Technical Paper No. 356

Local Knowledge and Harvest Monitoring of Nonsalmon Fishes in the Lower Kuskokwim River Region, Alaska, 2005–2009

by

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Alaska Department of Fish and Game **Division of Subsistence**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the reports by the Division of Subsistence. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

all commonly-accepted abbreviations; e.g., Mr., Mrs., AM, PM, etc.	
all commonly-accepted professional titles; e.g., Dr., Ph.D., R.N., etc.	
Alaska Administrative Code	AAC
Alaska Department of Fish and Game	ADF&G
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures):	first three letters (Jan,...,Dec)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
approximately	~
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mean	$\bar{x}$
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
plus or minus	±
population size	N
probability	P
sample size	n
second (angular)	"
standard deviation	σ or s
standard error (of the mean)	$s_{\bar{x}}$
type I error probability	P_a
type II error probability	P_b
variance	σ^2 or s^2

TECHNICAL PAPER NO. 356

LOCAL KNOWLEDGE AND HARVEST MONITORING OF NONSALMON FISHES IN THE LOWER KUSKOKWIM RIVER REGION, ALASKA, 2005–2009

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Final report to the U.S. Fish and Wildlife Service, Office of Subsistence Management, to fulfill obligations for Study No. FIS 06-351 under contract number 701816C260.

The Division of Subsistence Technical Paper series was established in 1979 and represents the most complete collection of information about customary and traditional uses of fish and wildlife resources in Alaska. The papers cover all regions of the state. Some papers were written in response to specific fish and game management issues. Others provide detailed, basic information on the subsistence uses of particular communities which pertain to a large number of scientific and policy questions.

Technical Paper series reports are available through the Alaska State Library and on the Internet: http://www.subsistence.adfg.state.ak.us. This publication has undergone editorial and professional review.

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ABSTRACT

The Lower Kuskokwim River communities of Eek, Tuntutuliak, and Nunapitchuk are located off the mainstem of the Kuskokwim River, in areas of smaller rivers and lakes that are prime habitat for nonsalmon fishes. Through a combination of household harvest surveys and key respondent interviews, the Alaska Department of Fish and Game (ADF&G) Division of Subsistence and the Association of Village Council Presidents (AVCP) developed baseline documentation of traditional ecological knowledge and subsistence harvests and uses of nonsalmon fishes in these 3 communities. In the first year of the project (April 2006–March 2007), household surveys and key respondent interviews for the project period were conducted in Eek, Nunapitchuk, and Tuntutuliak. Follow-up key respondent interviews were conducted in fall 2008 and winter 2009. Information collected with surveys included the species and number of fish harvested, type of gear used, and general locations of harvests. Information collected during key respondent interviews included contemporary and historical nonsalmon fish harvest and use patterns, areas of use, gear types, and processing methods; life histories of the nonsalmon species, including habitats, seasonal migrations, spawning locations, and diets; community taxonomy of nonsalmon species; and contemporary and traditional self management practices.

Key words: northern pike, *Esox lucius*, burbot, *Lota lota*, sheefish, *Stenodus leucichthys*, broad whitefish, *Coregonus nasus*, humpback whitefish, *Coregonus pidschian*, Alaska blackfish, *Dallia pectoralis*, lamprey, *Lampetra* spp., eel, Arctic grayling, *Thymallus arcticus*, rainbow trout, *Oncorhynchus mykiss*, Dolly Varden, *Salvelinus malma*, Arctic char, *Salvelinus alpinus*, smelt, *Thaleichthys pacificus*, threespine stickleback, *Gasterosteus aculeatus*, needlefish, longnose sucker, *Catostomus catostomus*, Pacific herring, *Clupea pallasi*, Kuskokwim River, Eek, Tuntutuliak, Nunapitchuk, Johnson River, Kialik River, Eek River, harvest monitoring.

INTRODUCTION

Communities in the Johnson River, Kialik River (north of Tuntutuliak), and Eek River drainages are highly dependent, both contemporarily and historically, on fish resident in area fresh waters. These communities are located in the large Yukon–Kuskokwim Delta, away from the mainstem of the Kuskokwim River, close to other rivers and large tundra lakes that contain numerous freshwater fish species (Figure 1). Previous research by the Alaska Department of Fish and Game (ADF&G) Division of Subsistence indicated freshwater fish constituted the largest portion of Nunapitchuk residents' total subsistence fish diet, and that 100% of households reported participating in the harvest on an annual basis (Andrews 1989). This dependence may increase if declines in Kuskokwim River salmon stocks persist. Because of the importance of nonsalmon fish species to the subsistence lifestyle of area communities, ADF&G, with the Association of Village Council Presidents (AVCP), proposed research to document the harvests, uses, and knowledge about these species in 3 Lower Kuskokwim River drainage communities, Eek, Tuntutuliak, and Nunapitchuk.

The residents of these communities, the majority of whom speak Central Yup'ik, follow a historical[1] seasonal round of harvesting a variety of species from permanent winter villages and seasonal camps. Fishing for nonsalmon species occupies a central role in this seasonal round. According to Andrews (1989) in her ethnographic description of the seasonal round for the *Akulmiut* area, which includes Nunapitchuk, the annual cycle begins in spring as ice is breaking up. Residents harvest nonsalmon fishes such as northern pike and whitefishes, as well as waterfowl and their eggs and small land animals such as muskrats, mink, and otter. Families then move to summer fish camps along the Kuskokwim River to take advantage of the salmon runs. Some family groups remain in the tundra areas to harvest migrating whitefishes and northern pike, and they continue to harvest waterfowl. Nonsalmon fish harvests continue into fall, with residents targeting whitefishes, northern pike and burbot; they also hunt caribou, trap furbearers, continue waterfowl harvests, and go berry picking. As fall transitions to winter, families move back to their spring camps or permanent winter dwellings for an active ceremonial period and preparation for spring subsistence activities.

The project area is within the federally managed Yukon Delta National Wildlife Refuge. The Federal Subsistence Board made a positive customary and traditional use determination for the federally qualified rural residents of these 3 communities for Pacific salmon *Oncorhynchus* spp., rainbow trout *O. mykiss*, and all other finfishes except for Pacific herring *Clupea pallasi* and Pacific cod *Gadus macrocephalus*. The Federal Subsistence Board did recognize customary and traditional uses of Pacific cod for the communities of Eek and Tuntutuliak, but not Nunapitchuk (USFWS 50 CFR Part 100.24(a)(2)). State of Alaska customary and traditional use findings were similar, with positive findings in the Kuskokwim River fisheries management areas for Pacific halibut *Hippoglossus stenolepis*, Pacific cod, Chinook salmon *O. tshawytscha*, chum salmon *O. keta*, sockeye salmon *O. nerka*, coho salmon *O. kisutch*, pink salmon *O. gorbuscha*, herring and herring roe, and all other finfishes (5 AAC 01.286). Under state regulations all Alaskan residents can participate in subsistence fishing opportunities if there are sufficient allowable harvests to provide for all subsistence uses.

For several years, residents of the project area expressed concerns about declining fish populations, especially whitefishes *Coregonus* spp. and *Prosopium* spp. (DOI 2004:197–199). Freshwater fish harvest data for Lower Kuskokwim River communities are scarce, save for 1 year of harvest information from 1983 that is based on a sample size of 17 Nunapitchuk households (Andrews 1989). Very little documentation of traditional ecological knowledge (TEK) exists regarding population dynamics, life histories, and critical habitats of freshwater species within this region.

[1] "Historical" in this context generally refers to the period from the mid 1800s through the early- to mid 1900s, at a time when many families were congregating into largely permanent villages. In contrast, the term "traditional" is used to describe a generalized cultural pattern that has persisted through time.

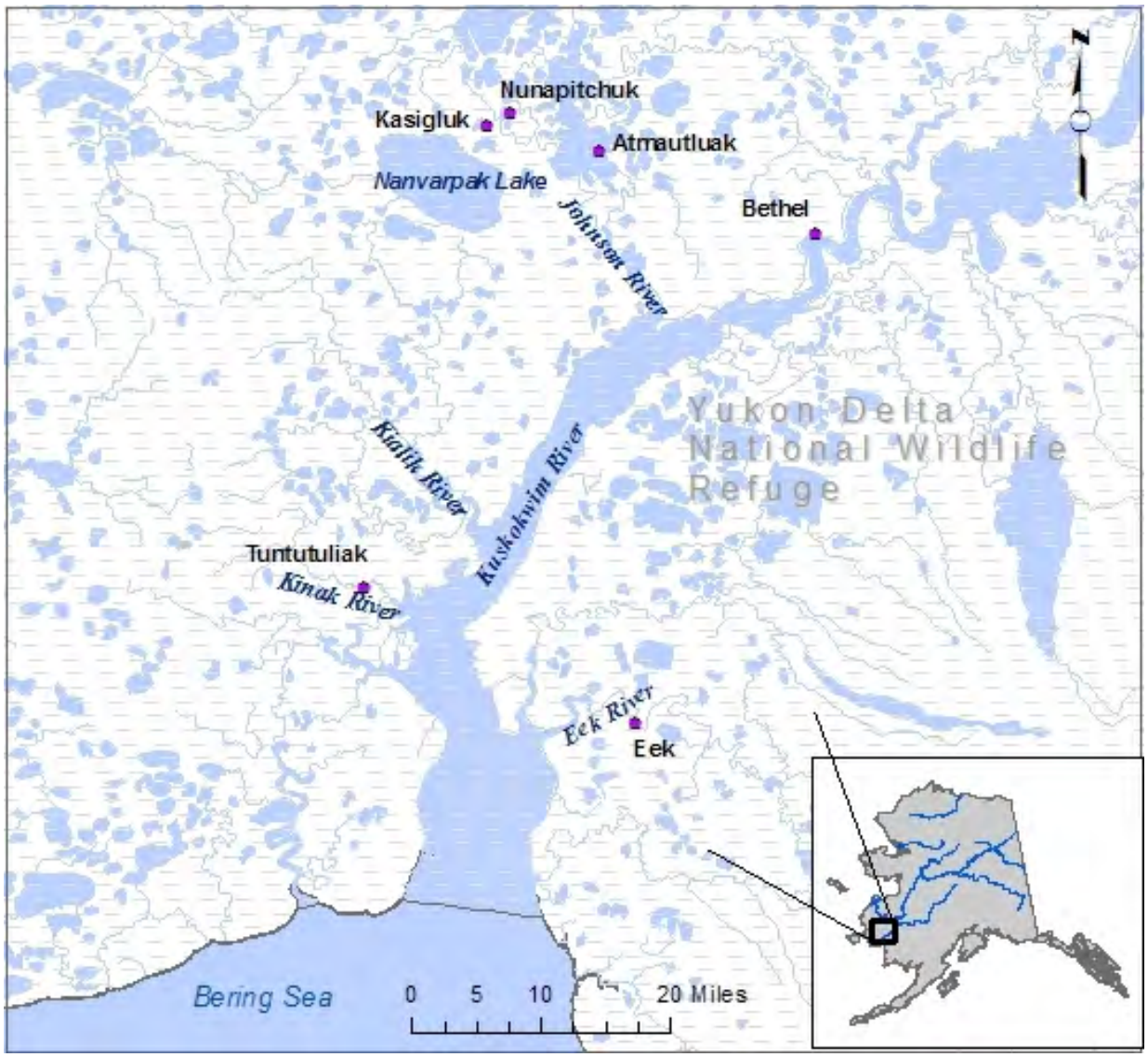

Figure 1.–Map of project area.

The major source of information about the subsistence uses of nonsalmon fishes comes from Andrews (1989:247–248), who reported that in 1983, 100% of 17 surveyed households in Nunapitchuk participated in the subsistence harvest of freshwater fishes. The subsistence harvest estimate of freshwater fish for this community comprised 46%, in pounds usable weight, of the total wild resource harvest (including berries). Harvests of salmon comprised 36%, in pounds usable weight, of the total wild resource harvest. Nunapitchuk residents' per capita harvest of fish from fresh waters was 365 lb. Northern pike *Esox lucius* were harvested at a higher level, in pounds usable weight, than any other freshwater species (or any other single resource), followed by Alaska blackfish *Dallia pectoralis*, whitefishes, and burbot *Lota lota* (also called "loche").

When interviewed, community residents reported that they considered the freshwater fishery for nonsalmon fishes to be the most important for subsistence uses. Andrews found that in Nunapitchuk in 1983, all of the surveyed households reported harvesting nonsalmon fishes in fresh waters and only 65% reported harvesting salmon. However, despite residents' concerns regarding the health and abundance of

resident fish resources in the region, much of the fisheries research in the Kuskokwim Region has been directed toward salmon. Research on the biology, harvest, and subsistence uses of freshwater fish has been limited. Recent declines in salmon runs, coupled with seriously declining moose *Alces americanus* populations upriver of these communities, and increased local and nonlocal competition for many fish and game resources have increased the residents' participation in fisheries management issues (Brown, Krauthoefer and Koster *In prep*).[2] Many of these residents have called into question the health and status of freshwater nonsalmon fish populations. Community residents have reported decreases in fish size, abundance, distribution, and overall fish health. They have consistently raised these concerns during Federal Subsistence Regional Advisory Council meetings, ADF&G advisory committee meetings, Kuskokwim River Salmon Management Working Group meetings, Kuskokwim Interagency staff meetings, and at other forums.

Research reported by Krauthoefer et al. (2007) quantified Aniak and Chuathbaluk residents' 2001–2003 baseline nonsalmon harvest levels. Research conducted by the Kuskokwim Native Association and the U.S. Fish and Wildlife Service (USFWS) (Harper et al. 2007) on whitefish stocks at Whitefish Lake, southwest of Aniak, represents the most recent nonsalmon fish work conducted on the Kuskokwim River. This work suggests that the whitefishes in Whitefish Lake, which are harvested by residents of Aniak, Chuathbaluk, and other Central Kuskokwim River communities, spend a part of their lives in the brackish water near Eek and Tuntutuliak as well as in the tundra lakes around the Johnson River and Eek. Furthermore, Aniak fishers interviewed by Krauthoefer et al. (2007) also noted overall declines in the size and abundance of whitefishes in the last 20–30 years. Lower Kuskokwim River area residents have also noted significant declines in the abundance of broad whitefish *C. nasus* (Robert Nick, area resident, personal communication to Krauthoefer, October 15, 2004). Concerns have also been raised regarding the health and abundance of northern pike and burbot populations (Mary Gregory, area resident, personal communication to Krauthoefer, March 3, 2004).

Some Nunapitchuk residents expressed concern over the increasing use of gillnets in the Nanvarpak Lake drainage, which is north of Nunapitchuk (Figure 1), citing this method of harvest as the primary cause for declines in the health and abundance of nonsalmon fish populations. Although gillnets are a common method for harvesting nonsalmon fish, area residents traditionally treated Nanvarpak Lake with extra care. Elders from the communities of Nunapitchuk, Kasigluk, and Atmautluak stated publicly that the Nanvarpak Lake drainage is very important for whitefish reproduction and that gillnets placed in the lake drainage block migration routes for salmon, whitefishes, and other fish species important for subsistence. Furthermore, in 1992, the aforementioned communities passed a joint resolution (Resolution 92-01) to prohibit the use of setnets in the Nanvarpak Lake drainage "to preserve and protect the development of white fish and their migration to spawning grounds" (Appendix A). Currently, there are no state or federal restrictions specific to the use of setnets for fish other than rainbow trout in the Nanvarpak Lake drainage, though some resident subsistence users have requested an enforcement program that would prohibit excessive use of setnets in the region.

Other users cite changing environmental conditions, commercial fisheries on salmon and whitefishes, or competition with users from other communities as reasons for the declining health, distribution, and abundance of nonsalmon fish populations. In particular, numerous area subsistence users voiced concerns over the increasing number of beavers *Castor canadensis* and abandoned beaver dams, and their effects on freshwater fish and salmon habitat in the Lower Kuskokwim River Area (Billy McCann, area resident, personal communication to Krauthoefer, October 14, 2003; James Charles, area resident, personal communication to Krauthoefer, January 13, 2004).

[2] Brown, C., Krauthoefer, T. and D. Koster. *In prep*. Household harvests of moose, caribou, bears, and wolves in Central Kuskokwim drainage communities, Alaska, 2003–2006. Alaska Department of Fish and Game Division of Subsistence Technical Paper No. 310, Fairbanks. Hereinafter cited as Krauthoefer and Koster *In prep*.

This project documented traditional ecological knowledge (TEK) as well as baseline subsistence harvests of nonsalmon fishes in 3 Lower Kuskokwim River communities. Information was gathered from both harvest surveys and key respondent interviews and mapping activities, in order to investigate the contemporary and historical characteristics of nonsalmon populations in the area, and to discover reasons for the changes observed by community residents. This information also provides documentation of the annual seasonal cycles of nonsalmon harvests, including methods and gear types used, in order to inform both the analyses of regulatory proposals as well as the development of regulations that provide reasonable opportunities for customary and traditional uses of nonsalmon fishes consistent with Alaska's constitutionally mandated sustained yield principle. Information collected during this project complements similar information collected in Aniak and Chuathbaluk from 2001 through 2003 (Krauthoefer et al. 2007), in the Lower Middle Yukon River communities of Grayling, Anvik, Shageluk, and Holy Cross from 2002 through 2004 (Brown et al. 2005), and in Koyukuk River communities from 2001 through 2003 (Andersen et al. 2004). It contextualizes and informs biological investigations of whitefishes and other nonsalmon fishes in the Kuskokwim River Area and throughout the state.

OVERVIEW OF CURRENT STATE AND FEDERAL FISHING REGULATIONS ON THE KUSKOKWIM RIVER

The Alaska Board of Fisheries (BOF) found that freshwater finfish in the Kuskokwim River fisheries management area were used for customary and traditional uses (5 AAC 01.286). Under state subsistence fishing regulations, there are no permit requirements (5 AAC 01.280), bag limits, or season restrictions for subsistence nonsalmon fish harvests, with the exception of the Aniak River from June 1 to August 31, which is relatively distant from the 3 communities in this study area. However, from June 1 to August 31 in that portion of the Aniak river drainage upstream of Doestock Creek, when subsistence fishing with a hook and line attached to a rod or pole, the bag and possession limits are linked to the sport fishing limits and rainbow trout may not be retained. Additionally, under federal regulations, from March 15 through June 15, rainbow trout may not be targeted with gillnets, dip nets, and fyke nets, although under both federal and state regulations they may be retained if taken incidentally in other subsistence fisheries. Nonsalmon fishing is generally open by regulation 7 days per week, 24 hours a day, year round, but the Goodnews, Kanektok, and Arolik rivers are closed to the subsistence taking of fish by nets for 16 hours before, during, and 6 hours after each open commercial salmon fishing period. These rivers are located on the east side of Kuskokwim Bay and are not within the traditional fishing areas of the 3 project communities.

In the Kuskokwim River area, nonsalmon fish may be taken only by set gillnet, drift gillnet, beach seine, fish wheel, pot, longline, fyke net, dip net, jigging gear, spear, a hook and line attached to a rod or pole, handline, or lead (5 AAC 01.270 (c)). Under federal regulations, rainbow trout may only be taken by gillnets, dip nets, fyke nets, rod and reel, handline, spear, or by jigging through the ice. State regulations continue to apply to subsistence fisheries in the Kuskokwim River area unless superseded by federal regulations. Federal management authority over subsistence uses is implemented under Title VIII of ANILCA, which asserts that rural Alaska residents have a priority in subsistence activities as federally qualified subsistence users.

Sport fishing regulations for the Kuskokwim River for most nonsalmon species provide for moderate to liberal daily harvest limits, and the sport fishing season is open year-round (e.g., 5 AAC 71.010). Daily harvest limits range from 2 fish for rainbow trout to 15 fish for burbot. In several area drainages there is an annual limit of 2 rainbow trout 20 inches or longer. The regulations provide sport fishing and recreational harvest opportunity with rod and reel gear for all finfish as well opportunities to use spears and bow and arrows to harvest suckers and burbot (5 AAC 71.030).

STUDY AREA

Eek

The community of Eek is located on the Eek River, 12 mi from the mouth of the Kuskokwim River and downstream of the streams that drain the Eek Mountains. An old village site, where many Eek residents still maintain fishing camps, is located on Eek Island near the entrance to the Eek Channel and the Eenayarak River. The community was moved to its current location further inland in the 1930s because of recurrent flooding at the old village site and because a secondary school had been established at the current location. Eek fishers fish primarily for subsistence and commercial purposes.

A distinct feature at Eek is the silty-bottomed Eenayarak River, which is fed by large lakes to the north of Eek and which provides numerous opportunities for fishing. According to project respondents in both Eek and Tuntutuliak, the Eenayarak River was heavily fished during the nonsalmon commercial fishery that operated intermittently between the late 1960s and early 1980s. During this time, commercial nonsalmon fishing by residents of nearby villages and subsistence fishing by Eek residents occurred concurrently, which, key respondents revealed, caused conflicts between these user groups.

The Eenayarak River and local lakes and sloughs offer short-cuts to the regional hub community of Bethel, as well as other lower river communities and local fishing grounds, especially when inclement weather or flooding makes travel difficult on the mainstem Kuskokwim River. However, residents reported that drying lakes and beaver dam damage have severely affected not only the utility of these waterways, but also residents' fishing practices.

Nunapitchuk

Nunapitchuk is 1 of 3 villages (the others are Kasigluk and Atmautluak) known as the "tundra villages," which are located northwest of Bethel around a tributary of the Lower Kuskokwim River called the Johnson River. The tundra villages share several resource harvest areas, most notably the Nanvarnarllak Lake region, which is comprised of several lakes in the Johnson River drainage. They also share various other sloughs, streams, and lakes, including the large Nanvarpak Lake, which respondents consider the source of the main freshwater species in their area (broad and humpback whitefishes *C. pidschian*, northern pike, burbot, and Alaska blackfish). Nanvarpak Lake was mentioned by several Nunapitchuk respondents to be the spawning grounds of all the fish that migrate to the lake from the Kuskokwim River. Residents of the 3 tundra villages have long sought to conserve the resources of Nanvarpak Lake, and in 1992 adopted a resolution designed to prohibit overfishing in that area (Appendix A).

People lived in several other village sites prior to relocating to the 3 villages after federal Bureau of Indian Affairs (BIA) schools were established in the 1950s and 1960s.

> Yeah there's people were sort of scattered, I guess some old villages were in different areas, there was other villages considered. Nunachuak and another one was Nanvarnarllak and they moved, some of the people moved to Kasigluk, some moved to Nunap[itchuck], 'cause there was a school here, and there was a school over there, too. And then ... not too long ago the people from Nunapitchuk, some of them moved to Atmautluak. Yeah the reason that some people moved to Atmautluak was there was a lot of fish there, too. A lot of whitefish in that area. (NR2 and NR10)

Kasigluk and Nunapitchuk are accessible by barge via the Johnson River. The Johnson River is also the location of significant spring fishing effort on northern pike by residents of Bethel and other nearby Kuskokwim River villages. Nunapitchuk residents commonly fish for salmon in the Kuskokwim River near Napakiak and several families maintain ties with Napakiak residents. Although some Nunapitchuk residents once participated in commercial fishing, at the time of this report they did not consider it worth the expense, given the price of gas and the travel distance.

Tuntutuliak

The Lower Kuskokwim River community of Tuntutuliak is located along the north bank of a minor tributary of the Kuskokwim River, the Kinak River,[3] which residents also call the Tunt River. Near this community are other rivers commonly used by Tuntutuliak residents, namely the Kialik River (pronounced "GAL-ik"), the Tagayarak River, the Muruyak River, and the Qataqrun River. In addition to these rivers, the landscape north of Tuntutuliak, which is inundated with lakes and marshy wetlands, provides many other riverine passageways to popular fishing areas. A prominent lake-and-slough route, of which many key respondents spoke in their interviews, is called the "shortcut," because it allows Tuntutuliak residents to reach the northern lake country by heading almost due north by boat, instead of following a more circuitous westward route on the Kinak River. This shortcut reportedly formed in the mid 1970s or 1980s and is not reflected on U. S. Geological Survey (USGS) maps of the area.

The village of Tuntutuliak was established by residents from at least 2 former villages in the area, the Kinak (or Qinaq) settlement, and another settlement called Qukakllircaraq.[4] A mission school was built in the area in 1909 but was later relocated to Eek in 1917. A BIA school was built in the present day location of Tuntutuliak in 1957. Respondents mentioned that the village was located in that spot because of the BIA school, and villagers were impelled to build year round residences in Tuntutuliak so that their children could be enrolled in the school. Because this location was not a historical harvest area, Tuntutuliak residents travel away from the village for many hunting and fishing activities; many families have used spring, summer and fall camps in the area for generations.

Most travel is by boat in summer and by snowmachine in winter. Tuntutuliak respondents recalled that dog teams were once a common mode of transportation, but now only a few households keep dogs for travel purposes, decreasing the need for larger nonsalmon fish harvests. Respondents said that canoes or kayaks were used for boat travel before motorized wooden and aluminum boats became the norm. Today most people use aluminum boats with outboard motors of varying horsepower. There are many commercial fishers in Tuntutuliak.

OBJECTIVES

This project had the following objectives:

1. Within the first 6 months of each project year, and in cooperation with the tribal councils, 1–2 technicians will be identified, recruited, and trained in each community (Eek, Tuntutuliak, Nunapitchuk,) to conduct harvest surveys.
2. By the end of each project year, nonsalmon harvest surveys in Eek, Tuntutuliak, and Nunapitchuk will be conducted to quantify subsistence harvests of nonsalmon fishes and to document harvest methods, gear, and timing.
3. By the end of the first project year, 15–20 key respondents from Eek, Tuntutuliak, and Nunapitchuk will be interviewed about nonsalmon fishes, including their subsistence harvest and use patterns, life histories, patterns of seasonal movement, changes in abundance and distribution, key aggregation sites; and about the key respondents' contemporary and traditional self management practices.
4. By the end of the project, a geospatial database will be developed that will cross-reference nonsalmon harvest and use patterns with the mapping of the environmental knowledge of the residents of Eek, Tuntutuliak, and Nunapitchuk.

[3] Also spelled Qinaq.

[4] The respondent who gave information about this village site was unsure of the proper Yup'ik spelling. His best approximation is used here.

METHODS

HARVEST SURVEYS

Because subsistence fishing patterns vary from year to year, this project called for 2 annual house-to-house surveys in each community. Harvest surveys are structured to elicit information on a recall basis for an earlier 12 month period in order to cover an entire annual time frame of fishing effort. The first survey covered the period from April 1, 2005, through March 31, 2006 (Appendix B). The second survey would have covered April 1, 2006, through March 31, 2007, but it was not implemented because of problems associated with finding interested local surveyors. The first harvest survey efforts were conducted in Eek, Tuntutuliak, and Nunapitchuk from May 2006 through July 2006. Following standard ADF&G harvest survey and data collection procedures, harvest surveys were designed as a census, so contact was attempted with each household in the 3 project communities. In both Eek and Tuntutuliak, surveyors were able to sample a relatively high percentage of households (Table 1). In Nunapitchuk, surveyors were only able to sample 21% of households.

Table 1.–Survey design and sample sizes for 2005–2006 harvest survey.

Community	Type of design	Total number of households	Household sample goal	Number of surveyed households	Percentage of households sampled	Unable to contact	Declined survey	Sampled household population	Estimated community population
Eek	Census	80	80	78	97.5%	1	1	277	284.1
Nunapitchuk	Census	111	111	23	20.7%	88 [a]	1	139	670.8
Tuntutuliak	Census	81	81	64	79.0%	17	0	318	402.5

Source ADF&G Division of Subsistence household surveys, 2006.

a. In Nunapitchuk, project investigators had difficulty contacting surveyors to check on progress. Project investigators enlisted the assistance of the Nunapitchuk IRA Council to encourage the surveyors to complete and return the surveys, with little success. Due to these challenges and after consultation with Office of Subsistence Management staff, investigators decided not to pursue additional surveys to cover the first survey year in Nunapitchuk.

The survey instrument was developed by ADF&G Division of Subsistence research and Information Management staff, in consultation with staffs from the ADF&G Division of Commercial Fisheries, the USFWS, and each community's tribal[5] council. The survey instrument was designed to elicit each household's uses, harvest levels, methods and means of harvest, quality of fish, and timing of harvests of nonsalmon fish species (Appendix B).

Project investigators worked with the tribal councils to identify, hire, and train 1–2 research assistants who then conducted the household surveys and assisted as translators during the key respondent interviews. Research assistants were identified by the councils, and then hired and trained by ADF&G Division of Subsistence staff. The principal investigator (Krauthoefer) traveled to each community and conducted training sessions with all surveyors in May and June 2006. The surveys were administered from May 2006 through July 2006. Following review by the principal investigator, the surveys were forwarded to ADF&G Division of Subsistence Information Management staff for data entry and analysis. Data have been analyzed and harvests estimated based on standard ADF&G Division of Subsistence

[5] Tribal councils in Alaska are the governing bodies of many Alaska Native villages that have a government-to-government relationship with the federal government. They usually come in the form of either traditional councils or IRA councils (Indian Reorganization Act). The term "tribal council" is used here to refer to the governing bodies more generally, while the specific terms of "traditional council" or "IRA council" are used where appropriate to refer to a specific council.

expansion formulas (see below). Data were entered into a Microsoft SQL Server[6] database designed specifically for this project by Information Management staff. All data were entered twice in order to identify and control data entry errors. The division applied the weighted means method (Cochran 1977) to generate harvest estimates for nonsalmon fishes from households sampled within each community. This approach applies the mean harvest of sampled households to all households in the community that were not surveyed. In cases where a household was known to have harvested, but the actual harvest was unknown, the mean was used in place of that household's actual harvest. The weighted means principle was also applied when generating the estimated number of fishers in each community. Information Management staff used the following formula to generate these estimates:

$$H = N\left(\frac{\sum x}{n}\right) \quad (1)$$

where:

H= total estimated harvest,

N = total number of households identified,

n = number of sampled households, and

x = household's reported harvest.

In using this approach, the mean of the estimate remains the same as the sampled mean and percentages derived from the sampled households can be applied to the entire household list. The principal assumption is that the group of unsurveyed households has the same harvest and use patterns as the households that were successfully contacted. Since the mean is the primary statistic used to develop the estimates, Information Management staff produced a confidence interval (CI), represented as a percentage, to measure the relative precision of the mean. The CI can also be applied to the total estimated harvest to obtain a likely upper and lower range for the estimate. The following formula was applied to create the CI percentage:

$$CI\% = \frac{t_{\propto/2} \times \frac{s}{\sqrt{n}} \times \sqrt{1 - \frac{n}{N}}}{\bar{x}} \quad (2)$$

where:

s = sample standard deviation,

n = sampled households,

N = total households identified,

$t_{\propto/2}$ = student's t statistic for alpha level ($\alpha = 0.05$) with n–1 degrees of freedom, and

$\bar{x}$ = mean harvest.

In order to compare the relative importance of different species, numbers of fish are converted to pounds using a standard conversion table (Appendix C).

[6] Product names are given because they are established standards for the State of Alaska and for scientific completeness; they do not constitute product endorsement.

KEY RESPONDENT INTERVIEWS

Researchers interviewed key respondents in October and November 2006, in March 2007, in October and December 2008, and in February 2009. During the 2006–2007 fieldwork, interviews with 13 key respondents were conducted, following protocols in Miraglia (1998) and of the Alaska Federation of Natives (ANKN 2009) (Appendix D). The target objective during the first year of the project was to conduct interviews with at least 5 key respondents from each project community, for a total of 15 interviews. However, due to travel and scheduling difficulties, investigators were able to conduct only 13 interviews. In Nunapitchuk, interviews were conducted with 5 respondents, while 4 respondents each were interviewed in Eek and Tuntutuliak. In the second year (2008–2009), 13 interviews with 16 key respondents were conducted, under the same protocols. In Tuntutuliak, 4 interviews were conducted with 5 respondents; in Eek, 3 interviews were conducted with 4 respondents; and in Nunapitchuk, 6 interviews were conducted with 7 respondents. For the entire project, a total of 29 individuals were interviewed: 12 in Nunapitchuk, 8 in Eek, and 9 in Tuntutuliak.

Respondents were identified by the tribal councils and community-based research assistants, based on their knowledge and experience with fishing and processing practices. Project investigators, with assistance from research assistants, interviewed respondents on an individual basis using a semistructured format of questions about nonsalmon harvest and use patterns, nonsalmon life histories, patterns of seasonal movement, changes in abundance and distribution, and locations of key aggregation sites and spawning locations (Appendix D). Most of the interviews were conducted in English with local research assistants acting as translators when necessary. Local research assistants were native Yup'ik speakers, though credentials on language training and translation were not collected. Illustrations of nonsalmon fishes and historical photographs of nonsalmon fishing practices were used to elicit responses during the interview process. Utilizing standard USGS topographical maps at 1:63,360 and 1:250,000 scales, respondents were asked to map patterns of seasonal movement, habitat features, key aggregation sites, and spawning locations, as well as traditional harvest locations and other important subsistence land use patterns. Additionally, respondents were asked about traditional and contemporary self-management practices, and their effects on nonsalmon fish populations.

Once informed consent of respondents was attained, interviews were audio recorded and have since been transcribed by ADF&G staff and analyzed.

Figure 2.–Research assistant Lincoln Enoch and key respondent Peter Lupie, Tuntutuliak, October 2006.

MAPPING

Information mapped during the key respondent interviews, including nonsalmon harvest locations, critical habitat areas, aggregation sites, and spawning and migration routes, was digitized into ArcGIS (see Objective 4) in order to create the maps included in this report. Mapped data was collected to varying degrees from all households interviewed, depending on fishing patterns. While the harvest data represents a single annual cycle of harvest, the key respondent interviews and mapping events, in contrast, represent the general fishing patterns of an individual or household. That is, TEK, including mapped data, might include multiple years of fishing practices in order to account for annual variations such as harvest locations while still representing the most important aspects of a respondent's fishing practices. Mapped data are organized by season and species for each community in order to show the seasonal variation of harvest. Place names are generally not recorded on these maps except for commonly referenced river and lake names. The maps contained in this report are derived from the fieldwork for this study; however, they should not be considered an exhaustive representation of all seasonal harvest locations for the participating communities.

Figure 3.–Mapping during key respondent interview.

COMMUNITY REVIEW

In November 2009, the draft report was presented to the 3 communities for review. Respondents and community leaders made appropriate edits, especially to maps, life histories, Yup'ik names, and tables summarizing gear and seasonal harvest. All the edits were incorporated into the final draft.

RESULTS

Harvest surveys are one of the most valuable tools in a wildlife or fisheries management system. They generate community-level harvest estimates for particular species within a proscribed period of time. Harvest estimates play an important role in management because they provide critical documentation of harvest levels which can be compared to other indices such as mortality and abundance counts, to assess harvestable surpluses and the general condition of the animal population. Use patterns, or the patterns of

resource distribution within and without a community, provide critical information important for customary and traditional use determinations and ensuring that reasonable opportunities are provided for those continued uses by both state and federal authorities. Finally, a comparison of harvest estimates may identify trends in the populations of certain species.

Harvest estimates are presented here by community. Data were collected on a community basis and the harvest estimates provide an interesting context for drawing comparisons between the communities. Explanations and analyses of the survey data highlight the major use patterns, but should not be considered exhaustive descriptions of subsistence nonsalmon fishing for each community. Harvest estimates for each species are presented by community in tables 2 through 13.

