Contemporary Subsistence Uses and Population Distribution of Non-Salmon Fish in Grayling, Anvik, Shageluk, and Holy Cross.

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Technical Paper No. 289

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January 2005

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ABSTRACT

Situated along the Innoko River and the lower-middle Yukon River, the communities of Grayling, Anvik, Shageluk, and Holy Cross (GASH) maintain a historically complex relationship with their land and the animals it supports, including non-salmon fish species. Most participating key respondents continue to follow a seasonal, subsistence round based on availability of the resource itself and the availability of other resources. As such, the subsistence economies of the GASH area continue to be flexible systems. As contemporary salmon resources decrease, there is growing concern about similar effects on non-salmon fish in the face of increasing reliance on these species. This study contains three approaches to understanding the role of non-salmon fish species in the lives of GASH residents. First, this project begins to document traditional ecological knowledge of non-salmon fish species though ethnographic interviews with area residents. Second, it produced estimates of village based use of non-salmon fish species using a door-to-door harvest survey conducted in 2002. Finally, this project addresses ongoing user conflicts in the area that have led local people to be concerned about their ability to maintain important subsistence harvests of pike. Specifically, this component considers the effect of existing harvest levels on the pike population in the area, and also examines the degree of overlap between the pike populations targeted by sport and subsistence fishermen.

Key Words: Alaska blackfish (*Dallia pectoralis*), Anvik, Arctic grayling (*Thymallus arcticus*), Arctic lamprey (*Lampetra japonica*), burbot (*Lota lota*), Grayling, inconnu (sheefish) (*Stenodus leucichthys*), Holy Cross, Longnose sucker (*Catostomus catostomus*), northern pike (*Esox lucius*), Shageluk, and whitefish (*Coregonus sp. & Prosopium cylindraceum*).

Citation: Brown, C.L., J. Burr, K. Elkin, and R.J. Walker 2005. Contemporary Subsistence Uses and Population Distribution of Non-Salmon Fish in Grayling, Anvik, Shageluk, and Holy Cross. Federal Subsistence Fishery Monitoring Program, Final Project No. 02-037-2. USFWS Office of Subsistence Management, Fisheries Resource Monitoring Program, Fishery Information Service, Anchorage, Alaska.

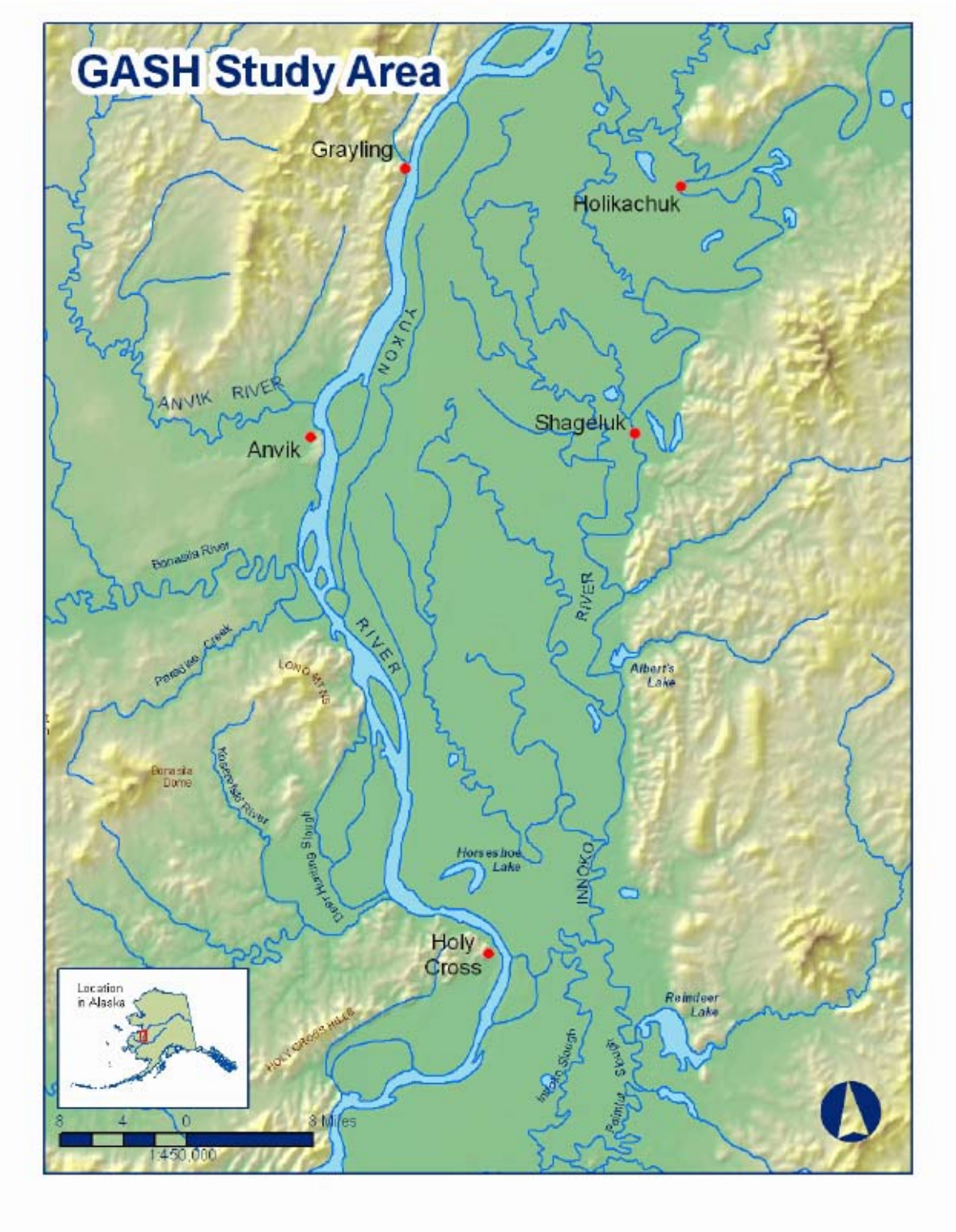
INTRODUCTION

> "They had a lot for respect for the fish, you know. A hundred years ago, there was no stores, no welfare, you know, you had to live off the country, so everything was well respected, you know. They didn't throw the fish away or waste anything, they just caught what they needed. They dry 'em out and the only thing that goes back was the guts." [A42104, Grayling]

Situated along the Innoko River and the lower-middle Yukon River, the communities of Grayling, Anvik, Shageluk, and Holy Cross (also referred to as the GASH communities) maintain a historically complex relationship with their landscape and the animals it supports (see Figure 1 for a map of the study area). Non-salmon fish species are an important part of that relationship. While seasonal salmon runs, particularly Chinook and coho salmon, have received much attention as comprising the largest portion of the total subsistence fish harvest in the four communities, non-salmon fish species including whitefish (*Coregonus sp. & Prosopium cylindraceum*), inconnu (sheefish) (*Stenodus leucichthys*), northern pike (*Esox lucius*), Arctic grayling (*Thymallus arcticus*), Longnose sucker (*Catostomus catostomus*), burbot (*Lota lota*), Alaska blackfish (*Dallia pectoralis*), and Arctic lamprey (*Lampetra japonica*) are a vital component of the subsistence harvest (Wheeler 1993, 1998). They figure into the subsistence way of life of GASH residents in biologically, historically, and culturally significant ways.

This research project documents traditional ecological knowledge (TEK) about non-salmon species utilized by residents of the GASH communities. Residents of the four communities rely on a wide variety of salmon and non-salmon species for subsistence, and much of the fish harvest occurs within federal conservation units. Fish are the most reliable subsistence resource in the lower-middle Yukon and Innoko region. As such, they constitute one of the largest components of the subsistence economy. Non-salmon species have long been important to local subsistence economies in interior Alaska, due in large part to their year-round availability (Loyens 1966; Nelson 1983, 1986; Snow 1981; Sullivan 1942; VanStone 1974, 1978, 1979b). However, use of and local perspectives on the ecology of these fish in the GASH area is not well understood by non-locals. The area is complex, with differences in

Figure 1. Site Map



species utilized, fishing patterns, and gear types occurring in the Yukon and Innoko areas. This study aims to document these uses and perspectives.

In addition to compiling local knowledge on non-salmon fish, a second component of this project assesses the annual cycle of all non-salmon fish harvests. With the recent trend of poor runs of salmon and low subsistence salmon harvests, harvests of these important non-salmon species are expected to increase. This survey complements more general post-season salmon surveys conducted by the Alaska Department of Fish &Game (ADF&G), Division of Commercial Fisheries, and updates subsistence baseline surveys conducted in the early 1990s. In light of this, and because there exists little current and comprehensive harvest information exists for these stocks, it is timely to conduct harvest assessment work.

A third component of the project addresses several contentious issues surrounding the non-salmon fisheries. Ongoing user conflicts in the area, including conflicts with sport fishing interests, have led local people to be concerned about their ability to maintain this important subsistence harvesting activity. Specifically, we consider whether or not existing harvest levels are adversely affecting the pike population in the area, and also examine the degree of overlap between the pike populations targeted by sport and subsistence fishermen.

Historical Context

The geographic area covered in this report encompasses the stretch of the Yukon River from the Paimiut Slough, south of the community of Holy Cross north to Blackburn Island, well above the community of Grayling. Also included is the Innoko River, a major tributary of the Yukon River that flows approximately 500 miles northeast to southwest from its headwaters in the Kuskokwim Mountains to its confluence with the Yukon River. This includes the subsistence use area for non-salmon fish species for the contemporary villages of Grayling, Anvik, Shageluk and Holy Cross. Deg Xinag is spoken by residents of Anvik and Shageluk, while Holikachuk is primarily spoken by residents of Grayling who moved

from the historic Holikachuk village site on the Innoko above Shageluk in the early 1950s. The population of these communities is primarily Deg Hit'an[1] Athabascan and Doy Hit'an Athabascan, also referred to in much of this report as Holikachuk because of its ties to historical place names (Wheeler 1998, cf. Vanstone 1978).

Historically, inhabitants of the lower-middle Yukon River territory followed a subsistence round utilizing seasonal camps until missionary and governmental influences eventually centralized settlement patterns into four permanent communities. However, there remains a high degree of mobility between the communities and the resources use areas surrounding them. As a result, ties between the communities remain strong, marked by marriage and kinship relations and shared subsistence practices. For example, one of the elders interviewed for this study was born in Shageluk, where family members still live. However, she married a man from Holikachuk, the historic village of Grayling located above Shageluk on the Innoko River, and lived there until residents of Holikachuk moved their village to Grayling, where she currently lives. These kinds of social relationships are not unusual in this area and confirm the strong connections between communities, resulting in deep and overlapping knowledge base of related resource use areas.

Key respondents participating in this project remembered traveling with their grandparents to spring camp where they trapped muskrat, summer camp to put up salmon, and to fall camp for moose hunting. Adherence to a seasonal round was hard work; respondents consistently talked about the commitment of time, energy, and resources needed to fish and hunt especially. The harvest of each resource continues to be seasonally patterned, based on availability of the resource itself and the availability of other resources. In this sense, the subsistence economies of the GASH area have long been and continue to be flexible systems, designed to maximize the productivity of the land at any given time. As contemporary salmon resources dwindle, there is growing concern about similar effects on non-salmon fish in the face of increasing reliance on these species.

[1] The term "Deg hit'an" is commonly used today to refer to the people historically residing in the Anvik-Shageluk area, while the term "Deg Xinag" refers to their language.

The first ethnographic accounts of the Deg hi'tan Athabascan and Holikachuk peoples were provided by Glazunov and Zagoskin, both employees of the Russian-American Company, in search of productive trade routes and relationships (Wheeler 1998, Osgood 1940, Vanstone 1978, Zagoskin 1967). Since then, Cornelius Osgood (1958, 1959, 1970) provided a wealth of ethnographic information about local Deg Xinag language, culture, and history based on his work in Anvik during the 1930s. This work is published in three related texts. James VanStone (1979b) also provided interesting perspectives on the human ecology of the GASH area. Most recently, Polly Wheeler (1998) conducted ethnographic work tracing the connections between subsistence and the role of cash in these lower-middle Yukon villages.

Few studies have focused specifically on subsistence fishing, especially of non-salmon species, by residents of the GASH communities. Several historical studies point to the long term importance of non-salmon species to indigenous inhabitants of the area (Osgood 1940, 1958, 1970; VanStone 1978, 1979a, 1979b) and an EIS for the Innoko National Wildlife Refuge mentions the importance of fishing to the local economy (US Fish and Wildlife Service 1987). According to VanStone (1979), historic resource use patterns in the GASH area centered on the seasonal activities of hunting, fishing, and gathering – of which fishing was by far the most important. While caribou may have been more plentiful in the early 1800s, significant moose and caribou crashes throughout the 1800s highlighted the predictability and reliability of fish resources (Wheeler 1993:79, 1998:192, VanStone 1979). Dog teams became an important part of most subsistence practices, acting as transportation and labor on traplines, for hauling fish, and packing wood and water. Residents of the area followed resources through the seasons and across the land, and operated out of seasonal camps.

Only one study, conducted in 1990-1991, provides a comprehensive look at the non-salmon fish harvest by the residents of the GASH communities while quantifying actual harvest and use (Wheeler 1993, 1998). This report builds on and enhances existing information on lower-middle Yukon resource use by focusing specifically on the detailed contributions of Athabascan TEK of non-salmon species.

Traditional Ecological Knowledge in the lower-middle Yukon and Innoko Rivers

The anthropological literature is replete with multiple and sometimes differing definitions of TEK exist in the literature. According to Berkes, TEK, or local knowledge as it is sometimes called, encompasses "a body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes 1999:8). According to this definition, TEK is local and place-based, cumulative and adaptive, shared, and integrative. In this sense, local knowledge is culturally embedded, an important aspect of understanding what many Alaska Native people, including those of the lower-middle Yukon, mean when they claim that subsistence is a "way of life." A generational, adaptive, and integrative approach to the natural environment is manifest in historical and contemporary technologies of fishing. Through generations of accumulated knowledge, the people of the lower-middle Yukon area have developed and evolved fishing implements and techniques that allow for year-round harvest of non-salmon fish species (cf. Andersen et al 2004), discussed in more detail below. It is also evident in the social organization of a community or communities. For example, a subsistence way of life that required an extensive and complicated knowledge of the natural world, historically created a patterned seasonal round. Today, significant patterns of resource distribution and sharing within and between communities continue to characterize the subsistence lifestyle.
As such, TEK, as a form of knowledge, should be critical in regulatory or management contexts, though it has found increased currency primarily in intellectual circles (Berkes 1999, Sallenave 1994, Wenzel 1999).

As a result of long term interactions with the land and resulting relationships with animal species that includes, but is not limited to harvest, Nadasdy (2003), among others, argues that local knowledge is deeply personal and experiential. As such, the "facts" of local knowledge, or what people know about an area or a species cannot easily be separated from how they know it (see also Huntington 2002). This raises an important consideration for translating or transcribing local knowledge provided in ethnographic interviews into written

narratives of TEK. While we present information here in a species-specific manner, people of the area generally talk about fish species in a more complicated fashion, often in relation to certain activities, other fish species and sometimes other non-fish animals. For example, when talking about setting fish traps under the ice after freeze-up in the early winter to catch whitefish, respondents often provided information about the seasonal movements and distribution of other species also caught in the trap. They repeatedly observed that certain species move in relation to other species and that information about where to set a net, or harvest fish more generally, could be gleaned from observations made while engaging in other non-fish related activities, such as moose hunting. For example, while moose hunting in the fall, an activity that often corresponds with low water periods in the river, some respondents said they could more easily see emergent sandbars and other shallow spots near the mouths of sloughs to set nets over the winter or during the following spring.

In a related fashion, elders and other village residents do not generally separate knowledge of what we might call fish "ecology" -- that is, more strictly, the natural environment and fish biology -- from its relationship to human interaction through observation, harvest, and use. Indeed, one might even suggest that because fish ecology and human ecology are not strictly separate, that ecological matters, from a local perspective, might also include such things as kinship (manifest in the organization of hunting/fishing activities and distribution networks), and other social factors such as knowledge transmission and language that shape explicitly social relationships with animals (cf. Nadasdy 2003). Consider the following explanation for the Deg Xinag term for humpback whitefish, which incorporates important elements of social life and organization for Deg Hit'an people.

> "These fish [humpback whitefish] which are described as hunchbacks have a name that means literally 'by-and-by tomorrow,' wherein lies a tale. The name was given to them because they do not eat little fish, it is said. Other species, like jackfish [spring pike], for example, becomes uncontrollably hungry. Living in their kashims,[2]

[2] The kashim in a Deg hit'an or Holikachuk village was essentially a large structure that served as a ceremonial house and the communal center of the village. According to Osgood (1958), kashims were the center of the men's world, a place where they gathered to work and visit; young men often lived in the kashim from puberty until they married. It also served as the place for sweat baths, council meetings, and shamanistic activities, and funerals. See page 79 for a picture of a contemporary kashim in the village of Shageluk, used primarily as a meeting place.

> they see their little ones swim out from underneath the benches, and being rapacious, devour them. The hunchbacks will not do this. They say, 'by-and-by tomorrow', we will find something to eat" (Osgood 1959:25).

These claims about a way of life and the personal and experiential nature of knowledge are essentially claims about social identity derived from the sum of one's approach to and relationship with one's environment. As many local people observe, the survival of a subsistence way of life extends beyond matters of physical survival and centers on the survival of their way of life as native people, specifically, the survival of their culture.

> "She used to say that when you do subsistence fishing, you take care of everything, don't throw nothing away. Just put everything away good, you know, because that way, if you put everything away good, it'll come back on you again and then you'll always have it if you take care of everything…" [H060204, Anvik]

In this sense, much of the local knowledge of non-salmon fish species (and every other animal for that matter) comes from direct observation of and use-based interaction with fish, rather than from abstracted scientific experimentation. For the majority of people in the GASH area, fish and other animals are not objects of study, but are subjects themselves in explicitly social relationships with humans, as can be seen again and again in the quotes found throughout this report from the interviews with elders and other knowledgeable fishers from the four communities (cf. Cruikshank 1990). Paying attention to how people know things and how they narrate this knowledge provides important clues for understanding the role of fish, in this case, non-salmon species, in the broader social and cultural context of village life. The value of this long-term, contextual information can provide invaluable insights to scientists who are unable to observe the environment and the residents' social relationships to it on a continuous basis over time. Often, because of the constraints of multiple projects and the availability of funding, scientific observation is neither continuous nor long-term. Local knowledge, understood in detail and analyzed properly, can complement scientific inquiry to both provide biological observation and also contextualize social relationships important to management, such as user-concerns.

Northern Pike studies in the lower-middle Yukon Area

In recent years, the Innoko River has become a popular destination for guided sport anglers seeking to catch northern pike. The Innoko River is unique in that it offers one of the best opportunities for sport anglers to catch large northern pike in Alaska. The current Alaska state record for sport caught northern pike is 38 lb 8 oz; this fish was caught in the Innoko River in 1991. Pike weighing 20 pounds or more are commonly caught in the Innoko area (Burr 2004). Northern pike in the area are targeted by both sport and subsistence fishers. Local subsistence fishers are concerned that sport fishing activities are adversely affecting local pike stocks. Most of the sport fishery occurs in an area demarcated by the mouth of the Innoko, the abandoned village of Holikachuk, and south of Reindeer Lake and Paimiut Slough. Most guides using the area encourage clients to practice catch-and-release but a small directed harvest does occur. Mortality of released pike is unknown but is assumed to be small (less than 5%) based on the results of previous studies (Burkholder 1992, Burr 1998). Estimated annual sport harvests of northern pike for the entire Innoko River drainage have averaged less than 100 fish per year in the last five year (1999-2003) period (Jennings et al 2004). In contrast, total catch (fish harvested plus fish released) has increased and currently averages approximately 10,000 fish for the Innoko River drainage. Current sport fishing regulations for northern pike in the Innoko River are 3 per day, 3 in possession, only one of which can be over 30 inches, and no closed seasons.

In 1998, ADF&G initiated a program in conjunction with the most active sport fishing guiding businesses to sample northern pike in the Innoko River area. A sample of the fish caught and released by guided clients was measured, scale samples were collected and the fish were marked with ADF&G tags. Over the past four summers more than 2,200 northern pike have been sampled in this way, providing information on age and length, and limited information on seasonal movement of sport-caught northern pike in the Innoko River.

In order to further assess northern pike inhabiting the Innoko River area, the ADF&G, Division of Sport Fisheries, initiated a study of seasonal movements of these fish using radio telemetry in May 2002. The study area lies entirely in the Innoko River drainage, centers on

Reindeer Lake, and radiates approximately five miles from the lake perimeter. The goal of this study was to describe the northern pike stock inhabiting the Innoko River in terms of fidelity to the Holy Cross study area. The objectives for this investigation included estimating the proportion of radio tagged northern pike that moved out of the study area during aerial surveys conducted during the open water fishing season. In addition, the locations of radio-tagged northern pike were documented during the summer post-spawning and feeding period (June-September), the winter (December-March), and the spawning period (May) for the two years following implantation. Another important component was marking northern pike with uniquely numbered internal anchor tags, recording fork lengths, and taking scale samples for age determination. During this project, 60 northern pike larger than 500 mm fork length (FL) (21 inches total length (TL)) were fitted with radio transmitters and approximately 500 additional northern pike were tagged. The locations of all fish fitted with active radio transmitters were recorded periodically from June 2002 through May 2004. A complete description of this study and the findings are expected to be published in Winter 2004/2005 (Scanlon *in prep*).

This project was conducted concurrently and cooperatively with the northern pike movement study described above, with the radio telemetry component designed to help addresses the concern of Holy Cross residents about the degree to which the sport fishery for northern pike affects the subsistence fishery. A central question is to what extent the sport fishery and the local subsistence fishery fishing target the same stock of northern pike. The proportion of the spawning stock of northern pike in Innoko River (Reindeer Lake) study area that leaves the area at different times of the year was estimated with radio telemetry. Understanding fidelity of the pike population to the study area during the open water season is important because virtually all of the sport fishing effort occurs during this time. Movement of northern pike out of the study area during winter into fishing locations used by Holy Cross residents would indicate that the population(s) of fish targeted by the sport and subsistence fisheries are not separate.

OBJECTIVES

This project was multi-pronged, involving harvest surveys, collection and analysis of TEK (to provide contextual data for harvest data and subsistence practices), and radio telemetry and harvest sampling as discussed above.

A. Collection of TEK:
    1. Collect information on taxonomy, life history, traditional/contemporary harvest and preparation methods, use, and relative abundance and population trends on non-salmon species
    2. Generate maps depicting important non-salmon species habitat areas
    3. Convert collected TEK information into a useable database
    4. Train TCC and local tribal staff in use of database
    5. Assess coverage of information by species, geographic area, and topic

B. Harvest Assessment objectives include the following:
    1. Estimate non-salmon species harvested for the calendar year 2002 by species and by season, for Grayling, Anvik, Shageluk, and Holy Cross
    2. Sampling of the subsistence harvest and tag recovery
        a. During the late winter-early spring 2003 and 2004, a portion of the subsistence northern pike harvest will be sampled for age/sex/size indices
        b. During the calendar year 2003, tag recovery from a population of approximately 3,000 tagged pike will be attempted

A final objective of this project was capacity building in local communities, tribal organizations, and non-profit organizations. All of these research objectives were accomplished within the original timeframe proposed in the Investigation Plan.

METHODS

Collection of Traditional Ecological Knowledge

Traditional ecological knowledge (TEK) was documented in several ways. ADF&G staff, in coordination with TCC staff and interns from the University of Alaska Fairbanks, Interdisciplinary Graduate Education and Research Training (IGERT) program, documented TEK through interviews with key respondents in the lower-middle Yukon River and Innoko River communities of Grayling, Anvik, Shageluk, and Holy Cross. These interviews occurred in two general phases. The first phase was conducted between July and December 2003, prior to analysis of the harvest survey data, described below. The second phase of interviews took place between March and June 2004. The timing of these community visits was planned with an entire annual cycle in mind and organized roughly around seasonal practices and specific fishing events, such as the Arctic lamprey run in late November/early December.

In each community, ADF&G and TCC staff identified individuals considered to be knowledgeable about non-salmon fish species, with the assistance of tribal councils and village residents. Interviews were conducted using a semi-structured interview format outlining general areas of discussion (below) and developed in advance by ADF&G and TCC staff, with the assistance of village residents. Interviews were recorded when allowed and supplemented with note-taking. Appendix A contains the protocol that guided the ethnographic interviews. During interviews, pictures of the fish species themselves and archival photographs from the Jesuit Oregon Province Archives at Gonzaga University were utilized to prompt information and significant memories about fishing practices. In one case, an elder from Grayling supplied an additional pictures also used during the interviews. This picture is included as Plate 22 in this report with her permission. Finally, researchers documented their work through photographs, when allowed. All of the photographs contained in this report were taken by Caroline Brown, unless otherwise noted.

Key respondent interviews addressed the following types of information:

1. Taxonomy - i.e., species utilized and local names for fish species;
2. Life History/Biology information, including habitat preferences, spawning and rearing areas, seasonal movements of fish;
3. Traditional/Contemporary Harvest Methods, including timing of harvest, gear used, mapping of harvest areas and collection of fish-related place names;
4. Traditional and Contemporary Preparation and Preservation Methods;
5. Use: how various fish and fish bi-products are used for human food, dog food, trapping bait, etc.; and
6. Relative Abundance and Population Trends.



Plate 1. Henry Deacon (Grayling) talks with Melissa Robinson about whitefish

A total of 22 interviews documenting local observations and knowledge were conducted with 26 individuals. All of the interviews were conducted by Caroline Brown (ADF&G) with assistance at times from Kim Elkin (TCC), Louann Rank (ADF&G intern) and Melissa Robinson (UAF, IGERT intern). These contributors all brought something different and useful to the interviews, based on their respective backgrounds in biology, oral history, and similar research in the Upper Tanana area. In addition, two Athabascan linguists, Beth Leonard and Giulia Oliverio, conducted additional interviews to document local taxonomies

in Deg Xinag and Holikachuk, respectively. Most of their respondents also participated in the ethnographic interviews. Table 1 lists respondents by community, year of birth, and date interviewed.

Table 1. Name and Year of Birth of Respondents by Community

Respondent	Year of Birth	Date Interviewed
Grayling/Holikachuk		
Gabe Nicholi	1952	December 2003
Herman Deacon	1948	April 2004
Henry Deacon	1928	July 2003
Dolly Deacon	1928	July 2003
Hannah Maillelle	1922	December 2003
Wilson “Tiny” Deacon	1925	July 2003 / December 2004
Edna Deacon	1938	June 2004
Nelson Deacon	1963	April 2004
Shageluk		
Raymond Dutchman	1925	July 2003
Elizabeth Workman	1922	April 2004
Hamilton Hamilton	1929	June 2004
Lucy Hamilton	1934	June 2004
James Dementi	1926	December 2003 / April 2004
Philip Arrow	1932	April 2004
Holy Cross		
Luke Demientieff	1926	March 2004
Alice Demientieff	1932	March 2004
Philip Demientieff	1964	October 2003
Alfred Demientieff	1954	October 2003
Vaska Gregory	1940	October 2003
Maurice Newman	1917	October 2003
Anvik		
Larson Maillelle	1948	June 2004
Angela Young	1946	June 2004
Carl Jerue, Sr.	1933	June 2004
Carl Jerue, Jr.	1961	July 2003
Dan Sawyer	1951	June 2004

Fieldwork also included standard anthropological methods of participant-observation. The interviewing process loosely tracked the seasonal cycle during which researchers observed and participated in various harvesting and processing activities. This provided a much more complete and detailed understanding of the role of fish in the lives of community residents, including particular harvest techniques, belief structures, values, and the social organization of harvesting and processing activities. Specific opportunities to participate included the winter Arctic lamprey harvest in Grayling, late spring/early summer open-water set net fishing in Grandmother Slough off the Anvik River, hooking pike during the winter in Holy Cross, net-making and fish cutting in Shageluk, and the setting and checking of under-the-ice set gill nets near Thompson Creek above Grayling.

Finally, the use of maps to record relevant information (e.g., locations of spawning areas, rearing habitat, traditional harvesting areas, etc.) using USGS 1:250,000 maps was central to most of the interviews. Respondents located important fish habitats, specific harvest locations, and other important geographical locations such as fish camps and place-names. These locations were recorded on mylar overlays and transcribed onto a regional composite map. Mapped data from the interviews are presented in Appendix F.



Plate 2. Raymond Dutchman of Shageluk maps important habitat and harvest sites for non-salmon fish species with Caroline Brown. Photo by Melissa Robinson

Subsequent to the interviews, materials were entered into a computerized, searchable database. Entries were key-worded by general categories. The computerized database is searchable using the AskSam program, which is the standard software used by the Division of Subsistence for qualitative narrative text databases. The software program produces individual documents organized by keywords established by the designer, and for this project, will allow users to research the eight species of fish individually or collectively by community, location of harvest information, and keywords that have classified topics of traditional knowledge reported.

Harvest Assessment

The harvest assessment component of this project is two-pronged: a 12-month assessment of non-salmon fish species harvests and a sampling of the subsistence harvest and tag recovery. While the ADF&G, Division of Commercial Fisheries collects harvest data on non-salmon species in the post-season salmon harvest surveys, they frequently involve small sample sizes, which yields incomplete and imprecise community estimates. Comprehensive household surveys using standard Division of Subsistence methods likely result in more precise community harvest estimates, and also documenting the participation, use, and sharing of non-salmon fish resources within survey communities. These surveys also result in data that are comparable to other division studies across the state.

The sampling component of this project was designed to examine whether or not existing harvest levels are adversely affecting the pike population in the GASH area, and also to assess the degree of overlap between the pike population targeted by the sport and subsistence fisheries.

Harvest Surveys

The primary harvest data collection method for this project was systematic household surveys. In addition to the harvest and use data, staff collected limited demographic

information and information on sharing and use of fish species, timing of harvest, and numbers and species harvested to provide context for the data. Based on retrospective recall, respondents were asked to provide specific information on numbers and species harvested. See Appendix B for a copy of the survey instrument.

The research was conducted consistent with the Division of Subsistence policy on research ethics. With the assistance of the tribal councils, TCC identified local research assistants to administer the surveys. Participants were provided a one-page informational sheet which also included information about the voluntary and confidential nature of their participation, along with contact information at both ADF&G and TCC in case they had further questions about the project following their interview.

All study communities had the opportunity to review and comment on the preliminary study findings, and final results were provided to each community. Harvest surveys were completed and returned to ADF&G by mid-June, 2003. ADF&G and TCC staff reviewed them for accuracy with the local research assistants. Surveys were then analyzed by the Information Management section of ADF&G, Subsistence Division, in December 2003.

Sampling Goals: A total of 188 households were identified in the GASH area. Because of the relatively small sizes of each community, a census approach was utilized and all of the households were invited to participate in the harvest survey. Table 2 below shows the number of households contacted and surveyed in each community; surveys were completed with 89% of all households in the study area.

Table 2. Community Sampling and Participation Rates

Community	Survey Design	Number of Households	Number of Surveyed Households	Percentage of Households Surveyed	Unable to Contact	Declined Survey	Community Population (US Census, 2000)
Grayling	Census	49	47	96%	2	0	194
Anvik	Census	35	34	97%	0	1	104
Shageluk	Census	40	32	80%	0	8	129
Holy Cross	Census	64	53	81%	0	12	227
All Communities		188	166	89%	2	21	654

***Pre-fieldwork training sessions*:** A pre-fieldwork training session took place in February 2003 prior to the harvest survey work, subsequent to the first phase of TEK interviews but before the second phase. The training session accomplished the following goals:

1. Summarize and discuss previous research in the study communities
2. Review project goals and procedures
3. Train local researchers in survey administration; practice conducting interviews
4. Discuss non-salmon fish population trends and other local observations and issues

Local research assistants were supplied with packets which included: a training manual to guide the instruction of local research assistants in survey administration and other project record keeping, a color non-salmon fish identification guide, and the informational sheets to be provided to each participating household.

***Data Collection Phase**:* Harvest and use data were collected for the calendar year 2002, in face-to-face interviews between the local research assistant and a household representative. Household surveys were conducted during March and April 2003. ADF&G and TCC staff monitored local research assistants in the field to answer questions or provide additional information and clarification on survey implementation. Local research assistants were compensated at a rate of $20 per completed survey form.

Harvest data were coded and sent to ADF&G, Information Management (IM) staff for review and analysis. Data were analyzed for estimated number and pounds of non-salmon fish species harvested by the four communities in the GASH region. Additionally, IM produced tables representing the percentage of households participating in the fishery by month and estimated rates of households fishing, harvesting, receiving and giving away fish during the calendar year.

Data collected using household surveys have consistently produced harvest estimates that are more precise and typically higher than those obtained by other formalized means, such as harvest tickets. Previous research projects utilizing local research assistants have demonstrated that village residents are generally more comfortable with local interviewers, which often generates more accurate information and higher levels of participation. This survey effort represents a continuation of this successful methodology.

Sampling of the subsistence harvest of northern pike and tag recovery

This project also seeks to describe the seasonal locations of subsistence fishing for northern pike, compare these sites with the presence of radio-tagged northern pike from the Reindeer Lake area, and to characterize the age and size composition of the subsistence harvest of northern pike. Specifically, this section of report: 1) Describes the fishing locations of the subsistence ice fishery for northern pike; 2) Describes age, sex and length (ASL) of northern pike captured in the subsistence ice fishery; 3) Documents the capture of northern pike in the subsistence fishery that were previously caught and tagged in the sport fishery by recording tag recovery information, and; 4.) Describes the winter locations of radio-tagged northern pike in relation to the winter subsistence fishery locations.

To describe the fishing locations of the subsistence fishery, information concerning fishing sites was summarized on maps from three distinct sources. Interviews with local residents were the primary source of information. Wintertime fishing locations were also recorded during aerial surveys while locating radio-tagged northern pike. Finally, the location of recapture of fish from voluntary tag returns provided fishing locations.

Information used to describe the age, sex and length of northern pike harvested in the wintertime subsistence fishery was collected by sampling the catch during spring season (ice fishing/hooking) near Holy Cross. For each fish sampled, fork length (FL) and total length (TL) were recorded, sex was determined by examination of gonads and scales were collected for age determination. This sampling was conducted during March 2003 and 2004 by project personnel with the assistance of students and teachers from the Holy Cross school.



Plate 3. Brendan Scanlon measures a pike caught near Holy Cross, 2004



Plate 4. John Burr helps students at the Holy Cross school dissect a pike, March 2004



Plate 5. John Burr helps a Holy Cross student to determine the sex and length of a pike,, March 2004

Voluntary tag returns were used to document the recapture of northern pike in the subsistence fishery that were previously caught and tagged in the summer season sport fishery. To facilitate the return of tags, posters summarizing the project and requesting the return of tags were displayed in public buildings in Holy Cross and in Shageluk. Tags from subsistence fishers were collected by Tanana Chiefs Conference sub-regional office in Holy Cross, by ADF&G staff in Fairbanks, and by direct mail to ADF&G offices.

The locations of northern pike fitted with radio transmitters were determined from periodic aerial tracking flights. The transmitters were surgically implanted during May/June 2002 in the Reindeer Lake area of the lower Innoko River/Paimiut Slough. Periodic flights (approximately every 6 weeks) were conducted during winters 2002-2003 and 2003-2004, except that no flights were completed during November – January. Additional tracking flights were completed in April through May as break-up approached. During the tracking flights all sloughs and channels of the Innoko River from Shageluk to Paimiut were overflown as were the channels of the Yukon River from near Anvik to Paimiut. Locations of radio transmitters were recorded electronically and on maps. A complete description of the methods used to conduct these aerial surveys is found in Scanlon *in prep*.

Capacity Building

The harvest assessment component of this project contributes significantly to its capacity building component. Tribal entities participated in survey instrument development, selected local surveyors, were consulted during data analysis and provided the opportunity to comment on the final product. Local research assistants were trained in project and survey design, survey implementation, and were consulted regarding findings.

In the sampling component of the project, local high school students assisted with the sampling aspect of the harvest assessment. In so doing, they received training to collect samples and information on age, sex, and length of harvested fish, and significantly, exposure to the methods of biological research.

Finally, the GIS department at TCC produced the maps for the final report. TCC staff trained Kim Elkin (TCC) and Louann Rank (ADF&G intern) to develop the maps utilizing the ArcView format.

RESULTS OF THE TEK COMPONENT

This section details the results of the ethnographic interviews and mapping sessions with key respondents. In order to analyze the volume of information provided by residents of the area, this section is organized into three major parts: (a.) language inventories; (b.) seasonal round and fishing technologies; and (c.) species summaries. Language inventories provide a useful context for understanding lexical specialization, or the complexity of vocabulary residents have for describing their world. As such, language is an important consideration for understanding the depth and density of local knowledge. The second part on seasonal rounds and fishing technologies examines how people structure their responses to interview questions in addition to the content of their answers. In this way, interviews can be analyzed for the connections that respondents draw between themselves and their environment,

between fish and the environment, and between fish species themselves. Finally, the ethnographic interviews are evaluated for information they provide about each species. According to this organization, readers can tailor their reading to match their interest.

Deg Xinag and Holikachuk Linguistic Inventories of Non-salmon Fish

As Berkes (1999) and Simeone and Kari (2002) note, the vocabulary used to identify and name species is integral to the study of traditional ecological knowledge. The lexical specialization exhibited within a community or language group is one index of the depth and complexity of knowledge about and experience with a species or group of species. For the purposes of this study, linguistic information is presented in both Deg Xinag and Holikachuk, the two distinct Athabascan languages spoken in the region. Before discussing the linguistic inventories for fish names, technology, and other related terms, a brief overview of the historical relationship between Deg Xinag and Holikachuk as they are spoken in the GASH area is presented. Assistance for this section was provided by Giulia Oliverio for Holikachuk and Beth Leonard for Deg Xinag; both scholars are actively engaged in language preservation work in this area.

According to a leading scholar of Alaska Native languages, Holikachuk can be considered the intermediary language between Koyukon and Deg Xinag, "partially intelligible to both, a bit closer to Koyukon linguistically but closer to Ingalik socially" (Krauss 1980: 37-38). In this sense, the Holikachuk language is closer to Lower Koyukon, but its speakers are culturally closer to Deg Hit'an people, as shown today by the social interactions and multiple kinship relations within the GASH villages, than with other peoples.

One area resident links the historical relationship between speakers of Deg Xinag, or what many locals referred to as "Shageluk" or "Anvik" language, and speakers of the Holikachuk language with the old village of Dishkaket[3] just below the Dishna River in the Upper Innoko. Dishkaket is a historic village in the Upper Innoko and was central to both the middle Yukon

[3] Holikachuk Diyhno' "Dishna River"; Dishkaket from diyh, -qa "mouth of (river)", -q'it "site of."

area around Nulato and Galena and the Upper Kuskokwim (McGrath and Nikolai area). He suggested that a significant amount of conflict in the Dishkaket area sent residents south to the Upper Kuskokwim area and north to the Nulato area, around the mid 1800s (possibly a response to the influx of miners into these areas and the depopulation and loss of leadership due to disease, along with inter-family disputes associated with shamanism[4]).

