Technical Paper No. 481

How Subsistence Salmon Connects Households and Communities: an Exploration of Salmon Production and Exchange Networks in Three Communities on the Yukon River, 2018–2019

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

Symbols and Abbreviations

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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

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

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ABSTRACT

This report summarizes the results of research about salmon production and exchange conducted in three Yukon River communities: Pilot Station, Nulato, and Beaver. Household surveys were administered to collect salmon harvest information and details on salmon exchanges. This report includes harvest estimates, harvest assessments, and network analysis of salmon production, sharing, barter, and customary trade. Ethnographic interviews were also conducted with longtime residents to further contextualize local sharing and exchange practices as well as to document how exchange practices have been affected by declining salmon populations. Results from this study continue to demonstrate the fundamental nature of sharing and exchange networks as part of subsistence economies and the importance of salmon as a keystone resource in Yukon River communities. Declines in salmon harvests not only affect fishing households but all households that are connected through subsistence exchange networks. Harvesting households provide for their kin, for those whose have moved away from the community, for elders, and for others who may not be able to harvest their own salmon. Salmon are also harvested to be shared at ceremonies and community events. Additionally, results from this report further confirm prior observations made by Brown et al. (2017) that forms of wild food exchange, including sharing, barter, and customary trade, are best understood on a continuum and that legal definitions and regulations about barter and customary trade do not adequately account for how wild food exchanges occur in practice. Because salmon holds social and cultural values beyond the nutrition it provides, declines in salmon have a far-reaching effect on community wellbeing. The effects of Yukon River salmon declines extend to other regions and other resources. For example, some Yukon River residents are increasingly relying on their connections to other salmon fisheries throughout the state to access salmon. Others attempt to increase their harvests of other local resources to meet their needs for wild foods. These patterns may provide challenges to traditional resource management regimes that are often species- and region-specific. As salmon populations continue to decline, on-going exploration of how communities and their far-reaching networks are adapting to change will be necessary for management and regulatory bodies to be able to respond to changing patterns in subsistence uses throughout the state.

Key words: sharing, customary trade, barter, customary and traditional use, Yukon River, Pilot Station, Nulato, Beaver, salmon, Chinook salmon, salmon declines, networks, network analysis, ERGM

1. INTRODUCTION

Alida Trainor, Brooke M. McDavid, and Drew Gerkey

Salmon are a staple subsistence resource for residents of most rural Yukon River communities. Chinook salmon in particular are a highly prized wild food that is harvested throughout the entire drainage. Harvesting households share their catches with broad and sometimes complex networks of others both inside their own community and in other communities across the state. For the past two decades, Chinook salmon have experienced sustained declines in abundance leading to restrictions on subsistence fishing implemented for biological conservation. These restrictions have affected the way people along the river fish for salmon and their ability to meet their subsistence needs for this resource. Although previous studies have explored changes in salmon harvest patterns and trends over time, none have yet explored how changing harvest patterns affect the sharing and exchange of salmon. This study attempts to document the socio-cultural norms and values that shape subsistence salmon sharing and exchange, the patterns of exchange, and how the customary and traditional practice of exchanging salmon is being affected by changes to the fishery.

Residents of three Yukon River communities—Pilot Station, Nulato, and Beaver (Figure 1-1)—participated in this study by providing information about their 2018 salmon harvests and information about who they shared and traded salmon with following the fishing season and through spring of 2019. These communities were selected to represent geographic diversity while balancing the labor-intensive costs of data collection and analysis. The study communities represent three regions of the Yukon River drainage that have differing fishing patterns in relation to species of salmon harvested, amounts harvested, applicable regulations, community size, and gear types used. Their residents also represent three different cultural and language groups located throughout the drainage: Central Yup'ik, Koyukon Athabascan, and Gwich'in Athabascan. Lastly, the Division of Subsistence had gathered social network data in each of these communities during prior study years to which the results of this study could be compared. As such, the three communities together represent diverse salmon harvest and distribution patterns across the Yukon River that allow for an examination of regional similarities or differences where they exist. Further, they allow for the exploration of how communities in different regions of the Yukon River drainage are affected by continued declines in Chinook salmon abundance. Information from these communities also provide comparison points to similar data from other regions of the state regarding how salmon are harvested and distributed and how those distribution patterns have changed over time.

Regional Background

The Yukon River originates on the eastern side of the Boundary Range of coastal British Columbia, 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). This vast river system provides spawning and rearing habitat for large populations of wild salmon. Hydrological changes that may be affecting salmon habitat and populations include degrading permafrost and a general decrease in surface water (Riordan et al. 2006; Osterkamp et al. 2000). 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; Brown et al. 2020; Weller and Anderson 1998). Recent research has begun to explore how seasonal flood events and variations in stream discharge affects salmon productivity (Neuswanger et al. 2015; Burril et al. 2009; Sykes et al. 2009); but due to the often extreme annual variations in weather patterns common in Western and Interior Alaska (Slaughter and Viereck 1986), long-term datasets are needed to understand trends.

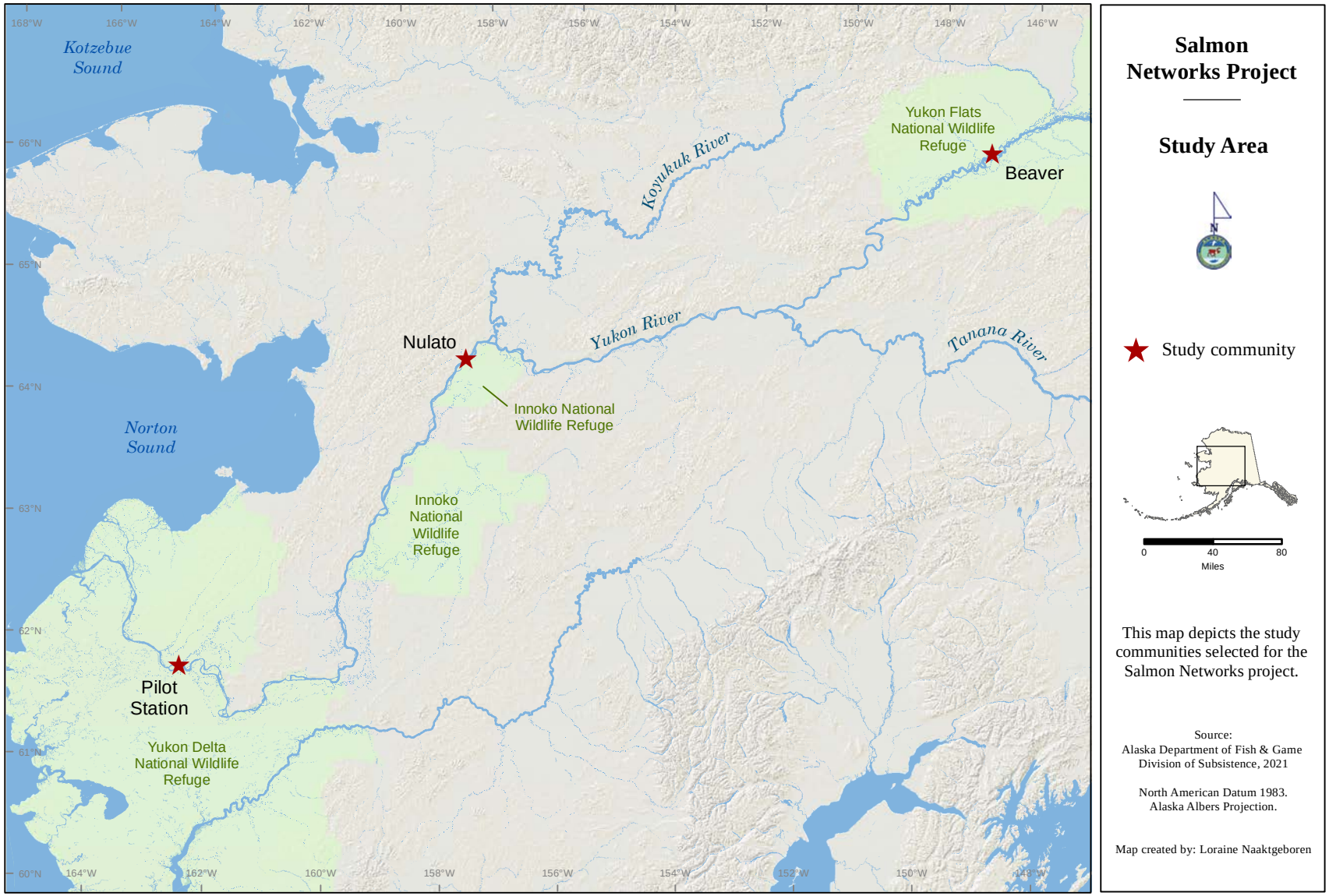

Figure 1-1.–Map of study communities, 2018–2019.

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 seasonal camps that generally allowed for fishing in late spring and summer and hunting and gathering in later summer and fall. Throughout the years, salmon, large game, nonsalmon fish, furbearers, greens, berries, and waterfowl were harvested in turn. Exchanging wild foods for other wild resources or for other goods had been a critical aspect of subsistence-based communities and practices long before contact with Europeans in the 18th century. Transregional trade relationships were, and continue to be, a way for residents of inland Alaska to gain access to coastal resources such as seal oil, muktuk, and salmonberries and for coastal residents to gain access to inland resources such as wolverine or wolf furs, moosehide, and blueberries. Distribution networks provide the means for households to access resources that they do not harvest, and these networks are hallmarks of subsistence economies (Wolfe and Ellanna 1983). Chinook salmon, highly prized for their high oil content, have always played an integral role in the exchange profiles of Yukon River communities. Other salmon species, such as fall chum salmon, have also been an important trade commodity. Throughout the early to mid-20th century, Yukon River fishers from the middle river communities of Holy Cross, Kaltag, Nulato, and Koyukuk sold dried chum salmon to traders who floated the river on barges. The dried salmon was packaged in bundles of 50 fish and was re-sold to trading posts and other residents for dog food to feed the extensive teams historically used for trapping, subsistence, and mail delivery during that time (Moncrieff 2007:18). Similarly, upper Yukon River residents harvested large quantities of salmon and sold the dried fish to barges and trading posts in the Tanana-Yukon rivers region. The dried fish was a major source of food for the dog teams that supported the trapping and wood-cutting industries and a significant source of income for Yukon River fishermen (Betts 1997:87).

Trade over great distances, between the Chukchi in Siberia to the Yup'ik in Alaska through King Island and Stuart Island, began in the latter half of the 18th century after Russian movement into eastern Siberia (Schroeder et al. 1987:222). This trade was international, with Alaska furs destined for the Chinese or European market and Siberian reindeer skin, iron, tobacco, tea, and some manufactured items headed for Alaska villages. Trading fairs took place across Alaska, including along the Yukon River near the contemporary community of Tanana at Noochuloghoyet Point, which is at the confluence of the Tanana and Yukon rivers (Clark 1974). The extensive exchange networks that existed historically continue today, and many of the transregional patterns are still present.

The locations of the three study communities span a distance of over 850 miles of the Yukon River.[1] Changes in river morphology and stock availability over this distance necessitate different fishing practices, timing, and gear types between communities. As such, fishing is regulated differently on each section of the river.

Pilot Station is located in District 2 of the Yukon River. In the lower river, Chinook and summer chum salmon fishing begins in mid-June (Ikuta et al. 2016). The river near Pilot Station is a large, deep channel where fishers can easily drift with gillnets in relatively slow-moving water. Many Pilot Station residents prefer Chinook salmon; however, fishers also harvest large numbers of summer chum, which are in better physical condition and are more palatable than chum salmon caught further upriver. A summer chum salmon commercial fishery provides income to the community and the opportunity to retain a portion of the commercial catch for personal use.

Nulato is located near the upper extent of District 4-A of the Yukon River, where fishers target Chinook salmon beginning in late June (Brown et al. 2015b). The river in this region is narrower and shallower and has more side channels and sloughs relative to the lower river. Nulato residents primarily harvest salmon with drift gillnets, although some fishers use fish wheels, set gillnets, and seine nets (Brown et al. 2015a). Residents prefer to eat Chinook salmon and fall chum salmon. At this point in the migration of summer chum salmon, the fish tend to be less palatable than those in the lower river.

1. Google Earth Pro V 7.3.3.7721. "Pilot Station, AK to Beaver, AK." 64°08'57.00" N and 155°08'08.50" W. Image IBCAO. Data SIO, NOAA, U.S. Navy, NGA, GEBCO. Image Landsat / Copernicus. 2021. Accessed May 14, 2021.

Beaver is located in District 5-D of the Yukon River. The upper river is braided with side channels and has shallow, swift moving water relative to lower sections of the river. Fishers primarily target Chinook salmon. All summer chum salmon spawning grounds are located in tributaries downstream of Beaver, and most fall chum salmon are in poor physical condition at this point in their migration and often considered unpalatable by many residents (Brown et al. 2015b). However, some households do harvest fall chum salmon, particularly in years when they were unable to harvest enough Chinook salmon for their needs.[2] Beaver fishers use set gillnets and fish wheels to harvest salmon. The swift-moving water in the upper Yukon River makes drift gillnet fishing difficult, and the shallow channels hide underwater snags that can damage nets.

Project Background

Social relationships are a fundamental part of subsistence economies in the Yukon River region and throughout rural Alaska. Family and friends often combine their labor and resources to harvest and process subsistence foods cooperatively, and then further share their harvests with others. When people work together to harvest and process salmon, they form and strengthen social relationships that connect people within and between families. Similarly, when people share salmon, these exchanges provide material and emotional support that extend throughout the community and beyond. Similar relationships tied to harvesting, processing, and sharing exist for other subsistence resources. These relationships are intertwined with many other aspects of life, linking subsistence to the personal experiences and cultural practices, values, and knowledge that shape a person's sense of identity and community.

Focusing on the role of social relationships in subsistence helps resource managers and researchers appreciate why people living in rural communities continue to stress that subsistence is about more than harvesting natural resources. Subsistence links the material, social, and spiritual parts of life. As Kawageley (2006:8) explains, "the subsistence-based worldview" is "a complex way of life with specific cultural mandates regarding the ways in which the human being is to relate to other human relatives and the natural and spiritual worlds." This focus on how people relate to one another and their environment shifts attention away from the individual components of the subsistence worldview—the human, the natural, and the spiritual—and toward a more holistic perspective. When people work together to pull in a full net or cut and smoke fish, they are dialogically connected in that moment with salmon, the environment, and with each other, each shaping and being shaped by the others. They are also connected through memories with the people in the past who taught them how to do these things and the previous generations of salmon that fed them. The fundamental importance of social relationships in subsistence has been passed down for generations within rural communities and documented by Native scholars (Kawagley 2006), non-Native ethnographers (Fienup-Riordan 1983; Nelson 1983; Fienup-Riordan 1995; Langdon 2021; Fienup-Riordan 1986), researchers in the Alaska Department of Fish and Game Division of Subsistence (Magdanz et al. 2016; Fall 2016; Langdon and Worl 1981), and others.

In traditional Alaska subsistence economies, the taxonomy of types of exchanges can be complex. For example, for the Yupiit of the lower Yukon River, Wolfe (1981:211–220) discussed several categories of sharing, including *chigiq*: giving of food as unsolicited gifts; *navolhotuq*: the exchange of one economic good for another, or "barter;" and finally, *tungyiaq*: the trade of goods involving some form of currency, or "customary trade." Local definitions of sharing, barter, and customary trade tend to be more fluid and complex in practice[3] than the legal definitions precisely because they are based on complex social norms, cultural and historical values, or locally defined needs (Brown et al. 2017; 2015b; Fienup-Riordan 1986; 1994; Fienup-Riordan et al. 2000; Moncrieff 2007). In any particular community setting, sharing, bartering, or selling a resource may result from or incur a sense of obligation or reciprocity by the participants. At times,

2. C.L. Brown, A. Trainor, B.M. McDavid, J.S. Magdanz, and G. Rakhmetova. *In prep.* Patterns and trends of salmon harvest and use in the Yukon River drainage, Alaska, 1990–2014. Alaska Department of Fish and Game, Division of Subsistence Technical Paper No. 442. Hereinafter *Brown et al. In prep.*
3. For example, there are at least 25 different words or expressions used by Central Yup'ik speakers related to the concept of "gifting" in English, including a specific term for reciprocal gifting: *mumigarute* (Jacobson 2012:1102).

the motivation for selling or trading may result more from a set of social rules or priorities than economic gain. Fienup-Riordan (2000:186) writes that after working with Yupiit for three decades, she "realized in a small way the Yup'ik view of material wealth as something to be shared rather than possessed."

Foundational anthropological studies explored some of the nuances of exchange practices in indigenous societies and categorized these practices into various types of "reciprocity." Mauss (1990rep.) and Sahlins (1972) both describe reciprocity in terms of the timing that dictates the contours of the exchange. They use the terms "generalized," "delayed," and "balanced" reciprocity to distinguish between types of exchanges with different timing and expectations of a return, including the absence of any expectation of return. Generalized reciprocity refers to sharing food or other items as gifts without the expectation of a reciprocal return. Delayed reciprocity encompasses sharing exchanges that are reciprocated at a future time, but without an explicit assumption about the certainties of reciprocation. Balanced reciprocity, on the other hand, involves an explicit expectation of a return and can involve negotiation over the terms of the exchange. These various forms of reciprocity defined in the literature represent an outside perspective on local practices of exchange. Additional research has shown that reciprocity may be better understood as a continuum between generalized reciprocity and balanced reciprocity, and that ultimately a combination of socio-cultural and individual values defines how exchanges play out in the real world (Brown et al. 2017).

With whom one shares or trades can be an important factor in understanding exchanges of wild foods. Community residents operate through complex and varying social systems that require the fulfillment of certain obligations to others, depending on kinship or other social relations. Generalized and delayed reciprocity tends to characterize exchange between close kin and friends, while balanced reciprocity may be more likely to structure exchanges with more distant relatives or acquaintances, strangers, and newcomers. Past research has shown that relationships are an important factor in exchange practices within and between communities (Brown et al. 2017)

Not all subsistence users or households participate equally in the harvest of all resources, yet most households in subsistence-based communities use a wide variety of subsistence resources. Often, a few very high harvesting households within a community harvest the majority of the community's resources and then share them with others (Wolfe 1987). This distribution system is a hallmark of subsistence economies in that it provides subsistence resources to those who are unable to participate in the harvest themselves (Wheeler 1998; Wolfe et al. 1993) and upholds the social responsibility of providing for certain individuals regardless of whether they can harvest wild foods for themselves (Brown et al. 2017). These high harvesting households can be thought of as extremely influential within subsistence networks in that they fulfill a key role in providing access to wild foods to others. Indeed, much of the previous research about subsistence networks in Alaska has focused on the characteristics and roles of these households. Wolfe et al. (2009) found that high harvesting households were associated with the following characteristics: multiple working age males, commercial fishing involvement, multiple sled dogs, and higher wage income. Conversely, they found that lower harvesting households tended to have single-person, female or non-Native heads of household, or advanced aged elders as household members. A household's productivity and demographic characteristics are therefore factors that influence patterns of giving and receiving wild foods.

Along the Yukon River and in much of rural Alaska, salmon and other subsistence resources are distributed locally and widely through sharing, barter, and customary trade (Brown et al. 2015a; 2017; 2015b; Hutchinson-Scarbrough et al. 2020; Ikuta et al. 2014; Krieg et al. 2007; Langdon and Worl 1981; Magdanz et al. 2007; Moncrieff 2007; Pappas 2012). In Yukon River communities, salmon consistently contribute one of the largest proportions of any resource category to total community subsistence harvests. Since 2000, Chinook salmon abundance in the Yukon River has drastically declined (JTC 2019). Subsequently, the harvest of Chinook salmon has also declined throughout the drainage. This has resulted in many households not being able to meet their needs for subsistence salmon and forcing households to adapt their harvest strategies (Brown et al. 2015b; Fall et al. 2020).[4] Previous research has found salmon to be one of the most commonly shared subsistence resources in Yukon River communities and also a central

4. Brown et al. *In prep.*

resource in barter and customary trade networks (Brown et al. 2017; 2015b).[5] Brown and Godduhn (2015b) studied the socioeconomic effects of Chinook salmon declines in communities along the Yukon River. Data for that research were collected in study years 2009 and prior, just before significant restrictions on harvesting Chinook salmon for subsistence were implemented for the Yukon River. In their conclusions, the authors argued that the loss or decline of a central subsistence resource, such as salmon, would likely have widespread effects on communities throughout the Yukon River that would require significant adaptive responses from both subsistence fishers and management.

Declines in salmon abundance have had widespread effects on Yukon River households, but households may not feel those effects equally. Some fishing households have greater adaptive capacity and can more flexibly respond to changes in the fishery. For example, they may be able to buy new gear when old gear types are banned, and they may have more flexible schedules that allow them to fish when openings are announced with little notice. Overall, they may be able to afford to increase fishing effort during shorter openings even if they are ultimately not able to harvest as many fish as they need. They may also be able to replace salmon with harvest of other resources. Other households may not be able to afford new gear types, to put more effort into getting less fish, or be able to harvest other resources to substitute for low salmon harvests. Brown et al. (*In prep*) examined patterns and trends in salmon harvest for a 25-year period (1990–2014). They found that average household salmon harvests decreased over time and that harvest amounts became less equally distributed among households within communities. In other words, harvest specialization increased: fewer households were responsible for harvesting the majority of the fish used by the community. A large body of literature purports that sharing networks, and particularly the sharing done by high harvesting households, may mitigate the effects of resource declines and may help prevent more vulnerable individuals or segments of a community from being disproportionately affected (Baggio et al. 2016; Scaggs et al. 2021; Janssen et al. 2006).

Applications of Social Network Analysis to Understand Subsistence Economies

As previously mentioned, social relations underpin subsistence economies in rural Alaska communities and have been well-studied through an ethnographic approach (Fienup-Riordan 1986; Langdon and Worl 1981; Wolfe 1987). Recently, subsistence researchers in Alaska and elsewhere have begun to apply concepts and methods from social network analysis (SNA) to systematically analyze the complexities of these social relationships as they apply to systems of resource production and distribution. SNA provides methods that are useful for documenting and understanding social relationships (Hanneman and Riddle 2005; Borgatti et al. 2013; Wasserman and Faust 1994).

Social network analysis is particularly appropriate for understanding subsistence harvests and the circulation of food, labor, and knowledge in the Yukon River area. A unique advantage of SNA is its ability to facilitate analysis across various scales by encompassing variables at the level of the individual, the household, the community, and between communities. Previous research suggests that subsistence harvests in Alaska reflect longstanding patterns of kinship, mobility, and cooperation that have existed for many generations, and the cultural values that sustain these patterns remain important for people's well-being and sense of identity today. Tracing networks that facilitate the harvesting, sharing, bartering, and cash trade of subsistence resources within and between communities can provide insight about how Alaskans access wild foods. In turn, this knowledge can inform policy.

In Alaska and throughout the Arctic, SNA is becoming a standard tool for studying social relationships that underlie subsistence harvests and mixed cash-subsistence economies, including studies by Alaska Department of Fish and Game (ADF&G) (Brown et al. 2012; Hutchinson-Scarbrough et al. 2020; Magdanz et al. 2002)) and by other researchers who work in Alaska and throughout the Arctic and sub-Arctic (Baggio et al. 2016; BurnSilver et al. 2016; Ready and Power 2018b; Scaggs et al. 2021; BurnSilver and Magdanz 2019; Collings 2011; Collings et al. 2016; Natcher 2009; Ready and Power 2018a; Reedy and Maschner 2014).

5. ADF&G CSIS.

The ADF&G Division of Subsistence has used SNA methods to document and understand subsistence harvests and resource distribution in rural communities throughout Alaska since 2002 (Magdanz et al. 2002) and has continued to adapt and improve these methods since then. To date, the Division of Subsistence has conducted seven research projects in the Yukon River drainage that included network analysis components (Brown et al. 2015a; 2017; 2015b; Brown and Kostick 2017; Ikuta et al. 2014; 2016).[6] Earlier studies were more simplistic in their approach to utilizing SNA methods, but they nevertheless enabled researchers to begin thinking about subsistence practices from a network perspective and to further develop analytical capacity. For earlier studies that included network analysis, network modules were added to standard comprehensive subsistence surveys for each resource category. Most surveys included questions that asked respondents to indicate who (in their own household, another household in the community, or a household in another community) harvested or processed subsistence resources used by the responding household, and who else gave them resources if they did not know the details of who harvested and processed them. From these data, researchers produced a single network graph that aggregated all recorded relations and exchanges and described the network in a narrative format. As an example, Figure 1-2 depicts a network of wild food exchanges between Nulato households and with households in other communities. These network diagrams showed that 1) almost all households in each study community were connected to other households within their own community, 2) many households were connected to households in other communities, and 3) some households had much greater numbers of connections than others. However, these earlier network analyses did not explore the patterns shown by these graphics in further detail. In addition, many of the complexities already known through qualitative research about cooperative production and resource exchange were not analyzed. For example, by simply asking who produced and harvested resources used by the household, the data could not show whether households were working independently and then sharing resources, or if the households were working together cooperatively to harvest and process resources, which is a common practice.

To further explore the potential of using SNA in subsistence research, the Division of Subsistence partnered with other researchers to document cooperation and distribution networks of wild foods in three northern Alaska communities (Kofinas et al. 2016). Like the early Yukon River network studies, Kofinas et al. (2016) focused on documenting the support and resources that a household received from others, but they further broke down the types of relations of production between households. Specifically, they explored the many different ways a household could acquire resources: by producing their own resources; working with others to produce resources; being given resources for helping others with harvest or processing or for contributing supplies, money, or equipment; receiving resources through sharing, through barter, or through customary trade; and receiving resources that were distributed at feasts or other events. They also tracked the amounts of resources that were produced or received through all these types of connections. Lastly, they compared household characteristics to their positions in the network. Although asking about so many different relations, types of exchanges, and multiple resource categories resulted in a robust network dataset, it also required a lengthy survey that took over an hour to administer. Adding this many additional questions to already lengthy comprehensive subsistence surveys was not a viable option for the Division's research program. However, learning from Konfinas et al. (2016) described above, Division of Subsistence staff updated and incorporated network modules into another comprehensive subsistence survey (Brown and Kostick 2017). Brown and Kostick (2017) was the first Yukon River Region network study that began to further explore how household characteristics such as harvest amounts, household head maturity, household head type, income, and ethnicity affected network structure.

Through these projects, it became clear that network analysis might function better when included in more focused studies, such as those that were limited to only certain resources or types of exchange. Taking a more focused approach allows researchers to gather more meaningful details about certain exchange practices or resource categories without overwhelming respondents. For example, Brown et al. (2017) used network analysis to explore barter and customary trade networks in three Yukon River communities. This

6. B. McDavid, ADF&G Subsistence Resource Specialist. Allakaket and Alatna big game project, unpublished data, 2011–2017.

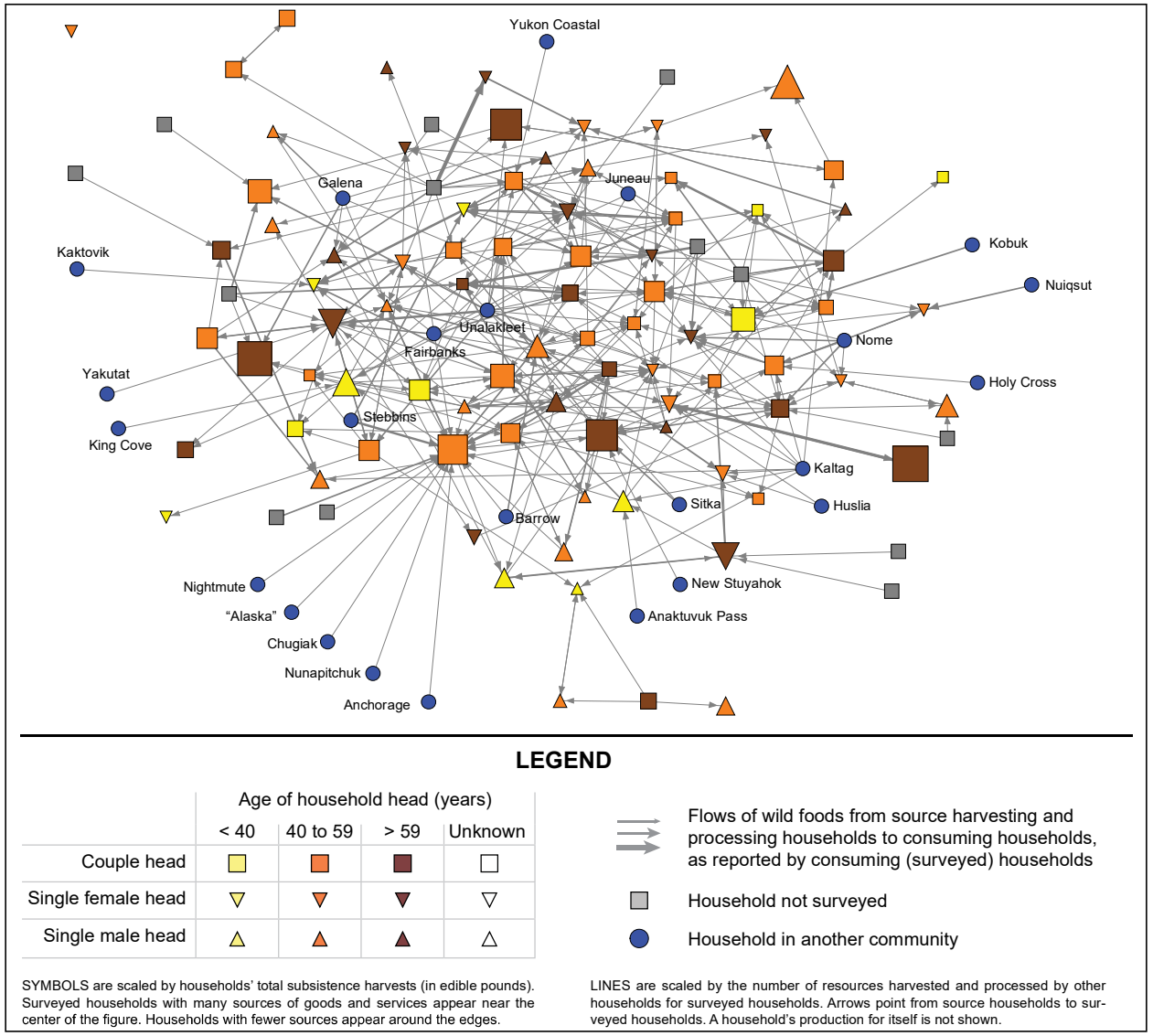

Figure 1-2.–Example network map from previous research (Brown et al. 2015a).

was one of the first studies in the Yukon Region that documented both amounts of resources exchanged and relationships between parties in each exchange, both within and outside of the community. Another study annually documented moose hunting and sharing networks, including the amounts harvested, divided among hunting groups, and shared with others both inside and outside the community.[7]

Many of the lessons learned from these projects were incorporated into the research design for this study. Although previous projects often focused on a specific type of exchange, this is the first project to simultaneously examine cooperative production, sharing, barter, and customary trade networks in order to holistically explore the continuum of these exchange practices from a network perspective. The survey instrument sought to gather detailed information about the demographics of the responding household, the relationship between the two households involved in the exchange, the quantities and processing methods of the resources exchanged, the role of community events in exchange patterns, and many other nuances that had not previously been attempted on a Yukon River network survey. This project is also the first time the Division has incorporated exponential random graph models (ERGM), discussed in more detail below, into network analysis methods. This approach reflects the Division's efforts to gain more targeted insight into the complexities of wild food exchanges.

Further, by conducting this research in communities where previous network data were collected, we are able to compare salmon networks for 2018–2019 with previous salmon networks (study years 2010, 2011, 2013). As such, we can begin to explore whether exchange patterns have changed as Chinook salmon abundance has remained historically low over time. ADF&G researchers are familiar with anecdotal accounts that subsistence fishers are unable to share as widely or as much salmon as they would like or did in the past because of low abundance, regulatory restrictions, and increased time and money spent for smaller harvests. The qualitative and quantitative information gathered in this study allows a more systematic documentation of this information and an investigation of how established norms, values, and practices of sharing and exchange are affected by declines in salmon harvest.

This project explores not only how salmon declines affect household and community harvests, but also how declining salmon affects the entire salmon distribution network and the socio-cultural relations that underpin it. Do distribution networks increase access to salmon? How might harvesting patterns and distribution networks change as Chinook salmon runs decline? Do other salmon species or subsistence resources take the place of Chinook salmon? Will additional management safeguards be necessary to protect those alternate species? Will declines in salmon harvests alter or increase the harvest of other terrestrial resources? How will these changes differ across the various regions of the Yukon River where salmon availability varies by species and stock, and where different harvest and use patterns prevail? Will these changes affect households differently based on their demographic characteristics?

Regulatory Context

Sharing, Barter, and Customary Trade

The sharing, barter, and customary trade of wild resources harvested for personal or family consumption are recognized as legal "subsistence uses" in both Alaska state law[8] and in federal law[9]. Neither source provides a legal definition of sharing, but sharing generally means giving with no obligation or expectation of reciprocation. Both sources similarly define barter as the exchange of fish or wildlife or their parts taken for subsistence uses for other fish, wildlife or their parts; or for other food or for nonedible items other than money, if the exchange is of a limited and noncommercial nature.[10,11] Sharing and barter are not actively

7. B. McDavid, ADF&G Subsistence Resource Specialist. Allakaket and Alatna big game project, unpublished data, 2011–2017.
8. AS 16.05.940 (34)
9. 50 CFR §100.4
10. AS 16.05.940 (2)
11. 50 CFR §100.4

managed or tracked through regular monitoring and therefore do not present monitoring or enforcement concerns.

Regulations for customary trade are much more complicated. Both state and federal law define customary trade of fish as the exchange of subsistence-caught fish for cash and require it to be of limited and noncommercial nature.[12,13] Neither provides a definition for what constitutes noncommercial sales. Under state law, the Board of Fisheries must define customary trade in each region before participation in that activity is legal; the Board has not yet done so for the Yukon River region and likely will not do so until it receives a proposal asking for it to be defined.[14] Therefore, salmon caught in state waters of the Yukon Area cannot be customarily traded legally. Federal law allows for the customary trade of salmon caught in waters adjacent to federal lands, but places geographic limits on the practice in times of low salmon abundance: it may only take place between residents of federally-qualified, rural subsistence communities.[15] Further complicating the federal requirements on customary trade is the requirement that fish be sold in the round or be processed in a facility that is compliant with Alaska Department of Environmental Conservation regulations, both of which are inconsistent with the customary methods of processing fish on the Yukon River.[16]

In summary, customary trade on the Yukon River is currently only legal if salmon are harvested in waters adjacent to federal land, and if they are exchanged between federally-qualified rural residents as whole, unprocessed fish. The three study communities in this project are within or adjacent to national wildlife refuges,[17] and residents in these communities tend to fish in waters regulated under federal law. Fish caught in sections of the Yukon River that flow through or next to federal land may be sold if they meet federal customary trade conditions. Customary trade of salmon caught in state-managed waters of the Yukon River is not yet legal. However, these laws, or lack thereof in the case of state regulations, do not adequately consider the realities of how the historical and contemporary practice of customary trade occurs. For example, Yukon River fishers commonly harvest salmon from state-managed waters, process salmon in fish camps and their homes, and trade salmon with friends and family living in urban regions of the state for cash. Salmon customarily traded under these conditions is outside the bounds of the law. In addition to the complex regulations that recognize customary trade as a traditional practice but do not provide adequate means for it to be legally practiced, some high-profile cases of legal enforcement on the Yukon River have resulted in fines for those involved with selling salmon outside the bounds of the law. These issues contribute to making customary trade a somewhat sensitive topic of research, which should be considered in the interpretation of results.

Yukon River Fisheries Management

Management of transboundary stocks of Pacific salmon, such as the Canadian origin stocks of Chinook and fall chum salmon, are part of an international treaty known as the Yukon River Salmon Agreement (YSA). The YSA established the Yukon River Panel, a body made up of stakeholders and managers from Alaska and Yukon Territory who are charged with implementing the YSA and establishing escapement goals for

12. AS 16.05.940 (8)
13. 50 CFR §100.4
14. The only cases in which customary trade is legal under state law are for herring roe on kelp in Southeast Alaska (5 AAC 01.717) and subsistence-harvested finfish, which includes salmon, in Norton Sound-Port Clarence area (5 AAC 01.188).
15. Rural determinations are reviewed on an on-going basis by the Federal Subsistence Board. All communities are considered rural except for those included in the nonrural determination list. The most recent list of nonrural communities is published in 72 FR 25688.
16. In 2012, the State of Alaska adopted new regulations permitting the sale of certain home-prepared "cottage foods" (18 AAC 31.012), but fish are considered potentially hazardous by Alaska Department of Environmental Conservation and are still required to be processed in inspected facilities.
17. Pilot Station is in the Yukon Delta National Wildlife Refuge (NWR), Nulato is across the river from the Innoko NWR, and Beaver is in the Yukon Flats NWR.

transboundary stocks. Currently the mainstem escapement goal for Chinook salmon across the U.S.-Canada border is 42,555 to 55,000 fish, and the escapement range for fall chum is 70,000 to 104,000 (JTC 2021).

In the U.S., Yukon River salmon fisheries are also managed in accordance with regulations decided by the Federal Subsistence Board (FSB) and the State of Alaska Board of Fisheries. The Yukon River Drainage Subsistence Salmon Fishery Management Protocol, which is administered through a memorandum of agreement between state and federal agencies, provides the guidelines for the cooperation of these agencies in the management of subsistence fisheries in the Yukon River drainage (Fall et al. 2018). This protocol also promotes cooperation with various fisheries interest groups. Fishery managers from the ADF&G Division of Commercial Fisheries and the U.S. Fish and Wildlife Service (USFWS) work in direct collaboration to manage the fishery during the season. They also solicit feedback from subsistence fishers during pre-season meetings and throughout the season through teleconferences. Since 1990, the Yukon River Drainage Fisheries Association (YRDFA) has facilitated weekly teleconferences throughout the summer and fall fishing seasons during which managers present in-season run information and management strategies (JTC 2019). Subsistence fishers give input on management actions and provide fishing updates during these meetings. These meetings provide an opportunity for direct two-way communication between mangers and subsistence users during the fishing season.

Yukon River salmon management efforts are divided into two seasons: summer and fall.[18] The summer season begins in May when the first Chinook salmon are detected in the river. Summer management is directed at Chinook and summer chum salmon and continues until July 15 in District 1. On July 16, management in the lower river becomes focused on the fall chum and coho salmon runs, while management of Chinook and summer chum salmon continues upriver until these species have passed through the upper river districts.

For Alaska salmon managers, meeting escapement goals as outlined in the YSA takes priority over offering subsistence, commercial, sport, or personal use fishing opportunities. Salmon runs are enumerated in-season by a variety of assessment projects that include two SONAR stations: one at Pilot Station in the lower river and one at Eagle near the Canadian border. Although pre-season run size projections give managers an idea of how many salmon may return, in-season assessments allow them to adjust their management strategy based on the number of salmon observed in the river. Alaska managers can use a variety of tools to ensure that escapement goals are met, including closing or reducing fishing periods and restricting gear types. They can also use different strategies in different regions of the river to account for the variations in fish availability and harvest patterns throughout the drainage.

Management Responses to Yukon River Chinook Salmon Declines

Chinook salmon declines in 2000, again in 2009, and in most subsequent years have significantly decreased harvest levels throughout the drainage. Chinook salmon were classified as a stock of yield concern in 2000 after the Chinook salmon run failed to meet its escapement goal several years in a row (JTC 2019). The following year, in an effort to increase escapement and limit the harvest of any one stock of salmon, the BOF instituted a subsistence fishing schedule that limited fishing to specific "windows" of opportunity throughout the week. The windows schedule was intended to spread harvest across the entire run. Between 2000 and 2018, the strength of the Chinook salmon run continued to falter, prompting managers to issue numerous Emergency Orders during fishing seasons that reduced fishing opportunity by either shortening or eliminating open fishing periods, and implementing restrictions to legal gear.

In 2010, the BOF limited maximum gillnet mesh size to 7.5 inches or less in an effort to limit Chinook salmon harvest while allowing fishers to harvest summer chum salmon. This forced fishermen to buy or obtain new nets.[19] However, in response to in-season indications of poor Chinook salmon runs, ADF&G often uses Emergency Order authority to further reduce maximum mesh gillnets to a stretched mesh net

18. Fall, J.A., A. Godduhn, G. Halas, L. Hutchinson-Scarbrough, B. Jones, B. McDavid, L.A. Sill, T. Lemons. *In prep*. Alaska Subsistence and Personal Use Salmon Fisheries 2018 Annual Report. ADF&G Division of Subsistence, Technical Paper No. XXX.
19. In 2011, Tanana Chiefs Conference initiated a net exchange program. Fishers could send in their large mesh gillnets and receive a 7.5 inch mesh gillnet at no cost.

size of 6 inches, which causes an additional financial burden on fishers. In 2013, the BOF adopted first pulse protection, which prevented fishing during the first pulse of Chinook salmon in the lower river. This action was an attempt to account for uncertainty in the preseason run projection and assure that the first Chinook salmon entering the river were not harvested. In 2014, Yukon River fishermen experienced unprecedented restrictions. Managers did not offer a targeted subsistence opportunity for Chinook salmon. At the same time, Yukon River managers attempted to provide commercial opportunity for the abundant summer chum salmon by introducing new, more selective gear types, such as beach seines and dipnets. These gear types allowed fishermen to return Chinook salmon to the water. In 2018, the BOF decided that first pulse protection was only needed in years when the preseason run projection anticipated that Chinook salmon escapement goals would not be met.

Since 2000, the Yukon River salmon fishery has undergone extreme change, in terms of both stock abundance and of the myriad of fishing restrictions implemented as necessary conservation measures. These rapid changes have forced fishing communities to restructure their traditional fishing practices such as where they fish, with whom they fish, and what they do with the limited amount of fish they catch.

2018 Fishing Season

Prior to the beginning of the 2018 season, Yukon River fishery managers estimated a Chinook salmon run of 173,000 to 251,000 fish (Carroll and Jallen 2018a). A run of this size would meet the escapement goal but would not definitively provide a surplus of fish for subsistence harvest. Managers anticipated adopting a conservative strategy early in the season. This strategy included beginning the season with a reduced regulatory schedule and gillnet mesh size restrictions of 7.5 inches or less; these restrictions would continue until the run proved to be adequate for a more liberal fishing strategy. Prior to the season, managers also anticipated a greater than average summer chum salmon run that would allow for commercial fishing; however, the summer chum salmon commercial fishery would begin with selective gear types that would allow for the live release of Chinook salmon.

In 2018, fishers were allowed to target nonsalmon fish with 7.5 inch gillnets 24 hours per day prior to the arrival of Chinook salmon (JTC 2019). The 2018 Chinook salmon run began later than average, and the early season run was lower than preseason forecasts. Information provided by fishers at the YRDFA meetings indicated that high water, debris in the river, and poor weather hindered fishing and fish preservation early in the season.

On June 11, Pilot Station fishers and other District 2 fishers were limited to two 18-hour periods per week: half the time allowed by the normal regulatory schedule.[20] One 18-hour window was then cancelled the following week to further limit the Chinook salmon harvest until run strength could be better estimated. Estimates at the Pilot Station sonar station continued to indicate a smaller than expected run size. On June 21, managers limited gillnet mesh size to six inches or smaller to allow fishers the opportunity to harvest summer chum salmon while still restricting Chinook salmon harvests. This mesh size restriction remained in place until ninety percent of the Chinook salmon run moved through the District. The reduction in length of the fishing windows also continued throughout the summer season.

Similar to District 2, Nulato fishers in District 4-A were limited to half of the normal regulatory schedule, two 24-hour periods per week, throughout the summer season. Also, two 24-hour windows were cancelled early in the season due to uncertainty about the developing Chinook salmon run. District 4-A fishers were restricted to using six inch or less gillnet mesh size for one of the two fishing windows each week. Fishing windows alternated between 6 inch and 7.5 inch maximum mesh sizes to allow for some opportunity to allow for some reduced opportunity to harvest Chinook salmon.

Beaver fishers in lower District 5-D were also restricted to fishing opportunities equal to half of the normal regulatory schedule. Salmon fishing closed on July 1, then opened again on July 5 for one 84-hour period per week throughout the season. District 5-D were also restricted to gillnet mesh size of 6 inch or less from

20. ADF&G, n.d. “Commercial fishery announcements (includes subsistence and personal use).” Accessed May 26, 2021. http://www.adfg.alaska.gov/index.cfm?adfg=cfnews.search

the beginning of the summer season until fishing was opened to 24 hours per day, seven days per week with 7.5 inch mesh size on August 9. Fishers in District 5 are able to target Chinook salmon with six inch mesh gillnets more effectively relative to the lower sections of the river because very few summer chum salmon are present.

The sonar project near the upper river community of Eagle estimated Chinook salmon passage at 57,959 fish. This escapement likely met the required allowable catch for Canadian fishers as determined by the U.S./Canada Yukon River Salmon Treaty (Carroll and Jallen 2018a). Chinook salmon escapement goals were also met in most Yukon River tributaries, and the drainagewide summer chum salmon escapement goal was exceeded in 2018.

Preseason projections of the fall season anticipated that the fall chum salmon run would meet escapement goals and allow for subsistence and commercial fishing (Estensen and Borba 2018). Fishing throughout the fall season on the Yukon River mainstem occurred on a full regulatory schedule and allowed for gillnet mesh size up to 7.5 inches.

Despite meeting mainstem escapement goals in 2018, subsistence harvests in the Alaska portion of the Yukon River drainage were below historic averages and did not fall within the range of amounts necessary for subsistence (ANS)[21] for any species except pink salmon ((JTC 2019). The drainage-wide harvest in 2018 was 31,812 Chinook salmon, 76,926 summer chum salmon, 64,494 fall chum salmon, and 5,527 coho salmon.

Study Objectives

This project had the following objectives:

1. Use a social network survey to build on salmon harvest data for 2018 and systematically document the scope of and local characteristics of salmon exchange in three Yukon River communities, paying attention to exchanges both within and between communities and the types and quantities of salmon exchanged;
2. Conduct indepth ethnographic interviews about salmon exchange practices and changes over time. Interviews will include questions about a) the amounts and types of fish or other resources shared; b) the relationships between people who cooperatively harvest and share wild foods; c) decision making factors that structure salmon sharing and exchange; d) the ceremonial context of exchange; e) forms of exchange, such as sharing, barter, and customary trade; f) perceptions of change in the environment, particularly with regard to salmon and other subsistence resources, and how these affect exchange practices; and g) perceptions of change in exchange practices in order to describe how exchange practices fit within the overall social, cultural, and economic life in the Yukon River; and
3. Contribute to local capacity-building by utilizing a framework of community involvement in research.

Final Report Organization

This report summarizes the results of systematic household surveys and ethnographic interviews conducted by staff ADF&G and local research assistants (LRAs), and also incorporates resident feedback provided at community review meetings. The findings are organized by study community. Each results chapter includes tables and figures that report findings on demographic characteristics of households in the community, participation in harvesting and processing of subsistence salmon, networks of cooperation and exchange of salmon, and harvest and use trends over time. Additionally, ethnographic information from key respondent interviews is used to support and enrich the quantitative and network data.

21. In 1993, the BOF made a positive customary & traditional use finding for all salmon in the Yukon–Northern Area and determined that the Amounts Necessary for Subsistence (ANS) ranged between 348,000–503,000 salmon for all species combined (5 AAC 01.236). In 2001, the BOF made species-specific ANS determinations for each of four species of salmon harvested in the Yukon Area, including separate ANS determinations for summer chum salmon and fall chum salmon. In 2013, the BOF added an ANS for pink salmon.

2. METHODS

Drew Gerkey and Brooke M. McDavid

Overview of Social Network Analysis Terms and Methods

Social Network Analysis (SNA) begins with two basic building blocks: 1) a set of **social actors** and 2) a set of **social relationships**. A **social actor** could be a person, a household, or any other entity that engages in social interactions. **Social relationships** can represent a range of interactions, including exchanges of material resources or the spread of information, as well as durable social ties among relatives, friends, or co-workers. Together, a set of actors and relationships form a **network**. There are a variety of terms used in SNA to refer to actors and relations. **Actors** are also often called **nodes** or **vertices**, in addition to whatever type of entity they represent. **Social relationships** are often called **ties** or **edges**, as well as more familiar terms like "connections" or "relations."

A network can be represented and analyzed in a variety of ways. Visual representations of a network typically display actors as circles (or other shapes) and relationships as lines between them (Figure 2-1). Arrowed lines can further indicate direction of the relationship. Mathematical representations of social networks use a matrix, with a row (i) and a column (j) for each actor, with the value for each cell (i,j) indicating the nature of the relationship between them. Whether represented visually or mathematically, a network is always a simplified representation of a complex social context. No single representation can capture all of this complexity, but by carefully developing and analyzing multiple representations, researchers can uncover useful insights about that complexity.

Analysis of social networks can focus on different scales, from individual actors and groups of actors to the network as a whole. At the individual scale, analysis focuses on how individual actors are positioned within the network. **Centrality** is a key concept for defining position, and there are multiple definitions of centrality that capture different aspects of an actor's position in relation to others in the network. The simplest is **degree centrality**, which represents the number of social relationships or ties that directly connect an actor to others in the network. Actors with higher degree centrality scores are considered more central than actors with fewer ties because they have more connections in the network. Depending on the nature of the social relationship represented in the network, the social relationship may have "direction," with a tie going from one actor to another actor. In this case, the network is "directed," and an actor's degree centrality score can be divided into the number of ties coming to the actor (**indegree centrality**) or going from the actor (**outdegree centrality**).

Expanding from individual actors to groups of actors, the focus of analysis shifts to patterns in social relationships among two or more actors. The simplest groups are **dyads**, composed of two actors (Figure 2-2). When a network is **directed**, dyads can be asymmetric, with only a single tie from one actor to another running in either direction, or they can be mutual, with two ties going in both directions between the two actors. Mutual dyads indicate **reciprocity** in social relationships, similar to the adage: "Do unto others, as you would have them do unto you." Adding a third actor forms a **triad**, leading to more complex configurations of social relationships. Analysis of triads often focuses on "transitivity," where ties connect all three actors in the triad, creating a triangle structure in the network. Transitivity in social relationships suggests similarity in the connections among all actors in the triad. For example, in a friendship network, three people who are all friends with one another embody **transitivity**, similar to the adage: "Any friend of yours is a friend of mine." An actor that is not connected to others in the network is referred to as an **isolate**.

Dyads and triads represent the most basic units of any network, combining to form more complex structures of social relations. These structures are evident when shifting analysis to the scale of the network as a whole. Networks with larger numbers of mutual dyads and transitive triads have higher **density**, a measure that represents the proportion of ties observed in the network relative to the number of possible ties in the network. Density values range from a value of 1—for a dense network with ties connecting each actor

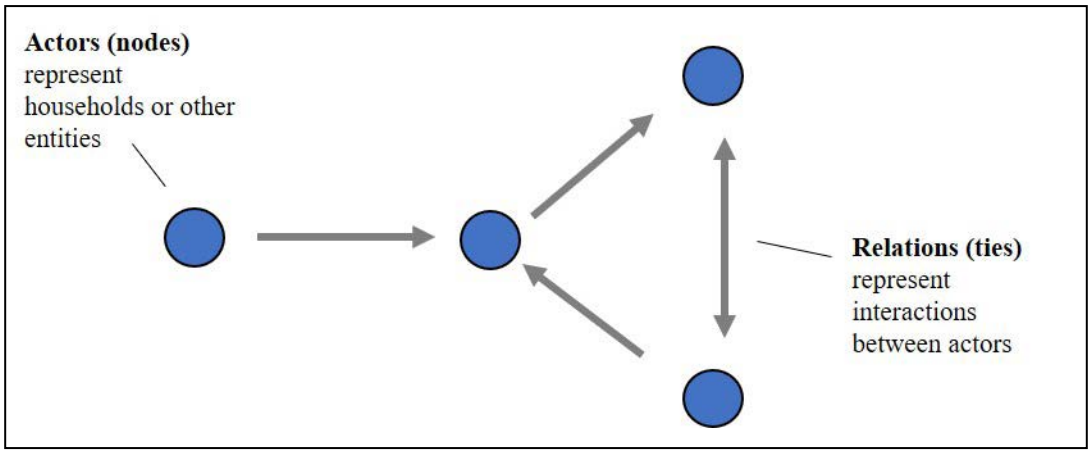

Figure 2-1.–Example of a simple network diagram.

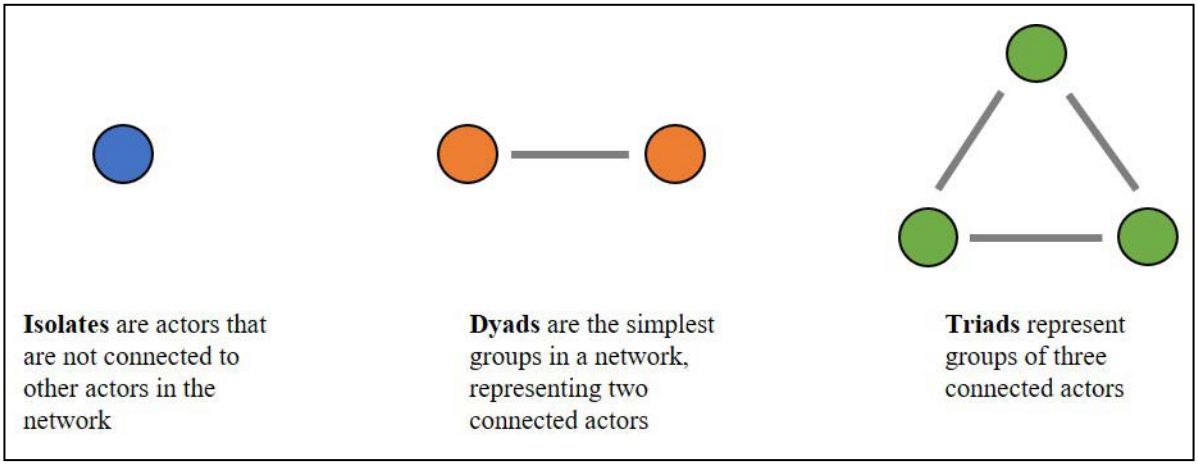

Figure 2-2.–Network building blocks.

to every other actor—to a value of 0—for a sparse network composed entirely of isolates, with no ties among any actors. Similarly, reciprocity and transitivity can be calculated at the level of the entire network, generating a single number that reflects the proportion of mutual ties (reciprocity) or transitive triads (transitivity) in the network. Considering these simple measures of network structure together can describe a lot about the social dynamics underlying the network. For example, a network with low to medium levels of density and high levels of transitivity suggests that the network is composed of clusters of actors who are highly connected with each other but relatively isolated from other actors in the network: a structure that may indicate social dynamics that create sub-groups within the broader community. There are a variety of ways of defining these sub-groups, but the simplest approach is to look at components, the set(s) of actors who are connected by any number of direct or indirect ties in the network. Counting the number of components provides a quick measure of structure within a network, helping to identify sub-groups of actors that are connected to one another in some way, directly or indirectly. Technically, an isolate is its own component as well, but it is often useful to count isolates and components separately. For example, counting both isolates and components preserves distinctions between a network with one large component and a few isolates from another network that has several medium-sized components but no isolates. The social dynamics underlying each of these networks likely differ in important ways. Perhaps the network with a single, large component arises in tightly integrated community where everyone works together, whereas the network with several medium-sized components reflects a community with substantial internal divisions that determine who does and does not work together.

The decision to analyze a social network at the network level or at the actor level depends in part on how the network is defined, how data were collected, and the questions that drive the analysis. In most cases, a network-level analysis is appropriate when the boundaries of the network are clearly defined: the network includes the complete set of actors and ties, and research questions focus on the structure of the network and the processes that shape it. When these conditions are met, an actor-level of analysis is also appropriate, particularly when the questions focus on an actor's position within the network and how actor traits affect tie formation. Actor-level analysis can also be useful when the boundaries of the network are less clearly defined or the data set is missing actors or ties. In those circumstances, a network-level analysis may be limited because key measures often assume a clear boundary and complete sets of actors and ties. For example, a survey documenting food sharing networks between households in a single rural community that includes only one-half of the households in the sample can provide accurate measures of degree centrality at the individual level for households included in the sample, but network-level measures like density will be inaccurate due to missing data for actors and the ties they would have reported if they had been included in the sample.

Project Planning, Approvals, and Staff

This study was a collaboration among the Alaska Department of Fish and Game (ADF&G) divisions of Subsistence and Commercial Fisheries and the Oregon State University (OSU) Department of Anthropology (Table 2-1). A cooperative agreement was signed with OSU (see Appendix A). OSU collaborated with ADF&G to design the survey instrument, analyze the household social network data, and write the final report. ADF&G Division of Subsistence researchers obtained project approval from the tribal councils of each community (Table 2-2). Project approval included endorsement of the field work for this study as well as approval of an alteration of the usual methods used by Division of Commercial Fisheries (DCF) when conducting annual salmon harvest surveys in the study communities, as described below.

Systematic Household Surveys

Quantitative data for this project were collected through two separate household surveys. Salmon harvest data were initially collected by Division of Commercial Fisheries (DCF), and salmon exchange data were later collected by Division of Subsistence. Table 2-3 shows the number of households surveyed in each community by DCF and Division of Subsistence. Salmon harvests by Yukon River communities are estimated annually through a postseason household survey administered by DCF staff (Jallen et al. 2017; Appendix B). Data collected in these postseason surveys include the total number of each species of salmon harvested by a household's fishing group, amounts of salmon retained from the group harvest, types of fishing gear used, location of harvest, and which other households were part of the respondent's fishing group. These data are typically collected using a stratified sample where strata are based on historical household harvest amounts. However, in preparation for this project, DCF staff agreed to attempt a census in each study community so that reported salmon harvest data would be available for the greatest number of households. The 2018 postseason salmon harvest survey achieved a 100% sample in Beaver, a 98% sample in Pilot Station, and a 93% sample in Nulato.[1] Following data collection in fall 2018, DCF shared household-level harvest data with the Division of Subsistence. Later, DCF staff also shared data about salmon fishing groups and household sizes.

Division of Subsistence developed the survey instrument for the network component of this project in coordination with Dr. Drew Gerkey, Co-PI at Oregon State University. The instrument was designed to collect information about household demographics, confirm and supplement harvest survey data collected by DCF, as well as detailed information about salmon sharing, barter, and customary trade exchanges. The survey also included sections that prompted respondents to assess changes to their salmon harvests and sharing of salmon over time. The last page of the survey form gave respondents an opportunity to provide additional comments or observations about local resources, resource management, or general concerns. Division of Subsistence researchers presented a general overview of survey questions at the community

1. A. Padilla, ADF&G Division of Commercial Fisheries, personal communication, November 2018.

Table 2-1.–Project staff.

Task	Name	Organization
Northern Regional Program Manager	Caroline Brown	ADF&G Division of Subsistence
Principal Investigator	Alida Trainor	ADF&G Division of Subsistence
	Drew Gerkey	Oregon State University, Department of Anthropology
Administrative support	Pam Amundson	ADF&G Division of Subsistence
	Tamsen Coursey-Willis	ADF&G Division of Subsistence
	Deanne Lincoln	ADF&G Division of Subsistence
	Stephanie Wilson	ADF&G Division of Subsistence
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Data Analysis	Dave Koster	ADF&G Division of Subsistence
	Drew Gerkey	Oregon State University, Department of Anthropology
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	Helen Cold	ADF&G Division of Subsistence
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	David Kelley	Pilot Station
	Elaine Fancyboy	Pilot Station
	Robyn George	Nulato
	Josephine Mountain	Nulato
	Debbie Kozloff	Beaver
	Gary Pitka	Beaver

Source ADF&G Division of Subsistence, 2020.

Table 2-2.–Community meetings, study communities, 2019 and 2021.

Community	Community approval meeting	Fieldwork	Community data review meeting
Pilot Station	April 19, 2019	May 6–13, 2019	June 1, 2021
Nulato	April 19, 2019	May 9–14, 2019	July 7, 2021
Beaver	May 16, 2019	June 4–6, 2019	July 9, 2021

Source ADF&G Division of Subsistence, 2021.

Table 2-3.–Sample summary, postseason harvest surveys and network surveys, study communities, 2018 and 2019.

Household status	Pilot Station	Nulato	Beaver
Not surveyed	27	11	4
Postseason survey only	32	13	9
Network survey only	12	3	4
Both surveys	78	59	17
Total households	149	86	34

Sources ADF&G Division of Commercial Fisheries postseason harvest surveys, 2018 and ADF&G Division of Subsistence household network surveys, 2019.

approval meetings for review and input. Following community feedback, Subsistence Division and OSU finalized the survey instrument for the three study communities in March 2019. Appendix B includes the survey instrument that was used in Pilot Station.

The household demographics module of the survey followed the standard template used by the Division of Subsistence. The salmon harvest module was modified from the standard template because harvest data had already been collected for the majority of households in each community. When administering this section of the survey, researchers followed two different protocols depending on whether the household had already completed a postseason salmon harvest survey. If the household had been surveyed previously by DCF, researchers reviewed with the respondent the number of each species of salmon that the household had reported. These respondents either verified their harvest data or provided corrections. If a household had not been previously surveyed, respondents were asked to provide harvest information.

Salmon exchange network modules were the central component of the survey instrument. Each module focused on one of three types of salmon exchange: sharing, barter, or customary trade. They were adapted from previous network research conducted by the Division of Subsistence (Brown et al. 2017; Brown and Kostick 2017; Hutchinson-Scarbrough et al. 2020). For each type of exchange, respondents were asked to identify the species of salmon exchanged, the amount, how it was processed, who the other party in the exchange was, and their relationship to the other party. Three survey modules collected information about sharing. The first salmon sharing module only collected information about salmon given to other households within the study community. The second salmon sharing module collected information for salmon both given to and received from households in other communities. The third sharing module focused on salmon given to and received from events. A survey module for barter documented salmon that was either given or received in barter, and the goods or resources received or given in exchange for that salmon. For the customary trade module, respondents provided details about the amounts of salmon they bought or sold, and the amount of cash given or received in exchange for that salmon. The barter and customary trade modules allowed respondents to identify if their exchange partner was located within or outside their community.

Household Network Survey Implementation

Division of Subsistence staff worked with tribal councils and local research assistants in each community to create a list of all households in the community. Households were then assigned numeric identifiers that corresponded to the identifiers previously used on the postseason harvest survey in order to maintain consistency for data analysis. Households were eligible to complete the survey if any household members resided in the community for at least six months in 2018. A census was attempted in each community. If researchers were initially unsuccessful at making contact with an eligible household, they made at least two more attempts to survey the household.

Sample achievement ranged from 62% of households surveyed in Beaver to 79% of households surveyed in Nulato (Table 2-4). Refusal rates of households declining to participate in the survey ranged from 9% in Beaver to 20% in Pilot Station. Household surveys took from a minimum of 4 minutes to a maximum of 61 minutes to complete (Table 2-5). In both Beaver and Pilot Station, surveys averaged 15 minutes. In Nulato, average survey length was 19 minutes.

Pilot Station

ADF&G staff obtained project approval from the Pilot Station Traditional Council on October 16, 2018 (Table 2-2). From May 6–13, 2019, three researchers from ADF&G Division of Subsistence conducted fieldwork in Pilot Station. Training with three LRAs was completed on May 7, 2019. Each researcher worked with an LRA to contact the households and administer the household surveys. During the seven days of fieldwork, 90 of the 134 households completed a survey and 22 households declined to participate (Table 2-4).

Nulato

Staff from ADF&G Division of Subsistence provided the Nulato Tribal Council with project information and received approval on October 16, 2018 (Table 2-2). From May 9–14, 2019, three researchers from ADF&G Division of Subsistence conducted fieldwork in Nulato. Training with two LRAs occurred on May 9, 2019. Researchers each worked with an LRA to contact the households and complete the household surveys. During the five days of fieldwork, 62 of the 79 households completed a survey; seven households declined to participate (Table 2-4).

Beaver

The Beaver Village Council approved the project on May 16, 2019. From June 4–6, 2019, two researchers from ADF&G Division of Subsistence conducted fieldwork in Beaver (Table 2-2). Training with two local research assistants (LRA) took place on June 4, 2019. Each researcher worked with an LRA to contact the households and administer the household surveys. During the three days of fieldwork, 21 of 34 eligible households completed a survey; two households declined to participate (Table 2-4).

Key Respondent Interviews

Researchers worked with tribal governments and LRAs to identify key respondents to interview. They also identified key respondents during survey administration. The goal of key respondent interviews was to increase understanding of the social and cultural values that shape the unique ways in which salmon are harvested and exchanged in each community. To help guide discussions with key respondents, researchers used a semi-structured interview format that included prompts and questions related to overall research goals (Appendix C). Many of these questions were informed from previous research that documented subsistence resource sharing networks in the study communities. In addition to investigating salmon resource sharing networks broadly, the interview protocol addressed themes such as household and individual participation in salmon harvesting and processing, observed changes in sharing, and local and nonlocal sharing.

Researchers conducted a total of 15 interviews involving 21 study community members: ten interviews were completed in Nulato, seven in Pilot Station, and four in Beaver. Key respondents were all long-time community residents and experienced subsistence salmon fishers. They represented different age and gender groups.

Table 2-4.–Estimated households and sample achievement, networks surveys, study communities, 2018–2019.

Sample information	Community		
	Pilot Station	Nulato	Beaver
Number of dwelling units	138	91	34
Survey goal	100%	100%	100%
Households surveyed	90	62	21
Households failed to be contacted	22	10	11
Households declined to be surveyed	22	7	2
Households moved or occupied by nonresident	12	12	0
Total households attempted to be surveyed	134	79	34
Refusal rate	19.6%	10.1%	8.7%
Final estimate of permanent households	134	79	34
Percentage of total households surveyed	67.2%	78.5%	61.8%
Survey weighting factor	1.49	1.27	1.62
Sampled population	429	175	54
Estimated population	638.7	223.0	87.4

Source ADF&G Division of Subsistence household surveys, 2019.

Table 2-5.–Survey and interview lengths, study communities, year.

Community	Survey length (minutes)			Interview length (minutes)		
	Average	Minimum	Maximum	Average	Minimum	Maximum
Pilot Station	15	4	52	40	22	72
Nulato	19	5	61	42	17	94
Beaver	15	7	32	41	24	64

Source ADF&G Division of Subsistence household surveys, 2019.

Prior to beginning the interview, researchers gave an overview of the topics of interest and asked each respondent to provide informed consent. All interviews were audio recorded with the permission of the respondent. Key respondents were informed that, to maintain anonymity, their names would not be included in this report. Researchers also took notes during the interviews to provide additional context for this report. Key respondents received a stipend to compensate them for their time and for sharing their knowledge. A copy of the audio recording and a printed transcript of the interview were sent to each individual respondent.

Data Analysis and Review

Survey Data Entry

Surveys were coded for data entry by research staff and reviewed by the project leads in each community for consistency. Responses were coded following standardized conventions used by the Division of Subsistence to facilitate data entry. Information Management staff within the Division of Subsistence set up database structures within Microsoft SQL Server[2] at ADF&G in Anchorage to hold the survey data. The database structures included rules, constraints, and referential integrity to ensure that data were entered completely

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

and accurately. Data entry screens were available on a secured internal network. Daily incremental backups of the database occurred, and transaction logs were backed up hourly. Full backups of the database occurred twice weekly. This ensured that no more than one hour of data entry would be lost in the unlikely event of a catastrophic failure. All survey data were entered twice, and each set compared in order to minimize data entry errors.

Once data were entered and confirmed, information was processed with the use of Statistical Package for the Social Sciences (SPSS) software, version 21. Initial processing included the performance of standardized logic checks of the data. Logic checks are often needed in complex data sets where rules, constraints, and referential integrity do not capture all of the possible inconsistencies that may appear. ADF&G staff also used SPSS for analyzing the survey information. Analyses included review of raw data frequencies, cross tabulations, table generation, estimation of population parameters, and calculation of confidence intervals for the estimates. Missing information was dealt with on a case-by-case basis according to standardized practices, such as minimal value substitution or using an averaged response for similarly-characterized households. Typically, missing data are an uncommon, randomly-occurring phenomenon in household surveys conducted by the Division.

Salmon Harvest and Use

In order to develop the best possible community-level estimates, all available household harvest data was used. This included all harvest information collected by DCF, whether Division of Subsistence contacted the same household or not, as well as any harvest information collected by only the Division of Subsistence. Because the Division of Subsistence survey was an attempted census in each community, standard community harvest estimation procedures assuming a simple random sample were followed. This resulted in separate community estimates from DCF. Additionally, numbers of fish were converted in to pounds usable weight using standard factors (see Appendix D, Table D2-1 for conversion factors).

Harvest estimates and responses to all questions were calculated based upon the application of weighted means (Cochran 1977). These calculations are standard methods for extrapolating sampled data. As an example, the formula for harvest expansion is:

$$H_i = \bar{h}_i S_i \tag{1}$$

$$\bar{h}_i = \frac{h_i}{n_i} \tag{2}$$

where:

H_i = the total estimated harvest (numbers of resource or pounds) for the community *i*,

$\bar{h}_i$ = the mean harvest of returned surveys,

h_i = the total harvest reported in returned surveys,

n_i = the number of returned surveys, and

S_i = the number of households in a community.

As an interim step, the standard deviation (SD) (or variance [V], which is the SD squared) was also calculated with the raw, unexpanded data. The standard error (SE), or SD of the mean, was also calculated for each community. This was used to estimate the relative precision of the mean, or the likelihood that an unknown value would fall within a certain distance from the mean. In this study, the relative precision of the mean is shown in the tables as a confidence limit (CL), expressed as a percentage. Once SE was calculated, the CL was determined by multiplying the SE by a constant that reflected the level of significance desired, based on a normal distribution. The value of the constant is derived from student's *t* distribution and varies slightly depending upon the size of the community. Though there are numerous ways to express the formula below, it contains the components of a SD, V, and SE:

$$C.L.\%(\pm) = \frac{t_{a/2} \times \frac{s}{\sqrt{n}} \times \sqrt{\frac{N-n}{N-1}}}{\bar{x}} \quad (3)$$

where:

s = sample standard deviation,

n = sample size,

N = population size,

$t_{a/2}$ = student's t statistic for alpha level (α=.95) with n–1 degrees of freedom, and

$\bar{x}$ = sample mean.

Small CL percentages indicate that an estimate is likely to be very close to the actual mean of the sample. Larger percentages mean that estimates could be further from the mean of the sample. As expected, the estimated number of salmon harvested by each study community differed between Division of Subsistence and Division of Commercial Fisheries (tables D2-2, D2-3, and D2-4). The differences in total salmon harvest estimates were 63 (+13.2%), 263 (+9.2%), and -1,544 (-24.6%), for Beaver, Nulato, and Pilot Station respectively, not including Sockeye salmon. These differences are due to variations in sampling, and it is beyond the scope of this study to examine more detailed reasons for these differences.

Standard Division harvest survey protocol includes five questions regarding harvest and use:

- Did you use the resource?
- Did you harvest the resource?
- Did you try to harvest the resource?
- Did you give any away?
- Did you receive any from another household?

Because this survey focused on salmon sharing and validating previously collected information, responses to these questions could largely be derived from other questions. The percentage of households harvesting comes from households reporting harvest amounts. Households attempting to harvest could not be entirely derived from other questions and is a minimum amount that does not include households unsuccessfully trying to harvest. Although the percentage of households unsuccessfully attempting harvest is unknown, in subsistence salmon fisheries, the number of unsuccessful fishers is seldom greater than 10% of respondents.[3] Percentages for households receiving and giving were derived from the networking questions regarding who they received from or who they gave to, respectively. The households using percentage was calculated by applying the standard Division assumption that any household receiving or harvesting a resource has engaged in a subsistence use. Households receiving salmon and giving it away without retaining any for consumption are also included in this calculation.

To compute per capita harvests, DCF information on the number of household members was supplied alongside harvest reports for households not surveyed by Subsistence staff.

The corrected final data from the household survey will be added to the Division of Subsistence Community Subsistence Information System. This publicly-accessible database includes community-level study findings.

3. Alaska Department of Fish and Game (ADF&G) Division of Subsistence, Juneau. "Community Subsistence Information System: CSIS." https://www.adfg.alaska.gov/sb/CSIS

Population Estimates and Other Demographic Information

As noted above, a goal of the research was to collect demographic information for all permanent households in the study communities. For this study, "year-round" was defined as being domiciled in the community when the surveys took place and for at least three months during the study year 2018. Because not all households were interviewed, population estimates for the community were calculated by multiplying the average household size of interviewed households by the total number of year-round households, as identified by Division of Subsistence researchers in consultation with community officials and other knowledgeable respondents.

There may be several reasons for the differences among the population estimates generated from the Division's surveys and other demographic data developed by the 2010 federal census, the U.S. Census Bureau's American Community Survey,[4] and the Alaska Department of Labor and Workforce Development.[5] Sampling of households, the timing of surveys, or eligibility criteria for inclusion in the survey may explain differences in the population estimates.

Key Respondent Interviews

Key respondent interviews were audio transcribed verbatim using Olympus DSS Transcription software and Microsoft Word. Transcripts were then imported into ATLAS.ti, version 8, for coding. The interview data were analyzed using a mix of inductive and deductive coding to identify all prominent themes linked to wild food sharing traditions and networks. These qualitative data were integrated into the report by using direct key respondent quotes whenever possible.

Social Network Analysis

Division of Subsistence research staff restructured data from the survey network modules using SPSS into formats necessary for SNA. Ultimately, two files were created: a wide nodes file containing attribute data for each actor in the network and a long ties file containing information about each fishing relationship or salmon exchange. Then, Dr. Gerkey at OSU conducted social network analysis using the open-source software program R[6] and the companion program RStudio[7] along with a variety of companion packages, including statnet[8], igraph[9], tidyr[10], ggplot2 (Wickham 2016), and stargazer[11].

The final network dataset contained a variety of node and tie types and required different analysis techniques to be used for each. The data contained four different types of nodes: households within the

4. U.S. Census Bureau, Washington, D.C., n.d. "Explore Census Data." Accessed December 3, 2019. https://data.census.gov/cedsci/
5. Alaska Department of Labor and Workforce Development (ADLWD), Research and Analysis Section, Juneau, n.d. "Population of Alaska by economic region, borough and census area, 2010–2013." Accessed December 3, 2019. http://laborstats.alaska.gov/pop/
6. R Core Team, 2018. "R: A Language and Environment for Statistical Computing (3.4.3)." Vienna, Austria: R Foundation for Statistical Computing. Accessed May 13, 2021. https://www.R-project.org/
7. RStudio Team. "RStudio: Integrated Development for R (1.1.419)." Boston, MA: RStudio Inc., 2016. Accessed May 13, 2021. http://www.rstudio.com/
8. Handcock, Mark S., David R. Hunter, Carter T. Butts, Steven M. Goodreau, and Martina Morris, 2003. "statnet: Software tools for the Statistical Modeling of Network Data (2016.9)." Seattle, WA: University of Washington. http://statnet.org/
9. Csardi G, Nepusz T, 2006. "The igraph software package for complex network research." InterJournal, Complex Systems, 1695. Accessed May 13, 2021. https://igraph.org
10. Wickham, Hadley and Lionel Henry, 2018. "tidyr: Easily Tidy Data with 'spread()' and 'gather()' Functions (R package version 0.8.2)." https://cran.r-project.org/web/packages/tidyr/index.html
11. Hlavac, Marek, 2018. "stargazer: Well-Formatted Regression and Summary Statistics Tables (R package version 5.2.2)." Bratislava, Slovakia: Central European Labour Studies Institute (CELSI). Accessed May 13, 2021. https://CRAN.R-project.org/package=stargazer

study communities, households in other communities, events, and the ADF&G test fishery in Pilot Station. It also contained four different types of ties: cooperative production, sharing, barter, and customary trade.

Cooperative production ties were recorded using data from Division of Commercial Fisheries that indicated which households worked together to harvest and process salmon in 2018. These ties are represented in the analysis as undirected relationships, rather than directed flows of resources. Because each household was asked to list other households they worked with, there were instances where ties reported by one household did not match those reported by another. For example, household A reported fishing with household B, but household B either did not report fishing with household A or household B was not surveyed. In these cases, the analysis assumes that a tie existed between A and B even if only one of the actors reported it.[12] DCF did not collect information about cooperative production relationships beyond which households fished together.