Nonsalmon Fish Harvests in Eek

Residents of Eek harvested 15 species of nonsalmon fish during 2004–2005, including herring, various species of smelt, Pacific tomcod *Microgadus proximus*, halibut, Alaska blackfish, burbot, Dolly Varden *S. malma*, Arctic grayling *Thymallus arcticus*, northern pike, sheefish *Stenodus leucichthys*, rainbow trout, and 4 species of whitefish: broad whitefish, humpback whitefish, Bering ciscoes *C. laurettae*, and least ciscoes *C. sardinella* (Table 2). Of these species, northern pike and whitefishes (specifically humpback whitefish) comprised the majority of the annual harvest in 2004–2005. Overall, Eek fishers harvested an estimated 40,814 lb of nonsalmon species, which averaged to approximately 144 pounds per person. During 2004–2005, 87% of participating households reported harvesting nonsalmon fish, 91% reported using nonsalmon fish, 15% of households reported sharing nonsalmon fish and 50% of households reported receiving nonsalmon fish (Table 2).

Of the species harvested by Eek respondents, northern pike, whitefishes, burbot, and Alaska blackfish were used by the most households (Figure 4). The most heavily harvested nonsalmon species by weight was northern pike (24,840 lb), which represented 61% of the nonsalmon fish harvest (Figure 5). The second most heavily harvested species were whitefishes (9,565 lb), which represented 23% of the total nonsalmon fish harvest. Furthermore, 86% of Eek households used northern pike in 2004–2005 and 81% of households actually harvested northern pike (Table 2). The harvest of whitefishes shows similar patterns, with 58% of households harvesting whitefishes and 8% of those households giving some portion of their harvest to an estimated 31% of households in the community, which resulted in 73% of households in Eek reporting the use of whitefishes (Table 2). Of these whitefish species, the largest component by weight was humpback whitefish (5,179 lb), followed by Bering ciscoes (2,237 lb). Fewer broad whitefish were harvested than humpback whitefish, potentially consistent with local concerns expressed about the decreased numbers of broad whitefish available in the Lower Kuskokwim River area.

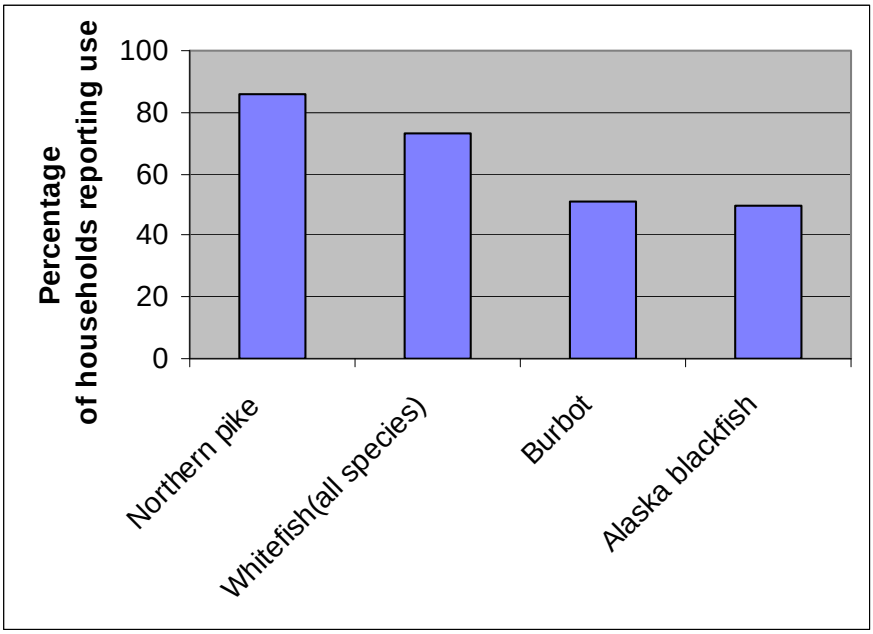

Figure 4.–Most commonly used nonsalmon species, Eek, 2004–2005.

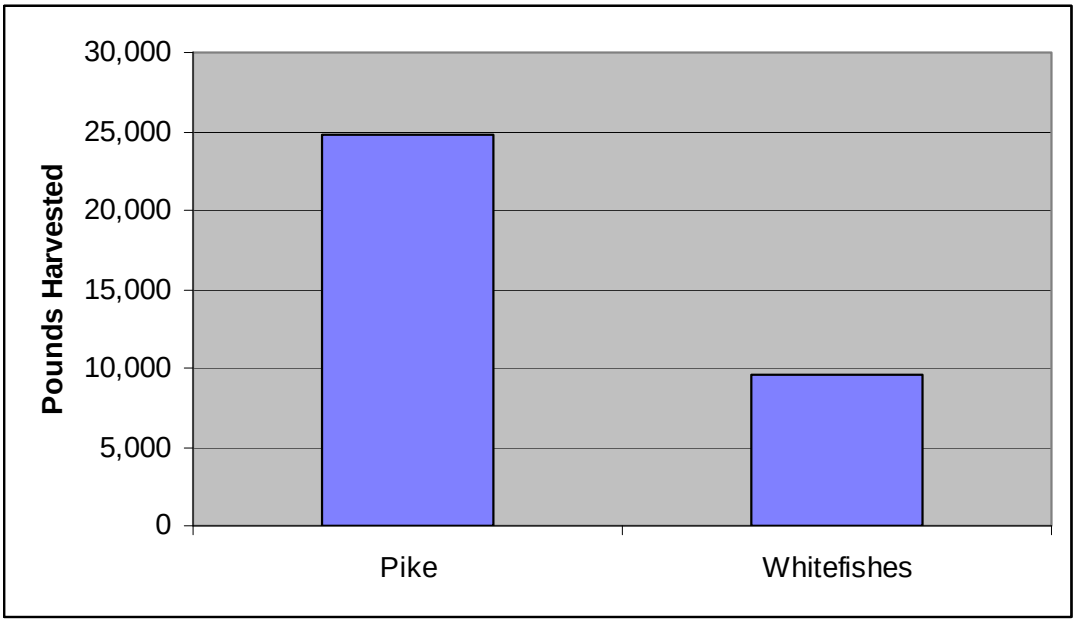

Figure 5.–Most harvested nonsalmon species, in pounds, Eek, 2004–2005.

By weight, burbot also contributed significantly to the annual subsistence harvest of nonsalmon fish by Eek fishers. An estimated total of 747 burbot (1,792 lb) were harvested by Eek households. Burbot were used by approximately one-half of the households in the community. Other species, such as Alaska blackfish and sheefish were harvested at moderate levels and were used and shared among many households. Table 3 shows harvest estimates by species and by month for the community of Eek for 2004–2005. Eek was also the only community where residents reported some harvest in every month

during 2004–2005. In fact, a minimum of at least 2 nonsalmon species were harvested in any given month, an average of 5 species were harvested in any month, and harvests ranged from 2 species to 8 species. May and September were the months of the largest variety of species harvested (whitefish species, northern pike, Arctic grayling, Dolly Varden and sheefish), likely because of seasonal migrations. Northern pike harvests registered the greatest contribution, in terms of pounds, to Eek residents' subsistence diet, and the majority of this harvest occurred in the spring months of March and April, likely due to their availability and perceived quality during this time of year. However, northern pike were also harvested in other months of the year, with the exceptions of June, August, and September, potentially reflecting residents' focus on salmon species during those months. The majority of northern pike were harvested using hook and line methods (94%, Table 4) in rivers and sloughs (Table 5). No other species were harvested on such a broad seasonal scale.

Whitefish harvests were largely focused between May and December, with most (93%) occurring in September for all species, likely during fall migrations from the lakes (Table 3). The timing of this harvest is consistent with information shared by key respondents, who explained that whitefishes migrate during spring and fall and that they are not harvested in spring because of their poor quality. Eek fishers reported using setnets as the primary gear type for harvests of all whitefish species, including sheefish (Table 4). According to the surveys, sheefish, broad whitefish, and humpback whitefish are primarily harvested in lake habitats (Table 5), while Bering ciscoes and least ciscoes are primarily harvested in rivers or sloughs. This is consistent with areas mapped by respondents during TEK interviews, during which they showed most whitefish harvest locations to be in lakes north of the Eenayarak River.

Gear Used by Residents of Eek

The majority of nonsalmon fishes harvested in Eek in 2004–2005 were harvested by hook and line (Figure 6 and Table 4), and the majority of these fish were northern pike. Hook and line was the primary method for harvesting northern pike (94% of total northern pike harvest), burbot, and the lesser fished species such as Dolly Varden and rainbow trout. Setnets were the gear of choice for the second highest amount of fish harvested by weight, and were used to target broad and humpback whitefishes, sheefish, and Bering and least ciscoes. Although 475 lb of northern pike were harvested in setnets, this represents just 2% of the total northern pike harvest. A few other fish, such as burbot, were retained after they were incidentally caught in setnets, but this was not the primary means used to target these species.

Driftnets were used in Eek primarily to harvest herring and tomcod, although 923 lb of northern pike were harvested in driftnets (4% of the total northern pike harvest). A few other species, such as whitefishes, were reported harvested in driftnets, but quantities were so small as to be incidental. Herring were reportedly harvested using drift gillnets in saltwater habitats. Harvests of burbot occurred in September and October only. Traps were the only method of harvest for Alaska blackfish.

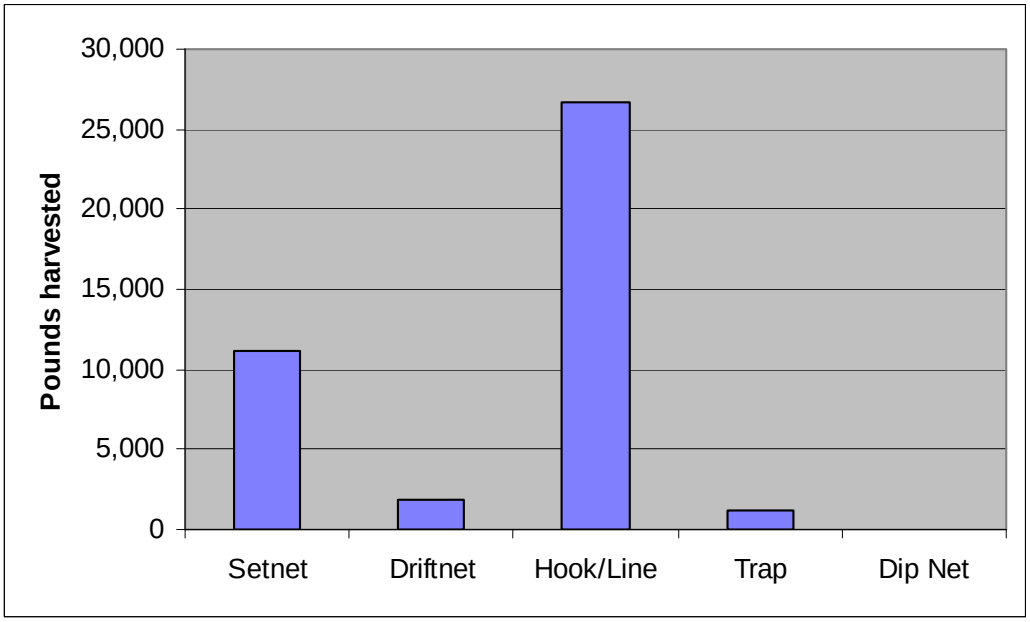

Figure 6.–Pounds of nonsalmon fishes harvested by gear type, Eek, 2004–2005.

Seasonality of Harvest by Eek Residents

Eek residents harvested the largest quantities of nonsalmon fish in the month of September (Table 3). September was the primary month for harvests of all species of whitefish, sheefish, burbot, and tomcod. March, April, and November were other months with high harvests of nonsalmon fish. Northern pike was the primary species harvested in March and April, and northern pike and Alaska blackfish were harvested in November. Eek respondents did not report much fishing for nonsalmon fishes during June–August, although herring fishing occurred in May, and there was a small additional harvest in November (Table 3). From October through December, residents reported fishing for Alaska blackfish and northern pike, although northern pike were harvested in much smaller quantities than they were during spring.

Harvest Locations used by Residents of Eek

Most nonsalmon fish harvested by Eek fishers were freshwater fishes (96% of total harvest), and these were mostly harvested from rivers and sloughs (72% of total harvest) (Figure 7 and Table 5). Northern pike, burbot, and Bering ciscoes were primarily harvested in rivers and sloughs. Humpback and broad whitefishes, sheefish, and Alaska blackfish were primarily harvested from lakes. Eek residents reported harvesting herring, tomcod and halibut from saltwater locations, but saltwater fishes made up only 4% of total nonsalmon harvest by weight.

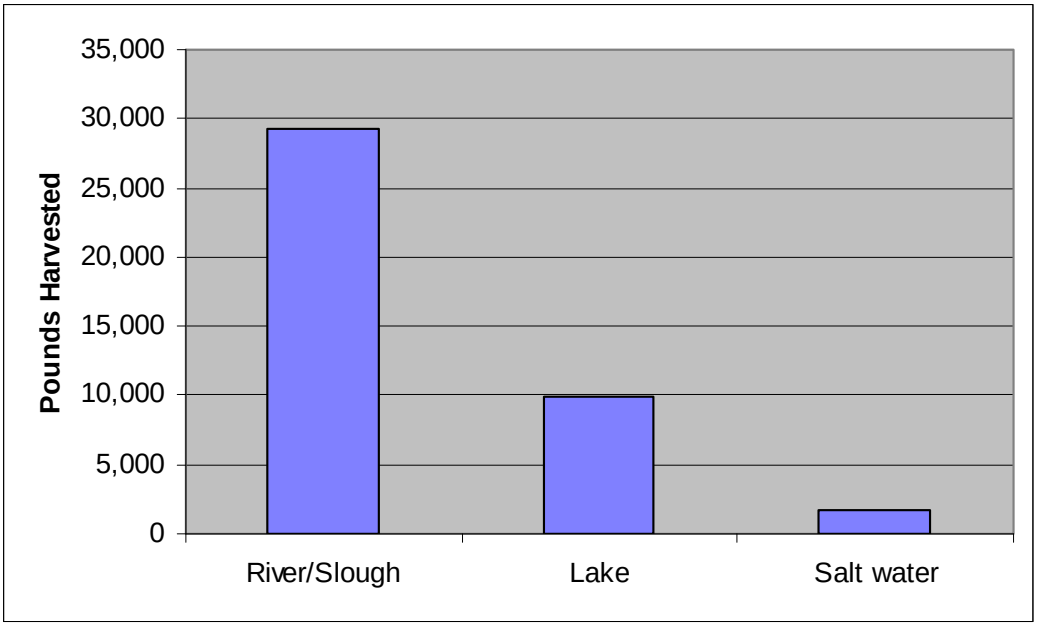

Figure 7.–Pounds of nonsalmon fishes harvested by location, Eek, 2004–2005.

Table 2.–Estimated harvests and uses of nonsalmon fishes, Eek, 2005–2006.

	Percentage of households					Pounds harvested			Amount harvested			95% confidence limit (±),
Nonsalmon fish species	Use	Att	Harv	Recd	Give	Total	Mean HH	Per capita	Total	Unit	Mean HH	harvest
Herring	9.0%	3.8%	3.8%	5.1%	0.0%	229.7	2.9	0.8	574.4	Ind	7.2	10.8%
Smelt	10.3%	7.7%	6.4%	5.1%	1.3%	37.2	0.5	0.1	148.7	Ind	1.9	8.3%
Pacific tomcod	16.7%	7.7%	7.7%	9.0%	0.0%	464.1	5.8	1.6	928.2	Ind	11.6	14.8%
Halibut	17.9%	9.0%	9.0%	9.0%	1.3%	1,000.2	12.5	3.5	47.2	Ind	0.6	7.3%
Lamprey	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Rockfish	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Stickleback (needlefish)	1.3%	0.0%	0.0%	1.3%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Alaska blackfish	50.0%	39.7%	38.5%	16.7%	6.4%	1,190.8	14.9	4.2	1,190.8	Lb	14.9	5.4%
Burbot	51.3%	47.4%	47.4%	5.1%	3.8%	1,792.0	22.4	6.3	746.7	Ind	9.3	3.1%
Arctic char	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Dolly Varden	15.4%	10.3%	10.3%	5.1%	0.0%	79.4	1.0	0.3	88.2	Ind	1.1	8.9%
Arctic grayling	28.2%	26.9%	26.9%	1.3%	1.3%	107.0	1.3	0.4	152.8	Ind	1.9	4.3%
Northern pike	85.9%	80.8%	80.8%	10.3%	2.6%	24,840.0	310.5	87.4	5,520.0	Ind	69.0	2.0%
Sheefish	16.7%	14.1%	12.8%	3.8%	0.0%	1,415.4	17.7	5.0	235.9	Ind	2.9	14.5%
Sucker	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Rainbow trout	2.6%	2.6%	2.6%	0.0%	0.0%	93.3	1.2	0.3	66.7	Ind	0.8	15.5%
Whitefishes												
Broad whitefish	28.2%	21.8%	20.5%	9.0%	2.6%	2,129.2	26.6	7.5	532.3	Ind	6.7	7.5%
Ciscoes												
Bering cisco	61.5%	47.4%	46.2%	19.2%	3.8%	2,237.1	28.0	7.9	1,597.9	Ind	20.0	3.9%
Least cisco	2.6%	1.3%	1.3%	1.3%	0.0%	20.5	0.3	0.1	20.5	Ind	0.3	16.7%
Subtotal, ciscoes	64.1%	48.7%	47.4%	20.5%	3.8%	2,257.6	28.2	7.9	1,618.5	Ind	20.2	3.8%
Humpback whitefish	53.8%	39.7%	37.2%	21.8%	3.8%	5,178.5	64.7	18.2	1,726.2	Ind	21.6	3.7%
Round whitefish	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Subtotal, whitefishes	73.1%	59.0%	57.7%	30.8%	7.7%	9,565.3	119.6	33.7	3,876.9	Ind	48.5	3.9%
Total, nonsalmon fish	**91.0%**	**87.2%**	**87.2%**	**50.0%**	**15.4%**	**40,814.4**	**510.2**	**143.7**	**13,576.4**	**Ind**	**169.7**	**2.3%**

Source ADF&G Division of Subsistence household surveys, 2006.

Table 3.–Estimated nonsalmon fish harvests by month, Eek, 2005–2006.

	Estimated number of fish harvested [a]													
Resource	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Unknown	Total
Herring	0.0	0.0	0.0	0.0	512.8	0.0	0.0	0.0	0.0	0.0	61.5	0.0	0.0	574.4
Smelt	15.4	0.0	51.3	0.0	41.0	0.0	0.0	0.0	0.0	0.0	41.0	0.0	0.0	148.7
Pacific tomcod	0.0	0.0	0.0	0.0	0.0	5.1	0.0	0.0	923.1	0.0	0.0	0.0	0.0	928.2
Halibut	0.0	0.0	0.0	0.0	11.3	34.9	1.0	0.0	0.0	0.0	0.0	0.0	0.0	47.2
Alaska blackfish	25.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.3	165.1	907.7	82.1	0.0	1,190.8
Burbot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	687.2	59.5	0.0	0.0	0.0	746.7
Dolly Varden	0.0	5.1	12.3	41.0	3.1	1.0	0.0	20.5	0.0	0.0	0.0	5.1	0.0	88.2
Arctic grayling	1.0	0.0	20.5	8.2	15.4	20.5	50.3	31.8	0.0	0.0	5.1	0.0	0.0	152.8
Northern pike	133.3	41.0	2,140.5	1,764.1	112.8	0.0	5.1	0.0	0.0	374.4	846.2	102.6	0.0	5,520.0
Sheefish	0.0	0.0	4.1	0.0	10.3	0.0	2.1	5.1	214.4	0.0	0.0	0.0	0.0	235.9
Rainbow trout	0.0	0.0	61.5	0.0	0.0	0.0	0.0	5.1	0.0	0.0	0.0	0.0	0.0	66.7
Broad whitefish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	521.0	0.0	10.3	0.0	0.0	532.3
Bering cisco	0.0	0.0	0.0	0.0	20.5	20.5	0.0	61.5	1,413.3	82.1	0.0	0.0	0.0	1,597.9
Least cisco	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.5	0.0	0.0	0.0	0.0	20.5
Humpback whitefish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,654.4	0.0	71.8	0.0	0.0	1,726.2

Source ADF&G Division of Subsistence household surveys, 2006.

a. Alaska blackfish harvests were reported in pounds.

Table 4.–Nonsalmon fish harvests by gear type, Eek, 2005–2006.

	Driftnet		Setnet		Hook and line		Trap		Dip net		Other gear	
Resource	Amount	Pounds	Amount	Pounds	Amount	Pounds	Amount	Pounds	Amount	Pounds	Amount	Pounds
Herring	574.4	229.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smelt	0.0	0.0	0.0	0.0	56.4	14.1	0.0	0.0	92.3	23.1	0.0	0.0
Pacific tomcod	902.6	451.3	0.0	0.0	0.0	0.0	25.6	12.8	0.0	0.0	0.0	0.0
Halibut	0.0	0.0	0.0	0.0	47.2	1,000.2	0.0	0.0	0.0	0.0	0.0	0.0
Alaska blackfish	0.0	0.0	0.0	0.0	0.0	0.0	a.	1,190.8	0.0	0.0	0.0	0.0
Burbot	0.0	0.0	28.7	68.9	717.9	1,723.1	0.0	0.0	0.0	0.0	0.0	0.0
Dolly Varden	0.0	0.0	12.3	11.1	75.9	68.3	0.0	0.0	0.0	0.0	0.0	0.0
Arctic grayling	0.0	0.0	0.0	0.0	152.8	107.0	0.0	0.0	0.0	0.0	0.0	0.0
Northern pike	205.1	923.1	105.6	475.4	5,209.2	23,441.5	0.0	0.0	0.0	0.0	0.0	0.0
Sheefish	8.2	49.2	208.2	1,249.2	19.5	116.9	0.0	0.0	0.0	0.0	0.0	0.0
Rainbow trout	0.0	0.0	0.0	0.0	66.7	93.3	0.0	0.0	0.0	0.0	0.0	0.0
Broad whitefish	4.1	16.4	527.2	2,108.7	1.0	4.1	0.0	0.0	0.0	0.0	0.0	0.0
Bering cisco	41.0	57.4	1,515.9	2,122.3	41.0	57.4	0.0	0.0	0.0	0.0	0.0	0.0
Least cisco	0.0	0.0	20.5	20.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Humpback whitefish	25.6	76.9	1,679.0	5,036.9	21.5	64.6	0.0	0.0	0.0	0.0	0.0	0.0
Total, nonsalmon fish		**1,804.1**		**11,093.0**		**26,690.6**		**1,203.6**		**23.1**		**0.0**

Source ADF&G Division of Subsistence household surveys, 2006.

a. Alaska blackfish harvests were reported in pounds.

Table 5.–Nonsalmon fish harvests by fishing location, Eek, 2005–2006.

	River–Slough		Lake		Salt water	
Resource	Amount	Pounds	Amount	Pounds	Amount	Pounds
Herring	0.0	0.0	0.0	0.0	574.4	229.7
Smelt	148.7	37.2	0.0	0.0	0.0	0.0
Pacific tomcod	0.0	0.0	0.0	0.0	928.2	464.1
Halibut	0.0	0.0	0.0	0.0	47.2	1,000.2
Alaska blackfish	a.	117.9	a.	1,072.8	0.0	0.0
Burbot	726.2	1,742.8	20.5	49.2	0.0	0.0
Dolly Varden	88.2	79.4	0.0	0.0	0.0	0.0
Arctic grayling	152.8	107.0	0.0	0.0	0.0	0.0
Northern pike	5,437.9	24,470.8	82.1	369.2	0.0	0.0
Sheefish	30.8	184.6	205.1	1,230.8	0.0	0.0
Rainbow trout	66.7	93.3	0.0	0.0	0.0	0.0
Broad whitefish	12.3	49.2	520.0	2,080.0	0.0	0.0
Bering cisco	1,556.9	2,179.7	41.0	57.4	0.0	0.0
Least cisco	20.5	20.5	0.0	0.0	0.0	0.0
Humpback whitefish	52.3	156.9	1,673.8	5,021.5	0.0	0.0
Total, nonsalmon fish	**29**	**,239.3**	**9,**	**881.0**		**1,694.1**

Source ADF&G Division of Subsistence household surveys, 2006.

a. Alaska blackfish harvests were reported in pounds.

Nonsalmon Fish Harvests in Nunapitchuk

Table 6 shows the estimated harvests and uses of nonsalmon species in Nunapitchuk in 2004–2005. Residents of Nunapitchuk harvested an estimated total of 90,157 lb of nonsalmon fish. Due to a larger human population (Table 1 and Table 6), this harvest is significantly larger than Eek's community harvest of 40,814 lb. Nunapitchuk residents reported an annual harvest rate of approximately 134 pounds per capita compared to 144 lb per capita in Eek. Species harvested included smelt, halibut, Alaska blackfish, burbot, northern pike, sheefish, broad whitefish, Bering ciscoes, humpback whitefish, and round whitefish *P. cylindraceum*. During 2004–2005, 65% of participating households reported harvesting and using some kind of nonsalmon fish, 30% of households reported sharing nonsalmon fish, and 39% of households reported receiving nonsalmon fish. The most commonly received fish included Alaska blackfish (26% of households), herring (22%), smelt (22%), and northern pike (17%). The most commonly used fish were northern pike, whitefishes, Alaska blackfish, and burbot (Figure 8).

By weight, the largest contribution to community subsistence uses was again made by northern pike (66,672 lb), representing approximately 74% of the total nonsalmon annual harvest (Figure 9). Northern pike were also the species used by the largest percentage of households in Nunapitchuk (Figure 8), and survey results also indicated measurable sharing levels between households (13% of households reported giving northern pike to other households and 17% of households reported receiving northern pike) (Table 6). Northern pike were harvested primarily from April through June and again in November (Table 7), although a significant portion of the annual harvest (20%) were taken in unknown months. This seasonal harvest pattern suggests that residents targeted northern pike as the fish migrated between rivers and area lakes. The largest component of the annual harvest was taken by hook and line (80%) with approximately 19% taken by setnet in rivers and sloughs of the area (Figure 10, Table 8, and Table 9). Fewer than 1% were taken in area lakes.

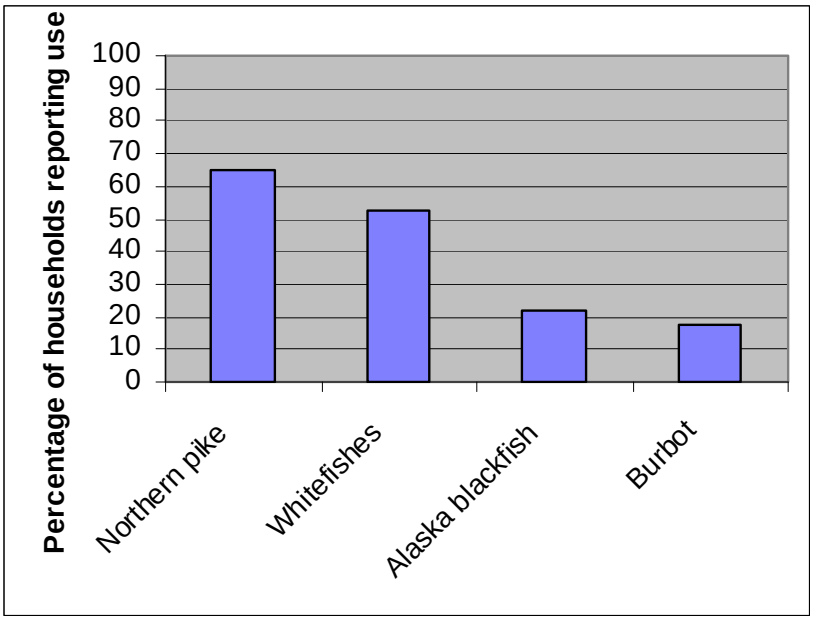

Figure 8.–Most commonly used nonsalmon species in Nunapitchuk, 2004–2005.

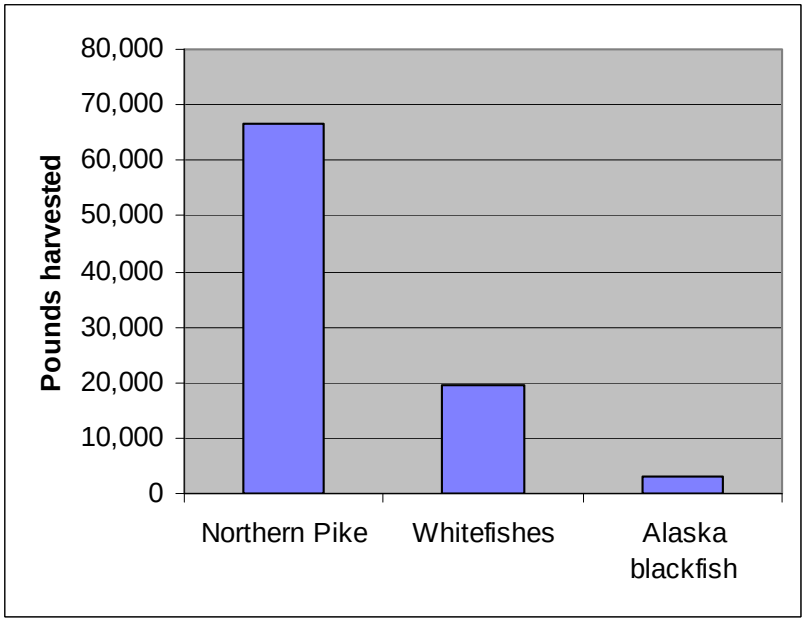

Figure 9.–Most harvested nonsalmon species, in pounds, Nunapitchuk, 2004–2005.

The second largest contributors to the annual subsistence nonsalmon harvest in 2004–2005 were whitefish species. By weight, approximately 22% of the 2004–2005 harvest consisted of 5 whitefish species: sheefish, humpback whitefish, broad whitefish, Bering ciscoes, and round whitefish (Table 6). Least ciscoes were not reported harvested by Nunapitchuk fishers. Whitefish are an important part of the Nunapitchuk's subsistence harvest, and approximately 52% of the community households harvested whitefish species.

Gear Used by Residents of Nunapitchuk

The majority of nonsalmon fish, by weight, were taken with hook and line (Figure 10 and Table 8). Hook and line was the primary method used to harvest northern pike (81%) and burbot (63%). The second most common method for harvesting nonsalmon fish was the setnet. Setnets were used to harvest broad, humpback and round whitefishes, sheefish, Alaska blackfish, burbot (37% of total burbot take) and northern pike (19% of total northern pike take). According to the survey, smelt were harvested only by dip nets, and the majority of Alaska blackfish were reported harvested in "other" gear, such as bowls or frying pans often used to dip blackfish out of lakes. The survey results indicated that driftnets were not extensively used by respondents for nonsalmon fishing.

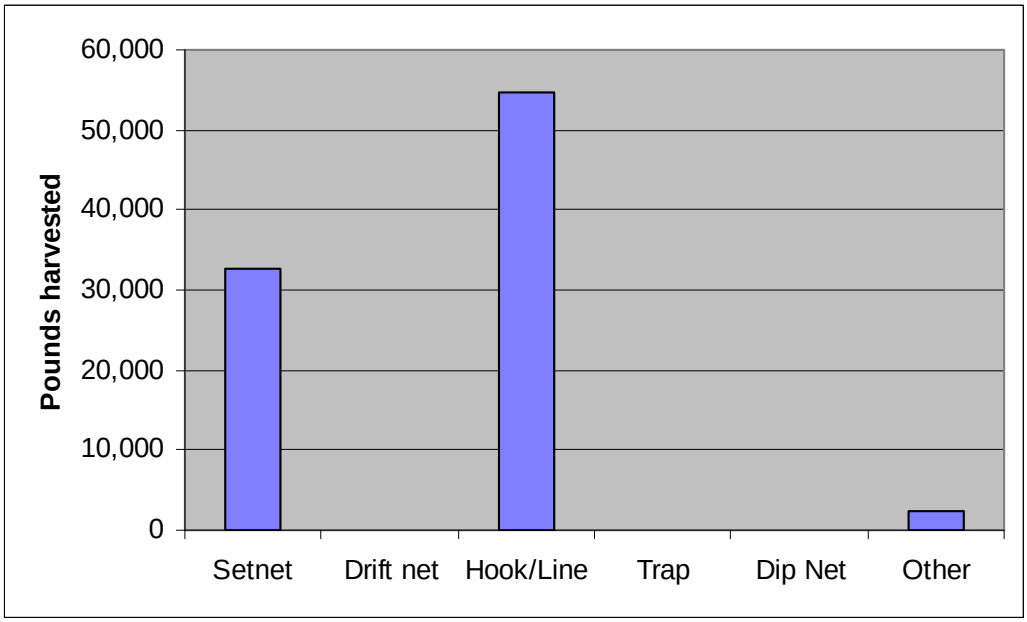

Figure 10.–Pounds harvested by gear type, Nunapitchuk, 2004–2005.

Seasonality of Harvest by Nunapitchuk Residents

Nunapitchuk had a different harvest pattern from the other 2 communities in this project. While Eek and Tuntutuliak did most harvesting of nonsalmon fish during spring and fall, residents of Nunapitchuk reported their heaviest harvests in May and June (although a significant portion of the harvest was reported as occurring during an unknown month) (Table 7). These harvests consisted primarily of northern pike and broad and humpback whitefishes (Table 7). Northern pike were harvested from April through June and again in November. Broad whitefish were harvested primarily in June, and humpback whitefish in May and June. Alaska blackfish were harvested in March and November.

Harvest Locations used by Residents of Nunapitchuk

Nunapitchuk residents reported all nonsalmon species as harvested in rivers and sloughs (100%), with the exception of a few halibut that were harvested in salt water (<1%) (Figure 11 and Table 9). No fish were reported harvested from lakes.

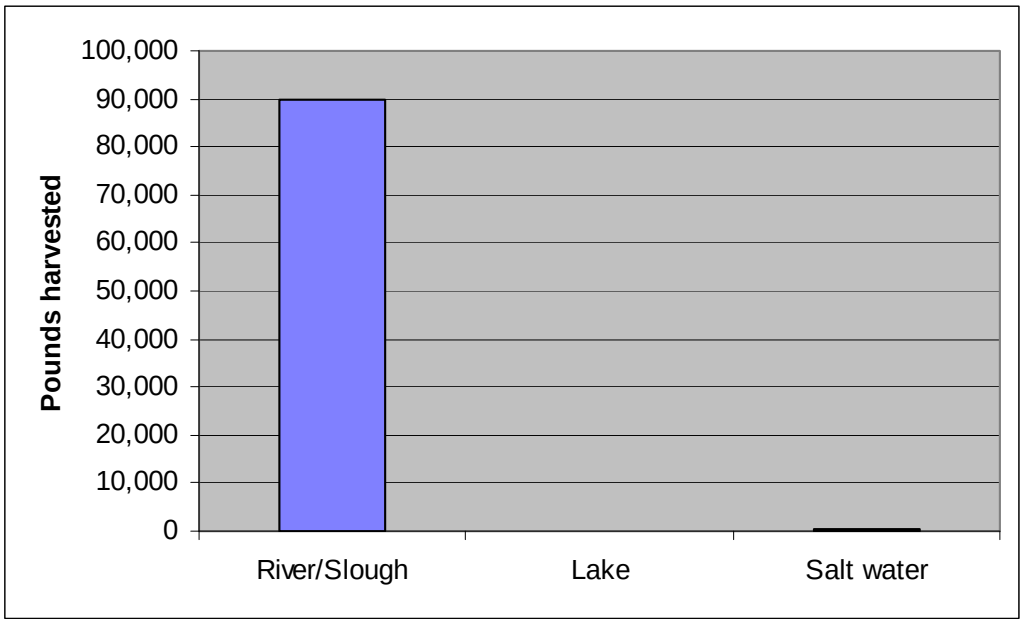

Figure 11.–Amount of nonsalmon fish harvested by location, Nunapitchuk, 2004–2005.