This movement may explain the linguistic similarities between Deg Xinag and Upper Kuskokwim languages. Linguistic boundaries are somewhat misleading considering the extensive travel of neighboring peoples and the number of cognate or similar terms shared by other Athabascan languages including Dena'ina bordering on the southeast. Around 1906, with the diphtheria sickness in the area, much of Dishkaket ceased to exist and the survivors resettled down river at Holikachuk. Despite contemporary efforts at language preservation, both Deg Xinag and Holikachuk are spoken by a declining number of people, primarily by elders, although some younger adults have begun the study of these languages via audio-conferencing and the utilization of master-apprentice methods. Formal school-based programs are currently unfunded, although some teachers make an effort to include some bilingual instruction when elders are available.

Deg Xinag and Holikachuk fish inventories appear largely congruent with Linnaean classifications, with some exceptions. In general, Deg Xinag and Holikachuk terms were identified for all of the major non-salmon fish species distributed throughout in the region. In some cases, Deg Xinag and Holikachuk speakers also distinguish life phases such as juvenile fish (in Deg Xinag, *gina'yozr* for baby blackfish and *ił ch'eddh* for whitefish fry). One superb example of increased lexical variation within these two languages is in the terminology for whitefish species. Biologists recognize five different species of whitefish (not including sheefish) as present in the lower-middle Yukon region: broad whitefish (*Coregonus nasus*), humpback whitefish (*coregonus pidschian*), round whitefish (*Prosopium cylindraceum*), least cisco (*Coregonus sardinella*) and bering cisco (*Coregonus laurettae*)

[4] According to Osgood (1958, 1959), shamans played an important role in pre-contact and early post-contact cultural beliefs among the Deg Xinag. Shamans conducted much of the ceremonial life in a community and often acted as healers by enlisting the help of animal spirits. They might also engage in warfare between families or other social groups in different settlements.

(Mecklenburg, Mecklenburg and Thorsteinson 2002). Osgood (1959) identified five terms for whitefish by residents of Anvik (Deg Xinag), including sheefish, but was unable to cross-reference them with the Linnaean classifications. As part of this project, six terms were identified in Deg Xinag and Holikachuk to reference whitefish species, indicating a slightly different taxonomy of whitefish, organized around descriptions of different species, age, and location or condition of fish.[5] Table 3 (next page) details Deg Xinag and Holikachuk terms for most non-salmon species, along with meanings or translations of the terms, where available.



Plate 6. Wilson Deacon of Grayling works with linguist Giulia Oliverio on a Holikachuk taxonomy

[5] Interestingly, the general term for whitefish in Holikachuk is also the word for fish more generally. While this could possibly suggest historic cultural and linguistic values placed on whitefish as an important resource, any conclusions to this effect would require linguistic analysis of the Proto-Athabaskan terms as they evolved into the Holikachuk language, according to one linguist (Oliverio, personal communication 7/14/04).

Table 3. Deg Xinag and Holikachuk terms for non-salmon fish species

English	Deg Xinag	Holikachuk	Literal Translation
Pike	Giliqoy	K'oolqoy goolqoy	"a lance, something speared at something"[2] "that which is speared at"
Baby pike	Giliqoy ch'uq		Pointed lance? Ch'uq = pointed, sharp
Alaska Whitefish	łegg	łoogg	
Little whitefish, whitefish fry	Xiłch'edh Ilch'eddh[1]	K'ithk'ooy iłk'oodh	
Broad whitefish	Tilay		
Lake whitefish	Taghiy	Taghiy	Bottom of water[2] *Tax-* = underwater, submerged
Round whitefish (also a general term for small whitefish?)	Xiłting'	Dilmig	
Humpback whitefish	Q'ontoggiy	Q'adiq ney	By and by tomorrow[2]
Alaska Blackfish	Xozrigh	Oonyeyh	Possibly 'spread upwards'[3] (Deg Xinag)
Baby blackfish	Gina' yozr		Its young
Lamprey (Eel)	łeggided	łoogg dood	Long, skinny fish
Grayling	Srixno' legg	Sixno' loogg Sixno' xigiloogg	(Side) stream fish; creek fish
Burbot/Loche	Gidhiyh	Gidhiyh	
Sheefish	Sresr	Ses	
Sucker	Tonhts'ix, Tonhts'ixgi	Toonts'ix	Stand still mouth[2]
Dolly Varden	Tritr Doggizr	Tsits daggiz	*Tritr*= wood *Doggizr* = something forked/with gap?
Clamshell	*Xił tth'og,* *Xiłtth'ok*	xiłtth'og	Oval dish 'freshwater clam; shell ladle'
Sculpin	Tidhi'on qatl'ox ?tlton		Bottom of fishtrap (tlton=?)
Brook Trout*	Vithye legg	Mith yeloogg	(cut) bank of the creek fish

[1]From Deg Xinag Stem Dictionary
[2]Literal translation from Osgood 1958
[3]Literal translation from Koyukon Dictionary
*According to ADF&G biologists, Brook trout are not likely present in this area. What exactly local residents are identifying remains to be investigated – possibly lake trout or rainbow trout.

In addition to fish terms, several other terms were identified that relate to fish and fishing activities and which hint at valued interconnections within the natural world communicated in these languages. According to Oliverio, the Deg Xinag and Holikachuk words for 'spring'

are based on the Proto-Athabascan word for 'ice', "*łu*", meaning "ice or glacier" and referring to break-up in the springtime and are not historically related to the words for fish. However, contemporary speakers have re-analyzed these terms as derived from the word for 'fish' due to a similarity in the words. It should be investigated if an association of meaning related to the spring migrations of whitefish in the region (see also Osgood 1959) also plays a role in the association of these two words in the minds of speakers. While today's term is not historically related to the word for "fish", it could be a connection that today's speakers make through shifts in Deg Xinag folk etymology (Oliverio, personal communication 10/9/04). The Deg Xinag word for November, *łeggided no'o*, translates into "eel month" indicating the annual runs of arctic lamprey up the Yukon River during that month. In Holikachuk, November is translated as *łoogg dood mininh iligh*, meaning "month when the eels come (swim). Two Deg Xinag animal terms also reference fish behavior: *łeggi ney* (or, in Holikachuk, *łoogg ney*), the flycatcher (bird), is literally translated as " 'fish,' it says or calls." According to one Shageluk elder, as the fish get closer to the villages, these birds come out of the woods and their calls resound though the forest. The Learners' Dictionary lists the same term for the junco with a slight spelling variation, *łegg ne*, and includes the call of the junco, "*łegg yiq, łegg yiq, di'ne*," translated literally by another Shageluk elder as "fish are coming, fish are coming, junco says!" Finally, the gray butterfly, or *łegg nilivits*, translates literally as "fish butterfly" (or in Holikachuk, *łoogg nilimidz* 'kind of butterfly'). According to Osgood (1959:39), they are named so in Deg Xinag because they appear in August after the fish run. These connections not only point to the interconnectedness of Athabascan world views, they also provide valuable information on run timing and other natural indicators.

Table 4. Other Fish terms in Deg Xinag and Holikachuk

English Word	Deg Xinag	Holikachuk
Fish Parts		
Fish stomach	givid	gimit
scales	giggithgi	giggootth
Fish guts		gits'eg
Whitefish guts	gighizr	gighiz
Fish oil	łegg gha'	łoogg gha
Fish eggs	q'en'	q'oon'
Harvesting Tools		
Big fish trap	tidhi'on	ti'on chux, tadhi'on chux
Pike trap	giliqoy tidhi'on	k'oolqoy ti'on
Blackfish trap	xozrigh tidhi'on	oonyeyh ti'on
Winter loche trap	xiyh tidhi'on	
Fish fence	taghitroth	xitseł, niłtsits
Fish fence poles		tandadhi'oy
Fish trap location	giniq'a	gineq'at (fishing location)
Whitefish net	łegg tixve	łoogg tameł
Grayling net	ni'ililod (seining net)	sixno' loogg tameł
Net floats	tixveł dhi'on	mik'ełusgi
Dipnet	ti'isr	datł' ooł, ti'is
Dipnet fishing place		ti'is q'at
Eel stick	taxteghul	tagh teghul
Foods and other Uses		
Fish soup	łegg tol	łoogg tol
Boiled fish meat for ice cream	ginolay	k'inadlagh
Fermented fish	gitsitl	dzeniq
Smoked whitefish	xilivizr	xilmiz
Fish head grease	gitthejigha'	gitthegigha'
Scored dry fish	nithizriy	dinadiziy
Dry spring whitefish	dingh dongiy	xulooggi doniy ggun
Whitefish guts grease	gighizrgha'	gighizgha'
Indian ice cream	vanhgiq	nathdlod
Snow ice ream	dhiyh vanhgiq	tsetł nathdlod
Fish ice cream	vanhgiq	k'inot nathdlod
Loche stomach bag	gidhiyh vit	gidhiyh mit

This brief description clearly demonstrates that language is an important index of the depth and complexity of local knowledge, primarily through the development of specialized

vocabulary. While documentation of this linguistic variation certainly builds on existing work (Osgood 1958), it is by no means a comprehensive linguistic analysis of fish terminology and taxonomies for native speakers of either Deg Xinag or Holikachuk; additional socio-linguistically focused research would likely illuminate the rich cultural information communicated through language structure and use. Considering the data from the Koyukon area, multiple terms for each species may exist, or existed at one time – but are currently undocumented. Fish "ethno-taxonomies" remain generally unexplored; other potential data sources include yet untranscribed and untranslated narratives by Belle Deacon (less than half of her recordings have been transcribed/translated), and access-restricted recordings of Deg Xinag elders from the Alaska Native Studies elders-in-residence program at the University of Alaska Fairbanks (Leonard, personal communication 9/13/04).

Regional overview of GASH villages, river systems, and fishing sites

One way to organize the quantity of information recorded in ethnographic interviews is through a regional perspective that then telescopes in on specific communities, waterways, and harvest patterns. The larger GASH area itself contains several important features that figure prominently in fish migrations and harvest locations which, in turn, provide the context for understanding use patterns. While considering the large composite USGS topographical maps used during interviews, one fisherman from Grayling described a seasonal, geographical pattern of non-salmon fish movements from a regional perspective that included the use areas of all four study communities. His description linked knowledge of different kinds of habitats provided by rivers, tributaries, and lake systems to observations on the seasonal movements of various species and the seasonal round of harvest activities. In this sense, a basic understanding of the environmental characteristics of the region provides one context for understanding local patterns of resource use.

The approximately 75-mile stretch of the Yukon River between Holy Cross and Grayling is relatively wide and is characterized by the presence of several islands and tributaries that influence primary fishing methods and locations for GASH communities. In the southern

portion of this stretch near Holy Cross, Paimiut Slough, Deer Hunting Slough, and the Innoko River break off from the main river and form important habitats for pike, whitefish, eels, burbot, and sucker. Given their proximity to the Innoko waters, Holy Cross residents reported fishing into Reindeer Lake and up the Innoko to Albert's Lake. Further upstream, the Bonasila and Anvik rivers are significant waterways for migrations of whitefish, pike, and sheefish. Grayling residents utilize the areas around Eagle Island and Fox Point Island for lamprey and burbot fishing, while traveling further upstream to the mouth of Thompson Creek for pike, whitefish, and sheefish. According to respondents, the Yukon is alternately muddy or gravel-bottomed, of varying depths, and more recently, affected by ever-shifting sandy deposits that change the major waterways, sometimes dramatically. For example, the topographical maps used by ADF&G to map critical habitats and harvest areas show a large island on the east side of the Yukon right across from Anvik. Flying over the village, one can see that the island itself has filled in on its west side while eroding on the east side such that the primarily channel is no longer in front of the village but on the east side of the island. These changes have significant impact for fish movements and so, harvest locations. Significantly, Grayling fishers still maintain ties to the area around Holikachuk, above Shageluk, where they fish for pike, sheefish, whitefish, and blackfish in the lakes systems of the upper Innoko. As the excerpt below suggests, people from this region have accumulated a rich body of knowledge organized through the recognized relationships between people, place, and animals.

> "Well, there's certain lakes that they [pike] go to, like there's one behind Holikachuk and there's one below Holikachuk….There's one…*Noono xichux* …That's another lake…that we fish in. We're just talking about the area. And *Noono xigudz* it's the small one, that's a bigger one. ..The lake, that big lake that we're talking about.... Big Lake and that Indian name – [*Gidiminq'it*]…Up every bend, there's names for those lakes. And every creek has a name…That one stretch in the slough, that long stretch, that one was uh, *Xogh ts'itsin'di qogg*, that means Stingy Stretch, used to stretch long…for miles… Used to paddle, and they take long time to pick it, and so they named it Stingy Stretch 'cause you couldn't pick anything out of it." [O072503, Grayling]

As pointed out by the Grayling fisherman above, a general description of these rivers provides a context for understanding fish distribution as well as harvest methods and choice

of gear. In comparing the Tanana and Innoko rivers in her examination of whitefish ecology, Robinson (2004) notes ecological characteristics of the Innoko that affect fish habitats and movements. By extension, these characteristics also help to contextualize fishing practices to contribute to an overall understanding of the entire area connecting the Yukon and Innoko rivers. As a major tributary of the lower Yukon area, the majority of the Innoko is wide and deep, with generally slow moving water "acting more like a large lake than a river system" (Robinson 2004:4). Commonly ranging between 50 and 60 feet deep, the banks of the Innoko drop off quickly into significant depths; as a result, these depths hold for both deep water channels and most of the river's width itself. Much of the Innoko from its confluence with the Yukon River near Holy Cross to above Holikachuk winds through marshy wetlands areas characterized by networks of sloughs connecting lakes and oxbows (Brabets et al. 2000). Many of these sloughs are likely similar to the Innoko itself in depth with slow-moving water, while backwater sloughs that connect to lake systems are likely shallower, though still deeper and cooler than the lakes (Robinson 2004).

Like the Yukon, the Innoko experiences periods of high and low water, coincident with spring snowmelt and summer rains. Some respondents observed that the Innoko River water is "red" and seasonally "rotten," suggesting a certain quality that is not life-sustaining. High water in the Yukon generally backs up into the lower reaches of the Innoko, causing this stained water to become silty. Similar patterns prevail in the area above Shageluk where the Holikachuk Slough, a channel of the Yukon, enters the Innoko (Robinson 2004). This interconnected system of river, sloughs, and lakes figures significantly in Shageluk residents' harvest and observations of non-salmon fish species: Shageluk residents fished in the series of sloughs connected to lake systems around their village, such as the Shageluk Slough and the Old Village Slough, as well as downriver to Callign Creek[6], Layman's and as far down as Albert's Lake.

[6] Callign Creek is the local place name used by residents of the GASH area, primarily residents of Shageluk and Holy Cross. It is located roughly twelve miles below Shageluk off east bank of the Innoko River. Different spellings exist, however. The spelling here is consistent with Jeff Stokes' spelling in his land use maps for ADF&G. One Shageluk respondent noted, though, that the pronunciation of Callign was simply a mispronunciation of "Collins", named for an old trapper who used that area for trapping and fishing.



Plate 7. Set net by Shageluk, 2004

Fishing Technologies and the Seasonal Round

As noted in the Introduction, fish have long been critical to the seasonal subsistence round of lower-middle Yukon and Innoko residents. While certain non-salmon fish species are available in the GASH area all year, elders and other fishers identified periods of concentrated seasonal effort for harvesting individual species or grouped species. Indeed, the information provided by respondents was usually explicitly organized by season. For example, during the semi-structured interviews following an established interview protocol organized by species, informants regularly responded to questions beginning with an orientation to a seasonal round. Their responses were often informed by participation in a subsistence cycle marked by the seasonal movements of grouped species and resulting harvest efforts, implicitly offering an alternative means of understanding and organizing information about non-salmon fish species. Further, because a great deal of respondents' observations were related to harvesting activities, responses often linked seasonal activities to the fishing technologies appropriate during that time of year for the species or groups of species harvested. While some gear types were designed to target a single species, respondents were clear that many of the nets and traps caught "whatever swims by."

Ethnographic accounts of this seasonal round also describe the major food gathering activities that are linked to a significant collection of fishing technologies. These technologies are used at different times in the year in response to river and slough conditions, weather, and species or groups of species generally caught in particular habitats (Osgood 1958, VanStone 1979, Wheeler 1998). Successful harvest continues to rely on a significant knowledge base derived from intimacy with the landscape and extended, active observation and use of these complicated fisheries. According to VanStone (1979), "To a very large degree, the yearly subsistence cycle focused on the seasonal migrations of fish and a considerable amount of Ingalik [sic] technology centered on the taking of fish" (21). The following section describes the seasonal round for non-salmon species and the major fishing technologies developed and used by GASH residents to harvest non-salmon fish species.

While most ethnographic accounts of the GASH area begin their description of spring fishing with the breakup of river ice, many local residents utilize under-the-ice gill nets in the early spring months prior to breakup to bring home fresh meat after a long winter of frozen or dried supplies. The 2002 harvest survey also bears out this assertion: at least three of the four communities reported pre-breakup harvest, usually of pike, whitefish, or sheefish, and one community - Holy Cross – reported the majority of their harvest of pike occurred through the ice in March and April.

As shown in the pictures below, setting a net under the ice involved "threading" a net (usually a 5- 7/8 inch mesh size or dog salmon net cut off to about 60 feet, rather than a smaller mesh whitefish net) under the ice using a series of holes drilled in a straight line across the surface of the ice. One fisherman demonstrated this process using two large sticks – one slightly longer than the distance between the holes and the second with a forked end, shown below. One end of the net was tied to the first stick which was then placed into the water under the ice. The fisherman could then position the stick so that the far end could be seen through the next hole where it could be held in place with the forked stick until slid forward and repositioned so that the end could be grasped through the next hole, and so forth until the stick could be pulled out of the final hole, bringing the end of the net with it. This

fisherman noted that he often cuts the floats or "floaters" off of under-the-ice nets to avoid freezing the net to the underside of the ice. Notice that the holes on each end are elongated, while the center holes are small, approximately one foot in diameter. This allows the fisherman to easily pull a net with fish out from either end. Under-the-ice nets typically produced broad whitefish, pike, and sheefish, species generally available in the area all year round and large enough to be caught in the larger size mesh of these nets.



Plate 8. A net set under the ice near Grayling. The net was threaded through the six holes shown in this photograph



Plate 9. Two fishermen from Grayling pull the net out from under the ice. The net yielded 2 pike and 2 sheefish that day.

Gill nets set under the ice were typically placed at or near the mouth of a river or major slough in an eddy or slow moving water to avoid the net becoming tangled in fast moving water or being swept away. One Holy Cross resident identified one such area called "Victor's" above Gost Creek just north of Holy Cross at the mouth of Walker Slough:

> "Yeah, they catch 'em under the ice with net too. Victor's. Yeah, they put nets up there …Under the ice. You gotta' have good place. Not much current or eddy place…It's the mouth of the river, the big hill right there. It used to be a fish camp up there….up where you make the bend." [B102703, Holy Cross]

After breakup, many respondents described using a second type of net – dipnets - to target whitefish during their spring migration, though other species might also show up in the nets. Osgood (1958) describes this process as well:

> "As soon as the ice is well out of the way, a man takes his dip net with a handle more than twice his height and , placing it over the bow of his canoe, paddles out into the river. Reaching a place where he thinks there will be fish, he directs his canoe upstream and lowers the dip net vertically on his left side, paddling a bit with his right hand to keep the canoe straight. In this manner, he drifts downstream, the babiche mesh of his dip net opening like a bag behind him…and he pulls the dip net straight up by sliding the long handle down crosswise over the canoe creating a counterbalance which will aid in keeping the canoe upright" (236).

The dip nets used in the GASH area today are generally commercially made with metal handle and hoop, and nylon webbing for the net. However, several examples of hand-made dip nets could be seen in almost every community. These nets were usually made of spruce and willow lashed with twine or bark strips, with a hand-woven twine net.



Plate 10. Hand-made dipnet from Grayling



Plate 11. Old hand-made dipnet, Anvik Historical Society

While a few elders remembered this technique of fishing from boats in May and June described above, especially around the Holikachuk area, others described using dip nets in

the spring from the river banks. The excerpt below links the whitefish migration to water quality in the Innoko – important clues for fishermen locating productive locations and timing their harvest.

> "I guess, there is many in the sloughs. My thoughts are way back – we used to dip 'em. In the spring of the year there are lots [whitefish], they go along the Innoko slough. Find a spot, you gotta' look for a spot and use a dip net. You can dip them right out of the water like that… It is kind of murky water…They mill around the mouth of the slough. When the ice move, then the iron water is running out. It's moving that ice, then they go in." [E032404, Holy Cross]

Area fishers also reported using gill nets in open water in the springtime after break-up to harvest whitefish, pike, and sheefish during their seasonal movements. These nets were often placed in similar spots as gill nets set under the ice, or further up tributaries, such as the Anvik River, at the mouth of various sloughs. Below, a picture of a fisherman from Anvik depicts the use of a set net. This net was set atop a sandbar, located during fall moose hunting trips when the water levels are typically lower. Here the water is shallower, increasing the efficiency of the net.



Plate 12. Anvik fisherman checks his net, June 2004

Before the common availability of commercially made nets, several elders remember making nets to catch whitefish, pike, and sheefish during the spring months. These nets were

fashioned from alternative, often recycled materials. Young women would begin making nets in late winter or early spring, out on the bank or in the house. Net floats were shaped from cottonwood bark while net weights were constructed out of caribou or moose bones and also sometimes out of bits of bone and rock sewn into canvas bags and attached to the bottom of the net. One Shageluk elder remembered the winter preparations for spring fishing with dip nets and gill nets, based on observations of pike spawning.

> "They just make whitefish net. They make dip net like that, but they didn't have no twine like this…even blue jeans she was undoing. Yeah, any kind of cloth. And they roll it up and then they make twine out of it. All kinds of colors she had! She cuts 'em, though. When they don't do nothing [in winter], that's all she does – knitting fish nets, dipnets…my mother used to say, 'pike is just hollering back in the lake! I need to braid that kind [of net]….he says fish eggs is getting big in his stomach!' All spring long, I do that [make pike nets]…" [Q060304, Shageluk]

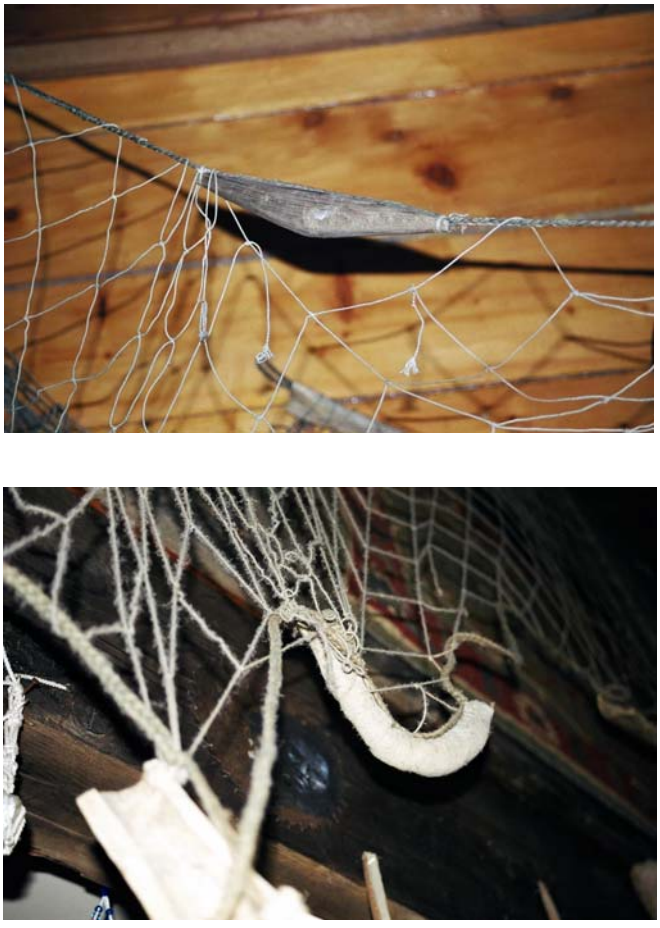


Plate 13. Net float (above) and net weight (below) off of an old net in Grayling

Osgood describes an additional open-water spring gear – small blackfish traps – historically used to target blackfish during their springtime movements in and out of back country lakes. According to Osgood, small traps were set in small channels not much larger than the trap itself. "Resting in this runnel it may be almost completely filled by blackfish during a single night. In the morning the fisherman simply rolls it out and slides his catch on the shore" (1958:242). While this method of spring fishing was not described by any of the respondents, residents of Grayling reported harvesting blackfish during the spring months of March and April.

Although the salmon runs constitute the most significant fishing activity during the summer months, larger non-salmon species are often harvested as by-catch in gill nets. Additionally, in the early summer months, just prior to the salmon runs, fishers actively use set nets at the mouths of sloughs and tributaries to harvest whitefish, pike, and especially sheefish, which apparently swim up-river in larger numbers just ahead of the first runs of salmon, according to many respondents.

Primarily used to harvest salmon during the summer months, fish wheels are also important in harvesting the smaller whitefish species, specifically round whitefish, or *dilmig*. While these smaller species of whitefish generally escape capture in the gill nets with larger mesh size, local fishers reported that they follow fall chum up river and are harvested in significant quantities in fish wheels. While *dilmig* were used for both human and dog food, fish wheels appear to be used less today than in the past when dog teams were more prevalent. Some fish wheels are still in operation, though, and during the course of one springtime visit to Anvik in 2004, two wheels were under construction. On the Innoko, one respondent claimed that changing river conditions precluded the effective use of fish wheels.

> "They used to use fish wheel too, when I was kid. There were about 3 or 4 of them…but after I get big enough to handle it, no more current. There used to be lots of current, too many bars, that's what they were saying, sandbars…that's what make no more current. I used to see lots of fish wheel in the Innoko…gee, while I was still kid." [Q060304, Shageluk]

Area residents also reported catching grayling during the summer months with a hook and line in the clear, fast moving tributary waters, primarily off the western side of the Yukon River. Sucker might also be caught on lines or in nets, usually considered by-catch, since they do not appear to be heavily used. While hook and line does not produce large quantities of fish, many local residents enjoy this means of fishing and reported that especially children learn early about fishing with a line. Hooking is also practiced during the winter in a slightly different fashion, described below.

As the summer months fade into fall, the time around freeze-up marks another major fishing effort. Fall time marks a second major annual migration for many non-salmon species, specifically pike and whitefish. Right after freeze-up, when the river ice is thick enough to walk on, elders remembered "shutting down the river," a practice that facilitated both fall and winter use of dip nets and traps. Residents of Holy Cross and Shageluk in particular describe this practice given their proximity to the Innoko, where whitefish migrated in significant numbers. Community members select an area of the river that was not too deep, approximately ten to fifteen feet deep according to some residents. They would cut a long narrow channel in the ice and insert a fence made of willow brush and stabilize it with long poles inserted vertically to hold the fence in place under the ice. During the fall, fishers would cut large rectangular holes directly in front of the fence to dip fish out of the river. One Holy Cross resident offered memories of the finer points to using a dip net in this way:

> "There's an art to it. The hole is about 10 to 12 feet long and then, that's in the fall of the year. When they dip in the ice, there's only about 2 inches to 4 inches [of ice] – 2 inches is dangerous, it's slippery and it bends when you walk on it. The hole is about 10 feet in length and about 4 feet wide. And the fence would be right here at the end of the hole. You fix your net, shove it down to the bottom and walk along with the current until you hit the fence, then you scoop it up. You scoop it up and hold it under the ice, and pull it out and the fish is there, they can't jump out. Yeah, pull it out on the ice…Get about as much as 4 and 6, you know, in a scoop. You get different species of fish too. Sometimes we fish all night. And you get a heck of a load, we go by sled-load, dog-team days. We don't count the fish! We get a couple of sled loads…Yeah, and any more than that, those who have fish – they pass it around the village, you know, so that everybody has fish." [E032404, Holy Cross]

According to Wheeler (1993), traps could also be placed in the tributaries to catch whitefish during their seasonal migration. Other species, including pike, arctic char, and burbot were also collected during this time in the traps, such that, according to VanStone (1979), traps were the most common and productive gear for fishing. Small blackfish traps can also be used during the fall and winter months. According to one elder from Holy Cross, the best time to harvest blackfish is in the fall right after freeze-up before the ice gets too thick in the winter months. Large funnel traps would be placed along the fence or at the end of the fence facing up-river. Some respondents offered information about the use of traps during winter months. Most respondents noted that traps were best set later in the winter after the ice had sufficiently stabilized to avoid damage to the trap by moving ice.

> "…in December and November there's very little snow. And when you had a fence, a trap, the ice is so cold them days, the ice freezes thick and it freeze up your fence and everything and then it do a lot of damage to your fence, either buck on it or bust it. Its (the ice) capacity is about the first of January for doing any damage…And that's when they set their fence in and their trap, and very little damage, that's when they catch a lot of fish. You could set it before but the ice'll do a lot of damage…it all depends on – them days used to be cold!" [E032404, Holy Cross]

While nets seem to have replaced traps in the GASH area, elders and even younger fishers clearly remember their construction and use. Because of their large capacity, traps were critical in catching significant numbers of non-salmon fish for dog teams. According to Andersen (1992), the number of dogs in the GASH area has declined, if unevenly. For example, Anvik reported a relatively steady decline in the number of dogs while in Grayling, the number of dogs has inconsistently dropped and spiked between 1977 and 1989. As the excerpts below suggest, dog teams, prevalent in interior villages until their decline in the last few decades, were an important part of the subsistence cycle, both in providing labor for subsistence activities and as major consumers of subsistence products.

> "In the winter, they usually catch 'em with nets, but when I was growing up, they didn't have any nets, they have fishtraps. They catch loche, whitefish, sheefish, pike, anything that's on the Yukon. They were backwards traps, only thing was that they were about 8-10 feet long and [4 feet] around…but on the Yukon, you know they have a fence and those guys are fishing. They have a fence, under the ice, and down the end of it, that's where they have their trap…one trap." [G060104, Anvik]

> "There's no doubt, they use it mainly for dogs. Everybody had dogs in them days. The whole town had dogs. They had to feed the dogs something. That is the reason they shut it [the river] down." [P102703, Holy Cross]

> "Yeah. Everything by dogs, to pull something…I remember that…I used to go beaver trapping with my Dad, with dogs. They haul boat. Everything powered by dogs. Winter time." [C120604, Grayling]

The traps themselves were constructed out of willow, a lightweight wood that made it easy to handle such a large trap. Several Holy Cross residents showed the tools they or their fathers and grandfathers used to make these traps. The handle, usually made from antler and polished from years of use, was shaped into a wedge at one end to split straight, dry spruce logs into long thin strips. The blade end, made from the tough metal of a conibear trap, was used to shape the willow trap sticks and lashings.

> "Every old timer had this, only this part was made out of wood, you know. And this is the splitter here. The splitter goes all the way down and you work…Yeah, They make them out of a dry spruce. You get a straight, dry spruce in the summer, drift log, you know? They split them then in pieces so they can work them with the knife…then, they split the willow in half and lay it flat and round it at the top and before that, they strip the bark off the willow and they use that bark to tie the willow onto their (the spruce) surface." [E032404, Holy Cross]



Plate 14. Trap-making tool rests on a map of the Holy Cross area

Traps were generally ten to twelve feet long and up to three or four feet in diameter, tapering down to a small opening at the back, affixed with a hinged door. Fishermen could haul the

trap out of the water, resting it atop poles set across the hole to keep it suspended above the water while they emptied fish out from back onto the ice from a long handled scoop made with wire or rawhide mesh to drain the water. The following excerpts describe parts of this process in the words of the fishermen.

> "…they make it out of willows, they make it so they can handle it. Some use spruce, long time ago, that's all they used, spruce…it's all they used to use. They make it, they split and make fish trap out of it…lots of work, but they get ready before it freeze-up, I know. And they don't use rope either, they use *gałtim*. Willows on the bank, you never see that right now, it used to be just white on the bottom…it's just dry, dry, you couldn't use it. Willow bark, little willow bark, [you take] the inside [layer]. You take the barks off, thrown it away and you roll it up…never buy rope…if you try to break, it'll break if it's dry you know, just got leave it the way you put it. Take the barks off, put it in the water and strip it the way you want it, I did lots of that when I was a kid with grandpa. They soak it and after they soak it, you couldn't break it, no way you could break it! "term" they call it. Willow, that's all they used to use. Now we pitch in and buy rope. I think about these things I did when I was growing up!" [Q060304, Shageluk]

> "Yeah, That size. The back end. There's a little square opening, and uh, and when you open it, they have a scoop that's about 14 inches in diameter…and when you reach in there, you just scoop all the fish out. [The scoop] is separate, you have it with you on the sled. When it's time you open the back of the trap, you know, the hinge door, you open that, and you take the scoop to take the fish out with…they have poles underneath the trap to hold it up…and you on the back end, you open the door and you scoop them out, right onto the ice." [E032404, Holy Cross]

In addition to traps, area residents also harvested fish using hooks set under the ice. "Hooking" or "jigging" for pike is common today, often with large groups of people fishing together on the frozen river. Small circular holes are cut in the ice and residents fish with commercial or hand made lures tied to a line wrapped around a short stick. These sticks can often be "set" over a forked stick or by wedging the short stick handle into the snow so that one person can use several fishing lines at one time or take a break while continuing to fish. These fishing events were critical during the biological component of this project, where ADF&G biologists sampled pike caught in this fashion in Holy Cross. Below are pictures of the sampling efforts and a home-made pike lure fashioned from a tablespoon.



Plate 15. A lure made out of a tablespoon, Holy Cross, March 2004

A final gear type utilizing hooks described by local fishermen (detailed in more detail below in the burbot species summary) is the burbot lines. Fishers described several ways to set a hook or several hooks at once to catch loche, noting that loche are most easily caught at night, when a fisher sets his or her hook in the evening and checks it in the morning. Most sets appear to be variations on the same theme: hooks placed near the bottom, usually around a sandbar, and baited with live blackfish, or small pieces of meat. Their design, however, begins to show the ingenuity with which fishers accommodated the natural environment during prime fishing periods, usually winter.

> "What's the best for pike, sheefish and loche is to get them little blackfish and put a hook, a single barbed hook, and put a leader on there, tie a string on there, and you get a pole like that, and you get 5 or 6 hooks off that pole and make a hole in the ice and stick it down in there. It will be stuck right in the ground and you put snow in there so it wouldn't move around and then each fish are swimming around and these loche will get them. You could use spam too you know! We still do that, you could catch a lot, you know…we just stick the hook right in their fin right here at the top, it's not gonna' hurt them. Even around his tail." [A42104, Grayling]

> "In the spring, first you have to have bait, live blackfish are preferable, works the best. Under the ice, one big hook, you can have two or three on one line. Or you can have a long line, set just like a net, 'cept you have all these lines weighed down to the bottom and sitting there. It works just like a fishnet where you have a long line coming up another hole. Train it back and forth." [G060104, Anvik]
>
> "Anywhere there is sandbars, you can set a loche line…just a hook with a blackfish on it. Right, underneath the ice." [P102703, Holy Cross]

A final under-the-ice burbot set is described by a Holy Cross respondent. In this set, a series of hooks are attached by lines to the length of a long pole. Two strong strings are attached to the pole: one at the pole's mid-point that acts as a suspension and the second attached to one end that allows the fisher to pull up one side of the pole in order to pull it out vertically through a small hole in the ice (see the section on Burbot for an illustration of this set).

Species Summaries

Proceeding from the above discussion of the seasonal round for non-salmon fishing organized through gear type, this section takes a more detailed look at each species individually. Species-specific information from interviews with elders and knowledgeable fishers is introduced by observations intended to highlight the cultural importance of the species, where appropriate. Following this introduction, data are then organized into two broad categories: (1.) life history information which includes observations on seasonal movements, spawning, and other biological factors, and; (2.) the social practices of harvest and use. It is important to keep in mind that these categorical distinctions are made here to provide for certain general categories of information potentially useful for a broader audience of local residents, biologists, social scientists, and policy makers.

Northern Pike (*giliqoy / k'oolqoy*)

Residents of Grayling, Anvik, Shageluk, and Holy Cross repeatedly referred to this stretch of the Yukon and the Innoko River as "pike country." Indeed, this area yields some of the largest and well-conditioned northern pike in Alaska, attracting sport fishermen alongside

long-term subsistence users. As a result, northern pike are a significant component of the annual non-salmon fish harvest for these communities. As noted by Andersen et al (2004) for the Koyukuk River region, much of their importance in the GASH area derives from their year-round availability.

> "Pike are all over the place, you know. Any place you go, that's the first fish you'll catch. Pike. And they bite anything, those things, yeah." [B102703, Holy Cross]

As the above quote suggests, pike are present throughout the year and in multiple locations, making them highly accessible throughout the region. They inhabit the main stems of the Yukon and Innoko, as well as the sloughs and lakes in the area, commonly ranging in size from two or three feet up to four or five feet long. Translated roughly as "lance, something that is speared at something" (Osgood 1970) or "that which is speared at", the Deg Xinag word for pike is *giliqoy* and in Holikachuk, *k'oolqoy*.

In addition to their physical presence, pike figure prominently in the oral history and cultural belief structures of Deg Hit'an and Holikachuk peoples. One fisherman from Grayling, originally of Holikachuk, noted that pike were also associated with medicine men in the Innoko area, "We get them in the Innoko, too. They have a lot to do with the medicine man, shaman, you know. Some lakes, you know, they get pretty big, twenty feet long…"[A42104, Grayling]. A story told by Belle Deacon (1987), originally from Anvik, depicts one aspect of pike's connections to medicine in its origin. As part of the larger environment, pike are central in subsistence activities, both as a source of food and through the important social relationships between humans and animals.[7]

Briefly, "*Nił'oqay Ni'idaxin*" (The Man and Wife), describes the life of a couple living by the mouth of a side stream where the man pursued a variety of seasonal activities and the woman maintained their domestic space, including making fish ice cream. The woman made fish ice cream everyday as her husband complained that he could not feel full without it. One

[7] The full text of the story can be found in "*Ni\'oqay Ni'idaxin – The Man and Wife*" (Deacon, 1987); Beth Leonard provided much of the information contained in this analysis of the pike story, based on her own doctoral research.

day, after feeling sick, the wife did not make any ice cream until she was urged to do so by her husband. Leaving the house to gather snow, she was captured by giants living in a village under the water. Very nearly dying without his wife, the man was visited by Raven, who offers to help him retrieve his wife. In order to do so, Raven and the man carve a huge pike from a large spruce tree, hollowing out the center so that the man could travel in the pike to the bottom of the river to find his wife. Raven transformed the wooden pike into a living being through his breath. The man is instructed to chop a hole in the ice that will accommodate the giant pike and gather objects for his journey to the underwater village, including a clay lamp for light inside the pike's belly. After rescuing his wife, the under-water villages begin to attack the pike with arrows, so the pike swamps the village, killing many village residents. Upon their return, Raven is waiting for them and in the English version of the story, reprimands the pike for killing the villagers. Raven then instructs the fish to "stay in a place where there are lakes, where no one will go," and "For people who step there on the ice of the lake, you will shake your little tail" (Deacon 1987:31), indicating "someone's impending death."