Salmon exchange ties—including sharing, barter, and customary trade—were represented as directed flows of resources from one actor to another. Each type of salmon exchanged between two actors was recorded on the survey, including how it was processed. Conversion factors were applied in a similar manner as they were for harvest data to convert all reported units into pounds and more easily examine the amounts that were exchanged (Table D2-1). In sharing exchanges, partners commonly exchanged more than one type of salmon as part of the same transaction. Because of this, the total number of ties in the network was tallied in two ways. First, a sum of "all ties" was calculated to account for each individual type of salmon that respondents reported exchanging. For example, if household A gave household B one frozen fillet of Chinook salmon and one pint of smoked Chinook salmon strips, this exchange was counted as two separate ties because two types of salmon were exchanged. Second, ties were summarized by focusing on the relationship between nodes, regardless of the number of items they exchanged in a transaction. In the example above, the two ties were collapsed into one "unique tie" that represents a single directed sharing relationship. Because of the directional nature of sharing, if household B gave household A five whole fall chum salmon, this exchange would constitute an additional unique tie between these two households, with the roles of giver and receiver reversed. In practice, for barter and customary trade exchanges, a resource flows in each direction. For example, household A gives household B some salmon and household B gives household A some caribou in return. Although two items were exchanged back and forth, this barter exchange represents one tie between the households.

Using different combinations of actor and tie types, we generated several different networks for each community. Each network includes different combinations of node and tie types that enable analysis of different aspects of subsistence salmon networks. First, we generated a network containing all ties occurring within and outside each study community among all node types. This network includes all cooperative production, sharing, barter, and customary trade data collected for this project, and is used to illustrate the full complexity of subsistence salmon networks in each study community. Second, we generated a network containing all ties occurring within a study community, excluding ties connecting households within the community to partners outside it. This network represents a complete record of subsistence salmon networks within each study community. Third, we generated a network containing all ties occurring within a study community but excluding ties from events and the Pilot Station test fishery. This network is used to analyze household-level demographic and economic characteristics associated with subsistence salmon networks. Fourth, we generated a network containing all ties occurring with partners located outside a study community. This network enables comparisons of salmon sharing, barter, and customary trade within and outside study communities.

For this study, analyses were completed for each study community at both the network and actor levels, using each of the networks described above. At the network level, we provided descriptive statistics for the actors and ties that compose the network. Specifically, we reported the total number of households in each community, along with the number of active, or connected, households with at least one tie in the network.

12. In Pilot Station, 19 cooperative production ties were only reported in one direction. In Nulato there were 50 and in Beaver there were 4.

We reported both the number of dyads with at least one cooperation or salmon exchange tie ("unique ties"), and the total number of ties across all dyads, which includes multiple exchanges or exchanges of different types of salmon between partners. Finally, we reported the total pounds of salmon exchanged, estimated using the procedures describe earlier in this chapter. Additionally, we included several standard descriptive statistics that reflect different aspects of network structure: density, number of components and isolates, reciprocity, and transitivity.[13] At the actor level, we used degree centrality to measure an actor's position within the network and report the amounts of salmon exchanged in pounds, using estimation procedures described earlier in the chapter.

Our analysis reports average degree centrality and average amount exchanged, calculated by several household characteristics that previous research suggests are associated with subsistence harvests and social networks: 1) household type, 2) household maturity, 3) harvest level, and 4) whether or not the household was a commercial fishing household. Many of these characteristics are also included in our network visualizations. "Household type" represented whether or not the household head(s) were a couple or single male or female. "Household maturity" represented the age range of the heads of household. Developing households included those with household head(s) less than 40 years old, mature head(s) of household were between 40 to 59 years old, and elder head(s) of household were ages 60 and greater. Household harvest categories were calculated using the mean household harvest in each community and included no harvest, low-to-average harvest, above-average harvest, and high harvest categories. The upper limit of the above-average harvest category was one standard deviation (SD) over the mean. The high harvest category was any harvest greater than one SD over the mean. Together, network visualizations and descriptive statistics for degree centrality and amount exchanged can help us start to identify possible associations between household characteristics and salmon exchange networks.

Although visual and descriptive analysis may suggest associations between household characteristics, network position, and network structure, it can be difficult to determine whether these associations stand out as reliable signals of the social dynamics that shape subsistence salmon networks. One way to accomplish this is to use inferential statistical models designed to estimate associations between household characteristics and network structure. In this section, we introduce one prominent method, exponential random graph models or "ERGM" (Goodreau et al. 2009; Harris 2014; Krivitsky et al. 2020), that can be used to estimate the size, direction (positive, negative, neutral), and statistical significance (p-value) of associations between household characteristics and network structure.

An ERGM takes an actual network as a starting point then simulates thousands of networks that share basic structural features with the actual network. Although the number of ties, number of actors, and actor characteristics are identical between the actual and simulated networks, the ties among actors vary randomly across simulated networks. By aggregating the patterns in actor position and network structure in simulated networks and comparing them with the actual network, an ERGM can generate estimates of the size, direction, and statistical significance of associations between actor characteristics and network structure. In other words, an ERGM can help identify patterns in the actual network that are unlikely to occur in simulated random networks, indicating the presence of social dynamics that shape network structure. Practically speaking, an ERGM is constructed by using previous research and theory to identify characteristics that are thought to shape the actual network, then using the results to assess these expectations. By examining the direction, size, and statistical significance of actor characteristics and other model terms in relation to expectations from previous research and theory, researchers can use an ERGM to gain insight about factors underlying the formation of ties within the network. By comparing multiple models with different combinations of model terms, researchers can identify which combinations of factors capture structural features of the observed network. Although no single ERGM is likely to capture all the social dynamics that generate the actual network, building and assessing models using different combinations of variables can often lead to useful insights about these social dynamics and guide additional research.

13. Although our salmon exchange networks include both undirected ties (cooperative production, barter, customary trade) and directed ties (sharing), we report measures of density and transitivity measures that treat all networks as undirected to facilitate comparisons across networks.

ERGM relies on a few core assumptions. First, an ERGM provides more accurate results when data on the actual network used to generate the model are near complete. For example, our analysis of cooperative production focused on connections between households within each study community, so an ERGM using these data will generate more accurate results when we have complete data on all the households in the community and all the cooperative production ties that connect them. Of course, the challenges of survey research often make it difficult or impossible to collect fully complete data, so in practice researchers may use an ERGM with a sample representing as little as 60–70% of the total population, similar to the samples in this project. The results of models based on less than a 100% sample might differ from results that used a complete sample, and our ability to understand these differences is limited, so caution should be exercised when interpreting the results. Second, a standard ERGM estimates the presence or absence of a tie between two actors. This approach works well for some social relationships and less well for others. For example, it works well for understanding whether or not two households share salmon with one another, but not how much salmon is shared. Recently, programmers have developed extensions of ERGM (Krivitsky 2012; 2013) that enable estimates of the value of a tie between two actors (e.g., amount of salmon given), but these models are currently more difficult to estimate and still relatively under-studied compared to a standard ERGM.

Our research uses ERGM to analyze two social networks associated with subsistence salmon harvests: 1) cooperative production and 2) sharing salmon. Although households in our study communities had ties to others outside of the community for salmon production and sharing, for the purposes of the ERGM analysis we have limited these networks to focus on households within a study community and the connections among them. In other words, these networks within the community have a clear boundary that allows us to identify all the households within the boundary and assess the completeness of our sample. Assessing network completeness is not possible for networks that include partners located outside a study community. Networks with partners outside the community include many households that are not included in our survey sample, and therefore we cannot assess how many additional sharing ties and partners are missing from our sample, limiting the accuracy of the model results.

Our analysis uses a standard ERGM that predicts the presence or absence of a cooperative production or sharing tie between two households. For cooperative production networks, a standard ERGM works well, because we only have data on whether or not two households worked together to harvest salmon, and it is unclear how much more we would learn from data on the amount of time households spent working together. However, for salmon sharing networks, we do have data on the amounts of salmon exchanged between households, and these data reflect an important aspect of salmon sharing networks that is not fully reflected in a standard ERGM that examines whether or not two households exchange salmon. Despite the importance of understanding amounts of salmon exchanged, we have chosen not to use extensions of the ERGM approach that can model these amounts due to fact that these models are still relatively under-studied and more challenging to estimate. Doing so is an important goal for future research.

Study Limitations

Although this project builds on decades of experience within the Alaska Department of Fish and Game in collecting and analyzing data on subsistence harvests and social networks, there are some important limitations to highlight.

First, in an effort to minimize the burden placed on individuals and communities participating in the project, we designed our survey to incorporate existing data on subsistence salmon harvests and cooperative production relationships among households from the Division of Commercial Fisheries (DCF). In some cases, the roster of households and estimated harvest amounts differed between DCF data and the data collected for this project. Participants in this project were given the opportunity to correct harvest amounts from DCF data in our survey. However, considering the time between the DCF postseason harvest survey and this project and the different methodologies used, it is difficult to say definitively which estimates are more accurate. Similarly, this project used DCF data to define cooperative production ties, but limited information about how fishing groups were defined by DCF impeded our ability to describe and analyze these relationships in detail. For example, some cooperative production relationships involve households

that work together to harvest and process salmon as equal partners, but in other cooperative production groups household contributions may be less equal. Additionally, households could be a part of the same group but have different roles, such as one household primarily fishing and the other leading processing efforts. Incorporating survey questions designed to document the different ways households engage in cooperative production onto the existing DCF survey would enhance the ability to integrate these different kinds of relationships in the analysis of subsistence networks. The ethnographic methods used in this study allowed researchers to learn more about participation in cooperative production.

Second, there were several challenges this project faced in designing social network modules to collect data on practices related to sharing salmon. For sharing networks between households within a study community, the survey only documented salmon given by each participant. If a complete census of households in the community is achieved, then all salmon given and received would be documented using this method. This method avoids the well-known problem of "double-counting" in studies of social networks, where two accounts of the same tie are recorded, one from each actor involved in the tie. When these two accounts differ, researchers are faced with a difficult decision about which account to prioritize when constructing and analyzing the network. By asking only about salmon given to other households, our survey prioritizes the account of the "giver." However, when households are missing from the sample, sharing exchanges that were received from a household not included in the sample will not be documented. Considering the number of households that were not surveyed in each study community, this suggests that some sharing ties in each community may be missing from our dataset. Another challenge arose when documenting the role of community events in circulating salmon throughout the community. Households frequently contribute salmon to and receive salmon from community events, including holiday celebrations, potlaches, and memorial services. When collecting this data, it was difficult in many cases to determine whether an event mentioned by one household was the same event mentioned by another household. Unless the details provided by each household clearly indicated a singular event, all sharing ties associated with events are treated separately in our analysis. As a result, the number of events is likely over-estimated in our network visualizations, and the connections created between households who gave to or received from the same event are likely under-estimated. Future research on the role of events in sharing networks could address this issue by collecting additional data on each event, such as the date, location, purpose, and list of participants.

A third limitation had to do with local understandings of exchange, one of the theoretical underpinnings of this research. Compared to previous ADF&G projects that focused primarily on barter and customary trade, this project documented fewer instances of these forms of exchange. It is possible that the choice to collect data on sharing along with barter and customary trade led to conceptual overlaps among different types of exchange and confusion between researchers and survey participants. As data from the qualitative, key respondent interviews from this project suggest, the distinctions between sharing and barter that exist in scholarly research and formal regulations may not align neatly with local understandings and practices. For example, if household A gives salmon to household B, and several months later, household B gives moose to household A, is this an example of barter or sharing? This question probably depends on the extent the initial exchange of salmon involved an explicit agreement or obligation to reciprocate with moose or some other resource, which would be typical of barter. However, such agreements and obligations are often implicit and, in many cases, may not be accounted for and enforced, which is more typical in sharing. Many of these exchanges feature a complex, nuanced set of explicit and implicit agreements that reflect the unique relationship among each actor involved, making it difficult for any single survey question to capture the full context. This project sought to address this challenge by using separate questions to document different types of exchange and using key respondent interviews to better understand the norms and values that guide different types of exchange. Future research could build on this approach by revising survey questions to better align with local perspectives and practices.

Fourth, as in many studies involving survey research, this project was limited by problems of missing data. This problem is especially important for the social network analysis components of the project, where many key measures of network structure and methods for analyzing it assume a complete set of actors and social relationships. This is particularly true for exponential random graph models (ERGMs), which require complete data on all nodes and ties in the network, as well as complete data on any node

and tie attributes used to construct the models. Compared to previous projects by ADF&G and published studies of subsistence networks throughout the Arctic, the samples in this study are fairly typical in terms of completeness. However, it is difficult to estimate how the networks reported in this project would change had a full sample been achieved. Future studies should continue to strive for a complete census, and when this not possible, perhaps more advanced estimation techniques for missing data in social networks can be applied to analysis.

Finally, one goal of this project was to compare subsistence salmon networks collected previously by ADF&G with networks collected for this project to understand how declines in salmon abundance and harvests affect salmon exchange networks. However, differences in the methodology used to collect network data in each project limited the ability to make these comparisons. The previous projects documented salmon exchange networks by asking two questions: 1) "Who caught the salmon your household used last year?" and 2) "Who processed the salmon your household used last year?"[14] These questions were intended to document sharing relationships, but may also be understood to refer to cooperative production, depending on the nature of the relationship between households and how the survey participant understood the question. To facilitate a limited comparison between the networks from both projects, we assume that the ties reported in the previous project are simply "salmon connections" and compare these with the combined networks documented in this project. In other words, we compare in a generalized way how households were connected by salmon regardless of the specific connection, such as production, sharing, or trade. However, a standard social network module used for all ADF&G projects would enhance the ability to make comparisons like these.

Community Review Meetings

Unfortunately, due to COVID-19 concerns, ADF&G Subsistence staff was unable to travel in person to present preliminary results and study findings. Instead, a remote review process was implemented. Tribal councils received summary draft results, a list of pertinent questions from lead authors, and a draft copy of the report to review. These documents were sent out in August 2021 and feedback from the tribal councils was incorporated into this report.

14. In the previous Pilot Station study, an additional question "Who else gave salmon to your household?" was also asked (Ikuta et al. 2016).

3. PILOT STATION

Jeff Park

This chapter presents the results of a two-phase research effort approved by the Pilot Station Traditional Council (see Methods chapter for additional details). During the first phase, as described in Chapter 2: Methods, Division of Commercial Fisheries (DCF) administered household salmon-harvest surveys. Each fall after salmon fishing has ended, DCF staff conduct surveys in all Yukon River communities to collect household salmon harvest data that are used to estimate community salmon harvests. Typically, DCF uses a stratified sample for the postseason harvest survey, but in preparation for this study they agreed to expand their sample to a census so that harvest data would be collected for as many households as possible prior to the second research phase. In October 2018, DCF staff surveyed 116 households in Pilot Station (87%) about their salmon harvests (Table 3-1).

During the second phase of research in May 2019, three Division of Subsistence staff and three local research assistants (LRAs) administered an additional survey that verified each household's previously reported salmon harvests and explored the ways in which harvested salmon were shared and distributed within and outside of the community in the months following the fishing season. Ninety households (67%) participated in the salmon exchange survey (Table 3-2). The average salmon exchange survey length was 15 minutes (Table 3-3). Thirty-two households only participated in the harvest survey, six only participated in the salmon exchange survey, and 12 households did not participate in either survey (Table 3-1).

Division of Subsistence staff also worked with LRAs and the traditional council to identify key respondents to participate in recorded ethnographic interviews. Five interviews were completed with seven longtime Pilot Station residents, all of whom were experienced and knowledgeable salmon fishers. The average interview length was 48 minutes. Through these interviews, respondents shared local and traditional knowledge about the nature of salmon fishing and the cultural practices around the distribution of wild foods in the community that could not have been obtained from the surveys alone.

Community Background

Pilot Station is a Central Yup'ik community on the lower Yukon River within the Yukon Delta National Wildlife Refuge (Figure 1-1). The community is located approximately 122 miles from the mouth of the Yukon River and approximately 430 air miles west of Anchorage.[1] No roads connect Pilot Station to other communities; access to the community is by airplane, boat, or snowmachine. Barges deliver supplies, gasoline, and diesel fuel via the Yukon River during the ice-free summer months from June to October.[2]

The community has been known by different names, including Anvychagmiut and Potiliuk, and has existed historically at different sites in the vicinity of the current location (Runfola et al. 2018). Renamed in 1916, the name Pilot Station refers to the location's function as a checkpoint for riverboats traveling the Yukon River in the early 20th century. The community sits among rolling hills and tundra valleys at the southern extreme of the Nulato Hills and is surrounded by a variety of landscapes, including coastal tundra flats, wetlands, and boreal forest. This location provides good access to a wide variety of subsistence resources that the residents rely on. These resources include terrestrial mammals such as moose, a variety of salmon and nonsalmon fish, waterfowl, and sea mammals such as seals and beluga whales. Kurgpallermuit, a former village site one-third of a mile downriver from the current community location, is a designated historic site because of its involvement in the Bow and Arrow Wars (Runfola et al. 2018). The coastal Cup'ik and Yukon River Yup'ik peoples fought these wars over several generations prior to the mid-19th

1. Google Earth V version. "Pilot Station, AK." 61°54'42.40" N and 157°44'38.88" W. Image IBCAO, Data SIO, NOAA, U.S. Navy, NGA, GEBCO. 2020. Accessed January 12, 2021.
2. Alaska Department of Commerce, Community, and Economic Development (ADCCED) Division of Community and Regional Affairs, Juneau. n.d. "Welcome to DCRA Open Data: Pilot Station." Accessed January 12, 2021. https://dcra-cdo-dcced.opendata.arcgis.com/

Table 3-1.–Sample comparison, ADF&G Division of Commercial Fisheries and ADF&G Division of Subsistence, Pilot Station, 2018 and 2019.

	Number
Total households in community[a]	134
Total sampled households	122
Households sampled in postseason harvest survey	116
Households sampled in network survey	90
Households sampled only in postseason harvest survey	32
Unsampled households	12

Sources ADF&G Division of Commercial Fisheries postseason harvest surveys, 2018, and ADF&G Division of Subsistence household surveys, 2019.

a. Total number of households identified by Division of Commercial Fisheries postseason survey. This number may differ from the Division of Subsistence total households.

Table 3-2.–Sample achievement, ADF&G Division of Subsistence, Pilot Station, 2019.

	Community
Sample information	Pilot Station
Number of dwelling units	138
Survey goal	100%
Households surveyed	90
Households failed to be contacted	22
Households declined to be surveyed	22
Households moved or occupied by nonresident	12
Total households attempted to be surveyed	134
Refusal rate	19.6%
Final estimate of permanent households	134
Percentage of total households survyed	67.2%
Survey weighting factor	1.49
Sampled population	429
Estimated population	638.7

Source ADF&G Division of Subsistence household surveys, 2019.

Table 3-3.–Survey and interview length, Pilot Station, 2019.

	Length (minutes)		
Community	Average	Minimum	Maximum
Interviews	40	22	72
Surveys	15	4	52

Source ADF&G Division of Subsistence household surveys, 2019.

century. Local oral history indicates that these conflicts would occur when coastal people traveled inland via the Kashunak River.

Pilot Station is incorporated as a second-class city, and the Pilot Station Traditional Village is a federally recognized tribe. The community has a kindergarten through grade 12 school represented by the Pilot Station King Salmon mascot. Pilot Station also has a health clinic operated by the Yukon-Kuskokwim Health Corporation, a public safety facility, a volunteer fire department, a post office, a community hall, and two grocery stores (Ikuta et al. 2016). A diesel power plant generates electricity for the community, and a water treatment facility provides potable water. The Alaska Department of Transportation completed construction of a new 4,000-foot runway in 2016.

History of Local Salmon Fishery

Salmon account for a large portion of Pilot Station's wild food harvest. An ADF&G Division of Subsistence comprehensive subsistence harvest survey conducted in 2013 showed that summer chum, Chinook, and fall chum salmon made up over one quarter of the community's subsistence harvest (Ikuta et al. 2016). Also in 2013, Pilot Station fishers harvested 26,882 pounds of salmon, second only to large land mammals in edible pounds (38,209 lb). Salmon fishing typically starts in Pilot Station when the Chinook salmon begin to pass by the community in mid-June (05112019PQS2). The summer chum salmon run begins soon after this, and the two species continue to run concurrently for several weeks. Some families travel to nearby fish camps at this time to harvest and preserve their salmon, often with the cooperation of several other families. A key respondent explained why fishing for salmon early in the season is critical:

> That's the only time, before the house flies come around. That's when we try to cut fish. But the month of July, mid part of July, that's when it starts raining and once in a while it rains so much that the fish that we catch and those people catch start rotting…So we try to have our fish done just about mid part of June. (05112019PQS2)

The deep, slow-moving water of the lower Yukon River makes drifting with gillnets the best option for most Pilot Station salmon fishers (Ikuta et al. 2016).

In 2013, summer chum salmon accounted for 75% of the salmon harvest and fall chum salmon accounted for 13% (Ikuta et al. 2016). Chinook salmon made up 7% of the harvest, and coho salmon contributed 2%. Poor returns and fishing restrictions for most years over the last two decades have caused Chinook salmon harvests to decrease. Summer chum salmon accounts for the large majority of salmon harvested; however, Chinook salmon are also an important resource and are highly prized. One key respondent described their preferences:

> The chum salmon to the Natives is a comfort food. It's, the Yukon salmon is one of the richest statewide. The chum salmon, the Natives prefer the chum salmon over the king [Chinook] salmon, in excess, okay. The king salmon is a delicacy food, but the chum salmon is comfort food.[3] (05072019PQS1)

Another respondent explained that they mainly eat summer chum salmon because the Chinook salmon is too rich for their tastes: "We usually cut mainly chums. But very few kings. 'Cause they're too rich. Too rich for me now…Yeah, we usually get like maybe 15, 25 kings and 200 chums" (05112019PQS2).

Pilot Station residents preserve salmon by a variety of methods including air drying and smoking, jarring, freezing, and salting. A key respondent specified that he likes to preserve his Chinook salmon by salting because of its high fat content: "Yeah, salt fish. That's what we mainly put away kings. Because even though they are rich…they're not rich as when we first catch them and put them away, you know, that salt picks up that fat" (05112019PQS2).

3. In contrast to residents of other Yukon River regions, many lower Yukon River residents prefer chum salmon to Chinook salmon. In the upper Yukon River, Chinook salmon have a lower oil content, and chum salmon are not available (Brown et al. 2015b).

Many Pilot Station households participate in the summer chum salmon commercial fishery. Commercial fishing provides income to acquire and maintain fishing equipment, and some families with commercial fishing permits give salmon from their catch to families who are unable to fish: "There's like 54 families[4] in Pilot Station who have commercial fishing permits. They're the ones who have the boats, the means, and the gear to go out and fish. And people know who, families that don't participate or don't have the commercial fishing gear" (05072019PQS1).

The Alaska Department of Fish and Game (ADF&G) maintains a sonar site near Pilot Station annually from June 1 to September 7 to estimate Yukon River salmon passage.[5] These estimates aid managers in making decisions about subsistence and commercial fishing opportunities during the season. 'ADF&G also operates a drift gillnet test fishery in conjunction with this sonar project. The test fishery crew conducts 18 gillnet drifts per day in specific locations using a variety of gillnet mesh sizes. Fish caught in the test fishery provide an index of abundance for each salmon species. This allows researchers to better estimate the proportion of each salmon species passing through the sonar counting station. The test fishery crew delivers the fish they catch to the beach at Pilot Station to make them available to community members. Many residents utilize the fish provided by the test fishery, particularly early in the fishing season before most households have harvested their salmon for the year. A key respondent explained that some households are able to meet their salmon needs with salmon caught in the test fishery: "Some of those, their fish racks are full before some of us start doing subsistence because they start already early and they start picking it up. They're down there already in line." (05112019PQS2).

ADF&G has conducted annual postseason subsistence salmon harvest surveys in Pilot Station since 1990 (Figure 3-1). Total salmon harvests have decreased over this period, from 14,393 salmon in 1990 to fewer than 8,000 salmon each year since 2012. Chinook salmon harvest has decreased even more drastically over this time from a high harvest of 3,786 Chinook salmon in 1990 to a low of only 163 in 2014 due to fishing and gillnet mesh-size restrictions intended to conserve Chinook salmon. However, Chinook salmon harvests have gradually increased since 2014, though they are still much lower than historical averages. One key respondent said that many fishers in the community have appreciated the opportunity to harvest more Chinook salmon in recent years: "In the last several years our community has been meeting our king salmon needs and our salmon needs. We, you know, we're happy with that" (05072019PQS1). Pilot Station's summer chum salmon harvest has fluctuated between approximately 4,000 to 6,000 fish from year to year since 1990 but has not changed significantly over this period. The number of Pilot Station households harvesting salmon increased from the late 1990s through the mid-2000s, possibly in correlation with the community's population increase throughout this period.[6] However, the number of households harvesting Chinook and summer chum salmon has decreased steadily since the mid-2000s.

Population Estimates and Demographic Information

The Division of Subsistence gathers demographic data to understand household maturity and to understand how factors such as, age, marital status, and number of household members impacts the use and harvest rates of wild foods. An estimated 639 Pilot Station residents lived in 134 households in 2018. (Table 3-4; Figure 3-2). This estimate indicates a population increase of seventy-one people since the last U.S. Census counted 568 people living in 121 households in 2010. This trend is also consistent with the American Community Survey (ACS) 2014 through 2018 average population estimate of 576 individuals living in 122 households. The Native Alaskan population was estimated to be 612 individuals (96%) in 2018.

4. Sixty-two Pilot Station residents held Alaska Commercial Fisheries Entry Commission (CFEC) permits in 2018. https://www.cfec.state.ak.us/plook/#downloads
5. ADF&G, n.d. "Yukon (Pilot) River." Accessed January 12, 2021. https://www.adfg.alaska.gov/index.cfm?adfg=sonar.sites
6. C.L. Brown, A. Trainor, B.M. McDavid, J.S. Magdanz, and G. Rakhmetova. In prep. Patterns and trends of salmon harvest and use in the Yukon River drainage, Alaska, 1990–2014. Alaska Department of Fish and Game, Division of Subsistence Technical Paper No. 442.

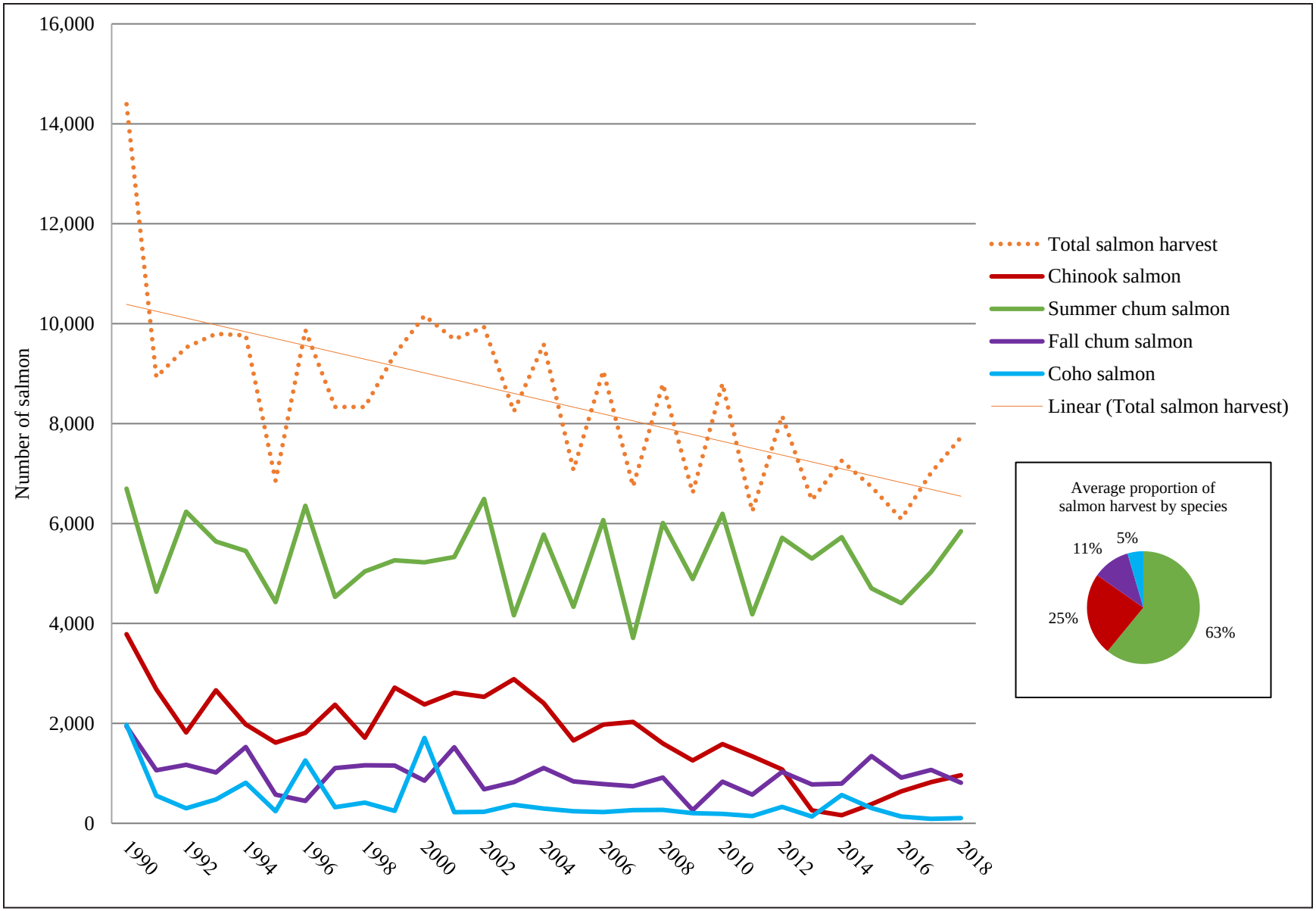

Figure 3-1.–Salmon harvests by resource and amount, Pilot Station, 1990–2018.

Table 3-4.–Population estimates, Pilot Station, 2018.

	Census (2010)	5-year American Community Survey (2014–2018)		This study (2018)	
		Estimate	Range[a]	Estimate	Range[b]
Total population					
Households	121	122.0	106 – 138	134.0	
Population	568	576.0	512 – 640	638.7	598 – 680
Alaska Native					
Population	558	571.0	509 – 633	611.8	572 – 652
Percentage	98.2%	99.1%	88.4% – 109.9%	95.8%	89.6% – 102.%

Sources U.S. Census Bureau (2011) for 2010 estimate; U.S. Census Bureau for American Community Survey (ACS) 2018 estimate (5-year average); and ADF&G Division of Subsistence household surveys, 2019 for 2018 estimate.

Note Division of Subsistence household survey elegiblity requirements differ from those used by ACS.

a. ACS data range is the reported margin of error.

b. No range of households is estimated for Division surveys.

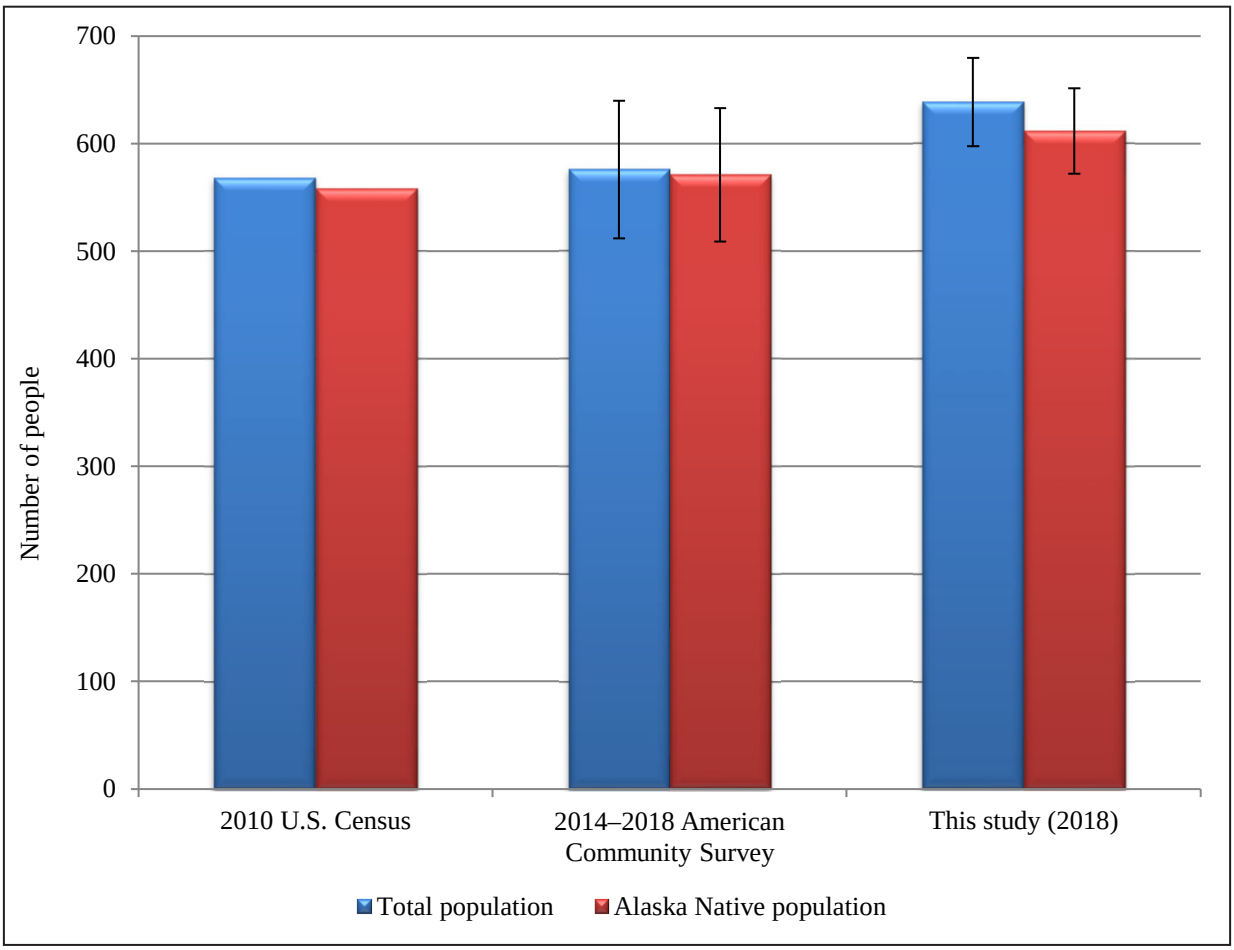

Figure 3-2.–Alaska Native and overall population estimates, Pilot Station, 2018.

Table 3-5.–Sample and demographic characteristics, Pilot Station, 2018.

Characteristics	Community Pilot Station
Sampled households	90
Eligible households	134
Percentage sampled	67.2%
Sampled population	429
Estimated community population	638.7
Household size	
Mean	4.8
Minimum	1.0
Maximum	10.0
Age	
Mean	24.9
Minimum[a]	0
Maximum	93
Median	26.0
Length of residency	
Total population	
Mean	19.6
Minimum[a]	0
Maximum	93
Heads of household	
Mean	33.0
Minimum[a]	0
Maximum	77
Alaska Native	
Estimated households[b]	
Number	123.3
Percentage	92.0%
Estimated population	
Number	611.8
Percentage	95.8%

Source ADF&G Division of Subsistence household surveys, 2019.

a. A minimum age of 0 (zero) is used for infants who are less than 1 year of age.

b. The estimated number of households in which at least one head of household is Alaska Native.

Table 3-6.–Population profile, Pilot Station, 2018.

	Male			Female			Total		
Age	Number	Percentage	Cumulative percentage	Number	Percentage	Cumulative percentage	Number	Percentage	Cumulative percentage
0–4	35.5	11.0%	11.0%	26.2	8.4%	8.4%	61.7	9.7%	9.7%
5–9	24.7	7.6%	18.6%	38.6	12.3%	20.7%	63.3	9.9%	19.6%
10–14	30.9	9.5%	28.1%	29.3	9.4%	30.0%	60.2	9.4%	29.1%
15–19	30.9	9.5%	37.6%	23.1	7.4%	37.4%	54.0	8.5%	37.5%
20–24	18.5	5.7%	43.3%	18.5	5.9%	43.3%	37.0	5.8%	43.3%
25–29	23.1	7.1%	50.5%	27.8	8.9%	52.2%	50.9	8.0%	51.3%
30–34	21.6	6.7%	57.1%	15.4	4.9%	57.1%	37.0	5.8%	57.1%
35–39	17.0	5.2%	62.4%	12.3	3.9%	61.1%	29.3	4.6%	61.7%
40–44	6.2	1.9%	64.3%	12.3	3.9%	65.0%	18.5	2.9%	64.6%
45–49	15.4	4.8%	69.0%	9.3	3.0%	68.0%	24.7	3.9%	68.5%
50–54	18.5	5.7%	74.8%	15.4	4.9%	72.9%	33.9	5.3%	73.8%
55–59	13.9	4.3%	79.0%	18.5	5.9%	78.8%	32.4	5.1%	78.9%
60–64	15.4	4.8%	83.8%	10.8	3.4%	82.3%	26.2	4.1%	83.1%
65–69	4.6	1.4%	85.2%	9.3	3.0%	85.2%	13.9	2.2%	85.2%
70–74	6.2	1.9%	87.1%	6.2	2.0%	87.2%	12.3	1.9%	87.2%
75–79	1.5	0.5%	87.6%	1.5	0.5%	87.7%	3.1	0.5%	87.7%
80–84	1.5	0.5%	88.1%	3.1	1.0%	88.7%	4.6	0.7%	88.4%
85–89	0.0	0.0%	88.1%	1.5	0.5%	89.2%	1.5	0.2%	88.6%
90–94	0.0	0.0%	88.1%	1.5	0.5%	89.7%	1.5	0.2%	88.9%
95–99	0.0	0.0%	88.1%	0.0	0.0%	89.7%	0.0	0.0%	88.9%
100–104	0.0	0.0%	88.1%	0.0	0.0%	89.7%	0.0	0.0%	88.9%
Missing	38.6	11.9%	100.0%	32.4	10.3%	100.0%	71.0	11.1%	100.0%
Total	**324.0**	**100.0%**	**100.0%**	**313.2**	**100.0%**	**100.0%**	**637.2**	**100.0%**	**100.0%**

Source ADF&G Division of Subsistence household surveys, 2019.

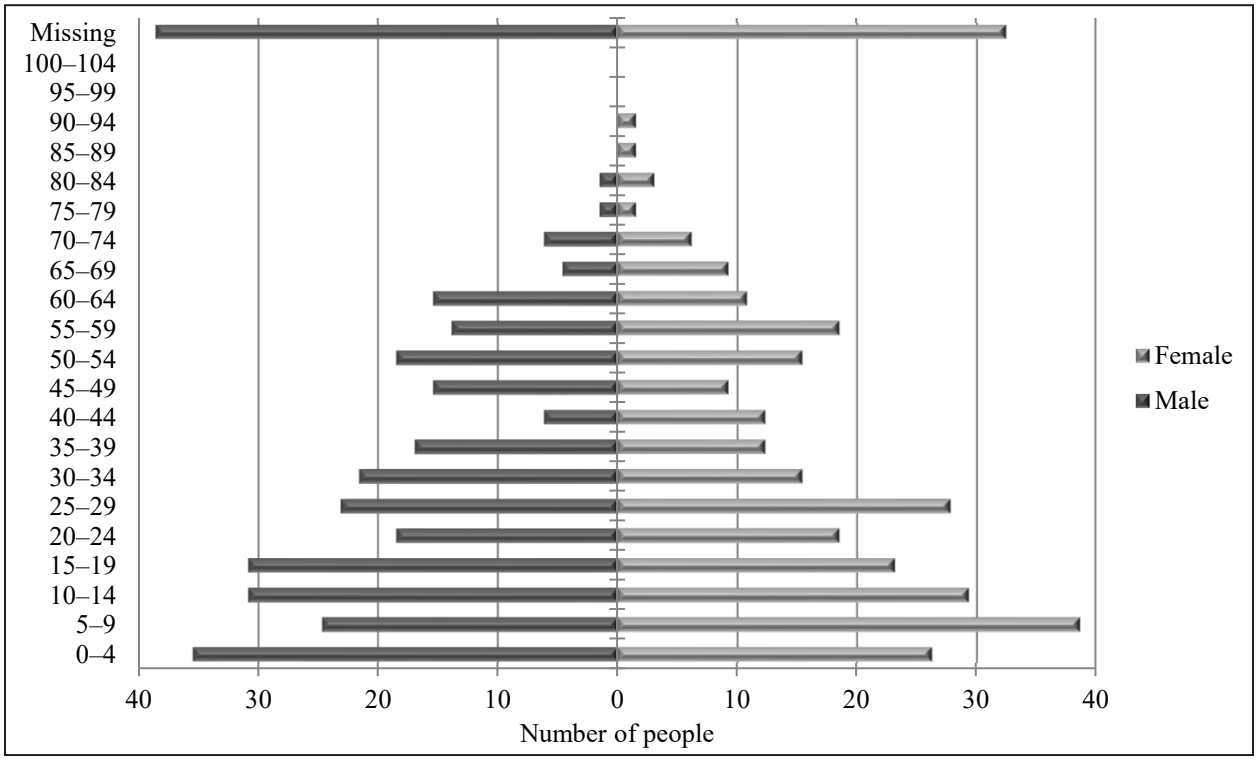

Figure 3-3.–Population profile, Pilot Station, 2018.

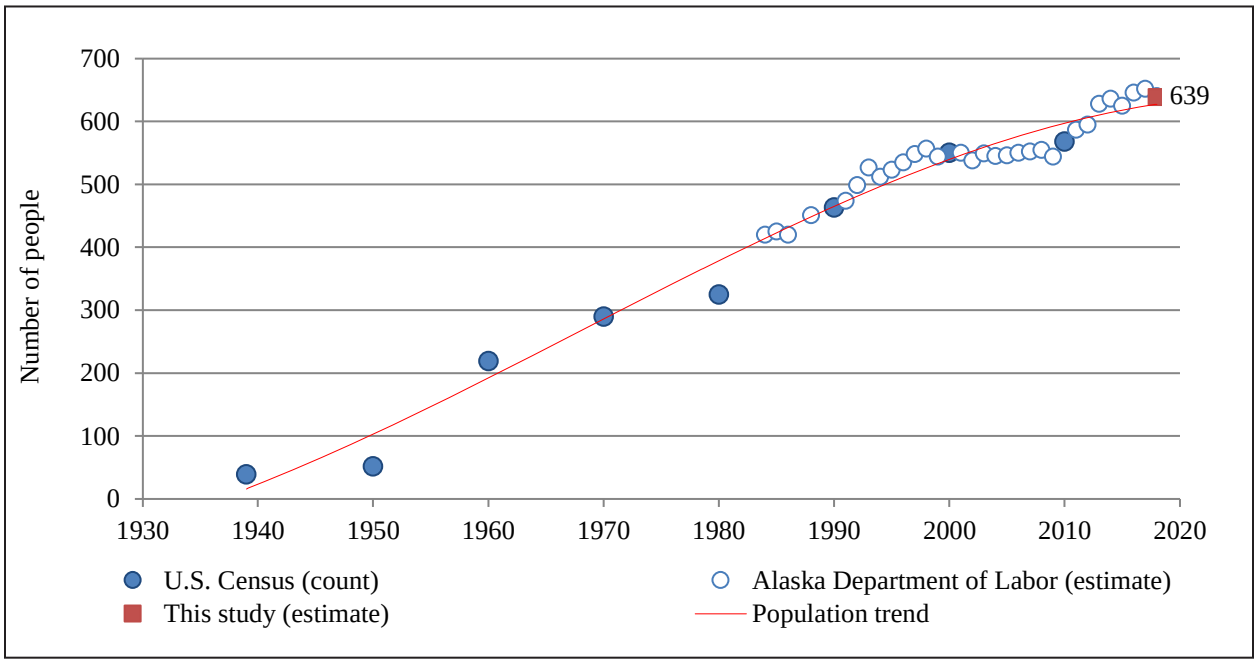

Figure 3-4.–Population estimates, Pilot Station, 1939–2018.

Table 3-7.–Birthplaces of household heads, Pilot Station, 2018.

Birthplace	Percentage
Alakanuk	1.4%
Aniak	0.7%
Bethel	1.4%
Kotlik	0.7%
Marshall (Fortuna Ledge)	2.1%
Mountain Village	0.7%
Pilot Station	70.3%
Pitkas Point	2.1%
Russian Mission	1.4%
Scammon Bay	0.7%
Saint Marys (Andreafsky)	1.4%
Tuntutuliak	0.7%
Upper Kalskag	0.7%
Chakaktolik	4.8%
Other U.S.	3.4%
Foreign	1.4%
District 2 Subtotal (Yukon)	0.7%
Missing	5.5%

Source ADF&G Division of Subsistence household surveys, 2019.
Note "Birthplace" means the place of residence of the parents of the individual when the individual was born.

Table 3-8.–Birthplaces of population, Pilot Station, 2018.

Birthplace	Percentage
Alakanuk	0.7%
Aniak	0.2%
Bethel	0.5%
Kotlik	0.5%
Marshall (Fortuna Ledge)	0.7%
Mountain Village	0.2%
Pilot Station	84.1%
Pitkas Point	0.7%
Russian Mission	0.5%
Scammon Bay	0.2%
Saint Marys (Andreafsky)	0.5%
Tuntutuliak	0.2%
Upper Kalskag	0.2%
Chakaktolik	2.1%
Other U.S.	1.4%
Foreign	0.5%
District 2 Subtotal (Yukon)	0.2%
Missing	6.3%

Source ADF&G Division of Subsistence household surveys, 2019.
Note "Birthplace" means the place of residence of the parents of the individual when the individual was born.

The average household size was 4.8 residents in 2018, and households ranged in size from 1 to 10 people (Table 3-5). The average age during the study year was 25 and the eldest resident was 93 years old. Pilot Station has a young population: 38% (239 individuals) of the population was age 19 or younger in 2018. This study estimated the number of females to be 313, and the number of males to be 324 (Figure 3-3; Table 3-6). Figure 3-4 shows the population of Pilot Station as recorded by the U.S. Census since 1939 and the Alaska Department of Labor since 1984. Pilot Station's population increased steadily from 39 residents in 1939 to 550 in 2000. Population growth largely stopped in 2000 and remained stable until 2010 when it began increasing again from 568 to the current estimate of 639.

In 2018, 70% of household heads were originally from Pilot Station, and 5% were from Chakaktolik, an abandoned village once located on the Kashunuk River approximately 26 miles southwest of Pilot Station (Table 3-7; Orth 1971rep.). Small percentages of household heads are originally from a variety of nearby lower Yukon River communities, including Pitkas Point, Marshall, Russian Mission, and Alakanuk. A few heads of households are from a variety of Kuskokwim communities and 3% are from elsewhere in the United States. The origins of Pilot Station's general population show less variation (Table 3-8). Eighty-four percent of residents are originally from Pilot Station, and 2% are from Chakaktolik. Less than 1% of residents reported originating from any other Yukon or Kuskokwim river communities.

Participation in Salmon Harvesting And Processing

(Table 3-9) shows the expanded numbers and percentages of individuals harvesting and processing salmon in 2018. Twenty-eight percent of Pilot Station residents harvested salmon in 2018, and 40% processed salmon. Figure 3-5 shows participation in the harvesting and processing of salmon by age group and sex of individuals. More males harvested salmon in each age category below age 59, and only males harvested salmon in the 60 years and older category. Sixty-eight percent of harvesters were between 19 and 59 years old and only 12 individuals aged 60 or older harvested salmon. More females processed salmon in each age category.

Table 3-9.–Individual participation in salmon harvesting and processing, Pilot Station, 2018.

Total number of people	**638.7**
Salmon	
Fish	
Number	178.4
Percentage	27.9%
Process	
Number	254.6
Percentage	39.9%

Source ADF&G Division of Subsistence household surveys, 2019.

Figure 3-6 shows the percentages of households using, attempting to harvest, harvesting, giving away, and receiving salmon by species. More households fished for, harvested, received, and gave away summer chum salmon than any other species. Fifty-eight percent of households used summer chum salmon and 42% fished for and harvested them. Forty-seven percent of households used Chinook salmon and 36% harvested them. Twenty-one percent of households used fall chum salmon, and 13% fished for and harvested them. Only 8% of households used, attempted to harvest, and harvested coho salmon. No respondents reported receiving or giving away coho salmon.

Table 3-10 compares the numbers of Pilot Station households that participated in subsistence and commercial salmon fishing in 2018. Of the 66 households that fished for salmon, 40 fished both commercially and for subsistence use. Only three households fished commercially for salmon and did not fish for subsistence. However, as discussed below, these households may have retained some commercially harvested salmon for subsistence use.

Salmon Harvest Quantities and Composition

Table 3-11 summarizes salmon harvest information by species for the 2018 fishing season. Pilot Station fishers harvested a total of 23,538 edible pounds of salmon (4,755 fish). This amounts to 176 lb per household and 37 lb per person. Summer chum salmon accounted for 66% of the harvest in edible pounds (15,622 lb; Figure 3-7; Table 3-11). Chinook salmon was the second most harvested species and made up 21% of

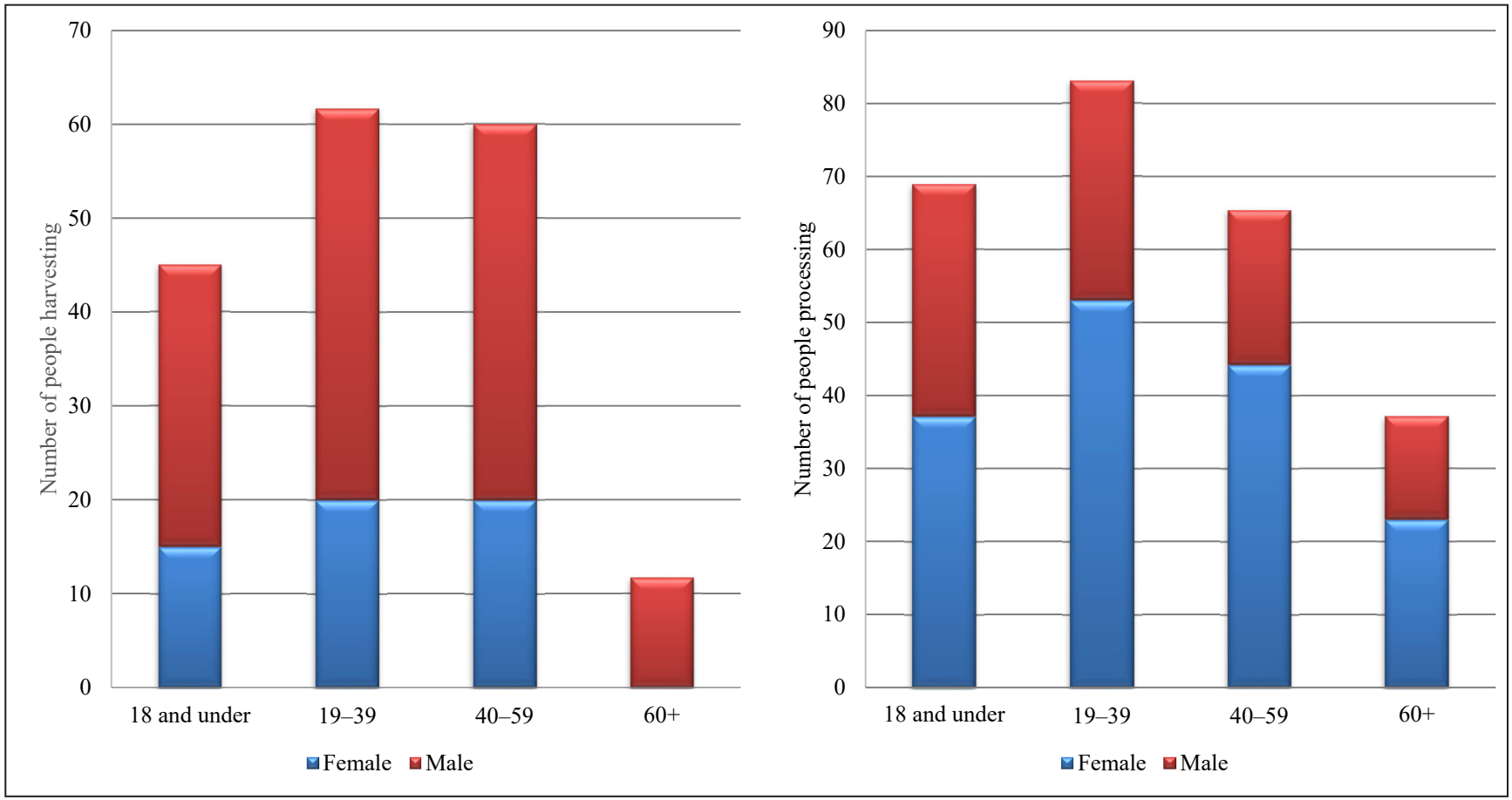

Figure 3-5.–Individual participation in salmon harvesting and processing by age group and sex, Pilot Station, 2018.

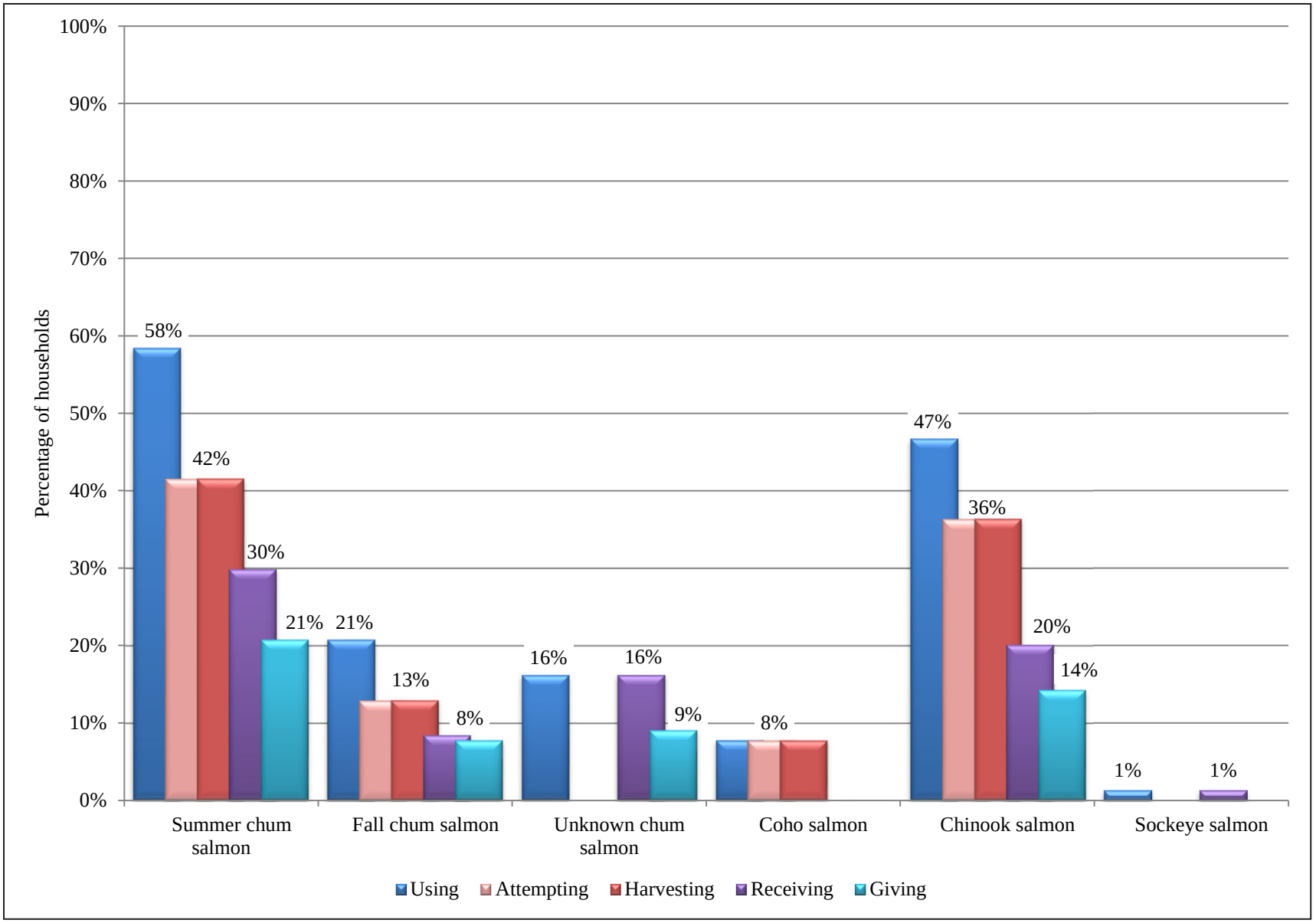

Figure 3-6.–Percentages of households using, attempting to harvest, harvesting, receiving, and giving salmon, by resource, Pilot Station, 2018.

Table 3-10.–Household participation in commercial and subsistence fishing, Pilot Station, 2018.

	Number of households
Total subsistence fishing households	66
Only subsistence, no commerical harvest	19
Subsistence fishing, unknown commercial participation	9
Total commercial fishing households	43
Only commercial, no subsistence harvest	3
Both commercial and subsistence harvest	40
Households not fishing	63
Total households	**134**

Source ADF&G Division of Subsistence household surveys, Pilot Station, 2019.

the community's harvest (4,831 lb). Fall chum salmon accounted for 12%, and coho composed 1% of the harvest. Forty-four percent of households harvested salmon, and 66% used salmon in 2018 (Table 3-11). All households that fished for a salmon species were able to successfully harvest them. Fifty-eight percent of households used summer chum salmon, 47% used Chinook salmon, and 21% percent used fall chum salmon. Forty-three percent of households received salmon and 32% gave salmon to another household.

Previous studies (Wolfe 1987; Wolfe et al. 2010) have shown that in most rural Alaska communities, a relatively small portion of households produces most of the community's fish and wildlife harvests, which they share with other households. A study of 3,265 households in 66 rural Alaska communities found that about 33% of the households accounted for 76% of subsistence harvest of all resources (Wolfe et al. 2010). Sixteen percent of Pilot Station harvested 70% of the salmon in 2018 (Figure 3-8). The "30-70 rule" holds for all subsistence resources; the ratio is typically more specialized for individual species or resource categories. This survey only measured salmon harvest which tends to require more equipment to harvest, and therefore more specialization, than some other resource categories.

Household harvests were categorized based on the amount of salmon they harvested compared to the mean household harvest in the community (Figure 3-9). Nineteen households were considered high harvesters, 26 were in the above-average category, 23 were low to average, and 74 households did not harvest salmon. Households surveyed by the Division of Subsistence were also categorized by household maturity, household head type, and participation in the commercial fishery. Table 3-12 shows harvests in terms of these categories. Mature households harvested more salmon on average (245 lb) compared to elders (206 lb) and developing households (161 lb). Household led by couples harvested more salmon (269 lb) than households with a single male head (118 lb), or a single female head (85 lb). Households participating in the commercial fishery harvested far more salmon on average (309 lb) than households that did not (139 lb). Key respondents indicated that this is because commercial fishing households use the money from the fishery to purchase and maintain fishing equipment and use this equipment to harvest salmon for subsistence use by the community (05072019PQS1, 05112019PQS2).

Production and Exchange of Salmon

The cooperative production, sharing, and trade of wild foods is foundational to subsistence economies throughout Alaska (ADF&G Division of Subsistence, n.d.). To broaden the understanding of how salmon are harvested and used in Pilot Station, this study combined cooperative salmon production data from the 2018 fishing season with data about how people shared or exchanged salmon after production. Specifically, survey respondents provided detailed information about other households with which they fished for and processed salmon as well as with which households they shared, bartered, and bought or sold salmon during a study period that included the 2018 salmon fishing season through May 2019. This resulted in network data for a cooperative production or fishing group, and network data for three exchange types: sharing, barter, and customary trade. In total this resulted in 4 different types of salmon network graphs.

Table 3-11.–Estimated harvest and use of salmon, Pilot Station, 2018.

Resource	Percentage of households					Harvest weight (lb)			Harvest amount[a]			95% confidence limit (±) harvest
	Using	Attempting harvest	Harvesting	Receiving	Giving away	Total	Mean per household	Per capita	Total	Unit	Mean per household	
Salmon	**65.6**	**44.2**	**44.2**	**42.9**	**31.8**	**23,537.9**	**175.7**	**36.9**	**4,754.9**	**ind**	**35.5**	**4.6**
Summer chum salmon	58.4	41.6	41.6	29.9	20.8	15,622.2	116.6	24.5	3,487.1	ind	26.0	4.9
Fall chum salmon	20.8	13.0	13.0	8.4	7.8	2,775.3	20.7	4.3	619.5	ind	4.6	10.3
Unknown chum salmon	16.2	0.0	0.0	16.2	9.1	0.0	0.0	0.0	0.0	ind	0.0	0.0
Coho salmon	7.8	7.8	7.8	0.0	0.0	309.8	2.3	0.5	64.9	ind	0.5	12.9
Chinook salmon	46.8	36.4	36.4	20.1	14.3	4,830.7	36.0	7.6	583.4	ind	4.4	5.3
Sockeye salmon	1.3	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	ind	0.0	0.0

Source ADF&G Division of Subsistence household surveys, 2019.

Note The percentages of households attempting to harvest and receiving salmon could not be entirely derived from survey questions. Attempting harvest is a minimum amount that does not include households unsuccessfully trying to harvest. Receiving is also a minimum calculated through reported giving by other households.

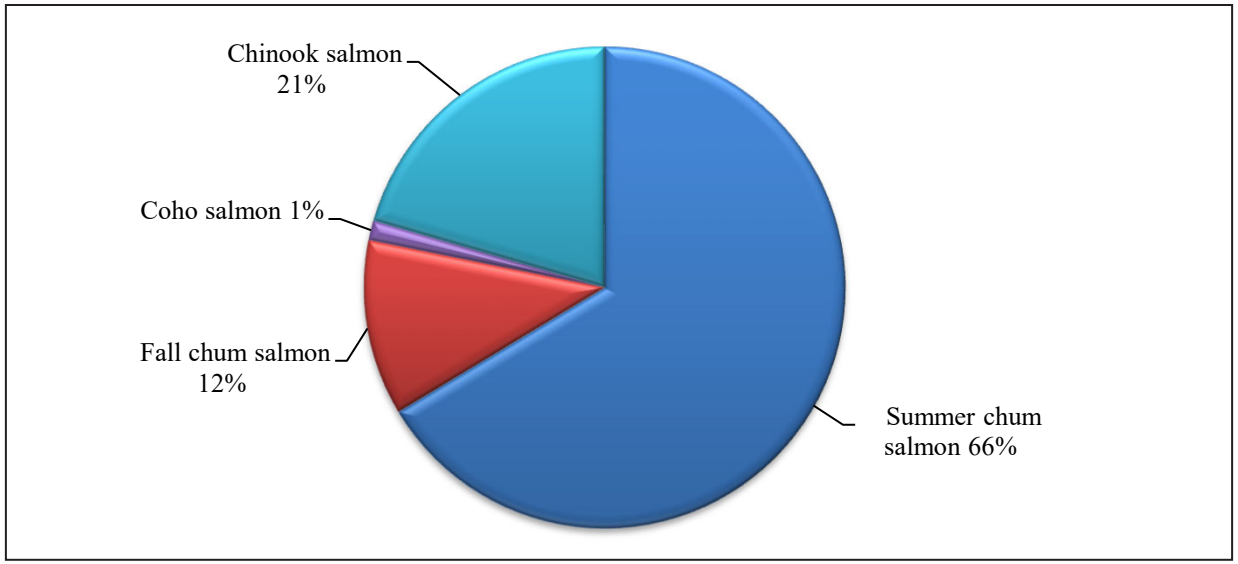

Figure 3-7.–Composition of salmon harvest weight, by resource, Pilot Station, 2018.

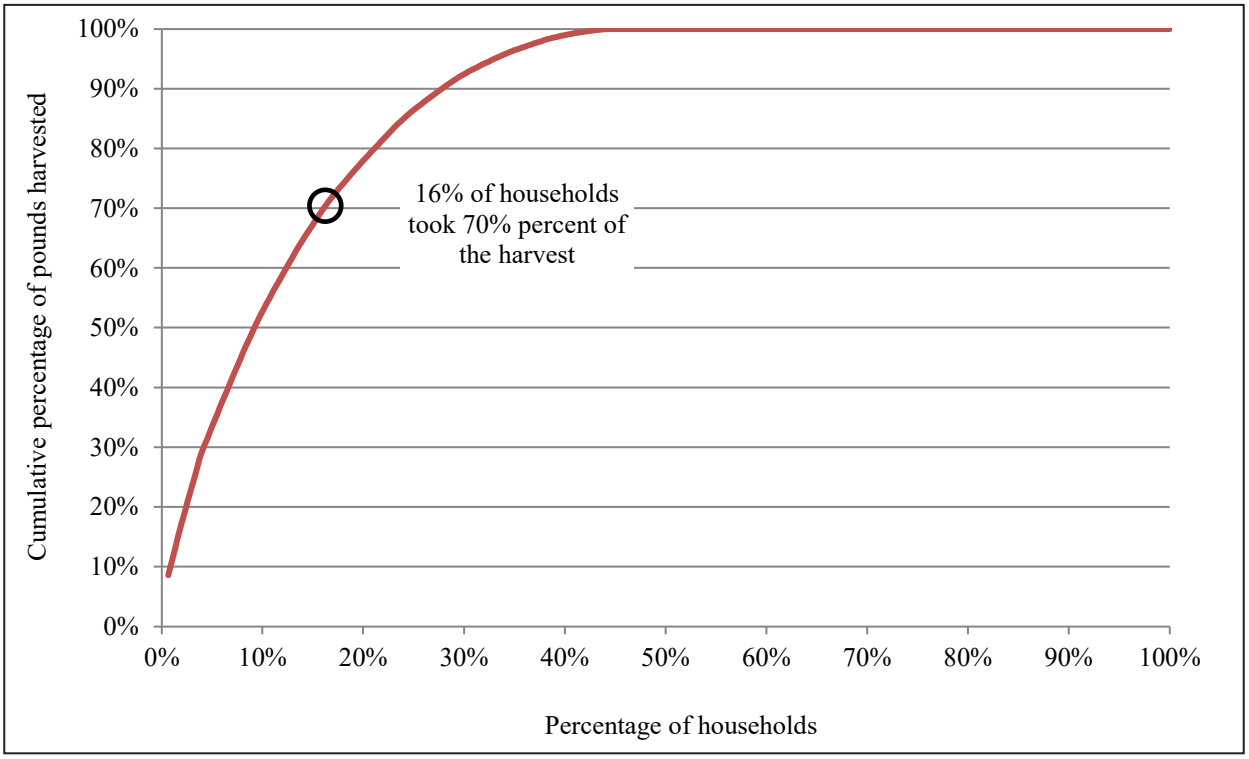

Figure 3-8.–Household specialization in salmon harvesting, Pilot Station, 2018.

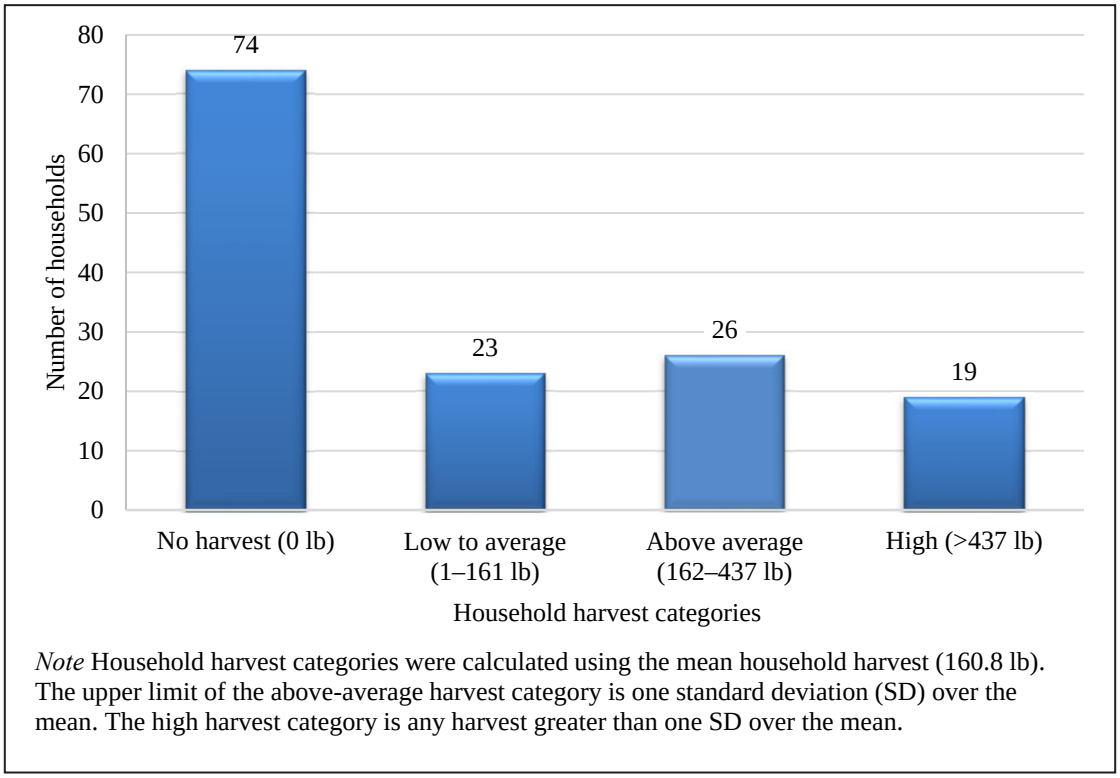

Figure 3-9.–Number of households harvesting salmon, by harvest level, Pilot Station, 2018.

Table 3-12.–Characteristics of subsistence harvesting households, Pilot Station, 2018.

	Number		Harvest weight (lb)		
	Households	Harvesting households	Mean	Minimum	Maximum
Household maturity					
Developing[a]	24	12	160.8	0.0	891.9
Mature[b]	37	25	245.2	0.0	965.2
Elder[c]	28	14	205.9	0.0	1,957.6
Unknown	1	1	1,159.5	1,159.5	1,159.5
Household head					
Couple	56	39	268.6	0.0	1,957.6
Single female	19	5	85.3	0.0	600.0
Single male	12	6	118.0	0.0	623.8
Unknown	3	2	294.6	0.0	613.6
Commercial fishing					
Yes	29	27	309.0	0.0	965.2
No	55	21	138.7	0.0	1,957.6
Unknown	6	4	395.9	0.0	883.4
All sampled households	**90**	**44**	**210.7**	**0.0**	**1,957.6**

Source ADF&G Division of Subsistence household surveys, 2019.

Note This table only summarizes harvests for households sampled by ADF&G Division of Subsistence. Demographic information is not available for households sampled by ADF&G Division of Commercial Fisheries postseason surveys.

Figure 3-10 combines data from the four types of salmon networks in Pilot Station listed above and presents an overview of how households were connected by salmon during the study period. The symbols, or "nodes," on the figure represent households, events, and other communities. Symbol shapes depict the type of heads of household and shape colors shows the age of heads of household or whether the node is an event or other community. Symbol sizes for households are scaled to indicate a household's salmon harvest in pounds. The arrows on the figure, or "ties," represent the cooperative fishing relationships and exchanges of salmon reported by survey respondents. Arrows representing cooperative fishing relationships point in both directions. Arrows representing salmon exchanges show the direction of the exchange from giver to receiver. Although cooperative production and exchange ties cannot be distinguished on this figure, they will be separated and discussed in subsequent sections of this chapter.

Some nodes in the figure are not connected to others, either because they represent households that did not report any ties to other households or because they were not surveyed. Nodes with higher numbers of connections to others are located closer to the center of the network diagram, and nodes with fewer connections are located closer to the outside. The ADF&G test fishery appears near the center of the salmon network in Pilot Station because it provides salmon that are utilized by a large number of households. The city of Anchorage also lies near the center of the network. Arrows pointing to Anchorage show that many Pilot Station households sent salmon to that community. Many other Alaska communities appear further from the center of the figure and represent exchanges with fewer Pilot Station households. Many mature households led by couples (represented by orange squares) appear near the center of the network because households with this demographic provided salmon to the highest number of households. Households with other demographic characteristics, such as developing households and households led by a single person, participated in fewer salmon exchanges and lie further from the center of the network. Arrows pointing to these households show that they primarily received salmon from others in the community.

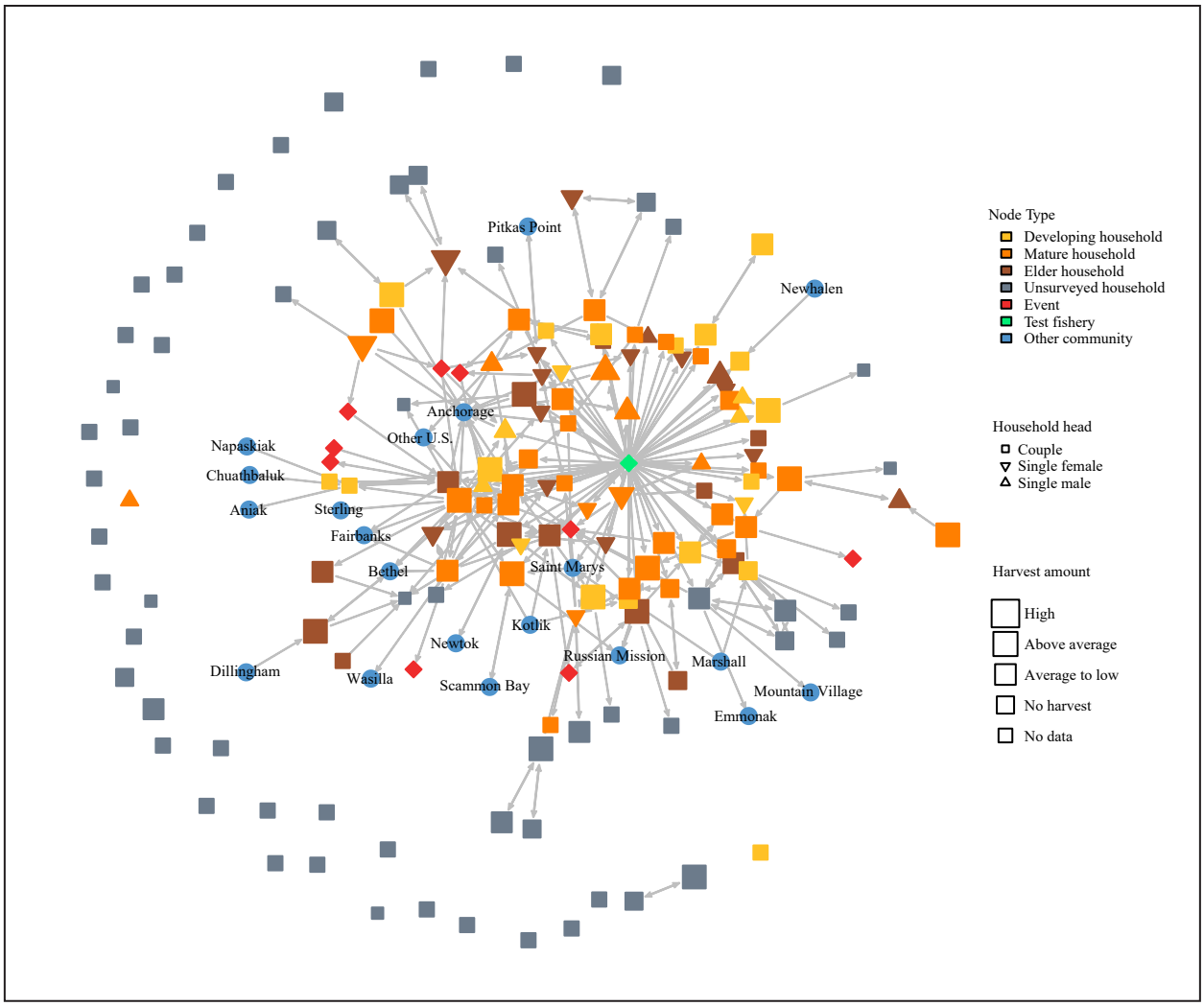

Figure 3-10.–Salmon production and exchange network, Pilot Station, 2018–2019.

Overall, the network included 90 sampled households and 59 unsurveyed Pilot Station households, as well as households in 20 other communities (Appendix Table D3-1). Residents also exchanged salmon during at least nine different community events. Pilot Station households reported 338 total exchanges of salmon that represent 230 pairs of connected households. Of the 338 total exchanges, there were four instances of barter- and one customary trade exchange recorded. Pilot Station households shared salmon 122 times with other Pilot Station households and 49 times with households in other communities (Appendix Table D3-3). Twenty-seven households exchanged salmon at a community event, and 68 received salmon from the ADF&G test fishery. Twenty-nine households fished independently and 35 fished cooperatively with another household or group of households (Appendix Table D3-2).