Table 6.–Estimated harvests and uses of nonsalmon fishes, Nunapitchuk, 2005–2006.

	Percentage of households					Pounds harvested			Amount harvested			95% confidence limit (±),
Nonsalmon fish species	Use	Att	Harv	Recd	Give	Total	Mean HH	Per capita	Total	Unit	Mean HH	harvest
Herring	0.0%	0.0%	0.0%	21.7%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Smelt	4.3%	4.3%	4.3%	21.7%	0.0%	120.7	1.1	0.2	482.6	Ind	4.3	75.2%
Pacific tomcod	0.0%	0.0%	0.0%	4.3%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Halibut	4.3%	4.3%	4.3%	8.7%	0.0%	306.9	2.8	0.5	14.5	Ind	0.1	75.2%
Lamprey	0.0%	0.0%	0.0%	8.7%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Rockfish	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Stickleback (needlefish)	0.0%	0.0%	0.0%	4.3%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Alaska blackfish	21.7%	21.7%	21.7%	26.1%	13.0%	2,895.7	26.1	4.3	2,895.7	Lb	26.1	41.7%
Burbot	17.4%	4.3%	17.4%	8.7%	0.0%	278.0	2.5	0.4	115.8	Ind	1.0	38.0%
Arctic char	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Dolly Varden	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Arctic grayling	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Northern pike	65.2%	56.5%	65.2%	17.4%	13.0%	66,672.4	600.7	99.4	14,816.1	Ind	133.5	14.7%
Sheefish	17.4%	13.0%	17.4%	4.3%	0.0%	318.5	2.9	0.5	53.1	Ind	0.5	42.9%
Sucker	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Rainbow trout	0.0%	0.0%	0.0%	4.3%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Whitefishes												
Broad whitefish	39.1%	39.1%	39.1%	13.0%	13.0%	9,285.4	83.7	13.8	2,321.3	Ind	20.9	30.4%
Ciscoes												
Bering cisco	4.3%	0.0%	4.3%	0.0%	0.0%	40.5	0.4	0.1	29.0	Ind	0.3	75.2%
Least cisco	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Subtotal, ciscoes	4.3%	0.0%	4.3%	0.0%	0.0%	40.5	0.4	0.1	29.0	Ind	0.3	75.2%
Humpback whitefish	47.8%	43.5%	52.2%	8.7%	8.7%	10,120.3	91.2	15.1	3,373.4	Ind	30.4	23.3%
Round whitefish	17.4%	13.0%	17.4%	4.3%	0.0%	118.2	1.1	0.2	236.5	Ind	2.1	39.7%
Subtotal, whitefishes	52.2%	47.8%	52.2%	13.0%	13.0%	19,564.5	176.3	29.2	5,960.2	Ind	53.7	24.4%
Total, nonsalmon fish	**65.2%**	**60 .9%**	**65.2%**	**39.1%**	**30.4%**	**90,156.6**	**812.2**	**134.4**	**24 ,338.0**	**Ind**	**219.3**	**15.2%**

Source ADF&G Division of Subsistence household surveys, 2006.

Table 7.–Estimated nonsalmon fish harvests by month, Nunapitchuk, 2005–2006.

	Estimated number of fish harvested [a]													
Resource	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Unknown	Total
Smelt	0.0	0.0	0.0	0.0	482.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	482.6
Halibut	0.0	0.0	0.0	0.0	0.0	14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.5
Alaska blackfish	0.0	0.0	386.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	820.4	0.0	1,689.1	2,895.7
Burbot	0.0	0.0	0.0	0.0	48.3	19.3	0.0	0.0	0.0	48.3	0.0	0.0	0.0	115.8
Northern pike	0.0	0.0	0.0	2,027.0	3,561.7	5,221.8	0.0	0.0	0.0	0.0	1,110.0	0.0	2,895.7	14,816.1
Sheefish	0.0	0.0	0.0	0.0	29.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.1	53.1
Broad whitefish	0.0	0.0	0.0	0.0	77.2	1,375.4	96.5	289.6	0.0	0.0	0.0	0.0	482.6	2,321.3
Bering cisco	0.0	0.0	0.0	0.0	29.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.0
Humpback whitefish	0.0	0.0	0.0	0.0	1,105.2	675.7	193.0	434.3	0.0	0.0	0.0	0.0	965.2	3,373.4
Round whitefish	0.0	0.0	0.0	0.0	125.5	111.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	236.5

Source ADF&G Division of Subsistence household surveys, 2006.

a. Alaska blackfish harvests were reported in pounds.

Table 8.–Nonsalmon fish harvests by gear type, Nunapitchuk, 2005–2006.

	Driftnet		Setnet		Hook and line		Trap		Dip net		Other gear	
Resource	Amount	Pounds	Amount	Pounds	Amount	Pounds	Amount	Pounds	Amount	Pounds	Amount	Pounds
Smelt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	482.6	120.7	0.0	0.0
Halibut	0.0	0.0	0.0	0.0	14.5	306.9	0.0	0.0	0.0	0.0	0.0	0.0
Alaska blackfish	0.0	0.0	a.	386.1	0.0	0.0	a.	96.5	0.0	0.0	a.	2,413.0
Burbot	0.0	0.0	43.4	104.2	72.4	173.7	0.0	0.0	0.0	0.0	0.0	0.0
Northern pike	0.0	0.0	2,750.9	12,378.9	12,065.2	54,293.5	0.0	0.0	0.0	0.0	0.0	0.0
Sheefish	0.0	0.0	53.1	318.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Broad whitefish	0.0	0.0	2,321.3	9,285.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bering cisco	0.0	0.0	29.0	40.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Humpback whitefish	0.0	0.0	3,373.4	10,120.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Round whitefish	38.6	19.3	183.4	91.7	14.5	7.2	0.0	0.0	0.0	0.0	0.0	0.0
Total, nonsalmon fish		**19.3**		**32,725.7**		**54,781.4**		**96.5**		**120.7**		**2,413.0**

Source ADF&G Division of Subsistence household surveys, 2006.

a. Alaska blackfish harvests were reported in pounds.

Table 9.–Nonsalmon fish harvests by fishing location, Nunapitchuk, 2005–2006.

	River–Slough		Lake		Salt water	
Resource	Amount	Pounds	Amount	Pounds	Amount	Pounds
Smelt	482.6	120.7	0.0	0.0	0.0	0.0
Halibut	0.0	0.0	0.0	0.0	14.5	306.9
Alaska blackfish	a.	2,895.7	0.0	0.0	0.0	0.0
Burbot	115.8	278.0	0.0	0.0	0.0	0.0
Northern pike	14,816.1	66,672.4	0.0	0.0	0.0	0.0
Sheefish	53.1	318.5	0.0	0.0	0.0	0.0
Broad whitefish	2,321.3	9,285.4	0.0	0.0	0.0	0.0
Bering cisco	29.0	40.5	0.0	0.0	0.0	0.0
Humpback whitefish	3,373.4	10,120.3	0.0	0.0	0.0	0.0
Round whitefish	236.5	118.2	0.0	0.0	0.0	0.0
Total, nonsalmon fish		**89,849.7**		**0.0**		**306.9**

Source ADF&G Division of Subsistence household surveys, 2006.

a. Alaska blackfish harvests were reported in pounds.

Nonsalmon Fish Harvests in Tuntutuliak

Residents of Tuntutuliak reported harvesting 17 species of nonsalmon fish, with a total harvest of 100,297 pounds, or 249 pounds per capita (Table 10). Species harvested included herring, smelt, Pacific tomcod, halibut, unknown species of lamprey *Lampetra*, Alaska blackfish, burbot, Dolly Varden, Arctic grayling, northern pike, sheefish, rainbow trout, broad whitefish, Bering ciscoes, least ciscoes, humpback whitefish, and round whitefish. During 2004–2005, 97% of participating households reported using nonsalmon fish, 88% of households reported harvesting nonsalmon fish, 63% reported sharing nonsalmon fish, and 70% of households reported receiving nonsalmon fish. The most commonly received fish included whitefishes (38% of households), northern pike (31%), Alaska blackfish (23%) and smelt (20%) (Table 10).

Of those species used by Tuntutuliak residents, northern pike, whitefishes, burbot, Alaska blackfish and sheefish were reported used by the most households (Figure 12). As in Eek and Nunapitchuk, northern pike was the most harvested species, with residents reporting a take of 39,059 lb (8,680 fish), for 39% of the total nonsalmon harvest (Figure 13 and Table 10). Ninety-two percent of Tuntutuliak residents reported using northern pike, while 83% harvested the species and 33% of households reported sharing northern pike with other households. These harvest and distribution patterns perhaps account for the high per capita harvest rate of northern pike in Tuntutuliak (97 pounds per capita). Interviews with elders and other knowledgeable fishers from Tuntutuliak suggest that northern pike were the first fish to return to the area in spring, and that other fish, such as whitefishes, were not considered good quality at that time. This may explain why northern pike were heavily harvested by Tuntutuliak fishers in the spring months of March and April (Table 11). There also was a smaller focused harvest in fall, between September and December. Hook and line was the most common method of harvesting northern pike (67% of northern pike harvest); setnets were also used (32%) (Figure 14 and Table 12). Most northern pike were reported as harvested from river and slough habitats and a smaller number were harvested from area lakes (Table 13).

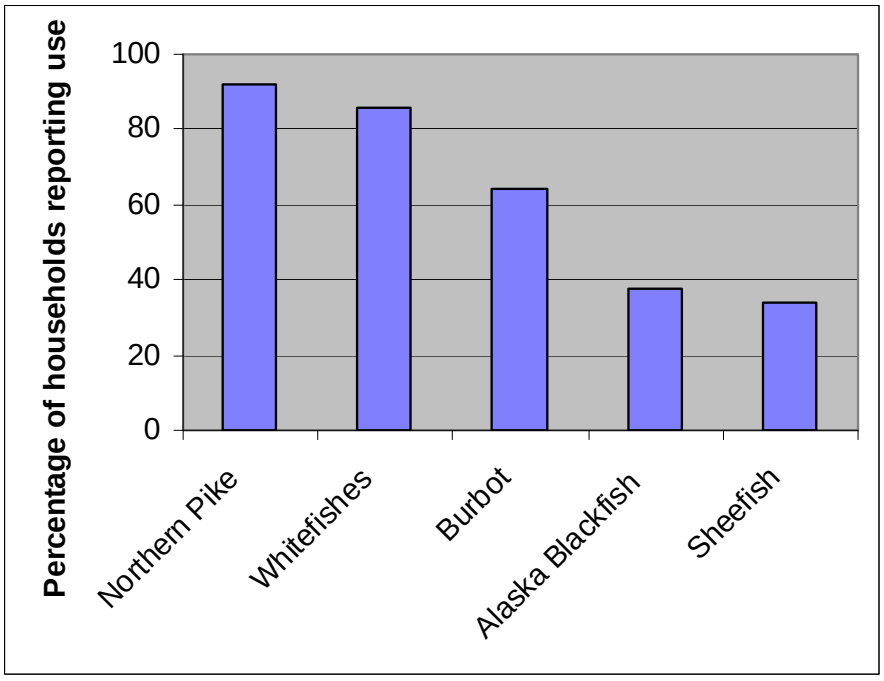

Figure 12.–Most commonly used nonsalmon species, Tuntutuliak, 2004–2005.

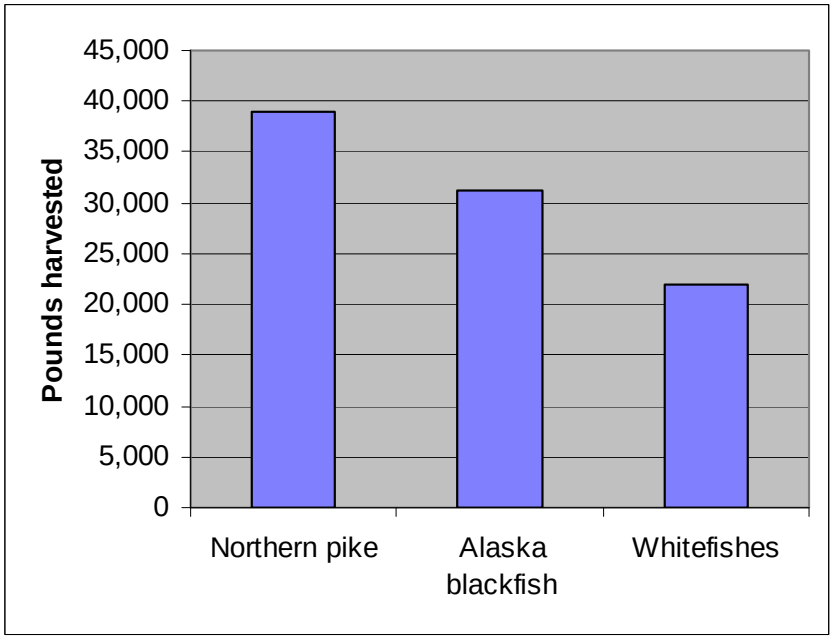

Figure 13.–Most harvested nonsalmon species, in pounds, Tuntutuliak, 2004–2005.

As mentioned previously, northern pike was the most heavily harvested species by weight (Figure 13 and Table 10), followed by Alaska blackfish (31,303 lb) and then combined whitefish species, primarily broad whitefish and humpback whitefish. Tuntutuliak respondents reported harvesting all 5 whitefish species, with a total take of 21,882 lb, or 22% of the total nonsalmon fish harvest. Of this estimate, broad whitefish comprised 7,903 lb and humpback whitefish comprised 13,004 lb of the total whitefish harvest

(Table 10). For Tuntutuliak residents, the majority of fishing in general, and whitefish harvest in particular, occurred during the months of September and October, depending on species (Table 11).

Gear Used by Residents of Tuntutuliak

In Tuntutuliak, setnets were used to harvest the largest quantity, by weight, of the nonsalmon fish harvested in 2004–2005 (47,991 lb) (Figure 14 and Table 12), and hook and line was used to harvest the second highest quantity by weight (30,493 lb). This is different from Nunapitchuk and Eek, where the largest quantity of nonsalmon fish were taken by hook and line.

Respondents reported using setnets as the primary method of harvest for sheefish; broad, humpback and round whitefishes; and Bering and least ciscoes (Table 12). Setnets were a major method of harvest for Alaska blackfish (42% of total blackfish harvest), burbot (31% of total burbot harvest), and northern pike (30% of total northern pike harvest). Hook and line was the major method of harvest for northern pike and burbot, as well as for the species with less effort, such as Arctic grayling and Dolly Varden.

Traps were the only other method that resulted in a large harvest of nonsalmon fish, and 18,241 lb of Alaska blackfish were harvested in traps. Driftnets were not an important method for harvesting nonsalmon fish, although a few species (e.g., northern pike, sheefish, and broad whitefish) were retained when harvested incidentally.

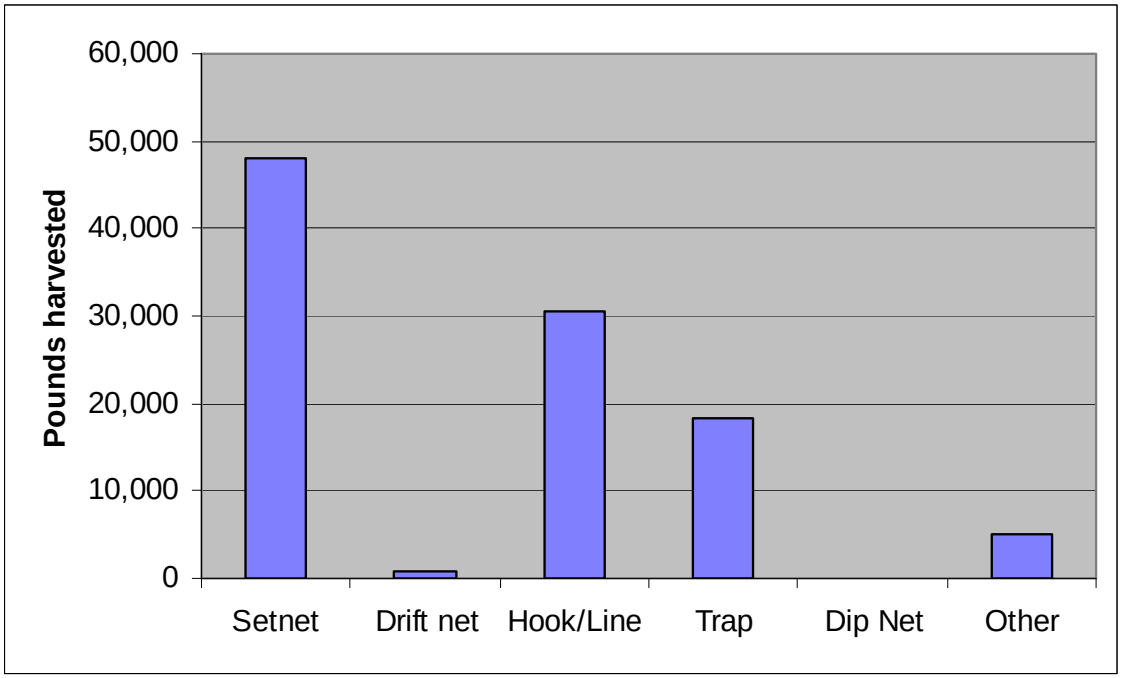

Figure 14.–Amount of nonsalmon fish harvested by gear type, in pounds, Tuntutuliak, 2004–2005.

Seasonality of Harvest by Tuntutuliak Residents

As mentioned earlier, seasonal harvest patterns differed by village. Harvest data by month for Tuntutuliak reveal a pattern slightly more focused on fishing during fall (Table 11), in contrast to residents of Eek and Nunapitchuk who focused their efforts during the spring months. During the 2004–2005 season, October and November were the most frequently reported months of nonsalmon fish harvests by Tuntutuliak fishers. Residents reported harvesting humpback and broad whitefishes primarily in September and

October. Northern pike were also harvested in fall, but not as much as during spring. Alaska blackfish were harvested from October through December and were the primary species harvested during winter months. Some northern pike and whitefishes were also harvested throughout winter, although in much lower quantities than other months. In Tuntutuliak, northern pike were the primary species reported harvested in spring, and few nonsalmon fishes were reported as harvested in summer.

Harvest Locations Used by Residents of Tuntutuliak

Tuntutuliak residents harvested the majority of nonsalmon fish from rivers and sloughs (77%) (Figure 15 and Table 13), followed by lakes (21%), and salt waters (2%). Alaska blackfish, smelt, burbot, and northern pike were primarily harvested in rivers and sloughs. Broad and humpback whitefishes, sheefish and Bering ciscoes, were reported harvested from rivers and sloughs as well as lakes, with more sheefish and broad and humpback whitefishes being harvested from lakes. A large number of northern pike were also harvested from lakes. Tuntutuliak residents reported harvesting herring, halibut, and tomcod from salt waters.

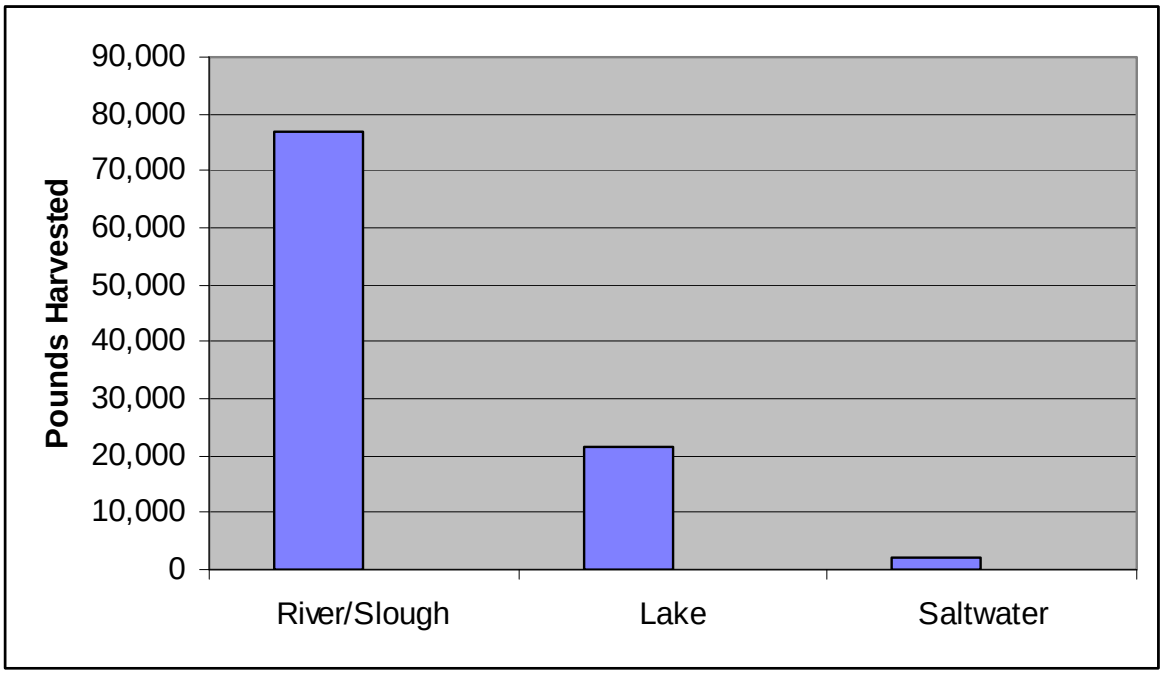

Figure 15.–Amount of nonsalmon fish harvested by location, Tuntutuliak, 2004–2005.

Table 10.–Estimated harvests and uses of nonsalmon fishes, Tuntutuliak, 2005–2006.

	Percentage of households					Pounds harvested			Amount harvested			95% confidence limit (±),
Nonsalmon fish species	Use	Att	Harv	Recd	Give	Total	Mean HH	Per capita	Total	Unit	Mean HH	harvest
Herring	12.5%	4.7%	3.1%	10.9%	3.1%	162.0	2.0	0.4	405.0	Ind	5.0	38.6%
Smelt	23.4%	7.8%	7.8%	20.3%	4.7%	102.5	1.3	0.3	410.1	Ind	5.1	32.3%
Pacific tomcod	14.1%	3.1%	3.1%	12.5%	3.1%	25.3	0.3	0.1	50.6	Ind	0.6	32.4%
Halibut	23.4%	12.5%	12.5%	12.5%	3.1%	1,878.2	23.2	4.7	88.6	Ind	1.1	27.3%
Lamprey	1.6%	1.6%	1.6%	1.6%	1.6%	1.5	<.1	<.1	2.5	Ind	<.1	41.1%
Rockfish	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Stickleback (needlefish)	3.1%	1.6%	0.0%	3.1%	1.6%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Alaska blackfish	37.5%	28.1%	21.9%	23.4%	17.2%	31,302.5	386.5	77.8	31,302.5	Ind	386.5	23.3%
Burbot	64.1%	57.8%	56.3%	18.8%	21.9%	3,192.4	39.4	7.9	1,330.2	Ind	16.4	8.0%
Arctic char	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Dolly Varden	15.6%	12.5%	12.5%	6.3%	4.7%	205.0	2.5	0.5	227.8	Ind	2.8	24.7%
Arctic grayling	14.1%	14.1%	14.1%	1.6%	4.7%	93.0	1.1	0.2	132.9	Ind	1.6	18.1%
Northern pike	92.2%	84.4%	82.8%	31.3%	32.8%	39,058.5	482.2	97.0	8,679.7	Ind	107.2	5.7%
Sheefish	34.4%	31.3%	31.3%	4.7%	3.1%	2,232.6	27.6	5.5	372.1	Ind	4.6	16.2%
Sucker	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0	Ind	0.0	0.0%
Rainbow trout	12.5%	9.4%	9.4%	7.8%	6.3%	161.2	2.0	0.4	115.2	Ind	1.4	26.2%
Whitefishes												
Broad whitefish	81.3%	65.6%	65.6%	28.1%	20.3%	7,902.6	97.6	19.6	1,975.6	Ind	24.4	6.5%
Ciscoes												
Bering cisco	23.4%	20.3%	20.3%	7.8%	4.7%	653.8	8.1	1.6	467.0	Ind	5.8	14.1%
Least cisco	20.3%	15.6%	15.6%	6.3%	3.1%	264.5	3.3	0.7	264.5	Ind	3.3	15.6%
Subtotal, ciscoes	32.8%	26.6%	26.6%	12.5%	7.8%	918.3	11.3	2.3	731.5	Ind	9.0	12.7%
Humpback whitefish	78.1%	62.5%	62.5%	28.1%	26.6%	13,004.3	160.5	32.3	4,334.8	Ind	53.5	7.5%
Round whitefish	10.9%	10.9%	10.9%	1.6%	3.1%	57.0	0.7	0.1	113.9	Ind	1.4	24.0%
Subtotal, whitefishes	85.9%	71.9%	71.9%	37.5%	35.9%	21,882.2	270.2	54.4	7,155.8	Ind	88.3	5.8%
Total, nonsalmon fish	**96.9%**	**89.1%**	**87.5%**	**70.3%**	**62.5%**	**100,296.9**	**1,238.2**	**249.2**	**50,273.0**	**Ind**	**620.7**	**7.9%**

Source ADF&G Division of Subsistence household surveys, 2006.

Table 11.–Estimated nonsalmon fish harvests by month, Tuntutuliak, 2005–2006.

	Estimated number of fish harvested [a]													
Resource	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Unknown	Total
Herring	0.0	0.0	0.0	0.0	0.0	25.3	0.0	0.0	0.0	0.0	379.7	0.0	0.0	405.0
Smelt	0.0	0.0	63.3	5.1	316.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.3	410.1
Pacific tomcod	0.0	0.0	38.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.7	50.6
Halibut	0.0	0.0	0.0	0.0	0.0	17.7	70.9	0.0	0.0	0.0	0.0	0.0	0.0	88.6
Lamprey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	2.5
Alaska blackfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	126.6	278.4	15,263.4	13,415.6	1,265.6	952.8	31,302.5
Burbot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	401.2	632.8	55.7	0.0	240.5	1,330.2
Dolly Varden	0.0	0.0	141.8	6.3	50.6	6.3	7.6	15.2	0.0	0.0	0.0	0.0	0.0	227.8
Arctic grayling	0.0	0.0	1.3	0.0	0.0	0.0	62.0	0.0	57.0	12.7	0.0	0.0	0.0	132.9
Northern pike	0.0	88.6	2,804.6	1,917.4	12.7	0.0	12.7	0.0	553.1	841.6	164.5	75.9	2,208.5	8,679.7
Sheefish	0.0	0.0	2.5	1.3	0.0	0.0	19.0	15.2	210.1	27.8	3.8	5.1	87.3	372.1
Rainbow trout	0.0	0.0	63.3	38.0	0.0	0.0	3.8	0.0	2.5	7.6	0.0	0.0	0.0	115.2
Broad whitefish	0.0	0.0	0.0	0.0	7.6	75.9	0.0	63.3	944.2	683.4	19.0	3.8	178.5	1,975.6
Bering cisco	0.0	0.0	0.0	12.7	0.0	0.0	0.0	0.0	215.2	78.5	0.0	0.0	160.7	467.0
Least cisco	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	192.4	34.2	0.0	0.0	38.0	264.5
Humpback whitefish	0.0	0.0	0.0	0.0	94.9	25.3	0.0	31.6	2,026.3	1,670.6	101.3	44.3	340.5	4,334.8
Round whitefish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.0	6.3	1.3	0.0	25.3	113.9

Source ADF&G Division of Subsistence household surveys, 2006.

a. Alaska blackfish harvests were reported in pounds.

Table 12.–Nonsalmon fish harvests by gear type, Tuntutuliak, 2005–2006.

	Driftnet		Setnet		Hook and line		Trap		Dip net		Other gear	
Resource	Amount	Pounds	Amount	Pounds	Amount	Pounds	Amount	Pounds	Amount	Pounds	Amount	Pounds
Herring	0.0	0.0	25.3	10.1	0.0	0.0	0.0	0.0	0.0	0.0	379.7	151.9
Smelt	0.0	0.0	0.0	0.0	63.3	15.8	0.0	0.0	346.8	86.7	0.0	0.0
Pacific tomcod	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.6	25.3
Halibut	0.0	0.0	0.0	0.0	88.6	1,878.2	0.0	0.0	0.0	0.0	0.0	0.0
Lamprey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	1.5
Alaska blackfish	0.0	0.0	a.	13,035.9	0.0	0.0	a.	18,241.3	0.0	0.0	a.	25.3
Burbot	0.0	0.0	418.9	1,005.4	911.3	2,187.0	0.0	0.0	0.0	0.0	0.0	0.0
Dolly Varden	19.0	17.1	30.4	27.3	178.5	160.6	0.0	0.0	0.0	0.0	0.0	0.0
Arctic grayling	0.0	0.0	0.0	0.0	132.9	93.0	0.0	0.0	0.0	0.0	0.0	0.0
Northern pike	75.9	341.7	2,604.7	11,721.0	5,429.5	24,432.9	0.0	0.0	0.0	0.0	569.5	2,562.9
Sheefish	31.6	189.8	256.9	1,541.5	83.5	501.2	0.0	0.0	0.0	0.0	0.0	0.0
Rainbow trout	0.0	0.0	0.0	0.0	115.2	161.2	0.0	0.0	0.0	0.0	0.0	0.0
Broad whitefish	70.9	283.5	1,835.2	7,340.6	63.3	253.1	0.0	0.0	0.0	0.0	6.3	25.3
Bering cisco	0.0	0.0	467.0	653.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Least cisco	0.0	0.0	251.9	251.9	12.7	12.7	0.0	0.0	0.0	0.0	0.0	0.0
Humpback whitefish	0.0	0.0	4,069.0	12,207.0	265.8	797.3	0.0	0.0	0.0	0.0	0.0	0.0
Round whitefish	0.0	0.0	108.8	54.4	0.0	0.0	0.0	0.0	0.0	0.0	5.1	2.5
Total, nonsalmon fish		**832.1**		**47,849.0**		**30,493.1**		**18,241.3**		**86.7**		**2,794.8**

Source ADF&G Division of Subsistence household surveys, 2006.

a. Alaska blackfish harvests were reported in pounds.

Table 13.–Nonsalmon fish harvests by fishing location, Tuntutuliak, 2005–2006.

	River–Slough		Lake		Salt water	
Resource	Amount	Pounds	Amount	Pounds	Amount	Pounds
Herring	0.0	0.0	0.0	0.0	405.0	162.0
Smelt	410.1	102.5	0.0	0.0	0.0	0.0
Pacific tomcod	0.0	0.0	0.0	0.0	50.6	25.3
Halibut	0.0	0.0	0.0	0.0	88.6	1,878.2
Lamprey	2.5	1.5	0.0	0.0	0.0	0.0
Alaska blackfish	a.	30,960.8	a.	316.4	0.0	0.0
Burbot	1,302.3	3,125.6	27.8	66.8	0.0	0.0
Dolly Varden	203.8	183.4	5.1	4.6	19.0	17.1
Arctic grayling	132.9	93.0	0.0	0.0	0.0	0.0
Northern pike	7,616.5	34,274.4	1,063.1	4,784.1	0.0	0.0
Sheefish	134.2	804.9	237.9	1,427.6	0.0	0.0
Rainbow trout	113.9	159.5	1.3	1.8	0.0	0.0
Broad whitefish	574.6	2,298.4	1,401.0	5,604.2	0.0	0.0
Bering cisco	243.0	340.2	211.4	295.9	12.7	17.7
Least cisco	2.5	2.5	262.0	262.0	0.0	0.0
Humpback whitefish	1,468.1	4,404.4	2,866.6	8,599.9	0.0	0.0
Round whitefish	0.0	0.0	113.9	57.0	0.0	0.0
Total, nonsalmon fish		**76,751.1**		**21,420.2**		**2,100.3**

Source ADF&G Division of Subsistence household surveys, 2006.

a. Alaska blackfish harvests were reported in pounds.

KEY RESPONDENT INTERVIEWS

Eek

Seasonality and Gear

Eek residents reported fishing for nonsalmon fishes throughout the year and that nonsalmon fishes provide important nutrition during every season (Table 14). Key respondents explained that fishing activities are timed to follow the movements of the fish and for optimal quality, taking into consideration safety and access. For example, one respondent explained why it is easier to fish for certain nonsalmon species in winter months: “In wintertime, it’s easier when the ice gets thick enough, safe to travel, and you can shortcut across the lakes. But in summertime it’s a long way, and the creeks are windy” (ER7). Seasonality is an important aspect of how local residents think about their fishing practices; as such, the results here are organized by season as described by respondents, beginning with the spring as the “start” of the annual cycle.

During spring months, Eek residents harvest Alaska blackfish by using traps set in creeks through holes in the ice created by the movements of the fish. These traps are usually set so that the opening faces the current, but are sometimes set vertically, especially when Alaska blackfish are surfacing at the melt holes, likely as a means to access higher oxygen levels when lake water oxygen levels decrease during winter months. One resident described his Alaska blackfish trap: “It’s made out of garden fencing. Fencing wire. About four inch to a quarter inch, the little holes ... I made ‘em like three feet high. A foot and a half in diameter” (ER7). Elders explained that past traps were larger, longer, and rounder, and made from birch.

Spring is also the time residents harvest northern pike, Arctic grayling, and small numbers of burbot at thawing lake outlets. Whitefish species, such as ciscoes and humpback whitefish, are not directly targeted in spring, however, because of their poor quality at that time.

As summer progresses, most fishing effort shifts from nonsalmon species to salmon, although sheefish are sometimes incidentally caught while fishing for salmon. Some residents reported keeping these sheefish but others said they release them because the flesh quality is poor during summer.

Respondents reported fishing for broad and humpback whitefishes in the late summer months, around August and later in the fall, coincident with other subsistence activities:

> When the salmonberries are growing, too, you just move out for picking berries. That's the time they fish for whitefish, too. They just cut them up and hang 'em up same time. Because in those days they don't have a fishing motors or boats to travel. They just had to save their own travelling energy. (ER4)

One elder explained that he used to wait to set nets for humpback whitefish until the time he started trapping, because the cold weather made the fish fatter. Another elder agreed: "They're better in the falltime. In summertime when silvers [coho salmon] or kings [Chinook salmon] are here, we don't fish for them. We fish for those kings, reds [sockeye salmon], chums [chum salmon] and then by September we start fishing for them 'cause they get fat" (ER2).

Although elder respondents described historical uses of fences in their lifetimes for harvesting whitefishes and other fish during the fall season, this method was no longer in use in 2008. Instead, most fishers reported using setnets to fish for broad and humpback whitefishes, Bering ciscoes, smelt, tomcod, and juvenile burbot. Most nets could also be set under the ice or in lakes, rivers, or sloughs during ice-free periods. The mesh size residents usually use for each species is presented in Table 15.

