Technical Paper No. 398

Socioeconomic Effects of Declining Salmon Runs on the Yukon River

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July 2015

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

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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	
Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
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
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.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

TECHNICAL PAPER NO. 398

SOCIOECONOMIC EFFECTS OF DECLINING SALMON RUNS ON THE YUKON RIVER

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July 2015

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This document should be cited as:
Brown, C. L. and A. Godduhn, editors. 2015. Socioeconomic effects of declining salmon runs on the Yukon River. Alaska Department of Fish and Game, Division of Subsistence Technical Paper No. 398, Fairbanks.

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ABSTRACT

In recent years, Chinook salmon returns to the Yukon River have experienced severe declines, resulting in commercial and subsistence salmon fishing closures, as well as a number of economic disaster declarations. Chinook salmon returns on the Yukon River during the 2009 season failed to meet U.S.-Canadian border passage requirements of the Pacific Salmon Treaty (PST), and some spawning escapement objectives for the State of Alaska. In August 2009, as a result of the closures, the U.S. Secretary of Commerce declared the 2009 Yukon River salmon fishery an economic disaster. In response, the Alaska State Legislature requested that the Alaska Department of Fish and Game (ADF&G) investigate the effects that poor salmon returns had on Yukon River communities, resulting in this report. The primary goal was to study the influence of low Chinook salmon returns on fishing patterns and priorities. Specific objectives of the project included documenting multiple aspects of the Yukon River salmon fisheries: 1) the effects of Chinook salmon shortfalls on the social organization of fishing activities; 2) the locations and gear types used for salmon fishing in different parts of the drainage over time and as related to salmon shortfalls; 3) how restrictions have affected subsistence opportunities for Yukon River salmon; and 4) the patterns of redistribution of fish within and beyond Yukon River villages through the exchange practices of sharing, barter, and customary trade. Principal investigators worked in 5 Alaska communities representing the cultural, social, and economic diversity present throughout the Yukon River drainage in terms of location, community size, cultural and economic profiles, historical fishing patterns, and contemporary fishing priorities: Eagle (including Eagle City and Eagle Village), Beaver, Nulato, Marshall, and Emmonak. Field research included 52 ethnographic interviews with 57 key respondents and 172 surveys on exchange practices.

While the disaster declaration attended primarily to the closure of the commercial fishery in the Lower Yukon River that left many families with few or no sources of income, the low runs of Chinook salmon also affected subsistence fishing families throughout the river. In an area so dependent on a mix of subsistence and commercial harvests, the effects of the 2009 run cascaded through many aspects of community life. Salmon fisheries remain a critical component of these mixed subsistence-cash economies, and declining salmon runs have created a complex situation for residents, who have depended on Yukon salmon fisheries for sustenance, exchange, and maintenance of cultural tradition over multiple generations. The primary socio-economic effects that researchers documented included: a decline in fish camp use; changes in the dynamics of mixed subsistence-cash economies, including increased fuel costs and the increased need for and constraints of wage employment; the effects of changing regulations on salmon fishing; increased knowledge about salmon throughout the drainage; and changes wrought by shifts in gear types and dog use. Finally, this research documented important aspects of exchange in subsistence economies. Sharing, barter, and customary trade can be understood as occupying a single continuum for distributing subsistence products, rather than as discreet and fundamentally separate activities. Even in times of decline, salmon continue to play a critical role in the subsistence economies of Yukon River communities. It follows that as Chinook salmon become less available through both decreased returns and conservative management, the effects of the decline will cascade through the entire economy; the loss or decline of a central subsistence resource will likely have widespread effects on communities throughout the Yukon, requiring significant adaptive responses from communities.

Key words: Chinook salmon, king salmon, Yukon River, Emmonak, Marshall, Nulato, Beaver, Eagle, salmon disaster, subsistence, barter, sharing, customary trade

1. INTRODUCTION

Anna Godduhn and Caroline L. Brown

Overview

The Yukon River supports runs of 5 species of salmon. As a result, Yukon River residents have developed a critical dependence on salmon as a subsistence and commercial resource. Chinook salmon, chum salmon, and coho salmon swim up the Yukon River as far as Canada, and pink salmon swim to the Anvik River. Some sockeye salmon make their way into the lower Yukon River but do not have major spawning grounds within the drainage and are not managed by the Alaska Department of Fish & Game (Table 1-1). People from the Yukon River drainage have extensive, practical knowledge of salmon and the ecological cycles surrounding the fisheries that have reliably provided sustenance to hundreds of generations. The significance of salmon extends beyond the excellent nutritional value of wild Pacific salmon, especially Chinook salmon (Hamilton et al. 2005), because of the need for families to work together. The annual harvest and preservation of wild foods provides important cultural teaching and learning opportunities that transcend the use of fish as a dietary staple (ADF&G 1987; Joseph 1997).

Communities along the river are still bound by their dependence on salmon, and by their participation in a "mixed, subsistence-based socioeconomic system" (Wolfe 1984a:177). According to Wolfe (1984a), rural Alaska economies are "mixed" in the sense that both wild foods and cash income are essential, but "subsistence-based" because wild foods are the foundation. Despite flux and variability, this general rule still holds in small communities across the state. Food security in rural Alaska now includes access to national and global markets, but remains fundamentally dependent on locally available wildlife and fish populations. Expensive store-bought food in community stores is often processed and packaged for long-distance transportation and shelf life rather than nutritional value. According to many river residents, these foods are not a satisfactory replacement either in substance or in spirit.

The centrality of salmon to livelihoods on the Yukon River is reflected by the importance of fish camps, where extended families work under flexible gender- and age-based divisions of labor. The use of fish camps as part of the seasonal round of wild food harvest activity intensified with the burgeoning cash economy early in the 20th century. As local economies integrated cash resources and technology, wage employment became more prominent. By the 1970s and 1980s, many adult family members would travel back and forth to work, leaving mostly elders and youth in camp for long periods. This new pattern worked well enough when gasoline was affordable and fish were abundant, but has become less and less tenable over recent decades. As documented here, the use of fish camps has plummeted and fewer families continue to relocate for even part of the fishing season.

Episodes of depletion and recovery in Yukon River fisheries have been documented over the last 100 years ago. The most recent decline dates to 1998, when the Chinook salmon run was less than 60% of the prior 15-year average spanning most of the 1980s. Most of the 14 years since then have produced weak or below average runs for all Yukon salmon species, and the Chinook salmon run in 2009 was declared a disaster because of poor returns (Figure 1-1). By summer 2012, the Chinook run had not recovered. The 2012 run was extremely late and weak—the second latest return on record. The run was at the low end of pre-season projections and insufficient to meet escapement goals.[1] Summer chum and fall chum runs, however, came back strong. Scientists have not identified a primary cause for the Chinook salmon crash; a variety of factors including warming ocean and river temperatures, the bycatch of salmon in the commercial pollock fisheries in the Bering Sea, and other stresses may be acting together.

1. Steve Hayes; Eric Newland, Geoffrey L. Hasket, and Peter J. Probasco. (2012). 2012 Yukon River Summer Salmon Fishery News Release #86 Fairbanks, Alaska Department of Fish and Game; US Fish and Wildlife Service, http://www.adfg.alaska.gov/static/applications/dcfnewsrelease/203815060.pdf (Accessed 6/24/2014).

Table 1-1.–Yukon River salmon species, including non-Linnean names.

Common name		Nickname	Yup'ik[a]	Koyukon	Gwich'in[b]	Han[c]	Linnean name	Upriver range (district)
Chinook		king	*Taryaqvak, Kiagtuk*, or *Aciirturtet*	*ggaal*	*łuk choo*	*tr'oja*	*Oncorhynchus tshawytscha*	British Columbia
("small salmon")	Chum					*theyy*	*O. keta*	
	summer			*Noolaaghe*				Koyukuk River (4a)
	fall	dog fish	*Iqalluk, Kangitneq*, or *Aluyak*	*Noldlaaghe*, often "silver" sometimes "Chinook"	*khii or shii*	*tsaghah luu*		Yukon Territory
	Coho	silver	*Caayuryaq, Qakiiyaq, Uqurliq*, or *Qavlunaq*	*Leghaane*	*nehdlii*		*O. kisutch*	Yukon Territory
	Pink	humpback					*O. gorbuscha*	Anvik River
	Sockeye	red	*Cayak*, or *Sayak*				*O. nerka*	To Tanana (5a), but not up the Tanana River

Note With noted exception, terminology in this report is consistent with ADF&G standards for salmon species.

a. *Source* Central Yup'ik names is Jacobson (1984).

b. *Source* " Dinjii Zhuh Ginjik Nagwan Tr'iłtsąįį: Gwich'in Junior Dictionary," compiled by Katherine Peter, National Bilingual Materials Development Center and the Alaska Native Language Center, 1979, accessed June 30, 2014. http://library.alaska.gov/hist/hist_docs/docs/anlm/24000656.pdf

c. *Source* "Han Gwich'in Athapaskan noun dictionary," draft manuscript from August 1978, accessed June 30, 2014 http://www.uafanlc.arsc.edu/data/Online/HN976R1978b/ritter-1978-han_dictionary.pdf.

Commercial fisheries on the Yukon River historically occurred all along the river but now primarily take place in the lower river and are an extraordinarily well integrated example of Alaska's mixed economy. Small, family-owned commercial fishing operations are generally an extension of subsistence fishing and entail a shift in focus from catching and preserving fish for domestic use to harvesting fish for sale. In economic terms, the production unit is usually a family, or extended kin group—and the workforce often includes 2 or more generations. However, commercial fisheries have been restricted since 2008, causing severe effects for families and communities who invested in and rely on that activity.

In August 2009, Alaska Governor Sean Parnell requested that U.S. Commerce Secretary Gary Locke declare the low Chinook salmon return a disaster. "Commercial fishing is the only identified industry in the region that brings new money into the economy," wrote the governor.[2] Not long after the governor's request, a disaster was declared and relief money was appropriated. It was this development that prompted the Alaska State Legislature to request further information from the Alaska Department of Fish and Game (ADF&G), which in turn led to this ethnographic and survey-based research.

As more fully described in the methods section (Chapter 2) and each chapter's introduction, the information reported here was collected by ADF&G Division of Subsistence staff in the fall and winter of 2010 in an effort to document the social and economic effects of the Yukon River Chinook salmon disaster from the perspective of the fishers. Changes to the social organization of fishing, such as the declining use of fish camps, were documented—along with limited information regarding patterns of the traditional subsistence

2. Office of Governor Sean Parnell, "Parnell Urges Declaration of Disaster," news release August 7, 2009, http://gov.alaska.gov/parnell/press-room/full-press-release.html?pr=5011 (Accessed June 24, 2014).

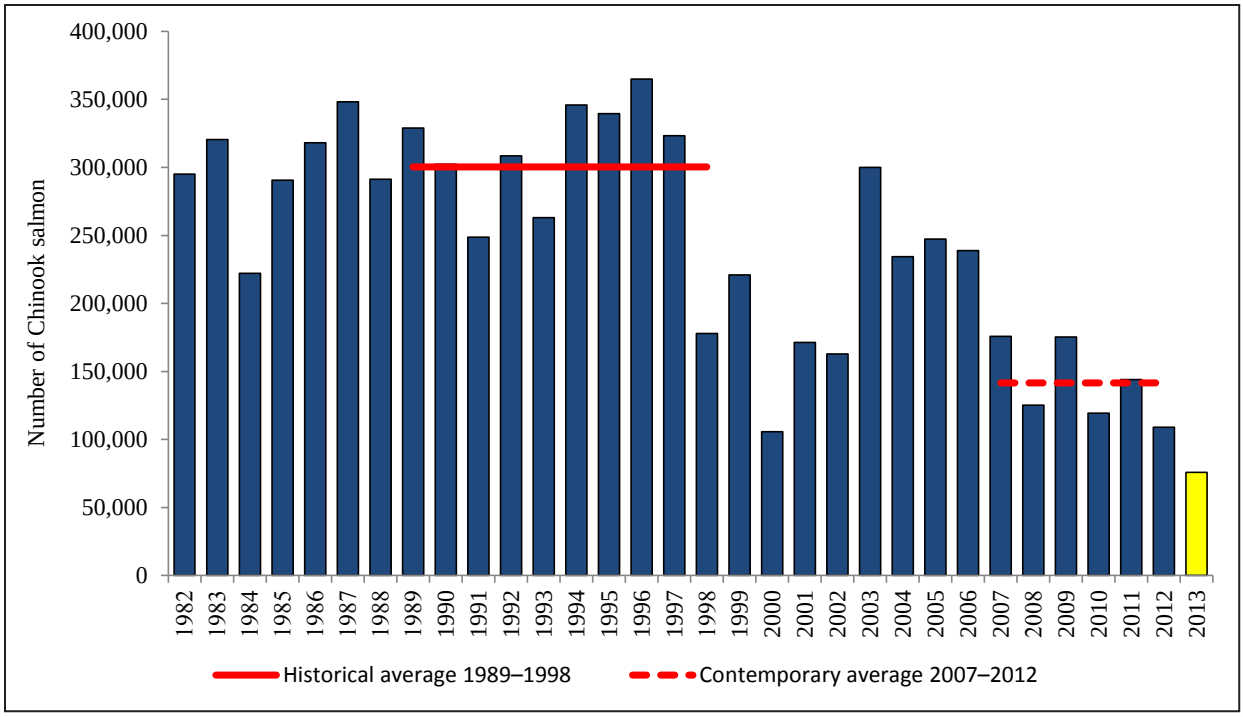

Figure 1-1.–Estimated Chinook salmon returns showing the change in average run size.

practices of barter[3] and customary trade[4], terms that will be discussed in their social and legal contexts in the Discussion. The research was conducted in 5 communities that span the river and represent the 3 general regions (Figure 1-2): Emmonak and Marshall in the lower river, Nulato in the middle river, and Beaver and Eagle in the Alaska portion of the upper river. Emmonak (ADF&G District 1) is situated on a major slough, or "pass," of the Yukon River on the Yukon Delta—an important wetlands and waterfowl breeding area. Marshall (District 3) is more than 100 miles upriver from Emmonak, near the northeastern border of the Yukon Delta. Nulato is in the middle river (District 4A), where many salmon begin to bank orient in preparation for spawning in various tributaries. Beaver (District 5D) is in the Yukon Flats, another vast wetlands region known for its biological productivity. And finally, Eagle (city and village; District 5D) is the last community on the Alaska portion of the river, just below the Canadian border.

Subsistence salmon demands tend to be stable and relatively low over time (Wolfe 1984b). However, the availability and harvest of Chinook salmon in particular has fallen in recent years with declining runs. Restricted subsistence harvests, especially of Chinook salmon, are increasing the demand for other foods—but salmon declines have affected residents' lives much more deeply than a simple change in diet. In addition to the social loss of extended periods of fishing from fish camp and the economic loss of commercial fishing, repercussions may be felt across the state as networks of sharing are stressed by the shortage of a highly prized resource. Patterns of exchange of subsistence-caught salmon, including barter and customary trade, continue to evolve as a vital component of local economy and culture. This report documents the financial hardship and sense of loss described by responding residents of 5 communities along the mainstem Yukon River, along with their environmental observations and recommendations related to both fisheries management and mitigating the socioeconomic effects of the crash. General issues and common phenomena with regional variation are introduced here, and developed with local detail in later chapters.

3. Sec 16.05.940 (2): "barter" means the exchange or trade of fish or game, or their parts, taken for subsistence uses (A) for other fish or game or their parts; or (B) for other food or for non-edible items other than money if the exchange is of a limited and noncommercial nature.

4. Sec 16.05.940 (8): "customary trade" means the limited noncommercial exchange, for minimal amounts of cash, as restricted by the appropriate board, of fish or game resources; the terms of this paragraph do not limit the money sales of furs or furbearers.

Geography and History of the Yukon

The Yukon River originates on the eastern side of the Boundary Range of British Columbia's coast, approximately 1,980 river miles from the Bering Sea. The 331,726 square mile Yukon River drainage is flanked by rugged mountains, and comprises rolling hills of boreal forest and sprawling valley floors. The permafrost has been discontinuous and fairly stable for thousands of years, underlying seemingly endless bogs of muskeg. Most tributaries are clear water, but the headwaters and the Tanana River are "muddy" with glacial silt. The often-braided Yukon River transports millions of tons of suspended particles to the treeless tundra of Western Alaska and the Bering Sea each summer, and has been building its part of the Yukon–Kuskokwim Delta over millennia (Brabets et al. 2000:75). Hydrologic changes that may be affecting salmon populations include degrading permafrost and a general decrease in surface water (Osterkamp et al. 2000; Riordan et al. 2006). Scientific documentation and local observation from across the watershed generally agree that winter ice is thinner, forms later, and is less reliable, and that water levels have dropped (Andersen et al. 2013; Weller and Anderson 1999). Weather in Alaska's Interior is extremely variable (Slaughter and Viereck 1986), making it difficult to discern the effects of changing flood patterns on salmon productivity, but extensive research is underway (American Fisheries Society 2009).

For more than 10,000 years, the people of the Yukon River have participated in hunting and gathering in some of the most extreme conditions on the North American continent. Extended families or small groups would travel between 3 or 4 seasonal camps that generally allowed for fishing in summer, hunting in fall, and trapping in spring. Camps were often situated so that multiple resources could be accessed. Small and large game, nonsalmon fish, furbearers, greens, berries, and waterfowl were harvested in turn, as described later in the community chapters. Trade fairs, such as at *Noochu Loghoyet* (Turck and Lehman Turck 1992) were attended by people who traveled long distances. By the end of the 1700s, trade goods included new items of European and Russian origin that may have been passed along a chain of trade from the Bering Sea coast all the way to the Upper Tanana River (Andersen and Scott 2010:7; Simeone 1995:19).

Beginning in the mid-1800s, Russian traders in the western portion of the drainage and Euro-Americans in the east created a demand for transportation, and dogs were the answer:

> The lucrative trade in furs provided significant incentives for improved winter transportation methods and the establishment and expansion of new trail networks as the indigenous population modified their seasonal round to emphasize the harvest of furs and access distant trading posts. Across the North, the expanded use of dogs for winter transportation after 1850 and the availability of western commodities such as twine for making durable fishnets led to another important modification in the traditional seasonal round—an increased emphasis on summer fishing to provide dog food. These adaptations and the abundant salmon runs of the Yukon River combined to allow dog traction to take hold and flourish in Alaska's interior. (Andersen and Scott 2010:1).

Multiple factors have played into the use and management of Yukon River fisheries over time; one critical factor in recent history has been dogs. Dog teams were used for checking traplines that had expanded for the Russian fur trade in the 1700s. The Alaska Purchase (1867) and the Klondike Gold Rush (1898–1902) brought dramatic increases of traffic on the river, creating a demand for wood to fuel steam boats and more fish to fuel dogs that hauled the wood and provided winter transportation. Fish were harvested to feed dogs and to sell through customary trade relationships. Dried chum salmon, packed in bundles of 25 to 50 fish, became a common commodity at trading posts along the river. By 1918, about 1 million salmon were being harvested each summer to feed approximately 6,000 sled dogs along the Yukon River (Andersen and Scott 2010:3). Dogs moved freight for trappers, miners, and the U.S. Postal Service—and were used recreationally as a central feature of winter carnivals across the state.

In the 1920s, airplanes, and then later, snowmachines, changed transportation methods, particularly regarding the demand for dogs. Aviation continually decreased the need for dogs to transport goods, mail, and people between larger communities as airstrips were constructed, especially in the early 1940s. However, dog teams were still the primary method of local winter travel until snowmachines became available in the

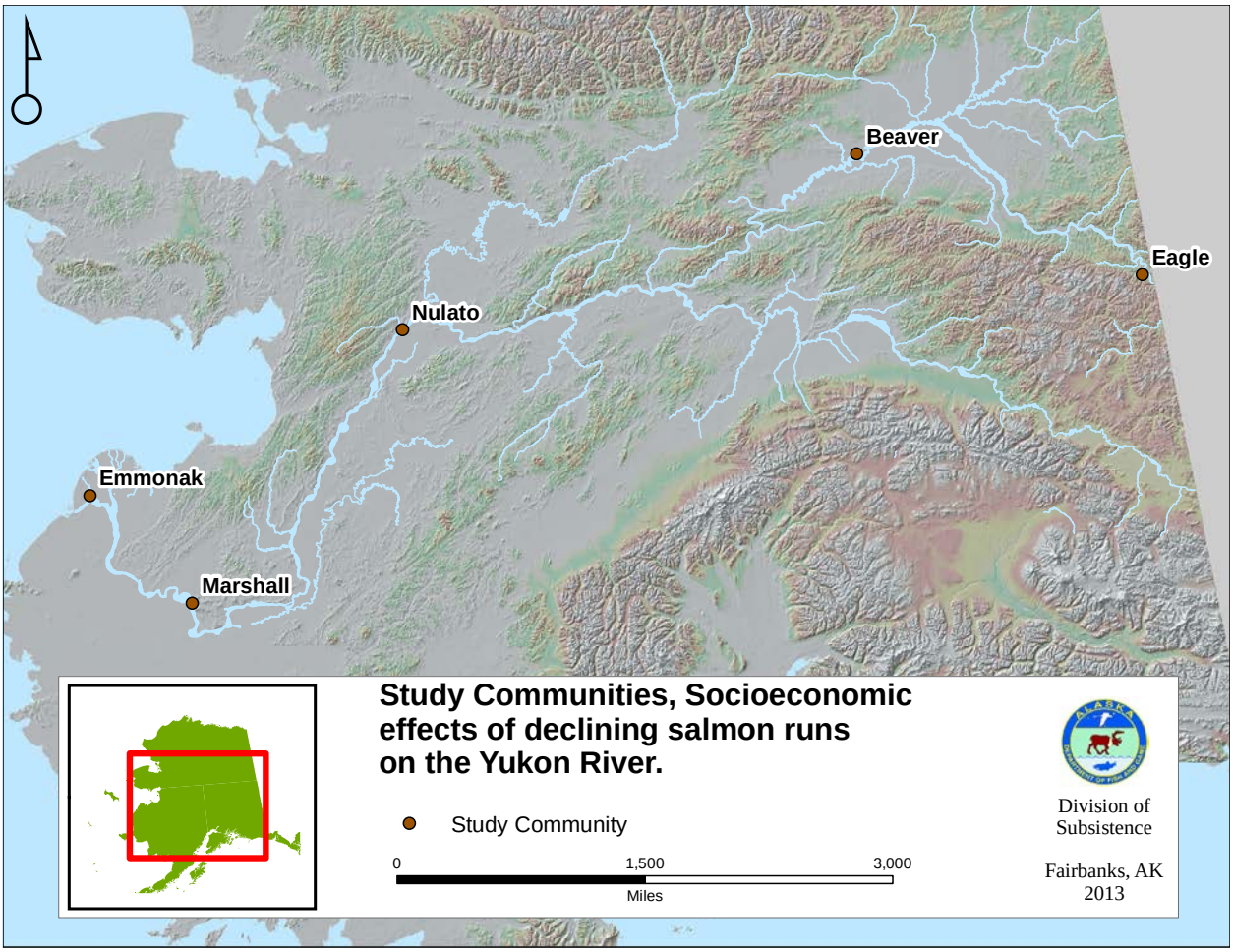

Figure 1-2.–Study communities 2010–2011.

1960s and more reliable in the 1970s. Sled dog racing lulled, but many dog yards remained, and mushing expanded again in the late 1970s, 1980s, and 1990s with the repopularization of recreational sled dog racing. More recently, large dog yards have all but disappeared from many Yukon communities—in rough parallel with the chum salmon decline and the advent and development of motorized vehicles suitable for the terrain surrounding rural Alaska communities (Andersen and Scott 2010:57).

Advances in gear have also influenced the volume of specific salmon harvests. Early on, local needs for dog food and salmon for human consumption throughout the drainage were mostly met by the harvest of chum salmon with nets set from shore. For Chinook salmon, fishers in the middle river especially practiced a labor-intensive, traditional form of drift dipnetting into the 1920s (O'Brien 2011:77). In the middle and upper river, expansive forests provided ample wood used to build fish wheels, which were brought into use in about 1910 (Andersen 1992:8; Clark 1981). Fish wheels were widely adopted because, with their limited depth and proximity to shore, they are especially efficient for catching chum and coho salmon species. Because setnets reach farther out from shore and more deeply into the water column, they provide better access to Chinook salmon than fish wheels in most places in the mainstem Yukon River (Wolfe and Case 1988:4), but these and other gear types catch a mix of fish in all parts of the river.

Activity in the Yukon River region has waxed and waned with the boom and bust of Alaska's economy, but fish, especially salmon, have remained central to residents' lives—as described in this report. The river is still the primary travel corridor—by boat in summer and snowmachine in winter. Uncertainty surrounding the seasonal shift between modes of travel required for harvesting food has been enhanced by changing

weather patterns and the decreasing reliability of ice (Kofinas et al. 2010). The middle and upper Tanana River regions, from Manley Hot Springs to Northway, are connected to the road system. Few Alaska communities on the Yukon River mainstem have an overland connection to the state: Rampart and Eagle in summer, and Circle all year. Otherwise, Yukon River communities have short roads for local activity, but travel to Anchorage or Fairbanks usually involves flying.

When all goes well, freight, including petroleum for transportation, heat, and electricity, is delivered to Yukon River communities by barges, a mode of transportation that began to replace steamboats before World War II. When river or ocean conditions prohibit these deliveries, freight must be flown in at even greater expense. Energy and supplies come at great cost, stable work is rare, and the cost of living is high in rural Alaska (Loring and Gerlach 2009). Given the reliance on salmon to help alleviate those problems, it is likely that the salmon decline is contributing to outmigration from many communities, especially in the middle and upper river communities. For reasons that varied, key respondents often expressed sadness that the salmon declines and more restrictive regulations have negatively affected important activities, such as going to fish camp, dog mushing, and even the tendency for family living in urban centers to return home to fish. The variety of social and economic issues at play, along with the difficulty in distinguishing between the hardship imposed by the shortage of salmon and the hardship imposed by regulations intended to protect salmon makes a thorough examination of context vital to any analysis.

Socioecology of Yukon River Salmon

Four managed species of salmon migrate up the Yukon River to reach spawning grounds found throughout the drainage, including in Canada (Table 1-1). Salmon are anadromous fish: all species are hatched in fresh or brackish water as fry and grow to become smolt that spend different lengths of time in fresh water before migrating to the sea, where they spend 2 to 6 years growing and maturing before returning to their natal stream to spawn and die. The annual input of salmon carcasses provides such an enormous nutritional boost to an ecosystem that its reduction in watersheds where salmon are depleted may limit the ability of the salmon populations to recover (Schmidt et al. 1998).

Salmon enter the Yukon River "ocean bright." They are silver, with markings that distinguish the species, and have firm flesh. They are loaded with oil for the journey to their spawning stream, during which most species (including Chinook and chum) do not eat. When they enter the river, they begin to experience morphological change—generally going from a shiny silver coloring to various tones of bright red, rusty orange, or grey; male chum salmon develop a streaked, calico pattern. As they approach the tributary they will follow to their spawning ground, they begin to "bank orient"—preferentially swimming closer to that shore. Closer to their spawning grounds, their jaws become hooked, and they develop large teeth. In their final approach to spawning grounds, the flesh becomes soft, more difficult to cut and dry, and less desirable for human consumption. All Alaska salmon die a week or so after spawning. Although they become less suitable for human food, spawning or spawned out fish remain suitable for sled dogs that require high-quality nutrition to live and work in harsh winter conditions.

Salmon runs overlap in dynamic ways that take shape as fish move up river, making targeted fishing and management a challenge. In particular, Chinook and summer chum salmon migrate together early in the season. These 2 species provide for much of the fishing along the river; the much smaller coho salmon run is harvested along with a generally large fall chum salmon run primarily in the middle and upper river areas (fall chum are also commercially harvested in the lower and middle river areas). As fish swim upriver, they tend to stay in the middle until they approach their spawning tributary—unless central currents are extremely strong, or they stop in an eddy to rest.

Chinook are the first salmon to appear in the Yukon River each year, in mid- to late May, and they spawn throughout the watershed in 3 major stock groups. The Lower stock group spawns mostly in streams of the Andreafsky Hills and Kaltag Mountains; the Middle stock group mostly spawns in the Koyukuk and Tanana river drainages, and most of the Upper stock group reaches streams in Yukon Territory, Canada (Leba and DuBois 2011). Chinook salmon are prized along the river and around the world for their rich taste, high-

quality oil, and large size. Their size, providing for more efficient fishing than smaller fish, makes Chinook salmon extremely appealing as either a commercial or subsistence catch.

There is one Chinook salmon run, usually the first to enter the river in early summer, in roughly 3 distinct pulses. Their extremely rich, high-quality oil content and large size make Chinook salmon the most highly valued salmon species, but big fish have been rare in recent years. Chinook salmon have been commercially exported for more than 100 years, with multiple events of depletion and increased regulation occurring. Commercial markets for Chinook salmon have varied over time. Historical demand for wild Alaska salmon was interrupted by the availability of farmed salmon beginning in the 1980s (Buklis 1999; Herrmann 1994), but has been reinvigorated by more recent controversies surrounding farmed salmon (Hamilton et al. 2005; Hites 2004). Yukon River Chinook salmon are vitally important along the river and are considered to be "luxury seafood" on national and international markets[5].

Chum salmon enter the Yukon River in 2 distinct runs—summer and fall—and both have always been consumed by people. Although they are commonly called dog fish in parts of the river, summer chum salmon are a popular human food among some residents—especially in the lower river. Drying chum is a much faster process than drying Chinook salmon, so there is less risk of running out of the dry weather needed to complete the drying process. Easily the most abundant fish in the Yukon River, chum salmon were heavily used throughout the 20th century to fuel dog transportation and are now targeted primarily for commercial export to U.S. and foreign markets. Summer chum salmon spawn in the lower and middle river and are targeted primarily by lower and middle river fishermen, while fall chum salmon, which spawn in the upper river on both sides of the border, have been a primary target for subsistence fishers in middle and upper river communities. Chum salmon are, on average, harvested at higher levels than Chinook salmon due in part to higher abundance and more differences in use patterns. While higher, chum salmon harvests have also fluctuated more over time, subject to shifting uses and more variability in abundance, especially in the fall run.

Fishers have adapted their methods of harvesting fish to the introduction and evolution of the cash economy and new technology over the last 2 centuries. The introduction of twine in the early 1800s, for example, expanded fishing capacity substantially, as briefly described in Chapter 5. The chapters of this report demonstrate the changing human relationship with salmon, as many diverse advantages and demands of modernity have their particular effect on local affairs—often via global markets. A brief summary of primary fishing targets and gear types over time is given here, in general and regional terms, following salmon up the river. Local details of related patterns are more fully described in the community chapters.

Lower river fishers historically used dip nets and later setnets and fish wheels to catch Chinook and summer chum salmon for subsistence and commercial sale. Driftnetting is the dominant method used today. Both species are popular for local human consumption in the lower river and both are sold commercially, except during most of the last decade when Chinook salmon have rarely been open for commercial harvest and subsistence fishing has been severely limited. As described below, summer chum fishing has also been limited—often to help protect Chinook salmon.

In the middle river, summer chum salmon availability is more limited because many of the fish have left the mainstem for spawning grounds. In contrast to Chinook salmon at the mouth of the river, summer chum caught in middle river nets and wheels can be difficult to process because of low oil content at this stage in their migration. While some people do eat summer chum salmon in the middle river, much of it is considered more suitable for dogs. A commercial roe fishery targeting summer chum operated in the middle river from 1974 to 1996, which may have contributed to the longevity of dog mushing in that region compared to the lower river. Estimated surpluses were allowed to be taken in the roe fishery, but the carcasses had to be hung and dried, which meant an excess supply of dried fish for dog food. Fall chum salmon are also used for both human consumption and dog food in the middle and upper river regions, depending on the quality of individual fish. The reintroduction of driftnetting in the 1980s allowed subsistence fishers in parts of the middle river to more efficiently target Chinook salmon which is reserved for human use.

5. Judith Blake, "Going Wild over Yukon River king salmon," *The Seattle Times*, June 23, 2004, http://community.seattletimes.nwsource.com/archive/?date=20040623&slug=salmon23 (Accessed June 30, 2014).

Upriver fishers historically targeted Chinook and fall chum salmon with dip nets, shifting to fish wheels and setnets beginning in the 1960s. Setnets are now the most common gear type in the upper river for both Chinook and fall chum salmon, though some wheels are still maintained. The continuing use of fish camps may be most common in the upper river, where setnets still allow reasonably efficient fishing because more salmon swim closer to shore as the river narrows and the fish approach their tributaries.

Management of Yukon Salmon

The lucrative sale of Alaska salmon had earned profits of $7 million by 1898, mostly for industrialists from Seattle (Schwatka 1898). The first commercial sale of Yukon River salmon, which is documented in an early ADF&G report that summarizes pre-statehood history, was in the Yukon Territory. In 1903, the first year of record, some 70,000 pounds of mostly Chinook and what were probably fall chum salmon were sold fresh locally (Pennoyer et al. 1965:6), presumably around Whitehorse, Dawson, and probably Eagle. That number increased to 143,500 by 1916.

The Pennoyer summary (1965) briefly describes undocumented reports of privation and dogs being killed for lack of food in the winter of 1917–1918, which initiated U.S. Department of Commerce oversight of existing commercial fisheries at the mouth of the Yukon (Pennoyer et al. 1965:6–8). Although the local sale of salmon was already a standard economic exchange, a floating cannery owned by the Carlisle Packing Company of Seattle opened in 1918 at the mouth of the Andreafsky River and became the first plant on Alaska's Yukon River to process fish for commercial export. That year, 125 barrels (approximately 200 pounds per barrel) of mixed chum and coho salmon, plus 13,356 cases (4,224 of Chinook salmon, 6,471 of chum salmon, and 2,661 of coho salmon), along with approximately 112,304 individual salmon (73,921 chum, 26,144 coho, and 12,239 Chinook) were purchased from an unknown number of fishers at the mouth of the river, many of whom had been issued boats and gear in partial payment (Pennoyer et al. 1965:8–10). The fish were exported to mostly foreign markets.

That winter the U.S. Department of Commerce began regulating the commercial fishery on the Yukon River, leaving the ocean unregulated. In 1919, the Carlisle Packing Company adapted to the regulations by taking more than half of their harvest from coastal waters outside the mouth of the river (the total harvest having been approximately 104,000 Chinook salmon and 328,000 chum salmon) (Pennoyer et al. 1965:10). In 1921, more reports of disastrous subsistence salmon harvests led the U.S. Department of Commerce to limit commercial fishing for export from within the river and for "500 yards outside each mouth or slough of the delta at high tide" in the interest of preserving the subsistence economy on the Yukon River (Gilbert and O'Malley 1921:153; Pennoyer et al. 1965:2). Three years later, commercial sale of salmon taken from Alaska's Yukon area, including coastal waters, was prohibited in part because sled dogs were so critical to developing the territory (Pennoyer et al. 1965:2). Personal and household uses (i.e., subsistence harvests and the traditional practices of sharing, barter, and customary trade) were left unregulated.

The "dog salmon" (chum) sector waned with the introduction of aviation and a decline in the price of fur that decreased the use of sled dogs (Pennoyer et al. 1965:2). In 1931, the U.S. Department of Commerce allowed for a commercial fishery because of the reduced demand for salmon as dog food (Pennoyer et al. 1965:2). Mesh size restrictions (to avoid the harvest of Chinook salmon), harvest quotas, and season limits were put into place for the commercial endeavors, but people on the river continued to fish for subsistence without restriction—to eat, to share, to feed their dogs, and to make a little money through customary trade. Military activity of the 1940s brought a boom of airstrip construction and distraction from fishing; sled dog use continued to decline.

In 1959, Alaska statehood transferred fisheries management authority from the United States Fish and Wildlife Service (USFWS) to the Alaska Department of Fish and Game. (An analysis of the present dual [state and federal] management of navigable waters in Alaska is beyond the scope of this document, although there is some discussion below.) Many changes to subsistence and commercial regulations followed statehood. The most significant was the change from a quota system of management to an adaptive fishing schedule involving multiple openings and closures of commercial fishing, with no set limits on the number

of harvested fish. Subsistence fisheries were closed during commercial openings, but for many years the fish were plentiful enough, and schedules were open enough, that little "restriction" was felt by subsistence users.

By the early 1970s, the State of Alaska was compelled to prevent overfishing by limiting the number of fishers participating in the lucrative commercial sale of fish. In 1972, Alaskans voted to amend the state constitution to regulate fishery entry permits for certain purposes—such as conservation, the prevention of economic distress, and the promotion of aquaculture (Homan 2006). In 1973, the Alaska Legislature enacted the Limited Entry Act and established the limited entry permit system for commercial salmon fisheries. Fisheries of the Arctic–Yukon–Kuskokwim region showed sustained stability despite increasing harvests and were not among the fisheries limited that year (Shirley 1992:5). However, the limitation of other fisheries may have increased pressure on Yukon River salmon (Shirley 1992:5). By 1975, the relative dominance of commercial and subsistence fishing had flipped: in 1961, only 27% of the total catch was sold commercially; by 1975, 76% of the total catch was purchased by commercial processors (Shirley 1992:2).

In 1975, Yukon River commercial fisheries had "reached levels of participation which require[d] the limitation of entry (AS 16.43.240 (b)" in order to protect sustained yields for both subsistence and commercial fishers (Shirley 1992:1). In setting the limit on numbers of gear units that could operate, managers looked to the maximum number that had operated in any recent year. As it turned out, more fishers were active on the Yukon in 1975 than had ever been before (Shirley 1992:9). The 1975 count of fishers was used to set the maximum number directly and was then revised upward, at least twice, to include fishers who had been missed in the first rounds of allocation. The Alaska portion of the Yukon River was divided into districts to recognize distinctions between regions, and because there are so many more fish there, the numbers of permits were much higher in the lower river. To be eligible, fishers had to have held a gear license within the previous 15 years. The point system for allocation of the permits was based on fishing experience and economic dependence. Those more likely to experience more severe hardship without the economic opportunity of fishing were given priority (Shirley 1992:9).

Beginning in 1974, the commercial harvests of Chinook and summer chum salmon were separated by allowing large mesh nets early in the season, when the Chinook salmon run was strong, and restricting mesh size (< 6 inch) when chum salmon were being targeted, to avoid the incidental harvest of Chinook salmon. Commercial harvests of both species were very high during this time. After 1984, periods of restriction were intermittent, but concern about excessive harvest prompted a reduction in harvest in the late 1980s (JTC 2006:3).

The 1976 imposition of "limited entry" increased the value of existing permits, many of which have since been transferred by sale, exchange, or gift—most often locally or to another state resident (Homan 2006). Unlike most other fisheries in Alaska, the majority of the commercial permit holders on the Yukon River are local residents. For example, local people owned 86% of the Lower Yukon area gillnet permits in 1994 (Holder and Senecal-Albrecht 1998:45). The transferability of the permits was designed to help Alaska residents retain the permits, even as particular fishers retired, and seems to have been successful. In 2005, while the ratio of rural to urban permit holders had decreased, only 23% of limited entry permits statewide were held by residents of states other than Alaska (Homan 2006). By January 1992, 709 permanent (limited entry) permits had been issued to Lower Yukon area gillnet operators, 75 to Upper Yukon area gillnet operators, and 133 to Upper Yukon area fish wheel operators (Shirley 1992:15), exceeding the maximum total permits of 904 set in 1975 (Shirley 1992:15).

In 1993, the Alaska Board of Fisheries (BOF) adopted regulations that separated subsistence and commercial salmon fishing times in districts 1 (which includes Emmonak), 2 (which includes Marshall), and 3, and in the lower portion of District 4 (now Subdistrict 4A; Figure 1-3). In these areas, subsistence salmon fishing is allowed 7 days per week but may not occur 24 hours prior to the beginning of the commercial salmon fishing season or for 24 hours immediately following its end. By regulation, in districts 1, 2, and 3, once the commercial season is open, subsistence salmon fishing may not occur 18 hours immediately before, during, or for 12 hours after each summer season commercial fishing period in that district. During the fall season,

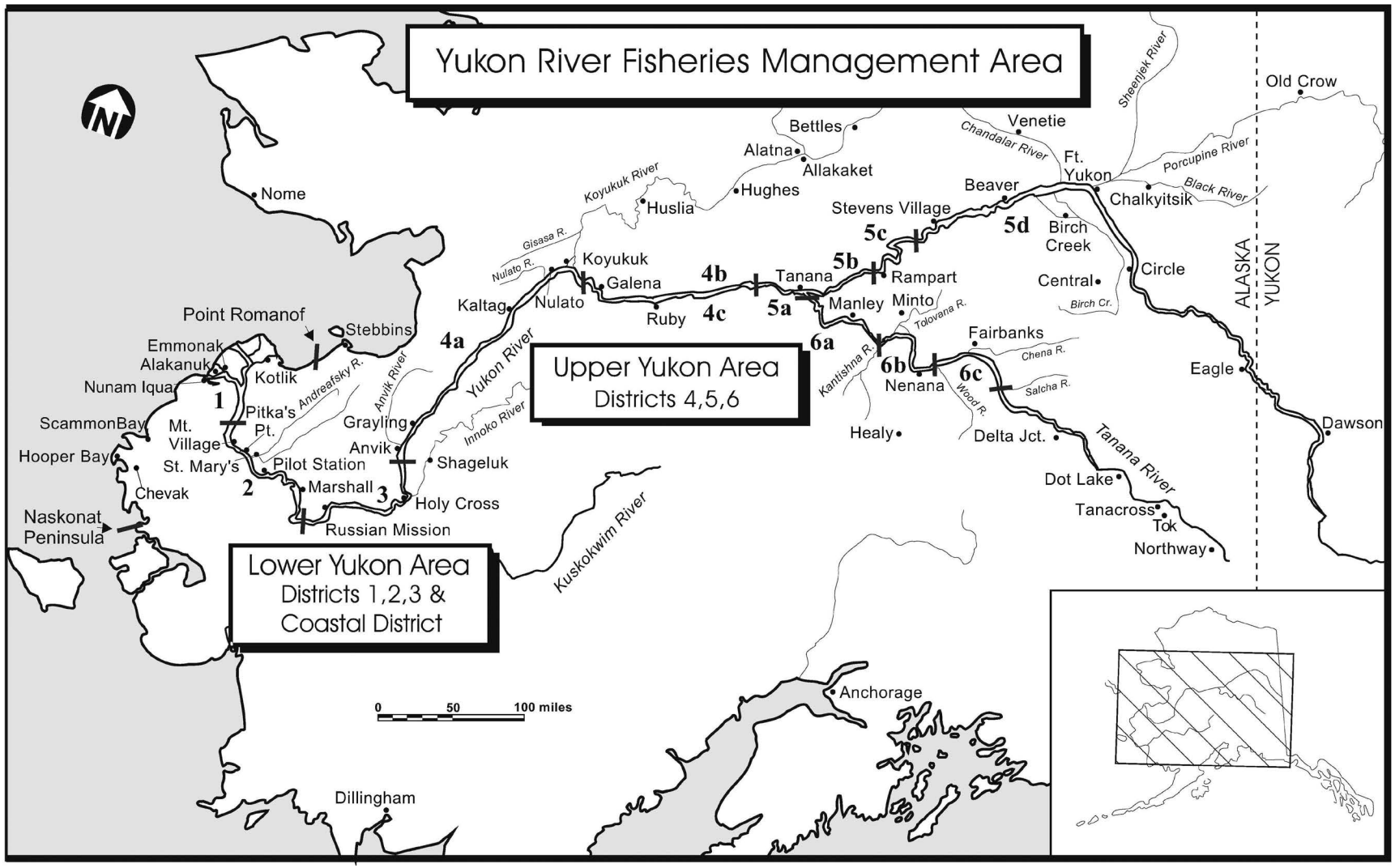

Figure 1-3.–Yukon River Fisheries Management Area showing subdistricts.

subsistence fishing may not occur 12 hours immediately before, during, or 12 hours after each commercial fishing period.

In Subdistrict 4A (which includes Nulato), subsistence salmon fishing may not occur 12 hours immediately before, during, or 12 hours after each commercial salmon fishing period throughout the season. Those commercial periods are variable in length (often 12–36 hours), depending on the strength and timing of the run being managed. The general result is 2 shorter subsistence openings per week. In the upper portion of District 4 (subdistricts 4B and 4C) and in subdistricts 5A, 5B, and 5C (Tanana to the Yukon Flats), subsistence salmon fishing is allowed 7 days per week until 24 hours prior to, during, and immediately following the commercial salmon fishing season. Additional subsistence-only salmon fishing periods may be allowed during the commercial salmon fishing season. In Subdistrict 5D (including the Yukon Flats to Eagle), subsistence salmon fishing is allowed 7 days per week, regardless of commercial activities. In these areas, subsistence salmon fishing periods overlap commercial salmon fishing periods.

In 1993, the BOF also reaffirmed a positive customary and traditional (C&T) use finding for all salmon in the Yukon–Northern area. Once a positive C&T determination is made, the BOF, or Alaska Board of Game (BOG) in the case of game species, sets an amount reasonably necessary for subsistence (ANS) range, which usually reflects the historical subsistence use levels and should provide for a reasonable opportunity to use part or all of the harvestable surplus of a given species for subsistence uses. ANS ranges provide one measure of the extent to which reasonable opportunity is provided in a subsistence fishery. Harvests below the lower bound of an ANS range may indicate, with other factors, that reasonable opportunity for subsistence harvests was not provided during the previous season. Harvests that are consistently lower than the lower bound of the ANS are an indication to the BOF to consider whether existing regulations provide for reasonable opportunity. For example, low abundance may require additional management actions to provide reasonable opportunities for subsistence, or fishing patterns may have changed requiring a reexamination of the regulations. In the Yukon area, the ANS determination was established at 348,000–503,000 salmon for all species combined. Since 1990, the overall total subsistence salmon harvest in the Yukon area has declined by approximately 30%. In 2001, the BOF determined species-specific amounts of salmon necessary for subsistence based on historical harvests. The estimated range of the number of Chinook salmon necessary to provide a reasonable opportunity to meet Alaska Yukon River subsistence needs was established at 45,500–66,704 fish each year (5 AAC 01.236); however, subsistence harvests have only fallen within this range in 6 of the last 12 years. In 2009, only 33,932 Chinook salmon were taken for subsistence purposes, well below the ANS range, suggesting that fishers may not have had a reasonable opportunity to harvest subsistence salmon.

Since 1999, the Yukon River subsistence fisheries have been co-managed by ADF&G Division of Commercial Fisheries and the USFWS Office of Subsistence Management. State managers are responsible for management of subsistence, commercial, sport, and personal use fisheries in all waters—except that federal managers are responsible for management of subsistence fishing by qualified rural residents in applicable federal waters. The regulation and management of Yukon River drainage subsistence salmon fishing follows the Yukon River Drainage Subsistence Salmon Fishery Management Protocol, which provides a framework for coordinated subsistence fisheries management between ADF&G and the federal subsistence management programs in the Yukon River drainage. This protocol is applied through a Memorandum of Agreement between state and federal agencies which formalizes the working relationships between state and federal managers and fosters cooperation with federal regional advisory councils and fisheries interest groups. The protocol also directs state and federal managers to solicit input from the Yukon River Drainage Fisheries Association (YRDFA), the Yukon River Coordinating Fisheries Committee (YRCFC), and other stakeholders during the decision-making process.

Since 1998, depressed salmon runs have led to severe restrictions resulting in substantial changes to the subsistence and commercial fisheries in the Yukon River. The average of subsistence and commercial harvest of Chinook salmon was less than 88,000 between 2004 and 2008, a steep decline from the annual harvest of about 156,000 fish between 1989 and 1998 (Howard et al. 2009:44).

The total Chinook salmon run projection for 2009 was too low to fulfill adequate escapement goals and Canadian border passage requirements, and failed to provide for unrestricted subsistence harvests or a directed commercial fishery. The run provided only 316 incidentally harvested Chinook salmon to commercial processors (Eggers et al. 2010:22), a negligible number when compared to 69,562 caught in directed commercial fisheries in 1999 (Moncrieff et al. 2009:77) The total (all salmon) estimated profit to commercial fishers on the Yukon River in 2009 was $556,000, approximately 76% below the average of $2.3 million between 1999 and 2008 (Eggers et al. 2010:23). Chinook salmon have not been intentionally harvested in a commercial opening since 2008, and subsistence fisheries have been heavily restricted in recent years. Since 2010, Chinook salmon incidentally caught in commercial chum fisheries cannot be sold; they can be released if they are alive, or kept for subsistence purposes. Commercial fishing for summer chum has also been limited by the need to conserve co-migrating Chinook salmon, but is still an important source of income for residents in the lower Yukon River districts 1 and 2.

Although not as disastrous as the Chinook salmon crash of 2009, which showed only further decline in 2012, the chum salmon runs faltered after the salmon crash of 1998 but appear more recently to be recovering. One difficult issue, as alluded to above, is the incidental harvest of Chinook salmon in size-restricted mesh nets intended for chum salmon—especially in the lower river. The Chinook salmon run begins first, and, to allow their passage, commercial openings for summer chum have been postponed in recent years, causing additional hardship in lower river commercial fishing communities as described in the Emmonak and Marshall chapters. Summer chum were targeted for commercial sale in a 2012 fish wheel opening in District 4A, where the fish processing plant at Kaltag has been on the verge of permanent closure for most of the last 15 years. Stipulations on the fishery are intended to enable the release of incidentally caught Chinook salmon without affecting their survivability. This is accomplished through a constant monitoring of wheels adapted to allow the Chinook salmon to be returned to the river unharmed (Proposal 385 – 5 AAC 05.362).

Another contentious management issue is the bycatch of salmon in the Bering Sea. During their ocean phase, Chinook salmon feed on pollock and are often caught in the nets that trawl for pollock. In response to fishers' long-term concerns surrounding decreased salmon populations, actions have been taken by the North Pacific Fishery Management Council (NPFMC), which manages fisheries in the Bering Sea. In 2009, the NPFMC voted to set a goal of limiting the incidental bycatch of Chinook salmon in the Bering Sea pollock trawl fishery and provide incentives to the pollock fleets to comply (ADF&G 2011). The proposed incentive program did not satisfy local fishers and led to the Marshall "fish-in" in the summer of 2009, described in Chapter 4. However, it was a significant first step into bycatch management and was approved by the National Marine Fisheries Service.[6] Since then, several bycatch-related research projects have been undertaken, such as the Western Alaska Salmon Stock Identification Program. The variability of salmon bycatch makes the task of management more challenging, but analyses contribute to our understanding of the distribution and composition of particular salmon stocks at sea (Myers et al. 2004; Stramm and Ianelli 2009).While no particular study has defined the relationship between bycatch and the Yukon River salmon crash, each contributes to understanding the dynamics at play. Extensive research will be required to determine with certainty what factors are most responsible for the Yukon River salmon decline, and how these factors interact (Schindler et al. 2013).

Many issues related to Yukon River fisheries management were discussed at an April 8, 2010, Summer Season Preparedness Meeting, including a review of the 2009 season and a small group discussion of how to handle a worse than expected run. One group discussed a proposal to enact a 12-year moratorium on fishing the first pulse of Chinook salmon. A moratorium of this kind would protect the mostly Canadian-bound run for 2 life cycles in the hopes of rebuilding the upriver stock. Some members at the meeting disagreed with the length of such a moratorium and favored a shorter period. Still others rejected the concept entirely, in part because of stress that might place on other fisheries (Hale 2010:95).

6. National Marine Fisheries Service (NMFS), 2014, "Chinook Salmon Bycatch Management," National Marine Fisheries Service Alaska Regional Office, http://alaskafisheries.noaa.gov/Sustainablefisheries/bycatch/default.htm (Accessed June 24, 2014).

Local and Scientific Perceptions and Observations

Although this is not a report on salmon biology, a discussion of ongoing efforts to understand salmon ecology and sustainability provides additional context for understanding some of the socioeconomic effects of the decline. There are many factors that affect the ability of Yukon River salmon to survive, though none are clearly linked to the Chinook salmon disaster and ongoing decline. Here we discuss the factors that were most frequently raised by respondents, as well as the concerns they expressed with the management of Chinook salmon.

There are many points of agreement between scientific and local knowledge of Yukon River fisheries and the environment, including trends in apparent Chinook salmon size and abundance, increased parasitism, more extreme and generally warmer weather, and changing hydrologic conditions. The total harvest and the fish themselves are smaller, and very large fish are increasingly rare. However, the research on Yukon River Chinook salmon ecology has generally validated local concerns or has been insufficient to draw definitive conclusions.

> Existing analyses document a decrease in the mean weight of commercial harvests, a reduction in the prevalence of the largest fish, and the apparent near disappearance of age-8 fish. However, other important metrics, such as mean length-at-age, do not appear to have changed substantially ... . Whether the changes observed within Yukon River Chinook salmon have resulted from environmental or fishery induced selective pressures, or a combination of both, is difficult to determine with certainty. (JTC 2006)

Evidence that ocean conditions have contributed to smaller fish has been reviewed by the Yukon River Joint Technical Committee. One study (Bigler et al. 1996) found reductions to body size in 45 out of 47 populations of Pacific salmon that might be explained by ocean conditions that increased salmon survival. If habitat enhancement programs that were popular in the 1980s and 1990s effectively increased survivorship, then each individual fish might not have access to as much food. Such a decrease in individual resource availability could have contributed to the "ocean-wide reduction in the size of salmon" (JTC 2006:8). This possibility does not explain the dramatic decline in Yukon River Chinook salmon numbers, however. A competing possibility is that the selective exploitation of large fish promulgated by the popularization of driftnetting may have reduced salmon size and age at maturation over recent decades, with detrimental effects on the population's productivity (Bromaghin et al. 2008).

Incidental bycatch of salmon in the Bering Sea Aleutian Islands (BSAI) walleye pollock fishery is another ongoing concern among residents of the Yukon River. Bycatch numbers vary widely, but hundreds of thousands of Arctic–Yukon–Kuskokwim (AYK) region salmon are caught each year unintentionally during their ocean phase and cannot be sold.[7] The numbers of salmon bycatch increased each year beginning in the early 2000s, breaking old records, renewing concerns, and inflaming frustration on the river, as described in Chapter 4. The numbers peaked in the mid-2000s, with some 700,000 chum salmon in 2005, and more than 121,000 Chinook salmon caught in pollock nets in 2007 (Gisclair 2009). Genetic data from 1998 showed that about 40% of Chinook salmon taken as bycatch was of Yukon River origin (Gisclair 2009). How different that portion is from year to year is not known. Assuming they are fairly consistent, these numbers (approximately 50,000 Yukon River fish taken each year) alone do not seem to explain the steep decline of the last 15 years. However, they are distressing to fishers on the river who cannot always get the few dozen fish they need and clearly represent to them a "non-essential" use of salmon. In addition to a hard cap on bycatch numbers (beyond which the pollock fleet would be required to cease operations) improvements in both mechanical methods, such as exclusionary devices, as well as economic methods, such as labeling laws, have been recommended.

Fishers raised concern about increased parasitic infection with Ichthyophonus *(Ichthyophonus hoferi)* in the mid-1980s that peaked in the late 1990s. The prevalence of infection seems to have stabilized since then, but there remains disagreement over whether the substantial increase was a true trend, a cyclic

7. National Marine Fisheries Service (NMFS). 2014. "Chinook Salmon Bycatch Management." National Marine Fisheries Service Alaska Regional Office. http://alaskafisheries.noaa.gov/Sustainablefisheries/bycatch/default.htm (Accessed June 24, 2014).

phenomenon, or increased awareness and monitoring (Horstmann-Dehn et al. 2012; Kocan et al. 2004; Zuray et al. 2012). How much climate change may influence the prevalence of parasitic and other infections is still unclear. There is evidence that warmer conditions in both marine and terrestrial aquatic environments have enabled more extensive outbreaks and related mortality (Kocan and Hershberger 2003), but how much this has affected salmon populations is not clear. Among important questions are the levels of pre-spawning mortality, and whether compensation for that mortality is needed in escapement numbers (Kocan et al. 2003).

It is widely agreed that climate change is occurring and altering Yukon River ecology in ways that may affect salmon. In particular, lower water levels during critical periods of migration and increased sedimentation in tributaries from the degradation of permafrost threaten salmon productivity (Prowse et al. 2006). There are also indications that warming temperatures may have positive effects on salmon populations. For example, less ice cover during early spring migration may improve productivity. Further, due to their ecological plasticity, Chinook salmon may be able to expand their ranges (Irvine et al. 2009; Pappas 2012). Currently ADF&G is researching new populations of Chinook salmon in North Slope drainages and identifying the genetic markers for these fish (B. Retherford, Subsistence Resource Specialist, ADF&G, Fairbanks, personal communication, November 14, 2012). Ecological plasticity may contribute to Chinook salmon survivability as habitats change and variability increases, but it may also increase uncertainty in local residents' reliance on traditional knowledge. Their ability to read the landscape has already been disrupted by so many changes—including their own decrease in actual time on the land due to external economic, climactic, and management factors. Local perceptions and observations about the effects of climate change on Yukon River drainage fisheries were recently collected and linked with scientific research (Andersen et al. 2013).

Beyond observations of environmental conditions and concern about the many factors that influence salmon populations, respondents also expressed concerns and opinions regarding the management task of estimating salmon abundance. While fishers—both subsistence and commercial—themselves have long been a primary source of information about salmon run timing, abundance, health, and size, sonar technologies have greatly improved the department's enumeration abilities. Real time estimates have improved, as demonstrated by increasingly close alignment with weir counts that are used to test the estimates (C. Pfisterer, Fishery Biologist, personal communication, June 12, 2012). Also since the time of the present study (2010–2011, concurrent to adoption of the 2010 Chinook Salmon Action Plan) (Howard et al. 2009), concerted efforts have been made to explain the research methods that are used to appropriately verify and adjust data collected by multiple methods.

However, as described in Chapter 4, sonar data have limitations that biologists recognize as sources of uncertainty. Test fishing, either by net or wheel, is used in conjunction with Yukon River sonar projects. Because the Yukon River sonar cannot identify the fish it counts, test fisheries are used to obtain a representative sample of fish; total abundance itself is not being measured, but rather *relative* abundance. The test nets allow biologists to estimate the proportion of different species counted by sonar. Lower river respondents expressed concern about the placement of these test nets, especially those near the Pilot Station sonar, questioning the validity of results. Many suggested that the test nets should adapt to the different fish runs by moving to more successful locations. However, the scientific method demands consistency for comparability and therefore multiple nets are used in the same locations year after year to provide both annual and long term information. Nevertheless, these methods raise questions for local fishers. If salmon, responding to unseen or measured stimuli, swim through the river differently year to year, can a consistent net placement accurately count them? Or, if managers cannot predict or measure the annual or even daily changes in run development, how can they shift net sites to accurately assess the run, and how would they know that they are catching a representative component rather than an over- or underrepresentation of the run in terms of abundance or species apportionment? Answers to these questions remain elusive, contributing to conflict over management decisions, especially regarding the provision of commercial opportunities or restrictions to subsistence.

Mesh size restrictions are another area of local concern. The BOF implemented a new regulation of 7.5 inch mesh in the subsistence and commercial fisheries in 2011, intended to allow the harvest of smaller Chinook salmon while protecting the very large fish. Further, when Chinook salmon counts are low and restrictions to subsistence fishing are necessary to protect Chinook salmon, the department has restricted gillnet mesh size to 6 inch. Mesh size limits of 6 inch or smaller on the commercial fishery were intended to allow the commercial harvest of summer chum while avoiding Chinook salmon.