Stories such as these explain the origins and design of the natural world, including human-animal relationships and most importantly, the codes of proper behavior towards the environment (cf. Nelson 1983). They describe a connection to the environment and other living things ruled by elements of belief not necessarily found in western ideologies or management practices, but having the same affect as many management missives. In this story, the wooden pike, transfigured into a living being, is imbued with a powerful spirit capable of great destruction. At the same time, the pike is also a figure of deliverance. Relegated to the lakes, one of their primary summer habitats, pike also inhabits a culturally important space in its connections to medicine in this origin story.

According to one respondent, in its relationships to other non-salmon species, pike also played a role in determining the weather during important subsistence activities:

> "Mom used to talk a lot about the pike though. She said when, you know when it's going to rain? And then if you talk about that pike, you have to send them down-river, she said, towards where the whitefish are….she said to talk in Deg Xinag, to the

> whitefish down the river…the pike was telling the whitefish and she said, we don't want it to rain up here, so we're going to send you something down there, send you lots of our fish, so you put that rain in another direction instead of coming this way….she would talk to the whitefish through the pike, telling it, telling down-river not to send that rain towards where we're fishing because we want to cut fish without being bothered by the rain! And the clouds used to turn and go another way, it never used to rain!" [H060204, Anvik]

In this sense, northern pike are more than food or simple subsistence resources; they figure prominently in Athabascan social life and cultural beliefs, all of which (in addition to external regulation and management) inflect social practices and use patterns.

Life History. As described by key respondents, pike are generally available "all over the place", and the geographic distribution of their harvest by GASH residents matches this description, extending as far north on the Yukon near the Blackburn Island area on Papa Willie Creek and Shovel Creek, toward the east on the Iditarod River, south to an area referred to as "Nesquan" on Paimiut Slough and on the west bank of the Yukon in the mouths of sloughs off Deer Hunting Slough and the Bonasila and Anvik rivers (see Figure 1). According to the harvest survey component of this study, pike are a significant resource for all four communities. Interestingly, residents of Shageluk reported the largest and most focused harvest, while Anvik and Holy Cross reported smaller, but still significant harvests. Residents of Grayling, on the other hand, reported pike harvest in every month but November and December.

Upon looking at the map we were using, one respondent noted that pike were present primarily on the east side of the Yukon in the interconnected system of marshy lakes and sloughs between the Yukon and Innoko rivers and in the sloughs and lakes off the Innoko. Most people said that pike were generally absent from the swifter, clear water streams off the west side of the Yukon. These observations were clearly linked by a familiarity with good pike habitat and confirmed in other observations about pike movements related to food sources (below). The area between the Yukon and Innoko rivers is flat and grassy, characterized by a series of lakes accessible (and sometimes only seasonally so) by the slow-moving water of slough and channels off the main rivers.

The annual cycle of seasonal movements for pike is marked by movement back and forth between the main rivers and the countless sloughs leading to lakes. As the quote below suggests, these seasonal movements are significantly related to water levels. This has been found in other projects as well (cf. Andersen et al. 2004).

> "… the springtime, they go back to the lakes, because that's the only time they can get there from the sloughs, you know. They dry out. In the winter, in the fall like this. Gets too low, they all come out. They stay in the Yukon." [B102703, Holy Cross]

In the springtime, respondents describe how pike "mill around" at the mouths of sloughs in April and May, before moving up the sloughs to lakes, their likely spawning areas.

> "What we used to do was go to the mouth of each slough that we come to and make our hook, tie a string on, and put a little, usually yarn, in the mouth of the slough, and get a pike. They're waiting there, to catch 'em. One or two, they're waiting there, sunning themselves in the water, waiting to go up into the creek, and spawn. And every mouth of each slough that's going up the hills, Reindeer Lake, Clearwater…they're going up to spawn …in the meantime, they're milling all around there." [E032404, Holy Cross]

In addition, pike movements are linked, in the experience of local residents regularly harvesting these species, to the movements of other fish. One respondent from Anvik noted that pike appeared to move on the same schedule as blackfish. Other individuals said that pike "know where the dinner table is" and mirror whitefish movements because they provide an important source of food for pike.

> "Pike probably spawn in the spring, too…they follow [blackfish] right into the lakes…they probably eat them too, but a lot of pike, they spawn in the lakes and sloughs, same time as blackfish." [G060104, Anvik]

> "At the mouth of any slough, that's where usually the whitefish hang out too, you know, whitefish are in jeopardy of getting eaten too. You know where there's whitefish, there's pike around! You know, down by [person's] fishing spot up there. We always catch huge pike in the salmon net. Trying to catch whitefish or something, 'Whoa! Look at that – shark!'" [G060104, Anvik]

The predatory behavior of pike might also affect their movements in sloughs and lakes. According to one respondent, pike move into the sloughs in the spring before the ice goes out and prefer traveling when they can hide in their environment, and later use their habitat as camouflage when "waiting for a meal to swim by." "Pike are too smart to expose theirselves, you know…to predators, to humans, to bears, anything that wants a pike…they wait until they can travel along the lake grass." [G060104, Anvik]

According to local residents, pike spawn in early spring, usually moving under the ice through the sloughs and back into their spawning grounds. Typically women noticed these movements through their harvest and use of pike parts, specifically eggs. Another resident from Anvik connected spawning practices to differences in habitat between the rivers and the lakes.

> "But in the spring time, before the ice goes, right around when the ice is going, that's the time the pike they lay their eggs 'cause they have big fish eggs at that time…they have big fish eggs in springtime, yeah…Pike, too, has…white [eggs]…'cause they always used to collect them and fluff up their eggs and make like a pudding with it." [O072503, Grayling]

> "They won't spawn along the Yukon 'cause the water in the Yukon is too, too stirred—you know, too much sand in it." [I102803, Holy Cross]

Local residents reported that after spending the majority of the summer in the lakes and sloughs, pike move back into the main rivers for over-wintering. One elder from Shageluk reported that he heard from upriver people (Holikachuk) that pike were responsible for decreased muskrat populations in the large lakes around the old village. He noted that the Innoko and adjoining sloughs are thick with pike in the fall; "When you're riding in the boat you can see them jump out of the water…fall time in the Shageluk Slough so many pike there they hit the boat."

During the winter, Yukon River residents noted large congregations of pike in the Yukon; Innoko residents, however, reported that pike were nearly absent from the Innoko in the wintertime, except at the mouths of the sloughs, primarily because of the quality of Innoko River water during the winter months, described as "rotten." Instead, many pike over-winter

in the mouths of sloughs where the water is still deep but has a fresh water source from the slough. According to Shageluk respondents, the Innoko water runs cleaner in the summertime so Shageluk people find more pike (and whitefish) in the Innoko during the summer.

> "…you gotta' hook [pike] mouth of the creeks. Yeah, they come out and they eat, but they go – we got rotten water and they go back up. They don't go in the [Innoko] river in the wintertime. …it's the river…all the rivers that run into the Innoko, I mean, it's good, you know, in the wintertime, fresh water running all winter in the creeks. It come from the spring someplace back there, they stay fresh all winter. But when they hit Innoko, it's just red, our water, it's just red. Rotten, they say. Even in the lakes, sometimes, they get rotten too. That's when the blackfish float up dead…it get old, that water." [Q060304, Shageluk]

> "They come all year round, they stay around all winter, like Callign Creek [approximately 20 miles downriver from Layman's], Layman, 'cause the water [is] fresh water all the time. They come out and they fish in the mouth, they hook in the mouth in the winter time." [Q060304, Shageluk]

> "They're on the Yukon in the winter, and then just before the ice run, they go up the river, they go up the creeks, they go up the sloughs…they all leave the Yukon. Scared! [They return to the Yukon] just when the ice quits. There's fish coming down the Anvik River right now, going out to the Yukon. If we go up in one of these sloughs and put a net, it'll just fill up in a little while [put it in the mouth of the slough]…" [K060204, Anvik]



Plate 16. A young girl from Holy Cross jigs for pike on the Yukon, just outside the village, March 2004

Pike are known to have voracious appetites; they are often said to bite at anything. Many respondents recounted experiences with pike eating habits that were sometimes detrimental to the fish's health.

> "Ducks, young ducks, you outta' see them. All the young ducks when they're running on the water, they get in the slough. One gone, another one gone, another one gone. That's the way they eat, pike….Muskrat, even muskrat, big ones." [O072503, Grayling]

> "I've seen like a whitefish in a big pike, the tail hanging out. I'm not even going to pull 'em up. I just wonder why they bite the hook when they have something in their mouth already!" [N102903, Holy Cross]

> "Sometimes when we used to go up there, we'd find them little ones on the beach, and…they'd try to eat another one as big as theirselves and they'd both perish…on the side of the water.…they hold it right in their mouth, they hold it like that. I guess, that fish couldn't move….You know we used to get some of 'em, their tails just stick out…" [O072503, Grayling]

Many of these observations of pike come from the direct harvest and use of the fish for subsistence purposes. As such, the seasonal movements and the pike behavior described by respondents also affect harvest patterns and uses, described below.

Harvest and Use. As the nickname for the area – "pike country" - implies, northern pike are prized in this stretch of the Yukon and the area including the Innoko. Year-round availability, historic importance as a source of food for dog-teams, and the abundant ways to use pike and pike parts (skin, etc.) combine to make pike a valuable and heavily relied upon resource (cf. Andersen et al 2004).

Though pike are reportedly caught almost anywhere, area fishermen appear to harvest in very specific areas, depending on the community. For example, around Holy Cross, several areas were repeatedly identified as potentially excellent places to hook pike in summer or winter, or to set a net during the spring and fall seasons. These areas, including but not limited to Layman's Lake (also used by Shageluk residents), Albert's Lake, Reindeer Lake and in the main stem of the Yukon River just in front of the village, are heavily utilized and productive

pike spots, exploited at different times of the year with various gear types. Fishermen from the village of Grayling reported significant harvest patterns on the Yukon around Thompson Creek, but also on the Innoko River above Shageluk and in the surrounding lake system because of their historical links to the old village of Holikachuk, above Shageluk. Anvik and Shageluk, on the other hand, reported utilizing sloughs and river mouths much closer to home, although some fishermen also travel greater distances to harvest pike depending on personal experience.



Plate 17. Hamilton Hamilton, Sr. carries two pike home caught in a net set by his wife in a slough near their home, Shageluk

As described earlier, pike were caught historically in a variety of ways, many of which are still in use today. Interview excerpts and observations reveal that the primary means of taking pike currently are with gill set nets, set under the ice during the winter, usually in the spring before break-up, or in slow-moving open water after break-up during the spring, and into the fall.

> "It [pike] goes in anytime, but it go down there before it freeze up. One time I get about 300, maybe 400, somewhere around there, down Layman's. Fishnet! Right in the mouth, cross-ways, down with the current where it come out. Both sides of the river. All

> the way across the slough. And then one in the river, too. The current is coming out from the slough and the river is coming down – just where it hit each other, you know, kinda' angle on the river. And they come in and swim around. You take it out and about not even half hour, you go down there. You gotta' be pretty busy on it because they roll up on it." [Q060304, Shageluk]

Hook and line is another important means of catching pike today. Area residents primarily use this method during the winter months with artificial lures attached to string that is wrapped around a short stick. One individual from Holy Cross even fashioned a lure from a large metal tablespoon, a practice we saw repeated in two other communities (see Plate 12). "Hooking" or "jigging" in this manner is usually done through the ice on the main river since that is a primary over-wintering location for pike. While an individual or two will regularly go out to hook for fresh fish, larger groups also hook in a series of holes together.



Plate 18. A hook set for pike, Holy Cross, March 2004

Osgood (1958) describes these gear types in addition to a few others that were used historically but are not in common use today. He notes that area residents took advantage of the spring movements of pike (referred to as "jackfish") in late April and early May to set a fenced trap across the deep end of a slough, with the mouth of the trap facing upstream. "The fat jackfish coming down from the lakes on the way to the rivers are plentiful in the flooding water" (Osgood 1958:237). The fisherman drives the fish to the removable conical basket in the back of the trap using a long spear tipped with a caribou bone point, killing the fish with the point. Fish are then extracted when the conical basket is removed. Osgood also

describes a modified lance or spear as another, albeit minor, gear type utilized by area residents. The spear has a detachable point that, when driven into a fish, releases from the shaft and is held by a short piece of babiche line (Osgood 1958:239).

The choice of specific fishing spots is important to successful harvests, depending on time of the year and gear type. According to interview excerpts, fishermen tend to focus on eddies or near the mouths of sloughs where pike congregate to eat. These areas are not too deep and offer the slow-moving water important for the successful deployment of a set net.

> "…they tend to group right below the creek, you know. I think they're probably eating little grayling and stuff like that. They winter there too…they're hanging there, right there. They're hanging at that one spot along the bank, probably about a quarter mile long. And there's a bar on the outside, that's why they're hanging in there, see?...we don't look for deep places when we set nets. We try to look for …10 feet of water, at least…" [J120503, Grayling]

> "They come out and they go close to the shore, but we can't set our net in strong current 'cause the net would go up and we can't catch no fish. It has to be in an eddy or in the mouth of the slough, you know." [K060204, Anvik]

Fishermen balance many different kinds of information when assessing fishing activities. Fishermen from Grayling talked about the significance of water level, also discussed above in relation to seasonal movements:

> "…in the fall time, before it freeze up, then we always set fishnet for pike 'cause we could keep 'em over the winter frozen. And they set them in the mouth of those side streams [off the Innoko]…before the ice freezes, before the water freezes in the fall time, they do that. Sometimes they catch lots, you know. If the water is dropping, then the, those old peoples long ago, they used to say, 'If the water is dropping, then the fish that in that slough comes to the mouth.' And if the water is rising, they're way up on the headwaters. And it's really true, too, 'cause when you try to hook for fish when the water's rising, you don't catch anything. So, we never bother with it, they just wait 'til it comes down…Well right now the water's rising again. And when they went up and tried to fish the other day, all they did was catch little ones. Sometimes they catch those really big ones on the Innoko River. You know, they're like 48 and 50 inches long and they're about that much weight too. And they're really fat. Get them by the hundreds in fall." [O072503, Grayling]

One fisherman from Grayling noted the difference between pike caught in lakes and pike caught in the river: "We get 'em year round. They're land locked. Yeah we get them in the river, too, but they're not as good as the lakes, they're fatter, you know, bigger. Probably better quality water." [A42104, Grayling]

As one of the most widely distributed fish species in the middle-lower Yukon region, pike are used in a variety of ways, reflecting their importance in an annual cycle of subsistence activities. Pike were, and are commonly used for both human and dog food. Many respondents who grew up with dog teams described separating large, well-conditioned pike to eat while setting aside the smaller pike for the dog pot (cf. Andersen et al. 2004). Long ago, when families regularly set up a spring trapping camp for trapping, pike, among other species, were harvested to introduce fresh fish to the long winter human diet of dried fish and other meat. Even now, fresh spring pike are a significant contribution to a subsistence diet; residents of each village set several nets during the course of this research to harvest spring pike in the sloughs just before and right after break-up. These fish were distributed among several families within each community, with special parts of each fish, such as the fat-rich belly section, reserved for elders.

Preservation techniques differed with the season. During summer months, when pike are generally caught with hook and lure, the pike may be dried, either in the sun or in a smoke house. According to one respondent, large harvests of pike were cut without scaling and made into "flat fish," with a stick from fin to fin to keep it stretched. Flat fish were generally dried on a rack in the sun. Sun-drying was not always the preferred technique, however, as many respondents noted that pike do not dry well due to their low fat content.

> "In a smoker, it dries pretty well, but if you let it sun-dry, it get hard as a toothpick…back in them days you didn't have much salt to waste, just bring a sprinkle of table salt." [G060104, Anvik]
>
> "Just freeze, um hum. They keep. Wintertime they keep. Summertime you gotta' dry them but… some people cut 'em up. I don't cause they get just bone dry, you know, they have no, not much grease on 'em." [B102703, Holy Cross]

The seasonal movement of large numbers of pike in the fall time, however, combined with the seasonal ability to freeze pike for winter use as a preservation technique noted above, made fall harvests of pike a significant activity in the villages of the lower-middle Yukon. According to residents, each fish may be cut differently, depending on its kind, size, and eventual use. This requires significant knowledge of fish anatomy and pike were no exception. While in the field, two fishermen checked their under-the-ice net and brought home two large pike and two sheefish. Later, in one of the fisherman's sister's kitchen, Brown watched as she cut one of the pike, noting her care in processing the fish – pike can be challenging to cut and fillet neatly because of a Y-shaped bone along the backbone, unlike salmon**.** Additionally, she remarked on the difference between their back scales and the scales along their bellies, which are shaped like bluebells.

> "I know she used to cut the pike and they're sure hard to cut, because they have those scales that they have, you know, a layer of scales. Whitefish, they have scales, but you can take them off. Pike you can't do that 'cause they're hard, but mom, she used to cut it. The head, she used to put it in the ground because they didn't have freezers. They dig a hole and put them all in the ground so that way, they store it. I think they used to make those birch bark baskets and put them in there. They give it to the dogs." [H060204, Anvik]

As described above, pike were frozen whole for later used or semi-processed and stored in below-ground holes that were lined with birch bark for winter keeping.

Pike were thoroughly used as both a human food source in all seasons and for other purposes. When there was a large harvest of pike, a big pike from the group would be selected to be cooked in a soup, generally called "pike soup" or "flour soup." Flour soup was made with a little bit of flour, potatoes, and the liver. Sometimes, the cook might "spill eggs in it." Pike was also cooked over a fire. Residents reported poking a stick through it to roast it, using a willow branch with a sharpened point. In addition to the meat, pike eggs are widely used by area residents. An elder from Grayling remembered one particular recipe:

> "Pike eggs with lowbush cranberries. You mash the [frozen] eggs first. You take the membranes out and then you whip it. In another bowl you smash the berries. You mix it all together and whip it until it looks like whipped cream. Then you add sugar. It

> tastes so good you won't stop eating it. It's got a little wild taste. My Dad used to add a tablespoon of whitefish oil." [L060404, Grayling]

Several respondents from Holy Cross described making "pike caviar." Spring-caught pike are full of eggs in the spring. The eggs are removed from the membrane, mixed with onions, and left to sit overnight, usually in a cool spot like a refrigerator, and then eaten with crackers the next day. Other uses highlight the importance of pike to other subsistence activities, including berry-picking, customary trade and other distribution practices.

> "Pike tastes good with seal oil. When people went to Unalakleet they brought back seal oil. Judy Deacon's grandfather, Gichidl (means 'younger brother') Workman, used to go to Unalakleet in the springtime, around March and April. He would bring back one bag filled with seal oil. The bag was made of sealskin. He shared it with the whole village." [L060404, Grayling]

> "We used to take dried pike and dried whitefish for lunch for berry picking." [L060404, Grayling]

Finally, pike were used for other purposes, including clothing. In the following examples, two different elders remembered using pike skins for boots. As noted earlier, pike skin can be extremely tough, making it a good material for boots. Both noted that only the skins of pike and dog salmon were strong enough for this purpose and with proper care, both provided excellent waterproofing qualities.

> "I skinned a few fish for her [to make boots]…just right down the belly. I just cut the fin right off, I cut right around the fin, you know….then pull it off, tail to head." [A42104, Grayling]

> "My mother made me fish skin boots, with pike, knee-high, for the spring of the year. It was in the 30's. We didn't have hip boots in them days. A funny thing happened. There a good thing to have, they're waterproof and there's a way to sew them, so that they don't leak at all. In the spring of the year there is a lot of water and muskrat. You can't too close to the heat of the fire or else the heat will shrink them. And then in the morning, we would oil them, if you have bacon grease. There is only one thing wrong if you hook up your dogs, then they start licking on your shoes. I had a lot of that. As long as they don't bite into it!" [E032404, Holy Cross]

In general, most residents reported that pike are as abundant as they ever have been, based on seasonal and geographic patterns, with the exception of Holy Cross residents. One elder from Shageluk noted that pike might be responsible for "cleaning out" the muskrat in the large lakes north of Shageluk in the Holikachuk area. Without exception, Holy Cross respondents expressed concern about three things: potentially increased mortality of pike due to a near-by catch and release fishery, pressure on pike during key spawning times, and more generally, the decreasing size of pike. This last concern also seems to have shifted harvest patterns among village residents slightly. However, both observations are critical since pike are such an important source of food.

> "These last few couple of years we haven't been catching right outside Holy Cross and we usually catch big pike…right outside on the Yukon River about 5 or 6 years ago, we used to catch really big ones. Catch lots of pike. These last few years seems like they're smaller [roughly 24 inches], not really big [approximately 4 feet]. That is why we moved down below to catch the big ones." [N102903, Holy Cross]

Whitefish (*łegg / łoogg*)

Although the lower-middle Yukon region is known for the quality and size of its pike, whitefish remain the most heavily harvested and used non-salmon fish species for area residents. According to the harvest survey, whitefish constituted the largest percentage of the total non-salmon fish subsistence harvest for the region. In this sense, whitefish are truly a staple in the annual subsistence harvests. Respondents were asked about five different species of whitefish: broad, humpback, round, and two species of cisco – least and bering. Not surprisingly, various ways of recognizing, categorizing, and using these different species were part of local residents' responses. For example, while all respondents recognized humpback and broad whitefish, fewer individuals interviewed made the same species-specific distinctions between round whitefish, least cisco, and bering cisco. A common way of categorizing these species was through the distinction between "big" whitefish and "little" or "small" whitefish. This organization was also reflected in the language; when speaking in English, most residents did not distinguish between the biologically categorized species of whitefish, rather, words for different whitefish in Deg Xinag and Holikachuk reflected size or

age and where the fish might be found. As a result, this report attempts to distinguish between whitefish species as it was reported by respondents, being clear when species-specific information was provided.

The Deg Xinag word for whitefish is *łegg* (or in Holikachuk, *łoog*), which is also the generic word for "fish" in both dialects. According to Osgood, residents of Anvik distinguished between five species of whitefish, though these species distinctions did not map precisely onto Linnean classifications. Instead, he notes that "What is significant collectively about the whitefish…is that they were grouped together"(Osgood 1959:153). In one case, the literal translation for the word describing a humpback whitefish, *q'ontoggiy*, was provided by Osgood as 'by and by tomorrow." According to Osgood (1959:25), this name was used because humpback whitefish do not eat other fish, unlike other species such as pike. "Living in their kashims, they [pike, for example] see their little ones swim out from underneath the benches, and being rapacious, devour them. The hunchbacks do not do this. They say, 'by-and-by tomorrow, we will find something to eat' ". No terms for either least cisco or bering cisco were collected through the linguistic data, although it is clear that these species were regularly harvested. Instead, many respondents referred simply to *dilmig*, or "small whitefish" (also translated in Holikachuk as round whitefish specifically). Residents also had words for juvenile whitefish: *iłk' oodh* in Holikachuk and *iłch'eddh* in Deg Xinag, harvested off the fences used to shut down the rivers for dipping whitefish, discussed in more detail below.

Life History. According to key respondents, whitefish are distributed throughout the range of the Yukon and Innoko drainages utilized by GASH area residents. Whitefish appear to seasonally occupy the wide variety of habitats present between the Yukon and Innoko drainages, including the main rivers and area lakes (cf. Andersen et al 2004). Presented in more detail below, the observations of local residents are best understood through a seasonal cycle characterized by marked migrations of whitefish beginning in the spring, just prior to and immediately after break-up. A second migration occurs in the fall time and is targeted by residents for harvest after freeze-up.

While the main rivers and lakes are important seasonal habitats for whitefish, the sloughs and channels that connect these bodies of water were repeatedly identified as prime whitefish habitats. Interviews with local fishermen indicated that the mouths of sloughs and creeks have long been used to harvest consistently large quantities of whitefish. As Robinson (2004) points out, knowing when and where people fish provides significant information about fish migration and seasonal locations.

> "…[whitefish] go inside that creek from the Innoko River….Shageluk, they used to, ah, this slough above Old Village. Right side, I told you, used to set fish trap. She [his wife] knows about it. You used to set fish trap in that slough. See, I told you could haul off the whitefish….Old Village…It's called *Łooge git no'* [name of the slough]." [M072503, Grayling]

According to one elder in Shageluk, whitefish travel from the Yukon, up the Innoko, and all the way up the sloughs off the Innoko.

> "Well, every spring they come up the river from down the river…All summer they go up the river…where they always go, yeah. All the way up the Innoko River, *all* the way up. They go up in the sloughs. All the way, sloughs. And then …fall time they come back, they come back down the river…from the sloughs, mostly from the sloughs. All the way up the Innoko River. It run about, over a week. I tell you they go up the river every spring. And then they go in the sloughs, all over the sloughs, like Shageluk Slough. That's *long* slough, they go all the way that slough." [F072403, Shageluk]

As the above quote also indicates, broad and humpback whitefish species are available most of year, with significant seasonal movements in the fall and spring that make them easier to target for harvest. One Shageluk elder noted that frogs, or *xiłghiy*, indicate the coming of whitefish in the springtime. A chorus of croaking frogs is said to be translated as "the fish are coming" or "*łegg ghilux*."[8] According to area residents, the larger whitefish species begin an up-river migration under the ice in the springtime, heading out of the main rivers and into sloughs and lakes. These migrations are usually described as coinciding with the seasonal break-up of river ice in the spring.

[8] Osgood's (1959) notes the belief that "the longer the frogs croak in the spring, the more fish there will be in the runs (pg. 138).

> "Yeah, when I first noticed them using dipnets when I was a little kid, up here at the mouth of village slough up here, about a mile up here [upriver from Anvik], used to be right in the middle of the village, you know. Anyway, in the spring when the Yukon starts running, all the fish are zooming back with the waters that are going back in there [into the sloughs], right ahead of the ice, getting out of the way of the ice…the fish would be going into the side sloughs…usually the sloughs are melted before the Yukon goes. They're [all different non-salmon species] all mixed in there together, but I used to get a lot of those whitefish right off the cutting raft." [G060104, Anvik]

As also noted by Andersen et al (2004) for the Koyukuk River drainage, lower-middle Yukon fishermen report that this pulse of whitefish is typically healthy and fat. The condition of these fish was very important during the lean times of early spring, especially compared to other fish, and is important for a variety of uses, including cooking.

> "They used to get oil off that whitefish because they used to be fat, you know those first ones that come about this time. And they used to skim it off, you know boil it for 10-15 minutes and then skim it off and get that fat and they used to use it for cooking and for berries, when they make ice cream…that's what mom used to do, but not that much pike, 'cause pike isn't that rich you know, whitefish mostly." [H060204, Anvik]

Harvesting observations noted in the interviews with Shageluk elders also suggested an interesting feature of the seasonal migrations – the potential size distribution within whitefish runs. According to one elder, during these seasonal migrations identified as primarily broad and humpback whitefish, fishermen harvest larger fish at the beginning of the run (harvest techniques will be discussed in more detail below) and continue fishing until the size of the whitefish decreases. It was unclear if these smaller fish are a different species of whitefish or are undesirable simply because of their size. One fisher from Shageluk suggested that pulling nets or traps out of the water when the size of the whitefish decreased is one way in which fishers locally manage their harvest of the fish runs; decreasing size of fish is one possible indicator that fishers have reached a harvest limit and should pull their nets, even if needs have not been met. Additional information, local ecological observations or biological analyses, might illuminate the details of this observation.

> "…we dip right now [springtime] lots…they're going up river, against the current. Then when they get small, we quit dipping. Yeah, when they get small. That's small fish, I show you. They come back after freeze-up and that's when we shut the river, shut it all the way across and we catch whitefish 'til they get small…going downriver." [Q060304, Shageluk]

High water events can facilitate these spring movements, while mid-summer low water can prohibit significant movement: "I don't know if they [whitefish] do right now [July]; because it's really low water right now…They want high water around there. I don't know if fish go all the way right now" [F072403, Shageluk]. As explained in several other studies (Robinson n.d., Brown and Fleener 2001), high water causes creeks and slough water levels to rise and as with other non-salmon species; this high water provides whitefish a means of accessing and moving between backwater ponds and lakes, important summer habitats.

In addition to their seasonal presence, broad whitefish in particular were also reported as year-round residents of certain lakes in the Holikachuk area. Some respondents noted that lakes were important whitefish habitat, potentially offering better quality and quantities of food. According to several respondents, lake habitats provide a variety of food for whitefish during the summer months, including snails and green plants. One elder woman described finding little snails and lots of plant matter in the bellies of whitefish, leaving what she described as a "mossy" taste to the fish.

> "They're better quality in the lakes – they're fatter. They have more food to eat. You know, whitefish and pike we get, they're pretty fat coming out of the lakes, you could see fat in their guts. We call them *givid*. You could eat that part of that that's big, you know. All along the outside [of the belly] you know. I mostly get them for their liver, but I take the whole fish, I don't turn nothing away." [A42104, Grayling]

Fall time, right around freeze-up, brings another migration in the opposite direction as whitefish move back down through the sloughs to the main rivers. "Yeah, they're going in the spring…and this time, this month [October], next month sometime they'll be coming out." [B102703, Holy Cross]

Holy Cross and Shageluk residents, who have the best access to Innoko waters, reported that their water gets "rotten" during the winter months, apparently high in iron, a situation that they claimed most fish avoid. As fall progresses into winter and freeze-up occurs, Innoko waters reportedly become higher in iron; this stagnant water drains out in the spring with break-up, allowing the spring movement of whitefish back into the Innoko River and its tributary sloughs. As previously discussed, this condition was also noted by residents for pike movements.

> "Our water's no good, all whitefish, they go back to the Yukon, November, they all go out…they stay out in the Yukon during the winter. Our water's no good, it gets rotten." [Q060304, Shageluk]

> "…And in the spring you can go out there and dip. And, you gotta' try get over there before the ice rot, when the slough drains all that iron water out, then they start going up again …Yeah, they're going in the spring." [B102703, Holy Cross]

While most residents focused on these seasonal movements in their characterization of whitefish distribution and harvest, this information complemented others' experiences with wintertime harvests in the Yukon to present a fairly consistent picture of whitefish seasonal movements. Residents, especially around Holy Cross, reported fishing with hooks in the Yukon over shallow areas like sandbars: "You know, with hooks [at Victors]. We catch them a lot out here, too…right on the sandbar. It's shallow, you know. 'Cause you go out in where it is too deep. They're tough to catch. …I haven't caught them in the sloughs." [N102903, Holy Cross] One fisherman from Grayling believed that after whitefish traveled out of the sloughs in the fall time, they over-wintered in deep spots along the Yukon River, an observation consistent with those reported in Shageluk and Holy Cross.

A third large type of whitefish has long been observed and harvested in the lower-middle Yukon and Innoko regions. Residents from all four communities reported that they had either seen, caught, or heard about the large "lake whitefish" primarily found near the historical village of Holikachuk. The fish are referred to as *taghiy* in Deg Xinag and Holikachuk, which in Holikachuk also appears to be the same word for broad whitefish, although residents distinguished these two fish in English. In both languages, the term

indicates a large, fat fish found in the lakes. According to Osgood, the literal translation from Deg Xinag, "bottom of water" suggested not that the fish can be found at the bottom of lakes, but that it swims with its head down because it "is said to be so fat that it cannot keep on an even keel. On hot days, its tail shows an inch above the surface of the water in the lakes around Shageluk" (1958:26).

Residents from Grayling and Shageluk today still identify a few lakes near Holikachuk, just up-river from Shageluk, where these lake whitefish might be found. Fishermen repeatedly stated that they looked similar to broad whitefish, but were much larger, like sheefish. Several fishermen also pointed out specific features, such as the shape of the mouth, skin coloring, texture of meat, and fat content to distinguish them from other whitefish species also harvested.

> "Big Lake – *Gidiminq'it*… it's whitefish there. Lake whitefish - it's really *white* fish, with just fat, really fat, yeah. Really fat fish.…Yeah. They taste mossy, like lake moss. They're lakey…It's kind of soft." [M072503, Grayling]

> "That's big whitefish, but they're whitefish. Maybe they're this kind [broad whitefish] but they're big. Landlocked... They catch them…by *Noono xichux*. That's where they catch them. They catch them in king salmon nets. That's where they set those and those catch them, BIG whitefish. About this big. They're a big fish, and *small* head. Small head and big body. Boy, they're rich, and fat. They live in the lake, they don't …Well, they're landlocked fish… Only when it's high water then the fish wants to swim over the land, get to the river. Real big, good fish, rich. …rich, and it's really…It's a nice dry flaky flesh. Really nice and fat." [O072503, Grayling]

Lake whitefish were mostly described as land-locked, as their name in Athabascan indicates. However, two fishermen described seasonal movements that followed general patterns described earlier for whitefish, with high water events or other factors allowing for access to the main rivers. One respondent stated that he had caught a few in king salmon nets in the Yukon at the mouth of Lucky Point, just north of Holy Cross. He suggested that while most probably stay back in the lakes, some may travel out to the Yukon.

> "I don't know where they stay in the lakes. But, sometimes when we're, we like go out fish out in the Yukon, near a slough, you catch those lake whitefish…they're not sheefish, they look something like this, like [broad whitefish]…But, they're BIG,

> they're wide, and about that long. About that wide body [roughly 4 or 5 inches]. They're just like king salmon, rich. But there're very, very few…I seen only one so far in my life. The lake whitefish are bigger than that [broad whitefish]. Three feet…they have a different mouth than that. They have something like this [motions an underbite]…But they're really, really fat. I call 'em lake whitefish, and only once in my life…Up in the mouth of Lucky Point… It was coming out. It was in the fall. That's about maybe 40 years ago, and that's the only one I seen so far. You very seldom catch them." [B102703, Holy Cross]

Lake whitefish are harvested primarily in the winter, when access to the swampy, interconnected lake system around Holikachuk is the easiest. Using under-the-ice nets primarily, only a few fishermen reported making the trip out to Holikachuk to catch these fish today. "It's eaten right away. They didn't catch very much of that fish…Lake whitefish is eaten boiled only…It's boiled with fishtrap sticks keeping the belly open…It tastes different from the river fish, it tastes like lake plants." [L060404, Grayling]

Most residents interviewed made a primary distinction between large whitefish that were generally available all year – broad and humpback whitefish – and smaller species of whitefish – the round whitefish, least cisco and bering cisco – species reportedly targeted during late summer runs up the Yukon River following dog salmon, where they are most often caught in fish wheels. Identification between these smaller species was uneven; many individuals, such as some experienced fishermen and elder women who spent years processing these fish, distinguished easily between species, while others spoke about them more generally.

While these species are often considered by-catch to salmon, others target them specifically because of their oil-rich quality and desirable taste. One respondent thought they might be present year-round, but that they were rarely harvested in the under-the-ice nets used to catch the larger non-salmon species.

One fisherman from Anvik noted that this late summer run indicated a fall spawning event specifically for round whitefish. They congregate in the mouths of the creeks and sloughs, likely feeding and, according to this elder, also possibly spawning.

> "Maybe these little guys are jumping the mouth of the creek, these guys…Well, they're feeding in the mouth of the creek [Grayling Creek]. They got to be feeding and spawning, eh? Yeah. We start seeing 'em in August, September; they're steady jumping while they're feeding. This type right here [round white fish] …Catch 'em on the fly once in awhile. They're steady jumpers…August, September. Maybe they are spawning then, spawning and feeding. They could be spawning and feeding when they return to wherever they come from, eh? Yeah, but there's lot of them." [J120503, Grayling]

This fall-time congregation of whitefish at the mouths of sloughs and creeks was also reported by other respondents who identified these areas as significant spawning areas for whitefish more generally. In early fall, whitefish travel out of the lakes into the sloughs which most respondents believed to be spawning areas (cf. Andersen et al 2004). When not land-locked, lake whitefish are said to be full of eggs in August and September when they, too, begin traveling up the river. In the wintertime, however, when most are caught, one elder woman reported that they have no eggs at all. While respondents did not identify many specific spawning areas, several did report that they often target whitefish during this time for their eggs, setting nets and historically, traps, in the mouths of sloughs.

> "Right now [October] people are trying to catch whitefish. They'll cut 'em open and they'll save the fish eggs. And, they make what they call a "caviar." Onions and stuff, boy, it's really good. You spread it on top of your bread...Okay, after you catch the fish, you put onions, you put all kinds of spicy stuff. You don't eat it right away, you have to age it." [I102803, Holy Cross]

> "But the whitefish, right about now they have big fish eggs. They have, uh…some of them have yellow, you know…some are yellow colored…These kind [broad whitefish] I think have big white eggs, and then there's some like this humpback one, have yellow. Pike, too, has…white. No, white! Cause they always used to collect them and fluff up their eggs and make like a pudding with it." [O072503, Grayling]

While the eggs are valued, female whitefish are said to be in poor condition right before spawning. Referring to a fall spawning time, one elder woman from Grayling remarked that the females were better eating earlier in the summer while the males remained fat into the fall, during the spawn.

> "I imagine the whitefish is in the fall time because right now they're… If we catch them early in the summer their eggs are very small. But, right now they're getting

> full of eggs…Well the fish is not very good when they're too full of eggs. They're kind of, on the poor side. But we like the male fish, they're fat."[O072503, Grayling]

Several respondents shared their observations of the general whitefish population trend and the condition of the fish. One fisherman from Anvik expressed concern that whitefish numbers were declining, which he attributed to decreasing food sources related to other fishing activities. When more people used to fish along the Yukon and throw the guts and other parts into the river, whitefish reportedly had more food, suggesting that a decline in salmon and/or salmon harvesting is also connected to a decline in whitefish.

> "Now there's hardly any fishermen out there, and there's hardly any whitefish out here. Because the whitefish, you know, he just eats when we cut the fish up for dogs, all summer, all these whitefish used to be around. Now we don't even have no whitefish out here, they don't have anything to eat out here. A lot less whitefish." [G060104, Anvik]

Another fisherman, however, observed that the whitefish in his area were fatter in the last few years. Interestingly, he attributed this to warmer weather. The relationship between weather and the landscape in the lower-middle Yukon area needs further investigation to determine if there might be different factors at play here than in the Koyukuk region, where warmer weather was more generally linked to increased silt levels and water temperatures that had an overall negative impact on the health and condition of whitefish (Andersen et al 2004:96-7).