Unlike the labor intensive methods of salmon fishing, which require multiple participants, the harvest of whitefish species can be done by a single individual: "We can go solo because we use small nets, short nets ... because we're basically fishing the smaller creek areas. So one person's ok, two people's ok, but you can do it by yourself because it's really simple" (ER8).

Fishers also use setnets to fish for cisco species, especially Bering ciscoes in fall. If the larger whitefish species are less available, families fish more heavily for ciscoes. During the fall moose hunting season, respondents opportunistically use rod and reel to fish for Dolly Varden and Arctic grayling, at least until November when they harvest sheefish and, as conditions permit, Alaska blackfish. One respondent explained that he starts trapping Alaska blackfish as soon as it is safe to travel on the ice.

Finally, during winter months, Eek residents focus on nets and traps set under the ice. They target Alaska blackfish using traps in the larger tributaries, particularly in deep spots where the trap cannot freeze in the ice. Some respondents also reported setting nets under lake ice in order to target whitefishes, taking care to avoid grassy areas where there are dangerous ice conditions, while others suggested that these practices are more characteristic of upper river communities. Later in winter, once the ice is stable, respondents explained that they harvest burbot, northern pike, and sheefish by jigging through the ice. In the past, elder respondents explained, people used wooden burbot traps that were longer and larger than traps for Alaska blackfish: "Mouth of this creek, there used to be an old lush [local name for burbot; also loche] fish trap here made out of wood. Last year it was there. No, it's not in use. It's probably rotten by now" (ER7).

Respondents explained that in 2008, instead of using traps under the ice, people preferred jigging through the ice when targeting burbot and sheefish. One respondent described how he jigged: "We just take just like a little stick about that long, a stick and some twine, just buy these little heavy weight or light weight jigs, some little jigs, heavier is better sometimes because of the current sometimes it pulls on the jig" (ER8).

In addition to subsistence fishing, several Eek fishers reported that they had participated in a limited commercial fishery for whitefish species in the 1970s and early 1980s. However, this fishery required

more attention and time than the subsistence fishery, and according to some fishers, caused conflict with other local subsistence fishers:

> You have to check your net every day to make sure your fish alive, fresh. 'Cause you want a fresh fish for those local buyers, like Swansons, ANICA, and they don't want ... you know, those fish are different than fresh fish. I did it one time and then I didn't do it again after that. (ER9)

Also,

> And those broad [whitefish] fishermens up there, they kind of used to piss off the subsistence fishermens because those broad fishermens, some of them, they took other people's nets. They pick the fish out of them and deliver it … and we go check them and there's only dead fish, not alive ones. They let us go up there for nothing. And sometimes let us waste gas. (ER5)

Table 14.–Eek nonsalmon fishing, by season.

Spring	Setting vertical or horizontal traps for Alaska blackfish where the fish have melted creek ice.
	Fishing for northern pike and Arctic grayling at lake outlets as lakes begin to thaw.
	Harvesting small numbers of burbot in the lakes during break-up.
Summer	Focusing on salmon species.
	Sheefish sometimes incidentally caught during salmon fishery. Some residents retain them and some release them because they consider them poor quality at that time.
	Fishing for broad and humpback whitefishes begins in August.
Fall	Fishing for broad and humpback whitefishes in September.
	Fishing for Bering ciscoes in September.
	During moose season, rod and reel fishing for Dolly Varden and Arctic grayling.
	Using boats to fish for burbot prior to freeze-up.
	Fishing for tomcod during October.
	Fishing for sheefish during November.
Winter	Setting traps for Alaska blackfish in larger tributaries.
	Setting nets under the ice for whitefishes.
	Jigging through the ice for burbot, northern pike and sheefish.

Table 15.–Eek nonsalmon fishing gear.

Species	Current gear	Historical gear
Broad whitefish	Set gillnets with 4½–5½ in mesh.	Set gillnets with 6 in mesh. Fences.
Humpback whitefish	Primarily set gillnets with 4–4½ in mesh. Occasionally set gillnets with 2 in mesh.	Fences.
Ciscoes (unspecified species)	Setnets with 2 7/8–3 in mesh.	None mentioned.
Smelt	Small nets used in river. Jigs. Dipnets with ½ in mesh.	None mentioned.
Tomcod	Small nets used in river.	Beach seines.
Sheefish (*ciiq*)	Primarily jigs. Occasionally subsistence salmon fishing gear such as fishwheels.	Jigs.
Alaska blackfish	Traps made from garden fencing wire.	Larger, longer, rounder traps made from birch.
Burbot	Jigs.	Traps that were longer and larger than Alaska blackfish traps and that were made from birch.
Dolly Varden, Arctic grayling	Hook and line attached to a rod or pole.	Hook and line attached to a rod or pole.

Harvest Locations

Harvest locations mapped by Eek respondents are presented in figures 16–19. Eek respondents reported fishing for nonsalmon fishes in the lakes north and south of Eek, and in the areas around the Eenayarak River, Eek Channel, and Apokak Slough. Nonsalmon fishing also frequently occurs in the Eek River upstream and downstream of the village, in the Kuskowak Creek area, and in the lakes and rivers northwest and southwest of Eek Lake. Respondents reported fishing for broad whitefish and humpback whitefish in Sooktuk Lake and Fish Stop Lake, and on the Eenayarak River. They reported harvesting ciscoes in the Eek River downstream from the village, and in sloughs, such as Apokak Slough, which is also downriver from Eek. Sheefish are targeted in deep, slack waters, where the current is slower, such as near points or bends of the river, while other fishes, such as northern pike and Dolly Varden, are also harvested from slower waters. For example:

> Sometimes it [the river current] gets pretty strong ... we used to be trying to go to where the water is kinda still, like back where two rivers meet, where the water isn't going by so fast ... that's where we usually go fish ... that's why we have certain points we go to like right there where the current isn't strong. At the eddies, eddies are a great place to fish. (ER8)

The mouths of lakes are used to fish for northern pike and to set traps for Alaska blackfish. Closer to the mountains, fishers use rod and reel to harvest Dolly Varden and Arctic grayling. Although there was some use of these species, respondents said these species are not heavily utilized for subsistence because of the lack of an efficient means of harvesting large quantities, and because these fish are found at a significant distance from the village.

Interviews with residents suggested that harvest locations are determined by a combination of learning from elders and experimentation. Respondents usually had their first introduction to fishing at a young age, while accompanying older family members. As one man explained: "Since my father showed me, I fished" (ER7).

Another elder described a similar start in fishing:

> Like I told you that I grew up eating fish, and I follow the footsteps of my dad. I still do fishing. ... My dad had a wooden boat and he had an outboard motor, but I also used to follow him with kayak when I was a boy. Homemade. My dad used to make kayaks himself. They're scarce nowadays. We got kayaks now that are made in foreign countries. (ER2)

As people learned to fish, they began to combine the knowledge their elders taught them with their own experiential knowledge. By focusing on information that was shared by elders and confirmed by experience, many respondents developed successful fishing methods: "But [the fish] don't have oil in the summertime, that's for the falltime. The elderly once told me in summer days [the fish are] not fat, and I noticed that … [The elders] know more than we do" (ER6). Another elder commented, "Sometimes I think of what I heard from my elders and I … try 'em for myself. That's the way I understand ... Sometimes you can have a doubt, you know to find out [for] yourself" (ER4).

As fishers become more experienced, they draw more extensively on their own observations. One elder explained the role of observation and deduction in determining a good location for fishing:

> You have to find place that have a lake, and that creek. I notice my catches of pike, they can be full of blackfish at the mouth of that main creek. In springtime the mouth of that creek is good fishing for pike. And then in spring after the thaws I notice on the creek where there's melted ice along the creek on the reeds and then there'll be blackfish, maybe coming up. Sometimes it'll be about two feet wide. That hole on the ice where it's thawed. (ER7)

Success in fishing not only depends on learning from elders and on personal observation, but also on flexibility and experimentation. One respondent described his fishing strategies by saying "If we don't catch much then we move on to another lake" (ER6). Another explained that once he had learned where he could find a certain fish, he would then test similar areas. One elder explained that he incorporates investigation of fishing spots into other subsistence activities: "When I went to pick berries. I threw out my net very shortly to find out what species was out there, I thought I caught a salmon, big sheefish … find out there's lots of them in salmon season time" (ER4).

Respondents also find good fishing spots for specific species through their knowledge of and observation of other species. For example, one elder said that predatory fish, such as burbot and northern pike, could usually be found in summer in areas where they could prey on Alaska blackfish.

The process of experimenting in order to find good fishing spots was continual, because locations did not always stay the same. For example, one elder explained that people are harvesting northern pike in nets set where he once harvested whitefishes, and that other, once-productive spots no longer yield any fish.

Finally, in order to learn where to fish successfully, fishers must learn how environmental factors affect short term fish movements. In the Eek area, tides have the most influence on daily fish movements: even the lakes are affected by the tides. Elder respondents commented that most species of nonsalmon fish move according to the tides, the wind, and the water levels. For example, one respondent said that ciscoes come in with the tide and then are pushed out by the tide. Another also said that ciscoes move into creeks at high tide. Respondents said that people start to fish as the tide goes out because the nets become full of mud and grass during an incoming tide. A south wind causes a larger tidal movement and brings in more ciscoes. One elder commented that the tidal changes are good for fishing in general while another commented that the period before the tide turns is a good time to fish for burbot. Another commented that it is better to fish when it is overcast and windy:

> ‘Cause it’s really hard to catch fish when it’s, like, where there’s no wind and lots of sun. You don’t catch lots when it’s like that, when it’s too calm and too sunny it’s not a good time to fish. They like cold water. The rougher the better. (ER8)

Another respondent explained that during breakup the river is too dirty for fish, so many species seem to go into the tributaries.

Preparation and Use

Elder respondents reported changes over their lifetimes in the harvest and uses of nonsalmon fishes. A decreased use of dog teams for travel and work lessened the need for harvesting quantities of fishes that were primarily used as dog food, such as least ciscoes and sheefish.

One elder noted another kind of change in fishing and preparation of fish:

> There’s hardly people going to their fish camps now. Like in the old days there used to be more fish camps along the river, downriver. Nowadays there’s [a] kind of die out, there’s only one down there as far as I know and there’s maybe two or three upriver right there. They still do subsistence drying fish but most of them they dry them in the village and smoke them in the village. Most people who dry fish around here have jobs, too. (ER2)

Other respondents agreed that people generally bring fish to the village for smoking because they are unable to be away from their jobs for long periods of time. According to respondents, however, this shift in the social practices of the location of fish processing has not prevented people from preparing fish in traditional ways.

Key respondents said that they prepare whitefishes in a variety of ways, including drying, freezing, and aging underground. Preservation methods vary greatly depending on the season. Residents reported similar methods of preservation for both broad and humpback whitefishes, and note that broad whitefish have more fat than humpback whitefish.

Both species of whitefish are frozen and eaten raw, and are also used to make *agutaq* (sometimes also called “Eskimo” ice cream) made from fish, berries, and some kind of fat. Another respondent explained that it is possible to prepare whitefishes without having to cut them:

> The only one I’ve personally opened up is the sheefish. ‘Cause I gut them and take off the scales. But the whitefish and the pike and the loche [local name for burbot], you don’t even have to open it up ‘cause you can just cook it whole. (ER8)

One respondent described a traditional method used to age whitefishes:

> Those old folks, they used to make grass baskets, some were good sized baskets out of grass. Not this regular grass but … down below there’s flat grass that grows about that long. They’re hard to break. They weave ‘em and they make a basket and they put those whitefish in there, clean their tummies first. Put ‘em there and let ‘em maybe rot a little while and then they eat ‘em raw. They’re good. Number One food. (ER4)

Another respondent explained that people still age whitefishes, although they now use cardboard boxes rather than grass baskets.

Participants explained that they do harvest a large number of sheefish and that these fish are mostly harvested in winter, and are preserved by freezing. According to respondents, northern pike are eaten fresh or dried. They can be dried in spring if the weather is warm, and eaten with seal oil, salt, or soy sauce. Northern pike are also be harvested in winter, when they can be cold-weather dried, which produces a softer product, “like freeze dried” (ER5).

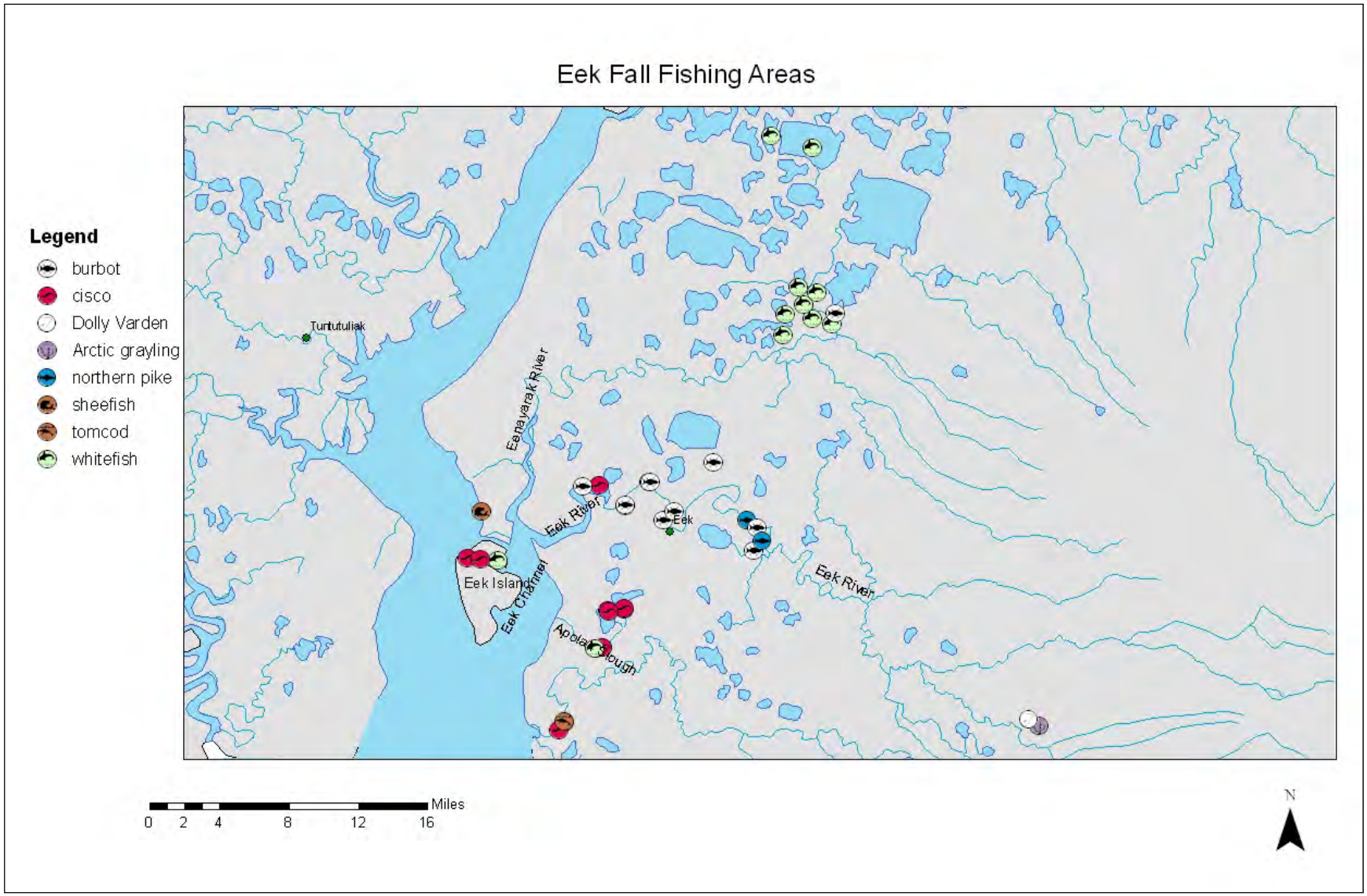

Figure 16.–Eek fall fishing areas.

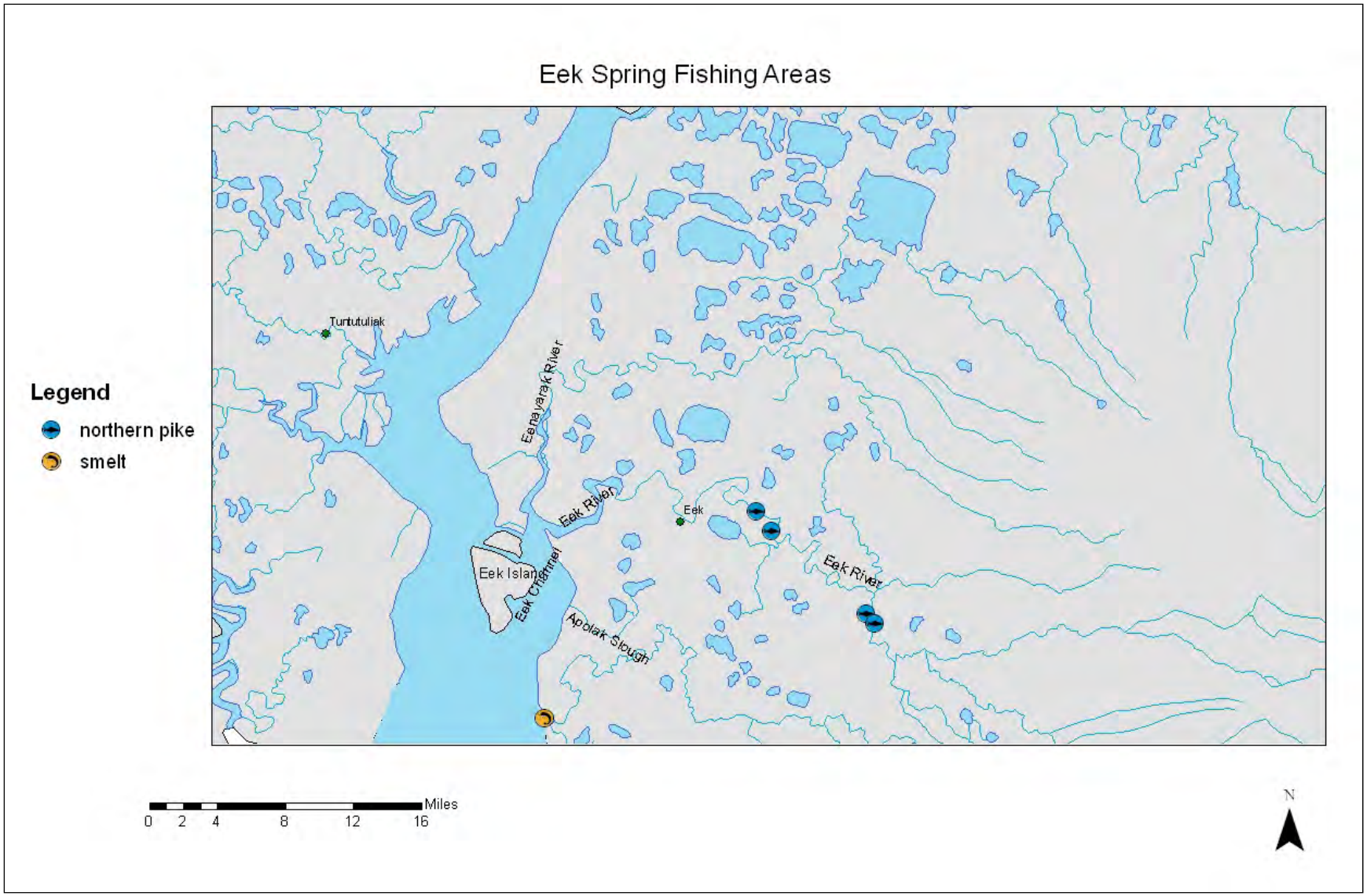

Figure 17.–Eek spring fishing areas.

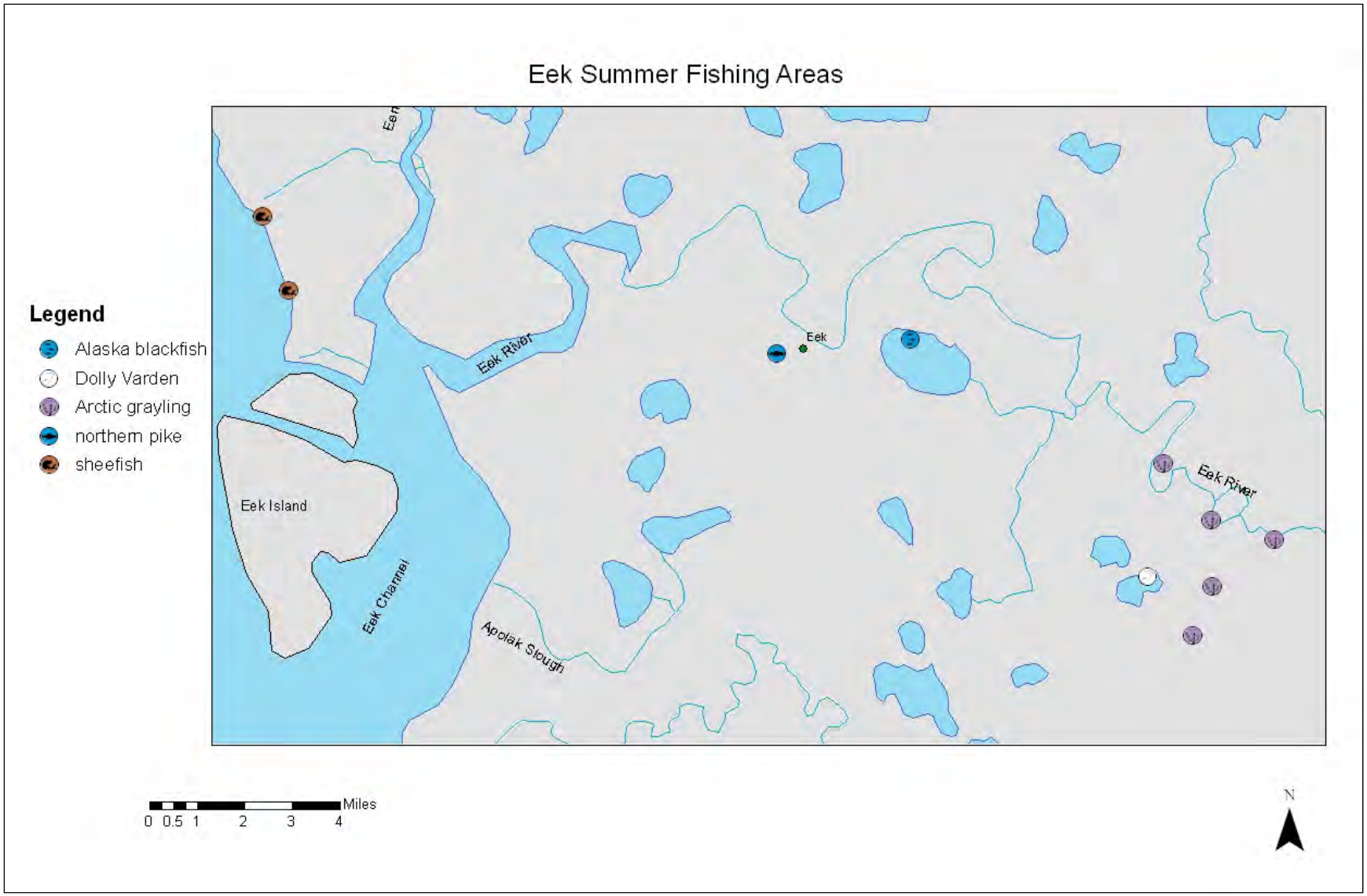

Figure 18.–Eek summer fishing areas.

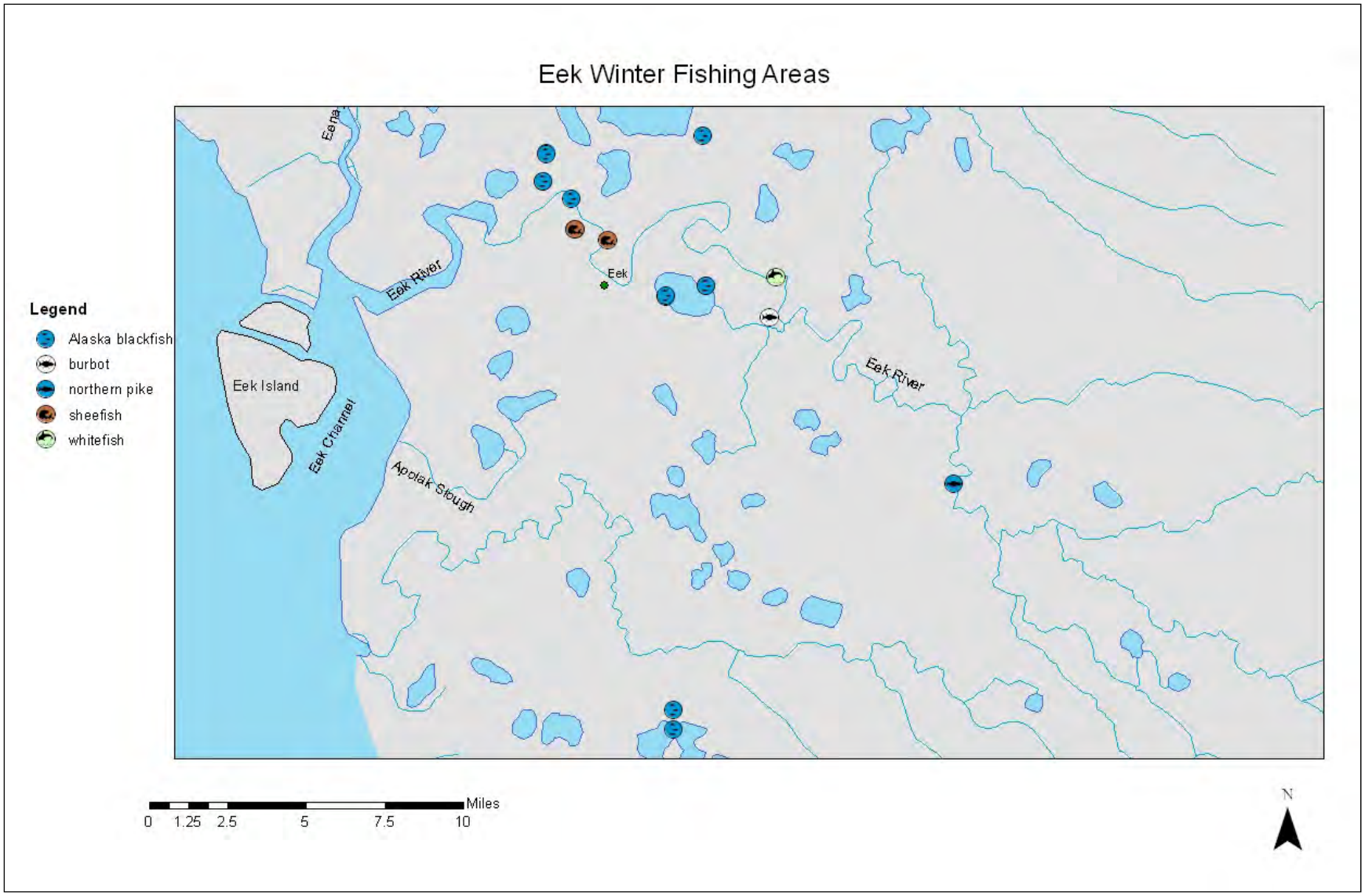

Figure 19.–Eek winter fishing areas.

Alaska blackfish are a versatile fish, according to respondents, and are used as both human food and dog food. One elder explained that Alaska blackfish preparation and preservation is fairly simple, they are usually just frozen or boiling water is used to clean them of slime, which can make them hard to handle.

Alaska blackfish are boiled and eaten, or simply eaten:

> And those older folks they used to eat 'em raw. Those blackfish, they really like 'em raw … but freshly caught, they let them stay there a certain time and then when their tongues or stomachs turn red, they freeze 'em. And they eat 'em raw. (ER4)

Alaska blackfish are also be used as bait for burbot: "Cut them in pieces about one inch from the head down" (ER7). Another respondent described their use as dog food:

> If you want to have a long trip, even with the dogs, those blackfish, they cut 'em. They're frozen, they cut 'em. When they're checking their trap they just feed them maybe two or three. For the energy. (ER4)

Respondents also described the uses of other less commonly harvested fishes. "Needlefish" (the local name for several species of stickleback) are eaten raw and are frozen as well. Arctic grayling are often eaten raw with seal oil, or are baked. Burbot were said to need especially careful preparation because they are bottomfish:

> To preserve it, take the contents out from the stomach and pull the stomach out. Clean it. Those loche, they have a tapeworm that kind of spreads … in the flesh. My wife cut it. Put it right through to the bone, in sections. Cook it fresh. She dried it before. I noticed when she dried it the tapeworms in there started coming out ... Yes. Boil them out. They boil any fish, any bottomfish. (ER7)

Parasites were reported as found in other fish, such as northern pike, but are generally not considered to pose health risks, especially if care is taken during preservation (usually through drying) and when preparing them as food.

A final, perhaps unusual use of nonsalmon fish was mentioned by one elder: "Except when they didn't have a Bandaid or sterile gauze, when there was a boil outbreak in the village they use to put the fish, or the pike's skin, keep that wound from sticking to you" (ER7).

Traditional and Contemporary Self Management Practices

> That's why … our elders used to respect the ground. They just didn't want to mess it [up]. Even with the hunters, [they] have got to be trained by the elders to respect everything, even the ground where the plants … You just want a environment the way this [is], you just wanta not to disturb the ground, you know. The plants and the river for the fish. That's how I grew up. That's how I was taught by one of the elders, too. (ER4)

Eek respondents described a general ethic of respect towards their food sources that has resulted in several specific self management practices. Self-limiting harvests are a fundamental aspect of traditional management principles. For example, people self limit Alaska blackfish harvests so that they trap only what is needed: "When they're trapping for blackfish, sometimes when you catch too many, they just pull them [the traps] out for awhile"(ER4).

This elder also explained that people take care not to exhaust a good spot for Alaska blackfish:

> Seems like every year because they're not trying to clean them [Alaska blackfish] out all at once. They don't [need] all that. That's how we've been taught, not to waste, and when your trap is frozen, you can remove it ... But some guys they just pull 'em out, don't go there next year. 'Cause they want a good decent place to set nets for the future. (ER4)

In addition, elders explained that unused nets for nonsalmon fishes should be removed from the water, especially during winter, in order to avoid harvesting fish that cannot be used.

People also limit harvests of fish for other traditional reasons. One resident reported that local families voluntarily refrain from both fishing and seal hunting for 1 year after a death or miscarriage in the family because of the effect on the environment:

> When a person do that [seal hunting or nonsalmon fishing in the year following a family loss] there's always big waves. And some big chunk of ice moves. That's what happened to us. One of our relatives went down. Wife had miscarriage. Almost lose our snowmachine. Even we lose our sleds. It's not safe. (ER6)

Eek respondents also explained the importance of sharing fish, a practice that helps prevent waste. One elder told interviewers that he cuts and boxes the fish in order to share it with other residents Any extra parts are not wasted: "Give 'em to the dogs. We gather what we need, we don't spoil. When we have enough, we give 'em to our relatives" (ER6). Another elder explained: "The rule was not to waste fish and every subsistence [product]" (ER2).

Several respondents explained that sharing is more than simply a physical means of preventing waste. There is a deep belief that guarding the resource selfishly and not sharing results in damage to the resource:

> And there's a saying that when people are saying bad things or talking mostly about them in a bad way or saying it's for them only, not for outsiders, the numbers go down. And when they say it with everybody there, the abundance or quota will go down, surprising. (ER5)

Because of this belief in sharing, respondents explained, they do not mind if people from nearby villages use the area to subsistence fish, as long as they act respectfully: "I would say it's at least go there, at least take your trash with you when you go back. Keep the land clean. That's just what we were [taught], just keep the land clean, keep it clean, that's all that we ask" (ER5). And:

> Yeah, this area's for everybody, you know. The way I heard, those elders, they got relatives scattered all over as far as Bristol Bay. And Yukon. All over. 'Cause it's how they used to find ... to encourage their hunters to respect ... even to have the villagers, they have to have the cooperation... not against, but cooperation, to respect the area where they intend to camp there. (ER4)

Harvest timing is also an important element of self-management practices because successful subsistence economies rely on efficient harvest practices. Eek respondents reported timing their fishing efforts for periods when the fish are fat and avoiding times during which the fish are skinny or otherwise poor quality. For example, although residents of neighboring communities harvest and dry humpback whitefish in spring, Eek respondents reported that they did not target whitefishes in spring or summer because the fish do not get fat until after the weather turns cold. Likewise, burbot and ciscoes are also primarily targeted during fall and winter because respondents said, they taste better during cold months: "In the spring time we just leave them alone. We don't care to fish for them because we know their meat is not right" (ER4). Finally, sheefish incidentally harvests in summer salmon nets are often released until it is later in the season, when their flesh becomes more firm and fat.

Harvest timing also plays a critical role in the logistics of preparation: "June is the best part for drying. In summertime they hardly do [that] because of worms and everything that get into it, spoil the fish. End of September it's not too bad" (ER2).

Changes in Abundance, Distribution, and Health

The initial reports of declining populations of broad whitefish in the area, which in part prompted this project, were further affirmed by project participants. "Like I said, they're not like they're used to be.

There's not as many and they're small" (ER6). One elder described his personal experience of this decline in whitefishes and recalled their greater abundance when he was a child: "I remember there used to be so many [white]fish in that Eenayarak when I was a kid, but now we don't have that many fish in that river. They're the kind we used to fill our wooden boat [with] when I was a kid. The fish have changed and the people change" (ER2).

According to local fishers, the change in population, including the decline in abundance, began in the 1960s and 1970s. A respondent explained that in an average contemporary harvest of 100–200 whitefishes, only about 20% were broad whitefish and the other 80% were humpback whitefish. He further commented that there were fewer whitefishes in general, and that total whitefish harvests were not as plentiful as in the past. Fishers gave several explanations for the decline. One elder felt that prior to the decline in abundance of broad whitefish, people left their nets set too long and the nets froze. He said this is one reason for the decline. Another participant had a very different explanation for the decline in broad whitefish:

> Well, I used to hear stories that there was quite a few at Eenayarak, but after the earthquake happened there was not. This one got shallower and catching fish got harder. They used to use big boats. Big boats to go through here to get diesel over at Bethel and they'd come back, they'd use this trail ... it was pretty deep, they'd use big boats, now it's really hard just to go by Lund [brand of skiff] 'cause it's getting really shallow. (ER8)

Several elders did comment that a certain amount of variation in whitefish populations is natural. "Like king and dog [chum] salmon, some years they're less, some years they're more" (ER6). However, this fisher also noted that, more fishing effort is needed for the same amount of fish, although 2 years ago there were "lots" of whitefishes. This might be explained by one elder's comment that fishing effort is related to more than just fish abundance:

> No, sometimes we hardly catch. When we don't have south winds it's low on every fish, like north and west, we don't catch as many as south wind. Last summer we didn't have much south wind, and August we hardly had south wind. It was poor for commercial [salmon]. (ER20)

One respondent explained that in a year of high water, it could be nearly impossible to catch whitefishes. Another respondent mused that perhaps people were becoming less skilled fishers, which was why people weren't harvesting as much: "When I used to go with my dad we used to catch lots, so many sometimes, but now we don't catch as many as we used to. Maybe they were better hunters than we do" (ER2).