As described in the chapters, many respondents, especially in the lower river, disapproved of mesh size restrictions out of concern that they could cause "drop-out" loss of Chinook salmon. Few studies exist to measure the actual occurrence of fish that fall away from a net injured or dead from temporary entanglement, and the portion of fish that successfully spawn despite net injuries is unknown. One tagging study of Atlantic salmon in Finland found that, in addition to fish running downriver for up to 45 km (27 miles) after release, the use of nets to catch fish for tagging could injure fish. Of the 19 fish caught with gillnets and released after tagging, 3 (15.8%) died of internal injuries despite apparent "good condition upon release" (Mäkinen et al. 2000:119). The authors conclude that temporary gillnet entanglement can impair the ability of salmon to spawn.

ADF&G net mesh studies indicate that greater numbers of large Chinook salmon avoid capture when mesh size is reduced (i.e., smaller nets catch smaller fish; (Howard and Evenson 2010), and fish visibly injured by temporary entanglement are found in spawning grounds[8]). These observations do not prove that all large fish will avoid capture or that all temporarily entangled fish survive to spawn, but they do suggest that slightly smaller mesh may be beneficial to large Yukon River Chinook salmon. However, many fishers are concerned about this perceived trade-off and suspect that drop-out rates are higher than managers realize; others worry that the regulation will simply eliminate the next size down of Chinook salmon. As a result, many respondents felt changing mesh size regulations were more representative of best guesses rather than studied decisions. Another important aspect of mesh size is the sex ratio of caught fish. Female Chinook salmon tend to be rounder during the migratory run to spawning grounds because they are plump with eggs. Only one individual (at the Marshall community review meeting for this report) described observations regarding sex ratio: prior to mesh size restrictions he caught a 1:1 male to female ratio and with the smaller mesh he was catching closer to a 3 males:1 female ratio—similar to research that indicates more large fish will avoid capture in smaller mesh. Two respondents in Eagle also noted an increased presence of large females during years when mesh restrictions had been imposed (EAG 5 and EAG 8).

Report Overview

Based on the firsthand accounts of Yukon River fishers, and augmented by other scientific and fisheries literature, this report provides an overview of the context and the socioeconomic effects of the 2009 Chinook salmon disaster including recommendations. While this research was conducted in response to the 2009 disaster declaration, it necessarily relies on and draws from the development of the fishery since the 1980s at its peak. The report does not claim to be comprehensive or definitive, even for the communities where data were collected. However, the authors worked to ensure good representation of each village's fishing population and to provide a holistic and systematic framework for evaluating the effects of the salmon decline. Following a methods chapter that outlines and describes the protocols used to collect this information (Chapter 2), a chapter on each of 5 communities where the 2010 research was conducted—Emmonak, Marshall, Nulato, Beaver, and Eagle (chapters 3–7)—describe the unique attributes and circumstances of each village and also the common themes and regional variations. Chapter 8 is a synthesis of the chapters that provides a contextual and largely qualitative discussion and analysis of the state of the Yukon Chinook salmon fishery, especially as experienced by the fishers. The chapter includes a discussion of recommendations documented at the end of each village chapter, additionally informed by research literature and the experiences of report authors.

8. Dave Cannon, "Talking Points of KYUK's Call-In Show On June 21," Native Village of Napaimute, posted June 22, 2012. http://napaimute.org/2012/06/22/talking-points-of-kyuks-call-in-show-on-june-21/ (Accessed June 25, 2014).

2. METHODS

Caroline L. Brown and David Koster

In 2010 and 2011, the ADF&G Division of Subsistence designed and implemented the Yukon River Salmon Disaster Project with the goal of understanding and documenting the socioeconomic effects of the disastrous 2009 Chinook salmon run on fishing communities, especially within the context of generally declining runs since 2000 and more severe declines since 2008. This report seeks to aid lawmakers and managers in addressing those effects on Yukon River residents. The primary objective was to study the influence of low Chinook salmon returns on fishing patterns and priorities. Specific objectives of the project included documenting multiple aspects of the Yukon River salmon fisheries: 1) the effects of Chinook salmon shortfalls on the social organization of fishing activities; 2) the locations and gear types used for salmon fishing in different parts of the drainage over time and as related to salmon shortfalls; 3) how restrictions have affected subsistence opportunities for Yukon River Chinook salmon; and 4) patterns of redistribution of fish within and beyond Yukon River villages via the traditional practices of sharing, barter, and customary trade. This chapter describes the methods used to collect, analyze, and synthesize the information collected regarding the effects of the Chinook salmon decline.

Research Design and Instruments

Researchers selected 5 communities to capture the social and economic diversity of Yukon River communities in the 3 distinct regions of the Alaska portion: the lower, middle, and upper river. Communities that were chosen represent various aspects of village life along the Yukon River. Specifically, communities were chosen with reference to population size (Table 2-1), and to represent distinct cultural and linguistic groups along the Yukon River. It was important to include communities with different priorities for the use of different salmon species, particularly including both subsistence and commercial fishing in order to consider the relationship between them. Additionally, salmon meet multiple needs in the larger context of subsistence harvests and it was important that these variable uses, including customary trade, be demonstrated.

The communities chosen were Emmonak and Marshall (both Yup'ik) in the lower river, Nulato (Koyukon Athabascan) in the middle river, and Beaver (Gwich'in Athabascan) and Eagle (including both Eagle City and Eagle Village, Han Athabascan) in the upper portion of the Yukon River drainage in Alaska. All participating communities are along the Yukon River mainstem.

This research documented the effects of declining Chinook salmon returns on fishing communities using both qualitative and quantitative approaches. To do this, researchers employed 3 primary methods: semi-structured ethnographic interviews, participant observation (both qualitative), and surveys (qualitative and quantitative). Two instruments were used: 1) a semi-structured ethnographic interview protocol that documented individual fishing histories over the respondent's lifetime (see Appendix A), and 2) a shorter structured "survey" interview related to customary and traditional trade and barter practices (see Appendix B). Throughout this report, reference to "interviews" indicates the longer, semi-structured ethnographic interviews.

Field research included 52 ethnographic interviews with 57 "key respondents" as detailed in Table 2-1. The key respondent sample was designed to capture the array of fishing experiences along the river and also to span a timeframe that included the dramatic changes of the 1970s and older history, as possible. Thus, experienced fishers knowledgeable of both historical and contemporary fishing activity were approached, in consultation with local leadership, to participate in interviews.

Key respondents were asked about their fishing and fish-related experiences from their earliest memories through the decline of Chinook salmon in the 2000s, and during the 2009 disaster. Questions probed for information about personal fishing histories over time, the locations and gear types used, experiences with and understanding of fishing regulations, the redistribution of salmon, and finally local recommendations for

Table 2-1.–Data collection detail in study communities.

Community (pop.) Lead researcher	Date of community approval	Dates of research	Date of community review	Names of assistants	Ethnographic interviews		Exchange surveys	
					No. of interviews	No. of individuals	No. of surveys	Percent of total households[a]
Emmonak (796) Seth Wilson	08/26/10	9/10/2010–9/17/2010	06/30/11	Michael Jimmy	12	13	63	43%
Marshall (407) Danielle Ringer	06/26/10	10/10/2010–10/19/2010	06/29/11	Frances Evan Jack George	11	11	38	52%
Nulato (275) Brittany Retherford	12/02/12	12/10/2010–12/16/2010	08/26/11	Noreen Mountain	10	14	not conducted, per community request.	
Beaver (77) Jaime Van Lanen	01/04/11	1/26/2010–2/1/2011	6/28/2011, 7/12/2012	none hired	9	9	30	91%
Eagle (96) Alida Trainor	11/01/10	11/17/2010–11/25/2010	07/05/11	Frank Pitka Craig Edwards	10	10	41	66%

a. Number of occupied households according to 2010 U.S. Census, cited in the Alaska Community Database Community Information Summaries http://www.commerce.state.ak.us/dca/commdb/CF_CIS.htm

management. Mapping exercises during the interviews recorded locations of historical and contemporary salmon fishing sites and gear types used. Interviews were audio-recorded and then individually transcribed and coded.

The other instrument, used in 4 of the 5 villages, was a shorter structured interview focused on the distribution of salmon through a larger system of exchange and is referred to in this report as the "survey." Although it provided numeric data, the survey was intended to document local views and general trends regarding barter and customary trade, rather than to quantify or estimate the actual extent of those practices on a household or community level.

Researchers conducted 172 surveys from a stratified random sample of all households in each community based on the same strata used in the ADF&G Division of Commercial Fisheries post-season salmon survey (Jallen and Hamazaki 2011). Because many salmon exchanges occur between fishing households and non-fishing households, the survey sample included households in all strata of fishing effort from heavy harvesters to non-fishing households. Confidentiality was maintained through the use of identification codes instead of residents' names or addresses. Households and individuals were assigned numerical codes before surveys began. The household code sheet was maintained by each community lead researcher during survey administration, and remained in his or her custody after survey completion.

The survey was intended to describe and quantify the *prevalence* of different types of exchange involving salmon. As such, the survey included questions about the frequency of different types of exchanges, including sharing (analyzed through forms of reciprocity), barter, and customary trade. These questions were directed toward both that particular household (recorded as "actual" exchanges), as well as the community in general (recorded as "typical" exchanges). It also included questions about the types of items traded and bartered and the reported reasons for doing so. The survey instrument defined barter as the exchange of subsistence foods for something other than cash, and customary trade as the noncommercial exchange of subsistence foods for cash, consistent with state statutes (AS16.05.940(2) and (8)). The exchange network charts presented in the community chapters that result from these analyses show connections between different resources that have been exchanged for each other. In each community, the resources that are exchanged for the widest variety of other resources are found towards the center of the chart, while resources rarely exchanged migrate to the periphery. Likewise, the thickness of a line between two resources indicates the volume of exchanges: the thicker the line, the more common the exchange.

One of the policy objectives in Alaska subsistence management is determining whether reasonable opportunity for subsistence uses is being provided, as gauged by subsistence harvests compared to the amount the BOF has found are reasonably necessary for subsistence uses. The amounts reasonably necessary for subsistence (ANS) are determined by the board for each particular resource primarily by reference to historical harvests (AS16.05.258(b)), with 2 important assumptions: 1) people were able to harvest what they needed in the

past, and 2) people stop harvesting when their needs are met (Wheeler 1987:103). The interviews conducted for this research support those general notions, but suggest that other factors, particularly conservative management actions that restrict the amount of time allowed for fishing and the increasing cost of fuel, have begun to limit fishers' ability to meet their subsistence needs for Chinook salmon. The assessment questions provide important information about variation from year to year and place to place that is masked by general historical data. In the event that harvests were reported to be insufficient, respondents were asked why this occurred, and how they had adapted.

It should be noted that researchers have some concern about the completeness of this quantitative data set. This research coincided with a USFWS enforcement investigation into customary trade practices along the Yukon River, responding to complaints that individuals were selling processed salmon from subsistence harvests in amounts that exceeded (undefined) noncommercial levels (Pappas 2012:34). While customary trade is recognized in Alaska's subsistence statute (AS16.05.940(33)), it is not currently legal under state regulations in the Yukon; only low but undefined levels of unprocessed salmon taken from waters adjacent to federal land can be sold under federal customary trade regulations. As a result, many study participants were nervous about answering questions regarding any involvement in customary trade. Leadership in the community of Nulato asked that the survey not be conducted there because of this investigation. However, ethnographic interview questions related to the distribution of fish do provide a limited context for characterizing these exchanges in Nulato. As a result of this anxiety, we suspect a general underreporting of total activity.

The sale of strips of subsistence-caught Chinook salmon has been a source of income to fishers along the entire river for generations (Moncrieff 2007), but the ambiguous line between customary trade and commercial enterprise, along with state statutes and regulations, and, to a lesser extent, federal regulations, leaves many residents of the river feeling criminalized for their traditional practices. Such stigma means that respondents who push the invisible limit of noncommercial trade were potentially unlikely to participate in this research. This means not only that the data are likely incomplete, but also that they may be skewed. However, enough data were gathered to provide general information about the traditional values and contemporary patterns of customary trade and barter along the river. Researchers are reasonably confident that the information collected is representative of general patterns of the "limited" exchange of fish for cash in participating communities. While Moncrieff (2007) provides an excellent history of customary trade along the Yukon River, this study remains the only attempt to quantify any aspect of exchange practices, and an analysis of the data is found in Chapter 8.

Standardization of the data collection process was important because different people gathered data in each community. One or more ADF&G employees were present throughout the administration of the surveys and worked with local assistants to administer the survey. Standard protocol and quality control were accomplished through an initial orientation and training process, daily reviews of surveys as they were completed, and a post-administration review of all surveys. ADF&G staff coded all of the surveys, and coded surveys were reviewed by lead researchers before data entry.

Procedures

In 2010, principal investigator Caroline Brown supervised Division of Subsistence staff Seth Wilson, Danielle Ringer, Brittany Retherford, Jaime Van Lanen, and Alida Trainor, who acted as community lead researchers in Emmonak, Marshall, Nulato, Beaver, and Eagle, respectively. These community leads were aided in their fieldwork by other division employees based in Fairbanks and Anchorage, as well as community residents hired as local assistants. Because of staff changes in the early stages of report writing, Trainor took responsibility for the Beaver chapter and ADF&G Division of Subsistence researcher Hiroko Ikuta wrote the Marshall chapter.

Between August 2010 and February 2011, ADF&G staff traveled to the communities to meet with tribal councils in order to seek community approval for the work, review survey instruments, and prepare updated household lists. From February through June 2011, research teams traveled to the communities to implement

the project—including the ethnographic interviews as well as the distribution and exchange surveys. Most ADF&G community leads hired 1 or more local assistant(s) to help with all aspects of data collection, as recommended by the tribal councils and summarized in Table 2.1.

In each community, the ADF&G community lead conducted an orientation and training session with the local assistant(s). During orientation, the household lists were verified, and ADF&G staff and local assistants reviewed and practiced the instrument protocols with one another. Following training, the local assistants arranged surveys and interviews by phone, VHF radio, and in person. Researchers usually worked in pairs, including a local assistant and an ADF&G staff member. Interviews and surveys were conducted in person, usually at the respondent's home, at a time selected by the respondent. ADF&G employees conducted all of the mapping. In most cases, the local assistant administered the surveys with the lead researcher present. Local community research assistants were paid for their time in training and for each completed survey. Since the interviews often required an hour or more to complete, key respondents were compensated for their time through honoraria.

After data collection, surveys were reviewed for completeness and coded for data entry by ADF&G staff during fieldwork, and entered by staff supervised by ADF&G Division of Subsistence Information Management coordinator David Koster. Data analysis was conducted by Koster and ADF&G Division of Subsistence researcher James Magdanz. ADF&G Division of Subsistence researcher Nicole Braem prepared the maps of historical and contemporary fishing locations that appear in this report. Terminology used in this report, unless otherwise noted, is consistent with ADF&G standards. Ethnographic place names are used for historically important locations. Where English names are common and appear on contemporary maps, historical ethnographic names are given in parentheses.

After survey data and map data had been entered, analyzed, and summarized, the lead researchers returned to each community between June 2011 and July 2012 to conduct community review meetings. They delivered a Microsoft PowerPoint[1] presentation summarizing the results, including mapped data, in each community. After these meetings, community leads prepared community chapters, which were then compiled into this report and supported by a regional discussion of the primary themes raised during the research.

Data Analysis

SPSS and Microsoft Excel were used for analysis of the survey information. For each participating community, data analysts summarized self-reported household characteristics, levels of involvement in cash trade and barter activities, kinds of food exchanged (where possible) and household and community customary trade/barter histories. Researchers then restructured the survey data into a visual network analysis format and read it into NetDraw, a social network analysis program (Borgatti 2002). In NetDraw, researchers graphed the flow of foods in barter and trade exchanges, by resource or resource category, for each community. This network software allowed the visual exploration and illustration of the flow of foods and cash within and between communities, but not calculation of network statistics (Magdanz et al. 2007:20).

1. Product names are given because they are established standards for the State of Alaska or for scientific completeness: they do not constitute product endorsement.

3. EMMONAK

Seth J. Wilson

Setting and Context

Local Research and Respondent Profile

Twelve interviews were conducted in Emmonak by 2 ADF&G staff members over the course of 1 week in September 2010 for this research. Key respondents included 3 female fishers and 12 male fishers. Two interviews were conducted with fishing couples, and one with brothers. All but 2 of the interviewed respondents were active fishers, either in the subsistence fishery or commercial fishery. Most were active in both. The average age of the respondents was 60 years of age. The youngest respondent was 42 at the time of the interview and the eldest was approximately 80 years old. All respondents were born in the Yukon Delta or Black River area.

Seven maps were created to portray historical and contemporary fishing and settlement locations. The findings are compiled into 1 map (Figure 3-1). The map shows key locations in the personal fishing histories of local respondents to illustrate some of the local information provided, but is not meant to be an exhaustive documentation of geographic fishing patterns of Emmonak fishers.

A brief household survey was conducted on Emmonak residents' personal experiences with, perceptions of, and opinions about customary trade and barter. Of the estimated 148 households in Emmonak, a stratified random sample, as described in the Methods chapter, generated 97 households that were contacted for survey. ADF&G staff successfully surveyed 63 of the 97 selected households, about 43% of Emmonak households.

Historical Background and Natural Environment

Emmonak is a Central Yup'ik community located on the Yukon River Delta, approximately 120 miles northwest of Bethel and 490 miles from Anchorage. Biologically productive wetlands dominate the arctic tundra of the 19 million acre Yukon Delta National Wildlife Refuge, which includes the delta region of the Kuskokwim River as well. Land use is characterized by interspersed wildlife refuge (federal) and private land ownership—primarily Native corporations and individual private allotments. Emmonak (*Imangaq* in Yup'ik), translated as "blackfish," is located 12 miles from the Bering Sea coast on the north bank of Kwiguk (*Kuiguk* in Yup'ik) Pass, a small northern slough of the south pass of the river. Emmonak experiences daily tidal variations due to its proximity to the sea.

The historical community of Kwiguk was located 1.4 miles south of the current Emmonak town site. Due to flood and erosion, the community was moved north in 1964–65 and renamed Emmonak. At 13 ft above sea level, the community is prone to flooding. In the vicinity of Emmonak, the Yukon River breakup usually occurs in late May with freeze-up occurring in October.[1]

With a relatively large rural population of approximately 788, Emmonak serves as the regional hub for nearby Alakanuk, Kotlik, and Nunam Iqua. The community is incorporated as a second class city within the Bethel unorganized borough. Services and infrastructure include electrical generation by the Alaska Village Electric Cooperative, public water and sewage, and a state-owned airstrip. Access to Emmonak is by air, water, or overland on winter trails. Emmonak includes a health clinic, two grocery stores, a large community center, several city and tribal government buildings, a small restaurant, and the only active fish

1. Alaska Department of Commerce, Community, and Economic Development (ADCCED) Division of Community and Regional Affairs, Juneau: "Alaska Community Database Online: Community Information." Accessed August 2013. http://commerce.alaska.gov/cra/DCRAExternal/community.

Figure 3-1.–Contemporary and historical salmon fishing locations, Emmonak, Alaska.

processing plant in the lower river today. Community members of Yup'ik descent are represented by the federally recognized Emmonak Tribal Council.[2]

Diane Calamar Okonek

Plate 3-1.–The community of Emmonak.

The mixed economy in Emmonak is characterized by fishing, hunting, and gathering wild resources throughout much of the year (Fall et al. 2012), with all (100%) surveyed households reporting that they used some type of subsistence resource in 2008 (Fall et al. 2012). Among respondents, 53% reported some type of wages in 2008, mostly earned by seasonal employment. Individual community members often play multiple economic roles, including wage earners, subsistence producers, and commercial fishers and trappers. Commercial activities and wage labor have become vital components of the Yukon Delta economy since the earliest historical accounts of the area. Commercial fishing and winter trapping for local use and export have declined but continue along with fishing and other subsistence activities (Fall et al. 2012). Emmonak residents earned or received an estimated total of $7.7 million in 2008, of which $3.74 million (44.7%) was from wage employment. Per capita income, including non-wage income, was an estimated $9,749, and average household income was $42,935 (Fall et al. 2012). The estimated the per capita income by American Community Survey was $15,865.[3]

During the 20th century, the major source of financial income in Emmonak was commercial salmon fishing and processing, which in 1980 provided on average 46% of annual monetary income per household in the lower Yukon region (Wolfe 1981). By contrast, in 2008, agriculture, forestry, and fishing occupations provided only 11% of income in the community (Fall et al. 2012), reflecting the large reduction in commercial salmon harvests in recent years. In 2009, 103 residents held limited entry commercial fishing permits. Several fish buying and processing facilities in or near Emmonak have provided salmon-associated jobs throughout the years. Only one, Kwik'pak Fisheries, LLC, a subsidiary of the Yukon Delta Fisheries Development Association, processes and exports salmon from Emmonak today.

Wild food from the land and sea is central to Emmonak's economy. In 2009, households reported using an average of 22 different subsistence resources, including salmon, nonsalmon fish, moose, beluga whales, seals, waterfowl, berries, and other vegetation. A total of 379,803 edible pounds of subsistence resources, supporting 788 residents, were harvested by residents of Emmonak in 2008. Chinook salmon are highly valued, yet summer chum salmon have consistently been the most heavily harvested salmon species. Chinook salmon composed 8% of the total community subsistence harvest at 30,944 lb, about 39 lb per person (Fall et al. 2012). Chum salmon composed about 26% of the total subsistence harvest. Commercial and subsistence fishing in Emmonak have evolved together throughout the years since commercial fishing enabled fishers to earn cash income to purchase equipment and supplies for subsistence fishing (Moncrieff et al. 2009).

2. Alaska Department of Commerce, Community, and Economic Development (ADCCED) Division of Community and Regional Affairs, Juneau: "Alaska Community Database Online: Community Information." http://commerce.alaska.gov/cra/DCRAExternal/community.(Accessed August 2013)

3. ADLWD (Alaska Department of Labor and Workforce Development). n.d. "Research and Analysis Homepage: Population." Juneau: State of Alaska Department of Labor and Workforce Development. (Accessed April 2014)

Deena Jallen

Plate 3-2.–Student parking.

Subsistence harvests characterize much of the cultural and economic activity in Emmonak, and remain a priority for residents.

Life in Emmonak has long been based on a seasonal round of harvest and production by family and extended family groups. Yup'ik people who identified themselves as *Kuigpagmiut*, or "people of the big river," lived in the lower Yukon River region at historical contact (circa 1833), moving seasonally from place to place according to the availability of resources (Wolfe 1981:36). Today, residents of Emmonak live a more centrally located existence based out of Emmonak for most of the year.

The annual cycle for Emmonak residents accelerates just before breakup of the Yukon River ice in May. Migratory waterfowl, sheefish, northern pike, broad whitefish, Bering ciscoes, burbot, saffron cod, and snowshoe hares are some of the resources targeted at this time. Subsistence harvesters also begin preparing for the salmon season before the fish arrive. In the Yukon River Delta, the first run of Chinook salmon, or "kings," usually occurs in early June. Traditionally, many families and individuals moved to summer fish camps for extended periods.

Summer is usually busy with subsistence and commercial fishing as successive runs of Chinook salmon, summer and fall chum, pink, and coho salmon migrate through the region en route to their spawning streams. Commercial fishers normally retain some of the harvest strictly for subsistence use. Likewise, they depend on the commercial fishing income in part to conduct their own subsistence activities. Wolfe (1981:67) states, "For most households, salmon represented the largest single source of food and monetary income. Of all resources, it might be considered the staple food and primary market product of the region." While fishing for salmon during the summer months, residents often harvest other resources opportunistically, such as beluga whales or seals, and other fish species (Wolfe 1981). Salmon fishing usually continues through August and the first part of September. As fall approaches, salmon fishing occurs along with the harvest of berries, such as blueberries, salmonberries, crowberries (or "blackberries") , and lowbush cranberries. After the end of the salmon runs, subsistence activities segue to fall waterfowl and moose hunting.

Community Fishing Profile

The following historical fishing profile of Emmonak is based primarily on the discussions and accounts of local fishers included in the sample and supplemented by additional sources. The earliest accounts from the eldest respondent began around the mid-1940s. However, most respondents' experience dated back to the 1950s and 1960s.

The interviews provided extensive information regarding profound changes to commercial and subsistence salmon fisheries on the lower Yukon River. At times the respondents spoke of the 2 fisheries interchangeably, referring to one then the next in successive sentences, without specifying commercial or subsistence fishing, leaving the meaning of their statement to be found in its context. In the case of Emmonak, one cannot be discussed in isolation from the other. Income from the commercial fishery supports subsistence fishing efforts. Knowledge and experience gained from the subsistence fishery allow fishers to succeed in commercial fishing.

Seth J. Wilson

Plate 3-3.–Yukon River scene.

History of Local Fisheries

Salmon are the most reliable and significant subsistence resource on the lower Yukon River and were a fixture of intertribal commerce before Euro-American influence in the area; dried fish was regularly traded among villages along with other commodities such as furs and sea mammal products (Wolfe 1981:34) Dried fish continued to develop as a trade item throughout the periods of the expanding fur trade and the gold rushes of the late 19th and early 20th centuries, with the greatest volume, especially chum salmon, traded to feed dogs for transportation and shipping.

> Back in the late fifties and early sixties, our parents used to put up as much fish as they could and use some of those things for bartering [at] the stores like the Sheppard Trading Company, for flour, sugar, stuff like that. They used to bundle them up in packs of fish. Twenty-five chums or 25 kings … tied in a bundle. My father used to barter those things for like 3 dollars a pack. I know they used to have warehouses full of fish … for people … sold them dried fish for bartering. (KR10)

This practice of bundling fish for trade and barter is noted as occurring in the region as early as 1886 (Wolfe 1984). The first commercial salmon fishery for export did not occur until early 1918, when a Japanese firm began preserving salmon with a mild cure process for overseas export. Due to excessive commercial harvest, fishing in the Yukon River for export was prohibited in 1921 until 1934 (Pennoyer et al. 1965).

In 1935, the commercial salmon fishery was legalized on the Yukon and Kuskokwim rivers. On the Yukon River there was a 100,000 Chinook salmon quota, which was reduced by half to 50,000 fish the following year (Pennoyer et al. 1965:3). Subsistence salmon fishing remained unregulated, and following recovery

Joe Redington Sr. Family Collection; Anchorage Museum, B2006.23.1561

Plate 3-4.–Fish buying station in Emmonak.

from the high harvests in the early 20th century, commercial fishing became well integrated into the seasonal subsistence round of Emmonak residents. According to respondents, the community of Emmonak grew substantially in the 1930s. Individuals from smaller communities immigrated to Emmonak in response to the presence of commercial fishing opportunities; at the same time there was an intensification of pressure on children to attend government-approved schools. "That was the main reason these coastal towns were developed…because of the fishery" (KR11). For most respondents, their first memories began at a fish camp, often relatively far away from Emmonak. For the 2 eldest respondents, this was at the Black River camp of New Knockhock, a large spring and summer subsistence camp that, as of the 1940s, still did not have a commercial fishing presence.

> It used to be nothing but subsistence camps over there. People go over in the summer and put fish away for summer time. But they claimed the whole thing for ANCSA [the Alaska Native Claims Settlement Act]. We were over there, but we don't have land over there because we were up here. In 1948 we moved from New Knockhock…the water was low, and people were told that if kids don't go to school, people will go to jail. It's a really nice place. New Knockhock. (KR2)

This was the only respondent whose parents did not participate in the commercial salmon fishery. At the time of his youth, commercial fishing opportunities were not available in the Black River. Another younger respondent recalled learning to subsistence fish in the Black River area and accompanying his father at age 14 to nearby Sheldon Point, present-day Nunam Iqua, to setnet for a large saltery (KR5). These and the following descriptions demonstrate that the integration of commercial fishing with subsistence activity varied through time and also across the delta as the export market for salmon grew.

The following examples of commercial fishing operations show how they were supported by a traditional system of fish camps spread throughout the Yukon Delta. At the time of these accounts (pre-statehood),

Joe Redington Sr. Family Collection; Anchorage Museum, B2006.23.4331

Plate 3-5.–Local processing plant in Emmonak.

commercial markets for Chinook salmon included between 2 and 6 salteries and between 1 and 3 "hand-pack" canneries, and between 2 and 3 canneries in the Yukon Delta (Pennoyer et al. 1965:17). One respondent, originally from Emmonak, recalled that in the early 1950s, his father would be gone most of the time in June to commercial fish for Chinook salmon, only returning to sleep at the camp. He laughed as he said he was usually too busy to help his father fish when he was a boy because he was playing ball and swimming at fish camp during the king salmon season. After the commercial season ended, his dad would return full-time to focus on fall chum and coho salmon for their subsistence harvest. In his teens, he entered the commercial fishery as an employee at the Northern Commercial processing plant. It was there that he saw commercial fishing as a means of making a living. (KR8)

> I saw guys making a bundle, I saw guys who fish and buy brand new motors. So I got to try it out. I would catch a few, get by, and get a new motor. I was maybe 18 or 19 and adapted. (KR8)

Though he perceived commercial fishing as a means to substantial income, he has since found that it does not provide more than a modest income and just enough to gradually invest in the industry. Although commercial fishing income has declined since the 1980s, it had been reliable until recently.

The commercial fishery opened up opportunities for local investment and entrepreneurship. Many of the respondents fished for salteries owned by local entrepreneurs, such as Arnold Akers in Chuloonawick, Axel Johnson in Middle Mouth, and John Amukon in Black River, most of whom were Alaska Native. These locally-owned salteries were operated in Sheldon Point (Nunam Iqua), Akulurak, Alakanuk, Mountain Village, and Marshall. In the 1960s, as processing moved from salting to canning, these individuals took chief operating positions in the canneries.

In addition to providing an accessible and reliable means of livelihood in the decades before statehood, the commercial salmon fishery on the lower Yukon River became a source of pride and local identity in the transitional period of statehood and afterward, as reflected by the following respondent:

> I grew up helping my dad fishing for king salmon and dog salmon… I was 16 years old when my dad gave me ten dollars for a permit…. I was old enough and strong enough, but I didn't have my own boat, so I used my brother's... I fished, and I didn't just catch a few….I never shared my own net; I never let my dad take care of it. If I let him he would say, "You take care of this. It's yours." He has to take care of his own. I've been fishing all my life. I don't have a GED or a high school diploma, the only income I have is fishing right now. (KR6)

Commercial fishing was one of very few opportunities to achieve the security of reliable employment beginning at an early age and lasting nearly a lifetime. The interviewee continued to describe his inability to obtain meaningful employment since the decline of the Chinook salmon run. Though his options were limited due to the educational inequalities rampant in rural communities prior to statehood, there is now better access to education. However, limited employment options in Emmonak were a common theme in the interviews, especially among younger generations, as discussed below.

Advancements in transportation and seafood processing changed the primary method of processing from canning to flash freezing. Large ocean vessels arrived with flash freezing capabilities that transported salmon to Anchorage and Seattle. In 1963, the first Alaska Native-owned flash freezing plant, Yukon Delta Fish Marketing Cooperative, was established and stayed in business for more than 30 years. This company issued credit to fishers for advances on gasoline, oil, and nets/webbing, as well as non-fishing equipment such as wood stoves and tents.

In 1973, the Alaska Legislature passed the Limited Entry Act, authorizing the State of Alaska to prohibit or allow access to Alaska fisheries. The lower Yukon River gillnet fishery was not limited to entry until 1976, when 709 permits were issued. Entry to the fishery was merited on the fisher's participation as a registered gear license holder between 1970 and 1975, consistency of fish landings, and economic dependence on the fishery (Shirley 1992). Most of the respondents in this study were either past or present permit holders. Earlier research suggested that the inequality in permit distributions created intra-river tensions between communities, and that the permit distributions in the community of Emmonak created a 2-tiered social system between those who were awarded permits and those who were not (Wolfe 1984). Respondents spoke of owning permits and the obligations of paying annual renewal fees. Most treated a limited entry permit as a family asset, passing them along kinship lines as older generations retired from the fishery.

Two interview respondents, brothers of the same age cohort but with very different life experiences, described the transition to the limited entry system in early 1976. Born at fish camp in the Black River, their parents did not commercial fish because of their distance from a buyer. Rather, the brothers grew up subsistence fishing. One brother began commercial fishing on his own at the age of 15. He left the area to attend high school but returned every year to fish for a local fish buyer. After high school, he left Alaska in 1971 for an extended period to attend college. His absence precluded him from obtaining a limited entry permit. His older brother continued subsistence fishing with his family through high school. After high school he served in the armed forces. He returned just in time to apply for a limited entry permit and began commercial fishing.

The commercial and subsistence economies in Emmonak coexist almost symbiotically. Neither fishery displaces a fisher's participation in the other. In fact, as in other communities on the lower Yukon, the presence of the commercial fishery positively influences the diversity and robustness of Emmonak's subsistence fishery and seasonal round. However, on principle, some respondents delineate between the two. "… Even though commercial salmon is very important for paying our bills and stuff like that … subsistence comes first" (KR10). With so much of Emmonak's community identity based in the commercial fishery, residents have had to balance the demands of fishing for an export market with the need for providing subsistence fish for the winter's use. The following examples describe the logistical connection between the commercial

fishery and subsistence fishery, including the division of labor, targeted species and incidental catch, and preservation of the harvest for home use. This connection differed in all cases; however, all respondents noted its existence.

> The commercial and subsistence linked together, they both help the families economically and, you know, the food put away for the winter use. These can't be separated. If we commercial fish, we get money to buy gas and motor oil … you got to have an outboard motor and a boat. And also commercial fishing provided us with gasoline for us to go after different species of fish, for their family use, and different species of different types of berries, we just got done with salmonberries, and some went out blueberry picking, and strawberries. (KR10)

Families adopted different methods of balancing fishing for personal use and fishing for commercial sale. The following quote is a short description of a family processing unit during the Chinook salmon season in the Black River area. It was from the oldest respondent and the only one whose family did not commercial fish as a child:

> Sharing was important in those days. The first catch was shared, distributed among all families; after that, people began to harvest for their own families. The number of fish harvested was dependent upon the size of the family. Maybe 20–30 kings were needed at the time. Later, the children were more involved in the harvest and processing of the fish. The women cut fish. Nothing was thrown away but the guts. (KR5)

While the majority of fish caught for subsistence remained summer chum salmon, fishermen had to make a choice with the Chinook salmon that were caught. "When we used to commercial fish, my mom used to be with us during Chinook season. She'd take enough for winter time and go back home and work in Emmonak." Each Chinook salmon sold in exchange for cash was withheld from the family's cache, and each taken for subsistence was withheld from the family's income. The respondent explains:

> In those days there was no chum commercial season. But they used a lot for subsistence. After Chinook is done we'd go subsistence fish for chum. So that's how it used to be done a long time ago. Commercial was only on Chinook until around 1967. (KR 2)

There were additional methods of allocating subsistence and commercial harvests of salmon. One respondent described a large communal fish camp in existence prior to statehood.

> I remember it was 1960-something because we went to the Halfway camp before they started commercial fishing, before we sold the fish. They'd make a big smokehouse at Halfway, but there is no more Halfway right now. The women used to gather…lots of fish…..they would fill that [smokehouse] with dried fish. They would cut them and hang them, and when they were ready to smoke them….the men would watch the smokehouse. Then when they dry, they would divide the fish for their winter harvest. …That was the subsistence fish. (KR6)

This respondent also explained how people—approximately 10 families— moved to this large camp prior to the commercial season and would attempt to harvest Chinook salmon early, before the commercial season opened. This allowed the best salmon to be harvested for subsistence and allowed them to be preserved during the best weather. Families or individuals who did not have their own camps could go to Halfway camp to process salmon. Processing capacity and availability was another consideration in dividing the catch between commercial and subsistence:

> During commercial season openings when these fisheries can't purchase any more fish, depending on how well the salmons are running and how many people are selling them fish, when they can't buy any more fish, the people that harvest these fish for commercial purposes, when they don't have no buyers to sell them to, they bring them home and take care of them for their own use. (KR10)

After the new state government assumed management responsibilities of the Yukon River fishery and exchanged the salmon quota system for one based on flexible salmon fishing schedules, the allocation of Chinook salmon for subsistence or commercial harvest became simplified. Fishers alternated subsistence and commercial efforts based on the regulatory schedule. However, because commercial fishing was open for periods as long as 3 days at a time, many of the fishing patterns did not change substantially.

> We do commercial fish at the same time as we subsistence fished. They are not separate. We have a family back home, in camp that we maintain. When there is a closure on the kings, we go back and subsistence. We subsist right away. We work hard in the summer time putting fish away. You know my dad used to tell me "Even if you work hard in the summer, you can rest all winter long." (KR9)

The presence of 2 fisheries, commercial and subsistence, demands an adaptive social structure. The following passage reveals much about the social structure, gender roles, and competing demands on Emmonak's labor force surrounding Chinook salmon subsistence and commercial production in Emmonak's mixed economy.

> I remember going across to fish camp at my grampa's camp. They ran that camp alone with the help of grandchildren. … This was in the early '70s, that I can remember. I was maybe 4 or 5 years old. He'd use the chums, the kings, make strips. They would salt fish. They would do this all summer long, and took only what they needed. My grandparents on my mom's side … had a big house up there with a big smokehouse. We'd go to both camps during the summer. I don't know how many brothers and sisters, but they'd all work together and get as much as they could because they got a bigger family… I always went to my grandparents' because my dad worked all summer. He worked on the LCM [surplus military barges converted to fish tenders] for the fish factory. He also fish tendered boats. He did that every summer. My mom was busy working. Doing anything subsistence, we had to go with my grandparents. (KR1)

Comments from the youngest daughter of a family show how accommodating families were to support fishing efforts. For example, if the only son was away in college, the eldest daughter could replace him to help harvest salmon.

> I was more watching the kids, and my older sister would be helping my mom. And since my older brother was in Anchorage, my other older sister would be helping my dad. I would be watching my older sister's kids. (KR4)

This flexibility of gender roles in the subsistence fishery also transfers into the commercial fishery. Even though commercial fishing does not require home processing, a function generally performed by female members, women do have an option in the roles they can play in the Emmonak commercial fishery. For instance, the young girl in the passage above grew up and fished commercially with her husband before buying her own limited entry permit. Another female respondent described commercial fishing with her brother and husband.

> I didn't really participate in the fishing part of subsistence, just cutting subsistence fish growing up. Only after high school did I try commercial fishing as a helper with my brother and more recently I commercial fished with my husband 3 years ago. (KR3)

The role of youth is another important aspect of the Chinook salmon fisheries on the lower Yukon River. The subsistence and commercial fishery is a key venue for the transmission of knowledge and reinforcement of gender roles. Every interview began with the respondent relating his or her earliest memories of the Chinook salmon fishery. One of the elder respondents reported:

> I started helping around 12 years old. I remember sitting in the boat and watching the relatives work. By 15 years old, I was checking the nets myself. I had to be careful because Chinook are strong fish and knock you in the water. My elders constantly warned me to be careful. The fish are very heavy and you need help pulling them into the boat. (KR5)

Another respondent made similar comments. "When I was a child, I helped my dad fish. I couldn't even pick up the kings when I first helped him. Mainly I just hold the net for him" (KR8). A slightly younger respondent offered the following comments about his early fishing efforts:

> I started at, like, the age of 13 to 15 years old…I remember only Chinook salmon, 3 different species of king salmon. Seems like I hardly went fall fishing for silvers [fall chum salmon] or cohos. …I participated in [the subsistence fishery during] my younger days. From when I was 10 until a teenager. That's when I slacked off. After I graduated, from the time I was 19, I hardly remember …. (KR12)

In commenting on the changing roles of youth, one female respondent made an interesting observation. She noted that her daughter is 21 years old and has only started cutting fish, but also implied that children these days have more life responsibilities and expenses.

> There is a reason. It's the way you are raised. Some parents make it part of your chores to participate in subsistence activities. My parent didn't. She waited until I started asking, "So when am I going to cut fish?" then she would let me start. But having been that way, how I came in my own good time getting started in subsistence, cutting, fishing, I got to learn how to cut fish, how to smoke fish. I know the way that she liked it, and I could manage to make the fish just the way she liked it, and the same way for myself. I can make it just the way I like it ….
>
> …[My daughter] is 21 and busy with school and work. Like her mom, when she was ready, when she asked, she got to participate…To me it seems that more participate in the commercial fishery than in subsistence because they get paid. Kids have expenses too, you know. (KR3)

The above comments illustrate that the subsistence demand for salmon remains strong, albeit adaptive to evolving household and community circumstances. The most significant factor in recent memory affecting household demand was the decline of sled dogs as personal transportation, which allows families to harvest fewer chum salmon. Differences in levels of need for salmon within individual households reflect different uses and apportionment of the scarce resource. Most families would like to harvest enough salmon to share outside the household or fishing group, within the community, including salmon used in communal ceremonies, potlucks, and shared with community members unable to harvest salmon or receive salmon from their own kinship group. Another important part of a family's level of need is sharing with family members who are living outside of Emmonak. If the household is unable to harvest what they need, the social obligations of sharing may be negatively impacted.

Collection, Processing, and Distribution of Fish

Together, respondents discussed several factors that determine how many fish a given household needs for the year. Size of the household and the nature of social ties were among the most important. Respondents described needing anywhere between 20 or 30 Chinook salmon to 100 or more, depending on their circumstances. One respondent estimated that he tries to harvest about 600 chum salmon and around 100 Chinook salmon so that he can help feed 9 households in an extended family (KR8), while another thought that the average family needed about 20–30 Chinook salmon. According to yet another respondent, "Well, the family needs maybe 100 or less Chinooks. In my day everyone had a dog team. You have to feed them, so it's about 200–300 chums for dog food in wintertime" (KR 2).

Other households, when asked about their personal harvest goals and salmon needs, related them not in whole numbers but in processed quantities. For instance, one respondent reported that his family used wooden barrels to preserve fish for winter:

> Three or 4 of them. And from the late '60s to maybe late '70s, a decade, we started seeing those 5-gallon plastic buckets. We used to put away, from the mid '70s to late 70's we

> put away from, like, 6 to 8 5-gallon buckets. And now it's maybe we only have 2 of them today. (KR12)

This was for a family of 4; one 5-gallon bucket contains about 6 Chinook salmon in a dry salt cure. When asked if 2 buckets were enough, he shrugged and stated, "Lot of our younger people don't hardly eat subsistence food anymore. We are the ones that have been taught the traditional subsistence way of life. We eat it. Forty year old to elders" (KR 12).

Gear

Fishing gear selection in the Yukon Delta subsistence and commercial fisheries has changed over the lives of the respondents in this study. Since statehood, ADF&G has used limitations on legal gear types as a management tool. Regulatory changes, technological advancements, and fluctuations in the price of equipment and supplies (including gasoline), and transformation of food preference, require a complex analysis of the costs and benefits of one gear type over another, leading to new gear choices.

Historically, salmon were taken in the Yukon Delta by weirs and fish traps, dip nets, and setnets made of animal sinew and willow bark. However, by the 20th century, and certainly by the earliest memories of the key respondents, linen nets, and eventually nylon nets had become the primary means of taking salmon. Although drift gillnetting by means of rowing or poling boats occurred in other parts of Alaska, it was not reported in the literature or respondent interviews. Drift gillnetting on the lower Yukon River did not occur until motor-powered boats were introduced, and it became a legal method of taking salmon in 1950 (Pennoyer et al. 1965:4).

Two respondents, whose fathers fished for the Northern Commercial Company, recalled that their fathers fished with 3 50-fathom setnets, leased to them each year by the company. Both respondents noted that the company did place restrictions on the length of net that was used by each fisherman. However, mesh size was unlimited, save for what was available through the company. "The biggest they had was 9 inch mesh" (KR8). For subsistence and commercial Chinook salmon fisheries, the preference had always leaned toward larger mesh nets, although not all fishermen feel that mesh size is the most important factor in catching large fish. "The mesh size that we have nowadays, you could catch those big ones. That's the truth to it. I hang my net loose, super loose and that's how I catch the big ones" (KR8).

One respondent indicated that in years past the major limiting factor was the fisherman's strength and ability. If he did not have the energy or was too old to fish 3 nets, he would choose to only fish 100 fathoms of setnet. If fishers got tired, they would roll their nets up and tie them with string so the fish could pass.

There is currently only 1 fish buyer readily available to Emmonak fishers, but that was not the case historically. Different buyers usually leased gear, such as nets, to the fishers with whom they contracted, which could determine the gear choice, or fishers could choose their buyer if they had their own gear. Access to multiple buyers could provide fishers with several options depending on their personal needs regarding gear, and at times different fishers in the same family did business with different buyers. For example, one respondent chose to fish for a different buyer than his father. The buyer, Arnold Akers, lent him an 8 inch mesh net each year, and he was under contract to sell fish exclusively to Akers. Some buyers also provided boats and motors for lease each year to fishermen who did not otherwise have access to them.

> My father used to go to Point Adam's … Axel Johnson's company, and they were issued an outboard motor, a boat, and some commercial fishing nets. And they took care of those things like their own, but then at the end of the season they returned those things back to the company. But if they owed something to the company, they don't make any money. … But then that's how it worked. (KR10)

This system of non-local processing companies owning gear and leasing it to local fishermen was not unique to the Yukon River. Similar situations were present in fisheries in Bristol Bay, Cook Inlet, and Southeast Alaska. The arrival of the commercial fisheries did provide unprecedented access to new fishing technologies and equipment that would also be put to use in the subsistence fishery. However, according to respondents, this changed after limited entry.

> Later on, after they started issuing out fishing permits, back in the late '60s … that's when most of the fishermen went independent. Whatever fish they harvested they sold to different companies that came in to buy salmon. (KR10)

As limited entry changed the structure of fishing, fishermen became independent contractors, shifting the logistics and realities of running a business more directly upon themselves. This included the cost of maintaining a fishing operation, although some leasing of gear continued. Key respondents in 2009 described purchasing their own commercial and subsistence fishing gear, either as an up-front purchase or through a fish buyer-provided charge account (KR6).

Fishing Practices

For much of the 20th century, the commercial salmon industry in Emmonak supported not only a townwide, but also a regionwide community. Emmonak's prime location for salmon fishing made it a center for the commercial salmon industry on the Yukon River Delta, providing a base for fish processing facilities and multiple fish buyers (Pennoyer et al. 1965). This development, together with the pressure to place children in approved schools, led residents from several surrounding communities to move to Emmonak permanently or on a seasonal basis.

Historically, there were numerous smaller communities supported by the salmon runs in the middle and south mouths of the Yukon River. One such example was Akulurak, near Kwikluak Pass. St. Marys Mission at Akulurak, in existence from 1903 until 1951 and reportedly the only location with fish wheels in use, operated a saltery which drew fishers from nearby camps. In 1951 the mission moved to present-day St. Marys because the slough silted in.

Another community supported by the fishery was Chuloonawick, previously located on the north bank of Kwikpak Pass where Arnold Akers purchased and processed fish. The operation supported many fishers in the middle mouth of the Yukon River. Erosion forced the community of Chuloonawick to relocate, and today most former residents of Chuloonawick reside primarily in Emmonak (KR7).

The disappearance of these communities, restricted fishing schedules, and high gas prices have influenced patterns of seasonal fish camp settlement. In general, respondents indicated that traditional fish camp locations have been less frequently used, and for shorter periods of time, in recent years: "Well, right in the middle mouth delta, you can see the abandoned fish camps … all the way down towards Black River. And they're just becoming abandoned" (KR 11). Extensive mapping of fish camps was conducted and reported by Wolfe (1982). Recall that Figure 3-1 is a depiction of fishing areas relevant to the research participants and should not be extrapolated to represent the community of Emmonak's fishing areas as a whole. However, their experiences show how fishers select fish camps, and how that selection has changed over the years (see also Fall et al. 2012:135).

One middle-aged respondent born in Kwiguk recalls going to a single fish camp, near "Snotty Slough," until he was about 30 years of age. The camp was established by his parents and was very close to the fishing village of Chuloonawick. His family continued fishing there until the 1980s. The saltery at Snotty Slough had ceased operation by that time, and the family chose to move their fish camp to Nunam Iqua, where he could continue commercial fishing while his parents subsistence fished. He was able to return to Emmonak from this location between commercial openings to deliver salmon. His fish camp was abandoned in 2000 when the respondent chose to invest in driftnetting, and he has since fished from Emmonak (KR12).

Only 2 respondents continued to operate a setnet site for subsistence and commercial salmon fishing. Setnet sites were common at the coastal mouths of the Yukon River Delta and near notable sloughs and travel corridors, and prime setnet locations historically went hand in hand with fish camp locations. One respondent explicitly noted that he had abandoned his camp when commercial setnetting became obsolete in the 1990s.

There are a number of drift fishing locations used by respondents (Figure 3-1). Respondents note that good drift locations change yearly due to changing channels and new snags (KR 7) and are acknowledged as common property by all fishers. Drift locations are plentiful near Emmonak and Kwiguk Slough, with the

advantages of a short travel distance and minimal fuel use. Many other respondents noted that they choose to "gamble" and make the long commute upriver to target salmon as they become bottlenecked in the single channel.

> Subsistence today is different than a long time ago. We can put away more fish than ever before, we have freezer, canning machine, everything. As long as you got something to can, that's good enough. (KR2)

Most respondents varied in their personal tastes and preferences; however, they all use at least 3 different types of preserved salmon. The following paragraphs relate the number of ways that salmon is preserved, with emphasis on Chinook salmon, for household consumption.

The most common, and relatively recent, method of preserving salmon is by freezing whole, in fillets, or as steaks—and freezers are an important asset to a household. "We just got a freezer. Three of us had to pay for that freezer and it was secondhand from Kwik'pak. So we can freeze more fish for the winter" (KR7). All species of fish are frozen for later use and fishers generally target the freshest and best salmon to freeze.

> I try not to harvest more than what we can eat. … Thirty to 40 chums are put in the freezer along with 20 kings. …
>
> I try to keep it [need for fish] steady. One year I didn't get enough and I tried to get some fish from the cannery but couldn't get ahold of [someone] for fish. The next year I put more in the freezer. And that next year we didn't get enough kings and I don't like having to get fish from Fish and Game [fish removed by a local test fishery and donated to the community] because they check their nets every 12 hours. They aren't the freshest fish. I had no choice and I had to get my kings from there to prepare strips. (KR4)

Another important salmon product is salmon strips which are almost exclusively made from Chinook salmon, although some families use fall chum salmon. No respondent specifically commented on the importance of salmon strips to the local diet, but it can be inferred from the number of people who produce them and the care that goes into strip production.

> I have to think smart. The thicker they are, it takes longer to dry. I need to get meat on the strips, but they have to dry. I have to think ahead because the strips they take 2 weeks longer than the dry fish. (KR4)

The cut strips are then hung to dry in the open air for an amount of time and then cold smoked with wet wood. "The smoke was constantly attended; the wet-wood smoke would keep the flies away" (KR5). Green alder and cottonwood are commonly used for this process. This is not to be confused with dry fish which is simply split, cut, and hung.

Cold smoking is a traditional method of preserving many subsistence species and reportedly used for most parts of the Chinook salmon. One elder gave this account of processing 1 Chinook salmon.

> Nothing was thrown away but the guts. The heads were cut off and the gills thrown away. Both the head and the tail were hung on hooks and smoked. The body of the fish was cut open, the eggs if any, were saved, preserved in a bag or container, and served as a high-energy, warming food during the winter. The back bone was separated, hung and dried, then smoked with a wet-wood. The smoke was constantly attended; the wet-wood smoke would keep the flies away. Sometime the fish skin was cleaned and used to make boots. The head, like the rest of the meat, was put in the smokehouse. In the winter the smoked fish heads were boiled. (KR5)

Another traditional but no longer common method of preserving Chinook salmon is by brining them and storing them in plastic 5-gallon buckets. "… we harvest Chinook and salt them in buckets. … plastic

buckets … that way they're preserved in salt and brine anyway. We like to harvest more Chinook if possible because of fat content" (KR10).

Sharing, Barter, and Customary Trade

As mentioned, salmon were a staple commodity in interregional trade and barter from before the time of Euro-American contact to the middle of the 20th century (Wolfe 1981). Barter was conducted between Yup'ik, Athabascan, and Iñupiaq communities for objects and commodities that were not available in their respective territories. At the local level, neighbors exchange goods with each other for much the same reason: to obtain what they are unable to harvest in sufficient quantities. Ultimately, an increased sense of personal security and reinforced relationships with neighbors and kin are gained through engaging in barter and customary trade (Fienup-Riordan 1986).

A survey documenting household participation in and community-level perceptions of barter and customary trade was conducted in 4 of the communities selected for this project. Results from the survey for all communities are available in Appendix C. A sample of 63 households was surveyed in Emmonak. Respondents reported using all 3 methods of exchange: sharing, barter, and customary trade. When asked about their household's exchange practices, many of the respondents felt that the survey did not apply to their household, reasoning that they only shared resources— exchanging them without an expectation of immediate reciprocation. Nonetheless, events and perceptions of customary trade and of barter were described by many others, and the patterns indicate the ongoing importance of these methods of food distribution in Emmonak.

The survey identified 13 households that have bartered and 21 that have engaged in customary trade at some time in the past (Appendix C, tables C1 and C2). Emmonak was unique among study communities in that there were more households that reported participating in customary trade than in barter. Of surveyed households, 25% reported the customary trade of salmon during the study year. These respondents provided 17 examples of actual trade events, all of which included salmon (Chinook, chum, and unidentified salmon); 16 were purchases and 1 was a sale. Additionally, when asked to comment about current trends in barter and trade, respondents consistently expressed a reluctance to comment on the actions of others. There are likely many reasons for this reluctance, including an unwillingness to comment on the activities of their neighbors to a stranger or hesitancy to give misinformation. Many respondents simply commented that they could not describe what they did not see.

Barter, the exchange of one resource for another without the use of cash, was reported by respondents to occur less frequently than any other exchange. Of the 13 households that reported bartering, 39% said they almost never bartered, while another 31% said they did it about once a year (Appendix C, Table C1). Respondents reported bartering histories of 0 to 39 years, averaging 13 years (Appendix C, Table C3). When asked why they participated in bartering, 85% indicated that they did so because they needed food. The second most commonly stated reason was that another household needed food and approached the respondent to barter (Appendix C, tables C4 and C5).

In Emmonak, the most bartered item was salmon; salmon was reportedly most often exchanged for moose (reported by 6 households), muktuk (by 5 households), and seal oil (4 households). Some indicated that they exchange wild foods for gasoline, a commodity associated with high monetary value, or even groceries. The data are supported by 1 respondent's description of the local definitions of exchange in Emmonak:

> To me, there is not very much trading going on at the community level. In Alaskan communities, it's not trade, it's sharing. Its sharing your success, it's sharing with your family. Trade, I think of Emmonak with Gambell. For example, Gambell wants Yukon smoked salmon; I want muktuk. If I could find somebody in Gambell willing to trade with me, then we would be able to barter for amounts. (KR3)

This respondent used the term "trade" to describe an exchange that would legally be called barter: the exchange of one commodity for another—often one that is not obtainable in a traditional harvest area. Note that the terms "trade" and "barter" are used interchangeably. However, "trade" is used in a variety

of contexts, including barter and customary trade, whereas barter is used here to describe the negotiation of amounts to be exchanged. Because of possible miscommunication and varying definitions of exchange, researchers were very careful when asking key respondents about the nature of customary trade in their community. When asked about the existence of customary trade ("the exchange of a wild resource for a limited amount of cash") respondents generally described its occurrence in the context of "making ends meet." Of 21 households who indicated participation in customary trade, 29% said that they almost never do it, and 57% said they do it about once a year (Appendix C, Table C2). The average number of years that respondents reported engaging in customary trade was 7 years, with some indicating they no longer need to do so.

A number of reasons for engaging in customary trade were offered from both sides of the exchange (Appendix C, tables C6 and C7). On the demand side, respondents generally reported buying dry salmon under 2 specific conditions. First, 76% said they bought dried fish because they needed it. This exchange occurs once a year and generally during the winter months when personal caches run out. Second, respondents also reported making this exchange because the seller needed the money but was not looking for charity. Five percent of the respondents indicated that they purchased salmon because someone else needed something other than food.

Individuals reported an increased variety of reasons for selling their subsistence-caught fish. The most common, as indicated by the survey results, was that they needed something else other than food (24%). Another 19% indicated that they sold salmon because they had extra salmon and 14% said that they sold salmon because someone else needed food. Lastly, 10% indicated that they did so because they needed money. They observed that the value of processed salmon varied. Respondents reported that 1 gallon of dried salmon sells for about $50–$75 or a 5-gallon bucket for $300.

> I don't really see a problem with it. Seems like it's overpriced. It cost a lot, takes a lot of work to make dry fish, but I still think it's kind of overpriced. Three hundred dollars for a bucket of fish. Especially the people that are buying it—some of them are having a hard time already. I've never sold any subsistence fish, and I don't think I ever will. I think if people have to do that just to get by, I don't see why not. I wouldn't sell fish that we worked so hard on. Keep it in the family. (KR1)

Information from other respondents generally supported these figures. One individual was concise in expressing his preferences. "I would cut 200 chums because I would share with people who need them, but some of those people like to buy [salmon]" (KR6).

> Personally I think it would be nice to be able to trade salmon…Part of what is going around in my mind is that we are so regulated that we are struggling to fill our own quotas. The only way we can fill those [quotas] is to trade when we are shortchanged ourselves…I'm sure some people, if they get desperate, would resort to selling their fish, their berries even. It's really hard work to get all that done. To smoke fish, to pick berries, it's really hard work. (KR3)

As seen in the "All Exchanges" diagram for Emmonak (Figure 3-2), salmon are the central resource involved in exchanges. Salmon, found in the center of the diagram, can be used to obtain a wide variety of resources, including non-food resources such as cash and gasoline. Chinook salmon, with their large size and high quality, are the most commonly exchanged—especially as strips; indeed, Chinook salmon were exchanged for cash more than any other single resource. The loss of Chinook salmon or the ability to use Chinook salmon in exchange practices will likely have serious negative effects on the exchange networks that are an important part of Emmonak's subsistence economy.