Production of Salmon

Although harvest data were previously described at the household level, in reality, much of the harvesting and processing, or production, of subsistence foods is achieved by households within a community that work cooperatively (Charnley 1984; Kari 1983; Lonner 1980; Magdanz 1988; Magdanz et al. 2002; 2007; Magdanz and Wolfe 1988; Moncrieff 2007; Stickney 1984; Wolfe et al. 1993). During postseason salmon harvest surveys, respondents provided information about the other households with whom they fished and their total group harvest amount. These data are typically only used to confirm that group harvest amounts are not counted twice; however, further analysis of these data using network methods can reveal information

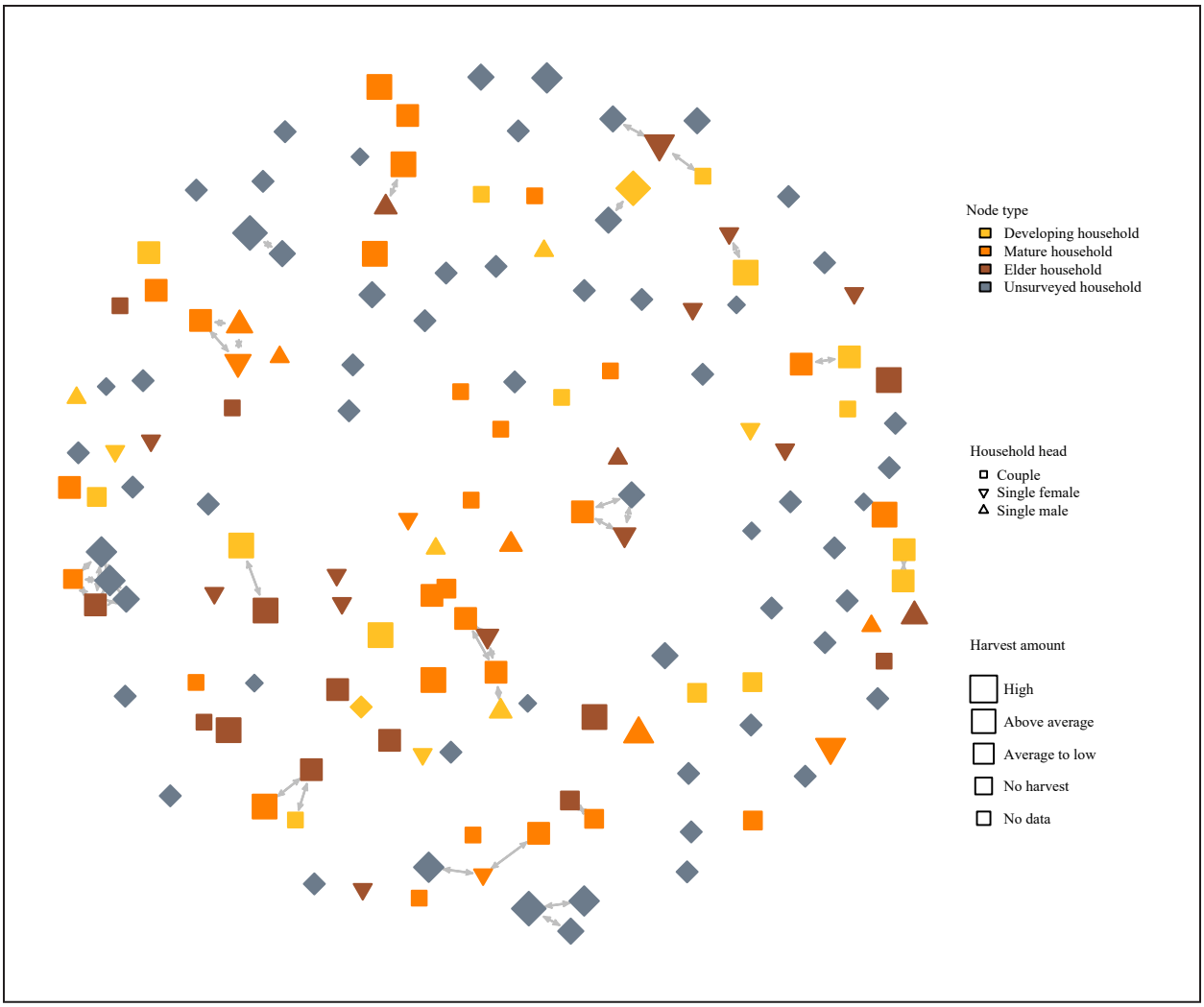

Figure 3-11.–Cooperative salmon fishing network, Pilot Station, 2018.

about the complexities of salmon production and distribution systems. Cooperative production groups, or fishing groups in the case of this study, are often organized based on kinship. Although DCF postseason surveys do not collect kinship information, key respondents described fishing with their extended families in 2018 (05072019PQS1, 05112019PQS2, 05112019PQS5).

Figure 3-11 shows which households in Pilot Station worked together to harvest and process salmon. Colors of the symbols represent household maturity and sizes of the symbols represent household productivity. Thirty-five households fished with others, and 29 households fished alone. Nearly all fishing groups with known demographics included an elder household. The majority of fishing groups consisted of two or three households working together, and only two groups consisted of four or more families.

The existence of a commercial salmon fishery on the lower Yukon River could reduce average subsistence fishing group size in Pilot Station, because some families who commercial fish for salmon utilize part of their catch for subsistence. Several of the most productive households fished independently, possibly due to participation in the commercial fishery. Households with commercial fishing permits have the equipment to harvest large amounts of salmon. These households often provide salmon caught while commercial fishing to other households for subsistence use. This may make them some of the most productive households in the community.

Table 3-13 shows the average number of cooperative production ties between households based on different characteristics. Above average harvesting households had the highest number of cooperative salmon production ties, and high harvesting households had the lowest average number of ties. These findings suggest that a household's total salmon harvest is not necessarily positively correlated to the number of fishing partners that household cooperated with. Mature and elder households had the highest average number of cooperative fishing ties. Developing households cooperated with the fewest number of households on average. Households headed by couples and single females had more cooperative production ties on average than those headed by single males.

Households often fish cooperatively at a fish camp away from the community: "We had people at our fish camp who had like four other families, and we'd all help each other collect fish for the summer" (05122019PQS7). Key respondents described fishing cooperatively with extended family: "Right now it's with me and my daughter-in-law and my other son's significant other. We work together" (05112019PQS5). One key respondent explained that other family members travel from other communities to help fish:

Table 3-13.–Mean production ties and mean harvests of households in the cooperative production network, by household characteristic, Pilot Station, 2018.

	Number		Mean household harvest (lb)
Household characteristic	Households	Mean production ties[a]	
Harvest category[b]			
High	17	0.47	615.05
Above average	22	1.27	285.3
Low to average	13	0.85	68.42
No harvest	38	0.13	0
Maturity[c]			
Developing	24	0.38	160.75
Mature	37	0.62	245.19
Elder	28	0.57	140.99
Unknown	1	4	270.17
Household head type			
Couple	56	0.57	237.94
Single female	19	0.58	85.33
Single male	12	0.33	117.96
Unknown	3	1.67	294.59
Commercial fishing			
Yes	55	0.6	105.03
No	5	0.2	386.78
Unknown	1	0	441.2

Sources ADF&G Division of Subsistence household survey 2019 and Division of Commercial Fisheries postseason harvest survey, 2018.

a. Average number of other households with which sampled household cooperated in harvesting and processing of salmon.

b. Household harvest categories were calculated using the mean household harvest (160.8 lb). The upper limit of the above-average harvest category is one standard deviation over the mean (437 lb). The high harvest category is any harvest greater than one SD over the mean.

c. Developing: age(s) of households head(s) is less than 40 years. Mature: age(s) of household head(s) is 40–59 years. Elder: age(s) of household head(s) is greater than 59 years.

> I fish with my brother-in-law. He's got family and his wife…And we have another daughter that lives in Russian Mission. They come down and do some subsistence…And we have another living in Marshall. And our other daughter lives in Scammon Bay. So when they come around, we let them cut fish and we share some. (05112019PQS2)

Key respondents provided several reasons for fishing in groups. Cooperation increases efficiency because it allows each member of the fishing group to provide whatever they are best able to, whether it is fishing equipment, expertise, labor, or childcare. One respondent said that they fish cooperatively out of necessity because they are physically unable to do it alone (05112019PQS5). Another respondent described needing help for health reasons: "Yes, we've had help from my brother…he's been fishing for us because…my back was giving out so I had to ask him to fish for us so that we could cut the fish and smoke them, and then once they had dried up we'd distribute them with my parents and my brothers and sisters" (05122019PQS6). Cooperative fishing can also be a way to trade labor for salmon. A key respondent said that he will sometimes allow his neighbors or relatives an opportunity to earn some salmon by helping him: "…if they need some more fish I'll take one of them along and they'll help in that way" (05072019PQS1).

Exchange of Salmon

Sharing

Local Characterization of Sharing

Sharing wild foods has always been a cornerstone of life in Native Alaskan cultures: "…it's true for every small village in Alaska where almost everyone is related with everyone, it's just part of the custom that they've developed over the years" (05072019PQS1). All Pilot Station key respondents in this study said that they were taught to share early in life: "That's our value. Since the time that we are growing up. My parents tell me to share everything. What you have from the land. It was given to us to share with the people. Still today that's how we live. Sharing" (05112019PQS2). One key respondent explained that the values of sharing and cooperation originated as needs for survival:

> Sharing our subsistence food with family and friends, that was taught to us as we're growing up. It's always been. It's always been to share. And to work together to get our subsistence food. Because we have to survive. Yeah, to survive. (05112019PQS5)

The ethic of sharing food has spiritual origins for some: "There's a Native custom where, for example we talked about spiritual, there's this Native belief that when you share eventually it will come back to you. Or it will come back to the family. We see it all the time" (05072019PQS1) Another respondent said, "Yeah, it's a spiritual thing. They tell us you give the people that need it most. The poor that can't do anything. Just give it to them. And in return you don't ask, you know, once in a while they want to give us some in return, but we tell them no. They tell us in return you get more. That's how we live. (05112019PQS2)

Recipients of shared food sometimes feel the need to reciprocate by returning the favor at some point in the future. Respondents stressed that this reciprocation is an aspect of food distribution through sharing and does not represent bartering. A key respondent described learning this as a child: "…he taught me don't expect a return. Just give. As long as you give" (05112019PQS5).

Key respondents frequently described sharing salmon with family in other communities, particularly in hub communities where residents have less opportunity to harvest their own salmon: "We got families like in Bethel or Anchorage. Whenever we get a chance to get in [to those communities] we share with them" (05122019PQS3). This sharing of wild foods with family who live in other communities can be more about preserving a culture than supplementing a diet:

> My parents, we had a big family, extended family. They were always sharing the same way that we continue to do the same thing today. And it's mainly relatives in other communities who don't have a chance or who move from Pilot Station. And, you know, the salmon, the foods we eat, keeps them in touch with culture and

> they are really happy anytime we bring Native foods to Anchorage or Fairbanks, and it's just part of our family tradition, and we really don't expect any payment in kind. When they come out, they'll bring fresh fruits and vegetables which is great. But for the Native foods, it's valued all over. (05072019PQS1)

Respondents also described sharing with people who are unable to harvest wild resources for themselves in Pilot Station. This includes elders who are no longer able to fish and households who cannot afford the equipment needed to fish. One key respondent explained: "The main thing is that some of these families don't usually have any, very much at all. Those are the ones that I talked about that don't have any equipment and can't afford anything. They're the ones that mainly once in a while needed some salmon" (05112019PQS2). Another key respondent specified that a fundamental aspect of sharing wild food is being willing to share it with anyone:

> It's our tradition, our subsistence way of life revolves in everything we do. It's not one thing, it's the whole thing. The family. And friends. And…the people that cannot afford, don't have fish permits to commercial, or they have no way of getting food…Because they are people just like you. They eat like you. Do everything like you. No matter the color, the race, anything. They are just the same as you. Me and you. (05112019PQS5)

Sharing wild resources at community and cultural events is also a core value that facilitates food distribution. These events include memorial gatherings where residents come together to support a family by providing food for them: "Especially when elders pass away or a family loses someone and there's a death in the community. There's a lot of effort, community effort to help the family. It not only, they try to lessen the burden to the family and there's all this support and it's reciprocal" (05072019PQS1). Food is also distributed among guests who attend these memorial gatherings. Community events also include potlatches in cooperation with nearby communities: "When we have potlatches, we have Native guests who come to stay in our village and our communities. Same way when we go to St. Mary's. And during these ceremonial events, one Native takes a king salmon to share with the others, you know, it's a Native custom to share that meal, or the strips" (05112019PQS2). Key respondents also described sharing salmon at other events in the community including weddings and birthdays (05122019PQS3).

Sharing food tends to be practical in that it provides resources to families who need it; however, sharing can also be a symbolic act that represents the continuation of long-held customs by exchanging a token amount of some highly prized food such as Chinook salmon. One key respondent described sharing salmon at potlaches with other communities: "It was like, during potlatch time we do that, but we give it to them and they give back, but in different flavors…it's like what we caught they get, and what they caught we get. Like we're getting it back" (05122019PQS3). Key respondents also share the salmon they catch early in the season to provide people their first taste of fresh salmon for the year:

> Well, we mainly like, when we catch our first king, like maybe two, three, four kings, we practically cut it in small portions, and anybody who wants fresh king for the, what we get they usually go down to the boat and pick up some. Or we bring it, my wife cut it up and share it with the elders. (05112019PQS2)

Some of the values related to sharing, such as helping other meet their needs, extend to the salmon provided by the ADF&G test fishery. Respondents said that most households in the community make sure to allow elders and those who cannot fish for themselves the first opportunity to take fish from the test fishery tote:

> Fish and Game Pilot Station sonar site delivers salmon fish to the community dock. Whitefish, you know, whatever they catch for that day. And community members will come and get some fresh salmon for that day…Families who have their own fishing gear, like me, or other commercial fishermen, will allow families without a first opportunity. Or the elders, they'll allow the elders the first opportunity to take as much as they can. Because we know their limitations. So those families without the access and the gear, they're pretty much meeting their food security, or some

> of their food security. But for those families who have the gear have to wait until the next day or wait until Fish and Game gives permission for everyone to go fish. (05072019PQS1)

This study did not document whether salmon taken from the test fishery were then shared among households in the community.

Salmon Sharing Networks

Survey respondents provided information about which Pilot Station households, community events, and household in other communities they gave salmon to. Pilot Station residents gave away 6,785 lb of salmon during the study period, of which 4,417 lb was summer chum salmon, 958 lb was Chinook salmon, and 594 lb was fall chum salmon (Table 3-14). Surveyed households gave 5,819 lb of salmon to households within in the community, 726 lb to households in other communities, and 241 lb at community events. Summer chum salmon were the most shared with other communities, however Chinook salmon were shared at events far more than any other species. Pilot Station households received 4,706 lb of salmon from the ADF&G test fishery (tables 3-14 and 3-15) in 2018. Fall chum salmon accounted for the majority (3,179 lb), followed by 809 lb of summer chum salmon and 667 lb of Chinook salmon. Residents also received 201 lb of salmon from other communities and 58 lb during community events (Table 3-14).

Table 3-16 shows the number of times salmon was shared and received by Pilot Station households. Eighty-nine salmon sharing instances involved summer chum salmon, 64 involved Chinook salmon, and 24 involved fall chum salmon. Salmon was most commonly given to other households in the community (127 ties),but was also shared with households in other communities (60) and community events (22). Respondents reported a total of 129 salmon receiving ties, 102 of which were instances of receiving fish from the ADF&G test fishery. Eighteen Pilot Station households received salmon and nine gave salmon at a community event during the study period.

The number of salmon sharing ties, organized by the type of salmon and the way it was processed, is shown in Appendix Table D3-4. Ninety-four ties involved salmon that was dried, smoked, or jarred, and eighty-four ties included whole salmon. Less common processing types included filleting, baking, and salting. Residents were most likely to share whole fish within the community and dried or smoked salmon with

Table 3-14.–Reported weight of salmon shared between respondent households, by exchange partner and resource, Pilot Station, 2018–2019.

	Pounds							
	Type of salmon							
Exchange partner	Chinook	Summer chum	Fall chum	Unspecified chum	Sockeye	Coho	Unknown salmon	Total
Given to								
Local household	722.3	4,057.1	371.8	662.0	0.0	0.0	5.3	5,818.5
Other community	126.1	319.1	188.1	92.6	0.0	0.0	0.0	725.9
Event	109.3	41.2	34.2	56.2	0.0	0.0	0.0	240.9
Total	957.7	4,417.4	594.1	810.8	0.0	0.0	5.3	6,785.3
Received from								
Other community	72.0	50.3	1.1	9.6	67.7	0.0	0.8	201.5
Event	11.0	18.6	0.0	28.9	0.0	0.0	0.0	58.5
Test fishery	666.5	808.6	3,178.6	0.0	0.0	52.5	0.0	4,706.2
Total	749.6	877.5	3,179.7	38.5	67.7	52.5	0.8	4,966.1

Source ADF&G Division of Subsistence household surveys, 2019.

Table 3-15.–Reported number of salmon received from test fishery, Pilot Station, 2018.

	Number		
Salmon	Households	Fish	Pounds
Chinook salmon	18	80.5	666.5
Coho salmon	3	11	52.5
Fall chum salmon	59	709.5	3,178.6
Summer chum salmon	22	180.5	808.6
Total	**68.0**	**981.5**	**4,706.2**

Source ADF&G Division of Subsistence household surveys, 2019.

Table 3-16.–Reported instances of giving and receiving salmon between respondent households and others, by exchange partner and resource, Pilot Station, 2018–2019.

	Number of ties[a]							
	Type of salmon							
Exchange partner	Chinook	Summer chum	Fall chum	Unspecified chum	Sockeye	Coho	Unknown salmon	Total
Given to								
Local household	40	56	12	15	0	0	4	127
Other community	15	28	8	9	0	0	0	60
Event	9	5	4	3	0	0	1	22
Total	64	89	24	27	0	0	5	209
Received from								
Other community	4	6	2	1	2	0	1	16
Event	2	3	0	5	0	0	1	11
Test fishery	18	22	59	0	0	3	0	102
Total	24	31	61	6	2	3	2	129

Source ADF&G Divison of Subsistence household surveys, 2019.

a. Total instances of giving or receiving.

other communities (Table D3-5). Salmon given at an event was most commonly baked, smoked, or whole. Smoked or dried salmon accounted for nearly all salmon receiving ties with other communities and events.

Figure 3-12 shows the sharing network that occurred between Pilot Station households, at community events, and with the test fishery. Figure 3-13 shows a second network that occurred only among community households. Arrows on the figures show the direction of salmon exchange from giver to receiver. Respondents were not asked to report from whom they received salmon. Although respondents could specify that they shared more than one type of salmon with the same household, this level of detail is not discernable on the diagram.

A large number of Pilot Station households received salmon from the test fishery (Figure 3-12). To understand the sharing patterns that exist within Pilot Station regardless of the test fishery influence, this study removed these fish from the network data to explore whether differences existed in those patterns as a result. The sharing network is greatly transformed when salmon received from the test fishery are removed (Figure 3-13). Elder households were about as likely to give away salmon as they were to receive it within the community. Also, elder households were involved in the majority of salmon exchanges that occurred at community events. About half of the most productive households gave salmon to multiple other households. One household gave salmon to at least 10 different households. The majority of the

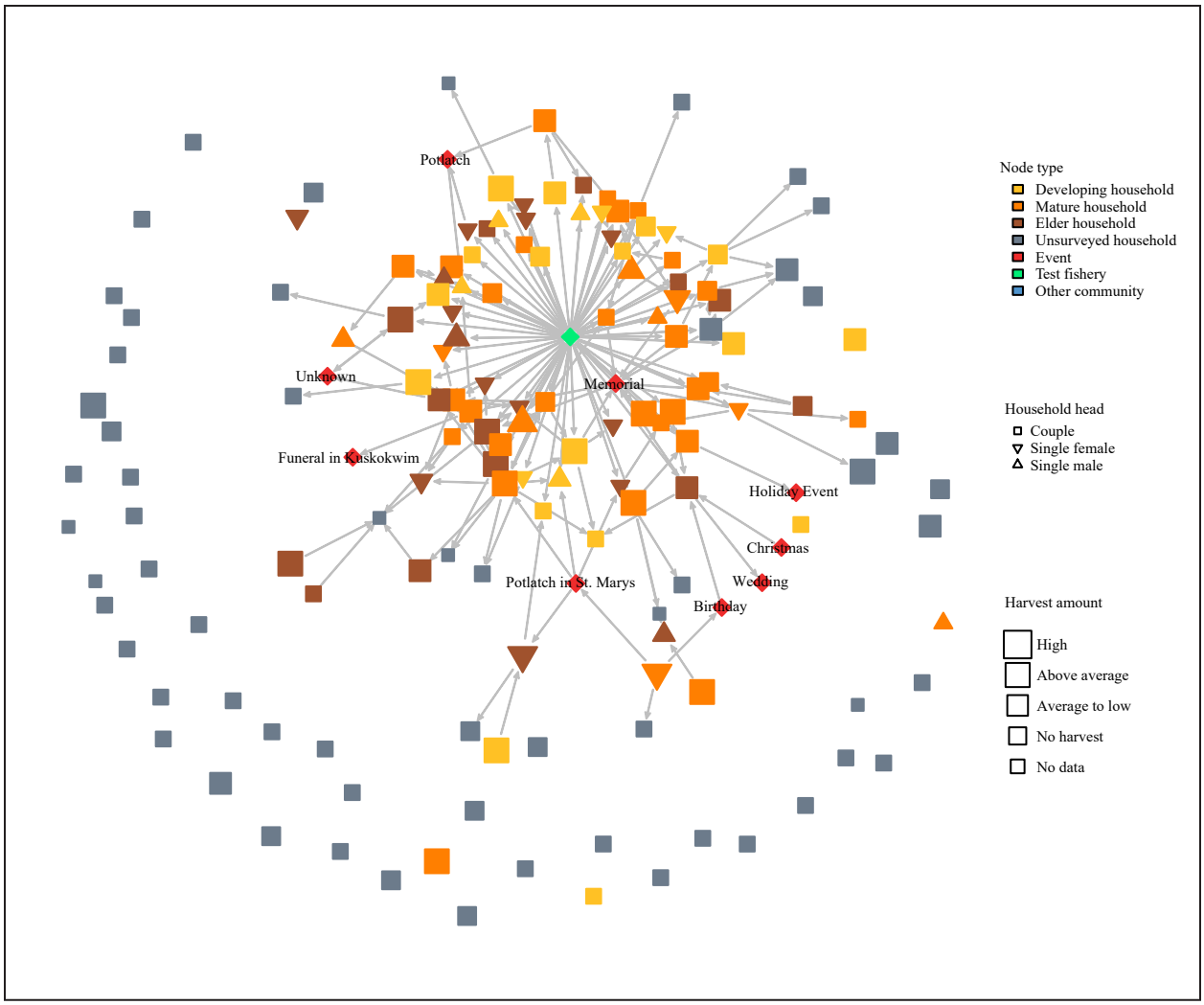

Figure 3-12.–Sharing network between respondent households, other local households, ADF&G test fishery, and events, Pilot Station, 2018–2019.

most productive households were led by a couple. Given that 44 households were not surveyed and that respondents were not asked to report from which households they received salmon, this diagram likely represents only a portion of the salmon sharing that occurred between households in Pilot Station during the study year.

A large number of Chinook salmon giving ties account for a relatively small amount of Chinook salmon given (figures 3-14 and 3-15). This appears to demonstrate the importance of sharing even small quantities of Chinook salmon.

Pilot Station respondents were asked about the salmon they shared or received during a community event. As discussed in the Local Characterization of Sharing section above, the sharing and eating of wild resources is a central feature of community events and gatherings. Sixteen households reported giving away 241 lb of salmon at community gatherings (Table 3-17). The majority of salmon was given away during funeral or memorial potlatches. Eleven households shared 178 lb of salmon at a funeral or memorial potlatch. These events include a funeral in a Kuskokwim River community where a Pilot Station household shared 33 lb of salmon. As described above, many respondents said that providing salmon at a memorial potlatch—to be distributed among those in attendance and to support the family of the deceased—is common. Respondents also reported giving away salmon at events such as birthdays, weddings, and holiday events.

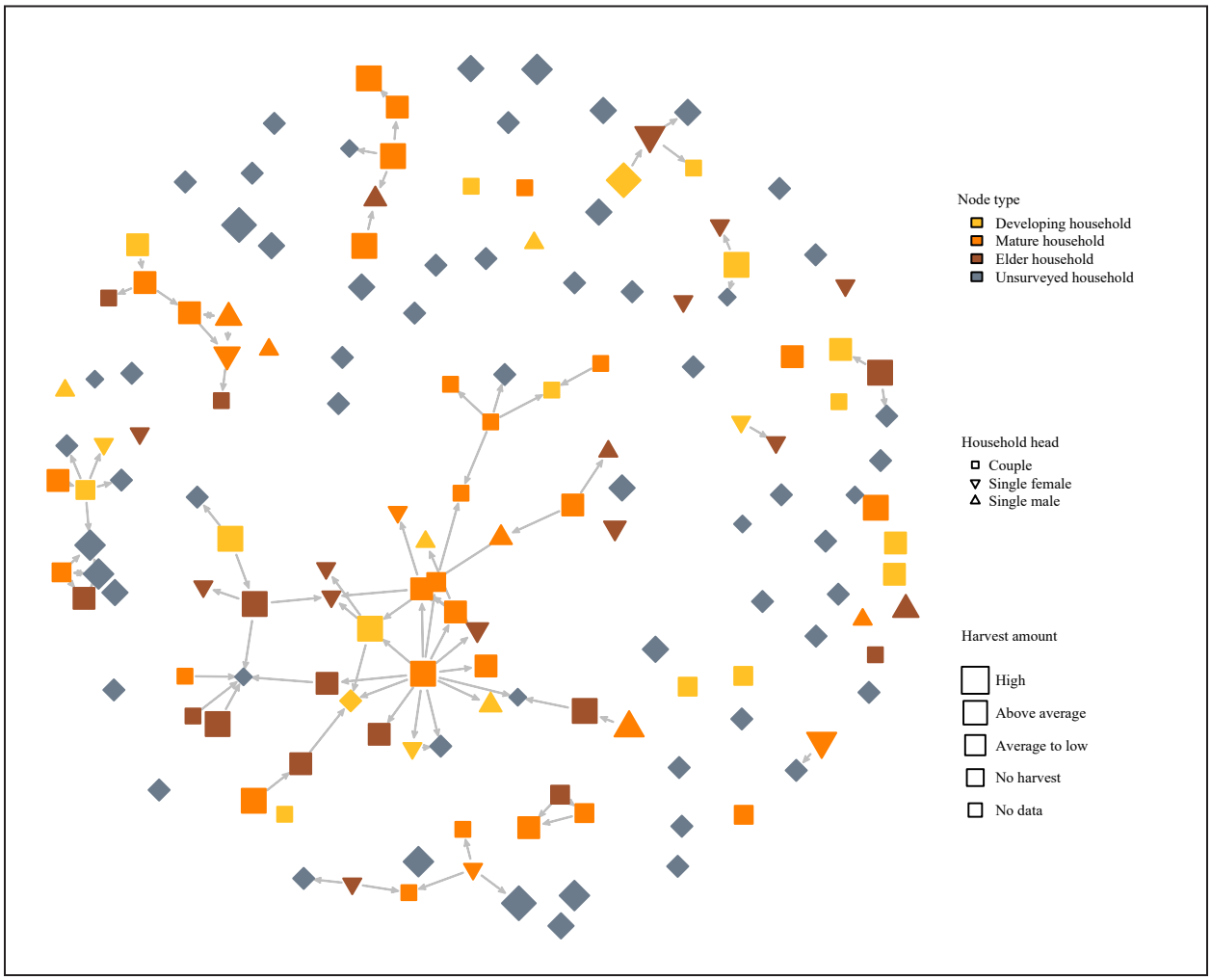

Figure 3-13.–Sharing network between respondent households and other local households, Pilot Station, 2018–2019.

Eight households received a total of 59 lb of salmon during events. The majority of this occurred during a potlatch in the nearby community of St. Mary's, where four households received 28 lb of salmon.

Twenty-four Pilot Station households shared 726 lb of salmon with people in 15 communities (Table 3-18). These communities included nearby Yukon River communities such as St. Mary's and Pitkas Point as well as distant communities such as Fairbanks and a U.S. community outside of Alaska (Figure 3-16). Pilot Station residents also shared salmon with a number of Kuskokwim River communities such as Bethel, Aniak, and Chuathbaluk, as well as the coastal community of Scammon Bay. Nearly half of the salmon given to other communities was shared by 13 households that gave 351 lb to Anchorage residents (Table 3-18). As discussed above, key respondents reported sharing salmon with family members who have moved to larger communities and are unable to harvest salmon themselves. Eleven households received 202 lb of salmon from seven different communities, including the nearby communities of Marshall, Kotlik, and St. Mary's, as well as more distant communities such as Dillingham in Bristol Bay and the Lake Iliamna community of Newhalen.

Figure 3-17 shows salmon exchanges between Pilot Station households and other communities by region. The greatest number of sharing instances occurred between Pilot Station households and urban areas of Alaska. The remaining instances of sharing occurred primarily with rural communities on the Yukon River and rural communities elsewhere in Alaska. Nearly all instances of receiving occurred with rural Yukon

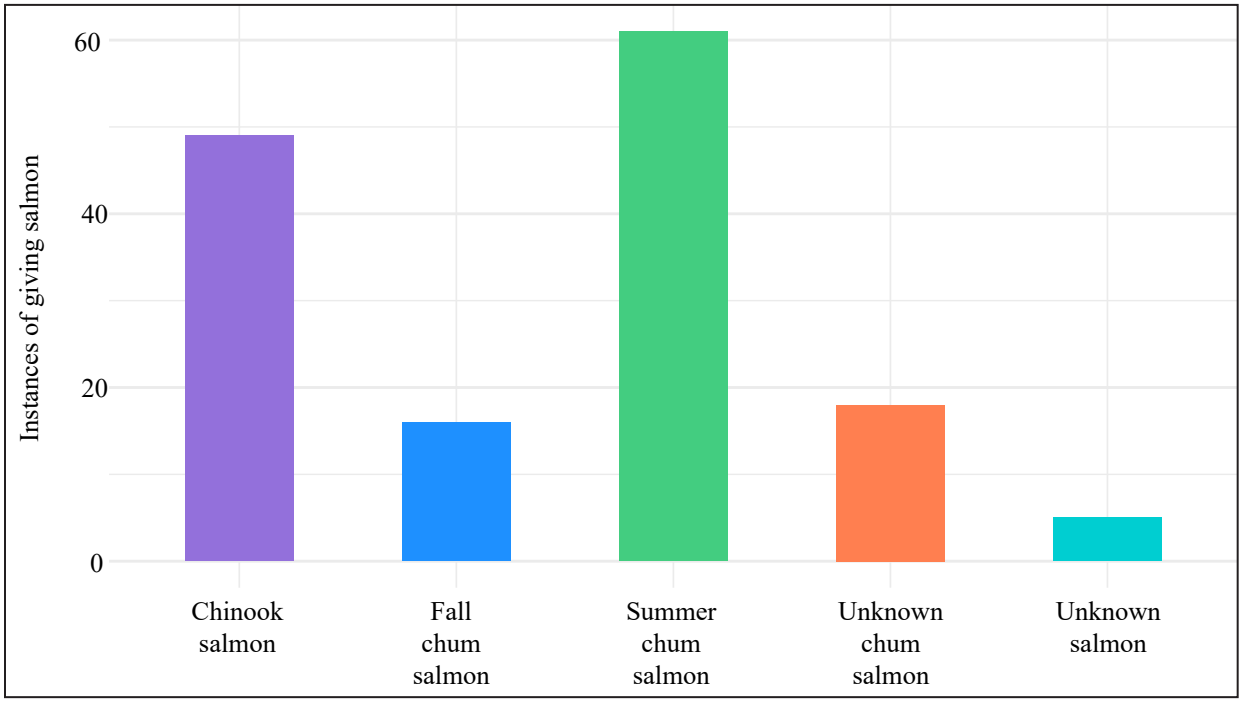

Figure 3-14.–Reported instances of salmon giving between respondent households and other local households by resource, Pilot Station, 2018–2019.

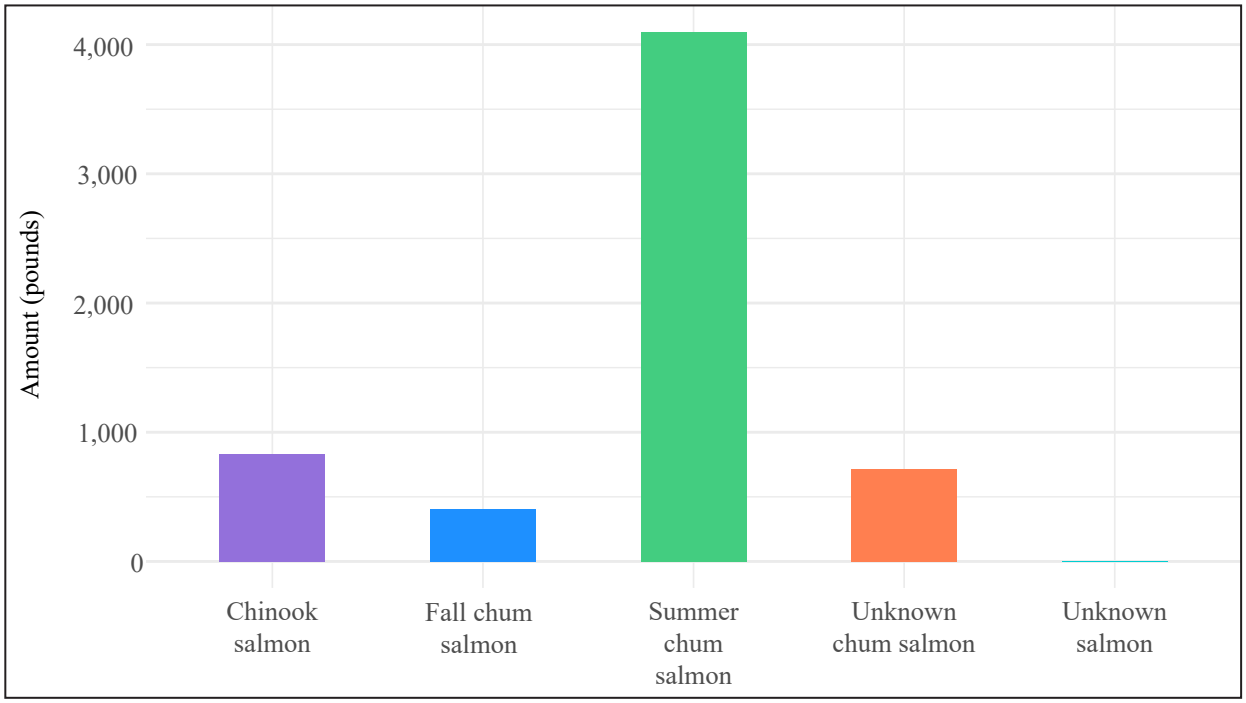

Figure 3-15.–Reported pounds of salmon given between respondent households and other local households by resource, Pilot Station, 2018–2019.

Table 3-17.–Reported instances and pounds of salmon given to and received from events, Pilot Station, 2018–2019.

	Give			Receive		
	Number			Number		
Event	Households	Ties[a]	Salmon (lb)	Households	Ties[a]	Salmon (lb)
Unknown event	2	3	5.9	1	1	0.0
Birthday	1	1	3.4	1	1	6.2
Christmas	0	0	0.0	1	1	3.4
Funeral in Kuskokwim	1	1	33.1	0	0	0.0
Holiday event/potlatch	1	2	3.4	0	0	0.0
Funeral or memorial	10	11	145.1	1	2	19.2
Potlatch in St. Marys	1	1	6.2	4	5	28.2
Wedding	1	1	6.2	0	0	0.0
Potlatch (unspecified)	2	2	37.6	1	1	1.5
Any event	**16**	**22**	**240.9**	**8**	**11**	**58.5**

Source ADF&G Division of Subsistence household surveys, 2019.

a. Total instances of giving or receiving.

Table 3-18.–Reported instances and pounds of salmon given to and received from other communities by community, Pilot Station, 2018–2019.

	Giving by respondents			Receiving by respondents		
	Number		Amount	Number		Amount
Community	Households	Ties[a]	(lb)	Households	Ties[a]	(lb)
Anchorage	13.0	37.0	350.7	0.0	0.0	0.0
Aniak	1.0	1.0	4.8	0.0	0.0	0.0
Bethel	3.0	3.0	80.6	0.0	0.0	0.0
Chuathnaluk	1.0	1.0	4.8	0.0	0.0	0.0
Dillingham	3.0	0.0	0.0	1.0	1.0	66.6
Emmonak	1.0	1.0	9.6	0.0	0.0	0.0
Faribanks	3.0	5.0	69.3	0.0	0.0	0.0
Kotlik	0.0	0.0	0.0	3.0	4.0	45.5
Marshall (Fortuna Ledge)	0.0	0.0	0.0	2.0	4.0	39.5
Mountain Village	1.0	1.0	4.8	0.0	0.0	0.0
Napaskiak	0.0	0.0	0.0	1.0	1.0	1.1
Newhalen	0.0	0.0	0.0	1.0	1.0	0.8
Pitkas Point	2.0	2.0	9.6	1.0	2.0	9.6
Russian Mission	1.0	1.0	48.0	0.0	0.0	9.6
Saint Marys (Andreafsky)	3.0	3.0	9.6	2.0	2.0	28.8
Scammon Bay	1.0	1.0	24.0	0.0	0.0	0.0
Sterling	1.0	1.0	3.3	0.0	0.0	0.0
Wasilla	2.0	2.0	67.2	0.0	0.0	0.0
Other U.S.	1.0	1.0	39.6	0.0	1.0	0.0
All communities	24.0	60.0	725.9	11.0	16.0	201.5

Source ADF&G Division of Subsistence household surveys, 2019.

a. Total instances of giving or receiving.

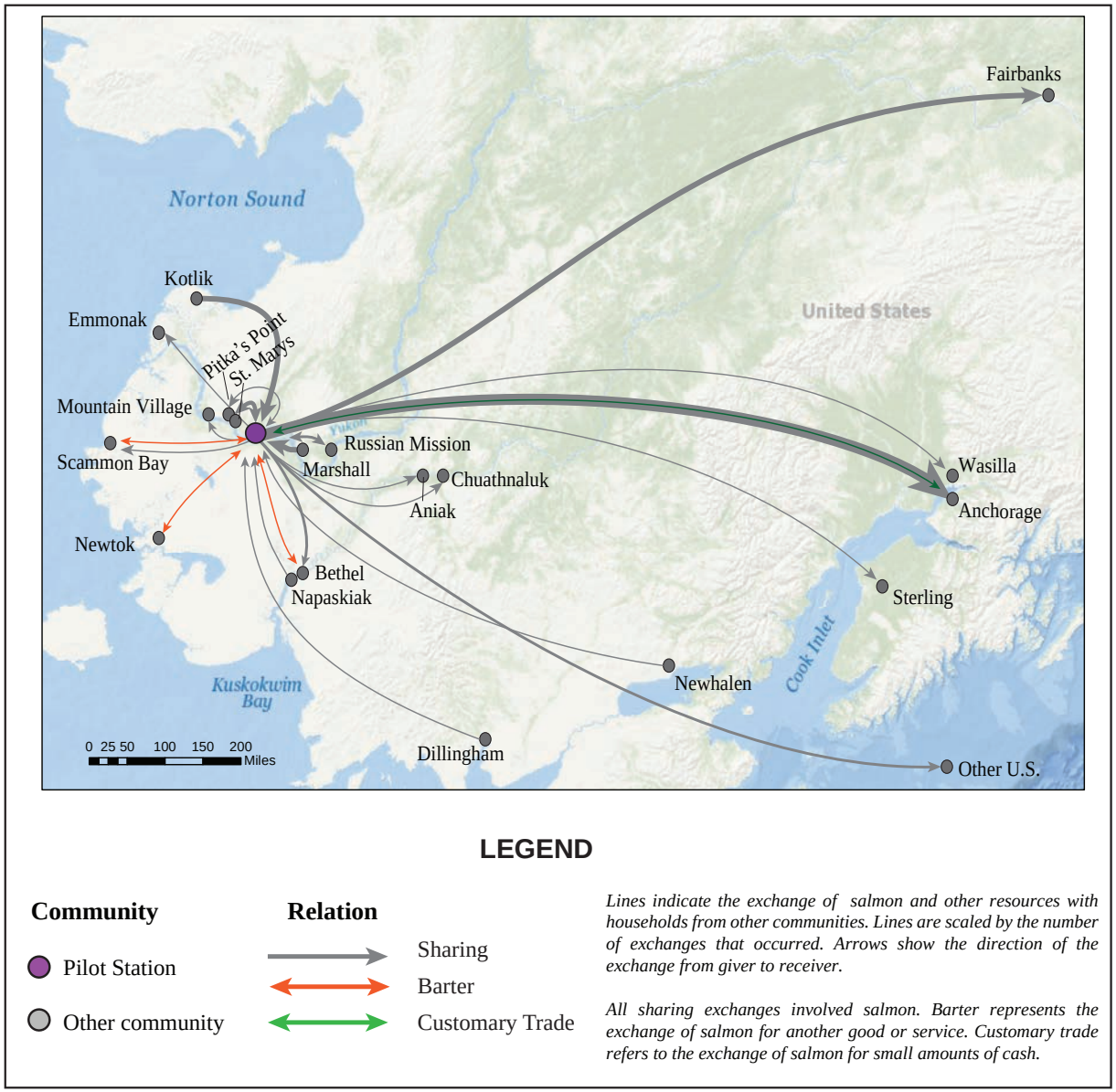

Figure 3-16.–Intercommunity sharing, barter, and customary trade map, Pilot Station, 2018–2019.

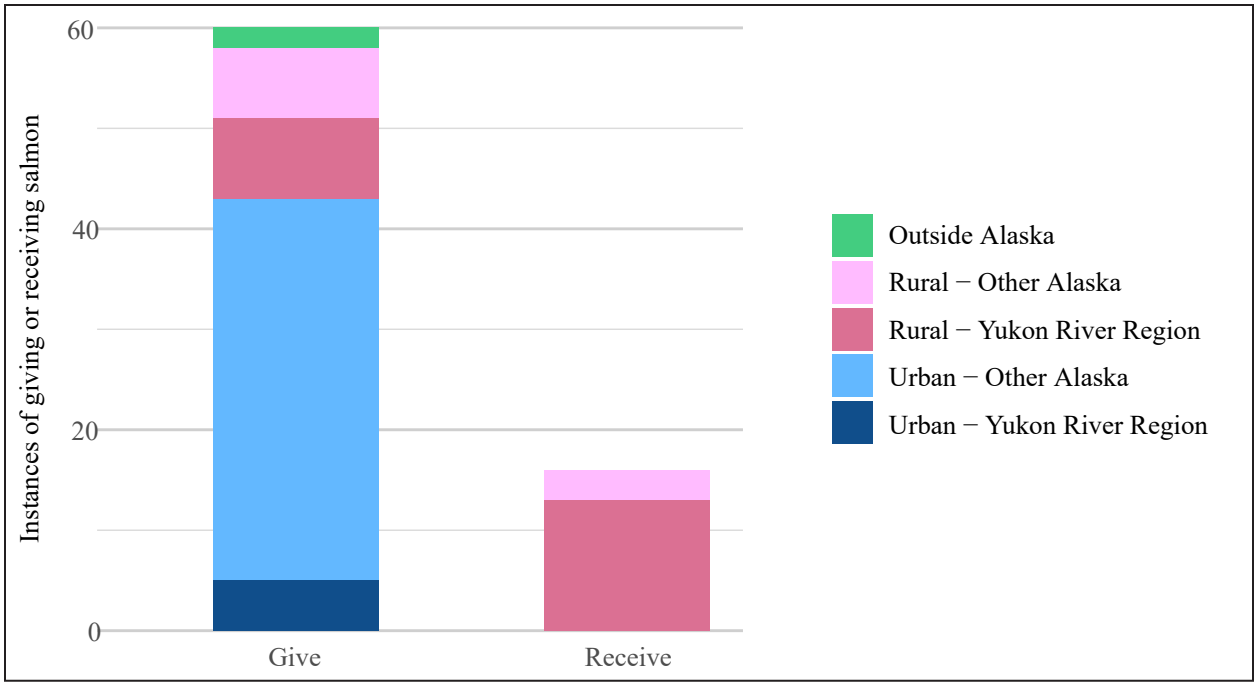

Figure 3-17.–Reported instances of salmon giving and receiving between respondent households and other Alaska communities by region, Pilot Station, 2018–2019.

River communities. When sharing with other communities, Pilot Station residents most frequently gave summer chum salmon, which also accounted for the most edible pounds given (figures 3-18 and 3-19). Households gave less Chinook salmon than summer chum salmon to other communities.

During the study year, 122 instances of sharing salmon with others were reported. Each instance of sharing is called a "tie" between two households. Of the 122 sharing ties, 79 were with family members, and 27 were with family members in elder households (Table 3-19). Six sharing ties were with elders outside the family and five were with friends. There were also two instances of sharing with coworkers and one with a Pilot Station school teacher. Pilot Station gave the most salmon to elderly family members (181 lb), followed by 112 lb given to a teacher (Table 3-20). However, this instance of sharing may not accurately represent the amount of salmon typically shared with teachers. All salmon received from outside of Pilot Station was given by family members.

Table D3-6 compares household characteristics to the average number of sharing ties respondents had with other Pilot Station households and other communities. High harvesting households reported more instances of sharing salmon with other Pilot Station households and other communities compared to households in other harvest level categories. Households led by couples reported more instances of sharing salmon than households with a single male or female lead. Mature households reported sharing salmon with more households within Pilot Station and in other communities compared to households at other maturity levels. Finally, commercial fishing households shared salmon far more commonly than those households that did not participate in the commercial salmon fishery.

Barter and Customary Trade

Local Characterization of Barter and Customary Trade

In Alaska, the barter and customary trade of wild food resources are recognized as customary and traditional practices in state subsistence law. State statute defines barter as "the exchange or trade of fish or game, or their parts, taken for subsistence uses for other fish or game or their parts; or for other food or for nonedible items other than money if the exchange is of a limited and non-commercial nature" (AS 16.05.940(2)). Customary trade refers to the exchange of subsistence resources for "minimal amounts of cash" (AS

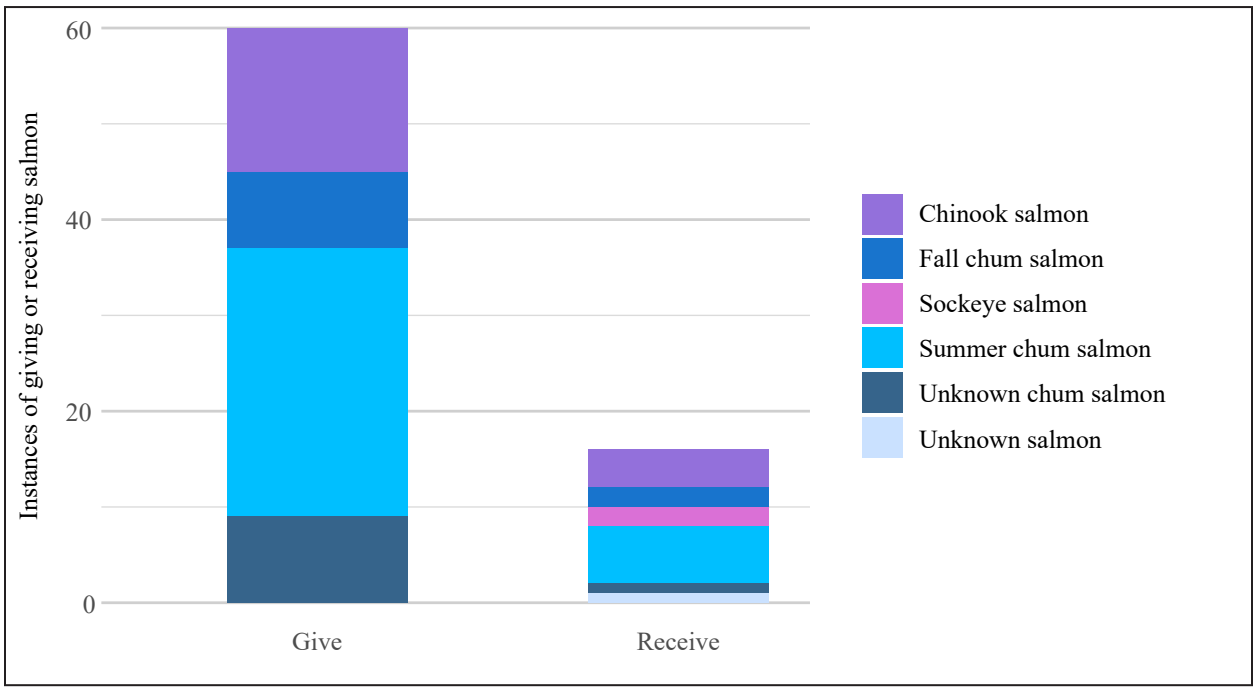

Figure 3-18.–Reported instances of salmon giving and receiving between respondent households and other communities by resource, Pilot Station, 2018–2019.

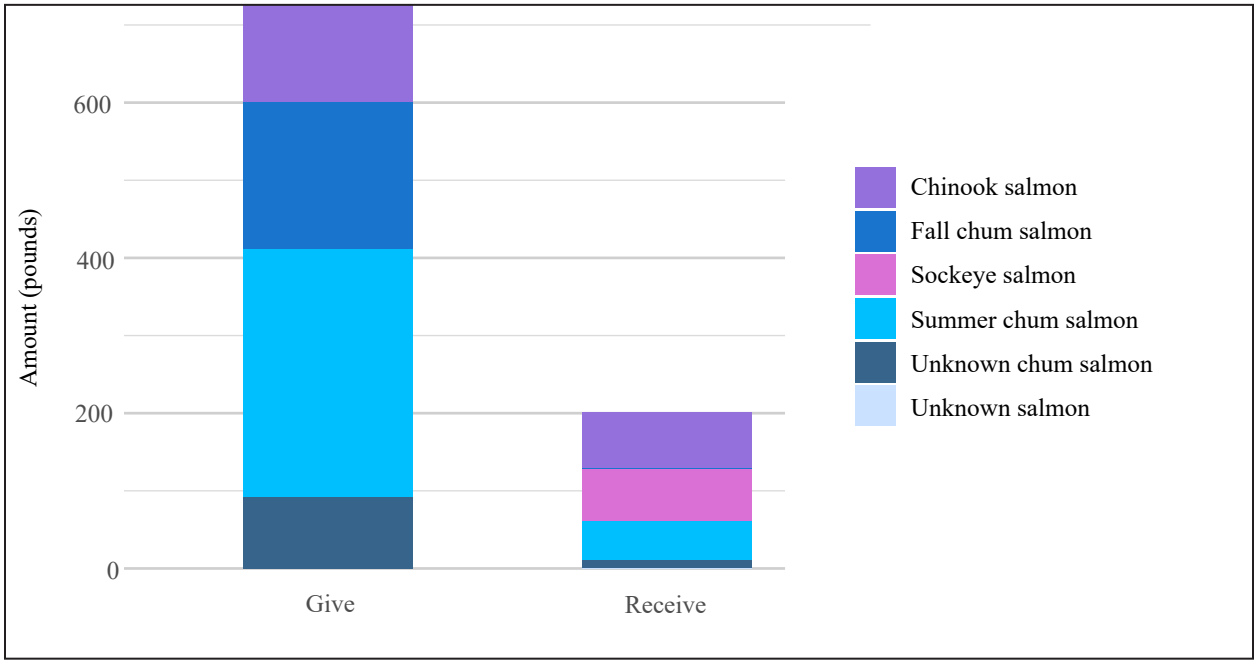

Figure 3-19.–Reported pounds of salmon given to and received from other Alaska communities by resource, Pilot Station, 2018–2019.

Table 3-19.–Number of unique instances of sharing between respondent households and exchange partners by relation, Pilot Station, 2018–2019.

	Unique ties[a]							
Exchange partner	Family (besides elder)	Elder in family	Other elder	Coworker/ Meetings	Friend	Teacher	Unknown	Total
Given to								
Local household	55	19	5	2	4	1	2	88
Other community	24	8	1	0	1	0	0	34
Total	79	27	6	2	5	1	2	122
Received from								
Other community	9	3	1	1	2	0	1	17

Source ADF&G Division of Subsistence household surveys, 2019.

a. Relationship between two households or entities

Table 3-20.–Average pounds of salmon given to and received from exchange partners by relationship, Pilot Station, 2018–2019.

	Average amount (lb)							
Exchange partner	Family (besides elder)	Elder in family	Other elder	Coworker/ Meetings	Friend	Teacher	Unknown	Total
Given to								
Local household	59.4	180.9	21.9	9.0	11.2	112.0	268.8	663.2
Other community	24.2	18.4	67.2	0.0	2.7	0.0	0.0	112.6
Total	83.6	199.4	89.1	9.0	13.9	112.0	268.8	775.7
Received from								
Other community	16.9	16.4	0.0	0.0	0.0	0.0	0.0	33.3

Source ADF&G Division of Subsistence household surveys, 2019.

16.05.940(8)); although the law does not list specific limitations, it does state that transactions must be "non-commercial." In other words, individuals cannot make a business of selling subsistence resources. The terms barter and customary trade are rarely used in everyday language, and their legal definitions often do not align well with the myriad ways in which wild foods are actually exchanged in local communities (Brown et al. 2017). The following section discusses barter and customary trade primarily through the words of key respondents.

Respondents indicated that bartering wild resources was more common in the past, particularly for foods that were available to coastal communities. As one key respondent explained:

> Back then, growing up, like the coastal area didn't have very many beaver down in that area. So we used to bring beaver skin and barter with them for seal oil… And once in a while they go down to coast, barter with them poke fish. The poke fish is where the coastal people they put the fish in the seal container and they put that salmon, chum salmon or dried salmon, and they soak into the oil and during winter they open it and they have that. Once in a while my parents used to barter with them for that. Yeah. Poke fish, they called it. (05112019PQS2)

Advances in transportation since this time have made traveling to the coast easier for Pilot Station residents. Because residents can harvest their own marine subsistence resources, barter relationships with coastal communities are less common. A key respondent explained: "But as the years go by, everybody's starting to have all those what they need now, so they very seldom barter anymore" (05112019PQS2). This respondent also said that bartering may not be as common in Pilot Station compared to other places because of the wide variety of resources available near the community: "See, we don't barter 'cause we have what we want and we get what want in this area…we have the resources. Mainly here we're right in the middle" (05112019PQS2).

Though less common, barter exchanges continue to occur with coastal communities. One key respondent said that residents of coastal communities often want to trade for resources that are only available inland such as punk, a shelf fungus that grows on birch trees[7]. "What they do is they mainly trade with [the] fungus. They call that *araq* for tobacco. Or they come and drop off whole seal to someone, and they want in return a couple big sacks of those fungus. That's how they barter" (05112019PQS2). Other key respondents described trading with coastal communities for a variety of marine resources including seals, seal oil, beluga whales, Pacific herring, and herring eggs (05112019PQS5; 05122019PQS6). One key respondent also said that they trade moose meat or fish for bowhead whale from the northwest Alaska community of Kotzebue (05122019PQS3).

Bartering most commonly occurs among family: "Anchorage and Fairbanks and other places that we share and I trade food with…Friends and family, yeah. Sometimes we plan it…We talk amongst each other what to trade" (05112019PQS5). Also, bartering typically involves exchanges with people in other communities, likely because a function of bartering is to acquire foods that are not otherwise easily obtained locally. One respondent said that his household has bartered for goods from several regions of Alaska and that having children who attend the Mt. Edgecumbe boarding school in southeast Alaska facilitates bartering:

> When we can we'll trade for not only salmon, but other, like, geese or what do you call it, king crab from the Bering Sea. We've got families who we trade with. Or herring eggs from Southeast when we can. Especially when we have students who attend Mt. Edgecumbe. It just all depends on who you network, or who you know. We'll trade blueberries for salmonberries from somebody from Scammon Bay. (05072019PQS1)

Another key respondent explained that commercial fishing also facilitates bartering because fishers travel downriver and have the opportunity to barter with other lower Yukon River communities. (05122019PQS6).

7. Ashes from the shelf fungus *Phellinus igniarius*, also known as punk, are added to chewing tobacco to alter the pH and increase the rate of nicotine absorption into the bloodstream.

Respondents described bartering as a way to increase variability in their diet. One respondent said that they often trade moose meat and salmon: "Some people will ask to trade moose meat for salmon…like if they have more meat and less fish, and if we have more fish and less meat, we trade. It's just good, 'cause, won't have too much of one thing" (05122019PQS7). Another key respondent described trading berries with other communities in years when there is a good crop: "Yeah, some years when we have a really good salmonberry season and they have good blueberry season, we'll trade. Or the other way" (05072019PQS1).

Some households trade salmon with communities elsewhere on the Yukon River based on personal taste: "There's some families we know where they prefer the lower Yukon [salmon] and my wife actually prefers the upper Yukon salmon, so it's just that taste. And they know the lower Yukon [salmon] is really rich" (05072019PQS1). Also, some households trade different salmon species with other communities depending on the amount they were able to harvest locally:

> And some of the people downriver, they miss the king salmon run and want to trade kings for chums. That one year we had so many kings I put away in the freezer. I probably only had two bags, maybe one chum I put away. We had to trade for chum because king is so oily. Not used to eating it all summer. Made me want to trade for chum. (05122019PQS7)

Finally, one key respondent explained that some people do not trade salmon with other communities because they prefer their own preservation method: "Once in a while they will ask us, they could barter with us. Few times some people did that, but they realized that some people have a different way of drying their salmon" (05112019PQS2).

Although no surveyed households reported selling salmon through customary trade, some respondents indicated that they have occasionally seen people selling small bags of dried and smoked salmon strips in Pilot Station.[8] Key respondents indicated that they have not witnessed the activity frequently: "I've seen it in, up when I'm over in some areas, they do. They constantly trade it for cash. They call that customary trade. But we never have a problem with that around here, that I recall" (05112019PQS2). One key respondent indicated that selling salmon is not common in Pilot Station because of the cultural and spiritual significance of salmon:

> They say not to sell it. Yeah. We can't sell our food. I don't know. I mean some people do, but not many. Certain people sell and certain people don't. But it's kind of like against our tradition, religion. 'Cause they say it will be bad luck…Bad luck to sell. It's better to just, here, you know, take it. So in return we'll get more. (05122019PQS3)

Another key respondent said that she has seen customary trade in the past, but elders in the community voiced their opposition to it: "It's a, mainly it's just sharing and giving. I hardly know anybody that does selling anymore. But in the past, I knew there were some people that were selling some subsistence food, and I guess the elders had a talk with them and told them it's not right to be selling subsistence food" (05122019PQS6).

Key respondents specified that the selling of salmon that they have witnessed in Pilot Station has been occasional and small scale: "It's not really a commercial effort. That's a different arena than what we're talking about…Everything is so small scale, so it's not, everything is like a one-time deal and it just depends on the conditions or the circumstances, but it's not really an organized effort" (05072019PQS1). The community may tend to self-regulate the amount of customary trade that occurs based of the traditional belief that one should not sell subsistence food. A key respondent explained that any community member that did sell salmon on a large scale would likely be reported to the authorities: "…people never keep their eyes closed, you know. Something going on, something fishy, they just go ahead and report that, and Fish and Game corrects that. 'Cause they have the feeling, you know, if that guy abuses it, we're going to be to blame. So that's how the system goes" (05112019PQS2).

8. J. Park, ADF&G Division of Subsistence, field notes, May 2019.

Many Pilot Station households participate in the commercial salmon fishery, which provides a way of profiting from salmon that is not available to communities further up the Yukon River. One key respondent speculated that customary trade of salmon might be more common in Pilot Station if the commercial fishery did not exist: "But you never know. If the commercial started to slowly deplete, and money depleting from the government and state, they might tap on it once they start seeing that. You know, for their own survival" (05112019PQS2).

When asked about customary trade, many respondents referred to subsistence-caught salmon that is commonly sold by individuals at the Alaska Federation of Natives convention (AFN), held alternatingly in Fairbanks and Anchorage: "…when I go to Anchorage I see that, you know, when they are having AFN there's people that line up having that brine fish, pickled fish. They let us sample it" (05112019PQS2). This respondent said that he does occasionally buy salmon at AFN, but he prefers salmon that are caught near Pilot Station: "I usually sample 'em around, but they're not rich as our fish, so we very seldom, but once in a while we just go ahead and buy some." Another key respondent said that she does not buy salmon in Anchorage because she prefers her own preservation method: "I did one time. I'd rather have my own. They make it too different…Too salty" (05122019PQS3).

Salmon Barter and Customary Trade Exchanges

Pilot Station respondents reported four unique barter ties and one customary trade tie for the study period (Tables D3-3 and 3-22). All barter exchanges occurred between family members (Table 3-21). Barter exchanges took place between a Pilot Station household and households in the Kuskokwim River community of Bethel, as well as the coastal communities of Newtok and Scammon Bay (figures 3-16 and 3-20). Two barter transactions took place within Pilot Station between a single tie involving two mature households (Figure 3-20). Salmon was exchanged for spotted seal, moose, caribou, and blackberries (crowberries) in barter transactions (figures 3-21 and 3-22).

One Pilot Station household reported purchasing a small amount of dried or jarred Chinook salmon from someone they did not know in Anchorage (Table 3-21). No other customary trade transactions were reported during the study period. Due to the sensitivity of these questions and the stigma surrounding customary trade, these results could be an underrepresentation of customary trade activity within Pilot Station.

Comparison of Network Types

Figure 3-23 shows diagrams for production, sharing, and barter and customary trade networks that occurred within Pilot Station. As discussed above, salmon are shared though a complex network; however, respondents reported very few barter and customary trade exchanges during the study period. Stigmas around buying and selling fish may cause some people to underreport customary trade; however, the same stigmas may also limit customary trade in the community. Barter primarily occurs with other communities and, as a key respondent explained, by his definition, barter is uncommon relative to sharing: "Barter? No, we don't barter. What they do is, you know, we give them salmon and they thank us" (05112019PQS2). This respondent said that reciprocated sharing is not bartering, and shared foods are not accounted for: "But later on, for me, when we go someplace and come home, when moose season is open, there's some moose in the porch that's already there. We don't even know who brings it" (05112019PQS2).

Table D3-7 compares descriptive statistics about each of the salmon networks at three different scopes or scales: all ties, ties between local households only, and ties between local households and other communities only. Density values range from zero to one, the closer to one the higher the number of connections between households. Density values are most meaningful when compared to one another in a particular context, such as sharing, or in fishing groups. When isolated, a low-density value means little without considering the broader social implications of activity being examined. For example, fishing groups would likely never reach a density value of 1 because it is unreasonable to expect all households to fish with every other household in a community. In Pilot Station, sharing had the highest density, or the most connections between households, whereas barter and trade experienced a density value close to zero. In cooperative production, households were typically only connected to a few others at most. The most connections, or highest density,

Table 3-21.–Reported barter and customary trade exchanges by resource and exchange partner, Pilot Station 2018–2019.

Exchange type	Resource given					Resource received					Exchange partner	
	Resource	Processing	Amount	Units	Pounds	Resource	Processing	Amount	Units	Pounds	Residence*	Relationship to respondent
Barter												
	Unknown chum salmon	Dried/smoked/stripped/ kippered (incl. jarred)	30	Individuals	100.8	Spotted seal	Whole, unprocessed	200	Pounds	200.0	Newtok	Elder in family
	Chinook salmon	Fillet	2	Gallons	12.0	Moose	Meat only	1	Gallons	5.0	Pilot Station	Family (not elder)
	Summer chum salmon	Fillet	2	Gallons	12.0	Moose	Meat only	1	Gallons	5.0	Pilot Station	Family (not elder)
	Fall chum salmon	Whole, unprocessed	20	Individuals	89.6	Blackberries	Whole, unprocessed	5	Gallons	27.0	Scammon Bay	Family (not elder)
	Summer chum salmon	Salt fish	5	Gallons	25.5	Caribou	Unknown	Unknown	Unknown	Unknown	Bethel	Family (not elder)
Customary trade												
	Cash	n/a	25	Dollars	n/a	Chinook salmon	Dried/smoked/stripped/k ippered (incl. jarred)	Unknown	Unknown	Unknown	Anchorage	Stranger

Source ADF&G Division of Subsistence household surveys, 2019.
Note If exchange partner residence was unknown by respondent, exchange location was reported instead

Table 3-22.–Mean number of ties and pounds exchanged in barter and customary trade networks, by network and by household characteristic, Pilot Station , 2018-2019 .

		Network							
		Between local households				Between Pilot Station households and households in other communities			
		Receiving		Giving		Receiving		Giving	
Household characteristic	Number of Households	Mean ties[a] (number)	Mean amount (lb)	Mean ties[a] (number)	Mean amount (lb)	Mean ties[a] (number)	Mean amount (lb)	Mean ties[a] (number)	amount (lb)
Harvest category[b]									
High	17	0	0	0	0	0	0	0.18	12.7
Above average	22	0	0	0	0	0.05	0	0	0
Low to average	13	0	0	0	0	0	0	0	0
No harvest	38	0	0	0.05	0.63	0	0	0	0
Maturity[c]									
Developing	24	0	0	0	0	0	0	0	0
Mature	37	0	0	0.05	0.65	0.03	0	0.03	2.42
Elder	28	0	0	0	0	0	0	0.07	4.51
Unknown	1	0	0	0	0	0	0	0	0
Household head									
Couple	56	0	0	0	0	0.02	0	0.05	3.86
Single female	19	0	0	0	0	0	0	0	0
Single male	12	0	0	0.17	2	0	0	0	0
Unknown	3	0	0	0	0	0	0	0	0
Commercial fishing									
Yes	55	0	0	0.04	0.44	0	0	0.02	1.83
No	5	0	0	0	0	0	0	0	0
Unknown	1	0	0	0	0	0	0	1	25.5

Source ADF&G Division of Subsistence household surveys, 2019 and ADF&G Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

Note This table only summarizes the side of the barter or customary trade exchange that involved salmon.

a. Total instances of giving or receiving.

b. Household harvest categories were calculated using the mean household harvest (160.8 lb). The upper limit of the above-average harvest category is one standard deviation (SD) over the mean (437 lb). The high harvest category is any harvest greater than one SD over the mean.

c. Developing: age(s) of households head(s) is less than 40 years. Mature: age(s) of household head(s) is 40–59 years. Elder: age(s) of household head(s) is greater than 59 years.

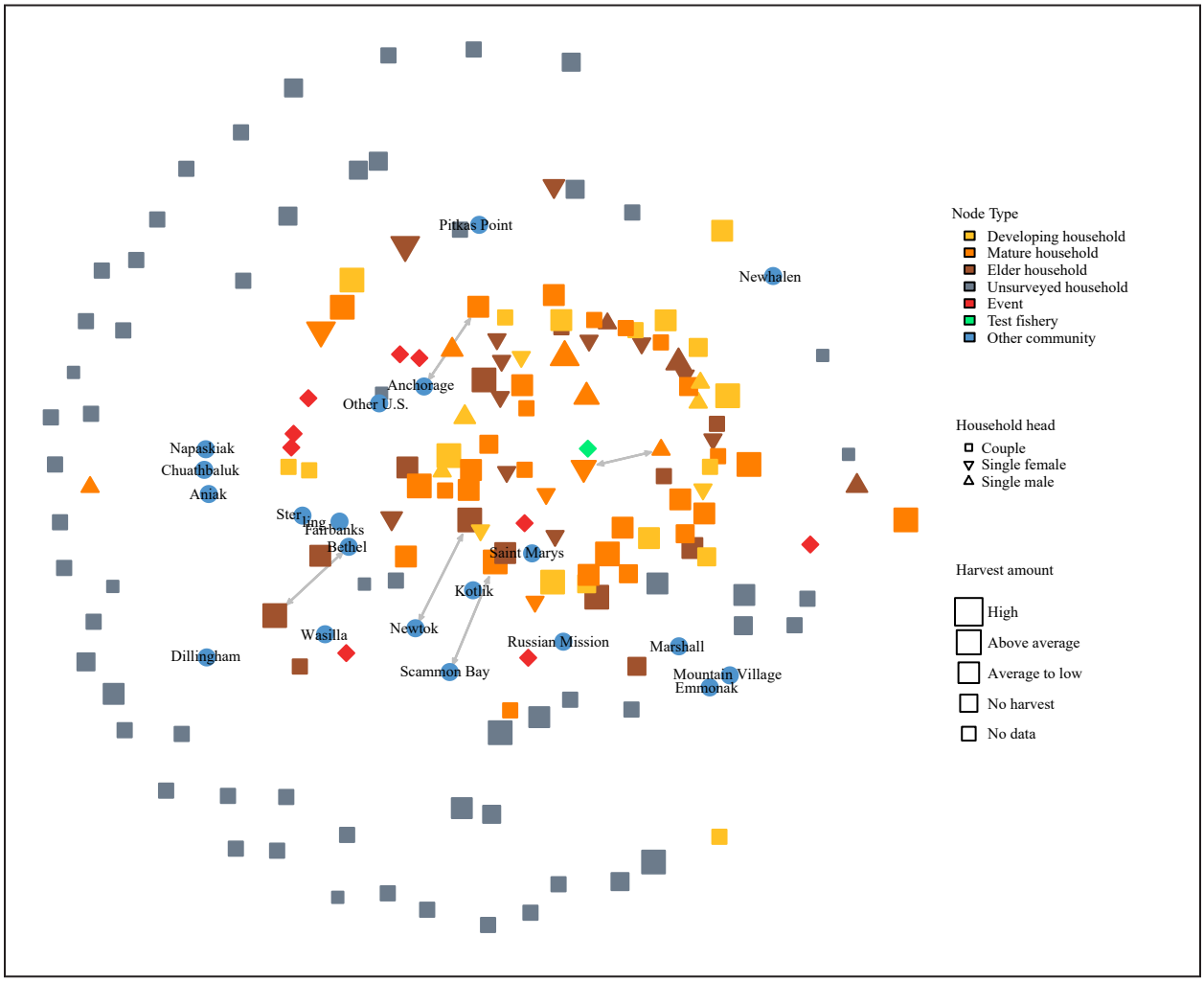

Figure 3-20.–Barter and customary trade network, Pilot Station, 2018–2019.

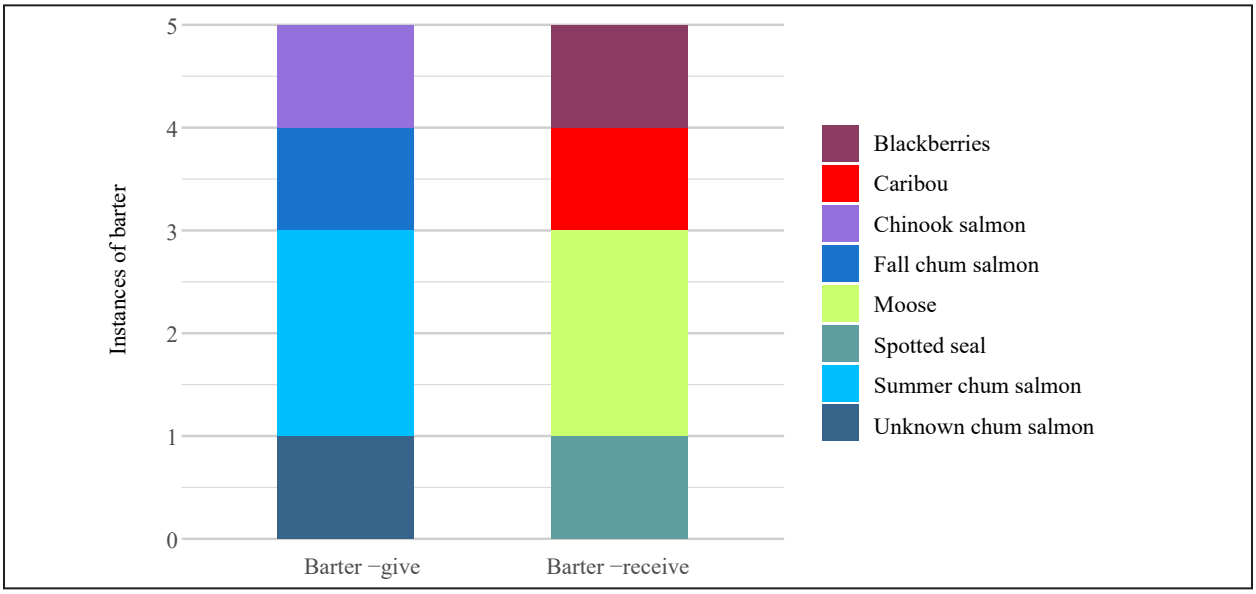

Figure 3-21.–Reported instances of barter by resources given and received, Pilot Station, 2018–2019.

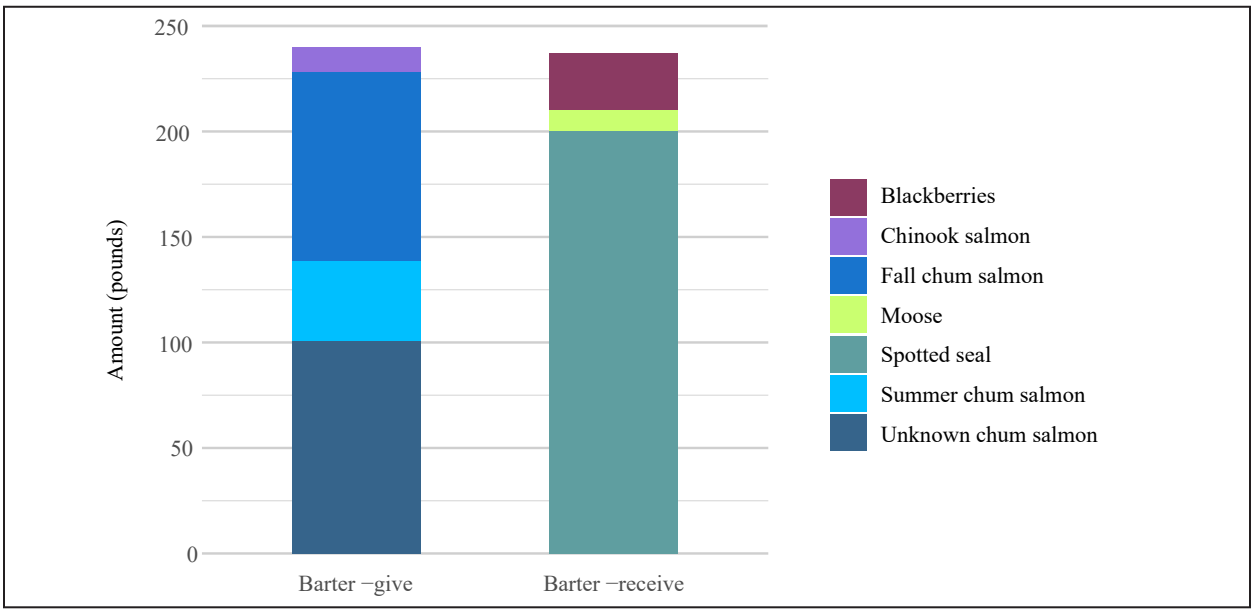

Figure 3-22.–Reported pounds of salmon and other wild foods given and received in barter, Pilot Station, 2018–2019.