In contrast, another elder felt that fishing today is easier because of technology and also because people no longer have to obtain enough fish to maintain a dog team. "In the early days they used to … fish for their dogs, and they don't even have snowmachine in the older days" (ER6).

Two elder respondents commented that cisco abundance used to be much higher, and one said that it was the weather that causes the Bering ciscoes to be less abundant. Another elder expressed a concern that Dolly Varden are becoming more scarce.

Changes in Land and Habitat

Elders in Eek were raised to have an intimate knowledge of their landscape and are sensitive to local change. They learned about the landscape through a lifetime of experience on the land, and had been instructed by their elders from the time they were young. For example, one elder (ER1) reported that he had been taught by his parents to memorize places on the landscape so that he would know where he was in case of a blizzard.

Environmental knowledge is also recorded and transmitted through placenames. The system for naming places often reflects environmental relationships, environmental changes, and human uses of the landscape. For example, one elder gave 2 different names for lakes that can sometimes be found at the

outlet of a river. One name seems to literally mean simply "big lake at the end of a creek or slough." The other word means a more specific "source of water." These terms are also interesting because they focus on the relationship between lakes and rivers or sloughs as it informs fishing practices: because many nonsalmon fish follow seasonal migration patterns through local rivers and into and out of lakes, they are often targeted at the lakes at the end of a creek or slough.

Other names focus on human uses of the landscape. For example, one place is named "Where the boats start going fast" because it is where people can first see Eek when returning from commercial fishing, so they tend to speed up there. Additional examples are the words that distinguish between a small man made ditch that connects two nearby water bodies, and a newly formed, but natural creek that connects two other nearby water bodies. The latter term shows that people track even the small changes in their local environments.

Eek elder respondents reported noticing many changes in the local land, water, and climate. They say less rainfall in recent years means decreased "flushing" of lakes by overflowing sloughs and creeks, which makes the lakes less healthy and more clogged with excess vegetation. Many also observed that lakes and sloughs are drying up, or have significantly lower water levels:

> The water's getting lower, and the lakes on that creek, they're getting lower and it seems like they're getting smaller, too. Vegetation growing on there … and if the lake doesn't flush out to the main river, it'll dry up. Or it'll grow vegetation in there. And that'll kind of close the good spot for setting blackfish trap. (ER7)

In addition, when water levels are lower, respondents note more erosion in certain places on the Eek River. Breakup can also cause significant erosion: "When the ice is jammed up, breakup, that's the most of the time we lost a portion of the cut bank, where they hit the bank and they move off with the ice" (ER4).

Other environmental changes have been observed over time. In general, respondents said, the weather is warmer, the ice is thinner, and breakup is sooner. Some elders reported drastic changes in the nature of winter:

> From the stories I heard, in the wintertime when we don't have so much south wind, that means we don't have much fish in summertime…. In the wintertime snow comes with south wind. When I was growing up in the village we used to have breakup sometimes in May, but now at this time of year it breaks up early, like end of April. The ice used to be very thick, too. Cold, cold, cold. Weather warmed up nowadays, all over. One time when I was with my grandmother upriver when she was alive I helped her on the ice go fishing and I think she had ice pick. By the time we hit water it was [a long time]. But now it's not that thick around here no more. (ER2)

Or, according to another respondent: "Yeah, it's getting less snow. These elders, they talk about, they said there used to be lots of snow. Over the house, banks, only the chimney would show up. And I couldn't believe what they were saying" (ER7). Reasons offered for earlier breakups range from lower snow loads on river ice to thinner ice during winter, which indicates warmer air and water temperatures. Furthermore, warmer water temperatures are considered detrimental to many fishes, especially northern pike and burbot.

Finally, several elders reported that the wind patterns have changed, with more north and west winds than in the past.

Residents also expressed concerns about beavers and their effect on the landscape. Fishers have observed an increase in the beaver population and distribution: "They used to be way upriver, we didn't hardly see any beavers down below in our area. But now they've headed downriver, I've been seeing beavers down below my fish camp by the mouth, too" (ER4).

Respondents say that beavers damage the creeks that are good places to target Alaska blackfish. One elder explained that beaver dams damage habitats by contaminating the water and thus killing fish in the area. "Yeah, they sure are disturbing everything, even spawning area. So that's why one of those elder guys he got tired of hearing it. He want 'em to bomb the dams" (ER4).

This elder explained that removing beaver dams by hand does not help because the beavers simply rebuild. "Back in our rivers, upriver, sometimes we just clean the dams out, they repair it next day. They got a good contracting service. Probably insure 'em, too. They're back overnight" (ER4). Trapping activities that historically managed beaver populations are no longer practiced by many local residents. "It's like they got more beavers when people start using sno-gos [snowmachines] not dog teams, 'cause back then they used to feed their dogs beavers, too. We rarely used to see beavers down here, only up there, nowadays we see them down here" (ER5).

Other Concerns

Several economic factors affect fishing practices and effort. In 2006, the price of gasoline in Eek was $5.37 per gallon, which, one participant explained, makes it difficult to go fishing. He also explained that beaver trapping is no longer profitable and the beaver population is growing, causing a decline in water quality and fish habitat.

Nunapitchuk

> You know just like white people keep working in order to feed themselves. The Yup'iks in the same way depend on subsistence to eat and thrive because the fish change throughout the seasons. That's how they survive. (NR4)

Seasonality and Gear

Nonsalmon species are an important part of Nunapitchuk subsistence, and key respondents reported year round fishing for them (Table 16). As one elder explained, in the recent past people moved with the seasons in large part to target different fish populations. Now, most fishing is done from the town of Nunapitchuk, although residents still follow a seasonal cycle of fishing activities.

> We used to go to a camp … We go by dogsled and my dad and a person that was staying with us came back and got the boat, took it over with sled, dog sled. In fact, that was right around April, March, April, sometime in that area. We'd be there until the ice is gone, and we'd follow the river going up to this lake and portage over here. In summer we go down to fish camps. But we moved around. And didn't come back until the ice start to form on the banks of the river. (NR 6)

In spring, elder respondents explained, it is fairly easy to harvest Alaska blackfish:

> Maybe in the late winter they start to do that where they break through the ice to get to air, maybe … and people set the blackfish traps standing, you know. But it have to be submerged underwater for the blackfish. (NR7)

One respondent commented that when Alaska blackfish are surfacing at a hole in the ice, they can be scooped out with just about anything from a dipnet to a ladle (Table 17).

People also go on the ice while it is still stable and jig for northern pike or burbot. Northern pike are the first fish to return in the spring, followed by whitefishes, so residents time their fishing accordingly.

When talking about preferred gear, one resident said:

> [The] under-ice-nets [are] smaller, targeting pikes and burbot in spring. Three [inch mesh], might be three and a half, four, four might be too big, I don't know. But in open water you might get to use bigger mesh size. Like I use four, four and a half, five. When

> the ice is gone. When I catch more whitefish, either that kind or this kind [broad or humpback whitefishes]. (NR6)

Respondents commented that they now purchase nets and do not need to make them, as they had to do in the past. One resident explained that his father used to use an antler gauge and twine to make short nets (about 1½ yards long) of varying mesh sizes.

After breakup, some people travel to the Kuskokwim River to fish for smelt: "As they [the fish] start coming up Kuskokwim, they announce over the radio. And I see quite a bit of boats racing down that way. With their dipnets" (NR6).

Respondents reported setnet fishing for whitefishes and northern pike during the summer months, with July an especially good time to harvest humpback whitefish in the Kuskokwim River. A few Nunapitchuk residents said they avoid fishing for whitefishes in summer because the flesh is too soft, but many said they fish for whitefishes from spring until fall. Most respondents reported retaining sheefish caught incidentally during the salmon fishery, but some people described targeting sheefish in the summer. Finally, some participants mentioned rod and reel fishing for northern pike in the summer.

After they had closed up fish camp for the season, residents began fishing more intensely for nonsalmon species, especially broad and humpback whitefishes during their migration from tundra lakes to rivers and streams.

> They set their nets right around here, right around July, close to Fourth of July. And later when they start going out, somewhere toward the end of September, before freeze-up time, when water starts to get cold. Nanvarnarllak and Kayigyalik up here. They have better fishing time toward when the water gets cold. Starts in, like, September, beginning maybe the second week or somewhere at that time, September tenth maybe, they get better. (NR3)

Residents described a special method historically used during fall whitefish fishing: "And the way we caught whitefish was mostly nets, and then starting September, middle of September 'til freeze-up time, they used to set up whitefish fence. Right across the river" (NR3). These fences were reported to be remarkably efficient, and could supply the whole community:

> Yeah, so, four main fish fences were used. Number one was by the school, they catch lots of whitefish! Their peaks, the time they hit the fish fence, people really fill up their boats, just in a matter of a couple hours. And they take turns. If one fill up, and one is waiting, one moves and the other one goes to the spot. Every family had a chance to participate. (NR3)

> But when I was young, up until I was about early twenties, we'd take a boat out to the fish fence, dipnet fill the whole boat, bring it up and then our parents would cut some and then put some underground to ferment for the winter. (NR6)

Residents reported that people stopped using fish fences because of complaints from a barge line company, because the legality of the method was in question, and because newer technology was available. "But people stopped using when they had more nets available … Availability of equipment diminished the old way" (NR3).

Although the fish fences were efficient, residents explained that it was difficult and labor intensive to build them, and they required a lot of materials as well. In 2008, residents still fished for whitefishes in the fall, but they use setnets instead of fences. One woman said her husband still went to a traditional fall camp site for 2 or 3 days in order to fill his boat with humpback whitefish. Another participant described an unexpected event that happened when he was fishing for fall whitefishes:

> I hardly, hardly ever see anyone fishing at the same time [as moose hunting]. Unless a person's camping out, waiting for a moose to come around, they set their net out. But I

> caught mine pretty much by accident two or three years ago. I was tending my net and ... drying the fish. That morning I went down, pulled the fish out, started going back, right not far from my camp, moose stood up. (NR6)

After fishing for whitefishes, many residents set nets for least ciscoes and northern pike, often immediately after freeze-up because the ice is not too thick. Respondents also said that people jig for northern pike and burbot during the fall and that they use Alaska blackfish for bait.

> That's lots of that now, we never used to. Until that lady from Tunt[utuliak] got married to a person from here, and she started fishing in front of their house. Evening as the sun go down, catch a few. ... She was doing that in front of her house, now when we go down favorite spots are in front of a couple sloughs over here by Kasigluk River and on down by the lake. You see lots of people jigging during the night. (NR6)

They also said that people begin setting traps for Alaska blackfish after freeze-up. One elder commented that it is best to wait until January to fish for Alaska blackfish because before then the fish have clams in their stomachs (the fish are usually eaten whole or "in the round"). Another elder described his method for finding a place to set a trap for Alaska blackfish:

> I had to maybe ask someone, or in a small stream or creek there's sometimes three or four traps in there, and you know I could set my net or trap in there, too. People say that there's a lake and there's a creek, that's the best place to set a trap out there. ... At the mouth or further down. … All the way under, to the bottom of the creek. I've seen also, on the river, people told me in the beginning of the fall, blackfish start going downriver and in the middle of the winter they start heading back again, so I [return to] the mouth. (NR7)

One respondent explained that the wire traps that Nunapitchuk residents use for harvesting Alaska blackfish can be purchased in the local store and no longer need to be made by hand out of wood, like in the past. Residents commented that Alaska blackfish are the only fish that can be found in local lakes in the winter, and that when they travel to the Kuskokwim River they can harvest a large number of northern pike, as well as some whitefishes and sheefish. Elders said that winter fishing on the Kuskokwim River is better upriver than downriver.

Table 16.–Nunapitchuk nonsalmon fishing, by season.

Spring	Fishing for Alaska blackfish with traps at breathing holes.
	Jigging for northern pike and burbot.
	Setting nets under the ice for northern pike, burbot, and whitefishes.
	Setting nets after breakup for whitefishes and pike.
	Dipnetting for smelt in the Kuskokwim after breakup.
Summer	Setting nets for whitefishes and northern pike.
	Fishing for sheefish with driftnets or setnets.
	Setting nets for least ciscoes in June, July and August.
	Using rod and reel for northern pike.
Fall	Setting nets for broad and humpback whitefishes after returning from fish camp.
	Drifting for whitefishes.
	Setting nets for least ciscoes.
	Fishing for northern pike with setnets or with jigs.
	Jigging for burbot at night.
	Setting traps for Alaska blackfish after freeze-up.
Winter	After freeze-up, setting nets under the ice (on the Kuskokwim River) for whitefishes, burbot and pike.
	Setting traps for Alaska blackfish (although some wait until January); also dipnets and ladles.
	Jigging for burbot and northern pike.

Table 17.–Nunapitchuk nonsalmon fishing gear.

Species	Current gear	Historical gear
Broad whitefish	Set gillnets with 3½–5½ in mesh.	Communal fish fences.
Humpback whitefish	Set gillnets with 3½–4½ in mesh.	Communal fish fences
Northern pike	Set gillnets with 2½–4 in mesh. Jigs through the ice. Rod and reel in summer.	None discussed
Sheefish	Drift gillnets or set gillnets with 3–4 in mesh.	None discussed
Alaska blackfish	Wire traps that can be purchased at local store with ¼ or ½ in mesh. Dipnets and even ladles.	Handmade wooden traps
Burbot	Jigs through the ice. Set gillnets with 3–4 in mesh.	None discussed
Least ciscoes	Set gillnets	Communal fish fences and dipnets

Harvest Locations

According to key respondents, Nunapitchuk residents fish in a variety of local spots. Fishing areas mapped by Nunapitchuk residents are represented in figures 20–23. Respondents reported that just about every available species of fish thrives in the Kasigluk–Nunapitchuk area, and that the fish from this area taste better than fish from other areas. Nunapitchuk respondents said that they commonly fish for nonsalmon fishes in Takslesluk and Kayigyalik lakes, as well as in a region near Newtok, along the shores of Baird Inlet, and on the Kialik river drainage near Tuntutuliak. Residents also reported use of the lower Johnson River area, the area of smaller lakes falling between Baird Inlet and Aropuk and Takslesluk lakes, and the Kutukhun River, which is a tributary of the Kialik River. One respondent explained that when people say they fish in a certain river "they use the river names to indicate generally … that he sets his net not far from the mouth of this river" (NR1).

The tundra villages' fishing area is extensive and several Nunapitchuk respondents remarked that there is widespread sharing of fishing areas between tundra villages and fishers from other nearby villages, including villages on the coast and on Nelson Island. Since the area around Nunapitchuk is known for high abundance and quality of whitefishes, residents from other areas travel here to fish. Nunapitchuk respondents reported that people come from Kuskokwim River villages as far away as Tuntutuliak and Eek in order to fish for nonsalmon fishes, and several Tuntutuliak respondents described fishing in the Nunapitchuk region.

Residents fish the Kialik River and the Pikmiktalik River near Atmautluak for broad whitefish. One resident, who travels usually every year to spring camp near the Kutukhun branch of the Kialik River, said this area has a "whitefish bowl," which is a good spot for harvesting whitefishes. Respondents harvest broad whitefish in the Kuskokwim River year round. Elder key respondents commented that the whitefishes from the Pikmiktalik River do not taste as good as the whitefishes from the lake country near the Johnson River, and speculated that this is because the Pikmiktalik River drainage does not have tributary lakes. Kasigluk respondents maintain fish camps by Nanvarpak Lake where they harvest very large, high quality whitefishes.

Respondents believed that Nanvarnarllak Lake was the feeding area for Nunapitchuk whitefishes, and they harvest many whitefishes there, in particular, humpback whitefish from July through September. They reported that humpback whitefish are targeted in the Kuskokwim River until the end of July, and that they are more plentiful than broad whitefish. Respondents said that humpback whitefish can be harvested on the Pikmiktalik River during their migration to a lake on that drainage. One resident said that

during August and September, the lakes above the Kutukhun River are a good spot to fish for humpback whitefish and people also harvest small quantities of broad whitefish. Respondents said they fish for whitefishes, burbot, and northern pike on the Kutukhun River itself during winter. Residents reported fishing the Kialik River year round for both broad and humpback whitefishes, and it was mentioned as an important area for historical spring and fall camps. The Johnson River was mentioned as a good place to jig for northern pike.

Respondents noted that they do not harvest Bering ciscoes in the Nunapitchuk area, but that these fish can be harvested near Toksook Bay. Least ciscoes are harvested in the area, and one man said the Pikmiktalik River is an especially good place for them. Sheefish are harvested in the Kialik River and burbot in the Kutukhun and Johnson rivers. Respondents also said that people fish for Alaska blackfish on the Kialik River as well as downstream of the Strait River, and use rod and reel to fish for northern pike downstream of Takslesluk during spring. One family makes an annual trip, by boat, to a camp north of Kayigyalik for a week in June.

Seasonal camps and old villages are located around good fishing locations. One man explained the logic behind the location of his spring camp, saying that the reason his parents and their ancestors "used to fish around there is because there's plenty of kinds of fish. [My] great-grandparents taught their kids to fish in that area" (NR2). In 2008, residents could reach old seasonal camps more quickly because of improvements in transportation, and were able to continue fishing traditional areas as well as areas further away without having to stay overnight away from the village:

> Half a day, less than a day to get over there, and then they go down from probably here on the river, Kuskokwim, Tuntutuliak, Kongiganak, Kwigillingok, those places that they never used to reach. If we'd go out, used to be like two, three days before we get there. With those small engines. (NR6)

Respondents have learned from their elders that certain traditionally fished lakes can be very productive, and they have combined this education with their own experiences: "He looks for a good spot. If he catches a lot there then he set his net there again. Over time they've learned to put their traps in a certain area" (NR2).

With experience, respondents have learned how to recognize good fishing areas, and also how to look for other signs that might lead them to fish:

> There are spots where the weeds don't grow, like an open space, and that's where they'd set their nets. Very hard to clean the net when they get tangled. Those areas he's marked, they don't have strong currents. ... You get more fish there. (NR1)

> In the summer? They're hard to find, hard to catch. My dad used to, probably for change of taste, would set a trap out someplace, I don't know why, I never go with him, sometimes he come home with the little pan or a pail filled with blackfish. I don't know where he'd catch them. But then he was telling me at one time, we were cleaning the net out, and he was telling me that [makes a mouth clapping sound] sound like that, when I hear that, I should know there's blackfish someplace in that area. (NR6)

> When I was in Kasigluk one man would go out and look along the river, he would look for foxes, 'cause the fox finds these holes where blackfish are coming out. And that's how they locate them and set their blackfish [traps]. (NR7)

In addition to knowledge and experience, good fishers are willing to experiment: "The people who are fishing constantly, they don't fish in the same spot all the time, they move around" (NR3).

> I don't know, sometimes you catch more up closer to the bank. Sometimes the one that's out in the middle gets more. … We just try here, you don't catch any, try someplace else. (NR6)

> It's like right now for blackfish, they're pretty much guesswork. They make a hole in one area, put their blackfish trap in, couple days check it. If it doesn't catch any, move to another one. Eventually you'll hit the spot where you'll catch quite a few. (NR6)

As in Eek, Nunapitchuk elders also explained that wind, currents, water levels, and tides affect the movements of the fish. Elders said that when there is a south wind, fish are less active. They also said that fish migrate in during times of high water but are very dispersed and hard to catch at that time. "Our ancestors said when the weather is bad in the lakes, big waves, the fish rest in the bottom" (NR4). During times of low water, respondents find fish in the deeper holes. Respondents also said that it is easier to catch fish during low tides and as the tide is turning, and that it is difficult to catch fish in strong currents.

> Local kind, what we call local kind, whitefish, pike. They're all over the place, they're all spread out. With the water low, less water, they're more together. So we probably catch more that way. And then when they used to have that fish fence, the only time we'd fish is when the tides start going out. The fish come from upriver down to the weir and they catch them when they're there. Whereas when the current starts coming in, high water, it push 'em back in, back up. You don't catch 'em, hardly any. (NR6)

Preparation and Use

Nonsalmon fish have an important place in the diets of Nunapitchuk residents, and elder respondents are able to describe a variety of preparation methods, many of which have been handed down for generations. Whitefishes, for example, are cut, dried, and smoked like salmon; cooked; fermented; or frozen. To make fermented whitefish, residents head and gut them, place them in cardboard boxes with grass between the layers, taking care that there is no air between the layers, and age them in underground pits called *kukuq*. This is an easy, efficient preservation and storage method for large quantities of fish. Fermented whitefish are prepared in fall, when temperatures are cold but not freezing. Residents call them *kassayaq* and eat them frozen.

> Sometimes the ladies used to make those baskets, great big ones, grass baskets. Fill them up with these [broad whitefish], after they were fermented, and some just put 'em in, removing the guts. That one you eat the way it is, you pick it out of the underground, pull it out, clean it up, eat it. That's what they call *kassayaq*. [They age it for] two weeks maybe. If you want strong ones, maybe leave it there for a couple months. (NR6)

> Really strong ones. We used to do that to feed the dogs. We'd put them underground in probably September, October, leave 'em there and pick 'em up in November. Even our dogs are eating 'em, too. I've heard it being said that fermented fish keeps you warm throughout traveling. Just like the eggs, salmon eggs do. (NR 6)

Fermented fish are a delicacy and are often served at special occasions, although they are occasionally further preserved by drying.

> In fact one time during Slavic [local term for Russian Orthodox Christmas], they were serving fermented whitefish, strong ones, and one of the teachers that was here at that time wanted to try. So I gave her one of mine. And I took the other one. She wanted more. She said it tasted like cheese. What kind of cheese I don't know. ... If you catch quite enough and they're fermented, in spring when sun starts warming. Clean out the bones, debone 'em, hang 'em out, dry 'em and eat fermented dry fish. (NR6)

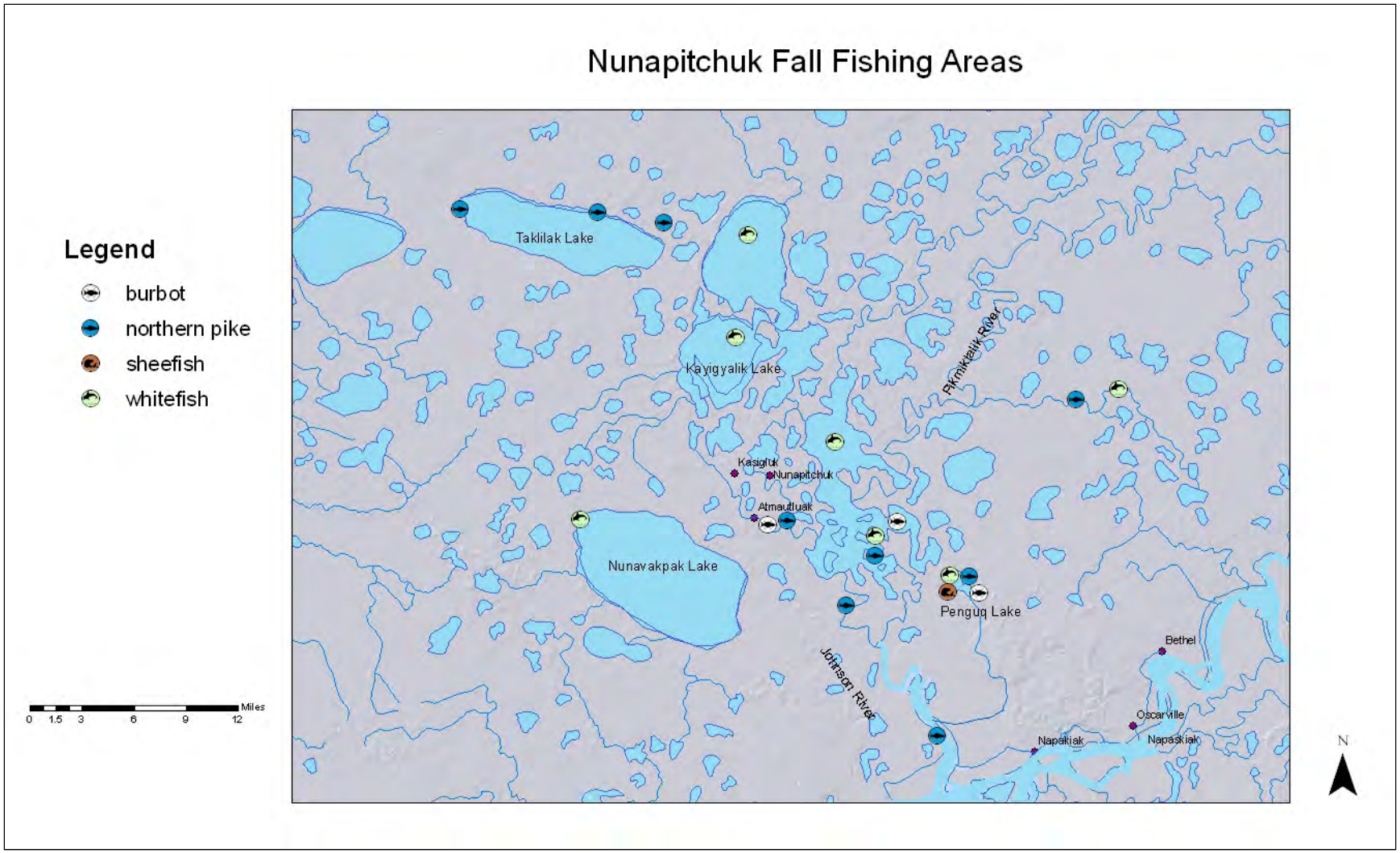

Figure 20.–Nunapitchuk fall fishing areas.

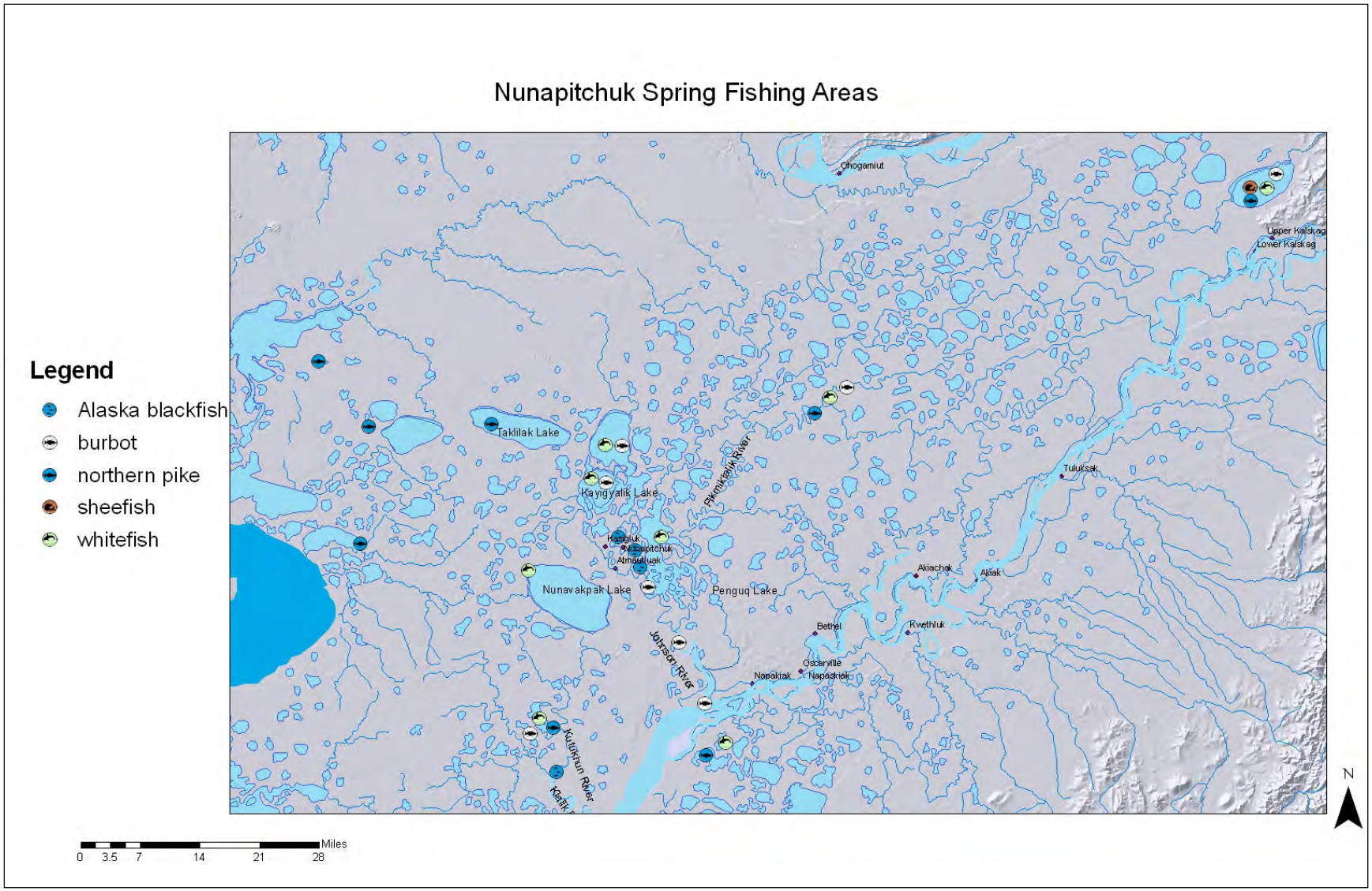

Figure 21.–Nunapitchuk spring fishing areas.

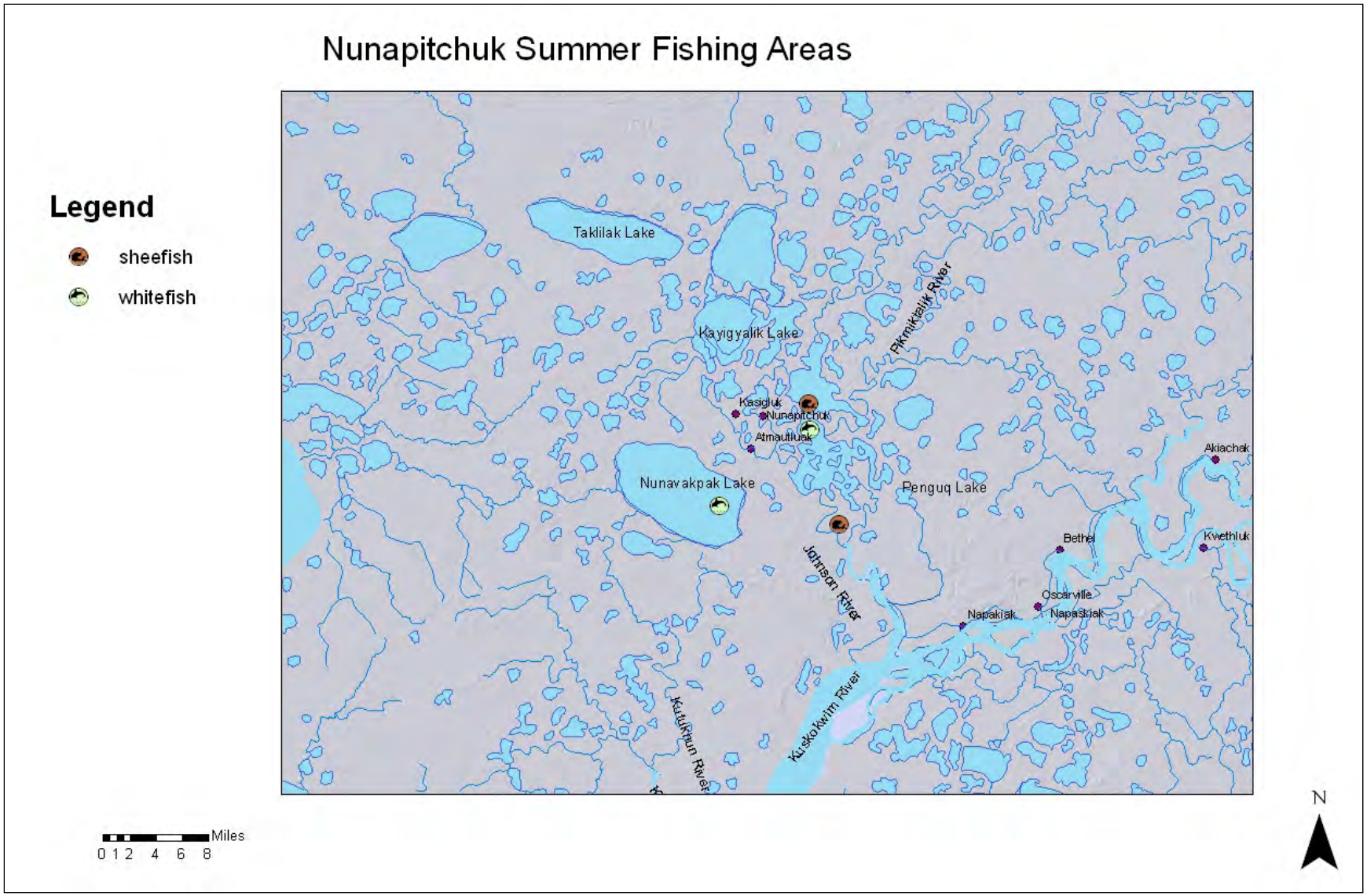

Figure 22.–Nunapitchuk summer fishing areas.

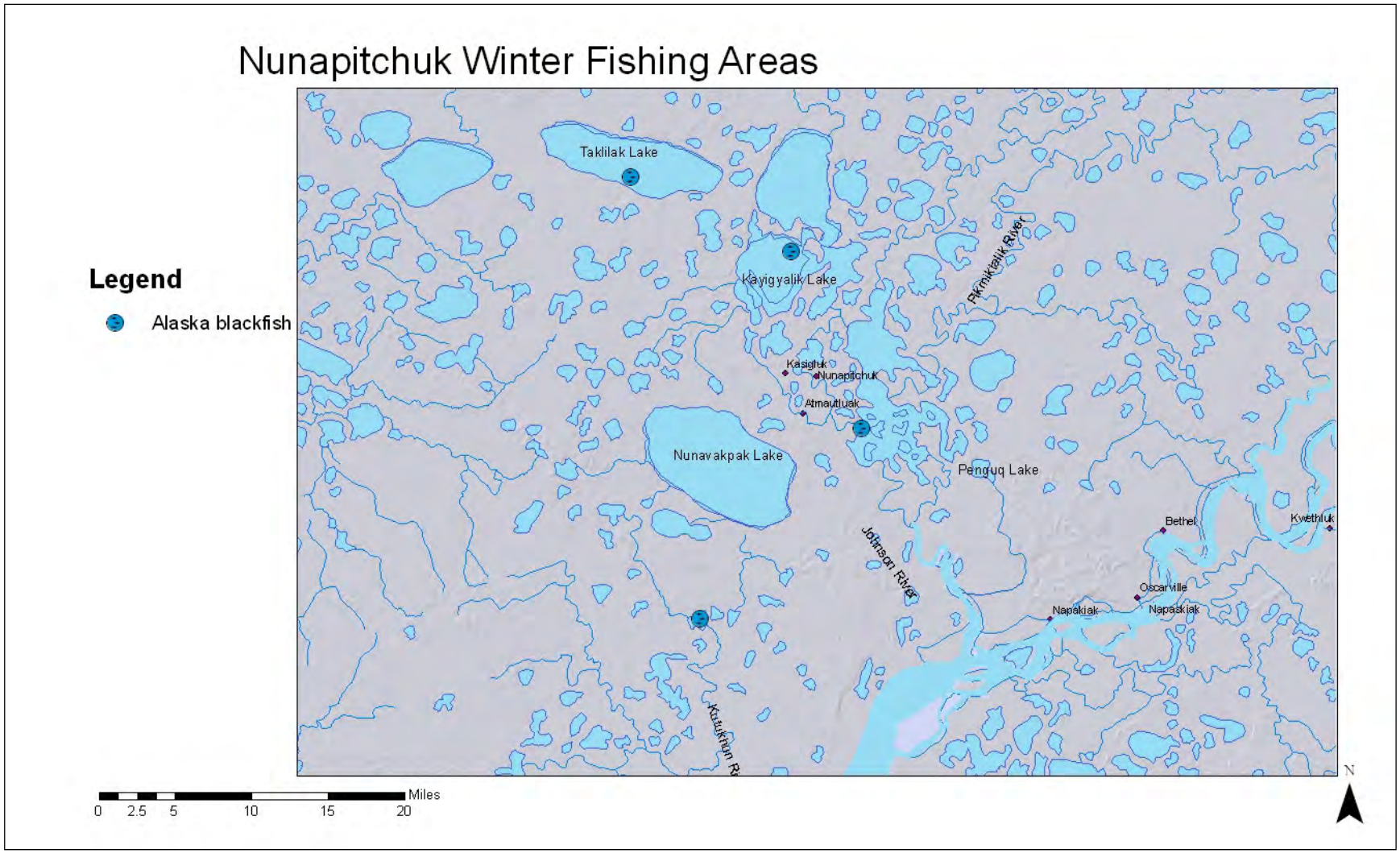

Figure 23.–Nunapitchuk winter fishing areas.

