out in

Oldman River. I never miss....not one time. We have old grandma, and his Dad [pointing] is my grandma's oldest son....And my old grandma, spring time, go by boat from spring camp in Oldman River and Chelatna.....row boat.....they were hunting muskrat. Mama hunt every day. Muskrat, pikes.....they get pike too in the lakes. So there was lots to eat in May." [H05, Hughes.]

### **Contact, Settlement History and Contemporary Communities**

Prior to direct Western contact in the early 19<sup>th</sup> century, the Koyukon were active participants in the Siberia-Alaska trade, obtaining goods such as steel knives and tobacco through coastal Eskimo middlemen in exchange for furs (Simeone 1971). The Koyukon, in turn, transferred these items further inland to neighboring Athabaskan groups along the middle and upper Yukon River via traditional trade routes. Direct contact with Europeans began with the intrusion of Russian explorers and fur traders into the lower Yukon and Koyukuk rivers in the 1830s. A post established by the Russian-American Company on the Yukon River at Nulato in 1838 represented the first year-round presence of non-Natives in the region and attracted Native traders from a large surrounding area including the upper Koyukuk. From the Nulato post, the Russian trader and traveler Zagoskin made a brief visit to a Koyukon settlement on the lower Kateel River some 50 miles up the Koyukuk in the 1840s—the first record of non-Native travel within the Koyukuk River drainage itself (Zagoskin 1967).

The existence of a traditional overland travel route from Nuklu'kyet (Tanana vicinity) to the upper Koyukuk was known and reported as early as 1869 and would prove to be the initial avenue of direct contact between non-Natives and Koyukon bands occupying the Kanuti River drainage. Via this travel route, Lieutenant Henry T. Allen is generally credited with making the first non-Native exploration of the upper Koyukuk River region in 1885, though Allen (1985) acknowledges that several white traders had preceded him and had reported the existence of a small Native settlement on the lower Kanuti River. Allen's account of his journey is noteworthy in that it provides the first documented glimpses of the Native inhabitants of this region.

Allen, accompanied by Private Fredrick W. Fickett, seven Native guides, and five pack dogs departed the Yukon River in the vicinity of the present-day community of Tanana on July 28, 1885 bound for the upper Koyukuk. Five days later the party was in the vicinity of Todatonten Lake. Near the lake on the left bank of the outlet stream referred to as "Mentanontlekaket,"

Allen (1985:78) reported a “house used by some Koyukuns [sic] during the season of fish in the lake.” The next day they arrived at the junction of Mentanontlekaket and Konootena [Kanuti] rivers and “on arriving several shots were fired to notify the villagers on the Konootena’ one-half mile above, of our approach. In a few minutes canoes came down the river and we paddled up it to a village of 5 men, 3 women and five children situated on it’s left bank.” From this small settlement of Natives on the Kanuti, Allen obtained several birch bark canoes and continued down the Kanuti River and up the Koyukuk for another 6 days, reaching as far as the lower John River on August 9 before turning around to descend the entire length of the Koyukuk to the Yukon and the coast.

During his brief time on the upper Koyukuk, Allen made several other observations pertinent to the human settlement of the upper Koyukuk and the late summer fishing activities the Native inhabitants were engaged in. While no Native camps or settlements were mentioned between the mouth of the Kanuti River and the South Fork, Allen’s Native guides made him aware of another small settlement less than a mile up the South Fork (reported by Allen as the Nohoolchintna River) which he visited and described as “the last settlement on the Koyukuk.”

Coming out of the John River on August 9 the Allen party also reported meeting a single “Mahlemute” headed to the John River headwaters with dried salmon obtained at the South Fork settlement. “His first request was for cartridges for his old model Winchester rifle which had been furnished by arctic whalers” (Allen 1985:83). The following morning they encountered “some women and children from the Nohoolchintna enroute to the Allenkaket (or Alatna) for fish” (Allen 1985:83-84).

These 1885 observations of the Koyukon Natives encountered by Allen are the closest thing we have to a first-hand description of the settlement patterns in the upper Koyukuk prior to the steady influx of Euro-American that would follow. The presence of two small seasonal settlements located off the main Koyukuk River on the lower reaches of the South Fork and Kanuti Rivers is interesting in that, while these settlements no longer exist, ancestral ties to both the South Fork drainage and the Kanuti River region are still distinguished among contemporary

residents of Allakaket. It is also consistent with the linguistic subdialects and regional homelands suggested by Clark (1981).

Allen's late-summer observations also hint at a preoccupation with fishing activities one might expect at that time of year. The summer harvest of salmon in 1885 was apparently abundant enough so that salmon could be offered in trade to a Nunamiut trader who had traveled from the Brooks Range foothills to obtain them. And based on what is now known about late summer and fall fishing patterns, the party of women and children Allen encountered from the South Fork settlement bound for the Alatna River was probably headed there to prepare for and participate in the fall harvest of whitefish and sheefish.

In the decade following Allen's initial foray into the upper Koyukuk there are few written accounts of non-Natives traveling through the region. Certainly, there must have been some, for the region was not overlooked by mineral prospectors in the sweeping search for gold that took place throughout the Yukon River drainage in the 1890s. In a brief history of the upper Koyukuk, Robert Marshall (1933) reported that 15 to 18 prospectors found their way to various creeks in the upper Koyukuk between 1885 and 1895 and that small gold deposits had been discovered in the region by 1893. But the population of Euro-Americans exploded throughout many parts of Alaska in 1898 as gold seekers overwhelmed the Klondike Gold Fields and then fanned out to prospect grounds far beyond Dawson. By the winter of 1898 there were an estimated 1,000 miners residing in the Koyukuk River drainage and the Koyukuk joined the list of locations across Interior Alaska that hosted a short-lived gold rush around the turn of the 20th century (Marshall 1933).

Concurrent with the height of mining activity on the upper Koyukuk, Walter C. Mendenhall with the USGS traveled through the upper Koyukuk enroute to Kotzebue Sound (Mendenhall 1902). Mendenhall entered the Kanuti River from the east via the Dall River along another route of traditional travel and trade connecting the upper Koyukuk with the upper Yukon River region. Via this route, Mendenhall traveled the length of the Kanuti River, and near the mouth of Mentanontli Creek encountered the same Native settlement visited by Allen 15 years earlier. It

had grown in size since Allen's visit and the material culture showed signs of more regular trade and contact with Euro-Americans. He described it as follows:

“On the Kanuti River is a similar fishing settlement of perhaps 75 Koyukuk Natives. They are generally supplied with food and clothing of white manufacture through the work that they do for the Koyukuk miners, or by the exchange of game and furs for articles kept by the traders at the various stations” (Mendenhall 1902:52)

Mendenhall's maps also show the location of several new settlements located along the main Koyukuk River precipitated by area mining activity--Arctic City on the Koyukuk opposite the mouth of the Kanuti River and a settlement known as “Bergman” on the right hand bank several miles upstream from Arctic City. Bergman apparently represented the limit of reliable steamship navigation on the upper Koyukuk. Though its heyday was short lived, Bergman flourished briefly and was populated year-round by 1898. Mendenhall judged the Native population of the upper Koyukuk in 1901 to be approximately 100 individuals located in small camps at the mouths of major tributaries and relatively new concentrations at mining settlements such as Arctic City, Bergman, Bettles and Peavy, near the mouth of the South Fork.

Through this process of nucleation around gold-rush settlements, the scattered indigenous population of the Koyukuk region established more permanent camps to take advantage of trading and wage-earning opportunities (Clark and Clark 1993). This paved the way for the establishment of more permanent year-round settlements in the early decades of the 20<sup>th</sup> century and the communities we see today. A 90-year old resident of Hughes summarized what he knew of the settlement of Arctic City and Allakaket during this important transition period and how these new settlements attracted scattered family groups from the surrounding region:

“Besides Nulato.....Nulato first, no Koyukuk, no Cutoff, no Hughes. Allakaket.....before Allakaket, Arctic City is first village. Its about 12 miles below Allakaket. That's what my mother say. My mother said they live in Arctic City and around 1905 Bishop Rowe come over from Tanana River.....I mean around Tanana area, and ah.....he asked people in Arctic City where they can put mission and church. Because Ah.....Eskimo people live camp to camp up Alatna River and ah....there....Allakaket people on the river, camp to camp that's all. So Arctic City....most of the people says they want Allakaket to be village....in 1905 Bishop Rowe come over, well, he Baptize lots of 'em too, anyway, at that time. And Allakaket start in 1907....They put church and mission there and that's how the village start. And the Alatna people, the Eskimo people on the other side.....Indian on this side....that's where I grew up.” [H04, Hughes]

According to the 2000 Census, the population of the Upper Koyukuk region consists of about 338 residents residing in the communities of Hughes (pop. 78), Alatna (pop. 35), Allakaket (pop. 133), Bettles (pop. 43) Evansville (pop. 28), and Wiseman (pop.21) (U.S. Census Bureau 2000). Residents of Hughes and Allakaket have particularly strong historic and contemporary ties to the lands and waters of the KNWR and thus served as a focus for the purposes of gathering LTK of this area.



**Figure 2. Koyukuk River Whitefish. Least ciscos (top), humpback whitefish, broad whitefish (bottom).**

## **LOCAL AND TRADITIONAL KNOWLEDGE OF WHITEFISH**

### *Native Language Terminology and Taxonomy of Whitefish*

LTK interviews typically began with the researchers showing close-up photographs of the various whitefish species and asking the respondent to identify each fish by its Native language name. This served to clarify the fish species of interest and reduce confusion with regard to nomenclature during the remainder of the interview. Apart from assisting the interview process, this approach gathered significant information regarding local nomenclature. The Koyukon taxonomic system for fish tends to be descriptive in nature and contains terminology that incorporates physical and behavioral traits as well as seasonal movements. Understanding the

terminology used for whitefish and whitefish- related products provides significant insight into how these resources are viewed and utilized by inhabitants of the Koyukuk.

The upper Koyukuk region is one in which several Native cultures, languages, and dialects converge. The Alatna River region and the community of Alatna have strong Inupiat Eskimo cultural ties and Andersen et al. (2004) collected Inupiaq language terms for fish from the upper Koyukuk. This project attempted to specifically identify and interview individuals with historic ties to waters of the Kanuti National Wildlife Refuge situated south and east of the Alatna River—an area not widely used by Alatna residents. For this reason, no residents of Alatna were among the identified respondents, and no Inupiaq language names for fish have been included. Koyukon language terms pertaining to whitefish are listed in Table 2. along with English language equivalents and Linnaean taxonomic terms.

**Table 2. Koyukon Language Terminology and Taxonomy of Whitefish.**

Common Name	Linnaean Name	Koyukon Terminology
Broad Whitefish exceptionally large broad whitefish	<i>Coregonus nasus</i>	taaseze menkke huk'etaaseze
Humpback Whitefish	<i>Coregonus pidschian</i>	holehge or telaaghe
Least Cisco	<i>Coregonus sardinella</i>	tsabaaye or ts'ol yoz delbeje or delbege
Round Whitefish	<i>Prosopium cylindraceum</i>	hulten
<b>Other Pertinent Terms</b>		
General term for "Fish" General term for "all whitefish" The spring surge or movement of fish (whitefish & others) Whitefish that have been preserved by drying Oil rendered from the guts of whitefish Ball-like gut or pyloric caecum found in whitefish Dried whitefish cut like salmon The late fall surge or movement of fish (whitefish & others) Fish eggs (general)	<i>Coregonids</i>	lookk'e ts'ol lookk'e too doggu zooze' taasez loo' or k'eghuze k'edzeede ghaa' dzeede' elebedze huyts'en look'e kk'oon'

Koyukon whitefish taxonomy is similar to English or Linnaean systems in that there are collective terms that recognize the similarities or relatedness of whitefish as a group, as well as individual species names which frequently incorporate physical or behavioral traits of the fish. The Koyukon naming system also adds additional terms for fish caught or moving in area waters at a particular time of year, or fish of unusual size.

### **Collective Terms**

The Koyukon language term that refers to the group of fish we know as whitefish is *ts'ol*. Because whitefish are one of the more common and sought-after fish in this region, sometimes the generic term for fish *lookk'e* is also used to refer generally to whitefish. Brown et al. (2005) also found that the collective terms for whitefish corresponded to the generic terms for fish in both the Deg Xinag and Holikachuk languages in the lower Yukon River region.

### **Specific Terms**

The Koyukon term for broad whitefish used throughout the upper Koyukuk region is *taaseze*. Jetté and Jones (2000) report that this term is cognate with neighboring Gwich'in language term for the broad whitefish (*cheyhshoo*) and translates to “water hump”-- a reference to the distinct rising of the back. The translation is sometimes interpreted as “water bear” because the back of the fish is said to rise like that of a bear.

Jetté and Jones (2000) list another Koyukon term for broad whitefish of exceptionally large size: *menkk'e huk'etaaseze*, literally “lake fish.” According to respondents, broad whitefish can sometimes become landlocked in certain lakes by floodwaters and can reportedly grow to unusually large size. Such fish are occasionally caught by fishers during high water events that flush these fish from their resident lakes. While none of the respondents utilized the above term in discussing broad whitefish, one respondent did report catching fish matching this description in a slough near Allakaket during a major flood event that inundated the upper Koyukuk in the early 1990s.

“In that flood, you know, I had fish net right down here in that slough for a little while and boy!....I was getting some different size of.....big *taaseze* [broad whitefish]. Right down there in that slough.....just big....different type of fish....I don't know where they came from, but, I just had fish net out for a little while because of the high water.....they came out of some lake.....big whitefish....I never seen anything

like that before. And they were a little different than these [examining photograph]...the one's I was catching was more...kind of more red on the scales."  
[A01, Allakaket]

Brown et al. (2005:64-65) also makes reference to and documents Native language terminology distinguishing large broad whitefish found in some lakes in the Grayling and Shageluk vicinity on the lower Yukon River.

Depending on the dialect, two Koyukon language terms are used for the humpback whitefish. In the Allakaket vicinity, the most common Koyukon language name for the humpback whitefish is *holehge*. The literal translation of this term is “it swims upward” (Jetté and Jones 2000). In the Hughes vicinity it is common for the humpback whitefish to be referred to as *telaaghe*.

Throughout most of the drainage, the Native language name for the least cisco is *tsaabaaye*. The literal meaning of this term is uncertain but it is thought to make reference to the color gray (*baa*). Jetté and Jones (2000) report that on the lower Koyukuk the term *ts'ol yoz*, meaning “small whitefish” is sometimes used for the least cisco but this term was not mentioned by any of the respondents residing in the upper Koyukuk. Another lower Koyukuk term for cisco; *delbeje* or *delbege* was reported by Andersen et al. (2004) but was not used by any of the respondents interviewed with this project.