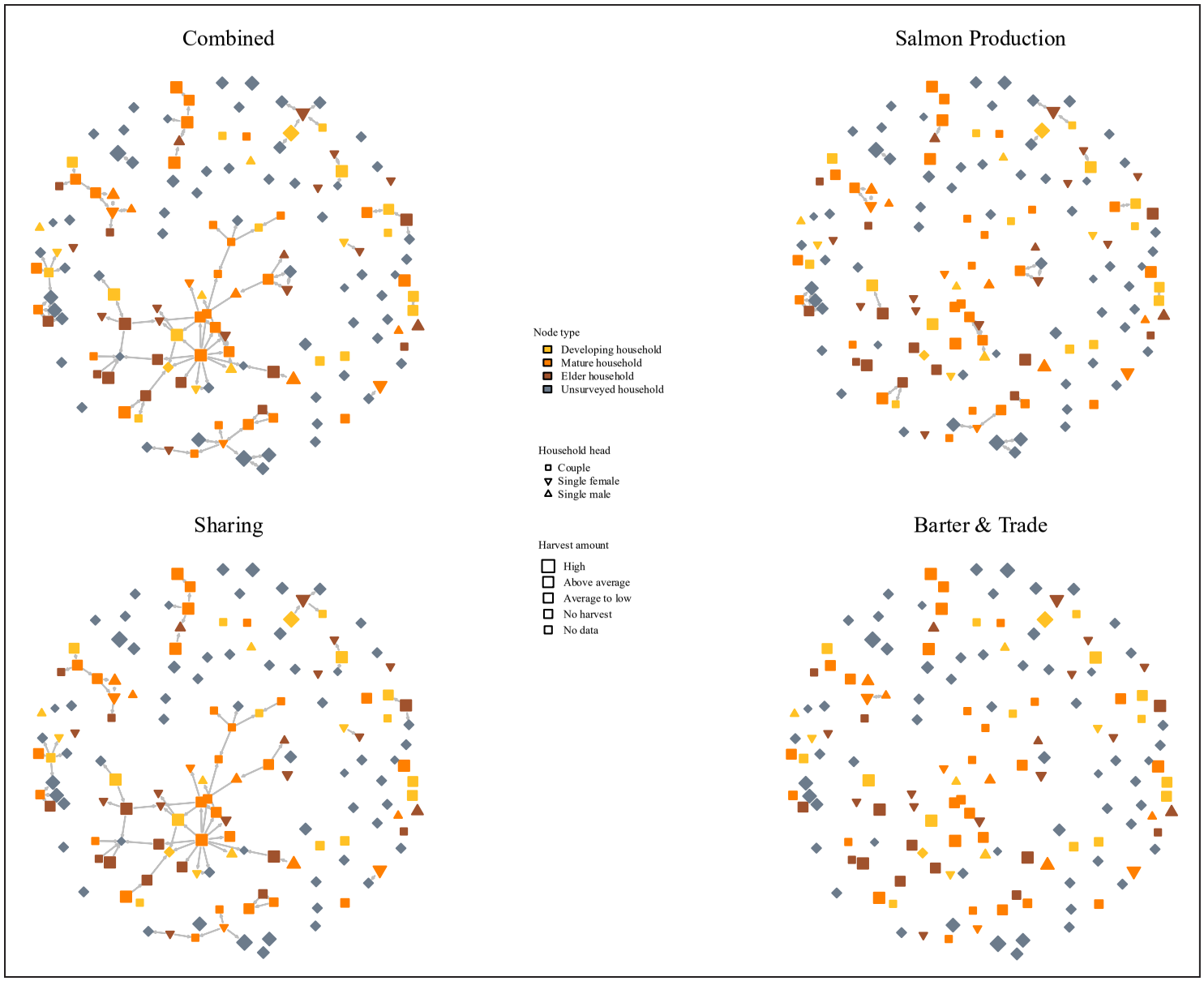

Figure 3-23.–Comparison of exchange networks between respondent households and other local households, Pilot Station, 2018–2019.

was observed for the combined networks scope that included local households, community events, and the ADF&G test fishery (0.01).

The sharing and combined networks had far more ties than the barter and customary trade networks. As a result, these networks had the highest density values and the fewest isolates and components at each scope. Reciprocity values for the production and barter and customary trade networks equaled one because production represents a cooperative relationship between two households that is inherently mutual. Similarly, barter and customary trade exchanges are always reciprocal in nature. Reciprocity values for sharing networks were very low; however, it does indicate that occasionally two houses share salmon with each other. Transitivity was highest in the production network (0.67); however, a few triads exist in the sharing network as well. The three different networks explored here each represent different ways people are connected in Pilot Station and each illustrate how these practices are utilized locally. By looking at the density values, reciprocity, and transitivity we are able to better understand the patterns that exist within these networks and make comparisons between them.

Comparing Salmon Harvests and Uses in 2018 with Previous Years

Harvest Assessments

In order to contextualize harvest and exchange practices of 2018 within a longer time period for residents of Pilot Station, researchers asked survey respondents to assess their 2018 salmon harvests in two ways: whether they used more, less, or about the same amount of salmon in 2018 as in the past five years, and whether they got "enough" salmon to meet their needs. These questions are used to understand how a single study year compares to other years and how local residents understand their own need and access to wild foods. Sharing, bartering, and buying wild foods are all ways to increase access to those foods. Answers to these questions demonstrate the continued need for salmon. If their use of salmon was different in 2018 compared to recent years, households were asked to provide reasons why. If they did not get enough salmon, they were asked what kinds and how much more salmon they needed. Additionally, they were asked to evaluate the severity of the impact to their household as a result of not getting enough.

Results mirrored the lower harvests that Pilot station residents have been experiencing for over a decade; 46% of responding households reported using less salmon in 2018 compared to recent years, 33% used about the same amount, and 17% used more (Table 3-23; Figure 3-24). Twenty-six percent of households reporting less use of salmon in 2018 said that they used less because of personal reasons, 24% used less due to fishing restrictions, and 18% used less because there were fewer salmon available (Table 3-24). Eleven percent of the households that reported using less salmon in 2018 said that they used less because they lacked the equipment needed to fish, and 11% used less due to time conflicts associated with employment. Other reason for using less salmon included receiving less from other households, weather conditions, and changes in household needs. Of the households that reported using more salmon in 2018, 40% said that less restrictive fishing regulations in recent years allowed them to harvest more. Thirty-three said that they used more due to an increased availability of salmon, and 20% said that they received more salmon compared to recent years (Table 3-25).

Forty-nine percent of households reported not getting enough salmon for their needs in 2018 (Figure 3-25). Forty-six percent of these households said that the impact of not getting enough salmon was minor (Table 3-26). Twenty-seven percent experienced a major impact, and 5% felt a severe impact from not getting enough salmon. Thirty-six households (40%) reported needing more Chinook salmon and 34 (38%) needed summer chum salmon (Table 3-27). Households reported needing more summer chum salmon (2,111 fish) than Chinook salmon (607 fish). Only six households (7%) reported needing more fall chum salmon, and one (1%) needed more coho salmon. Sixteen households that did not get enough salmon reported replacing it with other subsistence foods, and 10 reported using more commercially bought food (Table 3-28).

Sharing Assessments

Respondents were asked to describe how their household's sharing of salmon has changed in recent years. Thirty-seven percent of responding households reported that the amount of salmon they share has not

Table 3-23.–Changes in household uses of salmon compared to recent years, Pilot Station, 2018.

Sampled households	Valid responses[a]	Households reporting use: Total households Number	Total households Percentage	Less Number	Less Percentage	Same Number	Same Percentage	More Number	More Percentage	Households not using Number	Households not using Percentage
90	87	84	96.6%	40	46.0%	29	33.3%	15	17.2%	3	3.4%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response.

Table 3-24.–Reasons for less household uses of salmon compared to recent years, Pilot Station, 2018.

Community	Households reporting that sharing patterns changed. Valid responses	Number	Percentage	Less Chinook salmon Number	Percentage	Less other fish Number	Percentage	Less fish overall Number	Percentage	Shared with fewer households Number	Percentage	No sharing Number	Percentage	Other reason - less sharing Number	Percentage	More Chinook salmon Number	Percentage
Pilot Station	85	30	35.3%	10	11.8%	0	0.0%	10	11.8%	1	1.2%	3	3.5%	1	1.2%	5	5.9%

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Table 3-34.–Continued.

Community	Households reporting that sharing patterns changed. Valid responses	Number	Percentage	More other fish Number	Percentage	Less other fish Number	Percentage	Shared with more households Number	Percentage	Shared all fish Number	Percentage	Other reason - more sharing Number	Percentage	Other reason - amount neutral Number	Percentage
Pilot Station	85	30	35.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	5.9%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 3-25.–Reasons for more household uses of salmon compared to recent years, Pilot Station, 2018.

Valid responses[a]	Households reporting reasons for more use	Personal Number	Personal Percentage	Increased availability Number	Increased availability Percentage	Used other resources Number	Used other resources Percentage	Favorable weather Number	Favorable weather Percentage	Received more Number	Received more Percentage	Needed more Number	Needed more Percentage	Increased effort Number	Increased effort Percentage
87	15	1	6.7%	5	33.3%	0	0.0%	0	0.0%	3	20.0%	0	0.0%	1	6.7%

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Table n-m.–Continued.

Valid responses[a]	Households reporting reasons for more use	Traveled farther Number	Traveled farther Percentage	More success Number	More success Percentage	Had more time Number	Had more time Percentage	Store-bought expense Number	Store-bought expense Percentage	Got/ fixed equipment Number	Got/ fixed equipment Percentage	Substitue for unavialable resource(s) Number	Substitue for unavialable resource(s) Percentage	Had more help Number	Had more help Percentage
87	15	0	0.0%	1	6.7%	0	0.0%	0	0.0%	1	6.7%	0	0.0%	0	0.0%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response and households reporting never use.

Table 3-26.–Reported impact to households reporting that they did not get enough salmon, Pilot Station, 2018

Sample households	Households not getting enough salmon.				Impact to those not getting enough salmon.									
	Valid responses[a]		Did not get enough		No response		Not noticeable		Minor		Major		Severe	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
90	83	92.2%	44	53.0%	8	18.2%	2	4.5%	20	45.5%	12	27.3%	2	4.5%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Includes households failing to respond to the question and those households that never used the resource.

Table 3-27.–Types and amounts of salmon that sampled households reported needing, Pilot Station, 2018.

Resource	Households needing	Amount needed	Percentage of households
Chinook salmon	36	607	40.0%
Summer chum salmon	34	2,111	37.8%
Fall chum salmon	6	177	6.7%
Coho salmon	1	100	1.1%
Other salmon	0	0	0.0%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 3-28.–Things households reported doing differently as a result of not getting enough salmon, Pilot Station, 2018.

Valid responses[a]	Bought/bartered		Used more commercial foods		Replaced with other subsistence foods		Asked others for help		Made do without	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
27	0	0.0%	10	37.0%	16	59.3%	1	3.7%	1	3.7%

-continued-

Table 3-28.–Continued.

Valid responses[a]	Increased effort to harvest		Got a job		Obtained food from other sources		Got public assistance		Didn't share as much		Other	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
27	0	0.0%	0	0.0%	1	3.7%	0	0.0%	0	0.0%	3	11.1%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Includes households failing to respond to the question and those households that never used the resource.

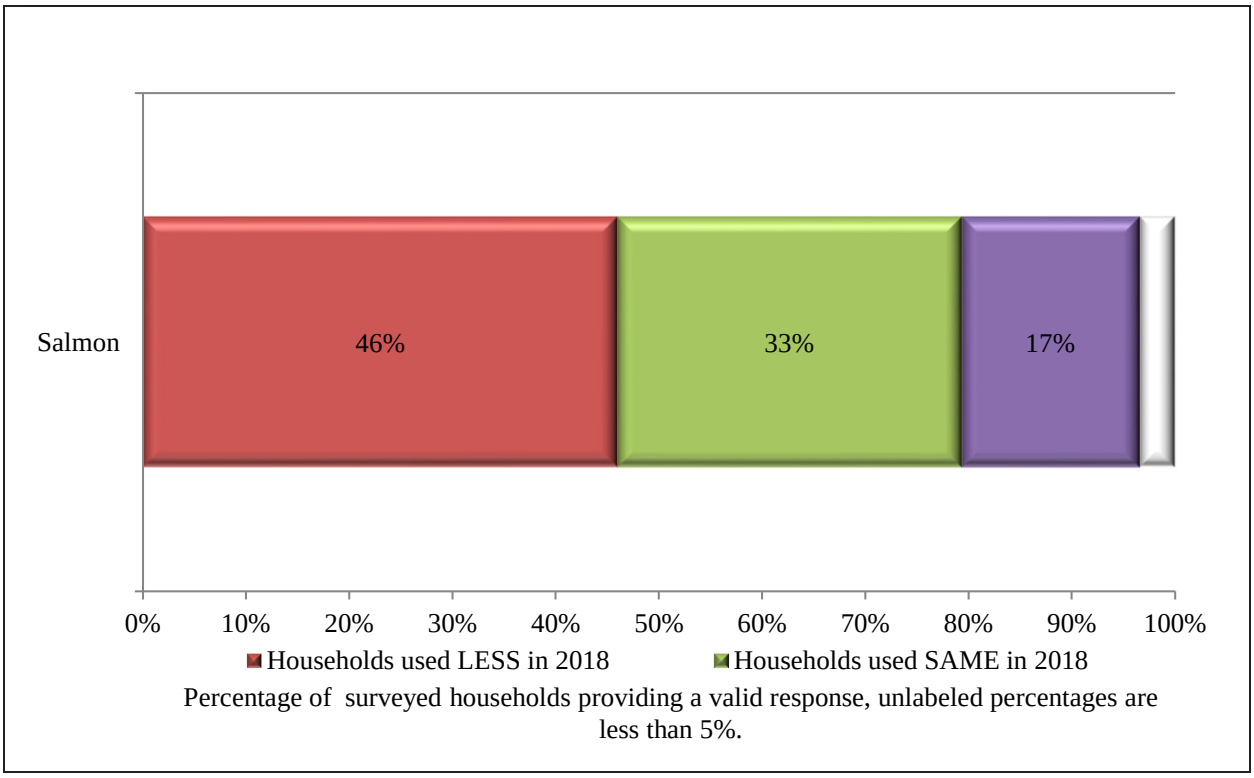

Figure 3-24.–Changes in household uses of salmon compared to recent years, Pilot Station, 2018.

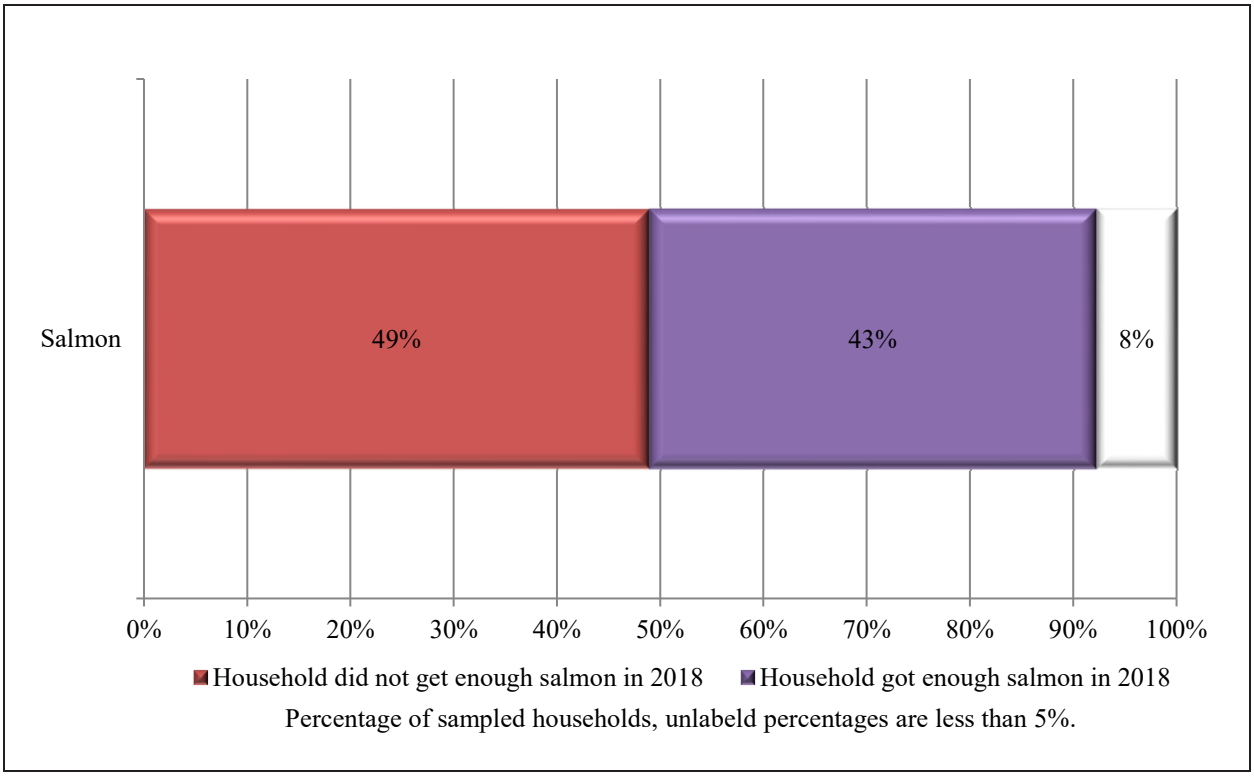

Figure 3-25.–Percentage of sampled households reporting whether they had enough salmon, Pilot Station, 2018.

changed (Table 3-29). Twenty-nine percent reported sharing less salmon, and 11% shared more compared to recent years. Table 3-30 shows changes to the number of households that respondents reported sharing with. Fifty-one percent of respondents reported that the number of households they share with has not changed, 11% shared with fewer households, and 4% shared with more households compared to recent years. Table 3-31 shows the reported changes in sharing of each salmon species. Of 74 responding households, 42% shared less Chinook salmon, and 24% shared less summer chum salmon compared to recent years. Reasons for sharing less largely mirror the reasons given for using less salmon described above. Seven respondents (28%) who reported sharing less salmon said that it was due to personal reasons (Table 3-32). Six households (24%) shared less compared to recent years because there were fewer salmon available and four (16%) reported sharing less because of fishing restrictions. Nine respondents provided a reason for sharing more salmon in 2018 (Table 3-33). Two of these households (22%) were able to share more because they had received more salmon, and two (22%) shared more because they increased their fishing effort in 2018 compared to recent years.

Respondents were also asked how their household's sharing patterns have changed over the last ten years Table 3-34. One research objective of this project was to understand how local perceptions of change, including changes to resource abundance and the climate, impact exchange practices. Asking how and why sharing patterns have changed provided the opportunity for survey respondents to self-report the most important factors impacting their exchange practices. Twelve percent of households reported sharing less Chinook salmon, 12% shared less salmon overall, and 4% were unable to share over the last ten years. Six percent reported sharing more Chinook salmon. Finally, respondents were asked to identify the primary factors that affect their ability to share salmon (Table 3-35). Twenty-one households (49%) named fishing restrictions as a primary factor that determines their sharing of salmon. Eight respondents (19%) said that the amount of salmon they harvest was a primary factor, and five (12%) named personal factors that affect their ability to share salmon. Small numbers of respondents named other factors, including the cost of fishing, the amount of salmon needed by the household, and work schedules that conflict with fishing opportunities.

Previous Salmon Network Data

Figure 3-26 shows a salmon network diagram created from data collected by ADF&G in 2013 (Ikuta et al. 2016) as well as the salmon network documented in this study. The 2013 data were collected as part of a comprehensive subsistence harvest survey in which respondents were asked to identify who was involved in the production of salmon their household used and who else gave them salmon. Due to differing methods between that study and this one, it is not possible to compare the datasets in detail. However, the two datasets do allow for a more general comparison of the number of households connected by salmon within the community during the two study years.

Table 3-36 shows descriptive statistics for Pilot Station sharing networks in 2013 and 2018. Comparing prior salmon networks to the networks produced for the 2018 study year allows researchers to look for patterns of salmon exchange that exist within a single community through time and helps to understand how households are connected through production and exchange. In 2013 fewer households were connected by salmon, and households reported fewer ties than in 2018. Researchers identified 72 households connected by 81 salmon ties in 2013 and 98 households connected by 106 salmon ties in 2018. Some of this difference is likely related to the variation in total number of households in the sample in each year. The density values between the two years are comparable. Density values are very low for both years, as would be predicted due to the nature of salmon fishing in Pilot Station. Fishing households typically do not have reason to cooperate with more than a few other households. Transitivity numbers are also low, because only a few households cooperated in groups of three or more households. Also, the difference in the number of households between study years likely dictates the differences seen in unconnected households and transitivity values. Researchers identified 12 components in each study year, with 29 in 2013 and 50 isolates in 2018. The large number of isolates in 2018 may also be related to study design, which combined household lists from two projects (post-season surveys and network surveys).

Table 3-29.–Changes in the amount of salmon shared compared to recent years, Pilot Station, 2018–2019.

Valid	Does not share/ uncertain of change		Less		Same		More	
responses	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
86	20	23.3%	25	29.1%	32	37.2%	9	10.5%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 3-30.–Changes in the number of households shared with, Pilot Station, 2018–2019.

	Valid	Does not share		Less		Same		More	
Community	Responses	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Pilot Station	81	28	34.6%	9	11.1%	41	50.6%	3	3.7%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 3-31.–Changes in amount of salmon shared compared to recent years, by resource, Pilot Station, 2018–2019.

		Sharing of _____ compared to recent years							
	Valid	Does not share/ uncertain of change		Less		Same		More	
Resource	responses	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Chinook salmon	74	26	35.1%	31	41.9%	13	17.6%	4	5.4%
Summer chum salmon	74	22	29.7%	18	24.3%	31	41.9%	3	4.1%
Fall chum salmon	75	41	54.7%	9	12.0%	23	30.7%	2	2.7%
Coho salmon	74	64	86.5%	3	4.1%	7	9.5%	0	0.0%
Other salmon	52	52	100.0%	0	0.0%	0	0.0%	0	0.0%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 3-32.–Reasons for sharing less salmon compared to recent years, Pilot Station, 2018–2019.

Valid responses[a]	Households reporting reasons for less sharing	Family/ personal		Resources less available		Too far to travel		Lack of equipment		Less sharing		Lack of effort		Unsuccessful		Weather/ environment		Working/ no time	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
86	25	7	28.0%	6	24%	0	0.0%	3	12%	0	0%	0	0%	1	4.0%	0	0.0%	0	0.0%

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Table 3-32.–Continued.

Valid responses[a]	Households reporting reasons for less sharing	Regulations		Small/ diseased animals		Did not need		Equipment/ fuel expense		Used other resources		Competition		Not enough/ no help		Other reasons	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
86	25	4	16%	0	0.0%	0	0.0%	1	4.0%	0	0.0%	0	0.0%	0	0.0%	4	16.0%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response, and households reporting not sharing, or using the resource.

Table 3-33.–Reasons for sharing more salmon compared to recent years Pilot Station, 2018–2019.

Valid responses[a]	Households reporting reasons for more sharing	Personal		Increased availability		Used other resources		Favorable weather		Received more		Needed more		Increased effort		Regulations	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
86	9	1	11.1%	1	11.1%	0	0.0%	0	0.0%	2	22.2%	0	0.0%	2	22.2%	1	11.1%

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Table 3-33.–Continued.

Valid responses[a]	Households reporting reasons for more sharing	Traveled farther		More success		Had more time		Store-bought expense		Got/ fixed equipment		Substitue for unavialable resource(s)		Had more help		Other	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
86	9	0	0.0%	1	11.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	22.2%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response, and households reporting not sharing, or using the resource.

Table 3-34.–Reasons for changes in household sharing patterns over the past ten years, Pilot Station, 2018–2019.

	Households reporting that sharing patterns changed.			Less Chinook salmon		Less other fish		Less fish overall		Shared with fewer households		No sharing		Other reason - less sharing		More Chinook salmon	
Community	Valid responses	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Pilot Station	85	30	35.3%	10	11.8%	0	0.0%	10	11.8%	1	1.2%	3	3.5%	1	1.2%	5	5.9%

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Table 3-34.–Continued.

	Households reporting that sharing patterns changed.			More other fish		Less other fish		Shared with more households		Shared all fish		Other reason - more sharing		Other reason - amount neutral	
Community	Valid responses	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Pilot Station	85	30	35.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	5.9%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 3-35.–Factors having the greatest effects on subsistence salmon sharing, Pilot Station, 2018–2019.

	Valid	Personal		Amount needed		Amount harvested		Cost		Equipment		Regulations	
Community	responses	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Pilot Station	43	5	11.6%	3	7.0%	8	18.6%	2	4.7%	1	2.3%	21	48.8%

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Table 3-35.–Continued.

	Valid	Having help		Work schedule		Amount available from test fishery		Other	
Community	responses	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Pilot Station	43	1	2.3%	2	4.7%	2	4.7%	1	2.3%

Source ADF&G Division of Subsistence household surveys, 2019.

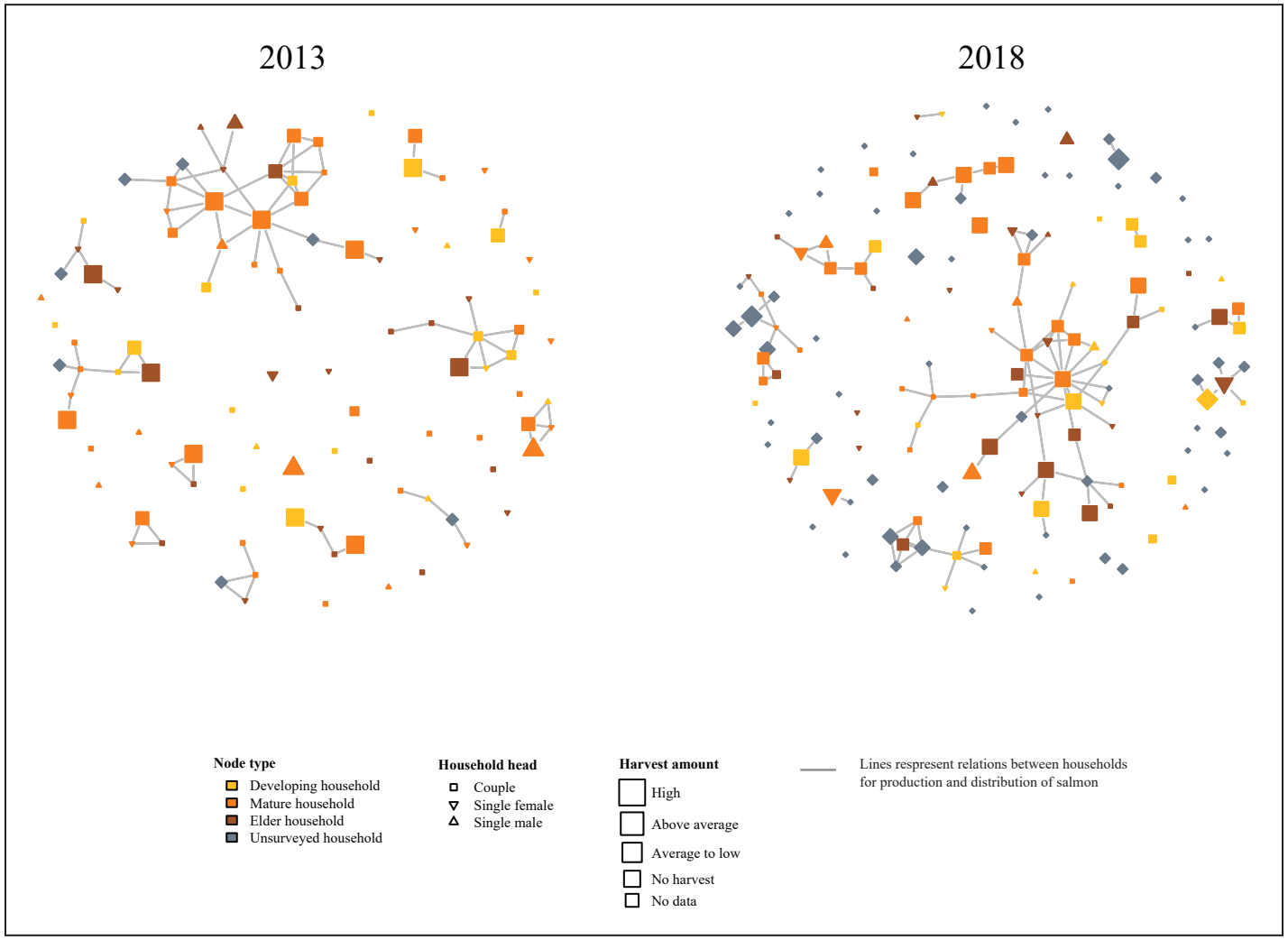


Figure 3-26.–Salmon production and exchange networks, Pilot Station, 2013 and 2018.

Table 3-36.–Numbers of nodes, numbers of unique ties, pounds exchanged, and descriptive network statistics, Pilot Station, 2013 and 2018.

	Households (nodes)			Unique	Salmon	Descriptive network statistics		
Year	Total	Connected	Unconnected	ties[a]	harvest (lb)	Components[d]	Density[e]	Transitivity[g]
2013	101	72	29	81	19,617	12	0.009	0.25
2018	149	98	51	106	20,878	12	0.006	0.4

Sources ADF&G Division of Subsistence households surveys, 2011 and 2019; ADF&G Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. Relationship between two households or entities.

b. The number of clusters of connected actors in a network.

c. The proportion of observed ties in the network relative to all possible ties.

d. The relative number of triangles in the network compared to total number of connected node triplets.

Concentration of Salmon Harvests Among Households

As discussed previously, a small percentage of households typically accounts for the majority of a community's total subsistence harvest. In 2018, approximately 16% of Pilot Station households caught 70% of the total community salmon harvest (Figure 3-27). This is consistent with data gathered during a Division of Subsistence comprehensive subsistence harvest survey conducted in Pilot Station in 2013 when approximately 14% of households accounted for 70% of the total salmon harvest (Figure 3-27). In 2013, 36% of households harvested a total of 26,882 lb of salmon (Ikuta et al. 2016). This is also similar to data gathered in the current study that shows that 44% of households harvested an estimated 23,538 lb of salmon (Table 3-11).

Local Comments and Concerns

This section summarizes local concerns that have not been discussed above. These comments and concerns were recorded during surveys, ethnographic interviews, and community meetings. Some households did not offer any additional information during the surveys and interviews, so not all households are represented in this summary.

Many comments from survey respondents focused on salmon fishing restrictions and the hardship of not having enough Chinook salmon. A key respondent described one way that short windows of fishing opportunity disrupt traditional harvest patterns:

> The traditional families went out and fished when they were ready. When the salmon was here. And every effort was to minimize wanton waste…one example is when windows[9] first started coming out, my mom was ready to cut fish. I went out with a couple of my brothers and we got lots of fish. And there was some elders at the beach, and they told us we're catching too much fish. And we told them no it's not, we're trying to catch fish because Fish and Game gave us permission to go fish. (05072019PQS1)

Other respondents talked about how fishing restrictions early in the season have made salmon preservation more difficult:

> They try to minimize the harvest of the first pulse of kings coming into the river. But for the first pulse the families, for many Native families, it's a good time of the year to start drying. That's when the weather conditions are excellent. Before the rains and before insect infestations. Like the flies coming out. (05072019PQS1)

Early-season fishing restrictions have also created situations in which fishers must harvest their Chinook and summer chum salmon simultaneously. A key respondent explained that this can result in an overharvest of summer chum salmon:

> The Natives, we feel more comfortable meeting our king salmon needs first and then meet our chum salmon needs. So Fish and Game has reversed that traditional harvest effort…When the families were meeting their 6-inch [gillnet mesh] chum salmon needs and then Fish and Game opened 7½-inch gillnets for Natives to go out and get king salmon, there was more incidental catch of chum salmon. The whole community was out there fishing at the same time. So everybody is trying to get king salmon, but at the same time they are saturated with chum salmon, because they already met their chum salmon needs. (05072019PQS1)

This respondent also described how fishing gear restrictions preventing the use of gillnets have caused changes in the community's salmon harvest patterns:

9. The term "windows" refers to the salmon fishery management method of limiting salmon harvest by only allowing fishing during certain time periods or "windows" of opportunity.

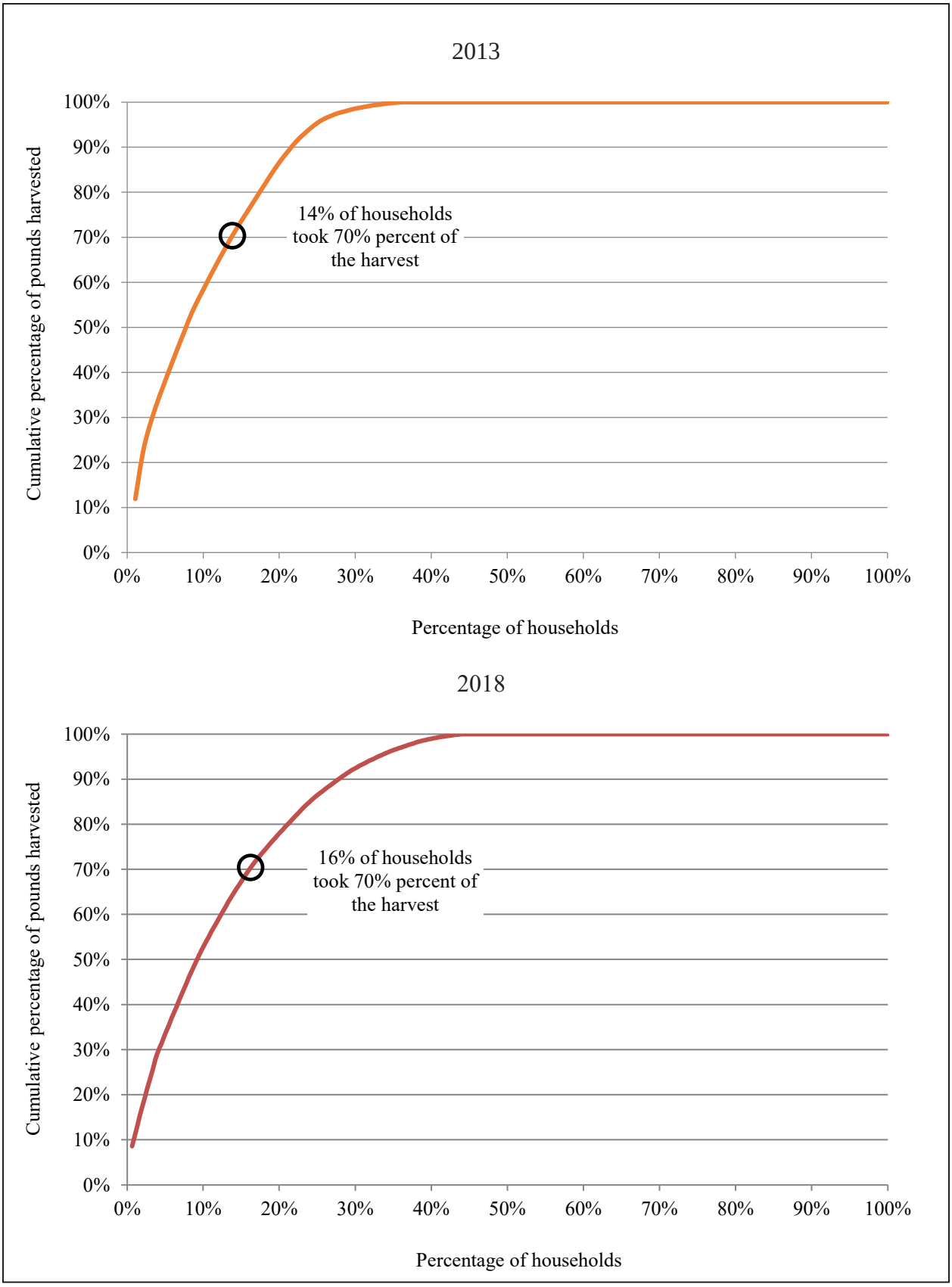


Figure 3-27.–Salmon harvest specialization, Pilot Station, 2013 and 2018

> When the dipnet fishery came out, more families were expending more time and effort to harvest the salmon and families were, their time management really changed everything. The traditional families. Where, for example, the young boys were the ones who went out to fish and the mothers and the daughters were the fish cutters. So what happened was more of the family was going out to fish together. (05072019PQS1)

A few respondents commented that fewer people are harvesting subsistence resources compared to the past. As one key respondent explained: "And these younger generation are not adapted to it now…And I'm starting to see that when older people start passing on, this younger generation don't participate in that. They just slowly lost that subsistence way of life" (05112019PQS2). Another respondent said that certain technological advances in the last 20 years are partially to blame for this trend: "Sometimes I wish I could go back to that era…You didn't have to worry about anything. This technology and the cell phones, and boy, that's really, it's too much" (05112019PQS5).

Finally, some survey respondents commented about the changes in climate that they have witnessed over their lifetimes, including an overall increase in temperature, longer summers, and short, warmer winters.

Conclusion

Salmon continue to be an important cultural and dietary resource in Pilot Station. The exchange and production networks described in this chapter demonstrate the ways in which salmon is harvested cooperatively and given to households in the community who want or need it. Households contribute however they can—with effort, expertise, equipment, supplies, and cash—to help ensure that food is distributed throughout the community. Pilot Station residents harvest and share summer chum salmon in larger quantities compared to Chinook salmon. However, Chinook salmon tend to be highly prized and are shared widely when available. Many households use salmon caught by the test fishery, and some households rely on it. Fishers in the community would likely harvest more salmon, and the sharing network within Pilot Station would likely be more complex, if salmon were not available from the test fishery. Respondents reported very few barter and customary trade exchanges during the study period. Barter exchanges primarily occurred with other communities. Sharing food can be reciprocal, and households that receive food often want to return the favor. Respondents explained that this network of exchanges represents the nature of sharing and differs greatly from a barter transaction that is negotiated and agreed to.

ACKNOWLEDGMENTS

ADF&G Division of Subsistence would like to thank the residents of Pilot Station for your patience and for allowing us into your homes. The author would also like to thank the Pilot Station Tribal Council for approving this research project and the key respondents for freely providing details about their lives and their culture. Finally, thank you to our local research assistants who helped us schedule and administer surveys and who shared their knowledge of the community with us.

4. NULATO

Helen S. Cold

The information presented in this chapter is the result of a two-phase research effort approved by the Nulato Tribal Council (see the Methods chapter for additional details). During the first phase, as described in Chapter 2: Methods, Division of Commercial Fisheries (DCF) administered household salmon harvest surveys. Each fall after salmon fishing has ended, DCF staff conduct surveys in all Yukon River communities to collect household salmon harvest data that are used to estimate community salmon harvests. Typically, DCF uses a stratified sample for the postseason harvest survey, but in preparation for this study they agreed to expand their sample to a census so harvest data would be collected for as many households as possible prior to the second research phase. In October 2018, DCF staff surveyed 72 of 79 households in Nulato (91%) about their salmon harvests (Table 4-1).

During the second phase of research in May 2019, three Division of Subsistence staff and three local research assistants (LRAs) administered an additional survey that verified each household's previously reported salmon harvests and explored the ways in which harvested salmon were shared and distributed within and outside of the community in the months following the fishing season. Sixty-two households (79%) participated in the salmon exchange survey (Table 4-2). The average salmon exchange survey length was 19 minutes (Table 4-3). Ultimately, 75 households (95%) participated in both surveys; 72 households completed the postseason harvest survey, 62 houses completed the network survey, 13 households only participated in the harvest survey, and 4 households did not participate in either survey.

Division of Subsistence staff also worked with LRAs and the tribal councils to identify key respondents to participate in recorded ethnographic interviews. Six interviews were completed with 10 longtime Nulato residents, all of whom were experienced and knowledgeable salmon fishers. The average interview length was 43 minutes. Through these interviews, respondents shared important local and traditional knowledge about the nature of salmon fishing and the cultural practices around the distribution of wild foods in the community that could not have been obtained from the surveys alone.

Community Background

Nulato is a Koyukon Athabascan community located on the west bank of the Yukon River set among the Nulato Hills east of the Nulato River (Figure 1-1). The community is about 35 miles west of the regional hub of Galena and 310 air miles west of Fairbanks.[1] The Innoko National Wildlife Refuge is situated on the east bank of the Yukon River directly across from the community of Nulato and includes the Kaiyuh Flats, an almost 300-square-mile floodplain consisting of a network of streams, lakes and wetlands. Local residents refer this area as "Kaiyuh" and use it heavily for subsistence hunting, fishing, and gathering activities. Nulato falls within the continental climate zone, which is characterized by extremely cold winters and warm summers. Local weather ranges to over 70° F in summer months around -40° F in winter, and average annual precipitation is 16 inches, including 74 inches of snowfall. The landscape around Nulato is typical of Interior Alaska: it is dominated by vast forests of spruce, birch, and aspen, along with expanses of alder and willow shrubs and muskeg.

Prior to contact with Russian and European traders in the early-mid 1800s, Athabascan people living in the area around Nulato were semi-nomadic, traveling to harvest wild resources in accordance with seasonal cycles of abundance. Families would move among spring, summer, fall, and winter camps as they harvested plants and animals found in specific locations on the landscape. The community has a long history as a location for trading. It was used as a meeting area for trading between Interior Athabascans and Iñupiaq Eskimos in the time before European contact (Joe 1987; Loyens 1966; Moncrieff and Klein 2003), and in

1. Alaska Department of Commerce, Community, and Economic Development (ADCCED) Division of Community and Regional Affairs, Juneau. n.d. "Welcome to DCRA Open Data: Nulato." Accessed February 16, 2021. https://dcra-cdo-dcced.opendata.arcgis.com/

Table 4-1.–Sample comparison, ADF&G Division of Commercial Fisheries and ADF&G Division of Subsistence, Nulato, 2018 and 2019.

	Number
Total households in community[a]	79
Total sampled households	75
Households sampled in postseason harvest survey	72
Households sampled in network survey	62
Households only sampled in postseason harvest survey	13
Unsampled households	4

Sources ADF&G Division of Commercial Fisheries postseason harvest surveys, 2018, and ADF&G Division of Subsistence household surveys, 2019.

a. Total number of households identified by Division of Commercial Fisheries postseason survey. This number may differ from the Division of Subsistence total households.

Table 4-2.–Sample achievement, ADF&G Division of Subsistence, Nulato, 2019.

	Community
Sample information	Nulato
Number of dwelling units	91
Survey goal	100%
Households surveyed	62
Households failed to be contacted	10
Households declined to be surveyed	7
Households moved or occupied by nonresident	12
Total households attempted to be surveyed	79
Refusal rate	10.1%
Final estimate of permanent households	79
Percentage of total households survyed	78.5%
Survey weighting factor	1.27
Sampled population	175
Estimated population	223.0

Source ADF&G Division of Subsistence household surveys, 2019.

Table 4-3.–Survey and interview length, Nulato, 2019.

	Length (minutes)		
Community	Average	Minimum	Maximum
Interviews	42	17	94
Surveys	19	5	61

Source ADF&G Division of Subsistence household surveys, 2019.

1838, Nulato was established as a Russian trading post (Clark 1981). The establishment of this trading post increased competition among local groups for control over the flow of manufactured items and furs, which ultimately culminated in a large massacre at Nulato in 1851 (Joe 1987; Loyens 1966; Wright 1995).

After the United States acquired Alaska from Russia in 1867, missionaries and gold miners joined those Russian traders who continued to live in the area around Nulato (Loyens 1966). Koyukon Athabascans living in the area began to slowly adopt a mixed cash-subsistence economy that, although still characterized by seasonal cycles, also included new opportunities associated with the increased economic activity that went along with gold mining and larger, more permanent settlements. In 1887, Catholic missionaries established a school and a church, and by the turn of the century, steamboat traffic on the adjacent Yukon River had reached its highest levels. Along with the increase in human traffic came devastating diseases: in 1900, a combination of measles and widespread food shortages resulted in the deaths of nearly one-third of all Nulato residents (Loyens 1966). Epidemics continued to plague the region into the 1930s. When the U.S. Air Force began constructing an airfield in Galena in 1941, some families migrated from Nulato to Galena to take advantage of new job opportunities. Compulsory schooling in the 1950s further changed the semi-nomadic way of life of many residents by making multigenerational travel more difficult, although many families did still spend large portions of the spring, fall, and winter months at camps in Kaiyuh (Brown et al. 2010; 2015a).

One ethnographic respondent spoke in great detail of her childhood during the middle of the 20th century, when she lived in seasonal camps with her extended family:

> For the first, about, almost 10 years of my life, we were nomadic, as a people. So, in the fall time we moved to Patsy Slough. Before that was up in Kaiyuh. That's where lotta the families here helping each other. Because a lotta the people had rowboats. And few people had inboards. So they'd help those people to move up in the spring. That's the whole household. Dogs, and all. And I remember we lived in Patsy Slough. We'd go over there in the fall, and grandma and grandpa would move with us. I remember rolling up sod. Grandma always cut it, and I'd roll it up. And then she'd tie it in a bundle. And we lived in that while they built the log cabin. It was [located on] a cut bank. I remember they had to make steps before we could move, step up. We moved there every fall and moved away back here every spring. One year Uncle [name] stayed with us. That was when they built the cabin. And Grandpa was younger then, so he helped 'em. But the grandmas helped, like, with the sod and the moss and stuff like that. They brought that out and great big gunny sacks. And they put the moss in between the logs. And I remember, they cut the willow, or small tree poles, and that's what they put on top of the house. Then the grandmas, mostly, cut the grass. Long, tall grass from in the lake. And they put that on top of the logs. And then on top of that they put dirt. For the roof. And then on top of that they put sod. Yeah, I remember that our dogs were right here. And they used to go up to, in towards the slough. That's where Mom and Dad trapped. (05132019NUL7)

Nulato was incorporated as a city in 1963; the community was located directly adjacent to the east bank of the Yukon River. In response to a devastating flood in 1979, many families and community buildings relocated to an area of higher elevation in the Nulato Hills two miles from the original site, although the school, church, community hall and many family homes either remained or returned in later years to near their original locations. This newer part of town has two stores, a washeteria, a post office, a city office, a tribal office, and teen and adult recreation centers. The school, Catholic church, community hall, and another washeteria are located within the original townsite.

In 1975, fisheries in the Yukon Area were divided into districts to protect sustained yields for subsistence and commercial salmon fishers (Shirley 1992). Nulato is located in District 4, Subdistrict A of the Yukon River watershed (5 AAC 05.200).

History of Local Salmon Fishery

Salmon are a resource of central importance to residents of Nulato: in 2010, salmon accounted for nearly half of all wild food harvests by weight (Brown et al. 2015a). Prior to the cultural and economic changes of the mid-late 1900s, families would disperse to fish camps situated along the banks of the Yukon River for miles both upriver and downriver of the community and would remain in camp for the entirety of the salmon fishing season catching and processing the several species of salmon traveling upriver to spawn. One key respondent spoke of a time in his youth where his entire extended family would spend summers at fish camp:

> When [I was] in elementary school, day after school they brought us to Bishop Mountain. And then day before school, they brought us back [to] fish camp. So day after school was out, we went to fish camp, and day before the school started, we went back. There was a lot of work, a lot of work to do. We were there all summer. And parents, grandmothers, uncles, aunties. There was actually, at one point there was 65 of us there. We had like 15 buildings there. It was like a little town. Yeah, so, we all grew up there, and everybody stopped by there. They had visitors every day because, people from here, Galena, lotta people went there and fished, and just went there to stop there to eat fish, I guess. (05132019NUL9)

With the gradual shift away from a semi-nomadic way of life, many families abandoned their seasonal fish camps and relocated their smokehouses to town. An ethnographic respondent with many decades of fishing experience recounted the challenges of transitioning to a more stationary way of life predicated on the new rules surrounding children and schooling:

> School is where all the kids couldn't get out to camp. At their age, you know. That's when they stop us—I mean, they didn't *stop* us, I mean they stop the family from bringing the kids out. They had to go to school. They stay with grandma, yeah. And then after she, my younger boys, she took care of them while we're out camp. Fall camp, winter camp, springtime. (05132019NUL3)

Additionally, the availability of motorized watercraft meant people no longer had to stay at camp to process fish, because the fish could be easily transported longer distances (05132019NUL3, 05132019NUL4, 05132019NUL5). Although within the last 40–50 years most families have relocated their salmon processing stations to Nulato, some families continue to spend a large amount of time at fish camps outside of town.

Runs of chum, Chinook, and coho salmon pass Nulato as they travel to their spawning grounds. Salmon fishing usually begins in June, although if breakup happens early the activity can occasionally start in May. Chinook and summer chum salmon are generally caught in June and July, and coho and fall chum are targeted in late July and early August. Although summer and fall chum salmon are the same species, residents make a clear distinction between these spawning populations. Summer chum salmon are locally known as "dog fish," and fall chum salmon are locally referred to as "silvers" (05132019NUL3, 5132019NUL6, 5132019NUL7). Both fish can be and are consumed by people, but they are often processed differently. According to one ethnographic respondent, the first run of summer chum salmon is especially rich, similar in quality to Chinook salmon, and they use most of the fish from that first harvest for human consumption (05132019NUL3). Filets of prime-quality summer chum salmon are often air-dried to create what many Nulato locals call "sun-dried" or "Notzel," and poorer-quality summer chum are cut and dried for dog food (05132019NUL3). Later in the summer, fall chum salmon are processed in a variety of ways, including canned, smoked, kippered, and dried (05132019NUL2). Chinook salmon, the species of choice for many Nulato fishers, are processed and consumed in a wide variety of ways as are the limited number of coho salmon captured (05132019NUL6, 05132019NUL7, 05132019NUL2, 05132019NUL4).

People in Nulato have changed the types of fishing gear they use for salmon over the last several decades. Before the availability of snowmachines (starting in about the 1960s), many residents used sled dogs for transportation. During that time, most fishers captured salmon with set gillnets and fish wheels. Many families would dry or smoke thousands of chum salmon to keep their dog teams fed throughout the year.

Before the appearance of formal commercial fisheries for salmon roe in District 4 in the late 1970s, chum salmon were traded for cash or credit that was used to purchase commercial items at local stores (05132019NUL3, Wheeler 1987). Many fishers would sell excess fish to a regional buyer, who would then resell the fish to families that needed additional dog food later in the year (05132019NUL3). The combination of increased personal need and economic incentive resulted in the use of a large number of fish wheels, which, although involving a large time investment to create and deploy, can allow for the continuous capture of large quantities of salmon. As snowmachines began to replace dog teams, families no longer needed to harvest such large numbers of salmon for dog food; many scaled back their efforts to catch only what they needed for human consumption (Andersen 1992). The cessation of the commercial chum salmon roe fishery also contributed to a decline in intensive fishing. Large fish wheels became less commonplace, and more families set gillnets. With this gear type, fishers began catching larger quantities of Chinook salmon (05132019NUL3, 05132019NUL6, 05132019NUL7). One fisher described their family's transition from fishing for primarily summer chum salmon to fishing for Chinook salmon:

> We had [a] fish wheel, and setnet too, though. Yeah. We had both. We were getting mainly summer chum. We didn't hardly get any king [Chinook] salmon. It was just by accident or if people gave it to us. So, and all my cousins, we didn't become, become king salmon fishermen until drifting came along. And then drifting just opened it up because you could just find a good spot and get it, all you would need. That was like in the 19-, late '80s, yeah. Because we caught our biggest fish in the mid-'90s. (05132019NUL6)

Past studies have documented the central role of salmon in the mixed cash-subsistence economy of Nulato. An ADF&G report of all wild food harvests in the community for the year 2010 indicated that salmon constituted about 45% of the total edible pounds of wild foods collected that year (Brown et al. 2015a). Additionally, a report published the same year detailed the socioeconomic effects of declining salmon runs in the Yukon River, and Nulato was a collaborating community in that work (Brown et al. 2015b). Although many people harvest and consume chum and coho salmon, most Nulato families prefer Chinook salmon. In 2010, local fishers harvested a total of 28,211 edible pounds of salmon, 18,878 lb (67%) of which were from Chinook salmon (Brown et al. 2015a). The remaining salmon harvest consisted of 4,153 lb of coho salmon (7%), 3,563 lb of fall chum salmon (6%), 1,476 lb of summer chum salmon (2%), 137 lb of sockeye and 5 lb of pink salmon (both less than 1%). Although most salmon harvested for subsistence are destined for human consumption, others are still fed to dog teams. In 2010, approximately 2,933 lb of of fall chum coho salmon were fed to dog teams.

Since 1990, ADF&G has used postseason harvest surveys to record numbers of salmon (by species) harvested for subsistence purposes by residents of communities along the Yukon River. This information can reveal harvest trends over time. Since 1990, total subsistence salmon harvests in Nulato have declined, although this decline was comparatively mild when compared to declines measured in other communities (Figure 4-1). Chinook and fall chum salmon were harvested in greater numbers than summer chum and coho salmon for most years between 1990 and 2018, except for a large peak in harvest of summer chum salmon from 1998–1999. The increased capture of summer chum in the late 1990s coincided with high harvests of fall chum and Chinook salmon. After years of relatively high harvest, the runs of all Yukon salmon species were weak or below average (Brown et al. 2015b). In the years following the 2009 economic disaster declaration[2] associated with an extremely low Chinook salmon return, regulatory restrictions impacted fishing patterns. From 2013–2015 harvests of Chinook salmon dropped dramatically in Nulato (Figure 4-1). In 2013, Nulato fishers caught 602 Chinook salmon, but they did not catch any in 2014 and only 33 in 2015. In other years, Nulato fishers harvested between 1,250 and5,199 Chinook salmon . Perhaps to compensate for the lack of Chinook salmon between 2014 and 2015, Nulato fishers harvested more chum salmon. Fall chum salmon, in particular, were the most heavily harvested salmon species in Nulato from 2012 to 2016.

History of Local Events

Several prominent social events take place annually in Nulato, and many families exchange wild foods at these gatherings. The timing of community social events often coincides with the colder months of the year

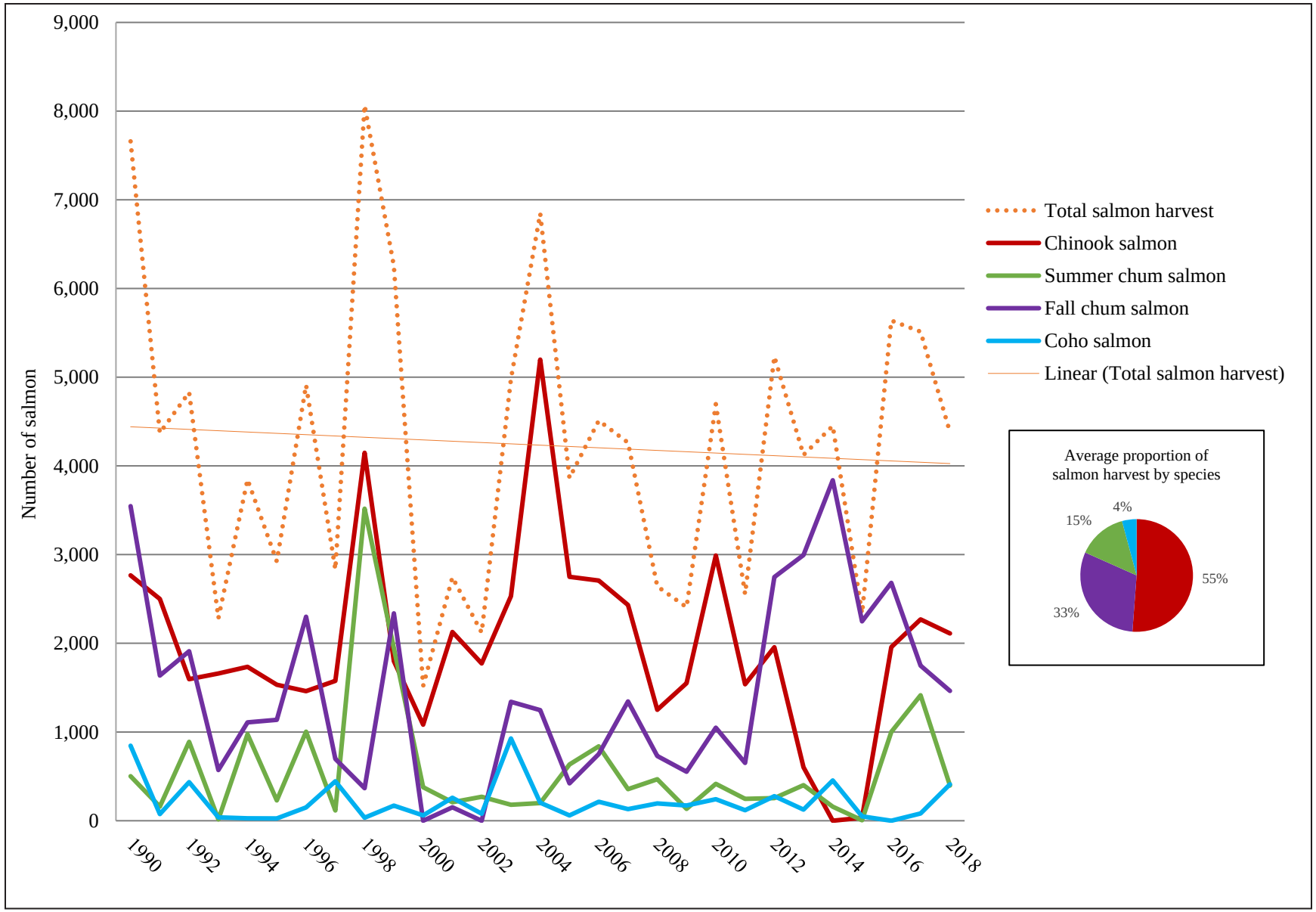


Figure 4-1.–Salmon harvests by resource and amount, Nulato, 1990–2018.

when resources can become scarce for some. Salmon, as one of the primary wild foods in the community, are commonly shared.

Three annual potlaches take place in Nulato: on Memorial Day, Labor Day, and New Year's Day. The potlach for New Year's Day, locally referred to as Medzeyh okko, has deep historical roots within the community (05132019NUL3, 05132019NUL6). The name "Medzeyh okko" is derived from a song sung for many generations in which the ancestors of today's Nulato residents ceremonially called the caribou (05132019NUL4). The ceremony takes place from January 1–3. To prepare for the event, volunteers travel from house to house collecting whatever foods each family wishes to donate. The volunteers carry a large, stretched canvas cloth held open between them as they approach, and each family tosses the donated food items onto it. One ethnographic respondent describes how the donated foods are delivered to and distributed at the community hall:

> And then they bring all that, truckloads of food. When their vehicles get full, they'll bring it down to the hall. And then there'll be piles of fish, piles of meat, piles of canned foods, crackers, everything. And they'll open up all the fishes and put them in totes. And then they just pass out fish. And they pass out like crackers, and candy, and canned foods. So everybody gets a little bit of everything. (05132019NUL5)

In addition to the annual potlatches, community members participate in a semi-annual six-day ceremonial potlatch called Stickdance. Stickdance is a memorial ceremony that is unique to the communities of Nulato and Kaltag that memorializes a deceased person or persons. Households that are memorializing a friend or family member spend considerable time (often years) and money to gather and prepare enough food and other resources to feed event guests. Wild foods, especially salmon, are critical to hosting a successful Stickdance. Families who are hosting the event provide meals throughout the week for all attendees, which sometimes number in the hundreds of people. In addition, jars of salmon and bags of processed salmon strips are given to attendees to take home. The entire week is filled with dancing and eating and sharing food. According to one interview respondent, "A lot of people share their fish, their best they have, for the week with family and friends, everybody that comes in. They give away jarred fish, jarred strips, yeah" (05142019NUL1). The length of a Stickdance event and the elaborate ceremonies and preparation that go into it make it a unique type of memorial potlatch. The way these ceremonies and traditions revolve around the sharing of wild foods, particularly salmon, speaks to the significant role the sharing of salmon plays in all aspects of Koyukon Athabascan life. Being able to provide food for all guests is a great undertaking, and putting a loved one to rest is largely dependent on that ability.

Population Estimates and Demographic Information

The Division of Subsistence gathers demographic data to understand household maturity and to understand how factors such as, age, marital status, and number of household members impacts the use and harvest rates of wild foods. ADF&G estimated the population of Nulato in 2018 to be 223 individuals in 79 different households; 98% of the population identified as Alaska Native (Figure 4-2; Table 4-4). Population counts conducted by the U.S. Census in 2010 and the ACS estimates for the years 2014–2018 are somewhat higher, which may suggest differing methods and population decline in the community. Figure 4-3 shows a population decline for Nulato starting around 1990. In 1939, the community had 113 residents, and from that year until 1986 the population grew to 378 individuals. Since 1986, the number of residents has slowly declined for estimates across all age cohorts.

Surveys were administered to 62 of 79 eligible households in Nulato, or 79% of all households (Table 4-5). The mean household size was three individuals, with a minimum household size of one and a maximum of seven. The average age of Nulato residents was 38 years old, and the oldest resident at the time of survey was 98. Although individuals were present from all five-year population cohorts from 0–99 years of age, there were many male and female residents from 10–20 and 55–65 years of age, and the majority of residents over 70 were female (Figure 4-4; Table 4-6). Average length of residency was 31 years, whereas the average length of community residency for heads of households was 44 years (Table 4-5).

Table 4-4.–Population estimates, Nulato, 2018.

	Census (2010)	5-year American Community Survey (2014–2018) Estimate	5-year American Community Survey (2014–2018) Range[a]	This study (2018) Estimate	This study (2018) Range[b]
Total population					
Households	92	87.0	71 – 103	79.0	
Population	264	257.0	221 – 293	223.0	208 – 238
Alaska Native					
Population	250	251.0	216 – 286	219.2	204 – 235
Percentage	94.7%	97.7%	84.% – 111.3%	98.3%	91.3% – 105.2%

Sources U.S. Census Bureau (2011) for 2010 estimate; U.S. Census Bureau for American Community Survey (ACS) 2018 estimate (5-year average); and ADF&G Division of Subsistence household surveys, 2019 for 2018 estimate.
Note Division of Subsistence household survey elegiblity requirements differ from those used by ACS.
a. ACS data range is the reported margin of error.
b. No range of households is estimated for Division surveys.

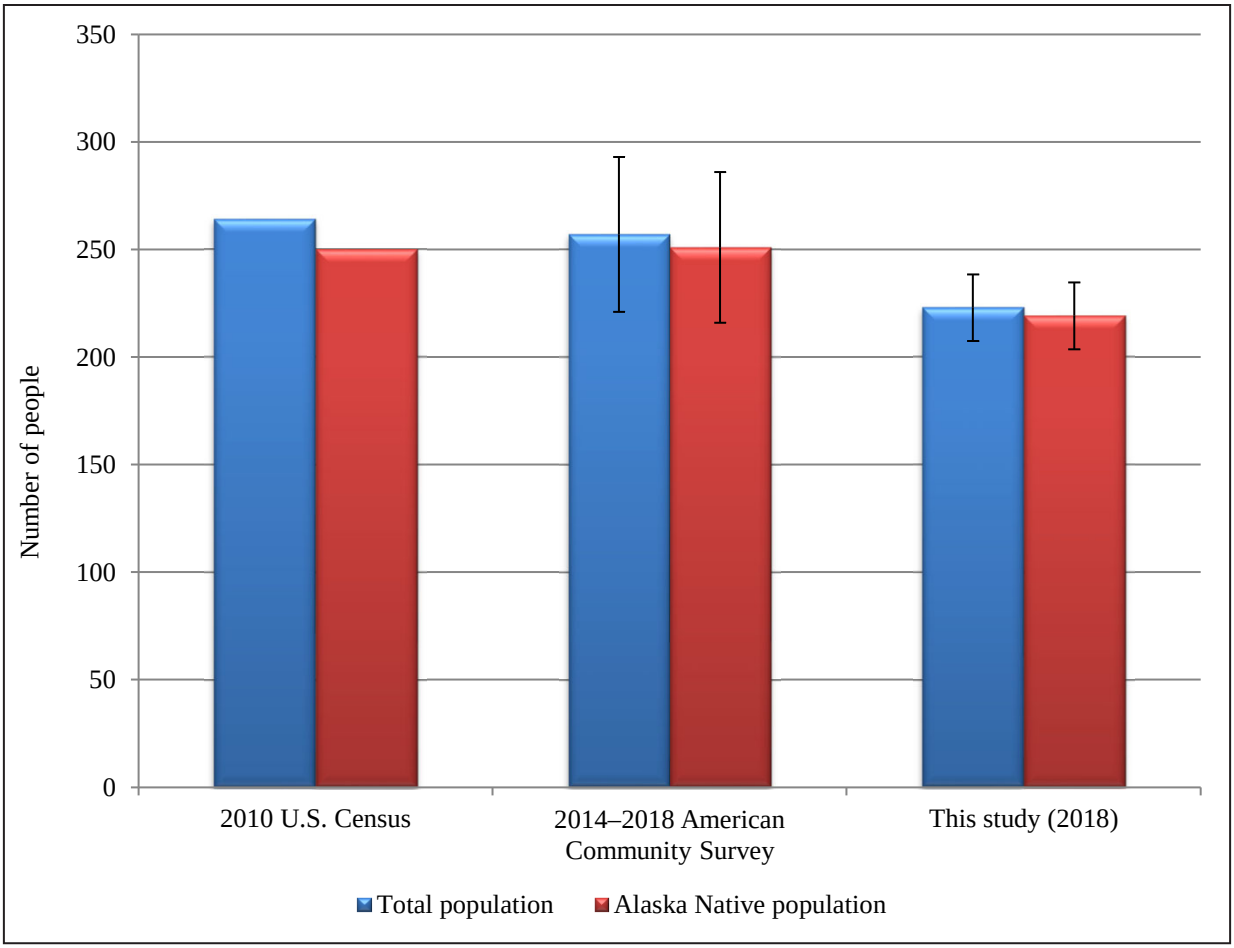


Figure 4-2.–Alaska Native and overall population estimates, Nulato, 2018.

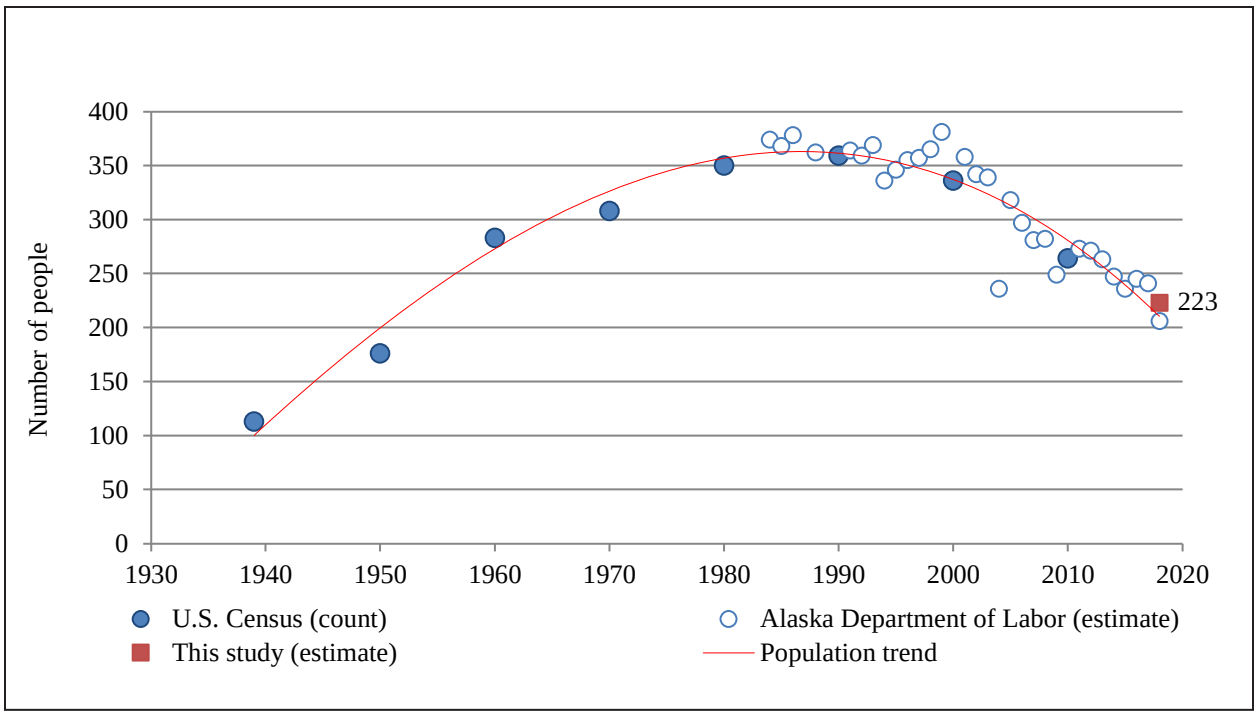


Figure 4-3.–Population estimates, Nulato, 1939–2018.

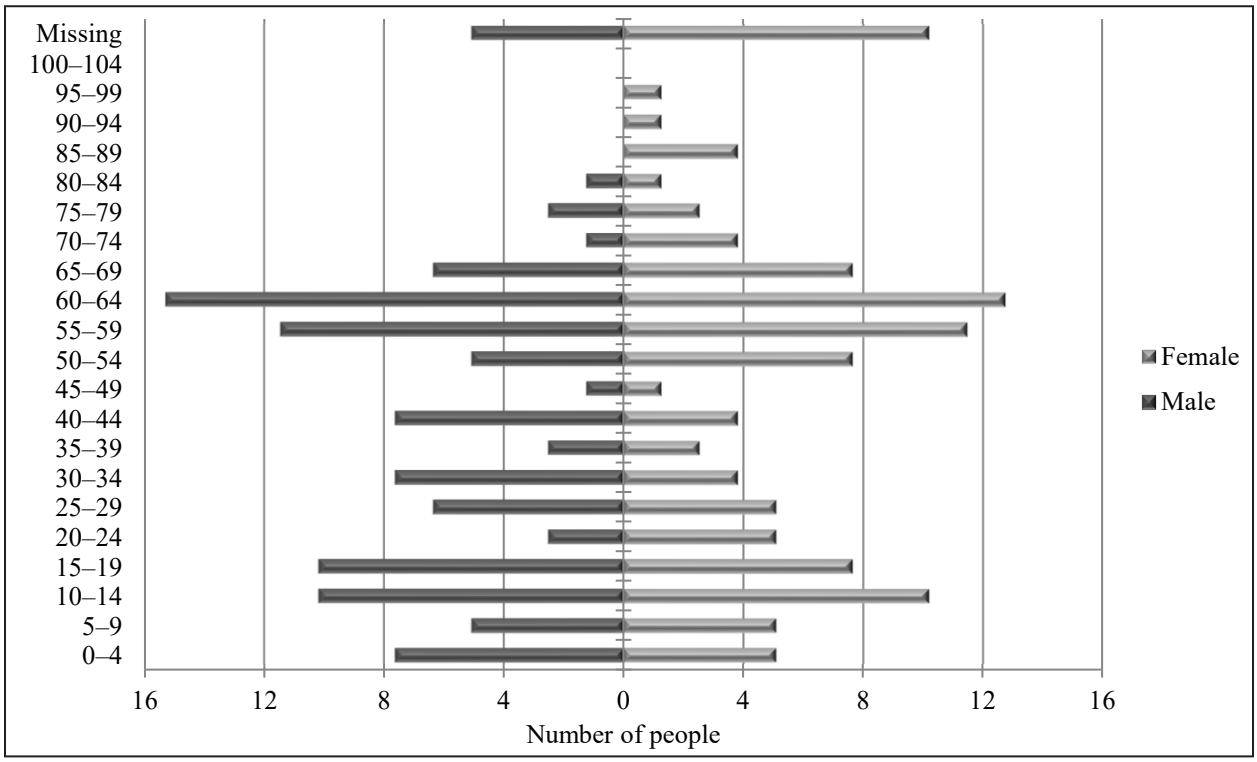


Figure 4-4.–Population profile, Nulato, 2018.

Table 4-5.–Sample and demographic characteristics, Nulato, 2018.

Characteristics	Community Nulato
Sampled households	62
Eligible households	79
Percentage sampled	78.5%
Sampled population	175
Estimated community population	223.0
Household size	
Mean	2.8
Minimum	1.0
Maximum	7.0
Age	
Mean	38.0
Minimum[a]	0
Maximum	98
Median	43.0
Length of residency	
Total population	
Mean	31.3
Minimum[a]	0
Maximum	98
Heads of household	
Mean	43.6
Minimum[a]	1
Maximum	98
Alaska Native	
Estimated households[b]	
Number	77.7
Percentage	98.4%
Estimated population	
Number	219.2
Percentage	98.3%

Source ADF&G Division of Subsistence household surveys, 2019.

a. A minimum age of 0 (zero) is used for infants who are less than 1 year of age.

b. The estimated number of households in which at least one head of household is Alaska Native.

Table 4-6.–Population profile, Nulato, 2018.

	Male			Female			Total		
Age	Number	Percentage	Cumulative percentage	Number	Percentage	Cumulative percentage	Number	Percentage	Cumulative percentage
0–4	7.6	7.0%	7.0%	5.1	4.5%	4.5%	12.7	5.7%	5.7%
5–9	5.1	4.7%	11.6%	5.1	4.5%	9.0%	10.2	4.6%	10.3%
10–14	10.2	9.3%	20.9%	10.2	9.0%	18.0%	20.4	9.1%	19.4%
15–19	10.2	9.3%	30.2%	7.6	6.7%	24.7%	17.8	8.0%	27.4%
20–24	2.5	2.3%	32.6%	5.1	4.5%	29.2%	7.6	3.4%	30.9%
25–29	6.4	5.8%	38.4%	5.1	4.5%	33.7%	11.5	5.1%	36.0%
30–34	7.6	7.0%	45.3%	3.8	3.4%	37.1%	11.5	5.1%	41.1%
35–39	2.5	2.3%	47.7%	2.5	2.2%	39.3%	5.1	2.3%	43.4%
40–44	7.6	7.0%	54.7%	3.8	3.4%	42.7%	11.5	5.1%	48.6%
45–49	1.3	1.2%	55.8%	1.3	1.1%	43.8%	2.5	1.1%	49.7%
50–54	5.1	4.7%	60.5%	7.6	6.7%	50.6%	12.7	5.7%	55.4%
55–59	11.5	10.5%	70.9%	11.5	10.1%	60.7%	22.9	10.3%	65.7%
60–64	15.3	14.0%	84.9%	12.7	11.2%	71.9%	28.0	12.6%	78.3%
65–69	6.4	5.8%	90.7%	7.6	6.7%	78.7%	14.0	6.3%	84.6%
70–74	1.3	1.2%	91.9%	3.8	3.4%	82.0%	5.1	2.3%	86.9%
75–79	2.5	2.3%	94.2%	2.5	2.2%	84.3%	5.1	2.3%	89.1%
80–84	1.3	1.2%	95.3%	1.3	1.1%	85.4%	2.5	1.1%	90.3%
85–89	0.0	0.0%	95.3%	3.8	3.4%	88.8%	3.8	1.7%	92.0%
90–94	0.0	0.0%	95.3%	1.3	1.1%	89.9%	1.3	0.6%	92.6%
95–99	0.0	0.0%	95.3%	1.3	1.1%	91.0%	1.3	0.6%	93.1%
100–104	0.0	0.0%	95.3%	0.0	0.0%	91.0%	0.0	0.0%	93.1%
Missing	5.1	4.7%	100.0%	10.2	9.0%	100.0%	15.3	6.9%	100.0%
Total	**109.6**	**100.0%**	**100.0%**	**113.4**	**100.0%**	**100.0%**	**223.0**	**100.0%**	**100.0%**

Source ADF&G Division of Subsistence household surveys, 2019.

Table 4-7.–Birthplaces of population, Nulato, 2018.

Birthplace	Percentage
Anvik	2.2%
Fairbanks	1.1%
Holikachuk	1.1%
Holy Cross	1.1%
Hughes	1.1%
Kaltag	9.0%
Koyukuk	3.4%
Nulato	75.3%
Shageluk	1.1%
Stebbins	1.1%
Other U.S.	3.4%

Source ADF&G Division of Subsistence household surveys, 2019.
Note "Birthplace" means the place of residence of the parents of the individual when the individual was born.

Table 4-8.–Birthplaces of household heads, Nulato, 2018.

Birthplace	Percentage
Anvik	2.9%
Fairbanks	2.3%
Grayling	0.6%
Holikachuk	0.6%
Holy Cross	1.7%
Hughes	1.1%
Kaltag	5.7%
Koyukuk	1.7%
Nenana	0.6%
Nulato	77.1%
Ruby	1.7%
Shageluk	0.6%
Stebbins	0.6%
Other U.S.	2.9%

Source ADF&G Division of Subsistence household surveys, 2019.
Note "Birthplace" means the place of residence of the parents of the individual when the individual was born.

The majority of Nulato residents (77%) were born in the community, and many others were born in the nearby community of Kaltag (6%), or other communities along the Yukon River, notably Anvik (3%), Holy Cross (2%), Koyukuk (2%), and Ruby (2%; Table 4-7). Two percent of residents were born in Fairbanks, and about 3% were born in other locations in the U.S. Smaller percentages of household heads were born in Nulato (75%), and greater numbers were born in Kaltag (9%), Koyukuk (3%), and other U.S. locations outside of Alaska (3%; Table 4-8).

Participation in Salmon Harvesting And Processing

Salmon harvesting for subsistence involves gear preparation, capturing and transporting fish, and cleaning and processing the catch. Different individuals participate in various parts of the process, and roles are often divided by age, gender or both. In 2018, approximately 84 residents, or about 38% of the Nulato population, fished for salmon (Table 4-9). A greater number of residents participated in salmon processing activities: 128 individuals, or about 58% of people in Nulato.

Table 4-9.–Individual participation in salmon harvesting and processing, Nulato, 2018.

Total number of people	**223.0**
Salmon	
Fish	
Number of people	84.1
Percentage	37.7%
Process	
Number of people	128.7
Percentage	57.7%

Source ADF&G Division of Subsistence household surveys, 2019.

Individual participation in activities surrounding the harvesting and processing of salmon varies, and different individuals will have different preferences for the kind and level of involvement. Some people had strong preferences for participation in specific activities, while others were happy to assist wherever it was needed. One ethnographic respondent spoke of her role as a salmon processor at her family's fish camp:

> I don't go out in the boat. I stay home and work with the fish. Yeah, it's like more of the same people that do the fishing. But they enjoy it, so I don't mind being home and doing, waiting for them to come home, yeah. And, like, if there's a boat out and we already have the king salmons there, and we're working at it, and waiting for the other boat. Then that way we don't get, you know, swamped with everything all at once. (05142019NUL1)

Another respondent said that she expected her children to help with fish processing at their family's smokehouse: "We don't allow our kids to have video games. But these kids are active. They can't stay up all night playing games. They have to help at the smokehouse!" (05132019NUL5)

In Nulato, men of all age classes participated in fishing and processing, and women over 18 years of age also participated in both activities (Figure 4-5). However, in 2018, slightly more men than women fished for salmon, and more women than men processed fish. The vast majority of fishers were at least 40 years old, and individuals of ages 40–59 constituted the greatest cohort. Few individuals 18 and under (5) participated in fishing in 2018, and all of those individuals were male. In contrast, over 20 individuals that reported processing salmon were 18 or younger, suggesting that some of the tasks involved in processing are better suited to younger family members. This statement also holds true for the older generation, including those people 60 and above: over 40 individuals within the oldest age bracket reported participating in processing, and slightly more women than men were involved with the activity.