Key respondents said that people prefer the meat of broad whitefish to that of humpback whitefish, and that humpback whitefish are harder to prepare: "The humpbacks they tend to have tender meat, but they deteriorate at a faster rate, after you catch it you have to take care of it and if you left it for a while when you cut them, the meat will stick and kind of come off" (NR1).

Although one respondent reported primarily feeding humpback whitefish to dogs, several respondents reported fermenting or drying them for human consumption. One family explained that they prefer to dry the fish in July and to ferment them in the fall. Strong "stinky" (fermented) fish is important to residents because it "will make you feel better and no cold" at –30°F or –40°F (NR1).

In addition to their uses as food for dogs, whitefish eggs and oil are also valuable as food for humans. Respondents said that whitefish eggs are eaten raw or used in *agutaq* (sometimes also called "Eskimo" ice cream) made from berries and cooked broad whitefish meat. One man explained that in the past, his mother used fall whitefishes to make whitefish oil, to tan the skins of small furbearers, as well as to make *agutaq*. Another respondent explained that the oil from broad whitefish is used more frequently than the oil from any other nonsalmon fish.

Humpback whitefish are often fed to dogs, along with Alaska blackfish, northern pike, and least ciscoes. One man explained that he places northern pike and humpback whitefish in a big kettle and cooks them for his dog team, instead of feeding them whole frozen fish, because the fish go further that way, and because they keep the dogs more hydrated. Respondents who own dog teams explained that each fish species has its advantages and disadvantages: northern pike are more likely to give dogs worms than whitefishes, whitefishes provide the best energy, fermented fish warms a dog but can make them sick in warm weather, and Alaska blackfish are a "lighter" fish, more suitable for warmer temperatures while still providing a lot of energy.

Alaska blackfish are also very popular as human food, and Nunapitchuk residents can tell the difference between local and nonlocal fish:

> Even the blackfish have distinctive tastes, like in our area they have a taste like genuine blackfish. In other areas, because of their area or where they're from, like, from the Kuskokwim, they taste like paper or something, dirt, maybe sand. So depending on where you catch them, the blackfish, their tastes will be, if you're good at tasting them, you will notice the difference. (NR1)

Alaska blackfish are dried, aged, and eaten frozen or cooked in almost boiling water. One respondent commented that, except for the bones, every part of Alaska blackfish is eaten (the fish were not gutted).

Sheefish are another primary nonsalmon species eaten by key respondents. Unlike other whitefishes, respondents said, sheefish are not usually frozen. Instead they are boiled in stew, fried, or dried. For example:

> One time when I didn't catch any whitefish of either kind, my son and I went drifting down below, the bluffs, a little below the bluffs, and we caught quite a lot of these [sheefish] and they were ok for dry fish. We dry 'em and smoke 'em. They were little ones, though. (NR6)

Respondents did not give many details about preparing burbot: one said they were boiled or dried.

Northern pike, like whitefishes, are deboned, hung and dried, fermented, cooked, or eaten raw. One respondent commented that the technique for drying northern pike is different from that for whitefishes, but did not elaborate. Respondents also explained that pike could be eaten raw.

> He said that pike, they're already cooked. Ready to eat. You can just catch it and pick it up and eat it. Old people used to say the fish are ready to eat any time, even when you just cut it you can eat it. You can eat all the fish raw. (NR2)

Another elder explained that northern pike are also aged differently than whitefishes: “They can be eaten right away or they would prefer it to be aged a little bit ... They put ‘em in a gunnysack and put ‘em in the fish house” (NR2). “You don’t smoke pike. Here, they don’t. You just dry ‘em, if they’re dry enough you pull ‘em down, put ‘em in boxes. Some like to put ‘em in freezers to keep ‘em fresh and soft, flexible all winter. Talking about all this is making my mouth water” (NR 6).

One resident reported that except for burbot, she eats the eggs from all fish. She explained that she boils whitefish and sheefish eggs, uses northern pike eggs in red berry *agutaq*, and eats least cisco eggs raw or cooked.

Many nonsalmon fishes are eaten with seal oil, and residents reported that they continue their historical trade of whitefishes and salmon for seal oil and other marine foods produced by residents of the coastal areas. Some area residents travel down the Kuskokwim River in order to hunt for seals.

Nunapitchuk respondents reported that nonsalmon fishes are important not just for food but also for many other uses. Respondents reported that they used fish skins to make boats, tarps for sleds, mittens, raincoats, windows in sod houses, and sails for small boats. As was said in Tuntutuliak, one respondent said that whitefish skins are too delicate to use, and that northern pike and salmon skins are tougher.

Historical and Contemporary Self Management Practices

Elder respondents in Nunapitchuk related a very strong concern for good management and conservation of nonsalmon fish stocks, a concern they say has been passed down from their elders: “They don’t want them to waste fish, when you go out, catch only what you eat, and bring it back. You know not overcatching and throwing it away. We don’t do that” (NR2).

Respondents maintained that there is a direct relationship between human actions and fish behavior and that complaining about the fish or not sharing them causes the fish to go away:

> These fish … all species … our elders taught us that we have to share our fish … everyone. We’re not saying that the fish are ours, they’re for everyone to share. They’re here for survival. So, the fish are open to everyone, if any one wants to fish, they’re urged to do so, that’s how we are, because we use the fish for subsistence, and the whole area around here is our table. (NR2)

In addition, respondents explained that while it is important to share fish with people from other places, resource use is also managed by respecting the traditional resource use areas of certain families:

> I think the first rule of thumb is we encourage everybody to take part, and it’s open. They can move around when they hear of a good spot, they can move there, while they’re fishing. And some people use traditional spot, certain families have that, they hold on to that, and we respect it. (NR3)

When a family uses nets or traps, it is their responsibility to take care of the fish in them. These respondents explained that it is very important to check nets and traps regularly, so as to ensure that fish are not unusable and therefore wasted:

> But for whitefish we just go out, set it, leave, come back, probably check the next day. It depends. If there’s quite a few. If we’re catching quite a few of them, sometimes we go out in the morning and in the evening. ‘Cause when those seagulls start raiding the little ones, they pick on our fish. So we have to keep going out, morning and evening. (NR6)
>
> Well, last year when I was setting a blackfish trap, I check them every two to three days, they’re under the water you know so, you have to worry for the fish to expire ‘cause they’re under the water. (NR7)

These elders also explained that if someone leaves his or her net in too long and dead whitefishes are in the water, other whitefishes do not want to remain in the area.

> But the reason why they started going down is there were people setting fish nets out there and forgetting about them. Not checking them. Our elders used to tell us if we do that, the fish will not want to come back to our area. (NR2)

Elder respondents explained that it is important not only to prevent waste by taking good care of fish scraps, but also to treat them with respect:

> Well they had a general rule that in order to preserve fish in this area that they are not to scatter fish parts, they would prefer them to put 'em in a place where it won't spread. (NR2 and NR8)

> When they go down to fish salmon he ... would dig a pit and put all the scraps together in one place and then cover that ditch or they would be devoured … those maggots would tend to eat the leftovers and there would be nothing left. (NR2 and NR9)

Elders further explained that there is a tradition of particular care at Nanvarpak Lake. Respondents believe that Nanvarpak Lake is the source of all fish in the area, and that whitefishes from this lake taste better, possibly because of the water quality. It seemed to key respondents that whitefish populations are declining, and elder key respondents worried that this is because nets were being set indiscriminately in the lake, particularly at the mouth. "Yeah, the reason that they do not allow people to fish in that lake is so that the fish would be, fish would come out from that area and scatter around this area" (NR2).

Several elders referred to a story that they said has been told for many generations. The story is of a man who saw a northern pike in Nanvarpak Lake that was the same size as his canoe. The man concluded that there was a "bottomless" part of the lake that allowed this creature to travel. Elders said that people are warned to use caution when boating in this lake, and the lake has been treated with respect and protected from heavy use.

In 1992, the 3 tundra villages issued a joint resolution that was intended to better manage the number of nets fished in the lake and to prevent overfishing (Appendix A). Ordinances resulting from this resolution include limits to the amount of time one can leave a setnet in the water and closures of certain areas at certain times, especially winter. These ordinances indicate a high level of local concern about nonsalmon fish species in the area and a willingness to be involved in active fisheries management.

Changes in Abundance, Distribution, and Health

Just like elders in Eek and Tuntutuliak, elder key respondents in Nunapitchuk reported a noticeable decline in broad whitefish that had begun in the 1960s. Some said that while the broad whitefish numbers have declined dramatically in the past 40–50 years, they have only recently begun to rebound in the area. Elder respondents also commented that people are fishing for broad whitefish in different locations than in the past. Respondents find fish in new areas, such as the Kialik River and in Alvinagrik. Interestingly, some elder respondents attributed the decline in whitefishes to people grumbling about them:

> Right after they started complaining about the fish, I noticed a decline in their number. That's what our elders tell us, not to complain, like they're doing, not to be stingy with other people, but to share that area with everyone, that's how we are … when they do that [be stingy] … the fish knows about their intentions and they don't want to thrive in their area anymore. (NR5)

Some elder respondents also said that people had left their nets in too long, or had forgotten about them, and this also contributes to the decline. Others felt that the decline is part of the natural cycle that populations experience. "They kind of revolve like small mammals around here. Sometimes there's a lot of them around here, but then they start moving around elsewhere. And then they change and start coming back again" (NR4). Another respondent added:

> I was talking to a couple of elders at the time, we were catching quite a bit and [the fish] were getting large and [the elders] were telling me that [the fish were] going to be

> changing. I guess deplete for a while and then come back in. Fresh stock of 'em come in. (NR6)

Respondents said that beavers have become more abundant, and elder key respondents felt that the increase in beavers is the primary reason for declines in fish populations. Beavers block the lakes from their connecting rivers and sloughs, they said, thus also blocking fish passage and access to important feeding or other habitats.

In addition to declines in the populations of the traditionally more important fish, several respondents also noticed some fish species are appearing in new areas. One resident commented that burbot can now be harvested from the Kutukhun River, a tributary of the Kialik River, and another mentioned that people now harvest trout and Dolly Varden in the area.

A number of respondents commented that fish are generally smaller than in the past. When asked about parasites in fish, one elder woman reported seeing hard, red worms in some of the area's nonsalmon fish. She explained that a fish with parasites is not cut or hung to dry. Several respondents related their experiences with parasites specific to whitefishes: one respondent reported finding worms in round whitefish, and another finding "something strange" in broad and humpback whitefishes:

> "…my dad passed away about five years ago now. … At the time he was sick I was taking care of the whitefish in our fish racks. I saw some at that time, and even now and then I'd see in their meat some kind of puslike ... and they'd come out when you press the area, and you could almost take it out like that. (NR3)

Changes in Land–Habitat

Elder key respondents in Nunapitchuk reported seeing many changes in the area over their lifetimes, changes they attributed to changes in climate, such as record high temperatures in recent summers. Trees that are normally shrubby are getting taller, they said, and the winds and weather are less predictable. For example, south winds used to bring bad weather, and north winds a change from bad weather to good, but recently, according to one elder, after the wind changes from south to north the weather does not improve. Several elders noticed changes in the land, and commented that maps of the area do not match present-day conditions. Other perceived changes are that the land seems more waterlogged than before, that erosion is becoming a problem, that some good fishing areas have become shallow, and that there is less snowfall in the winter, which leads to lower water levels. Elders reported that lakes and sloughs are becoming shallow and grass is starting to grow in them.

> The only thing that I keep thinking of is the water level, everywhere tundra area, getting shallow and shallower. There's some places on the lakes where you go across where you never used to hit the bottom with your outboard, they're coming up through it. (NR6)

> That's probably why the fish numbers are going down. 'Cause some places where we used to put our nets out there and never reached the bottom, you can walk. Shallow, yeah, shallower. I don't know, probably the clay from surrounding land is seeping out. I'm not sure, but when that happens, when that clay underneath, the permafrost melts and that clay start coming out, like ghost town. Lakes, rivers, get shallow. I don't know if that's the cause of that around here. One of the things that I find seem to hold true is we got so many motors, outboards, lots of boats, speeding around. In my young, younger days, even my dad used to tell me, don't bump into the bank. Easily, easily, very easily come up. Not to disturb the ground underneath. Now … so many outboards, heavy waves hit it. (NR6)

Just like residents in Tuntutuliak and Eek, people in Nunapitchuk felt that beavers are a major force of negative change in the area. Beavers are known to dam lakes, and even if people remove a beaver dam the

animals rebuild it overnight. As one resident said, “Right now there are too many beavers and it’s the number one reason for our fish declining”(NR2).

> Our elders used to say, “When a period of hunger is approaching, beavers congregate in great numbers. After that, it takes maybe ten…years, and the fish start to die off. And then eventually the people will start starving.” (NR2)

One elder said he had heard people see fish trapped behind a beaver dam, and expressed the concern that beaver dams prevent the usual movement of fish. Respondents explained that the high density of beavers in the area is a recent development:

> My very first beaver I saw was when I was twenty-some years old and me and my cousin were out hunting muskrats, canoes, he had kayak I had canoe. I didn’t know what it was. So I called my cousin over and he said, “That’s a beaver,” in Yup’ik, “Shoot it!” That was my first time I saw one and first time I catch one. I never did see any of ‘em until then. I was twenty-some years old at that time … now, too many of ‘em. They block off where the fish go up to spawn, like the whitefish, they block that off. Couldn’t come out. They probably die after it freezes over. That must be part of the reason why the [fish] numbers really went down. But I cannot say precisely. (NR6)

Many attributed the increase in beavers to the fact that people have jobs and no longer need to hunt or trap beavers for cash exchange or clothing.

Tuntutuliak

Seasonality and Gear

Key respondents in Tuntutuliak described a wide variety of harvest practices for nonsalmon fishes, with most activities occurring during the spring, fall, and winter months (Table 18). Spring and fall were reported to be particularly productive times because a variety of nonsalmon fishes were migrating into and out of area lakes.

In early spring, respondents said that residents use setnets under the ice to target humpback whitefish, broad whitefish, and sheefish. Spring is also when residents, primarily women, jig for northern pike. One respondent explained that jigging is more common these days because it gave families time to do something together and was more fun than setting a net underneath the ice. Shortly after breakup, respondents noted, people harvest smelt and herring in the Kuskokwim River, and children sometimes use a coffee can or dipnet to harvest various species of stickleback (“needlefish”) from the rivers. Once the ice is gone, usually in late May, fishers use setnets, or occasionally dipnets, to harvest whitefishes in the river during their migration to the lakes. In the past, residents used handmade fish nets to harvest whitefishes and other nonsalmon fish. Currently, Tuntutuliak residents use manufactured set gillnets for harvesting nonsalmon fish, primarily nets that are shorter than the drift nets used for salmon fishing. Table 19 shows the mesh sizes used for different species. These setnets range from 12–25 fathoms in length, and one resident explained that they are often not too deep.

> See, some of ‘em, they cut the regular net, you know like regular five and one-sixteenths and if it’s like thirty five mesh a lot of them cut it in half. … A lot of times in the lakes up there, the water’s so shallow that it’s not useful to have a thirty five mesh net when the lakes is only like four feet deep. (TR5)

Few nonsalmon fishing activities were described as occurring in summer because most people focus on salmon fishing in the Kuskokwim River mainstem at that time, and because it is more difficult to catch many nonsalmon fishes since they are feeding in area lakes. However, sheefish are sometimes retained if incidentally caught during salmon drift gillnet fishing. Respondents explained that both children and adults fish with rod and reel during summer months and harvest various species of suckers and small eels, as well as northern pike and sheefish. However, respondents emphasized that rod and reel fishing is more

for recreation than for serious food acquisition. Respondents also reported that nonsalmon fishing resumes in late August, when people harvest outmigrating humpback whitefish or other resident species. "When people go berry picking they bring a whitefish net and fish for broads, or they fish for any whitefish, they call 'em whitefish anyway: broads, humpbacks, pikes, sheefish … we don't catch sheefish too much out there" (TR1).

Another respondent said that moose hunters occasionally bring a small net, and set it in a small slough in order to harvest fish to eat while camping.

Elder key respondents recalled historical practices of building fish fences in fall, and using dipnets to harvest the fish that collect behind them. Most mentioned that this practice ended in the 1970s. One respondent commented: "I think the last time I remember them doing that was, like, when I was in junior high here, long time ago!" (TR5).

One respondent explained that the Yup'ik word for the fish fence is *capun* and that it means "something you close a river with." Elder key respondents also described community fish traps that once were set in October at lake outlets:

> And in the falltime, like now, when the fish start going out from the lakes, he says, up at their fall camps they used to put out these huge fish traps. And these huge fish traps they get all species: lush [burbot], pike, whitefish, and sheefish. These traps are set out in the month of October or earlier and they set them at the place where the lake meets the river. … They put out a fence and in this part they put out a fish trap. (TR8)

These community fish traps are no longer used, according to key respondents; instead, people fish with setnets.

> Starting in August, that's when most broads and humpbacks are easy to catch, after that it's not as easy, and people set out more different sizes, like from four and a half inch and four inch, they catch 'em in five and three inch, those were the best nets for broads them days, fifty fathoms set in the lakes. Twenty nine to forty five meshes deep, but it's not that deep, the water's not that deep. (TR1)

Residents reported trying different mesh sizes to target a species, and keeping track of their success: "Four and a half inch, in the past he used a fifty five mesh, but last year he replaced it with probably a twenty five fathom. The one he replaced his older net with has a smaller mesh size and he's noticed that he's not getting as many fish" (TR9).

Respondents said that people use herring nets to fish for Bering ciscoes in September, October, and November, and that in the past they set traps at the mouths of rivers to catch these fish. After freeze-up, residents reported jigging for northern pike, sheefish and burbot. Respondents also said that once the ice is safe for travel, people place setnets under the ice to target whitefishes and northern pike, as well as traps for Alaska blackfish. Respondents noted that modern Alaska blackfish traps are made from chicken wire, while in the past they were made from wood and were called *taluyaruaq.*

Although most respondents described the subsistence harvest of nonsalmon fishes, one respondent had been closely involved in the commercial whitefish fishery that operated in the Tuntutuliak area in the 1970s and 1980s.

> So I had a small processing plant back in seventies, early seventies until middle eighties. And I got permit to buy whitefish them days. Nonsalmon permit. Fish and Game used to issue me.…Eenayarak, yeah. People used to go fish over there and bring their catches to me. If they don't go to Bethel.... There was limits, though. I had two thousand whitefish permit. .. I bought mostly broads, they were mostly broads, anyway, them days, until the numbers dropped, but the numbers dropped after I quit buying. That was early eighties. I was buying salmon for about ten years. … Just gut 'em and freeze 'em, I had a freezer

plant. I sold ‘em locally. My customers were mostly down the coast, *Kwig* [Kwigillingok] Chefornak, and here in the village. (TR1)

Table 18.–Tuntutuliak nonsalmon fishing, by season.

Spring	Jigging through the ice for northern pike.
	Using setnets under the ice to target humpback and broad whitefishes.
	Using nets to harvest sheefish.
	Harvesting whitefishes in the river after breakup as they head to lakes, using nets or dipnets.
	Harvesting smelt and herring in the Kuskokwim River after breakup.
	Children dipnetting for stickleback in the rivers immediately following breakup.
Summer	Children fishing with rod and reel at fish camp.
	Adults occasionally fishing with rod and reel for suckers, small eels, northern pike, and sheefish.
Fall	Fishing for whitefishes as they leave the lakes, which occurs at the same time as berry picking. More residents fish for whitefishes in the fall than in the spring, because the quality of the fish is better. Net or dipnet.
	Fishing for various species of ciscoes with herring nets in the Kuskokwim River upstream of the Eek River and in the Kinak River by Tuntutuliak.
	Jigging for northern pike, sheefish, and burbot after freeze-up.
Winter	Setting nets under the ice for humpback and broad whitefishes.
	Setting traps for Alaska blackfish once the ice is safe for travel.
	Residents of Kwigillingok and Konigninak traveling to Tuntutuliak to fish for whitefishes.
	Setting nets under the ice for northern pike.
	Jigging for northern pike and burbot.

Table 19.–Tuntutuliak gear for nonsalmon fishing.

Species	Current gear	Historical gear
Broad whitefish	Set gillnets with 4–5¾ in mesh.	Fish fences (*capun*).
	Dipnets, in spring (rare).	
Humpback whitefish	Set gillnets with 4½ in mesh.	Fish fences (*capun*).
Bering ciscoes	Herring nets with 3 or 3½ in mesh.	Traps.
Northern pike	Jigs.	Fish fences (*capun*).
	Setnets with 4–5 in mesh.	Long line baited with blackfish.
Sheefish	Set gillnets with 4 in mesh.	Fish fences.
	Rods and reels.	
Alaska blackfish	Traps made of ¼ to ½ in wire mesh.	Wooden traps (*taluyaruaq*)
	Gunnysacks and dipnets at melt holes.	
Burbot	Jigs.	Fish fences.
	Long lines baited with Alaska blackfish.	Fish traps.
		Long line baited with blackfish.
Stickleback	Coffee cans.	None given.
	Dipnets.	
Suckers	Rods and reels.	None given.
Arctic grayling	Rods and reels.	None given.
	Small nets.	

Harvest Locations

Areas mapped by respondents in Tuntutuliak can be seen in figures 24–27, which show the Tuntutuliak fishing areas by season. Residents of Tuntutuliak commonly fish the Kuskokwim River from Eek Island north to the Johnson River. Tuntutuliak residents with ties to Napakiak also travel to fish with family members there, especially since the trip is less than an hour by snowmachine. The Kialik River is a popular place to fish for broad and humpback whitefishes. Respondents explained that they used to fish the Eenayarak River near Eek, but after whitefish populations declined they stopped going there. In winter, residents go to the Kialik River and set nets under the ice to target northern pike. The area from the mouth of the Kialik River to the mouth of the Inuk River is used for jigging in winter. One respondent mentioned fishing for halibut in Kuskokwim Bay south of Kongiganak but north of Quinhagak.

Most of the community's fishing effort on nonsalmon fishes occurs in the rivers, lakes, and sloughs on the Tuntutuliak side of the Kuskokwim River, especially north of Tuntutuliak and south of the Kialik River, depending on the species being targeted. Several historical spring camps are located north of the Kialik River on the Tuntutuliak side of the Kuskokwim River. Community members go to the Eek side of the Kuskokwim River to fish for ciscoes, especially in the Apokak Slough area. Ciscoes are also harvested on the Kinak River by Tuntutuliak. Broad whitefish are harvested in the Kinak River as they migrate to the lakes in spring, and at the mouths of local lakes as they outmigrate in the fall. Sheefish and northern pike are harvested in the local lakes, and during the winter, on sloughs off the Kuskokwim River. Respondents said that smelt and herring had to be harvested in the Kuskokwim River because they did not migrate into lakes. Respondents also noted that the Tagayarak River is an important place for harvesting Alaska blackfish. One resident explained that he prefers to set his traps on specific small sloughs off of lakes. Another resident explained that Alaska blackfish can be found in small sloughs in October, but by December they are in the main sloughs.

Through years of harvesting in specific places, Tuntutuliak residents developed an understanding of the location to target most species. One resident explained that his uncle showed him a small river that elders used to dam, and told him they would only catch burbot there. Another resident explained that he learned that a certain spot at the mouth of the Kialik River would reliably produce northern pike in winter. Respondents noted that it was possible to target different whitefish species by fishing in different spots:

> Then there's places for the broad whitefish and humpback. In certain areas you can catch more broad fish than you would, you know, the humpback … you find out that they like to have their own certain areas and then you have to find them. (TR5)

Residents explained that it is not only location that affects fish availability, but also environmental factors such as tides, water levels, and wind. People also know when to fish in certain places, in order to work with environmental conditions:

> Yeah, I think weather and the time of the tides affect the fish any where. Like right now, technically, I like to fish when the tide is coming in. And then there're certain areas that you fish when the tide is just coming, and then if you fish here, and then, for example, if they catch quite a few fish during high tides here, low tides there will be nothing, so you move to another area. So you kind of move with the tide, I think. (TR5)

> They have good predictions and their predictions used to come true, when there's a lot of snow or a lot of rain in fall time, they know that it's not going to be easy to catch fish out of lakes because water's gonna be high and fish will have more room to move around, and when the water's low they're easy to catch. (TR1)

> Like, with the wind, the best time for us to go whitefishing is, like, when it's north, northwest. You start getting west and southwest and south ... you're hardly gonna get any whitefish. It's the opposite of, like, salmon. Salmon around here, if the wind is going from southwest, west, south, you know the fish are coming in. Well, mainly because

> they'll be coming in from the bay. ... But with the whitefish and stuff, they like to, I guess, run around when the wind is from north, northeast. And water's pretty low. You know when the water's high they like to spread out, I guess. But when it gets low they start getting into the main rivers and that's when you start fishing for them. (TR5)

In addition, successful fishers are willing to observe and experiment, since fishing conditions change over time and good fishing spots are not always immediately apparent:

> The river itself changes, you know, 'cause like right now, like in the past few years right by the gas station where I dock my boat and stuff, right by there, used to catch a few loche fish now, but this year I have had hardly any, they're catching near upper village maybe because the river is changed over the summer. Like right now Tuntutuliak, I usually fish right here, and I'm hardly catching anything, but they're catching up there. (TR5)

> Yeah, most of these lakes up there, the ones that people are talking about, this area, there used to be a lot of broad whitefish back way back, and then all a sudden they're gone and these little ones, the humpback, start coming up. So, kinda look all over the place, checking all the, wind up way over by Qataqrun [River] and Kavirlirraalek, that area. That whole area there. … We start kinda moving around and found out where they were and my brother and I found ours up there, way up there. (TR5)

> He says when a person goes out and he looks at the lake, this person might think that this point might be a prime area and he would set out and get nothing. Whereas another area might look like not a prime spot and you'd set out there and get a lot of fish. And he thinks that areas where there's some vegetation growth in the lakes, that those are better places to set net. (TR9)

An observant fisher can detect not only the spots that produce the most fish or a certain kind of fish, but also the spots that produce the best fish:

> They're starting to come back and this past fall, they were catching the broad ones up there more than they did those humpbacked. But somehow their taste is different there, too, maybe it's their diet. 'Cause like I say, is sweet tasting and here is kinda muddy type, depending, I think, their diet. That's why I don't fish here, I drive up this over there. (TR5)

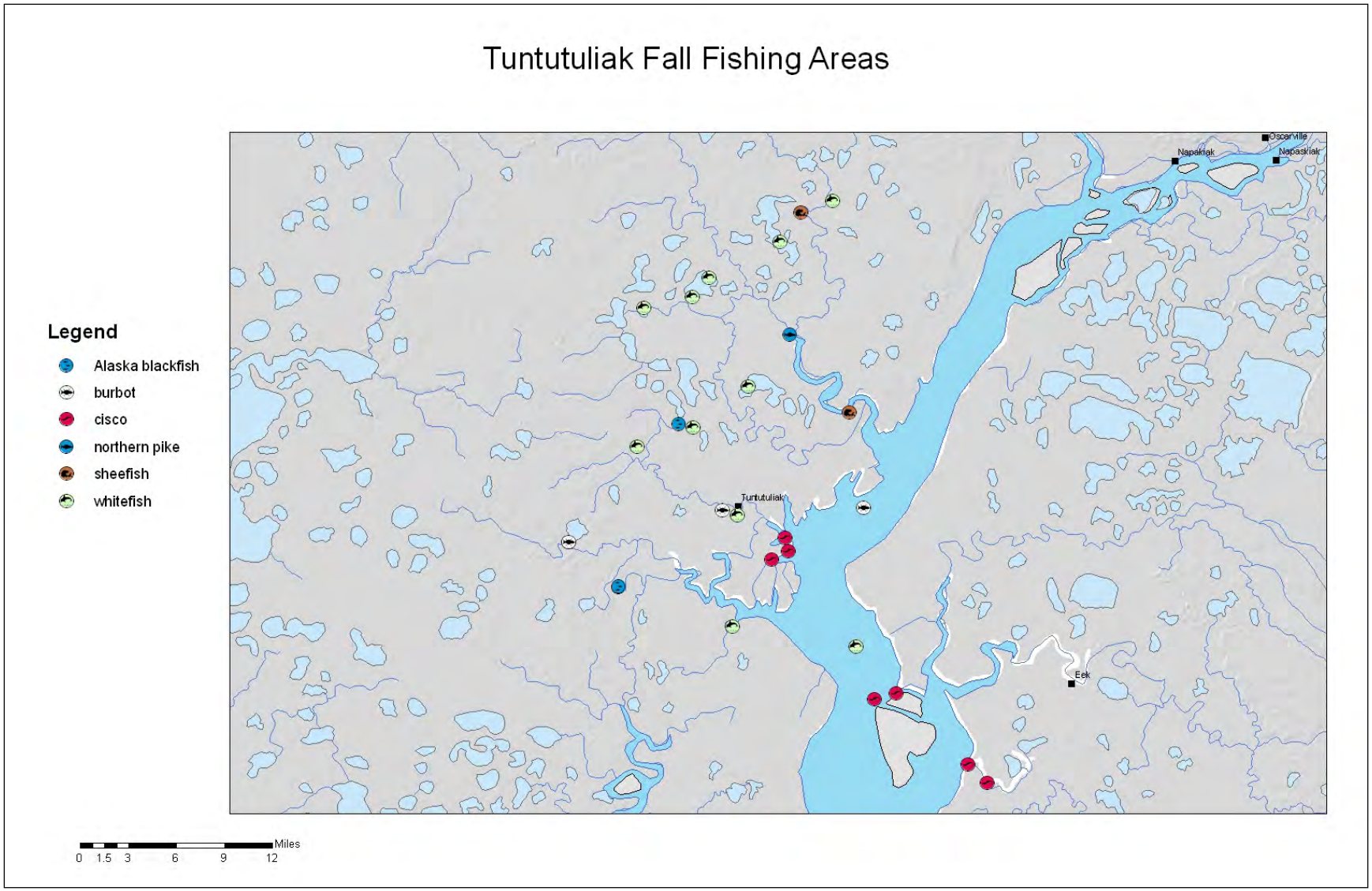

Figure 24.–Tuntutuliak fall fishing areas.

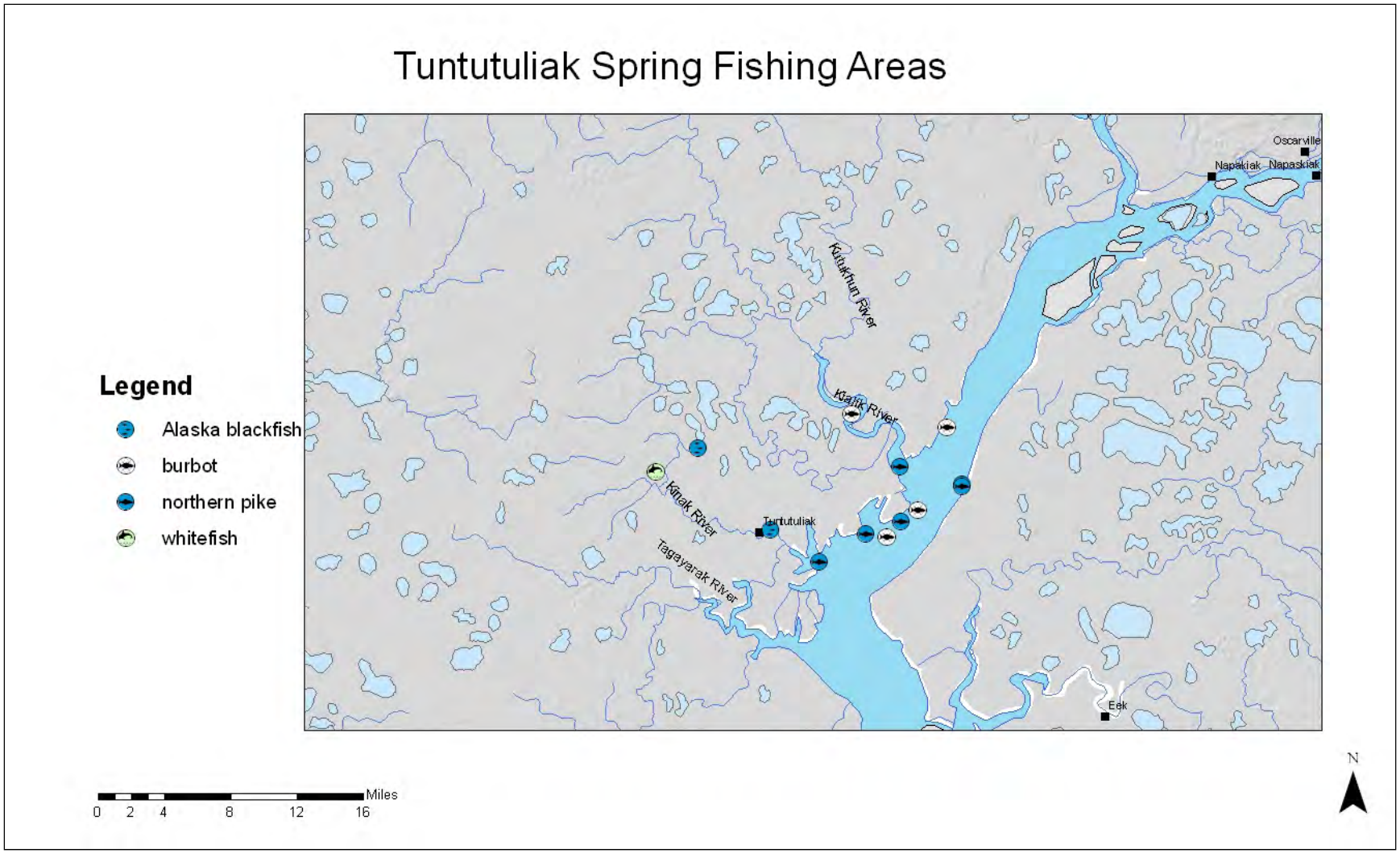

Figure 25.–Tuntutuliak spring fishing areas.