Using photographs of fish with interview respondents, Andersen et al. (2004) identified the term *tsaabaaye* as the Koyukon term for both the least cisco and the Bering cisco. Harvest information gathered as part of that study also indicated that significant numbers of Bering cisco were harvested throughout the Koyukuk drainage during the 2002 survey year. Recent biological work on Koyukuk River whitefish, however, has not shown Bering cisco to be distributed in the upper Koyukuk River (R. Brown, USFWS, 2006, pers. comm.) and Andersen et al. (2004) acknowledged that it was unusual that these two fish, if common to the region, would not be distinguished by separate Native names. While they are similar in size, it is unlikely that subtle differences in appearance, run timing, body condition, etc. would have escaped the keen observation of generations of life-long fishers. In other areas where both species commonly occur, such as the neighboring Gwich'in language area of the upper Yukon

River and the Kotzebue region, distinct Native names are used to identify them (Andersen and Fleener 2001; Georgette and Shiedt 2005). As a result of this apparent discrepancy, questions surrounding the presence or distribution of Bering cisco in the upper Koyukuk River were specifically identified as topic for further examination as part of this study.

Presented with more detailed photographs of the two cisco species, none of the respondents associated with this study expressed familiarity with the Bering cisco and none were able to identify the Native name for it. This was in stark contrast to the more or less instant recognition of the other whitefish species. This seems to confirm that the Bering cisco is not commonly found on the upper Koyukuk. Data showing the harvest of Bering cisco in the 2002 household harvest survey now appears to have been an error. By including Bering cisco in the survey list of possible fish species harvested, and having surveyors explain to some fishers that these two species were sometimes difficult to distinguish, it may have suggested to some fishers that they were unknowingly catching them, causing them to divide their catch of “small whitefish” to report both species. Upon closer examination, it appears likely that the term *tsasbaaye* in the upper Koyukuk appears to refer specifically to, and only to, the least cisco.

The round whitefish is rarely caught in large numbers but is also present in Koyukuk waters and is referred to in the Koyukon Language as *hulten*. Andersen and Fleener (2001) reported this same term for the round whitefish in the Gwich'in language where it is said to translate as “sled handle”, a reference to the slender round shape of the fish. Because the Koyukon and Gwich'in language areas converge near the headwaters of the Koyukuk River it is likely that the Koyukon use of the term *hulten* has been borrowed from the Gwich'in. One respondent noted that there was a traditional prohibition against eating the round whitefish:

“That’s *hulten*.....we can’t eat ‘em.....that’s our old story. Grandma and Grandpa tell us don’t eat that kind. I never ask them why, I just cook ‘em for my dogs [A07, Allakaket].

Another respondent said they were told as children that round whitefish were not to be eaten by anyone but elders and that they had an odd taste “like grass lake water.” Because they are only present in small numbers and not recognized as a major food resource, less than one half of the respondents knew much about this fish or could identify it by its Native name.

### **Whitefish Terms Incorporating a Seasonal Reference**

Koyukon Language taxonomy includes several terms for fish that are season-specific rather than species-specific. The term *too doggu zooze'* translates to “that which is clustered during high water” (Jetté and Jones 2000;747) and is a term applied to “spring fish” or fish that have been caught and dried during the period of high water surrounding spring breakup. This term is not specific to whitefish and might also be used to identify spring-caught northern pike or longnose sucker, but whitefish taken at this time of year would fall into the category of *too doggu zooze'*. Similarly, the general movement of fish in area streams with the approach of fall is collectively called *huyts'en look'e*, literally “fall fish.” Whitefish and other fish species such as sheefish, northern pike, and arctic grayling commonly taken at this time of year might be collectively identified using this term. Jetté and Jones (2000) reports that the 13<sup>th</sup> month of the traditional Koyukon lunar calendar (roughly corresponding to September) makes specific reference to the abundance of fish available at this time with the name *huyts'en look'e noghe*, literally “fall fish month.”

### **Other Miscellaneous Terms**

Whitefish meat, oil, and eggs are all utilized and referred to using Koyukon language terms. Jetté and Jones (2000) document at least three Koyukon terms for dried fish produced from whitefish. The general term for dried whitefish is given as *taasez loo'* (Jetté and Jones 2000:419) or *k'eghuze* (Jetté and Jones 2000:265) in the lower Koyukon dialect. Whitefish that have been cut and scored for drying like salmon is known as *elebedze* (Jetté and Jones 2000:101). The general Koyukon term for fish eggs is *kk'oon'*. This term is not specific to whitefish and might be used to reference the roe of any fish. Whitefish eggs are sometimes eaten raw or cooked and are also sometimes mixed with berries to make a traditional dish known as *kk'oondzaah* (Jetté and Jones 2000: 368). The ball-like gut or pyloric caecum of whitefish is known as *dzeede'* and is sometimes fried and eaten. Oil rendered from the guts of whitefish is called *k'edzeede ghaa'* and is used for making several traditional dishes or as a nutrient-rich dip for dried meats. One respondent noted that when tanning moose hides, whitefish oil was sometimes used to soften especially thick or dry portions of the hide:

“We use that on moose skin. I did that long ago.....not all the skin, just some places where it is really dry.....use moose brains and soak it, but some places its

really hard to tan, like on the back where it is thick.....we rub on that fish oil to help soften it.” [H03, Hughes]

### ***Fishing Methods and Gear***

In essence, LTK interviews with respondents about the behavior and biology of whitefish were multi-faceted discussions about fishing for and processing whitefish. Questions posed to respondents about fall whitefish movements, for example, might precipitate a lengthy discussion about the traditional use of fish traps-- how traps were constructed, how certain creeks in certain locations were chosen to set them in, and how fall-harvested fish were processed and handled. Similarly, questions about whitefish movements in the spring might be answered with a description of where traditional spring camps were located, how fishing activities were carried out during and immediately following the breakup of river ice and the fish processing activities that typically took place there. With this in mind, it is useful to provide an overview of the various fishing methods and gear used to harvest whitefish in this region.

### **Contemporary Fishing Methods and Gear**

***Set Gill Nets.*** Commercially manufactured set gill nets are one of the most commonly used gear types for the harvest of whitefish. Set nets are typically tied to the shore on one end, and the outer end anchored so that the net hangs in the water roughly perpendicular to the shoreline. They are a passive gear type which can be set and left to fish for six to 12 hours while the fisher attends to other tasks. During high water conditions, where excessive drifting debris may accumulate or snag nets, gillnets may be more closely attended.

Modern nets are manufactured from mesh made of nylon twine and typically come complete with plastic floats and lead-lines. According to fishermen, these factory made nets can be fished “right out of the box” with few modifications. Most set nets used by fishers on the upper Koyukuk are between 50 and 80 feet in length, and eight to 10 feet deep, with mesh sizes ranging between 2 and 6 inches. Mesh size is critical in determining the size and species of fish that will be caught in the net. A net mesh that is too small will allow larger fish to “bounce off” the net without being gilled while a mesh that is too large allows more fish to pass through the net. Local fishers typically own several nets of various sizes in order to catch the full range of fish

available to them on the upper Koyukuk. One active fisherman in Allakaket described his inventory of nets this way:

“I got 5 nets.....that’s for everything.....five nets. For this one [humpback whitefish] I got 2 ½ inch mesh. This one [broad whitefish] takes 4 inch net for that one. Then I got salmon net.....5 3/8 inch and 6 inch. 5 3/8 can catch the big taaseze [broad whitefish], I get them sometimes with that one, but little ones can get through. And then I got seine net.....that’s 1 ¼ inch.....catch everything in the river with that one.”  
[A08, Allakaket]

Fishers may target certain preferred species of fish by fishing at certain times of the year, selecting a certain fishing location, or selecting a certain net mesh size. But all fishers know that in using set gill nets, a variety of fish species will likely be caught. A fisher targeting humpback whitefish, for example, might also catch significant numbers of longnose suckers and northern pike. All fish that find their way into a fisherman net are appreciated and utilized.

Some fishermen may use or modify damaged gillnets to make something they refer to as an “ice net.” These are gillnets used to fish under the ice. Typical modifications include shortening the depth of the net to 3 or 4 feet and reducing the number of floats so that the net hangs low in the water, reducing the chance that the net will freeze to the underside of the ice. These nets are set through a series of holes in the ice using a pole to thread the net from hole to hole.

***Seine Nets.*** Fine-mesh beach seines or “seine nets” are utilized by some of the more active fishermen on the upper Koyukuk. These nets are typically 150 to 300 feet in length, 10 to 12 feet deep and have 1¼ inch mesh. The use of a seine net requires the active participation of a team of three or more fishers and a boat. Using this fishing method, shore-based fishers hold one end of the net while the net is deployed from a boat to impound the targeted fishing area—usually a river eddy. Once the net is fully deployed and the impound area is completely sealed by the net, the seine is pulled to shore by hand and the catch is retrieved. Because river currents are typically moving the net downstream as it is being deployed, fishers must move along the bank holding the net ropes until the process of retrieving the net has begun. As a result, the seine net actually performs a “sweep” of an area that may be several hundred yards in length. While whitefish, and sheefish are the species most commonly targeted using seine nets, the small-mesh size of the net catches most adult species of fish present in the sweep or impound area and the



**Figure 3. A seine net hangs to dry in Allakaket.**

harvest resulting from seining frequently includes non-target species such as arctic grayling, northern pike, and longnose suckers.

### **Traditional Fishing Methods and Gear**

Respondents spoke of several fishing methods that are no longer in common use.

***Traditional Nets.*** Prior to contact, gill nets and seine nets were traditionally made from willow bark. Floats were made from wood or cottonwood bark, and sinkers were fashioned from stone or antler. Andersen et al. (2004) provides a description the processed used to strip and twist the bark for net making and the special care required to maintain these willow bast nets in working condition. Following contact in the mid-19<sup>th</sup> century, traditional net making skills incorporated the use of cotton twine to make larger and more durable nets similar to those used today.

***Funnel Traps.*** Prior to the 1940s wooden fish traps were commonly used to harvest whitefish at key locations. Traps were typically 10 to 12 feet in length and three or four feet in diameter. These elongated baskets fitted with a funnel entrance were made of split spruce slats tied with spruce roots. They were typically placed in small streams in the fall to harvest fish as they exited

these streams to reach spawning and over-wintering areas. Several respondents had clear memory of witnessing fish traps being made and used into the 1940s and were able to offer some details on materials, construction techniques and how the traps were deployed.

“Fish trap is maybe about 10....12 feet long....and about that (indicates three feet) big around. My dad make it out of spruce. He uses his 2 finger.....that’s the space between the poles. They start with small trees. They cut it flat, you know, maybe about ½ inch round sticks. And they make opening right in back out of rope. And when you drag it back you open it here.....there is string to tie it up. Take it off and get your fish out. They look for good tree with no limbs.....good size tree (gestures six inches around) the he split ‘em up. Strait grain.....sometimes with those that lay over the water.....that’s the kind he used to look for. That was around 1948 ....49. He sit there all day long every day. He got those roots to tie it up with. They want that kind over the cut bank.....pick up roots around there from the tree.....those that lay over the cut bank he used to pick them up from under the bank---anytime---summer time you can gather them and keep them. They put it in water whenever they gonna use them. It might take him about a month to make it, I guess. Just use pocket knife and little plane.” [A06, Allakaket]

This excerpt is interesting because it emphasizes the attention that was paid to selecting wood for trap construction that had the proper grain, suggests that traditional materials such as spruce root lashings continued to be used for specific parts of the trap into the middle of the 20th century despite the availability of imported alternatives, and sheds light on the significant time involved to construct a trap.

This respondent went on to say that spruce or willow fences were used to block the stream area between the bank and the funnel opening. Shallow fishing areas were chosen that would allow the top of the trap to remain out of the water. Traps would be placed facing upstream and the trap opening was generally square-shaped to allow the trap to rest evenly on the bottom. To check the trap, fishers would go upstream and walk toward the trap slapping the water with willow sticks to drive any fish in front of them towards the trap opening. These large traps were checked frequently and when even partially full required two or more people to drag them out of the river to recover the harvest. According to respondents these large fish traps were stored near fishing locations by hanging them from the lower branches of spruce trees. This kept them off the ground and protected from the elements and allowed them to remain serviceable for many years.

One respondent and active fisher in Allakaket remembered traveling as a child with his father up the Kanuti River to the Lake Creek vicinity in the 1960s. At that time, old wooden fish traps could still be found hanging in trees along the river bank and he speculated whether or not remnants of those traps might still be found.

“I see those traps when I was kid. We had camp there and me and Dad went around the bend and there was lots of long funnels like in that picture.....maybe about 10 feet long. Maybe they’re still in the trees, you know. Right around the bend (mapped location) right on the right side there is big trees in that area, there was old trap, it was still there. Maybe it flood out thought. Right below there is berry picking place.....lots of cranberries on the left side between the river and that lake, and then on the right there was those funnels.....I see them. Made out of spruce, they’re fancy, you know! Must have been 35 or 40 years ago.” [A04, Allakaket]



**Figure 4. Henry Beatus of Hughes holds a funnel trap of traditional design used to harvest blackfish. The trap is constructed of split spruce with willow bark lashings. Larger versions of this trap were utilized to harvest whitefish.**

***Dip Nets.*** Dipnets were historically used to harvest several species of fish including whitefish. Dipnets had a handle approximately eight to 10 feet long holding a circular hoop net with an opening three or four feet in diameter. These nets were typically used during spring in high water conditions in certain sloughs and side-stream areas. According to respondents, pike, sheefish, and whitefish moving in streams at this time would seek the calmer waters of sloughs and side-streams to rest and avoid ice and debris. Where shoreline conditions were right, and fish were relatively concentrated, dipnetting could be a productive method of taking fish.

“Old way.....if all you wanted was a few whitefish to eat was to use a dipnet.....spring time, in the sloughs along a cutbank.....just dip them out.” [A08, Allakaket]

“Right after breakup they have dip net.....that’s how they used to get their fish in the spring. All kinds of fish in spring.....dip net. There’s a place below our spring camps, right here down around the bend.....there is small lake that come out.....right there was the best place they say for dip net. I try it once.....I got one pike.” [A06, Allakaket]

### ***Seasonal Movements of Whitefish in the Upper Koyukuk River***

Comments from local fishers suggest that the three most common species of whitefish in the upper Koyukuk River region: broad whitefish, humpback whitefish, and least cisco, occupy generally the same habitats, move in roughly the same patterns, and are widely distributed throughout the waters of the upper Koyukuk River drainage. There may be slight differences between the species (and even within the same species) in habitat preferences and exact timing of seasonal movements, but in general, and throughout most of the area utilized by local fishers, all three species commonly occur together. A fourth species, the round whitefish, is seldom found in large numbers and is generally regarded by local fishermen as a “clear water” or “headwater” fish.