Most households in Nulato reported using salmon in 2018, regardless of their participation in fishing or processing activities (Figure 4-6). Chinook salmon were the most widely used species: 72% of households reported either harvesting or receiving them. Just over a third (36%) of households used fall chum salmon, 27% of households used summer chum salmon, and 13% of households used coho salmon. Two percent of households used chum salmon that survey respondents did not differentiate between summer and fall chum salmon. The same percentage of Nulato households that attempted to fish for salmon, did harvest. Over half of all residents (55%) fished for Chinook salmon, and fewer individuals fished for summer chum (23%),

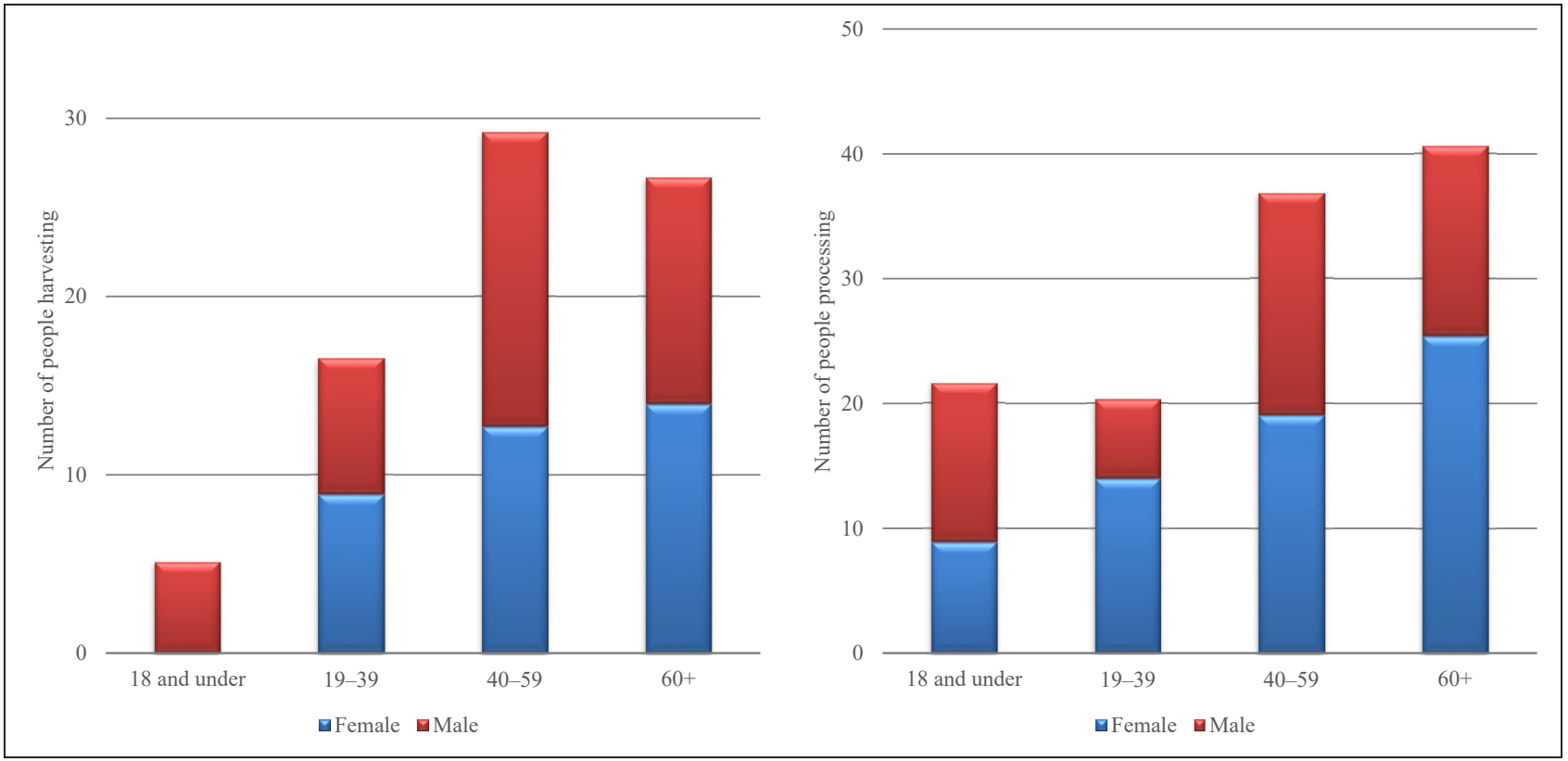


Figure 4-5.–Individual participation in salmon harvesting and processing by age group and sex, Nulato, 2018.

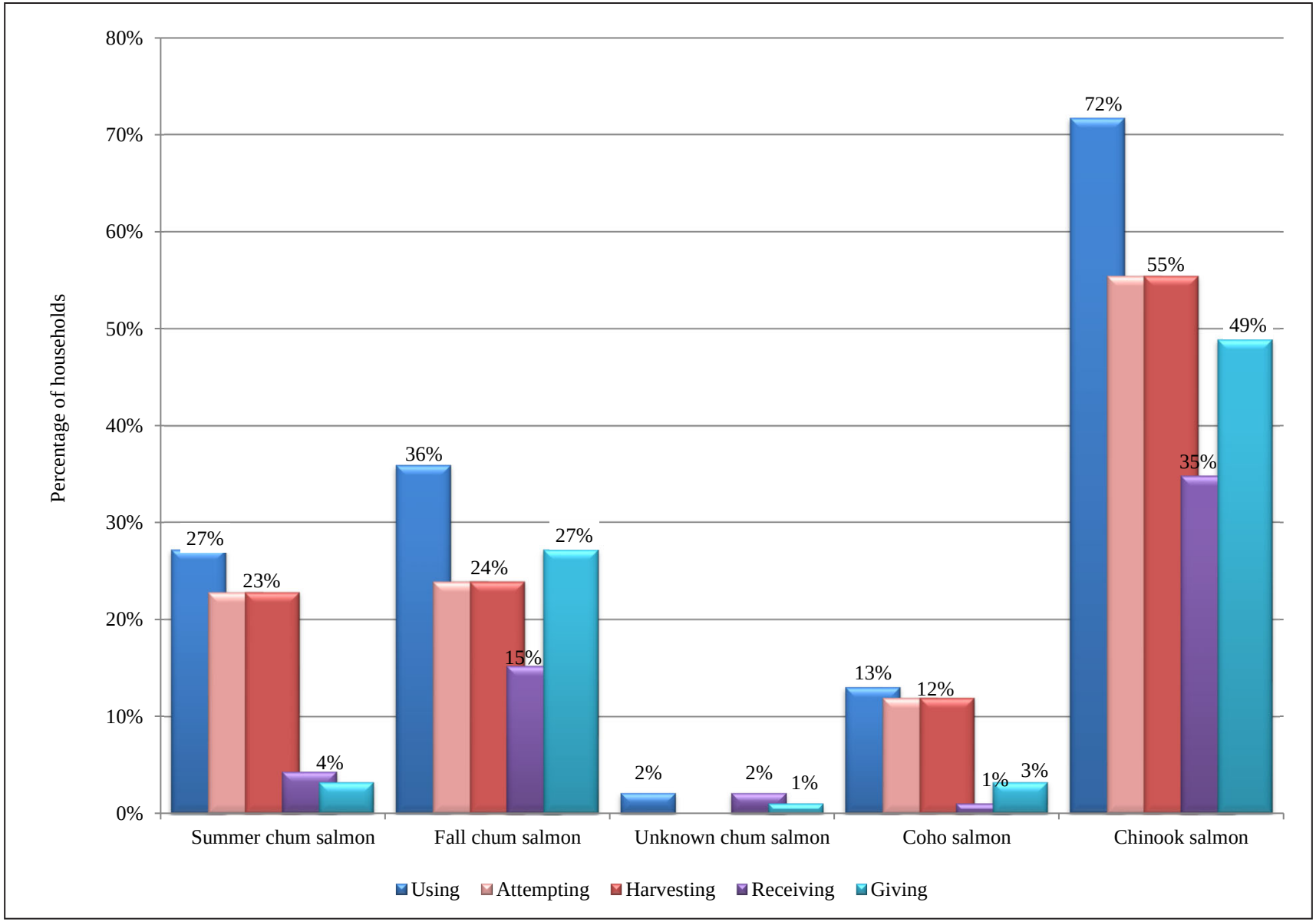


Figure 4-6.–Percentages of households using, attempting to harvest, harvesting, receiving, and giving salmon, by resource, Nulato, 2018.

Table 4-10.–Household participation in commercial and subsistence fishing, Nulato, 2018.

Participation	Number of households
Total subsistence fishing households	57
Subsistence fishing only, no commercial fishing	46
Subsistence fishing, unknown commercial fishing	1
Total commercial fishing households	13
Commercial fishing only, no subsistence fishing	3
Both commercial and subsistence fishing	10
No fishing	19
Total households	79

Source ADF&G Division of Subsistence household surveys, Nulato, 2019.

fall chum (24%), and coho (12%) salmon. Households both gave and received Chinook salmon more than any other salmon species. Thirty-five percent of households reported receiving Chinook salmon from others while 49% gave some away.

In some years, Nulato fishers possessing the proper permits can take advantage of a commercial fishing opportunity for summer chum salmon in the vicinity of Kaltag, which is within 35 river miles downstream of Nulato. In 2018, ADF&G provided commercial fishing opportunity for summer chum salmon in Subdistrict 4A with fish wheels only. Commercial fishers were required to staff fish wheels while in operation, immediately release any Chinook salmon caught in the wheel into the water alive, and to use "fish friendly" components on their wheels, such as soft mesh baskets and smooth-bottomed chutes with foam-lined sides (Carroll and Jallen 2018b). Commercial fishing began in Subdistrict 4A on June 26 and was thereafter open for 24 hours a day, 7 days a week during the summer season. Of 79 total households, 13 households commercial fished in 2018 (Table 4-10). Ten of these also subsistence fished for salmon and three did not. Forty-six households harvested salmon for subsistence only, and 19 households indicated they did not fish for salmon in 2018.

Salmon Harvest Quantities and Composition

Table 4-11 summarizes salmon harvest information in Nulato for the 2018 fishing season. Nulato fishers harvested a total of 2,898 salmon that contributed 18,162 edible pounds (about 230 lb per household) to the wild food diets of residents. Over half of all salmon harvest by weight consisted of Chinook salmon (10,994 lb), although they constituted fewer than half of the number of total fish, suggesting Chinook salmon were generally larger fish than the other salmon species. Fishers also caught 912 fall chum salmon totaling 4,084 edible pounds, 466 coho salmon (2,222 lb), and 192 summer chum salmon (862 lb). On a per capita basis, these harvest weights equate to about 82 lb of edible weight for salmon combined, further divided into 49 lb of Chinook salmon, 18 lb of fall chum salmon, 10 lb of coho salmon and 4 lb of summer chum salmon. Chinook salmon madfe up 61% of the total salmon harvest by weight (Figure 4-7). Fall chum salmon contributed the second largest percentage (22%), followed by coho salmon (22%), and finally summer chum (5%).

Previous studies (Wolfe 1987; Wolfe et al. 2010) have shown that in most rural Alaska communities, a relatively small portion of households produces most of the community's fish and wildlife harvests, which they share with other households. A study of 3,265 households in 66 rural Alaska communities found that about 33% of the households accounted for 76% of all wild food harvests (Wolfe et al. 2010). Although overall the set of very productive households was diverse, factors that were associated with higher levels of subsistence harvests included larger households with a pool of adult male labor, higher wage income, involvement in commercial fishing, and community location.

As shown in Figure 4-8, in the 2018 study year in Nulato, about 22% of the community's households harvested 69% of the total estimated pounds of salmon harvested. Researchers also categorized Nulato

Table 4-11.–Estimated harvest and use of salmon, Nulato, 2018.

Resource	Percentage of households					Harvest weight (lb)			Harvest amount			95% confidence limit (±) harvest
	Using	Attempting harvest	Harvesting	Receiving	Giving away	Total	Mean per household	Per capita	Total	Unit	Mean per household	
Salmon	**75.0**	**58.7**	**58.7**	**44.6**	**52.2**	**18,162.4**	**229.9**	**81.5**	**2,897.7**	**ind**	**36.7**	**4.0**
Summer chum salmon	27.2	22.8	22.8	4.3	3.3	862.1	10.9	3.9	192.4	ind	2.4	7.9
Fall chum salmon	35.9	23.9	23.9	15.2	27.2	4,083.7	51.7	18.3	911.5	ind	11.5	7.9
Unknown chum salmon	2.2	0.0	0.0	2.2	1.1	0.0	0.0	0.0	0.0	ind	0.0	0.0
Coho salmon	13.0	12.0	12.0	1.1	3.3	2,222.3	28.1	10.0	465.9	ind	5.9	9.7
Chinook salmon	71.7	55.4	55.4	34.8	48.9	10,994.2	139.2	49.3	1,327.8	ind	16.8	3.2
Sockeye salmon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ind	0.0	0.0

Source ADF&G Division of Subsistence household surveys, 2019.

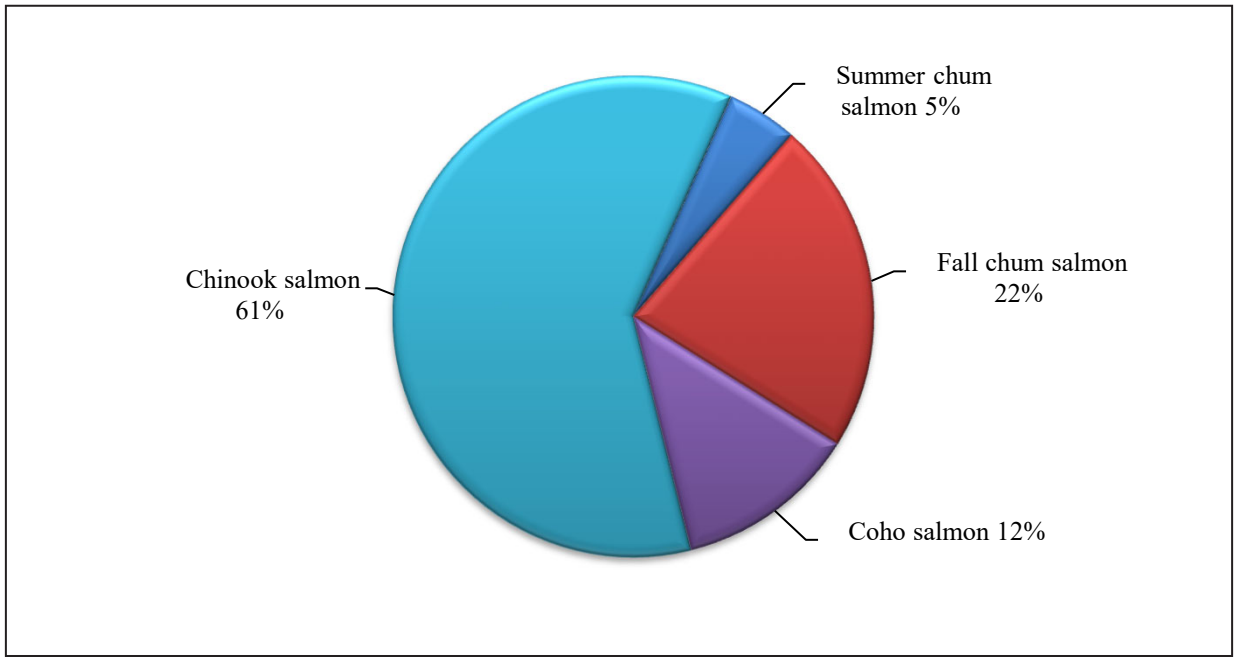


Figure 4-7.–Composition of salmon harvest weight, by resource, Nulato, 2018.

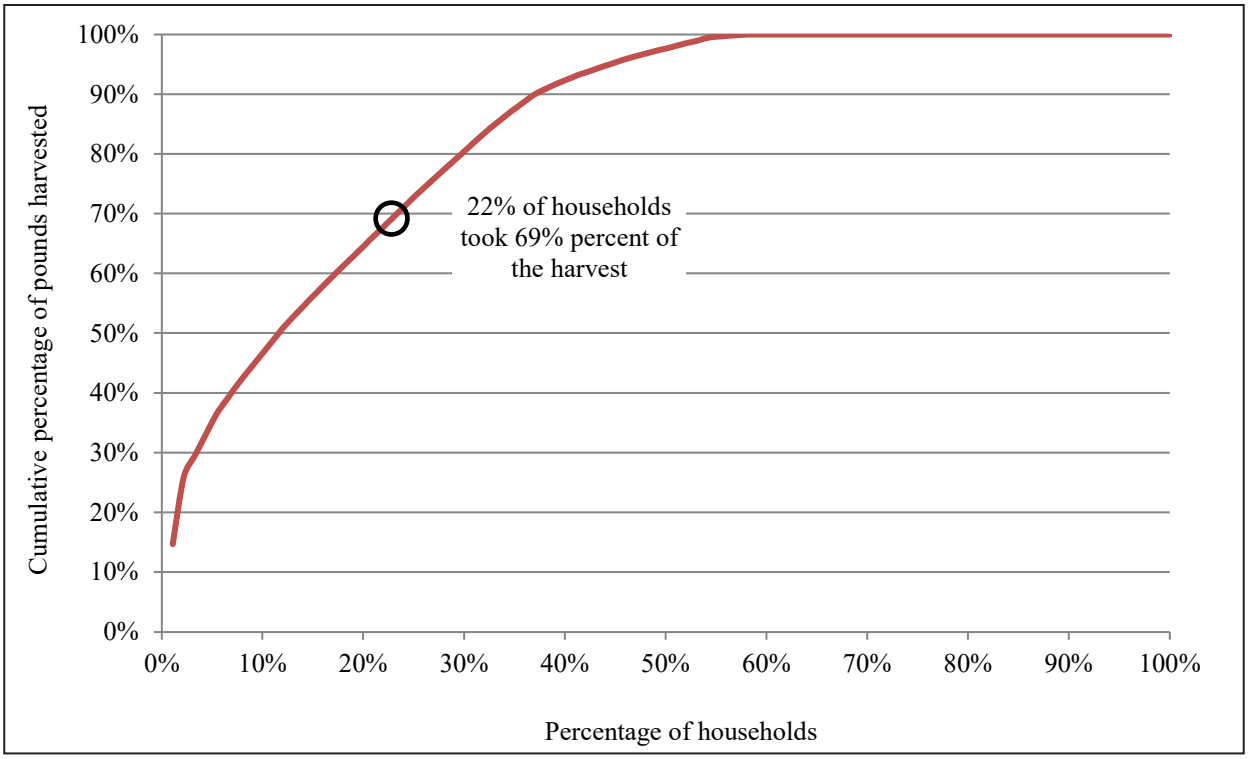
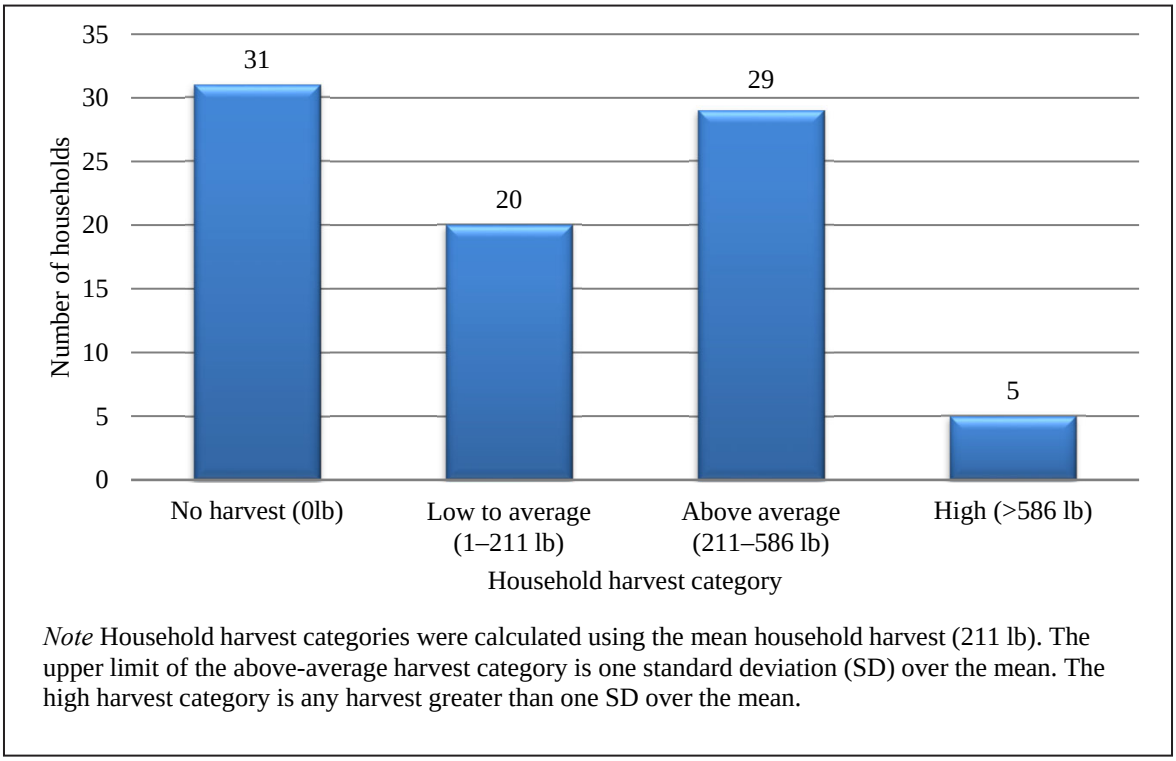


Figure 4-8.–Household specialization in salmon harvesting, Nulato, 2018.



Note Household harvest categories were calculated using the mean household harvest (211 lb). The upper limit of the above-average harvest category is one standard deviation (SD) over the mean. The high harvest category is any harvest greater than one SD over the mean.

Figure 4-9.–Number of households harvesting salmon, by harvest level, Nulato, 2018.

Table 4-12.–Characteristics of subsistence harvesting households, Nulato, 2018.

	Number		Harvest weight (lb)		
	Households	Harvesting households	Mean	Minimum	Maximum
Household maturity					
Developing[a]	11	7	356.3	0.0	2,006.0
Mature[b]	20	16	183.4	0.0	683.0
Elder[c]	31	21	260.1	0.0	2,633.0
Household head type					
Couple	26	21	259.5	0.0	637.0
Single female	23	16	245.7	0.0	2,006.0
Single male	13	6	250.2	0.0	2,633.0
Commercial fishing household					
Yes	10	8	191.3	0.0	637.9
No	51	36	263.6	0.0	2,633.0
Unknown	1	1	297.6	297.6	580.7
All sampled households	**62**	**45**	**252.4**	**0.0**	**2,633.0**

Source ADF&G Division of Subsistence household surveys, 2019.

Note This table only summarizes harvests for households sampled by ADF&G Division of Subsistence. Demographic information is not available for households sampled by ADF&G Division of Commercial Fisheries postseason surveys.

a. Age(s) of households head(s) is less than 40 years.

b. Age(s) of household head(s) is 40–59 years.

c. Age(s) of household head(s) is greater than 59 years.

households by their levels of salmon harvest, including no harvest (0 lb), low to average harvest (1–211 lb), above average harvest (212–586 lb), and high harvest (>586 lb). In 2018, 31 households in Nulato did not harvest salmon, 20 were categorized as low to average harvesters, 29 as above average harvesters, and 5 were considered high harvesters (Figure 4-9). Researchers further categorized households by maturity level,[3] gender of household head(s) and commercial fishing participation and compared those values to household harvest levels. Developing and elder households each harvested more fish on average per household than mature households: developing households harvested an average of 356 lb and elder households harvested an average of 260 lb, compared to a mean harvest of 183 lb by mature households (Table 4-12). Harvest values did not differ greatly by household head type (couple, single male, or single female). However, households that did not commercial fish harvested more salmon for subsistence use by weight than those households that did commercial fish.

Production and Exchange of Salmon

The production, sharing, and trade of wild foods is foundational to subsistence economies throughout Alaska (ADF&G Division of Subsistence, n.d.). To broaden the understanding of how salmon are harvested and used in Nulato, this study combined cooperative salmon production[4] data from the 2018 fishing season with data about how people shared or exchanged salmon after production. Specifically, survey respondents provided detailed information on two topics: who they fished for salmon with, and which households they exchanged salmon with during a study period that included the 2018 salmon fishing season through May 2019. This resulted in network data that describe the local production network, and three different exchange networks: sharing, barter, and customary trade.

3. Developing households had household heads of less than 40 years of age; mature households, 40 to 59 years; and elder households, greater than 59 years.
4. For the purposes of this research, production includes both the harvesting and processing of salmon.

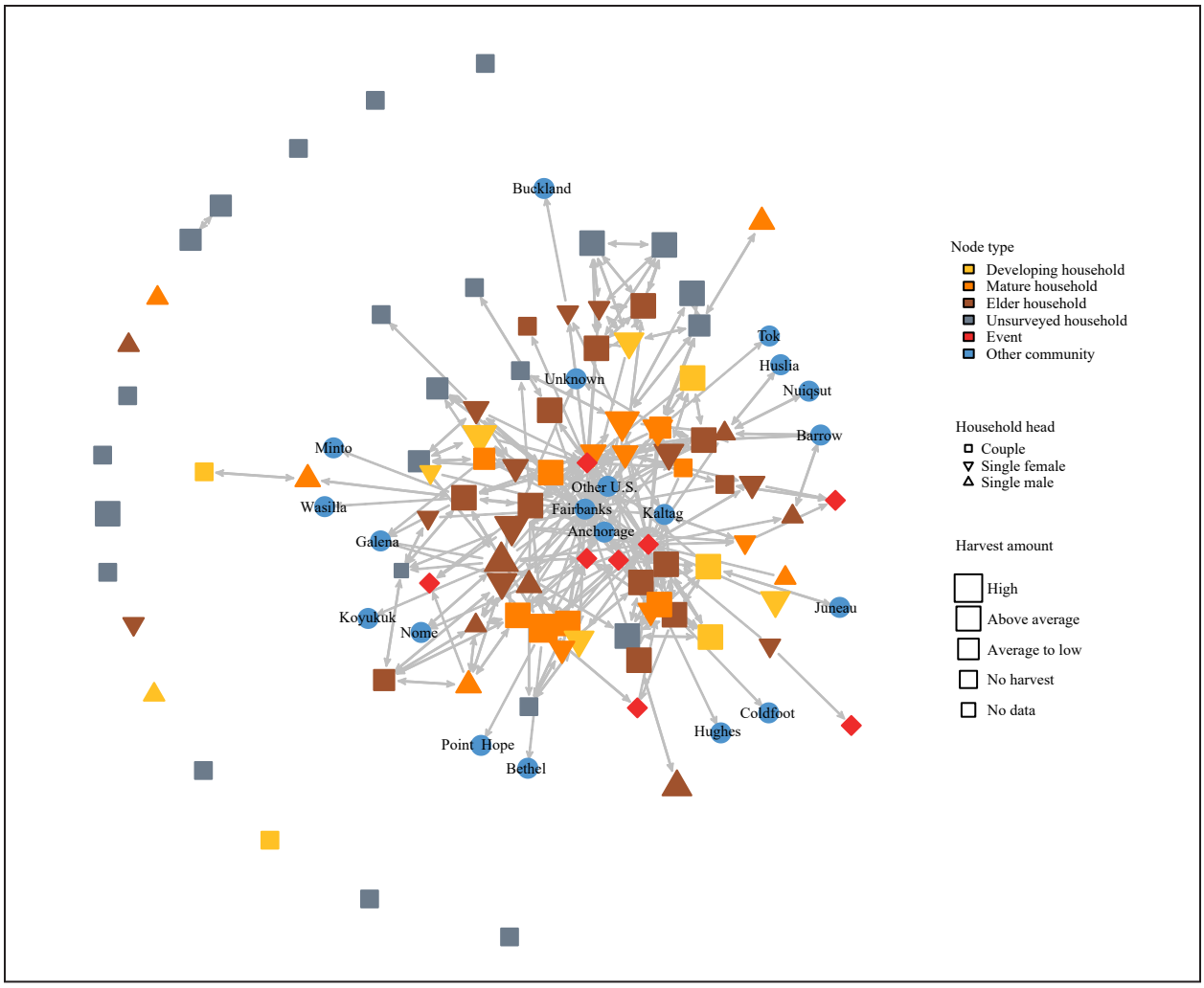


Figure 4-10.–Salmon production and exchange network, Nulato, 2018–2019.

Figure 4-10 combines data from the four types of salmon networks in Nulato listed above and presents an overview of how households in Nulato were connected by salmon during the study period. The symbols, or "nodes," on the figure represent households, events, and other communities. Symbol shapes depict the types of heads of household and shape colors shows the ages of heads of household or whether the node is an event or other community. Symbol sizes for households are scaled to indicate levels of salmon harvest. The lines on the figure, or "ties," represent the cooperative fishing relationships and exchanges of salmon reported by survey respondents. Arrows representing cooperative fishing relationships point in both directions to represent a mutual relationship between households. Arrows representing salmon exchanges show the direction of the exchange from giver to receiver. Although cooperative production and exchange ties cannot be distinguished on this figure, they will be separated and discussed in subsequent sections of this chapter.

Some nodes in the figure are not connected to others, either because they did not report any ties to other households, or because they were not surveyed. Nodes with higher numbers of connections to others are located closer to the center of the network diagram, and nodes with fewer connections are located closer to the outside. Salmon are shared widely at community events, and many nodes representing events are located near the center of the network. The cities of Anchorage and Fairbanks and the community of Kaltag are located near the center of the salmon network in Nulato, indicating that many Nulato households exchange salmon with family members or friends in those communities. Many other Alaska communities appear

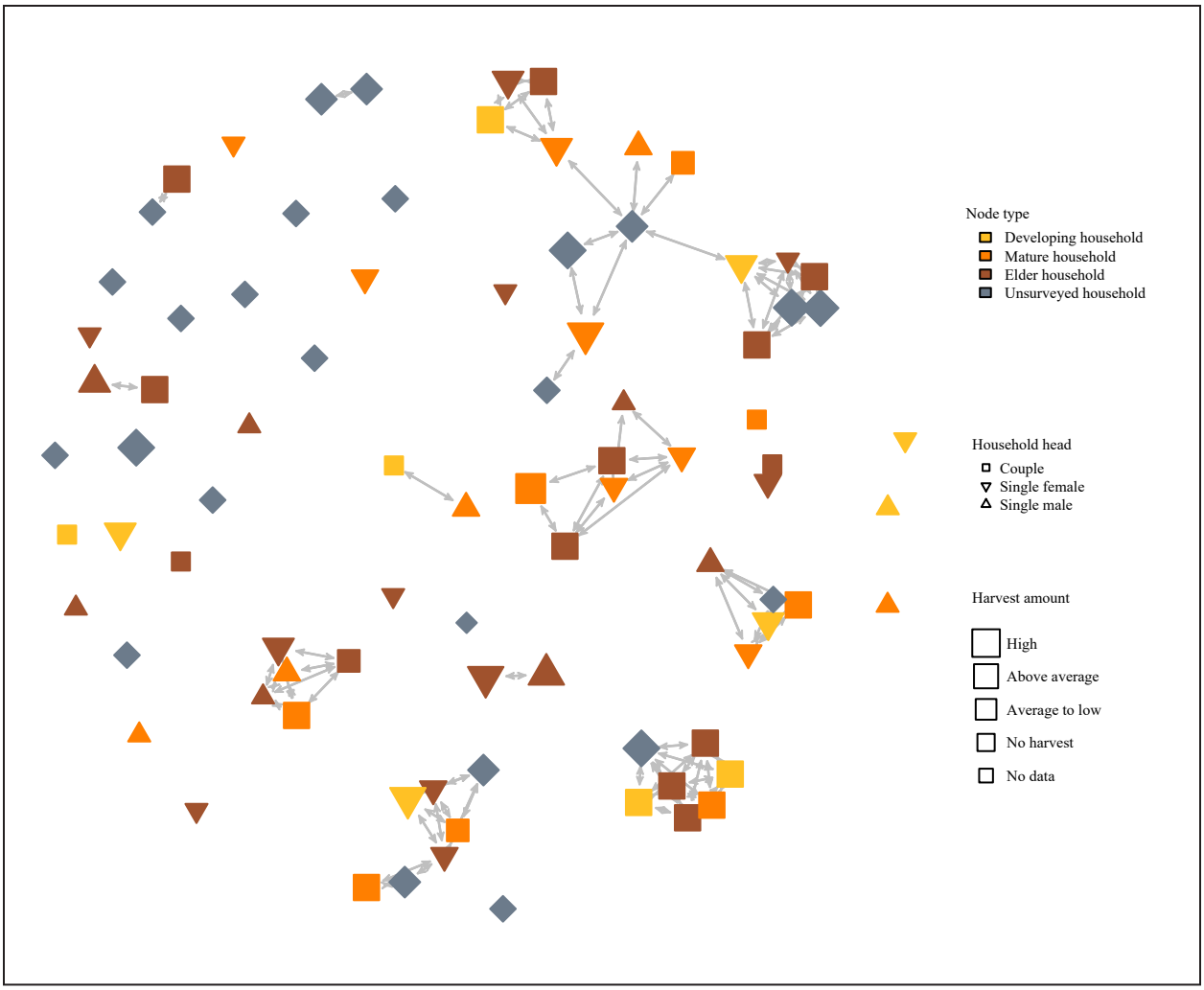


Figure 4-11.–Cooperative salmon production network, Nulato, 2018.

farther from the center of the figure and represent exchanges with fewer Nulato households. Households led by mature and elder couples are especially prominent near the center of the network, indicating high levels of involvement by these household types. However, households led by single men and women from mature and elder household categories also fall near the center. Many of these households had high or above average salmon harvests in 2018. Households that harvested average to low amounts of salmon were usually located toward the periphery of the graphic, indicating fewer cooperative production, sharing, barter, and customary trade ties.

Appendix tables D4-1 and D4-2 provide details about the nodes and ties in the networks. Overall, the network included 62 sampled Nulato households, 24 unsurveyed Nulato households, households in 20 other communities, and nine types of events. (Appendix Table D4-1). Respondents also gave or received salmon from nine types of events. Households reported a total of 655 ties, with 276 unique ties (Appendix Table D4-2). As ties represent individual exchanges or interactions among households, and "unique" ties represent social relationships between two households, these numbers indicate that households with established relationships will often interact multiple times throughout the year. Appendix table D4-3 provides a summary of all salmon exchanges by network type. Out of a total of 437 unique ties, the majority were associated with either the fishing network (197 ties) or the sharing network (190 ties), suggesting that barter and customary trade relationships play a more minor role in the collective exchange network . Nulato households bartered 38 times, and customary trade occurred 12 times.

Production of Salmon

Although harvest data were previously described at the household level, in reality, much of the production of subsistence foods is achieved by households within a community that work cooperatively (Charnley 1984; Kari 1983; Lonner 1980; Magdanz 1988; Magdanz et al. 2002; 2007; Magdanz and Wolfe 1988; Moncrieff 2007; Stickney 1984; Wolfe et al. 1993). During postseason salmon harvest surveys, respondents provided information about the other households with whom they fished and their total group harvest amount. These data are typically only used to confirm that group harvest amounts are not counted twice; however, further analysis of these data using network methods can reveal information about the complexities of salmon production and distribution systems. Cooperative production groups, or fishing groups in the case of this study, are often organized based on kinship. Although DCF postseason surveys did not collect kinship information for fishing groups, six of ten ethnographic respondents described fishing with their extended families during 2018 (05142019NUL1, 05132019NUL2, 05132019NUL3, 05132019NUL4, 05132019NUL5). Additionally, some respondents mentioned that family friends or other community members were also part of their fishing groups. Expanding the fishing group to include nonfamily members ultimately benefited both parties, because sometimes nonkinship ties involved single-person households that otherwise may not have the means to obtain salmon for themselves. One ethnographic respondent mentioned how an unrelated community member had joined their fishing group out of necessity, reflecting a larger cultural expectation to help provide for others in the community:

> [She] is fishing with us [because] she has nobody, she lives alone. She don't have a boat, and it's easier for her to put away her fish and then she'll be [a] big help there too. That's the way we Athabascans work things. Always trying our best to make ends meet up. Always trying our best to make sure the next person have food put away. (05142019NUL8)

Figure 4-11 shows which households worked together to harvest and process salmon in 2018. Numerous groups of households worked together to produce salmon; most of the cooperating households were high or above average producers. Cooperative fishing groups involved households of all age and marital status classifications, but mature (15 households) and elder (22) households had greater representation, as did households headed by couples. Production groups involved between two and seven different households. In three instances, an individual household formed a link between multiple fishing groups. Although some production groups are connected by one or two households who take part in each group, the more common pattern is production groups that share many ties among households within the group and few (if any) ties outside the group. This can be seen in the distinct clusters of households in the cooperative production network (Figure 4-11). Some families may work with different groups to catch fish at different times of the year or to target different species as they become available. Additionally, several ethnographic interview respondents spoke to the fluid nature of fishing and processing group composition over time. Those individuals that had numerous years of working with salmon indicated that as families grew, individuals married, and participants moved and aged, fishing ties often shifted. One participant mentioned switching from fishing with their parents and adult siblings to fishing with their in-laws, citing a need for a larger share of fish to feed their own immediate family as the reason for the switch (05142019NUL1). Another pair of respondents mentioned that they used to fish with a member of the extended family until the needs of that family member's immediate family grew to the point that they required a greater share of fish, so the respondents needed to find a new fishing group (05132019NUL6, 05132019NUL7). One interview respondent mentioned how in years past, some unrelated families formed cooperative fishing groups out of necessity: "And a lotta those families, long ago they lived together because they were, like, broken families. Like, one of the parents would die, or somebody. So they would help one another" (05132019NUL5).

Another individual spoke of more specific fishing-group dynamics and considered future fishing group changes within their own family:

> Maybe if things are gonna be different, maybe if [name] and her sisters moved to Nulato, if she's gonna stay here for fishing and if she wants to fish for us, then we'll definitely have to get more fish. Yeah. So that's good, that's a change. And also, we

> got three cutters, we lost 'em. We could get more, you know. I could catch more. I just quit after about two hours, time to come home. That's what I'm doing mostly, is, 'cause I work in the daytime, you know. (05132019NUL2)

These stories shared above by key respondents help show the social nature of salmon fishing and the dynamic nature of fishing groups. Each household and fishing group has unique ways in which they operate, and different households may join or leave the effort at various times throughout the season. Many of the same households fish together from year to year, but fishing groups can vary with circumstances of the year. Reasons households work cooperatively may vary from household to household but may include carrying on traditions, dividing labor and resources, increasing efficiency, and spending time with friends and family.

Table 4-13 provides information on the characteristics of households in the cooperative production network in Nulato. Households in the above-average harvest category had the greatest mean production ties (3.75), followed by low to average salmon-harvesting households (2.93 mean ties) and high-harvesting households (2.2 mean ties). Elder households had the greatest mean number of production ties (2.45) when compared to other maturity groups. Households headed by couples were more tied to the cooperative production network (3.08 mean ties) than those headed by single females (2.43 mean ties) or males (1.38 mean ties). The low number of mean production ties for households headed by single males in Nulato suggests that those households were less likely to be involved in the production network than those led by single females. Commercial fishing households had a slightly higher mean production tie value (2.7 ties) than those households that did not participate in commercial fishing (2.37 ties).

Exchange of Salmon

Sharing

Local Characterization of Sharing

Sharing is integral to the culture and mixed subsistence-cash economy of Nulato. Community members generally define sharing as giving something away without the expectation of something in return. In Koyukon Athabascan culture, sharing is an important tradition: those with an abundance of resources are expected to share with others in the community that have a need, regardless of kinship ties (05132019NUL6, 05132019NUL7, 05142019NUL8, 05132019NUL9). Older family members teach younger generations, often by example and not explicitly, to share with "whoever's in need. Share and share alike, with everything" (05142019NUL1). One respondent emphasized the deep importance of the practice by indicating that people "will give their last" if they feel someone has a need that they can provide for (05132019NUL9). Even in years when resources are scarce, households will still share with others, although they may decide to share less than they would normally. Such a situation was described by one respondent, who spoke to the changes in their sharing practices for Chinook salmon in recent years of lower harvests: "Yeah, but now we usually just cut like 150 [Chinook salmon], that's about it. And, that, and, we're good. It's enough. And we still share. We still share, but just not as much." (05132019NUL5)

Households within a community frequently share with those that either cannot obtain resources themselves or have greater difficulty doing so, such as elders or those households headed by a single parent (05132019NUL9). When deciding how much of a particular resource to harvest, families will often include the needs of those within their sharing network. Some individuals harvest resources specifically to provide food for community events, and others have relationships with specific individuals in the community with whom they regularly share (05132019NUL9, 05132019NUL2).[5] One fisher indicated that they set harvest goals for salmon based on the idea that they will give away half of what they catch, but that as resource availability changes from year to year, they tailor the amount they share based on what is available (05132019NUL5). Another respondent mentioned that during the study period, "we didn't go silver salmon fishing, so we didn't give as much half-dried fish away, [or] jarred fish for casseroles and sandwiches. We didn't jar enough of those" (05132019NUL2). Overall, families indicated that they almost always try to share some of what they have harvested, although the amount that they can comfortably share changes based

5. Helen S. Cold, ADF&G Division of Subsistence, field notes, May 15, 2019.

Table 4-13.–Mean production ties and mean harvests of households in the cooperative production network, by household characteristic, Nulato, 2018.

Household characteristic	Number		Mean household harvest (lb)
	Sampled households	Mean production ties[a]	
Harvest category[b]			
High	5	2.2	631.59
Above average	24	3.75	337.72
Low to average	14	2.93	78.74
No harvest	19	0.63	0
Maturity[c]			
Developing	11	2.45	191.33
Mature	20	2.35	183.41
Elder	31	2.58	184.03
Household head			
Couple	26	3.08	259.54
Single female	23	2.43	169.77
Single male	13	1.38	51.63
Commercial fishing			
Yes	10	2.7	191.31
No	51	2.37	181.46
Missing	1	6	297.61

Sources ADF&G Division of Subsistence household survey, 2019 and Division of Commercial Fisheries postseason harvest survey, 2018.

a. Average number of other households with which sampled household cooperated in harvesting and processing of salmon

b. Household harvest categories were calculated using the mean household harvest (211 lb). The upper limit of the above-average harvest category is one standard deviation over the mean (375.4 lb). The high harvest category is any harvest greater than one SD over the mean.

c. Developing: age(s) of households head(s) is less than 40 years. Mature: age(s) of household head(s) is 40–59 years. Elder: age(s) of household head(s) is greater than 59 years.

on the amount of a resource they were able to procure (05132019NUL5, 05132019NUL4, 05132019NUL3, 05142019NUL1, 05132019NUL6, 05132019NUL7, 05132019NUL2). Respondents cited conflicting work schedules (05132019NUL2), participation in commercial fisheries, and lower run sizes (particularly Chinook salmon; 05132019NUL5) as factors that influenced their ability to share salmon.

Ethnographic respondents did not talk at length about sharing with specific individuals within the community of Nulato, despite that the network survey indicated that many households share with each other. Most individuals surveyed were part of larger fishing groups in the community. Ethnographic respondents did, however, speak of frequently sharing salmon with family and friends living outside of Nulato as well as sharing at local cultural events. One respondent sent bags of salmon strips to several adult daughters who live in other communities around the state and indicated that they were less able to procure salmon for themselves than the individual's adult sons (05132019NUL2). Others send large quantities of salmon to family members living in more metropolitan areas, such as Fairbanks, Anchorage, and Wasilla, where subsistence fishing opportunities are not locally available (05132019NUL4, 05132019NUL5). Nulato families often gave away salmon when they traveled to see relatives in other parts of the state; "Just about every time we go down we bring 'em one or two bags. And they luck out if we have to go a lot!"

(05132019NUL2). Another respondent said that they often took salmon during visits to a family friend who was an elder living alone in a nearby community (05132019NUL9). All ethnographic respondents indicated sharing salmon at multiple community events.

Community-wide potlatches are held during several holiday celebrations, including Easter, Labor Day, and Memorial Day, and salmon in many forms are often shared as part of the meal or as gifts to be distributed to attending families. Many families share a wide variety of wild foods, including salmon, at Stickdance when it is held in Nulato. The event of Midzeyh okko, part of a week-long New Year's Day celebration in early January, is grounded in the idea of sharing food at a time of year when resources are scarce for many. All interview respondents emphasized the importance of sharing salmon at community events, and some saved salmon specifically for that purpose, especially if they planned on honoring a deceased family member during a specific event. Fish might be processed differently depending on its intended purpose at an event; for instance, one respondent mentioned saving dried Chinook salmon strips and whole fillets for eating at Stickdance, while putting aside jarred salmon strips specifically to give away to attendees (05142019NUL1). Another fisher spoke of the joy that collectively sharing salmon at these events can bring to the entire community:

> And everybody's, everybody's really happy. Because some families, don't have boats. They don't have anything. Yeah, there's some families in town that like eating fish and stuff. They wanna cut fish, but they don't have ways to cut fish. (05132019NUL5)

Members of extended families that live outside of Nulato often return to visit family during the times that community events take place. "A lotta people from, extended families from Fairbanks come home just for that because they don't get this kinda Native foods. And they'll collect their foods and they'll go back to Fairbanks" (05132019NUL5).

Salmon Sharing Networks

Respondents in Nulato provided information about which Nulato households, households in other communities, and events they gave salmon to. Figure 4-12 gives a visual representation of the sharing network within the community of Nulato. Many ties connect households to community events, which, coupled with the locations of the events at the center of the network indicate that a large number of families share at these events. Many households that harvested high or above-average amounts of salmon are connected to other households with directional arrows that indicate that they gave salmon. The majority of these households were headed by couples, but there were also several high- and above-average-harvesting households headed by a single male or female. Many of these households fell into the elder age class, but both mature and developing households shared widely. Figure 4-13 simplifies the previous network graphic by removing the events and highlighting sharing ties between households. Several high- and above-average-harvesting households shared with multiple households. Of the households surveyed, sharing relationships within the community occurred among mature and elder households only. Because sharing ties play a key role in connecting otherwise disconnected production groups, in Nulato mature and elder households play a unique role in the community's subsistence network.

Table 4-14 summarizes the amounts of salmon given to and received from events in Nulato. Forty-two households gave salmon to at least one community event, for a total of 119 instances of sharing and 1,059 lb of salmon. About half of households shared salmon for the New Year's celebration and other, unspecified potlaches; eight households shared for Memorial Day and seven for Labor Day. Other community events included Stickdance, various raffles, Easter, and other unspecified holidays; a few families provided salmon for each of these events.

Nulato residents gave away 6,917 total lb of salmon during the study period, of which 3,923 lb (57%) was Chinook salmon, 2,934 lb (42%) was fall chum salmon and 59 lb (less than 1%) was summer chum salmon (Table 4-15). Of those fish, 3,592 lb (52%) were sent to friends and family living outside of Nulato, 2,296 lb (33%) went to local households, and 1,029 lb (15%) was given away at local events. Nulato families shared more Chinook salmon (by weight) with individuals outside of the community, whereas they shared more

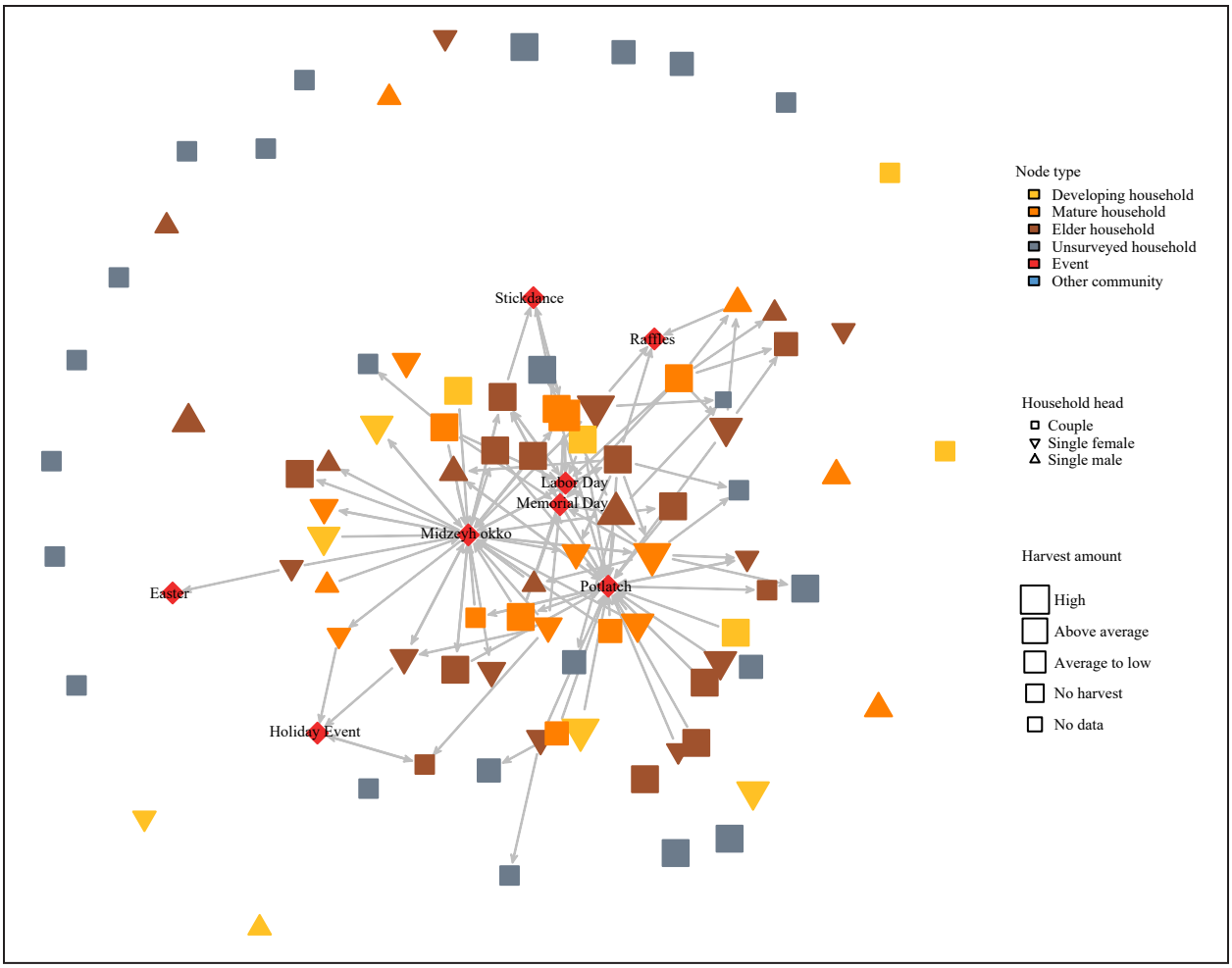


Figure 4-12.–Sharing network between respondent households, other local households, and events, Nulato, 2018–2019.

fall chum salmon (by weight) to other Nulato households. When fishers in Nulato shared Chinook salmon, they usually shared with households in other communities (129 ties), but also shared Chinook salmon at local events (77 ties) and with other local households (25 ties; Table 4-16). However, even though a larger proportion of fall chum salmon by weight that was shared remained in the community, sharing fall chum salmon only happened between Nulato households five times, but households shared fall chum 38 times for local events and 70 times with other communities. The relatively few ties for fall chum salmon for local households and comparatively large quantity by weight of fall chum salmon remaining in the community seems to indicate that on average, each sharing event with a local household was a large gift, averaging 297 lb.

Nulato residents were asked for details regarding the way in which the fish they shared was processed (Table 4-17). For gifts to both other local families and to households outside of Nulato, households most commonly shared fish that had been processed in a way that facilitated ease of transport, including by being dried, smoked, stripped, kippered, or jarred. Nulato households shared salmon of this processing type with other local households 22 times, and 148 times with households outside of the community. Nulato respondents shared whole, gutted fish 6 times with other local households and 35 times with households in other communities. For events, the number of ties by processing type were more evenly distributed: baked or cooked salmon were shared the most (43 ties), followed by dried/smoked/stripped/kippered/jarred (38 ties); whole, gutted fish (25 ties); and filleted fish (11 ties).

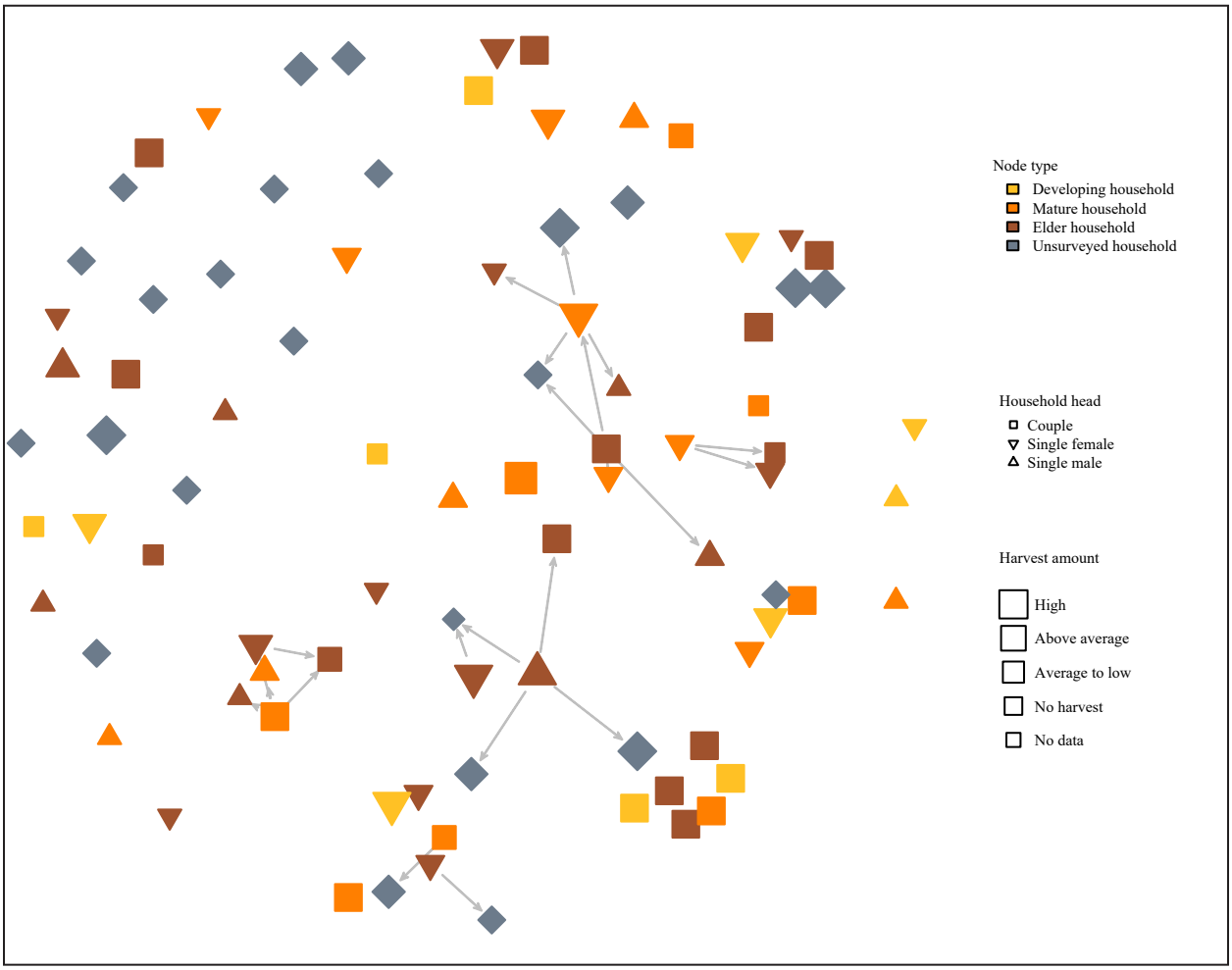


Figure 4-13.–Sharing network between respondent households and other local households, Nulato, 2018–2019.

Appendix Table D4-4 further categorizes the number of times Nulato households shared salmon by the way in which each species was processed. Chinook salmon had the greatest variety of processing types and were given the most frequently. Although Chinook that had been dried, smoked, stripped, or kippered were the most commonly given processing type, whole gutted fish, baked or cooked fish, and filleted fish were also commonly shared. Fall chum salmon, especially when dried, smoked, stripped, or kippered, were next commonly given, but many transactions involved whole, gutted fish of this species as well. Chinook salmon were the most frequently received species, and Nulato households usually received them after they had been dried, smoked, kippered, or jarred.

The greater number of sharing ties by processing and exchange partner type for both other communities and events may indicate the manner in which sharing takes place for each. When sharing salmon of any processing type with another local household, the proximity of the exchange may facilitate sharing larger quantities in a single event. In contrast, when either physically transporting or shipping salmon to a friend or family member outside of the community, the number of transactions may increase while the quantity of each transaction decreases. For sharing ties related to events, cooked salmon is commonly shared for meals at potlaches and other gatherings, and fish of other processing types are donated and gifted to attendants.

Survey respondents were asked further details on their relationships with individuals with whom they shared salmon, both for sharing events within the community and sharing with households in other communities. When sharing within the community, Nulato households mostly shared with elders (Table 4-18). When

Table 4-14.–Reported instances and pounds of salmon given to and received from events, Nulato, 2018–2019.

	Give			Receive		
	Number			Number		
Event	Households	Total ties[a]	Salmon (lb)	Households	Total ties[a]	Salmon (lb)
Easter	1	1	15.5	0	0	0.0
Holiday event/potlatch	3	3	18.8	1	1	31.1
Labor Day	7	11	75.7	2	3	1.4
Memorial Day	8	12	116.4	2	3	1.4
Midzeyh okko	24	36	317.1	15	18	203.2
Raffle	3	3	27.4	0	0	0.0
Stickdance	2	4	28.7	2	3	4.7
Potlatch (unspecified)	23	49	458.8	6	7	31.9
Any event	**42**	**119**	**1,058.5**	**22**	**35**	**273.5**

Source ADF&G Division of Subsistence household surveys, 2019.
a. Total instances of giving or receiving.

Table 4-15.–Reported weight of salmon shared by exchange partner and resource, Nulato, 2018–2019.

	Pounds					
	Type of salmon					
Exchange partner	Chinook	Summer chum	Fall chum	Unspecified chum	Coho	Total
Given to						
Local household	793.1	20.2	1,483.2	0.0	0.0	2,296.5
Other community	2,367.9	33.6	1,188.3	2.4	0.0	3,592.2
Event	761.5	4.8	262.3	0.0	29.9	1,058.5
Total	3,922.5	58.6	2,933.7	2.4	29.9	6,947.1
Received from						
Other community	50.1	0.0	12.4	0.0	0.0	62.5
Event	259.0	0.0	13.5	1.0	0.0	273.5
Total	309.1	0.0	25.9	1.0	0.0	336.0

Source ADF&G Division of Subsistence household surveys, 2019.

Table 4-16.–Reported instances of giving and receiving salmon between respondent households and others, by exchange partner and resource, Nulato, 2018–2019

Exchange partner	Number of ties[a]					
	Type of salmon					
	Chinook	Summer chum	Fall chum	Unspecified chum	Coho	Total
Given to						
Local household	25.0	3.0	5.0	0.0	0.0	33.0
Other community	129.0	1.0	70.0	1.0	1.0	202.0
Event	77.0	1.0	38.0	0.0	3.0	119.0
Total	231.0	5.0	113.0	1.0	4.0	354.0
Received from						
Other community	4.0	0.0	1.0	0.0	0.0	5.0
Event	27.0	0.0	7.0	1.0	0.0	35.0
Total	31.0	0.0	8.0	1.0	0.0	40.0

Source ADF&G Divison of Subsistence household surveys, 2019.

a. Total instances of giving or receiving.

Table 4-17.–Reported instances of sharing by processing method and exchange partner, community, 2018–2019.

Processing type	Exchange partner			All exchange partners
	Local household	Another community	Event	
Giving				
Baked or cooked	0.0	3.0	43.0	46.0
Bellies	0.0	0.0	1.0	1.0
Dried/smoked/stripped/kippered (including jarred)	22.0	148.0	38.0	208.0
Filleted	1.0	8.0	11.0	20.0
Roe	1.0	0.0	0.0	1.0
Unknown	0.0	6.0	0.0	6.0
Whole, gutted	6.0	35.0	25.0	66.0
Whole, unprocessed	3.0	2.0	1.0	6.0
All processing types	33.0	202.0	119.0	354.0
Receiving				
Baked or cooked	*n/a*	0.0	6.0	6.0
Dried/smoked/stripped/kippered (including jarred)	*n/a*	3.0	22.0	25.0
Filleted	*n/a*	0.0	2.0	2.0
Unknown	*n/a*	0.0	2.0	2.0
Whole, gutted	*n/a*	2.0	2.0	0.0
Whole, unprocessed	*n/a*	0.0	1.0	1.0
All processing types	*n/a*	5.0	35.0	30.0

Source ADF&G Division of Subsistence household surveys, 2019.

Table 4-18.–Number of unique instances of sharing between respondent households and exchange partners by relationship, Nulato, 2018–2019.

	Unique ties[a]				
Exchange partner	Family (besides elder)	Elder in family	Other elder	Friend	Total
Given to					
Local household	5	12	6	1	24
Other community	54	3	3	3	63
Total	59	15	9	4	87
Received from					
Other community	3	0	1	0	4

Source ADF&G Division of Subsistence household surveys, 2019.

a. Relationship between two households or entities

Table 4-19.–Average pounds of salmon given to and received from exchange partners by relationship, Nulato, 2018–2019.

	Average amount (lb)				
Exchange partner	Family (besides elder)	Elder in family	Other elder	Friend	Total
Given to					
Local household	65.8	154.3	11.6	45.4	277.2
Other community	46.3	26.1	333.5	117.0	522.9
Total	112.1	180.5	345.1	162.4	800.1
Received from					
Other community	8.4	0.0	37.2	0.0	45.6

Source ADF&G Division of Subsistence household surveys, 2019.

Nulato households shared with households outside of the community, most instances (54 of 63) involved sharing with family members who were not elders. In both local and nonlocal sharing events, elder family members received the greatest amount of salmon by weight (Table 4-19). This indicates that although there are many more sharing events between Nulato households and nonelder family members in other communities, when Nulato households do share salmon with nonlocal elders, they share on average much more fish by weight per sharing event. Although providing for family may be a priority, other elders and family friends are also supported through the sharing network. Additionally, most sharing relationships are recurring: 95% of all sharing relations were reported to have occurred in the past, and four households reported sharing with the same partner more than once during the study year.

Nulato residents share salmon widely across Alaska, and even to other states within the U.S. Figure 4-14 is an illustration of sharing and barter exchanges of salmon among Nulato and other communities. Arrows in this figure are scaled in size to show the number of exchanges. The greatest number of sharing events occurred between Nulato households and households in Fairbanks, followed by Anchorage and other U.S. locations outside of Alaska. Twelve other communities were connected to Nulato via sharing networks, including both other Interior Alaska communities within the Yukon River basin and other communities in

eastern, western, and southern Alaska. Overall, Nulato households shared most frequently with households in urban areas. Most of the rural communities that Nulato residents shared with have less access to salmon than those communities situated on the lower and middle Yukon River (such as Tok, Minto, Coldfoot, Hughes, Buckland, and Point Hope). Although some communities that Nulato household heads identified as birthplaces were included within the sharing network, most communities that Nulato fishers shared with were not included in that list.

Figure 4-15 gives a visual summary of salmon given to and received from other communities by Nulato households. Of just over 200 ties, around 125 ties represented sharing events between Nulato households and urban areas within the Yukon River drainage (namely Fairbanks). Other urban areas within Alaska and areas outside of the state constitute the next largest numbers of ties. A small number of ties indicates receipt of salmon by Nulato households from other rural communities within the Yukon River region. On a community level, many of the ties between Nulato and other Yukon River communities appear to be reciprocal, while ties between Nulato and other communities with limited access to salmon and urban locations are more unidirectional (Figure 4-14). This could indicate that there are two kinds of sharing networks outside the community; a regional network of Yukon River communities that shares reciprocally, and a statewide and urban network that involves one-way flows out of Yukon River communities.

Table 4-20 summarizes the sharing events that took place between Nulato households and other outside communities and includes the amounts (in pounds of edible weight) of salmon that was shared. Nulato households shared the most frequently with households in Fairbanks, totaling 126 exchanges at over 1,700 total lb of salmon. Households in Anchorage and other cities outside of Alaska also had multiple sharing connections with Nulato households. However, the number of sharing events did not always coincide with larger amounts of salmon by weight. For example, Nulato households shared 670 lb and 369 lb of salmon with households in Galena and Kaltag, respectively. These quantities were shared with fewer households and through fewer exchanges than were present for Anchorage and other US cities.

Chinook salmon were by far the most widely exchanged kind of salmon among Nulato households and other communities (Figure 4-16). Graphical depictions of both the number of ties by species and the number of pounds exchanged by species provide extremely similar images. Both the majority of ties and majority of edible weight for sharing consisted of Chinook salmon, followed by fall chum salmon and a small amount of summer chum salmon (figures 4-16 and 4-17).

Figures 4-18 and 4-19 depict salmon exchanges between local households by number of ties and pounds of edible weight. Nulato households shared Chinook salmon more frequently than any other species, followed by fall chum salmon and smaller numbers of summer chum and coho salmon (Figure 4-18). However, Chinook and fall chum salmon were shared in roughly similar amounts, and the amounts of summer chum and coho salmon shared become almost indiscernible (Figure 4-19).

Appendix Table D4-5 compares household characteristics to how connected they were in local and intracommunity networks. In networks between Nulato households, those households with high salmon harvests gave the most often: an average of 1.8 ties per household. Mature households had the greatest amount of giving ties (0.6), followed by elder households (0.39); while developing households had no ties. Because considerable investment is required to purchase and maintain both fishing gear and the boats needed for fishing, it is likely that households headed by mature households have amassed the financial resources necessary for fishing. Additionally, as individuals age and retire from the workforce, they may have more time and greater flexibility for fishing. Households headed by single females had more average giving ties (0.43) than those household headed by couples (0.38) and single males (0.31). Households that participated in commercial fishing had more giving ties (0.5) than did those that did not commercial fish (0.37).

For between-community networks, high-harvesting households had the highest levels of giving: an average of 2.2 giving ties per household. Households harvesting low to average amounts of salmon had an average of 1.2 giving ties per household, and those with above-average harvests had about 1.1 giving ties. Mature and elder households had more giving ties than did developing households (1.3 and 1.1 vs. 0.4), and those

Figure 4-14.–Intercommunity sharing, barter, and customary trade map, Nulato, 2018–2019.

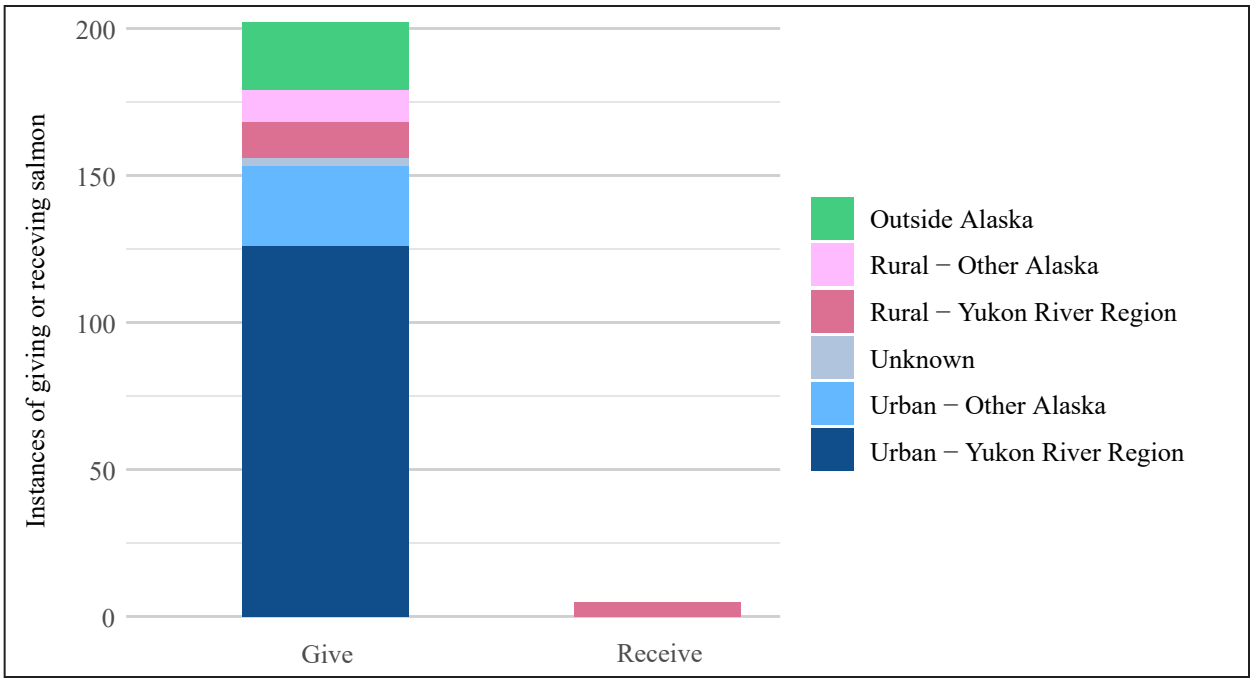


Figure 4-15.–Reported instances of salmon giving and receiving between respondent households and other Alaska communities by region, Nulato, 2018–2019.

Table 4-20.–Reported instances and pounds of salmon given to and received from other communities, by community, Nulato, 2018–2019.

	Given by respondents			Received by respondents		
	Number		Amount	Number		Amount
Community	Households	Ties[a]	(lb)	Households	Ties[a]	(lb)
Anchorage	8.0	24.0	285.8	0.0	0.0	0.0
Bethel	1.0	2.0	5.5	0.0	0.0	0.0
Buckland	1.0	2.0	11.3	0.0	0.0	0.0
Coldfoot	1.0	2.0	29.0	0.0	0.0	0.0
Fairbanks	31.0	126.0	1,717.2	0.0	0.0	0.0
Galena	3.0	6.0	689.6	1.0	2.0	37.2
Hughes	1.0	1.0	12.4	0.0	0.0	0.0
Kaltag	2.0	2.0	368.5	3.0	3.0	25.3
Koyukuk	1.0	1.0	123.6	0.0	0.0	0.0
Minto	1.0	2.0	9.6	0.0	0.0	0.0
Nome	1.0	2.0	6.6	0.0	0.0	0.0
Point Hope	1.0	1.0	9.8	0.0	0.0	0.0
Tok	1.0	2.0	16.6	0.0	0.0	0.0
Wasilla	1.0	3.0	85.8	0.0	0.0	0.0
Other U.S.	7.0	23.0	198.9	0.0	0.0	0.0
Unknown community	2.0	3.0	28.6	0.0	0.0	0.0
All communities	41.0	202.0	3,598.7	4.0	5.0	62.5

Source ADF&G Division of Subsistence household surveys, 2019.

a. Total instances of giving or receiving.

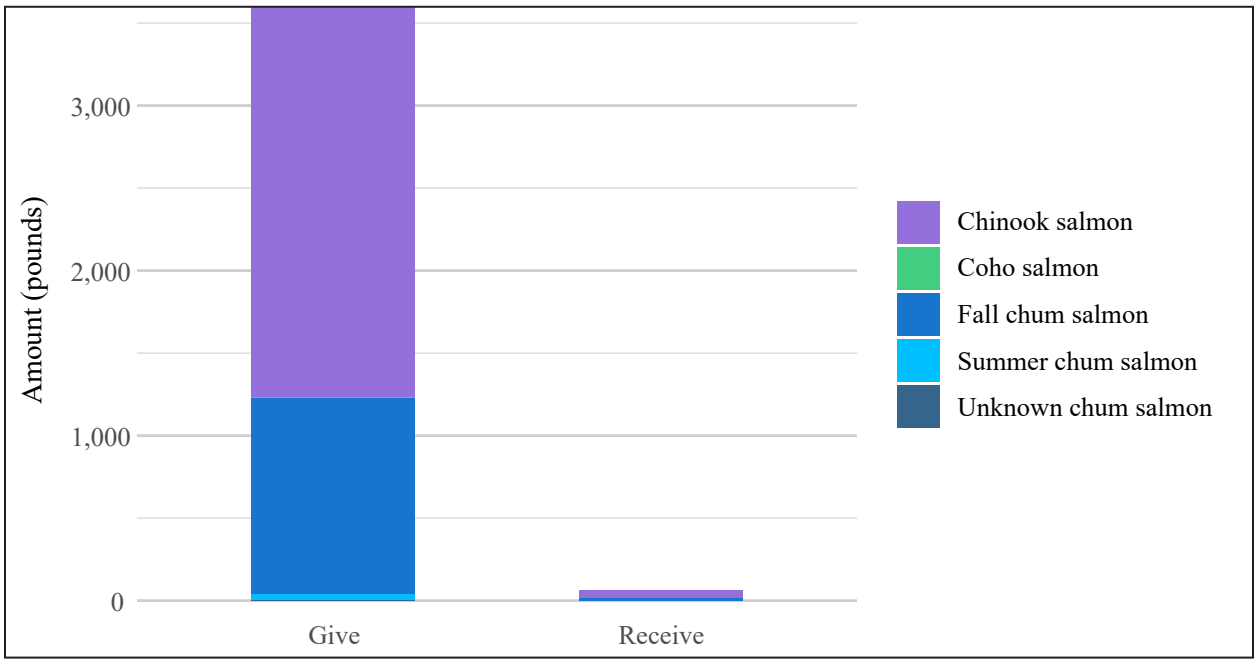


Figure 4-16.–Reported pounds of salmon given to and received from other Alaska communities by resource, Nulato, 2018–2019.

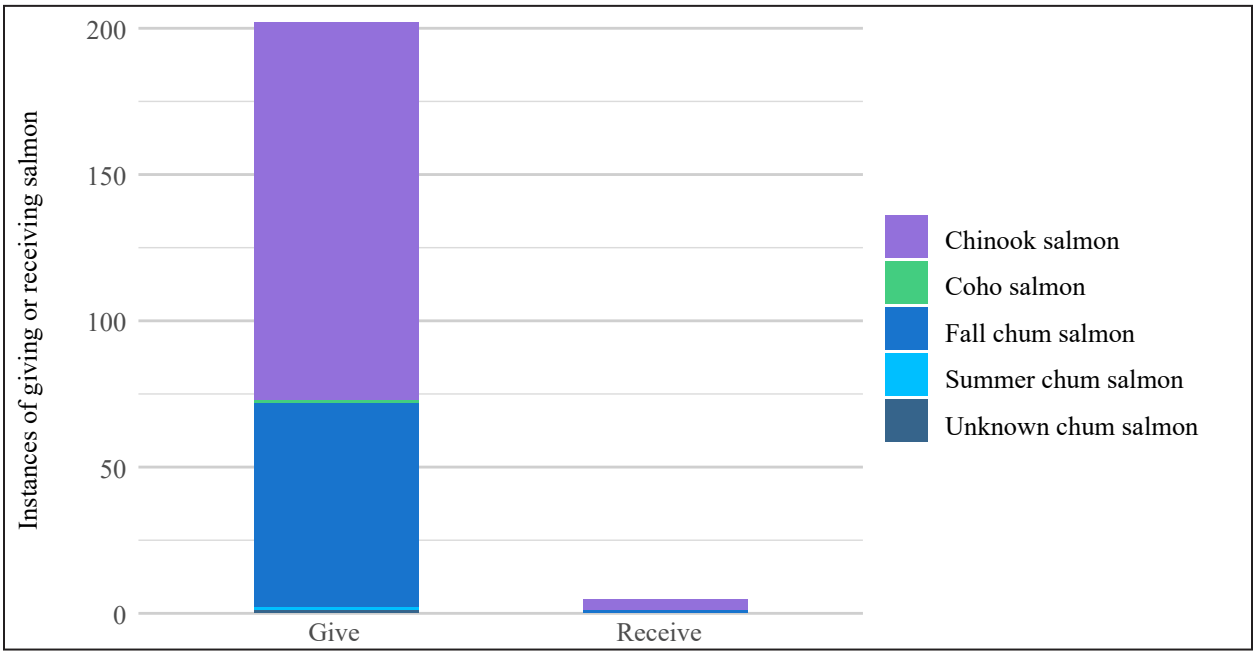


Figure 4-17.–Reported instances of salmon giving and receiving between respondent households and other communities by resource, Nulato, 2018–2019.