> "See the last two, three years the whitefish have been fatter than I ever noticed…Maybe the warm weather…Yeah, probably, cause I noticed that. They're more fatter. Some years, you know, they don't have much fat." [B102703, Holy Cross]

Harvest and Use. As discussed above, residents of the lower-middle Yukon area continue to utilize their knowledge of whitefish movements to efficiently harvest whitefish species all year, with concentrated effort in the spring and fall. These migrations allowed for potentially large harvest with focused efforts; the people of the lower-middle Yukon area developed

different gear types to exploit whitefish in their seasonal habitats. These seasonal harvest practices and gear types are discussed in more detail below.

During the spring migration, as whitefish begin moving up-stream through the sloughs to lakes, residents of the area historically used dip nets as the ice was breaking up. According to an Anvik resident, whitefish are going back into the lakes this time of year (early June), right after the ice "quits." When the ice "starts going," people start fishing for them more heavily. Fishermen focused their efforts on following the whitefish movements, dipping their nets at the mouths of creeks and sloughs near all four communities. Again, fishermen from the Holy Cross and Shageluk areas who commonly access Innoko waters describe the movement of whitefish in relation to the movement of ice and the draining of stagnant "iron water" out of the Innoko that allows for the re-entry of whitefish.

> "I guess, there is many in the sloughs. My thoughts are way back – we used to dip 'em. In the spring of the year there are lots, they go along the Innoko slough. Find a spot, you gotta' look for a spot and use a dip net. You can dip them right out of the water like that… It is kind of murky water…They mill around the mouth of the slough. When the ice move, then the iron water is running out. It's moving that ice, then they go in." [E032404, Holy Cross]

> "Other side of the river. Holikachuk, other side of the river, on that bar side, that's where they, I see them, I remember. That's where they dip, too, from the boat, dipnet…whitefish in the springtime. That's around May. May, June, yeah. First of June, and May…above the island. That's where they catch whitefish." [C120604, Grayling]



Plate 19. Springtime dipnetting for whitefish outside of Holy Cross.
Image used with the permission of the Jesuit Oregon Province Archives, Gonzaga University

As the above excerpt and photograph indicates, dip nets could be used from the shore or while standing in boats. One elder described the process of dragging his boat across "rotten ice" to dip in the open leads. According to Osgood, "During April and May he will catch mostly whitefish of two kinds (ses, k'odok'nei) [sheefish or possibly broad whitefish and humpback whitefish]" (Osgood 1958:236).



Plate 20. Edna Deacon of Grayling with her hand-made dipnet

Whitefish are typically caught in gill nets during the spring and summer months, when nets can be placed in river eddies near the mouths of sloughs where whitefish reportedly rest or in lakes known to produce large quantities of whitefish. Osgood (1958) provides an historical perspective on summer gillnet fishing of whitefish in lakes as primarily a women's activity. He identifies the primary species fished as the lake whitefish described by many respondents that resides almost exclusively in lakes in the vicinity of Shageluk and Holikachuk.

> "To do this, she takes a gill net, which is narrower but longer than a seine net, and colors it with blueberry or black current dye so that it will be less visible to this kind of whitefish which are not easy to catch…this particular type of gillnet fishing is, of course, limited to certain districts such as the region around Shageluk by the proximity of lakes containing the fish" (Osgood 1958:239).



Plate 21. Lucy Hamilton of Shageluk making a net while visiting with a neighbor

Only a few respondents specifically mentioned harvesting the smaller whitefish species, some were dip netted out of the river in the spring, but most respondents suggested that they saw them primarily during late summer following the fall chum run. Because of their small size, round whitefish and other smaller species – least and bering cisco – likely pass through the larger mesh nets used to target salmon and other large non-salmon species, such as pike, sheefish, and broad whitefish. As mentioned above, one fisherman from Grayling thought they might be present year-round in the waters near his village like the broad whitefish, but

that they eluded capture in the under-the-ice set nets. However, several respondents did note a recognized run of small whitefish that showed up in their fishwheels at summer fish camps. These fish were processed in a slightly different way than the larger species; the quote below provides additional information about summertime preservation practices and the differences in these processing techniques. Despite the lack of abundant information provided on smaller whitefish species, several people reported that they were the best tasting whitefish and often the fattest.

> "Some of those fish used to be this small, after that run of dog salmon, and then there's, gee!...just small little whitefish…about after this first run, about this time [June], after that first run of fish, of salmon, then they used to catch those little whitefish about this big [about 6-9 inches], and they used to give it to mom. Gee! Tub-full, you know of all this whitefish and mom, she was so neat in everything they did, I used to have scale it for her…in the fish wheel, they used to give mom fish all the time from the fish wheel and some people used to have nets, they used to give her some from the fishnets…you just take the guts out, mostly the small ones, she wouldn't even score it, she'd just cut it in half and just hang it as long as the guts were out, with the tail and everything. Sometimes even with the head. She'd take the backbone out but she'll leave the head on, especially if they're small, she'll just slice that head right in half. And then hang it on the rack for a while, then bring it to the smokehouse and dry it, and then from there, eat it or put it away, you know. We used to have caches in those days…they used to have poles, used to be high up above the ground, that's where they used to leave all their fish that they cure, you know. Everybody used to have caches downtown, long ago." [H060204, Anvik]

> "This one. [round whitefish] Long ago they called them candle fish. That's so, it was so rich it could… yeah, they could burn… Um, they're not really flat but they're not round either. But they're very rich and they're… We just cut the tail and the head off and we clean 'em and fry 'em….It take long time to cut them, you know, just as long as if you're gonna' cut a big fish. And when those kids get to the smokehouse, fix a fire and stuff, they're all eating up the whitefish. And we used to catch lots in the fish wheel, after the salmon went by." [O072503, Grayling]

According to most respondents, fall time fishing afforded one of the greatest opportunities to harvest whitefish. Fishermen from most of the communities described the historical practice of "shutting down" or "plugging" the Innoko River. Residents of Holy Cross shut down the river near the mouth of the Innoko, across from the village while residents of Shageluk and Holikachuk (now of Grayling) shut the river in shallow spots across from the old village of

Shageluk, located between the airport and the current village. Once the river was closed off or partially closed off, fishermen could either use dip nets or traps to harvest whitefish.

> "You make a cut all the way across the river. And you stick your main posts, you know, your posts on every three feet. And you put your …fence, make like that to go and restrict the whole river…You gonna' have 6 to 10 inch of ice you gonna' have. And it depends and if it's not too strong current, too. If too strong current while you're doing part of it, it might just push the bottom out. But then that one year we was almost three quarters of the way, it just took off." [B102703, Holy Cross]

> "In the fall time we look for the shallowest places so we could uh, shut the river… all the way across…no, we close the river with willow, all the way across. In the shallowest place, where it's not too deep. All the way across with willows. We used to use dip nets a long time ago. We dipped 'em out above the place we shut. Lots!" [F072403, Shageluk]

Blocking off the Innoko River was no small feat; it was cold, hard work, requiring many people and several days to create an effective barrier for migrating fish. According to one elder, shutting down the river took approximately two to three days and was a community event. "Everybody went off the ice had a meeting right there, I said I'll get some chicken wire tomorrow…We did it in two days that time. Everybody came over help out there. Don't take long when you get lots of help." [B102703, Holy Cross]

As indicated in the excerpts above, residents first isolated a shallow area in the river and cut a narrow trench, approximately four to six inches wide across the river. In addition to shallow spots, fishermen looked for areas with little current to keep their fence from being swept away under the ice. Below, one respondent from Holy Cross describes placing large posts every several feet to act as a stabilizer for the fence made of willow brush and sticks, or more recently, chicken wire that was placed on the up-river side of the main posts to block the current and the fall movement of whitefish down-river.

> "You put a post down, yeah, make a fence, block it all the way out. Then you make holes and you dip net, you dip them out…Yeah, you…just like this, you know, you shut the river off. Put your sticks down…Yeah, about a foot wide, enough to put your how deep is your water, your post, main posts 3 or 4 feet apart. Then you put fence in front, front side, it stays like that. And it's all blocked off now, the fence -- either willow or chicken wire. And after that you make holes, about this far apart -

how deep net you got. Further deep you go in the middle, deep. Then you fish maybe 4 or 5 days. First day is nothing much. About third day that's when you start catching lots of whitefish." [B102703, Holy Cross]

Once the fence was built and in place, fishermen could either dip net or set large funnel traps to harvest whitefish. In both cases, respondents described cutting several large rectangular holes in the ice along the up-river side of the fence for dipping or trap placement at the back edge. This the second photograph below (Plate 22), circa 1940, provided by an elder from Grayling and picturing an elder from Shagleuk who participated in this project, illustrates the placement of a trap in one of these holes. Note the poles under the trap; to check the trap, fishermen would lift the trap out of the water and rest it on these poles as they scooped fish out from the back.



Plate 22. Historic photograph of "shutting down the river" and using a dipnet outside of Holy Cross. Image used with permission of the Jesuit Oregon Province Archives, Gonzaga University



Plate 23. A Shageluk family checks a whitefish trap outside of the village, circa 1940s.
Picture courtesy of Hannah Maillelle, Grayling

Timing was an important element of building fences to efficiently exploit whitefish movements. According to most observations, the fall movements of whitefish occur as the ice is forming, so once the ice is thick enough, described as approximately six to ten inches thick, fishermen begin building the fence. Several elders noted that it took about two or three days to start catching whitefish in quantity, though it was unclear if this had to do with building a concentration of whitefish at the fence, or if it indicated a fine-tuned observational knowledge of run timing, or some other reason.

> "Fence. See the river—okay we plug it with poles, and then it will make willow fence, put it down …and tie it together, right down, all the way across …and then you wait, uh, maybe two days….in the fall time, yeah. [whitefish] go inside that creek from the Innoko River….Shageluk, they used to, ah, this slough above Old Village. Right side, I told you, used to set fish trap. She [his wife] knows about it. You used to set fish trap in that slough. See, I told you could haul off the whitefish….Old Village…It's called *Łłooge git no*' [name of the slough]." [M072503, Grayling]

According to one elder woman, these traps not only yielded whitefish inside of the trap, but on the outside as well. What were identified as juvenile or baby whitefish attach to the bark lashings that secure the fish trap to the fence. These baby whitefish were also harvested for food.

> "When they plug up the river for fish, there's a wire fence tied up with *gałtim* [bark] to the fishtrap. *Ilch'edh* were hanging on it. They'd take the fence up, off, and gather them. You scale them a little bit and then fry them." [L060404, Grayling]

Placement of a trap was a significant factor in targeting whitefish. According to an elder from Holy Cross, whitefish traps are most effective when placed on a gravel bottom found most often by "poking" the bottom with a stick to distinguish between gravelly and sandy/muddy bottoms.

> "You can find a place along the river where there's gravel, and make a fish trap. I used to do that…You gotta have gravel bottom…Cause they're clean fish. They don't like any kind of water. They like that gravel water. And if you fish above and there's sand, you'll catch pike mostly, no whitefish." [B102703, Holy Cross]

Residents reported that they do not generally shut the river down anymore; instead, they commonly use gill nets in the fall and throughout the winter into early spring to catch the larger whitefish species. Set in shallow, low-current areas, usually near or in the mouths of sloughs and creeks, gill nets can produce fresh fish during the fall and winter months into the spring. Certain important harvest locations were repeatedly mentioned by residents. One elder described a prime whitefish fishing location, just above the village of Holy Cross above the mouth of Gost Creek, where there is a large eddy known to be populated by whitefish resting during their fall movements.

> "Yeah, they catch em under the ice with net too. Victor's. Yeah, they put nets up there …Under the ice. You gotta have good place. Not much current or eddy place…It's the mouth of the river, the big hill right there. It used to be a fish camp up there….right above [the mouth of Gost Creek], up where you make the bend." [B102703, Holy Cross]

> "There is an eddy in there [at Victors], you know. A big eddy. The fish come and they rest." [N102903, Holy Cross]

As a staple of area residents' subsistence harvest, whitefish can be thoroughly used, including their meat, eggs, and guts. Whitefish oil is also highly valued. To preserve them, whitefish were both frozen and dried, and they were cut differently depending on size according to several respondents. Again, large whitefish were processed differently than the smaller species, if they were to be dried. When drying large whitefish, called *diyh dongiy*, the fish is cut in two lengthwise, then scored, then hung to dry in the sun. It is hung in June and part of July, then stored in a cache for the winter. Whitefish is also sometimes smoked, but not very often.

> "Yeah, she did, she cut those big ones. She cut them different, though, than from the smaller ones. Well, you slice them, you could score them, too or you could cut them different ways…I would probably score it right down the belly, take the guts out, and then I turn it around and take all that meat off that backbone, on the one side, and the other side, then I'll score it. Then after you score it, you just stretch it, you know. You stretch it, then you salt it and then hang it….so there wouldn't be, 'cause there's a lot of bees and stuff going there, if you don't stretch it, you know, they hatch in those little score places. So you just stretch it so they have a harder time to get in there. They like to go places where it's damp. Or sometimes with those medium-size ones, you just cut it in the middle, then you score one side, but you leave the backbone on, and you score the backbone and then both sides….people eat the whole thing, but if it's too dry, then in the fall time then they eat it for their snack." [H060204, Anvik]



Plate 24. Whitefish drying on racks outside of Anvik

Other whitefish parts were also considered favored foods by many of the elders, especially the eggs, guts, and the oil or grease. Whitefish guts, referred to as "pipes," could be fried or boiled. One elder from Grayling reported that historically, fish eggs could be preserved in the ground, often with fish heads, primarily to feed to dogs, though sometimes for human consumption. Eggs could also be dried and stored in the preserved airbladders of king salmon and dog salmon. Whitefish oil was particularly useful: "My Dad used to eat ripe rosehips with some whitefish guts oil" [L060404, Grayling]. Another elder remembered from her mother that the oil rendered from boiling whitefish was used in making what was referred to as "fat ice cream," or *k'iq'ux nathdlod,* in Holikachuk. After "rotting" the fish in the water and eating the gristle, the rest of the head and meat was boiled for a long time, until the grease on top, called *gittheg-gha* or "fish head oil", could be skimmed off and used to make fat ice cream. She also described another kind of ice cream, called "snow ice cream," described below.

> "Grease from whitefish guts is used to make snow ice cream…for snow ice cream you need something that looks like snow. Seeds from the cotton tree to hold it together. You whip it with snow until it's fluffy and white, and you put fish grease [from whitefish guts]. You keep scooping snow in. You put in blackberries or cranberries. Or other berries. Sometimes a little bit of lard. The snow, you take the top layer off, and you use the snow underneath, that's like crystals…If there's something wrong with the person making it [snow ice cream], or with the person coming in while you're making it, it won't work, it will turn into a ball. Something [bad] will happen to that person."

Making ice cream, however, has more significance than simply providing food. One elder suggested that the making of ice cream can also act as an indication of the future: if the person making the ice cream is alone and it begins to fall apart, then something will happen to that person making the ice cream. If the ice cream making is going well but when a person comes in, it starts to disintegrate, then something bad will happen to the person who just came in.

The social aspects of food production were also commented on by Osgood (1958). Here, Osgood describes the ice cream ceremony, or as it was called, "putting down of ice cream." In the springtime, usually April or May, young married women "put down" a large bowl of

fish ice cream and dry fish for the occupants of the kashim. Generally, the young woman will bring in the large bowl, along with dry fish, and place it by her husband, with her head bent in modesty. Her husband then distributes the ice cream in a prescribed order, beginning with the old men in the left corner of the kashim and moving sunwise around the kashim, skipping his wife's close relatives. If there is not enough ice cream, he may also skip over the young unmarried men to prioritize the older men in the kashim. The men do not eat the ice cream themselves, but send it home to their families where it will be eaten later. The ceremony itself highlights the significance of certain fish as subsistence resources in ceremonial activities and their distribution along kinship and other social relations.



Plate 25. A contemporary kashim in Shageluk.

Alaska Blackfish (*xozrigh / oonyeyh*)

Alhough small in size compared to most other fish species in the Yukon and Innoko River regions, the Alaska blackfish is hardly diminutive in reputation. They are often described as "survival fish," as they both fed people of the region in lean times and were survivors themselves (cf. Andersen et al. 2004). Most respondents spoke of blackfish with great respect and in awe of their odd biological ability to come back to life if thawed after freezing. Blackfish could be caught in dipnets or traps, left on the ground to freeze and later, when

food or bait was needed, could be chopped off in a chunk and brought back to life in a dog-pot or pail of water.

> "They survived our people, a hundred and fifty years ago, there's no stores and all the money in the world wouldn't do you no good 'cause you got nothing to buy, you have to live off the land, you know. So the Indians had great respect for all the fish." [A42104, Grayling]

> "But that used to be a lifesaver, too now…those blackfish in the lake, that's a really historic fish. Historic. Lifetime fish, I guess. It's an old, I don't know how you would call it. Those kind of fish can freeze in the water…sometimes they come back to life. That's what I mean. Historic, but there's a name for it. It's a long-living thing, that blackfish." [O072503, Grayling]

As survivors, blackfish also inspired important stories about survival. One elder remembered a story he often told to his grandchildren about the man who went out to check his blackfish trap but forgot the important objects he would need to complete his task and survive his trip. After checking the trap, he realized that he forgot his shovel, so he removed one of his shoulder blades to shovel the blackfish out of the trap. Once he had removed the fish, he saw that he had no way to get them back to the village, so he took some of his ribs to make a sled. But since he had to pull the sled home but he had no rope, he removed his guts to make a rope to pull his sled. Once home, he had no way to cook his blackfish, so he removed his head to use as a pot. After telling the story, the elder stated that in order to survive, you have to remember that no matter how or where you get stuck, there is always a way to get out of it.

According to this elder, stories like this one about checking the blackfish traps in the middle of winter were meant to encourage thought about survival in all aspects of interrelated subsistence activities and to provide information about proper conduct towards the environment. As "historic" and "long-living" fish, blackfish were the ultimate survivors. While blackfish are no longer harvested in large quantities, area residents retain a vivid knowledge of blackfish ecology, harvest techniques and fishing spots.

Life History. According to local residents, blackfish are found primarily in the lakes and swampy areas surrounding most of the GASH villages. Good blackfish habitat was described as swampy, grassy areas and smaller lakes with poorly oxygenated water. While some area residents noted that blackfish could be found in many of the lakes in their areas, others identified specific lakes that consistently yielded large harvests.

Anvik and Holy Cross residents reported fishing for blackfish in the lakes and sloughs near their villages, while many Grayling residents remembered looking for blackfish around the old village of Holikachuk, where a few lakes in particular often yielded significant blackfish harvests. Shageluk residents travel a few narrow sloughs south of the village to a series of lakes for their harvests. This marks an interesting departure from the Koyukuk River region, where blackfish are reportedly located only in certain lakes, usually landlocked (Andersen et al 2004). However, in the lower-middle Yukon area, the sloughs and channels that connect the lakes to the main rivers figured centrally in respondents' descriptions of blackfish distribution and harvest locations.

According to local observations, blackfish move seasonally between these lakes through the sloughs and into the main rivers, like other non-salmon species such as pike. Many respondents linked these movements to high water events during the spring and fall. Generally, blackfish seemed to utilize high water periods of break-up in the spring to travel from the rivers back into the lakes where they spent the summer before returning to the rivers in the fall.

> "Long ago I remember when I was a teenager, LOTS of blackfish in one of the lakes down there. There's a…what you call it, opening to the lake from the river. Yeah, narrow slough. About, I don't know - a couple, three miles maybe. Long lake back there. In the springtime they, when it's high water, they go back there. Back in the slough, when it's high water. After breakup, when it's high water." [F072403, Shageluk]

However, many respondents reported that while some blackfish move with the water levels, many also stay in the lakes to over-winter, where they are available to fishermen who set

traps below the lake ice (see below). According to one elder from Anvik, blackfish harvests began in the spring when his family set out for their spring trapping camp.

> "They go back in the woods, into the lake, and wait for the salmon to start running in June, in the meantime, you have to have something to eat!" [G060104, Anvik]

> "Oh yeah, back here in the lakes, maybe about, well the first lake is maybe about a mile back, you know and then there's lakes all the way back, about four miles…first they usually catch blackfish that are coming back to the sloughs, the lakes, from the river…" [G060104, Anvik]

According to Osgood, blackfish were a primary source of fresh fish in the winter during the time of his fieldwork in the 1930s, although the most successful time to catch them was in May, after break-up, when traps could be placed in a channel connected to a lake. These channels, often not bigger than the trap itself, might "be almost completely filled by blackfish during a single night" (Osgood 1958:242).

Right before freeze-up in the fall time marks another major movement of blackfish leaving the lakes through sloughs leading to the main rivers. Heavy rains sometimes facilitate this movement between the lakes and the rivers during the fall months. This movement was also connected to the movement of other fish, specifically pike and whitefish. These movements are significant for assessing good harvest times and locations.

> "Sometimes during the fall [before it freezes] if you have a heavy rain and the lakes are overflowing, I see them on the Yukon where the lakes spill right into the Yukon. They're hundreds of seagulls there fishing!" [G060104, Anvik]

> "…they come out [of the lakes] during the fall. So does most of the pike, the pike is right behind 'em. They [blackfish] go into the river [Yukon] during the fall, yeah. They go back into the lakes…in the spring, they go there and spawn and they come back out in the fall…catch 'em either time, spring or fall, or even during the winters if you find that place where you have drainage from one lake to another, you place your fish trap there." [G060104, Anvik]

> "…in the fall time right after freeze-up they put fish trap right in that slough. Facing backwards. They're coming out. LOTS of blackfish I used to see long ago. Big piles, what they catch." [F072403, Shageluk]

The distribution of blackfish that remain resident in area lakes during the winter is also important information for local fishermen and is usually indicated by a peculiar winter behavior of opening holes in the ice for "breathing." Blackfish reportedly swim in groups under the ice in a circular or up and down pattern to create these holes (cf. Andersen et al 2004). Other respondents observed that blackfish also utilize existing muskrat or beaver holes in the ice for their "breathing" behavior. Many fishermen noted that they took their cues from other animals on the lakes:

> "Well, there used to be lots around here long ago. Yeah. The way they find it in the lakes long ago, lots of crows or foxes fool around in the lakes where there's open holes. And they [people] look in the open holes in there and see lots of that kind. And they set fish traps…in the lakes." [F072403, Shageluk]

Many residents reported that blackfish found in the lakes during the early spring displayed what was most commonly described as a bag or a bump in their mid-section. This bag gave the fish a bloated or puffed-up appearance and, according to most respondents, appeared generally in the early spring months. The presence of this "puffed-up" characteristic was linked both to the breathing noted above and possibly to a post-spawning condition. While blackfish remain a popular food among elders today, they are less desirable after spawning. Bloated blackfish were described as being "full of water"; as a result, many respondents did not "go after them in the summer."

> "They have big, kinda' like frogs, they have big, kind of like bag underneath their front of their head around there someplace. Yeah, they have to have air all the time." [J120503, Grayling]

> "They do like that after they have their eggs [puff up], yeah and they're not very good. After they spawn then their stomach will be filled up with water 'cause there'll be big bump around here [points to mid-section]. They didn't like them too much after they spawned…sometime in March…and they're not very good." [A42104, Grayling]

Harvest and Use. Blackfish are harvested beginning in the fall right before freeze-up through the winter until just after break-up, although most respondents focused their harvests during the winter months when blackfish can be dipped easily from holes in frozen lakes. Residents remain acutely familiar with where and how to find blackfish during these winter

months. Additionally, since most good blackfish spots were identified as swampy, marshy areas, travel to these places is greatly facilitated by ice and snow. According to one Holy Cross resident, blackfish are harvested primarily in the early winter in particular places because the ice is "running" in other spots, making the lakes inaccessible.

The primary means described by local residents for harvesting blackfish today are dipping and blackfish traps. Dipping, or dipnetting blackfish, usually entails a small dip that can be held in one hand and dipped through an existing hole in a lake. Fishermen described watching other wildlife, such as foxes, to lead them to holes (see above) where blackfish came to "breathe." Since a hole in the lake can indicate dangerously thin ice, most respondents were careful to point out that one had to approach these holes with care. In some cases, chipping the hole to a slightly larger size helped to stabilize the ice by removing the thin ice on the edges and facilitated the use of a small dipnet. Dipnets could be made out of just about anything that would hold blackfish and fit in a hole. Some respondents described using small nets tied to a short stick handle, a berry strainer, and even a small, handled kitchen sieve.

> "When you go into these lakes, you'll see big holes and they're coming up for the air. You got stuff you know you strain food with, like a berry strainer, it's got a wire mesh, little handle on there. We just stand right by the hole and dip them out…we catch them during the winters, we don't follow them during the summers..." [A42104, Grayling]

> "I usually tie a little stick on my little net, use it like a little eel net – catch lots with them and scoop them right out…might be seventy or eighty, depending on how big scoop you got. You could just freeze 'em in big logs and chop a chunk off and throw it in the water and they come back to life! You could freeze them all winter out of doors and throw 'em back in water and when they thaw out and come back to life." [A42104, Grayling]

One fisherman described making the hole himself and stirring up the water to find blackfish.

> "…I used to watch my grandpa. Take a five-foot piece of willow, and take it like this, make a hole in the lake, stir the bottom up like this and wait a little while. These things will come up, they'll just go like this, they'll just keep coming like this 'til you take a net…yeah, and you just scoop 'em." [I102803, Holy Cross]

The same elder also described using blackfish traps, another primary means of harvesting blackfish, especially in larger numbers. Blackfish traps are relatively simple traps compared to the other larger, in-river funnel traps used to harvest whitefish and other larger non-salmon species. Importantly, blackfish traps were designed and set to take advantage of the both the seasonal movements of blackfish and their peculiar winter schooling behavior described above (see also Andersen et al 2004).

> "And my dad used to take a fish trap…what you'll do it is take a blackfish trap like this. They'll put it up like this, like here's the hole. They'll cut a hole like this and they'll put it like this (vertically), and they'll do that about a couple inches like this [indicates 6-7 inches] from the ice…or they can lay it down like this [horizontally] in the lake, you know like this, and he's got fencing. You make a little fencing like this. And sometimes, not very often, but mink will go inside the trap and eat ALL the blackfish! Yeah, boy you should see that mink. Man, he have big stomach in there!" [I102803, Holy Cross]

> "The trick is to find out where they're coming in and leaving, that's where you'll put your trap and catch 'em." [G060104, Anvik]



Plate 26. Evan Newman with his father's (Maurice Newman) blackfish trap

According to Osgood, "The most important type of fish trap used in winter is set in small lakes for blackfish" (Osgood 1958:241). During the time of Osgood's fieldwork in the early 1950s, blackfish traps could be set in one of two ways. The first type of trap was set under the water at the end of a fence, extending out from and perpendicular to the shore of a lake.[9] The mouth of the trap was placed facing the shore (Osgood 1958, 1970). A second method of placement was to insert the trap vertically into a "pothole where blackfish come up to breathe" (Osgood 1958:242). This vertical trap was set approximately six inches below the surface of the water with the mouth pointing straight up, attached to a willow stick that was pushed into the mud at the bottom of the lake (Osgood 1970). Both traps could be set as single traps or with multiple sets to increase the harvest. Osgood notes that the fence trap is often less productive than the vertical traps since a good location for the fence traps is usually less obvious than the existing breathing holes already being used by blackfish where vertical traps are placed.

Blackfish traps are the smallest traps made, due to the small size of the blackfish. Most respondents described the traps as being approximately four to five feet in length, constructed of split spruce sticks about a quarter-inch wide. Importantly, they are not wide in girth so as to discourage other predators, such as muskrat, from entering the trap in pursuit of the blackfish. According to Osgood, blackfish traps can be characterized by the end of the trap, where the sticks are tied together in a bundle that can be loosened to remove the fish (Osgood 1970:232).

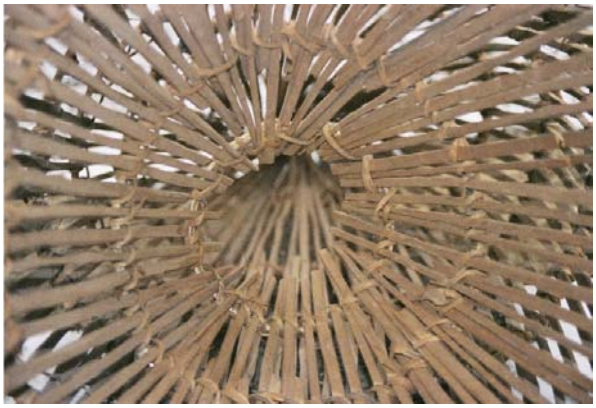


Plate 27. Detail of a blackfish trap opening

[9] See Osgood 1970:234-5 for a description of the construction of a blackfish trap fence.

While most respondents only referred to blackfish in general, Osgood (1959, 1970) notes that blackfish traps varied in size, depending on the size of the blackfish targeted. Baby blackfish, or *gina' yozr* ("its young" in Deg Xinag), are caught in the smaller variety of trap, placed under the ice in lakes only.

Blackfish were caught long ago for both human food and dog food. They could be preserved by freezing, or eaten fresh, usually boiled. One elder even described the process of drying blackfish and storing them tied in a bundle resembling a necklace for food during lean times.

> "We eat meat, just boil them up. I used to eat them years ago. Five minutes and they're done - throw them in the water, live, you know, in the boiling water…Slip them right there – salt and pepper!" [P102703, Holy Cross]

> "When there was no dog food, they used to go look for it…I used to love blackfish…You catch them, then freeze them in blocks to bring them back…They're really tasty. Sometimes there's eggs…You can dry them [the fish]. You peel a diamond willow, burn the end, poke it through the head. And tie them together, in a big round thing…When there was hard times, people chewed them, dried." [L060404, Grayling]

Blackfish appear to have lost some of their importance as a source of fresh fish in the spring, except possibly among elders who fondly remember fishing for and eating blackfish. Additionally, blackfish were an important source of dog food when more community members maintained dog teams. Today, blackfish are relied upon less as a food source, though residents still know a great deal about them from direct observation and experience and know where to get them. However, even as they decrease in importance as a food source, most respondents reported that blackfish are an important bait fish for pike and burbot especially. Blackfish make good bait because they stay alive if hooked properly and will swim around attracting other fish. This shift in use might also be related to a shift in harvest timing as well. According to one Holy Cross resident, blackfish are harvested primarily in the early winter when lakes are accessible. He does not fish at other times of the year because blackfish are used less for human or dog food these days, and more as bait for burbot fishing at this time of the year.

> "If you have blackfish. That's a sure way to catch a loche… Well you just put the fishhook down in the hole that you made… You have to use some sort of wire or something 'cause if they, you use a line, you know, they'll go around and pretty soon they'll cut the line in half with the ice…. Make sense? It's like rubbing a piece of twine on a broken glass. Eventually you cut it." [O072503, Grayling]

Nearly every resident interviewed remarked that blackfish numbers are declining in the area. It is unclear exactly why this is so; one respondent mentioned that blackfish declines result from lack of use, while others repeatedly pointed to changes in the landscape, such as dried up sloughs, that affect blackfish habitat and movements. Comments surrounding this observation suggest that some newly land-locked lakes cannot support existing blackfish populations while others suggest that dried up sloughs also block passage of blackfish in to the lakes.

> "…all the sloughs are dried up. That's why there's no more blackfish…Long ago I used to trap beaver, in March - February and March. In March when I'm ready to put my beaver traps out, maybe two more days, maybe end of March sometime. I look, I go to my beaver again. In that lake way up there….And it got no slough. There's no slough going into it, that I know. And I open that beaver hole right there, boy - nothing but dead blackfish." [F072403, Shageluk]

> "Blackfish. No more of that. Disappear! When I was a kid, there was lots…had fish trap, too, in the pond. No more now 'cause the sloughs are all dry. I go back in the slough, not even one blackfish trying to go up to the lake. They go up the lake in springtime, right now, already they go. They come out in the fall time, see…little tiny ones…" [Q060304, Shageluk]

Arctic Lamprey (*łeggided / łoogg dood*)

Very little is reported in the scientific literature about the ecology of arctic lamprey, or "eels" as they are commonly referred to in the GASH area. Much of the research documenting harvest and use of lamprey in Alaska comes from the Kuskokwim River drainage (Zagoskin 1967, Wolfe 1979, Wolfe 1981, Charnley 1984, Kari 1985, Stokes 1985), or the lower Yukon (Pete 1985), but there has been little documentation of lamprey harvest and use in the lower-middle Yukon villages. However, residents of Holy Cross, Anvik, Grayling and Shageluk maintain a rich body of knowledge about certain aspects of eels, or *łeggided* in Deg Xinag

(translated literally as ‘long, skinny fish’), based on their direct observation and use of lamprey since before contact, discussed below.



Plate 28. Caroline Brown and Dave Andersen (Research North) distinguish Arctic lamprey from Pacific lamprey in the scientific literature! Photo by Shirley Clark

Eels are not available all year-round, unlike many other non-salmon species. Instead, residents must be constantly vigilant or they risk missing the run altogether. As a result, local fishermen adhere to a collection of beliefs and practices that enable them to exploit the run. During interviews, local residents repeatedly commented about the highly sentient nature of eels which set eels apart from other fish species. This is not to say that local residents did not also recognize an interactive relationship between themselves and other fish species, only that eels were especially sensitive. Further, this sensitivity shapes their continuing relationship to eels, specifically in terms of harvest techniques. Many comments from local residents indicated that the eels were “smart” and “superstitious”; they were aware of the activities of the fishermen and acted accordingly.

> “Well like I said that thing it knows everything when it's coming. It's under water but they got feelings, those fish. Yeah. When something's wrong, when somebody like... somebody lost his family in...during the year, or six months, those things, if they [people] get on the ice, they'll (eels) feel that guy, and they'll split. There wouldn't be much. But when there's nothing around, that thing is right against the ice.” [C120604, Grayling]

> "I heard something about it. Yeah. They have a spirit these fish. *Łoogg dood* is 'eels'…*miyeg*, its 'shadow'(Holikachuk work for eel spirit)…When they (the eels) know something's wrong, you know, they'll go down the mud, they said…nothing would touch it. Yeah. Or they move other side." [C120604, Grayling]

As a result, fishermen in all four villages were careful to observe long-term practices that would not offend or scare the eels and drive them away. Interview comments also indicated two characteristics of eels useful in determining their location – an emitted light and the weather. Several people reported that eels themselves were seen to emit a blue light underwater, visible through smooth, clear ice at a distance, during their winter movement up the Yukon River. Fishermen commented that in some cases, this is how they knew the eels were coming before seeing them pass under the holes in the ice. In his ethnographic account of fishing in Anvik, Osgood also noted this observation, "it is said that lamprey emit a kind of light as they swim. They appear in the Yukon River for a limited time in the fall, moving en masse upstream at a speed of about four miles in twenty-four hours. They arrive in such quantities that their advent seems to cause the water to rise in the river" (Osgood 1959:24).

> "Those eels, they're electric eels. One time, when we used stay in Holikachuk long time ago, the Holikachuk men used to go to, come out to the Yukon, to go to Fox Point…And from that place where they were waiting for the eels, they could see way down the Yukon. And it was hardly no snow yet then. And they see a *blue light* down there, on top the ice, a flashing blue light. And they knew the eels were coming…on top the ice, they see that light…you know, flashing. And they knew where the eels were… The eels were coming, they knew it. So they waited for it right there and they got lots of eels that time." [D120603, Grayling]

Eel movements are also connected to the weather, but in a different way than described for pike and whitefish. As eels move up-river and pass certain prescribed spots, the weather changes. For many elders, this is another indication of eel location. According to several elders from different villages, when the eels arrive in Holy Cross, the weather gets warm until they reach the Bonasila area, where the weather turns cold again. By the time eels migrate up to Anvik, residents expect it to warm up a bit with wet snow or rain. These observations might also reflect a movement by eels in response to changes in the weather conditions.

> "…like it brings weathers too. Yeah. Did you ever hear that?...Warm weather, and bad weather, snowing. Rain…you know when it gets around Anvik, it's rain." [C120604, Grayling]
>
> "And then when it [the eels] takes Anvik, usually it gets a little bit warm. Snow. And then it pass Anvik, and then it hits this hill down here, Rita's Hill, that little hill…. It warms up when it hits that hill down there [also referred to as Eli's Nose]." [D120603, Grayling]

Life History. According to Morrow (1980), Arctic lamprey range from the Kenai Peninsula north to the arctic coast and inland up the Yukon, Kuskokwim, and even the Tanana River drainages. Interestingly, while few other communities above Grayling on the Yukon River actually target the lamprey fishery, Morrow notes that they are present into the Yukon Territory and a small population is known to spawn in the Chatanika River. According to fishermen in the GASH area, eels run thick in most years up to Fox Point, across from the mouth of the Yukon Slough where many fishermen from Shageluk set up eel camps on the Yukon in November (see Maps 2-5). While a few eels reportedly have been caught in fishwheels upriver in Kaltag, Nulato and as far up as Tanana, respondents suggested that the run likely thins out or scatters such that focused eel fishing is no longer efficient. Eels usually are not found in the Innoko River, but this summer (2004), Grayling residents at a culture camp removed several eels from the stomachs of sheefish caught around Holikachuk. Given their condition, one resident believed the eels had to have been eaten in the Innoko as they would have been more decomposed in the time required for the sheefish to eat them in the Yukon and then migrate to the Innoko.

Typically, large migrations of lamprey occur in the lower Yukon area usually between late October and early December, generally around Thanksgiving. These migrations are targeted by local fishermen in all four villages. According to several respondents, there are at least two runs of eels on the Yukon River, possibly three. One elder suggested that the first run arrives around Thanksgiving and consists of smaller eels, while the second run arrives shortly thereafter. This second run consists of larger eels: "….I know the Yukon eels are big, the last run, it's BIG! Always the last run, but the first run, that's not so big…I think it's only two runs." [D120603, Grayling]. This respondent wondered if the 2003 run targeted by village

fishermen was the second run since the eels came after Thanksgiving in early December. According to another respondent, there is a third, earlier run, usually in late October, around Halloween, or early November.

> "Eel - you get three runs. First run you get some big eels. Nobody catch that long time…it's about, around Halloween out there. Between 28th to about the 5th, somewhere around there. They missed 'em now long time. They don't stay out there, that's why they miss 'em." [B102703, Holy Cross]

This fisherman suggested that this first run of eels is usually missed, in part because people are not out watching for them. The ability of fishermen to get out on the river to watch for eels can be affected by weather, specifically the onset of cold weather. The elder who described the two runs earlier said that, in some years, residents might miss the eels if the ice is not thick enough to support fishing activity.

As they migrate up the river, eels swim approximately a half-mile an hour, averaging about twelve to fifteen miles a day, according to several respondents. As mentioned above, understanding this timing is critical to a successful harvest, discussed in more detail below.