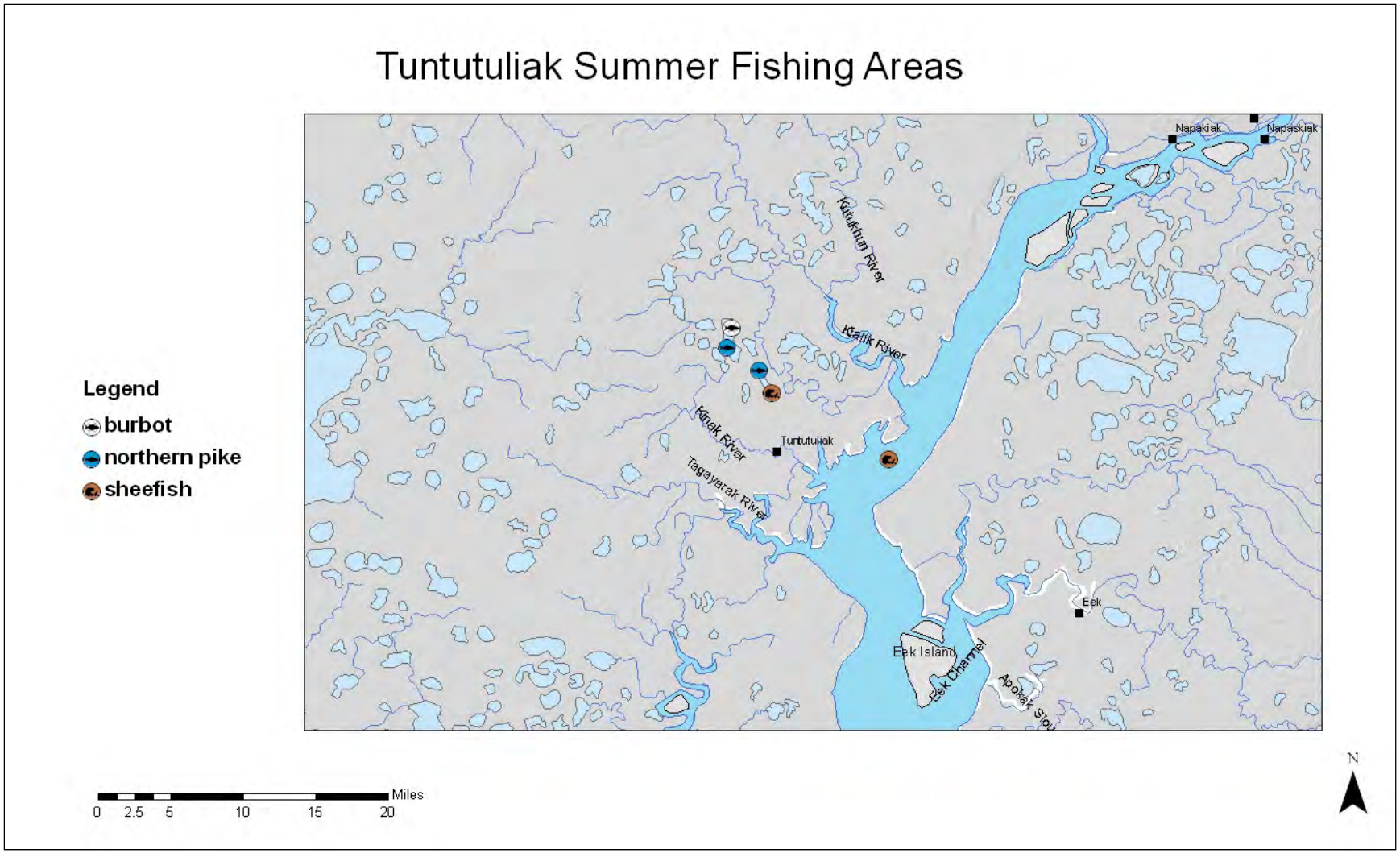

Figure 26.–Tuntutuliak summer fishing areas.

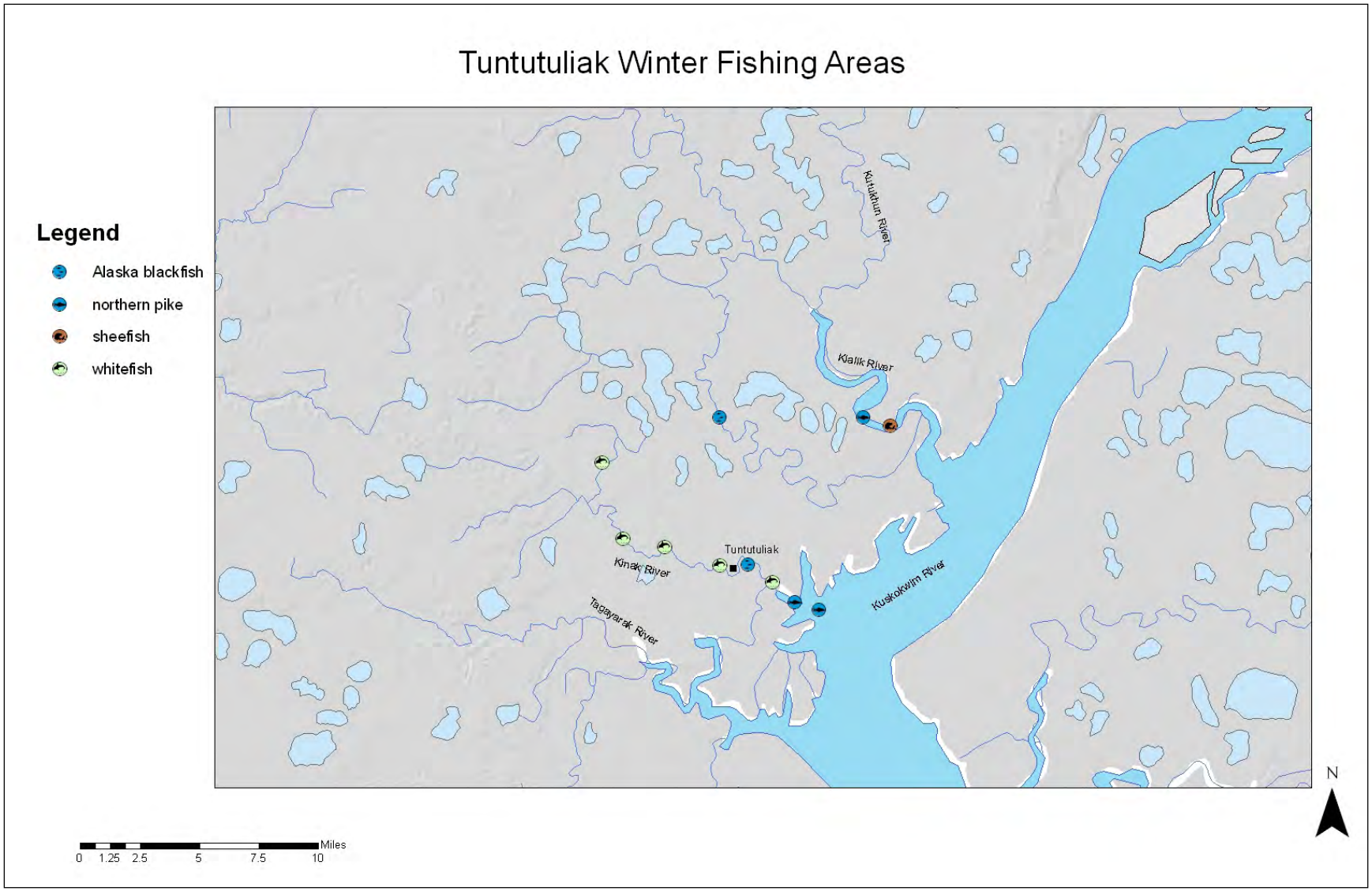

Figure 27.–Tuntutuliak winter fishing areas.

Preparation and Use

Respondents explained that nonsalmon fishes continue to be preserved in a variety of traditional methods that reflect both the characteristics of the fish and the seasons in which they are harvested. For example, the best drying and smoking occurs when the weather is neither too hot nor too cold. For frozen fish, respondents said that they used to wait until the weather was cold enough to freeze them outside, but now they can use their home freezers to preserve small quantities of whitefishes.

Elder key respondents described processes of preparing frozen, fermented, half dried and frozen, fully dried, and smoked whitefishes. Whitefishes harvested in spring are not very fat and can easily be dried and smoked, although fattier fall whitefishes can also be prepared in this manner (Figure 28). In colder months, whitefishes can be frozen in the round and then eaten or they can be frozen in the round and cooked later.

Figure 28.–Whitefishes cut for drying in Nick Frank's smokehouse, Tuntutuliak, October 2006.

In fall, people can bury whitefishes where they ferment into *kassayaq*. One respondent described his method:

> We [put] tundra grass, tundra grass around it and then lay 'em down, cover 'em up for maybe two weeks, and then take 'em out. … Well, a lot of 'em prefer to take the guts out. But some of 'em once in a while put 'em all in. I think people do that when they know it's gonna be in the dog food or something. But for, like, human consumption, usually clean 'em up, 'cause it's better to clean 'em up than trying to clean 'em up when you're

> gonna eat ‘em, you know. Better to clean ‘em up and then thaw ‘em out and then just cut it up and eat it. I’m getting mouthwater. I tell you, they’re tasty. (TR5)

Another respondent explained the difference between cutting fish for drying and cutting fish for fermentation:

> The ones he’s going to put in a pit to ferment they just slit the stomach part from the around the gill area and then make a slit to cut the end of the intestines and pull the stomachs out. And the ones they’re going to hang they cut to debone, hang deboned. (TR9)

Whitefish fat is used to make oil, and broad whitefish, especially those harvested in fall, are important because they have more fat:

> People used to use the fat before we go seal hunting too much, not every man used to go seal hunting in springtime. So they used fish oil for *agutaq* and other stuff. Women, when they cook, boil the whitefish, mostly the broads, they used to be fat so we skimmed the oil out and contain it or put it away for other uses. (TR1)

Residents said that the taste of whitefish depends on their origins: some have a sweet flavor and others taste muddy. Some respondents also eat whitefish eggs, which they call *agakik*. “Taking eggs, too. For make some soup, boiling and put some on cabbage, cutting cabbage, mix ‘em up. Really good soup” (TR3).

Sheefish are not targeted as much as other whitefishes, but when harvested they are preserved in the same ways, frozen or dried and smoked. Northern pike are also hung and dried or frozen, and their eggs are also eaten. Several Tuntutuliak respondents reported that northern pike are an important species for dog food, and can be fed raw and frozen or cooked in the “dogpot.”

> [I give my dogs] mostly pike but they don’t like pike after a while. Yeah, they say “Not another pike!” But I usually give them pike and the dead whitefish that I get. My net has maybe like twenty five fish and one of ‘em has died, you throw it to go to the dogs. But you know if you haven’t had pike for awhile they’ll be, you know, happy, when dogs are, maybe two or three times they’re really glad and like fourth or fifth time: “Not another pike!” (TR5)

Alaska blackfish are eaten fresh, dried, or frozen, and often with seal oil. One man said that he dries Alaska blackfish in the same way he dries herring, and 2 respondents said they age Alaska blackfish. Another man explained that care is needed when cooking Alaska blackfish: “The blackfish have to be cooked a little bit, just kind of like you probably cook lobster or something” (TR7). Respondents also reported that they feed Alaska blackfish to dogs:

> You can either give it to the dogs when they’re frozen or put ‘em in hot water and you boil them, just a quick, quick cook. But a lotta times if you give ‘em blackfish and they’re alive they’ll throw ‘em up. For some reason they’re not dead. … A lot of ‘em, you know, if I’m going to give blackfish to my dogs, I freeze ‘em for, like, weeks and they don’t taste so fresh and they won’t throw ‘em up. For some reason, dogs, they don’t like fresh blackfish. (TR5)

Ciscoes are often boiled but residents take care not to overcook them: “For most sea mammals and fish from the sea, not necessarily salmon, they usually say ‘they cook easy.’ They don’t have to be boiled for a long time” (TR7). One respondent reported that stickleback are baked in the round.

In addition to being used as food, nonsalmon fishes have other uses. Historically, respondents said, whitefish skins were used to make waterproof boots and mittens. Women made *kuspuks* from the skin of northern pike in order to protect their clothes while they worked with fish or seal oil. The skins of burbot

were used for window coverings, rain parkas, and were made into bags used to store dried fish. One elder described the process for tanning a burbot skin:

> The way that the skin is taken off a lush is they made a slit across the belly part and right across the head there and they take a stick and they loosen the skin, roll it onto that stick, pulling it off as they go along. And once they've done that they take the skin, scrape the inside off, take all the flesh off, and then they stick it onto something like wood, and dry it there. Once it's dry they put it in that aged urine pot again. They wash it in there and take it off and scrape it again and stick it on to something and then dry. And he says back then the houses didn't have glass window panes, and that they used the skin off the burbot for that. They used that for window panes in the houses as well as the men's houses, I guess you've heard about men's houses. He said the window was right up on the center of the roof. (TR8)

One elder respondent explained that it is important not to wear fish skin boots inside a house because they shrink in the heat. Respondents explained that in contemporary times most people do not use the skins of whitefishes, northern pike, or burbot. One respondent said that his wife still uses salmon skins to make mittens because they are tougher than whitefish skins, and that she occasionally uses fish skins to make small handicrafts for sale.

Contemporary and Traditional Self Management Practices

Elder key respondents in Tuntutuliak described a variety of strategies for self-management, including limiting harvests, avoiding waste, and respecting the important relationship between humans and fish.

Respondents explained that people fish only as much as was necessary, and that fish fences or traps do not stay deployed for longer than is necessary. Elders noted that leaving nets in the water long enough so that fish rot is prohibited because such a practice affects the area and the fish will not return. People also frequently check nets, at least every other day, and avoid setting a net if they are unable to check it regularly. An Alaska blackfish trap needs to be checked at least every 2 days.

> He noticed that the lakes are getting shallower and if a person has left their net and it freezes over and the fish that were left in there rot and are left there over the winter, and that has an effect on that particular place, where the water and quality changes, and the fish aren't abundant as they use to be after a person has left their net in there over the winter. … He says when he started fishing or trapping, his mom or the other elders told him not to leave his net or other trap and then stay there the whole winter, they taught them to always take it out or not to leave it there and he says he one time pulled the net out at their lake camp, that net had been there all winter, when he pulled it out he noticed that that mud in that area was real soft. He said that whenever he takes scrap from a fish he dumps them out along the river, he notices that the spot where he dumps them tends to have soft ground. He thinks that when the fish rot that has an effect on the area and the fish don't want to come there. (TR9)

In addition to the practices described above, some respondents reported that they avoid waste by timing their harvest of certain fish species, such as broad whitefish, to months when the meat is in the best condition. One respondent explained that in his mother's time, people liked fishing for whitefishes in spring because the meat was "not so fatty and they can dry very fast" (TR5). Respondents today explained that they more often fish whitefishes in fall because the fish have more fat and firmer flesh than whitefishes harvested during spring. People time their use of the resource to optimize quality in order to avoid waste, and avoid fishing at times when it would be difficult to preserve fish: "And before that, go fishing whitefish, and my wife told him, 'Don't fish too much really hot weather. 'Cause they spoil'" (TR3).

One respondent also times his gear use in order to preserve the fish population:

> But, like, in the fall time we use bigger mesh, like in the fall time when I go up there to whitefish, I use a five and one-sixteenth, 'cause I don't like to use a small one, mainly thinking that small ones…they'll come back again. So I wind up using big ones and let the others go. But in the winter time, like now, we start using smaller mesh, four inch, three and a half. (TR5)

In addition, some elder respondents described traditional rules about allowable fishing locations, a self-management practice that distributes resource pressure. One elder explained that in the past, each family claimed exclusive use of a particular lake slough, so no one else would fish there:

> And he mentioned that these headwaters, where the lake meets the river, used to be owned by certain people, was owned by his ancestors and the family, land, he used that spot for fish trap but nobody else, they respected that when they set their traps. (TR8)

Finally, elders explained their belief that the health and abundance of the fish population depends on humans' respectful behavior. One elder commented that there are many taboos about behavior near fish traps, taboos that encourage people to be respectful of the resource:

> He says that there are a lot of "do's" and "don'ts" with the fish, like not to move with your feet because they might become extinct or stop swimming in that certain river. … One thing they were told not to do is when they have their fish trap out and when they're checking it and even though they need something from their house or there's another person up there, they were told not to shout at that person to bring something down or whatever, they were to walk up there. Once again, they were told that if they shouted, that could cause the fish to not swim there. (TR8)

Older residents pay close attention to behavior around fish fences and fish traps, and many reported hearing stories about fish decline caused by improper behavior, such as:

> He says up at the headwaters, up here, at the lakes, there was a camp where a certain family had a dad who had a fish trap like that. And one morning he went across the lake, the lake wasn't that big, he went across and checked his trap, and when he checked it the third part there was full of fish, it had gotten full overnight. So this man calls out across the lake to his house: "Bring me more containers, I have a trap full of fish." So they brought containers over to him. And the next morning he went over to that same trap. He took it out and there was nothing in there. That's why they were told not to shout. (TR8)

Once the fish are harvested, people treat them with respect in order to ensure that the fishery will continue:

> People back then used to really take care of the fish they got. And when they bring them into the house, they always put them in a container, carry them into the house in a container, and when a fish happens to fall out of that container onto the floor, they used to pick up that fish and suck on the mouth, and then put it back in the container. They said that if they didn't do that, the fish would decline in numbers. All fish. (TR8)

Changes in Abundance, Distribution and Health

Elder key respondents in Tuntutuliak reported that broad whitefish seemed to disappear shortly after the commercial whitefish fishery, but it was unclear to them if overfishing caused this because humpback whitefish did not suffer the same decline:

> I really don't know, maybe they were fished out when they were commercial fishing for them, but that made me think sometimes when broads drop, or fished out, soon these humpbacks would do the same because the sizes are not so different. But humpbacks there're more, and [there are] less broads. (TR1)

Several respondents commented that since all animal populations are cyclical, the decline of broad whitefish might be part of a natural cycle. One respondent felt abundance is related to changing fishing patterns and environmental conditions:

> He says that local people as well as fish and wildlife people are saying that the fish are coming down in numbers, salmon as well as the not-salmon species. He says that's been the trend for the last several years. And he says that this fall they're hardly getting any whitefish up at the lakes, and the reason, he says, is that people say that when the lakes are low in water, the fish come out quite early. Earlier than they usually come out to the rivers, and spend their time in the rivers. And he told his sons that [if] they try and get fish up at the lakes they're not going to get that many because the water was real low up there. He told them that if they fish the rivers, they'd get whitefish. (TR9)

A number of respondents said that broad whitefish numbers started to rebound in 2005, and the broad whitefish run in 2008 was particularly strong and that they harvested more broad whitefish than humpback whitefish. Several respondents said that overall abundance of both species is not as high as it once was.

Respondents said that harvest rates of Bering ciscoes appear to be increasing, and 1 elder key respondent said it is possible that these fish are more abundant. Another respondent said there seems to be more northern pike than there used to be. In spite of these positive reports, elder key respondents felt that most fish populations are dwindling. One comment given was that fish are more plentiful when there is more snow, but there is less snow now and the lakes are shallower. This respondent was concerned that shallower lakes would cause a decline in the abundance of Alaska blackfish. In addition, respondents reported that beaver dams seem to be interfering with both Alaska blackfish and whitefish populations. There were reports of decreased Alaska blackfish harvests.

Parasites and poor fish health are not major concerns for Tuntutuliak respondents. One respondent said that it is more common to find salmon that look ill than whitefishes that look ill. Another respondent said that whitefish with sores or other skin problems are occasionally seen, although it is not common and not a cause for concern:

> I think that, I tell you the truth that, I don't remember in the past years, I don't remember seeing an unhealthy whitefish, but the last few couple years, once in a while, you run across one of those whitefish, either part of their scale is gone for some reason. They don't look sick, but some of the scales is kinda gone and kinda pinkish-looking, so you just don't eat that. (TR5)

Changes in Land and Habitat

Key respondents reported a number of changes in the landscape around Tuntutuliak, and also said that that historical travel routes are changing so people have to find new routes. They said these changes are due to several factors, including erosion and changes in the river, a drying pattern in the lakes, and major hydrological changes caused by beavers. Several respondents said that a new river has formed in the area and it has been draining the lakes and diverting water from the Kinak River, thus changing fish habitat. Respondents also attributed changes in fish behavior to other environmental changes:

> The elders say and he's noticing that that's been a trend lately, last two years or so, water level has been coming down gradual, and he's heard the tundra villages Nunap[itchuk], Kasigluk, saying the same. He says it's been a recent trend. The water level up at the lakes coming down early in the summer, thereby the fish coming down earlier than usual. (TR9)

Beavers were not historically present in the area, but have recently become a major force shaping the change in the waterways: "Like, when I was growing up in the sixties, my dad would take me out places,

he'd show me old beaver dams but no beavers, then in the seventies, you were starting to see beavers and they started to increase, maybe in the eighties until now" (TR7).

> ...When they first came around people were really excited about those and trap them. There was men trapping for those, I don't think people trap for them anymore, but when they first came out we were excited about those. Now, beavers come to these ponds around here by the village. (TR1)

Respondents noted that beavers not only change water patterns and affect whitefish and Alaska blackfish habitats, but they also change the navigation routes people use to access their fish camps: "No, they're shallow. They're shallower now than they used to be. 'Cause we used to drive our boats across these lakes, no problem. Now, some of 'em are really shallow and some of them have beaver dams on them at the creek" (TR1).

Several respondents observed that when beavers block sloughs, whitefish often are trapped. Since beavers affect people's ability to travel, they might also affect the fish as well: "There was beaver dam and when people broke the beaver dam there was whitefish coming out. That's not the first time I hear whitefish come out when people break the dam: (TR1). Another respondent said "Used to go from here, you could go from here, goes through here, and winds up in Meroyuk and Qukakllircaraq. But last two years, beavers been cutting 'em off, so we figured sometimes when those beaver dams are there, the whitefish may make another route, so maybe these guys, their whitefish start going over here. I don't know" (TR1).

Respondents said that the lakes seem to be getting smaller and shallower and that shorelines have eroded in a number of previously-used Alaska blackfish harvest areas, so they have to go farther in order to harvest Alaska blackfish. One reason elders thought lakes were getting shallow is because there is less snow accumulation in winter:

> Right now, we haven't seen any blackfish coming straight through the ice mainly because the lakes are all shallow, but there's a lake and small opening to main slough or river, once that's all frozen, with blackfish trapped in the lake, even on a very cold winter, maybe it's the action of rubbing, they would melt the ice and fox would come and eat them. People used to bring their gunnysacks and dipnets. People aren't mainly doing that any more, that I know of, because the lakes are frozen, or there's not enough water in the lakes anymore. (TR7)

NONSALMON FISH LIFE HISTORIES

Residents in all 3 villages demonstrate a detailed knowledge of nonsalmon fish behavior and life histories, knowledge derived from lifetimes of fishing experience. Long term observations during fishing activities provide insights into the life histories of various fish species. For example, elder key respondents have closely observed fish movements, and these observations have led them to conclusions about area habitats. For example, fishers use local lakes to fish for broad whitefish because of their observations that the fish migrate into these lakes in spring and migrate out around freeze-up, a pattern which led residents to suspect that lakes are summer feeding habitats. Another observation was given regarding habitats preferred by juvenile fish. An elder told of a large area lake that was rich in aquatic plants. He explained that when he takes his boat there in summer, he sees thousands of little fishes, probably juveniles, about 2 inches long, underneath his boat. He said he did not harvest any in his 4½ in mesh net and so his knowledge of these juvenile fish is limited.

Most elders said that their fishing practices cause them to observe certain phenomena and not others, which explains gaps in their knowledge of the life histories of nonsalmon fishes. For example, a resident reported that people used to catch juvenile whitefishes when dipnetting. In recent years, however, larger dipnet mesh selectively chooses adult whitefishes and so people are less aware of juveniles.

The following section describes residents' observations of fish life history, by species, as gleaned from the traditional knowledge interviews in each community. The observations are amalgamated to provide more regional perspective of fish movements, habitats, diets, and other aspects of nonsalmon life history.

Alaska Blackfish (*Changiiq* or *Can'giq*)

Elder respondents believe that Alaska blackfish stay in the area throughout most of the year, moving to the bigger tributaries in December because the ice is too thick in smaller waterbodies: "No fish, other than blackfish in fall, I guess most of our fish go out to the Kuskokwim. Blackfish, they hide underneath" (NR6).

In spring, elders said, Alaska blackfish return to the smaller streams, grassy lakes, and wet meadows, where they spend their summer and fall feeding. They said that the Yup'ik word for Alaska blackfish comes from the word for grass, because the fish are usually found in grassy areas, where they also spawn. Due to their observations of the presence and condition of Alaska blackfish eggs, key respondents concluded that these fish are fall spawners: "That's what I think they are, 'cause when I go out to check my traps, they have those eggs in there this time of the year, November. And in late winter, in February, seems like there are mostly males, there are no eggs in them" (ER7). Respondents have observed that Alaska blackfish leave the lakes for the larger tributaries around December, probably after spawning.

Respondents reported a small amount of trapping effort occurring in lakes, but noted that most people set traps at lake outlets in order to catch the fish during their December outmigration. Although it is widely believed that Alaska blackfish spawn in grassy lakes, one respondent reported harvesting egg-bearing Alaska blackfish in the rivers after outmigration. Those who set traps reported that smaller Alaska blackfish are the first to be harvested, so it appears that the bigger fish are the last to leave the lakes. Fishers also reported harvesting Alaska blackfish in spring, when the fish come to holes in the ice in order to breathe. These respondents use a trap set vertically, or a dipnet, or a ladle .

Fishers' observations of Alaska blackfish movements also include attention to weather. Elder respondents explained that Alaska blackfish move more, and thus are harvested more readily, during periods of north winds and cold weather. They also said that more Alaska blackfish are harvested from waters with slow currents: "When it's slow they're seem to be going out. When the current is going fast we're not catching anything. Especially in cold weather. We start going out when ice must be getting thicker on that lake" (ER7). It seemed to this respondent that high water, strong currents, and south winds that brought warm weather discourage Alaska blackfish movement.

When asked what these fish eat, one elder said: "I've seen their stomach content before and there's little snails in there. Sometimes they're full, in late February they seem to be all puffed up, and this time of year [October] or next month in November, their stomach's kind of empty" (ER7). He also commented that they mostly feed during "Summertime and falltime. Their color is lighter in summer and in winter they're dark, the water's kind of dark, there's not much current going in there 'cause of the ice" (ER7).

Whitefishes

*Bering Ciscoes (*Imarpinraq*)*

Respondents commented that Bering ciscoes come to the lakes in summer to feed and go back out to sea in the fall. Elders in Tuntutuliak and Eek reported that they harvest Bering ciscoes, whose Yup'ik name means "fish from the sea", at the mouths of rivers. They said that people harvest them in late fall, as they migrate to sea. One elder explained that ciscoes must be gone from the area in winter because "when it starts to freeze we hardly catch any" (ER2). Bering ciscoes were said to return in spring, but because they are not as fat as the September fish they are not targeted for harvest. One elder commented that ciscoes in the Eek area are fatter than ciscoes in other areas. Residents reported that they had not seen Bering cisco eggs or juveniles, so they did not know spawning locations. This absence is consistent with previously published information on Bering ciscoes, which suggests that juveniles rear in coastal waters or brackish

lagoons, and thus are not likely found as far inland as the project communities. It's assumed that these fish make a spawning migration to the main rivers in summer and early fall. Some immature adults, not ready to spawn, may feed in the Kuskokwim River delta area, and these may be the fish that local fishers have observed migrating in during spring and outmigrating in fall (Brown and Brown 2008).

*Least Ciscoes (***Irpayagak** ***or*** **Kassayak***)*

Respondents in Nunapitchuk said that they thought the least ciscoes they harvested were a resident, non-oceangoing species, in contrast with the Bering ciscoes harvested in Eek and Tuntutuliak. Nunapitchuk area ciscoes were thought to live in local lakes and to spend winters in the Kuskokwim River.

Broad Whitefish and Humpback Whitefish

Broad whitefish (*akakik*) and humpback whitefish (*cingikegliq*) were both present in the area, and were also thought to have a spring migration from tributaries of the Kuskokwim River to area lakes. As one respondent explained: "Fish come in when the ice is going out" (ER6). These larger whitefish species are thought to spend the summer in area lakes, moving temporarily into rivers during periods of low water. Broad and humpback whitefishes were observed to migrate out of the shallow waters in the fall, and to head down tributary rivers towards the Kuskokwim River, where they were thought to overwinter. One resident from Nunapitchuk suggested that whitefishes wintered upriver of the Johnson River:

> He's never heard of people catching a lot of whitefish downriver from the mouth. The people from Tuntutuliak and other villages. But mostly people from Napakiak and upriver get them during winter. So we don't know exactly where they migrate. They probably come out to the Kuskokwim because it's deeper, it doesn't freeze all the way and then during springtime they return to spawn. All these lakes that you're seeing they're spawning areas for fish. … That big lake there is the main source that's in our area. (NR1)

While detailed information on the movements of broad and humpback whitefishes was beyond the scope of this project, one elder was able to provide the insight that "Their travels are different" (ER4). Other respondents were also able to provide details that suggest differences in movements: one respondent observed that broad whitefish appear to leave the lakes late in the fall, and another couple reported that the larger broad whitefish left the lakes first, and the smaller ones left later. Respondents also explained that whitefishes of both species were "skinny" when they were harvested as they migrated into the lakes in spring, and fat when they were caught on their way out in fall.

Elder key respondents often fish for broad and humpback whitefishes in area lakes, and they expressed the belief that the whitefishes probably fed in the lakes. "In the lakes there are lots of weeds here and there. In the weeds there are worms. That's where they feed themselves" (NR 4). "They feed on those weeds. And they [the weeds] have seeds that grow. Sometimes they're like a little bud that grows on the weeds. That's what they eat. They're like a little seed" (NR5).

> I really don't know. I never pay attention to what the fish are doing on the lakes but you can see them feeding on some bugs on surface, I think. You see them maybe come up for air or something, but they come out in summertime when the water is calm, the weather is good, then you can see them. (TR1)

> Nowadays some young people are curious what they eat, especially some of these young ones, they cut the stomach and see what they eat. They say they eat other fish and maybe snails out of lakes. They say little bugs, but I don't know what kind they are. (TR1)

In Tuntutuliak, several elders explained that whitefish stomach contents can predict some weather patterns:

> He says when he sees his wife cutting up fish that the stomachs seem to contain muddy stuff and debris. … In the fall time he notices that when there's going to be a warming

> trend, their stomach tend to contain that. The stomach gets full with whatever's inside and then warm weather, he says, comes and the nets get hardly any fish. (TR9)

It also seemed to respondents that broad and humpback whitefishes spawn in the fall because that's when they found eggs: "Like, I know that the … eggs are still in there and they're pretty lots of 'em, and they're like that until the leaves start falling, and then when the leaves start falling, the eggs are gone" (TR5). Respondents reported variability in the timing of the spawning event, from mid August to after freeze-up. One participant reported that the timing varies considerably from year to year and is dependent on seasonal change:

> When we went fishing last month for whitefish up there, most of them had already hatched their eggs, and we thought maybe they know it's going to be winter soon 'cause usually when we go up, the time that we go up, they usually have eggs in them, and then last time, about the same time, we went up there and there were hardly eggs, just very little, and they already spawn out. Maybe they knew it was going to be winter. 'Cause in the past, like last year, the river didn't freeze up until this week, last week in October. And then we went up ice fishing around the first part and they had lotta eggs on them. And then about the same time of year this year, nothing. So maybe they know the seasons, I don't know. With a little brain they could be smart, you know. (TR5)

There was no clear agreement about spawning habitats. Some Nunapitchuk participants observed whitefish depositing their eggs in shallow, grassy lakes and ponds while others thought that different populations of whitefish spawned in different places: "I don't know if their originating point … There might be a difference between that, with their location, you know, where they spawn. Some might spawn in the Kuskokwim, and some might spawn up there" (NR 3).

According to Brown and Brown (2008), both broad and humpback whitefishes tend to spawn in upriver areas on such major rivers as the Kuskokwim River, although humpback whitefish are sometimes known to spawn in isolated lakes, which could explain the difference in observations by local residents (Brown and Brown 2008:6).

Respondents were unsure of the rearing locations of juvenile whitefishes. A respondent explained that it might be in lakes: "And then in the summertime we, I usually go up and daytrip, kind of, up there [a lake area] for picnic and rod and reel. You see all these little fish, I don't know what they are, maybe they're whitefish, I don't know" (TR5).

As previously mentioned, elder respondents in Nunapitchuk believe that Nanvarpak Lake is the source of all nonsalmon fishes in their area: "That's where most of the fish come out of. They can't understand really why they all tend to be from that area but they do come out and then stay around our area" (NR2). According to these elders, some whitefishes remain year-round in lakes that do not freeze to the bottom.

One respondent from Tuntutuliak thought that perhaps young whitefish follow their parents: "He says the baby fish won't stay up at the lakes 'cause they probably go out with their parents. He's seen small fish with big eyes and he assumes that they go out with their parents" (TR9).

During the interviews, respondents noted that they can usually tell the area of origin for particular whitefish species because they have different qualities. For example:

> Their bones are different, Atmautluak [Pikmiktalik] River fish has bigger bones. And going this way toward that big lake, Nanvarpak, toward Kasigluk area, they have smaller bones. And they get richer in fat. … Nanvarpak has a shorter river, shorter river towards the Johnson River. … From the snow … ice, water change. Yearly, you know. It goes out and new water comes. That's probably the environmental advantage of producing better fish. (NR3)

Years of fishing also contributed to residents' ability to observe change through time, though there is no general agreement resulting from this project as to what those changes are. Elder key respondents in Nunapitchuk reported noticing a number of recent changes in whitefishes. One commonly-given comment was that humpback whitefish are starting to resemble broad whitefish in "fatness" and taste. One elder said it is like there is a new species of humpback whitefish, one with a smaller head, a bigger body, and a build more similar to broad whitefish. He said the new fish could be coming from another area. Respondents also reported that broad whitefish sizes have been changing, and have recently become smaller. One elder commented that it was only the local broad whitefish that were smaller, and those in the Kuskokwim River that came down the Johnson River from the Kalskag area were still the larger size. Another commented that fish sizes have always varied from year to year and that fluctuations are probably natural. Residents in Eek also remarked that broad and humpback whitefishes were smaller than they used to be. One respondent commented that broad whitefish are coming back fat, and he saw this as a good sign (ER4). Finally, respondents from Nunapitchuk said that there is a species of whitefish that is closely related to broad whitefish, but is not the same. They call it *kiagglaq* and said that "they are…about the same size but darker….And they seem to have better eggs. Female has better eggs. More eggs" (NR3).

Residents in all 3 villages recognized round whitefish, which are known as *nequiak* ("little fish") or *ituli* ("big eyes"); however they did not share much information about movements.

Burbot (Loche or *Manignaq*)

Residents described life histories of burbot, including seasonal movements, food acquisition, and environmental factors. Fishers observed that burbot migrate up local tributary rivers in spring in order to spend summer in area lakes, similar to other nonsalmon fishes. Burbot then return to the Kuskokwim River in fall or winter, reportedly when the smaller lakes and rivers freeze. Burbot were described as a predatory fish that prefers to eat at night, and that can be found in areas where prey live: "The loche [burbot], pike, are the ones that are pretty numerous in summer and they eat the blackfish and the blackfish goes on what-you-call those swampy areas ground" (NR6).