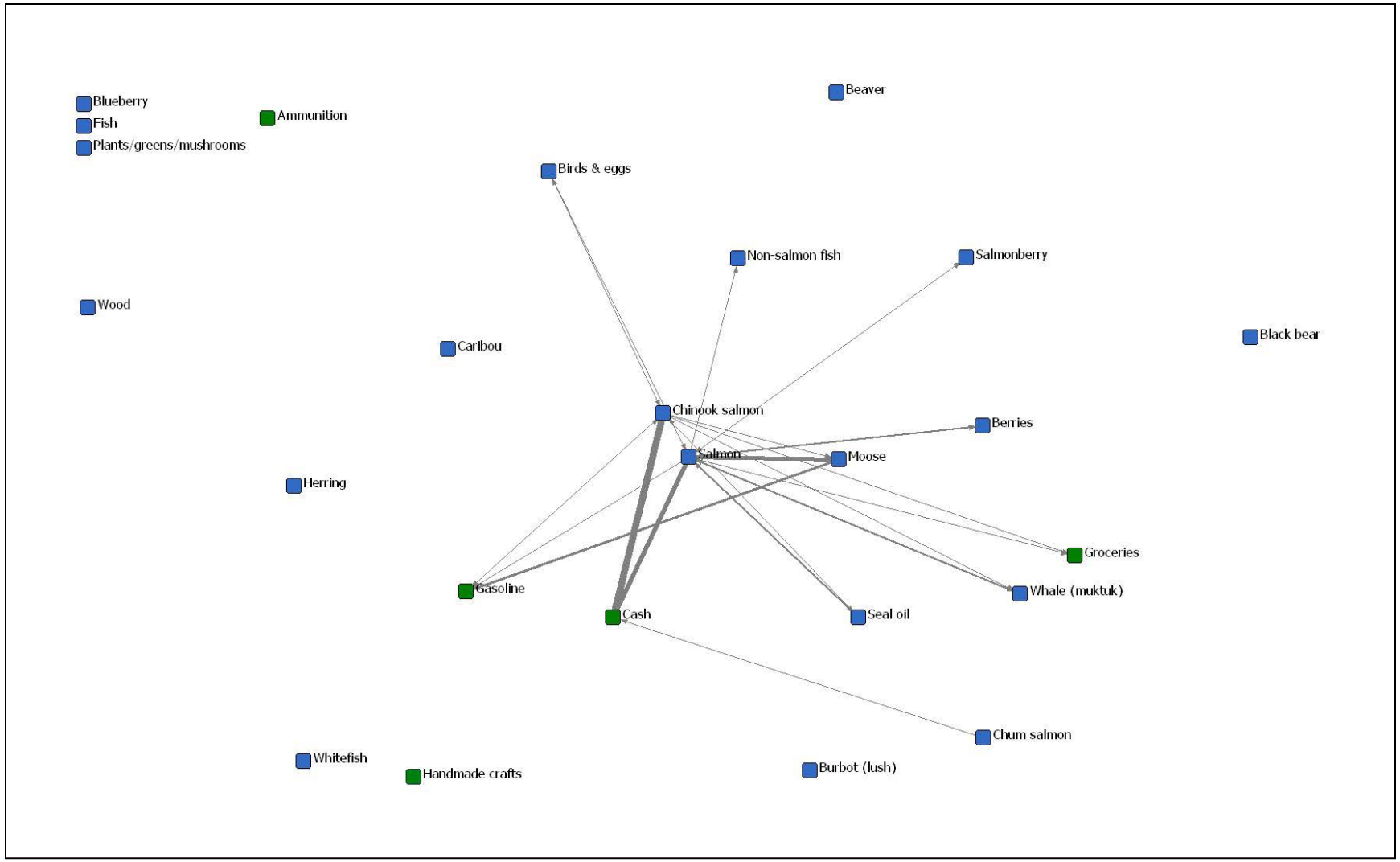

Figure 3-2.–"All Exchanges" network diagram of the barter and trade continuum in Emmonak; resources that are exchanged frequently migrate to the center of the diagram; those exchanged less frequently move to the periphery. The weight of the line connecting resources reflects the frequency of that particular exchange. The absence of a line does not indicate exchanges do not occur, but rather implies that the type of exchange is not common and/or not documented by the sample households: i.e., no specific incidents were documented, nor was the general pattern described.

Local Experiences of Salmon Decline and Disaster

Recounting past experiences led many respondents to compare present circumstances with the past. The following section describes key themes and common opinions that emerged in the second half of the key informant interviews, in order of emphasis.

Observations of Change

There were varying perspectives regarding the abundance and quality of Chinook salmon over time. The respondents' views on how much the run has declined, and when, or if it had at all, varied according to the age and participation status of each respondent. This section describes this array of local observations. Lastly, responses to the post-season salmon survey assessment will be reviewed (Jallen et. al, 2011).

The eldest respondent had the advantage of long-term perspective, having subsistence fished throughout his life and commercial fished from 1950 until 1975. When asked about changing salmon abundance he commented, "But in the past, the fish were there in abundance; however, the fish are still there. When there are fish, management keeps the commercial fishery closed. It seems that the fish are still there, but they are not allowed to fish them." He did not feel that the fish had declined greatly from when he was a youth. He further commented that sometimes Emmonak fishermen and ADF&G say that there are no fish in the river, "but then I hear reports that fish are caught at Mountain Village" (KR5).

A number of times throughout the interview, this elder demonstrated reluctance to discuss a decline in the salmon, instead speaking of how fishers and management should act. A fundamental strategy for many in this area is not to actualize effects through speech or to verbally attend too much to any particular resource. Reluctance to create commotion over a resource in decline is part of this culture's larger tenet of speaking appropriately and respectfully of wildlife and the natural environment (Hensel 1996) Instead of commenting on decline or abundance, the respondent spoke of the importance of taking only the fish that is needed, sharing if there is extra, and not wasting what is harvested. This theme was common in his interview—that fish are still in the river, but we just do not see them, that fighting over a resource is bad for the resource—is consistent with a traditional point of view that the resource will not return if the right behavior is not followed.

> A healthy return of fish comes every year if you take care of them. That is how it is. A long time ago, people didn't waste them. Whatever they got they take care of them, but today is different. (KR2)

Often when respondents were approached with the topic of declining Chinook salmon runs, they simply admitted the limits of their knowledge concerning the number of factors influencing salmon abundance. "The run depends on so many things—temperatures, winds, tides" (KR7).

> It's hard to say [if the runs are declining] because nowadays you are allowed 3- or 6-hour fishing periods. Nobody is allowed to fish. Everything is so regulated. It would be really hard to tell. If we were allowed to fish for 24 hours, like they did many years ago, we could probably catch as many as they did. (KR3)

The passage asserts that there is a difference between the abundance of salmon that swim in the river and the number of salmon that come into the community. Fishers can no longer assess the run properly because they are getting only glimpses of the run through limited openings, rather than seeing what is happening throughout the run by fishing at will. This respondent, as did most others, associated the abundance of salmon with the numbers harvested by fishers. Regulatory intervention disrupts harvests so that fishers cannot gauge the number of fish swimming in the river.

In addition to Yup'ik views of resource abundance and complications of regulatory interference and natural variations, fishers' perspectives are further influenced by their personal histories. For instance, one respondent, who had spent a number of years outside of Emmonak, held strong opinions regarding the changes in the fishery that he noticed upon his return. "I moved away in 1988 and I came back in 1992 and

somewhere around there, it [hardship] got started, and it was getting harder. The kings were getting fewer and fewer" (KR1). He elaborated:

> When I came back and started fishing in '92 there was a change. People were talking about how the Kuskokwim was only fishing for 3 to 6 hour periods and we [District Y-1] were getting more [commercial] fishing 24 hours. I saw a change right away when I came back because in the early days we were fishing for 3 or 4 days a week. Those weren't cake walks. … When we had 24-hour fish period and you were a driftnetter, you were out there 24 hours. … I remember, a couple times, we got over 800 chums in just 2 drifts. We can't do that nowadays. (KR1)

Observant fishers of different ages and different experience levels have varying understandings of run abundance through time. Taken together, a picture of larger runs with resulting larger harvests earlier in time develops.

> [A late community member] used to get thousands of kings per season. That's fishing 6 days a week. Month and a half … there weren't that many fishermen in those days. Now there are around 700 permit holders. Maybe there is less, I don't know. Or maybe people don't fish that much. Some of the commercial fishers are working full time, so when they get out, there are hardly fish in the river, they keep working and don't go out. But the people who don't have jobs go out to pay out their bill: gas, motor, or boat bill. (KR8)

The respondent alludes to commercial fishing any particular opening as an economic decision. Fishers predisposed to participate in openers with stronger runs of salmon may stay home during weak runs. This strategy could serve to bias their historical recollection of run strength in favor of stronger runs. "Four hundred in a set—to me that was a lot, but back then, there were a lot of fish. I would be home baby-sitting my sister's kids. So I didn't see how much fish they used to sell" (KR4). According to another respondent, "I know that a lot of fish pass by already. People used to be able to go and get 1,000 fish (likely a combination of summer chum and Chinook salmon) in one day" (KR2).

The Division of Commercial Fisheries conducts annual post-season subsistence salmon harvest surveys on the Yukon River. Respondents are asked to rate what percentage of their need for salmon was met. Some percentage of households always report failing to meet their needs even in years with abundant runs for variable reasons such as employment, lack of equipment, or illness. In 2009, a salmon disaster year, 81% of Emmonak respondents stated that they met only one-quarter or less of their subsistence need for Chinook salmon, the lowest success rate in the lower river, and the seventh lowest in the Yukon River drainage. Of the Yukon Area households that responded to the question regarding whether their Chinook salmon subsistence needs were met, 58% responded that only one-quarter or less of their Chinook harvest goal was met. The total subsistence and personal use harvest throughout the Yukon Area was estimated to be 33,932 Chinook salmon in 2009 (Jallen et. al, 2011). For comparison, the amount necessary for subsistence (ANS) for Chinook salmon on the entire Yukon River drainage, as set by the Alaska Board of Fisheries, is an annual harvest of 45,500–66,704 Chinook salmon (5 AAC 01.236).

When discussing the changing quality and diversity of the salmon run, lower Yukon River residents harvest from a mixed stock of Chinook salmon bound for different tributaries of the Yukon River. Salmon were not generally reported to be unhealthy by the respondents. Rather, concerns regarding the quality of salmon mostly pertained to the diminishing size and changing diversity of salmon phenotypes entering the river.

> The average used to be like 30 pounds, 27 to 30 pounds, now it's 12 to 15 pounds. I don't know why the kings are getting smaller; I couldn't figure it out. Maybe the earth is getting too old, maybe. Maybe the water temperature is getting warmer. I don't know where the big ones go. (KR8)

> When they opened king salmon June 1st we used to catch the first king salmon, white-nosed. Those weren't small, they were humungous. The largest one I caught was a 72-pound king salmon. That was big. (KR6)

However, just as respondents' historical perspective of salmon abundance is complicated by regulatory intervention, some respondents noted that the size of Chinook salmon harvested by community residents is influenced by mesh restrictions. When asked if he had seen the size of Chinook salmon decline over the years, one respondent replied, "Yeah, because we are using chum nets now and they don't catch the big ones" (KR6).

Fishers also commented on observable changes in the run, as noted by the relative quantity of phenotypic variations of Chinook salmon, referred to as "blackheads and whiteheads" (Moncrieff et al. 2005). When speaking of commercial fishing in the 1970's, one fisher noted the following:

> The average weight was over 35 pounds to close to 50 pounds and 3 different kinds of fish—of king salmon. … In the '90s seems like I noticed depletion of some certain species … the whitenose or steelheads we caught. They were like really depleting. … I've heard stories from friends and older guys, they said that the whitenose go up the Andreafsky. They come in later. (KR12)

Another fisher added, "They came more in numbers, the blackheads. We hardly see those anymore. Whitenose come every year" (KR8).

Few respondents commented on the health and quality of the fish. Salmon entering the lower river are characterized as "ocean bright:" not showing wear or spawning coloration typically seen upriver. Additionally, it is thought that salmon with parasitic infections, particularly *Ichthyophonus*, do not show clinical signs, such as smells, discoloration, or "mushyness" until further upriver. As discussed by Kahler et al. (Kahler et al. 2011), this was the case in 2004 and 2005. However, observable signs of health may also have been influenced by higher water temperatures in those 2 years. When discussing the general health of Chinook salmon, one fisher commented the following:

> …[Y]ears when they were kinda on a decline, they were … well … they didn't look like … too healthy. But they are, you know, this year is just when I noticed the really bright, healthy looking fish. So … hopefully healthy is gonna be on a rebound. But I doubt if it ever will be, with the amount of fighting there is on the river. It's just regulation after regulation that they placed on us. (KR11)

Beyond changes to the fish themselves, respondents commented on ecological changes related to salmon abundance and fishing habits. The majority of respondents, based on observations over their lifetimes, felt that the river channels are constantly changing in the Yukon River Delta, which they viewed as connected to which mouth the salmon enter and their variable migratory paths through different channels in the river. Furthermore, respondents have observed that sloughs and riverbanks frequently silt up or erode over the course of just a few years. Popular fishing locations and seasonal settlement areas are affected by this dynamic and changing environment, as discussed earlier. Fishers viewed adaptation to this environment as a necessity, and regularly moved to different channels to fish for salmon, depending on local abundance. The practical need for adaptive responses leads many fishermen to view ADF&G as unwilling to similarly adapt by moving test fish nets on an annual basis to areas where the salmon run is strongest, a practice respondents believed would provide more accurate estimates of salmon run strength.

> Us commercial fishers look for fish and move around. We look for fish. But Fish and Game, when they drift for no more than 20 minutes, in the same spot, never change, never look for fish. Then they say there is no fish. There is always fish, but they just aren't looking. … If there could be sonar that counts fish at South Mouth, Middle Mouth and North Mouth, and if those 3 count fish that are coming in, by the time they finish counting, before the king salmon go into a different slough. (KR6)

Emmonak fishers understand that lower Yukon River test-fishery catches may direct management to delay commercial fishing openers and reduce subsistence harvest opportunities, and are understandably concerned with potential inadequacies of the catch data. Test net locations are fixed in the same spot to allow managers to compare in-season run strength with runs of previous years. However, respondents assert that salmon do not move predictably through river channels. Salmon migration is influenced by annual variations in

water levels and changing river topography. Though the test net locations are not changed, the river itself can change around these locations, leading the managers, respondents felt, to gather an inaccurate glimpse of the current year's run.

Water temperature was noted as affecting salmon abundance and health, although informants did not describe the nature of this relationship in detail. Some respondents focused on environmental degradation and related habitat destruction as influencing salmon abundance. One respondent worried that dump sites, growing human populations, and growing use of gas and heating oil were contaminating Yukon River water (KR7). During the community review meeting for this project, community members also cited mining as a common unknown variable that is detrimental to salmon returns.

Management

> You have to work twice as hard right now in order to get the amount of fish that you have. 'Cause of all the regulations that we have to go by. The restrictions that are given to us. Even when we can go out there and … just only do subsistence. (KR10)

The most salient issue discussed by key respondents was changing the regulatory structure from a yearly predetermined harvest quota to a flexible fishing schedule of commercial fishery openings, which occurred in 1961. However, the most disquieting change for respondents has been the continued reduction of commercial fishing opportunity, beginning in the 1980s. The mechanism of this reduction is commonly referred to in the interviews as "windows."

> From June 1st through … we had a [commercial salmon harvest] quota, 120,000 king salmon … . We used to have quotas, but when I used to fish with my dad, before I start fishing my own, I don't think they had a quota. They would fish until they got enough fish. (KR6)

Three agencies have managed the Yukon River fisheries in turn. The first, the United States Department of Commerce, became proactive in management with the legalization of commercial fishing for export on the Yukon River in 1935 until 1940 when jurisdiction over the fishery passed to the United States Department of the Interior, Fish and Wildlife Service. The quota was progressively liberalized from there on. These historical accounts do parallel the accounts of the above quote, although fishing for subsistence and local commercial sale remained unregulated in the 1950s.

> And the Fish and Game [U.S. Fish and Wildlife Service], they used to always give us a quota, like 130,000 to 160,000 [Chinook] fish we could catch. This region area, Y-1. And every time we reached that quota they closed the king season. (KR12)

In 1960, ADF&G assumed management responsibilities of the Yukon River fisheries. In 1961, the flexible schedule of commercial openings was initiated and is still in operation now. However, respondents reported that the change in 1961 was hardly noticed. When asked if the 1970s and 1980s were just as hard as now, a key respondent replied, "No, because of Fish and Game regulations. They weren't too bad. We still had our 24- and 36-hour periods. That was okay, when it [windows] first came out it was alright" (KR 6). Both subsistence and commercial fishing were open at a minimum 5.5 days a week when they were first introduced. Another person commented that the new regulations were well received.

> Men were happy. They were relaxed, they could see their family for one day, go search, and take it easy. On Sunday evening they would go back to their camp. I had no one complain about 6 days a week. The men like it. I know my dad liked it. After that, the 48 hours, to the 12 hours, to the 6 hours. Today it was 9 hours. People started complaining about the short hours and not enough fishing time. (KR8)

Commercial fishing was reduced to 4 days a week in 1961. In 1974 subsistence and commercial fishery openings were separated. Finally, in the mid-1980s, ADF&G was delegated emergency order authority from the Board of Fisheries to open and close the fisheries in-season.

In 2001, the Board of Fisheries applied a fixed schedule of subsistence fishing windows to the subsistence fishery in Emmonak. The schedule was to be implemented chronologically up the river, based on average salmon migration speeds, to protect individual pulses of migrating salmon. Emmonak was allotted two 36-hour fishing periods per week, and, as indicated by the respondent above, the subsistence salmon fishery would be closed more hours in the week than it would be open. "And you know, they have windows right now and we're lucky if we fish, you know … they have windows in place where we watch all these fish go by …" (KR11). Limited windows that are not necessarily scheduled to provide fishing opportunities during times of local salmon abundance can lead to frustrating conditions. Local knowledge regarding fish abundance and the most efficient times to fish often proves useless since fishers have little choice as to when they are able to fish. The need to obtain salmon pressures many to fish during lulls in the run.

Another method of Chinook salmon conservation in the preceding decades involved limiting the methods and means for taking salmon. Lawful gear for harvesting salmon on the Yukon River is described in 5 AAC 01.220 and is also dictated by in-season emergency order. As noted above, salmon in the Yukon Delta are almost exclusively taken by set or drift gillnets. The common means of limiting harvest efficiency are with mesh size restrictions, restrictions on the depth of nets as specified by a number of meshes, and by net length restrictions.

> The biggest they had was 9 inch mesh. I remember there used to be a lot of big kings, until recently, there was big kings. We don't see those no more. (KR8)
>
> The gear was the same when I started [fishing]. Just the mesh was bigger on the nets for kings. Now we need 7.5 [inch] nets. … That regulation will go into effect next year. We didn't propose that, it was people from upriver that were proposing all sorts of proposals. (KR7)

Limiting the depth of the fishing gear as measured by the number of meshes diminishes the effective area of fishing gear but does not create a large financial burden.

> Seems like 10 to 15 years ago, when the fish start depleting, we started getting all kinds of regulations from the Department of Fish and Game. Like, before, we had 8 to 9.5 [inch] mesh size nets. The depth of the net was 70 meshes, really deep nets. Then 10 to 15 years ago they cut half of it to, like, 40, 45 meshes. That's when the fishing started going down. That's when I noticed—back in the mid-90s to 2000 area. (KR12)
>
> It's just regulation after regulation that they … placed on us, now we got … another restriction coming up next year where we have only a certain mesh size, which the elders know and I know is gonna really damage the big fish that they're really crying about for upriver. And that's been their main focus, the bigger Chinook salmon. And then down here … and I told the Board of Fish before … the big Chinook salmons run deep down here and we hardly ever catch them. We used to catch them when we were allowed to use 60 mesh deep. (KR11)

In 2010, the Alaska Board of Fisheries adopted further restrictive measures to limit the maximum allowable mesh size to 7.5 inch mesh or less. Because households typically own 2 sets of fishing gear, a chum net of approximately 6 inch mesh and a net of approximately 8.5 inch mesh, half of a family's gear was immediately rendered useless. Households that participate primarily in the subsistence fishery generally own larger nets, greater than 7.5 inch mesh, to target the larger fish. Because this action took place during the winter preceding the study and was to be enacted the following summer, many of the respondents were frustrated that they would have to acquire new gear to target Chinook salmon. Both Kwik'pak and Tanana Chiefs Conference administered net exchange programs to assist households in getting these new nets. The following account is given by one family that had just invested in a new net to harvest Chinook salmon in the subsistence and commercial fishery:

> We're like everybody else. We do the best we can with what we got. … We have 50 mesh deep nets, we try to avoid sandbars which make snags. We get a lot better at fishing this year and were able to sell what kings we got. It wasn't a lot, and we could have done

> better. We got to change our webbings. We had to go from an 8 inch to a 7.5 inch and we never used our brand new king net, not one commercial fishing opening. That is a $1,700 net and we never used it once for commercial fishing. We tried to use it for subsistence, but there was no fish that time. We are getting more chums than we are getting kings so we put away our king net when we were doing our subsistence and get the chum gear. … I don't see why they want us to lower our mesh size for commercial and subsistence. They say it's so the bigger kings will get away. They say that they are the ones that make more fish. (KR1)

The respondent above hints at what he and others perceive as a disconnect between the goals of the fishery managers and the likely effects of the restriction. Research has been published regarding the size selectivity of mesh sizes (Howard and Evenson 2010), but fishers assert that there are other considerations that have not been addressed. Multiple reports and discussions (Wolfe and Scott 2010) concerning mesh size restrictions point out that "drop-out" rates—fish caught long enough to be killed, but not harvested—should be considered. Other problems with mesh size regulations were identified by respondents. For example, one fisher explained how he can use his equipment to effectively skirt the intent of the new mesh size restriction. "I hang my net loose, super loose and that's how I catch the big ones" (KR8). Another fisher commented on the wear to nets from using smaller mesh when king salmon are in the river: "The big fish tear up our nets because the mesh is too little. The big king salmon, when they fight, they fight. Some get caught on their teeth" (KR6).

All respondents had opinions about management strategies and one indicated that he had been involved in the regulatory process. As perceived by respondents, management and regulation have very different venues. Management occurs generally through local interaction such as preseason management meetings, YRDFA (Yukon River Drainage Fisheries Association) teleconferences, and at the local ADF&G office. The regulatory process occurs less frequently at Board of Fisheries meetings and Federal Regional Advisory Council meetings. The most frequently expressed desire was that the regulatory process should occur closer to home.

> I wish the Board of Fish and Game would stay awake, for one week, at fish camp and observe. Come on up and observe. They tell themselves to investigate, not only here but they go all the way down the Yukon, not rely on someone else's information. They themselves should be doing what you are doing, or in summer season, they should at least observe. Spend time, a week in camp and see how we are doing. Even I tell them what is happening, but they don't know. They need to see for themselves. Spend time with some subsistence or commercial fishermen. Hang around them, stay with them, about a week. See how they are being affected. (KR8)

> And so does the Board of Fish, they just don't … they say they need the biological and data and stuff … the data we have are experience that we live through. It doesn't impact the decisions they make 'cause it's not written. And there's lots of local knowledge that just go in one ear and go out the other because it's not on paper. So then that's sad … I think and I know that [if they] listen to a lot of local knowledge, you probably wouldn't have this problem we're having now. Fish numbers getting so low. (KR11)

Local informants expressed a consistent concern that the regulatory process is directed by individuals lacking personal knowledge and experience of the local area. Fears and perceptions that the regulatory process is directed by "upriver" people and organizations with more money and more political clout were expressed:

> But work together. I had to do that in bad times, and the people were very good. And I think you should do that too; Fish and Game should do that too. Listen to the local people, not someone from out of town. And one thing that bothers me a lot is the top river people make decisions for us. They rarely listen to what we have to say. But they don't ask us enough, or when we make a proposal and it changes, they don't consult us. (KR5)

> That regulation will go into effect next year. We didn't propose that. It was people from up river. I never have tried to put a proposal myself. I would like to learn but it not that easy. You have to have a lot of background information and support from other people. (KR7)

Both distance from and knowledge of the regulatory process are common barriers to participation. Emmonak is unique in that it has a seasonally operated ADF&G office in the community that administers the lower Yukon River subsistence and commercial salmon fishing schedules and in-season assessment programs. Its presence does provide limited opportunity for participation in management on a formal and informal basis; however, trust and confidence are also somewhat limited.

> They have their purpose, counting. They are there to try to help us. Some people don't understand that. They get mad at the biologists. It's not their fault. Something is happening, something is wrong someplace, maybe the pollock, or the water is getting too warm. I don't know. Kings are getting scarce nowadays. They aren't like they used to be. Or they could be fished out, I don't know. But anyways that's what I do, help Fish and Game out as much as I can when they need help. Instead of wasting their time, they could be out test fishing. That's the reason why I do it. (KR8)

> I try to make recommendations here in town. They say "try." I try. I talk with them, let them know. Sometimes they ask me themselves, what my predictions are, or most of the time I just … kind of make suggestions to them. They don't have to listen, I am only one person. But it would be nice if they could get everybody to get suggestions from the elders, the people, to get one from each village. I know a lot of fishermen, good fishermen. Those are top notch fishermen. (KR8)

Socioeconomic Effects

Subsistence and commercial fishers face large monetary challenges to participation in either fishery. The costs of gear and a permit can come to tens of thousands of dollars, in addition to the annual cost of maintaining gear and purchasing gas. However, even in recent years of declining profits, families were still seeking to enter the commercial fishery. This section describes the ways in which families participate in the fisheries, the costs of entering, and how the cost of operating a fishing venture may affect personal strategies and decisionmaking in this period of salmon scarcity and conservative regulation.

For those who wish to enter the commercial fishery, the initial investment is substantial. Although the commercial fishing industry still provides access to equipment via financing, unfortunately, whereas there were 5 salmon processors providing access to equipment in the 1960s, currently there is only one. Most of the respondents charge fishing gear purchases at the Kwik'Pak Fisheries company store in the beginning of the season, and gas purchases during the openers in the hopes that they will break even. Others choose to leave the fishery and either retain their limited entry permit or transfer it to kin.

In terms of investment, the other major expense for a would-be commercial fisher is a limited entry permit. Most respondents acquired these through kin; however, 2 respondents chose to purchase them on the market. One respondent related that his family had to purchase a permit ($8,000), a boat and motor ($24,000), and nets ($1,500 each).

> We had to charge our rain gear, our fishing gear. That kind of brought our bill up. The boat and the permit were prepaid. Paid for already. We changed our nets and all our fishing gear. We owe quite a bit but not as much as many people. (KR1)

> Right now at the price rates, these boats and outboard motors are … most of the people can't afford those. Back then when we first started out … our parents thought maybe for a 5-horse or 10-horse-powered engine —300 bucks or 500 bucks was too much. Right now you purchase the same kind of outboard motor … 3-horse or 5-horse or 10-horse … you pay 3, 4 thousand dollars for those equipment. But then you want a 115, 150 horsepower,

> you pay 8 thousand to 15 thousand dollars. Or, for the purchase of a boat … 12 to 22 thousand dollars. How can you make money if you're paying that kind of … money for the equipment that you want to use? (KR10)

All respondents depended greatly on charge accounts—credit extended to the fisher from the processor—to participate in the commercial fishery.

ADF&G

Plate 3-6.–A drift gillnet fisherman unloads his catch of fall chum and coho salmon in Emmonak, Alaska, 2007.

> When we are going to go fishing, we go on the charge. We charge the gas, the equipment. Then we can go fishing. All the ones that we know around here, you go on charge. You got no money to start with anyways, so you charge the gas, the equipment, and you go fishing. Hopefully you pay for those, what you charge. Gas, every time I go fishing I go charge gas, about 30 gallons. That's what everybody does, charge. Some people pay for their gas, I don't know. The guys who have good steady jobs, they don't go in the hole. If I had the money I would pay for the gas so that way 1 pound [of salmon] would be my income. (KR8)

The overwhelming price of equipment, limited opportunities to fish, and mounting debt forced some respondents to opt out of the fishery for years at a time. However, some noted that this did not free one from the annual accumulation of debt or maintenance of equipment. Those who do not fish but wish to retain their permit still remitted the annual $75 permit fee. Those who cannot afford to continue in the fishery sold their permits.

> If they declare it a disaster, all commercial fishermen should be getting help from the disaster fund that they set aside. We are being restricted so much that some of us with the commercial license don't even go out anymore. The gas and food is so high, we don't make money. I don't go out anymore, but then I pay for license every year, so hopefully we'll have a good year. (KR9)

> Some people that are in dire need of money to pay for their bills and stuff like that, they do sell their permits. Right now … more or less, having a permit can put you in more debt rather than getting you out of debt. And you, almost like, you owe your life to the companies that are buying the fish that you harvest on the river. (KR10)

The price of gas is one the largest operational costs of both commercial and subsistence salmon fishing. Rising gas prices have recently affected Emmonak fishers by contributing to debt and limiting travel. High fuel prices limit options for the location of salmon and nonsalmon resource harvest and inevitably contribute to competition for the most easily accessible resources. In spite of high gas prices, fishers are reluctant to reduce the salmon harvests; several key respondents indicated that their annual harvest goal is fixed and

they will strive to meet that goal regardless of fuel costs. "I'm not the only one who goes in the hole. It's expensive because of gas" (KR6).

> …[T]here is a season and the season pretty much says this is when the fish run, and you go 'til you get enough. …Every family has their own quota [harvest goal]. We need 300 fish, so it will last us the whole winter. We need this many buckets and gallons and … we do everything we can to fill that quota. (KR3)

Although Emmonak fishers regularly demonstrate perseverance in their fishing despite fuel prices, the financial stability of both commercial and subsistence fishers is affected by these high prices. Many fishers border on or go into debt when earnings from commercial fishing do not replace gas expenditures.

> Depending how long you have to fish you get that gas to last the period. I'm sure people miscalculate. … Like I was saying before, you fish what you can afford. If you don't have any money and can't get it on credit, well you just don't go fishing. Even if you have a little of gas you go out to this muddy river and cross your fingers, toes, legs … for fish! (KR3)

One effect of fuel price is the limitation on the distance fishers will travel to harvest salmon, with many choosing to fish locally rather than travel upriver. In the case of the commercial fishery, a highly desirable drift gillnetting location is near the border of districts Y-1 and Y-2, where the Yukon River funnels migrating salmon into one channel. "If we could drift out here, and we are able to, we will go to middle mouth to try to catch there or up to the border line" (KR4). While commercial fishing, many respondents reported that they decide to use more gas to travel farther if they believe that they will catch salmon. However, lengthy travel to subsistence fishing locations, such as a family camp, was often reduced or eliminated. In the long term, this has influenced fishers to camp and subsistence fish in or near the community. "And also our subsistence and … price of gas and expenses kind of … made it … unfeasible for us to go to our fish camp, anyway, so … and that's the way it stands now" (KR11).

Respondents also described the reduction in income from commercial fishing, together with high fuel prices, as impeding their subsistence hunting and fishing.

> If there is no commercial [for Chinook salmon], I can't go out and go fish, I can't go hunt. … We are beached. We can't go anywhere because we have no gas, no money to buy gas because our commercial [fishing] has been closed this summer and last year. (KR6)

Market prices for unprocessed fish are also a major contributing factor to overall fishing expenditures. Salmon prices have recovered from a previous crash. Respondents generally credited the presence of competition between the multiple but now defunct processors in Emmonak for ensuring a higher price and one lauded Kwik'pak Fisheries' marketing efforts for achieving the same goal. In addition to the loss of fishing-associated jobs that these plants provided, respondents viewed the closures as impacting the market prices for fish through loss of such competition.

> And they had several processors and I was working for Arnold Akers, a fairly new processor. We already had Northern Commercial, we had Bering Sea … I don't know how many buyers, but we had 5 to 6 processors or buyers. They used to compete at how much they purchased the king salmons. (KR7)

> And then … Bering Sea Fisheries and … Polar Bear were the ones that finally started purchasing chum salmon at 10 cents per fish. And then everything started going … the price of fishery … harvested fish … started slowly going up. (KR10)

> I don't know how come we continue to fish with just one buyer. Nobody will jack up the price to have a competition anymore. So we'll just have one buyer, and that's the way it will be. …So I don't think it will get any better. (KR7)

Summary and Discussion

Declining returns of Chinook salmon and related regulatory changes are currently having profound direct and indirect effects on residents of Emmonak. Over the last century, commercial and subsistence fishing have become thoroughly integrated in Emmonak's economy; the decline and recent loss of a directed commercial fishery for Chinook salmon has meant the loss of the core of Emmonak's cash economy, a large component of its social identity, and the financial support of many subsistence activities. The current lack of economic activity on the lower Yukon River and recent increases in fuel costs are altering the lives of Emmonak residents in many ways. According to respondents, the community is in a state of economic disaster.

Increased regulatory actions on commercial and subsistence salmon fishing, reflecting conservative management of a diminished resource, have strongly influenced fishers' choices of fishing locations, techniques, and gear, leading to a general departure from historical fishing patterns. Such changes, together with the overall reduction in available cash, force residents of Emmonak to make frequent compromises as they attempt to balance the basic costs of maintaining a highly valued subsistence way of life with reduced and frequently unpredictable sources of cash income.

Residents of Emmonak have relied heavily on profits from commercial salmon fishing to support the basic costs of living and expenses related to subsistence hunting and fishing; the community's growth and development is largely due to the success of the commercial fishing industry. Several older respondents in this study indicated that this merger and Emmonak's development into the relatively large community it is today can be linked primarily to its good location and infrastructure for commercial fishing as well as compulsory school-based education for children in the 1950s.

Wolfe (1981) describes commercial fishing (which was dominated by Chinook salmon until 2008) in Emmonak and other communities of the lower Yukon River as "the largest and most consistent source of money … comprising (in 1980) 45.8% of their annual monetary income, or $8,026 per household" (Wolfe 1981:92). Adjusted for inflation and for the consumer price index in Anchorage (which does not fully account for the much higher cost of living in rural Western Alaska), this would be equivalent to around $18,400 in 2010.[4] By contrast, average income for a commercial salmon fisher in the lower Yukon River in 2009 totaled only $1,425 (Eggers et al. 2010), and no directed commercial fishing for Chinook salmon has taken place since 2009 due to conservative management actions.

In addition to reduced cash incomes for fishers and their families, the diminished commercial Chinook salmon fishery on the lower Yukon River led to a reduction from several to only 1 fish buyer/processor in the vicinity of Emmonak (Wolfe and Scott 2010). The closure of competing facilities meant not only reduced opportunities for fisheries-associated jobs, but also no opportunity for fishers to make business choices related to the sale of their product and leasing of fishing gear. The hardship imposed by the decline of income from commercial salmon fishing is intensified by recent increases in fuel prices, which have made travel and heating prohibitively expensive in Emmonak.

Revenue and equipment from commercial salmon fishing is important to subsistence hunting and fishing in Emmonak. Such revenue in the past was used to finance the purchase of a variety of supplies necessary for subsistence (Wolfe 1981). Respondents in this study indicated that, in general, the reduced cash that was earned from commercial fishing in recent years was primarily directed toward essential utility bills; in rare cases when there was enough of a cash surplus, as much as possible it was used to finance subsistence activities. In 2008, the majority of surveyed Emmonak residents in a comprehensive household subsistence survey described high fuel costs as limiting their subsistence activities due to lack of gasoline for travel and the need to spend time, as well as some gasoline, collecting firewood for heating (Fall et al. 2012). Respondents in this study described several ways residents of Emmonak are attempting to reduce costs and increase benefits from subsistence activities, including sharing transportation costs, not traveling as far from Emmonak, and at times practicing customary trade and barter "when they really need it." Residents of

4. ADLWD (Alaska Department of Labor and Workforce Development). n.d. "Research and Analysis Homepage: Cost of living and housing information." Juneau: State of Alaska Department of Labor and Workforce Development. (Accessed April 2014)

Emmonak have also been attempting to develop new economic enterprises in recent years (YDFDA 2011). In recent years, local fishing organizations have worked with ADF&G to develop a robust summer chum commercial fishery to make up for the Chinook salmon commercial losses.

Nonetheless, reductions in commercial Chinook salmon fishing on the lower Yukon River reflect not only declining returns of salmon, but also increasing regulation of the fishery based on conservative management of the resource. Key respondents expressed concern that primarily in-river management of Yukon River salmon neglected the importance of managing salmon with an ecosystem-based approach that focuses on threats to salmon survival both in-river and at sea. The threat of high seas salmon bycatch in Bering Sea fisheries was of particular concern because of the perception that those tens of thousands of fish were not "taken care of," meaning they are not respected, preserved carefully, and consumed. Salmon regulatory actions affecting residents of Emmonak have consisted primarily of limiting commercial and subsistence salmon fishing to progressively shorter fishing schedules (windows) and restricting the commercial sale of incidentally caught Chinook salmon during directed chum salmon fishing periods. Recent reductions in legal mesh size of fishing nets were imposed with the goals of recovering the resource and complying with international treaty by allowing escapement of higher numbers of larger and more fecund Chinook salmon. Windows regulations have had the intended direct effect of reducing the numbers of Chinook salmon harvested commercially (e.g., commercial catch of Chinook salmon in 2009 on the Yukon river was 99% below the previous 10-year average (Eggers et al. 2010), but have also directly affected Emmonak fishers' options and choice of fishing locations, techniques, and gear for both commercial and subsistence fishing.

Shortened fishing schedules for both subsistence and commercial fishing (generally 18–36 hours once or twice per week for subsistence salmon fishing, 4–6 hours periodically for commercial salmon) relative to the historical pattern of having multiple days per week to fish have led Emmonak fishers to try to adapt by optimizing time spent fishing, often at the expense of efficiency of fuel use and price of gear. Changes to fishing patterns that began in 1980 (Wolfe 1981:103) in response to shortened fishing schedules that would now be viewed as quite liberal have intensified; driftnetting is far more frequent than the formerly common setnetting; summer fish camps as a base of activity are far less common; and the use of powerful commercially manufactured boats has completely replaced wooden boats with low horsepower engines. These techniques and gear are viewed as necessary if one is to have a chance at catching any quantity of fish in such short periods of time. However, not catching fish in spite of high expenditures on gear is quite possible and led one respondent to describe commercial salmon fishing in recent years as a gamble (KR8).

The lack of a commercial Chinook salmon fishery in Emmonak has left the community in a transition state with high levels of uncertainty for the future. In this period of economic instability, respondents expressed concern for the loss of not only the Chinook salmon fishery and, the money that came with it in the past, but also the tradition and culture surrounding salmon for the next generations in Emmonak. Respondents in this study were eager for new economic opportunities in Emmonak. Many expressed great difficulty covering basic expenses such as heat, yet they also viewed the continuation of subsistence as essential and at least as important as the cash economy to their community. One respondent emphasized that although "commercial salmon is … very important for paying our bills … subsistence comes first." (KR 10). The commercial Chinook salmon fishery provided an opportunity for multiple generations of Emmonak residents to maintain a subsistence way of life while actively participating in the broader market economy and reaching a level of economic security; many members in the community are working to keep this tradition alive.

Recommendations

At the conclusion of each key respondent interview, fishers were asked to suggest final recommendations based on their life on and intimate knowledge of the Yukon River Delta. Responses were generally categorized into recommendations specific to fishery management and recommendations for developing the local economy. Many of their points were common themes in all the key respondent interviews and have been discussed, or already pursued, by ADF&G or other stakeholder organizations.

One respondent was adamant that ADF&G should move beyond in-season management and manage salmon at all life stages, emphasizing the years spent at sea (KR7). One respondent advocated for a moratorium on directed commercial openings for Chinook salmon, though allowing for subsistence (KR 7). A second respondent took this further to suggest a moratorium on subsistence Chinook salmon fishing (KR11). This would only work, he prefaced, if trawlers were subject to a moratorium as well. Many spoke of the Bering Sea trawl fishery and suggested conducting research and observations on the vessels to gain a better understanding of how they affect the Yukon River salmon fishery (KR 7 and 9). Many advocated restricting the bycatch and using the salmon caught (KR 1, 2, 4, and 12).

In terms of ADF&G assessment projects, respondents requested that ADF&G expand the use of sonar as an assessment tool (KR 1 and 6). Also, one respondent requested the test fish nets be moved to reflect changes in river channels (KR 6).

Focused on intra-river policies, one respondent advocated restricting the use of Yukon River salmon for dog food (KR 9), and another advocated making the sale of salmon roe illegal in the entire Yukon River drainage (KR 11). Lastly, 2 respondents suggested maintaining an active dialogue between management, the community, and the all river districts, but working harder at including the elders (KR 5 and 12). Lastly, one respondent requested that subsistence fishing be deregulated completely (KR 10).

Displaying a holistic understanding of the Yukon River Chinook salmon disaster, many respondents advocated measures to improve the local economy and alleviate the financial hardship felt by community members. One respondent suggested determining the feasibility of other nonsalmon fisheries in the Lower Yukon–Bering Sea Region (KR 9). Another suggested marketing efforts so that they could fetch a higher price for their salmon (KR 3). Local fishermen should also form a union to more effectively represent themselves (KR 10).

One respondent spoke of measures to lessen the financial burden of commercial and subsistence salmon fishing. He suggested waiving limited entry permit renewal fees for inactive fishers that wish to retain their permit. He also suggested that customary trade of processed salmon be allowed so that subsistence fishers can meet the expense of fishing (KR 6).

Deena Jallen

Plate 3-7.–Sunset on the Yukon Delta, 2008.

4. MARSHALL

Hiroko Ikuta

Setting and Context

Local Research and Respondent Profile

To better understand the role of subsistence and commercial salmon fisheries and evaluate the effects of declining salmon runs in Marshall, in 2010 we interviewed 11 active fishers (all men); they were born between 1948 and 1974 and ranged in age from 36 to 62 years old. Each of them has extensive knowledge and experience with subsistence and commercial fishing. We also held a community review meeting in Marshall on June 29, 2011. It was an intense four-hour meeting with more than 40 fishers who gave us invaluable feedback. In addition, the survey related to barter and customary trade was conducted with 38 (52%) of approximately 73 households, providing preliminary data regarding the significance of those practices in Marshall (Brown et al. 2015).

Historical Background and Natural Environment

Marshall is located on the north bank of the lower Yukon River, approximately 100 miles upriver from Emmonak and 233 miles downriver from Nulato (Figure 4-1). It is home to Central Yup'ik people, who identify themselves as *Marssercullermiut*, "people of Masserculleq." In the Yup'ik language, the area is called *Masserculleq*, which means "the place where salmon spawn," or Urluvra, "little bow." In November 1880, ethnologist E.W. Nelson visited Urluvra and witnessed and documented a local festival for the deceased (Nelson 1899:20).[1] During this expedition, Nelson was collecting ethnographic data and objects of the material culture of indigenous peoples in the Yukon-Kuskokwim Delta for the Smithsonian Institution. It is noteworthy that since Nelson's visit in the late 19th century, little ethnographic research has been conducted in Marshall.

Precontact history of the area is undocumented, but it is likely that local Yup'ik knew and utilized the area as part of their seasonal round of subsistence harvest. Records suggest that the community was founded by Euro-Americans as a mining camp (Orth 1971rep; Rinear and Vistaunet 2008)[2]. In 1913, E. L. Mack and Joe Mills discovered gold on Wilson Creek, approximately 7.5 miles northeast of Marshall. A camp was set up in a suitable location for a boat landing on a channel of the Yukon River and named after Thomas Riley Marshall, the Vice President of the United States during the Woodrow Wilson administration of the period. In 1915, when a post office was newly established in the community, government officials informed the local residents that the name "Marshall" was already being used in the contiguous United States and asked the Alaska community to change its name. Following this, the local people named the post office, thus the community, "Fortuna Ledge" after Fortuna Hunter, who was the first child born in the settlement. In the following decades, gold was discovered at several creeks in the region. Fortuna Ledge developed into a gold mining town where steamboats landed during the summer, and the population eventually exceeded 1,000 people. By the early 1950s, however, gold production declined, and most of the mines in the region were closed. In 1984, Fortuna Ledge was renamed Marshall.

While the community of Marshall was officially founded by gold miners, indigenous peoples in the region played a major role in its development. Ancestors of many current residents in Marshall migrated from two nearby Yup'ik communities: Takcak, five miles downriver, and Urr'armiut, which was located 25 miles

1. In his book, Nelson (1979) describes Urluvra as Razbinsky.
2. See also Marshall High School Journalism Class, 1984. n.d. The History of Marshall Alaska, Also Called Maserculiq and Fortuna Ledge. Marshall, AK.

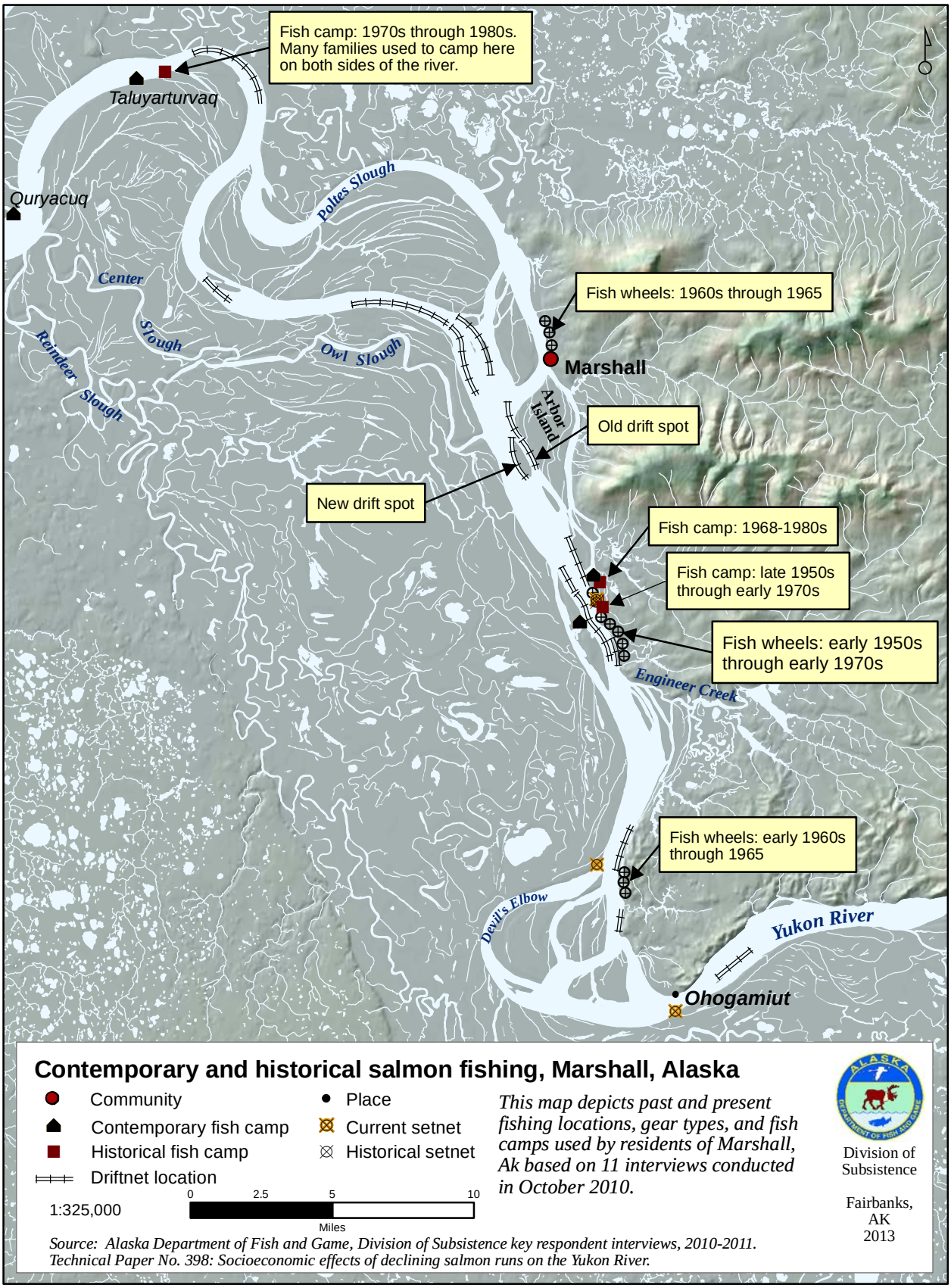

Figure 4-1.–Contemporary and historical salmon fishing locations, Marshall, Alaska.

upriver from Marshall.[3] By the 1940s, residents from both communities permanently relocated to Marshall due to territorial laws for children's school education. Thus, there are now 2 federally recognized tribes in Marshall, the Native Village of Marshall and the Village of Ohogamiut. Some Iñupiat also migrated to Marshall from Unalakleet on Norton Sound. According to the U.S. Census in 2010, the population of Marshall today numbers 414, of whom 95% identify themselves as American Indian/Alaska Native.

Danielle Ringer

Plate 4-1.–View of tundra north of Marshall, Alaska.

As all along the Yukon, people in Marshall rely heavily on salmon fisheries for subsistence purposes. The majority of residents earn limited income from seasonal or short-term jobs. In Marshall and the lower river region, commercial salmon fishing is the primary employment opportunity. Some households also receive government assistance. According to the U.S. Census in 2010, the estimated median household income in Marshall is $37,500 (c.f. national average: $51,914).

Community Fishing Profile

> Salmon to us is like potato to farmers … . Us as Natives, we eat a lot of salmon. It's just the way we are. It's just the way we were raised. (M4)

In the Central Yup'ik language, the Yukon River is called Kuigpak, which means "big river," and the residents in Lower Yukon, including those in Marshall, are collectively identified as Kuigpagmiut ("people from the big river") who rely on salmon for their livelihood. Salmon have long been a critical nutritional, social, and economic resource; Chinook salmon are highly valued, yet summer chum salmon are consistently the most abundant and reliable resource. Chum salmon are preferred by some because they contain less oil and dry quickly. In general, residents in the lower Yukon River tend to harvest fewer Chinook salmon and more chum salmon for subsistence than those of the upper river (Wolfe and Scott 2010:8).

Neither subsistence nor commercial fishing in Marshall is an individual effort; but rather, both types of fishing occur within complex production units based on kinship and are closely entwined. The labor of fishing in Marshall is generally shared by extended family members, including elders and youth who cooperate in both harvesting and processing. In the case of subsistence fishing, processing includes cutting, drying, smoking, salting, and storing salmon. Those who are not physically able to directly participate in harvesting often supervise novices, while children pay attention and learn by helping with minor tasks.

Nearly all respondents told us that they helped their parents with fishing in their childhoods. While young children may not be a productive labor force, they are expected to participate in fishing to gain empirical knowledge. One respondent said, "When you're that young, you aren't good for anything. But you know watching. At least you are looking and observing, knowing what is going on" (M4). Learning occurs by physical involvement, and knowledge undergoes continual regeneration in the process of learning. Yup'ik

3. In English, Urr'amiut is spelled Ohogamiut, while Takcak is spelled Takshak (see DeLorme (Firm) 2004).

children are expected to learn by observing experienced fishermen who know the fishing equipment and techniques, fish behaviors, anatomy, geography, and weather. As they grow, they practice as helpers.

> I was born into a subsistence family. My early recollections are good memories of abundance. Salmon played a vital role in my upbringing. It was a major source of nourishment with the family and my summers were spent at fish camp… where my parents and other community members dried king salmon, chum salmon for the winter. And of course, my family salted salmon as well. Salmon comprised about 70% of our diet. (M5)

In the Lower Yukon River, commercial fishing is well integrated with subsistence fishing (Holder and Senecal-Albrecht 1998; Wolfe and Scott 2010; Wolfe 1981, 1982, 1984). Commercial fisheries in Marshall are small scale, family-oriented operations that draw on the local ecological knowledge, pragmatic skills, social networks, and cultural values of subsistence fishing. In many cases, in both kinds of fishing, gear is owned by individuals and used by teams of extended family members to provide for many households—whether they produce fish or, eventually, cash. Regardless of age, family members participate in and contribute to subsistence, and, in the few families that continued it, commercial fishing. One respondent talked about his early involvement in fishing and explained how cash income from commercial fishing supported his family:

> I was about six years old when I stepped aboard on my dad's boat for commercial fishing ... . It was an important part of the family's income for many years. It was basically the sole income … for food, clothing, bills. Commercial fishing also provided us with income we needed to buy outboard motors, fishing, gear, snowmachines … . It was the economic engine for years. (M5)

Similar statements were made repeatedly by respondents. Neither subsistence nor commercial fishing alone is sufficient to support the local economy. Rather, together they have provided the livelihood of the people. This is particularly true during periods when Chinook salmon is abundant—which has not been the case for most of the last 15 years or so.

History Of Local Fisheries

Salmon have long provided a vital subsistence resource in the lower Yukon River. Chum salmon, which tend to swim closer to shore than Chinook salmon, are easier to catch in shore-bound gear such as setnets and fish wheels. Summer chum were the staple fish in the lower Yukon, used for feeding people and dogs. Until the late 1960s, large quantities of summer chum were harvested for the latter, whether the fisher owned the dogs or traded the fish for needed supplies. As that subsistence demand declined because of snowmachines, summer chum were allowed as a commercial target, along with fall chum and Chinook salmon, and Chinook salmon became a stronger focus of subsistence fishing. Chum salmon still provide a substantial portion of human food and vital economic activity in the region, while the decline in Chinook salmon has taken a severe toll on the community both socially and economically.

People in Marshall have witnessed a significant shift in salmon runs in the past several decades. Until the late 1990s, salmon were a stable resource for subsistence and cash income, and many respondents recalled this time of plenty. One respondent in his 50s remembered an abundance of the living resource when he was a young boy. "[We used to catch] maybe 200 kings and maybe 300, 400, 500 chums… There were a lot of fish, big ones too" (M8). Another fisherman in his 60s said:

> In the early '60s, the salmon, Chinook, chums, and cohos, they were abundant. In those days, you could just throw your net out in an hour if you are subsistence fishing, you can catch 40 to 50. (M2)

One respondent told us that he acquired a limited entry permit in 1989 when the price of a permit was over $25,000. His father had seen the investment value of obtaining the expensive permits not only for himself but also for his wife and their 15 year old son.

> Back in the fall of '89, my father bought a local permit in town. I think maybe $27,000, and he bought it because during that time, you were able to make a lot of money commercial salmon fishing. To him, I was at the age where he knew that I could handle a boat … . My dad bought my mother a permit before he bought me one. That's how lucrative the fishing industry was…. In '89, [someone] bought a condominium in Anchorage, and he paid straight up cash for it. He was telling me that he paid for that just from what we made during fishing. (M4)

The permit price of $27,000 was not exceptional during that period. According to Holder and Senecal-Albrecht (1998:48), open market values of a Commercial Fishing Entry Commission permit in the Lower Yukon between 1987 and 1996 ranged from $21,000 to $31,000. Only 7 to 12 permits were sold or transferred per year between 1989 and 1994.

The high price of permits was perpetuated by the abundance and high price of Chinook salmon. Marshall is located in District 2 of the management area, where the quality of salmon is highly valued by national and international markets. In 1992, for example, estimated ex-vessel value of Chinook salmon was $4.12 per pound in the Lower Yukon River, while its value was $0.91 per pound in the Upper River (Holder and Senecal-Albrecht 1998:49, 51). As a result, commercial fishing led to a boom economy in Marshall and some fishers enjoyed substantial cash income. One fisher said, "Every commercial fisherman would average from $30,000 to $48,000 after paying for gas, helpers. This was profit" (M2). Another mentioned, "Most I made was about $30,000 in one opening, in 24 or 36 hours out there. A lot of fishermen did about the same" (M8).

The affluence of commercial fisheries provided a number of business opportunities in the region for many decades. Like most communities on the Yukon River, Marshall is isolated and does not have a road system connected to other communities. Distant from national and international markets, fishers have depended on the processing industry for transporting and marketing of their salmon. In the 1990s, there were at least five commercial processors in districts 1 and 2 (Holder and Senecal-Albrecht 1998:52–59). One of the companies was Boreal Fisheries of Graham, Washington. It was a pioneer processor in the region, and operated its business at Pitka's Point in the middle of District 2. One respondent told us:

> I remember when Boreal came in. The first time I sold [salmon to] them was '74. He had just started. He had one little shack, his weighing scale and then some boxes to put the fish in that he had just bought. It was just a brand new operation. (M10)

Another company was Maserculiq Fish Processors (MFP), locally called "Fish Plant." It was a subsidiary of Maserculiq, Inc., the Alaska Native Claims Settlement Act village corporation of Marshall. A respondent remembered:

Danielle Ringer

Plate 4-2.–Despite a decline in demand, chum salmon are still used to feed dog teams along the Yukon River.

> Back then, commercial fishing was a big, big industry. And the Marshall Fish Plant was buying fish at the time. They had a couple of boats, big boats and then they had a fleet of maybe 4 or 5 smaller boats that would go out, up and down the river to collect fish. You didn't have to travel very far to deliver your salmon. (M4)

Based in Marshall, MFP purchased salmon from local fishers and brought them approximately 40 miles downriver to St. Mary's for air shipment. Unlike other lower Yukon River processors that targeted the Japanese market, MFP sold Chinook salmon to restaurants on the western seaboard of the U.S. (Holder and Senecal-Albrecht 1998:54). In the 1980s and 1990s, MFP competed with Boreal and other processors, contributing to economic development in commercial fisheries in the Lower Yukon. In the late 1990s, however, the size and quality of salmon and the volume of salmon runs began to decline; processors left the region or went out of business as profitable harvests became elusive.

Collection, Processing, and Distribution of Fish

Gear

Wolfe and Scott (Wolfe and Scott 2010:75) report that since the primary methods gradually shifted from wheels and setnets to drifting in the 1960s and 1970s, fishing and processing methods in Yukon River communities have been consistent. The adoption of drifting, which gave fishers better access to the middle of the river, allowed a new focus of subsistence fishing on Chinook salmon, and the subsistence harvest of that species increased dramatically. Some gear has been refined or updated, yet no dramatic change in types of fishing equipment or methods has been observed. Today, fishermen in Marshall use the same type of gear for both subsistence and commercial fishing: a skiff with an outboard motor and gillnets of various mesh size depending on the target species. Larger-sized mesh nets are used for Chinook salmon and mid-sized mesh nets for chum and other species of fish. Over the last several decades, two major fishing techniques are used to harvest salmon: drifting a net from a boat and setting a net along a river bank.

One important change to fishing in Marshall is the abandonment of the fish wheel as a harvesting method. In our interviews, respondents identified 12 fish wheels that were built and used by the residents of Marshall between the 1950s and the 1970s. According to our respondents, local fishermen actively used fish wheels until the mid-1970s. One fisherman recalled:

> [W]hen I first observed the kind of fishing I could see around me, [it] was fish wheels, They're abundant here … . But they were banned in this area. I think 1976, they started the ban on fish wheels. I don't know what was the reason, maybe they catch too much fish, I don't know. (M1)

Although rumors of a ban may have discouraged the use of fish wheels, they are still allowed as a gear type for subsistence fishing in Lower Yukon communities (5 AAC 01.220). The shift away from fish wheels was mostly related to the availability of snowmachines. The new mode of transportation replaced thousands of sled dogs that had consumed large numbers of chum salmon, which fish wheels harvest quite effectively. A decline in the use of fish camps may also have been related to the decreased demand for fish for dogs.

Fishing areas were often shared between subsistence and commercial fisheries for Chinook and chum salmon harvests. Decades ago, most families used camps that were outfitted with a cabin, wooden racks for drying fish, and a smokehouse. One fisherman recalled his childhood and said, "We stayed at the camp all the time. The fish wheel was right in the front" (M8). At the camp, he remembered that his family set nets, drifted nets, built and operated fish wheels, and dried and smoked the catch.

Fishing Practices

In recent years, people in Marshall have preferred to harvest salmon near their community instead of at their fish camps. Depressed salmon runs and shortened harvest windows, coupled with higher fuel costs, have made it much less beneficial for extended families to travel long distances to maintain and operate

their isolated camps. Staying in town not only saves costs of traveling and operating camps but also gives people, especially wage workers, the ability to fish in compliance with the regulations. An interviewee said:

> When I was a kid, we mostly spent our time in fish camp to watch those fish wheels, catching fish … . Things have changed. It's been like 20 or 30 years. People still go fish camping, but very few people go fish camp now. Very few. We prefer to have our fish camp here in Marshall. We built our smokehouses to save gas and energy ... . It's easier. We look after one another here in town. (M1)

Many respondents affirmed the finding (Wolfe and Scott 2010:75) that fishing regulations are a major factor in the shift of fishing locations. The change in fishing areas is one of the local responses to the salmon disaster and its economic effect, which will be discussed in greater detail below.

Sharing, Barter, and Customary Trade

In Marshall, 38 of 73 households were surveyed for information related to food distribution in 2010. As in other communities, sharing was the dominant method of subsistence food distribution. Of the 38 households, 18 reported participation in both barter and customary trade while 20 reported that they had never engaged in either activity (Appendix C, Tables C1 and C2). The survey identified a limited yet consistent barter in Chinook salmon, moose, and berries to people inside and outside of the community.