Much of the information presented here about eels comes directly from residents' experience fishing for and using eels. As a result, less information is provided about their range or distribution. Local residents indicated that lamprey likely spawn in the late winter or early spring. According to Mecklenberg et al. (2002:62), Arctic lamprey build a circular redd with their mouths in the gravel and juvenile lamprey burrow in muddy areas. Residents see eels again at their summer fish camps when juvenile eels emerge from the mud along the Yukon River, usually at the mouths of sloughs and tributaries. Children playing in the mud on the banks of the Yukon at summer fish camps often unearth juvenile eels approximately six inches long and store them in old coffee cans. One elder remembered raking small, red colored eels up through the mud along the main stem, near the mouths of sloughs. She thought that they ate the guts and other discarded fish parts thrown into the river during salmon processing at fish camp.

> "You know, in the summertime, after fishing, long ago when our kids were small….they (the kids) all stayed in fish camp with us. And they used to play in the water…pretty soon they bring can with little tiny eels in them. They come out along the shore. When the water's dropping, you could see them coming out of the mud – little eels…yeah, along the Yukon, after dog salmon, July, all summer…they must be laying their eggs in the mud." [D120603, Grayling]

Harvest and Use.[10] Unlike other non-salmon fish harvests, the harvest of lamprey is generally a group activity, likely because of the concentrated nature of the run. As mentioned earlier, harvesting eels is never a guarantee for several reasons. First, the runs are not necessarily consistent year to year. Many fishermen commented that it is always a gamble and that while many years produce good returns of eels, a run can last anywhere from fifteen minutes to several days. Second, even in years of good returns, fishermen can easily miss the run, either because of ice conditions or simply by not watching for them closely enough. One elder from Grayling was careful to point out that harvesting eels required thorough preparation and patient observation.

> "*If* they catch 'em. It's something that you cannot just catch, that one. You have to wait and sometimes you don't get any…you gotta' be there…It get real hard too…Well you see them. They got net, a hole in the ice. You see them coming. And you can't make a hole in the ice because it drives 'em down even more." [O072503, Grayling]

To increase their chances of intercepting the eels, fishermen from the area continue their historic practice of camping out and watching. Several elders remembered their experiences as young men when large groups of fishermen would camp together with one or two individuals assigned to watch for the eels. These camps sometimes required significant travel. In Anvik, for example, one elder remembered traveling down-river roughly twenty miles to a preferred harvest location. After camp was set up, fishermen cut holes in the ice that allowed them to see when the eels were passing and where they would eventually dip for them.

[10] Because of local beliefs about and prohibitions on the participation of women in the actual eel harvest, Caroline Brown was not present on the ice when the eels were running. Instead, David Andersen of Research North accompanied her to Grayling to observe the harvest and take pictures. This section relies heavily on Andersen's notes and pictures describing the fishery.

> "I know we used to camp down there long time. We had to catch 'em long time ago for our dogs, so we just wait down there until we get 'em…everybody used to camp in the woods right there, waiting for the eels, maybe a couple of days – 'til we get 'em! That's why we're waiting, 'cause we don't know…in those days, they say in Holy Cross, it's about 4 days to get here [island below Anvik, near Bonasila River]…there's no current around here [Anvik], there's predominantly dead water. Now down here's lots of current [by the tip of the island]…'cause they bunch together. Where there's no current, they spread out." [R060304, Anvik]

During the 2003 harvest in Grayling, several fishermen set up camps eight to twelve miles below the main fishing spot by the community; it is unclear if that is a regular practice or one encouraged by the presence that year of the first commercial fishery for eels.[11] In his ethnographic account of eel fishing, Osgood suggests that camps were regularly set up at least some distance down-river as an additional observation point to alert the community of the run. "Then one has to wait for the lampreys, the coming of which is signaled by fishermen at holes lower down the river, who, as the run begins, turn upstream and cry 'wi' as forewarning" (Osgood 1958:40).

As mentioned earlier, understanding and tracking the timing of the run is critical to a successful harvest. Historically, for days before the eels were expected to arrive, men gathered in the village kashim to make new eel sticks and repair old ones (Osgood 1958). Once the first eels first appear in nets or in the stomachs of other fish down-river, in Mountain Village and St. Mary's for example, there is an active dialogue between fishermen up and down the river regarding timing between villages. Reports travel over the telephone between villages and households, over the CB radio, and byword of mouth. In the middle of one interview in Grayling, a CB radio message at 1:30 pm on December 5th announced that eels had "hit" near Anvik, approximately 18 miles below Grayling. Many fishermen who had been harvesting eels year after year could fairly accurately predict when the eels might "hit."

[11] 2003 marked the first year for an experimental commercial harvest of Arctic lamprey, managed by the ADF&G, Division of Commercial Fisheries. The harvest for the fishery was approximately 44,000 lbs of lamprey with buying stations set up in St. Mary's and in Grayling. As part of the fishery, ADF&G biologists were present to collect preliminary harvest and biological data for lamprey.

> "At Holy Cross…that's where they tell they [eels] go by. See, they set hooks down there all the time, with blackfish? They catch good sized pikes, good sized loche…and they cut 'em open and look in their stomach all the time…when they go by…most of the time, they got eels in them…see they have good location down there…" [J120503, Grayling]

> "We keep track with them. When they hit Russian Mission, you can take ten days at least: five to Holy Cross and five to here. That's what we figured out. And it works pretty good once in awhile. Once in awhile it doesn't work...like I tell you guys, it's not a sure thing. It's a gamble most of the time. You have to watch them all the time." [J120503, Grayling]

During the 2003 harvest in Grayling, fishermen began dipping for eels at a location known as Charlie Wolf's camp, approximately twelve miles below the village, around midday, December 6th. By that night, a second harvest location began to develop eight miles downstream from Grayling. Fishermen used flashlights to monitor the holes and by 2:00 a.m. Sunday morning, dippers were catching ten to thirty eels per dip at that location. A final spot, located about four miles down-river from the village and that had been prepared earlier, became the focus of fishing activity by early Sunday morning. One would expect that the presence of a first-time commercial fishery for this species might affect the subsistence practices of dipping eels; even so, this habit of moving upstream from spot to spot was described by many respondents. Moving around allowed dippers to fully exploit a run, especially if they missed the run further down-river or did not have a very productive hole in a down-river spot. Even with much attention paid to the timing of the run, the eels can still evade the guesses of even the most experienced fishermen.

> "…he figured they'd be there in a couple hours. Nothing! There about 3 - 4 hours, so he walked down. There's clear ice, no snow. He looked down, he could see eel. They're all stuck on the ice, hanging. He walked out halfway across the Yukon, they were, down like that, hanging on the ice…They rested for about 3 - 4 hours like that. Resting, yeah…They bite on that ice and they just hang. Well, some place they have a tough place coming up under the rough ice, they gotta' go up and down you know. And glare ice will go straight, they go fast on it. Over there, they stayed about 4 - 5 hours like that." [B102703, Holy Cross]

Harvesting of eels is an occupation engaged in exclusively by men. In their harvest practices, fishermen adhere to historical taboos, most obviously the exclusion of pre-

menopausal women and any individuals who have lost family members within the previous year.

> "They're not like regular fish, you know. They're smarter. I mean, because see like, if you lose a person during the year, you can't go under that ice, you'll scare them too much. The whole thing. Lose a person, of your family. Your family can't go on that ice. That's how come we always lose them in here, 'cause some person go on the ice. All you gotta' do is stand on the ice." [B102703, Holy Cross]

> "It wasn't that good [referring to 2002]. They catch few, people that not supposed to be on the ice were out there…We tried to tell 'em but they wouldn't listen. They gotta' learn the hard way. And there we missed 'em all the way. Even Anvik missed 'em. They caught 'em up in Grayling… [B102703, Holy Cross]

In 2003, Grayling residents cut eels holes in the ice below the village, on the edge of the river, where there is a steep slope. According to residents, the water runs swifter in that place, a necessary element of a successful eel fishing place. Eel fishermen in Grayling look for glare ice as an indicator of a potentially good fishing spot. Glare ice can indicate places where the river runs swiftly; the eels tend to congregate in swift spots. Additionally, where the water moves more slowly, thicker ice forms, necessitating more work to cut holes. Where water moves fast, there tends to be thinner ice. One respondent reported cutting eels holes that were approximately 14 inches thick in 2003 in swift spots.

> "Best place is where the current is. They go slower, you know… They travel on one side of the river all the time… if they go on this side they stay on this side, they don't cross…they wouldn't cross the river. If they're in one side they stay there all the way up." [B102703, Holy Cross]

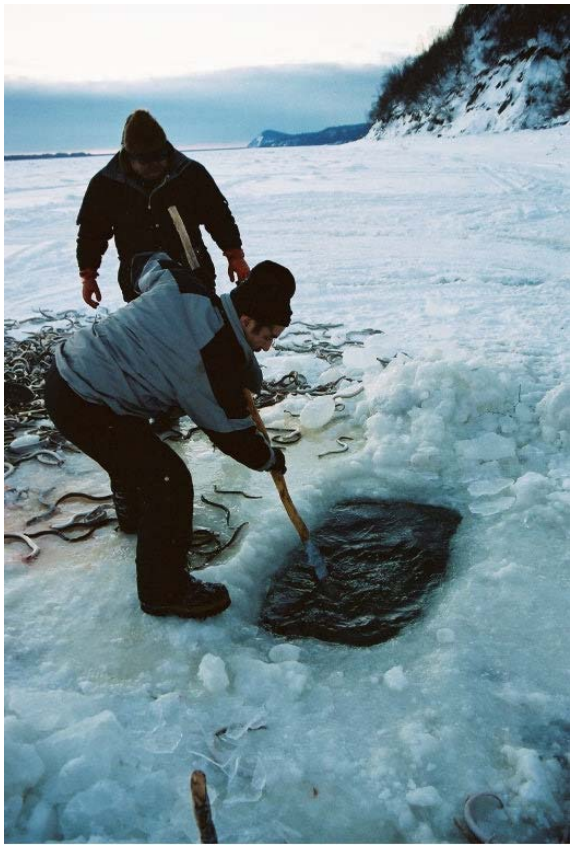


Plate 29. Grayling fishermen dipping for "eels." Photo by Dave Andersen, Research North

In earlier days, there were at least two primary ways to catch eels – with sticks and with dipnets. Eel sticks are said to resemble hockey sticks while others had several nails protruding from the wood (these were also sometimes referred to as "rakes"). While none were observed in use during the 2003 harvest in Grayling,[12] Osgood (1958) notes that they were at one time preferable to dipnets. He describes their construction: eels sticks were typically about six feet long and made of spruce which is peeled and shaved down into an oval shape to permit grasping the pole without it twisting in one's grasp. "Near the end of the pole, one or two short pieces about 8 inches long are lashed in place with spruce root line, almost at right angles to the handle…these have four short notches in them which help to keep lampreys from slipping off"(1970:173). According to one fisherman from Grayling, the L-shaped curve of an eel stick is most commonly made by selecting small spruce trees that

[12] It is not clear why eel sticks were not present; they may or may not be in regular use anymore. It is important to note that dipnets were specified as the only legal gear for the commercial fishery and since many fishermen were fishing for commercial purposes in 2003 in addition to meeting subsistence needs, this might have affected that choice of gear.

are growing out of a cut bank, such that they grow out of the bank then curve up, creating an L-shape. If the fisherman used a stick, the hole was cut perpendicular to the shore in order to insert the crooked stick across the current to catch eels. Residents of all four villages reported the contemporary use of eel sticks. One elder recalls using these eel sticks:

> "*Tsits* 'wood' and *miloy gadatłtsitł ey*. It means 'in the end it's crooked', you know? Yeah. It looks like a hockey stick…same way. That stick, right in the end, it's got to be crooked. And you make your hole this way, square, like up Yukon, you make your hole this way, maybe about two feet. Then you dig that pole right in the water, move it down to the bottom, and then when you feel that thing, pfffft, eels just poke right, because those eels they're coming straight. They don't go crooked, they go side straight. That's where you hooked them." [C120604, Grayling]

The second type of gear most often used is a dipnet. In the old days, dipnets were made of spruce with handmade twine nets. Today, dipnets are both home-made and commercially manufactured; hoop sizes appeared to range from about fifteen inches to twenty-four inches in diameter, with mesh size of about ½ inch.

During the 2003 harvest in Grayling, fishermen cut holes immediately adjacent to the existing Grayling-Anvik Trail, relatively close to the west bank of the Yukon River. Snow was removed from the area and a chain saw was used to cut holes approximately four feet long and two feet wide. Holes were cut parallel to the river bank, which allowed fishermen to dip with the current. In advance of fishing, fishermen stood over their holes visiting and watching for eels. One fisherman described it as "just like watching a TV screen." Once eels started by, fishers inserted their nets to a depth of five or six feet at the up-river end of the hole and quickly dipped their net through the hole to the down-river end. If the net emerged with only a few eels, the fishermen could usually dump these on his own. As the number of eels increased to twenty or thirty eels per dip, the nets became too heavy for one person to handle and a second person had to assist in flipping the nets to dump the eels. A third person might be on hand to help spread out the eels on the ice to facilitate freezing and to keep any stragglers from finding their way back to the holes. Consequently, most fishermen worked in teams of two or three people. These teams would cooperate in the initial construction of the eel holes and during the fishing operation itself.



Plate 30. A team of two men from Grayling work together to harvest lamprey.
Photo by Dave Andersen, Research North

Eels are used both for human food and dog food. In the days when these communities maintained larger dog teams, eels were a critical food source because of their timing (early-mid winter) and high fat content.

While women are not present for the harvest, they are almost solely responsible for the processing. Historically, women would prepare a large feast of eels shortly after the harvest by pounding eels in a special pestle made of alder that would render out the oil. Cooked eels would then be dipped in this oil and eaten in the kashim (Osgood 1958, 1970). One older woman remembers this process in her lifetime.

> "Those womans, they used to cut them up and pound it. Pound it! They used to pound those eels while it was frozen. And then they put them in a baking pan and roast it in the oven. That way they get oil out of it. 'Cause they used to use eel oil for anything, you know, like Indian ice cream, snow ice cream. They used to use eel oil." [D120603, Grayling]

Residents do not generally clean out eel stomachs before processing; eels are a cartilage fish, thus there is no bone removal. The only parts not used are the heads above the gill pores and the tail. Eels can be baked or boiled whole and sliced for human consumption. This process

also renders much of the oil out of the fish. Also, residents smoke eels whole, then slice them for jarring. One elder from Grayling remembered that her mother used to use eel oil to make pancakes! Because they are rich in oil, many respondents noted that eels go rancid quickly – in about one month, even when frozen. One woman commented that freezing eels in water will preserve them a bit longer; she heard that people down-river did that as well.

> "Yeah. *Yi'ooditthux* right away. *Ooditthux*. Because it's got too much oil on it. Oil gets sour fast. Yeah….They ate them right away, I guess. Long time, they used to be hungry people around there. Eat everything that's ever around." [C120604, Grayling]



Plate 31. Shirley Clark of Grayling smokes eels before jarring them.
Photo by Dave Andersen, Research North

Eels had other uses, too. Eel skins were made into decorative and utilitarian bags, trimmed with yarn and ermine fur, while their oil might be used for keeping skin boots conditioned. Eel skins might also be used in trimming fur parkas. One elder believed that an especially talented sewer might also use them for waterproof garments such as a rain slicker. One woman remembered her grandmother teaching her how to skin eels: after cutting around the head and down the back around the lower fins, the skins were stripped off in one sweeping motion. The skins were washed and scraped, then hung to dry where they turned white, according to some respondents. During the field trip to Grayling for the eel run, we tried our hand at bag-making; after the skins dried (they looked a bit like waxed paper), we had to work them in our hands for a long time to make them pliable enough to sew together. Once worked, however, the eel skins are pure white and soft like silk.

"My wife, she used to skin that. When we were living in Shageluk that time. Yeah. I think she dried it that time, just like paper. But it's... not hard to tear or anything." [C120604, Grayling]

"…they used to peel those eels, skin them and wash them and hang them up, and they used to dry just white. And they used to make little bags and some of them used to make big bags to keep the fish in." [O072503, Grayling]

"Maybe for water boots. You know, they used to make water boots out of reindeer skin or sealskin. And, it has to be oiled, so it wouldn't dry up." [D120603, Grayling]



Plate 32. Tanned eel skins. Photo by Dave Andersen, Research North



Plate 33. Measuring eel skins to sew a bag with Shirley Clark, Grayling, December 2003. Photo by Dave Andersen, Research North

Grayling (*srixno' legg / sixno' loogg*)

While grayling do not constitute a large portion of the annual subsistence non-salmon harvest, the fishers in each community maintain specialized knowledge of grayling habitats in specific spots in their respective areas. The following section describes the life history and harvest and use patterns of residents from these four communities.

Life History. According to most respondents from the area, grayling tend to reside far up the sloughs, where there are gravel bottoms, clear water and "big holes," or deep spots that serve as potential spawning or feeding habitats. Fishers from each community easily identify the primary places to find grayling based on these specialized conditions. The village of Grayling is named for a nearby creek just downstream of the village, Grayling Creek, which, according to residents, still contains many grayling. Near Anvik, grayling can be found far up the Anvik and Bonasila rivers, where fishing for grayling occurs primarily by hook and line around August, after the Anvik River clears up again after the salmon migration. According to one respondent, they prefer deep spots in these rivers where he believed that they spawn and hang out to feed. Holy Cross residents travel up the Innoko drainage to find grayling in the narrow, fast running creeks around Albert's Lake and Layman's Lake and up the Yukon River to find them in Deer Hunting Slough. Around Shageluk, Callign Creek was repeatedly identified as good grayling habitat, though access could sometimes be challenging.

> "…in the creeks. Callign Creek, they go. You gotta' walk quite a ways up, up in the creek, yeah. I don't know how far you can go with canoe. 'cause you couldn't run your motor up there…there's some, but you gotta' go up." [Q060304, Shageluk]

During the interviews, most respondents made only a few comments about the seasonal movements of grayling. After apparently spending much of the summer way up the sloughs and creeks in fast, clear running water, grayling begin to move downstream during the early fall, around late August and September, where they are more available to fishers right before freeze-up.

> "After October first, maybe, we don't fish anymore. They move out of the creeks. Before that, September and August, you can catch them by, let's say, hundreds if you wanted to. They're slowly migrating down…that's what they tell us—about five miles down they say they winter." [J120503, Grayling]

> "They're up the sloughs, toward the head of any slough that has gravel. Late in the fall, just before freeze up is the only time we catch 'em. They're up there all year round though in the upper end of the sloughs, but we just never bother them. There's some, I don't know if they bite in summer." [B102703, Holy Cross]

> "I fish grayling too. Fall time too before the ice freezes. In Layman's and Albert's. Good fishing there right before it freeze. Grayling, they bite pretty good…I think they come down from way the heck up there and they come down…from the creeks [up the Innoko] and they're riding that little gravel from living up there…" [P102703, Holy Cross]

While few respondents provided information about spawning times or habits, most noted that they likely over-wintered in "holes" or deep spots, usually in 1st or 2nd order tributaries.

> "We just get them in the potholes up the other end of Albert's, creeks, it's gravel bars and creeks, it's narrow. There's potholes along there. It's swift, clear water…They're right along the creek, Albert's. It is like dead water in a swift current – it's where they rest in the swirly water. It is a real narrow, the creek, narrow and gravel bar." [P102703, Holy Cross]

Grayling eat a variety of bugs and also salmon roe, according to most key respondents. They are often out in the late summer/early fall to eat after the salmon runs. Some residents also suggested that grayling were quick to take lures baited with red meat, especially during the fall.

> "… we fished grayling, wintertime, not too long ago it was way up there [up the Anvik]…lots. Hook…I use mepps [a type of fishing lure], but you could use bait, bait is good too – also for trout…fishhook. Way up the Anvik…we never tried way down…. any kind of meat, you could put on the hook, red meat. They'll go for it." [R060304, Anvik]

The same resident felt that grayling numbers were remaining stable, possibly because there was not significant pollution that far up the river yet.

> "Grayling seems to be less, the last couple years. You hardly catch any if that's too warm. 'Cause as soon as it cools off, you can go and you can catch maybe six, seven, eight. Can't go out but catch 1 or 2. That's the only difference I noticed, this one about that grayling." [B102703, Holy Cross]

Harvest and Use. Between historical literature and contemporary ethnographic interviews, at least three ways to harvest grayling were identified. According to Osgood (1958), grayling could be abundantly caught in "side-stream" traps, which were similar in construction to the larger in-river funnel traps used to harvest whitefish and pike, though smaller to accommodate grayling and trout in smaller water channels. These traps were traditionally set in smaller side streams around August or September, facing downstream "at the entrance of a small pocket in the fence that extends from one bank to the other," and effectively shutting down the entire channel (Osgood 1958:240). Grayling moving downstream during that time are directed into the pocket by the fence, turning back into the funnel of the trap. Osgood notes that the position of the pocket and the trap was reversed in September to yield a greater catch and that the trap could also be set under the ice in March to catch returning grayling (Osgood 1958).

According to most respondents, grayling currently are best caught using a hook and line, during the summer and fall months when they congregate for feeding. Grayling also appear to be a favorite among kids, who fish for them regularly in most of these communities, especially Grayling. One respondent offered some fishing advice on effective lures learned from his father:

> "I'm gonna tell you what my dad told me when they used to work in the Flats… The way you can catch grayling and trout, you use what they call a bumble bee, a live bumble bee. Take it and put it in a jar… and then when they're ready to fish in there, take him out and put him on a hook, … a bumble bee. A bumble bee, yeah. My dad's boss in Flat, he had a fly, you know. My dad went in there and he got a bumble bee and he just put it on there and he catch [sucker] too." [I102803, Holy Cross]

While most respondents used hook and line to fish for grayling during the fall in swift, clear water creeks, one elder from Anvik remembered seining for grayling as a child with his

grandmother. His family lived year round at a permanent subsistence camp far up the Anvik River on Beaver Creek except during the summer months, when they came to the Yukon to fish for salmon. Before their return to Beaver Creek every fall, his grandmother would "knit" several small mesh seining nets for use on the Anvik River as they traveled home. Seining would bring in several hundred fish that they would leave on gravel bars in large, frozen heaps until they could transport their catch back to camp for use primarily as dog food. While seining was a one-time activity in the fall, this elder remembers using a hook and line to catch grayling all winter long for fresh meat. The following excerpt from his description of this process ties together important information regarding seasonal movements of grayling, harvest timing, net construction, seasonal habitats, and different harvest techniques.

> "I was up in Beaver Creek, seventy miles from here [up the Anvik River], and then I stay there. We go up in September and then I'd stay there 'til May….then we come down. Stay with my grandma, I was only seven. We stay in the Anvik and she cut fish, and her husband cut fish...when we're going up, my grandmother make a fishnet. She makes a fishnet you know. She knit grayling net, there's small mesh, about this square mesh [one inch], and then they seine going up. The mesh is smaller, and they seine going up, sometimes they catch 300-400 grayling…they do it on the Anvik River [just below the mouth of Beaver Creek]. They make about 3 or 4 seines and they catch about 300 or 400 grayling…she use wooden – and then they put the twine around - a certain kind of needle…made out of spruce, and they just fill it up with twine and they poke it back and forth…takes about 3 months, depends on how much ballast you put on it and how deep…I'd say about maybe 25 feet [long]…but you have to go on the gravel bar, it's shallow. Just one time, that's all, when we're going up in the fall time. Then in the wintertime, we fish in the mouth of the creek. We put bacon or something down to the bottom and we hook grayling, just swimming around…grayling are about this big [1 – 1½ feet], and then we had fresh grayling all winter. But the water has to be still, you know, so it, the hook doesn't come up to the top, the current will bring it up." [K060204, Anvik]

Seining during this time of the year was effective since the harvest could be easily preserved through freezing. "Just before freeze-up, we go up the last week when we know it's gonna' freeze up. And we go up and that's when we keep our food, you know? The north wind starts blowing, that's our last trip…grayling flopping all over the beach!" [K060204, Anvik]. Once the harvest was brought back to camp, they employed a traditional means of keeping the fish: "We put 'em in birch bark and put them in the ground where they can keep cool…it

had to be down to the frost…we used regular boxes, too [to line the holes]…" [K060204, Anvik].

Burbot (*gidhiyh / gidhiyh*)

According to Osgood, the common local referent for burbot, "loche," was originally a designation from French travelers in the Mackenzie River country "where the same fish was likened to Old World loach" (Osgood 1959:24). Burbot are a curious fish in this area. On the one hand, they have long been a wintertime staple, important as a source of fresh meat during the mid-winter months and reliably so. On the other hand, Osgood documents historic taboos surrounding the harvest and handling of burbot, that seemingly not practiced any longer, demonstrate a cognizance of and respect for the social relationship between humans and burbot.

In the historical literature, two practices concerning burbot are mentioned. First, loche apparently do not like the noise of cutting wood, therefore, it is taboo to chop wood and touch loche with one's hands on the same day. Otherwise, the fisher will not catch loche. Indeed, according to Osgood (1958), fishermen would avoid touching loche with their bare hands when removing them from a winter, under-the-ice trap. Instead, they would use a special rake, described in more detail below, to hook the fish and remove them from the back of the trap. When removed, loche would be placed in a large pile with their heads facing upstream. "The home of all fish is 'downstream' and the Ingalik [sic] like to keep them facing in the right direction" (1958:241). Finally, it was also considered bad luck to catch or keep any burbot caught in nets (Osgood 1959:136).

Life History. Burbot appear to be widely distributed throughout the area, present in both the Yukon and Innoko rivers, though many residents commented that they are less prevalent in Innoko waters.

> "We never get as much loche as the Yukon do. One now and then. All summer we fish, we never catch them." [Q060304, Shageluk]

Loche are known as a "winter kind of fish," likely because they are more reliably harvested during late fall and winter months. As with other non-salmon species, their seasonal movements influence times of increased harvest efforts. These seasonal movements are understood in relation to other species of non-salmon fish, as well. According to local respondents, burbot travel through the sloughs into the main stems of the Innoko and Yukon rivers in the fall. This fall migration marks the last of the fish migrations from summer habitats – after blackfish, pike, and whitefish have passed through the area.

> "Cause we know they come out the river in the fall like this, they come, they're last run, coming out of the sloughs. Like when you shut the river, and you catch that and that's the end of the fish, that's the last fish to come out." [B102703, Holy Cross]

And like other fish species, seasonal water levels appear to be a signal of this movement, making them particularly susceptible in certain identified spots.

> "Second one up, right on that point. I had a net there one day and I caught something like 40 in one day…when the water starts dropping back here's when they move out… Back in the slough area [fall time]." [J120503, Grayling]

Burbot migrate out to the main stems with other fish, but they also appear to do so in pursuit of other fish, according to many respondents. When harvesting burbot in winter traps, fishers find lamprey oil in their stomachs, indicating a relationship between seasonal movements and feeding habits. Arctic lampreys migrate up the Yukon River in November and December (and according to some respondents, as early as October) are available as food for burbot moving into the main stems.

> "Loche, they start going up the river right after the eels, right after the eels because when they catch loche, their stomach was just full of oil, fish, I mean, eel oil….'cause that's what they're going for, they're going after the eels." [D120603, Grayling]

Burbot over-wintering habitats are important to local residents since they focus their harvest efforts of this fish during winter months. According to respondents, burbot can most readily be found over sandbars in muddy-bottomed spots in the river, near where pike also hang out

(usually eddies and slower water where the fish might rest). Using traps and set hook lines, fishers can easily pull in large quantities of burbot for community use. One elder also suggested that burbot move around or are more likely to be caught during the nighttime hours, when it is dark. The excerpts below discuss winter habitats.

> "Wherever, um, like muddy bottom. They set fish trap, I know. Bede used to always have fish trap. He would set it. On the Yukon. Only on the Yukon, far as I know…" [O072503, Grayling]

> "Same place, right along the Yukon here, right here along the bars…Yeah, along these sand bars, that's where they hang out…Anywhere there is sandbars, you can set a loche line…just a hook with a blackfish on it. Right, underneath the ice." [P102703, Holy Cross]

> "Loche is like the winter kind of fish. We catch them in the winter and eat them…along the Yukon there where we pike fished…yeah, along the sandbars too. Mainly fish 'em at night, when it is dark …Yeah, sometimes they set lines…through the ice. Make a hole, like a fishing hole. They set it down, right above the ground - the line is at the bottom of the river." [N102903, Holy Cross]

Another elder from Holy Cross offered observations on the over-wintering habitats of burbot in areas outside of the Yukon or Innoko main stem. From his description, it appears that burbot might also seek out deep spots to over-winter in sloughs and lakes, in addition to the river main stems. While most residents of the GASH area discussed harvesting burbot primarily in the main stems of the Yukon and Innoko rivers, Andersen et al (2004) suggest that small, resident burbot populations inhabit the lakes of the Koyukuk River region. The following excerpt might indicate similar patterns in the GASH area.

> "In the middle channel, there's these pockets and there's one year, there's really clear ice, no snow, and you can look down and see all these burbot. Not moving…In three feet of water, in Reindeer Lake." [E032404, Holy Cross]

As mentioned above, loche are one of the species of non-salmon that eat other fish, including arctic lampreys. Loche can be significant predators of other fish as well, including whitefish:

> "Caught a big loche like this. My brother and I were checking our nets and I caught this loche, "Hey, it's pretty fat!" Nice, big round, got it out, kept checking the net,

> looked over here, "Hey, where'd that other fish come from?!?" A whitefish you know, came out of the loche's mouth while it was fightin' around there. I don't think it would've came back out but it was swallowed tail first and that whitefish was the same size as the loche, too! Only thing that kept the fish from escaping the first time was the loche was keeping his mouth shut, you know? When he got out of the water, he let it go!" [G060104, Anvik]

While Andersen et al. (2004) note that Koyukuk River residents generally agree that burbot spawn in December and January, (although it might also occur over a longer time span under the ice), little information was recorded about burbot spawning practices in the GASH area.

Harvest and Use. Based on their seasonal movements upstream in the fall, fishing techniques have developed to take advantage of the presence of burbot during the winter months. Historically, residents utilized large in-river funnel traps placed at the ends of brush fences, similar to the whitefish traps described earlier. While most fishers use nets now instead of traps, which went out of use in the 1960s, these older technologies are a significant component of the customary and traditional use patterns in the GASH area and suggest a great deal of local knowledge about loche ecology.

> "In the Yukon, they used to fish in the wintertime, though the ice. For loche, we call them. Lots, boy, there were lots. There's one, by Bonasila, somewhere around there. By the town – used to big town there. Somewhere around there they used to set fish trap at one time…anything they catch in the wintertime. BIG traps, square [about 4 or 5 feet wide]…[made of] same thing, spruce, long ago, and then after that, they used wire, thin wires, you know? Took them days, weeks, to make hole…they lay them flat on the bottom. They catch lots and lots that way." [F072403, Shageluk]

Residents observe that burbot tend to dwell near the bottom, so traps were usually placed on the gravelly and muddy bottom of the Yukon River, according to several elders. Originally made of lightweight spruce for easy handling, new materials such as wire facilitated trap making in later times, until eventually replaced by nets.

Osgood also describes these traps based on his fieldwork in the 1950s. A fisherman might use one or even two traps simultaneously facing each other to take advantage of fish moving both upstream and down stream. Checking a trap involved raising it out of the ice and

inserting a pole crosswise across the ice under the trap to suspend it above the water. Unlike the fall whitefish traps, which are closed at one end with an additional funnel opening, the winter loche traps had a vertical door at one end. This shortened the entire length of the trap, requiring less ice cutting to accommodate the trap. Fish were removed with a special rake, "…a pole of six to eight feet long with a straight point of caribou leg bone inserted through it" used to hook fish to pull them out of the trap (Osgood 1958:241).

One respondent remembers being a young girl at the Mission in Holy Cross when men from the village would bring loche caught in traps near the village for the Mission. The girls would skin and clean as many as one hundred and fifty loche at a time.

> "Long time ago, they used to have fish traps. Big, giant fish traps they used to have in the winter time…along the Yukon, I don't know how many people had fish traps and they used to catch lots of loche because when I stayed in the [Anvik] Mission, I was small. And when somebody had fish trap, they always gave us bunch of loche to the Mission and that's what you ate, too." [D120603, Grayling]



Plate 34. Harvesting burbot with a trap outside of the old Mission at Holy Cross, circa 1930s. Image used with the permission of the Jesuit Oregon Province Archives, Gonzaga University

Today most burbot are caught in nets or with a hook and line. Respondents described several ways to set a hook, indicating extensive knowledge of burbot behavior and habitat. The following excerpts describe these different sets, ranging from an under-the-ice like set to a vertical pole with many hooks. All have in common the preferred use of blackfish bait to lure burbot and placement on the river bottom. Using blackfish on a line to catch loche does not necessarily yield other fish species, such as pike or sheefish, because loche lines extend to the bottom, where, according to local residents, loche spend the majority of their time. Fishing efforts are also concentrated, according to the mapped information, atop sandbars in the river, often around islands in the Yukon main stem. As mentioned earlier, some respondents felt that fishing for burbot is often more successful at night, although the reason for this was not entirely clear.

> "In the spring, first you have to have bait, live blackfish are preferable, works the best. Under the ice, one big hook, you can have two or three on one line. Or you can have a long line, set just like a net, except you have all these lines weighed down to the bottom and sitting there. It works just like a fishnet where you have a long line coming up another hole. Train it back and forth." [G060104, Anvik]

> "…put a hook, a single barbed hook, and put a leader on there, tie a string on there, and you get a pole like that, and you get 5 or 6 hooks off that pole and make a hole in the ice and stick it down in there. It will be stuck right in the ground and you put snow in there so it wouldn't move around and then each fish are swimming around and these loche will get them. You could use spam too you know! We still do that, you could catch a lot, you know, I never tried since we didn't have no blackfish. They're kinda' hard to get, them blackfish, we know they're up Innoko, you know…we just stick the hook right in their fin right here at the top, it's not gonna hurt them. Even around his tail. A woman taught me this, how to fish them…from Galena. She was an old lady about 70-80 years old and she told me, "I got some blackfish, we're gonna get some loche. My dad died that time, so she came down, you know, and she wanted blackfish for loche. She said, "well, go down and make a hole in the ice." And I said, "what for?" "we're gonna catch loche!", she said. I tell her, "I won't be catching any loche." She said, "you don't know a thing, go just make the holes and get a couple of poles." Big poles like that and submerge them in 6-7 feet of water we put that pole down there, had long strings, about 3 feet, and you got a leader under there and you hook the blackfish and then we leave it there and next morning, we went down and she caught 8 or 9, and she told me, "you're not a believer, and you know now!" She's the one who taught me how to do it, you know." [A42104, Grayling]

Another elder from Holy Cross described a third method where the fisherman attaches a long, weighted stick or pole to a long line and off the pole hangs five or six hooks. The pole is inserted vertically through a hole in the ice and allowed to swing horizontally near the river bottom where the hooks might attract burbot. A second line is attached to one end of the pole and used to pull the pole vertically again in order to pull it out of the ice hole. His drawing below illustrates this process.

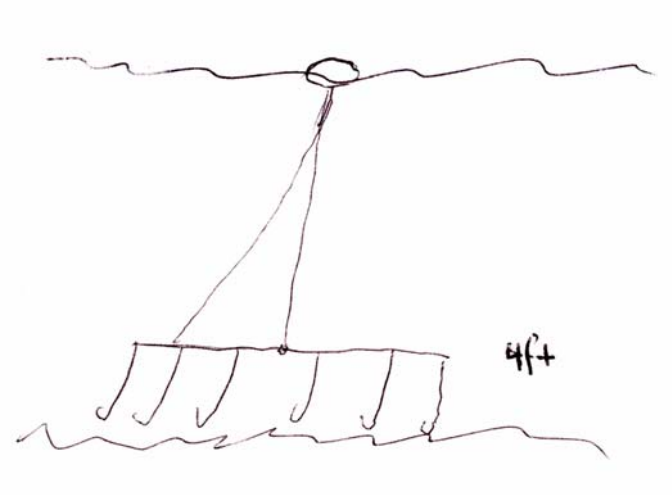


Plate 35. Illustration of a burbot set. This type of set is usually placed in about four feet of water and extends to the bottom where burbot are most likely to be caught.

According to one Holy Cross resident, loche are considered prime in the fall, when their livers increase in size. Their fattened livers are considered a delicacy and harvest efforts are concentrated during this time in the fall through the winter months. Burbot are not as fat or good in the summer or spring when many residents observed an increased frequency of white spots on burbot livers harvested in the spring (see also Stimmelmayr and Simon 2002). Diseased livers were generally not consumed.

> "Yeah, we get them and they've got the tastiest liver…all the way from November until now [April] be catching them right down the bank." [A42104, Grayling]

> "Oh on the liver, yeah. They used to be like that on some liver in the loche, long ago. Not in this lake. We used to catch maybe 3 or 400 in one night in a fish trap, you know, and take the liver. Some of it's spotted, we used to throw em away. Oh, it's quite awhile ago—30, 40 years ago. That's when they, the fish traps out there. Mentioned, village people had fish traps… But, anything spotted in the liver, we

> never touched that, you know, or white spots on the body. Discarded it." [B102703, Holy Cross]
>
> "Sometimes you fish here [loche], their liver is bad, fall time…It got white like, if you notice, a loche liver has spots on it, white spots. And the elders will tell us, 'Don't eat it. It's got a bum liver.'" [I102803, Holy Cross]

In addition to human food, burbot might be used as dog food in lean times, or added to the dog pot with other fish. However, they are not generally considered to be high quality food for dogs like whitefish or lamprey.

> "Yeah, they're not too good for dogs, they're too uh, they don't have nothing in them if you take out the liver, you know. You can feed em to dogs, it would keep them alive, that's about it. They just have no energy, nothing." [B102703, Holy Cross]

Burbot are eaten fresh or frozen to be boiled later, but not dried. Few people discussed cutting burbot, instead saying they were gutted and skinned whole as described below. In earlier days, only adults ate loche and the eggs were rarely given to children, for it was said that a child that eats loche eggs will have many cramps growing up. Loche are also prized for their medicinal value in curing colds and flu (see also Stimmelmayr and Simon 2002). Broth made from boiling burbot is said to help with sickness; one elder from Holy Cross described his father setting a burbot trap when the whole town was getting sick.