In terms of general distribution of whitefish species within the drainage, there appears to be a reduction in species diversity in portions of the drainage above the Alatna River mouth. For example, respondents noted that sheefish are rarely encountered in waters above the Alatna River mouth and that broad whitefish are less common on the South Fork Koyukuk than in areas farther downstream. In interviews with Bettles and Wiseman residents, Andersen et al. (2004) found that humpback whitefish, least cisco, and round whitefish were the whitefish species most commonly observed in the headwater regions of the Koyukuk but that there was little contemporary harvest of them. This information implies that humpback whitefish and least cisco are the most widely distributed whitefish species in drainage and perhaps the most adaptable to a variety of habitat types.

Pinning down the seasonal movement of whitefish in the waters of the upper Koyukuk region is complicated by the fact that these fish are able to utilize a variety of lake, slough, and river

habitats and thus, the same species of fish can be found in a variety of habitats in most seasons of the year. Georgette and Shiedt (2005) underscored the complexity of whitefish movements in the Kotzebue Sound, Kobuk River, and Noatak River region, noting that within this large and diverse area, local fishers reported very different movements of fish depending upon their geographic location. There appears to be no single location or habitat type that all whitefish seek out in any given season. Local fishers interpret the staggered arrival times of fish in the spring to mean that fish of the same species are likely arriving from multiple over-wintering locations—some relatively local and others more distant.

According to local fishers, whitefish are sensitive to changes in water levels and the direction of water flow, and use this sensitivity to enter and exit shallow tributaries and lake systems without being stranded. Consequently, periods of rising and falling water levels appear to stimulate movements of whitefish that fishers can take advantage of.

“When water is dropping, they’re coming out. You got fish net across the creek on Lake Creek that’s good place. They’re comin’ out of the lake. But when its water raise, they go back to lake.” [H04, Hughes]

“If high water, people will catch a lot of these [humpbacks] if they put small net in those sloughs or something. Its like up there at Huntington Creek, where those fish float out, they’ll be a lot of those fish. They stay where they could rest or something. Soon as that water start drop they’ll go out and move again.” [H02, Hughes]

While the ultimate destinations of individual whitefish and groups of whitefish at any given time of the year may vary, what local fishers know is that the Koyukuk and its tributaries are highways for the movement of whitefish and that there are seasonal components to these movements—times of the year when large numbers of whitefish will pass certain locations, be moving in certain directions, or will be concentrated in certain areas. The seasonal movements of fish and the seasonal activities of fishermen are intertwined. Both are affected by the presence or absence of river ice, changing water levels and temperature. For this reason, the discussion of seasonal fish movements below takes a similarly holistic approach, incorporating information on river conditions as well and fishing and preservation techniques, as it was offered in the context of the interviews. The narrative that follows, summarizes and examines the annual cycle of whitefish movements in the upper Koyukuk as seen by local fishers beginning with breakup and the open water season.

## **Breakup and the Open Water Season**

*Spring Movements.* The breakup of river ice on the mainstem of the upper Koyukuk River typically occurs during the first week of May. The actual breaking up of river ice in front of a village and the first movement of winter ice downstream can be a dramatic event, with huge slabs of ice being tumbled along by the swift current and rising water. While the actual breakup event generally occurs over the course of several hours or a single day, it is typically preceded by a week or two of deteriorating ice conditions that make river travel and river crossings difficult or impossible, and is followed by several days or a week of the river flowing large amounts of ice and debris. For these reasons, what is commonly referred to as “break-up” represents a period of several weeks during late April and early May where overland travel is somewhat restricted by river conditions. Many local residents utilize this period of relative inactivity to prepare boats, motors, and fishing gear for the upcoming open water season.

The spring breakup event is also typically accompanied by high water levels in local rivers and streams. In some years, water levels in rivers and streams may begin rising while rivers are still frozen and may hasten or contribute to the breakup of river ice. In other years the high water period may immediately follow the break-up event. This all depends on winter snow depths, the thickness of river ice, and how fast spring melting takes place.

“Always high water in spring....sometimes high water comes before the ice is completely gone.....sometimes the high water comes after the ice goes. Depends on the ice and what kind of water they have, and how fast the spring thaw happen.”  
[H02, Hughes]

The high waters of spring often result in localized flooding of camps and villages, but this is taken in remarkable stride by local residents who regard spring floods as a natural and necessary part of life along the river. There is also a recognition that the high waters of spring serve to “re-charge” inland ponds and sloughs with fresh water and provides resident fish species with opportunities to enter or exit habitats that may be less accessible during periods of low water. As one respondent put it: “I think fish like the high water because it lets them get to places they want to go.” [H02, Hughes].

According to respondents, there is an initial surge or movement of whitefish in the mainstem Koyukuk during the breakup period. Respondents were of the general opinion that this spring movement of fish represented fish moving out of their over wintering areas toward feeding habitats where they would spend the summer. A similar spring movement of whitefish immediately following breakup was reported in the upper Kobuk River region by Georgette and Shiedt (2005). Certain spring fishing camps were strategically located to be able to intercept this movement of fish. One respondent noted that the over-wintering location of fish could affect the taste and quality of these spring-caught fish.

“This time of year, right now, just after ice go you can find them too. Not any place, but special place. Like there’s one down ah.....Art’s camp, that slough.....there’s another one down below Bill’s.....Auntie Sue’s old spring camp—that place. There they come out they’re rich. It got little different taste.....grassy.....but rich. If they spend the winter in the lake they taste grassy” [H01,Hughes]

Several noted that this movement of fish at breakup was generally upstream and was spread out over a period of several weeks to one month. As noted previously, there is a special Koyukon language term that pertains to this spring movement of fish associated with breakup: *too doggu zooze*’ which translates to “that which is clustered during high water” (Jetté and Jones 2000: 747). This term is not specific to whitefish, but includes other spring species such as northern pike and longnose suckers which are also moving in the streams at this time.

There were mixed opinions on the arrival timing of the various whitefish species with some respondents stating that humpback whitefish were the first to arrive in the spring while others thought broad whitefish were typically seen first.

“Right after ice go out, for a couple weeks there is lots of fish. After that there is just a few---catch a few all summer long. These ones [broad whitefish].....we get them springtime, before these [humpback whitefish]. They must stay with us all winter so we catch them springtime. I think they may come from couple different places because, fall time there is lots more.” [A04, Allakaket]

“We get these ones in slough just around breakup. We use that small net, put it out in South Fork where it is open and get mostly these ones (humpbacks) and these (cisco). Right after it breakup .....lots of these (humpbacks), but early fish are skinny. [Broad whitefish] come later in summer....August. [A03, Allakaket]

The differing opinions on the arrival times of broad and humpback whitefish might possibly result from respondents observing fish at different locations. Respondents that spoke of the early

arrival of broad whitefish was generally associated with fish camps below Allakaket and in the vicinity of the Kanuti River mouth. Those that offered the opinion that humpback whitefish were usually the first to arrive in the spring were commonly utilizing fishing locations above Allakaket in or near the South Fork Koyukuk. There was general agreement, however, that the spring movement of whitefish usually included a mix of species, and the earliest arrivals were thought to be those that had over-wintered relatively close by, with later fish coming from locations farther away.

Fishers noted that during the actual breakup event, whitefish will move into relatively calm, ice-free sloughs off the main river to temporarily escape the strong current, ice-floes, and debris. Nets set in these areas can be productive for whitefish in the spring.

As noted above, early spring whitefish are reported to be somewhat skinny, but as spring progresses, fish are said to fatten quickly and by early June are considered prime.

“Spring whitefish are a bit lean—their meat is a little bit soft.....in May they are kind of soft.....mid June the meat start getting firm.” [A08, Allakaket]

Another elder respondent commented on the condition of spring-caught fish and was very specific about the time when fish were considered suitable for human consumption—noting that the condition of whitefish could be gauged by the appearance of certain spring grasses along the river bank.

“Both these fish (broad and humpback whitefish) come anytime. In spring we see it. Spring, everything in spring come. But June.....June 9 we have to put fish net in. Yeah, fat.....in June.....June 9 or 10, you see that grass around. When that grass is growin’ up this one (humpback) get fat.....he eats on the river. Before that they’re poor.....just cut ‘em for dogs. June, we eat it now.” [A05, Allakaket]

The availability of whitefish in the spring made them an especially important food species. The late winter and early spring period was traditionally a very lean time of year when winter food stores had been largely depleted. According to several respondents, spring camps were typically situated at locations that would allow families to take advantage of this spring movement of whitefish and other fish species moving in the rivers and sloughs at that time of year.

“Whitefish they say it is life saver .....them old people. You find those old camps.....spring camps at the mouth of a creek or where a creek come out, where they most likely catch the whitefish.....that’s where they have spring camp. And sure enough, after breakup the fish are in there....and they eat some, dry

some....they probably don't have much anything else to eat....maybe dry meat or something, but most of that meat is gone after the winter, and so they get ducks and fish." [A08, Allakaket]

***Summer Movements and Distribution.*** Following the spring surge and redistribution of whitefish during the high waters associated with breakup, they apparently become widely distributed throughout the waters of the upper Koyukuk. In late June, July, and early August, gillnets set in almost any mainstem eddy, tributary mouth, or connected slough will reportedly produce small numbers of humpback whitefish and ciscos. Most respondents, however, indicated that whitefish during the summer months are so widely dispersed in area lakes, streams, and sloughs that they are difficult to target in large numbers. For this reason, the focus



**Figure 5. Boats tied along the Koyukuk River bank at Allakaket.**

of most upper Koyukuk fishers during the mid-summer period of July and early August shifts to salmon and sheefish. Fishing efforts for these larger species are concentrated out of village and camp locations located along the Koyukuk mainstem and utilize large-mesh nets that are not particularly effective at catching smaller fish species. Consequently, responses to questions about the location, movement, and activities of whitefish during the summer months were typically vague. Several references to fish “fattening up” or spending the summer “back in the lakes eating bugs” point to a general recognition that summer is an important feeding period for

whitefish—as it is for nearly all northern animal species. But no respondents offered detail on specific food items or summer concentrations of whitefish in their area. In general, local residents were able to offer relatively little specific information on the mid-summer movement of whitefish in lakes and waters situated any distance off the main Koyukuk or its major tributaries.

Small or incidental harvests of whitefish are reportedly taken throughout the summer months. Larger whitefish can be caught in nets targeting chum salmon and some fishers reported using small-mesh gillnets set behind (or up-stream of) salmon nets in order to specifically target a variety of smaller fish, including whitefish, which might be moving in the river at this time. One respondent noted that humpback whitefish and least cisco seemed to have similar movement patterns during the summer and were often caught simultaneously:

“The humpbacks and these ones (least cisco) travel pretty much together—they are around all summer in the eddies. I can get ‘em while I’m salmon fishing if I got smaller net set behind my chum net.” [A08, Allakaket]

The practice of placing smaller mesh nets behind salmon nets becomes more common in August as the salmon run begins to taper off and whitefish begin moving up the Koyukuk in larger numbers. One respondent noted that the end of the chum salmon run typically signaled the start of the whitefish movement upstream.

“These (whitefish) travel upstream in the summer. It start right after dog salmon slack off. That’s when they start movin’ up. And I really don’t know how far up-river they travel, but before the ice hit, they travel downstream.” [H01, Hughes].

August rains typically cause water levels in area streams to rise by mid-month and several fishers noted that catches of whitefish tend to increase during these periods of high or muddy water.

“In August.....fist part of August, we get that rain, that’s the way it used to....long time ago. Then about middle of August we have a....the water come up, and its all just creamy water, and that’s when they used to set this little mesh net out, and they catch all these [whitefish] middle of August.” [A01, Allakaket]

Increased catches of whitefish during this late-summer period of high water can be attributed to two factors—high water levels reportedly spur the movements of fish and murky water conditions make fishing gear more difficult for fish to detect. According to another respondent, however, high water is not necessary to initiate this late summer movement of whitefish out of lake habitats and up the Koyukuk:

“In August month they come up the river....even water low.....that’s when my mother get ‘em in fish net up at 12-mile, and she say they come from the lake down there.” [H04, Hughes]

By early to mid August, whitefish are considered “prime”—full of eggs and rich with oil, and are prized by fishers along the upper Koyukuk. As the salmon season fades, smaller mesh nets are set out by an increasing number of local residents and are checked daily. As the number of whitefish moving in the rivers increases, the stage is set for fall fishing activities--the years most intensive harvest effort targeting whitefish.

***Fall Movements.*** According to respondents, by late August and early September the number of whitefish moving in Koyukuk waters increases substantially. On the upper Koyukuk, fall fishing efforts for whitefish fall generally into three categories that, together, define and describe the generalized movements of whitefish at this time of year: 1) The early fall harvest of fish moving out of shallow water habitats and toward upper Koyukuk spawning areas 2) Late fall seining efforts on spawning concentrations of fish on the Alatna River, and 3) under-ice nets harvesting fish moving downstream during and after freeze-up. Two of these fishing efforts occur during the open water season and are described below. The third category of fall fishing occurs during and immediately following freeze-up and is detailed in the description of “closed water fishing.”

Exit from Tributaries: Respondents report that in late August there appears to be a generalized movement of fish out of tributary streams, lakes, and sloughs toward the mainstem Koyukuk. It is primarily this movement of fish that was targeted with the use of fish traps historically.

Fishers took advantage of this early fall movement of fish by placing basket traps and fences in shallow streams at key fishing sites located off the mainstem Koyukuk and Kanuti rivers. The various species of whitefish constituted a major proportion of the harvest in these fall traps, but the harvest also included other fish species such as northern pike, arctic grayling, and longnose suckers that were moving out of shallow waters at that time.

Contemporary fishers still recognize this fall movement of fish, but with traps no longer in use, shallow tributaries draining key lake systems are no longer sought out as harvest areas. Today, most fishers in late August and early September utilize set gill nets at favorite fishing locations

along the Koyukuk mainstem to harvest this fall movement of fish. Traditional fish camps and fishing sites are frequently situated at or near the mouths of tributary streams. One respondent explained that the mouths of creeks are good fishing places because where creeks flow into the main river, the water currents tend to form an area of “dead water” immediately downstream of the confluence that is attractive to fish. The dead water area or eddy that is created collects food items and has a reduced current where fish can rest and feed. By selecting certain fishing sites and utilizing nets of various mesh-sizes, fishermen can more effectively target certain desirable species of fish, such as whitefish.