Danielle Ringer

Plate 4-3.–A skiff beached at Marshall displays both a fishing rod and a drift gillnet.

Although the numbers of examples of the two types of exchanges given were evenly split (18 each), the interview respondents indicated that barter (the exchange of one resource for another) was more common than customary trade (the exchange of a resource for cash). One respondent in his 50s said, "I've seen it [bartering] when I was growing up. I just traded some whitefish for some seal oil. So, I still barter" (M10).

Of the 18 households that reported bartering, more than half reported that they barter at least once a year and that they had been bartering for 1 to 45 years. Of the 18 bartering households, 83.3% reported doing so because they needed food, and 77.8% because someone else needed food (Appendix C, Table C4). The quantitative data of the survey was further explained by an interviewee:

> Some families will trade or barter with people from other regions for salmon strips for salmonberries. Or salmon strips for seal oil. Or salted salmon for blueberries. You know these things do happen, and it's part of our culture … . But it's not practiced on a wide scale level as it was back in the early, early days. Like salmonberries in this region, they are scarce. On the lower Kuskokwim on the other hand, they are in abundance. And a family wants some Yukon River salmon strips, and a family here wants their salmonberries. Oh, let's trade, we have a barter system going. Or back in the early days when moose was scarce down in the coastal areas, people traded some moose for seal

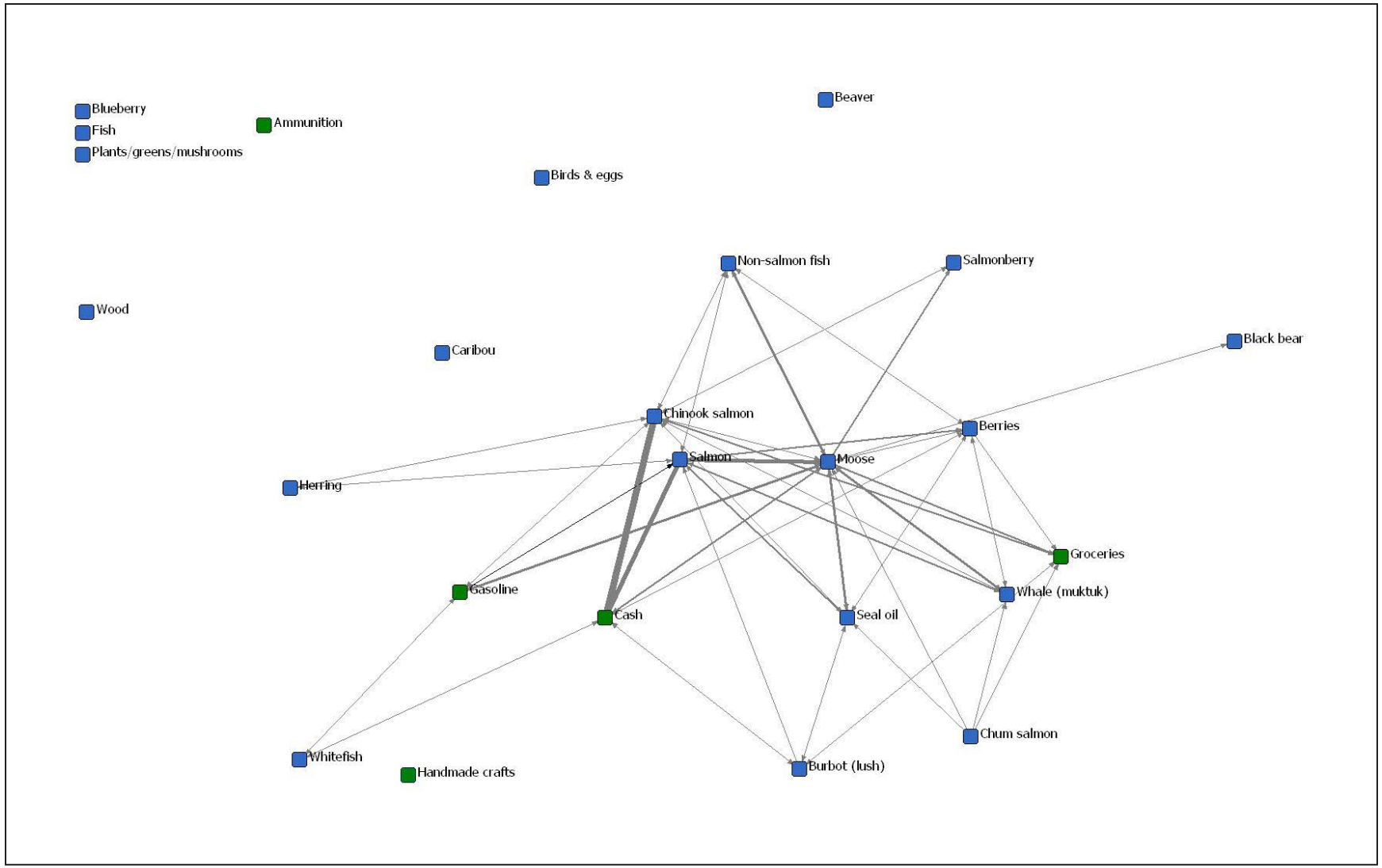

Figure 4-2.–"All Exchanges" network diagram of the barter and trade continuum in Marshall; resources that are exchanged frequently migrate to the center of the diagram; those exchanged less frequently move to the periphery. The weight of the line connecting resources reflects the frequency of that particular exchange. The absence of a line does not indicate exchanges do not occur, but rather implies that the type of exchange is not common and/or not documented by the sample households: i.e., no specific incidents were documented, nor was the general pattern described.

> oil. It's just basically on supply and demand. What we desire from that region and what this region desires from that region. That's customary. (M5)

In general, wild food acquired from the land and the ocean by subsistence activities is highly valued, and regional delicacies are often favorite trading items. In Marshall, people bartered salmon and moose for seal oil and muktuk with people from other communities, presumably residents from the coastal region. Among people living in Marshall, salmon was often traded for moose, berries, or nonsalmon fish (Figure 4-2). Barter events also included exchanges of moose meat, salmon, or berries for gasoline or groceries.

There is a long history of customary trade in Marshall, although the exact legal definition was unknown to most respondents. Given the definition (the limited, noncommercial exchange of a subsistence caught wild resource for cash), some people pointed out that customary trade in Marshall was more common in the 1960s when there was a trading post. During that period, a domesticated mink trade was active. Respondents in their 50s individually said:

> When I was growing up, we used to have a fur buyer here … . We don't see those no more. Those days, they were really getting into fur buying … . They called it trading post. (M1)

> Mink was a big thing back then in the '60s. And light mink brought the best price. So there was a lot of light mink here in town, in this end of town. I remember seeing a lot of salmon going to those minks. It would make them nice and shiny. But that was the first time I've seen money being exchanged. (M10):

This latter respondent was a child in the 1960s, so his earliest observation was not necessarily the earliest event. Indeed, the sale of fish for cash had been a substantial portion of local economies in the Yukon drainage for decades prior to Alaska statehood in 1959—when the exchange of subsistence fish for cash was disallowed. As the fur market crashed and the trading post went out of business, customary trade declined. Our respondents explained that customary trade was not a general method of food distribution in the community. Rather, sharing was much more common and important. This observation is well supported by other research conducted in rural Alaska (Wolfe 2000). One respondent said:

> I don't do it [customary trade]. I would rather give it somebody that really needs it rather than sell it to them. And I'm pretty sure you ask any other Native that and they'll tell you the same thing. (M4)

Another interviewee shared similar insights, yet acknowledged some customary trade activities in the community. He pointed out that wild food acquired by small scale subsistence activities could not be sold in large enough quantities to make profits.

> People in my area, Marshall, never really sold our subsistence salmon to make a living. A few families will sell a few bags of salmon strips or maybe a few bundles of dried salmon … . But this is not a big issue in our region … . Simply because it's a staple in our diets and we are not gonna sell our dried salmon, salted salmon to the point where we don't have any for the winter. Yes, there will be a few families that sell their surplus, not to make a lot of money. But we mainly give our family and friends, we share. It's part of our culture to share. (M5)

In our survey, respondents reported buying subsistence resources because they needed food (83%) or items other than food (22%). Some households sold resources because someone else needed food (22%) or items other than food (28%). Only 22% of those reported selling food because they needed money. Interestingly, 45% of households reporting customary trade said that they had never bought or sold the same food, which suggests that the practice is often spontaneous and opportunistic rather than orchestrated and routine (Appendix C, Table C6). The resources most commonly exchanged for cash within the community were salmon, nonsalmon fish, and berries. Customary trade with people outside of Marshall was most common for muktuk. The amount of cash exchanged per weight or volume of resource varies, as do the quantities exchanged. For example, the largest report was from one household that sold 125 gallons of dried

Chinook salmon. Others reported purchasing frozen berries (15 gallons and 3 quarts), 20 gallons of dried nonsalmon fish, and 10 whole fresh whitefish. In the only specifically reported customary trade outside of the community, one respondent purchased 18 pounds of muktuk from someone in Emmonak.

One respondent thought that customary trade had not been common in Yup'ik society. Yet, like any culture, Yup'ik people live in a changing world. He said:

> For many years … we had a belief that we were discouraged from selling our subsistence catches. There's also this issue of traditional Yup'ik … on the spiritual level that we weren't allowed to fight over the resources. Or that we were told to share with the less fortunate. But as the culture changes, all these beliefs are trickling away from the core of our value systems now. It's really kind of complicated. (M5)

Local Experiences of Salmon Decline and Disaster

Observations of Change

All respondents but one talked about the recent weak Chinook salmon returns. One fisher said, "There was more fish then, lots of kings. What I see compared to those times to this day is less kings running on, coming on the river" (M3). Another fisherman remarked, "It definitely is less now. We'd have more fish in the early days" (M10).

Fishers in Marshall have also observed the size of Chinook salmon decrease. One fisher explained, "There were a lot of big fish. But nowadays ... I can see the trend starts about 1996. I kind of noticed, the fish were getting smaller" (M1). Another respondent said, "On the sizes of fish, boy, they got small. The heaviest I think was an 82 pounder. Boy, that fish was big … . I don't see those anymore" (M10).

Observations of changing salmon size were sometimes described in reference to a particular phenotype of Chinook salmon run that local fishermen identify as "whitenose," and that are most prevalent late in the Chinook run (Moncrieff and Klein 2003). Respondents explained:

> These salmon have a cycle, different patterns for swimming up this river. Three kinds. [The first] ones, they're about 15–20 pounds come in the first week. 30–40 pounds comes in the next. The funny things nowadays I don't see those big, bright king salmons like I used to. They weigh about 60–90 pounds. (M2)

> At the time that I was helping my dad commercial fish, they used to catch those whitenose king salmon. There were lots and there were hardly any of those young ones. From now, what I'm seeing these salmon that we're getting, they're mainly medium size to small. (M3)

"Whitenose" is a local term to describe the fattest and largest size of Chinook salmon that arrive late in the Chinook salmon run, in late June. Phenotypically, a whitenose has a pale and protruded nose, gray, green, or blue sides, and darker dots (Moncrieff et al. 2005). Some fishermen have noted that they come with the south wind (Moncrieff et al. 2009:36).

Most local fishers agreed that the depressed Chinook salmon runs are the major reason of declining harvest. A few respondents suggested that the current fishery collapse was actually caused by fishing regulations. One respondent said that the number of fish is unchanged (M4). Due to increased regulations, people have fewer opportunities to fish and cannot catch as many fish. Thus, the local residents cannot make a living out of commercial fishing. The following section explores how the community residents view federal and state management.

Management

As the number of Chinook salmon in the Yukon River have declined since 2000, more conservative fishing regulations have been enacted. Tension between the local fishers and managers steadily increased in recent years as salmon runs hit record lows. In late June 2009, Marshall caught national and international media attention when community residents organized a "fish-in." The purpose of the fish-in was to protest restrictive subsistence and commercial fishing regulations on the Yukon River in response to a Bering Sea Chinook salmon bycatch management action taken by the North Pacific Fishery Management Council (ADF&G 2011a) a month earlier. In April 2009, the council had set a goal of reducing the number of Chinook salmon that could be harvested as bycatch in the Bering Sea pollock trawl fishery to fewer than 60,000 fish. The program was to be driven by incentive rather than punishment, and the fishers felt the number was much too high—especially while they were having trouble meeting their subsistence needs.

More than a dozen local fishers in six boats illegally caught 100 Chinook salmon for subsistence uses during a closed fishing period (*Anon* 2009a; DeMarban 2009a; Hopkins 2009). The fishers carried copies of a resolution of support for the action by the Ohogamiut Traditional Council in Marshall. On September 30, three months later, U.S. Fish and Wild Service officers flew to Marshall and cited only one person, the city police officer, Jason Isaac, who admitted his illegal fishing activity (*Anon* 2009b). A few days later, representatives of Ohogamiut, Executive Director Nick Andrew Jr. and Vice President William Andrew, protested the $275 citation that Isaac received. Their action was fully supported by the Association of Village Council Presidents, which represents 56 federally recognized tribes in the Yukon–Kuskokwim Delta. On October 21, 2009, the U.S. Department of the Interior, Office of the Solicitor sent the tribal council a letter that the case was dismissed (Andrew Jr. 2009; DeMarban 2009b).This incident highlighted the local fishers' frustration with state and federal fisheries management.

In our interviews in fall 2010, almost all respondents shared their concerns about the current regulations and management. Some people expressed strong resentment toward ADF&G. One interviewee said, "Fish and Game is giving so much laws. They are hurting our people" (M8). The major concerns raised were fishing periods and net mesh size, the accuracy of sonar at Pilot Station, and Chinook salmon bycatch in the Bering Sea.

State and federal managers have multiple obligations to consider as the run develops in the delta. They must meet escapement goals as well as the needs of subsistence fishers in upriver communities. They are also bound to honor the Yukon River Salmon Agreement between the U.S. and Canadian governments, which stipulates that the earliest pulses of salmon, which are composed of up to 50% Canadian-origin fish, be allowed to return across the national border. To accomplish this, subsistence fishing opportunities in Lower Yukon communities have been reduced, while commercial openings for chum salmon have been restricted in order to avoid incidental harvest of Chinook salmon. One respondent said:

> In those days, the regulations were two 36 hours per week—72 hours per week. Nowadays, time ... our regulation on commercial has been cut down very drastically to two 6 hours per week. Maybe 5 openings the month of June or July (M11).

As a result of the increased regulations, fishers are pressured to reach their harvest goals and meet their families' needs in shorter periods of intense fishing. One interviewee stated, "These shorter openings, people go fishing like crazy, just like swarming bees out into the river" (M1). This situation contrasts with the way people fished decades ago when people were able to control the amount of their harvests and fishing schedules. A fisher explained:

> The old days, we weren't gonna fish every hour, every second of the opening. They would have their own schedule you know, sleep at night, check the net early in the morning. Sometimes before the fishing opening is closed, they would pull their nets out earlier. They've had enough. They watched the fish. OK, you know this is a big run and I could catch a lot. This is a small run there is not much out there. They fished to satisfy their need. You need this much. It's a need. But right now, it's everybody "I want to get

> every fish I could get during this six hour opening." So it changed from not fishing the whole opening to "I'm gonna fish every second of an opening." (M10)

During one interview, a respondent asked, "How are you going to pay for family? For food on the table? Nobody in their life can only fish for 18 hours, 6 hours. Fish and Game, they think fishing for 18 hours is rich. We don't" (M8). From a slightly different perspective, a fisher in his 40s made a similar point and discouraged young people from becoming commercial fishers, because the majority of them would struggle with a life of debt due to restrictive regulations.

> Get an education. Don't rely on the fishing. You know it's a good supplement, that's all it is these days, supplement to our incomes for those of us working. But for many without regular jobs, it's their only income. And it's truly painful to see how all these restrictions—it's hurting unemployed. Those unemployed are going deeper in and deeper in and deeper into debt because the restrictions constrict. (M5)

Mesh size was another regulation with which local fishers took issue. For decades, many fishers in the region used nets with 8.5 inch mesh or larger for Chinook salmon and 6 inch mesh for chum salmon. Starting in 2011, however, the maximum allowance of mesh size for subsistence fishing was restricted to 7.5 inch mesh or less to avoid the capture of large Chinook salmon. For commercial fishing, mesh size was generally restricted to 6 inch or less—to avoid the capture of any size Chinook salmon. Many Marshall fishers were skeptical about the effect of the mesh size restrictions for Chinook salmon conservation because they did not expect the smaller mesh to save the Chinook salmon population. One respondent said:

> Ten years, there'll be no more salmon … . The big prized Yukon Canadian salmon will hit that small mesh gear. The only thing that will get stuck is their nose, which will make them not breathe, which means they will die by the time you'll pull them into the boat. They'll fall out of the net. (M4)

Wolfe and Scott (Wolfe and Scott 2010:70) use the term "drop-out loss" to describe these incidents. Another fisherman echoed concerns about drop-out loss and said:

> We are gonna slaughter more smaller fish and kill off the big ones. When the bigger salmon get hung up on the smaller mesh size, they twist, they fall off and they swim away wounded. The wounded fish won't be able to swim to its own designated spot. Fish and Game thinks if they can regulate smaller mesh size, they are gonna save bigger fish. It ain't gonna save no fish, it's just gonna make it more. Do damages on both sides, bigger fish, smaller fish. See the effects in a few years (M2).

One fisher felt that the gear restriction would harm large sized Chinook salmon, yet he told us that the 7.5 inch mesh size restriction did not affect his fishing. He was able to harvest various sizes of Chinook salmon, as he needed.

> I can guarantee you that they are gonna wipe the fish off the Yukon. Not only are they going to get these medium size king salmon along with these large chums as well … I had a 7.5 [inch]—boy, it was one of the catchiest nets that I ever had. As commercial fishermen, some of us are so much experienced we can use just about any kind of net and catch all the fish we want. (M1)

ADF&G has conducted research on the relation between net mesh sizes and the size of Chinook salmon harvested, as well as how mesh size restrictions contribute to Chinook salmon conservation (Howard et al. 2010). In the community review, however, a fisherman stated that since the 7.5 inch mesh restriction was enacted, 75% of Chinook salmon that he caught were male, 25% female. Before the restriction, the ratio of sex was 50/50. He pointed out that current management focuses on only numbers and species, but the managers should consider additional attributes during management. Several attendants in the community review meeting in 2011 suggested that future research needs to address sex, age, and drop-out loss of Chinook salmon. These questions are addressed in the Discussion, Conclusions, and Recommendations (Chapter 8).

Bycatch of Yukon bound Chinook salmon in the Bering Sea pollock fisheries was another major regulatory issue of concern for local fishers. One respondent said:

> It's unfair to the subsistence users as well as the commercial users that the Bering Sea fishery is allowed to incidentally catch, or as they say "bycatch," and basically toss and waste literally thousands of our salmon stocks. (M5)

Several attendants at the community review meeting echoed his statement. Some strongly insisted a complete shutdown of pollock fisheries in the Bering Sea should be implemented to protect Chinook salmon and subsistence fishing on the Yukon River.

Finally, the operation of the sonar located near Pilot Station, 26 miles downriver from Marshall, was one of the most heated topics during the community review in June 2011. The Pilot Station sonar plays an important role in Yukon Chinook salmon in-season management, which heavily relies on the data collected with sonar estimates. Many fishers in Marshall expressed distrust of the sonar due to its location, its inability to recognize fish by species, and the length of its operation. ADF&G is aware of these issues as outlined in the 2010 Chinook Salmon Action Plan (Howard et al. 2009:28) and has worked to improve sonar-based estimates, while justifying the use of sonar as one important tool for monitoring and assessing run strength. At the same time, ADF&G has produced websites and brochures to explain methods and the ways in which managers compensate for limitations in data collection (ADF&G 2011b). The difficulties of estimating run strength of fish by sonar are compounded at Pilot Station by the enormous volume of water and the mixing of many species of fish, including salmon. However, the data allow real-time estimates that make in-season management possible. ADF&G biologists use sonar in the present location as a critical tool for monitoring and assessing run strength. Four particular concerns provide examples where a better explanation of ADF&G methods and related interpretations might be helpful.

First, the sonar in Pilot Station is located on the north and south river banks. Local fishers suspect the arrangement misses fish that swim in the middle of the river. According to ADF&G biologists, the location of the sonar at Pilot Station minimizes this problem because the river is confined in one relatively uniform channel with very strong currents that push salmon toward the shores. Nonetheless, the possibility of missing fish in the sonar estimate has recently been explored with the use of side scan sonar. This new sonar application is deployed from an anchored boat at different locations across the river to check the middle of the river for fish that the split beam sonar might be missing. Data analysis is ongoing, but preliminary findings imply that a very small fraction of fish is missed by the split beam sonar. Whatever the numbers are, once determined, that portion can then be added to split beam estimates for a more accurate number.

Secondly, Marshall fishers are concerned that sonar cannot identify fish by species but records the passage of any species, including rainbow trout and northern pike. This is quite true, but ADF&G biologists can estimate the ratio of various species swimming past the sonar sites by using a fish wheel or drifting test gillnets to estimate species apportionment, or "relative" abundance. As further addressed in the Discussion, Conclusions, and Recommendations (Chapter 8) of this report, the test nets at both Pilot Station and Eagle are positioned in the same place year after year to provide comparable data. In Eagle, the river is less than half its width at Pilot Station, carries less than one third of the water than at Pilot Station, and far fewer fish than at Pilot Station.

Thirdly, several fishers have suggested that the sonar should operate 24 hours a day, instead of segments adding up to 9 hours. ADF&G officials, on the other hand, see 24 hour operation as unnecessary because they have tried it, and comparisons show that there is very little difference between estimates derived from 24 hours of surveillance versus a total of 9 hours. The cost of sonar operation is high and money saved can be spent elsewhere.

Finally, some fishers feel that sonar should be located in a place where the river is narrower than Pilot Station so that it would not miss fish. In contrast, ADF&G biologists note that Pilot Station is located in the lowest part of the Yukon River, below all of its major tributaries, and that it is very important that this location be among those where data are collected. More complete information about efforts to improve the use of multiple interactive methods and tools could improve local understanding of management decisions.

There are some outreach materials available (ADF&G 2011b), yet more communication between the local fishers and the ADF&G management team is necessary to improve local understanding of, for example, how sonar is implemented in the field.

Socioeconomic Effects

As mentioned in this report's introduction, when the 2009 Yukon Chinook salmon run was declared a disaster, the total commercial harvest was 316 Chinook salmon, all caught during chum salmon directed openings in the Lower Yukon. This is compared to 69,562 Chinook salmon in 1999 (Eggers et al. 2010:22; Moncrieff et al. 2009:77) . The total estimated value of the Yukon Area commercial salmon fisheries in 2009 was $556,000, approximately 76% below the average of $2.3 million between 1999 and 2008 (Eggers et al. 2010:23). The drop in earnings hit many households in the Yukon River communities severely, and Marshall was not an exception. A local fisher said, "This year, [our household made] $6,900 around. Out of it, we get only a couple of thousand. The rest go out for gas or helpers" (M8). Another told us, "You are lucky if you make about $5,000. Right now, gasoline is so expensive, almost $5 a gallon. Last year, I was mostly on hold to go out fishing. I spent more on gas than the money I made" (M1).

In fact, the average income for Lower Yukon Area fishers from commercial fishing in 2009 was $1,425 (Eggers et al. 2010:23). The local fishers received an estimated average of $5 per pound for Chinook salmon, which was higher than in the 1980s and 1990s, yet the quantity of the fish was too small to make any profit. In comparison, the annual average gross income per permit was $9,600 from 1977 to 1995 (Holder and Senecal-Albrecht 1998:48). One fisher lamented, "They are really scraping the bottom of the barrel. Can't make living with the price of the economy going up every year … . Commercial can't sustain people solely these days" (M2).

The collapse of commercial fishery on the Yukon affected not only local fishermen but also the processors. According to a fisher in Marshall:

> I can see a big decline in these last 10 years … . Think about 20 years ago, there were a lot of fish buyers up around us, canneries and stuff. Those are going away because these fish buyers lose interest in doing business here in the Yukon because of the decline (M1).

In 2009, there were two processors in the Lower Yukon (Eggers et al. 2010:23), yet only one processor bought from Marshall fishers.

> Most of us people up here [used to] deliver our fish to the fish plant because we have fish buyers coming in from down river. Since our fish plant is out of commission, the only fish buyers we have right now is Kwik'pak, they are the ones who are picking up our fish today with a reasonable price (M2).

Kwik'pak Fisheries LLC was established in 2001 as a subsidiary of Yukon Delta Fisheries Development Association (YDFDA). Located in Emmonak, YDFDA represents Lower Yukon communities and plays a major role in the economic development of commercial fisheries in the region. However, when fish runs are weak, the processor does not send buyers upriver, and Marshall fishers have to deliver their catch a long distance.

> Like this last opener they had, nobody was ready to go out fishing because it opened September. It's risky. Right now, you have to go long ways to deliver your fish. We have to go like 70 miles downriver. It's a long way, if there is no fish buyer to come up here. (M1)

Summary and Discussion

As described above, Marshall residents are closely tied to salmon, and prolonged decline of the Chinook salmon populations since 2000 threatens the sustainability of Marshall's subsistence-based mixed economy. The constellation of challenges caused by declining Chinook salmon—less fishing time, net mesh size

reductions, reduced harvests, the absence of a commercial Chinook fishery and reduction of a summer chum fishery—are all directly related to economic difficulties currently facing residents.

Most residents linked declining harvests to the declining number of salmon (potentially due in part from the pollock fishery bycatch), however, a few residents questioned the department's estimates of salmon abundance and run strength and felt that the reductions in subsistence opportunity and even commercial opportunity were unwarranted. Concerns over the validity of the sonar stem from concern that low estimates of fish will lead to shorter subsistence harvest windows and mesh size changes.

Sharing, barter, and customary trade practices are all present in Marshall. Of the 45% of households who responded to the survey, about half reported participating in barter and customary trade practices over the years, and the other half reported that they had never participated in these activities. However, while customary trade does exist, most respondents agreed that it is not the primary method for distributing food around the community.

Recommendations

Summarizing opinions in Marshall is no simple task because opinions were not unanimous, making generalizations difficult. There were multiple common concerns, even as perceptions and ideas for solutions varied.

As described within this chapter, many fishers in Marshall expressed distrust of salmon run strength estimates based on data collected from the sonar at Pilot Station. First, the sonar in Pilot Station is located on the north and south river banks, and local fishers suspect the arrangement misses fish that swim in the middle of the river. Secondly, Marshall fishers are concerned that sonar cannot identify fish by species but records the passage of any species, including rainbow trout and northern pike. Thirdly, several fishers have suggested that the sonar should operate 24 hours a day, instead of segments adding up to 9 hours. Finally, some fishers felt that the sonar should be located in a place where the river is narrower than Pilot Station so that it would not miss fish. These issues, two of which continue to impose uncertainty and two of which ADF&G considers resolved, were discussed in more detail in this chapter and are discussed again, in regional terms, in the Discussion, Conclusions, and Recommendations (Chapter 8).

Another common concern was bycatch in the pollock fisheries in the Bering Sea. Several respondents strongly insisted a complete shutdown of the pollock fisheries should be implemented for the sake of Chinook salmon conservation and protection of subsistence fishing on the Yukon River.

Concerns regarding regulation were common and related to both the windows schedule of subsistence fishing, and the new 7.5 inch mesh size restriction. Fishers expressed dismay that the windows for subsistence fishing during the summer season have been shorter and less frequent in recent years, as managers close fishing to allow for escapement. Marshall fishers often reported spending more time to catch amounts similar to prior years, or even fewer fish, and attributed this more to the schedule than to declining fish runs. The implication seemed to be that windows should be long enough so that people can catch reasonable amounts of fish with reasonable efficiency, even if the opportunity does not occur when the most fish are in the river. Further, those opportunities need to be early enough in the season to allow for good drying weather.

Many Marshall fishers were also chagrined about the new 7.5 inch mesh size restriction. Some respondents described being able to catch any size fish with any size net, and expressed serious doubt that the restriction will contribute to Chinook salmon conservation. Rather, they expected, it will cause "drop-out loss," an issue that is further discussed in the final chapter of this report.

5. NULATO

Brittany Retherford

Setting and Context

Local Research and Respondent Profile

Three researchers from ADF&G Division of Subsistence visited Nulato during December 2010. With the assistance of a community liaison, Noreen Mountain, researchers conducted 10 interviews with 14 knowledgeable fishers. Nine of 10 interviews were recorded and transcribed; 1 respondent preferred not to be recorded but did allow notes to be taken. Respondents were asked about their earliest fishing memories and experiences, gear types used, changes observed in fish quality and abundance, and effects of recent regulatory changes on subsistence activities. Key respondents were also asked to map areas where they currently fish, as well as historical fishing areas around Nulato. At the request of the Nulato Tribal Council, the customary and traditional use survey, which was intended to document barter and customary trade of subsistence resources, was not conducted in Nulato.

Key respondents interviewed as part of this study spanned generations, with early fishing memories extending back to the 1910s. The youngest respondent was an active fisher in his early 30s, the oldest was a still active fisher in his mid-90s. Several older key respondents were born at seasonal camps, during an era when residents were more nomadic, traveling seasonally to follow or locate wild resources. Many younger respondents also had early memories of fish camp, but they grew up during a transitional period for Nulato when residents were becoming more tied to the village, using it as a home base for subsistence activities. While all respondents had a long history of living in Nulato (most were born and raised there), some have spent considerable time in other villages and cities on the Yukon and in other parts of, or outside, Alaska. Respondents included an even number of men and women. Four interviews were conducted with pairs of respondents, including two couples and two mother/child combinations. A majority of respondents were still active in the salmon fishery. Though physical ability to participate was limited for a few of the older respondents, they fulfilled roles as knowledge-bearers. One respondent was an active commercial fisher in Nulato, targeting summer chum salmon to be sold primarily to a Kaltag fish processing plant. The interviews provided a rich, long-term perspective of salmon fishing and its role in the way of life, livelihoods, and identity of the people in Nulato.

Historical Background and Natural Environment

Situated roughly 300 air miles directly west of Fairbanks in the Nulato Hills, Nulato is a Koyukon Athabascan village that is home to approximately 260 people. Nulato, or *Noolaaghe Doh*, which means "the main place to catch dog salmon in the summertime," originated as a fish camp on the north bank of the Yukon River and has long been an important trading center for the region (Loyens 1966:20; Yarber et al. 1985). The Innoko National Wildlife Refuge is situated on the opposite bank of the Yukon River and includes the Kaiyuh (Kkaayeh) Flats, a 289-square mile floodplain consisting of water and wetlands, and the home of Kkaayeh hut'aanh ne (Kaiyuh Indians or people). This area is referred to locally as "Kaiyuh," and is important for subsistence hunting, fishing, and other activities. The weather in Nulato commonly warms to over 70°F in the summer, dropping to lows of -40°F in winter, with records set at 90°F and -55°F.[1] The environment is typical of Alaska's Interior and is dominated by spruce, birch, and aspen forest, along with expanses of alder and muskeg.

1. Alaska Department of Commerce, Community, and Economic Development (ADCCED) Division of Community and Regional Affairs, Juneau. n.d. "Alaska Community Database Online: Community Information." Accessed 2013–2014. http://commerce.alaska.gov/cra/DCRAExternal/community

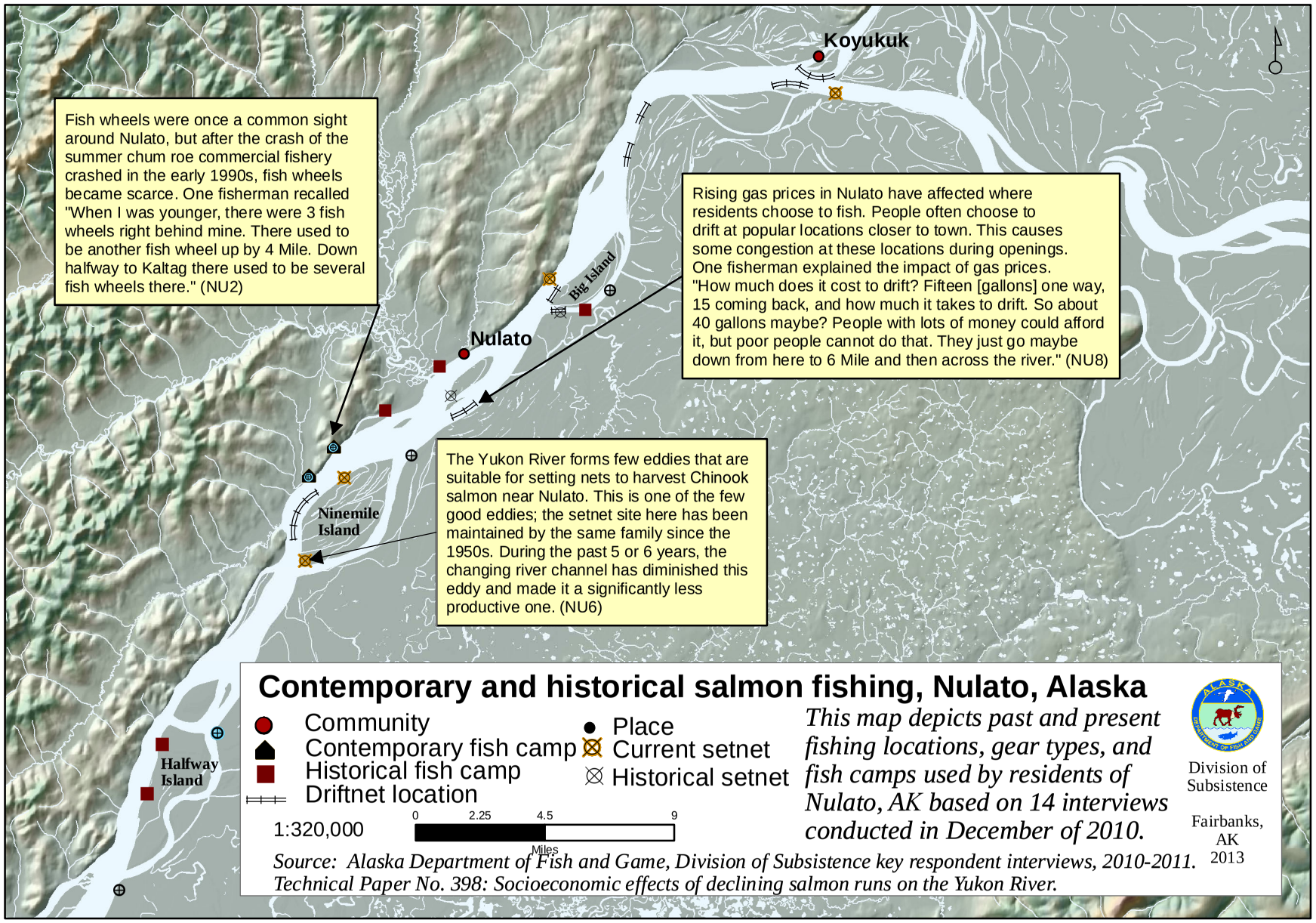

Figure 5-1.–Contemporary and historical salmon fishing locations, Nulato, Alaska.

A Russian trading post at Nulato was established in 1838 by Pëtr Vasil'evich Malakhov of the Russian-American Company. The location was ideally located for fur trading, since it was already used as a meeting area for trading between Interior Athabascans and Iñupiaq Eskimos from the Kobuk area of the Seward Peninsula (Clark 1981; Loyens 1966; Moncrieff and Klein 2003; Yarber et al. 1985). An established trading route between Kaltag and Unalakleet was in use at this time, and Lower Koyukon Athabascans attempted to keep it secret, but to no avail. This route funneled items such as Euro-American clothing, iron pots and kettles, and glass beads and tobacco to the Nulato area prior to Russian contact (Loyens 1966:9). Trade relationships continued to develop, with occasional skirmishes and one major conflict resulting in the massacre of as many as 100 people. That 1851 event was described by Nulato-born anthropologist Miranda Wright (1995) as the "Last Great Indian War."

After the United States' acquisition of Alaska from Russia in 1867, a few Russian traders continued to live in the Middle Yukon area and were joined by a new population: Euro-American missionaries and gold miners. Meanwhile, semi-nomadic Koyukon Athabascans of the area adapted to changes by adopting a mixed cash-subsistence economy characterized by enduring seasonal cycles. Major events included a gold rush in 1884 and the establishment of a mission school and Our Lady of Snows Roman Catholic Church in 1887. This heightened activity throughout the river drainage brought more people, new diseases, and economic opportunities. In 1900, there was a widespread outbreak of measles and this, combined with food shortages reduced the area population by one-third (Loyens 1966:140). Residents of nearby settlements began moving to the village of Nulato to weather the difficult times and be closer to available supplies (trading station) and a health facility. The establishment of a new U.S. Bureau of Education hospital in 1907 might also have lured some people to Nulato (Loyens 1966:143). Lead mining activity in Galena spurred the economic development of the area beginning in 1919. This time period was also characterized by a consistent demand for furs.

The 1930s were hard times for residents of Nulato and the Middle Yukon. This time period was characterized by epidemics of influenza and measles, combined with a sharp decline in the fur market. It was not until the 1940s when the U.S. Air Force began constructing an airfield in Galena that job opportunities in the area once again became available. Several people (especially younger families) migrated from Nulato to Galena (Loyens 1966:146). In the 1950s, compulsory school requirements forced people to be more tied to the village (Brown et al. 2010:59). This shift was already underway. With the introduction of gasoline-powered motor boats to the area in the 1920s, people were able to live farther from traditional hunting and fishing areas in Kaiyuh Flats and in a settlement where they were closer to the trading post, school, mission, and health care facility (Loyens 1966:147). These changes did not diminish the importance of Kaiyuh to Nulato people, however. Many families continued to spend a large portion of the spring, fall, and winter months at camps in Kaiyuh, returning to Nulato for holidays, church services, family visits, to exchange furs for cash, and to resupply for their next camp.

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Plate 5-1.–View of Nulato from the Yukon River.

Nulato was incorporated as a city in 1963. Local government

in Nulato includes a municipal government and a traditional village council. A devastating flood in 1979 prompted a decision to move the village from the bank of the Yukon River to the Nulato Hills about 2 miles inland. This section of town is known as "up town," and the majority of residents live here. Two stores, a washeteria, a post office, city office, tribal office, an armory, and teen and adult recreation centers are located in this part of town. In summer, some residents relocate to "old town" or "downtown" to be nearer to their smokehouses and fishing on the Yukon River. Located here are the school, the older washeteria, the Catholic Church, a community hall, and several houses (only a few of which are occupied year-round). Wage employment opportunities are limited in Nulato. Many people who are employed take advantage of seasonal jobs such as weatherization, construction, or firefighting. Other major opportunities include employment with the Nulato Tribal Council office, city government, and the Yukon-Koyukuk School District. It is common for Nulato residents to permanently or temporarily settle in cities such as Fairbanks where employment opportunities are more stable, and then to return to Nulato for subsistence activities and to visit friends and family.

Several events and celebrations take place in Nulato throughout the year. One of the most important is Stickdance or heeyo (hiyo), which is a week-long memorial potlatch and ceremony to honor loved ones who have passed away. Nulato is also an official checkpoint for the northern route of the Iditarod Trail Sled Dog Race, which takes place in early March. Nulato occasionally hosts other large events that draw significant numbers of people from around the state, including the Denakkanaaga Elders/Youth Conference, held in Nulato in June 2011. Other events such as weddings, funeral potlatches, winter carnival, and celebrations honoring elders, are commonly held throughout the year and bring friends and family from surrounding communities. Wild foods are always a prominent feature at these events.

Community Fishing Profile

Like other places around the state, Nulato residents maintain a local terminology for salmon species in Nulato and other Middle Yukon villages. Chinook salmon are locally referred to as "king salmon." One elder man was perplexed why a researcher kept referring to king salmon as Chinook salmon during an interview: "What you calling Chinook? Anything, huh? Well, the king salmon is our main fish" (NU6). This response demonstrated the differences in terminology and also highlighted the value of king salmon to Nulato residents. Younger fishers interviewed for this report were familiar with the terminology "Chinook," but middle-aged and older respondents were not. Less commonly, some of these older respondents instead referred to coho salmon as "Chinook." Fall chum salmon were referred to widely during interviews as "silvers," connoting their more silvery appearance than summer chum salmon. However, some Nulato residents did call coho salmon "silvers," particularly those who had experience working in the commercial fishing industry in other parts of the state. Summer chum salmon are commonly referred to as "dog salmon," a reflection of their utility as dog food during the era of dog teams. In 1982, an ADF&G Division of Subsistence researcher made similar observations, noting that coho salmon were included with fall chums in the category of "silvers" (Marcotte 1982). Likewise, Sumida (1989) recorded species names consistent with the terminology ADF&G researchers encountered in this study.

Fishing is an integral part of life in Nulato, and fish is a highly valued resource. Salmon in particular have always been a major component of the economic, social, and cultural life of area residents. As a result, a network of knowledge and skills has developed to efficiently harvest, process, and preserve salmon. This knowledge reflects generations of environmental observations and adaptations of skills and technologies that are best suited for the land and waterways around Nulato. This knowledge is also characterized by its malleability to circumstances. For example, during the era when dog teams were used for winter travel, residents focused their fishing efforts on harvesting large quantities of summer chum salmon to feed dogs; today, fishers prefer to target Chinook and fall chum salmon and have adapted their fishing methods to accommodate this preferred harvest. Dietary preferences, abundance of other resources, technological advances (such as the advent of the motor boat and snowmachine), and socioeconomic changes (such as commercial fishing opportunities and a decline in practices such as trapping) are all factors that have

contributed to determining what species of salmon Nulato fishers harvest. Because these factors are not stagnant, neither are patterns of harvest or use.

Traditionally, Nulato people lived a seasonally-based, semi-nomadic lifestyle that included migrating between camps to harvest various animals and plants available during different times of the year. For example, springtime brought a bounty of migratory birds, summer activities focused around the salmon harvest, fall was a time for hunting moose and other land animals, and winter was dedicated to trapping fur animals (for a more detailed explanation of the seasonal round, please see the Nulato chapter in Brown et al. 2015). Annual variability in resource abundance is a defining characteristic of subsistence harvests. One Nulato resident interviewed for this study noted that Nulato's seasonal round has been altered by the changing availability of some resources. He used the example of caribou, which were once abundant near Nulato. He said, "Here in Nulato, we are called the 'caribou people,' because that is all that used to be around here, are caribou" (NU5). People today primarily rely on various species of fish, but large land animals, primarily moose, also are considered a critical source of food. Historically, land mammals have occasionally been more important contributors to the diet of Nulato residents than fish (Nelson 1983:67). Though historical quantitative data depicting the significance of the salmon harvest to the overall diet are not available, in 2010, salmon (all species) contributed 45% of the 62,104 lb of subsistence harvested wild foods by Nulato households (Brown et al. 2015). The summer bounty of foods annually contributes a significant share of the overall annual subsistence harvests.

This section discusses the changes in salmon harvest and use patterns by Nulato residents over time. It begins with a summary description of major shifts experienced by Nulato fishers, followed by a more detailed discussion of historical and present day gear types, harvest practices, harvest locations, and other important topics, in order to develop a more holistic understanding of the impacts of the salmon resource crisis faced by Nulato residents today. This fishing profile tells a story about the profound and highly adaptive relationship Nulato people have to their natural environment in general and to salmon in particular.

History of Local Fisheries

Nulato fishing households have historically primarily targeted 3 of the 5 species of salmon common to Alaska waters: chum, coho, and Chinook salmon. Historically, Nulato fishers primarily targeted chum, but technological changes and other factors prompted fishers to begin targeting Chinook salmon during the 1970s and 1980s, discussed in detail below. Commercial fishing was active for summer chum roe from the 1970s through the late 1990s. A commercial fishery still exists in the Middle Yukon Subdistrict Y-4A, but in 2011 the primary processing plant that purchased local chum salmon, Washington-based Yukon River Gold, shut down. This is the only commercial fishery on the Yukon River that permits fish wheels as a gear type but with strict requirements for conservation of king salmon. Fish wheels must be manned 24-four hours a day, and fishers must use a live box or chute to release Chinook salmon. Some Nulato residents have been employed as workers at the processing plant in Kaltag.

The pattern of deploying to fish camps along the Yukon River (both up and downriver of Nulato) during summer has historically been one of the most important parts of the seasonal round for Nulato residents. Nulato families would leave their spring camps in the vast expanse of the Kaiyuh Flats wetlands as soon as waterways became navigable following breakup. Salmon fishing season on the Yukon River would commence at the end of June, and continue through the end of August. Chinook salmon and summer chum were harvested in early summer. In the late summer, fishers would target fall chum and coho salmon. A decrease in the availability of fresh caribou meat resulting from declining abundance of caribou, combined with increased pressure on Koyukon trappers engaged in a steadily more demanding fur trade, necessitated a heavier reliance on fish (Loyens 1966:148).

A main feature of fish camps during most of the 20th century was the fish wheel, introduced to the region in the early 1900s, which was known for its efficiency and large capacity in harvesting salmon. Summer chum salmon harvested and put away at summer fish camp was the primary food that fueled valuable dog teams. Dog teams pulling hand-made wooden sleds were the primary winter transportation method for trappers

taking part in the lucrative fur trade and also for subsistence fishers and hunters traveling the area in search of moose, whitefish, and other locally available wild foods.

As noted earlier, many people in Nulato refer to summer chum salmon as "dog salmon" because much of it was harvested for dog food. One elder man, who was born in 1925 in Kaiyuh Flats, recalled being able to harvest as many as 300 to 400 summer chum salmon a night during the run; there was never an issue or concern over abundance (NU3). Another elder recalled times when her family harvested as many as 700 summer chum salmon in one day (NU13). Indeed, the only limiting factor to the number of summer chum salmon that could be harvested was the speed at which the cutters could process the fish.

The 1960s were the beginning of an era of rapid change in the subsistence salmon fishery for the people of Nulato, for many reasons. The most visible change was the beginning of a decline in the use of fish camps and a semi-nomadic lifestyle to a more "sedentary" lifestyle. "Very few people live off the land anymore," one respondent explained to researchers. Starting in the 1960s, he said, "people no longer went to trapping camp, people no longer went to fishing camp. They became sedentary villagers" (NU5). Today, only two families have fish camps, but many residents participate in summer fishing activities. Most families who fish have smokehouses, caches, and summer cabins "downtown," and move there in the summer months. Even as the practice of spending entire summers at fish camp fades in memory, residents continue to value fishing as an important part of local diet, culture, and lifestyle.

River morphology is yet another contributing factor in determining where, what, and how fishers along the Yukon River fish. Chinook and summer chum salmon run timings overlap as they pass Nulato fishing areas, but local fishers observed that Chinook salmon prefer the deeper channel along the southern bank of the river, while summer chum salmon are harvested along the northern bank. Prior to the popularization of driftnetting during the late 1960s, king salmon were rarely harvested. One elder woman said, "I remember very few people fished for king salmons those days. Mostly, we just got fish for dog salmon with fish wheels" (NU8). The village of Nulato lies on the north bank of a relatively straight section of the Yukon River; there are few eddies along this stretch. King salmon typically are found in deep and swift water—and are difficult to access from the shore without the aid of an eddy. One respondent, whose parents used setnets at their fish camp, explained how this limited fishers who were interested in harvesting king salmon:

> My mom used to say long ago, when they used to be in camp, I guess they used to see fish way up out there. And her and my dad used to talk and they used to wonder, "Gee, how can we get that fish?" (NU7)

Yet king salmon were still a highly valued resource. A 72-year-old woman who was born at her family's fish camp on Halfway Island explained that though they were harvested less often, king salmon were still a part of the subsistence diet:

> I mean, people used to catch king salmons, maybe my mom would get one or two good king salmons in the wheel. But they never used to put out net for king salmons until later [when] they started going drifting for them. (NU12)

An elder man in his 90s was one of the few Nulato residents who historically targeted king salmon. He explained how his family was one of the few who were fortunate enough to have one of the few good eddies that were good for setting a net to harvest king salmon. "People were poor," he said. "They didn't have enough money to buy the material to go for king salmon. I think the most that my dad caught one time was 90" (NU6). This family would commonly share their harvest with other Nulato households who were not able to harvest the highly valued fish.

During the late 1970s and throughout the 1980s, some residents engaged in the chum salmon roe commercial fishery as a money-making enterprise. Because of Nulato's location on the middle river, the focus on commercial fishing has always been less intense than downriver villages (such as Emmonak and Marshall in this study). The Yukon River commercial salmon fishery has evolved, with its beginnings as an unlimited fishery in the early 1900s. From 1960 through 1964, it operated under a quota system until it shifted into a published calendar date and preset time fishery from 1961 to 1979. Presently it is managed in-season based on run assessments (Barnhill and Gillis 2004:4). Nulato is in Subdistrict Yukon 4-A of the ADF&G Yukon

River Fisheries Management Area. Several middle Yukon River communities, including Kaltag, used to maintain large commercial summer chum salmon roe fisheries until the late 1990s, when the markets were flooded by farmed salmon roe, and the price dropped and participation declined because it was no longer economically worthwhile (Fall et al. 2009).

During successful years, Nulato fishers were able to make a good income, "Oh yeah, $20,000–$30,000 during the season. Of course, you work 7–24s for it, but that was a lot of money in those days" (NU5). Although interviewees had fished all their lives, only a few were involved with commercial fishing in Nulato at some point in their past. Some described trouble securing a license because they did not qualify based on the point system that was used to determine who would receive a license. One man who was born downriver in Anvik expressed frustration with the permitting method:

> I've tried doing it since I moved up here but the state wouldn't let me have a license. I couldn't get enough points you know. They deprived me of making a living on the river... Fishing commercially, you know (NU4).

Another man described his experience the following way: "Our family didn't get a pick for the license they were giving out in the '70s. I don't know if they applied for it, you know, but I know that we didn't get one" (NU12).

Henry Ekada was interviewed in 1982 as part of a series of biographies by the Yukon-Koyukuk School District and he recalled getting his first commercial license in 1974 and fishing with his half-brother Eddie Hildebrand. The first year was poor, but

> ...finally, in 1976 is when everybody hit it. Guy named Staniford bought fish for 85 cents a fish. Then we had to rent a truck for ten dollars a trip to haul it up to the airport. Us, the fishermen, had to get that truck. He just didn't go at it right. Nothing. He had those kids working up there all night. But he made money flying it out of here. (Yarber & Madison, 1982, p. 38-39)

Typically, one person owned a fish wheel and hired crew members to help work it; the crewmembers were usually from Nulato as well. One elder who participated in the commercial fishery for several years alluded to what the introduction of cash meant for the community:

> We used to make our living by fishing and trapping, but now we have other income. People who are 65 years old are getting pension and their $30 a month. In them days, that was a lot of money because groceries were pretty cheap, everything was cheap. Nowadays you can't go to the store with $5. You can't buy anything with $5; $1 is useless, you can't buy nothing with that. Everything around here is expensive. You have to have $100 or more if you want to get groceries. (NU3)

Nulato and other Middle Yukon villages have unique perspectives concerning commercial fishing on the Yukon River. When commercial fishing first opened up during the 1970s, many Nulato residents participated and were able to take advantage of the influx of cash experienced by other commercial fishers along the Yukon at this time. Nulato residents also experienced the vacuum effect that occurred after commercial fishing crashed in the late 1990s, and commercial fishing opportunities declined in this section of the river. Because of Nulato's experience of the effects of losing commercial fishing as a livelihood, respondents interviewed as part of this study expressed empathy for the plight of fishers closer to the river mouth who are facing deep restrictions on commercial fishing. During the study year, only one person operated a fish wheel as a commercial endeavor in Nulato.

A key feature of subsistence salmon fishing today is the limitation imposed by high gas prices in rural villages. The price of gas affects day-to-day living expenses, including food, transportation, and housing. It also directly affects subsistence fishing because it takes cash to pay for the fuel necessary to operate a boat to driftnet or check a setnet. Limited opportunities for wage employment exist in Nulato. Those who do work face the challenge of balancing work with setting aside time to harvest sufficient fish to meet their needs and the needs of those with whom they share. This is an enduring and often exhausting struggle said

one respondent: "[We go fishing] early in the morning, come back in the afternoon. Eat and then go work on fish. Sleep for a couple hours and go over again. For a couple weeks" (NU7). Some employers find ways to coordinate employees' work schedules with subsistence activities. For example, the Nulato Tribal Council office staff is allocated a certain number of paid leave days per year and many use that time to go fishing in summer and hunting in the fall. Subsistence fishers employ creative strategies to cope with high gas prices and other costly subsistence-related expenditures, such as sharing boats between families.

Fish—both salmon and nonsalmon fish—were sometimes the most preferred of all wild foods to eat. Personal preferences were expressed for various preservation methods: dried, sun-dried ("chewing fish"), jarred, frozen, strips, etc. King salmon are especially prized for their high oil content and rich flavor, and one elder man who grew up 200 miles downriver said he believed Nulato's location was ideal for maximized flavor and quality of king salmon:

> The fish is more greasy down there. I think this is the perfect spot for fish. There is not too much grease in it. It dries perfectly. We are just right in the middle, where I think it is perfect. And it will always be like that, if it doesn't change. (NU5)

While the dietary preference for king salmon and fall chum salmon is well-established, one female respondent who was born in 1938 and grew up while fish wheels were common fondly recalled the taste of summer chum salmon: "Sometimes I like to work on dog salmons because they are good to chew, you know. Dry fish, good dry fish, but we only get king salmons and silvers [fall chum or coho salmon]."

Collection, Processing, and Distribution of Fish

Gear

Nulato fishers have employed an assortment of gear types to harvest salmon from the Yukon River and its tributaries, including fish traps, gillnets, fish wheels, and rod and reel. Notable differences exist within these gear type categories: length and depth of gillnets, mesh size, materials used, size of wheels, and others characteristics are among these differences. Selection of gear type has always been determined by a complex web of interconnected factors, including cost, river morphology, availability of resources, and intended species targeted. Nulato fishers have been adept at incorporating new technology into their gear to maximize efficiency of harvest.

Early visitors to Nulato observed fishers using fish traps on tributaries of the Yukon River near Nulato. When twine was brought to the Yukon River drainage by western traders, fishers adopted the technology to manufacture better and larger nets. These developments enabled fishers to harvest fish in the main river rather than just the tributaries (Loyens 1966:148).

Fish wheel technology was reputedly introduced along the Yukon River by non-Native residents of Ruby soon after the turn of the 20th century (Loyens 1966). Many families operated a fish wheel at their summer camps on the Yukon River. Fish wheels were constructed of wood and were deployed in a channel near the bank, and scooped fish in rotating buckets that harvested predominately chum salmon. Fishing activities were focused around maintaining the wheel and preserving the sizable bounty of fish that could be harvested using this method. Summer fish camps were typically comprised extended, multi-generational families. Each individual was expected to contribute and participate in the variety of duties necessary to accomplish the overall tasks of harvesting, cutting, preserving, and putting away fish. And while salmon fishing-related activities were the focus at fish camp, people engaged in a variety of other activities, such as hunting, berry picking, and food preservation in anticipation of the winter months.

Fish wheels could be operated day and night, maximizing the harvest. They could also be employed without supervision and with less attention than some other gear types, which enabled fishers to focus on other activities as well. As anthropologist Loyens (1966) observed while visiting Nulato during the early 1960s, "the advantages of such a contrivance [the fish wheel] over the fishnet or fish trap were enormous. A single day's catch would equal a month's work with other methods" (Loyens 1966:149). The plentiful bounty

supplied by fish wheels had a multi-pronged effect, not only on Nulato households, but also along the entire Yukon River where the fish wheel was adopted. Preservation methods changed to accommodate the quantity of fish harvested; trappers could maintain larger dog teams (facilitating larger harvests of fur-bearing mammals); and fishers and their families could live a more village-based lifestyle. Loyens (1966) noted that the advent of the fish wheel also had another, possibly unintended, cultural consequence: the disappearance of the first salmon ceremony, "as it became impossible to know which one was caught first" (Loyens 1966:151). Though not realized until decades later, the fish wheel enabled the development of a viable commercial fishing industry.

Brittany Retherford

Plate 5-2.–Nulato's fleet of boats used for fishing and hunting are tied to the bank of the Yukon River in August.

The first outboard motor was introduced to Nulato around the same time as the fish wheel. Motor boats were important during the operation of fish wheels to help maneuver the large structure into place; they also allowed greater flexibility for fishers to spend more time in the village where there was also a rise in employment opportunities, and also allowed them to access hunting and fishing locations more easily.

For some who did not have a wheel, a setnet was the primary means of catching fish, and some families used both a setnet and a wheel at or near their fish camps. Key respondents interviewed for this study preferred the wheel over the net because it was more efficient. "We used to get enough from the fish wheels. So we didn't have to fool around with fish nets," explained one elder (NU8). Another woman agreed, recalling: "We do more on the wheel. We'd have it right at the camp so we could put everything away. We are just there to dry them up. Put the rest in the refrigerator." (NU1)

During the 1960s, people started to employ a motor boat and gillnet to drift for salmon—a gear type shift that improved their capacity to target much-desired and highly valued king salmon. One respondent explained that this was when "everybody up and down the river started getting king salmon" (NU6). Driftnetting gear was then prohibited in 1974,[2] but was allowed again in 1981. In a report by ADF&G Division of Subsistence analyzing the drift fishery in Nulato and Kaltag, Marcotte (1982:2) found that there were only a few eddies near Nulato where king salmon could be harvested with a set gillnet. The limitation justified the allowance of driftnetting (in addition to setting nets) so that residents would be able to harvest enough fish to meet their needs. In 1982, the Board of Fisheries asked for the driftnet salmon fishery to be monitored as a way to ensure run timing coincided with the opening, which had not been the case for the 1981 opening. Marcotte (1982) also found that although a form of driftnetting was used by residents of the Middle Yukon early in the 20th century, the method was largely abandoned for many years until it was reintroduced in the 1960s, likely through multiple sources: a Catholic priest who was familiar with driftnetting from elsewhere; a man who had drifted on the Columbia River; and a Kaltag man who had observed driftnet fishing at St.

2. At this time, Nulato was in the Yukon District 3. After 1974, the upriver boundary was redefined from Cone Point downriver to near Anvik, the area from Anvik to Cone Point (midway between Koyukuk and Galena) became Subdistrict 4-A.

Marys on the lower Yukon. The reintroduction of driftnetting made it possible to catch the large Chinook salmon that swim mid-channel and evade wheels and setnets placed near the banks (Marcotte 1982).

Despite the rapid changes of the 1960s, fish camps remained a feature of the subsistence economy and way of life until the 1980s. Fishing was still an important activity, but fish camps were largely an experience of the older generations. When Marcotte conducted his study, Nulato was in the midst of a transitional period in which people were spending more time in the village, using it as a base of subsistence activities. People who participated in the chum salmon roe fishery were able to fish commercially at their fish camps, or "downtown," and to simultaneously pursue subsistence fishing activities. The summer chum salmon roe fishery eventually collapsed, and today there is only one viable commercial fishery operation that has had mixed results in recent years. Roe is no longer sold commercially, but fish wheels were employed for a commercial chum opening in District 4-A in 2012, as described in Chapter 1.

Today, most Nulato fishers employ a drift gillnet for harvesting salmon in Nulato. Some respondents refer to this method as "seining," a gear type that can also include drifting with a motor boat, but utilizing a different type of net. During a fieldwork visit to Nulato during the fall chum salmon fishing season, the ADF&G researcher observed that fishers used "seining" and "drifting" interchangeably to describe driftnetting[3].