> "They cut the head off, but you leave the fins...you gut 'em out, then you grab those fins and peel it all around where you cut the head off and pull it, it comes right out." [E032404, Holy Cross]
>
> "…these fish here - my dad long time ago that was saying people were sick. This fish here is like a medicine. You know, when people are sick, they eat the broth. They drink the broth of it and it's just like a medicine…they boil the whole thing. They cut it up like this…like colds, common colds. Uh, pneumonia. That stuff will get cured…whatever the animal has in it. I used to hear my grandma saying it has lotta vitamins. Yeah. But old people won't throw anything away from that fish. They won't throw it out. They'll use the whole thing. The broth, you know, they'll drink the broth. It's like juice." [I102803, Holy Cross]

Osgood (1970) describes another historical use for burbot. Loche stomachs were cleaned and processed to be used as bags for storing fish oil, specifically whitefish. According to his Anvik informant, whitefish were boiled and their oil rendered off, which was then skimmed off the top with a shell spoon and put into a wooden bowl. Using a funnel, the oil was then poured into the stomach bag and the bag was tied off at the neck with willow bark line. These bags were significant both for storage and for identifying the type of oil stored: "The type of bag serves to distinguish the kind of oil…Bags full of oil are put into birch bark baskets and stored in the owner's cache…" (159). Sheefish oil, for example, would be stored in a different kind of container.

Beyond general concerns about white spots on burbot livers, few residents suggested that burbot numbers are decreasing or expressed other concerns about the health of the stocks. It does appear that residents do not harvest burbot in amounts they once did when the large in-river funnel traps were still in use, as indicated by the following excerpt. "Yeah, here long ago, they used to catch four or five hundred loche - loche all over the ice! I was too small to remember…" [K060204, Anvik]. Instead, burbot appear to be more selectively harvested for fresh meat during the winter, especially their livers.

Sheefish (*sresr / ses*)

Sheefish are an important non-salmon fish species in the lower-middle Yukon region for at least three significant reasons: first, they can be and are harvested year round by residents, second, they are a large and particularly oil-rich fish, especially in the spring, and finally, they are considered to be an excellent eating fish, an important attribute especially during winter months when fresh meat is less available.

While sheefish are considered one species of whitefish by western science, they are distinct from the other whitefish species according to many local residents because of their size, distribution, and seasonal movements (e.g. Andersen et al. 2004, Georgette 2004). Cornelius Osgood follows this practice by describing sheefish as one of the five types of whitefish in the area. According to Osgood's classification, sheefish, or *ses* as he documented the Deg

Xinag word for the fish, are found in the Yukon during the month of June. He also notes that while sheefish might also be found in the Innoko River, they do not go into the Anvik River since they do not like fast water. Importantly, Osgood points out an important aspect of sheefish also noted by local respondents for this study: "It is noted that the oil of this fish is thinner and burns better than the oil rendered from salmon. Whitefish oil is almost transparent and even smells better than salmon oil…" (Osgood 1959:25).

Life History. Sheefish appear to be fairly evenly distributed around the lower-middle Yukon area and Innoko drainage used by the residents of Grayling, Anvik, Shageluk, and Holy Cross. Interviews with local fishers and the harvest estimates recorded in the harvest survey of non-salmon fish use, revealed sheefish are also available in the area year-round. While fishers in Anvik and Holy Cross reported the majority of their sheefish harvest during the summer and fall months, fishers from the village of Grayling reported harvesting sheefish in every month of the year (see Tables 7, 9, and 13). They described setting nets under the ice throughout the winter months and especially in the early spring. "Right now [December], if somebody set fishnet, they would catch sheefish…they're in the water, I guess, in the river…springtime and the fall time, too…" [D120603, Grayling]. Shageluk fishers, on the other hand, reported harvesting sheefish in the summer and early fall months of June through September. This harvest estimate, along with information provided by area fishers may suggest some questions about the distribution and availability of sheefish in the Innoko drainage during the winter months. "They say you could catch 'em some time in August, on the Innoko River, with hook." [B102703, Holy Cross]

Sheefish appear to have a distinct place in the general spring and fall seasonal movements followed by most non-salmon fish species. According to most respondents, sheefish movements in the spring immediately precede the run of chinook salmon up the Yukon River in June. Once the king run comes, large quantities of sheefish are mixed in with the run, but they also have their own distinct run prior to the kings.

> "We get them early in the spring too after the ice go out. We hook these big guys under the ice. They come up after the ice go, they usually running about a week

> before the salmon, they run pretty strong, they'll be a lot of them and they get about that big [about 4 feet]." [A42104, Grayling]

Sheefish move out of their over-wintering spots in the spring in a large migration. While few respondents noted the actual spawning timing for sheefish, many described this spring movement as traveling to their summer habitats and feeding grounds up major tributaries and sloughs before spawning. According to local observations based partially on harvest practices, sheefish travel up major tributaries, such as the Anvik River, to spawn in the sloughs. Last June, during the village of Grayling's spirit camp near Holikachuk, kids caught several sheefish migrating up the sloughs. As mentioned in the Arctic Lamprey species summary, juvenile lamprey were found in the sheefish stomachs, raising questions about the distribution of lamprey. However, the harvest of sheefish during that time period also provides additional information about the seasonal movements of this species. Local knowledge of sheefish seasonal movements is intertwined with the seasonal movements of salmon, and other non-salmon fish species, illustrated in the excerpt below.

> "We used to fish for them up at the mouth of the Anvik River every spring, be out there with your daredevils [lures]! After the ice goes out and the Anvik River's running pretty clear, you know. But they go up the Anvik…to spawn. They're probably before the salmon start running…yeah they probably have to run through the gauntlet of pike that stays down there, around the mouth in the grass." [G060104, Anvik]

As will be discussed in more detail, sheefish are particularly prized in the spring time because they are generally fat and rich in oil. "In the fall time they catch sheefish and in the springtime too and they're always fat." [D120603, Grayling]

According to Holy Cross residents, sheefish move from the Paimiut area up into the Innoko area around Seven Bend and Ten Bend Slough and up towards Albert's Lake, spawning in the area around Reindeer Lake, before traveling back to the Yukon to over-winter. Sheefish begin a second major seasonal movement during the fall months and, as a result, residents identify late summer and early fall as a good time to harvest sheefish as they are moving out of their summer lake habitats and into the sloughs on their way to the main rivers.

> "Yeah, we get those too. Right in the same, they come to the same place. Catch them in the eddies. Mainly the sheefish are in Reindeer lake with rod and reel. Right at the mouth…slough that goes up to Albert's, right in the mouth of that creek, there. Around July we fish for sheefish. Bitin' every cast…the fall time they come out. They come out to the Yukon. They travel all over the place, them sheefish" [P102703, Holy Cross]

As noted above, sheefish eat other fish, including arctic lamprey. According to one Anvik resident, sheefish eat all kinds of small fish, especially juvenile salmon, probably during their voyage to the ocean: "…other little fish, their stomach is just full of 'em, full of them…must be dog salmon from last year coming down." [R060304, Anvik]

Most residents recognized this spring and fall migration of sheefish, though one resident raised a question about a different kind of sheefish that looked slightly different from other sheefish in the area and arrived at a different time of the year. He only observed this fish in certain drainages in his area, and believed that they possibly returned to the ocean, rather than remaining resident in the area year round.

> "There's a strange sheefish, looks like this [picture] but it's much shorter and much more broader. And they're like ocean-going sheefish, their backs are blue, they're dark blue, some of them. All I seen them is up the Anvik River…they're maybe 30 inches and [a foot] deep. Maybe they're the same species, but they arrive at a different time of the year…they probably head up the Bonasila River, any clear water rivers." [G060104, Anvik]

Harvest and Use. While sheefish appear to be available in the lower-middle Yukon area all year round, local fishers consider the seasonal movements of sheefish in the spring and fall as particularly good times to harvest sheefish. Historically, sheefish might be caught in the large in-river funnel traps used during the spring and fall migrations of many non-salmon fish species. Today, however, sheefish are primarily caught in fish wheels and nets set in both open water during the summer months and under the ice during the winter and early spring before break-up.



Plate 36. Sheefish and pike on the ice above Grayling, taken from a net set under the ice.

Many fishers also use a hook and line in the late summer to harvest sheefish in smaller numbers. Holy Cross fishers appear to harvest sheefish only out of the sloughs during their movements, rather than in the lakes. "You could catch them on a pole right now [early June], or in a net, yeah." [R060304, Anvik]. The following excerpt describes fishing for sheefish with a hook and line during their fall movements out of the Innoko River at a place called Swiftwater, approximately ten miles downriver from the village of Shageluk. Swiftwater was an old camp site for families from Shageluk and many families lived there year round; today, it remains an important fishing site because of its proximity to sloughs and productive eddies.

> "I tell you, when the leaves come down, floating down, about 10 miles down there, there's eddy. And you'll see, jumping, jumping. Swiftwater is about 12 miles [downriver from Shageluk]…it's above in there, this side, couple of miles this side of Swiftwater – good eddy…there's another one up there, about 6 - 10 miles above Yukon Slough. We had hook…but we had no them little ones. Gee! Big shees – jumping! …hooked big one, we undo quarter inch rope and we tried to tie wire to it and we put it on quarter inch rope, it's all we got, and they're jumping. And we dragged it, quarter inch rope, paddling…we catch one, it grab that hook….trying to

> catch those leaves, I guess. Maybe they think they're food, I don't know!" [Q060304, Shageluk]

The springtime was identified as a particularly good time to harvest sheefish because of their rich oil and high fat content just before spawning. "They're real, real rich. Right before they spawn and you render all the parts of the fish where they store their oil in and render it down – nice, clear oil. Sometimes you get those big washtubs, and boil it down and save all that oil." [G060104, Anvik]. According to most local respondents, sheefish run "thick" during the spring months, just before the king salmon run. Several elders from the four communities offered their memories of rendering the rich sheefish oil for various uses, including cooking and gardening.

> "Sheefish come right before the kings. You know the kings are on the way when you catch sheefish in the net. They come pretty heavy at times, with the first kings. Then after that, kings only. We would cut them and hang them and as they're drying, we make birch bark troughs. Like a rain trough? About 10 to 12 feet hang 'em under the rail, with a slope and into a bucket. And they drip the grease and they fill a five gallon bucket. She used it for cooking hotcakes outdoors, or whatever." [E032404, Holy Cross]

> "They're real, real rich. Right before they spawn and you render all the parts of the fish where they store their oil in and render it down – nice, clear oil. Sometimes you get those big washtubs, and boil it down and save all that oil." [G060104, Anvik]

Sheefish parts were boiled thoroughly to render quantities of clear oil that would be stored in different containers to indicate different kinds of fish oil. According to Osgood, women could prepare the loche stomachs by cleaning them and tying on end with willow bark line and distending it with air by means of a grass tube inserted in the pylorus projecting from one side of the stomach (Osgood 1970:159). Ranging between 8 to 12 inches in length, the dried stomach bag was used to store whitefish oil; the stomach bags are themselves stored in birch baskets and kept in a cache.

> "Those are really fat, too. Mom used to save the grease too. She had garden too. She used to pour it on the garden in the fall time, for fertilization…same way, [she'd render it] but in different things – she'd have to know, this is whitefish or sheefish. Separate containers. In the fall time mostly though, they used to do that. After all the garden's picked and everything, they pour it in the garden 'cause they said this was

> good fertilizer. They'd pour it all on there in the fall time and then in springtime, they'd work it up." [H060204, Anvik]

Perhaps because they were such a good source of rendered oil, sheefish were rarely preserved as dried, smoked, or frozen fish. Local observations about sheefish in the GASH area provide an interesting counterpoint to observations of sheefish by Koyukuk River residents. Along the Koyukuk River, sheefish are an important subsistence resource (see Andersen et al 2004), though they are not particularly prized for the oil or fat content, instead they are considered a rather poor fish. The observations of the GASH area residents may provide clues about sheefish conditions in different parts of the Yukon area. Today, sheefish are generally caught and eaten fresh, or as in the past, rendered for oil. However, a few elders remembered drying sheefish as "flat fish," a descriptive term for a particular form of drying fish. According to one elder from Grayling, sheefish could be opened up at the belly with both sides spread out and dried flat using straight, spruce sticks, often the same kind used for making fish traps. "*Tedhi'on lay*…They made it mainly for fish trap. But they used them also for flat fish. When I see spruce with straight limbs, I cut it and split it. Then I have some when the fish comes" [Grayling, L060404].

Sheefish can be prepared in variety of ways, though one fisher remarked on the difficulty cutting them because of their thick backbone. Nonetheless, sheefish are prized fish for eating, especially in the spring when they are full of oil and eggs. Sheefish have eggs in the springtime and people eat the eggs, usually by frying or boiling them.

> "Oh yeah, they're good fish, man. I'd say just as good as kings…they're hard to cut, those. You have to scale 'em; they got thick backbone and everything. Martha makes strips out of them, too, once in a while, uh? Out of sheefish? That's what she tells us and they're really good. They're really good eating fish; they're kind of like halibut. Really good." [J120503, Grayling]

> "You scale it, bake it filleted or cut up in pieces for soup, flour soup…It was dried too, as "flat fish"…the eggs were fried on the stove." [L060404, Grayling]

Longnose Sucker (*tonhts'ix / toonts'ix*)

According to Osgood (1959), the native word for sucker, *tonhts'ix*, is literally translated as "stand still mouth," suggesting the "tendency of the fish to remain unmoving in the water, whereas the last element takes cognizance of the peculiarly shaped mouth of the creature" (Osgood 1959:25).

Suckers were not reported to be harvested in any significant amount by the four communities with the exception of Grayling. This harvest pattern is consistent with the contemporary use of suckers primarily as dog food, given the presence of more dogs in Grayling.

Life History. Longnose suckers appear to be widely distributed throughout the area and are present in the main stems of both the Yukon and Innoko rivers. Observations based primarily on harvest practices indicate that while they may be present in the area year round, suckers also move in larger numbers seasonally. Respondents agreed that early springtime marked the most significant movement of suckers. According to these reports, suckers move upstream into the sloughs in early May before the ice goes out. Significantly, this movement is also used to evaluate the run timing of other species, specifically whitefish and sheefish.

> "It supposed to be first run, sucker, first run up, now, first run up, and first time they went out, they caught two, next day they went out, they caught whitefish 'cause whitefish supposed to right behind the sucker, going up river." [Q060304, Shageluk]

> "They have suckers in the spring, they go up, I don't know when they come out, or we never see em in the fall. They're a bony fish. We don't try to eat, catch 'em much…they're too bony. Full of bones. You catch these and you know the whitefish are right behind, going up the river, into the sloughs. Cause these are the first ones to go in. In May, and the whitefish are right after that…Then after that is the whitefish, shee." [B102703, Holy Cross]

As with other non-salmon species, this movement is likely related to spawning activity for suckers. One elder woman remembered seeing eggs in suckers harvested during the spring in nets as they traveled from the main stems into the tributaries and sloughs.

> "When I see, they used to have kinda' like light orange- yellow eggs. First time they come out from Yukon, from Innoko River, whenever they do set net, they used to catch those suckers." [O072503, Grayling]

This association with whitefish and other non-salmon species continues at other times of the year, namely late summer and early fall when suckers are observed (and harvested) with fall chum, whitefish, and pike.

> "Catch 'em with a fishnet. Yeah, and um, they swim with our fall chum. And, they swim with the whitefish, and with the pike. Cause I used to have a fishnet up here, what they call Victor's, …and you could catch pike, whitefish, sheefish, fall chum, coho….Yeah, they called it Victor's because there's people used to have fish camps there. Yeah, and the fall time is the best time to collect your fish for the winter, and fish is used for like making, like when you have pot luck—you can bring that. You cook it and make Native ice cream with it, you know, with all that fish." [I102803, Holy Cross]

Very little additional information was documented on specific habitats, such as spawning, feeding (other than being bottom-feeders), and over-wintering habitats, or on the specific winter seasonal movements of sucker. This is likely because residents no longer actively engage in harvesting suckers, instead considering them now to be primarily a by-catch in the harvest of salmon and non-salmon species.

Harvest and Use. As mentioned above, while suckers may have been used by GASH area residents in the past, most respondents said that they do not use sucker very much anymore. Residents state that they often catch suckers as by-catch to whitefish harvests, but they are not good eating, since they taste like mud and are full of bones. One fisherman from Anvik described them as the "vacuum cleaners of the Yukon." Instead, suckers are fed to dogs since they are fat. However, several respondents noted that suckers are still eaten by elders who ate them as young people when suckers were consumed during the lean spring months when other food sources were scarce.

> "No, it's only in springtime, when you have nothing to eat. I remember that, eating suckers, boy that's…when you gotta eat, that's all you got when you catch them. Other than that you never try them or eat them…You cook them for dogs when they catch the peak. Long ago when I was a young girl, they never throw fish away… Uh

> huh. If we couldn't use it ourself, then we preserve it for the dogs. Or, don't bother catch it!...they say it was, uh, too bony to eat." [O072503, Grayling]
>
> "Suckers is a by-catch. We don't actually use 'em, except for dogs. When I used to set net under the ice I used to catch 'em, once in awhile. Goes straight into the dog pot. I heard stories when, we used to come up from Holikachuk to the Yukon long time ago when there used to be no fish, they eat 'em cause they had no choice. That's early spring. I probably ate it myself, though, I was too little." [J120503, Grayling]

Most respondents reported catching suckers in nets, or in the olden days, in traps targeting other species. As mentioned above, the presence of suckers in a trap or a net in the springtime usually signaled the coming whitefish migration. One Shageluk elder also noted that suckers were routinely caught with whitefish in dip nets used during the spring after break-up.

> "Yeah, sure they eat it. You know that guy I told you, this big medicine man in Holikachuk. He used to use fishtrap, even in the spring. He catch lots with that…*Toonts'i'ix*….the medicine man…yeah. From the shore a fence, out there maybe about eight feet, or six feet. I remember. I was about eight or nine years old. One or two times I went with him across there, I remember." [C120604, Grayling]

In the days when people ate sucker more often, it appears that they were eaten fresh in the spring as a source of fresh meat when other food was scarce, or cooked for the dogs. Few respondents talked about processing sucker for long term storage, except for those harvested in the fall. These fish might be frozen whole or dried, although this does not appear to be a common usage.

> "Around October, they would freeze the rest. It was never cut." [L060404, Grayling]
>
> "Sure gets hard when you dry it, though, hard as a rock. But dad really used to like to chew. I never did. Dry fish, sucker. I never did try it, my dogs eat 'em." [Q060304, Shageluk]

Osgood mentions an historical use for sucker skins not commented on by contemporary residents. According to Osgood (1958), the skins of sucker may be sewn into an over-parka. Though small and requiring much sewing, sucker skins were considered the softest of all fish skins.

This concludes the species summary section of this report. A few other species of non-salmon fish were mentioned by respondents, such as Dolly Varden and trout, however, these species were generally only mentioned in passing. As a result, researchers were not able to document enough information about these species to organize into separate entries. While these species may be harvested by various individuals at various times and in various places[13], the non-salmon fish included here comprise the primary species harvested and/or observed, historically and today.

RESULTS OF THE HARVEST ASSESSMENT COMPONENT

This section examines the contemporary subsistence harvest of non–salmon fish in the lower-middle Yukon area through door-to-door harvest surveys and an analysis of the subsistence winter pike fishery. This latter piece combines age/sex/length sampling techniques and telemetry to chart the population structure of pike harvested in the winter subsistence fishery and track the seasonal movements of pike tagged in the Reindeer Lake area. Together with the harvest survey, these efforts are directed at documenting different aspects of the subsistence pike fishery in order to address local concerns about increasing fishing pressure on pike.

Harvest Surveys

Harvest surveys are among the most valuable management tools in a regulatory system. Primarily, accurate harvest estimates document levels of harvest of a particular species to be protected through the regulatory process. Use patterns, or the patterns of distribution of a resource within a community as documented in this survey, provide critical information about subsistence practices important for customary and traditional use determinations that

[13] For example, several respondents from Holy Cross talked about catching Dolly Varden in Albert's Lake off the Innoko, usually with a hook and line.

are protected by Alaska's subsistence statute. Additionally, by documenting past and current levels of harvest, managers may identify questions or concerns about the population trends of certain species.

While much of the traditional ecological knowledge documented for this study was organized by species to facilitate focused readings and management approaches, harvest estimates are presented here by community and introduced with a regional overview. Data for this component were collected on a community basis and the harvest estimates provide an interesting context for drawing comparisons between the communities, explored in more detail below. Explanations and analyses of the survey data below highlight the major use patterns, but should not be considered exhaustive descriptions of subsistence non-salmon fishing for each community. Harvest estimates for each species are presented by community in Tables 5 through 13.

Overview of Current State and Federal Fishing Regulations

In 1987 and again in 1993, the Alaska Board of Fisheries (BOF) made a positive customary and traditional use determination for freshwater fish species in the Yukon area, including sheefish, whitefish, lamprey, burbot, sucker, grayling, pike, and char (see 5AAC 01.236). Under state regulations, there are no bag limits or season restrictions for subsistence non-salmon fish harvests. Non-salmon fishing is generally open by regulation seven days per week, twenty-four hours a day, year round. These state regulations continue to apply to subsistence fisheries in the GASH area unless superceded on federal public lands by federal regulations in the future. Federal management authority over subsistence uses is implemented under Title VIII of ANILCA. Under ANILCA, rural Alaskan residents have a priority in subsistence activities as federally qualified subsistence users.

Sport fishing regulations for the Innoko River drainage for most species are the same as the general regulations for the Yukon drainage. These regulations provide for liberal daily harvest limits and reflect the light level of use of most fish species by anglers. The liberal

regulations also provide harvest opportunity with rod and reel gear for fishers within the sport fishing regulation framework (5 AAC 70.022 (c)(1-7, 9)).

Sport fishing regulations for northern pike in the Innoko drainage are more restrictive, reflecting the higher level of fishing effort directed at this species in the area. The current regulation is three northern pike per day of which only one may be 30 inches or larger (5 AAC 70.022 (c)(10)(A)). The Alaska Board of Fisheries adopted this regulation in 2001 in response to recommendations by the GASH Fish and Game Advisory Committee and ADF&G staff.

Drainage-wide Harvest Overview

Table 5 provides information on non-salmon harvests by species by community for the GASH area during 2002. This discussion of GASH area harvests focuses on pounds of fish, rather than numbers of fish, to highlight their contribution to subsistence diets. In some cases, smaller fish, while potentially harvested in large numbers, might contribute relatively few pounds of food to subsistence diets, constituting a smaller percentage of the overall subsistence resources utilized by a community or household (see Appendix D for conversion factors). Overall, the villages of Grayling, Anvik, Shageluk, and Holy Cross harvested a total of 87,589 pounds of non-salmon fish during the 2002 subsistence harvest season. Whitefish constituted 39% of this total, with 99% of the total whitefish pounds comprised of the larger species – broad and humpback whitefish. Of the two, however, broad whitefish were harvested over three times more frequently than humpback whitefish. Reported harvests of the smaller whitefish were considerably less, comprising roughly 1% of the total whitefish harvest. The significant number of "unknown" whitefish reported are likely the smaller species, which are not differentiated from each other. This is consistent with the local practice of categorizing these smaller species as one large group, rather than by individual species, although some fishers were readily able to make these differentiations.

Arctic lamprey, or eels as referred to locally, accounted for the second largest species harvest, constituting 35% of the total non-salmon fish harvest. Lampreys are a significant

resource for both human and dog food and according to the 2002 harvest report, residents of Grayling harvested the largest quantity of lamprey – 74% of the total regional harvest. This could be for a variety of reasons, possibly including the presence of more dog teams in Grayling. Respondents in the TEK component of this project repeatedly observed that lamprey are not always available to village residents due to weather or ice conditions, the nature of the run, or simply because people miss them as they migrate through the region. Grayling appears to be the community most successful at harvesting lamprey in 2002. Sheefish and pike were the next most significant non-salmon harvests for the GASH area, at 14% and 10%, respectively. The relatively minor species of burbot, sucker, blackfish, and grayling accounted for less than 1% of the total harvest each. Smaller species such as longnose sucker and grayling were only harvested by the communities on the Yukon River. These species are associated with clear, coldwater and rocky streams, possibly explaining why they are not harvested in any quantity by Shageluk residents.

As noted by Andersen et al. (2004) for the Koyukuk River communities, harvest and use patterns among GASH residents generally follows Wolfe's analysis of the role of "super-households" in Alaska's subsistence economies. Super-households are specialized units within a larger set of households in a community that are responsible for harvesting the majority of the resources utilized by a community. According to Wolfe, "…it is not uncommon for about 30 percent of the households in a community to produce about 70 percent or more of the community's wild food harvest" (Wolfe 1987:17).

Non-salmon Harvest by Community

Grayling: Residents of Grayling harvested ten species of non-salmon fish during 2002, including lamprey, trout, blackfish, burbot, grayling, pike, sheefish, sucker, and two species of whitefish-- broad and humpback whitefish (Table 6). Of these species, lamprey and whitefish (specifically broad whitefish) comprised the majority of the annual harvest in 2002. An estimated 22,448 pounds of lamprey and 15,991 pounds of whitefish were harvested by Grayling residents and both of these species figured prominently in subsistence use patterns for the community. For example, while 50% of Grayling households fished for and

harvested lamprey, 29% of the harvesting households shared their fish with approximately 38% of households, so that a total of 69% of the community's households used lamprey in 2002 (Table 6). The harvest of whitefish shows similar patterns. Fifty four percent (54%) of households harvested whitefish. A significant portion of those households (44%) gave some portion of their catch to households in the community such that 75% of households in Grayling reported using whitefish. Sheefish and pike also contributed significantly to the annual harvest. An estimated total of 783 sheefish (4,698 pounds) and 780 pike (2,340 pounds) were harvested by Grayling households. Both species were shared between households. Overall, Grayling fishers harvested an estimated 46,380 pounds of non-salmon species (approximately 270 pounds per person) and of that amount, 48% was lamprey and 35% was whitefish.

Grayling's annual harvest was by far the largest of all four communities, likely due, in part, to its large population. Grayling also was the only village where residents reported some harvest in every month during 2002. While lamprey harvests registered the greatest contribution in pounds to their subsistence diet, the majority of this harvest occurred in November because of the nature of the lamprey migrations. On the other hand, sheefish and pike harvests, which comprised a much smaller percentage of the annual harvest, occurred throughout the year in every month. Interestingly, pike harvests did increase slightly in the fall and spring during their seasonal migrations to and from of summer feeding and spawning habitats, as reported by TEK respondents. These fish are often caught together because of the contemporary gear types used. As a result, these species are all significant subsistence resources both in quantity of harvest and because of year-round availability.

Table 7 shows harvest estimates by species, by month for the village of Grayling. Broadly speaking, residents appeared to take sheefish during much of the year with the highest percentage of the harvest taken in June. This is consistent with TEK information describing an early run of sheefish in the lower-middle Yukon River that arrives in the spring/early summer, just preceding the king salmon run in June. Harvests of blackfish in Grayling occurred in March and April only, suggesting potential use as bait for burbot fishing during the spring months. Grayling residents reported a fairly even harvest of pike in every month

of the year, with a small bump in the harvest during August and September, likely consistent with the seasonal movements of pike in the area heading to their over-wintering areas.

In Grayling, whitefish harvests were concentrated on broad whitefish and humpback whitefish in the spring, beginning in May through the summer into the fall months. The harvests appear to dwindle in October and November, consistent with the information provided in the TEK interviews about targeted harvests based on whitefish movements. Grayling residents reported a small number of "unknown" whitefish harvested in August and September. As mentioned earlier, these are likely the smaller whitefish species, including round whitefish, consistent with the local observations and reports of harvesting round whitefish in fish wheels during late summer. Although much of the whitefish harvest is likely taken with gillnets set in eddies, dipnets are also used in the spring after break-up.

Harvests of grayling by Grayling residents occurred primarily in August and September, likely because they are more available to fishers during that time as they travel down from the headwater tributaries out of their summer habitats. Grayling residents reported harvesting burbot in the winter months between September and March. According to the TEK interviews, burbot begin moving out of their summer habitats in pursuit of food, such as lamprey, on their way to their winter habitats.

Anvik: Table 8 shows the estimated harvest and use of non-salmon species in Anvik in 2002. Residents of Anvik harvested an estimated total of 16,142 pounds of non-salmon fish. By pounds, the largest contribution to subsistence diets was made by lamprey (6,671 lbs. harvested). Interestingly, while lamprey made up the largest harvest, whitefish were reportedly used by more households. This finding is consistent with information recorded in TEK interviews, given the decreasing contemporary use of lamprey as there are fewer dog teams in the area. Approximately 32% of the 2002 harvest consisted of four whitefish species: humpback whitefish, broad whitefish, Bering cisco, and least cisco. The importance of whitefish in the total subsistence harvest of Anvik residents is demonstrated by their use patterns: a total of 56% of households reported using whitefish. Approximately 38% of the community households harvested whitefish species, while 27% of households shared some

portion of their catch with other households. This high level of harvest and sharing accounts for a per capita harvest of 56 pounds of whitefish per person per year.

In addition to whitefish and lamprey, residents of Anvik relied heavily on pike (1,893 lbs. harvested) and sheefish (2,267 lbs. harvested). Household use of pike and sheefish followed very similar patterns in Anvik: just over one-half of the households reported using both pike and sheefish. Tracking harvests by month, Table 9 shows that Anvik residents also fished year-round, harvesting non-salmon fish species in every month except January. August and September, just before freeze-up, accounted for the largest percentage of households participating in the fishery and the most non-salmon fish harvests; those harvests were dominated by two species of whitefish (broad and humpback), pike, and sheefish, consistent with the seasonal movements of these fish. Small harvests of all four of these species in October, November and December are most likely the result of under-the-ice fishing with gill nets. Interestingly, Anvik was the only community reporting the harvest of least and bering ciscoes. The reason for this is unknown.

Shageluk: Located on the Innoko River, just below the historic village of Holikachuk, the community of Shageluk also reported a high level of reliance on non-salmon fish species during 2002, especially considering the absence of a lamprey harvest by Shageluk fishers. As indicated in Table 10, the estimated harvest of 19,758 pounds of non-salmon fish in Shageluk results in a harvest of just over 160 pounds per person. Significantly, whitefish species comprised approximately 54% (10,750 lbs.) of the total harvest and consisted exclusively of broad whitefish. The estimated per capita harvest of whitefish in Shageluk was 87 pounds per person in 2002. The importance of whitefish is demonstrated both in raw harvest numbers and in documented use patterns. While only 31% of Shageluk households fished for and harvested whitefish species, 16% of the harvesting households shared their fish with approximately 75% of households, so that a total of 90% of the community's households used whitefish in 2002 (Table 10).

Not surprisingly, sheefish and pike also registered as important fish species in Shageluk. Fishers from Shageluk harvested approximately 839 sheefish (5,033 pounds) and 1,288 pike

(3,863 pounds), primarily between July and September (Tables 10 and 11). While the same percentage of households reported harvesting sheefish and pike (34%), 84% of households reported using sheefish, while 69% of households reporting using pike in 2002. For both species, however, a relatively small percentage of households shared both species with a significantly larger percentage of households, demonstrating high levels of sharing and distribution for these non-salmon fish species. Approximately 6% of households reported giving pike away to 47% of households in Shageluk, while 9% of households gave sheefish away to 63% of households. These harvest and distribution patterns account for the high per capita harvest rate of pike and sheefish in Shageluk, measured at 31.2 and 40.7 pounds respectively. This compared to Grayling's per capita rate for pike (13.6) and sheefish (27.4), or Anvik's (pike, 20 pounds and sheefish, 24.5 pounds) per capita rates demonstrate the high levels of use in Shageluk.

Harvest data by month for Shageluk reveal a slightly more focused pattern than was observed in the other three communities (Table 11). Shageluk residents reported harvesting only four species: burbot, broad whitefish, pike and sheefish. This could possibly be linked to Shageluk's location on the Innoko where certain species, such as lamprey, are generally not available or are less available at certain times of the year, such as pike, as suggested by both the TEK interviews and the telemetry project discussed below. Interviews with elders and other knowledgeable fishers from Shageluk suggested that pike around Shageluk leave the area in the wintertime and head for the Yukon main stem (generally confirmed by the telemetry project), while water quality concerns ("red," "iron," or "rotten" water) reportedly drive other species, such as whitefish, out of the Innoko main stem, usually into the Yukon.

For Shageluk residents, the vast majority of fishing in general, and whitefish harvest in particular, occurred during the months of August, September, and November, depending on species. Seventy-eight percent (78%) of the total sheefish harvest was taken in August, while pike were harvested primarily in August and September, and 78% of burbot and 88% of the whitefish (again, exclusively broad whitefish) were harvested in November, after freeze-up. Thus, winter fishing centered on burbot and whitefish in November and December with no fishing reported in January and February. During the 2002 survey year, Shageluk residents

harvested more pike, sheefish, and broad whitefish than any of the other communities; even more interesting is that these harvests took place during very focused times, rather than being spread out over several months. This suggests that Shageluk residents were taking advantage of the seasonal movements of these species, possibly due to the environmental factors and other observations of fish movements in the Shageluk area. It is also interesting to note, within this context, that Shageluk did not report harvesting humpback whitefish, leaving questions about the range and distribution of humpback whitefish, given their presence in the other communities' harvests.

Shageluk was the only community that did not report harvesting eels. This also could have to do with the location of Shageluk on the Innoko River drainage. Mecklenberg, Mecklenberg, and Thorsteinson (2002) describe the Arctic Lamprey, or eel as referred to locally, as inhabiting the Yukon River drainage, where the communities of Holy Cross, Anvik, and Grayling are located. Eels are anadromous species that spawn in clear streams and are generally harvested while moving upstream to their spawning grounds in streams draining into the Yukon River drainage. However, as noted earlier in the TEK section for lamprey, Grayling residents reported seeing baby eels in the stomachs of sheefish caught in the Innoko River drainage near Holikachuk. Residents suggested that given the condition of the eels in the sheefish stomach, the eels likely were eaten in or near the Innoko since they otherwise would have more fully decomposed in the transit time from the Yukon. This might also be an additional clue about spawning and juvenile rearing habitats of lamprey.

Holy Cross: Residents of Holy Cross harvested only six species of non-salmon fish during 2002, including broad whitefish, sheefish, pike, grayling, burbot, and lamprey (Table 12). Of these species, pike, lamprey, and whitefish (specifically broad whitefish) comprised the majority of the annual harvest. Overall, Holy Cross fishers harvested an estimated 5,310 pounds of non-salmon species (approximately 30 pounds per person) and of that amount, 48% was whitefish, 27% was lamprey, and 20% was pike. An estimated 346 pike (1,038 pounds), 1,415 pounds of lamprey, and 639 whitefish (2,555 pounds) were harvested by Holy Cross residents.

While all of the species harvested in Holy Cross were shared between community households, the sharing of whitefish shows the strongest pattern. For example, while only 12% of Holy Cross households fished for and harvested sheefish, most, if not all of those harvesting households shared their fish with approximately 31% of households so that a total of 40% of the community's households used whitefish in 2002 (Table 12). The harvest of pike shows similar patterns. Of the 21% of households harvesting, 12% of households shared their whitefish with 14% of community households such that 35% of the households in Holy Cross reported using pike.

There is some concern about the levels of harvest reported on the survey by Holy Cross residents, given the lower harvest estimates as compared to the other communities. The absence of important fishing families through refusal or absence during the survey work may have affected the overall harvest estimates. Additionally, fishing efforts in a community may be affected by other events, social or environmental, that impact residents' ability to fish. Although fishers in Holy Cross harvested fewer pounds of fish than did other surveyed communities in the region, Table 13 shows that their harvests were spread out over more months than Shageluk, a community that harvested many more pounds of fish. Furthermore, harvests in Holy Cross were focused in the fall and the spring, likely taking advantage of the seasonal movements of certain species. This is a critical observation, given Holy Cross' location at the mouth of the Innoko, a major migratory path for pike and whitefish, especially. For example, 86% of the whitefish harvests occurred in May, right around break-up. This is consistent with information provided in the TEK interviews; Holy Cross residents talked about spring dipnetting more often than they discussed the post freeze-up trapping set by many Shageluk residents. By comparison, recall that 88% of Shageluk's whitefish harvest occurred in November.

Table 5. Estimated Pounds of Non-salmon Fish Harvested in GASH communities, 2002.

Resource	Anvik		Grayling		Holy Cross		Shageluk		Grand Total	
	# of fish	lbs of fish	# of fish	lbs of fish	# of fish	lbs of fish	# of fish	lbs of fish	# of fish	lbs of fish
Non-Salmon Fish		16,142		46,380		5,310		19,758		87,589
Eel		6,671		22,448		1,415		0		30,534
Blackfish		0		13		0		0		14
Burbot	32	64	180	359	58	116	56	113	326	945
Char		0	1	2		0		0	1	3
Lake Trout		0	1	2		0		0	1	3
Grayling	97	97	342	342	142	142		0	581	1,064
Pike	631	1,893	780	2,340	346	1,038	1,288	3,863	3,045	11,547
Sheefish	378	2,267	783	4,698	7	44	839	5,033	2,007	13,670
Sucker	1	2	93	186		0		0	94	281
Whitefish	1,434	5,149	4,529	15,991	639	2,555	2,688	10,750	9,290	42,302
Broad Whitefish	897	3,586	2,403	9,612	639	2,555	2,688	10,750	6,627	32,234
Humpback Whitefish	512	1,535	2,112	6,336		0		0	2,624	9,983
Cisco	26	28	14	0		0		0	40	42
Bering Cisco	5	7		0		0		0	5	7
Least Cisco	21	21		0		0		0	21	21
Unknown Whitefish		0		43		0		0	0	43

SOURCE: Alaska Department of Fish and Game, Division of Subsistence, Household Survey, 2003.

*blank spaces in "# of fish" columns indicate where actual number is not available

Table 6. Estimated Harvest and Use of Non-salmon Fish, Grayling 2002.

Resource Name	Percentage of Households					lbs Harvested			Amount Harvested		
	Use	Att	Harv	Recv	Give	Total	Mean HH	Per capita	Total		Mean HH
Non-Salmon Fish	**83.3**	**77.1**	**77.1**	**72.9**	**62.5**	**46,380**	**946.5**	**270.4**	**46,380**	**lbs**	**946.5**
Arctic Lamprey	68.7	50.0	50.0	37.5	29.2	22,448	458.1	130.9	22,448	lbs	458.1
Blackfish	12.5	6.3	6.3	8.3	2.1	13	0.3	0.1	13	lbs	0.3
Burbot	50.0	29.2	29.2	31.3	14.6	359	7.3	2.1	180	ea.	3.7
Char	2.1	2.1	2.1	0.0	0.0	2	0.0	0.0	1	ea.	0.0
Lake Trout	2.1	2.1	2.1	0.0	0.0	2	0.0	0.0	1	ea.	0.0
Grayling	41.7	33.3	33.3	22.9	10.4	342	7.0	2.0	342	ea.	7.0
Pike	68.7	52.1	52.1	45.8	35.4	2,340	47.8	13.6	780	ea.	15.9
Sheefish	70.8	58.3	58.3	47.9	37.5	4,698	95.9	27.4	783	ea.	16.0
Sucker	27.1	18.8	18.8	8.3	2.1	186	3.8	1.1	93	ea.	1.9
Whitefish	75.0	56.3	54.2	50.0	43.8	15,991	326.4	93.2	4,529	ea.	92.4
Broad Whitefish	66.7	50.0	50.0	45.8	35.4	9,612	196.2	56.0	2,403	ea.	49.0
Humpback Whitefish	64.6	52.1	50.0	43.8	33.3	6,336	129.3	36.9	2,112	ea.	43.1
Unknown whitefish	6.3	4.2	4.2	2.1	4.2	43	0.9	0.3	14	ea.	0.3
Cisco	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0	ea.	0.0
Bering Cisco	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0	ea.	0.0
Least Cisco	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0	ea.	0.0

SOURCE: Alaska Department of Fish and Game, Division of Subsistence, Household Survey, 2003.