For some individuals, the harvest of several hundred pounds of whitefish in their fall set-nets is all that their household requires. For others, particularly those individuals fishing to provide for large extended families or to feed sled dogs, harvests in fall set-nets represent only the start of fall fishing activities. Fishermen, especially those who plan to seine for whitefish in the late fall, pay particular attention to the timing, number, species composition and condition of fish taken in these fall set nets. Near the communities of Hughes and Allakaket the fall movement of fish in the river is predominantly upstream. The early segments of this fall run are typically composed of a mix of sheefish, humpback whitefish and least cisco, with broad whitefish moving up noticeably later than these other species. Early fall fishing efforts, and information shared between fishermen from various localities combines to form a forecast of sorts, for the fall seining operations that will follow. As large movements of whitefish are detected in set-nets, fishers may begin to utilize seine nets to fish snag-free stretches of the Koyukuk near Hughes, Alatna, and Allakaket, fishing along river bends and in eddies known to be productive for whitefish. Seining, while labor intensive, can produce harvests of thousands of fish in a matter of hours when conditions are right. One respondent in Hughes described using one sweep of his seine net in the fall of 2004 to provide all he needed to feed his family and his large dog team.

“This year I just did one seine and fill up my dog box. Got all I wanted in one seine. Took six or seven hours to throw them fish out [of the net]. There was about eight of us.....those kids want to go out seining but I was working 10 hours a day and ah.....Hey, I say, lets go out this evening, I told them right after school. Good thing I did or I would have got caught by the cold weather.” [H02, Hughes]

The “dog box”, mentioned above referred to an open plywood bin measuring four feet wide, two feet high and 12-feet long used by the respondent to hold fish that are utilized for dog food.

With the onset of freezing temperatures, whole fish stored in this bin will “sour” slightly as they slowly freeze and provide the primary source of winter food for his kennel of 16 sled-dogs.

The small mesh size of most seine nets (1 ¼ inch) results in the harvest of nearly all adult fish species present in the seining location. While whitefish and sheefish may be the main species targeted by seine fishermen, smaller numbers of other species such as arctic grayling and longnose suckers are commonly taken as well.

Fall temperatures figure prominently in fall fishing efforts—not because of changes in fish movements but because of requirements placed on fish processing. Fish harvested prior to mid-September generally need to be split, hung, and dried on racks to prevent spoilage.

Temperatures in late September are reliably cooler, allowing fish to be preserved whole and uncut through the natural freezing process described above. This method of storage represents a huge labor-saving advantage and fishers desiring large numbers of fall fish will typically wait as long as possible for the onset of cool temperatures before initiating major fall fishing efforts. Each year is said to be slightly different and fishers utilize careful observations of fish numbers, water levels, and weather to make critical decisions about when and where it will be most productive and efficient for them to attempt seining. Fishing families on the upper Koyukuk that desire thousands of pounds of whitefish have, for generations, headed for the Alatna River in late September to take advantage of the unique fishing circumstances that present themselves there: large concentrations of fish at a time of year when cold temperatures make for relatively easy preservation and processing of the catch.

Late Fall Seining on Alatna River Spawning Grounds. The last two weeks of September and the first week of October marks the three-week period during which most seining activity takes place on the Alatna River. At this time, tributary streams are just beginning to contribute slush ice to the Alatna River waters, but in quantities that do not yet interfere with boat travel or the deployment of nets. Whitefish and sheefish that are preparing to spawn have ascended the lower and middle reaches of the Alatna and are aggregated in a series of river bends and eddies along a 15 or 20 mile stretch of the middle river. Chebanika Creek, Siruk Creek, and Sinyalak Creek were frequently mentioned in the context of seining and roughly delineate that portion of the

Alatna most often associated with seining activity. It is unclear whether the actual spawning locations used by these fish encompasses this large area or if this is simply where spawning fish



**Figure 6. Allakaket fishermen complete a seining sweep for whitefish along an Alatna River gravel bar near Sinyalak Creek.**

congregate as they move towards more specific spawning locations. The timing of spawning and the kinds of habitats sought out for spawning may vary slightly between whitefish species based on what fishers observe in their seine nets. Some spoke of a general mixed bag of species caught at most locations while others noted that certain eddies could be counted on to produce certain species of whitefish under certain conditions.

“Some eddies is mostly sheefish. Others have a mix of these [humpbacks] and these ones [least cisco]. Only one eddy is just taaseze [broad whitefish].....big eddy, up above Chebonika that has a mud bottom. For some reason taaseze want to stay in muddy water.....and that’s where he spawns.” [A08, Allakaket]

“This one guy across here, he say the fish rest in all the eddies behind riffles.....all day, and towards evening they start traveling. And that’s true, because, we start seining at that time and sometimes we don’t catch nothin’ in those eddies and he says that’s because they’re traveling. But in the middle of the day they are resting in there. They all rest in the daytime. And there ‘s a difference.....like for these kind of fish [pointing to broad whitefish] .....a lot of these, they rest in those eddies where there is no real riffle.....and then there is those places where there is a big riffle and a little eddy above it, and that’s the kind of place the sheefish rest.” [A01, Allakaket]

This last comment is interesting in that it also points to a possible diurnal pattern of fish traveling during the nighttime hours and resting during the day.

Stories of fishermen actually observing—or hearing, sheefish in the act of spawning up the Alatna River were recounted in Andersen et al. (2004):

“[Sheefish] spawn around middle of September. Start second week in September.....they’re spawning it look like because, you know, its dark by that time, up Alatna, and if we have a camp close to riffle, at night time you hear squirting sound.....water and spawn All these [whitefish and sheefish] spawn same time.” [T061603,Allakaket] (Andersen et al. 2004:84).

According to these fishermen, the sight and sound of hundreds or thousands of sheefish in the act of spawning, which apparently takes place largely during nighttime hours, was impressive. Few respondents mentioned being able to actually observe or hear the smaller species of whitefish in the act of spawning, although residents of the upper Kobuk described the spawning act of humpback whitefish as being “real noisy and splashing” (Georgette and Shiedt 2005). That whitefish were very close to the time of spawning was generally gauged by the condition of eggs in harvested fish—numerous large, loose eggs that sometimes seeped from fish in the seine net. Based on these observations, sheefish appear to spawn and retreat from the spawning grounds slightly earlier than the other whitefish species, with broad whitefish arriving and leaving the Alatna River notably later than humpback whitefish and least cisco.

Due to the proximity of the Alatna River to the communities of Alatna and Allakaket, it is fishermen from those communities that typically have the strongest land-use ties to the Alatna River region and who most frequently participate in fall seining activities there. But even from these closest villages, a trip to the Alatna River seining grounds is a major undertaking, requiring several days time, a crew of several fishers, and significant quantities of expensive fuel. As stated above, the decision to go fall seining is carefully timed and based largely on environmental conditions—adequate water levels to accommodate the movement of heavily loaded boats, and cool fall temperatures that will facilitate the quick preservation of harvested fish.

The process of seining by a typical team of three or more fishers was described previously in the discussion of fishing methods. The spawning concentrations of whitefish and sheefish that congregate in the Alatna River as freeze-up approaches appears to be unique within the Koyukuk region—unique with respect to the number of fish present in the river and the broad expanse of river that can be effectively fished. While a similar seine fishery is carried out on spawning concentrations of whitefish in the neighboring upper Kobuk River region (Georgette and Shiedt 2005), the author knows of no other area in the vast Yukon River drainage where spawning concentrations of whitefish are harvested in such an elaborate and long-standing fishing tradition involving the use of seine nets.

### **Freeze-up and the Closed-Water Season**

Cold temperatures in late September and early October result in a relatively orderly freezing of aquatic habitats in the upper Koyukuk during a several-week process referred to locally as freeze-up. Standing waters such as ponds, lakes, and sloughs are the first to become ice-covered, followed by slow moving creeks and smaller tributary streams. Freezing temperatures reduce the amount of water flowing into area watersheds resulting in a general lowering of water levels in all area streams. During the first few days of October, slush ice is typically running strong in the mainstem of the Koyukuk along with the rapid formation of shore ice. As fall temperatures continue to decline, increasing accumulations of shore ice and flowing slush ice combine to freeze the surface of the Koyukuk bank to bank. River travel by boat is effectively curtailed with the arrival of heavy slush ice. Thus, the freeze-up process is associated with a period of relative inactivity with regard to travel as local residents shift from boats to overland transport methods and await the formation of ice solid enough to allow the safe crossing of area water bodies. While freeze-up dates vary slightly from year to year, the first 10 days of October was typically cited by respondents as the time period most often associated with freeze-up on the upper Koyukuk.

***Fall Movements Under the Ice.*** Local residents describe a general downstream movement of fish out of shallow tributaries and the upper Koyukuk region as the Koyukuk and its tributaries begin to freeze. Numerous respondents noted an association with ice running in the Koyukuk

and whitefish moving downstream with the ice. Most locals thought that fish at this time of year were seeking deeper waters where they would over-winter.

“Late in the fall time they travel. In the fall time you know, when that ice coming down and there’s ah....clear, low water, and ice coming down and see rocks on the bottom.....you see fish all the way across right behind each other, just like that, going down. I watch that sheefish done that too before. September...late. If it’s really low water coming down from Allakaket you can see them. All the way across when they rest.....then they travel. They rest before night time then they start early in the morning again. They are going down but we don’t know where they go.”  
[H02, Hughes.]

“When it gets cold—the slush ice start coming down.....the sheefish come down with it with the holehge [humpbacks] but taaseze [broad whitefish] stay up there. Taaseze come down later.....with the ice, or after freezeup. Late October we set fish net out in the river and we catch it [broad whitefish].” [A08, Allakaket]

As the above comments indicate, there appears to be some differences between species regarding the timing of this downstream movement with broad whitefish exiting noticeably later than other whitefish species. As noted previously, there may also be a diurnal component to the movement of fish, with fish resting during the peak daylight hours and moving more at night and in the early morning.

Several ice fishing techniques are used by fishers to take whitefish at this time of year. Fish coming down in late fall can be caught under the new ice of October. Fish nets can be set in river eddies just as ice is forming. Nets are initially set almost parallel to the bank, hanging just over the shore-ice edge. As ice thickens the net is progressively moved out over a period of days to a more perpendicular angle to the bank. This must be done carefully and while ice is just starting to form because this is when fish are moving downstream in large numbers. As one respondent put it:

“If you wait too long, by the time it freeze up real good and set your net good, you won’t catch nothin’ But if you set net while it is freezing, you catch sheefish, whitefish.....all goin’ down. They’re mostly empty with eggs.....well, some of them still have eggs....must be slower than the rest.....but most of it is empty.”  
[A04, Allakaket]

Once solid ice has formed, a series of holes can be made in the ice and nets set under the ice by using a pole to thread the net from one hole to the next. As described previously, ice nets are typically shallower in depth than summer nets to accommodate the lower water levels at this

time of year, and the number of corks on the float line is reduced to keep the net hanging low in the water to prevent it from freezing to the bottom of the ice.

The use of under-ice nets to take whitefish in October and early November typically marks the last significant effort to harvest whitefish by residents of the upper Koyukuk. In the annual round of fishing activities, burbot are known to be the next fish species that will be moving in the Koyukuk in large numbers. Local fishing efforts in November shift to the construction and placement of in-river burbot traps to take advantage this large run of burbot moving up the Koyukuk during the deep winter months (Andersen et al. 2004). According to fishers, ice-nets can continue to produce a few whitefish up until Christmas and small numbers of whitefish are occasionally found in under-ice burbot traps into December, indicating that some whitefish continue moving in Koyukuk waters in mid-winter. There was general agreement among respondents that in late December, whitefish begin a period of relative dormancy that lasts several months.

“After freeze-up they all head down to get away from the shallow stream before the ice. And down this way.....deep places, they park.....park all winter. Up a little ways from my camp there’s one place.....not the deepest place, but they park there. They quit moving around December on.....just park. [H01, Hughes]

“The people used to put fish net under the ice ‘till Christmas.....that’s December! My Mom, used to have fish net out.....they’re still good, telaaghe [humpback].....we get about two, three sometimes.” [A06, Allakaket].

“You can still catch them in the main Koyukuk in December but they probably find the deeper parts of the Koyukuk.....some might go far, but not all of them. There is always a few around.” [A08, Allakaket]

***Over-wintering Locations.*** Over-wintering locations for Koyukuk River whitefish appear to be dispersed throughout the Koyukuk drainage rather than centralized in a single vicinity or confined to a single habitat type. When asked where whitefish spend the winter, some respondents made reference to this broad distribution of fish and the idea that they were adaptable enough to utilize a wide variety of habitat.

“I used to ask my grandma what place these go to spend winter and she tell me they are just like us.....they go all over and find some good place and just stay there.” [A03, Allakaket]

Other respondents referred to specific locations they were familiar with where whitefish could be found during the winter months. Deep eddies in the mainstem Koyukuk or area lakes connected to the Koyukuk or its tributaries were commonly identified as over-wintering locations. Water depth, connection and proximity to tributaries, and availability of food items were sometimes referenced in these comments as the requirements for good over-wintering areas.

“There is special lakes, like down there just below Bill’s cabin there is a lake on this side.....there’s whitefish in that one. Stay there all year. And further down below Bear Mountain there is another lake. I never fish in that one but I heard about it. They’re [whitefish] looking for deeper lake and ones that got the right kind of food for it.” [H01, Hughes]

“About 12 miles down here, down river, there’s fish year-round right there.....whitefish....year-round right there in the main river. But there is creek coming out and they really like that stuff from the creek..... from the creek they really like that stuff—brown water and there is little bugs that come down,..... and where the fish are it’s deep.” [H02,Hughes]

As some of the above comments indicate, whitefish become relatively dormant in mid-winter making them unlikely to be taken in nets, and the meat of whitefish is also reported to be mushy at this time of year. Because of these characteristics, there is little harvest effort directed at whitefish during the deep winter months. According to fishers, whitefish improve in quality in March as they begin to feed again and become more active.

“Winter time they’re not that good eating. But then, in March.....I never try it in March but I heard they start moving around, start eating again. They [whitefish] have to travel and eat in order to be good shape.” [H01, Hughes]

Because there is little harvest activity on whitefish during the deep winter months, and therefore little attention paid to them, responses to questions about over-wintering locations were often vague. In a few cases, a specific over-wintering location was identified not because whitefish had actually been observed there during the winter months, but because they had been observed exiting certain locations early in the spring and were assumed to have over-wintered nearby:

“In springtime.....in Allakaket there, if you go up to Buzodoc, then in spring time there is lots of whitefish coming out.....coming out in springtime. Every spring you get good fish coming out. Must spend the winter some place in there or something.” [H02, Hughes]

Andersen et al. (2004) noted that the harvest of burbot in under-ice traps was the primary fishing activity on the upper Koyukuk during the period November to March. April brings lengthening

days and warmer temperatures and preparations begin for net fishing activities associated with spring camp and spring breakup. As whitefish begin to emerge from over-wintering areas and move in the Koyukuk mainstem, local fishers hungry for the first taste of fresh fish place nets in ice-free fishing locations as soon as conditions permit, and the annual cycle of whitefish fishing begins again.