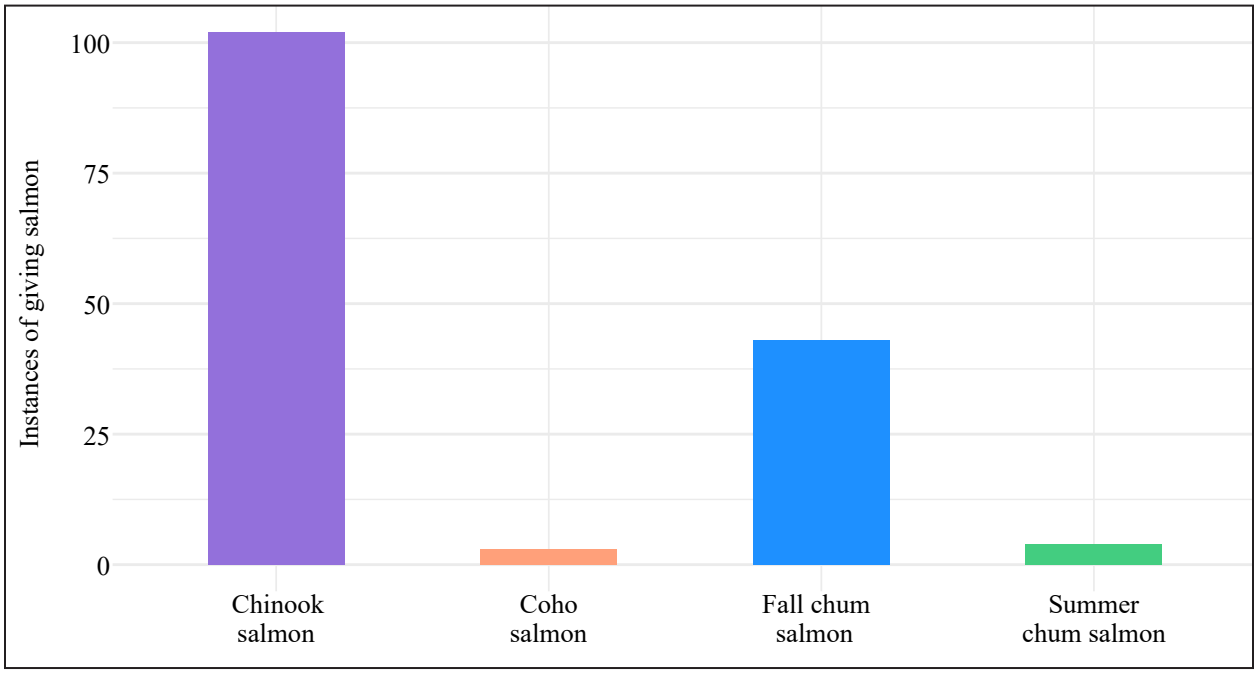


Figure 4-18.–Reported instances of salmon given between respondent households and other local households, by resource, Nulato, 2018–2019.

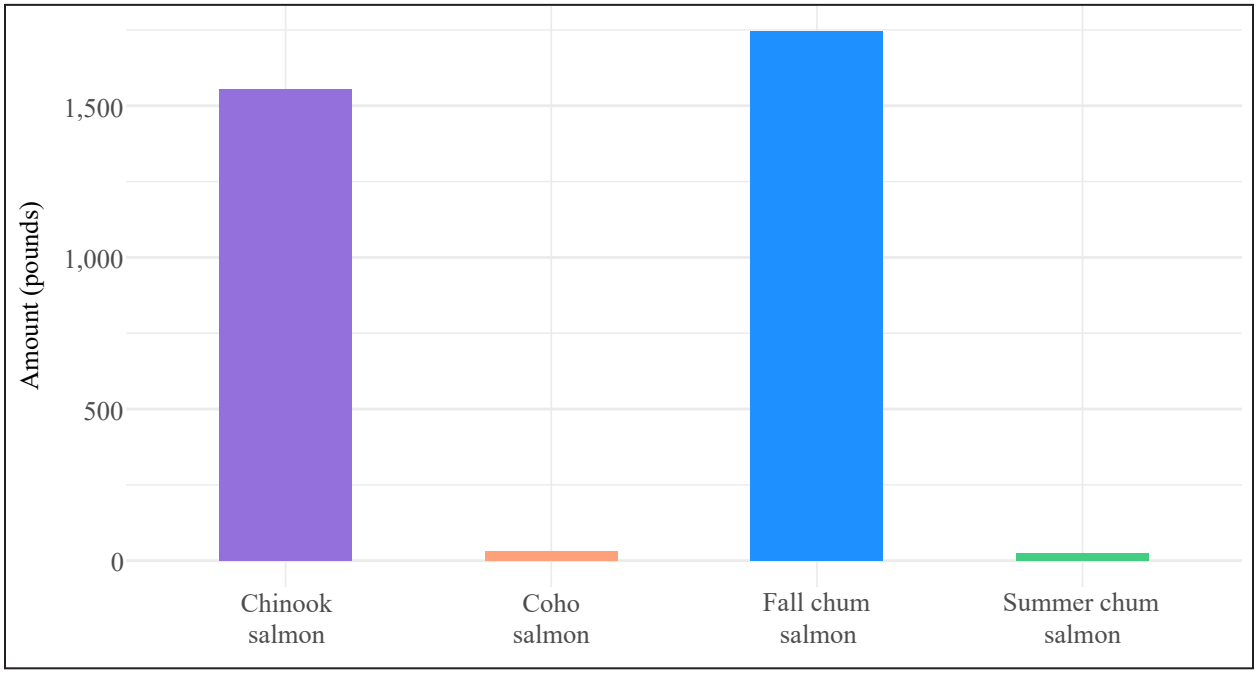


Figure 4-19.–Reported pounds of salmon given between respondent households and other local households by resource, Nulato, 2018–2019.

households that participated in commercial fishing had a greater number of giving ties (1.7) than did those households that did not commercial fish (0.9). The greater number of ties across most categories for between-community networks indicates that sharing is more extensive with communities outside of Nulato than within the community itself.

Barter and Customary Trade

Local Characterization of Barter and Customary Trade

In Alaska, the barter and customary trade of wild food resources are recognized as customary and traditional practices in state subsistence law. State statute defines barter as "the exchange or trade of fish or game, or their parts, taken for subsistence uses for other fish or game or their parts; or for other food or for nonedible items other than money if the exchange is of a limited and non-commercial nature" (AS 16.05.940(2)). Customary trade refers to the exchange of subsistence resources for "minimal amounts of cash" (AS 16.05.940(8)); although the law does not list specific limitations, it does state that transactions must be "non-commercial." In other words, individuals cannot make a business out of selling subsistence resources. Additionally, the customary trade of wild resources must be approved by the appropriate board. Currently, the Board of Fisheries has not approved the customary trade of salmon, or any other type of finfish on the Yukon River. As a result, selling small amounts of salmon remains illegal on the Yukon River under State regulations. The terms barter and customary trade are rarely used in everyday language in Yukon River communities, and their legal definitions often do not align well with the myriad ways that wild foods are exchanged in practice (Brown et al. 2017). The following section will discuss first barter and then customary trade primarily through the words of key respondents.

Although the formal definitions of barter and customary trade according to state statute are specific, in reality the interpretation of those terms varies greatly among individuals, even within the same community. In Nulato, many key respondents spoke of participating in bartering transactions that ranged from both parties agreeing upon specific amounts of each resource that would be exchanged to reciprocal sharing. One respondent described formally compensating family for room and board with both Chinook and chum salmon:

> Well, last year, like I said, I worked down at the fish plant [in Kaltag]. And I stayed with my grandma and my Auntie down there. And for pay I gave them half dried king, the chum. Gave them quite a bit and they enjoyed that. So, that was the two people I shared with. (05142019NUL1)

Another individual mentioned bartering salmon for muktuk with a friend from the coast, and salmon for smoked eels with a family member in another state. In both instances, even though it was expected that the household receiving salmon would eventually send some quantity of another resource, the timeline and amounts were loosely structured (05132019NUL2). For the barter involving muktuk, the Nulato household traded salmon with the understanding that they would be receiving that specific resource. For the barter involving smoked eels, although they knew they would eventually receive something in return, the Nulato household was surprised and delighted to receive smoked eels. Others spoke of witnessing or hearing about bartering within the community but said they did not usually barter themselves (05132019NUL9, 05132019NUL6). One respondent indicated that when gifted salmon or other resources, recipients want to "thank" the giver with a gift of their own, but they did not necessarily think of that interaction as a barter exchange (05132019NUL6).

Key respondents had very different views of customary trade, often locally referred to as "selling fish,", depending on the circumstance. Exchanges involving small quantities of cash were generally socially accepted, and not usually viewed as "buying fish," especially if the buyer would otherwise not have the means to procure their own salmon (such as a lone elder).[6] Often people thought of a gift of cash as a way to thank the fisher, and the cash exchanged may represent only a tiny fraction of the commercial value of the amount of salmon received or the cost to harvest and process it. Some respondents mentioned either

6. Helen S. Cold, ADF&G Division of Subsistence, field notes, May 15, 2019.

purchasing gas for another individual or having someone purchase gas for them as a way to contribute to salmon fishing efforts (05132019NUL6, 05132019NUL2). In this scenario, giving someone gas in exchange for salmon would meet the legal definition of barter. However, it was unusual for someone to physically hand the recipient a jug of fuel, but sometimes those that wanted to help pay for gas would give the fisher cash. Depending when the cash was given and when the fish was received, this exchange could be considered customary trade.. Other times the recipient would call the fuel depot and pre-pay for gas, and the fisher would use that gas credit for fuel; in this case, the exchange is legally considered barter. Most individuals that exchanged small amounts of cash for salmon viewed such contributions as another form of sharing or bartering, rather than the "selling" of fish. One resident explained how the practice of helping pay for gas has become more common and gained importance as fishing regulations and fuel prices have continued to affect fishing efforts: "And the gas got a little more expensive, so we all share with that, you know. We just put in our money, pay for so much gas and then have them use it. That's what we all, we all chip in too" (05142019NUL1).

The same respondent spoke about customary trading of salmon in the past, indicating that her mother had occasionally bought small quantities of salmon, but that she did not engage in the practice herself (05142019NUL1). Another respondent with decades of experience fishing for salmon spoke of fishing practices in prior decades, during which multiple families would use fish wheels to catch thousands of chum and coho salmon that they smoked or dried and sold by the baleful to a traveling local buyer (05132019NUL3).

Some key respondents spoke of instances where others had engaged in larger-scale production and selling of processed salmon outside of the community, generally in the urban centers of Fairbanks or Anchorage. Two key respondents spoke of separate instances in which individuals they knew gathered large quantities of salmon (usually dried Chinook salmon strips) and sold them at events where Native Alaskans living in urban centers frequently gather, such as the Alaska Federation of Natives convention (AFN), which is alternately held in Anchorage or Fairbanks, and the World Eskimo Indian Olympics (WEIO), which is held in Fairbanks every summer. One respondent spoke of a relative that used to harvest at least 3,000 lb of Chinook salmon and annually traveled from Nulato to Fairbanks via boat with the ultimate goal of selling salmon strips at WEIO. However, while en route for Fairbanks, the individual would stop at rural communities along the banks of the Yukon River and sell strips to people they knew. This practice ceased when the individual and others the respondent knew of who were selling fish at the time were reported and put under investigation by the State of Alaska (05132019NUL6, 05132019NUL7). One respondent spoke to the popularity of fish for sale when it was available, indicating that "you could just bring 300 lb there and be done with it in half an hour." However, they also said they did not approve of the practice and that they would "feel guilty doing something like that" (05132019NUL6). Another respondent mentioned that although he had heard similar stories secondhand, he believed that the practice was not as widespread as some believe it to be. He expressed frustration and suggested legal action in those cases where individuals are rumored to be selling fish on a large scale, stating that "It don't happen all the way up the Yukon. We all know each other, and we won't be doin' that" (05132019NUL9). These accounts indicate that Nulato residents had negative perceptions of the few, often historical instances of larger-scale selling of subsistence-caught fish. However, smaller-scale practices such as some individuals providing cash to help pay for gas is one way to ensure that harvest takes place and that residents without other means can obtain salmon.

Salmon Barter and Customary Trade Exchanges

Nulato survey respondents reported 38 unique barter ties and 12 unique customary trade ties during this study period (Appendix Table D4-3). High-harvesting elder households reported more barter/trade than other types of households (Figure 4-20). A total of 27 entities participated in the barter network: 18 surveyed households, one unsurveyed local household, and households from 8 other communities (Appendix Table D4-1). Seven households were involved in customary trade, including four surveyed households and three unsurveyed households. Details about barter and customary trade exchanges are provided in Table 4-21. Of 24 individual bartering exchanges, 21 exchanges involved households giving Chinook salmon in some form, and the other three involved giving fall chum salmon. In most cases, the bartered salmon were smoked, but

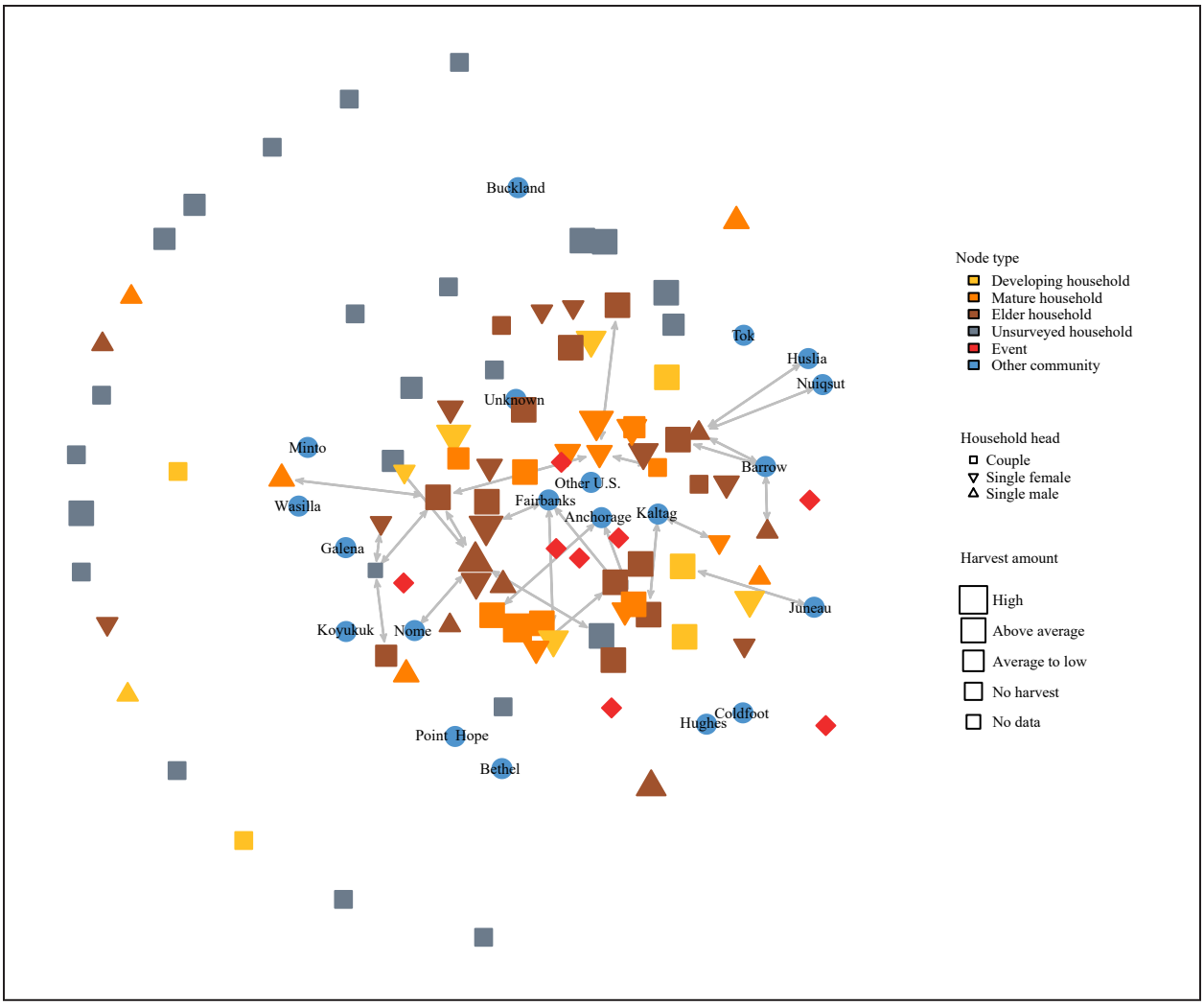


Figure 4-20.–Barter and customary trade network, Nulato, 2018–2019.

whole, unprocessed salmon and raw, gutted fish were both exchanged twice, while baked or cooked fish was exchanged once. Households generally bartered with family or friends, but some individuals also bartered with other elders or coworkers. Barter exchanges occurred with some other households in Nulato, but also many other households in communities across Alaska.

Households received a wide variety of resources and services in exchange for salmon, and often bartering involved the exchange of resources that were not readily available to the receiving community. For example, families residing in coastal communities sent whale products, seal oil, or salmonberries in exchange for salmon (Table 4-21). Some Nulato families received other types of subsistence foods, including moose, black bears, or blueberries, and one Nulato family received herring from a family in Juneau. In some cases, individuals received commercial foods or services in exchange for salmon. One transaction involved the exchange of gas for salmon; housing and maintenance and repair services were also exchanged for salmon. Figure 4-21 depicts the number of barter ties for each resource, and Figure 4-22 gives the amount in pounds for resources exchanged. Most barter exchanges (about 26) involved Nulato families giving Chinook salmon. Nulato households received a wide variety of resources in return, including whale products (about 6 exchanges) and seal oil (about 3 exchanges). Almost 500 lb of Chinook salmon were given by Nulato households, and whale products and herring roe were received in return at the greatest quantity by weight (roughly 25 lb of each).

Table 4-21.–Reported barter and customary trade exchanges by resource and exchange partner, Nulato 2018–2019.

Exchange type	Resource given					Resource received					Exchange partner	
	Resource	Processing	Amount	Units	Pounds	Resource	Processing	Amount	Units	Pounds	Residence*	Relationship to respondent
Barter												
	Chinook salmon	Raw, gutted	4	Individual	33.1	Groceries	Whole, unprocessed	8	Gallons	n/a	Fairbanks	Family (not elder)
	Chinook salmon	Smoked	4	Quarts	6.5	Whale	Whole, unprocessed	1	Gallons	5.0	Anchorage	Family (not elder)
	Chinook salmon	Smoked	2	Gallons	9.6	Whale	Raw, gutted	2	Quarts	2.5	Barrow	Other elder
	Chinook salmon	Smoked	2	Quarts	3.3	Whale	Whole, unprocessed	2	Pounds	1.9	Nuiqsut	Friend
	Chinook salmon	Smoked	2	Quarts	3.3	Salmonberries	Whole, unprocessed	2	Quarts	2	Nuiqsut	Friend
	Chinook salmon	Smoked	2	Quarts	3.3	Moose	Smoked	2	Quarts	2.0	Huslia	Friend
	Chinook salmon	Smoked	2	Quarts	3.3	Whale	Whole, unprocessed	2	Pounds	10.8	Barrow	Friend
	Chinook salmon	Smoked	Unknown	Unknown	Unknown	Room and board	n/a	n/a	n/a	n/a	Kaltag	Family (not elder)
	Chum salmon	Smoked	Unknown	Unknown	Unknown	Room and board	n/a	n/a	n/a	n/a	Kaltag	Elder in family
	Chinook salmon	Smoked	2.5	Pounds	2.5	Seal Oil	Whole, unprocessed	1	Pints	0.9	Nome	Other elder
	Fall chum salmon	Smoked	2.5	Pounds	2.5	Seal Oil	Whole, unprocessed	1	Pints	0.88	Nome	Other elder
	Chinook salmon	Smoked	1	Gallons	4.8	Seal Oil	Missing	1	Quarts	1.8	Fairbanks	Friend
	Fall chum salmon	Smoked	1	Gallons	4.8	Blueberries	Whole, unprocessed	1	Gallons	6	Fairbanks	Family (not elder)
	Fall chum salmon	Smoked	2	Quarts	2.3	Blueberries	Whole, unprocessed	1	Gallons	6.0	Fairbanks	Family (not elder)
	Chinook salmon	Smoked	1	Quarts	1.6	Coho salmon	Smoked	1	Gallons	6.5	Nulato	Friend
	Chinook salmon	Raw, gutted	6	Individual	49.7	Gas	n/a	10	Gallons	n/a	Nulato	Friend
	Chinook salmon	Smoked	6	Quarts	9.8	Herring Roe	Whole, unprocessed	6	Quarts	24	Juneau	Friend
	Chinook salmon	Smoked	1	Gallons	4.8	Whale	Whole, unprocessed	4	Pounds	4.0	Barrow	Friend
	Chinook salmon	Smoked	4	Quarts	6.5	Moose	Raw, gutted	2	Pounds	2	Anchorage	Coworker/meetings
	Chinook salmon	Smoked	4	Quarts	6.5	Black bear	Raw, gutted	1	Pounds	1.0	Anchorage	Coworker/meetings
	Chinook salmon	Smoked	2	Quarts	3.3	Honey	n/a	2	Pints	n/a	Fairbanks	Coworker/meetings
	Chinook salmon	Smoked	1	Gallons	4.8	Maintenance and	n/a	n/a	n/a	n/a	Nulato	Friend
	Chinook salmon	Whole, unprocessed	10	Individual	82.8	Ride to harvest	n/a	n/a	n/a	n/a	Nulato	Friend
	Chinook salmon	Whole, unprocessed	30	Individual	248.4	Gas	n/a	15	Gallons	n/a	Nulato	Elder in family
	Chinook salmon	Baked or cooked	4	Pints	3.2	Bowhead	Raw, gutted	2	Gallons	10	Kaltag	Family (not elder)
Customary trade												
	Cash	n/a	Unknown	Dollars	Unknown	Chinook salmon	Dried/smoked/stripped/ kippered (incl. jarred)	Unknown	Unknown	Unknown	Nulato	Unknown
	Cash	n/a	Unknown	Dollars	Unknown	Fall chum salmon	Dried/smoked/stripped/ kippered (incl. jarred)	Unknown	Unknown	Unknown	Nulato	Unknown
	Cash	n/a	50	Dollars	n/a	Fall chum salmon	Whole - Unprocessed	100	Individual	448	Nulato	Unknown
	Fall chum salmon	Whole, unprocessed	10	Individual	45	Cash	n/a	55	Dollars	n/a	Nulato	Elder in family
	Fall chum salmon	Whole, unprocessed	5	Individual	22	Cash	n/a	30	Dollars	n/a	Nulato	Elder in family
	Fall chum salmon	Whole, unprocessed	10	Individual	45	Cash	n/a	50	Dollars	n/a	Nulato	Elder in family
	Cash	n/a	30	Dollars	n/a	Chinook salmon	Fillet	6	Pounds	6	Nulato	Other elder

Source ADF&G Division of Subsistence household surveys, 2019.

Note If exchange partner residence was unknown by respondent, exchange location was reported instead

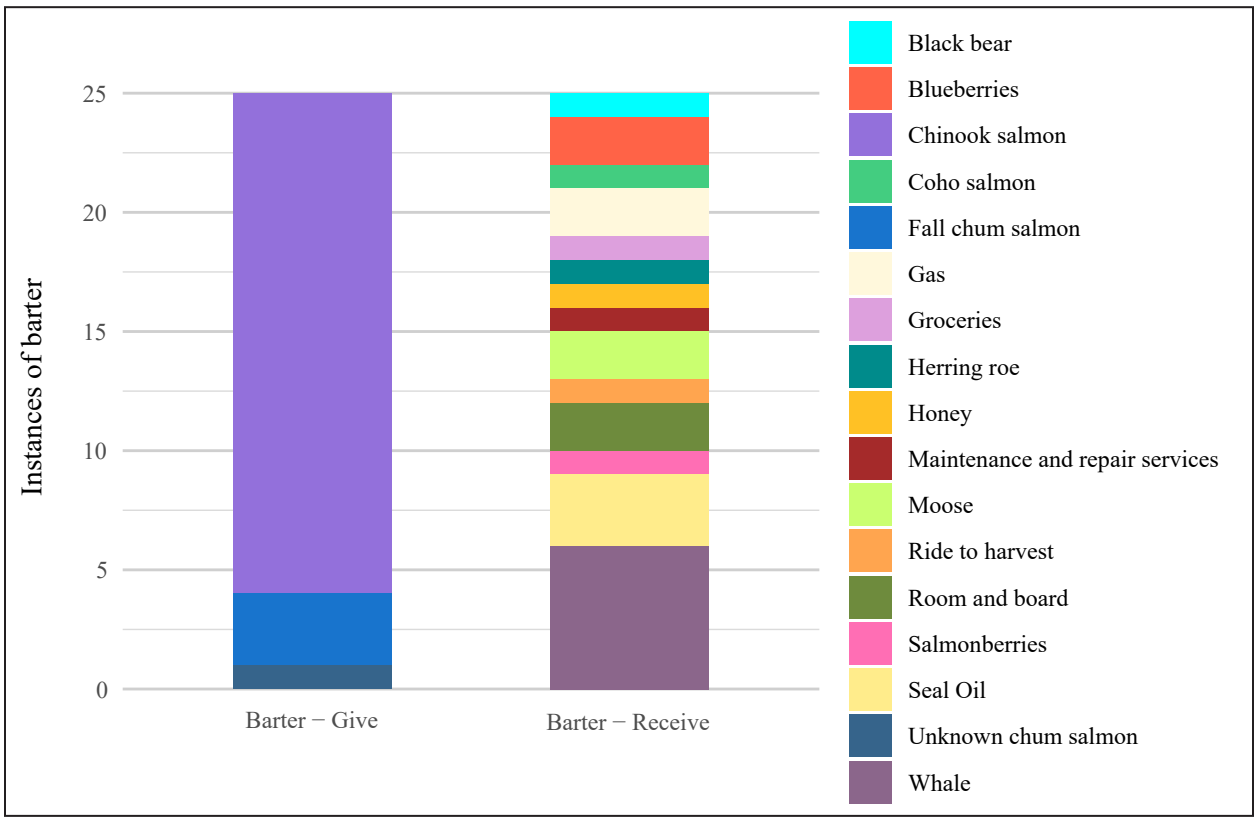


Figure 4-21.–Reported instances of barter by resources given and received, Nulato, 2018–2019.

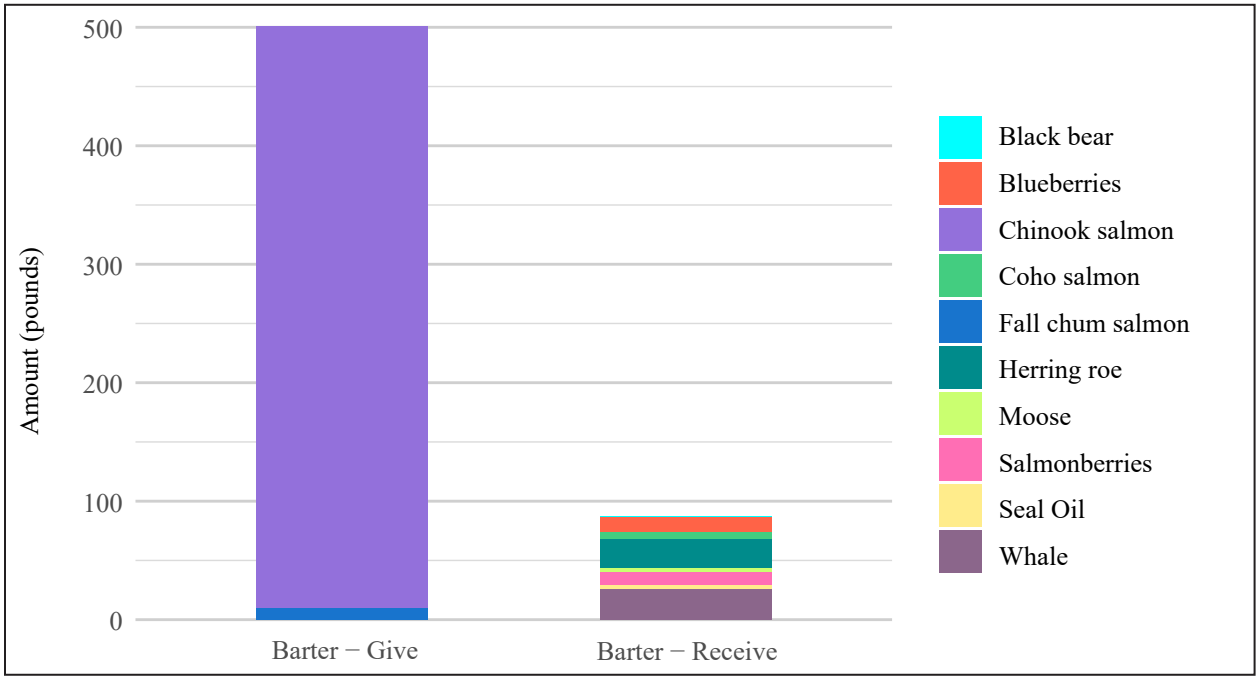


Figure 4-22.–Reported pounds of salmon and other wild foods given and received in barter, Nulato, 2018–2019.

Table 4-21 details customary trade exchanges reported by households in Nulato. In four instances, households gave cash in return for salmon, and households traded fall chum salmon for cash in three instances. Households received cash on three occasions, Chinook salmon on two occasions, and fall chum salmon on two occasions. Although some respondents chose not to disclose the exact amount of cash involved in these exchanges, the information from those who did shows that the cash value of salmon varies widely among individuals and transactions. For example, one household gave $50 and received 100 whole, unprocessed chum salmon, but another household gave $30 for 6 lb of fileted Chinook salmon. Figures 4-23, 4-24, and 4-25 illustrate customary trade exchanges by number of ties, edible pounds of salmon bought and sold, and cash for salmon exchanges within Nulato. Unlike the barter network, for Nulato households customary trade exchanges only took place among households within the community. Households purchased Chinook and fall chum salmon two times each, but households only sold fall chum salmon, and this happened three times. By edible pounds, customary trade transactions almost exclusively involved fall chum salmon: a small fraction of sale weight consisted of Chinook salmon (Figure 4-24). Collectively, households purchased over 400 lb of salmon and sold just over 100 lb of salmon. Just over $75 was collectively given by purchasers of salmon, and those that sold salmon earned over $125 (Figure 4-25). When compared to the number of pounds of salmon exchanged through customary trade, these low dollar-amounts comprise a mere fraction of the commercial costs for the quantities involved.[7] Due to the sensitivity of these questions and the stigma surrounding customary trade, these results could be an underrepresentation of customary trade activity within Nulato.

Table 4-22 describes the characteristics of households and salmon exchanges in the barter and trade networks of Nulato. High-harvesting households gave salmon the most frequently both within the community (0.6 ties) and with other communities (1 tie). Low to average harvesters gave more times, on average, than above-average harvesters within the community (0.21 vs. 0.08 ties) but did not have any ties outside of the community. Although above-average harvesters had low mean giving and receiving ties, they received the largest mean amount of fish by weight, which may indicate fewer transactions of this type but greater amounts of fish per transaction. Half of all surveyed households in Nulato are headed by elders; these households had the highest mean number of ties for both receiving and giving of salmon in Nulato, but received more mean pounds than the other maturity categories. Because almost 40% of Nulato residents are at least 55 years of age, the current age structure of the community may be driving the amount of barter and customary trade, and future shifts in the population profile could alter the relative importance of these types of interactions in the greater exchange network. Mature households gave the most salmon by weight, but this age demographic makes up a smaller percentage of the overall population than other maturity categories. The number of giving ties between Nulato and other communities was directly related to age: the number of mean ties decreased as age decreased. Households headed by single males had more giving ties for both within and between community networks, and those that did not commercial fish were more connected to giving and receiving networks both inside Nulato and with other communities.

Comparison of Network Types

Figure 4-26 compares network diagrams for production, sharing, and barter and trade networks. Of the three network types, sharing connections were most common among Nulato households. Few households with salmon production network ties also shared exchange network ties, which indicates that households in a fishing group did not commonly share salmon with each other. Rather, after dividing salmon harvests amongst themselves, those households then shared with households outside of their fishing group. Many of the same households that shared salmon were also engaged in barter and trade activities, in most cases with different households than the ones with which they shared salmon. Production binds together small groups of households that are disconnected from other groups, but sharing and barter bridge the gaps between these households, bringing together nearly the entire community in a single network

7. Alaska Department of Fish and Game, Division of Commercial Fisheries, n.d. “Alaska salmon fishery wholesale prices.” Accessed April 15, 2021. https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyfisherysalmon.salmoncatch_wholesale

Table 4-22.–Mean number of ties and pounds exchanged in barter and customary trade networks, by network and by household characteristic, Nulato , 2018–2019.

		Network							
		Between local households				Between Nulato households and households in other communities			
		Receiving		Giving		Receiving		Giving	
Household characteristic	Number of Households	Mean ties[a] (number)	Mean amount (lb)	Mean ties[a] (number)	Mean amount (lb)	Mean ties[a] (number)	Mean amount (lb)	Mean ties[a] (number)	Mean amount (lb)
Harvest category[b]									
High	5	0	0	0.6	22.4	0	0	1	3.37
Above average	24	0.08	18.94	0.04	0.07	0	0	0.38	3.14
Low to average	14	0.21	0.43	0.21	24	0	0	0	0
No harvest	19	0	0	0.05	2.61	0	0	0.32	1.11
Maturity[c]									
Developing	11	0	0	0	0	0	0	0.18	3.9
Mature	20	0.05	0.3	0.15	16.8	0	0	0.25	1.3
Elder	31	0.13	14.66	0.16	5.27	0	0	0.42	1.43
Household head									
Couple	26	0.15	17.48	0.04	0.06	0	0	0.31	1.62
Single female	23	0	0	0.17	16.77	0	0	0.22	2.1
Single male	13	0.08	0.46	0.23	8.62	0	0	0.54	1.76
Commercial fishing									
Yes	10	0	0	0	0	0	0	0.3	0.32
No	51	0.1	9.03	0.16	9.79	0	0	0.33	2.16
Unknown	1	0	0	0	0	0	0	0	0

Source ADF&G Division of Subsistence household surveys, 2019 and ADF&G Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

Note This table only summarizes the side of the barter or customary trade exchange that involved salmon.

a. Total instances of giving or receiving.

b. Household harvest categories were calculated using the mean household harvest (211 lb). The upper limit of the above-average harvest category is one standard deviation (SD) over the mean (375.4 lb). The high harvest category is any harvest greater than one SD over the mean.

c. Developing: age(s) of households head(s) is less than 40 years. Mature: age(s) of household head(s) is 40–59 years. Elder: age(s) of household head(s) is greater than 59 years.

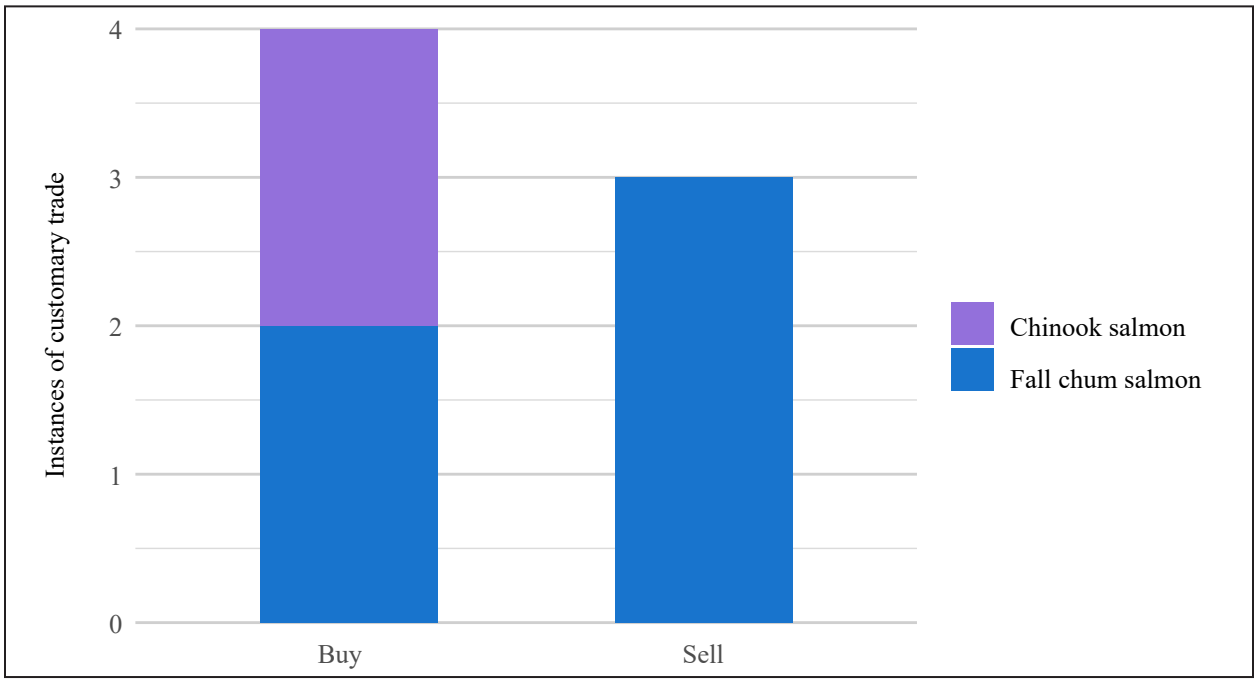


Figure 4-23.–Reported instances of customary trade exchanges, Nulato, 2018–2019.

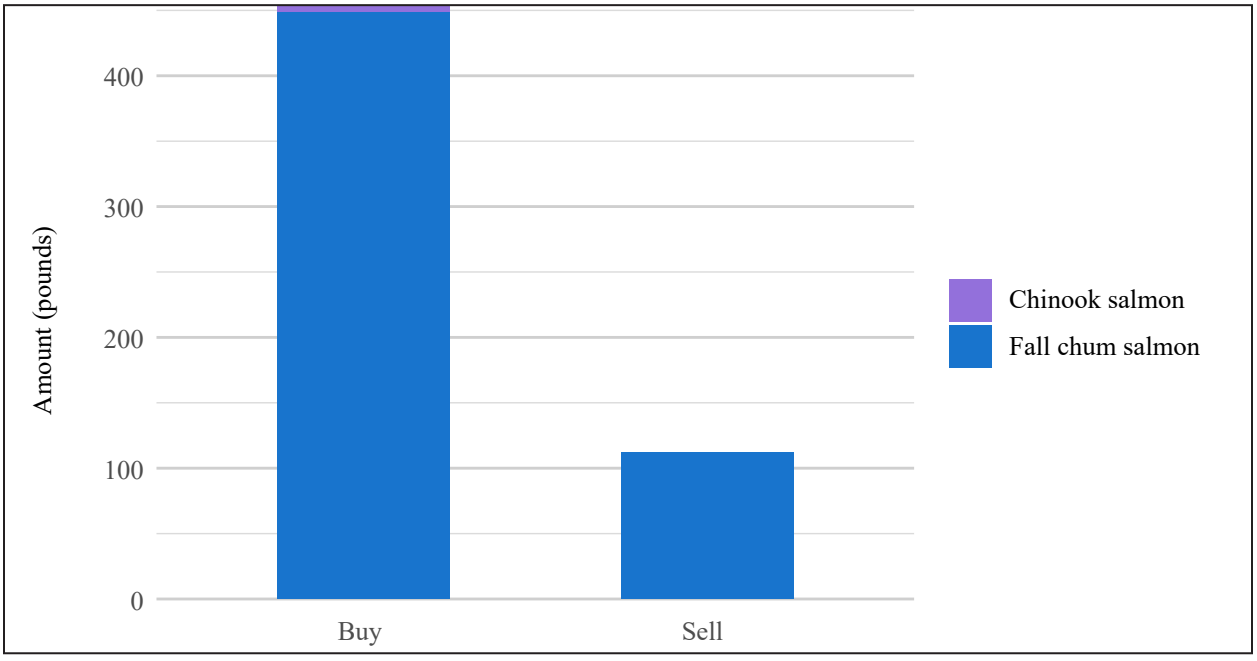


Figure 4-24.–Reported pounds of salmon bought and sold in customary trade exchanges, Nulato, 2018–2019.

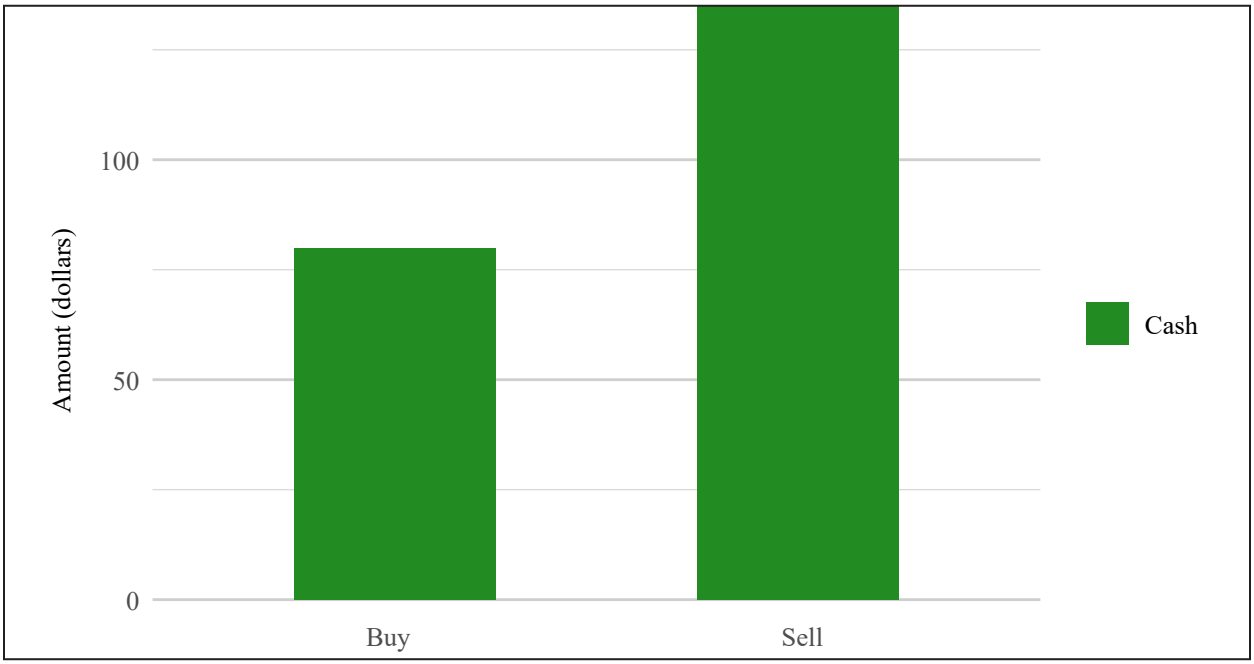


Figure 4-25.–Reported monetary value of salmon bought and sold in customary trade exchanges, Nulato, 2018–2019.

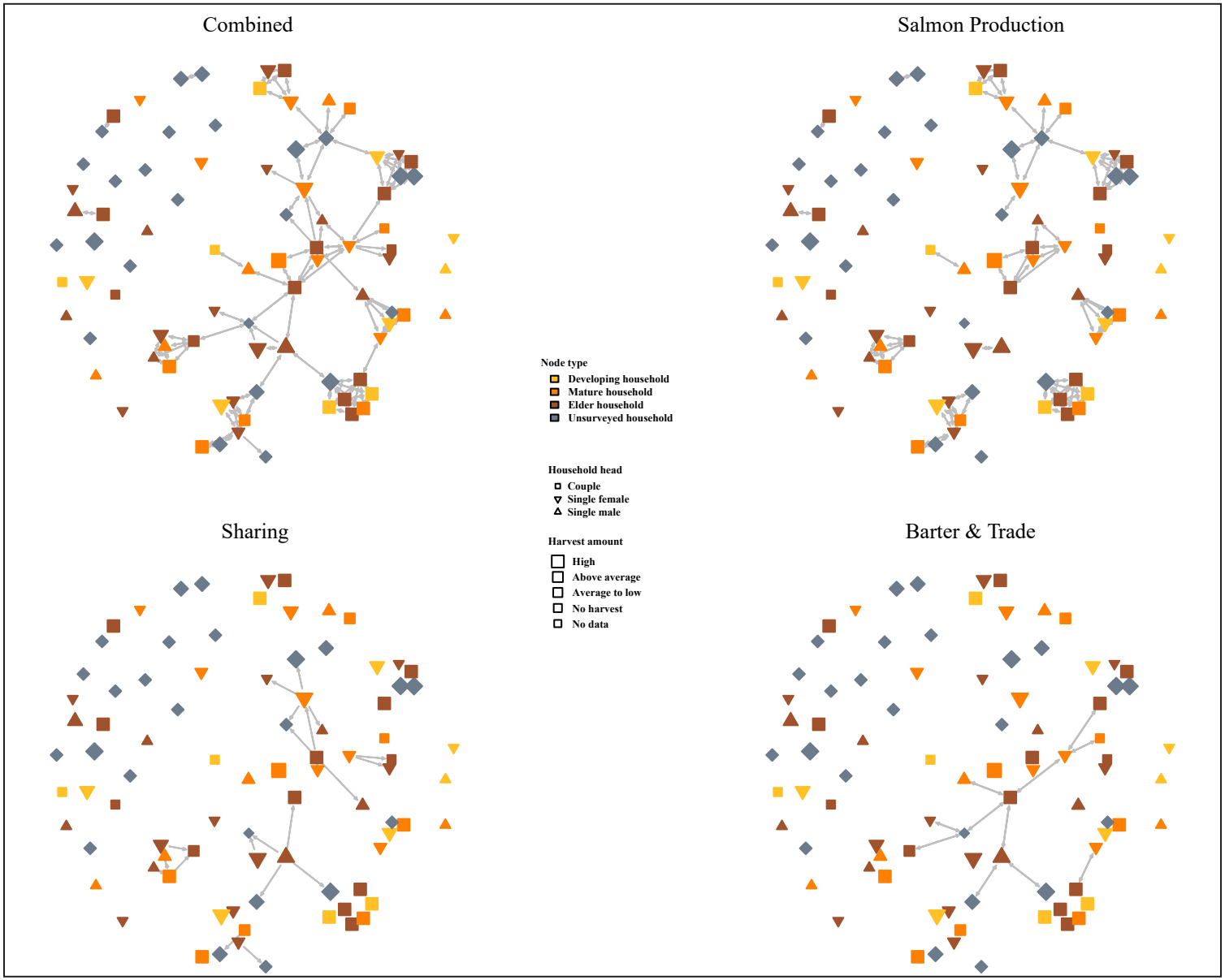


Figure 4-26.–Comparison of exchange networks between respondent households and other local households, Nulato, 2018–2019.

Previous research has found that sharing is far more common than bartering or customary trade (Brown et al. 2017; Ikuta and Slayton 2012). This study supports these findings for Nulato households, but it is also plausible that barter and customary trade were underreported in this study. Unclear regulations and differences in the legal and practical definitions of sharing, barter, and trade may have contributed to lower rates of reporting for these exchange types. Additionally, a social stigma associated with buying and selling fish may have caused some individuals to choose not to disclose customary trade activities. However, barter and trade exchanges may also be less common than sharing because of the high level of sharing present in the community, particularly at community events. Many Nulato households appear to be using barter to acquire resources not commonly available in their region and customary trade to support the fishing activities of other local fishermen.

Appendix Table D4-6 shows information about the various production and exchange connections between local households, between local households and other communities, and overall. Fifty six of 86 households in Nulato demonstrated cooperative production ties, which shows that the majority of Nulato households work together with others to procure and process salmon. More sharing connections are present among Nulato households and other communities (40 connections) than sharing connections between local households only (28 connections). However, this statistic does not include exchanges at community events, and therefore does not account for the prolific sharing that takes place within the community via that avenue. If sharing taking place at community events is considered, there are more sharing ties within the community than outside of the community. Cooperative salmon production and three types of salmon exchange will be described in detail in the following sections. Reciprocity values for production and barter and trade networks equaled 1; for production, this value reflects cooperative relationships between household fishing groups; for barter and customary trade, this suggests that goods are always being exchanged between households in both directions. In both cases, the relationship or exchange is reciprocal and inherently mutual. On the other hand, reciprocity values for sharing networks were either very low or equal to zero, which indicates that the household giving the resource generally did not receive something in return. Individuals both gave to and received salmon from community events, which would move reciprocity values away from 0. Transitivity was highest in the production network where most ties were between local households (0.86).

Comparing Salmon Harvests and Uses in 2018 with Previous Years

Harvest Assessments

Nulato households were asked to assess their 2018 salmon harvests in two ways; whether they used more, less or about the same amount of salmon in 2018 as the past five years, and whether they felt that they got enough salmon to meet their needs. Asking these questions is Division of Subsistence, standard practice. These questions are used to understand how a single study year compares to other years and how local residents understand their own need and access to wild foods. Sharing, bartering, and buying wild foods are all ways to increase access to those foods. Answers to these questions demonstrate the continued need for salmon. If their use of salmon was different in 2018 compared to previous years, households were asked to provide reasons why. If they did not get enough salmon, they were asked what kinds and how much more salmon they needed. Additionally, they were asked to evaluate the severity of the impact to their household as a result of not getting enough.

Of 62 sampled households, 58 households reported using salmon in 2018 (Table 4-23). Fifty-two percent said they used less salmon than in previous years, 34% used about the same amount, and 8% used more salmon in 2018 (Table 4-23; Figure 4-27). Households that reported using less salmon than in previous years cited a wide variety of reasons for doing so, most notably lack of effort (23%), less sharing (17%), and other reasons that did not fit into the discrete categories provided (17%; Table 4-24). Of the five households that reported using more salmon in 2018, 2 households (40%) mentioned needing more salmon (Table 4-25). Some households also mentioned that in 2018 they had more fishing success, got or fixed fishing equipment, and substituted salmon for other unavailable resources.

Sixty-eight percent of households said they did get enough salmon in 2018, 27% indicated that they did not get enough salmon, and 5% of households reportedly do not use salmon (Figure 4-28). Of those households

Table 4-23.–Changes in household uses of salmon compared to recent years, Nulato, 2018.

Sampled households	Valid responses[a]	Households reporting use: Total households Number	Total households Percentage	Less Number	Less Percentage	Same Number	Same Percentage	More Number	More Percentage	Households not using Number	Households not using Percentage
62	62	58	93.5%	32	51.6%	21	33.9%	5	8.1%	4	6.5%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response.

Table 4-24.–Reasons for less household uses of salmon compared to recent years, Nulato, 2018.

Valid responses[a]	Households reporting reasons for less use	Family/ personal Number	Family/ personal Percentage	Resources less available Number	Resources less available Percentage	Too far to travel Number	Too far to travel Percentage	Lack of equipment Number	Lack of equipment Percentage	Less sharing Number	Less sharing Percentage	Lack of effort Number	Lack of effort Percentage	Unsuccessful Number	Unsuccessful Percentage	Weather/ environment Number	Weather/ environment Percentage	Working/ no time Number	Working/ no time Percentage
62	30	1	3.3%	1	3%	0	0.0%	0	0%	5	17%	7	23%	0	0.0%	0	0.0%	2	6.7%

-continued-

Table 4-24.–Continued.

Valid responses[a]	Households reporting reasons for less use	Regulations Number	Regulations Percentage	Small/ diseased animals Number	Small/ diseased animals Percentage	Did not need Number	Did not need Percentage	Equipment/ fuel expense Number	Equipment/ fuel expense Percentage	Used other resources Number	Used other resources Percentage	Competition Number	Competition Percentage	Not enough/ no help Number	Not enough/ no help Percentage	Other reasons Number	Other reasons Percentage
62	30	3	10%	1	3.3%	1	3.3%	0	0.0%	1	3.3%	1	3.3%	2	6.7%	5	16.7%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response and households reporting never using the resource.

Table 4-25.–Reasons for more household uses of salmon compared to recent years, Nulato, 2018.

Valid responses[a]	Households reporting reasons for more use	Personal Number	Personal Percentage	Increased availability Number	Increased availability Percentage	Used other resources Number	Used other resources Percentage	Favorable weather Number	Favorable weather Percentage	Received more Number	Received more Percentage	Needed more Number	Needed more Percentage	Increased effort Number	Increased effort Percentage
62	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	40.0%	0	0.0%

-continued-

Table 4-25.–Continued.

Valid responses[a]	Households reporting reasons for more use	Traveled farther Number	Traveled farther Percentage	More success Number	More success Percentage	Had more time Number	Had more time Percentage	Store-bought expense Number	Store-bought expense Percentage	Got/ fixed equipment Number	Got/ fixed equipment Percentage	Substitue for unavialable resource(s) Number	Substitue for unavialable resource(s) Percentage	Had more help Number	Had more help Percentage
62	5	0	0.0%	1	20.0%	0	0.0%	0	0.0%	1	20.0%	1	20.0%	0	0.0%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response and households reporting never use.

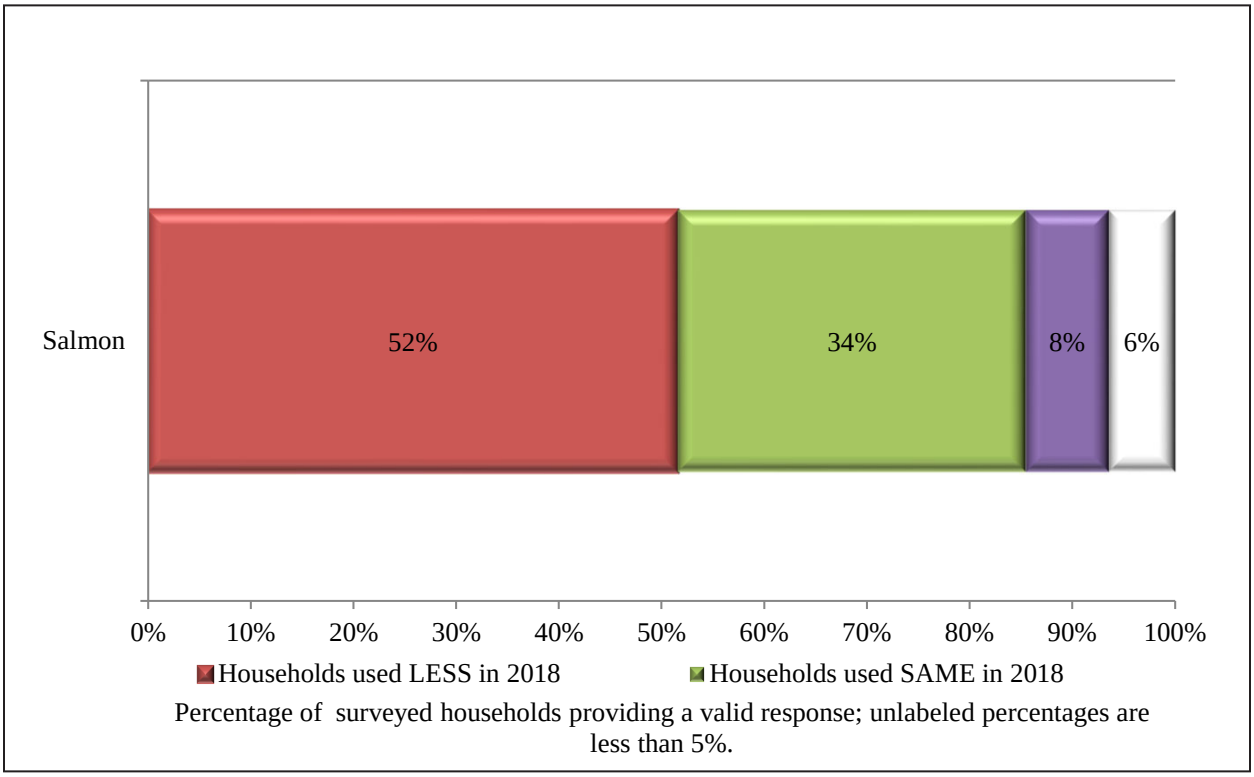


Figure 4-28.–Changes in household uses of salmon compared to recent years, Nulato, 2018.

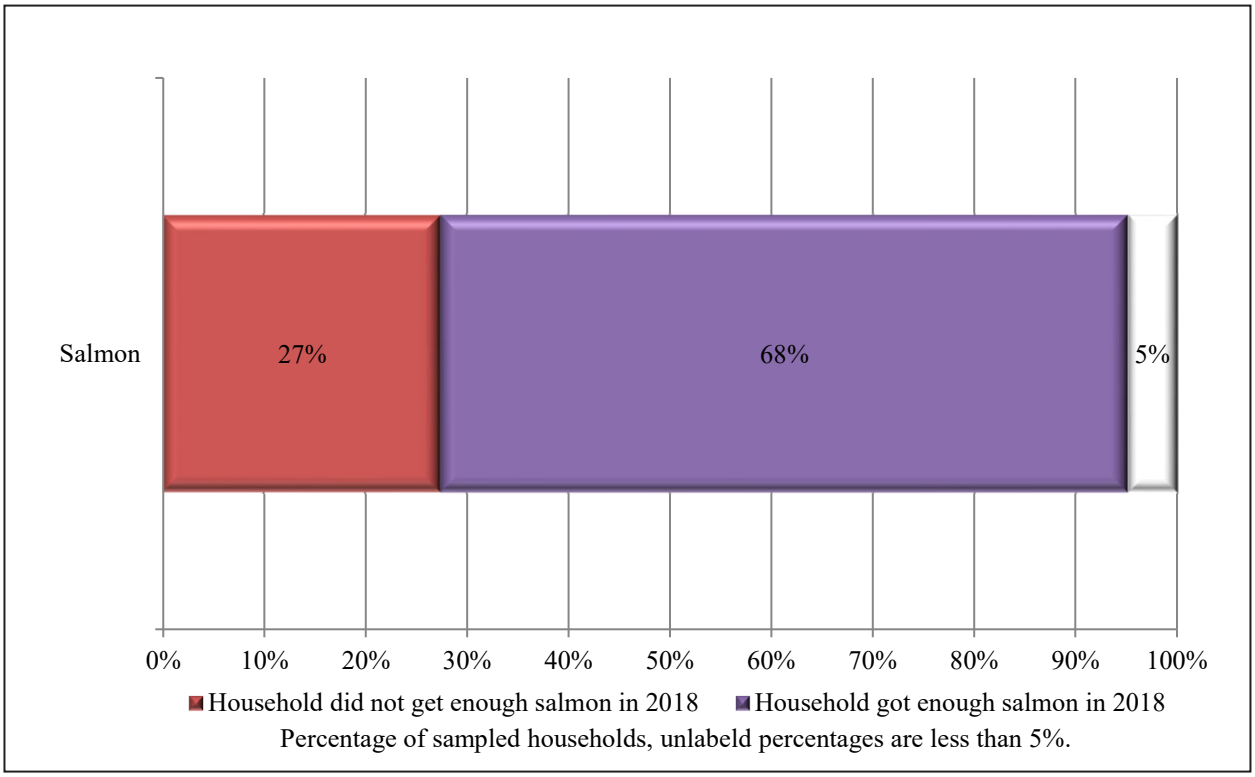


Figure 4-27.–P ercentage of sampled households reporting whether they had enough salmon, Nulato, 2018.

that did not get enough salmon, just under half (47%) said that the impact on their lives was minor, (Table 4-26). Households most commonly said that they needed more Chinook salmon (23% of households), followed by fall chum salmon (11%), and smaller percentages said that they needed coho and summer chum salmon (Table 4-27). Households that did not get enough salmon implemented several types of life changes to compensate, including making do without (33%), using more commercial foods (22%), and replacing with other subsistence foods (22%) (Table 4-28).

Information provided by ethnographic respondents can add additional context to of changing household uses of salmon by Nulato residents. Several individuals mentioned that the current regulatory structure of short-term openings during which fishers can target Chinook salmon has changed the way families fish for salmon. Because of the lack of flexibility in timing for fishing, some fishers are unable to take advantage of fishing opportunities due to work, familial, or other conflicts (05132019NUL5, 05132019NUL2, 05132019NUL9). Additionally, households must often fish nonstop during openings to procure enough salmon to meet their needs (05132019NUL9, 05132019NUL2). As one respondent stated: "We used to fish all week, you know. Not fish 24 hours and then just quit and another 24 hours. Two 24 hours a week, you know. We used to fish all week" (05132019NUL2). Another respondent described an exhausting fishing schedule due to the need to fit fishing in between other obligations:

> Last year I drove down from Fairbanks. I got up early, 5:30 in the morning, brought the boat to Nenana, went up, got another load, back in the boat by 8 o'clock, and had to go do something else so I left Fairbanks at, at, I think 12 o'clock, or Nenana, 12, 12 o'clock. I got down here [to Nulato] at one in the morning. And then they said fishing is open 'til tonight, so I went out fishing 'til 9 o'clock in the morning. We caught, I dunno, 53 kings or something like that, me and some other guys. Dropped 'em off, and then got all the water, got everything for them, then I was just gonna go to sleep, and they said, "Hey, the thing close tonight at 6 [o'clock]," so I had to go back out there and fish until 6 o'clock. (05132019NUL9)

Sharing Assessments

Survey respondents were asked to describe how their household salmon sharing practices had changed in recent years. Of the 62 households surveyed, 27 households reported that their salmon sharing practices had, in fact, changed within the last 10 years; 29% said they shared less in 2018 than in previous years, 55% said they shared about the same amount, and 15% indicated they shared more in 2018 (Table 4-29). When asked about changes in sharing on a species level, 39% of households indicated that they shared less Chinook salmon, and 25% said they shared about the same amount of Chinook salmon as in previous years (Table 4-30). The decline in sharing of Chinook salmon may have been absorbed by increased harvests of fall chum salmon; in comparison to Chinook salmon, sharing of fall chum salmon has remained relatively stable. For fall chum salmon, 15% of households indicated they shared less of the resources in 2018, 32% said they shared about the same amount, and 11% said they shared more. Overall, households that share fall chum and coho salmon indicated sharing about the same amount of both as they usually did.

Households gave numerous reasons for sharing either more or less salmon in 2018 than in previous years. Nine households shared more salmon, and the top reasons for doing so included getting or fixing equipment necessary for salmon fishing (22%) and other reasons that did not fit into a discrete category (44%; Table 4-31). Nearly twice as many households (16) reported sharing less salmon in 2018, and although they cited a variety of reasons for sharing less, the greatest percentage chose other reasons (31%) as the primary causes for doing so (Table 4-32).

Overall, survey respondents indicated a slight decline in the number of households that they shared with in 2018 when compared to previous years (Table 4-33). Fourteen households (23%) said they shared with fewer households in 2018, 32 households (53%) said they shared with the same number, 5 households (8%) said they shared with more, and 9 households (15%) did not share salmon in 2018. Households gave a variety of reasons for their changes in sharing patterns over the past 10 years. (Table 4-34). The most commonly cited reasons included less fish present overall (15%), less nonsalmon fish available (8%), less sharing of salmon

Table 4-26.–Reported impact to households reporting that they did not get enough salmon, Nulato, 2018

Sample households	Households not getting enough salmon.				Impact to those not getting enough salmon.									
	Valid responses[a]		Did not get enough		No response		Not noticeable		Minor		Major		Severe	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
62	59	95.2%	17	28.8%	4	23.5%	1	5.9%	8	47.1%	2	11.8%	2	11.8%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Includes households failing to respond to the question and those households that never used the resource.

Table 4-27.–Types and amounts of salmon that sampled households reported needing, Nulato, 2018.

Resource	Households needing	Amount needed	Percentage of households
Chinook salmon	14	251	22.6%
Summer chum salmon	3	380	4.8%
Fall chum salmon	7	195	11.3%
Coho salmon	4	50	6.5%
Other salmon	0	0	0.0%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 4-28.–Things households reported doing differently as a result of not getting enough salmon, Nulato, 2018.

Valid responses[a]	Bought/bartered		Used more commercial foods		Replaced with other subsistence foods		Asked others for help		Made do without		Increased effort to harvest	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
9	0	0.0%	2	22.2%	2	22.2%	1	11.1%	3	33.3%	1	11.1%

-continued-

Table 4-28.–Continued.

Valid responses[a]	Got a job		Obtained food from other sources		Got public assistance		Didn't share as much		Other	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
9	0	0.0%	1	11.1%	0	0.0%	0	0.0%	1	11.1%

Source ADF&G Division of Subsistence household surveys, 2019.

for unspecified reasons (7%), and sharing salmon with fewer households (5%). Those factors identified as having the greatest impact on subsistence salmon sharing included, most notably, personal reasons (24%), regulations (24%), and resource health and availability (22%; Table 4-35).

Several ethnographic respondents emphasized the effects of restrictive regulations on their sharing practices. They described how sharing practices change depending on the amounts of salmon they are able to harvest during a given year (05132019NUL2, 05132019NUL3, 05132019NUL4, 05132019NUL5). Often regulations worked in conjunction with other factors to prevent fishers from procuring the amounts of salmon they wanted. One respondent indicated that their family did not go fishing for fall chum salmon due to scheduling conflicts with wage labor and mentioned that they therefore did not give away as much half-dried or jarred fish as they normally would have (05132019NUL2). The same respondent indicated that the timing of salmon fishing closures often coincided with large pulses of fish, which they found frustrating. Another respondent said that although the amount of fish they harvest may vary year to year for a variety of reasons, they always attempt to share with others, and that most people do the same (05132019NUL9). This sentiment was echoed by other key respondents, who mentioned that they may share less in some years, but do still always attempt to share, even at the expense of their own salmon supply (05132019NUL3, 05132019NUL4, 05132019NUL5).

Previous Salmon Network Data

Figure 4-29 shows a salmon wild food sharing diagram created from data collected by ADF&G in 2010 (Brown et al. 2015a) as well as the salmon network documented in this study. The 2010 data were collected as part of a comprehensive subsistence harvest survey in which respondents were asked to identify who was involved in the production of salmon their household used. Due to differing methods between that study and this one, it is not possible compare the datasets in detail. However, by focusing only on the unique ties between households in each study, the two datasets do allow for a more general comparison of the number of households connected by salmon within the community during the two study years.

Table 4-36 compares basic information about the salmon networks in each study year. Comparing prior salmon networks to the networks produced for the 2018 study year allows researchers to look for patterns of salmon exchange that exist within a single community through time and helps to households are connected through production and exchange. The number of households in the community remained relatively consistent between the two years, decreasing by only five in 2018. The number of unique ties present in both networks was also comparable between the studies: 113 in 2010 and 110 in 2018. Despite a similar number of ties, the number of unconnected households was much greater in 2018. The decrease in number of connected households corresponds with a decrease in the amount of salmon harvested within the community. Although we cannot determine direct correlation with the data at hand, Nulato households may have shared with fewer other households in the community in 2018 because there was less fish available to share. Although there were more unconnected households in 2018, network transitivity was greater than in 2010. This suggests a greater tendency for households that all work together to harvest or share salmon with one another to form fishing groups in 2018 than in 2010, and perhaps a decline in ties that connect different clusters of households. This pattern could arise if households respond to reduced access to salmon by focusing their production and sharing relationships on those households with whom they have relatively closer social ties. However, considering the differences in study design for each year, it is important to consider alternate explanations, in particular that fishing groups were more explicitly recorded as part of the 2018 study. While acknowledging the difficulties of comparing across years, it is still worth noting that a substantial decline in the amounts of salmon harvested in 2018 did not lead to substantial declines in the number of unique ties in the subsistence salmon networks in Nulato. This result reinforces the statements from key respondent interviews about the importance of sharing and the efforts people made to maintain longstanding sharing relationships, even when resources are scarce. Despite these efforts, the number of disconnected households increased substantially in 2018, so the decline in resources at the community level does appear to have restricted the flow of salmon within the community.

Table 4-29.–Changes in the amount of salmon shared compared to recent years, Nulato, 2018–2019.

Valid	Does not share/ uncertain of change		Less		Same		More	
responses	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
62	1	1.6%	18	29.0%	34	54.8%	9	14.5%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 4-30.–Changes in amount of salmon shared compared to recent years, by resource, Nulato, 2018–2019.

		Sharing of _____ compared to recent years							
		Does not share/uncertain of change		Less		Same		More	
Resource	Valid responses	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Chinook salmon	53	14	26.4%	21	39.6%	13	24.5%	5	9.4%
Summer chum salmon	53	40	75.5%	5	9.4%	7	13.2%	1	1.9%
Fall chum salmon	53	22	41.5%	8	15.1%	17	32.1%	6	11.3%
Coho salmon	49	46	93.9%	0	0.0%	3	6.1%	0	0.0%
Other salmon	32	32	100.0%	0	0.0%	0	0.0%	0	0.0%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 4-31.–Reasons for sharing more salmon compared to recent years Nulato, 2018–2019.

Valid	Households reporting reasons for	Family/ personal		Resources less available		Too far to travel		Lack of equipment		Less sharing		Lack of effort		Unsuccessful		Weather/ environment		Working/ no time	
responses[a]	less sharing	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
62	16	2	12.5%	3	19%	0	0.0%	0	0%	0	0%	3	19%	1	6.3%	0	0.0%	0	0.0%

-continued-

Table 4-32.–Continued.

Valid	Households reporting reasons for	Regulations		Small/ diseased animals		Did not need		Equipment/ fuel expense		Used other resources		Competition		Not enough/ no help		Other reasons	
responses[a]	less sharing	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
62	16	2	13%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	6.3%	5	31.3%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response, and households reporting not sharing, or using the resource.

Table 4-32.–Reasons for sharing less salmon compared to recent years, Nulato, 2018–2019.

Valid responses[a]	Households reporting reasons for less sharing	Family/ personal		Resources less available		Too far to travel		Lack of equipment		Less sharing		Lack of effort		Unsuccessful		Weather/ environment		Working/ no time	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
62	16	2	12.5%	3	19%	0	0.0%	0	0%	0	0%	3	19%	1	6.3%	0	0.0%	0	0.0%

-continued-

Table 4-32.–Continued.

Valid responses[a]	Households reporting reasons for less sharing	Regulations		Small/ diseased animals		Did not need		Equipment/ fuel expense		Used other resources		Competition		Not enough/ no help		Other reasons	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
62	16	2	13%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	6.3%	5	31.3%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response, and households reporting not sharing, or using the resource.

Table 4-34.–Changes in the number of households shared with, Nulato, 2018–2019.

Community	Valid Responses	Does not share		Less		Same		More	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Nulato	60	9	15.0%	14	23.3%	32	53.3%	5	8.3%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 4-33.–Reasons for changes in household sharing patterns over the past ten years, Nulato, 2018–2019.

Community	Households reporting that sharing patterns changed			Less other fish		Less fish overall		Shared with fewer households		No sharing		Other reason - less sharing	
	Valid responses	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Nulato	61	27	44.3%	1	1.6%	9	14.8%	3	4.9%	1	1.6%	4	6.6%

-continued-

Table 4-34.–Continued.

Community	Households reporting that sharing patterns changed			Less other fish		Shared with more households		Other reason - more sharing		Other reason - amount neutral		More Chinook salmon	
	Valid responses	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Nulato	61	27	44.3%	5	8.2%	1	1.6%	1	1.6%	2	3.3%	2	3.3%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 4-35.–Factors having the greatest effects on subsistence salmon sharing, Nulato, 2018–2019.

Community	Households providing valid responses	Personal		Amount needed		Cost		Resource health and availability		Regulations	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Nulato	50	12	24.0%	2	4.0%	4	8.0%	11	22.0%	12	24.0%

-continued-

Table 4-35.–Continued.

Community	Households providing valid responses	Having help		Effort		Weather		Had or got enough		Amount harvested	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Nulato	50	3	6.0%	5	10.0%	2	4.0%	3	6.0%	4	8.0%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 4-36.–Numbers of nodes, numbers of unique ties, pounds exchanged, and descriptive network statistics, Nulato, 2013 and 2018.

Study year	Nodes			Unique ties[a]	Salmon harvest (lb)	Descriptive network statistics		
	Total Households	Connected households	Unconnected households			Components[b]	Density[c]	Transitivity[d]
2010	91	77	14	113	28,313	5	0.016	0.41
2018	86	61	25	110	13,128	6	0.028	0.81

Sources Division of Subsistence households surveys, 2011 and 2019; Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. Relationship between two households or entities.

b. The number of clusters of connected actors in a network.

c. The proportion of observed ties in the network relative to all possible ties.

d. The relative number of triangles in the network compared to total number of connected node triplets.

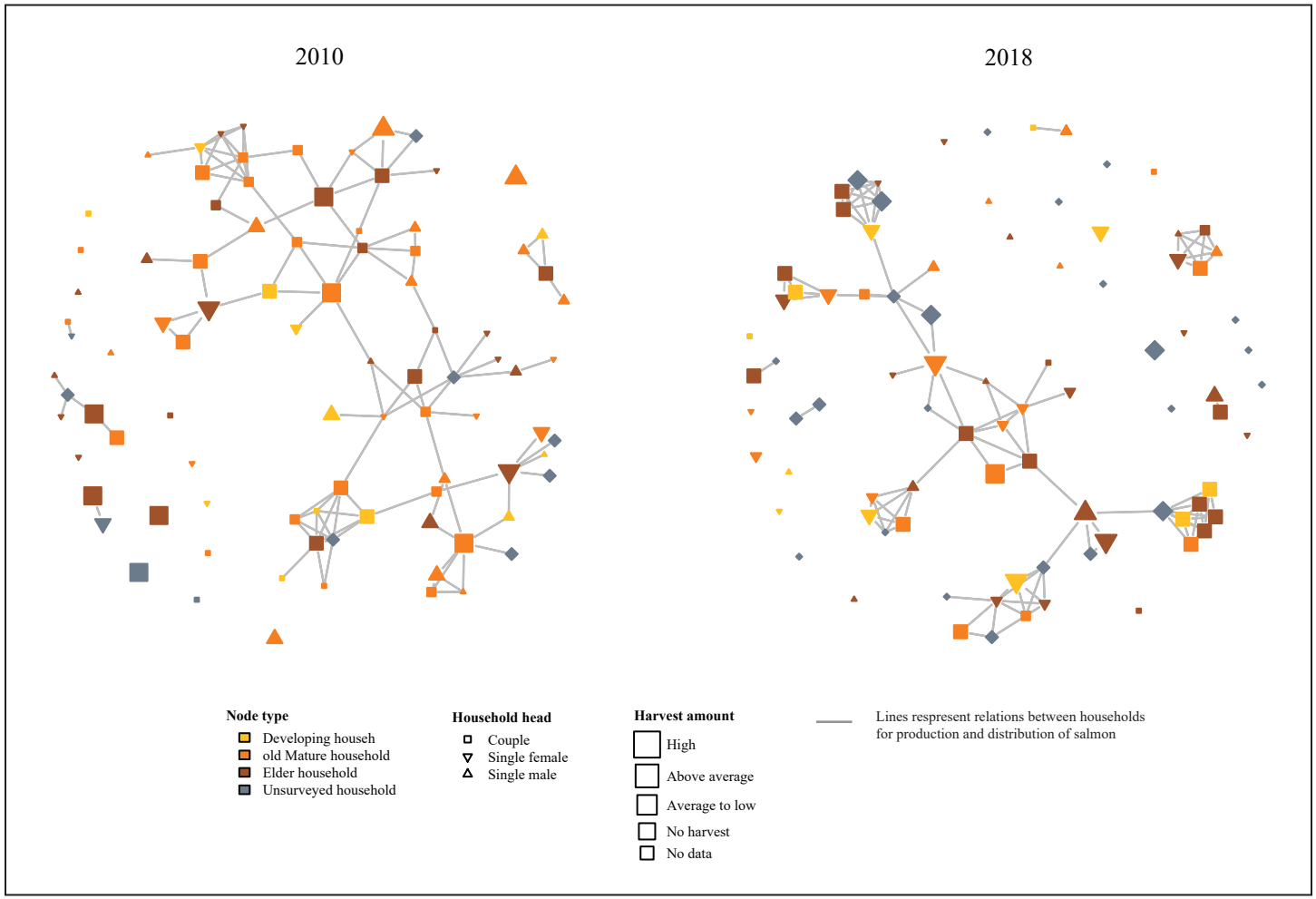


Figure 4-29.–Salmon production and exchange networks, Nulato, 2013 and 2018.

Concentration of salmon harvests among households

As previously mentioned, a small number of households typically harvests the majority of a community's total subsistence harvest. Specialization values changed very little when compared across studies: in 2010, 23% of households took 70% of salmon harvests, whereas in 2018, 22% of households took 69% of the harvest (Figure 4-30). However, total salmon harvests were much lower in 2018 than in 2010: an estimated 18,162 lb of salmon were harvested in 2018 (Table 4-11), whereas 28,210 lb were harvested in the community in 2010 (Brown et al. 2015a). These differences in harvest correspond to varying participation rates in harvest, use, sharing, and receiving between the two years. Values for all participation categories except for giving away salmon were higher in 2010 than in 2018. Although fewer salmon were harvested in 2018, higher household participation in giving of salmon that year (52% of households, vs. 39% of households in 2010) indicate that even in years of relative shortage Nulato households prioritize sharing salmon.