Table 7. Estimated Harvest of Non-salmon Fish by Month, Grayling 2002.

Resource Name	Units	Any month		January		February		March		April		May		June	
		Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total
Arctic lamprey	lbs	22,448	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Blackfish	lbs	13	100.0%	0	0.0%	0	0.0%	6	46.2%	7	53.8%	0	0.0%	0	0.0%
Burbot	ea.	180	100.0%	14	8.0%	14	8.0%	13	7.4%	0	0.0%	4	2.3%	0	0.0%
Lake Trout	ea.	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	100.0%	0	0.0%
Grayling	ea.	342	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	25	7.2%
Pike	ea.	780	100.0%	43	5.5%	42	5.4%	117	15.1%	44	5.6%	35	4.5%	34	4.3%
Sheefish	ea.	783	100.0%	26	3.3%	33	4.2%	43	5.5%	37	4.7%	50	6.4%	271	34.6%
Sucker	ea.	93	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	5.5%	0	0.0%
Broad Whitefish	ea.	2,403	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	378	15.7%	324	13.5%
Humpback Whitefish	ea.	2,112	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	235	11.1%	268	12.7%
Unknown Whitefish	ea.	14	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bering Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Least Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Resource Name	Units	July		August		September		October		November		December		Unknown month	
		Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total
Arctic lamprey	lbs	0	0.0%	0	0.0%	5	0.0%	521	2.3%	21,616	96.3%	0	0.0%	306	1.4%
Blackfish	lbs	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Burbot	ea.	12	6.8%	9	5.1%	48	26.7%	22	12.5%	17	9.7%	25	13.6%	0	0.0%
Lake Trout	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Grayling	ea.	37	10.7%	138	40.3%	133	38.8%	10	3.0%	0	0.0%	0	0.0%	0	0.0%
Pike	ea.	36	4.6%	108	13.9%	197	25.3%	55	7.1%	22	2.9%	47	6.0%	0	0.0%
Sheefish	ea.	121	15.5%	92	11.7%	49	6.3%	14	1.8%	22	2.9%	20	2.6%	5	0.7%
Sucker	ea.	37	39.6%	28	29.7%	6	6.6%	3	3.3%	9	9.9%	5	5.5%	0	0.0%
Broad Whitefish	ea.	310	12.9%	552	23.0%	689	28.7%	129	5.4%	21	0.9%	0	0.0%	0	0.0%
Humpback Whitefish	ea.	290	13.7%	522	24.7%	656	31.1%	109	5.2%	32	1.5%	0	0.0%	0	0.0%
Unknown Whitefish	ea.	0	0.0%	8	57.1%	6	42.9%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bering Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Least Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

SOURCE: Alaska Department of Fish and Game, Division of Subsistence, Household Survey, 2003.

Table 8. Estimated Harvest and Use of Non-salmon Fish, Anvik 2002.

Resource Name	Percentage of Households					lbs Harvested			Amount Harvested		
	Use	Att	Harv	Recv	Give	Total	Mean HH	Per capita	Total		Mean HH
Non-Salmon Fish	**64.7**	**58.8**	**58.8**	**41.2**	**32.4**	**16,142**	**461.2**	**174.2**	**16,142**	**lbs**	**461.2**
Arctic Lamprey	44.1	35.3	35.3	20.6	23.5	6,671	190.6	72.0	6,671	lbs	190.6
Blackfish	2.9	0.0	0.0	2.9	2.9	0	0.0	0.0	0	lbs	0.0
Burbot	23.5	20.6	20.6	5.9	0.0	64	1.8	0.7	32	ea.	0.9
Grayling	26.5	23.5	23.5	11.8	8.8	97	2.8	1.0	97	ea.	2.8
Pike	52.9	47.1	47.1	29.4	20.6	1,893	54.1	20.4	631	ea.	18.0
Sheefish	55.9	41.2	41.2	32.4	14.7	2,267	64.8	24.5	378	ea.	10.8
Sucker	2.9	2.9	2.9	0.0	0.0	2	0.1	0.0	1	ea.	0.0
Whitefish	55.9	38.2	38.2	38.2	26.5	5,149	147.1	55.6	1,434	ea.	41.0
Broad Whitefish	55.9	38.2	38.2	32.4	20.6	3,586	102.5	38.7	897	ea.	25.6
Humpback Whitefish	44.1	32.4	32.4	32.4	14.7	1,535	43.9	16.6	512	ea.	14.6
Unknown Whitefish	0.0	0.0	0.0	1.8	0.0	0	0.0	0.0	0	ea.	0.0
Cisco	5.9	5.9	5.9	2.9	2.9	28	0.8	0.3	26	ea.	0.7
Bering Cisco	2.9	2.9	2.9	2.9	0.0	7	0.2	0.1	5	ea.	0.1
Least Cisco	5.9	5.9	5.9	2.9	2.9	21	0.6	0.2	21	ea.	0.6

SOURCE: Alaska Department of Fish and Game, Division of Subsistence, Household Survey, 2003.

Table 9. Estimated Harvest of Non-salmon Fish by Month, Anvik 2002.

Resource Name	Units	Any month		January		February		March		April		May		June	
		Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total
Arctic lamprey	lbs	6,671	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Blackfish	lbs	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Burbot	ea.	32	100.0%	0	0.0%	0	0.0%	0	0.0%	5	16.1%	0	0.0%	0	0.0%
Grayling	ea.	97	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	6	6.4%	0	0.0%
Pike	ea.	631	100.0%	0	0.0%	0	0.0%	0	0.0%	9	1.5%	77	12.2%	13	2.1%
Sheefish	ea.	378	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	82	21.8%	48	12.8%
Sucker	ea.	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Broad Whitefish	ea.	897	100.0%	0	0.0%	15	1.7%	15	1.7%	43	4.8%	276	30.8%	6	0.7%
Humpback Whitefish	ea.	512	100.0%	0	0.0%	15	3.0%	22	4.2%	31	6.0%	64	12.5%	0	0.0%
Unknown Whitefish	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bering Cisco	ea.	5	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	100.0%	0	0.0%
Least Cisco	ea.	21	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	10	50.0%	0	0.0%

Resource Name	Units	July		August		September		October		November		December		Unknown month	
		Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total
Arctic lamprey	lbs	0	0.0%	0	0.0%	0	0.0%	0	0.0%	6,671	100.0%	0	0.0%	0	0.0%
Blackfish	lbs	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Burbot	ea.	0	0.0%	1	3.2%	21	64.5%	1	3.2%	2	6.5%	2	6.5%	0	0.0%
Grayling	ea.	19	19.1%	38	39.4%	34	35.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pike	ea.	12	2.0%	188	29.9%	250	39.6%	46	7.3%	7	1.1%	5	0.8%	22	3.4%
Sheefish	ea.	10	2.7%	21	5.4%	166	43.9%	23	6.0%	18	4.6%	10	2.7%	0	0.0%
Sucker	ea.	0	0.0%	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Broad Whitefish	ea.	0	0.0%	170	18.9%	216	24.1%	72	8.0%	41	4.6%	41	4.6%	0	0.0%
Humpback Whitefish	ea.	0	0.0%	175	34.2%	103	20.1%	31	6.0%	39	7.6%	32	6.2%	0	0.0%
Unknown Whitefish	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bering Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Least Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	25.0%	5	25.0%	0	0.0%

SOURCE: Alaska Department of Fish and Game, Division of Subsistence, Household Survey, 2003.

Table 10. Estimated Harvest and Use of Non-salmon Fish by Shageluk 2002.

Resource Name	Percentage of Households					lbs Harvested			Amount Harvested			
	Use	Att	Harv	Recv	Give	Total	Mean HH	Per capita	Total			Mean HH
Non-Salmon Fish	**93.8**	**34.4**	**34.4**	**78.1**	**15.6**	**19,758**	**493.9**	**159.7**	**4,870**	**ea.**		**121.8**
Arctic lamprey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Blackfish	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0	lbs		0.0
Burbot	31.3	12.5	12.5	18.8	0.0	113	2.8	0.9	56	ea.		1.4
Grayling	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0	ea.		0.0
Pike	68.8	34.4	34.4	46.9	6.3	3,863	96.6	31.2	1,288	ea.		32.2
Sheefish	84.4	34.4	34.4	62.5	9.4	5,033	125.8	40.7	839	ea.		21.0
Sucker	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0	ea.		0.0
Whitefish	90.6	31.3	31.3	75.0	15.6	10,750	268.8	86.9	2,688	ea.		67.2
Broad Whitefish	90.6	31.3	31.3	75.0	15.6	10,750	268.8	86.9	2,688	ea.		67.2
Humpback Whitefish	0.0	-	0.0	0.0	0.0	0	0.0	0.0	0	ea.		0.0
Unknown whitefish	0.0	0.0	0.0	1.8	0.0	0	0.0	0.0	0	ea.		0.0
Cisco	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0	ea.		0.0
Bering Cisco	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0	ea.		0.0
Least Cisco	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0	ea.		0.0

SOURCE: Alaska Department of Fish and Game, Division of Subsistence, Household Survey, 2003.

Table 11. Estimated Harvest of Non-salmon Fish by Month, Shageluk 2002.

Resource Name	Units	Any month		January		February		March		April		May		June	
		Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total
Blackfish	lbs	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Burbot	ea.	56	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Grayling	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pike	ea.	1,288	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	75	5.8%	13	1.0%
Sheefish	ea.	839	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	19	2.2%
Sucker	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Broad Whitefish	ea.	2,688	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Humpback Whitefish	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Unknown Whitefish	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bering Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Least Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Resource Name	Units	July		August		September		October		November		December		Unknown month	
		Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total
Blackfish	lbs	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Burbot	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	44	77.8%	0	0.0%	13	22.2%
Grayling	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pike	ea.	25	1.9%	469	36.4%	706	54.9%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Sheefish	ea.	44	5.2%	645	76.9%	131	15.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Sucker	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Broad Whitefish	ea.	38	1.4%	188	7.0%	88	3.3%	0	0.0%	2,375	88.4%	0	0.0%	0	0.0%
Humpback Whitefish	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Unknown Whitefish	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bering Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Least Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

SOURCE: Alaska Department of Fish and Game, Division of Subsistence, Household Survey, 2003.

Table 12. Estimated Harvest and Use of Non-salmon Fish, Holy Cross 2002.

Resource Name	Percentage of Households					lbs Harvested			Amount Harvested		
	Use	Att	Harv	Recv	Give	Total	Mean HH	Per capita	Total		Mean HH
Non-Salmon Fish	**57.7**	**28.8**	**28.8**	**38.5**	**21.2**	**5,310**	**83.0**	**29.5**	**5,310**	**lbs**	**83.0**
Arctic lamprey	9.6	7.7	7.7	1.9	7.7	1,415	22.1	7.9	1,415	lbs	22.1
Blackfish	1.9	1.9	1.9	0.0	1.9	0	0.0	0.0	0	lbs	0.0
Burbot	23.1	9.6	9.6	13.5	5.8	116	1.8	0.6	58	ea.	0.9
Grayling	23.1	15.4	15.4	7.7	5.8	142	2.2	0.8	142	ea.	2.2
Pike	34.6	21.2	21.2	13.5	11.5	1,038	16.2	5.8	346	ea.	5.4
Sheefish	3.8	1.9	1.9	1.9	1.9	44	0.7	0.2	7	ea.	0.1
Sucker	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0	ea.	0.0
Whitefish	40.4	11.5	11.5	30.8	11.5	2,555	39.9	14.2	639	ea.	10.0
Broad Whitefish	36.5	11.5	11.5	26.9	9.6	2,555	39.9	14.2	639	ea.	10.0
Humpback Whitefish	1.9	0.0	0.0	1.9	1.9	0	0.0	0.0	0	ea.	0.0
Unknown Whitefish	3.8	0.0	0.0	3.8	0.0	0	0.0	0.0	0	ea.	0.0
Cisco	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0	ea.	0.0
Bering Cisco	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0	ea.	0.0
Least Cisco	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0	ea.	0.0

SOURCE: Alaska Department of Fish and Game, Division of Subsistence, Household Survey, 2003.

Table 13. Estimated Harvest of Non-salmon Fish by Month, Holy Cross 2002.

Resource Name	Units	Any month		January		February		March		April		May		June	
		Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total
Arctic lamprey	lbs	1,415	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Blackfish	lbs	0	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Burbot	ea.	58	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Grayling	ea.	142	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pike	ea.	346	100.0%	0	0.0%	17	5.0%	171	49.5%	153	44.1%	0	0.0%	0	0.0%
Sheefish	ea.	7	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Sucker	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Broad Whitefish	ea.	639	100.0%	0	0.0%	0	0.0%	5	0.8%	74	11.6%	550	86.1%	10	1.5%
Humpback Whitefish	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Unknown Whitefish	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bering Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Least Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Resource Name	Units	July		August		September		October		November		December		Unknown month	
		Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total	Amt.	% of total
Arctic lamprey	lbs	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1,415	100.0%	0	0.0%	0	0.0%
Blackfish	lbs	0	0.0%	0	0.0%	0	0.0%	0	100.0%	0	0.0%	0	0.0%	0	0.0%
Burbot	ea.	0	0.0%	0	0.0%	0	0.0%	7	12.8%	14	23.4%	0	0.0%	37	63.8%
Grayling	ea.	0	0.0%	6	4.3%	9	6.1%	117	82.6%	10	7.0%	0	0.0%	0	0.0%
Pike	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	1.4%	0	0.0%
Sheefish	ea.	0	0.0%	0	0.0%	0	0.0%	7	100.0%	0	0.0%	0	0.0%	0	0.0%
Sucker	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Broad Whitefish	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Humpback Whitefish	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Unknown Whitefish	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bering Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Least Cisco	ea.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

SOURCE: Alaska Department of Fish and Game, Division of Subsistence, Household Survey, 2003.

Sampling of the Subsistence Harvest of Northern Pike and Tag Recovery

Information on the size, age, and sex of northern pike harvested by Holy Cross residents during the ice fishing season was collected in an effort to assess the portion of these fish in age and size categories and to assess the status or health of this stock. The sites used by subsistence fishers in the area were identified on maps along with the seasonal locations of northern pike fitted with radio transmitters. Tags were recovered from the subsistence fishery and the time, location, and gear of capture was documented. The location of radio-tagged northern pike or the recovery of numbered tags (initially captured in areas used by the sport fishery) in or near subsistence use sites would provide evidence that both fisheries are using one stock of fish. The voluntary return of tags also provides a gross indicator of the level of exploitation of northern pike by subsistence fishers.

Radio Telemetry

The tagging locations of northern pike fitted with radio transmitters in early June 2002 are shown in Figure 2. The May 2003 and 2004 locations of the radio tagged fish are illustrated in Figure 3. Because spawning occurs in May, these areas can be used as a loose representation of the spawning areas used by this group of fish. The summer time locations of the radio-tagged fish in 2002 through 2004 are summarized in Figure 4. During the summer period, radio-tagged fish were located as far up stream as Layman's Lake and as far south as Pike Lake. None of the fish were located outside of the Innoko River drainage during the open water period. Winter time locations (October through mid April) during 2002 - 2004 are shown in Figure 5. In contrast to results from the open water season, in winter the radio-tagged northern pike were regularly located in the Yukon River area near Holy Cross and near the confluence with Paimiut Slough.

Subsistence Fishing Locations

Locations that were reported as subsistence fishing sites for local communities for northern pike in summer are summarized in Figure 4. Winter (ice covered season) fishing sites are shown in Figure 5.

Age, Sex and Size of Northern Pike sampled from the subsistence fishery.

As reported in the interviews, the harvest of northern pike by "hooking" during winter/spring is an important subsistence activity particularly to the residents of Holy Cross. Members of the community participate in this fishery throughout the ice covered season and more intensively during periodic pike "fishing derbies" that take place on the Yukon River near the community. In late March in both 2003 and 2004 northern pike were sampled from this fishery. A total of 88 northern pike were sampled of which sex was determined for 73 fish. Sixty-two percent (45 of 73) were females; all but one of the females was in pre-spawning condition. Thirty-eight (28 of 73) of the fish sampled were males; all were in pre-spawning condition.

Female northern pike sampled from the fishery were larger than were males (Figure 6). All northern pike larger than 32 inches (total length) were female and were in pre-spawning condition. Female northern pike in the sample showed faster growth than did males; females were generally larger than males in the age groups represented.

Recaptured northern pike.

To date, six northern pike of the nearly 3000 fish which were tagged in the sport fishery or during the June 2002 ADFG sampling have been reported as recaptured in the subsistence fishery (Appendix E). Four of the fish were reported captured from the ice season fishery near Holy Cross or Paimiut in the Yukon River during March. The remaining fish were taken in set nets in the Yukon River down stream of Paimiut in summer.

Figure 2. Locations of initial capture and release during June 2002 of sixty northern pike fitted with radio transmitters.

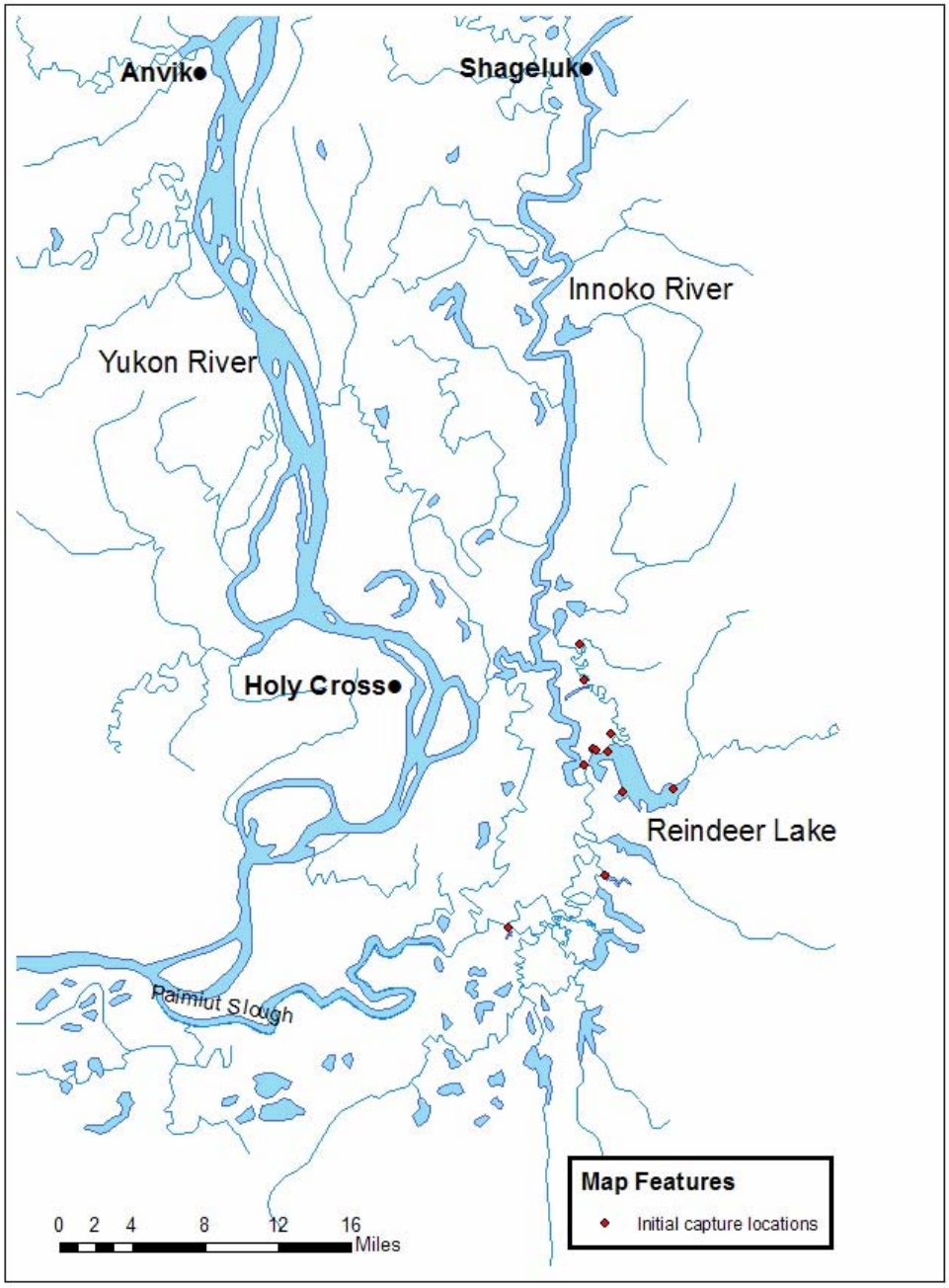


Figure 3. Locations of northern pike fitted with radio transmitters during May 2003 and 2004 (spawning season).

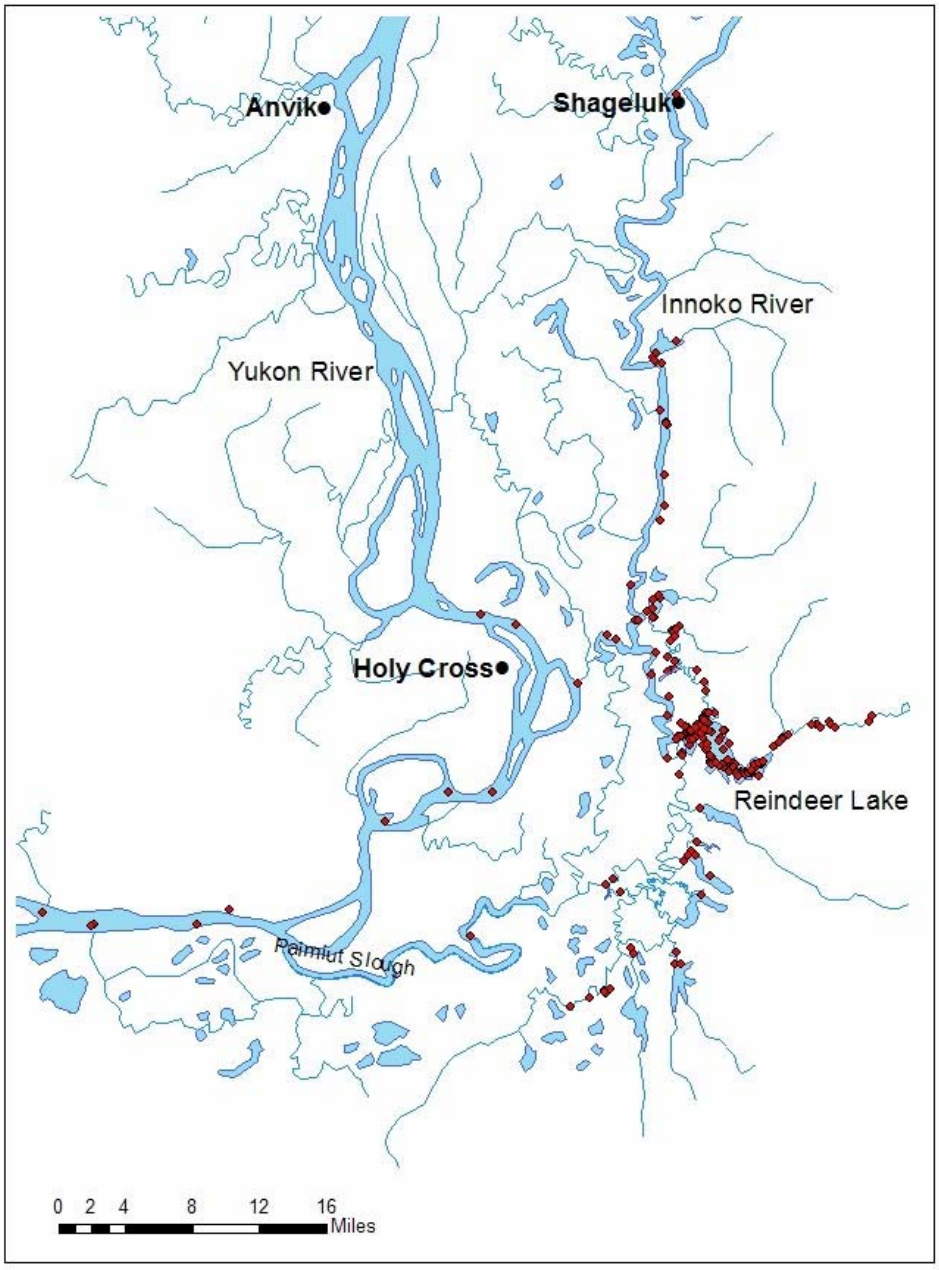


Figure 4. Locations of northern pike fitted with radio transmitters during open water season (May excluded). Summer time subsistence fishing locations are shaded. Areas used by the guided sport fishery between early June and September are shown in crosshatch.

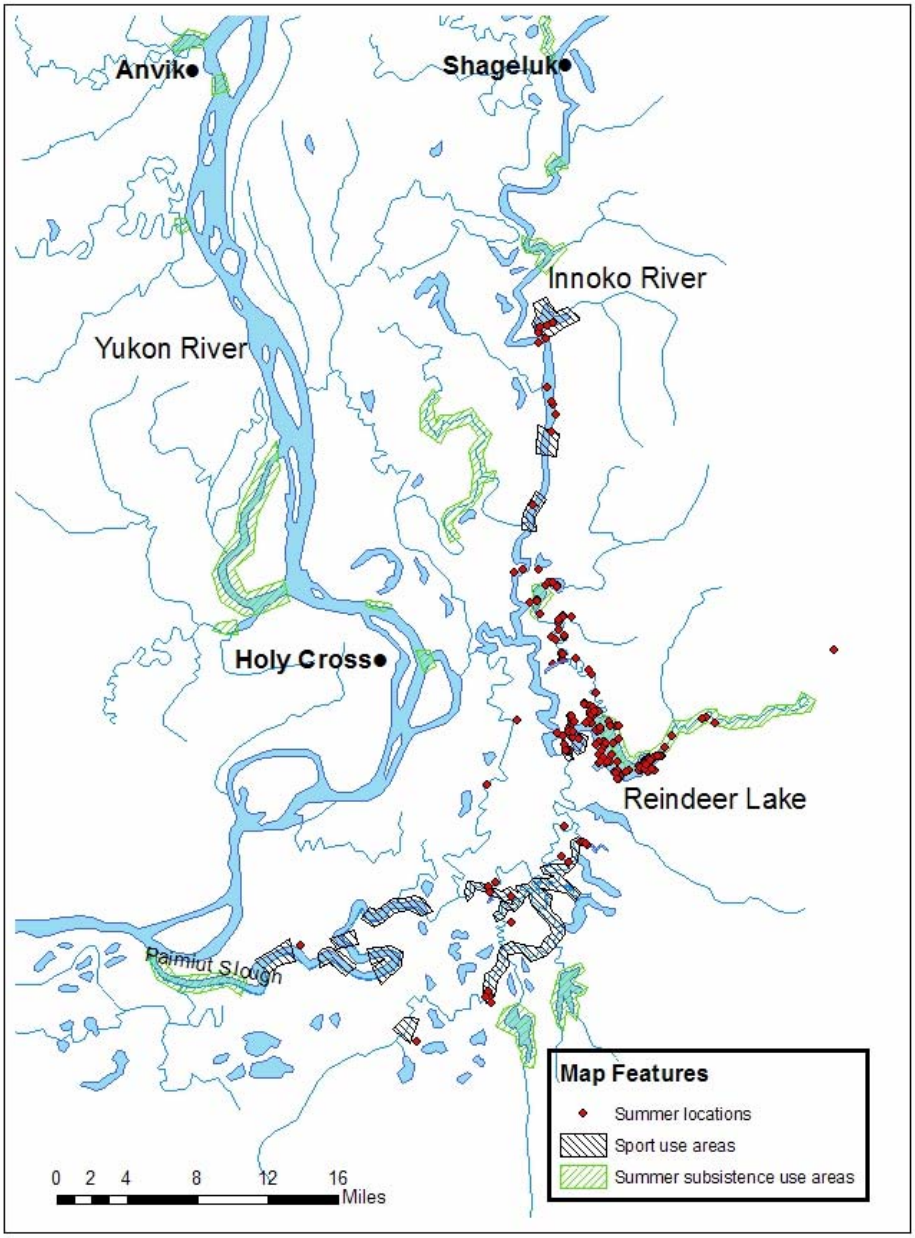
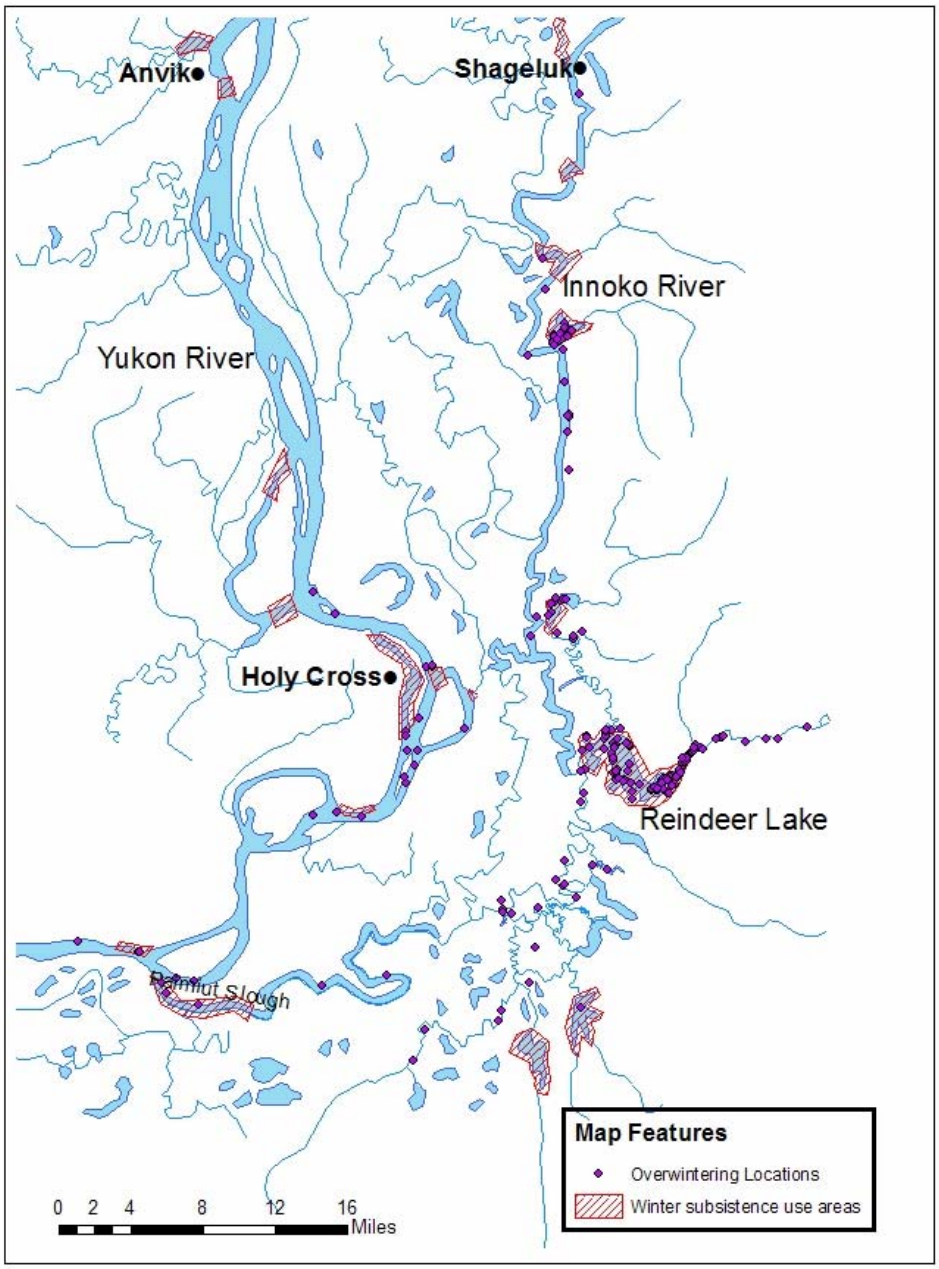


Figure 5. Locations of northern pike fitted with radio transmitters during winter (October - mid April). Winter time subsistence fishing locations are shaded.



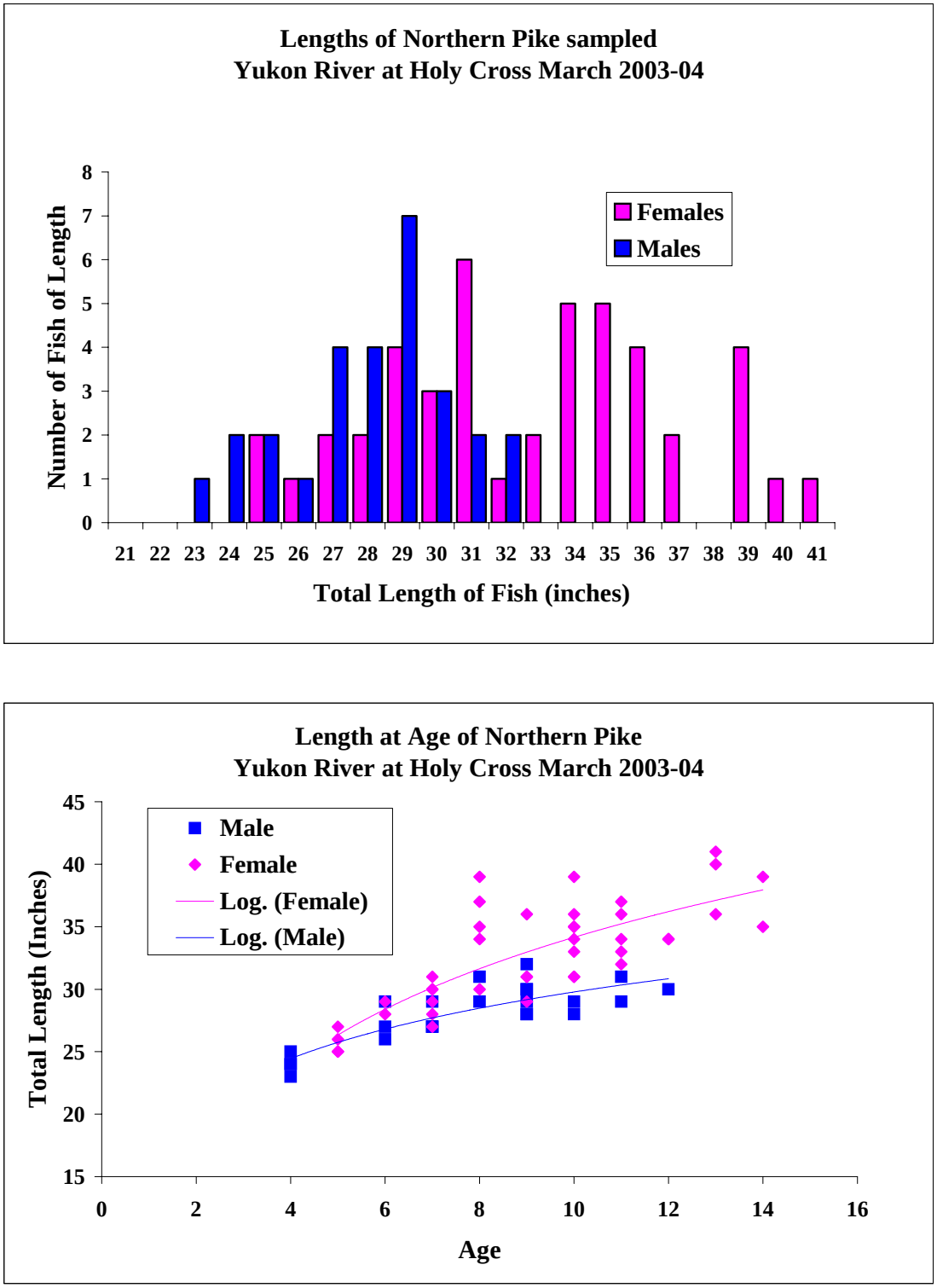


Figure 6. Northern Pike sampled from the subsistence fishery at Holy Cross during March 2003 and 2004. *Top panel* - lengths of 45 females and 28 males. *Bottom panel* - lengths and ages of 45 female and 28 male northern pike.

DISCUSSION

This project pulls together three very different data sets to address a general need for greater understanding of harvest and use of non-salmon fish species in the villages of Grayling, Anvik, Shageluk, and Holy Cross. The data sets – ethnographic data resulting from fieldwork, harvest surveys, and biological sampling of the late winter subsistence pike harvest with some telemetry analysis of seasonal pike movements – combine here to contextualize and describe the subsistence use of non-salmon fish, both historically and contemporarily, while also addressing a more specific management concern about user conflicts over pike in the Holy Cross/Reindeer Lake area. This discussion is organized to take into account the contributions of each data set and draws connections between them in addressing the larger objectives of this project.

Ethnographic fieldwork documenting traditional ecological knowledge confirms that area residents and fishers maintain an extensive body of information that is based on long-term observation of and interaction with these complicated fisheries and the larger ecological environment of which they are a part. Interviews indicate that local residents have a wealth of information regarding harvest practices for certain grouped species. Additionally, they have historically developed specific techniques to target single species that are responsive to the life history of the species and/or the other environmental factors such as weather or water conditions. For example, several species, including whitefish, burbot, pike, and sheefish are harvested using in-river funnel traps made extremely effective by "plugging" or "shutting down" the river with willow brush fences. At the same time, the effective utilization of these traps is highly dependent on an intimate knowledge of the waterways and their relationship to ice conditions as well as the life histories of targeted species.

Most of the ethnographic interviews also include mapped information documenting significant harvest areas and often specifying gear type and season. Combined with narratives about the life histories of these species, this mapped information locates areas of significant congregations of fish based on their seasonal movements and other ecological

factors, such as water quality. Wheeler (1998) provides essential resource use and distribution maps that include information about non-salmon fish species in the GASH area; this study builds on her report by providing detailed, species-specific data and additional season and gear type information. The combination of mapped harvest areas and narrative information about habitat and other environmental factors might be important for more detailed ecological studies.