***Spawning and Rearing Areas.*** Other than the Alatna River spawning grounds described above, no major whitefish spawning locations were identified by respondents in the upper Koyukuk or Kanuti River drainages. Fishery biologists have identified whitefish spawning areas in the extreme upper reaches of both the Kanuti River and South Fork Koyukuk (R. Brown, USFWS pers. com.). It would be interesting to ascertain if these areas were known and utilized as harvest areas by indigenous inhabitants when humans were more widely scattered across the landscape. Today these headwater spawning areas are relatively inaccessible to village-based fishers and are relatively unknown.

Respondent information pertaining to whitefish in the fry and juvenile stages was scarce. One comment from a respondent in Hughes, however, indicated that the lake-dotted landscape in the vicinity of Huslia, on the Middle Koyukuk, may represent an important role as a rearing area for Koyukuk whitefish.

“Whitefish live on the lake or something, grow up on the lake or something like that. That what my mother used to say. When its high water like this.....spring flood down around Huslia area, they come out to Koyukuk River and come up. My Mother .....she grew up down there, my mother....around Dulbi, below Huslia, and they were in Dalkli for a while and then they move up here to Arctic City, long ago. And she know about where these whitefish come from..... That’s from my country down there, she say.....down Huslia Flats. [H04, Hughes]

This comment also points to the important role that spring floods play in providing juvenile whitefish with ways to access and exit rearing locations.

### *How Whitefish are Used*

Whitefish are a preferred source of human food for residents of the upper Koyukuk. A household harvest survey in 2002 reported an annual harvest of 23,802 pounds of whitefish in Hughes and 13,135 pounds of whitefish in Allakaket (Andersen et al. 2004). Whitefish are also utilized to feed sled dogs and occasionally as trapping bait. Methods used to preserve and prepare whitefish for these various uses are briefly described below. While this may seem somewhat tangential to the central topic of fish movements, the seasonal movements of fish, the seasonal activities of fishers, and how fish are used and preserved are all components of the data set offered by local residents in interviews on this topic.

#### **Preparation, Preservation, and Use of Whitefish as Human Food**

One of the hallmarks of whitefish in the upper Koyukuk is that they are very thoroughly utilized. Traditionally, they provided a major source of protein, and preservation techniques were developed to make year-round use of not only the meat but whitefish eggs, entrails, and oil. These practices are briefly described below.

Fresh or frozen whitefish are commonly prepared for eating by baking them in the oven. In preparation for baking, loose scales and entrails are removed. Respondents also spoke of traditional cooking techniques for roasting whole whitefish on sticks over a campfire. Traditionally, and still today, spring and summer-caught whitefish are commonly preserved by drying on open-air fish racks. The techniques for cutting and drying whitefish are similar to those used for salmon, with fish split and sometimes scored to facilitate rapid drying. Smoke may be used during the drying process to deter insects and to impart a subtle smoke flavor. One elderly respondent commented on the traditional practice of burning a specific kind of willow during the smoking process for whitefish and stressed that the smoking fire should be kept low:

“Smoke....not too much, my Mama tell me....use willows....that red one, you know that willow that is red....that one.....make fire under it. Taste good with that one. Red willows, make fire and dry it, hang it up high, not close.” [A05, Allakaket]

Fall whitefish caught after the arrival of freezing temperatures are typically preserved by natural freezing. The unique fishing circumstances on the Alatna River spawning grounds that resulted in fishing parties taking thousands of pounds fish led to an equally unique method of processing



**Figure 7. Whitefish split and hung to dry in Allakaket.**

and preserving the catch. Stream-side boxes or cribs called *suluuns* were constructed to hold a winter supply of fish (Andersen et al. 2004). The word *suluun* is the Inupiaq Eskimo term for “box”. Family-owned *suluuns* were typically positioned near popular seining locations so that heavy boat-loads of fish did not have to be transported long distances. *Suluuns* were also strategically located to support winter hunting and trapping activities. Whole, un-cut whitefish and sheefish placed in a *suluun* would freeze naturally with the onset of cold weather and were used to feed both people and sled dogs. Respondents noted that *suluun* sites were recognized as belonging to certain families and there were conventions with regard to the handling of fish as they were placed in the *suluun*. Fish were typically strung on willow hoops to facilitate carrying them from the river bank to the *suluun*. Hoops of fish were layered with heads facing in alternate directions to prevent the mass of fish from freezing in a solid block and to make removal easier. The advent of reliable snowmobiles in the 1960s led to declines in the number of people requiring these remote food caches and the use of *suluuns* faded. Remnants of 20th

century *suluuns* can still be seen in some locations along the Alatna River. Today, village-based equivalents of the *suluun* are used, with fishers placing tubs of fall fish to freeze in smokehouses or plywood “dog boxes.”

Whitefish eggs are considered a high-energy snack and are sometimes eaten raw, directly out of freshly caught fish. This is particularly true for the eggs of cisco and humpback whitefish. As one respondent said “you never go hungry after eating that one [cisco eggs]....better than any lunch from store.” There seemed to be some cultural restrictions surrounding the consumption of broad whitefish eggs, although the details of these restrictions were not clear to the researcher. Comments from respondents indicated that broad whitefish eggs were less commonly consumed and that if they were to be eaten they were generally cooked. In fish camps, egg sacks from harvested whitefish fish are sometimes hung to dry on fish racks or scraps of fish net. The raw eggs of several fish species, including whitefish, are sometimes mixed with sugar and wild berries to make a traditional dish with a pudding consistency known as *kk'oondzaah*.

In the traditional Koyukon diet composed of local foods, fats and oils were especially prized and in particularly short supply. Whitefish had the reputation of being rich with oil and techniques were developed to render fats and oils from harvested fish. According to respondents, much of the fat present in whitefish is contained in the entrails. Whitefish stomachs, intestines, and livers are sometimes cleaned, fried, and eaten and rendered oil from the cooking process is poured into containers and saved for a variety of uses. In the Koyukon language, oil rendered from whitefish entrails is termed *k'edzeede ghaa'* and is commonly used today as a dip when eating dry or frozen meat or fish. Respondents noted that prior to “frying guts” they must be carefully cleaned and that a small green organ (gall bladder) should be discarded or it will spoil the taste.

“Right next to the liver is that small green one....what you call it?...and you take it out or it will smell....but oh yeah! lots of oil in the guts when you cook them. Its fish oil in it, and its really good, especially this one [humpback whitefish].....you clean the guts out and then cook 'em.....lots of oil in it! Liver too.....good!” [H04, Hughes]

### **Whitefish as Food for Sled Dogs**

Historically and today, whitefish and sheefish have served as a major source of food for sled dogs in the upper Koyukuk. As described above, the availability of large numbers these fish

with the onset of freezing temperatures allowed large stores of quality dog food to be preserved with minimal effort. Prior to the introduction of snowmobiles, dogs were used for everything from winter transportation, to pack dogs, to pulling boats upstream during the summer months (Andersen 1992). In the context of whitefish fishing, one respondent recalled that dogs in harness would not only be used to help pull boats up the Alatna to reach seining areas but would sometimes be used to assist in the seining process itself:

“Long ago my Dad and me used to, ah, that’s where I learn how to seine from.....travel up Alatna River, take us about 4 days to get where we want to go.....land with three dogs.....and one of us put the seine net in the water and one paddle real easy. And we got this old leader back there and he just tell that dog gee and haw and that dog pull that rope. Three dogs pull that net just by gee and haw. That’s how good lead dog they were long ago.” [H02, Hughes]



**Figure 8. Sled dogs in rural communities throughout interior Alaska are commonly fed a diet based on subsistence-caught fish.**

While mechanized travel has replaced the ubiquitous family dog teams of the early 1960s and before, a few families and individuals in each Koyukuk River community have chosen to retain the use of sled dogs and the lifestyle that maintaining a dog team in a village setting requires. It was observed that most of the active whitefish fishers, and virtually all of those involved in fall

seining for whitefish were those families who had sled dogs. At the time interviews were carried out (2004 to 2006), four of the 13 respondents were maintaining dog yards ranging in size from 9 to 28 dogs.

Whitefish used to feed dogs are commonly stored whole with entrails intact and allowed to freeze naturally in outdoor storage structures—formerly in streamside *suluuns* (described previously) and today in village-based sheds and smokehouses. Whole, frozen, fall-caught whitefish are sought after by mushers because of their high fat content. Another characteristic of whitefish that makes them especially attractive as dog food is the high moisture content of the flesh. Harvested whitefish are said to retain or even absorb moisture as they freeze helping to keep dogs well-hydrated as the fish are consumed. Fish fed to dogs are generally cooked (boiled) in large outdoor kettles or cookers into a soup or broth to which other ingredients such as rice are added (Andersen 1992). When trail or camp conditions call for simplicity, dogs might also be occasionally fed whole, frozen fish without cooking. Comments pertaining to the marginal quality of Koyukuk River salmon and the use of whitefish to feed dogs include the following:

“The salmon we got up in this part of the river are pretty far gone.....dries up....when you dry it it got no fat...just dries up to nothin’. Whitefish is better...got lots of fat in it for the dogs. They soak up water when they freeze and when dogs eat that frozen fish they got meat, fat, and water all at the same time.” [A08, Allakaket]

“Dog salmon...there is some, like silvers, we don’t get many up here, but they are good. But that first run, the first run of salmon... the meat is pretty thin, you know, no value in it. These [whitefish] are better for dogs than dog salmon.....more fat, more solid meat, better flavor—must be what they eat.” [H01,Hughes]

“That whitefish is good for dog food because frozen fish has water in it. Sometimes dogs don’t want to drink broth so if you feed them frozen whitefish they will get liquid with that.” [A04, Allakaket]

### **Whitefish Used as Trapping Bait**

When asked about the various uses of whitefish several respondents noted that whitefish is occasionally used as a bait or lure for use in furbearer trapping activities. This use was most often mentioned in the context of marten trapping. Fish that are slightly soured are said to be best for trapping bait and individual trappers recounted various tricks they had learned for souring fish. One trapper said that whitefish would sour quickly if placed in contact with

cardboard such as in a cardboard box. Another said that whitefish eggs stored outdoors in a blazo tin starting in August would sour perfectly for use as bait by the time trapping season started. The use of whitefish as trapping bait should be regarded as a relatively minor or incidental use. One trapper noted that using fish in this manner was simply a way to make good use of small numbers of spoiled or damaged fish and that almost any species of fish could be substituted for whitefish.

### *Summary of Mapped Information*

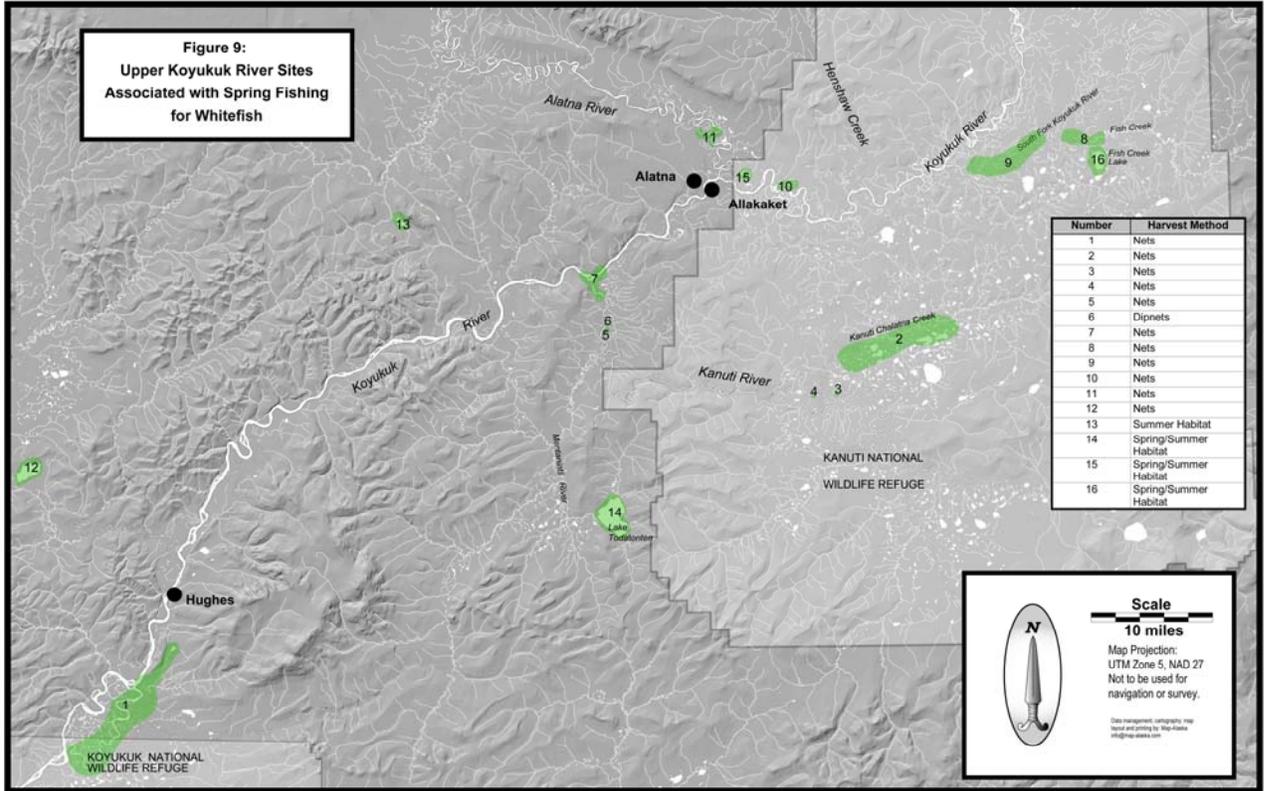
In addition to describing how whitefish are used, the identification of important whitefish fishing sites was another part of the data set provided by respondents. Maps were used during the interviews to record as many specific locations related to whitefish as possible. Interviewers made every attempt to elicit seasonal habitat information by asking where whitefish were at certain times of the year. The most common response to these queries was to identify fishing sites that were associated with a certain season. While a few specific summer and winter habitat areas for whitefish were identified by several respondents, comments from respondents indicated that whitefish could be found almost anywhere during the summer months and that they were widely dispersed in “deep lakes and holes” during the winter months. The willingness of respondents to place marks on maps was largely restricted to places they had personally used for whitefish fishing during their lifetime. Because of advanced age, some respondents were no longer active fishers, and the mapped data from these elderly respondents include some fishing areas that had been used during their lifetime but are no longer fished regularly today.

The mapped data are presented in Figures 9 and 10. Fishing for whitefish is largely a spring and fall activity with little overlap between seasonal fishing sites. Figure 9 identifies 16 sites associated with whitefish fishing in the spring. Figure 10 identifies 20 sites associated with fall fishing. Some inferences about whitefish seasonal movements can be drawn from these data and each map and each site is discussed below.