Fishing Practices

> Everyone used to come to town for Sunday [to attend church] from their camps. Sunday night we'd go back. There were no regulations. The fish were plenty, too, a lot of fish. The town was pretty empty during the week. Now you don't see anyone at the camps. (NU3)
>
> Now you go on the river and you won't even see one camp. Up this way, all the way to Koyukuk, there were tents long time ago. Not any now. (NU12)

Historical fish camps were predominantly scattered along the north side of the mainstem of the Yukon River, both up- and downriver from the village site. Factors that influenced where people fished included past success, as well as observations about changes in the river channel. Nulato residents had many close ties with Kaltag, but Kaltag and Koyukuk residents traditionally had distinct fishing locations (Moncrieff et al. 2009). One respondent, explained: "No, they had their own spots, their own camps. It's up and down the river for each village" (NU3). However, extended families often had fish camps near each other, which enabled them to help one another, as necessary; travel between camps was common (NU7). "Another family member had fish camp, maybe a few miles further. So there was a lot of interchanging, just traveling back and forth," explained one elder man (NU5).

The introduction of the motorboat allowed fishers to live in town, closer to jobs and services, while still being able to fish in historically successful locations, as well as in new places. Many families still fish in areas near their historical fish camps. There is an unofficial custom of respecting a family's setnet site, though one elder respondent who has maintained a productive site since the 1940s said he will allow others to set their nets closer than the required 200-foot minimum limit because he recognizes that a good eddy for king salmon is rare. One respondent explained: "We select a point with the current going past, the eddy below it and put the wheel out here. If you get a good spot you do pretty good at fishing" (NU3). Fishers are flexible and often alter locations in pursuit of fish. "Some years it does change. Some years are bum fishing, some years are good fishing. Maybe 2 or 3 years of good fishing and a couple years of bad fishing," explained one elder man (NU3).

King salmon are preserved in a variety of ways, including drying, smoking, freezing, and jarring (NU13). One elder male respondent described fishing from town: "I just bring my fish right here and I cut it up across, a little ways away in the smokehouse… it's right across the house here" (NU4). This close access to town is a change from the past when people would set up fish camps along the river further from the village. The close access allows for immediate freezing and other benefits, such as being able to better balance fishing and employment opportunities.

3. See also (Marcotte 1982)

Everyone agreed the process of preserving salmon was a lot of work. "And work…we used to catch lots. Work all day, all night sometimes…on fish" (NU8). "They stay up day and night! Two weeks. It's hard work. We had a 50-foot long smokehouse, 3 stories high. That thing used to be this full. Used to put lots of fish away" (NU14). The whole family helps to process, but when some work wage-based jobs during the days, it can make the preserving part of the process more difficult, which leads to another reason for fishing close to home: sharing the labor of fishing even among those with a job in town. Although fish camps were not too far from the village, it would take some time to get there: "A couple hours, maybe" (NU7). One woman explained how her family tried to balance work and subsistence fishing:

> My mom used to work. She used to be health aide. And my dad, he worked in the clinic, and then he would come home and have to cook, so we never really had time to go out. Or never made time. (NU7)

Brittany Retherford

Plate 5-3.–Everyone agrees the process or preserving salmon is a lot of work.

Opportunities to learn skills developed at fish camp have always been valued by Nulato residents. For example, one teen girl still spends time at a relative's fish camp near the village of Hughes (NU7). The fish camp experience was also an important time for the intergenerational transfer of knowledge, skill, and tradition. At fish camp, there were distinct duties for the different members of the family, but everyone shared in the work of harvesting and putting away fish.

Many respondents recalled their time at fish camp as a time of hard work and long hours for everybody. The days started early, one woman explained. "I remember my dad used to go out to the wheels 7 o'clock in the morning. We all worked the wheel and we'd get fish down" (NU12). Children and young people at fish camp were expected to pay attention and gain knowledge about river morphology, weather, and other things that help them know where to fish. Children, especially girls, were tasked with learning to cut fish from the older, more experienced women. One woman said that it took her a little while to learn, but once she got used to it, it was one of her fish camp responsibilities (NU12). Other chores included hanging the cut fish in the smokehouse and rowing her grandmother and another elder woman to check the net or across the river to find smoke wood. "I was their little motor," she said (NU12). Other jobs that required little skill but were necessary included ensuring the dog teams were fed. An elder male respondent recalled that it was his job to take care of his family's 17 dogs. "I was the cook for the dogs. Every day. That's my job," he said (NU14). Besides teaching and guiding younger generations in fishing practices, elders often had an active role in the process of harvesting and putting away fish. Staying actively involved was—and still is—important for many elders. "My mom still goes out fishing," said one woman with pride. "She cuts fish, actually. She has a hard time now, she just sits down and she cuts fish on her little table" (NU7).

The changing economy included the introduction of commercial fishing in Nulato. One key respondent linked the rise of commercial fishing to the decline in fish camps because people became more interested in the income potential offered by the new industry than in subsistence fishing. When commercial fishing

was first introduced, those who were able to secure a fishing permit were able to make a significant income, especially for rural Alaska where jobs have historically been scarce. "People were just more interested in money, didn't want to go to fish camp. And they could make a lot of money in those days, working short… commercial fishing" (NU5).

Sharing, Barter, and Customary Trade

At the request of the Nulato Tribal Council the customary trade and barter survey was not administered in Nulato. To respect the wishes of the NTC, and with respect for the sensitivity of issues that are more fully explored in this report's Discussion, Conclusions, and Recommendations (Chapter 8), key respondents were not directly asked about their personal practices in regards to customary trade. Instead, respondents were asked generally about whether these practices were common in Nulato, and to characterize those practices. Some respondents willingly shared personal stories about sharing and trading practices, reflecting the openness in which people engage in these activities. Some responses also demonstrated clear frustration with what they viewed as an intrusion on their subsistence traditions, though a few respondents said they did not believe people should make money from subsistence-caught fish.

There is a lengthy documented history of sharing, trading, and bartering practices by Nulato residents. Most recently, an ADF&G Division of Subsistence report illustrated that all except one household in Nulato was involved with the practice of sharing subsistence foods, either as a recipient, or as a harvesting household that gave foods away, or both (Brown et al. 2015). A 1982 study reported that of the 1,200 king salmon harvested in Nulato and Kaltag during the 1982 fishing season when commercial and subsistence openings coincided (Bonnie Borba, Fishery Biologist III, Alaska Department of Fish and Game Division of Commercial Fisheries, e-mail message to author, June 26, 2014), about 20% (250 fish) was sold by just one Nulato family to a Galena fish buyer. Just 4% was given away and the remaining 76% was used by the household, primarily being made into strips, though some was frozen, dried, salted, or canned (Marcotte 1982:19–21).

Households commonly shared fish through a variety of avenues. Fish are given away, brought to potlatches, and shared at community events like Stickdance. When this survey was conducted in December 2010, many residents had devoted significant time and energy to put away enough subsistence resources for the next Stickdance, which was scheduled for spring 2011. "It's what everybody was busy for this summer. For the Stickdance," said one respondent (NU12). Another explained:

> Well, people are always busy anyways, putting away fish, whether they are planning on Stickdance or not, so we are busy every year. This year we probably give most of our stuff away. Well, we have to feed our guests. There's potlatch every night and it is from Monday all the way to Saturday. (NU7)

Local Experiences of Salmon Decline and Disaster

> The salmon disaster is a big thing and… subsistence is so small. No one in the state, Senate or whatever, really is looking down at subsistence and the salmon really closely. They are looking at people, reading the paper, but if they look a little deeper they are going to have to open their eyes and ears at the same time to understand what is really going on. (NU2)

Present day fishers may rely on local knowledge passed down from previous generations, as well as observations of current environmental, weather, and economic conditions to ensure they harvest enough fish each year to meet their needs, but they are also faced with uncertainty about security of salmon harvests in the future. The demise of the fish camp's role in harvest practices and as a component of the seasonal round, technological changes and adaptations, and the rise and collapse of a commercial fishing industry have all contributed to the formation of a functioning and successful contemporary salmon fishery in Nulato, but challenges are profound. The decline in Chinook salmon abundance, a changing ecosystem, skyrocketing

cost of living, and the introduction of a more conservative management regime are among those challenges encountered daily by Nulato households.

Observations of Change

Because Nulato fishers spend considerable time on the land and waterways participating in harvest activities, they are keen observers of local environmental changes. Several observations were noted by respondents, including changes in abundance, size, and quality of salmon, as well as changes to habitat that have affected fishing locations.

Several respondents discussed concerns related to abundance of Chinook salmon, and many observed declines in recent years. The decline in abundance has had a direct impact on Nulato fishers: it has meant they have had to expend more time, energy, and cash to harvest the same quantity of, or fewer, fish. One fisher who was born and raised downriver near Anvik, but moved to Nulato in the 1970s, described the declines as "gradual:"

> You probably heard the same story up and down the Yukon River. The king salmon are declining gradually. It's not an instant transition from plenty to disappearing, but within the last 3–4 years, I can tell you that it has been a gradual decline. Every year we are fishing more, fishing longer, and getting less. For my family and my wife's family, if we get 200 kings then that's all we need to pull us through the winter and everything. Now we are lucky if we get 120. Like last year I think we got 120, and we fished longer. And we even had one pulse closed. (NU5)

Another fisher observed that after a terrible year in 2007, numbers were rebounding, which he thought could be a result of regulatory regimes or other factors. In 2007, he was only able to harvest 37 king salmon; he expended significant effort to harvest those fish, including traveling as far as Kaltag to go driftnetting. He harvested twice that amount the following year. "And last summer I caught over 100, I don't know, about 107. Between 107 and 110," he said (NU4). His observation of a rebounding population of Chinook salmon was not shared by other respondents.

Many people blamed commercial fishing on the Yukon River for the decline in Chinook salmon numbers. One respondent identified the commercial roe fishery as a driving factor in diminishing king salmon numbers, even though that fishery targeted summer chum salmon. Summer chum and Chinook salmon share a similar run timing, which resulted in some incidental harvest of king salmon in the commercial fish wheels. Other respondents did not feel that Chinook salmon were overharvested in the summer chum roe fishery because the morphology of the Yukon River in the vicinity of Nulato naturally separates the two fish species, according to local knowledge: the king salmon prefer the deep channel and the summer chum salmon follow closer to the shoreline. This is not the case in other sections of the river, however, which may be what this respondent was discussing in the following statement: "That's when they killed the river and the fish…. In later years they started buying roes, fish eggs. That's when there were no more fish after that" (NU3).

When asked whether she was cutting a lot of fish in recent years, one elder woman responded, "No, not too much. Last year we barely had any eating fish… We didn't have enough fish. Well, this year, too" (NU12). This woman was also experiencing some health problems that prevented her from being as active as she had been in the past, which contributed to her inability to get the fish she needed. Nonetheless, she felt there has been a gradual decline in fish during the past 3 to 4 years. People are worried about the declining runs because fewer fish to catch means fewer fish to eat.

> A lot of us depend on our subsistence food, like moose and fish. Fish is… we eat maybe 2 or 3 times a week. And it depends on how much we put away. We worry about the decline. I don't want to eat too much process foods. (NU7)

The declining numbers worried other respondents too, but were also viewed as an unfortunate and permanent change by one respondent, who said "I don't think we are going to see the king salmon numbers rise to the numbers of 30 to 40 years ago. I don't think that is ever going to happen anymore" (NU5).

Several respondents noted the decreasing size of Yukon River salmon, especially king salmon. One elder respondent recalled the average size of a king salmon as being much larger when he was a youngster: "I do remember when I was small, king salmon were huge. Sixty, seventy pounds—that wasn't unusual. Now we rarely see those. We see 30 pounders now if we are lucky" (NU5). Another respondent said: "Yeah. I noticed some of the kings were a lot smaller, some of them were small and I kept them. I've heard people say they caught more of the smaller kings, you know" (NU4). Importantly, smaller average fish means that households require a larger number of fish to meet their subsistence needs.

In the past decade, Nulato fishers have observed a few critical changes to the fish habitat in the area that have affected harvest levels. By many accounts, one of the most critical has been the increase in number of sandbars in the Yukon River, which has impacted fishing areas. One notable example is the loss of a historically successful setnet site at 9 Mile, on the south bank of the river, that once produced significant amounts of king salmon for Nulato households. River channel changes have provoked the formation of a sandbar, substantially reducing the site's productivity (personal communication with Nulato resident, August 2011).

Another observation noted by several respondents was low water levels in Kaiyuh Flats, which has limited access to that historically productive traditional subsistence harvest area for Nulato residents. Though not a harvest area for salmon, Kaiyuh Flats is important for other species, such as migratory waterfowl, moose, and nonsalmon fish species. Limited access to these resources compounds the effects of declining Chinook salmon populations.

ADF&G, the Bering Sea Fishermen's Association, and the Nulato Tribal Council jointly operated a weir from 2000 to 2003 approximately 5 kilometers from the mouth of the Nulato River to monitor salmon escapement. The river is believed to be the largest producer of summer chum salmon upriver of the Anvik River; Chinook, pink, and coho salmon have also been reported to spawn in the Nulato River (Barnhill and Gillis 2004:5). The project was unsuccessful for a variety of reasons, including crew retention and high water, but two researchers recommended reinstatement of the project if possible (Barnhill and Gillis 2004).

Management

Respondents in Nulato were keenly interested in discussing regulatory changes that have affected their lives and subsistence fishing activities. While opinions ranged widely, most respondents acknowledged the need for some regulations to allow for all subsistence users on the river to have a share. The major concerns raised by residents include fishing windows, change in mesh net size, a federal emergency order precluding non-local residents from subsistence fishing, and Chinook salmon bycatch in the Bering Sea.

Respondents recalled noticing changes in the fisheries management regime in the 1970s. One elder male respondent said this was when he started noticing regulations were getting tougher and managers were "making all kinds of laws" on the river. (NU3) The State of Alaska assumed management of the Yukon fisheries in 1960, and with it began implementing restrictions on gear, fishing areas, and fishing time (JTC 2006).

In 1993, the Alaska Board of Fisheries (BOF) adopted regulations that separated subsistence and commercial salmon fishing times in districts 1,2, 3, and 4A. Subsistence salmon fishing was allowed 7 days per week except for the 24 hours prior to and immediately following commercial salmon fishing opening. In Subdistrict 4A, subsistence salmon fishing may not occur for 12 hours immediately before, during, or for 12 hours after each commercial opening.

After 2000, a windows schedule was implemented for subsistence fishing, which in Nulato meant two 48-hour periods per week. The windows schedules regime was implemented as a way to help meet escapement goals and to distribute harvest across stocks. The regulation provoked responses from Nulato residents.

While there were some objections to the schedules themselves, the larger criticism was that the schedules did not coincide with run timing. One respondent explained: "It is enough time, but they closed it when the runs were going by. So just during that time, we just got a couple, a few there" (NU7). As a result, many residents felt that the regulations further decreased opportunities to harvest salmon, increasing frustration felt by Nulato households trying to put fish away for winter months.

One of the regulations most widely discussed in our interviews was a federal special action that prohibited non-rural residents from participating in harvesting activities. Because of the poor Chinook salmon return in 2009, federal managers restricted fishing in waters adjacent to federal land to residents of the river only. According to several respondents, this action hurt some Nulato residents, particularly elders who rely on non-local friends or family members that live in Fairbanks or other non-rural places to help them fish. The regulation was eventually withdrawn after successful communication between river residents and federal fishery managers.

Several quotes document how the regulation affected several families in Nulato:

> Yes, because my sisters that came here last year, they could have gone out and help us in the boat, they weren't allowed to, so it's just me, [and sister and brother-in-law] who goes out. Yeah, they could work on fish, but they couldn't be out in the boat. I like my sisters to be out and help me because they are a lot of help out there. There are three of us. It is mostly me and my sister pulling in the net and that's hard. (NU7)
>
> The daughter I have living in Juneau comes up every summer to help fish. Cut fish. You know, it's so crazy too… Yeah, they couldn't step inside the boat. (NU8)

Brittany Retherford

Plate 5-4.–Fall chum salmon and gill nets are hung to dry outside a smokehouse near the bank of the Yukon River in Nulato.

> Yeah, that's crazy. There's elders here that need help, and a lot of people that move away because they try to get jobs to help provide for the family, even if it is with our economy it's harder and tougher, and for... where food is more expensive, that's crazy to let those people say "No, you can't come help your grandma," or "You can't help your grandfather or... your age-old auntie." (NU15)

> That's right. And that, the first year that they done that, I was the only one who got hurt from that. My family lives in Fairbanks. Just me and my wife lives here and we are both old. My kids come down to help me, to fish. But when they came down, they could not fish. They were here, but they could not fish… We didn't have enough fish that year. So in the winter, they came out, Fish and Game came down here for a meeting, and I hollered about it. I said, "You didn't hurt anybody but me! And you didn't gain anything neither." People that take fish to Fairbanks is not selling it. They are giving it to their families. If they were here, they would get it, too. But they live in Fairbanks, they got to live in Fairbanks because that's where they got job. And they want fish because that's what they were raised on. So we send them what we think they need. And I don't know anybody that sell any fish from around here. Other places I hear there are a lot of people who sell fish, we don't get that much fish to sell it. (NU6)

> They could be in the boat, but they couldn't help them fish. They could help them work on the fish once the fish got to the smokehouse, but they could not help them hang out the net in the boat, pull in the fish that they got. In fact, they had to have a person, the only people who could work at the net were the people in the boat [who] were resident. So that stopped a lot of people being able to help their families. (NU5)

The YRDFA teleconferences that take place once a week throughout the summer season have proven to be an effective tool to promote better management and more effective regulations that do not harm the people who are most in need of help to go fishing. A fisher explained:

> So through these teleconferences, um, I, along with a couple of other people, voiced our disagreement with this regulation as a deterrent for people catching fish in the village and they took it away last summer. And that happened because of these teleconferences. (NU5)

Mesh size was another issue that residents discussed. Since the 2011 fishing season would be the first year for the implementation of the 7.5 inch mesh size restriction, there was considerable discussion about whether this restriction would work, as well as the cost to the fishers to switch their gear type. One respondent expressed his frustration with the restriction:

> Well, I'm kind of upset about the nets. We can't use them; it would be against the law to use them. And a lot of people here in the village, I know they are going to be mad. I listen to what they say, too, and I bring it up in the meeting. Like me I have my nets; I have three of them that I bought, and I use them every year, you know? Unless I don't lose them, you know; hung up or something, you know. They are too expensive; a lot of people can't afford to buy them, you know. (NU4)

Another respondent, however, was unconcerned about the change, saying:

> I really don't even care. When it's fishing, when it's coming, I'm going to get them. There are smaller ones and there are some bigger ones. One time I caught 36 big monster, huge silver…huge king salmon across from Koyukuk. I only had like 3 [fish] in an hour and a half. I was getting kind of bored. I was watching this guy from Koyukuk, he was in his 80s. He had a whole boat load in, like, 2 hours. I followed his spot. There were 3 of us, and I thought we had a snag because [my partners] couldn't pull [the net] in, so I went up there [forward in the boat] to help them. Then we pulled out like 10 monster ones. In another hour and a half we had like 36. Nowadays we will get smaller ones anyways.

> I just do it because it's a family thing. I just ask for, like, a case of fish and some strips before I start seining for them. I don't think it matters. (NU2)

And yet another respondent believed that while the managers should not tamper with the mesh size, the change would not have such a broad effect because some people use a smaller mesh size anyway. He explained:

> But the smaller mesh size, I don't think it would make any difference in this area. In fact, I know a few people in Nulato that don't even use an 8-inch mesh anymore because there is no big fish to catch. They always go out with 6-inch mesh nets anyway. (NU5)

Another respondent worried that the size restriction would affect not only the fish they were able to catch (i.e., the would catch fewer large kings), but the amount of fishing they would need to do as well as how they would process and preserve the salmon they did catch. She explained:

> We want some big ones, too. And when we get the bigger ones, we don't fish as much. Because the big ones we could jar, make strips, freeze, make filets. We don't need as many fish when we get the big ones. (NU15)

Residents were aware of the net exchange program[4], and also that only one net would be eligible to swap. There was concern about the cost of replacing their second net. One fisher explained why they keep two nets: one is the "backup net" in case something happened to their other net. (NU7) If a net were lost and there was no backup, it takes time to order a replacement and fishers can lose valuable fishing time. They usually purchase a new net once about every 3 to 4 years. One respondent explained:

> Oh man, for a 100 foot, it will cost about $500, I don't know. And I got a 150 foot net, that cost me, gee, almost $700, $700 or more. A lot of these people in the village, you know, they buy their nets, but some of them can't afford to buy them, you know. And it's hard for them to save up enough money to buy, unless two people go together and buy one. Even me, I don't know what I'm going to do. (NU4)

There was also concern about whether the mesh size restriction would work in the way that managers hoped:

> I think they shouldn't mess with the mesh size. Okay… they want a smaller mesh, so bigger kings can bypass the net and head upriver. If they enforce the smaller mesh along the whole Yukon River, what are we going to be catching here in Interior, mid-Yukon? Like I said before, we used to see 60 to 70 pound fish, that wasn't unusual. Now we are lucky if we see 30 pound fish. And a [7.5] inch mesh is not going to stop that 30 pound fish anyway. I don't know, maybe it won't hurt. There are no big fish to catch anyway. (NU5)

Socioeconomic Effects

Like other rural communities in Alaska, Nulato faces skyrocketing fuel prices, limited employment opportunities, and increased pressures on natural resources. Nulato faced a tough transition after the decline of commercial fishing in part because it had developed a heavy reliance on the cash sector of the local economy. One respondent explained that while the transition was difficult for residents, the community has been resilient and has managed without the jobs provided by the industry, though he has also noticed a greater reliance on federal and state entitlement programs:

> There has never been any jobs in Nulato except tribal government, city government, schools, that's never changed. Probably any time during the winter, there are probably 60 to 70 unemployed in Nulato. That's never going to change. So when commercial

4. The net exchange program was administered by Tanana Chiefs Conference for interior communities. Residents could exchange one of their existing nets for a new 7.5 inch net as prescribed by the BOF in 2009 as the maximum allowable mesh size for salmon nets in the Yukon River.

> fishing was over, commercial fishermen just fell right back into previous mode. Nothing replaced it. Some of us were lucky and went to go work on the [Trans-Alaska] pipeline for a while. But not very many people in Nulato do work on the pipeline. (NU5)

The prospect of a viable commercial fishery in Nulato in the future was met with mixed feelings. A $1.3 million processing plant was built in the downriver village of Kaltag in 2001, but remained idle until 2007 and has been sporadically in operation since then (Burke 2012). This processing plant is conveniently located for Nulato fishers interested in pursuing commercial fishing, but many worry about the viability of such an enterprise on the middle river. One fisher in Nulato continues to fish commercially and has invested considerable time and energy into the endeavor but described it as expensive and unpredictable:

> It costs a lot. You have to be right on it. This summer I was fishing for 4 days before it started working. I slept three hours. It all depends on Mother Nature. If the water rises you are going to have some problems. It depends on Mother Nature, if it is high or low or if there is a lot of drift. Drift kills all the fish wheels. You pretty much have to make a couple booms in front of the fish wheel because the current is turning it and anything coming down the river can bust it up. It was a pretty rotten summer this year. (NU2)

Other potential challenges were discussed, many related to the economics of the enterprise. "I don't even know if it would be worth it anymore. The windows are so short" (NU5). It is more difficult now to deliver fish to buyers than it was in the past, explained one respondent. Another said that tasks related to the care of roe for transportation are more cumbersome: "Now you have to gut the fish in a sanitary place and clean the eggs off them before you can even send them off" (NU2).

A few respondents noted an increased competition at some fishing spots, particularly 6 Mile. Sometimes the competition, especially between family members, is jovial and fun. One woman explained: "Yeah, sometimes we just throw our net right in front of another boat. Especially if they're from Galena. But sometimes I fool around with my uncles when they're on a boat, on the river, too" (NU15). Others also observed the increased presence of Galena-based subsistence fishers, and while there was some concern expressed over the infringement onto their fishing areas, it was minimal.

Declining Chinook salmon runs and tighter fishing restrictions have an exaggerated impact if other species are experiencing a decline in abundance as well. Respondents in Nulato also reported difficulty moose hunting. As noted above, historically, some people would hunt for moose or bear opportunistically while at summer fish camp. One respondent noticed that moose hunting is becoming increasingly more difficult and expensive. Though her family was successful at getting a moose in the year prior to this research, it was not without considerable cost. "Went all over this year. Went to the Koyukuk River. Went down to below Kaltag, went to Kaiyuh and way up to… maybe halfway to Galena" (NU13). All those river miles translate into dollars spent on fuel to run the motor boat. "It cost a lot of money just to go out with your boat, your motor and to try go cover all that land, you know. A lot of gas, especially when you don't have no luck too… it's pretty hard on you" (NU13). One moose (540 edible pounds) is not enough for many families, especially given the tendency for successful hunters to share their take with multiple households.

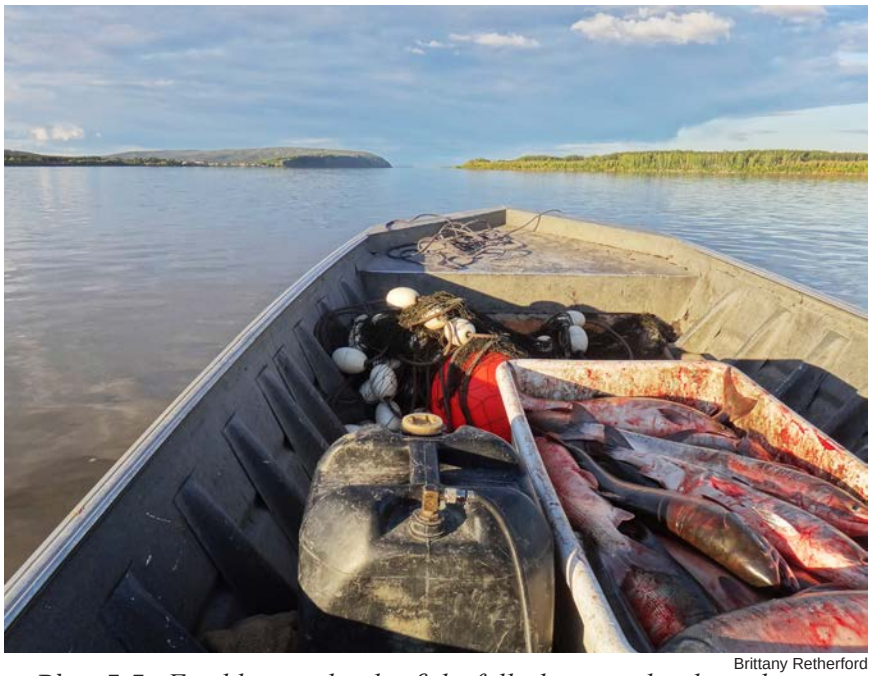
The high cost of fuel was cited by many respondents as a cause of hardship because high fuel costs limited the distances families could travel. In a related fashion, owning a motor boat is an important part of determining whether somebody can fish. No boat—and no access to a boat—can mean limited or no fishing for a season. One respondent recalled a time when her family did not own their own boat, and they had to rely on others to take them out fishing, sometimes even traveling to Galena or Koyukuk to fish with other people. (NU7)

For some families, there was no question that they were going to spend money on buying gas for the motor boat—fishing is too valuable. "No, we just… we need to fish so we just buy the gas. We have, you know, we have money to fish. And it is something that we need to do so… it don't matter. We've got to go out anyways" (NU7). To make ends meet, this family also earns money sampling fish for ADF&G:

> And that takes up a lot of our time, but it is extra income. Last year we got about $600 from it, helps pay for the gas. I think we got about the same for the last couple of years. Or it might have been about $5 a fish. Sometimes we are too tired, we don't want to sample,

so we say, forget it! (NU7)

Subsistence users have long relied on opportunistic hunting and fishing as a cost-effective means to gather and catch wild foods. Several seasons for fishing and hunting various species overlap with one another. Duck hunting in the spring coincides with whitefish fishing in Kaiyuh, sheefish are caught at the same time as king salmon, etc. Today, the only legal moose hunting season is in the fall. In the past, a moose killed at fish camp during summer would help to supplement the food needed for daily sustenance and variety while fishing, and much of the meat would be preserved for use later in the year.



Brittany Retherford

Plate 5-5.–Freshly caught sheefish, fall chum, and coho salmon are stored in a tub for easy transport back to Nulato.

Summary and Discussion

Perhaps the most notable feature of the fisheries surrounding Nulato (District 4) is the distribution of Chinook salmon in the river. Some Chinook salmon begin to swim closer to the river banks as they approach their natal tributary, while salmon bound for Canadian spawning grounds stay deep in the center of the river, since they still have hundreds of miles to go. As a result of this variable stock distribution, there has always been some incidental harvest of Chinook in shoreline nets and wheels set for chum salmon, which tend to swim closer to shore. However, there are only a few large eddies around Nulato that provide good wheel locations for targeting Chinook salmon, so access to them was limited until deeper water was made accessible by motor boats.

Subsistence fishing for salmon has been an integral part of the economy, culture, and social life of Nulato households for generations. Chinook salmon in particular have important nutritional and cultural values that are irreplaceable by any other food, especially store-bought fish and meat. Salmon feature prominently in cultural events, and the act of sharing subsistence resources not only redistributes wild foods to those who might be unable to harvest themselves, but also is symbolic of the extensive support networks that are critical for the survival of rural Alaska. Though evidence has shown that Nulato people can adapt to changes, such as technological advancements, and that they have been resilient in the face of challenges, the current situation of low Chinook salmon runs has the potential to severely and permanently alter the lives of the people who call Nulato home.

Recommendations

Nulato respondents offered some recommendations regarding fisheries management on the Yukon River, especially in the vicinity of Nulato, which are included in the discussion below.

General Management

One respondent expressed a positive experience with opportunities to access information and announcements about the current status of the Yukon River fishery. He said that public dissemination of information was good and that he listened to daily radio updates on Galena's station, KIYU, which announced openings and closures. Posters in public spaces, such at tribal offices and post offices, are helpful. He was also aware of the weekly YRDFA teleconference, which he typically did not attend because of other conflicts (NU4). In short, public outreach and education programs should continue.

Residents expressed concern about the incidental harvest of Chinook salmon in the lower river commercial summer chum fishery and about the bycatch of Chinook salmon in the high seas pollock fisheries. They recommended the elimination of these consumptive uses of Chinook salmon.

> My personal feeling is there shouldn't be commercial fishing at all, anywhere along the Yukon River. Um, the bycatch of king salmon for commercial fishing on the Yukon River is in the thousands. What is it for last year? 9,000 or 10,000? King salmon that they can sell now? If those 9,000 or 10,000 king salmon got to Eagle or even across the border into Canada, think of what a difference that could make for spawning kings up in that area. They don't need commercial fishing. We have all learned to live on, make a living somehow else. (NU5)

> I would tell them that pretty much, straight up, spread the wealth. Try something new. You are all thinking that this [is a] subsistence fishing problem, well, why don't you spread the wealth, cut down fishing at the mouth for a while and see if it builds up in the next 3 or 4 years. That is the step they are going to have to take and make all the fishermen below the mouth unhappy for a few years and see if the fish numbers build up again. If they don't understand that, or can't hear that, then they are not opening up their ears. What else can you try? Try that for a few years. If it causes the world to eat less fish then, whatever, it's okay. You are going to have to put up with that. Otherwise, after the numbers of fish go down there is going to be a point where we can't rebuild. Everything will be shut down after that. We will all be fighting over a few thousand fish going up the river. If they really want to help out and are worried about subsistence they should look at that. Where else can they start from? You can go up the Yukon and hear all these problems but where is it coming from? Down at the mouth. How much are they catching there? (NU2)

Gear

Comments regarding gear type regulations were mixed. The interviews in Nulato were conducted in December 2010, prior to the 2011 fishing season when the 7.5 inch mesh size regulation went into effect throughout the drainage. As noted above, Nulato fishers were skeptical of the mesh size change. However, during a community review meeting held in Nulato in September 2011, fishers present noted that the 7.5 inch mesh was more efficient at harvesting fish—including whitefish, sheefish, and salmon—and they were surprised to be pleased with the regulation change.

Windows and Openings

Some residents endorsed a more aggressive, drainage-wide management approach for conservation purposes. This would include shutting down all fishing (including subsistence) for king salmon, explained the respondent who offered this suggestion:

> I don't think we are going to see the king salmon numbers rise to the numbers of 30 to 40 years ago. I don't think that is ever going to happen anymore. I don't care what they impose in the ocean or anything, but if we want the numbers of salmon that our children can enjoy in years to come, everybody along the Yukon has to come to one agreement:

> shut down king salmon fishing, period, for one season. Shut it down completely. We can all live on dog salmon, silver salmons. Just tastes a little different. But I bet you do that for a couple years in a row and you'll see an astronomical jump in king salmon. Now you try to talk to people up and down the Yukon River if that is an agreeable solution, I am all for it. We might not get the same agreement from people up and down… but the way we are going now, it is just going to keep declining, declining. (NU5)

This same respondent also said he was supportive of the decision to close fishing on the first pulse of Chinook salmon and would probably support a similar measure in the future.

6. BEAVER

Alida Trainor

Setting and Context

Local Research and Respondent Profile

In January 2011, Alaska Department of Fish and Game, Division of Subsistence staff traveled to Beaver, Alaska to conduct research regarding the 2009 Yukon River salmon disaster. Seven interviews were conducted with 8 knowledgeable and active fishers (3 men, 3 women and a married couple), to gain insight about the Chinook salmon fishery in Beaver. Additionally, 31 out of 33 households were contacted, and a short survey was administered to those willing to participate (30, for a 91% sample). In order to understand aspects of the levels of Chinook salmon uses and the food distribution networks in Beaver, the survey documented participation in or knowledge of customary trade and bartering practices.

Historical Background and Natural Environment

At 66 degrees latitude, the community of Beaver, or *Ts'aahuudaaneekk'onh Denh* in Koyukon Athabascan, is the furthest north Yukon River community included in the study.[1] The history of Beaver is ethnically diverse and tied to frontier trade patterns of the mid-19th and early 20th centuries. Prior to the arrival of Euro-American explorers and traders, the area was occupied by Gwich'in Athabascans. This location, on the eastern cusp of Koyukon territory, meant that the people of Ts'aahudaaneekk'onh Denh blended aspects of Gwich'in culture and language with that of the neighboring Koyukon Athabascans (UAF 2012).

Ultimately Beaver became a confluence of Athabascan, Eskimo, Euro-American, and Japanese cultures (Schneider 1976). The Hudson Bay Company was the first to establish trading posts on the upper Yukon River area. In the early 1840s the company opened shop in Fort Yukon (83 miles upriver from Beaver) creating direct competition with Russian fur traders downriver in Nulato (470 miles downriver from Beaver). Until this point, the Russian establishment offered the only market for Alaska Native fur trappers. The competition created by the presence of the Hudson Bay Company increased the incentive for Gwich'in and Koyukon Athabascans to participate in the fur trade. The economic benefits drew other Alaska Native groups into the area, including the Kobuk and Tareumiut Eskimos (Schneider 1976:280).

Located in Interior Alaska, Beaver's historical use of dog teams was influenced by the fur trade and gold rush of the 1800s. Prior to these events, Interior Athabascans used dogs for hunting and hauling supplies to winter camps (Andersen and Scott 2010:1). However, the fur trade in the mid-19th century increased the number of dogs in the area. Dogs were essential to accessing distant trap lines and trading posts. Located in nearby Ft. Yukon, the Hudson Bay Company post, established in 1847, created an incentive for improved winter transportation and encouraged trappers in Beaver to establish new trail networks (Andersen and Scott 2010:2).

The closure of the Hudson Bay Company in 1869 reduced economic activity, but Beaver residents continued to live off the land. The discovery of gold in the area enticed Frank Yasuda, a Japanese trader and gold prospector, to leave Barrow in 1903 with a number of Iñupiat, who were struggling with starvation, and seek a settlement site in the Yukon Flats area. Long after Yasuda officially founded Beaver in 1910, the lucrative fur trade, discoveries of gold, missionary establishments, and steamboat operations continued to bring Euro-American settlers.

1. Alaska Native Language Archive. 2013. "Alaska Native place names." Fairbanks: University of Alaska Fairbanks. Hereinafter cited as (UAF 2012). http://www.uaf.edu/anla/collections/map/names/ (Accessed April 2014).

The social culture of the Gwich'in and Koyukon Athabascans came to center "more and more around the trading posts and the demands of the fur trade" (Schneider 1976:282). The Alaska Native people in the area adopted Christianity and annual celebrations brought by Euro-American outsiders. As a result, potlatches and memorial ceremonies became shorter, and traditional clothing was slowly replaced by Euro-American styles.

Commercial salmon fishing and the sale of roe constituted a profitable industry for many residents, but in the late 1990s commercial fishing in the neighboring Y4 fishing district came to an end. This closure brought a steep decline of income opportunities for Beaver residents who traveled downriver to participate. Without mining, a robust fur trade, or access to commercial fishing opportunities, Beaver was no longer in the center of Interior trade. The estimated population in Beaver in 2009 was 58 and most (89%) of the working-age population was employed solely by the local government.[2] The prohibitive expense of quality store-bought foods combined with a lack of economic opportunities make the continued availability of subsistence-caught resources vitally important. Residents rely quite heavily on subsistence-caught salmon to meet dietary needs throughout the winter months.

Elder respondents described a way of life dictated by the passing of the seasons and the animals that follow them, including the role that fishing played in the traditional seasonal round. In 1989, Sumida documented that nearly 30 species of fish and wildlife were being harvested by Beaver residents throughout the year (Sumida 1989:31). Similar to the 1989 study, respondents explained that through understanding of migration patterns, weather conditions, changing terrain, harvest methods, and regulatory restrictions, residents in Beaver take part in a traditional seasonal round.

One 81-year-old respondent drew the annual map her family lived by when she was young. The map comprised a circle divided into four sections, each representing a season. She mapped the continuity of change that accompanied a nomadic lifestyle. Her family was not stationary but rather traveled to the animals necessary for survival. Their family's spring camp lasted two to three weeks and consisted of muskrat harvests not far from Beaver. Their summer fish camp lasted from June through August and primarily centered on the harvest and preservation of Chinook salmon. Marked by warm weather and the arrival of fish, summer camp offered the opportunity to preserve a critical supply of food for the winter. When fall came, her family set up camp farther inland, hunting porcupines, grouses, hares, and moose. Her family spent October through May about 20 miles downriver from Beaver. They remained relatively stationary during the winter months, ran small trap lines, and relied primarily on the moose and salmon saved from the earlier seasons (B7).

Community Fishing Profile

As described above, in the 1890s during the Klondike Gold Rush, dogs were at the center of commerce, providing the primary means for transporting people, supplies, freight, and mail between camps (Andersen and Scott 2010:2). During this time large amounts of salmon, particularly fall chum salmon, were harvested to sustain sled dogs throughout the year. The prevalence of dog teams in Interior Alaska began to wane in the 1930s, when airplanes replaced them as the most efficient means for transporting freight and mail, and again in the 1960s when the advent of snowmachines replaced dogs as the most efficient means for overland transportation (Andersen and Scott 2010:5). The decline in dog use was reflected in the decline in fall chum salmon harvests. Today only one family in Beaver has a dog team. Respondents agreed that without more dog teams in the community, Chinook salmon harvested for human consumption have replaced fall chum salmon, historically harvested for dogs, as the primary subsistence fish. The primary reliance on Chinook salmon makes run declines particularly detrimental for the people of Beaver.

Despite the shift from harvesting chum salmon to harvesting more Chinook salmon, subsistence salmon fishing has always played a primary role in lives of Beaver residents. "I'm not sure of the date but I just remember my childhood … geez, I've been [fishing] all my life," one respondent emphatically stated.

2. ADLWD (Alaska Department of Labor and Workforce Development). n.d. "Research and Analysis Homepage: Population." Juneau: State of Alaska Department of Labor and Workforce Development. (Accessed April 2014).

Fishing in Beaver is not a hobby or a passing interest: all of the respondents made clear that salmon fishing is a part of their history, their physical sustenance, and their identity as residents of Beaver and the Yukon River.

Beaver residents today generally follow the same fishing strategies as previous generations. Residents begin preparing for fishing in June—working together to prepare supplies and equipment, and sharing expenses for fuel. Salmon fishing is heaviest during the month of July with at least one family spending several weeks in a fish camp, while other households fish by setnet or fish wheel closer to the community. Respondents reported that fishing can be expensive, and for those individuals with summer employment, fishing activities take place in the evenings or on weekends, sometimes making it difficult to obtain enough salmon.

With the waning exception of fish camps, families in Beaver maintain permanent year-round residency in the community. Hunting or fishing can draw residents away from the community for days or weeks at a time, but the seasonal migration described above has not occurred for decades. Community-based subsistence has not, however, changed the essential methods of teaching traditional hunting and fishing skills. All respondents learned how to catch, process, and preserve salmon through observation and participation. Most learned when they were children. One respondent was born on a river east of town in 1933. His earliest memories are of fishing with his father. At that time his family harvested thousands of salmon for their winter's food supply, their dog team, and for customary trade (B4).

One elderly respondent admitted she had very limited interest in fishing when she was a child: she preferred to play on the beach. Unfortunately, when it came time for her to fish as an adult, she did not know how. It was not until she married that learning how to fish became a necessity. After some trial and a lot of error, the respondent and her husband became very proficient and managed to keep the traditions and methods of their families' fishing practices alive.

> After I got married and we stay by ourselves down that way, my husband, he, um, he never cut fish, and I never cut fish when we were with our parents. So when we start staying alone we don't know how to cut fish, but we tell each other how we see our parents do. (B7)

Although fishing effort in Beaver has declined since their elders' younger days, some middle-aged residents continue to fish for salmon every summer. For example, a 50 year old respondent was responsible for providing subsistence foods to roughly fifteen members of his extended family (B4). The respondent's effort supported his own family, several elders, and a single mother with four daughters. A couple in their 40s worked diligently to harvest and put away fish for themselves and their elderly parents during the July Chinook salmon run (B3). An 81 year old respondent continued to stay in fish camp during the summer to process the fish caught by younger members of her family (B6). They worked together in fish camp during the Chinook salmon run and returned to Beaver once they had harvested and processed a sufficient amount of fish to supply their households for the coming winter. Another household that fishes heavily each year bartered Chinook salmon in exchange for groceries.

In order to harvest enough fish, whether for personal consumption or barter, cooperation is necessary. Similar to other communities on the Yukon River, fishing in Beaver occurs in groups or networks composed of extended family members and close friends. It is not uncommon to have more than three families using the same gillnet or camp. The communal nature of fishing in the area makes sharing salmon a fundamental feature of Beaver's character.

Fishing in Beaver, along with participation in other subsistence activities, is connected to a concept of respect. This concept was described by most of the respondents as being an essential component of successful fishing. One respondent recalled that his grandmother taught him how to respect the land, "and be thankful for it, never taking too much and never wasting it. You know, taking care of it. And being thankful and appreciating it … and sharing it" (B2). Furthermore the "number one rule" when elders recalled fishing practices, is to only take what you need and to never waste it (B4). When the grandson of one respondent found a moose killed by nonlocal hunters, with only the antlers and one hind leg missing, "he was so upset,

never seen all that meat just go to waste. [He] just couldn't even talk about it," she said (B7). Respect for wild resources serves as a conservation method that minimizes waste.

Knowledge of how to fish, including respectful harvest and processing practices, is passed through generations. They are not all easy lessons. One respondent described that when he was a young boy he began checking his father's fish net. He understood that "you gotta put food on the table" and to do that you have to kill something. "You can always do it in a respectful way, and, you know, I was like, okay with that idea." But when the respondent had to pull live fish into his boat, he "really didn't want to kill them." In order to take an animal's life, this respondent had to believe that the animal was not dying in vain nor experiencing suffering. Eventually, the idea of respect that had been taught to him became inseparable from his fishing. Disrespect for the resource, including overharvest, waste, and the maltreatment of animals is, in a sense, sacrilegious to these respondents—except the crime is against the natural order rather than a deity.

Traditional forms of conservation stem from a close relationship with the natural world that emphasizes the knowledge and power all animals possess. Consequently for the Koyukon people, "subsistence is more than just an economic pursuit—it is manifestly bound to religious ideology and ritual practice" (Nelson 1983:226).

In traditional Koyukon culture, each animal and fish has a unique power and distinct personality that manifests itself in the natural world. The spiritual power of fish, particularly salmon, is significant and can protect people from "supernatural harm" (Nelson 1983:68). A dried salmon tail or skin is sometimes nailed inside a house to protect occupants from harmful spirits and bad luck. These practices, documented by Nelson, demonstrate that the traditional relationships of Beaver people and the animals they use are deeply rooted and culturally bound.

Elder respondents described the decline of salmon in relation to the decline in fishing activity and the deteriorating relationship between the fish and the people of Beaver. One respondent noted that as people in Beaver move away from their reliance on Chinook salmon and other subsistence resources, the quantity and quality of those resources also declines. If a resource is not used or relied upon it will disappear (B4). The same respondent went on to explain that the history of the Gwich'in people is closely tied to the good stewardship of the land because traditionally they have always been caretakers and conservationists. Care and respect for the natural world declines when people no longer rely on the land or resources around them. Put simply, "you got to take care of what you got and just fish," otherwise, "you'll lose the pristine beauty of the land" (B4). The relationship between people and fish is bilateral, co-dependent, and the source for a spiritual connection with the natural world. The dependence of humans on other animals seems stronger than the dependence of other animals on humans. Indeed, humans more directly *rely on* animals—but, Yukon Chinook salmon *depend* on people. It is, at least in part, the human need for natural resources that creates a spiritual role for animals and a cultural concept of conservation.

History of Local Fisheries

Historically, Chinook, coho, and fall chum salmon are the primary salmon species residents in Beaver have harvested. Summer chum salmon are not available in large numbers in the upper Yukon River as they mostly spawn in tributaries below the Tanana River. Always an essential source of subsistence food, Beaver residents consider Chinook salmon the most valued species of fish. Fall chum salmon have primarily been harvested as dog food. For example "There's dog salmon for the dogs, but king salmon, that's for us," said one respondent (B6). Even though Chinook salmon are the target species, any fish that are caught are kept for some type of personal use. One respondent noted that, "whatever's caught, we cut and hang" (B3).

Over the last century, the nature of fishing in Beaver has changed. Nearly half of the respondents were old enough to remember a time when the fishing effort in Beaver was greatly dictated by the number of dogs that needed to be fed. In the past, dog teams were an essential, if not the only, method of transportation in the Beaver area. Elder respondents reported spending extensive time fishing because of the need to harvest large amounts of dog food. One respondent estimated that during the 1940s families would harvest an average of 700 fall chum salmon per season for both human consumption and dog food. He recalled that

each season his family would attempt to fill a fish rack four stories high and fifty yards wide. The respondent reported that, once processed, this seasonal harvest would total approximately 250 bales, each containing thirty to forty fish, providing not only their winter's supply, but a surplus to barter for other provisions, including groceries (B4). Today there is only one family left with a dog team, and unlike owners who came before them, they do not depend on fish as a source of dog food**.** As a result, Beaver residents did not report intentionally pursuing salmon for dog consumption.

Without dog teams to support, fishing effort for fall chum salmon has declined. Chinook salmon however, remain a major source of protein, and some families still try to put up enough to get through the winter in case of an unsuccessful hunt. During years when moose numbers are low and there is little meat in the community, Chinook salmon are consumed more—but there was a general consensus that no one eats as much Chinook salmon as they used to. For example, one respondent noted that today his family does not put away as much Chinook salmon as they used to. They mostly eat it in the summer to "just go with the season," and they rely more heavily on store-bought foods in the winter than they once did (B3).

Collection, Processing, and Distribution of Fish

Gear

Over time the fishing gear types used in the Beaver area have changed. For Chinook salmon, the two most popular forms of gear used are fish wheels and commercially made nylon setnets. In the past several decades, the use of fish wheels has declined, and most Beaver residents now use setnets. Several respondents reported that multiple families share the same net. This makes fishing more economically feasible and time efficient. One of these respondents noted that his family has never bought a net. Instead, they share a net with extended family in four other households (B3).

Fish wheels and nets both have their benefits and drawbacks. Fish nets, for example, can be expensive, running upwards of $600, and are subject to much wear and tear during each fishing season. Driftwood and sticks that float down the river can snag and damage the nets. These damages are often time-consuming to untangle and difficult to repair, and they reduce the number of salmon caught—or increase the effort required. One respondent pointed out that, "if there are too many snags [you] gotta just pull it out" (B6). This makes successful fishing dependent on river and weather conditions. If the water level is high, like it was during the summer of 2010, more drift[3] will float down and be picked up in nets, creating difficultly for fishers using setnets.

While not immune, fish wheels are less subject to the dangers of drift than nets. If drift is picked up in either of the rotating baskets it will be dropped into the box along with the fish, and, unlike a net, it is much easier to separate the fish from the drift. Nevertheless, high water and excessive or large drift can, in some cases, destroy a fish wheel if not closely monitored. Prior to the 1960s and 1970s, dipnets were used almost exclusively by residents in Beaver. But one respondent recalled that by the time of his return home from military service in Vietnam everyone had switched over to using either setnets or fish wheels.

Although wheels and setnets are more efficient than dipnets, they require constant upkeep. Every year residents must repair the rips or tears in their nets. One respondent explained that they need to "fix the net, sew it up" but often do not know how and must rely on their elders (B3). If repaired each season and stored properly, nets can last for a long time. Fish wheels can sometimes be built more cheaply than a net can be bought but require more maintenance. One respondent explained that he "usually build[s] one every two years…Sometimes it's less than that. Sometimes you don't even get a season out of them. Like …this year. I caught one fish in my fish wheel then the creek took it" (B2).

In the 1970s and 1980s, when more fish were in the river and when a greater number of people fished for dog food, wheels were the primary, if not the only, gear type used (B4). Fish wheels, introduced in the early

3. Drift, or driftwood, refers to the floating debris that is lifted from the shoreline during high water. Drift often includes sticks, logs, and occasionally trash. These items can tangle in nets either ripping large holes in them or requiring time and effort to remove.

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Plate 6-1.–Fish wheels are one of the most common gear type in Beaver but require a considerable amount of effort to build, maintain and tend to during fishing season. Here, a hand-built fish wheel rests on the bank awaiting repairs.

1900s, are capable of catching many fish in a very short period of time. When people in Beaver used fish wheels during this time they had to "cut [salmon] from morning until night and share with everyone" in order to process all the fish that were being caught by fish wheels (B6). Wheels are a productive gear type, but they do take some "babysitting" (B2). Fish spoil quickly during the summer heat, and fish need to be removed from the wheel's capture box regularly. One respondent reported that there are some people in Beaver who "MacGyver" their fish wheels in order to prolong the time it takes for fish to go bad (B2). Some make shades for the boxes in order to keep the fish cool while others attach a can to each basket so water will be poured over the fish with each rotation. This method also keeps birds and insects from picking at or infesting the fish. Regardless of these efforts, however, "four hours is a long time to not check the wheel" (B2). Setnets have the natural advantage of being underwater, thus allowing fish to remain cool and out of reach of scavengers like birds or insects.

The length of nets used by Beaver residents varies. Some respondents reported using a 60 ft net while another was using a 100 ft net. The length of the net depends on the fishing location. One respondent uses an 80 ft long net because the eddy her family fishes is not very wide (B6). Residents in Beaver who fished with a net use an average mesh size of 8 inch. This mesh size was repeatedly referred to as a "king net" because of its ability to effectively target Chinook salmon. It is accepted that the size of fish caught is related to the

mesh size of a fish net and residents are reluctant to change net size when regulatory restrictions call on them to do so.

Fishing Practices

All 9 respondents mapped their past and present fishing locations. Historical and contemporary fish camps, setnet, and fish wheel locations were documented (Figure 6-1). Three contemporary fish camp sites were identified from the interviews: two near Whirlpool Island and one on Fish Slough. In addition to the fish camps, two individual setnet locations were mapped. At first glance the map looks sparse. However, key respondent interviews reported extensive fishing networks consisting of many families who fished together and shared the harvest. This suggests that fishing effort cannot be evaluated solely on the number of mapped fishing locations. Nearly all respondents recalled fishing locations that are not used today because of their distance from the community. Two respondents, likely in the same fishing network, reported the use of a fish camp downstream from the Yukon River Bridge, approximately 110 river miles away from Beaver. They said that the feasibility of using that distant fish camp has long been impaired by the need for wage employment. Leaving the community for extended periods is not possible when a day job necessitates constant residence in the community (B8).

Beaver respondents consistently reported rising fuel costs have significantly changed their fishing practices over recent years. The gas price during summer 2010 was $7.50 per gallon. As of May 2012, gas prices had risen to $9.00 per gallon, and the trend is likely to continue upward. High fuel prices have caused most families to abandon use of traditional fish camps requiring long-distance travel and to choose to fish closer to town instead (B5). Several respondents reported high fuel prices were responsible for limiting the total number of trips each day. In order to reduce the financial burden of high fuel prices, some households now only travel from the community one time per day to check their setnets.

In the past, men in Beaver were often responsible for catching salmon and women were responsible for cutting. Similar to today, families worked together to hang fish on drying racks and maintain a smudge fire for smoking. Residents turned the harvested Chinook salmon into dry fish by hanging and smoking it:

> We dry fish every summer. Just dry it because we didn't have no refrigerator or anything like that. We dry everything. We [even] dry the head … and then in winter time we cook it for dogs. (B7)

Dried fish, whether fall chum salmon for dogs or Chinook salmon for humans, were usually put away in bales consisting of thirty to forty fish. Later, households began to process salmon in jars for winter storage. Residents either buried processed fish underground or stored them in above-ground caches:

> We didn't have electricity … [we] always had to go and clean out our holes we had down at the permafrost, which was our refrigeration. And then we'd have some special caches made. High caches is where we kept all our baled up fish. (B2)

In the latter half of the 20th century, freezers changed the way residents processed and stored fish. Residents continue to jar and smoke Chinook salmon for winter storage. However, instead of placing whole dry fillets into bales, strips are made. Some residents continue to smoke salmon roe for storage.

Respondents stressed the cultural and historical importance of using as much of the salmon as possible, which continues into modern times. For example, one respondent stated "We don't waste anything and we save the backbone. We throw it to our hound dogs and they eat that … it's rich, that backbone. Just the bone, even" (B7). Respondents also reported saving fish gills for use as dog food. Some Beaver residents maintain a practice of respectfully discarding salmon entrails by leaving them on the beach as a gift for local birds and land animals. One respondent reported utilizing unconsumed fish parts as garden fertilizer.

Sharing, Barter, and Customary Trade

Respondents reported that salmon caught on the Yukon River by Beaver residents are consistently shared with family members, elders, and residents in other Alaska communities, and that sharing is the primary

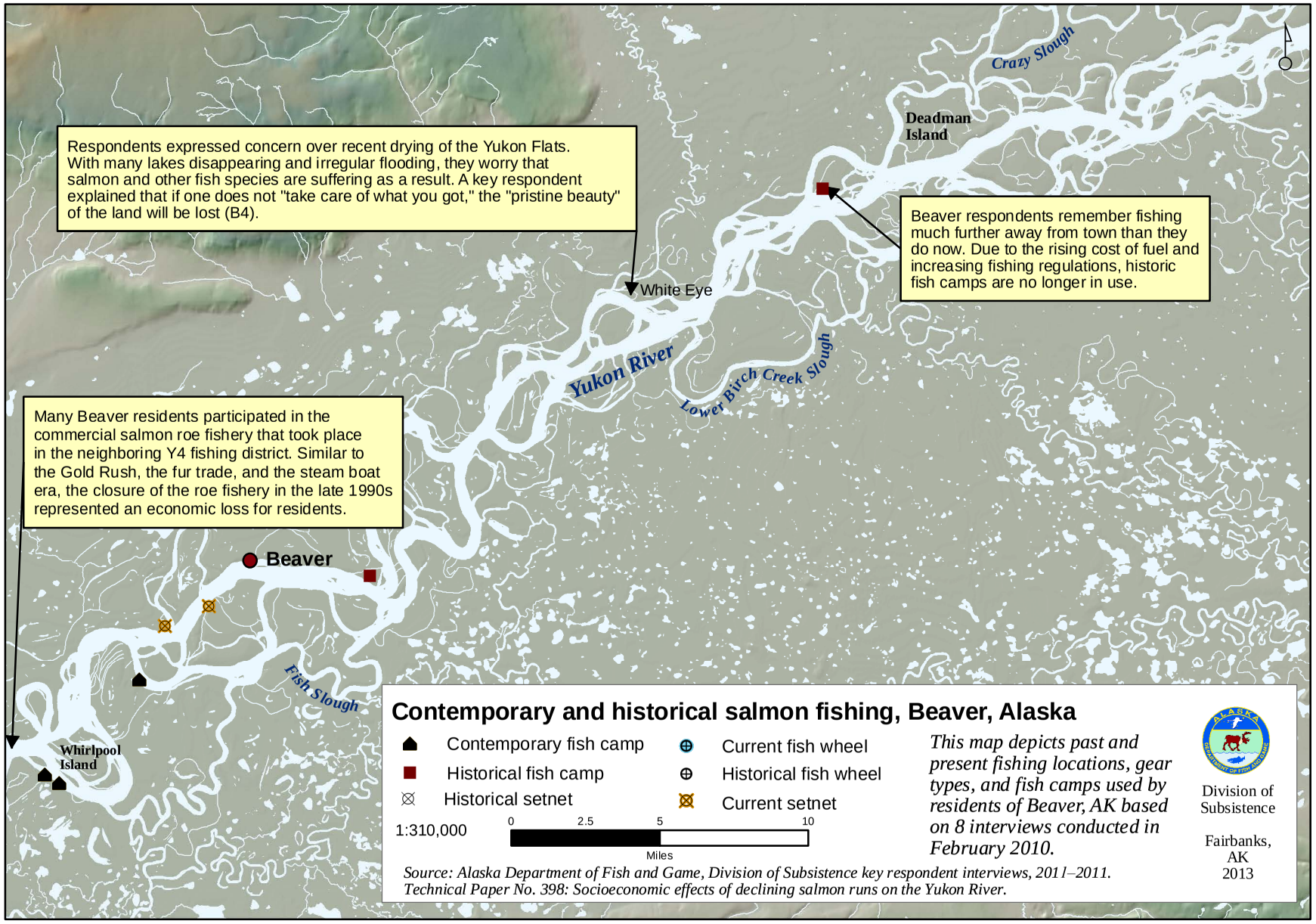

Figure 6-1.–Contemporary and historical salmon fishing locations, Beaver, Alaska.

method of distributing subsistence caught salmon. Respondents reported sending Chinook salmon to relatives in Fairbanks, although one respondent was concerned there could be negative legal consequences for sending Chinook salmon to a nonsubsistence area in the state[4] (B2).

A short survey was administered in Beaver asking participants to assess their household participation in both barter and trade and to assess what typical community participation looks like. Surveyor and participant comments recorded on the surveys indicate that the survey may not have captured the complete nature of these activities in Beaver. One survey summary recorded, "respondent refused to discuss [the details of] bartering but says it does occur" (HH12). Another survey summary noted, "Respondent seemed reluctant, but did talk about trading subsistence foods for coastal marine mammals" (HH28). Hesitation likely resulted from the recent federal investigations into alleged abuses of customary trade in other Yukon communities (Associated Press 2010) and from the general tension created around customary trade practices because of increased negative attention on the practices in light of declining Chinook salmon runs.