From an ethnographic perspective, this project is similar in design and research structure to an earlier study funded by the Office of Subsistence Management on the traditional ecological knowledge of non-salmon fish species in the Koyukuk River Drainage. As such, the ethnographic work in the lower-middle Yukon offers some interesting comparative data both supporting and affirming findings from the Koyukuk study, while indicating some regional and local distinctions with reference to non-salmon fish harvests and use. Both projects document a rich body of knowledge passed down generationally and characterized by a high level of active interaction with the natural world that fall generally into the following categories: 1) Native terms and taxonomy; 2) life history, seasonal movements and spawning; 3) traditional and contemporary harvest methods; 4) Use, preparation, and preservation methods; 5) relative abundance; and 6) traditional stories and beliefs. As can be seen in the Results section, there is a high level of consistency in knowledge about fish life history between the two regions, while, perhaps expectedly, some of the social practices surrounding non-salmon fish diverge. For example, one of the most prominent differences is the taboos surrounding the lamprey harvest. As documented in the species summary for Arctic lamprey, pre-menopausal women and anyone who has lost a family member in the preceding year should not be present on the ice when the "eels" are running. Local values and beliefs about the causal relationship between human behavior and lamprey migrations based on the lampreys' "sensitivity," define proper social action during the harvest to ensure adequate harvest of this important species.

Another example of regional and local distinctions involves language. While a comprehensive socio-linguistic analysis is beyond the scope of both the Koyukuk River and the GASH studies, both reports present and organize preliminary linguistic inventories of fish

species, with additional linguistic information for gear types and other harvest implements. In both cases, the research documents several examples of divergences between Native taxonomies and Linnean systems of classification, providing additional information on fish size, location, and behavior. Andersen et al (2004) describe these differences for Koyukon Athabascan. This study documents several instances of Deg Xinag and Holikachuck words for certain species where the literal translations provide descriptive information about fish in terms of size, location, and behavior not communicated by the Linnaean system. More specifically, the Deg Xinag and Holikachuk terms for whitefish do not map identically onto the Linnaean system. For example, several terms exist in Deg Xinag to describe whitefish. The general term for whitefish, łegg, is also the generic term for fish, while three other denote separate species: humpback (*q'ontoggiy*), broad (*tilay*), and round whitefish (*xiłting*). A fourth term, *iłch'eddh,* recognizes life cycle (baby whitefish), and a fifth term describes a whitefish species that does not easily fit into established western scientific inventories. This literal translation of this term, *taghiy*, separates this fish from other whitefish on the basis of body condition and primary habitat. While the general term suggests the importance of whitefish among other fish species, these specific terms might also suggest significant distinctions based on harvest practices.

Regional and local distinctions are also evident with reference to non-salmon fish harvests and use. Interestingly, whitefish constitute the majority of the non-salmon harvest for both the Koyukuk River region and the GASH area, attesting to the importance of whitefish species, especially humpback and broad whitefish. However, the different landscapes in the two regions also lead to some differences. For example, while grayling are present in the GASH area, they were not harvested in 2002, to the extent that they are in the upper reaches of the Koyukuk where the habitat may support larger populations of grayling and/or the absence of other fish increases the relative importance of grayling harvests. Additionally, Arctic lampreys are harvested in large quantities by fishermen in the lower-middle Yukon region, but not up-river, providing clues about the distribution of lamprey. While there are some reports of catching small "eels" in fish wheels in the middle Yukon area, these fish are not targeted for harvest.

The 2002 harvest data can also be usefully compared to harvest data collected earlier. First, Wheeler (1998) documented harvest levels in 1990-1991 for the four communities in the GASH area. While the 1990-1991 and 2002 data sets are not completely comparable because of the absence of lamprey harvest data for 1990-1991, a species-specific comparison reveals some interesting shifts in harvest patterns. The following table compares the edible pounds harvested of three large non-salmon species between 1990-1991 and 2002.

Table 14. Edible Pounds of Whitefish, Pike, and Sheefish, 1990-1991 and 2002 in Grayling, Anvik, Shageluk, and Holy Cross

Species	**Grayling**		**Anvik**		**Shageluk**		**Holy Cross**	
Years compared	**1990**	**2002**	**1990**	**2002**	**1990**	**2002**	**1990**	**2002**
Whitefish	15,637	15,991	6,460	5,149	9,158	10,750	8,447	2,555
Pike	3,047	2,340	2,434	1,893	6,263	3,863	7,725	1,038
Sheefish	10,730	4,698	3,071	2,267	2,081	5,033	5,587	44

With the exception of Holy Cross, whitefish harvests are the most consistent between 1990 and 2002, while pike and sheefish harvests show more variability between years and communities. More specifically, pike harvests appear to have decreased between the survey years in all four villages, while sheefish harvests appear to have declined to some degree everywhere except Shageluk. Demographic changes do not appear to be the cause of these shifts because comparing the per capita harvests by survey year of these same species shows similar patterns. For example, while whitefish per capita harvests have remained relatively stable for Grayling, Anvik, and Shageluk, sheefish per capita harvests have decreased in Grayling and Anvik and nearly doubled in Shageluk. Comparing harvest data between two non-consecutive years over a decade apart can reveal some potential trends, though longer term harvest data are needed to evaluate questions about decreasing non-salmon harvests, especially pike and sheefish. Overall however, it is clear that non-salmon fish harvests remain a significant contributor to the subsistence economies of the area.

Wheeler (1993, 1998) also provides comparative information in her description of the non-salmon fishery in terms of season and geographic distribution. A comparison of harvest area

mapping between Wheeler's research and the current study reveals significant overlap in documented fishing sites likely indicating that fishing patterns have not shifted significantly over the last decade. According to Wheeler (1993), summer and fall are the most productive times of the year for whitefish, while sheefish and pike can be caught year-round. The seasonal information collected in the 2002 harvest survey also follows this pattern. For example, 94% of Grayling residents' broad whitefish harvest was taken between May and September. The other communities reported similar patterns with the exception of Shageluk where the majority of the broad whitefish harvest (88.4%) occurred in November.

ADF&G, Division of Commercial Fisheries (CF) also collects non-salmon harvest data in the post-season salmon surveys conducted in communities along the Yukon River. However, it is important to keep in mind that collection of non-salmon harvest data is not the primary purpose for the post-season surveys. Furthermore, the implementation of this post-season survey immediately following the salmon season may not be timed to produce the most reliable results for non-salmon harvests. Finally, the survey time period differs for both surveys; the post-season surveys record harvests between September 2001 and September 2002 while the subsistence survey covers the 2002 calendar year. In general, the CF post-season salmon surveys documented significantly lower harvest levels than the 2002 subsistence survey of non-salmon fish species. For example, the harvest survey for this project recorded nearly two and a half times the amount of whitefish recorded in the post-season surveys (3,926/9,290). The estimates for other species follow similar patterns: nearly three times the number of pike was recorded in the non-salmon survey as were recorded in the post-season surveys (940/3,045). Interestingly, area residents reported a significant harvest of blackfish (5,278) that was not captured in the non-salmon subsistence surveys, though it is not clear that these blackfish were harvested during the 2002 calendar year measured in the post season subsistence surveys.

The non-salmon harvest survey also included an open-ended comment section. A total of 45 comments were received from three villages: four from Anvik, two from Holy Cross, and the rest from Grayling (see Appendix C). In general, most comments addressed one or more of the following categories: quantity or condition of non-salmon fish (15 comments), concerns

about declining salmon runs or subsistence fishing opportunities (15 comments), sport fishing in the area or regulation more generally (6 comments), and use (2 comments). Seven miscellaneous comments addressed such diverse topics as access to fish in urban centers, reasons for not fishing, and one particularly interesting comment about social prohibitions against talking about fish: "Don't ask any more questions about fishing, because fishing is too poor." One of the primary reasons for undertaking this research involved user conflicts over pike fishing, especially near the village of Holy Cross, and down-river from Shageluk. Comments on the harvest surveys regarding competition with sport fishers over pike in addition to concerns expressed during interviews, especially with Holy Cross residents suggest there is significant local concern about waste, declining size of pike, and mortality rates, "…Worried about pike population. Too many sport fishing. Catch and release doesn't work."

The harvest assessment data are also an important part of this project and provide a contemporary snap-shot of non-salmon harvests in a particular geographic area. This data set complements traditional ecological knowledge in several ways. First, it provides a contemporary picture of harvest helpful in quantifying uses described in the interviews. Second, it identifies the full range of species used in the GASH region, even when not identified in each interview, and the extent to which a species is used. Finally, the survey offers clues to how these species are distributed within a subsistence network; the questions tracking use, harvest, receipt and giving away of non-salmon fish suggest patterns in the social organization of subsistence for the region as a whole and in specific communities.

The final component of this study collected samples for age/sex/size indices from the subsistence winter harvest of pike in Holy Cross and provided information about seasonal distribution of pike tagged in the vicinity of Holy Cross and Reindeer Lake using radio telemtry. The northern pike fitted with radio tags in the Reindeer Lake area and in Paimiut Slough upstream of Innoko Slough in June 2002 were located only within the Innoko River drainage during the open water season in 2002 and 2003 (Figures 2 and 4). Radio-tagged fish were located in the Yukon River only during winter season (Figure 5). These results suggest that northern pike that spawn and forage in the Innoko River do not spend much of

the open water season in the main stem Yukon River. However, the recapture of a pike tagged in lower Piamuit Slough during June and August 1999 and recaptured in the Yukon River net set downstream of Paimuit (Appendix E) indicates that some pike do travel into the Yukon during the summer season.

Northern pike in the Yukon River area spawn in mid to late May. The location of radio-tagged pike during May 2003 and 2004 indicates that these fish spawn primarily in the Reindeer Lake area and in Paimiut Slough upstream of Innoko Slough. Access to the area is very limited during this period as ice and snow conditions make travel difficult. Because of poor access, subsistence harvest is likely to be minimal during the spawning season.

During the summer months most subsistence harvest of northern pike occurs near the mouths of streams tributary to the Yukon River or in the Yukon River as by-catch of fishing effort directed at other species including Pacific salmon (Figure 4). In contrast, during winter a greater portion of pike are harvested at sites that are not in or adjacent to the Yukon River (Figure 5).

The summer locations of the radio-tagged northern pike provide a general description of the area used by the sport fishery in the lower part of the Innoko River. The locations used by the primary sport fish guiding business are shown in Figure 4. Based on information provided by respondents on the summer season subsistence fishing areas, the fisheries appear to be separated geographically during the summer.

Northern pike fitted with radio tags that inhabit areas used by the sport fishery in summer were frequently located near fishing sites used by local subsistence fishers in winter (Figure 5). This provides clear evidence that the Holy Cross subsistence fishery and the lower Innoko sport fishery are utilizing northern pike from a single stock that migrates seasonally throughout a very large open system.

Nearly all of the samples collected from the wintertime subsistence fishery were obtained during March 2003 and 2004 from the Yukon River adjacent to the community of Holy

Cross. Spring time hooking (ice fishing) for northern pike is an important subsistence activity for the residents of Holy Cross. The fishery targets large northern pike that are preferred for traditional foods. The fish collected in the sample were predominately females and all but one was in pre-spawning condition. This result is consistent with previous studies that report that northern pike larger than 32" in Alaska are female. The large proportion of females in the catch is also consistent with other studies that have found that females feed more aggressively in winter/spring than do males (Diana 1983). The increased feeding behavior by females is due to the additional energy required for egg development in preparation for the spring spawning season.

An additional group of users targeting northern pike in the lower Innoko River/Paimiut Slough area was identified during this study. Residents of communities situated on the Kuskokwim River travel across country during spring (February-April) to harvest northern pike. Several individuals interviewed in the GASH area communities commented that people from the Kuskokwim drainage harvest northern pike from the area. The primary fishing location used by the Kuskokwim residents (identified from aerial surveys and from tag returns) was the Yukon River in the vicinity of Paimiut Slough. One-half (2 of 4) of all voluntary tag returns from the ice fishery harvest were returned by Kuskokwim drainage residents and from this site (Appendix E).

However, we are unable to evaluate the magnitude of the harvest of Innoko/Paimiut Slough northern pike by Kuskokwim area residents. Estimating the harvest of freshwater fish by the Kuskokwim communities was beyond the scope of this project and any measure of the harvest is qualitative at best. We suspect that the impact of harvest of northern pike by residents of these communities is substantial given the long distance they must travel to participate in the fishery, the high proportion of voluntary tag returns from these fishers, and because of the demonstrated selective harvest of large, pre-spawning females in the spring time ice fishery. A quantitative measure of the harvest of freshwater fish in the GASH area by residents of Kuskokwim communities is clearly needed to provide effective management of these stocks.

Several long-term local residents commented that the number of big pike has decreased in recent years and have expressed concern that this is the result of the relatively new sport fishing effort. It is clear that both the subsistence fishery and the sport fishery selectively catch larger northern pike. The sport fishery targets big fish as these fish are highly valued by sport anglers. The major guiding operations in the area do not permit their clients to harvest pike but instead practice catch-and-release fishing. However, there is some unknown level of mortality associated with catch-and-release fishing. All previous studies have estimated this incidental mortality to be less than 10% (Falk and Gillman 1975, Burkholder 1992). The subsistence fishery also targets large northern pike both in the ice fishery and during summer netting. The winter fishery selectively harvests large pike as discussed previously, and the net mesh sizes used in summer select fish of large body size. Nearly all northern pike caught in subsistence fishing are assumed to be killed. It is logical that through time the proportion of northern pike in larger and older size groups would decrease with both subsistence and sport fisheries directing fishing effort at this portion of the stock.

The stock of northern pike inhabiting the lower Innoko River is not believed to be in danger of over-harvest at this time. Movements of radio-tagged pike show that these fish travel extensively throughout a very large area of connected rivers, sloughs and lakes. The population size of northern pike inhabiting this area, though unknown, is likely to be very large. At present, approximately 3,000 pike have been tagged. The recapture rate in the sport fishery of tagged fish is less than 2% annually (Scanlon *in prep*). To date, only six of these tagged fish have been reported as captured in the subsistence fishery. A substantial portion of northern pike in the stock are in old and large size categories as shown in samples collected during tagging (Scanlon *in prep*) and from the subsistence fishery. The large amount of undisturbed habitat, the large population size, and the presence of many size and age groups, combine to make this population very resilient to moderate increases in fishing effort and harvest. The abundance of northern pike in the area is not likely to decrease. However, if either the subsistence use by local or non-local residents or the sport use grows substantially, a decrease in the proportion of very large and old fish is anticipated.

Implications for Fisheries Management

This study has significant implications for fisheries management in at least four areas. First, as outlined in Andersen et al (2004), these types of studies are important for documenting traditional ecological knowledge in support of state and federal subsistence regulation grounded in the concept of "customary and traditional" (C&T) use patterns. The Subsistence Division of ADF&G is legislatively mandated to document these customary and traditional use patterns to support the regulatory process. According to Andersen et al. (2004:142),

> The C&T concept has an implied temporal component that demands examination, and in some cases accommodation, of the past. Fisheries managers, especially those managing for subsistence uses, as well as policy makers, need to have a thorough understanding of the role that fish and fishing played and continue to play in the lives and culture of those that use the resource.

This study contributes to state and federal fisheries management by providing detailed information about historic and contemporary use patterns, including harvest methods, gear types utilized, preservation techniques, as well as systems of sharing and distribution within and between communities. This type of information is essential for evaluating regulatory proposals or management decisions that require detailed information about subsistence fishing of non-salmon fish species in the GASH area. Indeed, managers and other decision makers must have an informed perspective about the importance of non-salmon fish species to the people and communities of the lower-middle Yukon in order to "ensure the sustainability of subsistence practices" (Andersen et al. 2004:143).

While knowledge of the historical and cultural context in which fishing makes significant contributions to a subsistence economy has clear benefit for fisheries management, one specific example of this larger body of knowledge is harvest estimates. Community harvest estimates are a basic tool for managing resources. By estimating the harvest, use, and distribution patterns for communities in a calendar year, harvest surveys can quantify the importance of harvested species on a community level. The surveys employed as part of this study also map out harvest levels in different months, providing additional information about the seasonality of harvest. Information about the seasonality of harvest is particularly

important for species that are available, and therefore harvested, year round. More than simple quantification, estimated harvests by month provide a more thorough analysis of needs and practices throughout a seasonal cycle.

In addition to harvest estimates, TEK can provide important contextual biological information on at least two levels. First, local knowledge about certain fish species based on long-term observation and harvest can yield insights about fish life history, including migratory patterns and spawning/rearing timing and areas. Understanding these patterns *in a specific area* can have significant management implications in protecting a species during sensitive parts of the life cycle. For example, developing a detailed understanding for a particular area of pike movements to and from their spawning grounds in an area that includes both fish biology and the particularities of habitat (water levels, ice formation, etc.) at different times of the year could weigh heavily in the development of regulation to protect the species and multiple uses. As another example, this report provides detailed descriptions of Arctic lamprey life history, again for a particular area, that begins to inform the limited literature on an important subsistence (and now commercial) species. Observations about run timing and distribution, migratory patterns, and rearing grounds are all significant contributions to the growing body of documented knowledge about "eels."

TEK can also make a contribution to biological understanding of fish health and condition. While processing a catch, elders and other fishers spend much time examining the insides of fish and, as a result, cultivate a significant body of observations about disease and parasites that affect the fish they use, but also about the condition of fish at different times of the year. For example, the size of livers and quality or texture of flesh in certain fish such as burbot, pike, and whitefish may fluctuate during certain seasons, providing clues about feeding habits, habitat issues, or general health concerns. Another example comes from GASH residents' observations of sheefish. In the GASH area, residents repeatedly discussed the high oil and fat content of sheefish; historically, sheefish oil was rendered in quantities for use in cooking and even gardening. This is in contrast to Koyukuk River residents' observations that sheefish are a rather poor fish in their area. When compared, regional

observations may yield interesting information about fish condition in different parts of the Yukon area.

Finally, this project was envisioned partially in response to growing concerns about user conflicts over pike harvests in the Holy Cross/Reindeer Lake area. As discussed in the introduction to this study and in the preceding section, GASH area residents have increasingly expressed concern about a catch-and-release sport fishery targeting pike. To address these concerns, this study draws together ethnographic documentation of local observations about pike life history and role in a subsistence cycle with biological data that address questions about population composition and species distribution to determine (a.) whether or not existing harvest levels are adversely affecting the pike population in the area, and (b.) the degree of overlap between the pike populations targeted by sport and subsistence pike fishermen.

CONCLUSIONS

This study complements the work of Andersen et al. (2004) in "Traditional Ecological Knowledge and Contemporary Subsistence Harvest of Non-salmon in the Koyukuk River Drainage." This project combined structurally similar TEK research and harvest surveying in a different area of Interior Alaska to increase our knowledge about traditional ecological knowledge and cultural context of subsistence fishing of non-salmon species across the region. In this way, we can draw parallels across the region, while also noting regional and local distinctions in the knowledge about and harvest and use of these important species across different communities in our legislative mandate to protect and support subsistence priorities in Alaska. This project also included a third component designed to address a specific concern over the pike population in the area from a biological perspective. The ethnographic work provided an important context for these data by providing additional information on the seasonal locations of subsistence pike fishing and documentation of local

knowledge about pike ecology. This section will attempt to outline the broad conclusions of this study and highlight the intersections of social scientific and biological research.

The GASH region encompasses a large and diverse geographic area including two rivers (Yukon and Innoko) and several active tributaries and lakes that are used heavily during different parts of the year for harvesting non-salmon fish. Information provided by respondents allows a unique drainage-wide perspective with respect to how these non-salmon species move through and utilize the waterways of the GASH region, and how they are in turn utilized as a subsistence resource by the people who live there. It is clear that non-salmon species remain vitally important to GASH residents. The complexity and depth of local knowledge about fish ecology based on centuries of observation and use is really only suggested by the information documented and analyzed here.

Several examples indicate the nature and scope of this knowledge. First, the harvest survey estimates a significant annual harvest of non-salmon fish species, especially lamprey, pike, and whitefish. The harvest survey quantifies sharing and distribution patterns within each community, attesting to the importance of these species in local cultural practices while average annual household harvests in the region of 496 pounds per year attest to their significance in local economies.

Second, this study documents the accumulated knowledge and skills required to effectively exploit a non-salmon fishery through different seasonal conditions and in adaptation to long-term population or ecological trends. Specific information on historical and contemporary harvest practices, such as "shutting down" the river and the use of under-the-ice gill nets, demonstrate specific and long-term knowledge of and interaction with these fish and their environment. Other harvest events such as "eeling," technically fishing for lamprey, combine generational knowledge about fish behavior with long-term local values about the human behavior to provide important details and texture to any description of GASH subsistence practices. These examples make it clear that the seasonal subsistence cycle for GASH residents is embedded in a broader social context that includes stories and language as well as long term observation and use, all of which this report attempts to characterize.

In addition to the TEK and harvest survey work, this project included a component to biologically sample the pike population in the Holy Cross area. Preliminary telemetry results and sampling of the winter pike fishery along with samples collected during the open water fishery suggest that the stock of northern pike inhabiting the lower Innoko River is not in danger of over-harvest at the time of this study. Movements of radio-tagged northern pike show that these fish travel extensively throughout a very large area of connected rivers, sloughs and lakes. Based on recapture of tagged pike, it is likely that the population size of northern pike inhabiting this area is very large. Approximately 3,000 pike have been tagged. The recapture rate in the sport fishery of tagged fish is less than 2% annually (Scanlon *in prep*). To date, only six of these tagged fish have been reported as captured in the subsistence fishery. A substantial portion of northern pike in the stock are in old and large size categories as shown in samples collected during tagging (Scanlon *in prep*) and from the subsistence fishery. The large amount of undisturbed habitat, the large population size, and the presence of many size and age groups, combine to make this population resilient to moderate increases in fishing effort and harvest. The abundance of northern pike in the area is not likely to decrease. Results from telemetry, aerial surveys, and mapping seasonal harvest sites show that the local and non-local subsistence fishery and the sport fishery are using a single large migratory population. If either the subsistence use or sport use grows substantially, a decrease in the proportion of large and old fish is anticipated.

In conclusion, Andersen et al. (2004) suggest that the practical insights of TEK work can provide useful research direction for western biologists. In combining social scientific and biological methods to address specific questions about a fishery, this study parallels Andersen's work by suggesting places where these different approaches might inform one another. For example, systematic mapping of subsistence harvest locations and other important seasonal habitats can be considered alongside maps depicting the movements of tagged pike to more accurately describe the utilization and definition of population stocks. This overlay of mapping strategies and the separate forms of data on which they rely, provide a more complete picture of interaction between pike in this case and subsistence or other users than either data set could on its own. While TEK work might provide valuable long-

term observational insights that help shape biological research, it can also act as an independent set of data that informs specific research questions more fully when addressed by multiple approaches.

RECOMMENDATIONS

As stated above in the Conclusions section, this study combined different approaches (ethnographic fieldwork, survey implementation, and biological sampling) to address a need for more detailed information about non-salmon species in the GASH area, in addition to addressing specific questions about the health and distribution of the area pike population. As such, the results of this project provide a good introduction or overview for the geographic area encompassed by the use patterns of the four participating communities and significant detail about the local importance of non-salmon fish species to subsistence economies. However, several additional questions and issues arise from this work, including the following:

Harvest Monitoring: This study provided one of the first detailed descriptions of an annual cycle of harvest estimates focusing on non-salmon species for this area. However, harvest data can vary year to year due to a variety of circumstances, environmental and social. Additional years of harvest data might be valuable in order to more accurately represent yearly variations and harvest trends over time.

Potentially significant harvests of northern pike and other freshwater species were identified as being taken by residents of Kuskokwim River communities. Quantitative measures of these harvests are needed. Fisheries management actions apply to a stock at a location, not just to the persons residing at the location at the time. Hence, a measure of harvest by all users is needed to assess or manage the effect of fishing mortality on the stock or population.

Biological Sampling: The seasonal movements and age and size composition of northern pike in the Innoko River upstream of Shageluk should be investigated. According to the information recorded in ethnographic interviews, this area -- Holikachuk to several miles upstream of the Iditarod -- is especially important to the communities of Shageluk and Grayling for harvesting a variety of non-salmon fish species, including pike. The guided sport fishery also targets northern pike in the area. The northern pike stock in this area is believed to be generally distinct from the lower Innoko River pike stock which was investigated in the present study. To date, no movement of northern pike between these areas has been detected by recapture of tagged fish or by movement of radio-tagged fish.

Species Identification: The life history and seasonal movements of whitefish populations in the Innoko River area should be studied. The present study and previous studies have demonstrated the importance of whitefish to local communities. However, little is known about seasonal habitat use, migration timing and spawning areas for these whitefish species. Several individual elders and younger knowledgeable fishers described a type of whitefish that investigators were unable to identify. This fish, locally referred to as *taghiy*, was repeatedly isolated as a type of whitefish that did not fit easily into existing biological classifications. It is unclear if this is a linguistic marker meant to distinguish an existing species of whitefish in terms of location and condition or age, or if it represents a type unique to the area that should be identified.

Follow-up TEK Work: Ethnographic work in this study provided a good overview of non-salmon fish species in the area; however, additional TEK research might provide valuable new insights into the role and importance of non-salmon fish while also responding to some of the biological findings. Specific suggestions include:

a. **Distribution patterns –** The harvest survey included basic information about the degree of participation in sharing and distribution networks in the four communities. While the survey documented significant levels of sharing, additional work to outline the parameters of these networks might lead to a better understanding of how these networks function in a community, the role they play in local economies and the consequences of certain management decisions.

b. **Species-specific information –** Several areas of this study could be expanded through additional TEK work on the individual species themselves. For example, this study provided a cursory introduction to the traditional ecological knowledge of arctic lamprey, a species for which there is very little biological information available. A more detailed line of questioning that included attention to the specifics of local experience with lamprey documented here, such as long term observations on run timing and emitted light, might also provide direction for future biological inquiry. The information about whitefish documented here might also benefit from a more focused, species-specific study. For example, several respondents noted that harvest practices were responsive both to needs and to qualities of the run (e.g., fishers might stop harvesting when they noticed that the fish began to decrease in size). Specific questions about historical management practices and long term observations of fish migrations would build on this project and might yield interesting directions for biologists interested in whitefish. Specifically, more detailed questions about whitefish spawning and rearing grounds in the lower-middle Yukon would complement other focused biological and TEK studies in the state (Brown and Andersen, FIS 04-219; Robinson, *in prep*). Finally, a focused, ethnographic study of pike might provide information useful for resolving the current concerns about the intersection of the sport and subsistence fishery. When compared to the preliminary results of the tagging project, these local perspectives in conjunction with the small number of tags returned suggest the need for a more detailed population study addressing harvest patterns, seasonal distribution, sex ratio, size fluctuations, and general condition to track any changes in the pike population that might affect various uses.

c. **Natural Indicators -** This study indicated several places where long-time subsistence users have observed connections between the natural environment and fish behavior. For example, connections between fish movements and the activities of other animals such as birds or frogs are used to predict the arrival of certain fish species and to estimate their run strength. In another example, observations about the structure of whitefish migrations (smaller fish towards the end of the run) indicated when fishermen should remove their nets from the water to preserve the stock. Such an

observation might usefully be understood as a traditional management system. A more comprehensive and systematic study of natural indicators and related traditional management systems should be undertaken to explore these connections in greater detail. Observations that take multiple environmental connections into account may provide a more holistic and ecologically grounded understanding of fish behavior, suggesting potential areas for future research not identified by researchers who do not have access to these local observations.

ACKNOWLEDGEMENTS

A project of this size and complexity could never be attempted, much less completed, without the help of numerous individuals and groups. Primarily, the authors extend their gratitude to the people of Grayling, Anvik, Shageluk, and Holy Cross for their time, knowledge, and patience in answering our questions and helping to shape this research. Specifically, we wish to thank: Gabe Nicholi, Herman Deacon, Henry and Dolly Deacon, Hannah Maillelle, Edna and Wilson "Tiny" Deacon, Nelson Deacon, Raymond Dutchman, Elizabeth Workman, Lucy and Hamilton Hamilton, Jim Dementi, Philip Arrow, Luke and Alice Demientieff, Philip Demientieff, Alfred Demientieff, Vaska Gregory, Maurice and Evan Newman, Larson Maillelle, Angela Young, Carl Jerue, Sr., Carl Jerue, Jr., and Dan Sawyer. Additionally, the teachers and students of the Holy Cross and Shageluk schools contributed to this project immensely with their interest in the project and for allowing researchers to sample their pike caught during the winter subsistence fishery.

The harvest data component of this study was collected by four research assistants: Gabe Nicholi (Grayling), Randy Workman (Shageluk), Chad Walker (Anvik), and David Turner (Holy Cross). These individuals did a superb job in documenting the significant use of non-salmon fish species in their villages. This data was expertly entered and analyzed by Erin Baldwin, Maria Kerlin, and Robert Walker, all with ADF&G. Many thanks go to these individuals for their hard work to construct the harvest tables contained within this report.

Several interns assisted in both research and analysis, including Melissa Robinson (UAF, IGERT), Louann Rank (UAF, IGERT), Irv Franks (UAF, Rural Development), and Susan Vanek (UAF, Anthropology) for her careful reading. Craig McCaa (BLM) provided high resolution scanned images for use in this report and for the poster. Several others contributed to reviewing this project, including Jim Simon (ADF&G, IWA Regional Supervisor), Terry Haynes (ADF&G, DWC), Jesse Dizard (ADF&G, Research Director), Dave Andersen (Research North), and Polly Wheeler (OSM). Dave Andersen also deserves a special thank-you for being the "eyes" for Caroline Brown while documenting the lamprey harvest in Grayling. His presence and photographic skills on the ice during the lamprey run were invaluable contributions to the section on Arctic lamprey.

Finally, the U.S. Fish and Wildlife Service, Office of Subsistence Management, provided $299,154 in funding support for this project through the Fisheries Resource Monitoring Program, under agreement number 701812J419.

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APPENDIX A. Interview Topics

LOCAL TAXONOMY and NATIVE NAMES in Deg Xinag and Holikachuk*
Can you tell us the local or Native names for these fish? (Viewing Photographs of Fish)

Northern Pike-
Arctic Grayling-
Longnose Sucker-
Burbot-
Sheefish-
Whitefish (sp)-
Broad Whitefish-
Humpback Whitefish-
Least Cisco-
Bering Cisco-
Round Whitefish-
Alaska Blackfish-
Arctic Lamprey-

* Beth Leonard and Giulia Oliverio asked respondents about other fish terminology and place names included in this report, in addition to compiling existing archival resources.

LIFE HISTORY (Asked for each species of fish)*

- What can you tell me about the seasonal movements of (*species*)—(Do they come and go? Are they in this area year-round? When do people catch them? Any observations about why they move?)
- Do you know what they eat?
- Do you know where and when they spawn?
- Where do they spend winters?
- Where do they spend summers?

* Some additional questions were asked on a species-specific basis, i.e. more attention was paid to the seasonal movements of northern pike; researchers asked additional questions about whitefish condition, seasonal movements, and spawning to tease out species-specific information; the seasonal movements of arctic lamprey were discussed at length.

HARVEST AND USE (Asked for each species of fish)

- Where do you go to catch (*species*) (Map these and collect place names.)
- What do you look for in selecting an area to fish for (*species*)?
- What kinds of fishing gear are/were used?
- How is the catch normally preserved? (freezing, drying, smoking, canning)
- How are (*species*) prepared for eating?
- Use of fish as trapping bait or dog food? Other uses?

POPULATION TRENDS (asked for each species of fish)
Do you think the number of (*species*) in this area now is increasing, decreasing, or about the same as always?

APPENDIX B. Survey Form

2002 GASH Non-Salmon Fish Survey

HOW MANY PEOPLE LIVE IN THIS HOUSEHOLD?_____ ALASKA NATIVE? **YES** **NO**

COMMUNITY_____(_____)

DURING 2002, DID THIS HOUSEHOLD CATCH OR USE ANY KIND OF NON-SALMON FISH? **YES** **NO**

HOUSEHOLD ID NUMBER _____

IF NO, SKIP TO BOTTOM SECTION. *IF YES, COMPLETE SPECIES SECTION BELOW.*

	Activity Log						Number Harvested: Total and by Month													
SPECIES	**Us**	**Fis**	**Ca**	**Re**	**Gi**	Units		**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Unk**
Pike						individual														
Grayling						individual														
Sucker						individual														
Burbot (Lush)						individual														
Sheefish						individual														
Whitefish:																				
Broad Whitefish						individual														
Humpback Whitefish						individual														
Bering Cisco						individual														
Least Cisco						individual														
Unknown Whitefish						individual														
Blackfish						pounds														
Others (List)																				

HOW DID YOUR HARVEST AND USE OF THESE FISH IN 2002 COMPARE TO THE LAST 4 OR 5 YEARS?

WE USED **MORE** FISH THAN USUAL _____ (MORE)

WE USED **LESS** FISH THAN USUAL _____ (LESS)

OUR USE OF FISH WAS ABOUT THE **SAME** AS USUAL _____ (SAME)

DO YOU HAVE ANY COMMENTS ABOUT THE FISH IN THIS AREA?

APPENDIX C. Harvest Survey Comments

Community Name	HHID	Comment
Anvik	1	Catching less fish in the nets than usual.
Anvik	7	Some fish did not look too good or healthy.
Anvik	15	Used more because there was no salmon
Anvik	18	More and more people are cooking these fish for their dogs than eating them.
Grayling	1	Getting screwed on our fishing by commercial fishing at the mouth.
Grayling	3	Using more non-salmon fish because salmon are not as plentiful. Worried about pike population. Too many sport fishing. Catch and release doesn't work.
Grayling	4	Need more salmon openings.
Grayling	5	Close down commercial fishing on the lower Yukon.
Grayling	6	Not starving for fish. Almost spring and freezer is getting empty.
Grayling	7	More salmon openings, not enough salmon to last the winter. When the salmon season is closed, the fish are going by.
Grayling	8	Never ate any fish in Anchorage.
Grayling	9	More subsistence openings
Grayling	10	No chum salmon fishery, hurts our subsistence lifestyle.
Grayling	11	Stop sport fishermen in Innoko from taking pike.
Grayling	12	Why does Y-1 have a king commercial opening and Y-4 doesn't. Limited subsistence days because of window. Don't like sport fishing of pike by sports fishermen.
Grayling	13	When subsistence is closed that's when fish go by. Less in area.
Grayling	14	Subsistence schedule is too irregular.
Grayling	15	Wish the summer chum makes a return. Small amount of return hurts our subsistence lifestyle.
Grayling	16	More jet traffic. Would like to know about pollution. Worried about population of grayling. Fish are getting smaller, not as healthy looking.
Grayling	17	Fishing is adequate as long as you don't over fish.
Grayling	19	Salmon fishing is bad.
Grayling	20	We need commercial fishing in our area.
Grayling	21	Work, work, work.
Grayling	22	We are not getting much salmon.
Grayling	24	Nice fish.
Grayling	25	It's good.
Grayling	26	All the fish were good, especially pike and sheefish and lush, but the white fish was sickly - skinny and spots on them with worms eating on them.
Grayling	27	Catch more eels during the last three years, all luck.
Grayling	28	Don't ask any more questions about fishing, because fishing is too poor.
Grayling	29	Fishing is good.
Grayling	30	Wasn't in Grayling in 2002, was fishing on the high seas.
Grayling	31	Cut the Eskimos off from commercial king salmon fishing. We hardly catch king salmon for subsistence uses.

Grayling	32	Fished less but more eels. Salmon fishing is bad, especially kings and silvers, plus dogs. Hungry hardly any fish have to eat meat.
Grayling	33	No comments. As long as I get my fish, I am happy.
Grayling	36	No comment. As long as I get my fish, I am happy.
Grayling	38	Fishing is poor in summer 2002.
Grayling	39	Fish is fat.
Grayling	40	Never see people throw fish away.
Grayling	41	Plenty of nonsalmon
Grayling	42	Good fish.
Grayling	43	Not much fish. Kids ate all the strips already. Too much commercial fishing at the mouth of the Yukon River. Don't like being on subsistence schedule!
Grayling	45	Darn poor year, no fish.
Grayling	46	Keep fishing in the area, restrict If necessary.
Holy Cross	3	We are getting less fish in our nets than usual
Holy Cross	40	Do not need sport hunters.

APPENDIX D. Conversion Factors

Below is a list of the Conversion Factors used in 2002 GASH non-salmon fish surveys to convert numbers of fish into useable pounds. Recent/most often used conversion factors identified in the ADF&G Community Profile Database (CPDB) for the resource in the Interior Region was used for all resources, except for Bering Cisco and Least Cisco where recent/most often used conversion factor statewide was used (i.e., not previously identified with Interior Region survey data set).

Code Number	Fish Species	Measurement in pounds
120200000	Herring	lbs*
120404000	Hooligan	lbs
121200000	Arctic lamprey	lbs
124600000	Blackfish	lbs
124800000	Burbot (Loche)	2.0
125002000	Arctic Char	0.9
125010000	Lake Trout	2.0
125200000	Grayling	1.0
125400000	Pike	3.0
125600000	Sheefish	6.0
126000000	Sucker	2.0
126200000	Trout	1.5
126204000	Rainbow Trout	1.4
126404000	Broad Whitefish	4.0
126406040	Bering Cisco	1.4
126406060	Least Cisco	1.0
126408000	Humpback Whitefish	3.0
126499000	Unknown Whitefish	3.0

*Where “lbs” is listed for measurement (Herring, Hooligan, Arctic lamprey, and Blackfish), community residents reported their subsistence harvests in pounds only, rather than in individual fish numbers, generally because of the small size of these species.

APPENDIX E. Northern pike tagged in the Innoko River sport fishery and recaptured in the subsistence fishery 1999 - 2003

Tag	Date		Length (TL in)		Location	
Number	Tagged	Recaptured	Tagged	Recaptured	Tagged	Recaptured
81391	24-Jul-98	Mar-02	35	42	L Twin Lk (Paimiut Sl)	Yukon R @ Paimiut Sl
11179	8-Aug-98	2004	36		Sheefish Lk (Paimiut Sl)	Yukon R @
11286	16-Jun-99	17-Mar-00	37	37.5	Reindeer Lk	Reindeer R
11158	29-Jun-99	19-Jun-00	42		Piamiut Sl	Yukon R below Piamiut (Set Net)
47046*	11-Jun-02	2-Mar-03	38	40	Albert Sl (Reindeer Lk)	Yukon R @ Holy Cross
47672	31-Jul-02	6-Mar-04	29	31	Sheefish Lk (Paimiut Sl)	Yukon R @ Paimiut Sl

* Radio tag

APPENDIX F. Mapped Data from Ethnographic Interviews

The following maps represent important fish locations identified by respondents during interviews. As such, they are not comprehensive representations of community use areas, nor do they represent the entirety of fishing activities in the GASH area.

Mapped information collected during the interviews is organized by village with one map representing each community. Each location on the maps is identified with a three-part code, explained in the key located on each map. The codes supply information about species, season harvested, and gear type used for harvest for each fishing location identified. Where one of these pieces of information is unavailable, "UK" for "unknown" is used.

Readers should also refer to Wheeler 1998 for additional mapped information on non-salmon fish species for the GASH area.

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