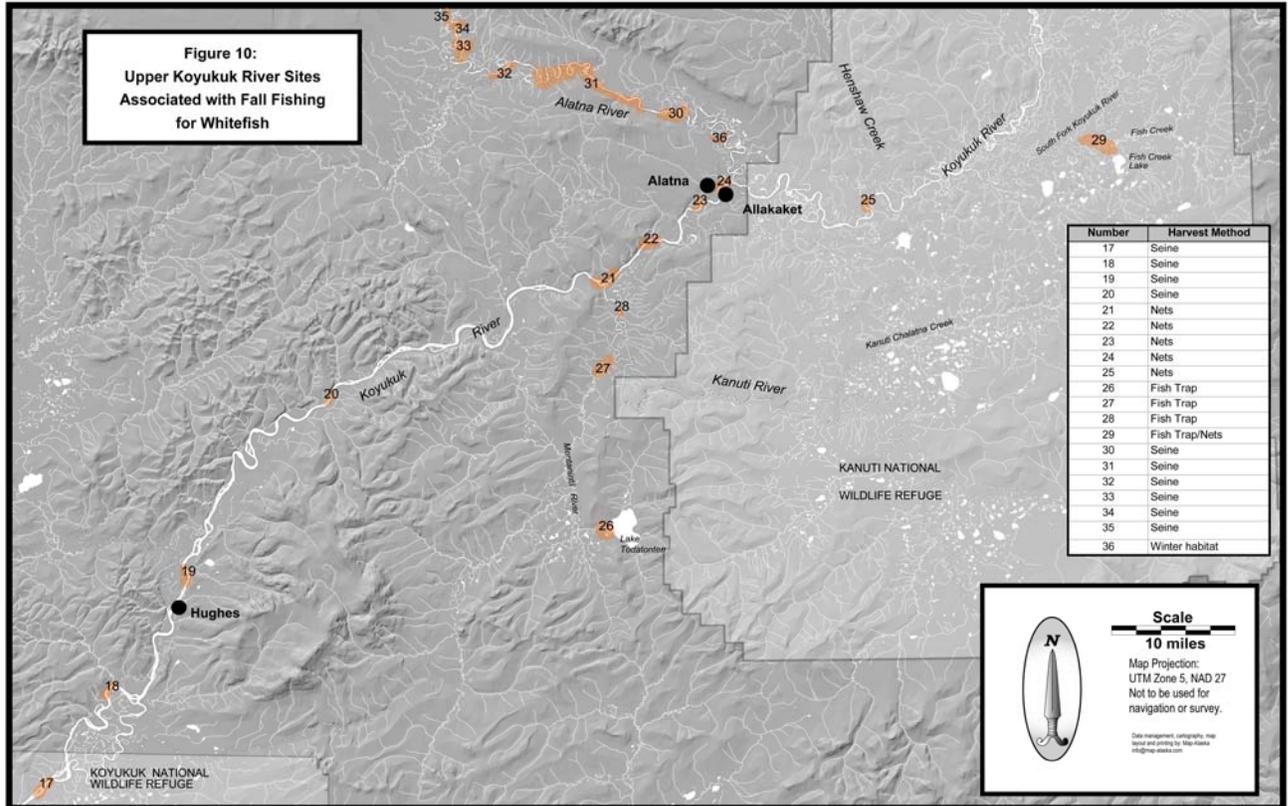
### **Spring Fishing Sites and Habitats**

One feature that characterizes spring fishing sites for whitefish is that they are predominantly located in sloughs and tributaries of the mainstem Koyukuk rather than the Koyukuk River itself.

**Figure 9. Upper Koyukuk River sites associated with spring fishing for whitefish.**



**Figure 10. Upper Koyukuk River sites associated with fall fishing for whitefish.**



This is likely due to two factors: 1) during the period surrounding spring break-up, the mainstem Koyukuk presents difficult travel and fishing conditions due to ice and debris, and 2) spring subsistence activities typically take place around traditional spring camp locations that are favorably situated for a variety of harvest activities in addition to fishing such as waterfowl and muskrat hunting. Sites 1 and 2 (Figure 9) represent major areas of traditional spring camps and spring subsistence activities for Hughes and Allakaket, respectively. What these areas have in common is that they are situated in close proximity to lake-dotted lowlands and drained by slough or tributary waterways—Matthew Slough (1) and Chelatna Creek (2), and are accessible by winter trails.

According to respondents, nets were set out at spring camp locations as soon as sloughs or lakes offered ice-free locations to set them. Several resident fish species are known to use the high water levels that accompany break-up to move into and out of tributary waters during spring and early summer. While various species of whitefish are primary targets for spring fishermen, northern pike and longnose suckers were also mentioned as species that were often caught in spring nets. Thus, the sites identified on map 2 are not necessarily representative of whitefish concentrations but of general spring fishing sites where whitefish are among the harvested species.

Sites 3, 4, and 5 are located along the Kanuti River and represent the locations of specific family spring camps. Site 6 is a Kanuti River site identified as a traditional/historic dip-net location for whitefish and pike, where specific cut-bank, current, and break-up conditions existed to favor the use of dipnets in the spring. Site 7, located in the vicinity of the Kanuti/Koyukuk confluence, is one of the few spring fishing sites that includes the Koyukuk mainstem. This site was identified by Allakaket respondents as one of the most heavily used fishing areas throughout the entire open-water season and represents the only identified overlap with fall fishing areas. Sites 8 and 9 are located along Fish Creek and the lower South Fork, respectively, and were utilized more historically than today. According to several respondents, there were large seasonal movements of whitefish (primarily cisco) to and from Fish Lake (site 16) through Fish Creek as recently as the middle 20th century. Cabins and seasonal camps were formerly located along lower Fish Creek to support a variety of subsistence activities, including whitefish harvesting. Beaver

dams and habitat changes over the last fifty years or so have reportedly made this drainage less suitable for whitefish, and Fish Creek is no longer the prime spring fishing area it once was. Spring fishing sites located along the lower South Fork (site 9) are still utilized by a few Allakaket residents with historic ties to this area. Whitefish caught in the South Fork are said to be primarily humpback and least cisco.



**Figure 11. Remains of early 20th century cabins at Fish Creek, South Fork Koyukuk.**  
Photo by Stanley Ned

Sites 10 and 11 represent small sloughs connected to the Koyukuk and Alatna Rivers, respectively. These were identified as areas known to host movements of whitefish during the spring break-up period. Site 10, is a traditional spring fishing site known as “*Buzodoc*.” Two respondents commented that whitefish caught there in the spring appeared to be using the high water levels associated with spring break-up to exit the slough and identified this as a likely over-wintering area for whitefish.

Specific summer habitat areas for whitefish were difficult for respondents to identify. Most noted that small numbers of whitefish could be found in almost any area water body. However,

five area lakes were identified as places that were assumed to host summer populations of whitefish because of the presence of traditional fishing sites or the observed movement of fish through their outlet streams. Sites 12-16 identify these lakes. It should be noted that none of the respondents currently used these lakes as summer fishing areas or could personally confirm the summer presence of whitefish in these lakes. Major fall fishing sites (historic and present-day) are located in or near the outlet streams of each of these lakes. Certainly, there are numerous other locations in the vast upper Koyukuk drainage that host significant summer populations of whitefish but fall outside the areas typically utilized for fishing activities, and thus outside the knowledge base of most local residents.

### **Fall Fishing Sites and Habitats**

In contrast to spring fishing sites, most fall fishing sites for whitefish are located in the mainstem Koyukuk and Alatna Rivers. Comments from respondents indicate that whitefish converge on the mainstem Koyukuk from surrounding shallow waters and tributaries in September and utilize the Koyukuk as a major travel corridor to reach spawning and over-wintering locations. Fall fishing is carried out using two types of gear—set gillnets and seine nets. Figure 10 lists identified fall fishing sites using both types of gear.

Sites 17-20 identify major seining locations for Hughes fishermen. Site 17, known locally as “Twenty five mile cabin,” is generally regarded as the downstream limit of seining activity for Hughes area fishers. Below this point, changes in the character of the river make seining difficult. Fishers also noted that downstream fishing sites require boats heavily loaded with harvested fish to travel upstream on the return trip to Hughes and that it becomes impractical to fish farther downstream. In addition to being good fall seining locations, both seining sites located below the community of Hughes (sites 17 and 18) were described as containing “deep holes” where whitefish were reported to over-winter.

Seining sites 18, 19, and 20 are all located in the vicinity of one or more tributary confluences. As noted previously, one fisher explained that the mouths of tributary streams are good seining

places because there is typically an “area of dead water” or eddy located immediately downstream of the confluence where fish can rest. Site 20, known locally as Red Mountain Creek, is regarded as the up-stream limit of seining activity by Hughes area fishers.

Sites 21-25 identify major set gillnet sites utilized by Allakaket fishers in the fall for whitefish. Some of these sites represent family fish camp locations where salmon fishing activities are centered during much of the mid to late summer. As the salmon run diminishes, smaller mesh nets for whitefish begin to replace salmon nets at these locations. For those who plan on participating in late fall seining activities, net sites located near the mouth of the Alatna River, serve to monitor the strength and timing of the whitefish run entering the Alatna. While set-nets are pulled as fall slush ice begins to run in the river, sites 23 and 24 located near the village become important set net locations again in late fall as soon as shore-fast ice allows the setting of ice-nets. This generally occurs in late October and early November. Late fall fishing activities at these sites target whitefish that are exiting the Alatna River and moving downstream. Because they are said to be “mostly empty with eggs” it is suggested that this is a post-spawning movement of fish toward downstream wintering areas.

Sites 26-29 on Figure 3 identify historic fish trap locations that supported large harvests of whitefish during the first half of the 20th century and before. Sites 26, 27, and 28 were all associated with the fall run of fish out of “Big Lake” (or Todatonten Lake) through Mentanontli Creek. Site 27, known as “Lake Creek” was described previously and mentioned by numerous respondents as one of the premier whitefish harvest sites in this region. Site 28, on Fish Creek, was similarly situated to take advantage of fall fish exiting the Fish Lake system and was the site of significant fall fishing activity for South Fork families.

Sites 30-35 delineate a 30 to 40 mile stretch of the Alatna River that is heavily utilized for fall seining by Alatna and Allakaket fishermen. As described previously, seining generally occurs in late September and early October—as soon as freezing temperatures allow the easy preservation of harvested fish and before freeze-up. Major seining sites are located at or near the confluences of most tributary streams, but depending on water levels and the timing of fishing activities,



**Figure 12. The junction of Mentanontli or "Lake Creek" and the Kanuti River.**

seining can reportedly take place in eddies and along gravel bars throughout this stretch of river. Fishermen are primarily targeting spawning concentrations of sheefish and whitefish at this time. Depending upon the timing of fishing activities this might include fish that are actively spawning, and those that are enroute to, or retreating from spawning grounds in this portion of the Alatna. While certain sites are known to favor sheefish or certain species of whitefish, most fishers report that a mix of whitefish species, arctic grayling, and longnose suckers are taken in fall seine nets. Site 35, the farthest upstream of the Alatna River sites, was identified by one active fisherman as a location where broad whitefish always seemed to congregate. As noted previously, site 36 on the lower Alatna River, known as "*Buzodoc*," was identified as a possible over-wintering location for whitefish due to their early presence there in the spring.

### ***Health and Population Status of Whitefish in the Upper Koyukuk River***

#### **Whitefish Numbers**

None of the respondents interviewed in conjunction with this project indicated that they had seen or detected a notable decline in whitefish numbers in the upper Koyukuk. Several elderly respondents who were no longer actively fishing deferred comment on the population status of fish stating that this question could be most accurately answered by those actively fishing. Most respondents who were active fishers thought that whitefish populations in the upper Koyukuk

had been relatively stable in recent decades and that populations of whitefish had increased somewhat from the 1960s when they were being more heavily harvested to feed family dog teams.

“I think they’re okay.....it seems to be getting more. I think because people nowadays don’t use as much. Years ago people.....everybody had dog team.....everybody pile up fish.....everybody have their own seining net. Now there’s just two or three of us here with seine net.” [A08, Allakaket]

No respondent spoke of a decline in any one particular species of whitefish. In discussing the population status of whitefish it was clear that respondents were speaking of whitefish as a whole. Several elderly respondents noted that certain streams and fishing locations that were popular whitefish fishing areas 50 or 60 years ago were no longer thought to be productive for whitefish due to habitat changes such as reduced stream flow, stream blockages, and vegetation changes. One respondent, whose family has utilized the Todatonten Lake (Big Lake) area for generations for a variety of subsistence activities, was uncertain about the current status of whitefish in the lake or its outlet stream.

“My Dad and their parents used to live there (Big Lake). They had three or four igloo houses right at the low end of the lake where the creek go out of the lake. They used to make fish trap right there. There used to be lot of these (broad whitefish) in that lake, but nobody ever do try it now.....set a fish net or anything in there. Fall time they did that....when the fish are coming out in the fall time. But I remember one time about 15 years ago I went up there just about----its after freeze-up but still open, and I see fish scales around where otter come out.....so 15 years ago there was still fish there. But I don’t know about now.” [A01, Allakaket]

What is clear from this statement is that local fishers are no longer utilizing this once-rich lake system for fishing as they once did. It is not clear if this is because whitefish are no longer abundant there or because fishing patterns have simply shifted fishing efforts closer to Allakaket. The implication from several respondents, however, was that whitefish numbers in these areas had declined. Respondents showed little surprise or concern over this. One suggested that these kinds of localized changes were all part of the natural process and that whitefish had found other areas to utilize and that their overall numbers on the upper Koyukuk had not changed.

It is worth noting that in the communities of Koyukuk and Huslia located on the lower and middle Koyukuk River, several active fishermen have indicated in recent years that whitefish populations seem to be declining. Predation of juvenile fish by an overabundance of large pike

was the most common cause given for this decline by these fishermen (Andersen et al. 2004 and Benedict Jones 2005 pers. comm.). That similar declines in whitefish populations have not been detected by active fishers in the upper Koyukuk may provide significant clues to the inter-relationship and movement of whitefish populations within the Koyukuk River drainage.

### **Observations of Disease and Parasites**

Respondents were asked if they had observed or heard of any problems with sick whitefish. Most respondents reported no incidents of disease or unusual parasites among harvested whitefish. However, two respondents in the community of Hughes noted that they had begun to see external sores on the heads and backs of some fall-caught whitefish in recent years. One respondent commented that he first started to see this on broad whitefish about 10 years ago and that it was now showing up on humpback and cisco as well. While large numbers of fish do not seem to be affected, respondents were both of the opinion that it was becoming more common and widespread.