Simply asking questions regarding barter and customary trade may have put participants on the defensive and created the possibility of underreporting. While there is no way to conclude with certainty that underreporting occurred, the hesitation of respondents to participate in the survey or discuss other people's activities suggests a strong likelihood of underreporting that may also reflect a strong cultural prohibition on speaking beyond one's own experience. Considering current sociocultural and historical circumstances, including distrust of government agents, and a general sense that subsistence lifestyles are under attack, under- or vague reporting might be at play in these data.

At least two factors, confusion and fear, could contribute to the very low reported rate of customary trade. First, while the survey did define barter and customary trade, participants may have confused the definitions and miscategorized their activities. Secondly, fears of enforcement or regulatory repercussions may have outweighed participants' willingness to give accurate responses despite the assurance of anonymity and confidentiality.

Among 30 participating households, 8 (26.7%) reported having ever bartered, and only 2 (6.7%) reported either buying or selling a subsistence food (Appendix C, tables C1 and C2). During the study year of 2010, the same number of households reported they had bartered and/or traded in the past. Residents frequently commented that they were uncomfortable characterizing other residents' participation in barter or trade activities. They reported that they were unaware of incidences of other people in the community buying or selling salmon, or that they were unsure of specific details.

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Plate 6-2.–Despite Beaver's location in the interior of Alaska, historic trade networks with Inupiaq people to the north persist. Here, muktuk, a coastal dish, is served with moose roast combining foods from two distinct regions.

However, some respondents did report that bartering salmon for other subsistence resources or commercial goods has been an ongoing practice in the community of Beaver for generations. The survey

4. Under State of Alaska regulation, sharing subsistence resources with family members is legal (AS 16.05.940 (33)).

attempted to identify the most important factor in bartered exchanges. Of respondents who reported bartering fish in the past, 75% did so because they "needed fish," while 12% bartered because they "had extra fish." Survey comments further explained the practice. One survey summary notes that "barter happens when one food is low" or when there are "hungry stomachs" (HH3). Of respondents reporting barter participation, 25% did so more than once per year while nearly 40% did so about once per year (Appendix C, Table C2).

The two resources "most often bartered" in Beaver were salmon and moose. Smoked and jarred salmon or salmon processed into strips is most often bartered or traded. Moose is traded fresh and unprocessed. Participants reported that salmon is often exchanged between Beaver residents for nonsalmon fish, moose, or gasoline. Salmon is exchanged with Venetie residents for caribou and berries. Salmon is exchanged for seal oil and whale muktuk with Barrow residents (Figure 6-2). When moose is bartered between Beaver residents, salmon, nonsalmon fish species, or groceries are the most common resources exchanged.

Traditional barter and trade networks exist across Alaska. As noted above, some Beaver respondents reported the existence of a traditional bartering relationship with the Gwich'in community of Venetie, 53 miles northeast of Beaver. Located on the Chandalar River, Venetie sits at the interface between the forested Yukon Flats and the tundra foothills of the Brooks Range. Traditionally, Venetie residents barter easily accessible caribou for Chinook salmon caught by Beaver residents. Regarding Chinook salmon, a Beaver respondent stated "I get a box full, and I send it to Venetie, to my friends. 'Cause they don't get that kind of fish up there" (B7). The respondent reported that, in loosely calculated reciprocity for Chinook salmon, Venetie residents often provide caribou meat to Beaver households, especially caribou heads for soup. "When they got lots of caribou … they send me caribou head or … [a] little dry [meat]" (B7). Over her lifetime, the same respondent reported a consistent practice of trading Chinook salmon heads for a caribou head. "We don't have no caribou around here. It's a good idea if you got no caribou … you … trade with fish head. And they [Venetie residents] like fish heads" (B7). Survey comments revealed subtleties in the rate of exchange for caribou and fish. In one example, one caribou head from Venetie equated to twenty or thirty fish heads from Beaver (HH35). The exchange rate is not fixed and depends on the size and availability of king salmon, as well as on the relationship of participants.

Both interviews and surveys captured reports of Chinook salmon harvested in Beaver being bartered for berries harvested in other Alaska communities. One Beaver respondent explained that blueberries, low-bush cranberries, and high-bush cranberries had become scarce in the region due to climatic changes. "We had berries, but that was long time ago; ten years ago there was a lot of berries, but it seems since then it has dried up. It is too dry; there was too much cold this spring, so there was no berries at all. So I would trade jar fish for berries" (B8). Survey summaries corroborate key respondent reports of berry and fish bartering. "Berries are really important. In the past, they grew all over, but now the environment has changed and has become too dry for them to grow. So people trade [fish] with Venetie for berries." The participant shouted, "Give me the berries!" (HH18).

An elder respondent recalled that during the 1940s, his family would barter around "250 bales of fish, with 30–40 fish in a bale" for groceries with the owner of a Yukon River barge (B4). The barge would pick up the salmon on its way upriver to Fort Yukon. Once there, fish was exchanged for groceries and then given to his family on the return trip downriver. This barter was essential for his family's winter food supply (B4).

Beaver households report still obtaining commercial goods with fish. One Beaver respondent reported bartering excess salmon with an Alaska rancher for regionally produced beef and also bartering salmon for groceries with rural Alaska ("bush") pilots. "They're hauling me fuel … bringing me groceries. They want salmon" said the respondent (B2).

Beaver respondents who reported bartering salmon for other subsistence resources or for commercial goods reported that they make no extra harvest effort to obtain salmon for those purposes. Rather, households only bartered salmon considered nonessential to household needs as the winter unfolds. Respondents who reported bartering explained that during years when their households did not obtain enough salmon to meet their own needs, they did not participate in any bartering.

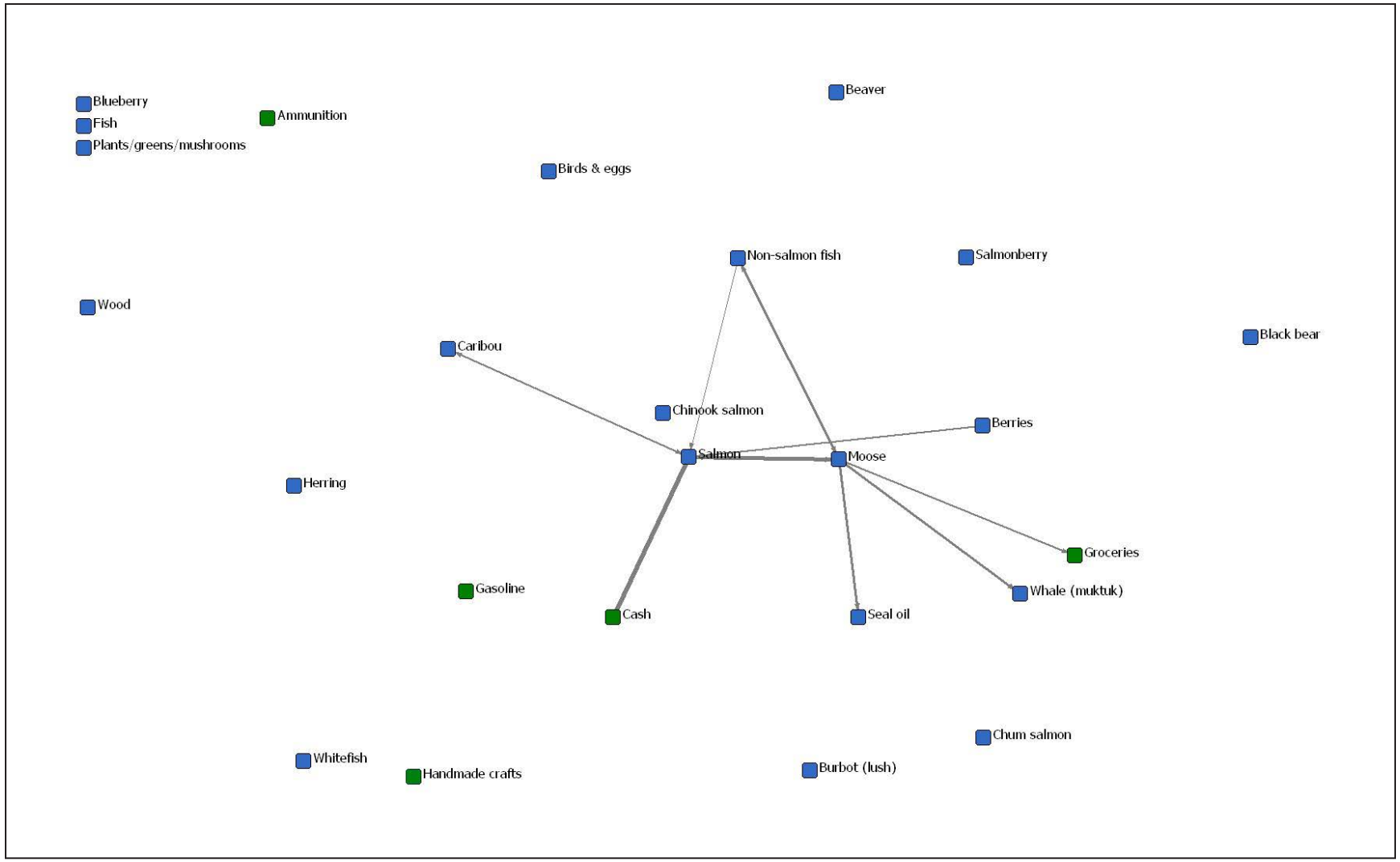

Figure 6-2.–"All Exchanges" network diagram of the barter and trade continuum in Beaver; resources that are exchanged frequently migrate to the center of the diagram; those exchanged less frequently move to the periphery. The weight of the line connecting resources reflects the frequency of that particular exchange. The absence of a line does not indicate exchanges do not occur, but rather implies that the type of exchange is not common and/or not documented by the sample households: i.e., no specific incidents were documented, nor was the general pattern described.

More than 90% of 30 responding households in Beaver reported that they did not participate in any customary trade. Only 2 households reported ever participating in customary trade: one reported selling while the other reported buying. When answering the question, "Why have you bought or sold subsistence food?" one respondent was motivated by a lack of food, and the other reported a need for money. In both the survey and the interview, most key respondents from Beaver reported that they did not know of anyone else in the community buying or selling Chinook salmon. They reported a belief that trading salmon for cash is unethical and goes against a longstanding local practice of sharing fish. For example, one respondent stated: "We were taught to never sell our Native foods. Just to share what you have" (B8). For this reason the respondent explained "I wouldn't sell my fish. I would share it with someone else" (B8).

However, some interview respondents did report that customary trade has been an ongoing practice for some Beaver households, dating back at least to the latter half of the 20th century. For example, one respondent recounted that during his childhood in the 1960s, his grandparents would sell Chinook salmon roe to buyers who flew in on airplanes to purchase it by the pound. While he explained that roe is no longer sold he did report personal participation in the sale of subsistence caught Chinook salmon (B2):

> Interviewer: How do you decide what the price is?
>
> Respondent: Sell it what the market is.
>
> Interviewer: Do you sell it by the case or by the can or…?
>
> Respondent: Yeah … um. I've sold whole fish. And people really want it.
>
> Interviewer: Is the price determined by the weight? The pound?
>
> Respondent: I mean, this past year, no. The year before, no. It's [salmon] just been too hard to get recently. But long ago when there was just, you know—I was getting more fish than I could do with. But ah, yeah, just by the pound. (B2)

This respondent was reluctant to discuss the details of his transactions but the account implies that the practice has been more common than survey results documented. As noted above, respondents reported very little customary trade activity in the surveys, leaving the extent of the practice in Beaver unknown.

Figure 6-2 shows all the exchanges made for food, supplies or services in Beaver. Frequently exchanged items move to the center of the diagram while resources that are less frequently exchanged move to the periphery. Salmon appear at the very center of the figure, connecting to numerous other subsistence resources, including seal oil, caribou and moose, and also connecting to cash. The thickness of the line indicates the frequency of the exchange for the two resources it connects. The absence of a line between two resources does not suggest that the exchange never happened but rather that the exchange was not common or was not captured on the surveys. Regardless of whether bartered, traded, or shared, salmon are a vital component of Beaver's exchange network and are widely distributed throughout the community.

Local Experiences of Salmon Decline and Disaster

Observations of Change

Beaver respondents reported that a constantly changing river affects year-to-year subsistence salmon harvests. In recent years, changes in water levels have affected fishing in unprecedented ways. For instance, respondents reported that at the peak of the 2010 Chinook salmon season in July, abnormally high and swift water levels heavily thwarted the community's ability to harvest fish (B6, B2, B3). Some households discontinued fishing effort after less than a week because of the unusually difficult river conditions (B3). Most, but not all, respondents reported harvesting little or no Chinook salmon in 2010. Respondents attributed the high water conditions to late spring runoff and heavy rains in upriver locations.

Respondents reported that the resulting increase in water flow took away normally reliable eddies, thereby shifting fishing locations. Additionally, high water brought large amounts of drifting debris into the river,

causing damage and prompting people to pull their nets. For example, one respondent reported that after three to four days of the family setnet only catching "drift," fishing effort was abandoned for the remainder of the season (B3). Another respondent reported that abnormally high water during 2010 had washed his family fish wheel away. "It's been tough fishing with fish wheels, really tough. And…it's not a picnic to run them when the water's not on your side," commented the respondent (B2).

Some respondents reported an observation that spring runoff has been coming later than normal in recent years. Respondents explained that fishing becomes challenging if the water is too high during the late June and early July Chinook salmon runs. "Well, there's always been high water but usually high water is the first of June…recently it seems like it's more toward the end of June now" (B2). During 2010, "when the water go down, the salmon run had already went by," explained one respondent (B6). Consequently, this respondent and others had a difficult time meeting their needs.

Despite abnormally high water in 2010, one elder respondent discussed long term warming and drying trends in the Yukon Flats (B4). The Yukon Flats is a vast region of clearwater wetlands and tributaries that feed the glacial river. The respondent expressed a belief that a lack of moisture and annual flooding in the region was having a negative impact on the entire socio-ecological system. Up until the early 1990s, the area surrounding Beaver would flood annually, refilling the lakes and sloughs. The replenishment of water

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Plate 6-3.–Beaver is located in the Yukon Flats, an area characterized by the numerous "braids," or shallow channels encompassing ever changing sand bars. The flat topography of the Flats makes the river very wide and slow moving in some places. This reduces the number of viable setnet locations and requires the use of fish wheels. This photo was taken from the river bank in front of Beaver.

to smaller tributaries allowed fish, especially nonsalmon species, to move freely, which helped them play a vital role in the local ecosystem. Without regular flooding, these fish often remain trapped in shallow water that freezes through during winter, instead of migrating to deep water that does not freeze through. The change in seasonal patterns and the deteriorating health of all fish species led the respondent to the following conclusion:

> My theory is that everything is not working in the Yukon Flats; the moose numbers are low and caribou numbers are getting low. Water is getting pretty low. They are all, all of the lakes that used to be good for muskrat have turned into meadow because there is no water. All our muskrat camps and fishing place, you know, high and dry. The reason for that is that there is no flooding ... Somehow, the water is drying up. I think it is because the caretaker left the country, and they don't take care of that land anymore. (B4)

According to the respondent, persistent drought and a lack of water in the region is "hurting the whole system." The respondent believed that the health of this system relies on the cultural relationship the community has traditionally maintained with the animals, plants, and land that surrounds Beaver (referred to as the "caretaker" in the above quote). Without such a relationship, Yukon tributaries are not replenished or retained throughout the year and thus are likely contributing to a decline in fish populations (B4). In other words, the generational decline in the Gwich'in people's spiritual relationship with the land has contributed to increasing aridity and decreasing resource populations in the region (B4). Because there are "no more songs and no more dances" performed for animals, the environment that community residents have traditionally relied upon is becoming unsustainable. One example of the repercussions of environmental change, whatever the cause, is the need to trade with Venetie for berries that are no longer locally prolific.

Beaver respondents consistently reported declines in Chinook salmon abundance. According to an elder respondent: "The main story is that there used to be a lot more fish than we have today" (B4). The respondent reported that during the 1940s fishers needed to quickly shut down their fish wheels to avoid taking more fish than they could process and he confirmed that both Chinook and chum salmon have declined over the last twenty years. Another respondent in her late 40s reported that in the past, her household could anticipate harvesting up to 100 Chinook salmon per day, but

> [W]e barely get any fish now. We would be happy to even get a hundred throughout the whole month. It's like eight a day now, compared to long time ago, it used to be at least thirty in the morning and maybe thirty five or forty at night. (B8)

Beaver respondents also observed declines in the size of available Chinook salmon. According to respondents, Chinook salmon were much larger in the latter half of the 20th century. For example, one respondent reported that during that time, an 80 lb Chinook salmon was considered a large fish, but today a 35 lb Chinook salmon is considered large. "It seems like when I was a kid fishing … we never got the little fish, the little 'jacks.' You know, the little young salmon. Seem like it's all we get now" stated one respondent (B2). "The size are really small now, compared to a long time ago" (B8), said another.

In recent years, declines in the size and abundance of Chinook salmon have made it difficult for some Beaver households to meet their needs or share with others at the same rate they have in the past. For example, a Beaver respondent, explaining the effects of not obtaining enough salmon in 2010, stated, "My cousin up there at the street with the four daughters … no. I didn't give them fish" (B2). One respondent reported a deficit that stopped his household from participating in an ongoing trading practice with local merchants who exchange fish for winter groceries.

Respondents from Beaver generally attributed the reported declines in abundance and size of Chinook salmon to overfishing on the river. Overfishing was generally attributed to higher human populations on the river, increased demand for the resource, and commercial fishing on the Yukon River. Respondents consistently expressed a viewpoint that downriver fishing activities are responsible for salmon declines. For example, one respondent stated that "They're getting them [salmon] at the mouth of the Yukon" (B2). Another respondent expressed a desire for fishery managers to establish a several year moratorium on Yukon River commercial and subsistence Chinook salmon fishing in order to allow the population to recover

from overharvesting (B4). His suggestion of a moratorium was singular among respondents. Instead, most advocated for longer openings and fewer restrictions. While this suggestion was not widely shared, it remains part of the continued discussion between fishery managers and stakeholders.

In addition to reports of declining Chinook salmon populations, there were reports of recent observations of unhealthy and/or diseased Chinook salmon. For example, one respondent stated "I mean, some of the meat is really poor. Like, mushy, and white, really white, not as rich as it used to be" (B8). Another reported signs of disease: "Maybe three years ago, four years ago. There was big king salmon like this in kind of a pinkish color and little white dots ... But I never see none last summer. All these many years, every summer I fish, I never did see anything like that until about three years ago" (B7). The observations described above illustrate the concern Beaver residents have for the resource and its environmental health.

Management

Most Beaver respondents are of the opinion that commercial salmon fishing on the Yukon River and in the Bering Sea has been the primary cause of Chinook salmon declines, and that commercial salmon fishing should be discontinued within the Yukon watershed. These respondents are concerned that the relatively minor subsistence needs of local peoples who "live off it" are not taking precedence over the interests of the commercial fishing industry (B3). Respondents pointed out that because of Beaver's location on the upper Yukon River, the community is "almost at the end of the line" for salmon and are thus in a position of great disadvantage for obtaining fish when compared to downriver communities (B3). Respondents feel that commercial fishing activities on the lower river and in the Bering Sea exacerbated the strain on upriver subsistence fishing communities.

With the exception of one respondent, who reasoned that commercial fishing is an economic necessity crucial for downriver fishers who are trying to make a living, respondents felt that, in order to allow for adequate escapement and spawning, commercial salmon fishing should only be allowed in the Bering Sea (B4). Other respondents expressed the opinion that salmon bycatch from Bering Sea commercial pollock trawlers is the single greatest cause of Chinook salmon declines on the Yukon River.

In May 2010, in response to bycatch concerns, the National Marine Fisheries Service (NMFS) approved Amendment 91, proposed by the North Pacific Fishery Management Council, which combined a cap on Chinook salmon bycatch with "incentive plan agreements and performance standards." This measure intends to limit bycatch while also allowing the pollock fishing fleet to harvest their total allowable catch for any given year (NMFS 2009). NMFS began implementing this new measure in the 2011 pollock season. It is yet to be seen if the action will have any positive effect on Yukon River Chinook salmon.

Some respondents opposed to pollock trawlers opposed commercial fishing of any type. Those voicing opposition to commercial fishing felt that the interests of the commercial fishing industry can never be reconciled with the interests of salmon conservation and subsistence uses, arguing that the ecological requirements of salmon are not compatible with commercial fishing methods or demands. These respondents believed that discontinuing commercial salmon fishing practices in general was the only sensible approach to recovering Yukon River Chinook salmon populations (B1, B2, B3, B4).

Beaver respondents expressed dismay that many downriver communities seem, to them, to be more loyal to the interests of commercial fishing than to conservation measures and the needs of subsistence fisheries on the Yukon River as a whole. They disagreed with the argument that commercial salmon fishing is an economic necessity. For example, one respondent stated: "I mean, what did all these people do down at the mouth of the Yukon before commercial fishing? Nothing? They had to be doing something. Commercial fishing's not that old on the Yukon River" (B2). The respondent went on to point out that "Upriver there used to be commercial fishing then it got shut down…people upriver found out a way to survive without it" (B2).

Some of the respondents have tried to involve themselves in the regulatory process to have their concerns heard. There is a sense of hopelessness among the respondents who have attempted to participate. For

instance, a former member of the Regional Advisory Council was left with an impression that local participation can cause very little change due to an impenetrable bias towards commercial fishing interests over subsistence needs (B2). After attempting to engage in the participatory management process in 2009, this same respondent voiced frustration that commercial fishing interests tend to overlook the subsistence needs of local people and the sense of community with which he was raised:

> I went to a [Board of Fisheries meeting] last year and that's like "Holy … !" These people are serious. They wanna get every fish that comes into the Yukon River … I don't know how the commercial people think. You know, I tried to … sometimes I sit and wonder like, "Oh wow, what are they thinking?" I can't even imagine. I can't think of anything. Just blank, you know. I think it's the way I've been raised and … I've been taught to care about mom and dad and the neighbor, you know? (B2)

Frustration with the conservatively managed subsistence salmon fishery on the Yukon compounds the general lack of acceptance with commercial fishing. Inseason subsistence fishing closures are part of a set of management actions initiated by ADF&G as a conservation measure for Chinook salmon. In this regulatory system, subsistence fishers are only allowed to fish during open periods referred to as subsistence "windows." District 5D (where Beaver is located), is usually open 24 hours a day, 7 days per week. In 2009, subsistence openings were halved to 3.5 days per week. Most Beaver respondents objected to the additional fishing closures on "pulses" in 2009. The main reason for opposition was that pulse closures often occur during optimal fishing times. Consequently, closures thwart either the ability for fishers to harvest enough salmon or the ability to do so in a timely manner. For example, one respondent recalled that during the 2009 season, a closure was initiated during the first pulse of the Chinook salmon run, which caused her family to miss their opportunity to obtain a sufficient harvest. The respondent contrasted the poor 2009 season with the 2010 season where there were no summer season closures, allowing her family to harvest enough Chinook salmon:

> We did better this year than the year before because we didn't have to take our nets out. And when we did have to take our nets out, it was when the fish was really going, the run was heavy, and we had to take our nets out, so we lost out on a lot of fish. It was really hard. (B8)

Several Beaver respondents advocated for either the elimination of inseason closures, or the implementation of longer open fishing periods; however, there was no consensus. Some respondents reflected favorably on a time when windows did not exist, and local people had the autonomy to fish free of regulations, while other respondents expressed concern for the salmon stock and consequently supported subsistence fishing "windows." Supporters of inseason closures believed that such actions were necessary for the recovery of Yukon River Chinook salmon. These respondents also credited any increased Chinook salmon availability to the window system (B1).

Another conservation method employed by ADF&G is the regulation of net mesh size. Beaver residents are skeptical of ADF&G management decisions regarding mesh size. Starting in the 2011 Chinook salmon fishing season, subsistence fishers are no longer allowed to use 8 inch mesh nets. Instead they are being required to use a 7.5 inch mesh net. Residents in Beaver were united in their displeasure with this change. One respondent felt that this new requirement was "silly" and explained that "7 inch mesh will get all the fish … big fish and little fish" but an 8 inch mesh net would allow all the smaller fish to pass and continue up the river while retaining the larger fish for the people who need them (B7).

The same respondent speculated that this change, which did not make much sense, may be attributed to the fact that ADF&G managers did not know what was is like to "live off the land" and were "just guessing" when it comes to identifying effective measures of Chinook salmon conservation (B7).

Other residents took issue with the change in mesh size because the half inch reduction seemed too small to make a real difference and was more of an inconvenience than anything else. One respondent suggested that if the goal was to let larger fish go, then cutting down to a 5 inch mesh size would have a more substantial impact (B4).

Additionally, respondents reported that navigating the world of dual federal and state resource management of all species, not just salmon, was often confusing, and the various jurisdictions surrounding Yukon Flats communities were especially complicated. In an area where Chinook salmon fishing has generally always been open, many respondents reported difficulty with keeping track of regulatory changes occurring within the Yukon River fishery. This frustration is likely intensified by earlier fall season restrictions experienced in the area. Some respondents reported keeping track of regulatory changes via announcements on the local radio. One respondent complained that emergency order announcements were too "abrupt," and made it difficult to stay informed when at fish camp (B7). Another respondent expressed frustration with the lack of clarity resulting from regulations changing too frequently (B6). In 2009, a federal regulation made it illegal for non-rural residents to participate in subsistence fisheries. Consequently, residents were confused about the legality of relatives living in Fairbanks or other urban hubs participating in the subsistence fishery on the Yukon River. While respondents voiced strong support for a rural subsistence preference, they were also concerned that leaving the community to work in Fairbanks would negate their ability to continue fishing for their family:

> If … your home was in Fairbanks, if you weren't living rural, you couldn't be out here fishing. I like that … but, to a certain extent I mean, if I lived in Fairbanks, my mother lived in Beaver … Come fishing time, my mother needs fish. I need to come over and fish for my mother. [The federal regulations need] an exception … where you're fishing for your family that is out here. (B2)

The frequent changes in regulations, of which residents reported they were often unaware, made residents feel harassed and unfairly persecuted. If forced to choose between not obtaining enough fish due to extremely conservative regulations or illegally harvesting salmon, some respondents acknowledged a willingness to accept the risk of breaking the law. "We'll do it anyway because it is our fish," said one respondent (B8). Additionally, some respondents expressed confidence that local stewardship methods can better serve conservation needs than the efforts of state or federal managers. For example, an elder respondent explained that, "In the early days, we had our own law, you know, we knew about it [management], you could only get certain animals under direction from elder or chief … [now] this is all we have … can't break game law" (B4). However, the respondent believed a revival of traditional Gwich'in stewardship practices would require a level of engagement from the community which is currently lacking. "There are no caretakers for the land anymore" lamented the respondent (B4).

Socioeconomic Effects

In the 21st century, Chinook salmon continues to be a critical component in the diets of Beaver residents, and subsistence salmon fishing remains an important summer activity for the community. However, elders reported that fishing effort in the past decade was much lower than at any time of their lives, especially their youth. Additionally, some respondents complained that younger generations were not participating or engaged in fishing like they once were. Limitations for those younger residents include high equipment and fuel costs as well as the employment required for the acquisition of cash for equipment and fuel. Elders attributed the decline of participation in subsistence salmon fishing to lower levels of dependence on salmon for human and dog food (B4, B6, B7). Some respondents reported that their families prefer to invest more time and resources during fall moose hunting rather than salmon fishing. This is due to a preference for moose meat over salmon and the feeling that a successful moose hunt can provide a more substantial amount of food than the low level of Chinook salmon harvests experienced over recent years.

Respondents reported that since about 2006 or 2007, more time and effort became necessary to harvest adequate numbers of Chinook salmon. Respondents believed that the increased time and effort required for salmon fishing resulted from a combination of factors, including lower abundance, stricter regulations in 2009, excessive harvests downriver, and busy work schedules. Generally, it takes Beaver households anywhere from one to three weeks of fishing effort to obtain the salmon needed for winter consumption, although some households reported spending up to a month and a half attempting to harvest salmon. Households that harvest large amounts of salmon reported doing so with the intention of sharing with

relatives and friends. For example, one high harvesting respondent reported that his household's fishing efforts normally provided salmon to support fifteen people (B4).

Respondents reported spending more effort for smaller annual harvests than in the past. In recent years, respondents reported harvesting between five and ten Chinook salmon per day, compared to 100 or more harvested per day during the mid-20th century. Despite these reported declines in daily harvests, most respondents reported a lack of interest in tracking daily fluctuations and tended to simply fish until they have "enough" for the winter:

> [We stop fishing when] we have enough. You know, my sisters each have two big fish in their freezer and all their jars. Mom has her salmon strips, and so we kind of just figure this is time we could pull our nets now and let them dry and dry our fish. (B8)

Respondents also pointed out that in a situation of declining Chinook salmon populations, there is a general expectation of uncertainty regarding annual harvest levels. "Now we just catch what we can and appreciate whatever we get" (B3). Declining annual Chinook salmon harvests mean that sharing levels also have a tendency to decline. For example, when one respondent was asked if his household obtained sufficient Chinook salmon harvest in 2010, he said "Yes. But it's not easy. It was really hard…and I didn't share quite as much, is why I have enough. You know, usually I'm hooking up mom and grandma … A lot of people depend on you." (B2)

Respondents reported that salmon are almost always available in the community and are still used for community events. However, they reported an overall decline in the consumption and day-to-day reliance on salmon as a food resource. An elder respondent reported eating salmon almost every day for the majority of her life, but now she only eats salmon once or twice a week (B6). Some respondents reported that they consumed salmon up to four days per week all year, and others reported average salmon consumption of two to four times per month. Respondents reported they tend to eat more salmon when fresh fish are available than they do during the winter months.

Despite declining levels of consumption, Chinook salmon continue to be considered a very important, healthy, and necessary subsistence resource for residents of Beaver. "[Salmon are] the best thing you could put in your body. For your heart and everything, you know," said one respondent (B2). Nonetheless, most respondents reported that their households had not been obtaining enough salmon for their subsistence needs over the last five years or more. Respondents said that a decreasing ability to obtain enough salmon has caused them to rely more on store-bought food.

While the customary trade survey was the first of its kind in Beaver and responses were guarded, an effect of limited salmon on customary trade was suggested. Despite the declining returns, the need for Chinook salmon remains the same. One survey summary noted that the respondent "purchased canned salmon from Fairbanks to supplement lack of salmon on the Yukon River. He is buying about 3 cases (75 cans) a year now" (HH9). This response suggests that participation in customary trade occurs when it is difficult or impossible to acquire salmon through personal subsistence efforts. To assess the full socioeconomic impact of declining Chinook salmon on the Yukon River, further customary trade and bartering surveys are crucial. Seventy-five percent of respondents who reported participation in barter did so because they needed fish. While reports of customary trade were low in Beaver there is a chance that underreporting did occur and that the motivations to buy salmon were similar to those behind bartering. With Chinook salmon on the decline, documenting rates of trade and barter over time can give insight into the rapidly changing economies of the Yukon River.

Summary and Discussion

Chinook salmon play cultural, spiritual, historical, and economic roles in the community of Beaver. Similar to the other 4 study communities, the significance of this resource cannot be overstated. Without adequate amounts of Chinook salmon, so central to diets in Beaver, the reliance on store-bought food has risen, and the economic strain on households has become more acute. The ethnographic interviews conducted

during this study documented some of Beaver's unique fishing profile features. These include, but are not limited to: the lack of a commercial fishery, the lack of access to summer chum and coho salmon due to species distribution, the historical presence of dog teams, the apprehension towards ADF&G customary trade research, and a distinctive perspective on conservation management.

Beaver is the smallest of the 5 study communities, and unlike Emmonak and Marshall on the lower river, Beaver has no commercial fishing openings. Limited employment opportunities in Beaver increase pressure on subsistence salmon fishers to harvest enough food for their families. Fishing in Beaver is cooperative by nature, and community members work together to provide for everyone's needs. To decrease cost, many families pool their resources by sharing the same boat and net and by splitting the cost of gas. Overall, respondents agreed that they ate Chinook salmon less often than they did in the past and harvested fewer fish per season. Explanations for this decline ranged from limited availability of Chinook salmon, the high cost associated with fishing, the inability to fish when working during the summer, and the convenience of store-bought foods. While declines in consumption were noted, in years of low moose abundance, respondents reported relying more heavily on Chinook salmon to get through the winter.

The declines in consumption accompany declines in fishing effort. Up until the advent of the snowmachine, the harvest of fall chum salmon for the many dog teams in Beaver exceeded the harvest of Chinook salmon for human consumption. Elder respondents described harvesting hundreds of fall chum salmon each summer for their dogs. Today however, there is only one dog team left in Beaver, and residents' fishing concentrates on Chinook salmon harvest in July. Without the need for large amounts of fall chum salmon, changes in gear types have occurred as well. Fish wheels, once the primary gear type, have declined in use and have been replaced by setnets.

The survey administered during this study was met with apprehension from survey participants. The 2009 federal investigation of customary trade on the Yukon was fresh in the minds of Beaver residents and likely contributed to the unease they expressed while participating in customary trade research. While the investigation did not come to Beaver, it did strike close to home in neighboring Fort Yukon. Consequently, underreporting should be considered when evaluating the results of the Beaver survey. The examples of barter that the survey did capture demonstrate a vital exchange network that extends well beyond the confines of the community. Berries, dry meat, muktuk, seal oil, and caribou were all reported as exchanged for Chinook salmon.

Finally, interview respondents expressed their deep concern for the health of the Yukon Flats ecosystems. In the past ten years they have observed a "drying" of the flats region (B4). Respondents believed there was a connection between the warmer, dryer weather and the condition of fish species, including Chinook salmon. State and federal research concerning declines in Chinook salmon returns, they believed, should include investigations into climate change.

Recommendations

Beaver residents urgently requested that fishery managers seriously reconsider the sustainability of commercial fishing for Chinook salmon on the Yukon River. Making the Yukon River an exclusively subsistence-only fishery could give the stock a chance to recover, while allowing Yukon River residents to get the fish they need. Additionally, lowering the cap on Bering Sea bycatch, and possibly administering a several year moratorium on Yukon Chinook salmon fishing are suggestions Beaver residents would like considered. In their view, policymakers should focus on preserving and promoting the Yukon Chinook salmon fishery for subsistence fishers today and for the evolving needs of generations to come.

Respondents felt that ADF&G and USFWS researchers should aim to conduct more thorough research across the Yukon drainage to better understand the role of climate and other contributing environmental factors.

All respondents disliked the recent reduction in Chinook salmon setnet mesh size. Some felt a reduction from 8 inch to 7.5 inch would make it difficult to catch large Chinook salmon and fulfill subsistence fishing needs, while others thought it was an inconvenient, "silly" measure that would do little to benefit the species.

Beaver respondents were split on the topic of fishing windows. Some felt they were burdensome and detrimental to subsistence fishing opportunities, while others thought they were a necessary and effective measure in rebuilding the Chinook salmon stock.

Several respondents discussed difficulty in navigating the dual state and federal management system. In general there seemed to be confusion surrounding subsistence fishing eligibility in state verses federal waters. Others found it challenging to keep abreast with inseason regulatory changes. In particular, emergency order announcements were seen as too abrupt and some respondents worried that residing in fish camps would make hearing these announcements more difficult.

This chapter is dedicated to Nora Billy, who passed away on May 20, 2011 at the age of 81. Nora was a respected elder of the community and contributed as an interview respondent for this study. Nora was known for her artistry in creating beautiful beadwork, especially on moccasins, mittens, hats, and so forth. She was known as being one of the last people in Beaver who practiced the art of brain-tanning moose hides. Nora was born in Beaver in 1930. Her mother was from the Kobuk River and her father from the Koyukuk and Alatna rivers. Her obituary notes that, despite having to eventually give up a nomadic way of life, "her heart remained in the woods of the Yukon." Nora was a mother, grandmother, great-grandmother, and great-great grandmother who made sure to include her children in a subsistence way of life.

7. EAGLE

Alida Trainor

Setting and Context

Local Research and Respondent Profile

In November 2010, Division of Subsistence researchers traveled to Eagle, Alaska, to conduct research on the 2009 Yukon salmon disaster. Currently, Eagle is loosely divided into two geographically distinct communities: Eagle City and Eagle Village. Each community has its own governing body, the city council and the tribal council, respectively. During spring 2009, a flood decimated the community, destroying the entire Eagle Village (now referred to as "the old village") and critical Eagle City infrastructure and historic buildings, and changing the surrounding landscape. Prior to the flood, the old village was only 3 miles from Eagle City. Now, the newly relocated village is nearly 10 miles away. Additionally, most residents in Eagle City are non-Native while most residents in Eagle Village are Alaska Native. Understanding this distinction is important when considering the community fishing profile discussed below. Key respondents were selected based on discussions with community representatives and members from both Eagle City and Eagle Village councils. Ten respondents were selected for their local expertise: 8 men and 2 women, including 4 Alaska Natives and 6 Euro-Americans. All respondents from Eagle City were active fishers, who continued to put up Chinook salmon for their families and others. Respondents from Eagle Village included two active men who assisted with the fishing activities of others, an elder who was still active processing fish that was given to her, and an elder with extensive experience as a provider for his community but who was no longer active as a fisherman. In addition, the customary trade and barter project survey was administered to 41 city and village households (66%).

Historical Background and Natural Environment

Located on the south side of the Yukon River, thirteen river miles from the Canadian border, Eagle is the most eastern community on the Yukon River and the last point of Yukon salmon harvests in Alaska. Unlike other study communities, Eagle is accessible by road for part of the year via the Taylor Highway. The townsite is surrounded by a variety of topographic features. In the far distance, the Ogilvie Mountains in Yukon Territory, Canada are visible, while to the north the Fortymile and Seventymile drainages flow through hilly terrain. The single channel of the Yukon River alongside both Eagle communities is wide and free of turbulence. Residents can easily access high tundra to the southeast of town for berry picking and caribou hunting.

The 2010 census reported that the total population of Eagle village and city combined was 148, 115 of whom were non-Native (78%) and 33 were Alaska Native (22%). Together the two communities had 83 males and 70 females, and the average age was 47.

Regional ethnohistory places Eagle within the Han Athabascan territory, an area surrounding the Yukon River roughly extending from Woodchopper Creek (60 miles northwest of Eagle) to the Klondike River in Yukon Territory, Canada (80 miles southeast of Eagle) (Mishler and Simeone 2004:xxi). Also known as "river people," the Han Athabascans have inhabited a geographic area surrounding present day Eagle, first known as *Tthee T'ãwdlenn,* for thousands of years.[1] In pre-contact times. the Han lived in a seasonal round, moving through the country to maintain access to seasonally-available resources, including fish, caribou, and moose.

1. U.S. Department of the Interior, National Park Service. 2014. "History and Culture." Yukon–Charley Rivers National Preserve Alaska. Accessed April 29, 2014. http://www.nps.gov/yuch/historyculture/index.htm

Han travel throughout their traditional homelands changed drastically in 1825 when their territory was divided in half by the creation of the United States–Canada border (Mishler and Simeone 2004:xxii). Without consultation, Han leaders were forced to accept division within their nation. Over time, they began living in year-round settlements including Eagle Village in Alaska, and Moosehide and Dawson in the Yukon Territory.

The fur trade, which began in the 1840s, increased contact with Euro-American traders and accelerated the move away from a transient, seasonal round lifestyle (Mishler and Simeone 2004:1). In exchange for material goods, the Han participated in commercial trapping. For many years, Han trappers traveled over 100 miles to the Hudson Bay Company located in Fort Yukon to sell their furs. In 1867, however, after the Russian sale of Alaska to the United States, an American trading post was built in Han territory at Ft. Reliance, 6 miles below the Klondike River.

The growing economic activity in the area eventually resulted in the establishment of Eagle City. Originally established on nearby Belle Island in 1894, Eagle became a trading post and farming site comprised of Han Natives and Euro-American trappers and gold miners.[2] With the partnership of traders and businessmen in the area, a city was formed on the Alaskan side of the international border in 1897. Two years later, in 1889, the U.S. Army built Fort Egbert at Eagle's present site with the goal of maintaining law and order, building roads, and connecting Eagle to the outside world via the erection of the WAMCATS (Washington-Alaska Military Cable and Telegraph System). Eagle became the center of trade, acted as a mining supply station, and housed many government buildings, including the courthouse headquarters for one of three judicial districts in Alaska responsible for more than 300,000 square miles of jurisdiction. In 1901, Eagle became the first incorporated city in Alaska's interior, with over 1,700 people.[3]

Not long after incorporation, Eagle's rapid growth began to wane. Gold strikes in the middle Tanana Valley nearly 400 miles away drew many miners away from the area. Judge Wickersham moved his regional headquarters from Eagle to Fairbanks, and the population dropped from 1,700 to 178 by 1903 (Krupa 2010:18).

Eagle sits near the border of the Yukon–Charley Rivers National Preserve. Today only a handful of residents utilize the preserve for subsistence activities, but prior to its establishment a much heavier use pattern existed in the area, both from pre-contact times of the Han Athabascans and the post-contact enterprises of trappers, traders, gold miners, and missionaries.

In the 1960s and 1970s, a new influx of settlers came to Eagle. Unlike the entrepreneurs that came before them, these people were not motivated by a possibility of financial gains; rather, many came to live a subsistence way of life away from modern societal conventions. The newcomers settled along the Yukon River and Yukon River tributaries between Eagle and Circle. Some built their own homes while others chose to re-inhabit abandoned structures. The establishment of the preserve changed their land use patterns substantially by discouraging residency within the preserve, ultimately impacting the community fishing profile of Eagle, as discussed below.

In December 1978 prior to the passage of ANILCA, President Jimmy Carter designated 2.5 million acres of land near Eagle as a national monument (National Park Service 2012). The designation granted the National Park Service new regulatory authority. Soon after, in early 1979, the National Park Service adopted a permitting system that effectively phased out residential use of lands within the national monument area. People who built their homes on park land after 1978 lost their cabin immediately. Those who built their cabin between 1973 and 1978 could apply for a permit and stay for one year. Finally, anyone who built their cabin prior to 1973 could apply for a five year permit. Although renewable, a permit could only be transferred to an immediate family member who resided in the cabin at the issuance of the original permit, systematically removing the historical human presence in the area (O'Neill 2006). The new permitting process targeted, whether directly or indirectly, non-Native individuals and caused many of them to resettle outside of the preserve in the nearby community of Eagle or to return to cities across Alaska and the rest of the United States.

2. Eagle Historical Society. "About Eagle." Accessed April 29, 2014. http://www.eaglehistoricalsociety.com/p/about.html
3. Eagle Historical Society. "About Eagle." Accessed April 29, 2014. http://www.eaglehistoricalsociety.com/p/about.html

The Alaska National Interest Lands Conservation Act (ANILCA) passed by the U.S. Congress in 1980 incorporated much of the land between Eagle and neighboring Circle into the Yukon-Charley National Preserve while also declaring the subsistence way of life and cultural value worthy of protection. Congress recognized that, "along the banks of the Yukon, the remains of many buildings attest to the river's use as an artery of trade, travel, and communication" and further directed the National Park Service to establish regulations to protect subsistence ways of life within parklands (43 U.S.C.1601). The regulation, including a residential permitting system discussed below, phased out residency in the area and, consequently raises a question of whether subsistence activities declined as well.

The ethnographic interviews cited in this chapter articulate the significance of the Yukon River both in terms of fishing activity and in individual, community, and historical identity for Alaska Natives and non-Natives alike.

Community Fishing Profile

> We are people of the river, we cannot fade away. The Yukon is our lifeline for subsistence and survival. (Silas 1988)

Respondents from Eagle Village grew up fishing on the Yukon River, learning to harvest and put up fish with family members who also grew up learning to fish along the Yukon River. Elders described moving with a majority of the village families downriver to fish camp every summer. One primary fish camp was situated on an island not far downriver from Eagle City. Entire families would make the move, bringing their dogs with them. Respondents recalled using gillnets and occasionally dip nets to harvest chum salmon along the bank of the old village site. At that time, one respondent recalled, they were catching up to 1,200 to 1,500 fish a day in the wheel (EAG1). Extended families shared the processing workload as well as the fish. Other fish camps were occupied further downriver and experienced a similar wealth of harvest. While one respondent fished with her grandparents at her fish camp on the island, her father-in-law:

> … used to fish further downriver, around Charlie River someplace, Charlie Creek. And he'd say at night they could just hear the fish, once the buckets are full, just falling back into the water. Many times they would have to go and just stop the fish wheel; it was so much. (EAG6)

Respondents recalled the abundance of fall chum salmon and fall fishing. As described in the Beaver chapter, summer chum do not travel to tributaries upriver of the Tanana River. As a result, residents of Eagle only have access to fall chum, coho, and Chinook salmon. The youngest of the village respondents remembered fishing for fall chum salmon with his father in the 1970s using a 6 inch gillnet. The chum salmon were harvested just above the old village site, on the same side of the river. He used a canoe to check the net. By that time Native elder Mathew Malcolm[4] had established his net spot just across the river from Eagle Village. Malcolm was a primary harvester of Chinook salmon for the village, and young men would assist him in setting and checking the net on a daily basis. In exchange for help, the youngsters would earn fish (EAG7).

Respondents not originally from the Eagle area either learned to fish alongside their parents or were fortunate enough as young adults to learn from village elders. Most interviewees from Eagle City moved to the community in their early 20s, but two were in their teens, and one was 29. Three key respondents credited Malcolm, who, even after he became blind, continued to fish and help others from both the city and the village. As a teacher and a role model he was cited as being responsible for their current fishing success. The relationship with area elders was expressed by a respondent:

4. Mathew Malcolm contributed to this study through his participation as a key respondent. While respondents' names are generally kept confidential, Malcolm is mentioned by name in many other Eagle-focused publications. In addition to his fame as a fisherman in contemporary literature, the mention of him by other key respondents and the role he played in their early fishing experiences contributed to the decision to mention him by name in this chapter.

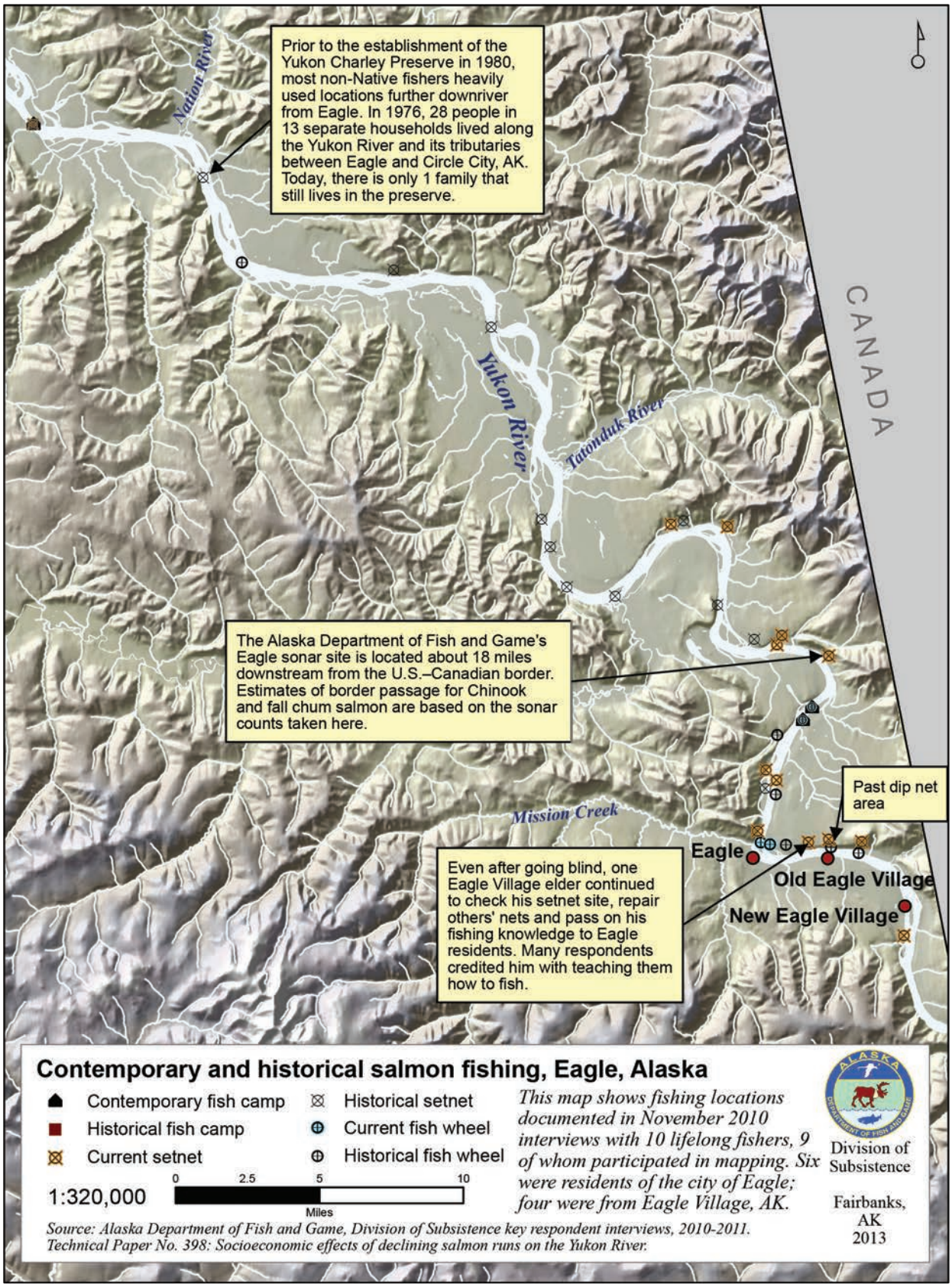

Figure 7-1.–Contemporary and historical salmon fishing locations, Eagle, Alaska.

> [They] kind of introduced me to canning and smoking, and it was great. And there were elders from the village … any of those people had a lot of knowledge, and they would share it with you, and we were very fortunate that way. (EAG3)

Most city respondents started fishing with nets; later, when they gained the craftsmanship, the materials, and the increased need, some started using fish wheels for the harvest of chum salmon for dog teams.

The composition of active fishermen in Eagle City is significant in the sense that many are Euro-Americans who came to the area in the 1970s. In 1979, a year before the establishment of the Yukon–Charley Rivers National Preserve, the most notable subsistence use in the proposed preserve area came from 28 people living in 13 separate households. Caulfield (1979) reported that these Yukon River residents, who lived along the river between Eagle and Circle, had four traits in common:

> (1) They are all non-Native; (2) they are recent arrivals to the area; (3) they tend to be individualistic and self-reliant and (4) they are heavily dependent upon the resources of the Yukon-Charley area for their livelihood. (Caulfield 1979:41)

Caulfield explains that the "river people" relied heavily on the land around them, "exploiting the resources at a lower level of technology than is probably optimally efficient; ten of the households either use dogs or snowshoes for traveling in winter" (Caulfield 1979:44). Additionally, they had a strong desire to learn traditional knowledge and skills from elders in the area, specifically seeking out Alaska Native elders in Eagle Village in order to continue traditions of the subsistence way of life. The sustained interest in subsistence activities led Caulfield to conclude that, "In Yukon-Charley, traditional knowledge and skills are being in part perpetuated by non-Natives. This includes knowledge of specific subsistence areas, techniques, and histories which are a key component of the human ecology of the area" (Caulfield 1979:87).

The National Park Service permitting process, discussed above, contributed to the relocation of the "river people" to Eagle and the decrease in subsistence uses and backcountry ways of life in the preserve. Although the city and village are ethnically distinct and geographically divided, they are united in their concern for the resources and their frustration with management that seems ineffective.

The study's respondents were not all born and raised in Eagle, but they were closely familiar with the increase in regulations and the change in fish populations that has taken place over the past 40 years. Fishing by Eagle Village residents has declined dramatically in the past few decades. One village elder identified alcohol as a contributing factor to the decline of fishing in the village. He noted that drinking continues to inhibit participation in traditional ways of life. The recent death of elders and the social impact of the 2009 flood described below have intensified the shift away from fishing. However, all fishers, whether currently active or not, expressed deep appreciation for those who taught them how to fish.

History of Local Fisheries

During the Klondike Gold Rush, sled dogs became a vital component of commerce and transportation in the interior and along the Yukon River. Sled dogs were so helpful that nearly every family in these areas kept a small dog team for transportation, hauling, and subsistence harvest activities. Along with the rise of a lucrative fur trade during the mid-19th century came a higher use of dog teams (Andersen and Scott 2010).

Unlike other study communities that either do not have any dog teams or keep them primarily for racing, many Eagle families keep dog teams for transportation, guided tours, and trapping. Ethnographic information documented in Eagle reflects the riverwide use of fall chum salmon as dog food, and Chinook salmon for people (EAG3, EAG4, EAG5, EAG8, EAG9). The value of Chinook salmon to residents can be seen in its full utilization. One respondent explained the relationship between dog teams and Chinook salmon:

> While it's frowned upon to feed Chinook salmon to dogs, the part of the fish that you are putting up, a lot of people, including [my wife] and I do feed the heads and guts to our dogs. On other parts of the river the head is considered a delicacy but our dogs, to us, are members of the family. Especially in the summer when you might be running low on commercial dog food, there sometimes is a gap between when we can start fishing for

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Plate 7-1.–Unlike other study communities, many Eagle residents continue to support dog teams for transportation, trapping, and as a source of income through guided tours. Consequently, fishing for dogs remains a vital component of summer subsistence activities. Respondents also cited an increased reliance on fall chum salmon in light of Chinook salmon declines. Here, dried fall chum are stored through the winter at the bank of the Yukon River.

> the chums, and so the heads, guts and backbones are good sources of food for our dogs. What doesn't get used beyond that goes into the garden fertilizer. Nothing gets wasted, it all gets used. (EAG8)

Because of their high nutritional value for humans and the regulations prohibiting the use of Chinook salmon for dogs, no Eagle respondent reported feeding Chinook salmon in the round to their dogs. Most people put up their Chinook salmon for human food by the end of July and then fished for fall chum salmon for their dogs in September when the weather cooled and the flies diminished (EAG5). As noted above, however, some people did use Chinook salmon scraps for their dogs or garden.

Collection, Processing, and Distribution of Fish

Gear

In the early 1900s Han Athabascans living in the Eagle area caught salmon with long handled "hand nets" (dip nets) that were let down into deep water and rapidly pulled out once the fisher felt a pull in the net (Schmitter 1910:8). One Eagle elder, during an ethnographic interview, explained how Han people would

pull salmon into their canoe before clubbing them. "King salmon is strong…They put fish head right here in canoe. They club it. They kill it. It's good fish. Dip net is good fish" (Mishler and Simeone 2004:59). Currently, dip nets are rare in Eagle. Only one respondent reported use of a dip net (EAG1).

Introduced by gold rush settlers on the Tanana River, the introduction of the fish wheel occurred in the Eagle area during the early 1900s (Caulfield 1979). The fish wheel revolutionized the traditional fishing economy by allowing residents to harvest large quantities of fish in deep, muddy waters where nets or weirs were less effective. Respondents described the use of many fish wheels in years past, but today there are only four in regular operation. One fish wheel, located on the north side of the river across from Eagle City is only employed for the harvest of fall chum salmon. The wheel is privately owned by one individual but is available for use to all those who do not have their own fishing spot. During the 2009 flood, many residents were unable to fish and relied on this wheel for their winter's supply.

Fish wheels and nets both have merits and drawbacks. One respondent explained that nets are easier to use in terms of "just putting the net in and pulling it back out. Fish wheels take time to build and time to maintain, but it is easier in terms of amount of effort per fish" (EAG8). Once a wheel has been built and placed in the water, a fisher can easily take the fish out of the catch box and toss them into the boat. In comparison, it can take hours to untangle fish and debris from a net. The time saved by not having to pick through a net makes fish wheels very appealing for individuals who need a lot of fish. Many residents in Eagle keep dog teams, and fish wheels make it possible to catch fall chum salmon more efficiently (EAG9). Oftentimes individuals choose to set a net for Chinook salmon and run a wheel for fall chum salmon to feed their dogs.

Setnets are a popular gear type in Eagle, and nearly all respondents reported using 8 inch mesh to catch larger Chinook salmon that would be unattainable with smaller mesh. Additionally, 8 inch mesh is also capable of catching fall chum salmon, making it a viable alternative to a fish wheel for those who have a dog team. Gillnets are tied to the shore and anchored into the eddy line. An eddy line, one respondent explained, is created when the flow of the water changes and travels backwards (EAG9). These nuances are not always obvious and "you can't just go on the bank and put a net out and expect to catch fish; you need to really know where to go" (EAG9). Certain bathymetric situations allow this to happen. For instance, a "projection in the current" created by a cut bank or hanging tree creates a back flow in the water where fish can more easily be wrapped up in a net. Alternatively, setnets can be placed in still water situations where they will hang straight down and not bow into the current.

> Some people have tried fishing off tips of islands because you have currents coming from both sides of the island, around the island, and then there's still water there and then the net is hanging straight, you know, parallel to the current, and the fish are wandering back and forth making a decision on which way they are gonna go. As they're doing this, they are weaving their way into the net that's hanging, you know, not like a normal net in an eddy would, but, you know, straight on down. So there's things people try. (EAG9)

There are other factors to consider in addition to finding a strong eddy. One respondent detailed the qualities that create a "good fishing spot." Eddies need to be deeper than six feet, he said, and in order to keep the fish within their bounds, they cannot be "too violent" (EAG8). The respondent referred to the violence of the oftentimes swift current surrounding an eddy, created by rocky offshoots or boulders underwater. It is important to look downstream from a setnet site because if there is a large creek flowing into the river the fish may choose to swim on the other side to avoid the influx of new water. Ideally, a setnet site should be far above any large tributary. The various strategies described above can take a lifetime to learn. The fishers in Eagle are aware of this fact, and all respondents spoke to the importance of learning from others and of being a patient participant in the trial and error process.

Fishing Practices

Out of the ten lifelong fishers interviewed for this study, nine chose to participate in the mapping portion of the interview. Six respondents lived in Eagle City, and 4 were from Eagle Village. Respondents were chosen

from both the city and village to capture any possible differences in fishing histories, profiles, and locations. The mapping portion of the interview asked respondents to map both past and present fishing locations and to identify the type of gear used. Because of Eagle's proximity to the U.S.–Canada boundary, all respondents fished below Eagle Village.

The fishing locations that some Eagle respondents used in the 1970s and early 1980s document a much larger use area than that of today. This is partly due to the forced abandonment of many homesteads in what is now the Yukon–Charley Rivers National Preserve. High gas prices and an increase in fishing regulations, with a simultaneous decline in Chinook salmon stock, have made it more difficult to catch the fish needed for winter in a timely manner and have exacerbated the decline in use area. Consequently, local residents tend to fish closer to Eagle, no longer traveling to fish camps.

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Plate 7-2.–Two sisters from Eagle, stand in front of their family's fish rack, approximately 50 miles downriver of Eagle, circa 1995. Prior to the establishment of the Yukon-Charley Rivers National Preserve in 1980, a number of people lived and fished in the area. After the establishment of the preserve nearly all people living in the preserve either moved to Eagle or left the area entirely. Today, for a variety of reasons, including increased management actions and a high cost of fuel, no one returns to their historic fishing locations in the preserve.

Currently the farthest fishing site, consisting of a camp and setnet anchor, is shortly below the Nation River, approximately 55 miles below Eagle. The respondent shares the setnet site with a neighboring family. Because of high gas prices and more recent restrictions to regulatory fishing windows, however, he does not consistently fish at camp every summer. Instead, he sometimes chooses to fish closer to town to minimize financial and regulatory burdens. Similarly, the majority of respondents fish a short distance from town, eliminating the need to set up a camp while making it possible to check a net more than once a day if necessary. Respondents who mapped their past fishing locations illustrated a much larger use area.