Elders reported that burbot with eggs in them have been harvested during fall, and one elder said burbot were thought to spawn in local lakes. One respondent commented that younger fish seem to be lighter in color, and that they move with the adults. Burbot are also affected by water levels and move into the creeks during periods of high water. Burbot tend to prefer slower water, and they move during slack tides. It is best to fish for them at dusk. One respondent explained: "I guess it's because of what they eat, little blackfish. You know, they're like catfish they have these little feelers on the bottom. I really don't know, but that's when we usually catch them is at twilight" (ER8).

One resident in Tuntutuliak expressed a concern that burbot seem to be smaller than they used to be.

Northern Pike (*Eleqruyak*)

Elders observed that northern pike migrate up the tributaries to headwaters in summer, and return in fall to the Kuskokwim River. Northern pike are reported by Tuntutuliak respondents to be the first fish to head upriver in spring. They are thought to spawn in local lakes, and to lay their eggs in shallow water. However, many respondents in all 3 project communities noted that northern pike appear to be resident in the area during the winter months as well because they could be harvested by jigging through the ice. In Nunapitchuk, elders said that most nonsalmon fish species remained throughout winter, and that northern pike are among the fish that remain: "They say, tradition says, some of the fish stays all winter. Pikes might be one of 'em. 'Cause before they start coming up, other nets start catching fish from that area, Kasigluk [upriver] area. Before the migration gets up [to Nunapitchuk from the Kuskokwim River]" (NR3).

Respondents reported that although northern pike are a predatory fish, unlike burbot, they prefer to eat during the day. Northern pike eat "…most likely blackfish and some of the small fish like smaller trout

and probably some baby salmon" (ER8). Northern pike have been observed to eat worms, sticklebacks, smaller northern pike, and even mice.

Although northern pike and other predatory fish are often harvested with similar methods and means, residents have observed some differences. For example, one respondent commented that northern pike are usually found in and harvested from shallower water than sheefish.

Concerns expressed by area residents were primarily about the size of the fish. Elders in Eek felt that both northern pike and sheefish are not as big as they used to be: "They're getting smaller. When I first went jigging they were big and large and now they're getting smaller and less people are going out" (ER7).

Sticklebacks (*Quarruuk* or *Quar'uuk*)

Sticklebacks are thought to swim upriver shortly after breakup; however respondents did not share additional knowledge about their movements. Key respondents in Tuntutuliak and Eek reported that the sticklebacks have become larger, and wondered if the fish are different species or an anomaly:

> Large ones, they're almost the size of those sardines. I've heard that they don't eat them, but they got those smaller needlefish that we still eat. It wasn't until a couple years ago that I saw my first one of these. And I asked around, nobody seemed to know they were that large and I was beginning to wonder if they were some type of mutant. (TR7)

Another man commented that stickleback and other fishes had returned late that year: "It's like most of the fish came in late 'cause of the warm weather" (ER8).

DISCUSSION

Together, the ethnographic interviews and harvest survey confirm the importance of nonsalmon fishes to the subsistence economies of the 3 Lower Kuskokwim River communities in this project. This discussion starts with a comparative overview of harvest survey results, and follows with a discussion of the results from the semistructured interviews with key respondents. The surveys also suggest that the most harvested nonsalmon species, by weight, in these communities in 2004–2005 were northern pike, various species of whitefish, and Alaska blackfish.

Drainagewide Harvest Overview

This discussion of Lower Kuskokwim River area harvests focuses on pounds of fish rather than numbers of fish to highlight their relative contribution to subsistence diets. Information on the numbers of fish harvested are found in the Results section. The harvest surveys confirmed that residents of the 3 project communities harvested and used large quantities of nonsalmon fish. Overall, the residents of Eek, Tuntutuliak, and Nunapitchuk reported a total harvest of 231,268 lb of nonsalmon fish during the 2004–2005 study year. Eek residents harvested an estimated 40,814 lb of nonsalmon fishes, or 143 pounds per capita, while residents of Nunapitchuk harvested an estimated 90,157 lb of nonsalmon fish, or 134 pounds per capita. Finally, Tuntutuliak residents harvested an estimated 100,297 lb, or 249 pounds per capita (Figure 29 and Table 20).

Table 20.–Nonsalmon fish harvests, by community.

Community	Percentage of households					Pounds harvested			Amount harvested [a]		95% confidence limit (±), harvest
	Use	Att	Harv	Recd	Give	Total	Mean HH	Per capita	Total	Mean HH	
Eek	91.0%	87.2%	87.2%	50.0%	15.4%	40,814.4	510.2	143.7	13,576.4	169.7	2.3%
Nunapitchuk	65.2%	60.9%	65.2%	39.1%	30.4%	90,156.6	812.2	134.4	24,338.0	219.3	15.2%
Tuntutuliak	96.9%	89.1%	87.5%	70.3%	62.5%	100,296.9	1,238.2	249.2	50,273.0	620.7	7.9%
Total						**231,267.9**					

Source ADF&G Division of Subsistence household survey 2006.

a. Amount of resource harvested is individual units, unless otherwise specified.

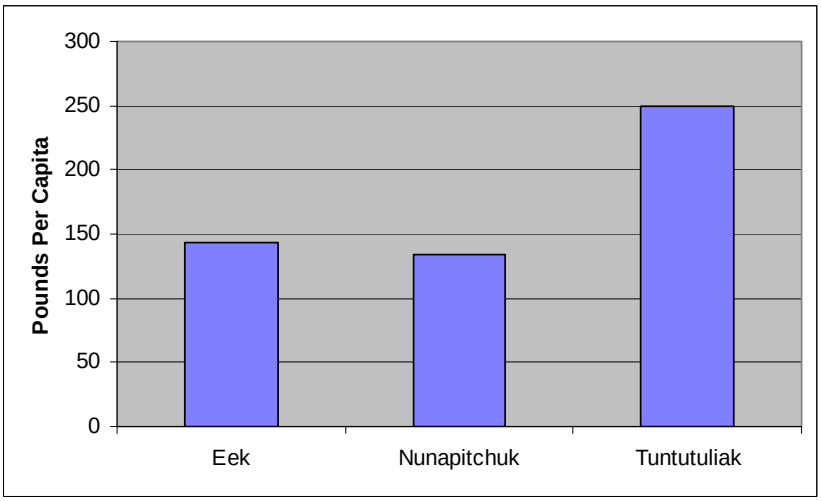

Figure 29.–Per capita harvest of nonsalmon fish in 2004–2005, project communities.

In general, the survey results demonstrated that more households use nonsalmon fishes than harvested nonsalmon fishes, which attests to the continued importance of sharing of wild resources to the economies of these communities (Table 20). In each community, a high percentage of households reported using nonsalmon fish, with 65% of households in Nunapitchuk reporting use, and 91% of households in Eek and 97% of households in Tuntutuliak (Figure 30 and Table 20). The harvest survey also indicates that sharing is important in all communities, with 39% of households in Nunapitchuk, 50% of households in Eek, and 70% of households in Tuntutuliak reporting that they received nonsalmon fish in 2004–2005 from other households.

Although Nunapitchuk appeared to harvest fewer nonsalmon fish than either Eek or Tuntutuliak, the sample size in Nunapitchuk was small, and may not be representative of the community's subsistence activities.

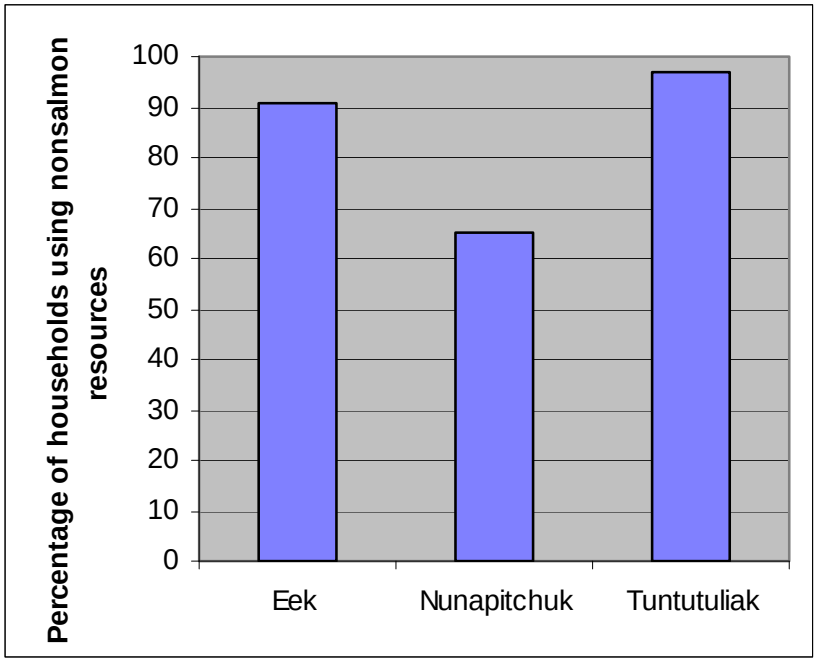

Figure 30.–Percentage of households using nonsalmon resources, project communities, 2004–2005.

Another interesting result of the surveys was the difference in harvest of saltwater fish between the 3 communities. While Eek and Tuntutuliak harvested more than 1,500 lb of nonsalmon saltwater fish per community, Nunapitchuk harvested almost none, most likely because it is further from the coast (Figure 31). In all 3 communities, freshwater fish were the majority of nonsalmon fish harvested, composing 96% of Eek's harvest, 97% of Tuntutuliak's harvest, and almost 100% of Nunapitchuk's harvest (Figure 31).

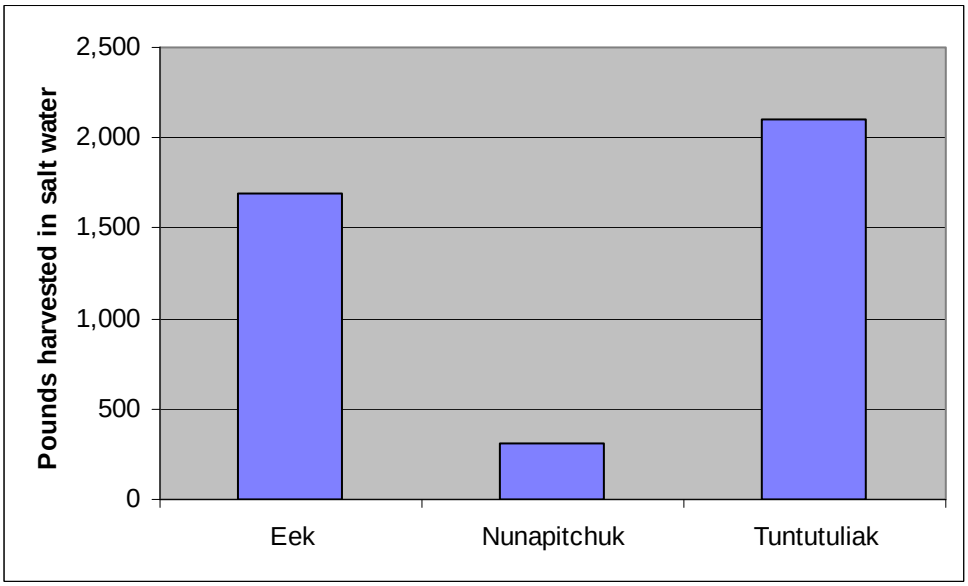

Figure 31.–Harvest of saltwater nonsalmon fish, project communities, 2004–2005.

Table 21.–Nonsalmon fish harvest, by location.

Community	River–Slough, pounds	Lake, pounds	Salt water, pounds
Eek	29,239.3	9,881.0	1,694.1
Nunapitchuk	89,849.7	0	306.9
Tuntutuliak	238,217	52,334	4,119

All 3 communities harvested northern pike more than any other nonsalmon fish species, at 56% of the combined total nonsalmon fish harvest. In Eek, approximately 86% of households reported using an estimated 5,520 northern pike (24,840 lb) (Table 2). Nunapitchuk fishers harvested an estimated 14,816 northern pike (66,672 lb) and northern pike were reported used by 65% of the households in the community (Table 6). In Tuntutuliak, 92% of households reported using an estimated 8,680 northern pike, or 39,059 lb (Table 10).

Whitefishes constituted 22% of the estimated total subsistence nonsalmon fish harvest, with 93% of the total whitefish harvest comprised of the larger broad and humpback whitefishes. While whitefish species comprised the second most harvested nonsalmon species in Eek and Nunapitchuk (an estimated 9,565 and 19,565 lb, respectively) (Table 2 and Table 6), they were the third most harvested (21,882 lb) in Tuntutuliak (Alaska blackfish was second at an estimated 31,303 lb) (Table 10). Humpback whitefish were heavily used in all 3 communities, broad whitefish in Nunapitchuk and Tuntutuliak, and ciscoes were heavily harvested in Eek. Humpback whitefish comprised 55% of the estimated total whitefish harvest and broad whitefish constituted 38% of the total whitefish harvest. Although many respondents indicated a preference for broad whitefish, they explained that due to declining populations it was easier to harvest humpback whitefish, which were more abundant.

Semistructured Interviews

The semistructured interviews reveal the importance of nonsalmon fishing in these communities, since respondents were able to describe a long history of nonsalmon fish harvest and use patterns. Nonsalmon fishing is an important part of local culture as well as social relationships, and elders were able to give many examples of local traditions and practices that have developed around the harvest of nonsalmon species.

In each of the 3 project communities, interview respondents explained that fishing for nonsalmon fish occurs throughout the year, although each community reports slightly different seasonal patterns. Most respondents reported that spring and fall camps are usually located at important nonsalmon fishing areas. Fishing effort during summer is usually on salmon as evidenced by respondents in Tuntutuliak and Eek who emphasized that they did not do much fishing for other species during this time, and by harvest surveys that showed negligible harvest during summer months. Respondents in Tuntutuliak and Eek reported a preference for fall whitefishes, which are fatter, and that they did not target whitefishes as much during other times of year, trends that are confirmed by the results of the harvest surveys. Harvest survey results suggest that Tuntutuliak residents harvest whitefishes primarily in September and October, and Eek residents in September. However, harvest survey results from Nunapitchuk suggest that residents deliberately target humpback whitefish in primarily May and June, in addition to fall.

Elders participating in this project have seen many changes over their lifetimes, with one of the biggest involving the seasonal movements between subsistence camps: e.g., residents no longer move to spring and fall camps for the season in order to harvest whitefishes and other nonsalmon species. However, this change has not reduced the harvest of nonsalmon fishes because it is the improvements in transportation that have made it possible for residents to make short term trips, since they can reach historical camps in a

fraction of the time it once took them. Some participants reported making these short trips, which range from a few days to a week, to camp areas in order to fish for nonsalmon fish and to combine nonsalmon fishing with other subsistence activities, such as berry picking or moose hunting. Elder respondents did not report major changes in the seasonality of fishing over their lifetimes, although one respondent did wonder if people were catching fewer fish due to changes in the timing of fish migrations.

Although seasonality of harvest has not changed, respondents did report changes over time in the technology used to harvest nonsalmon fishes. Respondents in all communities said that when they were young, people worked together to build communal fish fences and traps, which could harvest many species, large numbers, and different sizes of nonsalmon fish. Today, most families use hook and line or manufactured nets in a variety of mesh sizes in order to target specific species and sizes, although they often catch multiple species in the same net. Respondents explained that modern equipment is easier to use than were the fences, which took considerable effort, social cooperation, and materials to construct. In addition, residents in Nunapitchuk referred to regulatory restrictions that prohibit the blocking of waterways, and expressed concerns about interfering with barge traffic. The results of the harvest surveys show that Eek and Nunapitchuk fishers use hook and line, followed by setnet, to harvest significant amounts of nonsalmon fish, by weight, while Tuntutuliak fishers primarily use setnets and then hook and line to harvest fish. Setting traps for Alaska blackfish is a major method of harvest in both Tuntutuliak and Eek.

While fishing has seen some technological changes, the methods of preparation of harvested fish in the 3 communities has not changed. Although home freezers offer the option of preserving fish during any season, most families prefer more traditional methods, such as drying or fermenting, or freezing fish outdoors. Because most participants no longer have dog teams, they do not harvest and preserve fish in the quantities that they once did. Fish prepared in the traditional manner remain important for cultural and subsistence purposes, and respondents reported especially enjoying fermented fish at festivals and when travelling in winter.

All project communities described traditional methods to manage and conserve nonsalmon fishes, such as self-regulation of harvests, avoidance of waste, sharing, and respectful relationships between humans and fish. Respondents often said that they take care not to harvest more than they can use, and explained the importance of regularly checking nets and traps, as well as the importance of not leaving them in the water through the winter if they could not be checked. Harvested fish are handled carefully, and even the scraps are supposed to be disposed of in a respectful manner.

Elders explained that wasting fish could result in a decline in fish populations in a particular area. It seems as if the consequences of disrespectful behavior towards fish are specific to a location and can cause loss of production in that location. In addition, respondents reported that the spoken word has a powerful effect on fish and that it is important not to complain or argue about fish or to brag about fishing success because these actions prevent the return of the fish. This echoes earlier work by Jack (2002) who suggests that the residents of the coastal *Caneneq* area, the Canenermiut, believe that words should be chosen carefully because of their powerful effect on the well-being of the community (Jack 2002).

Residents in the project communities said that they learned to fish through a combination of knowledge shared by elders and experimentation. Data from harvest surveys suggest that the majority of fish are harvested from rivers and sloughs. Many good fishing spots have been used for years, and respondents said they learned about them while fishing with their parents and older siblings. This generational transmission of knowledge is combined with experimentation in order to ensure fishing success—respondents described continually trying new locations, especially when pursuing other subsistence activities.

Residents did remark that the area has changed, and good fishing spots did not always remain the same. Some of the major changes that residents noticed include more shallow lakes, increased erosion, and changes in waterways caused by beavers. Residents in the 3 project communities expressed significant

concerns about beavers, and most said that there were not nearly as many beavers when they were young. They believe that beavers are causing major fish habitat degradation.

Personal fishing experiences and communal knowledge provides fishers with knowledge of nonsalmon life history. For example, residents did not usually volunteer knowledge of spawning locations, but if directly questioned could offer suggestions based on their observations of the presence of fish eggs in harvested fish. They also learn about the feeding habits of nonsalmon fishes by observing stomach contents, and by noticing when fish such as northern pike or burbot would bite. Fishers learn about the migrations of nonsalmon fishes because fishing is timed to exploit seasonal migrations. Residents set nets throughout the year and know which fishes are moving at different times. In addition, respondents have knowledge of short term fish movements because they have learned how tides, winds, and water levels affect fishing.

Interviews with respondents confirm the concerns reported at public meetings about declining populations of broad whitefish that played a part in prompting this project. Respondents in all project communities said that declines in broad whitefish populations started 40 or 50 years ago. One interesting result of the project is that most respondents reported that in the years immediately before this project, broad whitefish populations were rebounding. There were no frequently expressed concerns about other fish species: a small number of elders in Eek feel that cisco populations are declining, and one respondent in Tuntutuliak feels that they are increasing. In general, respondents are not too worried about fish health. There were only a few reports of parasites, but those respondents were simply responding to questions about parasites, and did not seem to think the parasites observed were problematic. It should be noted, however, that some respondents indicated that fish with parasites were not used for human consumption.

INTERVIEW RESULTS COMPARED TO A RECENT WHITEFISH PROJECT

The observations made by key respondents during their interviews appear to confirm several patterns that have emerged in an important Kuskokwim River area whitefish radiotelemetry project conducted by Harper et al. (2008). According to Harper et al., numerous previous studies suggested that, as residents have long described, whitefishes migrate into the area in spring, feed in lakes during summer, and outmigrate in fall. The authors cite other reports that have confirmed this general pattern. In addition, Harper et al. confirm that whitefishes spawn in the fall, after leaving summer feeding areas, which corresponds with residents' observations of eggs inside fish harvested in fall. Several respondents for this project commented that they have seen juvenile fish in area lakes, and Harper et al. cites recent biological studies that suggest the juveniles do rear in the tundra lakes of the Kuskokwim river drainage (Harper et al. 2008:2–3).

Harper and his colleagues attempted to determine spawning locations of Kuskokwim River broad and humpback whitefish populations by implanting radio tags. However, failed tags and their inability to locate tagged fish complicated their findings and they were unable to definitively determine spawning locations, although several of the broad and humpback whitefishes tagged in the Kialik River between Tuntutuliak and Nunapitchuk were later found in the upriver reaches of the Kuskokwim River, and a few as far as the community of McGrath. According to Harper et al., this finding indicates that some proportion of the population travels a great distance in order to spawn. The project did not collect data during winter, so it was unable to address a Nunapitchuk resident's suspicion that fish overwinter upriver. It appeared to Harper et al. that many fish migrated upriver to spawn but it was unclear if they remained upriver during winter (Harper et al. 2008:8,9,11).

Several of the fish tagged in the Kialik River area were caught upriver in the Bethel area (Harper et al. 2008:11). This is a significant finding because the Kialik River is, and always has been, an important whitefish use area for residents of both Nunapitchuk and Tuntutuliak. Residents in both communities reported sharp declines in whitefish populations during interviews conducted for this project. A highly probable explanation for the declines is that, because local whitefish populations travel extensively at

certain times of year, as evidenced by the Harper et al. project, they may be experiencing additional pressure from residents of other, more populated areas (e.g., Harper et al. 2008:11).

COMPARING PROJECT RESULTS ACROSS REGIONS

Further insight can be gained by comparing the results of this project to similar studies in subsistence economies previously conducted on the Yukon River. The communities in this project had nonsalmon fish harvests that ranged from 134 to 255 pounds per person. These amounts are comparable to 2002 results from the Grayling–Anvik–Shageluk–Holy Cross (GASH) area where communities reported harvests ranging from 160 to 270 pounds per capita (Brown et al. 2005).[7] However, in the GASH area in 2002, whitefishes were the most commonly harvested nonsalmon fish, compared to this project, where northern pike were the most commonly harvested nonsalmon fish. There are also some differences in seasonality of harvest, with Grayling, Anvik, and Holy Cross residents reporting whitefish harvests from May to early September, similar to the pattern in Nunapitchuk, and Shageluk residents reporting the majority of their whitefish harvests in November, which is more similar to the fall whitefish fisheries in Eek and Tuntutuliak (Brown et al. 2005).

Similar nonsalmon research on the Koyukuk River also suggested that communities in that area harvest more whitefishes than any other nonsalmon species. Although northern pike were harvested, they were not harvested in nearly the same quantities as whitefishes. The nonsalmon fish harvest estimates ranged from 71 pounds per capita in Koyukuk to 411 pounds per capita in Hughes (Andersen et al. 2004).

These comparisons demonstrate that Lower Kuskokwim River communities have a much higher dependence on northern pike than communities in other areas. This might be because of reported declines in whitefishes in the area, which may have forced people to pursue other species, or it might be due to a long standing preference. Likewise, communities in other areas may have historically harvested more northern pike but this harvest may have declined with the decrease in the maintenance of dog teams. The 3 communities in this project did not maintain many dog teams, so the high harvests of northern pike are almost certainly for human consumption. During the interviews, elder respondents spent significantly more time talking about whitefishes and Alaska blackfish than about northern pike, but it is not clear if this was because high harvests of northern pike were a recent phenomena.

Work done in the lower Kuskokwim River area in the 1980s also revealed higher harvests of northern pike than of whitefishes, but, according to information gathered during this project, the major declines in whitefish populations had already occurred by that time. Coffing (1991) conducted a subsistence baseline study for Kwethluk in 1986–1987, and estimated that residents had an estimated community total harvest of 40,693 lb of northern pike, 33,735 lb of burbot, and 29,839 lb of whitefishes.

Andrews (1989), wrote her doctoral dissertation on the relationship between resource distribution and land use and chose Nunapitchuk because its location implied a higher dependence on nonsalmon species such as whitefishes and northern pike. She reported that in 1983, sampled households in Nunapitchuk harvested more northern pike per capita than any other fish species. She estimated a total community harvest of 19,617 lb of northern pike and 8,781 lb of whitefishes. According to the results of her surveys, residents harvested only 15,525 lb of Chinook salmon and 11,240 lb of chum salmon, both less than the estimated total harvest of northern pike. In addition, she reported 100% of households fished for northern pike and only 65% fished for Chinook salmon and the same percentage for chum salmon. Andrews did not report whether people historically had more dependence on northern pike than on other nonsalmon species, but she argued that the villages had been located where they were in order to take advantage of the migratory patterns of whitefishes, and that seasonal camps had been placed at good Alaska blackfish fishing locations. Future research in the area would do well to ask if people have historically harvested northern pike in higher proportions than whitefishes.

[7] Harvests estimates from Holy Cross are not included in this comparison because of methodological issues.

CONCLUSION AND RECOMMENDATIONS

In conclusion, this project demonstrates the importance of nonsalmon fishes to residents of Eek, Nunapitchuk, and Tuntutuliak. Harvest surveys show a high level of harvests, and interviews with key respondents show a long history of dependence on nonsalmon fishes. According to Andersen et al. (2004), this information can be valuable when determining "customary and traditional" uses and can help inform fisheries managers during formulation of resource management plans. For example, currently one person in the Bethel area has a permit to fish commercially for burbot and whitefish, and more such permits may be issued in the future. Considering the high subsistence use of nonsalmon fish demonstrated by this project, and the recent major declines in whitefishes reported by respondents, one recommendation would be for managers to proceed with caution when considering the expansion of commercial nonsalmon fisheries. It is not clear if the major decline in whitefish was due to the prior whitefish commercial fishery, but the timing was close enough to be suspicious.

This project used methods similar to Brown et al. (2005) and Andersen et al. (2004) to document both harvest patterns and traditional knowledge of nonsalmon fishes. Before this research, little had been documented on the uses of nonsalmon fishes in the Lower Kuskokwim River area. In addition, residents of the Lower Kuskokwim Region are highly dependent on subsistence foods, and this project helped to document those uses. Similar research in other Yukon–Kuskokwim Delta communities should be considered to better understand the role of nonsalmon subsistence fisheries to the economies and ways of life of area residents, as well as to ascertain whether similar trends in nonsalmon fish abundance are observed elsewhere, especially in light of recent commercial nonsalmon fishing efforts in nearby waters. In addition, studies on contaminants in nonsalmon fish should be considered, especially given the fact that all 3 communities reported heavy harvest and use of pike, a predatory species known to accumulate biocontaminants.

Interviews with elders show that fishing for nonsalmon fish is closely tied to local values and culture. Local families move to spring and fall camps in large part to be able to better harvest nonsalmon fishes, and the movements of these fish have a strong influence on residents' seasonal cycles. Elder respondents can demonstrate extensive knowledge of nonsalmon fishes and have adapted to changes in technology and social patterns of fishing necessary for successful harvest. Because nonsalmon fishes are available year-round, they are an important part of local survival strategies, and this project helped to make that use visible. Although some of the older traditions are no longer practiced, residents continue to maintain an ethic of respect towards nonsalmon fishes. This project was also important because it documented elders' knowledge of and experience with nonsalmon fishes, providing an important record of traditions of nonsalmon fishing in the Lower Kuskokwim River area. Community members' detailed observations of nonsalmon fishes, especially their movements and lifecycles, are valuable because few contemporary biological studies have been conducted on nonsalmon species in this area. The observations collected from project participants could help guide biologists designing a research project in the area. In addition, this project provides support for the argument that further biological research is needed on nonsalmon fish in the area, given the demonstrated local dependence on these species.

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APPENDIX A: RESOLUTION 92-01

ATMAUTLUAK TRADITIONAL COUNCIL & ELDERS
KASIGLUK TRADITONAL COUNCIL & ELDERS
NUNAPITCHUK IRA COUNCIL & ELDERS

JOINT RESOLUTION 92-01
92-01

WHEREAS; The Village of Atmautluak, Village of Kasigluk, Village of Nunapitchuk is and are ALASKAN NATIVE VILLAGES traditionally organized and are recognized by the United States through Seaxeatry of Interior, and

WHEREAS; The ATMAUTLUAK TRADITIONAL COUNCIL & ELDERS, KASIGLUK TRADITIONAL COUNCIL & ELDERS, AND NUNAPITCHUK IRA & ELDERS is and are the governing bodies of the VILLAGE OF ATMAUTLUAK, KASIGLUK, & NUNAPITCHUK and,

WHEREAS; JOINT RESOLUTION 92-01 was set up by the three membering villages of ATMAUTLUAK, KASIGLUK, AND NUNAPITCHUK to prohibit fishing in the water of NANVARPAK and the area where the fish goes out Nanvaq, below NANVARP on the bay area also the kuik called "KUIGA", and

WHEREAS; JOINT RESOLUTION 92-01, by our SOVEREIGN/SUZERIAN powers to govern, prohibits fishing to preserve and to equally provide our Tribal Member with adequate fish year round in other areas including the Kuskokwim area as well, and

WHEREAS; any fishnets found on the restricted waters shall be taken by the permission of the governing bodies of this area, and

WHEREAS; development of white fish and thier migration will be protected from the waters of NANVARPAK,

NOW THEREFORE BE IT RESOLVED that setnet fishing shall be prohibited in the wate of NANVARPAK to preserve and protect the development of white fish and their migration to spawning grounds, and

BE IT FURTHER RESOLVED that any fishnets found on the restricted waters shall be taken by the permission of the governing bodies through thier rights of Sovereign/Superian powers to govern.

PASSED AND APPROVED THIS SECOND DAY OF APRIL 1992

ELDER ELDER

ELDER ELDER

ELDER ELDER

ELDER ELDER

APPENDIX B. HOUSE-TO-HOUSE SURVEY INSTRUMENT

2005/2006 LOWER KUSKOKWIM NON-SALMON FISH SURVEY

HOW MANY PEOPLE LIVE IN THIS HOUSEHOLD?:_____

BETWEEN APRIL 1, 2005 AND MARCH 31, 2006:

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

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

COMMUNITY_____(_____)

HOUSEHOLD ID NUMBER _____

PIKE	**Y / N Use** **Y / N Fished For** **Y / N Catch** **Y / N Gave Away** **Y / N Received**	**Number of Pike Harvested By Month**														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

Burbot	**Y / N Use** **Y / N Fished For** **Y / N Catch** **Y / N Gave Away** **Y / N Received**	**Number of Burbot Harvested By Month**														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

SHEEFISH	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Number of Sheefish Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

BROAD WHITEFISH	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Number of Broad Whitefish Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

HUMPBACK WHITEFISH	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Number of Humpback Whitefish Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

ROUND WHITEFISH	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Number of Round Whitefish Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

LEAST CISCO	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Number of Least Cisco Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

BERING CISCO	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Number of Bering Cisco Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

LAMPREY	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Number of Lamprey Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

GRAYLING	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Number of Grayling Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

RAINBOW TROUT	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Number of Rainbow Trout Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

ARCTIC CHAR	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Number of Arctic Char Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

DOLLY VARDEN	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Number of Dolly Varden Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

SUCKER	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Number of Sucker Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

TOM COD	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	**Number of Tom Cod Harvested By Month**															
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

HALIBUT	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	**Number of Halibut Harvested By Month**															
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

HERRING	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	**Number of Herring Harvested By Month**															
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

ROCKFISH	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	**Number of Rockfish Harvested By Month**															
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

NEEDLE-FISH	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	**Pounds Needlefish Harvested By Month**															
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

BLACKFISH	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Pounds Blackfish Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

SMELT	Y / N Use Y / N Fished For Y / N Catch Y / N Gave Away Y / N Received	Pounds Smelt Harvested By Month														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Unk	Total
River/Slough	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Lake	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															
Saltwater	Drift Net															
	Set Net															
	Hook/Line															
	Other_____															

Thank you for participating, are there any comments or concerns that you have relating to subsistence fishing?

APPENDIX C: CONVERSION FACTORS

Resource	Reported units	Conversion factor
Northern pike	Individual	4.5
Burbot	Individual	2.4
Sheefish	Individual	6
Broad whitefish	Individual	4
Humpback whitefish	Individual	3
Round whitefish	Individual	0.5
Least cisco	Individual	1
Bering cisco	Individual	1.4
Lamprey	Individual	0.6
Arctic grayling	Individual	0.7
Rainbow trout	Individual	1.4
Arctic char	Individual	0.9
Dolly Varden	Individual	0.9
Sucker	Individual	0.7
Pacific tomcod	Individual	0.5
Halibut	Individual	21.2
Herring	Individual	6
Rockfish	Individual	4
Stickleback (needlefish)	Individual	0.2
Alaska blackfish	Pounds	1
Smelt	Individual	0.25

APPENDIX D: KEY RESPONDENT INTERVIEW GUIDE

These fish will be discussed. For each species, the following lines of questioning will be asked.

Northern pike

Burbot

Sheefish

Broad whitefish

Humpback whitefish

Least cisco

Bering cisco

Round whitefish

Blackfish

Lamprey (eels)

Grayling

Rainbow trout

Dolly Varden

Arctic char

Smelt

Needlefish

Sucker

Life History

[Show picture of fish, also have topo maps, colored pencils out and ready for mapping]

What do you call this fish in Yup'ik? What is the local name for this fish? Do you call it anything else?

1) What can you tell me about the seasonal movements of _____
    a. Do they come and go?
    b. Are they in the area year round?
    c. When do people catch them?

2) Do you know what they eat?
    a. What are their stomach contents at different times of the year?

3) Do you know when and where they spawn? (reference map too)

a. What do they look like at different times of the year

(example: humpback skin often gets rough like sandpaper during spawning)

4) Where do they spend their time? (reference map too)
   a. in the winter?
   b. In the summer?
   c. Juvenile habitat?

5) Is their movement affected by weather?
   a. water levels?
      (rain, tide, etc)
   b. time of day?
   c. Wind?

6) What kind of water do they like?
   (slow, swift, deep etc..)

   What makes good habitat for _____?

Harvest and Use

7) Where do you go to catch_____? (reference map)
   a. have you always fished here? If not, where else? Why did you move?

8) What do you look for in selecting an area to fish for_____?

9) What kinds of fishing gear do you use?
   a. size of net (mesh and length)
   b. other gear

10) Have you always used this gear or did you use to use something else?

11) How do you normally preserve your catch?

a. freezing, drying, smoking, canning, others

b. do you cut the fish differently for the different purposes? Like you would cut strips for salmon but also fillets?

12) What do you use the fish for?

    a. Eating?
    b. trapping bait?
    c. Dog food?
    d. Anything else?

13) Who participates with fishing? Harvesting? Cutting? Making–repairing nets?

14) At a seasonal camp, how many families? What are the relations between the families that go?

15) How do you know if its going to be a good year for _____? If it's a bad year (a low fish year), what do you do?

<u>Population and Environmental Trends</u>

16) Do you think the number of _____is increasing, decreasing, or about the same as always?

17) Do you think _____themselves are the same size? Are they getting bigger? Smaller? Is their appearance changing?

18) what about the water ways—are they different? How?
    a. water temperature?
    b. Quality (more silt? Higher water? Etc)
    c. How are these differences affecting the ecosystem in general?
    d. Environmental occurrences—fires, floods, earthquakes, volcano, drought, warm winter–cold winter, effect of snow, etc..?

After going through this for each species, should also ask

1) other than salmon and fish you catch in the ocean like halibut, are there any other local fish we haven't talked about that you use?

2) Are there any fish you used to catch but don't anymore?