“And these past years there’s infected spots either on the head or further on the back. They start getting sick. Last couple years I seen some on holehge [humpback] but I notice almost 10 years ago I see it with taaseze (broad whitefish). It’s spreading more and more. The ones that is bad I don’t even feed it to the dogs. I just put it away for the birds. Last fall I caught three I had to put away like that. That was before the ice. I had just one net out. [H01, Hughes]

### **Impacts of Beaver Dams on Whitefish**

Beavers are common in the upper Koyukuk. There is some trapping of them by local trappers but the yearly take of beavers today is thought to be much lower than it was in the heyday of dog teams and high fur prices during the middle of the 20th century. In several regions of Alaska, beaver dams have been identified by local residents as having detrimental impacts on whitefish populations. In areas such as the Yukon Flats and the Kobuk River, allegations have been made by local residents that high beaver populations and an abundance of beaver dams have caused localized declines in whitefish numbers by making certain waterways inaccessible (Linkous 1995; Andersen and Fleener 2001; Georgette and Shiedt 2005). Most respondents did not identify this as a problem in the upper Koyukuk region. One elderly respondent, however, did suggest that beaver dams and lower trapping pressure on beavers may be responsible for habitat

changes in recent decades that have resulted in fewer whitefish entering and exiting Fish Creek and Fish Lake on the South Fork Koyukuk—once a prominent fall fishing location for whitefish.

“Where I used to have fish trap was right there in Fish Creek. They [whitefish] just go right inside that, fill up in no time.....fall time. Now, after so many beaver dams, fish don’t run like that anymore. When we used to have dogs, everybody used to trap beaver.....nowadays when we have snogo, we catch a few beaver all right, but not like old days. There used to be no beaver around here when I was small. Since around 1940 the beaver start to grow up around here.” [A02, Allakaket].



**Figure 13. A beaver dam blocks a tributary stream on the South Fork Koyukuk.**

The respondent’s reference to lower beaver populations in the early 20<sup>th</sup> century is consistent with a statewide decline in beaver numbers in the early 1900s. The 19<sup>th</sup> century fur trade and decades of unregulated harvest is known to have decimated the beaver population at the northwestern limit of their range in Alaska resulting in a complete prohibition on the harvest of beaver in Alaska between 1911 and 1918 (Hakala 1952). Beaver populations recovered over a period of decades, and were probably kept in check by widespread trapping from the 1920s

through the 1970s. As a consequence, current beaver numbers may be at their highest levels in more than 100 years and may be having localized effects on fish populations that have not been seen by respondents in their lifetimes.

When specifically asked about the effect of beaver dams on fish movements, most respondents acknowledged that beaver dams are capable of blocking fish from entering or exiting certain locations. Blockages in spring or early summer might prevent fish from entering certain preferred summer habitats. Blockages in late summer or fall might prevent fish from reaching spawning or over-wintering areas. Most respondents noted that beaver dams typically represent only a temporary blockage, and that spring floods and other high water events throughout the open water season usually allows trapped fish to pass over or around beaver dams at critical points in their annual cycle. Andersen and Fleener (2001) reached this same conclusion on the Yukon Flats but noted that local residents spoke of recent climate changes that made flooding less common and resulted in beaver dams possibly becoming more long-term obstacles.

Andersen and Fleener (2001) also found that residents of the Upper Yukon region utilized a traditional method of harvesting whitefish impounded behind beaver dams, which took advantage of the sensitivity of whitefish to changes in water flow. The beaver dam would be breached by cutting a small notch to create an out-flow of water. This out-flow was then directed into a basket trap. Fish (particularly cisco) impounded behind the dam would quickly follow the flowing water to the point of exit and become trapped in the basket below. This method of harvesting fish was not unknown on the upper Koyukuk but does not appear to have been common. Only one respondent described the harvesting of fish impounded behind dams and rather than utilizing a basket trap, a gill net was set below the breached dam to catch the freed fish.

“Up at Fish Lake, this one guy used to cut the dam down a little, just enough to let fish go over, and they used to catch them there. Close to first of September the fish are trying to get out and they cut the dam. That’s where Uncle Albert chopped the dam down too much—made the hole too big. First time he did it I guess and he thought that was the way to do it and .....too much fish. They have a fish net down by this.....there is a little creek that run into Fish Creek and they had fish net there, but there’s just so much fish it just keep sinking the net.” [A01, Allakaket]

Respondents acknowledged that fish are sometimes trapped behind beaver dams for extended periods and will not survive if the conditions are not right. Winter-kills can occur if the impound area is not sufficiently deep and summer die-offs can occur with warm water temperatures or a deterioration in water quality.

“They’ll live.....as long as there is water they’ll live. But if it get hot, like in summer time, they’ll die. That water is too warm and it get too dry. ‘Cause you can find fish some places.....even pike do the same thing. These fish, they need cold fresh water.” [H02, Hughes]

“One time on that Fish Creek where it come out of Fish Lake I see.....springtime, all dead ones [whitefish] all swelled up along the river bank.....and gee! I wonder what kill them. Must have been frozen-in or something, I don’t know. That was about 30 years ago. They were just stuck in the creek I guess.....I don’t know.” [A02, Allakaket]

The death of fish trapped behind dams was regarded as “natural” with respondents noting trapped fish provided a source of food items for other animals such as ravens, foxes, otter, and mink.

### **Impacts of Floods on Whitefish**

As noted previously, fishers have observed that whitefish tend to move during periods of high water; taking advantage of the increased mobility that high water affords them to enter or exit specific locations. The normal periods of high water that periodically occur during the open-water season were generally regarded by fishers as being beneficial to fish. On the other hand, floods--periods of extreme high water marked by the rapid rise and fall of streams to levels over their banks, can reportedly lead to the occasional loss of fish. Turbid flood waters were thought by most fishers to be somewhat disorienting to fish, causing fish to move into areas they would not normally utilize. Several respondents noted that following a flood, dead whitefish, pike, and grayling could sometimes be found “stranded back in the willows” or on gravel bars. Others thought that major floods were probably responsible for fish residing in certain landlocked ponds or lakes, and that periodic floods also allowed such landlocked fish to escape or reposition themselves.

A notable flood event occurred in the upper Koyukuk in the fall of 1994, causing significant property damage in the community of Allakaket. One active fisherman in Allakaket stated that he thought the timing and severity of that flood caused local whitefish numbers to decline for a period of several years following the flood but that they had now recovered.

“That flood was in August.....for a couple years I notice there was not too many whitefish. They were probably lost or disoriented.....maybe some of those fish was in those big lakes too.....landlock back there. [A08,Allakaket]

As mentioned previously, another respondent spoke of the same flood and recalled catching exceptionally large broad whitefish during this period of unusually high water. He speculated that these were fish that had been previously trapped in a landlocked lake providing conditions that allowed the fish to grow unusually large, and that the 1994 floodwaters had released them back into the Koyukuk.

“In that flood, you know, I had fish net right down here in that slough for a little while and boy!....I was getting some different size of.....big taaseze [broad whitefish]. Right down there in that slough.....just big....different type of fish....I don't know where they came from, but, I just had fish net out for a little while because of the high water.....they came out of some lake.....big whitefish....I never seen anything like that before. And they were a little different than these [examining photograph]....the ones I was catching was more...kind of more red on the scales.” [A01, Allakaket]

Thus, while it was acknowledged by some respondents that flood events sometimes result in small numbers of fish being stranded in habitats they may not be able to survive in for long periods of time, in general, respondents did not identify floods as being overly detrimental to local fish populations. It seems somewhat intuitive that the timing and severity of a flood probably determines the extent of damage that may occur to fish and critical fish habitats as well as the species and life-stages of fish that might be most affected.

## **DISCUSSION**

Understanding the seasonal movements of whitefish in the upper Koyukuk River was the primary focus of this project. Local and traditional knowledge held by lifelong residents of the upper Koyukuk River encompasses a broad range of information on whitefish that includes, but is not limited to, seasonal movements of fish. For middle-aged and elderly respondents, whose

knowledge of whitefish is derived almost entirely from a lifetime of harvest activities, the somewhat narrow and esoteric topic of “seasonal movements” had to be rather delicately approached through a broader discussion of whitefish in general and within the context of fishing. It is this broader data set of how, when, and where whitefish are harvested and used that has been presented above.

The information provided by all respondents makes it possible to piece together a calendar outlining the seasonal movements of whitefish in the upper Koyukuk as seen through the eyes of Koyukuk River fishers. Table 3 summarizes this information. Overall, the data provided by LTK on the annual cycle of whitefish movements is rather general and qualitative in nature. While it shows that local fishers know the general whereabouts of whitefish during various seasons of the year, local knowledge lacks certain details that fisheries scientists seek in their quest to fully understand the regional life histories of whitefish.

The inability of LTK to provide complete answers to complex 21st century science problems should not be a surprise, and it would be a mistake to categorize this inability as a weakness. Scientists may be able to point to what they regard as gaps in the LTK data set—questions they have about a particular natural resource for which traditional knowledge provides no satisfactory answers. Holders of LTK, on the other hand, are likely to view their knowledge as magnificently complete for their particular needs. While there are significant areas where the interests of scientists and the knowledge of local users overlap, the two data sets are very different—different in the kinds of information deemed important to collect, different in the methods used to gather, hold, and pass on information, and different in how accumulated information is intended to be used. Understanding these differences sheds light on some fundamental characteristics of LTK that distinguish it from western science and provides clues as to where these two data types might most logically converge and collaborate.

### ***Local and Traditional Knowledge as a Data Type***

Local and traditional knowledge, accumulated through generations of interaction with the natural world has, for centuries, provided local residents with the requisite knowledge to thrive in a

**Table 3. Seasonal Movements of Whitefish and Activity of Fishermen in the Upper Koyukuk and Kanuti River Vicinity.**

Break - up	
May	May through Mid-June--Whitefish are moving in the Koyukuk and Kanuti mainstems from over-wintering areas into summer feeding habitats. The staggered arrival of fish over a period of weeks may be due to fish arriving from various local and non-local wintering areas. Fishers use set nets to target whitefish in main river eddies and near the mouths of tributary streams and sloughs. Spring whitefish remain relatively skinny until the second week of June.
June	
July	Mid June to Mid-August--Whitefish are widely distributed throughout the Koyukuk drainage utilizing river, lake, and slough habitats. There are localized back and forth movements of fish between main river channels and side streams/lakes throughout the summer as water levels rise and fall. Fish feed and fatten throughout this period and reach peak condition in mid August. There is little fishing effort directed at whitefish in mid-summer as they are widely dispersed. Some whitefish are harvested in conjunction with salmon fishing activities.
Aug.	
Sept.	Mid August thru October--Whitefish move out of summer feeding habitats into major rivers. Fish preparing to spawn head toward spawning locations. Fish are fat and in prime condition. Major spawning areas identified in the Alatna River. Some spawning also occurs in main Koyukuk and other small tributaries. Sheefish/humpback/cisco spawn first, followed by broad whitefish. Fishers use seine nets to take large numbers of whitefish as fish move to and from Alatna River spawning areas. Spawning is followed by a generalized movement of fish to deeper over-wintering areas. During and following freeze-up broad whitefish are making their exit from the Alatna River spawning grounds.
Oct.	
Freeze - up	
Nov.	Freeze-up to late December--Fish continue moving out of the upper Koyukuk under newly formed ice. Some fishers set under-ice gillnets to harvest this late run of fish. Some incidental harvest of cisco is reported in burbot traps into December.
Dec.	
Jan.	Late December to late March--Whitefish reach over-wintering areas and remain relatively dormant through deep winter. Wintering areas were described as deep river pools and lakes. Several respondents indicated that large deep lakes in the Huslia vicinity may provide over-wintering habitat for some Koyukuk drainage whitefish. Little or no harvest effort is directed at whitefish during this time. Winter whitefish are described as thin and watery with only sand and pebbles in their stomachs.
Feb.	
March	
April	Late March through April--Whitefish become active again and begin their movement out of wintering areas under the ice. No major harvest effort by fishers until waters are ice-free. Some harvesting in April occurs with set nets as sloughs and river channels become ice-free.

specific natural environment. For that particular purpose it has proven itself to be a very complete text.

For the local fisherman in search of a thousand pounds of fat whitefish to feed family and dogs, LTK provides specific instructions on when, where, and how to use specific kinds of fishing gear to accomplish that in the most efficient manner. With slush-ice running in the river, a seine net full of whitefish on the Alatna River spawning grounds is a validation of LTK. The fisheries biologist attempting to document regional life history intricacies of whitefish will have an additional set of questions about the fish in that fisherman's net—how old are they, how far did they travel to reach those spawning grounds, how frequently do they spawn, and where would they have gone for the winter had they not been caught? These questions are different than the ones facing the fisherman and contribute to a body of knowledge that is largely separated from LTK.

Moller et al. (2004) discuss some of the fundamental differences between traditional knowledge systems and western science. Scientific examinations of natural systems are characterized as taking place over rather short time periods with relatively small sample sizes, and are typically focused on the collection of numerically-based data analyzed and presented with an emphasis on statistical averages. Local and traditional knowledge systems, on the other hand, are typically based on long periods of observation (living memory or longer), incorporate very large sample sizes, focus on qualitative rather than quantitative information, and excel at the incorporation of variation and extremes into the knowledge stream. The LTK of whitefish collected through this project illustrates some additional characteristics of local and traditional knowledge that can affect it as a data type and influence its utility to western science.

First and foremost among these is that LTK has been largely derived from a harvesting perspective. In traditional times, and to a lesser extent today, the daily activities of groups, families, and individuals living in the Koyukuk region were focused on the never-ending task of obtaining, preserving, and preparing food. Much of what is now termed *traditional knowledge* revolves around how, when, and where the various natural resources of a region can be most

efficiently utilized. Doing so requires experience, skill, and a broad knowledge of both local geography and the natural environment. As broad as this traditional knowledge base is, the understandable emphasis is on knowledge that assists in the acquisition of food and other essential commodities.

One result of this harvest perspective is that not all plants, animals, and materials in the environment had an equivalent underlying body of traditional knowledge. Not surprisingly, traditional knowledge tends to be much more detailed for those resources that are heavily relied upon than for natural resources such as songbirds, insects, microtines and other small mammals that are present in the environment but are not regarded as primary subsistence resources. Information obtained from respondents on this project illustrates that even for resources that are heavily utilized, such as whitefish, the focus of LTK is, as one would expect, focused on certain points in the calendar year, certain life stages, or certain aspects of behavior or life history that are directly relevant to harvest, and tends to be rather vague on other aspects.