Local Comments and Concerns

Following is a summary of local observations of wild resource populations and trends that were recorded during the surveys in Nulato.[8] Some households did not offer any additional information during the survey interviews, so not all households are represented in the summary. Directly following comments and concerns recorded on surveys are comments received during a data review meeting held with the community prior to publication of the final report.

The theme most often discussed in the comments was the effect of regulations on fishing opportunity for Nulato fishers. Many households thought that there should be fewer rules and regulations surrounding salmon fishing in general, but others specifically cited a desire to increase the number and lengths of fishing openings. In addition to (and often compounded by) regulations was the concern that a changing environment was making successful fishing harder. Some households indicated that the formation of sandbars and other changes in the river make finding good fishing locations more challenging. Other households wished for additional research into salmon ecology and climate change in an attempt to understand trends in salmon populations. Several households expressed a desire to put a greater emphasis on fishing in future years, and hoped to do so by expanding or changing the composition of their fishing groups. Some households spoke directly to the nature of sharing in the community. In some cases they voiced frustration at exchange relationships among individuals who they believe did not need more fish and emphasized the desire that people would not sell fish. However, many respondents expressed satisfaction with the number of fish that they were able to procure, although even some of those households stated that they wished they could fish for longer during the season.

On July 7, 2021, SRS Helen Cold presented project results to Nulato residents at a Tribal Council meeting. Several council members provided feedback on project results. Specifically, members spoke to the importance of understanding how salmon harvests and sharing have changed over time, including in the years since data for this project were collected (2019, 2020, and 2021 fishing seasons). They indicated that salmon harvests have varied considerably over their lifetimes, and although sharing is an important cultural value, it has become increasingly difficult to share with regulatory restrictions limiting the number of fish households are able to harvest. Most notably, in 2021, unprecedented declines in spawning fall chum salmon and low numbers of Chinook salmon resulted in a moratorium on all subsistence salmon fishing for the season, creating extreme hardship for residents of Nulato and other Yukon River communities. Nulato residents stressed that widespread sharing does not indicate a surplus of fish, but rather speaks to the cultural and dietary importance of the resource, and as previously mentioned, the willingness of people to "give their last," even in years of scarcity and at their own expense (05132019NUL9).

Conclusion

Salmon are a key component of the subsistence economy and culture of the people of Nulato. Extensive production and exchange networks link households within the community, and sharing, barter, and trade of

8. ADF&G Division of Subsistence household surveys, 2019.

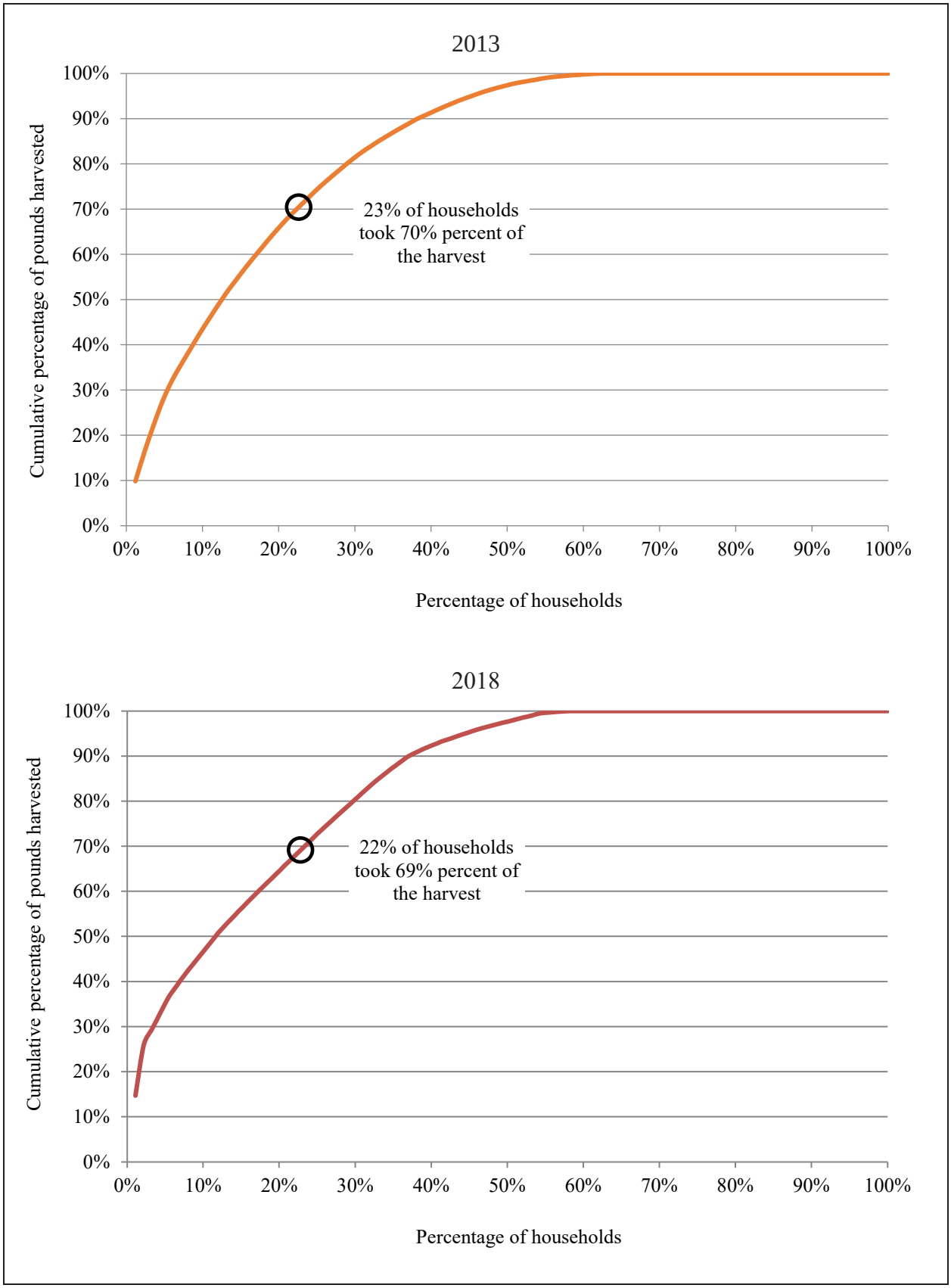


Figure 4-30.–Salmon harvest specialization, Nulato, 2010 and 2018.

the resource connects Nulato households with family and friends living in all reaches of the state of Alaska and beyond. The exchange of salmon is a feature at almost every community event and also facilitates the intake of resources that are not locally available to the wild food diets of residents, notably marine mammal products such as muktuk and seal oil. Many individuals in Nulato share salmon with relatives living in urban areas, which helps urban residents to stay connected with their families and their culture. Sharing is the most common type of exchange, although barter and customary trade are practiced by some households in the community. Often sharing exchanges involve delayed reciprocity, in which the receiving household will share another resource with the giving family at a later date. However, even those exchanges involving eventual reciprocity are still considered sharing as opposed to barter by many of the individuals participating, because amounts and quantities are not discussed at length and households rarely expect a returning gift.

The decline in Chinook salmon and resulting changes in salmon fishing regulations have been felt by Nulato fishers and have resulted in changes to fishing and sharing practices. Some fishing groups have welcomed new members; while often mutually beneficial, adding new members also helps provide for those individuals that would otherwise lack the means to procure fish themselves. Although many families feel that they are still able to meet their salmon needs, some have had to compensate for lower Chinook salmon harvests by substituting those fish with other salmon species (primarily fall chum salmon) or with nonsalmon species, by changing the composition of cooperative fishing groups, or by increasing their involvement in the salmon exchange network. Fishers expressed their desire for reduced regulations and more flexibility in fishing opportunity to allow their households the ability to harvest the amounts of salmon that their families need. Nulato fishers find themselves needing to fish more intensively over a longer time period, influenced by both the regulatory structure and the reduced numbers of fish moving through the river.

Outside economic forces have also impacted salmon fishing for Nulato residents. Increasing transportation costs can be prohibitive, not only to those directly participating in the fishery, but to their ability to distribute salmon throughout the community and beyond. In some cases, residents have formed relationships in which individuals contribute to the fishing effort by sharing fuel expenses through barter or customary trade transactions. However, despite the variety of challenges facing Nulato fishers, salmon continue to play an integral part in the exchange network of wild foods in the community.

ACKNOWLEDGMENTS

The Division of Subsistence would like to thank the Nulato Tribal Council for their support of this project. Additionally, we would like to thank our local research assistants for their dedication and enthusiasm for their work—we could not have done this without you. Finally, thank you to everyone in Nulato who took the time to share information with us about salmon. Special thanks to each of the ethnographic respondents who took the time to share their knowledge and expertise with the research team.

5. BEAVER

Brooke M. McDavid

This chapter presents the results of a two-phase research effort approved by the Beaver Village Council (see Introduction chapter for additional details). During the first phase, as described in Chapter 2: Methods, Division of Commercial Fisheries (DCF) administered household salmon-harvest surveys. Each fall after salmon fishing has ended, DCF staff conduct surveys in all Yukon River communities to collect household salmon harvest data and estimate community salmon harvests. Typically, DCF uses a stratified sample for the postseason harvest survey, but in preparation for this study they agreed to expand their sample to a census so that harvest data would be collected for as many households as possible prior to the second research phase. In October 2018, DCF staff surveyed 26 households in Beaver (76%) about their salmon harvests (Table 5-1).

During the second phase of research in early June 2019, two Division of Subsistence staff and two local research assistants (LRAs) administered a follow-up survey that verified each household's previously reported salmon harvests and explored the ways in which harvested salmon were shared and distributed within and outside of the community in the months following the fishing season. Twenty-one households (62%) participated in the salmon exchange survey (Table 5-2). The average salmon exchange survey length was 15 minutes (Table 5-3). Nine households only participated in the harvest survey, four only participated in the salmon exchange survey, and four households did not participate in either survey (tables 1-3 and 2-6).

Division of Subsistence staff also worked with LRAs and the tribal council to identify key respondents to participate in recorded ethnographic interviews. Researchers interviewed four longtime Beaver residents, all of whom were experienced and knowledgeable salmon fishers. The average interview length was 42 minutes (Table 5-3). Through these interviews, respondents shared local and traditional knowledge about nature of salmon fishing and the cultural practices around the distribution of wild foods in the community that could not have been obtained from the surveys alone.

Community Background

Beaver, or *Ts'aahudaaneekk'onh Denh,*[1] is located on the north bank of the Yukon River roughly halfway between Stevens Village and Fort Yukon, 932 river miles from the mouth of the river (Bergstrom et al. 2016) and 110 air miles north of Fairbanks (Beaver Village Council 2016). The community is located just south of the Arctic Circle within the Yukon Flats National Wildlife Refuge; the climate of the area is characterized by extreme seasonal temperature variations which can reach 50º F in the winter and 90º F in the summer. The Yukon River near Beaver consists of myriad braided sloughs and small river channels. Beaver is located on the boundary between Koyukon and Gwich'in Athabascan territories (Schneider 1976). People from both cultural and linguistic groups utilized the landscape and resources of the surrounding region for thousands of years prior to the exploration of this area by others. After gold was discovered in the Teedrinjik (Chandalar) River drainage in the early 20th century, miners developed the site of present-day Beaver as a settlement (Ducker and Spude 1982). The gold rush brought people of Gwich'in, Koyukon, Inupiat, Japanese, and Euroamerican cultures to settle together in the area and ultimately created a community with a diverse, mixed heritage.

The harvest and use of wild resources have both historical and contemporary significance to Beaver residents. For thousands of years prior to contact, the Native peoples of Interior Alaska utilized wild resources and raw materials for food, shelter, and clothing. Not only were these resources important for survival, but the harvest, sharing, and consumption of wild foods was an integral part of Native Alaskan culture, traditions, and spirituality. In contemporary Beaver, the harvest and use of wild foods remains culturally significant. Additionally, wild foods are essential to the community's food security. Because there is no local grocery

1. Alaska Native Language Archive, 2017, "Alaska Native Place Names," Accessed August 1, 2020, https://www.uaf.edu/anla/collections/map/names/index.xml?__state=xeJzblp1qkMjGWJJkZGGcAQAfBgP6

Table 5-1.–Sample achievement, ADF&G Division of Subsistence, Beaver, 2019.

	Number
Total households in community[a]	34
Total sampled households	30
Households sampled in postseason harvest survey	26
Households sampled in network survey	21
Households sampled only in postseason harvest survey	9
Unsampled households	4

Sources ADF&G Division of Commercial Fisheries postseason harvest surveys, 2018, and ADF&G Division of Subsistence household surveys, 2019.

a. Total number of households identified by Division of Commercial Fisheries postseason survey. This number may differ from the Division of Subsistence total households.

Table 5-2.–Survey and interview length, Beaver, 2019.

	Community
Sample information	Beaver
Number of dwelling units	34
Survey goal	100%
Households surveyed	21
Households failed to be contacted	11
Households declined to be surveyed	2
Households moved or occupied by nonresident	0
Total households attempted to be surveyed	34
Refusal rate	8.7%
Final estimate of permanent households	34
Percentage of total households survyed	61.8%
Survey weighting factor	1.62
Sampled population	54
Estimated population	87.4

Source ADF&G Division of Subsistence household surveys, 2019.

Table 5-3.–Population estimates, Beaver, 2018.

	Length (minutes)		
	Average	Minimum	Maximum
Interviews	42	24	64
Surveys	15	7	32

Source ADF&G Division of Subsistence household surveys, 2019.

store, store-bought food must be ordered and flown into the community, which is expensive and sometimes unreliable during poor weather conditions. Similarly to other communities in the Yukon Flats region, moose and salmon compose the majority of wild foods harvested by weight in Beaver.[2] Results from comprehensive subsistence surveys conducted for study year 2011 showed that 100% of households in Beaver used wild foods, and 92% harvested at least one resource (Holen et al. 2012). The total subsistence harvest that year amounted to an estimated 25,834 edible pounds or 359 lb per person. Moose, Chinook salmon, and chum salmon made up the largest portions of the harvest, but black bears, ducks, geese, whitefishes, beavers, and berries were also commonly utilized. Salmon, the resource of interest for this study, accounted for 43% of the total subsistence harvest by weight in Beaver during 2011. The salmon harvest amounted to 11,116 lb total or 154 lb of salmon per person.

History of Local Salmon Fishery

Fishing for salmon has been a cornerstone of the seasonal round of subsistence activities practiced by Beaver residents since the community was first settled. For thousands of years, Athabascan peoples gathered in fish camps along the Yukon River and spent the majority of summer harvesting and processing salmon. Fishing groups were often based on kinship: members of an extended family worked together to cut, smoke, and dry large quantities of salmon for the coming winter. In contemporary Beaver, many households continue to work together to harvest salmon. As explained by a respondent in Beaver, "Fishing is almost a religion. You know? That's when I feel closest to God, is when I'm out on my country doing what my ancestors did before me" (06052019WBQ2).

In early summer, families begin preparing for salmon runs to arrive by getting their fishing equipment ready. Two types of salmon are locally abundant in Beaver: Chinook and fall chum salmon (Estensen et al. 2018). Beaver residents primarily target Chinook, or king, salmon, which is prized for its firm flesh and high oil content. After swimming almost 1,000 miles upriver, Chinook salmon pass by the community during late June. An ethnographic respondent commented that flying cottonwood seeds are an indication that Chinook salmon will soon arrive. "As soon as the cotton start flying, that's when everybody gets excited" (06062019WBQ3). Summer chum salmon do not reach Beaver in any abundance, but some stray fish do occasionally make it as far as the community.

Fall chum salmon, locally called "silvers," begin to pass Beaver in late July and continue throughout August. Fall chum salmon quality in this part of the river is more variable than Chinook salmon, and some fish may not be fit for human consumption. In the past when sled dogs were the primary mode of transportation, fishers targeted chum salmon in larger quantities for dog food. As snowmachines replaced dog teams in the mid to late twentieth century, fewer fish were harvested for dogs. "We got bunch of dogs, that's our way of surviving a long time ago. SnoGos, whatever, was unheard of…The iron dog[3] came through, now we don't have to fish [like we used to]" (06062019WBQ1). In recent years, very few salmon have been harvested to feed dogs in Beaver.[4] Coho salmon also run with the late fall chum salmon and continue into October, but they are not commonly targeted. Instead, they are often caught incidentally while fishers are targeting fall chum.

Beaver residents use both set gillnets and fish wheels to harvest salmon, although setnets are much more common (Brown et al. 2015b; Holen et al. 2012). Use of fish wheels was more common in the past when large numbers of chum salmon were harvested to feed large dog teams. The river near Beaver is shallow and braided, making it difficult to find deep enough eddies to fish with a fish wheel. Fishers who use gillnets

2. Alaska Department of Fish and Game (ADF&G) Division of Subsistence, Juneau. "Community Subsistence Information System: CSIS." https://www.adfg.alaska.gov/sb/CSIS. Hereinafter ADF&G CSIS.
3. An "iron dog" is a slang term for a snowmachine; the term likens the machine to a sled dog, which was the primary means of winter travel before the introduction of the snowmachine.
4. C.L. Brown, A. Trainor, B.M. McDavid, J.S. Magdanz, and G. Rakhmetova. *In prep*. Patterns and trends of salmon harvest and use in the Yukon River drainage, Alaska, 1990–2014. Alaska Department of Fish and Game, Division of Subsistence Technical Paper No. 442. Hereinafter *Brown et al. In prep.*

can move their nets more easily in search of a productive fishing spot and use them in a wider variety of conditions than those required by a fish wheel.

Opportunities for commercial fishing in the upper Yukon River have always been much more limited than those in the lower river because of the decreased abundance and quality of salmon in the upper river as well as the logistics of getting salmon to market. Historically, localized markets for the sale of dried salmon to trading posts, miners, and steamboat operators lasted into the mid-20th century. Sometimes buyers purchased limited amounts of fresh salmon from upper river fishers to be sold in Fairbanks and other population centers (Pope 1980). Since 1997, there have been no commercial fishing opportunities in District 5D.[5] ADF&G records from the early 1990s do not indicate that any households in Beaver held commercial fishing permits during that time (Bergstrom et al. 1992; 1998).

Over time and especially in the past two decades, the salmon fishery in Beaver has experienced significant change. Much of this change was spurred by severe declines in Chinook salmon run sizes that first occurred in 1998 (JTC 2020). Since that time, weak and below average runs have been the norm. Several years produced record low runs: in 2009, the U.S. Secretary of Commerce declared an economic disaster for the Chinook salmon fishery on the Yukon River.[6] Declines in Chinook salmon abundance led to increased fishing restrictions that have reduced Yukon River fishers' access to salmon through the implementation of fishing schedules and net mesh-size restrictions. The strictest regulations occurred between 2012 and 2014 when there was virtually no directed Chinook salmon subsistence fishing allowed (Estensen et al. 2013).[7]

Since the severe declines of Chinook salmon in 2009, Beaver residents have participated in two studies conducted by the Division of Subsistence that specifically documented the effects of salmon declines in their community (Brown et al. 2015b).[8] The socioeconomic effects of salmon declines have been substantial. Most notably, the effort required to harvest adequate numbers of salmon has substantially increased. Fishers now have to fish longer to try to get the salmon they need and frequently have to make do with smaller harvests that ultimately do not meet their needs.

Since 1989, ADF&G has documented salmon harvest trends via postseason harvest surveys (Jallen et al. 2017). Salmon harvests have decreased over time, and Chinook salmon harvests have declined most steeply (Figure 5-1). Because Chinook salmon are the primary species targeted for human consumption, this decrease represents a significant reduction to the amount of food available for individuals to eat. Historical data show that Beaver residents commonly harvested over 200 lb per capita of Chinook salmon.[9] Since 2010, Chinook salmon harvests have averaged closer to 20 lb per capita and reached a low of zero pounds in 2014.

The socio-cultural effects of the decline have also been substantial. Harvesting salmon has continually been described by Beaver residents as a key component of their unique cultural identity and as people of the river. When fishing restrictions prevent local people from being able to carry out their traditions, communities experience profound effects.

> It's such a negative effect on a peoples' culture. And that's why you see suicide rates rising, or like domestic violence rising when those fishing crashes happen. Like that particular year of the salmon crash, there were like two or three really well-known adult males that committed suicide that year. That was just horrific. You know, they were providers for their family and like that kind of thing. It's just, that's horrific. Like, that's major. Because people don't fish for themselves alone.

5. B. Borba, ADF&G Fisheries Biologist, personal communication with B. McDavid, December 2020.
6. National Oceanic and Atmospheric Administration, 2020. "Fishery Disaster Determinations." Accessed February 16, 2021. https://www.fisheries.noaa.gov/national/funding-and-financial-services/fishery-disaster-determinations#numbers-53---16-(2010---2000)
7. In 2012, ADF&G allowed one 36-hour Chinook salmon opening in District 5 (Estensen et al. 2013).
8. Brown et al. *In prep.*
9. Brown et al. *In prep.*

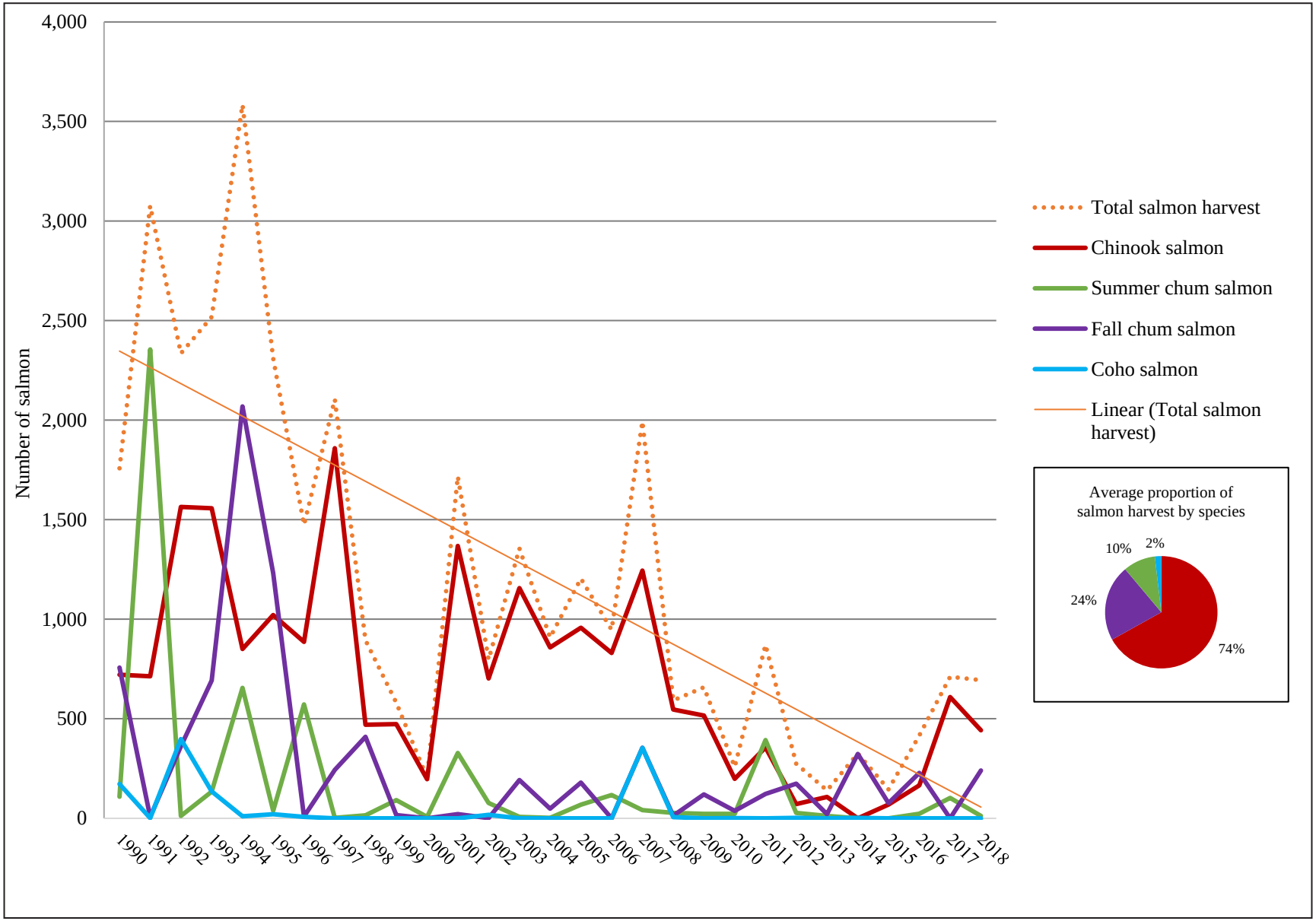


Figure 5-1.–Salmon harvests by resource and amount, Beaver, 1990–2018.

> Like, they fish for, you know, their whole extended family, their community. It's part of who they are. (01302020WBQ4)

Some Beaver households have tried to adapt to changes in the fishery, but not everyone has the additional time or financial resources needed to fish longer and risk still not getting what they need. In years of very limited fishing opportunity, fewer households tend to participate in the fishery altogether.[10] One respondent shared an observation about this: "I think just the lack of fish and the lack of fishing time that we get kind of dissuaded a lot of people from fishing. I see a lot more food boxes and orders from meat companies coming in. Yeah, there's a lot less fishing now" (06052019WBQ2). He also stated that changes to environmental conditions have compounded these issues.

> There used to be a lot of eddies but there was a lot more water… Due to erosion and everything, our water I guess is spread out I guess, that's the way it was explained to me. But, yeah, there isn't as many fishing spots available as there used to be. And we can go farther but that would mean more costs. (06052019WBQ2)

Some Beaver households still fish from summer camps, although they typically spend less time in camp than in the past due to employment, the high cost of gas required to travel the river, and increased fishing restrictions (Brown et al. 2015b). Beaver household fishing strategies will be described further in a subsequent section on salmon production.

History of Local Events

In Alaska Native cultures, the sharing and eating of wild foods plays a prominent role in social events and ceremonies. Households commonly harvest extra fish and game or save a portion of their harvest for such occasions. These events may include annual community gatherings, such as a spring carnival, or occasional affairs such as weddings or memorials. Some events to which people share wild foods may be smaller affairs with just close friends and family. In Beaver, survey respondents mentioned a variety of events to which they gave salmon. Although many of these events were celebratory in nature, such as birthdays, holidays, and Spring Carnival, respondents placed particular importance on sharing wild foods for funerary and memorial potlatches.[11] The word "potlatch" refers to the ritualized distribution of gifts and food (Alaska Department of Fish and Game, Division of Subsistence 2010; Guédon 1981). Athabascan peoples may hold potlatches for a variety of reasons and life events, but often when the word "potlatch" is used without further description it refers to a funeral or memorial potlatch held to commemorate the deceased. A funeral potlatch is held immediately following the funeral and burial, and a memorial potlatch may occur a year or more after someone has passed. Memorial potlatches are often large gatherings, to which people from other communities travel to attend. Because of the amount of planning and resources required to host a memorial potlatch, sometimes multiple families will work together to honor more than one deceased person. By holding the memorial potlatch at a later date than the funeral, the family of the deceased has time to grieve for their loved one and prepare the large amounts of food and gifts that will be given away during the ceremony. Traditionally, a memorial potlatch lasts three days. Sharing salmon and other wild foods at events such as these is a way for people to connect to one another, their heritage, and the land.

Population Estimates and Demographic Information

The Division of Subsistence gathers demographic data to understand household maturity and to understand how factors such as, age, marital status, and number of household members impacts the use and harvest rates of wild foods. ADF&G estimated the 2018 total population in Beaver to be 87 individuals living in 34 households and the Alaska Native population to be 84 individuals, or 97% of the total population (Table 5-4; Figure 5-2). The 2010 U.S. Census recorded a population of 84 persons (83 Alaska Native people) in 36 households. The U.S. Census Bureau American Community Survey estimates showed a lower five-year (2014–2018) average population of 46 individuals in 22 households, including 46 Alaska Native

10. Brown et al. *In prep.*
11. Survey notes, June 2019.

Table 5-4.–Sample and demographic characteristics, Beaver, 2018.

	Census (2010)	5-year American Community Survey (2014–2018)		This study (2018)	
		Estimate	Range[a]	Estimate	Range[b]
Total population					
Households	36	22.0	10 – 34	34.0	
Population	84	46.0	23 – 69	87.4	73 – 101
Alaska Native					
Population	83	46.0	23 – 69	84.1	70 – 98
Percentage	98.8%	100.0%	50.0% – 150.0%	96.2%	80.3% – 112.0%

Sources U.S. Census Bureau (2011) for 2010 estimate; U.S. Census Bureau for American Community Survey (ACS) 2018 estimate (5-year average); and ADF&G Division of Subsistence household surveys, 2019 for 2018 estimate.

Note Division of Subsistence household survey elegiblity requirements differ from those used by ACS.

a. ACS data range is the reported margin of error.

b. No range of households is estimated for Division surveys.

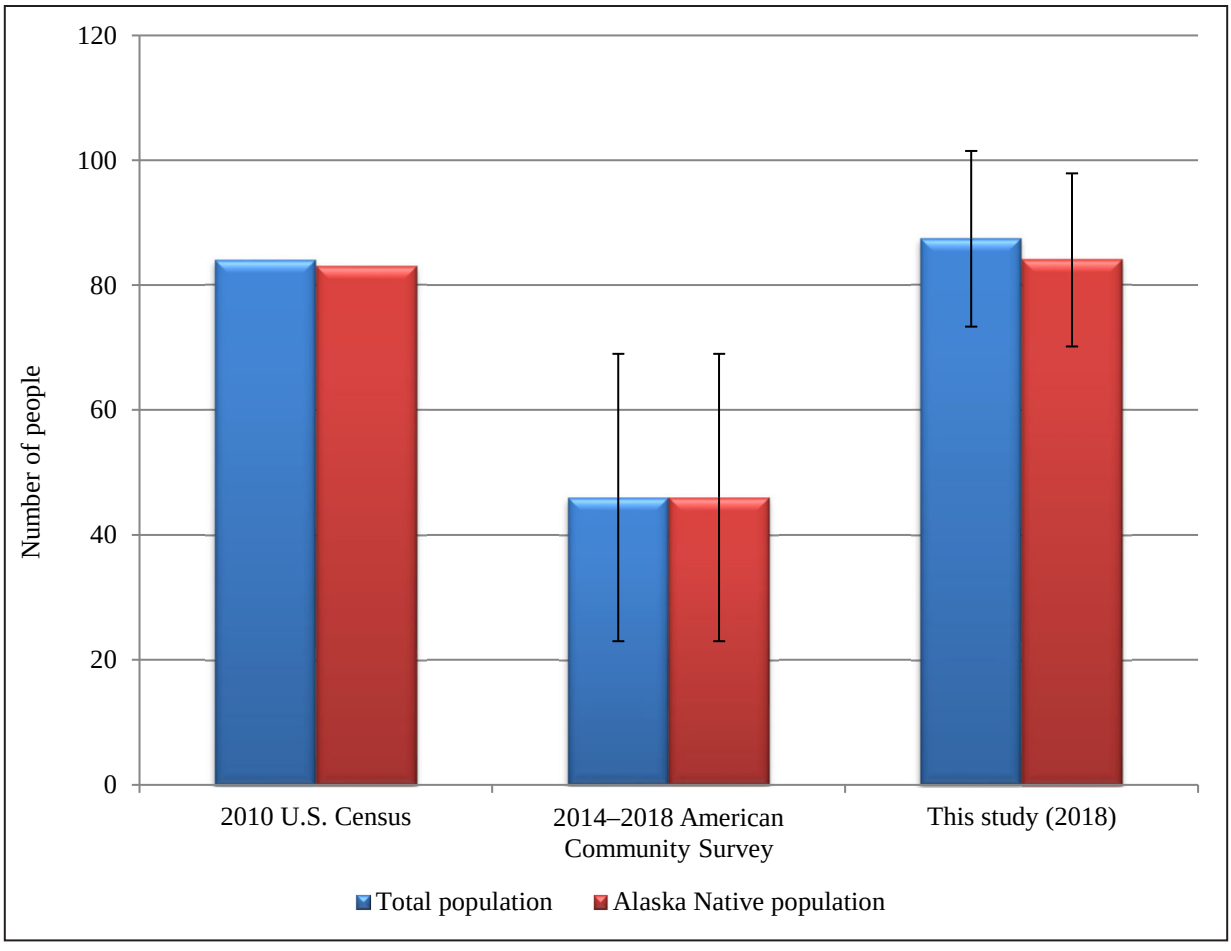


Figure 5-2.–Alaska Native and overall population estimates, Beaver, 2018.

individuals. The differences in these estimates likely result from variations in the sampling methods, timing of surveys, refusal rates, and definitions of residency.

Households in Beaver ranged in size from one to five individuals with an average of 2.6 residents per household (Table 5-5). The mean age of residents was 35, but residents ranged in age from 1 to 87. The average length of residency was 23 years, and the maximum was 87. All households included at least one resident who identified as Alaska Native. Figure 5-3 shows a visual representation of Beaver's population profile. Not all age classes are represented, and some age classes are not represented by both sexes. The most Beaver residents were in the 25 to 44 age range. Overall, equal numbers of males (44) and females (44) lived in Beaver (Table 5-6).

Historical population data available from the U.S. Census and Alaska Department of Labor (ADOL) show how Beaver's population has varied over time since 1939 (Figure 5-4). The population grew from 88 people in 1939 to 100 people between 1950 and 1970. In 1980, it declined to 66 people, and in 1990, the population was again counted at around 100. In the 1990s, the ADOL estimated a population as high as 126 people. Since 2000, the population has been around 85 people, although recent ADOL estimates have been as low as 58 people in 2014.

The majority of heads of household in Beaver reported that their families were living in the community when they were born (59%; Table 5-7). Nine percent of heads of households had families who were living in Stevens Village when they were born, and 6% were living in Fairbanks. The remaining heads of household were born to families living in other Alaska communities or elsewhere in the U.S. Most of the population as a whole (63%) was also born in Beaver (Table 5-8).

Participation in Salmon Harvesting And Processing

Table 5-9 shows the expanded levels of individual participation in the harvesting and processing of salmon by Beaver residents in 2018. Overall, 56% of individuals in the community harvested and 58% processed salmon during the study year. The majority of people who participated did both activities (69%), but 14% of individuals only harvested and 17% only

Table 5-5.–Population profile, Beaver, 2018.

Characteristics	Community Beaver
Sampled households	21
Eligible households	34
Percentage sampled	61.8%
Sampled population	54
Estimated community population	87.4
Household size	
Mean	2.6
Minimum	1.0
Maximum	5.0
Age	
Mean	35.0
Minimum[a]	1
Maximum	87
Median	38.0
Length of residency	
Total population	
Mean	22.9
Minimum[a]	1
Maximum	87
Heads of household	
Mean	32.8
Minimum[a]	1
Maximum	87
Alaska Native	
Estimated households[b]	
Number	34.0
Percentage	100.0%
Estimated population	
Number	84.1
Percentage	96.2%

Source ADF&G Division of Subsistence household surveys, 2019.

a. A minimum age of 0 (zero) is used for infants who are less than 1 year of age.

b. The estimated number of households in which at least one head of household is Alaska Native.

Table 5-6.–Population profile, Beaver, 2018.

	Male			Female			Total	
Age	Number	Percentage	Cumulative percentage	Number	Percentage	Cumulative percentage	Number	Percentage
0–4	0.0	0.0%	0.0%	3.4	7.7%	7.7%	3.4	3.8%
5–9	3.4	7.7%	7.7%	6.7	15.4%	23.1%	10.1	11.5%
10–14	1.7	3.8%	11.5%	1.7	3.8%	26.9%	3.4	3.8%
15–19	0.0	0.0%	11.5%	0.0	0.0%	26.9%	0.0	0.0%
20–24	1.7	3.8%	15.4%	0.0	0.0%	26.9%	1.7	1.9%
25–29	6.7	15.4%	30.8%	5.0	11.5%	38.5%	11.8	13.5%
30–34	1.7	3.8%	34.6%	5.0	11.5%	50.0%	6.7	7.7%
35–39	5.0	11.5%	46.2%	1.7	3.8%	53.8%	6.7	7.7%
40–44	5.0	11.5%	57.7%	3.4	7.7%	61.5%	8.4	9.6%
45–49	0.0	0.0%	57.7%	1.7	3.8%	65.4%	1.7	1.9%
50–54	3.4	7.7%	65.4%	0.0	0.0%	65.4%	3.4	3.8%
55–59	1.7	3.8%	69.2%	1.7	3.8%	69.2%	3.4	3.8%
60–64	0.0	0.0%	69.2%	8.4	19.2%	88.5%	8.4	9.6%
65–69	6.7	15.4%	84.6%	1.7	3.8%	92.3%	8.4	9.6%
70–74	3.4	7.7%	92.3%	0.0	0.0%	92.3%	3.4	3.8%
75–79	0.0	0.0%	92.3%	0.0	0.0%	92.3%	0.0	0.0%
80–84	0.0	0.0%	92.3%	0.0	0.0%	92.3%	0.0	0.0%
85–89	0.0	0.0%	92.3%	1.7	3.8%	96.2%	1.7	1.9%
90–94	0.0	0.0%	92.3%	0.0	0.0%	96.2%	0.0	0.0%
95–99	0.0	0.0%	92.3%	0.0	0.0%	96.2%	0.0	0.0%
100–104	0.0	0.0%	92.3%	0.0	0.0%	96.2%	0.0	0.0%
Missing	3.4	7.7%	100.0%	1.7	3.8%	100.0%	5.0	5.8%
Total	**43.7**	**100.0%**	**100.0%**	**43.7**	**100.0%**	**100.0%**	**87.4**	**100.0%**

Source ADF&G Division of Subsistence household surveys, 2019.

Table 5-7.–Birthplaces of household heads Beaver, 2018.

Birthplace	Percentage
Beaver	59.4%
Fairbanks	6.3%
Huslia	3.1%
Minto	3.1%
Nikolai	3.1%
Sitka	3.1%
Stevens Village	9.4%
Tanana	3.1%
Mentasta Pass	3.1%
Other U.S.	3.1%
Missing	3.1%

Source ADF&G Division of Subsistence household surveys, 2019.
Note "Birthplace" means the place of residence of the parents of the individual when the individual was born.

Table 5-8.–Birthplaces of population, Beaver, 2018.

Birthplace	Percentage
Beaver	63.0%
Fairbanks	9.3%
Huslia	3.7%
Minto	1.9%
Nikolai	1.9%
Sitka	1.9%
Stevens Village	5.6%
Tanana	1.9%
Mentasta Pass	1.9%
Other U.S.	3.7%
Missing	5.6%

Source ADF&G Division of Subsistence household surveys, 2019.
Note "Birthplace" means the place of residence of the parents of the individual when the individual was born.

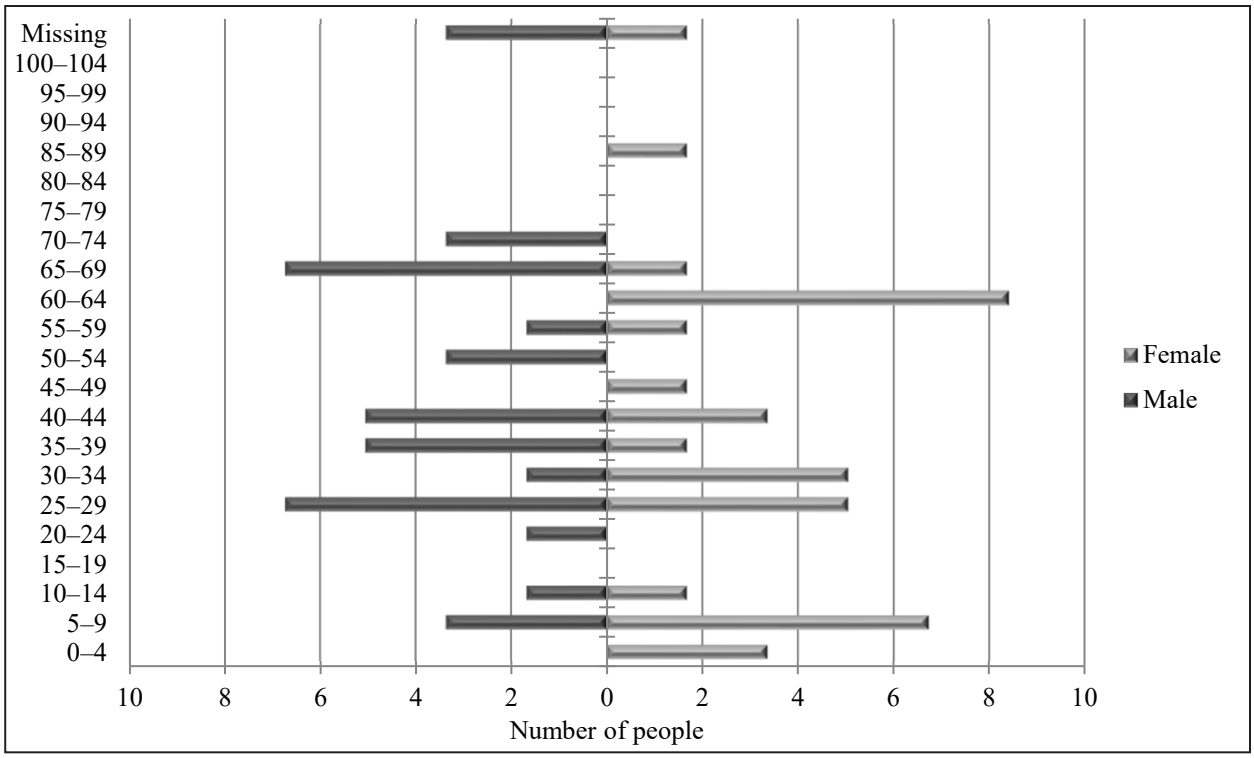


Figure 5-3.–Population profile, Beaver, 1939–2018.

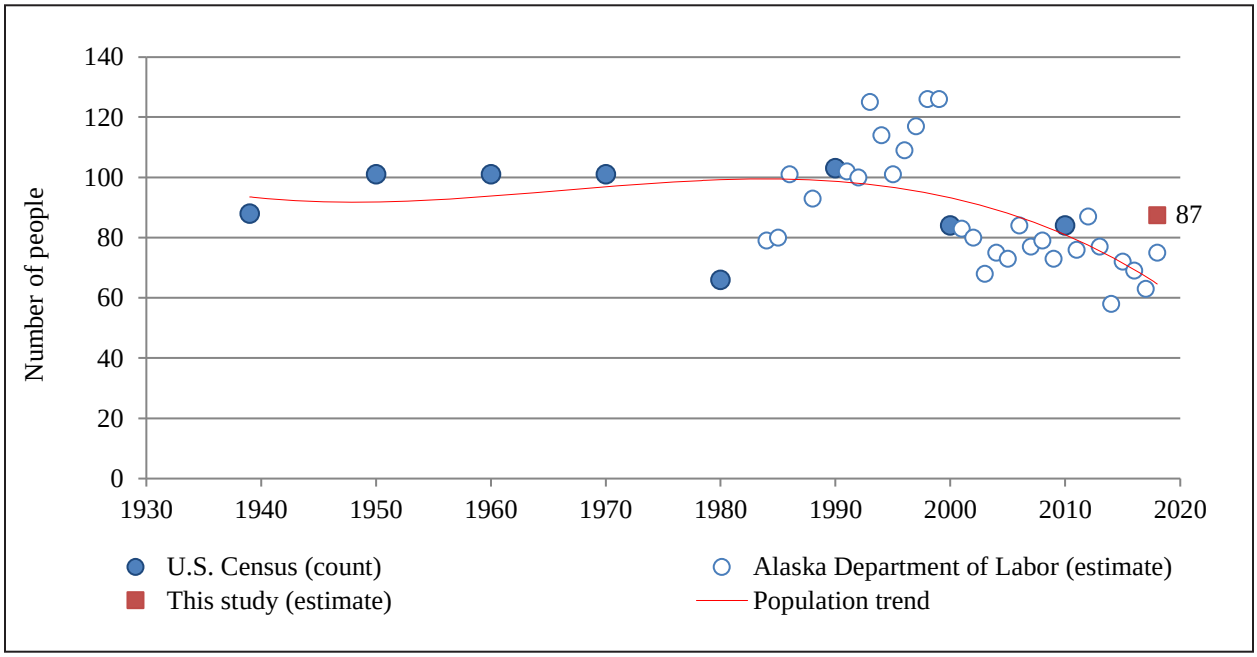


Figure 5-4.–Population estimates, Beaver, 1939–2018.

processed.[12] During a survey that documented the 2011 study year, Holen et al. (2012) found that 41% of individuals harvested fish and 63% processed fish, including both salmon and nonsalmon fish. In 2018, the question was only asked for salmon, but more individuals were involved in harvesting, and slightly fewer were involved in processing.

Table 5-9.–Individual participation in salmon harvesting and processing, Beaver, 2018.

Total number of people	**87.4**
Salmon	
Fish	
Number	48.8
Percentage	55.8%
Process	
Number	50.4
Percentage	57.7%

Source ADF&G Division of Subsistence household surveys, 2019.

Overall, slightly more males participated in harvesting and processing than females; however, this varied by age category (Figure 5-5). There were a greater number of younger (18 and under) and older (60+) females who participated in harvesting and processing than males. Similarly, more males aged 19 to 59 participated in harvesting and processing than females. This pattern reflects the population profile of the community, which shows slightly greater numbers of female children and elders than their male counterparts. Many Beaver residents participate in harvesting and processing salmon, and participation does not appear to be influenced by age or gender roles.

Figure 5-6 shows the percentages of households that used, attempted to harvest, harvested, gave away, and received salmon by species. Chinook salmon were used and harvested most commonly: 76% and 65% of households did so, respectively. Chinook salmon were also shared more than other species of salmon. Approximately 21% of households received.[13] Chinook salmon and 32% gave Chinook salmon to others. Twenty-six percent of households used and harvested fall chum salmon. However, no households reported sharing fall chum salmon. Harvest and use of summer chum, coho, and sockeye salmon occurred but was not common. Overall, 71% of households fished for at least one type of salmon in 2018.

Unlike the other communities in this study, there was no commercial fishing opportunity in Yukon District 5D, and no Beaver households reported participating in commercial fishing elsewhere in 2018.

Salmon Harvest Quantities and Composition

During the household surveys, respondent households were asked to verify their salmon harvest amounts as collected on the postseason survey or to provide harvest information if they had not previously done so on the DCF postseason survey. Detailed information about the 2018 salmon harvest in Beaver collected through these two surveys is shown in Table 5-10.

Beaver residents harvested a total of 4,277 lb of salmon that amounted to approximately 126 lb per household or 49 lb per capita (Table 5-10). The total salmon harvest by weight was composed of 73% Chinook salmon (3,106 lb), 15% fall chum salmon (655 lb), 10% sockeye salmon (427 lb), and 1% each of coho salmon (54 lb) and summer chum salmon (36 lb; Table 5-10; Figure 5-7). On average, households harvested 91 lb of Chinook salmon, 19 lb of fall chum salmon, and 13 lb of sockeye salmon. All salmon except for sockeye were harvested on the Yukon River.[14] A comparison of the 2018 salmon harvest to previous years' harvests will be presented later in this chapter.

Household harvests were categorized based on the amount of salmon they harvested compared to the mean household harvest in the community (Figure 5-8). In 2018, 7% of households were characterized as high harvesters, 23% were above average, 50% were low to average, and 20% did not harvest. Table 5-11 presents the harvest levels of households by household maturity and household head type. Mature households had the highest average salmon harvests (323 lb), followed by elder households (211 lb). Developing households harvested the least salmon on average (90 lb). Households headed by single females harvested slightly more salmon on average (288) lb than households headed by couples (275 lb). Single male heads of household tended to harvest the least salmon (52 lb).

12. Survey data, June 2019.

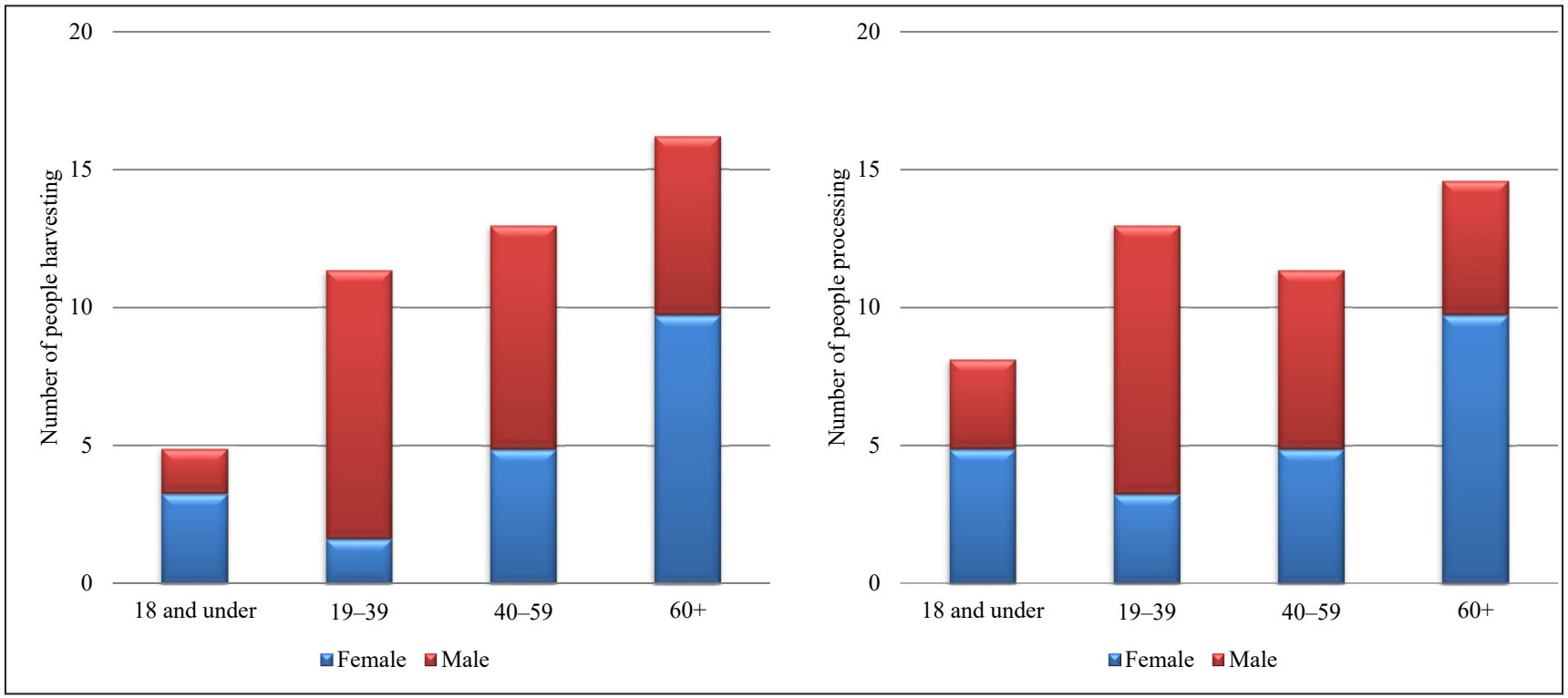


Figure 5-5.–Individual participation in salmon harvesting and processing by age group and sex, Beaver, 2018.

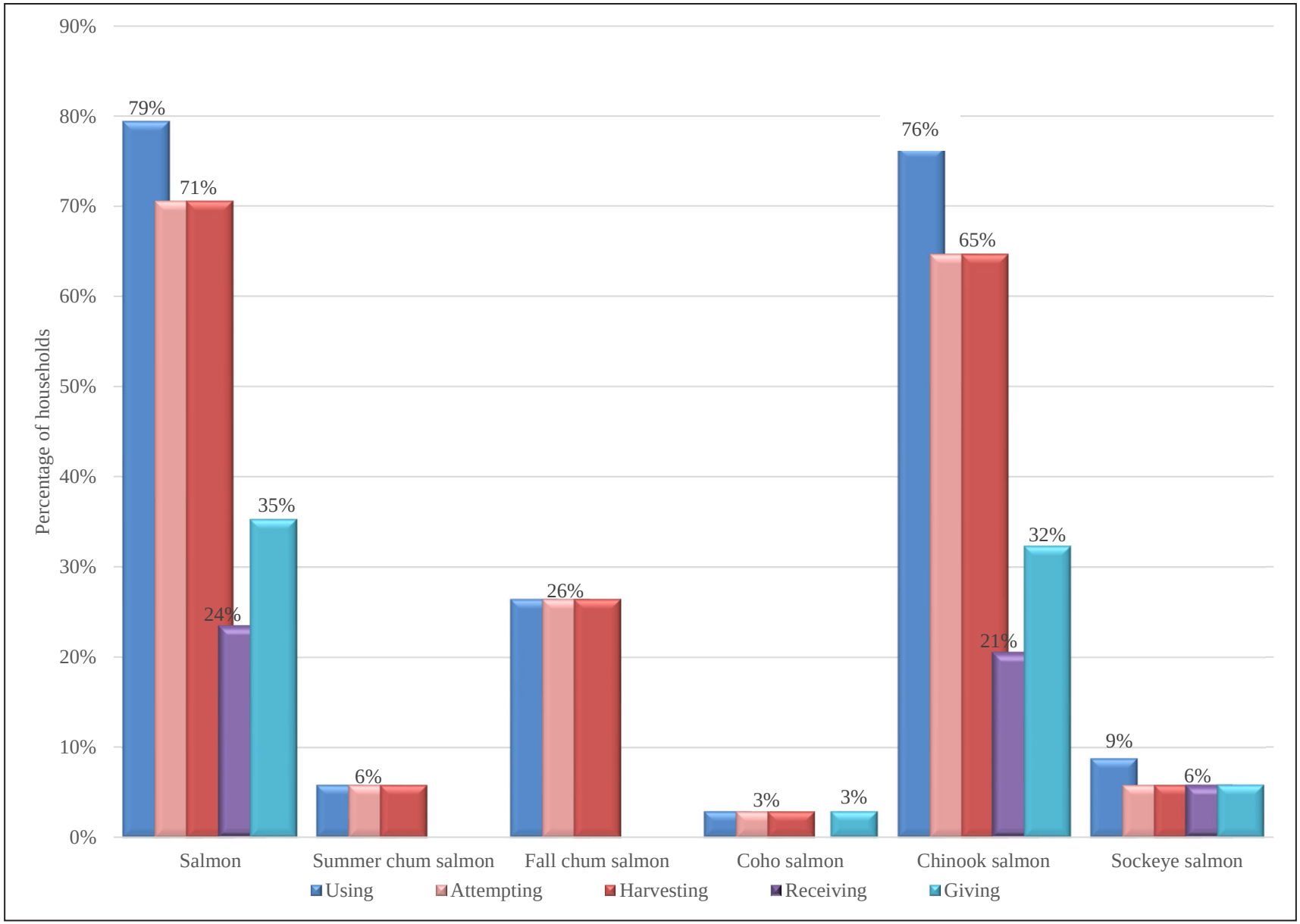


Figure 5-6.–Percentages of households using, attempting to harvest, harvesting, receiving, and giving salmon, by resource, Beaver, 2018.

Table 5-10.–Estimated harvest and use of salmon, Beaver, 2018.

Resource	Percentage of households					Harvest weight (lb)			Harvest amount			95% confidence limit (±) harvest
	Using	Attempting harvest	Harvesting	Receiving	Giving away	Total	Mean per household	Per capita	Total	Unit	Mean per household	
Salmon	**79.4**	**70.6**	**70.6**	**23.5**	**35.3**	**4,277.2**	**125.8**	**48.9**	**656.2**	**ind**	**19.3**	**15.0**
Summer chum salmon	5.9	5.9	5.9	0.0	0.0	35.5	1.0	0.4	7.9	ind	0.2	50.2
Fall chum salmon	26.5	26.5	26.5	0.0	0.0	655.0	19.3	7.5	146.2	ind	4.3	30.7
Coho salmon	2.9	2.9	2.9	0.0	2.9	54.1	1.6	0.6	11.3	ind	0.3	65.9
Chinook salmon	76.5	64.7	64.7	20.6	32.4	3,106.1	91.4	35.5	375.1	ind	11.0	16.2
Sockeye salmon	8.8	5.9	5.9	5.9	5.9	426.6	12.5	4.9	115.6	ind	3.4	64.6

Source ADF&G Division of Subsistence household surveys, 2019 and Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

Note The percentages of households attempting to harvest and receiving salmon could not be entirely derived from survey questions. Attempting harvest is a minimum amount that does not include households unsuccessfully trying to harvest. Receiving is also a minimum calculated through reported giving by other households.

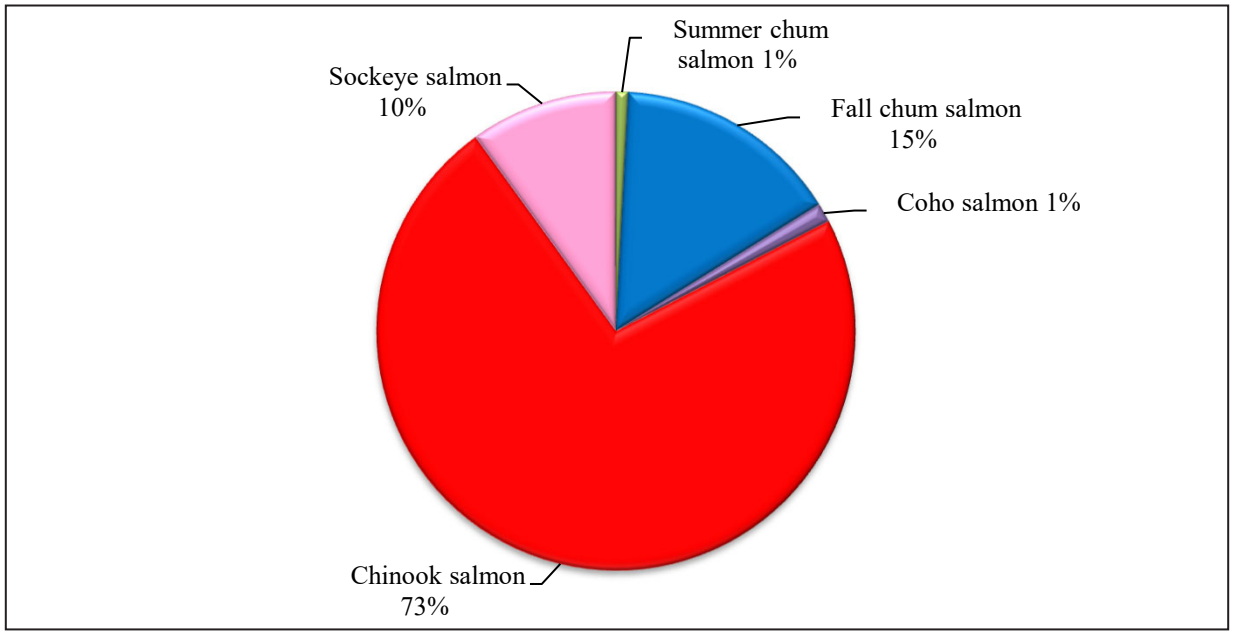
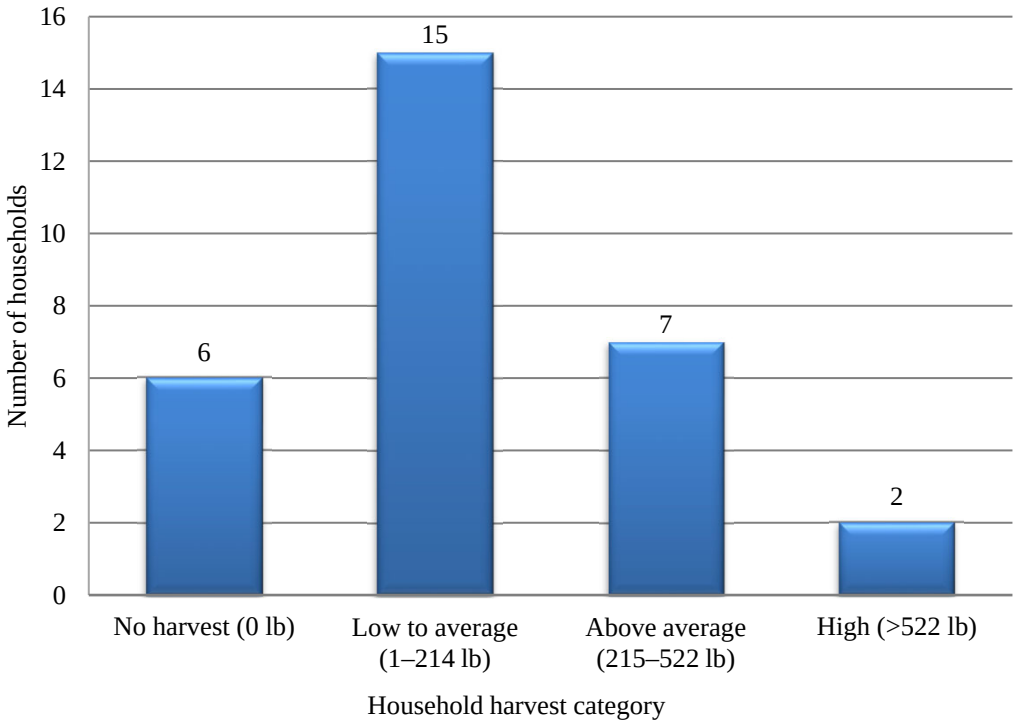


Figure 5-7.– Composition of salmon harvest weight, by resource, Beaver, 2018.

Table 5-11.–Characteristics of subsistence salmon harvesting households, Beaver, 2018.

	Number		Harvest weight (lb)		
	Households	Harvesting households	Mean	Minimum	Maximum
Household maturity					
Developing[a]	6	5	89.5	0.0	217.2
Mature[b]	7	5	323.3	0.0	979.0
Elder[c]	8	7	211.2	0.0	1,110.4
Household head type					
Couple	11	10	275.1	0.0	1,110.4
Single female	4	4	288.1	41.4	979.0
Single male	6	3	51.8	0.0	198.7
All sampled households	**21**	**17**	**213.8**	**0.0**	**1,110.4**

Source ADF&G Division of Subsistence household surveys, 2019.
Note This table only summarizes harvests for households sampled by ADF&G Division of Subsistence. Demographic information is not available for households sampled by ADF&G Division of Commercial Fisheries postseason surveys.
a. Age(s) of households head(s) is less than 40 years.
b. Age(s) of household head(s) is 40–59 years.
c. Age(s) of household head(s) is greater than 59 years.



Note Household harvest categories were calculated using the mean household harvest (213.8 lb). The upper limit of the above-average harvest category is one standard deviation (SD) over the mean. The high harvest category is any harvest greater than one SD over the mean.

Figure 5-8.–Number of households harvesting salmon, by harvest level, Beaver, 2018.

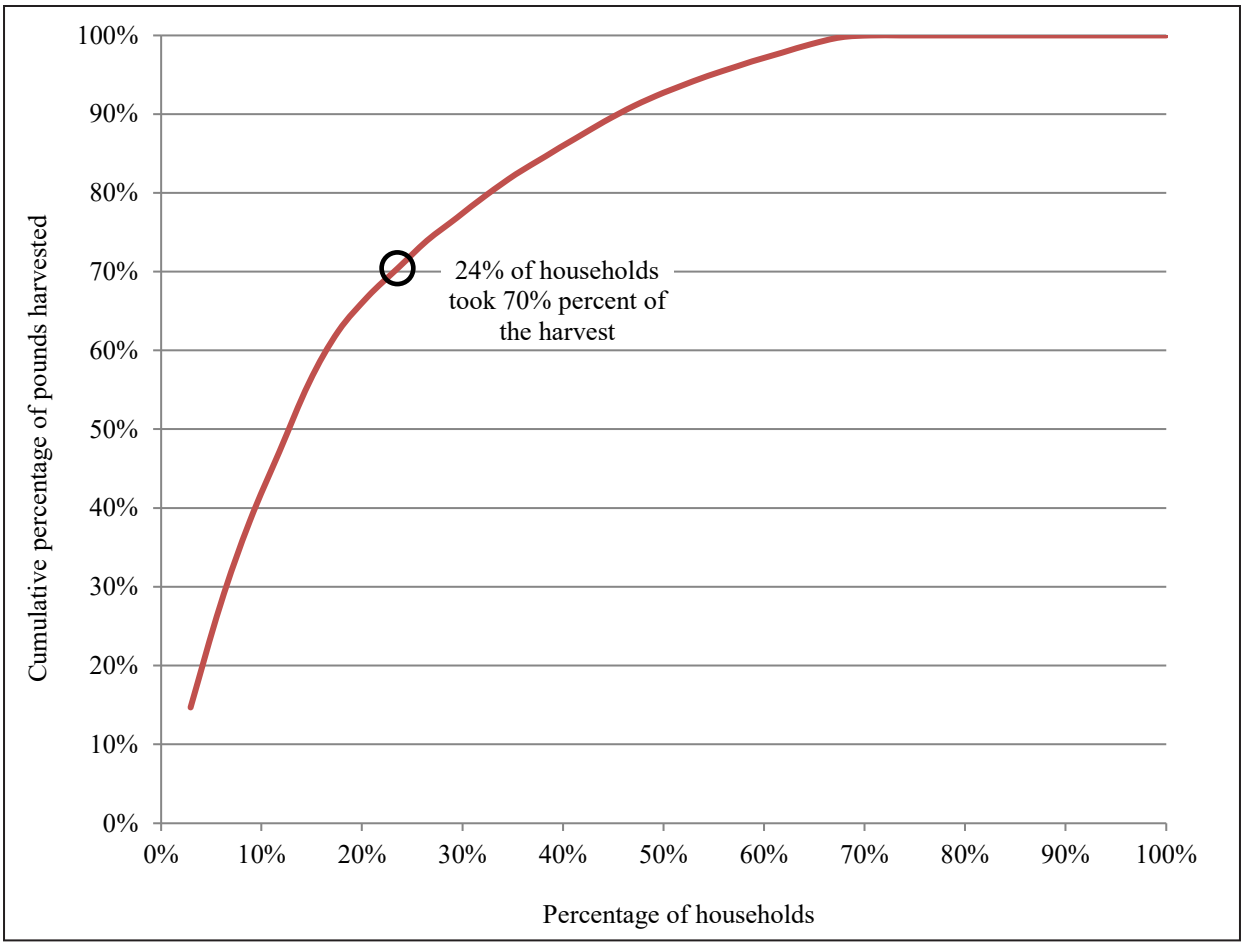


Figure 5-9.–Household specialization in salmon harvesting, Beaver, 2018.

Previous studies (Wolfe 1987; Wolfe et al. 2010) have shown that in most rural Alaska communities, a relatively small portion of households produces most of the community's fish and wildlife harvests, which they share with other households. A study of 3,265 households in 66 rural Alaska communities found that about 33% of the households accounted for 76% of subsistence harvests (Wolfe et al. 2010). When focusing on the production of a single resource, the ratio becomes even more extreme. As shown in Figure 5-9, in the 2018 study year in Beaver, about 70% of the salmon harvest as estimated in pounds usable weight was harvested by 24% of the community's households. Although this estimate is for a single resource category (salmon), it is similar to the overall harvest specialization found by Wolfe et al. (2010) for all resource categories combined.

Production and Exchange of Salmon

The harvesting, processing, sharing, and trade of wild foods is foundational to subsistence economies throughout Alaska (ADF&G Division of Subsistence, n.d.). To broaden the understanding of how salmon are harvested and used in Beaver, this study combined cooperative salmon production data from the 2018 fishing season with data about how people shared or exchanged salmon after production. Specifically, survey respondents provided detailed information about the other households they fished with and which households they exchanged (shared, bartered, bought or sold) salmon with during a study period.[15] This resulted in network data for one production network and three exchange networks: sharing, barter, and customary trade.

15. The study period ranged from the 2018 fishing season through May 2019.

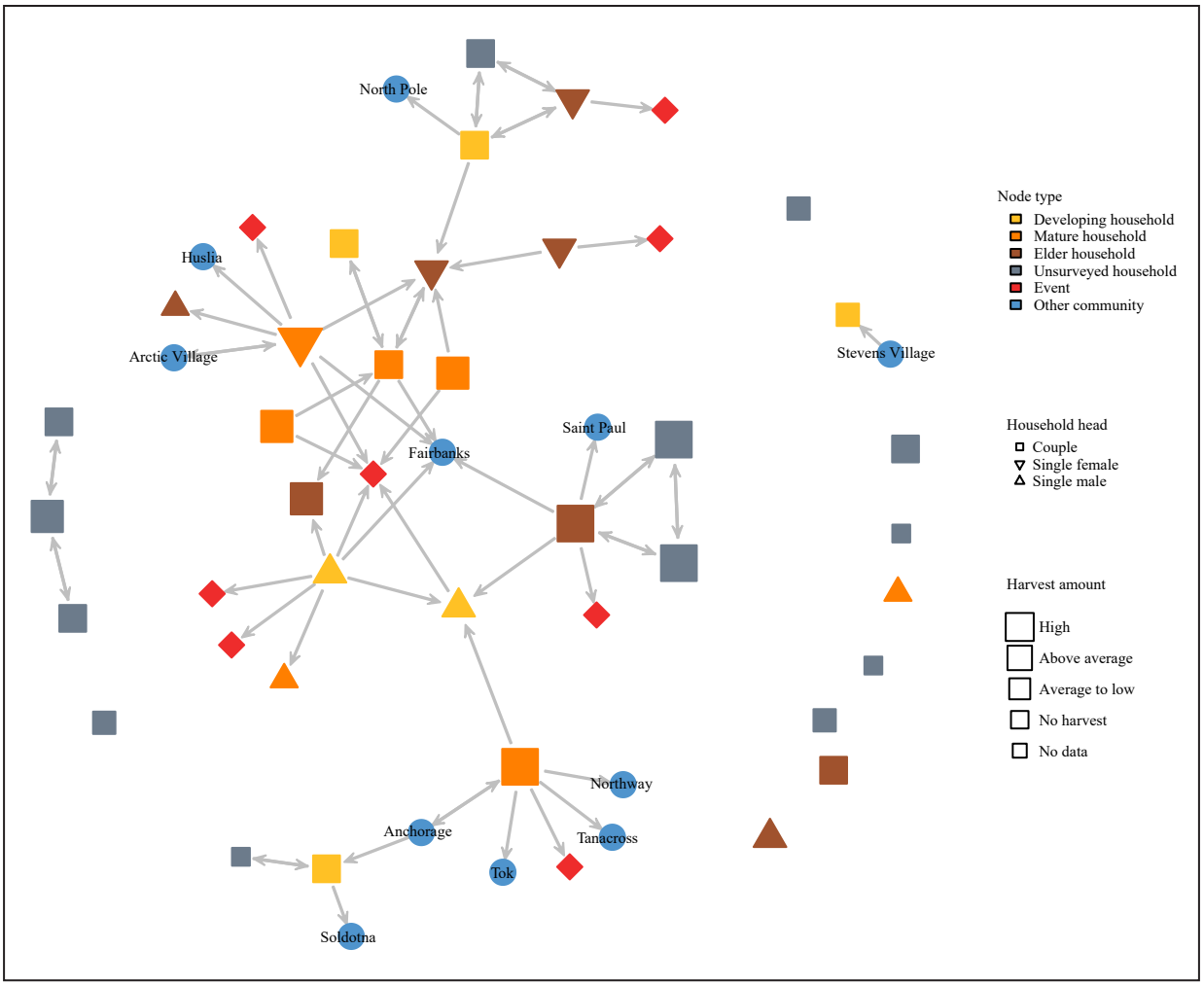


Figure 5-10.–Salmon production network, Beaver, 2018–2019.

Figure 5-10 combines data from the four types of salmon networks in Beaver listed above and presents a broad overview of how households in Beaver were connected by salmon during the study period. The symbols, or "nodes," on the figure represent households, events, and other communities. Symbol shapes depict the type of heads of household and shape colors shows the ages of heads of household or whether the node is an event or other community. Symbol sizes for households are scaled to indicate a household's salmon harvest in pounds. The arrows on the figure, or "ties," represent the cooperative fishing relationships and exchanges of salmon reported by survey respondents. For cooperative fishing relationships, arrows point in both directions to represent a mutual relationship between households. For salmon exchanges, arrows show the direction of the exchange from giver to receiver. Although cooperative production and exchange ties cannot be distinguished on this figure, they will be separated and discussed in subsequent sections of this chapter.

Appendix tables D5-1, D5-2, D5-3, and D5-4 provide details about the nodes and ties in the networks. Overall, the network included 21 sampled households, 13 other local households, households in 11 other communities, and eight types of events (Table D5-2). Beaver households reported 74 total ties that represent 52 pairs of connected nodes (Table D5-1). The number of total ties was almost equally distributed between local households, events, and households in other communities; however, more unique ties occurred between local households than with events or other communities (Table D5-3). The production and exchange of salmon in Beaver connected the majority of households in some way (Figure 5-10). Some households were not connected to the large, central component in the network, but were connected to one or two other

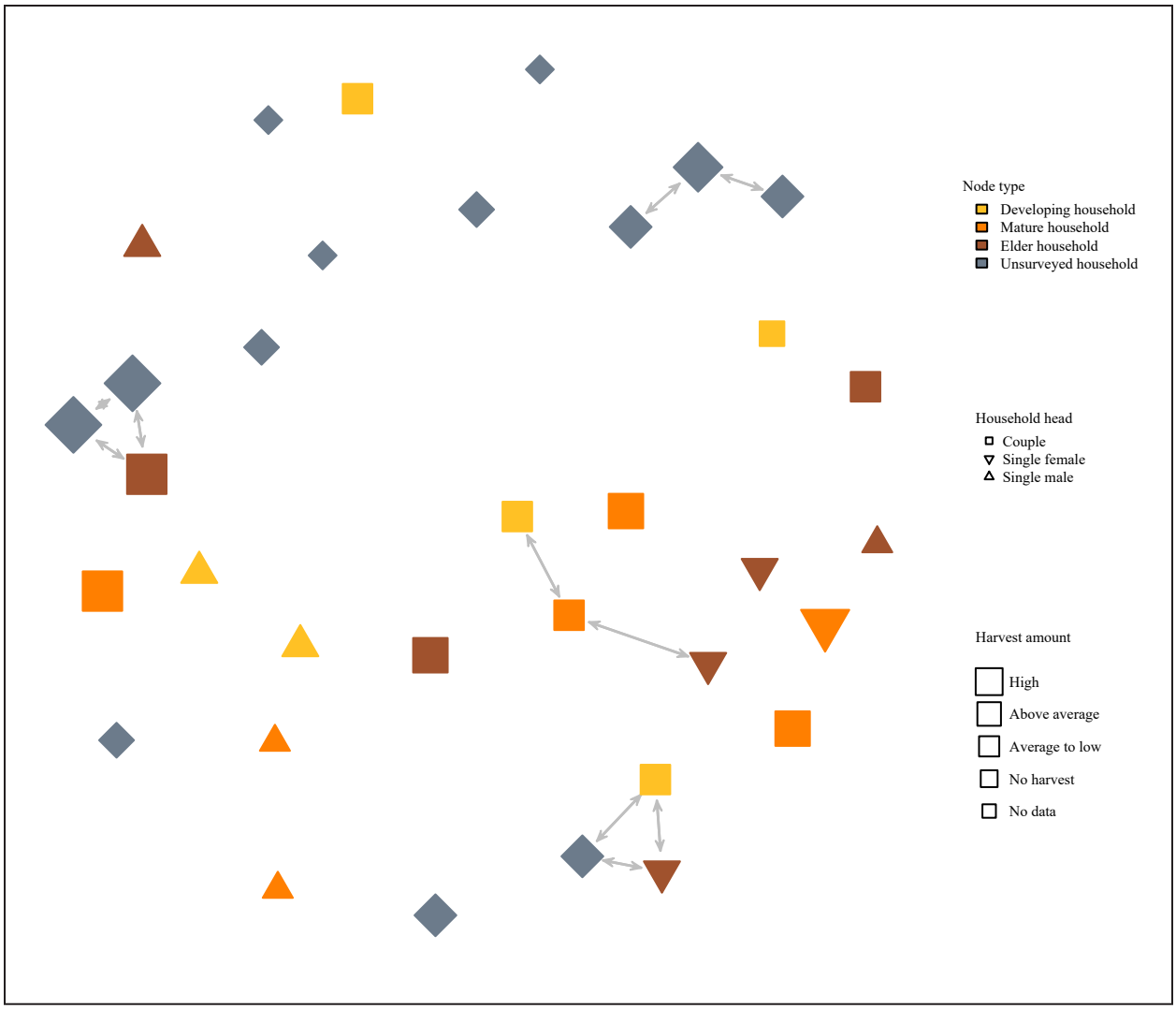


Figure 5-11.–Cooperative production network between respondent households and other local households, Beaver, 2018–2019.

households. Nine local households were not connected to others at all, either because they did not report any cooperative production or exchanges of salmon or because they were not surveyed (Table D5-4).