Only two respondents continue to fish within the preserve. However, historical mapping shows intensive use in the area prior to the establishment of the preserve. Multiple factors have contributed to the decrease of fishing in the area. First, prior to the establishment of the preserve, there were many more people living along the river in that area. Now many of those residents live in Eagle and find it more convenient to fish closer to town. Second, as mentioned above, high gas prices make it more costly to travel to and from a fishing site far away from town. There was one account of dipnetting near Eagle Village, but setnets were the most common gear type used by respondents in the past and in the present.

Until the past few decades most residents did not have the option of freezing fish and relied on drying or canning to preserve their fish. Some residents who did not own their own smokehouse or their own canning supplies helped others who did in exchange for canned fish. Recalling an example of this, one respondent described his relationship with a friend downriver: "I was helping him construct that cabin and then we had

also fished together down there, and he was really into canning, so, you know, like I say, you could trade work, you could help each other out" (EAG3).

For the most part, people in Eagle smoke, can, dry, or freeze their Chinook salmon. Fall chum salmon are usually frozen and dried outdoors since they are primarily harvested in the fall without the threat of warm days or excessive flies. Chum salmon are split and air dried on fish racks for convenient storage and proximity to dog lots.

Sharing, Barter, and Customary Trade

Respondents regularly reported that sharing and bartering with others were favored over selling to those in need. Participants in every survey and interview emphasized that sharing was the primary method of food distribution in the community and that it greatly contributed to a sense of community among residents. Fishermen reported often sharing with elders, family relatives, newcomers to the community, and people who are too busy to fish (EAG2, EAG4, EAG8, EAG9, EAG10). "Never trade or sell fish, always share. I just know what I do. If somebody is old, sick, or can't fish, I'd give them fish. Tradition here is not official trade, it's sharing" (EAG2). Respondents frequently differentiated between sharing and barter. When food passes between people, "it's sharing, not barter, because no one goes to someone [else] and says 'Hey, we have this Chinook salmon and it's in equity with the caribou you are getting.' It's not like that. It's more like, 'We have this fish … EAT IT!'" (EAG8). Oftentimes the sharing of fish, especially of Chinook salmon, occurred when active fishers did not want their catch to go to waste. The same respondent went on to explain:

> [W]hen we have an excess we don't want it to go to waste, so we give it to someone who will use it and will appreciate it, but there is no expectation for something in return, but what happens is that people here in Eagle are nice enough, that they will remember that. While there is no expectation for anything in return, people being kind, will remember you, and later on, when they have an extra caribou leg will think, "Hey, [they] probably need it, they have six kids, they could probably use an extra caribou leg." (EAG8)

The quantitative data illustrate the tendency for residents to barter rather than participate in customary trade. Of the 41 households surveyed, 15 (37%) reported a history of bartering at least one time per year (Appendix C, Table C1). In contrast, only 6 households (15%) reported ever buying or selling subsistence caught foods (Appendix C, Table C2). More than half (66.7%) of the respondents who reported ever having participated in customary trade did so because their household "needed food" (Appendix C, Table C6). However, during the study year only 1 household (2%) reported buying or selling a subsistence food (Appendix C, Table C9), which may reflect either cooperation during a very difficult year in Eagle (described below), or

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Plate 7-3.–Eagle residents use a variety of methods to preserve king salmon. Here, a resident jars pieces of smoked fish.

a reluctance to report a controversial activity. Some respondents did elaborate on their customary trade history:

> [Y]eah, we did that years ago, my dad and I, but that was when a dollar was a dollar. And we used to, people from Tok would come in, they know where to go, they know Dad's place and then we'd load them up, but my dad would have me count them. And we sold them, like, a dollar a fish. By the time we're done, I'm done counting, it's, like, over seven or eight hundred bucks right there.
>
> Interviewer: How many barrels did that fill?
>
> Well, a pick-up truck, like an eight foot bed? We could fit eight drums in there. Fifty-five gallon drums. Just stuffed them full [of Chinook salmon], if they wanted them clean, that's fine, you know, but then they wanted whole, I'd stuff the whole thing, as many as I can, you know, and I'd get maybe about twenty-five bucks out [of] it, you know. (EAG1)

When asked if customary trade was still occurring or if he had seen any changes in the practice, the same respondent answered:

> Nope, I don't think that's even happening; there's nothing, there's not enough fish to do like back in those days, like I said. Like my dad and I did, my mom and my brothers, but like today you keep every little piece you can get, and you be happy with it. (EAG5)

Another respondent expressed concern over the practice of customary trade in other regions of the river. The respondent was concerned that customary trade activities were working to the detriment of subsistence fishing and ultimately should be considered a commercial enterprise.

> Even the subsistence fishing issue on the lower river is sometime, in my mind, troubled. They, I have the suspicion; there is a lot of fishing subsistence and then turning it into money because they have such vast resources on fish. Then people consider it to be subsistence because it is part of their income, but I don't agree with that. People have to change their ways, but if we are after subsistence and wanting to conserve the fish so we have some for a few more years to come, then the authorities have to look into this matter. If you are turning fish into money, you can't call that subsistence. That would be commercial in my mind. (EAG8)

Of respondents who bartered one subsistence food for another, 67% did so because someone else needed food. This supports the ethnographic reports of an informal, communal food distribution network. One respondent, who had historically bartered with other community members, explained:

> I haven't actually participated in customary trade in this community, but I know it does exist, that people do participate in it. I participated more in bartering; in other words, if I have a grocery sack, let's say common size, of dry fish, I might trade that, and have traded that to another musher for some merchandise that they might have that I want. For example, [someone] who you know, his wife was a musher and she would trade with me a birthday cake in September and some groceries, you know, that would get sent down to me at fish camp, and I would send dry fish to her. Because she liked to have fish on the trail when she was mushing the dogs, dry fish. That worked fine, but that's not customary trade. (EAG5)

"Even if you don't fish, subsistence touches everyone's lives," stated one survey participant, suggesting that food distribution—whether it be from sharing, bartering, or customary trade—is an essential component of food security and local culture in Eagle (HH11). While not every household in Eagle sets a net or operates a fish wheel in the summer, salmon are a primary source of protein and a fundamental part of local diets.

Figure 7-2 shows all the exchanges made for food, supplies, or services in Eagle city and village. Frequently exchanged items move to the center of the diagram, while resources that are less frequently exchanged move to the periphery. Chinook salmon appear at the very center of the figure, connecting to numerous other

subsistence resources, including caribou, beavers, and moose, while also connecting to handmade crafts, cash, and gasoline. The thickness of the line indicates the frequency of the exchange for the two resources it connects. Regardless of whether bartered, traded, or shared, Chinook salmon are a vital component of Eagle's exchange network and are widely distributed throughout the community.

Although the research primarily concentrated on the salmon disaster of 2009, local conditions in Eagle during summer 2010 demonstrated the related problem of food insecurity that can come from a reliance on purchased goods and the continued importance of subsistence fishing and sharing. The Taylor Highway provides Eagle residents road access to Fairbanks in the spring, summer, and fall months. Food can be flown into Eagle, but the cost of freight is high and many residents choose to drive to Fairbanks to stock up on store-bought food and supplies. During summer 2010, heavy rains washed out the Taylor Highway, making it impassable for most of the drivable season. This created a challenge for residents who rely, to some extent, on purchased goods and increased the need for sharing resources in a period when many people were unable to participate in subsistence activities. Furthermore, the road closure resulted in a loss of tourism—a vital source of income for local craftsmen. The lack of access to store-bought food and additional limitation on income for some residents highlighted the importance of salmon and other subsistence goods, as well as the significance of sharing for public health.

Local Experiences of Salmon Decline and Disaster

Observations of Change

All respondents described a decline in fish abundance, size, and quality. As remembered by respondents, Chinook salmon harvested by net were caught at a rate of 14 to 30 fish on a good day. One respondent remembered a bounty of Chinook salmon from her days at fish camp: "I remember they were catching over three hundred [Chinook salmon] twice a day. My grandpa had a fish wheel" (EAG6). But during some interviews, others did not specify the species. People who harvested via fish wheel recalled the greatest daily catches, ranging from 300 to possibly 1,500 salmon a day. One respondent remembered catching 1,200 to 1,500 a day:

> We catch so much fish that while [Dad is] chucking fish out of the box, they would still be sliding and still hitting him in the back … I didn't have no play time. Man, I'd be, my mom would be cutting fish from morning till night. Then as soon as I get out of school, my job was to carry up all the fish my mom cut, and my dad used to work for the highway department out there, and I'd be carrying fish up to the fish cache and hanging them up. (EAG1)

Another respondent recalled a time when

> ... in the past where you go and your net's sunk, and it's just full of fish, and you start pulling fish out, and you get the net half picked, and it starts to float again, you know, and obviously a pulse of fish just happened to wham your net, and so you may have seventy fish in your canoe ... I don't ever go to my net and it's sunk full of fish; that's not happening again ever. (EAG5)

According to the respondent this level of abundance has not occurred for at least ten years. Another respondent estimated that his family was catching roughly half of what they were when he first started fishing over three decades ago (EAG5).

In more recent years, respondents said, it was still possible for people to get the fish they need, but it required more effort over a longer period of time because fish have declined in both number and size. "I'm catching fish half the size, so when I used to get, I'd be real happy with a fifty or thirty-five pound Chinook, now I have to be real happy with a twenty-five pound Chinook, or less" (EAG5). One respondent loosely quantified the historical size of Chinook salmon: "My impression was, I mean, is that they, [in the past]

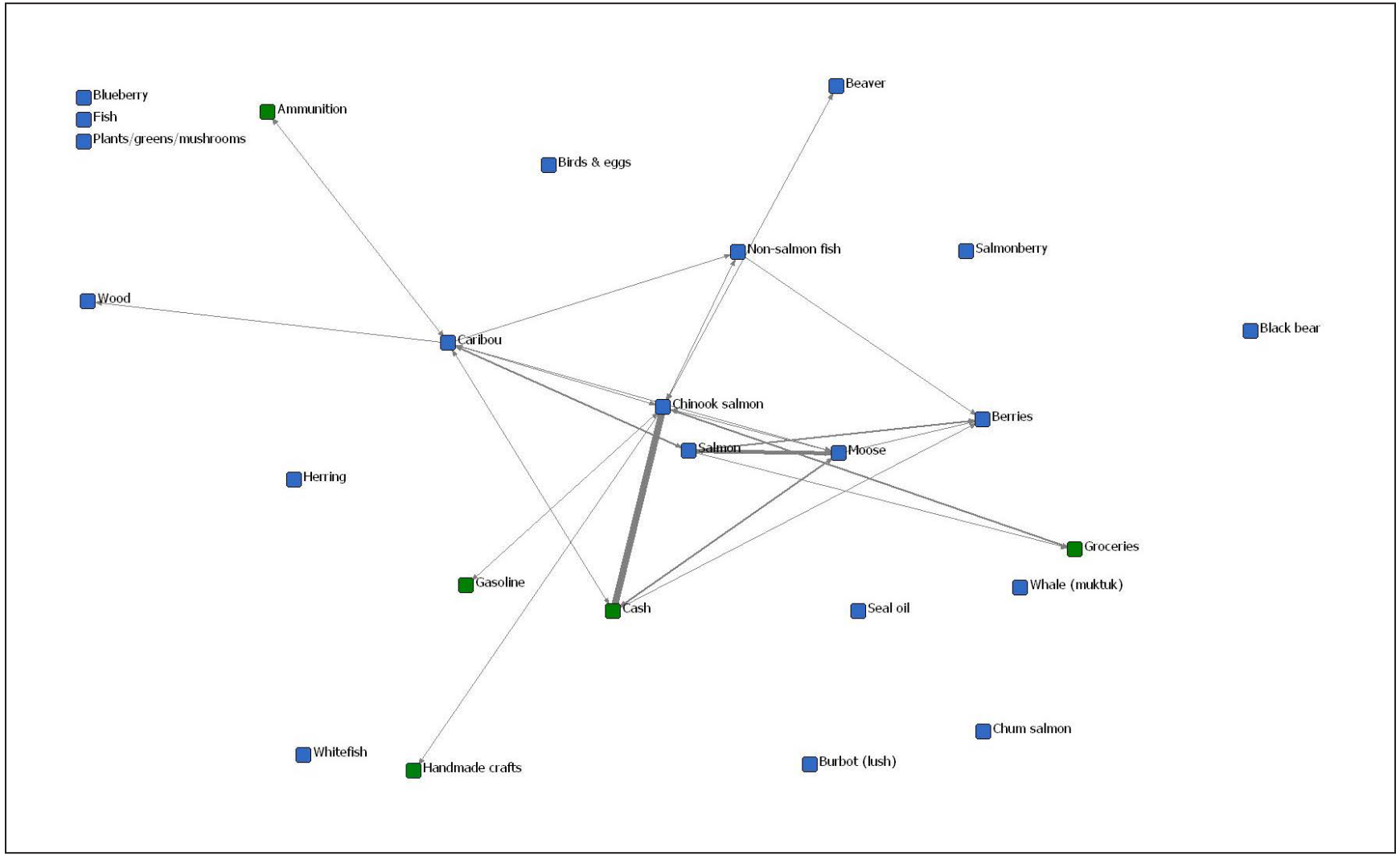

Figure 7-2.–"All Exchanges" network diagram of the barter and trade continuum in Eagle; resources that are exchanged frequently migrate to the center of the diagram; those exchanged less frequently move to the periphery. The weight of the line connecting resources reflects the frequency of that particular exchange. The absence of a line does not indicate exchanges do not occur, but rather implies that the type of exchange is not common and/or not documented by the sample households: i.e., no specific incidents were documented, nor was the general pattern described.

they were big, there were some, you know, you'd lay them down on a pallet, a four foot pallet, and it's like they're hanging down each end" (EAG4).

Respondents asserted that comparing the size of salmon over time is difficult because of differences in fishing gear. Every gear type has a set of biases: for example, a type of fish it favors and river conditions that suit it best. Generally, respondents communicated that wheels notoriously catch smaller fish, while nets, especially ones with larger mesh, are capable of catching the larger Chinook salmon, creating an extra confounder in the assessment of declining size over time. Nets are capable of reaching out further from shore while wheels stay anchored close to the beach. One respondent explained that the larger, stronger fish often swim away from shore in the main current where wheels are unable to reach. Overall, respondents agreed that the average size of Chinook salmon seems to be decreasing, but they acknowledged that nets, if set properly, continue to bring in the largest Chinook salmon.

In addition to the decreases in abundance and size of Chinook salmon, many respondents have noticed a decrease in fish quality. Reports of Ichthyophonus, a disease that leaves fish smelling "fruity" and makes them difficult to dry, have increased. White spots on the organs and skeletal muscles are identifiable signs of Ichthyophonus (Kocan et al. 2003). The disease is parasitic and infects a variety of marine fish, including salmon. While University of Alaska researchers have found that the disease is not harmful to humans, it likely contributes to inriver mortality of Chinook salmon (Meyers et al. 2008:46). Residents also attribute a decrease in flesh firmness to Ichthyophonus. For Eagle residents, firm flesh is a valued feature in high quality Chinook salmon. "Fish isn't firm anymore. Soft, you know? It's lost its muscle, you know?" (EAG9). The respondent continued, "If you can put your hand on it and you just press down a little bit and you leave an impression on the meat, that fish is soft and, you know, you want that fish to be firm, you know?"(EAG9). A fish unaffected by Ichthyophonus would take more force to leave an impression: one would have to "really press down to make any dent into the fish" (EAG9). One respondent, frustrated with this problem, described the effect Ichthyophonus has on the preservation process: "They won't cook, they won't dry. You know, if you have fish like that you can't, it won't dry, [but] you can can it" (EAG9). The inability to dry or cook a fish limits the variety of fish residents can put away for the winter and creates problems for those with a high dependence on dried fish.

Generally, respondents felt comfortable eating Chinook salmon affected by Ichthyophonus. One, however did not:

> When I was cleaning them, I take out all the guts and stuff out of them and I noticed white spots on the inside the ribs, like, little white spots, you know? And I asked, I said, well we better not be feeding this to the dogs, so I just leave it on the beach and ravens take care of it. (EAG1)

The same respondent, a lifelong fisher from Eagle Village, did not remember seeing white spots on fish when he was a child (EAG1). He estimated that the changes in fish quality, especially in regards to the presence of Ichthyophonus, became apparent approximately ten to twelve years ago.

All respondents recognized and expressed concern over the declining abundance, size, and quality of Chinook salmon. While their reactions and adaptations to these changes were not universal, a growing sense of urgency surrounding the Chinook salmon fishery was apparent.

Management

Key respondents in Eagle expressed deep concern that Chinook salmon were a steadily declining resource. Extinction was on the minds of many, leading to discussions on self-regulation with hopes of future preservation. One respondent articulated his concern:

> I don't want to consume more than I need to with the situation we have. It's really critical that we let this escapement go through, so I've been kind of, kind of watching it a little closer. And everybody's willing to protect this no matter what, you know, if it means no

> fishing, if the species is on the verge of extinction, we got to do whatever it takes and that's where I'm afraid we're heading with [the] wild stock salmon. (EAG3)

Concerns about the quality of Chinook salmon escapement accompanied the concerns surrounding diminishing returns. Some Eagle fishermen believed that without large female Chinook salmon, fewer eggs would reach the spawning grounds, resulting in fewer fertilized eggs and an overall decrease in returning salmon. One respondent described the sex and size composition of the Chinook salmon that pass by Eagle:

> Most of the fish we get are males, and I just assume those larger fish get up on the spawning grounds. That's why I was happy to see the year that they did have restrictions on the lower river that a lot of those big torpedo females with the eggs [made it to Eagle]. That's one factor that is going to save this run is getting those fish up the spawning grounds. (EAG8)

Another respondent agreed, saying that in order to raise the numbers of returning Chinook salmon, "it's going to take the large females, put them on the spawning grounds, [the ones with] three to four times as many eggs, that should help build the stock" (EAG5).

Some people in Eagle are electing to temporarily reduce their consumption of and overall reliance on Chinook salmon. Despite the lack of a commercial fishery in Eagle, some respondents sympathized with those lower river residents who rely on commercial fishing for regular income. One respondent described a winter he spent in Bristol Bay where he saw the value of commercial fishing while helping to build a commercial fishing boat:

> You're talking thousands of fish in a day. They can take just [an] incredible amount of fish, and it's great; the man was making a living, and he was doing well, and he spread the wealth, and I'm working for him … but all of that said, the number one thing that has to happen is to manage it so it can survive, otherwise it's, it's lost … I just hope that most people realize it, and I think they do here, very much, cause they really count on [Chinook salmon]. (EAG3)

Another respondent praised Yukon River residents across the border in Canada who were voluntarily reducing their fishing effort to be good stewards by letting the fish reach their spawning grounds (EAG5). Following the example set by Canadian fishers, the same respondent and his wife have reduced their fishing effort for Chinook by 50% (EAG5). In the past, he and his wife would put away ten cases of Chinook salmon for the winter; now they only put away five. To compensate, they are, "getting more rabbits; we're getting more beavers; we're eating more caribou…It has to start somewhere," he said. This fisher feels as though other Yukon River communities need to take similar action collectively in order to preserve the species. Furthermore, the respondent believed fishers should advocate for stricter regulations on commercial bycatch (EAG5).

Changes in individual fishing effort accompany the frequent changes in regulations. Fishing closures and mesh size reductions were the two most common managerial decisions discussed by respondents during the interviews. Those who commented on ADF&G regulations all confirmed that the temporary and periodic closing of subsistence fishing in District 5D, also known as the fishing "windows," have substantially impacted their fishing efforts, often making fishing more difficult. As with the rest of the river, Subdistrict 5-D experienced closures during the summer Chinook season: 4 times in 2008 and twice in 2009. Additionally, residents of Eagle experienced 2 closures in 2009 during the fall season (Jallen and Hamazaki 2011).

Eagle residents felt fishing windows have logistical, economic, and cultural effects. Because there are very few viable eddies near Eagle, all fishers must travel in their boat to set or check a net. Fishers spend more time and money on gas traveling to and from their setnet site in order to comply with net removal or tying[5].

Several respondents recognized the conservation value of the fishing windows schedule; however, one respondent expressed disfavor for reduced windows schedules because if windows were removed then nets

5. Prior to 2009, ADF&G required fishers to remove their nets from the water during closures. During summer 2010 fishers no longer had to do this but were instructed to tie the net up instead.

would not need to be visited more than once daily (EAG10). “Windows are more than an inconvenience; it costs money and energy to take a net out and put it back in,” one respondent commented (EAG2).

In recent years, fishers were required to remove their nets during each fishing closure. This was particularly difficult for one respondent who fishes alone. She described the rule, stating:

> There is one regulation that is particularly difficult to accommodate if you are a fisher who does not have help. The rule that requires fishers to remove their nets rather than just tying them up is time consuming and especially cumbersome if your net is set in a fast, strong eddy. It can be dangerous and a real pain to set and remove a net multiple times a month. (EAG2)

The same respondent summed up her frustration by saying, “We’re just trying to get food but regulations make it harder” (EAG2). In addition to the logistical and financial concerns created by fishing closures, the inability to travel to fish camp was cited as a significant and unfortunate result of more conservative regulations.

Strong feelings regarding the regulatory change that reduced allowable mesh size to 7.5 inch accompanied the concerns over fishing closures. Starting in 2011, ADF&G began managing for a drainagewide reduction in mesh net size from the common 8 inch mesh to 7.5 inch. There was not universal opposition to mesh size reduction in Eagle. Instead, respondents in Eagle had varying opinions regarding the effectiveness of mesh reduction as a conservation measure, the financial burdens of buying a new net, and the political nature surrounding the change.

One respondent who expressed deep concern over the declining Chinook run and his desire to grow the stocks summed up support for the new regulation when he said, “So, [do] whatever it takes, let’s make it happen, let’s do it” (EAG3). His attitude towards conservation was not uncommon in Eagle. Another respondent who has a background in fishery biology also advocated for the mesh size reduction:

> The idea behind that regulation was that in the lower river, or throughout the drainage actually, people were using 8 inch or 8.5 inch king gear. One of the ideas behind the decline of the size of the fish is that over the past 40 years, since we’ve been fishing them pretty hard commercially and otherwise, is with the 8.5 inch gear is that there has been a strong selection for that size of fish. So if you are fishing 8.5 or 8 inch gear a lot of the small fish will go through that, but the big fish are going to get caught. So essentially you are sieving out those fish, and over time you are removing that genetic component for other fish. That is the concern…I know there is a lot of controversy around whether or not that is going to work or not, but it was decided that is one thing that we can try and do. (EAG8)

The same respondent was in favor of this change because he believed that it will let larger “fecund” females, which are said to be often twice as large as other Chinook salmon, get to the spawning grounds, thus increasing the number of fish produced each year. Getting the fish to the spawning grounds, he said, is the “one factor that is going to save this run” (EAG8). Two other respondents expressed similar opinions. Larger females, one respondent explained, could have three to four times as many eggs as a smaller Chinook salmon. The respondent advocated for this change by participating in meetings of the Yukon River Drainage Fisheries Association (YRDFA), the Board of Fisheries, and the Eastern Regional Advisory Council and he feels that “it’s a very good conservation method.” Additionally, he would like to see restrictions placed on the depth of nets along the river (EAG5).

Some respondents were concerned that a half inch reduction in mesh size was not substantial enough to greatly benefit the species, while others felt that any change in size would pose an unnecessary financial burden. One respondent believed that a reduction in mesh size would cost her more than large fish. She felt that bigger salmon would “break the net” by ripping through it, which would decrease her ability to catch any fish at all and that “7 1/2 inch mesh only causes problems”(EAG2). The same respondent expressed concern that any change in mesh size will mean that everyone will have to buy new nets. A new net, which might be quickly damaged, will cost her close to $300, and there would not be a guarantee that the change

will help the salmon. She was skeptical of ADF&G management in general and the mesh size reduction in particular (EAG2). Similarly, another respondent disagreed with the decision because, in his opinion, there is little evidence that such a small reduction will benefit the Chinook salmon stock.

> The State Board of [Fisheries] decided to put in 7.5, and that's total nonsense 'cause it's pressure, you know, to, to allow a larger fish to escape to the spawning grounds, and it would be fine if they said 6 inch. But 7.5, half an inch on a gillnet does not make diddly squat of difference. (EAG9)

During Chinook salmon fishing season, the same respondent described how he often sets his 6 inch net in addition to his 8 inch mesh net. The respondent reported that he rarely ever catches large Chinook salmon in the smaller mesh net. From this observation, he felt that if management were interested in seriously limiting the number of large Chinook salmon caught, then a more drastic size reduction would be necessary. He went on to say that:

> [A] 6 inch net would serve the purpose well, to let the larger fish escape. Seven and a half is, is a pain because it means we're gonna be illegal if we fish an 8 inch net, that means we're gonna have to spend 260 bucks for a new net [when there might be] no real biological advantage for the fish. (EAG9)

The discussions in Eagle demonstrate the uncertainty surrounding this change. While residents did not oppose management of the Yukon Chinook salmon fishery, mixed feelings existed over the effectiveness and justification for current decisions. Regardless of their opinions over mesh size reduction, ultimately everyone acknowledged that current salmon fishing practices in the ocean and on the river are unsustainable.

Ideas regarding potential conservation measures shared by respondents included the reduction of marine bycatch, pulse protection, and decreasing commercial fishing for all salmon species on the river. When evaluating all the factors contributing to the declining salmon fishery, one respondent explained:

> We can't control the weather; we can't control tidal blooms in the ocean; we can't control climate change, but we can control bycatch, and we can correct our fishing methods, and we can correct the way we approach letting the first and second pulse get up on the spawning grounds, and if we don't do that we're not going to have a fishery, and those guys [state and federal fishery managers] are not going to have a job. (EAG5)

Eagle residents freely expressed their concern over declining Chinook salmon returns and their hopes for the future. Chinook salmon fishing has historical and contemporary cultural, nutritional, and traditional value for families and the community at large. While decreasing their overall fishing effort and harvest are not measures residents in Eagle enjoy, they accept them as legitimate and necessary steps towards protecting Chinook salmon stocks for future generations. At the conclusion of the interview, one respondent described the significance of subsistence salmon fishing on the Yukon:

> I don't have any questions, but I have a comment. I believe that the Chinook salmon fishery here in Alaska—we have a chance to get it right. I think that if we play our cards right in management and we could stop the bycatch out in the ocean, or at least reduce it to a reasonable level, we could have a fishery that has been in existence for millennia, and personally I would like to see the Chinook fishery managed for subsistence primarily. This is one of the few places in the world where you can go, take your family out on the river, put a net in the water and catch your own food and put it away. Not have to rely on some huge industry to feed yourself. There is a connection to the land, a connection to the resource that goes beyond just putting food on the table. I think we should be looking down the road to maintaining this, as much of a subsistence fishery as we can. That's all. (EAG8)

Socioeconomic Effects

Miriam Wahl

Plate 7-4.–In the spring of 2009 the Yukon River flooded Eagle, severely damaging infrastructure in the City and resulting in the relocation of the Village. Respondents commented on the impact it had on the fishing profile of the two communities and the relationship between them.

Eagle suffered a major flood event that, while not directly related to the socioeconomic effects of the salmon crash, were such a part of Eagle's experience of the last 5 years that it must be described to provide a contextual understanding of the situation Eagle residents find themselves in today.

In addition to the tangible damage, the flood appears to have had numerous sociological impacts on Eagle village and city, increasing the pronounced distinction between the two communities. Prior to the flood, Eagle Village was only three miles outside of the city limits. They hosted social functions, including Christmas parties, potlucks, dances, and funerals. The flood destroyed the church, tribal hall, clinic, and all the homes that once occupied the village. Disaster relief funds aided residents in the rebuilding process of the "New Village" construction, which is 10 miles beyond Eagle City limits. Due to bank erosion, the relocation of village residents has been a gradual process that has been occurring years before the flood, but the events of 2009 made the relocation an immediate imperative.

The increased distance between the city and village has changed the interactions between active fishers and other community members. The physical location of the new village has made social gatherings with residents from town less frequent, and, with the price of gas at nearly six dollars a gallon, more expensive. Some residents feel that the relocation of the village has made the separation between the two communities more distinct. Aside from the homes and landmarks that are missing, there is, to some degree, a lost sense of community. "Something has changed, Eagle doesn't feel the same anymore," said one key respondent (EAG1). As a result, many longtime residents in both Eagle City and Eagle Village have moved away in the past year. Simultaneously, several influential and well respected elders have died. Both events have decreased the number of knowledgeable long-time fishers in the area. Some participants in the surveys and interviews stated that the flood and the resulting relocation of the village have decreased the rate of sharing Chinook salmon and other wild resources between the two communities. This was attributed, in part, to the greater physical distance between the city and the village and less frequent interaction between residents of the areas. This observation was mentioned by some of the survey participants, but it is unclear to what degree this belief is shared. Other respondents described the communal fishing effort that took place during summer 2009 when so many had lost their equipment, and characterized it as providing greater opportunity for sharing and community interaction.

During that summer few people fished; instead, they worked on the recovery effort. "Two years ago, after the flood, we didn't... we didn't process any fish, we didn't catch any fish. Part of the thing was [that] my fish wheel was scrunched, and I was busy at work" (EAG4). During this time, an Eagle resident provided other Eagle City and Eagle Village residents access to his wheel. One respondent explained:

> The last few years, we've been having pretty bad luck. We lost our whole village in the flood, and [he] help us out then, you know, cause he put the fish wheel in and then he'd

> be catching a lot of fish and he'd come up…and he'd tell us, "You people want fish," he said, "just come on down to the boat landing" he said. "In the morning, in the evening," he said, "just take the whole thing." (EAG1)

Additionally, the flood changed the shape of the river, which some believed will change traditional fishing spots. One respondent reported that Bell Island, the island directly across from town, is more "pointed" and consequently could be changing the flow of the river. There were large mud slides, and extended stretches of bank on either side of the river were carved away by the ice and high water. While unclear on the specifics, the respondent was confident that the new topographical changes will affect the way fish pass through the river and thus the places where fish will be consistently caught. Fishers will need time to adjust in order to better predict the patterns of the fish run and productive points of harvest.

Overall, a decrease in fishing activity was undisputed; however, it is difficult to assess the long term impacts the flood and resulting social change will have on residents' ability to get the salmon they need or whether salmon will continue to be a fundamental food source.

In addition to the social changes the flood had on Eagle's fishing profile, the diminishing returns of Chinook salmon continue to impact the economic viability of Eagle's traditional fishing patterns. There are a small handful of active fish camps in the area historically occupied by Eagle City or Eagle Village residents. The increasingly sporadic opening and closing of fishing windows makes staying at a fish camp less feasible and favors the fisher who can harvest Chinook salmon closer to town. One key respondent had, until recently, traveled more than 50 miles each summer to set up camp for Chinook salmon fishing. With fewer fish in the river and longer fishing closures, it can take even longer for residents to get the amount of Chinook salmon necessary to meet their subsistence needs. Respondents reported that after a certain point, traveling to and staying at fish camp is no longer feasible (EAG5). Staying at fish camps for weeks at a time can be costly, especially if a family is foregoing earned income to be there. The openings and closures of the Chinook salmon fishing season are forcing residents to look for fishing spots closer to town, leaving family fish camps that have been in use for generations to be overgrown.

Summary and Discussion

Declining Chinook salmon stocks have substantial cultural and dietary implications for Eagle residents. Subsistence caught Chinook salmon are widely consumed, shared, and bartered, and are occasionally sold between residents. The importance of Chinook salmon and the respect Eagle residents have for the resource cannot be overstated.

All along the Yukon River, Chinook salmon are a vital resource. Yukon Chinook salmon have nutritional content unmatched by nearly any other food, are a reliable staple when other subsistence resources or store-bought goods are scarce, and are at the heart of food distribution networks and community in Eagle. There is an inherent respect associated with Chinook salmon. Similar to other subsistence resources, this respect can be illustrated by the practice of only taking what you need. This approach was explained by one respondent, who said, "There is an ethic here that you don't want to take more than what you need. That is pretty ubiquitous throughout the river. Nothing gets wasted; it all gets used. I think waste is frowned upon. Don't waste any part of the fish" (EAG8).

The prevalence of dog teams in Eagle is unique. Half (5 of 10) interview respondents had dog teams at the time of the interview, while several others had only recently quit running dogs. Unlike other Yukon River communities that largely keep dogs for racing, Eagle residents maintain dog teams primarily for transportation and other subsistence activities. The existence of dog teams in Eagle contributes to a unique fishing profile. Eagle residents do not feed whole Chinook salmon to their dogs, but in order to use all parts of the fish, scraps and entrails are sometimes fed to dog teams or used for fertilizer in addition to other salmon species such as fall chum and coho.

While not included in the survey, ethnographic reports recorded that sharing was the dominant form of Chinook salmon exchange in Eagle. Sharing Chinook salmon, whether jarred, stripped, or in the round, is a

feature of Eagle culture that every participant mentioned. Written comments recorded during the customary trade survey emphasized the importance of sharing fish with elders, those in need, and with friends.

Survey responses to questions on barter consistently reported that normal bartering with a fixed rate of exchange does not occur in Eagle. Instead, bartering is used informally with rates of exchange decided based on another's level of need. Some respondents had a difficult time differentiating between sharing and barter, often describing situations of delayed reciprocity. Many survey participants described situations where a neighbor gave them some salmon and later in the fall they would return the "favor" by giving some caribou or moose in return.

Instances of customary trade were low. Elder respondents described a time when the customary trade of Chinook salmon was more common, but today the reported rate is low (17% of surveyed households). Overall there seemed to be a stigma against the selling of Chinook salmon, especially with the continued decline. Many Eagle residents felt that the sale of subsistence caught fish is a contradiction in terms and an unsustainable practice that should be suspended until the stock recovers.

All respondents discussed a general decline in the size, quality, and quantity of Chinook salmon. Respondents were unsure of the causes behind the changes but speculated that environmental factors, overfishing, and bycatch in the Bering Sea each played a serious role in decreasing the number of Chinook salmon returning to the Yukon. Key respondents reported that a general decline in size of Chinook salmon has been occurring for decades. In contrast, reports of declining quality, especially in regards to Ichthyophonus, have been much more recent, occurring only in the past 10 to 12 years. Most notable however, was the respondents' concerns over declining quantity. Elder respondents (60 years or plus) remember catching hundreds of fish per day, but that volume does not currently exist. Residents using a setnet no longer check it as frequently as they once did.

Today, setnets are the most popular gear for residents and surpass the number of fish wheels in use. Only one key respondent described the use of dip nets during his childhood. A literature review confirmed that in the 19th and early 20th centuries dip nets were the most common gear type used to catch Chinook salmon in and around Eagle (Mishler and Simeone 2004). When people were able to catch a greater volume of fish, wheels were more popular because the effort needed to build them and the time needed to tend them was balanced by a higher rate of productivity. Fewer people operate fish wheels today, but the catch from one wheel is commonly shared with many members of the community. In general, the people of Eagle are rapidly adapting their fishing practices to meet the challenges posed by a weakened Chinook salmon stock, higher gas prices, and stricter regulations. To accommodate these factors, people are changing gear types, fishing closer to town to reduce fuel consumption, abandoning family fish camps to avoid inefficient fishing schedules, and relying more heavily on food distribution networks to meet household needs. Additionally, respondents are voluntarily reducing their fishing harvest with the hopes of preserving the resource. Real concern exists that fishing, a fundamental feature of the seasonal round in Eagle, might become extinct with the species.

In addition, there is a unified community sentiment that the priority use for fish be household consumption. This can translate into upriver frustration with commercial fisheries and the practice of customary trade.

Recommendations

All interview respondents and survey participants expressed deep concern over the declining numbers and were united in their belief that conservation measures need to be taken to preserve a healthy Chinook salmon stock for generations to come. Residents were split over the issue of mesh size reduction. Some felt it an unnecessary burden while others thought a 1/2 inch reduction would do little to benefit the stock. This led some to advocate for a more substantial decrease to a 6 inch or 5 inch mesh net. A several year moratorium on fishing was presented as a possible conservation measure. Most strongly, however, respondents expressed their favor of eliminating commercial fishing for Chinook salmon and eliminating or dramatically reducing commercial fishing for fall chum salmon on the Yukon. Several key respondents expressed the desire for a subsistence only Yukon fishery and further believed that until the resource

recovers, commercial enterprises are irresponsible and unfair. The conflicting interests of commercial and subsistence fishing are not reconcilable when the resource is in such devastating decline. Similarly, the noncommercial sale of Chinook salmon was frowned upon by Eagle residents. While the frequency of customary trade is unknown, Eagle residents believed the practice to be an abuse of subsistence fishing. Especially in times of concern, any sale of Chinook salmon should be eliminated.

8. DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Caroline L. Brown and Anna Godduhn

The broad objectives of this research were to describe and analyze the socioeconomic effects of the 2009 Yukon River Chinook salmon run—a run so poor that it was declared a disaster. The disaster declaration attends primarily to the closure of the commercial fishery in the Lower Yukon River that left many families with few or no sources of income. However, it is important to keep in mind that the disaster's effects exceeded those experienced by commercial fishing families or families in the lower river only. The nature of anadromous migrations from ocean to spawning grounds means that there will always be more salmon at the mouth of a river, with decreasing numbers moving upstream as fish either divert to their natal tributaries, die en route, or are harvested. The low runs of Chinook salmon affected commercial and subsistence fishing families, and subsistence restrictions were experienced throughout the river. As such, the effects of the 2009 run cascaded through other aspects of community life, discussed in the earlier chapters and in more detail below. Further, 2009 was a poor year after nearly a decade of average or below average runs, and was followed by further declining returns of Chinook salmon through 2013. In 2012 the Chinook salmon arrival was delayed—ice break up on the lower river occurred slightly later than average, and coastal ice was present near the river mouths for another month, until around June 20[1]. The run contained a near record low number of fish, prompting requests for another disaster declaration from Alaska's Governor to the U.S. Department of Commerce[2]. To put 2009 in the context of how it was experienced by people who live along the Yukon River, this report takes a broad perspective, including a longer view of changes in the Yukon salmon fisheries over the last few decades, while also looking towards the future.

This chapter summarizes the socioeconomic effects of the salmon disaster by capturing this complexity in terms that apply across the diverse communities in the Alaska portion of the drainage. While most Yukon River communities face similar economic circumstances, their different histories and experiences shape each community's unique set of challenges and opportunities. Thus, even as important village level distinctions exist, a discussion of general trends here allows for a broader consideration of the issues facing Yukon River residents through a qualitative assessment of the socioeconomic effects of the decline. This final chapter also considers the potential effects of declining salmon returns on the continuum of distribution practices that provide for families along the river and across the state. The role of cash, the extent of sharing networks, and the subsistence practices of barter and customary trade in Yukon River communities are considered in light of a critical resource decline. Finally, "Recommendations" provides suggestions based largely on respondent comments and concerns.

In their recent analysis of continuity and change in Yukon River salmon fisheries (based on fieldwork in 2008, the year before the 2009 salmon disaster declaration), Wolfe and Scott (2010) explore many of the issues further articulated here. Our research provides support for their general conclusion that salmon remain a major component of Yukon River economies, and that declines in Chinook salmon runs are causing extreme hardship in a multitude of related aspects of village life. Wolfe and Scott (2010) provide an excellent review of historical harvest estimates, demographics, and how the fisheries have changed over the last several decades. This report confirms and builds on those findings, while providing one of the first analyses of contemporary customary trade and sharing practices, as well as documenting recommendations communicated by local residents.

1. Steve Hayes; Eric Newland, "2012 Preliminary Yukon River Summer Season Summary," Anchorage, Alaska Department of Fish and Game; Division of Commercial Fisheries, October 1, 2012. Accessed 6/24/2014. http://www.adfg.alaska.gov/static/applications/dcfnewsrelease/203815060.pdf

2. Governor Sean Parnell to Rebecca Blank, Acting Secretary, U.S. Department of Commerce, July 14, 2012, "Federal Fishery Disaster," Accessed June 6, 2014. http://gov.alaska.gov/parnell_media/press/federal_fisheries_disaster.pdf

Effects of the Salmon Decline

As demonstrated throughout the chapters, Chinook salmon fisheries are a critical piece of the mixed subsistence-cash economies of Yukon River drainage communities. Changes to one aspect of these complex systems, such as declines in a particular resource or increased regulation, rarely occur in isolation. Changes often operate at different levels (e.g., household, community, region, etc.) and on different time scales (e.g., seasons or decades), and, because of their complexity, can be difficult to quantify. While many of these effects can be understood as short-term reactions to resource decline, others are at least partially related to other impacts, such as technological changes or external economic drivers. Indeed, these variable changes interact to shape the system as a whole; they affect and are affected by multiple other aspects of the fisheries through time. We discuss some of the salient changes experienced by Yukon River households here, attempting to describe the linkages between them. As such, we document the stress and hardship experienced by people who have depended on Yukon Chinook salmon fisheries for sustenance and trade over multiple generations. If food security exists when people have "…access at all times to enough food for an active, healthy life…" (Coleman-Jensen et al. 2011), then the Chinook salmon crash is a substantial threat to food security along the Yukon River (Loring and Gerlach 2009). Long term effects of and adaptive responses to the changes wrought by the recent pattern of Chinook salmon declines are still in process; the following discussion reflects perspectives in 2010.

Fish Camp

One of the most striking socioeconomic changes over the last 30 years has been a decline in the use of fish camps; this has been steepest and most widespread in the last 15 years and also more prevalent in the middle river than in lower or upper river communities (Wolfe and Scott 2010:10, 24). As part of a long-term pattern of seasonal movements in pursuit of wild resources, residence at summer fish camps has long served cultural, economic, nutritional, and educational purposes within the subsistence ways of life followed by Yukon River people. Given the quantity of food that families need to store for winter, seasonal residence at summer fish camps was an efficient way to procure and process the fish needed to feed people and dogs through a long winter. Additionally, the cutting and drying techniques employed at camp have historically been valuable cultural lessons that reflect generations of connections to the land and salmon, knowledge of which is shared with younger generations. Respondents in all of the study communities discussed the declining use of camps as seasonal residences, though camps are still used as bases of operation for many families to harvest fish and then take their catch back to the village for cutting, drying, or canning. Wolfe and Scott (2010) documented this change in other Yukon communities, suggesting a river-wide trend.

The decline in fish camp use may be partly related to the demands of wage based employment, changes in regulation (described in more detail below) and fish abundance over time, as well as shifts in gear types. As described in the Emmonak chapter, a robust network of summer fish camps provided production sites for both the subsistence and commercial fisheries. As the commercial fisheries have declined, fish camp stays are harder to support and justify. In a similar fashion, increased restrictions during the summer season to protect a declining Chinook salmon run have forced residents to sit idle at camp while the fishery is closed; as a result, many families abandoned camp to pursue productive work elsewhere. Further, while the general categories of gear used—driftnets, setnets, fish wheels—have remained largely the same with only minor improvements, important shifts in the patterns of their use are apparent. The expectation that Chinook salmon will provide the majority of subsistence-caught fish in the lower and middle river is relatively recent. With the popularization of driftnetting in the 1970s and 1980s, large Chinook salmon became much more available, contributing to a rise in numbers taken for subsistence use (Fall et al. 2014:73–74; Wolfe and Scott 2010:75). With the combination of oil content and harvest efficiency, which middle river fishers described as ideal, Chinook salmon became the primary subsistence species for human consumption and the reputation of chum salmon as "dog fish" solidified. The efficiency of driftnetting was increased by technological improvements to motor boats that also increased fishers' mobility and contributed to declines in fish camp use in some parts of the river. Fishers no longer needed to stay at camp all summer when it was just as easy to bring fish back to their home village for processing. Also, as noted by Wolfe and Scott

(2010:75), another important gear change has been a decrease in the use of fish wheels, especially in the middle and upper river where they were used most heavily (see for example, the Nulato chapter). Importantly, the decline in fish wheel use has also been linked to the changes in the commercial and subsistence chum and coho salmon fisheries in those areas. As described in the Introduction and in the Nulato chapter, the fish wheels of the middle river produced large quantities of food for dogs as a by-product to the commercial roe sales. When the roe market disappeared in the mid-1990s, subsistence harvests of these fish also declined.

The decline of fish camps has not been a simple direct result of fewer salmon, or any other single cause, but rather has resulted from a complex suite of realities on the river over time. The demands of wage labor, low salmon returns, increased regulation and restrictions, and ever-increasing gas prices all have combined to make most fish camps cost prohibitive today. As such, changes in these patterns then go on to affect other aspects of rural life. These overlaps and relationships can be seen in the following sections.

Regulations

Yukon River fishers have operated under increasing regulation of the salmon fisheries since statehood. In addition to a conservation mandate and subsistence priority, managers must also meet the border passage obligations of the Yukon Salmon Agreement as part of the Pacific Salmon Treaty that allocates salmon between Alaska and Canada. For many decades prior to decline, subsistence fishing was only closed during commercial openings (and for short periods before and after those openings); camps were busy either taking care of fish for the family, or, where applicable, harvesting fish for commercial sale.

Increased subsistence fishing restrictions have accompanied the decline in Chinook salmon runs in the Yukon River, and these restrictions, while necessary for conservation purposes, have increased the hardships caused by a declining resource. Decreased subsistence fishing time and changes in allowable gear types have both occurred over the last decade, intensifying since 2009. Beginning in 2008, gillnet mesh size was reduced to 6 inch or less in districts 1, 2, and 3 to allow the harvest of summer chum salmon while conserving Chinook salmon. Additionally, subsistence windows during the second and third pulses were reduced, chronologically moving upriver after the passage of the first pulse. In 2009, mesh size restrictions continued and included the Coastal District; the department also closed all Yukon area fishing during the first pulse of the Chinook salmon run. In 2010, no additional gear or time restrictions were implemented, largely due to environmental conditions limiting harvest opportunities. However, in 2011 the first pulse closure continued and the BOF restricted subsistence gillnet mesh size on the entire Alaska portion of the Yukon River to 7.5 inch or less. Subsistence fishermen in districts 1 and 2 were subject to a further restriction of 6 inch mesh size. In 2012, the first pulse closure continued for the entire river followed by a closure of the second pulse as well to conserve Chinook salmon. The second pulse was followed by reduced subsistence periods to provide fishermen the opportunity to harvest some summer chum salmon while conserving Chinook salmon. Mesh restrictions were implemented in the Coastal District and districts 1-3 and 4-A.

In terms of time, short windows of fishing opportunity were cited as a major impediment to harvesting sufficient salmon because they decreased the likelihood that a fisher would be successful if he or she was not able to fish the run efficiently. Fishers note that short windows also had economic effects by requiring them to spend more time out on the water—and hence buy more gas—to harvest the same amount or sometimes fewer fish. And in order to conserve Chinook salmon, the windows were not usually open during the times of fish abundance that usually coincided with optimal processing times in June. As a result, the whole fishing endeavor could become a waste if fish spoiled on the drying racks. Fishers all along the river spoke of the inefficiency of short or reduced windows for harvesting fish: processing a few fish at a time keeps them just as busy but is far less productive and jeopardizes the processing if the fish cannot be consistently dried (Wolfe and Scott 2010:65). Further, many fishers noted that shortened fishing windows put everyone in an area on the river at once. This highly competitive system of fishing created problems between fishers, especially where fishing locations were limited. In drifting areas, fishers found themselves either right behind or in front of other fishers, dramatically changing their ability to harvest and creating problems between neighbors.

Beyond the challenges to harvesting posed by regulations, some fishermen talked about how increasing regulation prohibits them from understanding the salmon runs (see Emmonak chapter). If much of local knowledge is based in practice, then restrictions on practice affect that knowledge base as well. Fishers can no longer assess the run effectively because they see only glimpses of the run through limited openings rather than being able to experience the fishery throughout the entire run.

With regard to gear, inseason reductions of allowable gillnet mesh size down to 6 inch or less also created challenges for fishers, sometimes in different ways depending on the location along the river. These reductions in mesh size were meant to conserve Chinook salmon by biasing the harvest towards smaller chum salmon. However, fishers throughout the river, but especially in the lower river, expressed concern about the "drop-out" of fish mentioned earlier: Chinook salmon caught in nets long enough to drown but not securely enough to stay in the net for harvest. They argued that the drop-out of dead Chinook salmon occurs more frequently with 6 inch mesh nets, giving them serious doubts about the conservation value of the measure.

In some areas, 6 inch gear is not generally available. In parts of the middle river, for example, fishers have shifted away from fish wheels or smaller mesh gear in their preference for large mesh drifting gear targeting Chinook salmon, leaving some fishers without any legal gear. Net replacement programs in the interior villages have alleviated some of this problem, though not without other costs, such as lost fishing time while waiting for new nets (A. Frothingham, TCC, personal communication, November 15, 2012). Finally, this research affirmed the observation by Wolfe and Scott (2010:20) that, when gear restrictions were applied to the lower river districts of Y-1 through Y-3, fishers in Y-4 experienced increased competition through encroachment into their traditional fishing areas by fishermen from Y-3 seeking to continue the use of their large mesh gear.

Dynamics of Mixed Subsistence-Cash Economies

From one perspective, the most obvious economic effects of the Yukon Chinook salmon disaster are being felt in the lower river where commercial fishing is thoroughly integrated with subsistence fishing. Chinook salmon have long brought the highest price. Although there has not been a targeted Chinook salmon opening since 2008, those caught incidentally by commercial fishers were legal to sell in some years until 2013. The decision whether to keep or sell each fish was carefully considered. Salmon shortfalls mean accumulating debt for fishers who invest in equipment and permits and can also mean less time on the water for subsistence fishing. Since 2008, fishermen have focused their commercial efforts on chum salmon and by 2013 had dramatically increased their revenues from chum sales. Nonetheless, most fishermen do not make nearly the same amount of money selling chum as they did selling the larger and more valuable Chinook salmon.

In a mixed cash economy, wage employment has a complicated relationship with subsistence activities. Wolfe (1982) first described the integration of subsistence and commercial aspects of mixed subsistence-cash economies of rural Alaska. Cash inputs from participation in the market economy often support subsistence activities, allowing households to buy the guns, boats, nets, gas, etc., needed to hunt, fish, and gather, as well as the supplies that enable long stays at summer fish camps (Wheeler 1998; Wolfe 1982). However, the scheduling demands of wage employment do not always integrate easily with fishing and hunting. Some jobs allow for flexibility during open seasons, but regular employment in rural Alaska often involves leaving home for job sites, especially for men. Firefighting and construction are both highly seasonal and unpredictable. Steady jobs, such as working the oil fields on the North Slope, often entail shift work that takes individuals away from the village—and subsistence activities—for weeks and sometimes months at a time.

Many respondents pointed to this economic relationship as a primary challenge to fishing, especially during low runs. As described in the chapters of this report, the cost of gas has become a significant factor in deciding when and where to fish and how much time to spend fishing. Regardless of gear type used, subsistence fishing requires a boat, and boats require gas. With fewer fish in the river and increasing regulations that

decrease fishing time and net efficiency, fishers have to time their fishing and allocate their gas expenditures carefully. Fishers also face decisions about how they fish. As Wolfe and Scott (2010) point out, driftnet fishing returns the most fish per gallon of gas, but usually requires a greater expenditure for gas. Often, fishers combine their fishing efforts in order to maximize harvests and reduce costs.

The resource crash may also be linked to human population demographics across the Yukon drainage—the choice to stay in one's home village or migrate to another community or urban center. Wolfe and Scott (2010:76) argue that salmon availability plays a significant role. The draw from small communities to larger ones has been an issue in rural Alaska since the time of Euro-American contact, generating "overlapping waves of migration starting before the turn of the 20th century and resulting in larger and larger settlements (Hippler 1969:2)."[3] Many families and individuals regularly relocated for seasonal opportunities, such as school in winter and fishing in summer; the availability of resources is an important factor in this seasonal movement (Lowe 2010). Alaska demographic trends show that many rural populations are still diminishing (Windisch-Cole 2009:4).

Residents of villages with other economic opportunities than commercial fishing may be less likely to leave permanently, but the calculation is complicated by the rise and fall of natural resources and many other variables (Huskey et al. 2004). In the Yukon River drainage, most communities in the Interior, particularly the Yukon–Koyukuk census area, are losing population; at the same time, the larger communities in western Alaska are growing, especially those in the Wade-Hampton census area of the Yukon Delta, where most communities enjoy a broader, more abundant resource base (Huskey et al. 2004:5).

A recent analysis of demographic changes from the nearby Kuskokwim River, which also supports a major subsistence salmon fishery, found that earnings from commercial salmon fishing were correlated with subsistence harvest levels (Howe and Martin 2009). Key respondents from the lower Yukon River for this research also noted this relationship. However, earnings from other commercial fishing (not within the Yukon River drainage) were negatively correlated with subsistence salmon fishing, so factors other than income must be considered when exploring the drivers of subsistence harvest levels (Howe and Martin 2009:455). Another finding was that population growth was generally negatively associated with per household harvest levels. The Kuskokwim's large population center, Bethel, tends to harvest less fish per household than small villages, presumably because of greater participation in the cash economy by the population that has a lower Native proportion than the villages for which it is the hub (Howe and Martin 2009:455).

A comparison of the 2009 estimated subsistence salmon harvests to earlier harvest estimates allows a greater understanding of the composition and quantity of harvests over time, and also illustrates the potential changes to harvest patterns through time, as well as variation along the river. Although the harvest of individual Chinook salmon across the drainage has remained stable (except in recent years of subsistence restrictions), increasing human populations in lower river communities mean that fish are actually being harvested at lower per person rates (Fall et al. 2012). In 1980, Wolfe (1981) surveyed 18 households in Emmonak and estimated a subsistence harvest of 2,256 Chinook salmon for the 100 household community, which was considered by residents to be a "poor" year. Between 1988 and 2008, for example, subsistence Chinook salmon harvests have ranged from 702 fish in 1996 to 4,372 fish in 1993 with an average of just over 2,000 fish (Borba and Hamner 1998; Busher et al. 2009) compared to the 2009 estimated harvest of 1,634 Chinook salmon (Jallen and Hamazaki 2011). Despite the slightly lower harvest in 2009, likely because of the disastrously low run, subsistence Chinook salmon harvests have remained relatively stable through time, with few exceptions (notably 1995, 1996, 2002, and 2005). However, Emmonak's human population growth over the same time period suggests a reduction in per capita harvests. For example, the

3. Gender has played a significant role in these trends, with women being more likely to leave their home villages for permanent residence in an urban center (Hamilton and Seyfrit 1993, 1994). High school girls are more likely to do well in school, attend college, and eventually hold full time jobs than boys, who may be either more interested in village and subsistence living, or less able to adapt to the new world economy (Hamilton and Seyfrit 1994). For Alaska Natives, especially men, confronting urban prejudices is challenging at best (Hippler 1969). Women, perhaps in part because of the "stabilizing effects of family," have been more successful at adapting (Hippler 1969:192). Migration out of rural Alaska is generally attributed to economic opportunities, especially employment. Notably, student populations are declining faster than general populations, implying that education is also an important part of the decision for families to move (Lowe 2010).

per capita harvest of Chinook salmon in 1980 was 80 lb (Wolfe 1981:125); in 2008, it was 39 lb per person (Fall et al. 2012). In the middle and upper river regions, populations and subsistence harvests are both generally decreasing.

Wolfe and Scott (2010:76) documented similar trends, noting that the larger villages of the lower river with a stronger history of commercial fishing and a more robust infrastructure that offers more locally-available jobs have retained more of their population than their smaller middle and upper river counterparts.

Cost of Goods

The cost of many necessary items, such as gasoline, fuel oil, food, and other commodities, is increasingly burdensome in most rural villages, exacerbating the problems caused by declining wild resources. As described earlier, subsistence activities go hand in hand with the cash sector in most villages. Most Yukon River communities are not on the road system, so bulk freight is usually delivered by barge, increasing costs in places where annual per capita incomes are already low (Loring and Gerlach 2009). As described earlier, the increasingly prohibitive price of gas presents challenges for traveling to fish camp and fishing in general, which in turn affect other aspects of life, such as the choices rural residents face about where to spend their scarce financial resources. Most rural residents have to choose between spending money on gas to harvest wood to heat their homes or buying heating fuel oil to do the job. Also, when residents cannot fill their smoke racks or freezers with fish, they have to make up the difference with other wild resources or substitute store-bought foods. Both options cost money. Further, the low quality store-bought foods available in most villages lack the nutritional and cultural value of salmon and other wild resources, threatening residents' health, economy, and culture. While this research did not collect quantitative data on subsistence salmon harvests and other household characteristics, such as the number of harvesters and fuel used for harvesting salmon, Wolfe and Scott (2010:21–22) did identify factors found to be statistically related to household salmon production. In a multiple regression model, they found that two variables were the best predictors of subsistence salmon production: the amount of fuel expended and the number of households eating the salmon harvested. The correlation between fuel expenditures and salmon production is supported by concerns raised in our research: many key respondents cited high fuel cost as a major hindrance to getting the salmon they needed, because they could not afford the gas to set and check nets or to drift. As Wolfe and Scott (2010:22) argue, "One variable measures a production input (fuel), while the other variable likely measures a production need (number of households to feed)." As they point out, large salmon harvests tend to feed more households and individuals, a relationship that may work in two directions: the greater the harvests, the more people and households that can be fed, but also the more people who need to be fed, the larger the salmon harvests need to be. However, given the growing pattern of spending more to harvest less, it remains unclear how households and communities will address this economic challenge in order to continue to fulfill social and familial obligations for salmon.

Dogs and Gear

Another factor in the current constellation of issues affected by declining salmon runs is the use and maintenance of dog teams. For the first hundred years after the U.S. purchase of Alaska, dog traction reigned as the primary form of winter travel in rural Alaska, and while it declined due to the availability of other forms of transportation, dogs remain an important cultural and sometimes economic aspect of village life (Andersen and Scott 2010; Andersen 1992).[4] In 2009, Yukon River residents kept an estimated 1,176 dogs and fed them 3,385 summer chum salmon and 20,459 fall chum salmon, along with other fish species and commercial dog food (Jallen and Hamazaki 2011). Regulations have prohibited the use of Chinook salmon to feed dogs since 2001 (5AAC 01.240(d)) and generally reserve Chinook salmon for human consumption. However, restrictions on Chinook salmon increase the reliance on other salmon species, depending on one's location on the river, to provide human food in addition to dog food. For example, during a community

4. For a detailed review of trends in dog numbers along the Yukon River, see Andersen 1992, Andersen and Scott 2010, and Wolfe and Scott 2010.

meeting in Eagle City on July 24, 2012, residents expressed concern about potential restrictions on the fall chum salmon run that would be providing the bulk of their dog food and human food if they forwent Chinook salmon harvests.

The history of dog use along the Yukon created a unique set of practices developed to support this use. The historical reliance on dog traction by Alaska Native people, non-Native miners, trappers, and the territorial postal system, and the need to feed these dogs, created a substantial trade in chum salmon (Moncrieff 2007; Wolfe and Scott 2010)—transactions later defined as customary trade. Commercial roe fisheries in the 1990s supplied readily available dog food in the form of chum salmon carcasses, reflected in a peak of dog numbers along the river during that time. Conversely, the decline of that commercial market and the shifts away from fish camps and fish wheels tracked with a decline in dogs, especially in the middle river (Wolfe and Scott 2010:45).