For example, the knowledge that whitefish move between habitat types in response to rising and falling water levels has been ingrained in LTK because it is useful for identifying times and locations where nets can be effectively used to harvest them. On the other hand, respondents were able to offer very little information on the juvenile life-stages of whitefish because they are not directly relevant to subsistence harvest. Several respondents made reference to a single Koyukon term *k'etlehone* (Jetté and Jones 2000) that refers generally to juvenile fish of any species. There appears to be little interaction between local fishers and fish in their early life stages. From the harvest perspective this is understandable in that fish in the fry and early juvenile stages do not typically appear in harvest gear, are difficult to observe, and do not represent an immediate or practical source of food. Other traditional knowledge studies have shown that where special circumstances raise the visibility or utility of juvenile-stage fish they are more commonly incorporated into the LTK lexicon. For example, on the lower Yukon River, C. Brown et al. (2005) documented a specific Native language term for juvenile whitefish that reportedly attach themselves to the bark lashings of traditional fish traps placed in rivers at certain times of the year. These tiny fish were apparently present in sufficient numbers that they constituted a protein source and were thus gathered and used as food. On the upper Koyukuk,

responses to questions about juvenile whitefish were typically along the lines of “Yes, we see the little ones sometimes, but we don’t bother it.”

Similarly, respondents were able to offer little information about whitefish feeding habitats or specific food items they eat. Through the cutting and cleaning of whitefish it was anticipated that some respondents might have a relatively detailed account of whitefish food preferences. In processing spring and summer-caught whitefish, it is still common for whitefish guts to be removed, cleaned, and fried—both as a food item and as a source of rendered oil. In the process of cleaning, stomachs are typically slit and washed and intestinal contents squeezed out, providing at least the potential for stomach contents to be observed. In reality, few respondents acknowledged examining the stomach contents during the very quick, almost instinctive process of cutting fish. Responses to questions about what whitefish feed on were typically rather generic and uncertain, such as “must be bugs” or “some sort of moss I think.” Georgette and Shiedt (2005) reported similarly vague answers from fishers regarding the feeding habits of whitefish. Answers to questions about what fish eat were more likely to be met with comments about the different condition and taste of “lake fish” and “river fish.” According to fishers, lake fish, are generally fatter and tend to take on a grassy taste. Fishers generally assume this has to do with what the fish are eating but are unclear about specific food items or preferences. From the pragmatic perspective of harvester, it seems enough to know that at key points in the calendar year the whitefish in their nets will be fat and in prime condition. Knowing the specific food items that made them that way does not appear to be relevant to the harvester.

Another result of the harvest perspective is that LTK of whitefish focuses on large groups of fish rather than individuals. Because whitefish are relatively small, their utility as a food resource is based specifically on knowing when and where large numbers of them can be taken. Local and traditional knowledge of large terrestrial animals such as moose, caribou, or bears, that are more commonly pursued individually and can be relatively easily observed by hunters, might very well include detail on the behavior of individual animals and sub-adult life stages. Fish are a bit different. Aquatic habitats do not generally lend themselves to casual in-situ observation. Whitefish are almost exclusively observed by local fishers only after being taken in fishing nets. And while certain aspects of whitefish seasonal movement can be interpreted from harvest

activities, other aspects cannot. The age structure of fish on the spawning grounds, home ranges, frequency of spawning and fidelity to critical habitats—these kinds of questions are difficult or impossible to answer using a fish net and a keen eye. The survival of the Koyukon people did not hinge on knowing the answer to these sorts of questions and LTK does not provide complete answers. These concepts are the purview of western science, which typically takes the approach of making careful observations about individuals, and extrapolating these observations to draw conclusions about larger groups. The radio-telemetry component of this project provides a good example of this strategy and highlights some of the basic differences in the kinds of information collected by scientists and traditional harvesters. Clearly, the record of individual whitefish, caught, fitted with transmitters, released, and relocated at regular intervals to monitor movements over a period of years, provides a data set that LTK cannot. To be fair, it is only recently, with the advent of new technologies that allow the remote tracking of individual fish over periods of several years, that scientists have had the necessary tools to begin examining life history details such as these.

Another important characteristic surrounding the harvest perspective is that LTK emanates from a specific traditional land use pattern and seasonal round of subsistence activities that can place temporal and geographic sideboards on the LTK data set. In the Upper Koyukuk River, no single subsistence resource was available in quantities sufficient enough to sustain families and groups through the year. Survival depended on the use of a variety of resources, taking each of them as they became available, could be most efficiently harvested, or were in prime condition, and then shifting attention to the harvest of other resources. The land use pattern that evolved placed people at designated locations, focused on specific harvest activities, at certain times of the year. Over eons of experience, whitefish fishing was relegated to two relatively narrow harvest windows in the upper Koyukuk seasonal round—several weeks in the spring following break-up, and a month or so during the fall prior to freeze-up. LTK of whitefish in the upper Koyukuk is quite good at describing the movements, habits, and condition of fish within these traditional harvest windows. Outside of these harvest windows, however, residents of the upper Koyukuk are fully occupied in the seasonal pursuit of other resources such as salmon, moose, waterfowl, or black bear, and are not generally in a position to make observations of whitefish.

The general lack of information provided by respondents on the mid-summer movements and summer habitats of whitefish provides a good example of how traditional land use patterns influence LTK. Traditionally, and today, residents of the upper Koyukuk spend the mid-summer months fishing for salmon and sheefish from camps and fishing sites located mostly along the mainstem Koyukuk. The large-mesh nets used in these fisheries are not particularly effective at catching whitefish except on a by-catch basis. Concurrently, during the summer months whitefish are thought to be very broadly dispersed through the vast regional complex of connected lakes, streams, rivers and sloughs. As one respondent said, “summer time they go everywhere....all around this county here.” Because of modest cash incomes and the high price of fuel, local residents generally remain in close proximity to villages and near-village fish camps during the summer months. Broader, overland access to large portions of the upper Koyukuk and Kanuti River drainages only becomes practical with the presence of snow and ice. This point was driven home by one 60-year old respondent who noted that in his lifetime he had never visited his family’s allotment on “Big Lake” during the summer months. It is still unusual for local residents to find themselves at distant inland waterways during the summer months where they might be able to more closely observe the summer movements of fish in remote wetlands and tributary streams. For this reason, LTK does not provide great detail on the summer habits of whitefish.

Having described some of the characteristics of LTK which may limit its utility to western science, it should be noted that there are characteristics of LTK that can make it a very useful information source as well. Among the greatest strengths of LTK is that it is based on observations made over very long periods of time and thus incorporates large sample sizes. The ability of LTK to offer a collection of regional or site-specific observations that, at a minimum, span the living memories of the observers is something western science is unlikely to be able to replicate at any cost. These long term observations offer important insights into aspects such as relative numbers, the overall health of populations, the occurrence of disease, resource anomalies, and cyclic phenomena. This long view is closely tied to another important attribute of LTK-- the ability to elucidate the interconnectedness of various environmental factors and include environmental changes into the data set. Moller et al. (2004) point out that the small sample sizes and relatively short time-frames that typify western scientific studies can easily

miss important variables or extremes that would become apparent with larger sample sizes. Observations made over life-times can, and do incorporate environmental extremes, habitat changes, and other disturbances and resource responses to them.

Recent observations by fishermen in Hughes, of external sores on harvested whitefish, provide an example where LTK's large sample size might see things that western scientific studies might overlook. Because only small numbers of fish are currently afflicted with these sores, it takes the sampling (or harvest) of thousands of fish for affected fish to be encountered. The fact that lifelong residents of the region have not observed this problem with fish in the past and see it slowly becoming more prevalent should perhaps place this on the "watch list" for fisheries scientists to monitor. It is this sort of collaborative relationship between LTK and western science that Moller et al. (2004) suggests is the most logical research paradigm, noting that:

"Traditional knowledge provides a shortcut to more relevant hypotheses for problem solving but does not usually address mechanisms, i.e., the "why" question. Science has powerful tools for testing the "why" but could waste time and effort on trivial hypotheses. The use of the two approaches together takes advantage of their relative strengths."

Another example illustrates the benefits of the time depth offered by LTK. Local fishers provided information on two lake systems (Fish Lake and Todatonten or Big Lake) in the region that formerly hosted major seasonal, or possibly even year-round, populations of whitefish that were heavily utilized by local harvesters fifty years ago. Neither of these lake systems has been fished in recent decades. Because local fishing patterns have changed, it is unclear whether whitefish still utilize these lakes as they once did. Local fishers tend to gravitate to those locations where fish are abundant. The fact that these lake systems are generally regarded by locals as "former" fishing locations suggest that whitefish are no longer present in these systems as they once were. If this is the case, what precipitated this decline? Have there been significant habitat changes that have altered the suitability of these lakes for whitefish? Could over-fishing have contributed to a decline in whitefish numbers? And if over-fishing contributed to declines why have whitefish not returned after decades of reduced fishing pressure in these lake systems? By focusing on one or both of these once-productive lake systems identified through LTK, western science may be able to shed important light on the population dynamics of whitefish and whitefish responses to localized habitat changes.

## **CONCLUSIONS**

Local and traditional knowledge offers much in the way of basic information about the seasonal movements of whitefish that can assist and serve as a good foundation for western scientific studies. For local fishers who are largely focused on maximizing their harvest of whitefish, LTK provides an elegant and complete set of instructions for catching and processing fish at key times of the year. But what local fishers know about fish movements, and what can be observe through generations of fishing activities is a qualitatively different data set than the one fishery scientists are seeking to acquire. While the two data sets may intersect at key points, and can be complementary, they are distinct types of information, the products of different contexts and designed to address different needs.

The differences between these two types of information are highlighted when local and traditional knowledge is taken out of context and called upon to help solve specific and complex scientific puzzles, such as the month-to-month movement, life history, and habitat preferences of whitefish in the upper Koyukuk River. As discussed above, the harvest perspective from which most local knowledge is accumulated tends to filter LTK of any given resource through a series of lenses that stress one particular life-stage over another, may be focused on relatively narrow portions of the calendar year and specific geographic locations. In some cases this rendering of information may provide the exact focus that is needed to answer or illuminate a scientific research question. In other cases it may not. On the central question of how and when whitefish move seasonally through the waters of the upper Koyukuk River, this study concludes that LTK can contribute and corroborate certain important pieces of the puzzle sought by scientists, but for all the reasons discussed above does not provide complete answers.

## **RECOMMENDATIONS**

The above discussion provides an objective evaluation of LTK as a data type. A key point made is the value of thorough documentation of local and traditional knowledge surrounding a wide variety of topics for illuminating and understanding subsistence use patterns. State and Federal laws and regulations have assigned subsistence uses as the highest priority consumptive use of a

resource. The need to accommodate subsistence uses is a major consideration of regulatory and management systems. Accommodation requires understanding of past and present practices that LTK can provide.

The conclusion that local and traditional knowledge may not always offer complete answers to complex 21st century science problems should not be interpreted to mean that LTK is unable to contribute to the scientific research process. On the contrary, the consultation and incorporation of LTK at multiple phases of the research process might prove to be the most beneficial research model. This allows researchers to benefit from LTK's strengths, such as: familiarity with local conditions, observations carried out over long time periods, and knowledge based on large sample sizes, at key points in the research process where these qualities could help focus or streamline research. During the research design phase, for example, LTK might be effectively used to quickly identify research or sampling sites that would be most productive or meet certain criteria. During the research phase itself, local expertise might be able to significantly streamline specific study elements and reduce associated costs. In tag-and-recapture studies, for example, local users are a logical source of recovered specimens, and local knowledge with regard to things such as animal movements at certain times of the year or in certain weather conditions might be effectively used to reduce search areas. In the analysis phase, LTK may also be able to assist in the interpretation of scientific results, provide insights into cause and effect mechanisms and help point follow-up studies in more productive directions.

In this collaborative way, LTK should be viewed by western science as a potentially valuable resource, recognizing the characteristics that distinguish it as a data type and finding those points in the research process where its strengths can be put to best use. The collaborative model recommended here has the added benefit of involving local residents in research as meaningful partners and can help build both communication and trust between local users and researchers.

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## APPENDIX: LTK Interview Guide

Date \_\_\_\_\_ Respondent \_\_\_\_\_ Community \_\_\_\_\_

### KANUTI WHITEFISH TEK PROJECT

#### TERMINOLOGY

Confirm/Clarify/Expand Current Collection of Native Terminology for Whitefish

All Whitefish *ts'ol lookk'e*      Early Spring Whitefish *telaaye*  
Broad Whitefish *taaseze qausriluk*      Humpback Whitefish *holehge qaaligiq*  
Round Whitefish *hulten quptik*      Least Cisco *tsaabaaya saavaayiq*  
Others: (seasonal names, regional names, juvenile fish, fish parts, etc)

### **FOR BROAD & HUMPBACK WHITEFISH**

#### SEASONAL MOVEMENTS AND HABITATS

We are interested in knowing how these fish move through this area, when they arrive and where they can be found at different times of year. Do they come and go or are they in this area year-round? Do these two fish move at the same time and use the same areas or are they different?

- Where are they in the **Spring** (right around breakup)?
- Where do you find them in the **Summer**?
- Do you know what they eat?
- Where do they go in the **Fall** (right around freeze-up)?
- Do you know where they spend the **Winter**?
- How do floods and high water affect whitefish?
- How do beaver dams affect whitefish?
- Do other animals eat whitefish?

#### SPAWNING

We are interested in finding out about when and where these fish spawn. Do these two fish have eggs at the same time and go to the same areas to spawn or are they different?

- What months do you see eggs in them?
- Do the eggs in these two fish look the same or different?
- Do you know where & when they spawn? (Map spawning locations)
- Do you ever see the young ones? Where/when.

### HARVEST AND USE of WHITEFISH

Do you use the same nets and go to the same places to catch these two kinds of fish or are the different?

- What time of year do you catch these two kinds of fish?
- Do you ever catch them under the ice?
- Do you ever catch whitefish behind beaver dams?
- When are these fish the best (fattest or richest)?
- Where do you go to catch them? (Map past and present locations)
- Is there anything fishermen do to make sure whitefish come back each year?
- What makes a good fishing area for Whitefish? (certain water, current, temp., depth?)
- What kinds of gear do you use to catch these? (past and present methods)
- How is your catch preserved? (past and present methods)
- On whitefish, do people eat only the meat or do people eat other parts of the fish?
- How are whitefish usually cooked for eating?
- Uses other than human foods—dog food, bait, etc.
- Native names for any traditional dishes using whitefish meat/guts/eggs?

### ANY ADDITIONAL INFORMATION ON THE SMALLER SPECIES OF WHITEFISH

Least Cisco

Round Whitefish

Bering Cisco

### POULATION STATUS and ABNORMALITIES

We would like to know if you think the Whitefish population in this area is healthy

- Have their numbers gone **UP, DOWN**, or remained **ABOUT STEADY** in recent years?
- Do you ever catch whitefish that seem sick, have a disease, or parasites?

### TRADITIONAL STORIES AND BELIEFS

- Do you know of any traditional stories or beliefs about whitefish?

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