Changes in gear use—a general shift away from fish wheels that can harvest large quantities of fish, usually chum salmon, for dogs toward drift gillnets that in many places more efficiently target Chinook salmon for people—have shaped fishing patterns in ways that make the decline in Chinook salmon particularly painful. The decline of the infrastructure and gear that efficiently harvested other salmon species worsen the challenges faced by community members who have developed a heavier reliance on Chinook salmon. For example, in Nulato where large quantities of summer chum salmon were harvested to feed dogs, Nulato fishers have adapted their fishing methods and gear to accommodate a contemporary preference for fall chum and Chinook salmon.

Species and Environmental Change

Although not a direct socioeconomic effect of the Chinook salmon decline, respondents from every village noted changes in the salmon runs, particularly Chinook salmon, and observations of environmental change that they felt affected either the availability of or access to Chinook salmon. Almost all respondents talked about declining runs and observed a decrease in the overall size of Chinook salmon. However, opinions about and observations of this decline were more varied in the lower river community of Emmonak. A fisher from Marshall noted these trends—from seeing very big fish to only the smaller ones, saying he hadn't seen the really big ones since the late 1960s:

> These salmon have a cycle, different patterns for swimming up this river. And there are three kinds. The [first] ones, they're about 15–20 pounds, come in first, the first week. 30–40 pounds comes in the next. The funny thing nowadays, I don't see those big, big, bright king salmons like I used to. They weigh about 60 to 90 roughly pounds…. 1968, since then I haven't seen those big white, big bright king salmons. (M2)

Shifting river channels from various causes (from erosion, for example) change access to eddies necessary for setnets or change the river bottom affecting drifting locations. One notable example was the loss of a historically successful setnet site outside of Nulato where river channel changes have provoked the formation of a sandbar, substantially reducing the site's productivity. In Beaver, several recent years of high water reportedly destroyed normally reliable eddies, shifting fishing locations. Further, high water brought large amounts of drifting debris into the river, causing damage and prompting people to pull their nets.

Other concerns were noted. In Emmonak, water temperature was noted as affecting salmon abundance and health, although informants did not describe the nature of this relationship in detail. Beaver and Eagle residents reported recent observations of unhealthy or diseased Chinook salmon, possibly from Ichthyophonous.

Drying lakes and slough complexes in the middle and upper river area may affect important juvenile salmon rearing locations (see Nulato and Beaver chapters). Importantly, while it is unclear how these changes are related to the decline in salmon in the Yukon River, they are part of the larger context in which salmon are declining. For example, low water levels in Kaiyuh Flats have limited access to that historically productive traditional subsistence harvest area for Nulato residents. Though not a harvest area for salmon, Kaiyuh

Flats is important for other species, such as migratory waterfowl, moose, and nonsalmon fish species. Limited access to these resources compounds the effects of declining salmon populations. As such, they are part of the complicated social, economic, and natural system in which community residents operate; these environmental changes are, in most, cases increasing the challenges of declining Chinook salmon faced by most community residents.

Alternatives

As evidenced in the chapters, residents of the Yukon River have adapted to environmental variability with the opportunistic use of available resources. As reported by respondents and documented in comprehensive subsistence surveys, Chinook salmon are among the most highly valued subsistence foods for most residents along the Yukon River, for both their oil content and their size. Because Chinook salmon run first, most people on the river know very early whether they have enough for winter, and how intense their fishing effort needs to be for other salmon. Then they know by fall whether they have sufficient salmon for the winter and how much additional food they will need. Nonsalmon fish, moose, caribou, and waterfowl are all put under greater pressure when salmon decline. If those alternatives are not available, store-bought foods may be used to replace salmon. By "available," we mean that a resource is present within a feasible distance, that the family has the capacity to harvest it, and that regulations allow that harvest. As noted above, the economic, cultural, and physiological effects of a shift from Yukon River salmon to the market foods available along the Yukon River are sure to add risk and vulnerability to the socioeconomic outlook for residents of the drainage.

Sharing, Barter, and Customary Trade

To track the socioeconomic effects of the 2009 salmon disaster, one focus of this research was on potential effects on the distribution of subsistence food. Sharing (the gifting of a resource with or without the expectation of reciprocity), barter (the calculated exchange of one resource for another), and customary trade (the limited exchange of a subsistence resource for a small amount of cash) have been documented as important aspects of the subsistence way of life. These forms of exchange can be understood as occupying a single continuum of distributing subsistence products, rather than as discreet and fundamentally separate activities.

As noted in all the chapters and by all respondents for this research, sharing is a central tenet of subsistence practices on the Yukon River. Often operating through complex kinship responsibilities, the practice of sharing strengthens relationships and fosters community health by supporting those in need. Sharing is often characterized by an unspoken and uncalculated reciprocity (meaning there is no negotiated or formulated rate of exchange), which occurs over time and provides security in times of hardship. This "generalized" reciprocity can occur within or over seasons, as those successful in the harvest of a particular resource share their bounty, and in turn receive the benefits of another's success in later seasons or other arenas. Or, reciprocity can occur over decades—as younger people grow up and take care of those who took care of them. As Lee (2002:5) argues, "…subsistence is a collective that is based on sharing, one of the most deeply held cultural values. As a rule, then, when Alaska Natives practice subsistence for the nuclear family, the extended family, and for others of the community in need, they are fulfilling cultural values…."

Recently, declines in the Chinook salmon run have refocused attention on the historical practice of customary trade. Despite diverse opinions and assertions expressed up and down the river, there exists very little quantitative data to describe the nature, levels, and frequency of customary trade exchanges. Rich qualitative accounts exist (Moncrieff 2007) to describe the history and various purposes and methods of customary trade exchanges in the Yukon River region; however, public descriptions of customary trade tend to oversimplify the practice, belying the variability, complexity, and adaptability of these exchanges and ignoring their role within the continuum of exchange practices in subsistence economies.

Given these increasing tensions over the allocation and regulation of a declining but historically critical resource, a brief history of the state subsistence law surrounding customary trade is required here. The

exchange of Yukon River salmon for cash began locally well over 100 years ago—mostly to supply dog food to the teams used for transportation through the long winters. Dry fish not only provided excellent nutrition but was easily stored and transported in bundles. Dog teams, primarily employed by the U.S. Postal Service, lived on dry fish on the trail and fish stew at home (Schneider 2012:33). Prior to statehood in 1959, the personal and household use of natural resources was unregulated and generally not monitored. The exchange of wild foods through sharing, bartering, and sale was practiced throughout the drainage, mostly within communities, but also between villages and other regions.

The new State of Alaska recognized damages wrought by the commoditization of wild resources elsewhere, and the sale of wild resources for cash was generally prohibited—except for commercial fishing and trapping (Magdanz et al. 2007:5). Alaska's original subsistence law was passed in 1978 (AS 16.05, McGee 2010). Second only to conservation, subsistence uses became the top priority. Importantly, sharing, barter, and customary trade were recognized as traditional subsistence uses of wild, renewable resources (AS 16.05.940 (33)). The line between customary trade and commercial profit, however, was not specifically established, and this ambiguity continues to complicate the debate over customary trade. Although the state has rarely enforced customary trade rules (Magdanz et al. 2007:72), the exchange of subsistence fisheries resources taken from State of Alaska lands or waters for any amount of cash remains prohibited with only two exceptions—both of which occur outside the Yukon River drainage (Moncrieff 2007).

Customary trade was federally recognized in the 1980 Alaska National Interest Lands Conservation Act (ANILCA) as a traditional and protected use of wild caught subsistence foods. As of this writing, the limited exchange of fish caught in federal waters remains legal but poorly defined (Pappas 2012). However, in an earlier analysis of food exchanges in the Yukon Delta, Wolfe (1981) argued that, like household consumption, local barter and trade practices were self-regulating because demand was limited (Wolfe 1981:218). These uses are generally not considered a threat to the resource base—until the market extends beyond local buyers (Magdanz et al. 2007:72).

Throughout the ban on customary trade, commercial fisheries (always more active in the lower river because of fish quality) continued to operate, contributing to regional tensions between upper and lower river communities regarding the allocation and use of salmon. Competing legal systems, concerns about declining Chinook salmon and increasing restrictions on harvest, confusion regarding federal rules, and recent federal investigations into allegedly excessive sales of subsistence resources have increased attention on this traditional practice without necessarily providing clear data or information about the nature and extent of the practice. Customary trade practices vary broadly in terms of products sold, by whom, on what scale, to whom, and for what reason; they are not easily reduced to a simple drainagewide description. As such, there is little agreement about how customary trade should be regulated. Respondents did not necessarily defend the customary trade of Chinook salmon in times of subsistence restrictions, but neither would they criticize their neighbor for selling fish to another neighbor who needed it or for buying fish because the seller needed cash.

Compounding the challenges of understanding customary trade as it is practiced along the Yukon River is the slippage between common local usages and the legal definition. Despite specific legal definitions, locally the terms "trade" and "barter" are often used interchangeably in a variety of settings from kitchen tables to regulatory meetings. While barter is generally understood as the exchange of one wild resource or product for another, the term is also used to describe the act of negotiating an exchange—that is, setting or establishing the commensurability of the resources in the exchange. The term "trade" is sometimes used to describe the exchange of resources for cash—what is legally termed customary trade. However, "trade" is most often used to describe the informal but negotiated exchange of items other than cash that would be legally termed "barter" (AS 16.06.940) For example, a respondent from Emmonak describes the continuum of exchange in locally significant terms:

> To me, there is not very much trading going on at the community level. In Alaskan communities, it's not trade, it's sharing. Trade, I think of Emmonak with Gambell. For example, Gambell wants smoked salmon, I want muktuk. If I could find somebody in Gambell willing to trade with me, we would be able to barter for amounts. (KR3)

Here, barter (called trade) serves as an important means of distributing resources and for obtaining resources not locally available (e.g., seal oil in non-coastal areas). However, as a result, dialogue between community members, fishers, and managers regarding these difficult regulatory subjects often becomes obscured by semantic confusion.

Multiple factors figure into the definitions and practice of exchange, such as the relationship of the exchange partners and the time frame of the exchange. Mauss (1990) and Sahlins (1972; see also Munn 1986) both describe reciprocal exchanges in terms of the timing that dictates the contours of the exchange. For example, generalized and balanced reciprocity (Sahlins 1972) refers to the nature of the exchange in terms of the obligation (or lack thereof) for a return gift and implies particular levels of closeness or relationships between exchange partners. Delayed reciprocity specifically introduces the concept of a timed expectation of a return. Therefore, with whom one trades and the timing of the trade are important factors; exchanges operate within complex and dynamic social systems that require the fulfillment of certain obligations to others, depending on kinship or other social relations. For example, as described by the Emmonak respondent above, the terms "trade" and "barter" are used interchangeably, distinguishing these practices from "sharing" (something one does with others from one's own community) based on the trading partner (usually someone who can supply items not available in the local area). But the exchanges of sharing and trading operate in essentially the same way, with variable reciprocal obligations and values that depend in part on the relationship between the parties involved and the timing of the exchanges. Indeed, the "types" of exchanges can overlap.

This tendency for relationships to guide such exchanges was expanded to the cash economy as it was integrated into subsistence economies. In her doctoral dissertation, Wheeler (1998) described the role of cash in four Yukon River communities and argued that the introduction of cash has not diminished the importance of wild foods. Wheeler's extensive analysis suggests that the common assumption—that the cash economy makes wild foods replaceable in these systems, reducing their use to optional recreation—is false (Wheeler 1998:258). Rather than given exclusive or special status as a singular resource, cash was used as one among many resources (especially salmon) that "function as the currency of the economy ... ." (Wheeler 1998:261). Wheeler observed that, like other resources, the value of cash is relative, and its value varies by availability that is often controlled by season (Wheeler 1998:263). Wheeler further noted that strategies to use cash mirror the use of other resources: "when it is available, use it to the maximum extent possible, and when it is not available, make do with other resources" (Wheeler 1998:268).

In these ways, communities display a substantial level of resilience and adaptation to the ever changing circumstances of subsistence lifestyles. Citing Schneider's (1982:169) discussion of the "important survival values of flexibility, innovation, and change," Wheeler concludes that the adoption of cash and modern tools does not necessarily mean either that people are giving up a subsistence way of life or that subsistence foods are becoming less important. "Rather, the use of cash and imported technology are part of an adaptive strategy which provides a means by which to deal with new economic, demographic, political, and cultural conditions" (Wheeler 1998:269). Wheeler finds that the adoption of cash within such contextual parameters has enabled continuity and contributed to economic resilience because cash is just one of many highly valued resources, the presence and value of which is expected to vary (Wheeler 1998:272).

While little quantitative data exist to measure customary trade, a few rich ethnographic accounts do exist to describe the practice (Wolfe et al. 2000). Fienup-Riordan (1986) and Moncrieff (2007) both describe exchanges of salmon for cash along the Yukon River. Fienup-Riordan (1986) described the sale of subsistence caught salmon in the early 1980s in the lower river. The exchanges were generally small in nature; the purpose of the sale was not for profit but rather to redistribute food through kin networks. She further argues that understanding these sales through the logic of the capitalist market economy (to maximize profit) is to ignore their actual role in subsistence economies that operate under other logics of accumulation for sharing and redistribution (1986:188).

In 2004–2005, Moncrieff researched customary trade practices in 3 communities from the lower and middle Yukon River. She found active customary trade exchanges in all 3 communities with levels slightly higher as one moved upriver. Moncrieff's (2007) study emphasizes that the "customary trade of subsistence

caught salmon takes a variety of forms, involves different kinds of social networks, and changes year-by-year depending on a number of cultural, economic, and environmental factors (Federal Staff Analysis for proposals 13-06, 07, 08 to the Federal Subsistence Board). However, both Moncrieff (2007) and Fienup-Riordan (1986), as well as descriptions of customary trade from other areas of the state (Krieg et al. 2007; Magdanz et al. 2007) emphasize that customary trade is not part of a market economy, but rather operates under local customs and values of sharing and distributing food. This marks a fundamental difference with the commercial fish market where fish are exchanged for money and distributed out of the geographical or cultural space of subsistence-based communities reliant on wild foods. Barter and trade are rather a way of distributing fish and other resources within that space, supporting continued subsistence ways of life and values. Customary trade "continues today as an active form of resource exchange and support for subsistence economies needing cash" (Moncrieff 2007:34). Given the regional, temporal, and material differences between customary trade exchanges, TCC and Doyon, Ltd argue that "a one size fits all" approach to capping customary trade does not align with the variation that exists across the Yukon and the greater dependence on customary trade that exists upriver" (2011)[5].

Our results from the short barter and customary trade survey implemented as part of this research generally support these conclusions. Through this survey, an initial attempt was made to document the continuity of customary trade and barter of Yukon River Chinook salmon. The survey did not attempt to comprehensively quantify the frequency of exchanges because of the growing sensitivity to the issue and the concurrent federal investigation. Four out of 5 study communities that span the Alaska portion of the river participated in the survey, and the results showed participation in both barter and customary trade in each village. Contrary to Moncrieff's study, however, our survey did not demonstrate higher levels of customary trade in the upper river communities than in lower river communities (Appendix C, tables C1 and C2). This could result from a variety or combination of reasons, including regional/village variation in customary trade participation, hesitancy to provide information based on distrust or concern for legality of the practice, and declining levels of participation since the mid-2000s due to declining salmon runs, among others.

The exchange survey allowed an exploration an important dimension of current salmon use practices by describing the continuum of exchange within and between communities. In each community, the survey asked: *What are the most commonly or typically bartered or traded subsistence resources?* We used network analysis to graph the results.

A network diagram (Figure 8-1) shows all recorded exchanges for all of the study communities. The graph includes all resources bartered and customarily traded in all the study communities, both actual exchanges and typical exchanges. In the graph, blue boxes represent subsistence resources and yellow circles represent other resources, such as cash, gas, and groceries. Lines connect resources that were traded for one another, and the weight of the line depicts the frequency of exchange between any 2 resources. Resources that are exchanged most often migrate to the center of the diagram; other resources that are exchanged less often fall to the periphery.

Individual community-level networks (found in community chapters) show slightly different configurations of resources that are exchanged. However, as seen in the aggregated network, salmon (specifically Chinook salmon) occupy a central position in all of the communities' exchange networks. Chinook salmon are connected to many other resources, including other salmon species, caribou, moose, cash, herring, berries, groceries, marine mammals, and gas, among others. In contrast, chum salmon figure in exchanges with a much smaller set of resources.

This network diagram demonstrates the clear importance of an exchange continuum in Yukon river communities. The barter and trade exchanges shown here as part of larger distribution networks occur strongly throughout the study communities. These networks are important methods of distributing subsistence resources within and between communities and these exchange networks are foundational characteristics of subsistence-based economies.

5. Yukon–Kuskokwim Delta Subsistence Regional Advisory Council, Meeting Materials, Fall 2012, "FP 11-08 Executive Summary."

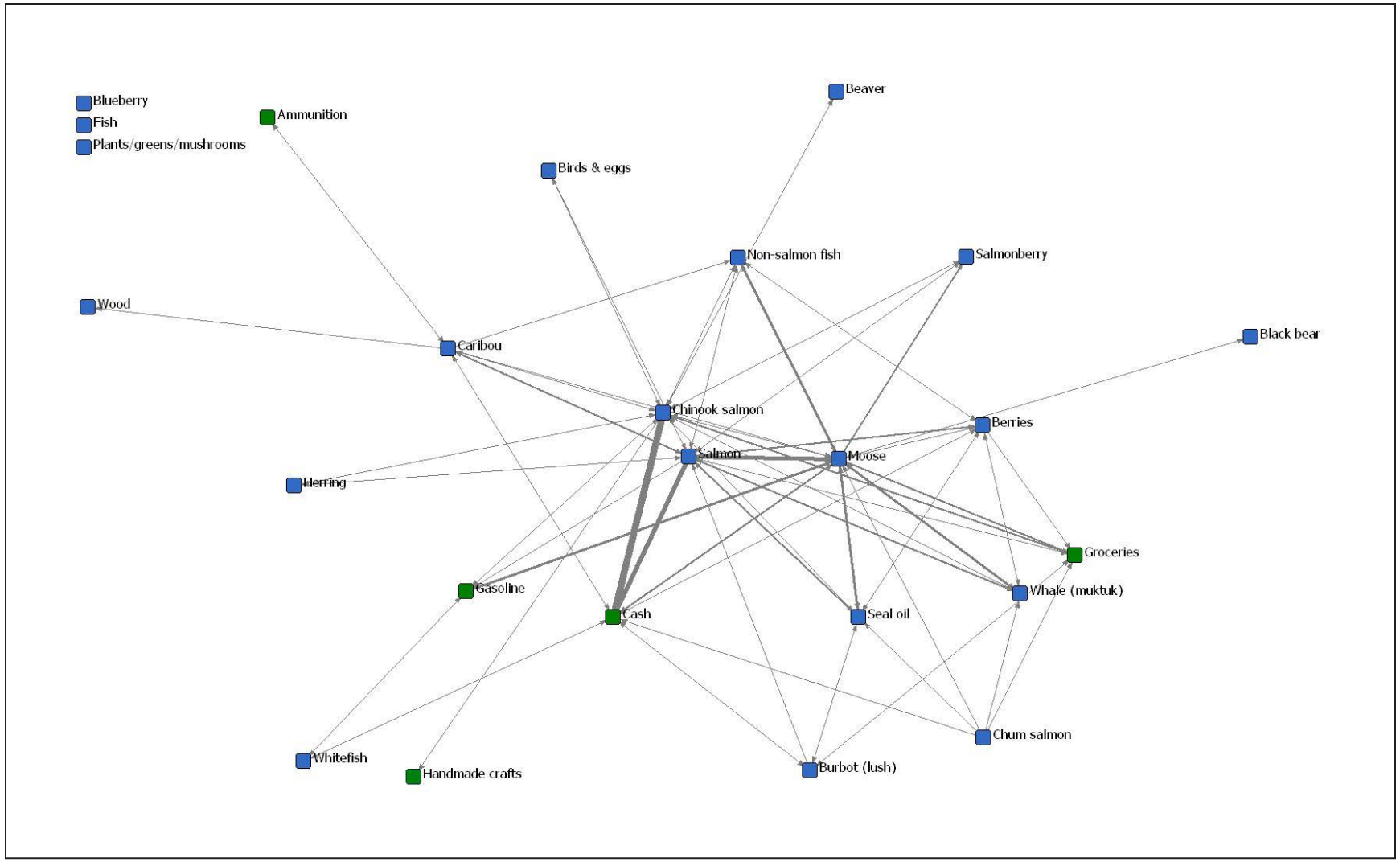

Figure 8-1.–"All Exchanges" network diagram of the barter and trade continuum for all study communties; resources that are exchanged frequently migrate to the center of the diagram; those exchanged less frequently move to the periphery. The weight of the line connecting resources reflects the frequency of that particular exchange. The absence of a line does not indicate exchanges do not occur, but rather implies that the type of exchange is not common and/or not documented by the sample households: i.e., no specific incidents were documented, nor was the general pattern described.

The relocation of many Alaska Native people to urban centers like Fairbanks and Anchorage creates challenges for customary trade rules. Lee (2002:6) notes that obtaining and sharing subsistence foods remains one of the primary means through which Alaska Native people maintain their cultural connections to their home villages and express their cultural identities—important mechanisms for coping with the stresses of urban life and disconnection from the geographic and cultural space of their homelands. As described above, outmigration from villages to urban centers is on the rise, especially in Interior Alaska, largely due to the need to find employment and the requirements of education. As employment possibilities in villages decrease, rural residents are faced with the stressful decision of needing to leave home in order to make money, which takes them away from their ability to practice subsistence and makes them reliant on those still in the village to provide subsistence resources. Sharing, barter, and customary trade have long been the means to do this.

In their 2011 letter to the Federal Subsistence Board, TCC and Doyon, Ltd., the regional non-profit and for-profit Native corporations for Interior Alaska, argued that denying or limiting customary trade practices would have detrimental effects on Interior villages[6]. Given the well documented role of cash in supporting subsistence activities, the Native corporations argue that limiting customary trade would further strain already reduced fish camp usage, an important site of cultural practice, teaching, and identity. It would also, they assert, decrease the ability to distribute fish within and between communities, affecting a community's ability to provide for "non-fishers, the elderly, the disabled, and the needy." As such, customary trade limitations would weaken the cultural backbone of subsistence (cf. Lee 2002). Since cash is an efficient means of exchange and is considered as one of many exchangeable resources (Wheeler 1988), customary trade continues to be an important mechanism of exchange.

Even in times of decline, salmon continue to play a critical role in the subsistence economies of Yukon River communities. It follows that as Chinook salmon become less available through both decreased returns and conservative management, the effects of the decline will cascade through the entire economy; the loss or decline of a central subsistence resource will likely have widespread effects on communities throughout the Yukon, requiring significant adaptive responses from communities. Key questions remain: How will communities respond to this decline over time? How will exchange networks change if Chinook salmon harvests decline further or, perhaps, eventually increase? Will or can other salmon species or subsistence resources take its place? And how will these changes differ throughout the region?

While there is no way to predict with certainty at this time the effect of the Chinook salmon decline and disaster on these networks of sharing, barter, and trade, there can be little doubt that lower fish harvests have enormous implications for subsistence fishers, as well as their social relations in both rural and urban Alaska. Vulnerability of rural Alaskan economies to the increasingly globalized Western economy has so far been buffered by an abundance of natural resources that are central to local well-being, and the fluidity of customary practices seems to enhance economic and cultural resilience in villages. However, as those resources decline, communities are more vulnerable to the demands of the cash economy. As with other subsistence regulations, related rules should be designed with room for adaptation in mind.

Recommendations

This section pulls together recommendations and options voiced by respondents in this research; these recommendations are not necessarily those of ADF&G or its staff but of the respondents in this research, who have participated in the Yukon Chinook salmon fishery through time. No one recommendation or option was unanimously voiced by all respondents. While the experiences of fishers along the Yukon River share many common threads—with endlessly nuanced variation between households, communities, and regions—one of the challenges of analyzing qualitative data is attending to both the points of consensus as well as individual observations and insights that may be critical for management. These recommendations, which are based on key respondent comments, must be qualified with acknowledgement that this set of ideas for how best to manage salmon in difficult times is neither comprehensive nor definitive. In all

6. Yukon–Kuskokwim Delta Subsistence Regional Advisory Council, Meeting Materials, Fall 2012, "FP 11-08 Executive Summary."

cases, however, the suggestions reflect a deep concern for livelihood and heritage. We begin with the most commonly voiced and widespread recommendations, including contrary opinions and some discussion directed toward the management agencies.

Eliminate Non-Essential Use

The most emphatically and unanimously voiced concern was related to salmon caught by the commercial pollock fishing fleet in the Bering Sea, or salmon bycatch. In the mid to late 2000s, bycatch figures rivaled or exceeded the size of the entire subsistence harvest in the Yukon River, and the pollock fishery has been a focus of blame for declining salmon numbers since. While it may be appreciated that many bycaught fish are now donated to food charities and no longer thrown, dead, back to sea, the concern over harvesting fish that would otherwise return to western Alaska streams still evokes strong sentiment. Up and down the river, respondents emphasized the responsibility of taking care of fish: taking what you need; cutting, hanging, and turning it; sharing and consuming it. Bycatch is seen as antithetical to these practices. Other nonessential uses were also mentioned: there was uncontested agreement that whole Chinook salmon should not be used to feed dogs.

Eliminate All Use

Despite the essential value of commercial harvests to local economies, especially on the lower river, some respondents in all regions suggested a need to end commercial fishing for Yukon River Chinook salmon. Fewer respondents suggested a moratorium on the commercial harvest of summer chum salmon to avoid the incidental harvest of Chinook salmon. Even a moratorium on subsistence Chinook salmon fishing was suggested by a few respondents (from all regions) as a preferred alternative to risking the permanent loss of Chinook salmon from the Yukon River.

Increase an Ecological Approach to Salmon Research and Management

Many respondents emphasized that declining Chinook salmon stocks demand a more holistic approach from policymakers and managers; this approach incorporates ecological perspectives, including the human element, into management of the resource. Simultaneous declines in the numbers of fish returning to the river and in fishing effort cause concern among Yukon River residents, especially elders and others who recognize the cultural connection between Yukon River salmon and community health. They worry that traditions and local knowledge, many of which are intimately connected to salmon fishing and processing, will be lost with the resource. In order to understand the implications of and solutions to declining salmon, managers should consider indigenous conservation theories and traditional knowledge. Traditional knowledge documented in this report includes the observation that the way the ecosystem functions in the Yukon River drainage has lost balance and predictability.

It seems widely recognized by respondents that extensive research and strong commitments will be required to understand and mitigate the cumulative stress that Yukon River salmon are experiencing. Although much is known about salmon biology and ecology, the interactive forces that control salmon abundance are dynamic, complicated, and not fully understood. Ocean bycatch, warming waters, changing aquatic and marine environments, and ever more effective harvest methods seem to be seen as the most influential factors by respondents—but their perceived importance varies. Those who spoke to such general management issues were unanimous in their call for a holistic approach to research and management that includes all stages of salmon life cycles and all habitats occupied during those various life stages.

Continue Public Outreach Programs and the Development of Communication Networks

Some respondents expressed appreciation and encouragement of collaboration between ADF&G and other organizations and increasing efforts to improve mutual knowledge by both explaining scientific methods and findings, and by listening to local concerns and observations. Some respondents acknowledged improved communication between fishers and managers and credited the Yukon River Drainage Fisheries Association for coordinating meetings and teleconferences that have contributed to resolutions of concerns and an increased local understanding of management methods and decisions. Two specific complaints were: 1) the short time frame associated with regulatory changes in the form of emergency orders and 2) confusion related to dual state and federal management. Unfortunately, emergency order announcements are, by definition, short notice; as such, the development of additional methods to make sure that word of management decisions reaches fishers at fish camp is vital.

Make Subsistence Fishing More Efficient

Respondents all along the river spoke of the inefficiency of short subsistence windows and noted that they have recently had to spend more time to catch and process fewer fish. However, some respondents see the windows as an effective tool for protecting salmon. In order to make windows more useful, some respondents seem to suggest that windows should be long enough that people could catch fish efficiently—even if the windows did not open directly on the main pulse. This issue will need to be balanced with the management goal of reducing harvest when restrictions on chum salmon fishing are put in place to conserve Chinook salmon. Subsistence restrictions on Chinook salmon are, in essence, an attempt to reduce harvests.

Continue to improve research methods for Accurate Run Enumeration and Assessments

Concerns regarding the accuracy of sonar-based assessments of salmon run strength and timing were pervasive on the lower river. As discussed in chapters 4 and 8, department biologists recognize the limitations of sonar and continue to make efforts toward more accurate estimates. Respondents called particular attention to sonar site location and in-site placement, methods of sonar count apportionment, and adjusting escapement goals to account for in-river losses of Chinook salmon to, or hindrance of their spawning potential by, Ichthyophonus and drop-out.

Protect Subsistence Practices of Sharing, Barter, and Customary Trade

According to ethnographic data collected for this report, sharing was clearly the most common method of distributing subsistence caught fish, with barter and customary trade occurring at lower levels. Given the current political debate over customary trade, information regarding actual levels of such trade for cash is difficult to obtain. Most respondents stated that customary trade was not a common method of food distribution in their community, but they could not say how often other people might sell subsistence foods. Opinions regarding customary trade differ along the river. Some respondents, especially in the lower river, objected to customary trade practices by virtue of its lack of regulation. Others, usually upriver, understood customary trade as a customary and traditional practice that plays a critical role in the larger subsistence economies of particular villages and that should be protected as a subsistence activity. Many respondents see no problem with customary trade in times of abundance, but have more trouble supporting it when the resource is so clearly threatened, as Yukon River Chinook salmon are today. In all cases, however, researchers, managers, policy-makers, and the public need to recognize customary trade as a complicated continuum of exchange practices and attend to this complication in policy development.

Continue to Research the Effects of Gear

Comments regarding gear type regulations were also mixed. A few respondents were concerned about drift gillnetting as a practice, but most comments were focused on the issue of mesh size reduction, over which respondents were split. Many fishers felt that a half inch reduction in mesh size was an unnecessary burden, or would do little to benefit the stock and might even further change the genetic composition of Chinook salmon. Several respondents suggested that more needs to be known about the effect of mesh size on drop-out rates—and the pre-spawning mortality that temporary entanglement may cause fish that are too large to get fully entangled in smaller nets, especially when subsistence fishing is limited to the use of 6 inch mesh by emergency order. As described in Chapter 5, Nulato fishers were skeptical of the new mesh size regulation but found the nets to be more efficient at catching fish than larger mesh nets.

Economic Mitigation of Salmon Disaster Effects

Finally, some respondents, especially in the lower river, had ideas about mitigating the economic effects of the Yukon River Chinook salmon disaster. Perhaps the most easily actionable suggestion here is the institution of a limited entry permit fee waiver for inactive fishers. Currently, this commercial fishing permit fee is only waived if there are zero fishing opportunities. Collaboration and collective representation among fishers were called for by some respondents. Finally, the possibility of developing nonsalmon fisheries for commercial export, especially in the lower river, was seen by some as a potential alternative to the extended economic hardship imposed by salmon shortfalls.

ACKNOWLEDGMENTS

A project of this size and complexity could never be attempted without the help of numerous individuals and groups. Primarily, we would like to extend our sincere gratitude to the people of Emmonak, Marshall, Nulato, Galena, Beaver, and Eagle for their time, knowledge, and patience answering our questions and helping to shape this research. The tribal councils in each community were extremely helpful in discussing the project, hiring research assistants, identifying key respondents and research questions, and generously helping with the logistics of working between several villages. Community-based research assistants contributed greatly to this project through their work helping with community contacts and facilitating the collection of network data. Many thanks go to Fortuna Manumik, Fred Andrews, and Paul Andrew (Emmonak); Frances Evan and Jack George (Marshall); Noreen Mountain (Nulato), Wilma Pitka, Frank Pitka, and Craig Edwards (Beaver), and Joyce Roberts (Eagle) for their hard work assisting with the data collection that contributed to the figures and maps contained within this report. Most importantly, these research assistants, along with key respondents, helped to craft the unique perspective and experience of each community this report attempts to describe. We appreciate the assistance of James S. Magdanz with developing the community sharing networks diagrams. Several people reviewed the final product, including Lisa Olson (ADF&G, Division of Subsistence Deputy Director), Jim Fall (ADF&G, Division of Subsistence Research Director), Jim Simon (ADF&G, Division of Subsistence Northern Regional Supervisor), Adam Knight (ADF&G, Division of Subsistence Publications Specialist) and Deena Jallen (Yukon Fishery Biologist). We also thank the Alaska Legislature for approving the funding for this project, to highlight the important effects of the Chinook salmon decline on the Yukon River.

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APPENDIX A–SURVEY INSTRUMENT

YUKON SALMON

DISTRIBUTION AND EXCHANGE PROTOCOL

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF SUBSISTENCE
1300 COLLEGE ROAD
FAIRBANKS, AK 99701

907-459-7319

THIS RESEARCH FUNDED BY THE STATE OF ALASKA, DEPARTMENT OF FISH AND GAME

HH ID:		
COMMUNITY:		
START TIME:		
STOP TIME:		
INTERVIEWER:		
DATE:		
CODER:		
SUPERVISOR:		

Information collected on this survey will be used by ADF&G to better understand how subsistence foods are distributed among households in the Yukon River area. You are <u>not</u> required to participate in this survey. We will <u>not</u> use the information from this survey for enforcement. We <u>will</u> publish a summary report, and send it to all the households that participate. We will <u>not identify your household</u> in any of our published materials.

ARE YOU WILLING TO PARTICIPATE IN THE SURVEY?

☐ **YES**
CONTINUE THE SURVEY...

☐ **NO**
STOP
THANK RESPONDENT.

PERSONAL HISTORY

CUSTOMARY TRADE

CUSTOMARY TRADE MEANS THE EXCHANGE OF SUBSISTENCE FOODS FOR CASH. HAVE YOU EVER BOUGHT OR SOLD SUBSISTENCE FOODS?

YES (1) NO (0) ____

If YES, continue below. If NO, skip to BARTER questions.

WHY HAVE YOU BOUGHT OR SOLD SUBSISTENCE FOODS?

_____ ____

_____

I AM GOING TO READ SOME REASONS THAT PEOPLE MIGHT BUY OR SELL SUBSISTENCE FOOD. PLEASE TELL ME WHICH REASONS HAVE APPLIED TO YOU.

DID YOU BUY OR SELL SUBSISTENCE FOODS BECAUSE…	*REASON APPLIES?*	*SINGLE MOST IMPORTANT?*	
…YOU NEEDED SUBSISTENCE FOOD	Y N		
…SOMEONE ELSE NEEDED SUBSISTENCE FOOD	Y N		
…YOU NEEDED SOMETHING ELSE (NOT SUBSISTENCE FOOD)	Y N		
…SOMEONE ELSE NEEDED SOMETHING (NOT SUBS FOOD)	Y N		
…YOU HAD SOME EXTRA SUBSISTENCE FOOD	Y N		
…YOU NEEDED EXTRA CASH	Y N		
…OTHER REASON *(Explain)*	Y N		
		"X" ONLY ONE!	

WHAT IS USUALLY THE SINGLE MOST IMPORTANT FACTOR IN YOUR BUYING OR SELLING FOODS? ____

WHAT WAS THE FIRST YEAR YOU BOUGHT OR SOLD SUBSISTENCE FOOD? YEAR _____ ____

HOW OFTEN DO YOU BUY OR SELL SUBSISTENCE FOOD?

(1) MORE THAN ONCE A YEAR | (2) ABOUT ONCE A YEAR | (3) LESS THAN ONCE A YEAR | (4) ALMOST NEVER ____

HOW OFTEN HAVE YOU BOUGHT AND THEN SOLD THE SAME SUBS. FOOD?

That is, how often are you the "middleman" in a customary trade?

(0) NEVER | (1) RARELY | (2) OFTEN ____

BARTER

"BARTER" MEANS TO EXCHANGE SUBSISTENCE FOODS FOR SOMETHING OTHER THAN CASH. HAVE YOU EVER BARTERED SUBSISTENCE FOODS?

YES (1) NO (0) ____

If YES, continue on this page. If NO, skip to next page.

WHY HAVE YOU BARTERED SUBSISTENCE FOODS?

_____ ____

_____

I AM GOING TO READ SOME REASONS THAT PEOPLE MIGHT BARTER SUBSISTENCE FOOD. PLEASE TELL ME WHICH REASONS HAVE APPLIED TO YOU.

DID YOU BARTER SUBSISTENCE FOODS BECAUSE…	*REASON APPLIES?*	*SINGLE MOST IMPORTANT?*	
…YOU NEEDED SUBSISTENCE FOOD	Y N		
…SOMEONE ELSE NEEDED SUBSISTENCE FOOD	Y N		
…YOU NEEDED SOMETHING ELSE (NOT SUBSISTENCE FOOD)	Y N		
…SOMEONE ELSE NEEDED SOMETHING (NOT SUBS FOOD)	Y N		
…YOU HAD SOME EXTRA SUBSISTENCE FOOD	Y N		
…OTHER REASON *(Explain)*	Y N		
…OTHER REASON *(Explain)*	Y N		
		"X" ONLY ONE!	

WHAT IS USUALLY THE SINGLE MOST IMPORTANT FACTOR IN YOUR BARTERS? ("X" one factor only) ____

WHAT WAS THE FIRST YEAR YOU BARTERED SUBSISTENCE FOODS? YEAR _____ ____

HOW OFTEN DO YOU BARTER SUBSISTENCE FOODS?

(1) MORE THAN ONCE A YEAR | (2) ABOUT ONCE A YEAR | (3) LESS THAN ONCE A YEAR | (4) ALMOST NEVER ____

HOW OFTEN HAVE YOU BARTERED THE SAME SUBS FOODS MORE THAN ONCE?

That is, how often are you the "middleman" in a barter?

(0) NEVER | (1) RARELY | (2) OFTEN ____

COMMUNITY EXAMPLE

QUESTION ON THIS PAGE ASK ABOUT YOUR COMMUNITY IN GENERAL, NOT JUST ABOUT YOUR OWN PERSONAL TRADING AND BARTERING.

WHAT KIND OF SUBSISTENCE **FOOD** IS TRADED OR BARTERED MOST OFTEN IN YOUR COMMUNITY?	HOW IS THIS FOOD USUALLY PROCESSED?	WHAT IS A TYPICAL AMOUNT THAT SOMEONE MIGHT TRADE OR BARTER?		
(Species)	*(Dried, Smoked, Strips, etc.)*	*(Amount)*	*(Unit)*	COMMENTS

IF the food listed above is also listed below, please cross it out BELOW before continuing. We do not need to ask about trading something for itself.

NOW, LET'S PRETEND SOMEONE HAD THE FOOD ABOVE AND WANTED TO BARTER IT FOR...

(Species or Item)	HOW OFTEN DO BARTERS LIKE THIS HAPPEN IN YOUR COMMUNITY? *(Circle One)*			HOW MUCH _____ WOULD BE A FAIR TRADE FOR THE FOOD ABOVE? *(Amount)*	*(Unit)*	FROM WHERE DOES THIS ITEM USUALLY COME? *(Communities)*	COMMENTS
SALMON	OFTEN	RARELY	NEVER				
FISH OTHER THAN SALMON	OFTEN	RARELY	NEVER				
SEAL OIL	OFTEN	RARELY	NEVER				
MOOSE MEAT	OFTEN	RARELY	NEVER				
MUKTUK	OFTEN	RARELY	NEVER				
GASOLINE	OFTEN	RARELY	NEVER		GALLON		
COMMERCIAL FOOD	OFTEN	RARELY	NEVER				

CAN YOU THINK OF ANYTHING ELSE YOU MIGHT BARTER FOR THIS FOOD?

(Species or Item)	HOW OFTEN...? *(Circle One)*			FAIR TRADE AMOUNT? *(Amount)*	*(Unit)*	*FROM WHERE...?* *(Communities)*	COMMENTS
	OFTEN	RARELY	NEVER				

IF SOMEONE OFFERED CASH FOR THIS FOOD, WHAT WOULD BE A FAIR PRICE?

(Item)	HOW OFTEN...? *(Circle One)*			FAIR PRICE? *(Amount)*	*(Unit)*	COMMENTS
CASH	OFTEN	RARELY	NEVER	$	DOLLARS	

HOW OFTEN DO PEOPLE HAGGLE OR BARGAIN ABOUT AMOUNTS...	...IN BARTERS?			...IN TRADES?		
	OFTEN	RARELY	NEVER	OFTEN	RARELY	NEVER

HOUSEHOLD _____ COMMUNITY _____

CUSTOMARY TRADE

"CUSTOMARY TRADE" MEANS THE EXCHANGE OF SUBSISTENCE FOODS FOR CASH.
DURING THE LAST 12 MONTHS, HAVE YOU OR SOMEONE IN YOUR HOUSEHOLD **BOUGHT OR SOLD** SUBSISTENCE FOODS? (1) YES (0) NO

IF YES… WHAT KINDS OF SUBSISTENCE FOOD DID YOU OR SOMEONE IN YOUR HOUSEHOLD BUY OR SELL DURING THE LAST 12 MONTHS?

ITEM #	WHAT KIND OF FOOD? *(Species)*	DID YOU BUY OR SELL FOOD? *(Circle One)*	HOW WAS THIS FOOD PROCESSED? *(Process)*	HOW MUCH WAS BOUGHT OR SOLD? *(Amount)*	UNIT? *(fish, lbs, gal, etc)*	WHERE WAS THIS FOOD HARVESTED? *(Location)*
1		BUY SELL				
2		BUY SELL				
3		BUY SELL				
4		BUY SELL				
5		BUY SELL				
6		BUY SELL				
7		BUY SELL				
8		BUY SELL				
9		BUY SELL				
10		BUY SELL				
11		BUY SELL				
12		BUY SELL				
13		BUY SELL				
14		BUY SELL				

HOUSEHOLD _____ COMMUNITY _____

SUMMARY

DO YOU HAVE ANY QUESTIONS, COMMENTS, OR CONCERNS?

INTERVIEW SUMMARY:

BE SURE TO FILL IN THE STOP TIME ON THE FIRST PAGE!!!!

APPENDIX B–SURVEY PROTOCOL

YUKON CHINOOK SALMON DISASTER SOCIOECONOMIC RESEARCH

SEMI-STRUCTURED INTERVIEW GUIDE

Name:_____ Birthplace: _____

Community of Residence:_____ Birth date: _____

Today we are going to discuss your knowledge and experience with the Yukon Chinook salmon fishery. The information areas we will touch on include your earliest experiences with fishing, your experience as an adult subsistence and commercial fisher, the locations and gear types you use for fishing, your experience with and understanding of regulations, your experience with and knowledge of customary trade (or the sale of subsistence caught fish), and finally, your recommendations for management.

Early Adulthood Experiences with Yukon Chinook Salmon Fishing:

- What are your first memories of fishing? Did your parents subsistence or commercial fish? Both? In what ways did you participate?
- Was commercial fishing important to your family when you were a child?
- When did you first start fishing independently as an adult? What year was it? How old were you?
- Where did you fish? How did you decide where to fish?
- Who did you fish with?
- How/when did you first get your own gear? Did you share? What kind of gear was in use then?
- What was abundance like when you first began fishing for salmon? How many fish did you harvest in a season?
- What kind of regulations were in place when you first started fishing?

Commercial Chinook Salmon Fishing:

- Does (Did) your family commercial salmon fish on the Yukon River?
- If yes, when did you first start commercial fishing for salmon on the Yukon River?
- Which species of salmon do you fish for commercially? Do or did you also fish for roe?
- How have your patterns of commercial fishing changed in recent years due to declining Chinook salmon returns? How has this affected your family's resources? How has it affected your ability to pursue subsistence needs?

- How many Chinook salmon did you hope to get during commercial openers (if any) this year? How did your commercial harvest goals compare with previous years?

- On average how much money do you make from commercial salmon fishing for Chinook salmon?

- Do you use the same fishing gear in the subsistence fishery?

- On average, how much does it cost to participate in the commercial fishery? How have these costs changed through time?

- Has commercial salmon fishing been economically successful for you and your family? How is income resulting from the commercial fishing used by your family?

- How has your fishing been affected by the establishment of the Community Development Quota program?

- Is it easier or harder to deliver commercially harvested salmon to buyers than in the past? Please explain these changes.

- How have the rules associated with commercial salmon fishing changed over time from your experiences?

- How does commercial fishing affect your subsistence fishing?

Subsistence Chinook Salmon Fishing:

- How many Chinook salmon did you hope to get for subsistence this year? How many did you actually get? How does this compare to the amount of subsistence salmon you would get in the past? Why has this changed?

- How much salmon do you or your family members hope to eat during the year? Every meal? Every day? Every week? Special occasions? What occasions need salmon (potlatches, other religious events, holidays, etc)?

- How long does it take to get the fish you need? Is this longer than in the past? What caused the difference (declining returns, regulations, technology, environmental changes)?

- How do you decide how many salmon you need each year? Are your harvest goals for salmon higher if you are unable to harvest other animals such as moose?

- Do you meet your harvest goals most years? If you didn't meet your harvest goals, what happened? If you don't meet your harvest goals, what would you do (e.g. fish for more whitefish)?

- How do you decide when to stop fishing? How did you decide in the past?
- How does the price of fuel affect your fishing strategy?
- How does your employment situation affect your fishing strategy?
- Are there cultural rules for respecting fish? What is respectful? Disrespectful? What happens if someone is disrespectful?
- How would people make sure in the past that there were enough fish?
- Who does the work (cutting, hanging, smoking)? What work do you do now? How did you learn to do this work?
- Are there people who don't fish but who help with preservation?
- Do you keep all the fish that you get? How do you choose?
- Do you share fish with others? Who do you share with? How much do you share? Do they give you something in return? How do you decide who to share with?
- Do people share with you?

Yukon Chinook Salmon Fishing Location:

- Where do you fish for Chinook salmon now? [map all salmon fishing locations, past and present, indicate time periods of use and abandonment]. Do you fish the same spots for commercial and subsistence? How long have you fished these spots?
- Are you familiar with any placenames associated with salmon fishing in your area? Chinook salmon in particular?
- What makes a good fishing spot? How do you find one? Do they differ for different salmon species?
- Do the good fishing spots change from year to year or have there been any trends to fishing spot availability? Is there more competition for fishing spots now? Why or why not?
- Do you go to fish camp or do you fish from town? How has this changed during your lifetime? Is fish camp used only for subsistence fishing? Or commercial fishing too?

- Do as many people go to fish camp today as in the past? Explain your reasons why. Are people from the younger generation interested in going to fish camp? How long do you stay in fish camp now compared to in the past? Why do people still go to fish camp?

- If you fish for Chinook salmon from town, do you go to the same spot to fish each time or does it vary from one trip to the next or from one year to the next? Is the distance you travel to fish affected by the price of fuel each year?

Salmon Fishing Gear:

- What gear do you use to fish for Chinook salmon currently? What mesh size(s) do you use? How long is your net(s)? How many meshes deep?

- Do you use different gear for chum/sockeye/coho/pink?

- Do most people use this kind of gear? When did you start using this kind of gear?

- Why do you use this kind of gear? Is it most effective? Do you use this kind of gear because of regulations? Would you use different gear if the regulations allowed?

- Does cost affect the kind of gear you can use? How much does a net cost? Where do you get your nets? Can people share if they can't afford the gear by themselves?

- How do changes in gear technology affect your fishing strategy?

- Who fixes gear? How often, on average, do you replace your gear?

Regulations:

- How did the 2001 subsistence fishing windows affect you over the last few years? How does the 2001 windows schedule compare to the pre-2001 fishing schedule and closure around the commercial periods affect your ability to meet your subsistence harvest goals of salmon? What do you think about the closures?

- How do you know about or keep track of emergency orders or closures or other communication about the salmon run from Fish and Game or Fish and Wildlife?

- Are there other regulations, such as for gear, that affect your fishing?

- Have you ever tried to have input into regulations? What happened?

- Were there years where regulations kept you from getting the fish you needed? Explain.

- What changes would you like to see in regulations?

Customary Trade in Yukon Salmon:

- Do you sell any of your subsistence-caught fish as customary trade (non-commercial for limited amounts of cash)? Are these whole fish "in the round" or processed fish like smoked strips or salt fish?

- When did you first start selling subsistence-caught salmon for limited amounts of cash? Have your patterns of customary trade changed through time?

- On average how much money do you make from selling subsistence-caught salmon each year? What is this money used for?

- Who do you sell subsistence-caught salmon to? How do you decide who to sell to and who not to sell to?

- Do you harvest additional subsistence fish in order to sell some or do you only sell fish that you decide are surplus for your own subsistence needs?

- Do you harvest your Chinook salmon from state or federal waters? Are you familiar with the regulations concerning customary trade?

Finally, as a life-long resident of this area and a commercial/subsistence fisher, what observations and recommendations do have regarding/for Yukon fisheries management?

APPENDIX C–ADDITIONAL TABLES

Table C1.– Household history of participation in barter for selected Yukon River communities, 2010.

			How often do you barter subsistence foods?										How often have you bartered the same food more than once?							
			More than once per year		About once per year		Less than once per year		Almost never		No response		Never		Rarely		Often		No response	
Community	Sampled households	Bartering households*	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.
Beaver	30	8	2	25.0%	3	37.5%	0	0.0%	1	12.5%	2	25.0%	6	75.0%	1	12.5%	1	12.5%	0	0.0%
Eagle	41	15	8	53.3%	2	13.3%	0	0.0%	4	26.7%	1	6.7%	13	86.7%	0	0.0%	0	0.0%	2	13.3%
Emmonak	63	13	2	15.4%	4	30.8%	2	15.4%	5	38.5%	0	0.0%	10	76.9%	3	23.1%	0	0.0%	0	0.0%
Marshall	38	18	6	33.3%	4	22.2%	3	16.7%	5	27.8%	0	0.0%	14	77.8%	4	22.2%	0	0.0%	0	0.0%

* Bartering households are those responding that they have bartered subsistence foods

Source: ADF&G Division of Subsistence, Household Surveys 2010

Table C2.– Household history of participation in customary trade for selected Yukon River communities, 2010.

			How often to you buy or sell subsistence foods?										How often have you bought then sold the same food?							
			More than once per year		About once per year		Less than once per year		Almost never		No response		Never		Rarely		Often		No response	
Community	Sampled households	Trading households*	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.
Beaver	30	2	2	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	100.0%	0	0.0%
Eagle	41	6	1	16.7%	2	33.3%	1	16.7%	2	33.3%	0	0.0%	6	14.6%	0	0.0%	0	0.0%	0	0.0%
Emmonak	63	21	2	9.5%	12	57.1%	1	4.8%	6	28.6%	0	0.0%	19	30.2%	2	3.2%	0	0.0%	0	0.0%
Marshall	38	18	4	22.2%	5	27.8%	3	16.7%	6	33.3%	0	0.0%	17	44.7%	0	0.0%	0	0.0%	1	5.6%

* Trading households are those responding that they have bought or sold subsistence foods in the past

Source: ADF&G Division of Subsistence, Household Surveys 2010

Table C3.– Household participation in barter and customary trade for selected Yukon River communities, 2010.

Community	Sampled households	barter				trade			
		Responses	Minimum	Maximum	Average	Responses	Minimum	Maximum	Average
Beaver	30	7	0	50	24	1	2	2	2
Eagle	41	12	0	45	21	5	2	44	21
Emmonak	63	12	0	39	13	21	0	40	7
Marshall	38	13	1	45	17	18	1	40	10

Source: ADF&G Division of Subsistence, Household Surveys 2010

Table C4.– Assessment of reasons households bartered in selected Yukon River communities, 2010.

		Households reporting why they have bartered															
		Ever bartered		Needed food		Someone else needed food		Needed something other than food		Someone else needed something other than food		Had extra food		Other reason		Households never bartering	
Community	Sampled households	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg
Beaver	30	8	26.7%	7	87.5%	5	62.5%	1	12.5%	2	25.0%	2	25.0%	0	0.0%	21	70.0%
Eagle	41	15	36.6%	9	60.0%	10	66.7%	6	40.0%	4	26.7%	6	40.0%	2	13.3%	26	63.4%
Emmonak	63	13	20.6%	11	84.6%	5	38.5%	3	23.1%	1	7.7%	5	38.5%	0	0.0%	49	77.8%
Marshall	38	18	47.4%	15	83.3%	14	77.8%	5	27.8%	4	22.2%	11	61.1%	2	11.1%	20	52.6%

* Percentages based on households who reported having bartered in the past.

Source: ADF&G Division of Subsistence, Household Surveys 2010

Table C5.– Assessment of the most important factor in barter in selected Yukon River communities, 2010.

		Households reporting what has usually the single most important factor in their barters															
		Ever bartered		Needed fish		Someone else needed fish		Needed something		Someone else needed something		Had extra fish		Other reason		No reason given	
Community	Sampled households	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.
Beaver	30	8	26.7%	6	75.0%	0	0.0%	0	0.0%	0	0.0%	1	12.5%	0	0.0%	1	12.5%
Eagle	41	15	36.6%	7	46.7%	2	13.3%	0	0.0%	2	13.3%	3	20.0%	0	0.0%	1	6.7%
Emmonak	63	13	20.6%	9	69.2%	2	15.4%	1	7.7%	1	7.7%	0	0.0%	0	0.0%	0	0.0%
Marshall	38	18	47.4%	10	55.6%	4	22.2%	2	11.1%	0	0.0%	0	0.0%	1	5.6%	1	5.6%

* Percentages based on households who reported having bartered in the past.
Source: ADF&G Division of Subsistence, Household Surveys 2010

Table C6.– Assessment of reasons households engaged in customary trade in selected Yukon River communities, 2010.

		Why have you bought or sold subsistence food?*																	
		Ever traded		Needed food		Someone else needed food		Needed something other than food		Someone else needed something other than food		Had extra food		Needed money		Other reason		Households never trading	
Community	Sampled households	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.
Beaver	30	2	6.7%	1	50.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	50.0%	0	0.0%	28	93.3%
Eagle	41	6	14.6%	4	66.7%	3	50.0%	1	16.7%	1	16.7%	3	50.0%	1	16.7%	1	16.7%	35	85.4%
Emmonak	63	21	33.3%	16	76.2%	3	14.3%	5	23.8%	1	4.8%	4	19.0%	2	9.5%	0	0.0%	41	65.1%
Marshall	38	18	47.4%	15	83.3%	4	22.2%	4	22.2%	5	27.8%	4	22.2%	4	22.2%	4	22.2%	20	52.6%

* Percentages based on households who reported having traded in the past.
Source: ADF&G Division of Subsistence, Household Surveys 2005

Table C7.– Assessment of reasons households traded in selected Yukon River communities, 2010.

		What is usually the single most important factor in your buying or selling?*																	
	Sampled	Ever traded		Needed food		Someone else needed food		Needed something other than food		Someone else needed something other than food		Had extra food		Needed money		Other reason		No reason given	
Community	households	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.
Beaver	30	2	6.7%	1	50.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	50.0%
Eagle	41	6	14.6%	3	50.0%	2	33.3%	0	0.0%	0	0.0%	1	16.7%	0	0.0%	0	0.0%	0	0.0%
Emmonak	63	21	33.3%	15	71.4%	2	9.5%	2	9.5%	0	0.0%	1	4.8%	1	4.8%	0	0.0%	0	0.0%
Marshall	38	18	47.4%	15	83.3%	0	0.0%	0	0.0%	1	5.6%	0	0.0%	2	11.1%	0	0.0%	0	0.0%

* Percentages based on households who reported having traded in the past.

Source: ADF&G Division of Subsistence, Household Surveys 2005

Table C8.– Summary and detail information for trades in Beaver, Alaska, 2010.

Summary		
Sampled households	30	
Did buy or sell	2	6.7%
Did not buy or sell	27	90.0%
No response	1	3.3%
Bought		
Households reporting buying	1	3.3%
Sold		
Households reporting selling	1	3.3%

Trades detail

Resource	Bought or sold	How processed	Amount	Units	Where was food harvested	Number of households
Salmon	Buy	Jarred - smoked other	1	Pint	Fairbanks	1
Chinook salmon	Sell	Refused	Refused	Refused	Beaver	1

Source: ADF&G Division of Subsistence, Household Surveys 2010

Table C9.– Summary and detail information for trades in Eagle, Alaska, 2010.

Summary		
Sampled households	41	
Did buy or sell	1	2.4%
Did not buy or sell	40	97.6%
No response	0	0.0%
Bought		
Households reporting buying	0	0.0%
Sold		
Households reporting selling	1	2.4%

Trades detail

Resource	Bought or sold	How processed	Amount	Units	Where was food harvested	Number of households
Chinook salmon	Sell	Strips	10	Pounds	Eagle	1

Source: ADF&G Division of Subsistence, Household Surveys 2010

Table C10.– Summary and detail information for trades in Emmonak, Alaska, 2010.

Summary		
Sampled households	63	
Did buy or sell	16	25.4%
Did not buy or sell	45	71.4%
No response	2	3.2%
Bought		
Households reporting buying	16	25.4%
Sold		
Households reporting selling	1	1.6%

Trades detail

Resource	Bought or sold	How processed	Amount	Units	Where was food harvested	Number of households
Salmon	Buy	Jarred - unprocessed	6	Gallons	Emmonak	1
Salmon	Buy	Dried	1	Quarts	Emmonak	2
Salmon	Buy	Dried	2	Gallons	Emmonak	1
Salmon	Buy	Dried	5	Gallons	Emmonak	1
Salmon	Buy	Dried	50	Gallons	Missing	1
Salmon	Buy	Strips	1	Gallons	Missing	1
Salmon	Buy	Strips	1	Gallons	Emmonak	2
Salmon	Buy	Strips	1	Quarts	Missing	1
Salmon	Buy	Strips	1	Quarts	Emmonak	1
Salmon	Sell	Strips	50	Gallons	Emmonak	1
Chum salmon	Buy	Dried	5	Gallons	Emmonak	1
Chinook salmon	Buy	Dried - smoked	100	Gallons	Unknown	1
Chinook salmon	Buy	Strips	1	Gallons	Emmonak	1
Chinook salmon	Buy	Strips	1	Quarts	Emmonak	1
Chinook salmon	Buy	Strips	2	Gallons	Emmonak	1

Source: ADF&G Division of Subsistence, Household Surveys 2010

Table C11.– Summary and detail information for trades in Marshall, Alaska, 2010.

Summary		
Sampled households	38	
Did buy or sell	7	18.4%
Did not buy or sell	30	78.9%
Missing	1	2.6%
Bought		
Households reporting buying	6	15.8%
Sold		
Households reporting selling	3	7.9%

Trades detail

Resource	Bought or sold	How processed	Amount	Units	Where was food harvested	Number of households
Fish	Buy	Dried	20	Gallons	Marshall	1
Salmon	Buy	Dried	2	Gallons	Marshall	1
Salmon	Sell	Jarred - smoked other	20	Quarts	Marshall	1
Chinook salmon	Sell	Dried - smoked	125	Gallons	Marshall	1
Whitefish	Buy	Fresh - unprocessed	10	Individual	Marshall	1
Whale (muktuk)	Buy	Fresh - unprocessed	18	Pounds	Emmonak	1
Whale (muktuk)	Buy	Filleted	1	Gallons	Other Alaska	1
Berries	Buy	Fresh - unprocessed	15	Gallons	Marshall	1
Berries	Buy	Frozen - unprocessed	3	Quarts	Marshall	1
Blueberry	Sell	Fresh - unprocessed	2	Gallons	Marshall	1
Salmonberry	Buy	Fresh - unprocessed	1	Gallons	Other Alaska	1

Source: ADF&G Division of Subsistence, Household Surveys 2010