Unlike the other two study communities, Beaver did not have comparable prior network data. As a result, comparative analysis is not included in this section.

Production of Salmon

Although harvest data were previously described at the household-level, in reality, much of the harvesting and processing, or production, of subsistence foods is achieved by households within a community that work cooperatively (Charnley 1984; Kari 1983; Lonner 1980; Magdanz 1988; Magdanz et al. 2002; 2007; Magdanz and Wolfe 1988; Moncrieff 2007; Stickney 1984; Wolfe et al. 1993). During postseason salmon harvest surveys, respondents provided information about the other households with whom they fished and their total group harvest amount. These data are typically only used to confirm that group harvest amounts are not counted twice; however, further analysis of these data using network methods can reveal information about the complexities of the salmon production and distribution systems. Cooperative production groups, or fishing groups in the case of this study, are often organized based on kinship. Although DCF postseason surveys do not collect kinship information for fishing groups, three of four ethnographic respondents

described fishing with their extended families during 2018 (06052019WBQ2019, 06062019WBQ3, 01302020WBQ4).

Figure 5-11 shows which households in Beaver worked together to harvest and process salmon in 2018. Twelve households fished with others, 12 households fished alone, and 8 households did not fish. Two respondents reported fishing with relatives who returned to Beaver from Fairbanks (Table D5-3). Respondents who fished with others reported fishing with only one or two other households. Figure 5-11 shows a total of four fishing groups. Two fishing groups consisted of three households where all the households were connected to each other. In two other groups, a central household was connected to two other households, but the other households were not connected. Although demographic data were not collected for every fishing group household, at least two of the groups comprised households of varying maturity levels. In Beaver, households that worked cooperatively with others to harvest salmon did not show a pattern of higher salmon harvests. Several households that fished alone harvested as much or more than households that fished with others.

Table 5-12 shows the average number of cooperative production ties that households had to other households based on different characteristics. Low-to-average and high harvesting households had similar average ties to other households, indicating that harvest amount is not related to the number of fishing partners a household had. Elder households and developing households had more cooperative production ties on average than mature households, which could indicate that elder and developing households rely slightly more on shared labor and resources than mature households. Households headed by couples and single females had more cooperative production ties on average than those headed by single males.

Each ethnographic interview respondent shared information about how his or her household fishes. An elder respondent recalled times of scarcity when she was growing up during which working together to fish and sharing fish were acts of survival (06062019WBQ1). She described contemporary salmon fishing as more of a choice, but when she was young everyone fished due to necessity. They not only had to harvest salmon for themselves, but for their dog teams. This respondent said that her elders gave her tasks at fish camp starting at a young age. "Otherwise I wouldn't survive if I don't know how to do anything!" Later in life, when she had her own family to take care of, she was well-prepared because of all the knowledge that had been passed down to her. In turn, she taught her daughter "how to do everything." Although she still has a fish camp upriver, she usually sets a net in town because she needs fewer fish and because it is convenient. "My daughter is the one that goes up to my fish camp because that's a good area. You don't have to be there very long to get what you need." Other people in the community sometimes use this respondent's fish camp when her family is not using it, because it is in a productive location.

Another key respondent explained that when she was growing up, she spent most of the summer between the Fourth of July and the start of school at her grandmother's fish camp (01302020WBQ4). She moved to town as a teenager, and because she worked during the summers, she was not able to return to Beaver to help with fishing. However, her brothers always returned to help. As an adult, she returned to Beaver and is able to take time off work during part of fishing season. "My mom and dad have a fish camp [downriver], so we go down there every summer, and they're able to stay there because they're retired. They both finally retired a couple years ago, so they're able to stay there a lot longer. I have to work a lot, so I don't get as much time as I need to down there." Her siblings often join her parents at their fish camp, too. Although she cannot spend as much time as she would like to at camp, fishing and working together as a family remains an important tradition that she wants her daughter to experience.

One key respondent said that he fishes with his father's and brother's households (06052019WBQ2). Often members of these three households harvest fish together, and then they divide those fish between the households. They each store fish in their own freezers. Occasionally throughout the fishing season, one or two of the households in the group might go fishing without the others. They may fish alone because they need or want more fish, or because others in the group are unable or unwilling to go. He described that in the past his father had a fish camp near Rampart, but that over time it became too expensive to travel that far to fish. Regardless of where his family fishes, he regards fishing as an important part of his identity. During an interview, he explained that some of his earliest memories were of fishing: "I can remember being in the

Table 5-12.–Mean production ties and mean harvests of households in the cooperative production network, by household characteristic, Beaver, 2018–2019.

Household characteristic	Number		Mean household harvest (lb)
	Sampled Households	Mean production ties[a]	
Harvest category[b]			
High	3	0.67	482.27
Above average	3	0	182.8
Low to average	11	0.73	66.62
No harvest	4	0	0
Maturity[c]			
Developing	6	0.5	53.5
Mature	7	0.29	202.18
Elder	8	0.62	123.97
Household head			
Couple	11	0.64	169.26
Single female	4	0.75	163.67
Single male	6	0	35.25

Sources ADF&G Division of Subsistence household survey, 2019 and ADF&G Division of Commercial Fisheries postseason harvest survey, 2018.

a. Average number of other households with which sampled household cooperated in harvesting and processing of salmon

b. Household harvest categories were calculated using the mean household harvest (213.8 lb). The upper limit of the above-average harvest category is one standard deviation over the mean (522 lb). The high harvest category is any harvest greater than one SD over the mean.

c. Developing: age(s) of households head(s) is less than 40 years. Mature: age(s) of household head(s) is 40–59 years. Elder: age(s) of household head(s) is greater than 59 years.

boat while my dad checked fish net and he built fish wheels, and I was running along the fish wheel raft at maybe about three years old. And that's where I learned how to walk." Other members of his family cherish the time they spend fishing together as well.

> The other year cutting fish [my brother] said, "This feels so good, it's just right"… He said he felt so much at peace just sitting there at the smokehouse, the kids running around the smokehouse, the wives cackling, and my dad sitting there cussing around about something. He said it just felt so right and so peaceful. And it's just those few hours a day when you can just give in and just cut fish and everything's right…My brother and I, we fish, we cut the fish, dry the fish, and it's almost meditative, you know, the way you sit there for hours and just cut salmon fillet after salmon fillet, and strip the fillet. And doing things like that is, like I said, is where I feel closest to God. It's where I'm at peace. (06052018WBQ2)

He wants to be able to teach his children how to fish, but he feels less able to do so because of declined salmon abundance and fishing restrictions. "I want to teach [my kids] all these things, but we can't teach them if we don't have the resources to teach them or if we're not allowed to access these resources."

Some household fishing patterns may vary more than others from year to year. A key respondent described that she sometimes she joins her sister's household at their fish camp, sometimes fishes from town, and sometimes does not fish (06062019WBQ3). She said that if a household does not have a boat, they might fish with someone who does.

The stories shared by key respondents help to show the social nature of salmon fishing. Each household and fishing group operates in a unique way. Fishing groups are not static: different households may join in or leave the effort at various times throughout the season. Additionally, although many of the same households fish together from year to year, fishing groups likely vary with circumstances of the year. Reasons that households work cooperatively likely vary from household to household, but may include carrying on traditions, division of labor and resources, increased efficiency, and spending time with friends and family.

Exchange of Salmon

Sharing

Local Characterization of Sharing

Sharing of salmon and other wild foods is a foundational part of subsistence economies. Sharing can be defined in a general way as giving without the expectation of something in return. However, sharing is part of Alaska Native culture and traditions. The act of sharing is nuanced and holds deep meaning for those who participate in the practice. Sharing begins well before an exchange actually takes place. When harvesting salmon or other resources, Beaver residents are not just thinking about the food they need, but also the food that others need. As one respondent described it:

> We don't only ever fish for ourselves. We don't only ever hunt for ourselves. We fish knowing that we're going to give a certain amount away to our family. So when we can't give that amount away even if we're feeding ourselves, then it's not okay. Then that means that our needs have not been met. Our need to give has not been met…it's not necessarily reciprocal but it's an important part of culture to give things away. That's how we distribute wealth and how our economy works; that's what the subsistence economy is. I mean, I think it's in direct contrast to Western economy, because you're able with money to put it in a bank and save it and hoard it or whatever, and with food you're not able to do that because it will spoil. So you have to share it. And then also it just comes down to like you know you really have to take care of the people around you. You have to make sure that they're okay, they have enough food for the winter. (01302020WBQ4)

In Beaver, social and cultural norms help determine with whom fish are shared. Three respondents said that first you must look after your elders by giving them fish (06062019WBQ2, 06062019WBQ3, 01302020WBQ4). Sharing the first salmon or the first waterfowl of the season with elders is customary. A younger male fisherman described his sharing patterns.

> First of all, I would share with my mom and my grandmother. Our women are very important in our culture. I share with them and then I would start giving away to the elders and to the people that can't fish... that don't have boats, don't have the means to do so. (06062019WBQ2)

However, when households are not able to harvest enough salmon to meet their own needs and their sharing obligations, they must either reduce the number of people with whom they share or reduce the amounts they share (06062019WBQ2, 06062019WBQ3, 01302020WBQ4). Typically, Beaver residents prioritize sharing with elders, close family, and people who may have a great need for fish. In times of salmon scarcity, Beaver residents are less likely to send salmon to more distant relatives and friends.

> Elders always get fish first. Elders: that stays pretty consistent. But, like, the other people you share with, like, you know, your auntie from your dad's side that you haven't seen for six years is probably not going to make the cut. (01302020WBQ4)

Sharing is not limited to within the community. Salmon are commonly sent to family living in Fairbanks or other rural communities, especially to elders and close family. If an obligation to share exists, it does not matter where the recipient resides: salmon can be sent as cargo or mail. One respondent said that buying meat in urban centers like Fairbanks is expensive and people that move there from Beaver miss their traditional foods (06062019WBQ2). Even when people no longer live in the community, their need for subsistence foods and the connection that these foods provide to their heritage does not diminish. In return, family who reside in urban centers often will contribute to the harvest effort by purchasing gas or sending other supplies needed for subsistence activities. One respondent explained how when her family moved to Fairbanks for a few years, they would send supplies to their grandmother who remained in Beaver and was in charge of all the fishing for the extended family (01302020WBQ4). They would send her a variety of supplies, including ammunition, fishing nets, groceries, and gasoline.

Although Beaver respondents did not describe the sharing of wild foods in specific annual gatherings or feasts, they often try to harvest and preserve extra salmon and other wild foods to share when there is a memorial potlatch for family or friends who have passed (06062019WBQ1, 01302020WBQ4). One respondent said that "if there's a potlatch coming up then [my parents] will jar extra cases [of fish]" (01302020WBQ4). People place less emphasis on wild foods at holiday events than at more traditional ceremonies like memorial potlatches.

> When you were growing up and all year long you ate moose or salmon, for Christmas or Thanksgiving, it's kind of a treat to eat a store-bought turkey. Like, that's really exotic food, a turkey or a ham. So we still have turkey and ham. But when people pass away or something, or there's a big funeral or a potlatch, then that's when we share [wild] food. And that doesn't happen every year. And we always try to set potlatch dates in the fall time where we know we'll have a freezer full of fish. Only people who live outside of Beaver want to have a potlatch in the summertime. Just because your freezer isn't going to be very full in June versus in August or September. Your family hasn't even had time to put enough food away for that people or event, because you know it's a three-day event, three meals a day you're feeding hundreds of people. And I know from my uncle's potlatch, we probably put away 12 cases of fish, just my family alone. That doesn't include everything that everybody else gave us. And there were a lot of geese you know. There's a lot of things. (01302020WBQ4)

One respondent described sharing as helping create a sense of community (06052019WBQ2). He said that during times where one resource, like salmon, is scarce, that the inability to share that resource as much affects the sharing of other wild foods. "Without the fish there is less geese to share. There's less moose to share, too, because we have to keep our freezer full and make sure we make it through the winter or whatever season we're at."

Two key respondents said that they most often share whole, unprocessed fish (06052019WBQ2, 01302020WBQ4). One said that sending whole, frozen fish is easier because making strips is so much work (01302020WBQ4). She said that in the past, making strips was more common, because more fish were available. The other respondent said that he usually sends whole fish to his mother in Fairbanks. "She wants us to smoke it and jar it, but a lot of time we send her whole fish, because, like, when you smoke it and jar it, that's a snack, Mom. We want to feed you. We're sending you this whole fish" (06062019WBQ2).

Parents and other adults do not necessarily teach children sharing values explicitly. Like many aspects of Native culture, younger generations often learn about sharing through observation. One elder respondent said that she learned about sharing from a young age just like she learned how to fish at a young age: by observing her parents and grandparents (06062019WBQ1). She noticed that "if a person don't have it very good, not gonna make it or something, they'd pitch in and help the person out." When asked how she later taught her own children about sharing, she said: "I'm always sharing things, and they just watch me and they do the same thing." Another respondent remembers that as a little girl, she learned that sharing is important because her mother made her take shares of moose meat to elder households (06062019WBQ3).

Table 5-13.–Reported weight of salmon shared by exchange partner and resource, Beaver, 2018–2019.

	Pounds					
	Type of salmon					
Exchange partner	Chinook	Summer chum	Fall chum	Sockeye	Coho	Total
Given to						
Local household	300.6	0.0	0.0	18.5	0.0	319.1
Other community	249.2	0.0	0.0	228.8	36.3	514.3
Event	353.7	0.0	0.0	11.1	0.0	364.7
Total	903.4	0.0	0.0	258.3	36.3	1198.0
Received from						
Other community	4.8	0.0	0.0	4.5	0.0	9.3
Event	0.0	0.0	0.0	0.0	0.0	0.0
Total	4.8	0.0	0.0	4.5	0.0	9.3

Source ADF&G Division of Subsistence household surveys, 2019.

Salmon Sharing Networks

Respondents in Beaver provided information about which other households within their community they gave salmon to, as well as to and from which other communities and events they gave or received salmon. Beaver households gave away 1,198 lb of salmon during the study period, of which 903 lb (75%) was Chinook salmon, 258 lb (22%) was sockeye salmon, and 36 lb (3%) was coho salmon (Table 5-13). No households reported sharing summer or fall chum salmon with others. Overall, more pounds of salmon were given to other communities (514 lb) and shared during events (365 lb) than were shared between local households (319 lb). Most instances of giving salmon involved Chinook salmon (47); there were only six instances of giving sockeye salmon and one instance of giving coho salmon (Table 5-14). Most instances of Chinook salmon giving were to events (23), followed by 13 instances of giving to other local households and 11 to other communities. Only two instances of receiving salmon were reported on the surveys: Beaver households received approximately 5 lb of Chinook salmon and 5 lb of sockeye salmon from other communities (Table 5-13).

Appendix tables D5-5 and D5-6 provide details about the way they processed the salmon they shared. Overall, whole, unprocessed salmon was shared most often. Chinook salmon were processed in a variety of ways. Beaver residents shared whole, unprocessed Chinook salmon most frequently (22 exchanges); Chinook salmon were shared in this form to other local households, other communities, and events. Cooked Chinook salmon was the second most common processing type by number of sharing exchanges (14), but they were only shared to events. Smoked or dried Chinook salmon were shared more commonly to other communities than either within the community or to events. All sockeye salmon were given as fillets or whole (Table D5-5).

Figure 5-12 provides a visual depiction of salmon sharing that occurred between Beaver households as well as for events in 2018. Beaver respondents identified other households within the community to whom they gave salmon, and the arrows on the graph represent the exchange of salmon from giver to receiver. Respondents were not asked to report from whom they received salmon. Although respondents could specify that they shared more than one type of salmon with the same household, this level of detail is not discernable on the diagram. Nine households reported giving salmon to six households. Households reported sharing salmon a total of 14 times but only 12 of these exchanges were unique connections between households (Appendix Table D5-4). In other words, at least one household received more than one salmon species or processing type from another household. Two households received salmon from more than one other household, noted on the diagram by more than one arrow pointing toward these nodes (Figure 5-12). Two households gave salmon to more than one other household, noted by more than one arrow pointing away

Table 5-14.–Reported number of sharing ties by exchange partner and resource, Beaver, 2018–2019.

	Number of ties[a]					
	Type of salmon					
Exchange partner	Chinook	Summer chum	Fall chum	Sockeye	Coho	Total
Given to						
Local household	13.0	0.0	0.0	1.0	0.0	14.0
Other community	11.0	0.0	0.0	4.0	1.0	16.0
Event	23.0	0.0	0.0	1.0	0.0	24.0
Total	47.0	0.0	0.0	6.0	1.0	54.0
Received from						
Other community	1.0	0.0	0.0	1.0	0.0	2.0
Event	0.0	0.0	0.0	0.0	0.0	0.0
Total	1.0	0.0	0.0	1.0	0.0	2.0

Source ADF&G Divison of Subsistence household surveys, 2019.

a. Total instances of giving or receiving.

from these nodes. Only one household in the network both gave salmon and received salmon. Because 17 households were not surveyed and because respondents were not asked to report from which other local households they received salmon, this graphic likely represents only a portion of the salmon sharing that occurred between households in Beaver during the study year. Salmon sharing between households within the community almost exclusively involved Chinook salmon, although a small amount of sockeye salmon was also given (figures 5-14 and 5-15).

Beaver respondents were also asked about the salmon they gave to and received at events. As discussed in the community background section, the sharing and eating of wild foods is often a central feature of community events and gatherings. Nine Beaver households reported sharing 365 lb of salmon to eight different types of events during the study year (Table 5-15). No respondents received salmon at events. Figure 5-13 depicts salmon shared between Beaver households and events. Five households provided 236 lb of salmon for potlatches during the study year (Table 5-15). Although the specific types of potlatches and locations were not recorded, potlatches are often held in memory of someone who has passed away. In this sense, the potlatch event category may overlap with the funeral or memorial event category to which one additional household provided 15 lb of salmon. Households also shared salmon for holiday celebrations, a health clinic dedication, and a Village Council event. One household reported giving salmon for nine different birthdays. As shown by studies in other communities, salmon are not the only type of wild food shared to events (Brown and Kostick 2017). If Beaver respondents were asked about additional types of wild foods, such as moose, for example, events would likely play a more prominent role in the sharing network.

During the study year, seven Beaver households gave 514 lb of salmon to households in eight other communities and received nine pounds of salmon from households in two communities (Table 5-16). Figure 5-10 shows how individual Beaver households were connected to other communities by salmon, and Figure 5-16 highlights these connections geographically. Four Beaver households had seven ties to Fairbanks where they sent nearly 180 lb of salmon. Each of the other communities received salmon from only one Beaver household. Most had only one instance of salmon sharing reported, except for Huslia and Soldotna which had two ties each, meaning that more than one type of salmon was given. Most households that shared with other communities only did so with one other community, but one household shared salmon to three communities, and two households shared salmon to two communities (Figure 5-10). Only two

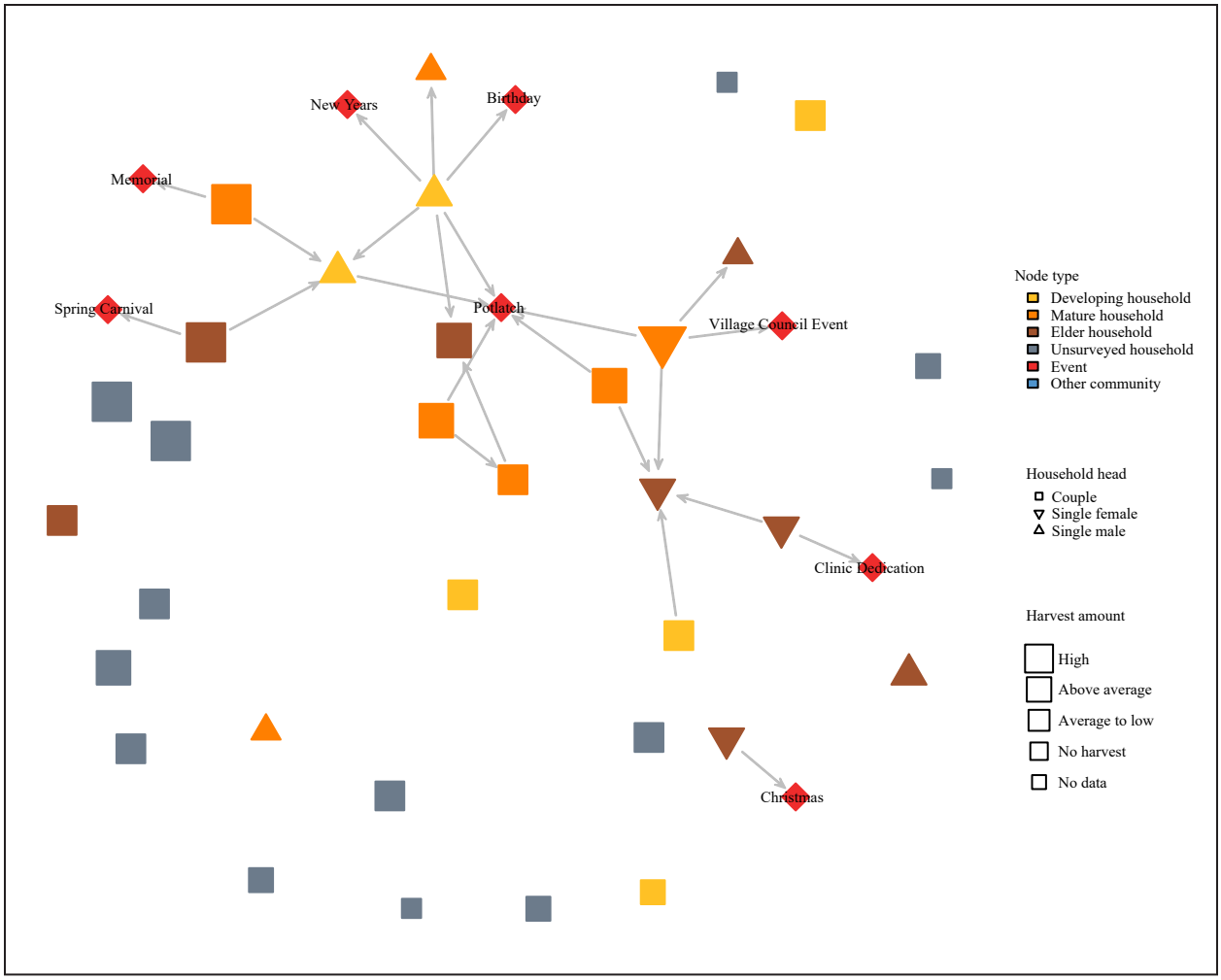


Figure 5-12.–Sharing network between respondent households and other local households, Beaver, 2018–2019.

households received salmon from other communities: one household received salmon from Anchorage and another household received salmon from Stevens Village. Approximately five pounds of salmon was received in each instance.

Most of the sharing that occurred with other communities took place within the Yukon River region (Figure 5-17). Approximately half of the sharing ties were to Fairbanks, the urban hub of the upper Yukon River region (Table 5-16). A quarter of the ties were to other rural Yukon River communities and a quarter were to rural communities in other regions of Alaska. Beaver residents gave Chinook salmon most commonly to other communities (Figure 5-18), but in terms of total pounds given to other communities, they shared similar quantities of Chinook and sockeye salmon (Figure 5-19).

Beaver respondents reported that 76% of the sharing relations in 2018 were relations that had also existed in previous years All salmon sharing relations except for one were between family members in 2018 (Table 5-17). Beaver respondents gave salmon most frequently to elders in their family (16 ties) and other family members who were not elders (six ties). These ties were split equally between local households and households in other communities. One household shared with an elder with whom they had no biological relation. For the two instances of salmon received from other communities, the giving households were related to the receiving households in Beaver. Table 5-18 shows the average amounts of salmon in pounds shared by relation type. Beaver residents gave elder family members in other communities the most salmon

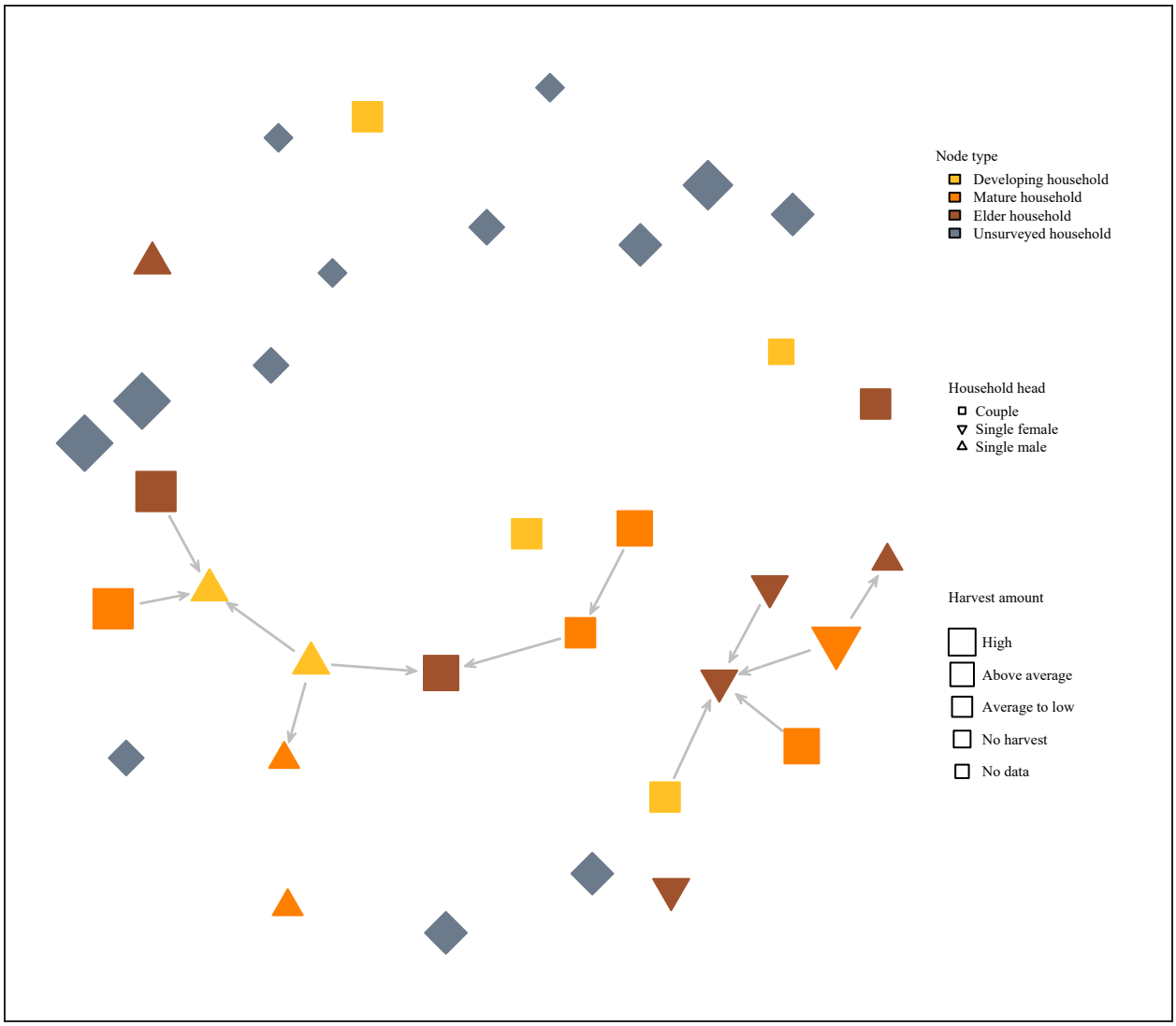


Figure 5-13.–Sharing network between respondent households, other local households and events, Beaver, 2018–2019.

on average (54 lb), followed by family members within the community (41 lb). Non-elder family members in other communities and elders within the community were given similar amounts of salmon on average, 27 lb and 23 lb respectively.

Appendix Table D5-7 compares household characteristics to the average number of sharing ties respondents had with other Beaver households and other communities. Within Beaver, households from every category gave salmon to others except for households that did not harvest salmon. High harvesting households, households with single female heads, and mature households had slightly more instances of giving within the community on average than households with other characteristics. Households from every category received salmon except for high harvesting households. Low-to-average harvesting households, those headed by single females, and elder households had slightly more instances of receiving on average than households in other categories.

High harvesting households gave salmon much more often to other communities than households that harvested less. High harvesting households also gave much greater amounts of salmon on average to households in other communities than they did to other households within Beaver. Elder households and those headed by single males had fewer instances of giving salmon to other communities than households

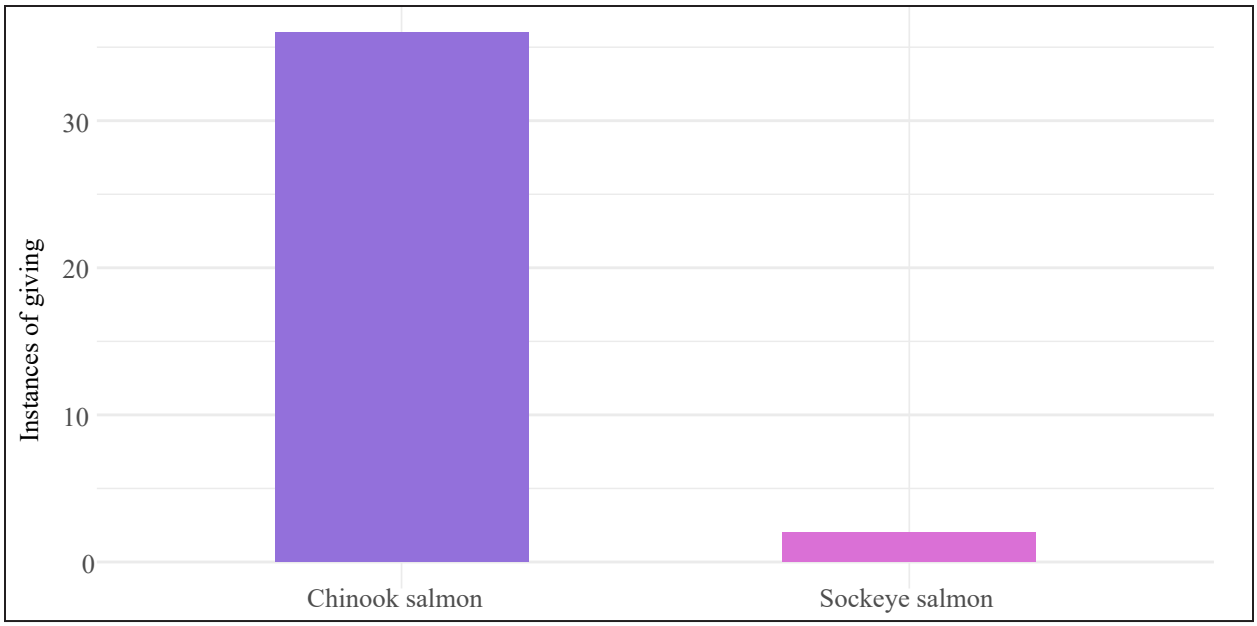


Figure 5-14.–Reported instances of salmon giving between respondent households and other local households, by resource, Beaver, 2018–2019.

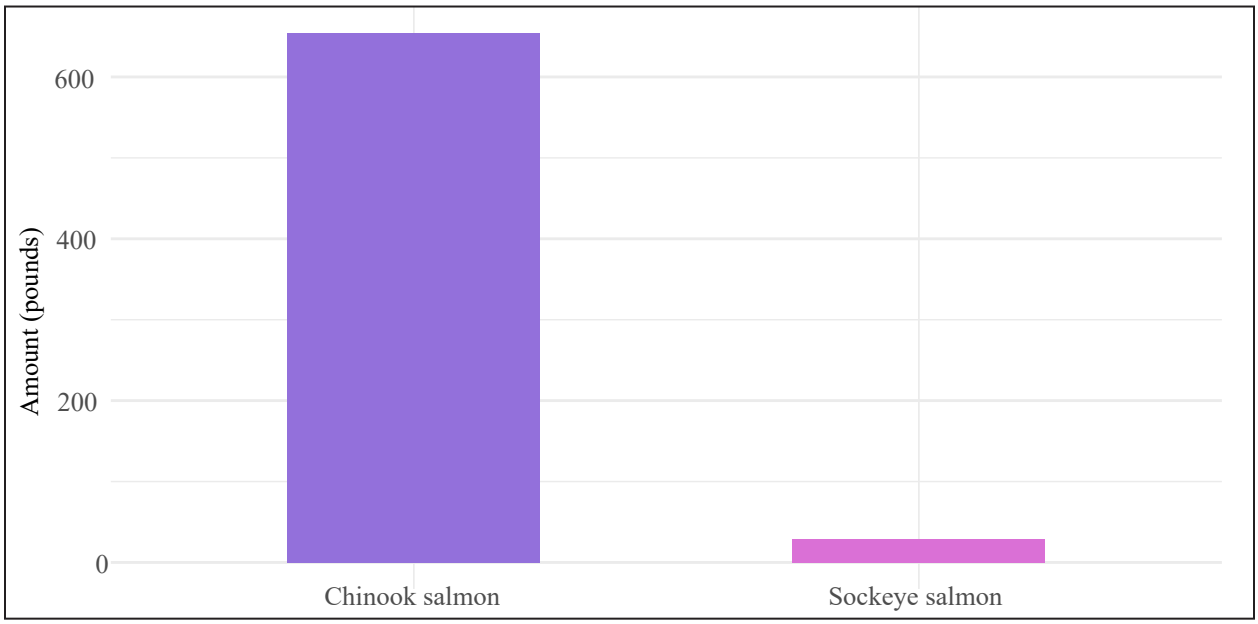


Figure 5-15.–Reported pounds of salmon given between respondent households and other local households by resource, Beaver, 2018–2019.

Table 5-15.–Reported instances and pounds of salmon given to and received from events, Beaver, 2018–2019.

	Give			Receive		
	Number			Number		
Event	Households	Total ties[a]	Salmon (lb)	Households	Total ties[a]	Salmon (lb)
Birthday	1	9	27.9	-	-	-
Christmas	1	1	16.6	-	-	-
Clinic dedication	1	1	4.9	-	-	-
Funeral or memorial	1	2	15.2	-	-	-
New Year	1	1	6.2	-	-	-
Potlatch (unspecified)	5	8	236.0	-	-	-
Spring Carnival	1	1	16.6	-	-	-
Village Council event	1	1	41.4	-	-	-
Any event	**9**	**24**	**364.7**		**-**	**-**

Source ADF&G Division of Subsistence household surveys, 2019.

a. Total instances of giving or receiving.

Table 5-16.–Reported instances and pounds of salmon given to and received from other communities, Beaver, 2018–2019.

	Given by respondents			Received by respondents		
	Number		Amount	Number		Amount
Community	Households	Ties[a]	(lb)	Households	Ties[a]	(lb)
Anchorage	0	0	0	1	1	4.5
Fairbanks	4	7	178.5	0	0	0
Huslia	1	2	44.4	0	0	0
North Pole	1	1	16.6	0	0	0
Northway	1	1	73.8	0	0	0
Saint Paul	1	1	9.7	0	0	0
Soldotna	1	2	43.7	0	0	0
Stevens Village	0	0	0	1	1	4.8
Tanacross	1	1	73.8	0	0	0
Tok	1	1	73.8	0	0	0
Any community	7	16	514.3	2	2	9.3

Source ADF&G Division of Subsistence household surveys, 2019.

a. Total instances of giving or receiving.

Figure 5-16.–Intercommunity sharing, barter, and customary trade map, Beaver, 2018–2019.

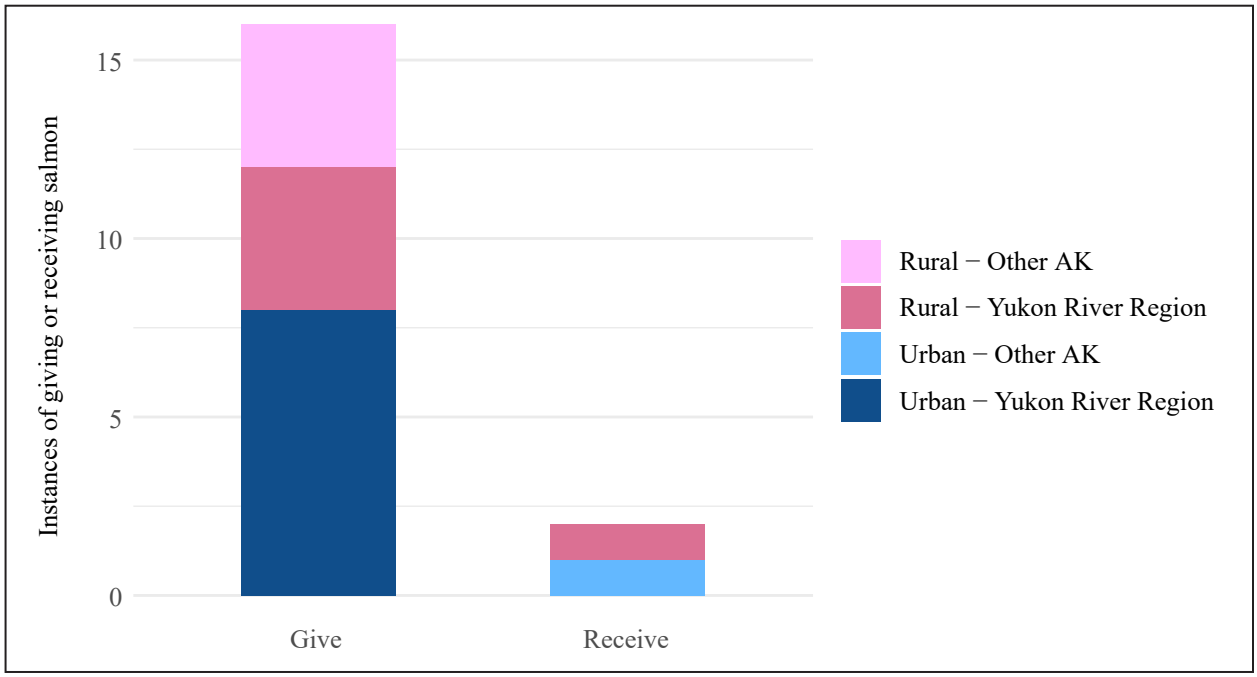


Figure 5-17.–Reported instances of salmon giving and receiving between respondent households and other communities by region, Beaver, 2018–2019.

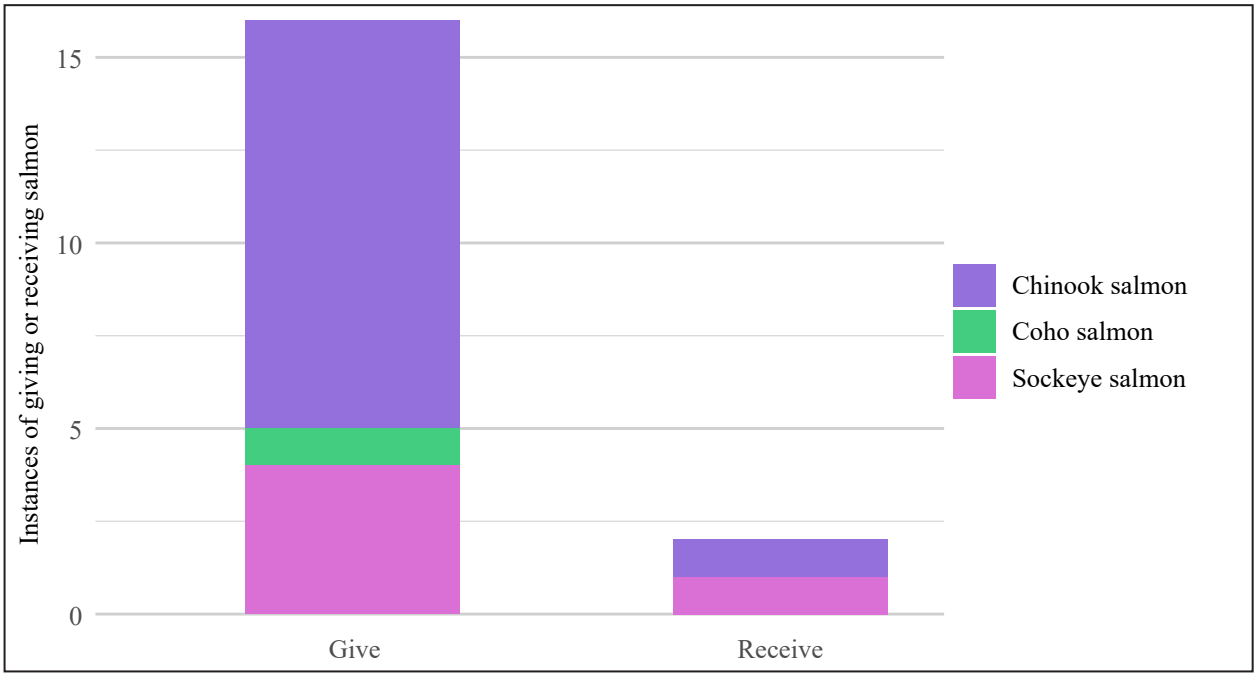


Figure 5-18.–Reported instances of salmon giving and receiving between respondent households and other communities by resource, Beaver, 2018–2019.

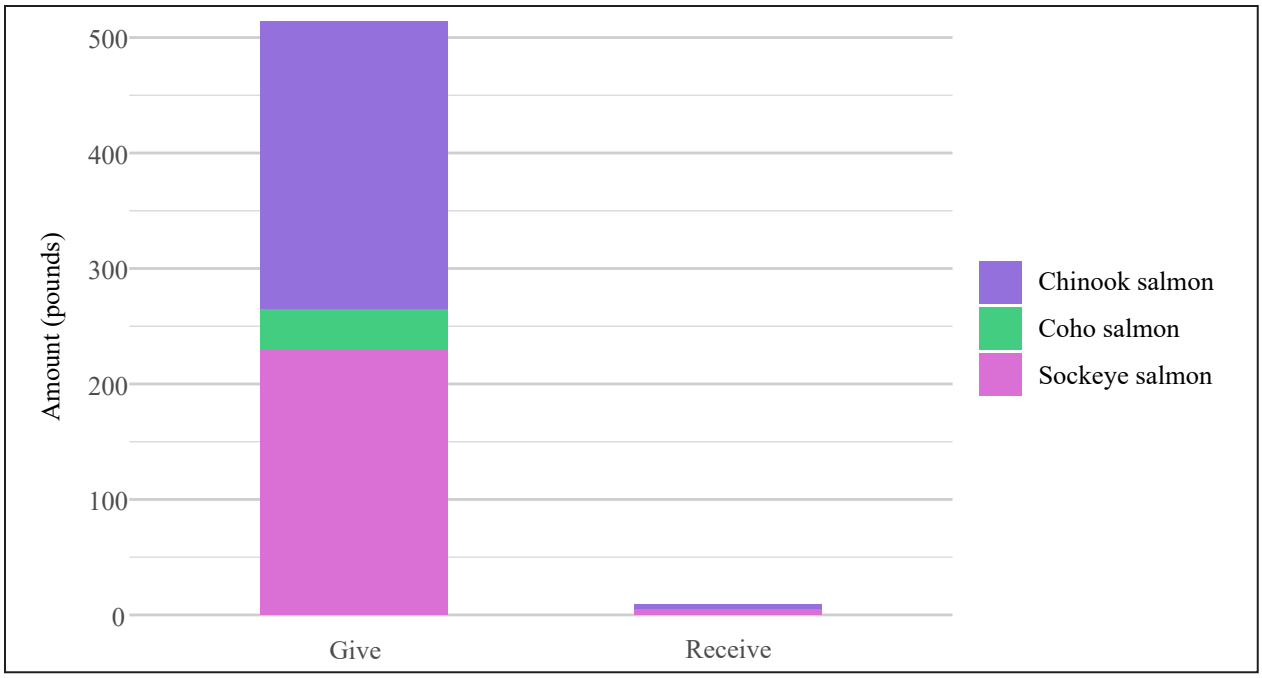


Figure 5-19.–Reported pounds of salmon given to and received from other Alaska communities by resource, Beaver, 2018–2019.

Table 5-17.–Number of unique sharing ties between respondent households and exchange partners by relationship, Beaver, 2018–2019.

	Unique ties[a]			
Exchange partner	Family (not elder)	Elder in family	Other elder	Total
Given to				
Local household	3	8	1	12
Other community	3	8	0	11
Total	6	16	1	23
Received from				
Other community	2	0	0	2

Source ADF&G Division of Subsistence household surveys, 2019.

a. Relationship between two households or entities

Table 5-18.–Average pounds of salmon given to and received from exchange partners by relationship, Beaver, 2018–2019.

	Average amount (lb)			
Exchange partner	Family (not elder)	Elder in family	Other elder	Total
Given to				
Local household	41.4	23.3	8.3	73.0
Other community	26.9	54.2	0.0	81.1
Total	68.3	77.5	8.3	154.1
Received from				
Other community	4.7	0.0	0.0	4.7

Source ADF&G Division of Subsistence household surveys, 2019.

with other characteristics. Households that did not harvest salmon reported the most instances of receiving salmon on average, and households in the above-average and high harvest categories did not receive salmon from other communities. As described by ethnographic respondents above, reasons for sharing are often based on relationships and the needs of others and therefore may not necessarily be related to how much a household harvests or its demographic characteristics (06052019WBQ2019, 06062019WBQ3, 01302020WBQ4). Nevertheless, some household characteristics may increase a household's ability to share with others. For instance, high harvesting households likely have the ability to share with greater numbers of people and in greater amounts because they have more salmon available to them. Elder households may be more likely to receive salmon because of the cultural obligations to support and respect elders. Mature households that accumulated resources for fishing over time may be able to harvest and share more salmon than younger households.

Barter and Customary Trade

Local Characterization of Barter and Customary Trade

In Alaska, the barter and customary trade of wild food resources are recognized as customary and traditional practices in state subsistence law. State statute defines barter as "the exchange or trade of fish or game, or their parts, taken for subsistence uses for other fish or game or their parts; or for other food or for nonedible items other than money if the exchange is of a limited and non-commercial nature" (AS 16.05.940(2). Customary trade refers to the exchange of subsistence resources for "minimal amounts of cash" (AS 16.05.940(8)); although the law does not list specific limitations, it does state that transactions must be "non-commercial." In other words, individuals cannot make a business out of selling subsistence resources. The terms barter and customary trade are rarely used in everyday language and their seemingly straightforward legal definitions often do not align well with the myriad ways wild foods are exchanged in real life (Brown et al. 2017). The following section will first discuss barter and then customary trade primarily through the words of key respondents.

During one key respondent interview, it was noted that the term barter has a connotation of haggling or that it involves an agreement between two parties about types and amounts of resources to be exchanged. According to the respondent, this type of direct reciprocity is very rare. Instead, values of reciprocity often prompt the receiver of a gift to return the favor. This system of delayed reciprocity is not captured by the legal definition of barter.

> I wouldn't ever give a gift to you because I'm expecting something in return. But you would receive a gift and then give me a gift in return. You know? I would never expect anything, any kind of return from that gift, but if you were raised properly and you have manners, then you would just give a gift in return because that's how our culture works. (01302020WBQ4)

The respondent explained that her family regularly sends salmon to family in Arctic Village, and those family members send them caribou dry meat in return. "If you want to call that barter you can," but local participants just think of it as sharing.

Two key respondents explained that salmon is the primary resource that Beaver residents would typically trade for another resource. They trade salmon as a means to get resources that are not locally available (06052019WBQ3, 01302020WBQ4). "From our particular area like we mostly get salmon so that's what we trade a lot with." However, as salmon harvests have declined, the amount of trade with other communities may have also declined.

> Now without fish, we have nothing worth bartering for. I mean I guess we can do moose, but everywhere gets moose except for way up north where we get the muktuk. Our relationships with other tribes seem to be suffering a little bit from not being able to barter…When I was growing up, my family would barter with other family or friends in villages that would get caribou. We don't get caribou here. So we'd send king salmon up, they'd send caribou down, and same way up north. We barter for muktuk you know… And we've been bartering since the beginning of time with other tribes. So it's almost, it almost seems like it could be like it's making the tribes further and further apart, too, without that bartering. (06052019WBQ2).

Although all key respondents described the importance of sharing, not all participate in barter. For example, one respondent said that her family does not really barter, and they never did when she was growing up either (06062019WBQ3). Beaver residents who do barter or trade most often do so with family or close friends. They also occasionally barter opportunistically, such as when meeting new people through work or travel. For example, a key respondent was in Sitka for a work training and met some women who offered to trade herring eggs for some geese in return (06052019WBQ2). The respondent missed out on this opportunity to get herring eggs because he could not afford to give away any of the food he had harvested. "They don't get geese like we do in Sitka, but because we have less fish, I have to keep more geese in my freezer and there's less to barter. It's a ripple effect." This respondent also said that if someone cannot get a particular resource that they want locally, that they probably know someone somewhere in the state with whom they could trade. "Native Alaska is really interconnected. I mean you point at a village on the map and I think I have like a 75% chance of telling you I know somebody from there." He also said that "you barter with the people who have the best caribou and the best muktuk" (06052019WBQ2).

Ethnographic respondents provided examples of resources that might commonly be exchanged for one another. For barter within the community, one respondent said that the most common items to be exchanged were: "Salmon for moose. Geese for moose or salmon. It's just mostly geese, ducks, salmon, and moose" (06062019WBQ3). Another respondent said that for exchanges between communities, trading ammunition for ducks and geese is common, as well as trading salmon for dry moose or caribou meat (01302020WBQ4). This respondent said that in the past, law enforcement searched planes from the region and confiscated geese that were being sent to relatives in Fairbanks, leading to confusion and frustration about regulations and the legalities of sending traditional foods to family.

Beaver residents described the buying and selling of subsistence-caught salmon as an occasional practice rather than a common practice. Additionally, they expressed differing opinions on buying versus selling salmon. Similar to bartering, people buy wild foods in order to obtain scarce or uncommon resources.

One respondent said that he thinks people buy salmon more commonly now because the ability to harvest enough salmon locally is less common.

> We buy a lot of fish from people from places that still get fish, like the Copper River, you know, different tributaries that get fish. We'll buy strips and stuff. And it almost feels dirty. It does. But that's what we need to do in order to get the food that we love since we can't fish our own. We have to buy it from our neighbors. (06052019WBQ2)

Another respondent described circumstances in which she would buy wild foods: "In the past I've, like, to give as a gift I would buy dry meat or something. Or jarred fish to give someone if you know we didn't have enough to share ourselves" (01302020WBQ4). She explained that these types of transactions are small in scale. "It's never so much so that, like, it wouldn't ever really be a business for somebody, like a commercial thing."

The same two respondents also described buying salmon from people who sold it to them at the annual Alaska Federation of Natives convention (AFN), held alternatingly in Fairbanks and Anchorage (06052019WBQ2, 01302020WBQ4). One of these respondents said that in the past her family would always harvest enough salmon to have salmon strips that lasted all winter and to share with others. Because they can no longer harvest enough, she sometimes buys strips as a treat (01302020WBQ4). The other respondent said that the price of strips has increased in recent years because salmon have been in higher demand.

> The price is going up, I mean I remember about five or six years ago I bought a bag of fish for like, a big gallon-sized bag for like 25 bucks. And right now, you go to AFN or something, that same gallon-sized bag of fish full of salmon strips is going to cost you almost $100. I mean I saw people buying it for 75, 80 bucks. I mean I, I stop after 25 bucks. I'm like "No," you know? (06052019WBQ2)

Respondents described the selling of wild foods somewhat differently than purchasing them. Although they generally felt that purchasing small amounts of salmon from others was acceptable, some individuals explained that their own moral code would prevent them from selling salmon (06052019WBQ2, 01302020WBQ4). "Growing up, if people needed something, we'd give it to them. It was always instilled in me that selling fish, our natural-caught foods, was wrong" (06052019WBQ2). This respondent was of the opinion that selling fish "should be extremely small scale" (06052019WBQ2).

> Once you start making a living off of it, you're a commercial fisherman. You know, if you're doing it to make ends meet for a limited amount of time, you know, I can kind of understand that. I mean, I'd never sell fish. But if somebody was making a few hundred dollars here and there, that's kind of, it's okay. It's not good, but it's okay. But if somebody's making a living off of selling fish, a finite resource, then I don't believe in it. (06052019WBQ2)

When he was approached by someone wanting to buy some salmon, he refused to sell it. "The other year during that okay run people were asking me, you know 'Hey, I'll send you some money, you want to send me some fish?' I'm like, 'No, I'll give you a few pieces but I'm not going to sell you anything'" (06052019WBQ2). Another respondent said it would take a "pretty rare" circumstance for her to sell salmon (01302020WBQ4). She said was not exactly sure what that circumstance would be, but that maybe if someone who was not particularly close to her family approached her to buy a case of jarred strips that she might sell them one if she had enough.

Other respondents described historical customary trade. An elder said that when she was growing up, her father would sell bundles of dried salmon in Fort Yukon so that he could buy the supplies they needed for winter from the store there (06062019WBQ1). Another respondent recalled one time that her mother sold small barrels of salt fish in order to get gas money to return to Beaver after salmon fishing downriver (06062019WBQ3). Her mother occasionally sold salmon at other times, as well. "She would make sure that we had our winter supplies. She wouldn't, you know, she'd just sell enough for maybe gas or something."

Neither contemporary or historical examples of customary trade shared by respondents involved large amounts of cash or resources. When asked her opinion on the rumors about subsistence fishers selling enough salmon to purchase trucks, one respondent described that as an "urban myth" (01302020WBQ4).

> I want to meet that guy that bought the truck! I want to see this truck. I think it's a lie…I think that urban myth perpetuates because so many people on our Regional Advisory Councils are commercial users. They are guides, they own fish processing plants. So I think they feel that that customary trade cuts into their business…If there are bad apples, they are very few and far between. And I've

> not really run into any, is the thing. Like I've never met anybody who got rich off subsistence fishing. My God! If you want to find something to sink a bunch of money into and get no return on, go fishing. (01302020WBQ4)

Even though she does not think that people abuse customary trade, she still thinks that it should be more defined in regulations.

> I think that there needs to be a dollar value on that, but that's not a very popular opinion. I think there needs to be a dollar value on it because a lot of people do not understand the value of something unless it has a dollar attached to it. (01302020WBQ4)

Another respondent was less concerned with limits being placed on customary trade "I think it's self-regulated. Most people know. Maybe there's one or two, you know, that would abuse it, but I think most people know [that it should be limited]" (06062019WBQ3).

Salmon Barter and Customary Trade Exchanges

During the study period, Beaver respondents engaged in three barter exchanges that involved both giving and receiving salmon (Figure 5-20). Beaver respondents provided Chinook salmon and plucked feathers from geese in exchange for caribou and sockeye salmon. In terms of weight, equal amounts of resources were not given and received (Figure 5-21). Many factors likely determine amounts that are exchanged, including how much each party has available and the time and effort required to harvest and process the resource. Two households reported bartering: one bartered with another local household and one with a household in another community (Figure 5-22; Table 5-19). In each instance, the parties involved were related to each other. Chinook salmon from Beaver exchanged for caribou from Arctic Village represent a trading of locally available resources for those that are not locally available. Not all barter involves the exchange of two kinds of wild foods, as evidenced by exchanging the labor of plucking geese for sockeye salmon.

During the study year, Beaver respondents reported three instances of customary trade, each of which involved the purchase of a different type of salmon (Figure 5-23). Only one household purchased salmon. In

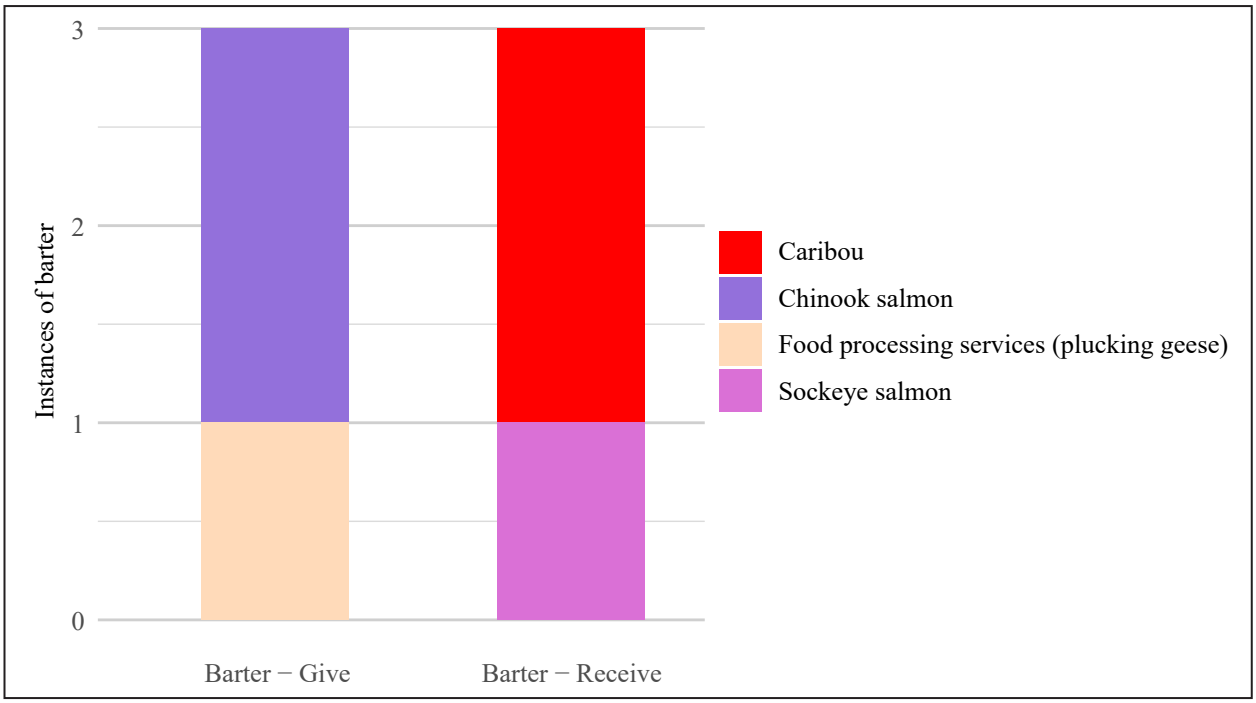


Figure 5-20.–Reported instances of barter by resources given and received, Beaver, 2018–2019.

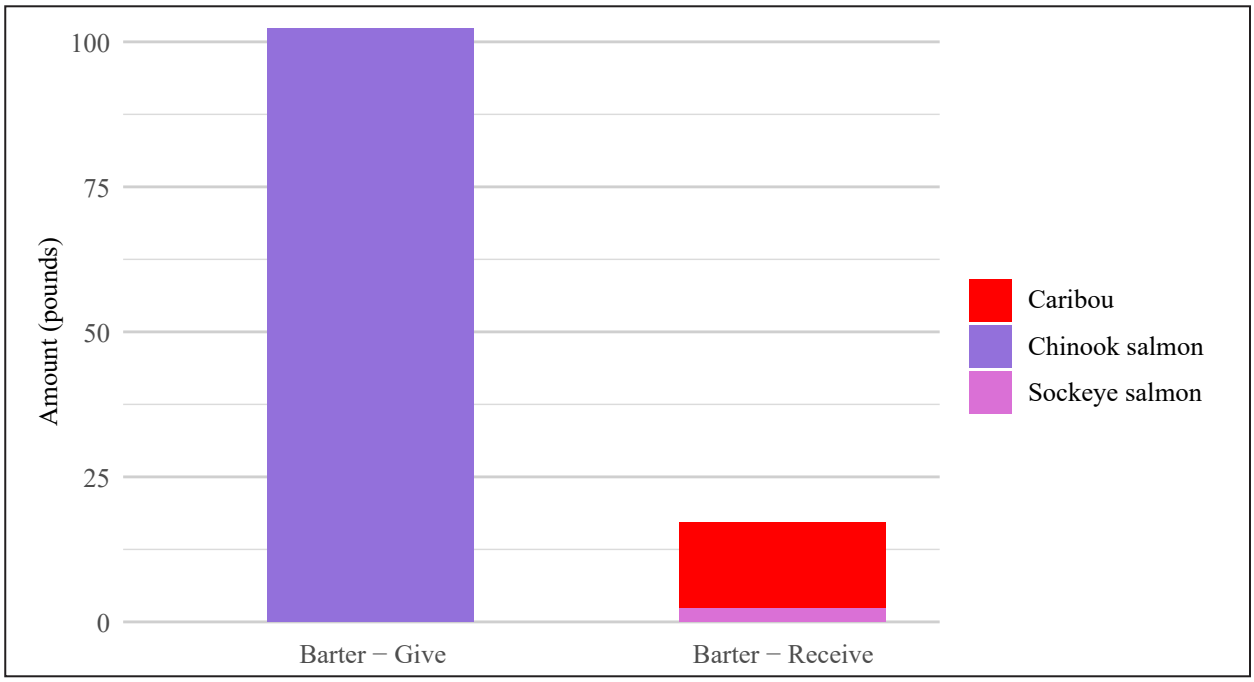


Figure 5-21.–Reported pounds of salmon and other wild foods given and received in barter, Beaver, 2018–2019.

total, they purchased approximately 45 lb of salmon for which they paid $375 (figures 5-24 and 5-25). All salmon were purchased in Anchorage from sellers that the buyer did not know (Table 5-19). Although there may be some underreporting of customary trade due to the sensitive nature of the topic, previous research in Beaver also found very few instances of customary trade (Brown et al. 2015a). These results suggest that the practice of buying and selling salmon is rare but does occur.

Overall, only three households participated in barter or customary trade during the study year (Figure 5-19). Within Beaver, one household in the low-to-average harvest category received salmon (Table 5-20). High harvesting households both gave and received salmon in exchanges with households in other communities.

Comparison of Network Types

Figure 5-26 compares network diagrams for production, sharing, and barter and trade networks between Beaver households. Sharing was by far the most common way that salmon connected households in Beaver. Previous research has also found that barter and customary trade occur much less frequently than sharing. Social stigmas and complex regulations around buying and selling fish may cause some people to underreport or not report these types of exchanges. However, few customary trade exchanges may have been reported both because of the nonmonetary values that Beaver residents place on wild foods and because a culture of sharing prevails. Another reason may be that the legal definition of barter differs from the way resource exchange typically occurs through delayed reciprocity.

The salmon production network ties represent relationships, rather than exchanges. Only a few small fishing groups occurred in Beaver, likely because of the small community size. As described above, fishing groups are typically based on kinship. For the most part, households in a fishing group did not share salmon with each other after they divided the harvest among the households in the group; instead, they shared fish with other households that they did not fish with.

Table D5-4 describes the Beaver salmon networks at three different scopes: all ties, ties between local households only, and ties between local households and other communities only. Density values range from zero to 1, the closer to 1 the higher the number of connection between households. Density values are most meaningful when compared to one another in a particular context, such as sharing, or in fishing

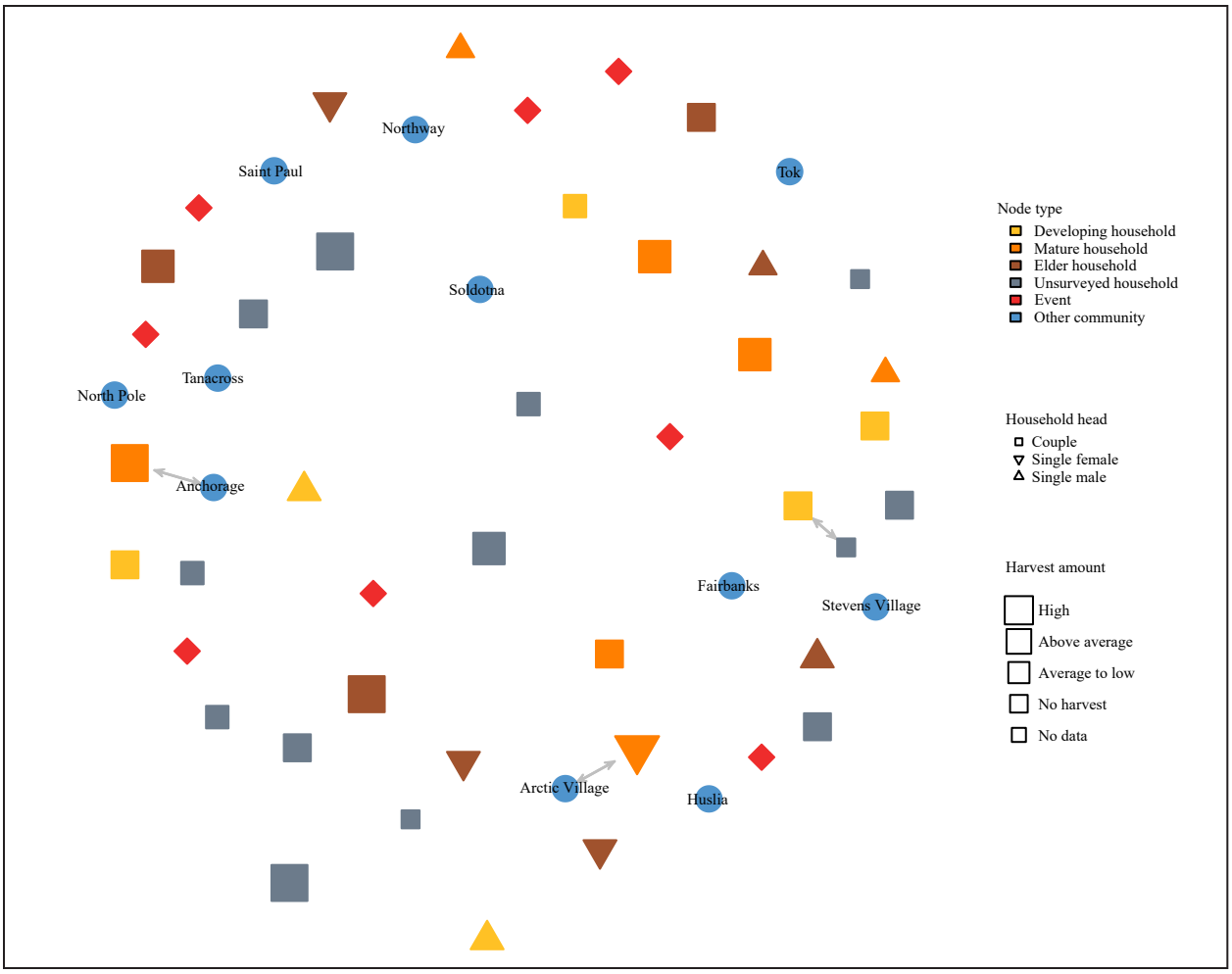


Figure 5-22.–Barter and customary trade network, Beaver, 2018–2019.

groups. When isolated, a low-density value means little without considering the broader social implications of activity being examined. For example, fishing groups would likely never reach a density value of 1 because it is unreasonable to expect all households to fish with every other household in a community. For all networks and scopes, density values, or the number of observed ties compared to possible ties, were quite low. Low density values overall indicate that on average households were connected to relatively few others, but this is to be expected since it would be unlikely for a household to share with every other household in their community. The highest observed density was for the combined networks that only included local households (0.03). At each scope, density values were highest for combined networks and for sharing because those networks had the most ties. Similarly, because the combined and sharing networks had the most ties, they had the fewest isolates and components.

Reciprocity values for production and barter and trade networks equaled one. For production, the reciprocity value reflects a cooperative relationship between two households, and for barter and customary trade, it reflects that goods are always being exchanged in both directions. On the other hand, reciprocity values for sharing networks were equal to zero. This reflects the unidirectional nature of sharing exchanges. Although two households could share salmon with each other, it is likely uncommon. Transitivity was highest in the production network where most ties were between local households (0.67). Production networks were the only networks in which there were interconnected households that formed triangles, representing fishing groups (Figure 5-26).

Table 5-19.–Reported barter and customary trade exchanges by resource and exchange partner, Beaver, 2018–2019.

	Resource given					Resource received					Exchange partner	
Exchange type	Resource	Processing	Amount	Units	Pounds	Resource	Processing	Amount	Units	Pounds	Residence*	Relationship to respondent
Barter												
	Chinook salmon	Whole, unprocessed	10	Individual	82.8	Caribou	Dried	2	Gallons	7.5	Arctic Village	Family (not elder)
	Chinook salmon	Smoked and jarred	12	Quarts	19.6	Caribou	Dried	2	Gallons	7.5	Arctic Village	Family (not elder)
	Plucking geese	n/a	Unknown	Unknown	n/a	Sockeye salmon	Jarred	2	Quarts	2.3	Beaver	Elder in family
Customary trade												
	Cash	n/a	100	Dollars	n/a	Sockeye salmon	Smoked	5	Gallons	24	Anchorage	Stranger at conference
	Cash	n/a	100	Dollars	n/a	Coho salmon	Smoked	9	Quarts	14.67	Anchorage	Stranger at conference
	Cash	n/a	175	Dollars	n/a	Chinook salmon	Strips	1	Individual	6.21	Anchorage	Stranger at conference

Source ADF&G Division of Subsistence household surveys, 2019.

Note If exchange partner residence was unknown by respondent, exchange location was reported instead

Table 5-20.–Mean number of ties and pounds exchanged in barter and customary trade networks, by network and by household characteristic, Beaver, 2018–2019.

		Network							
		Between local households				Between Beaver households and households in other communities			
		Receiving		Giving		Receiving		Giving	
Household characteristic	Number of Households	Mean ties[a] (number)	Mean amount (lb)	Mean ties[a] (number)	Mean amount (lb)	Mean ties[a] (number)	Mean amount (lb)	Mean ties[a] (number)	Mean amount (lb)
Harvest category[b]									
High	3	0	0	0	0	1	14.96	0.67	34.12
Above average	3	0	0	0	0	0	0	0	0
Low to average	11	0.09	0.21	0	0	0	0	0	0
No harvest	4	0	0	0	0	0	0	0	0
Maturity[c]									
Developing	6	0.17	0.38	0	0	0	0	0	0
Mature	7	0	0	0	0	0.43	6.41	0.29	14.62
Elder	8	0	0	0	0	0	0	0	0
Household head									
Couple	11	0.09	0.21	0	0	0.27	4.08	0	0
Single female	4	0	0	0	0	0	0	0.5	25.59
Single male	6	0	0	0	0	0	0	0	0

Source ADF&G Division of Subsistence household surveys, 2019 and ADF&G Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

Note This table only summarizes the side of the barter or customary trade exchange that involved salmon.

a. Total instances of giving or receiving.

b. Household harvest categories were calculated using the mean household harvest (213.8 lb). The upper limit of the above-average harvest category is one standard deviation (SD) over the mean (522 lb). The high harvest category is any harvest greater than one SD over the mean.

c. Developing: age(s) of households head(s) is less than 40 years. Mature: age(s) of household head(s) is 40–59 years. Elder: age(s) of household head(s) is greater than 59 years.

Table 5-21.–Reported impact to households reporting that they did not get enough salmon, Beaver, 2018–2019.

Sample households	Households not getting enough salmon.				Impact to those not getting enough salmon.									
	Valid responses[a]		Did not get enough		No response		Not noticeable		Minor		Major		Severe	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
21	20	95.2%	13	65.0%	0	0.0%	2	15.4%	7	53.8%	2	15.4%	2	15.4%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Includes households failing to respond to the question and those households that never used the resource.

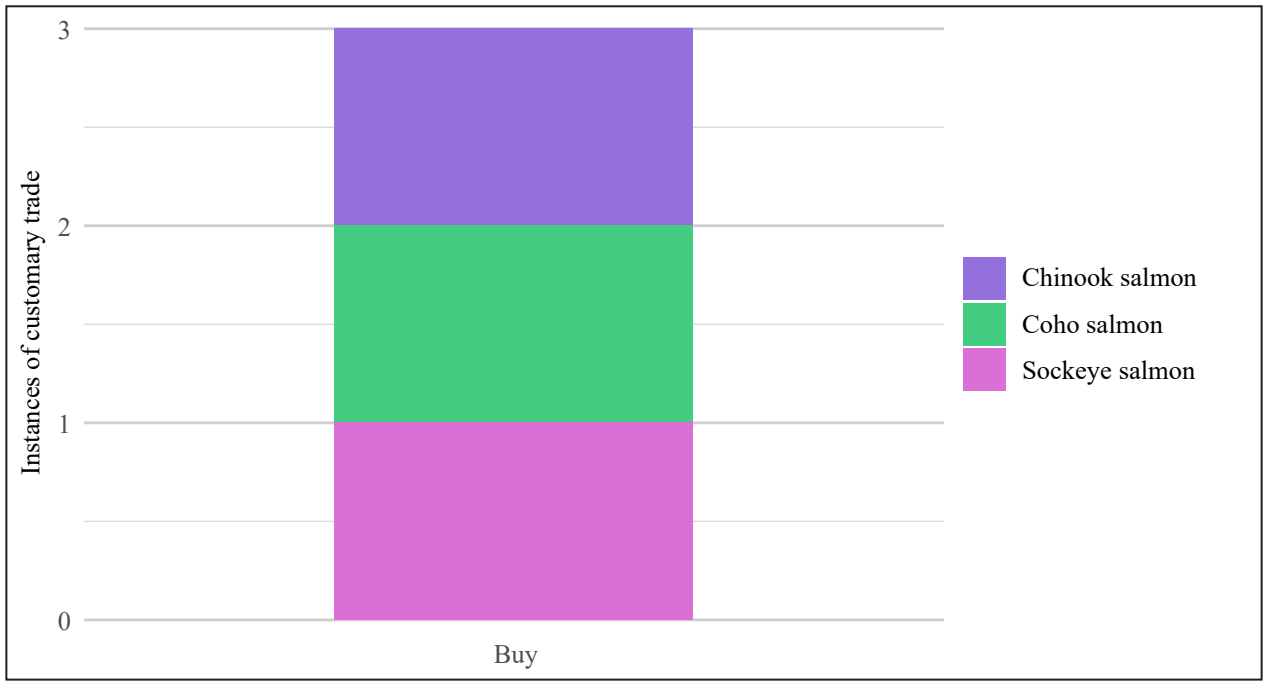


Figure 5-23.–Reported instances of customary trade exchanges, Beaver 2018–2019.

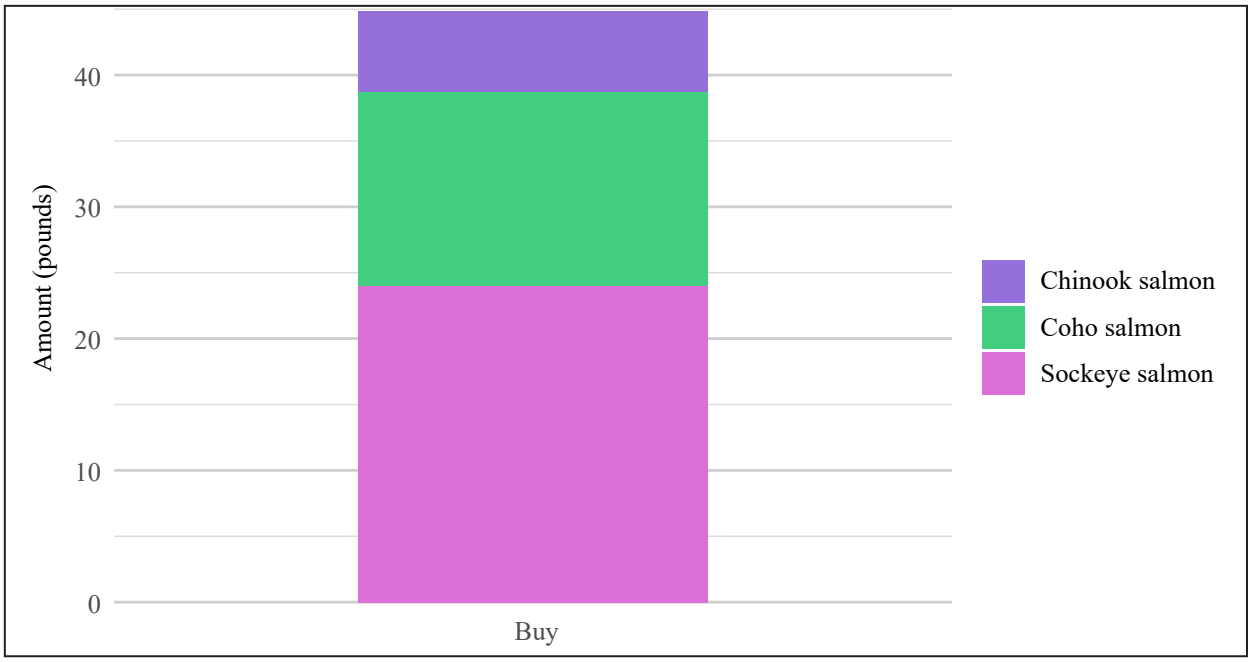


Figure 5-24.–Reported pounds of salmon bought and sold in customary trade exchanges, Beaver, 2018–2019.

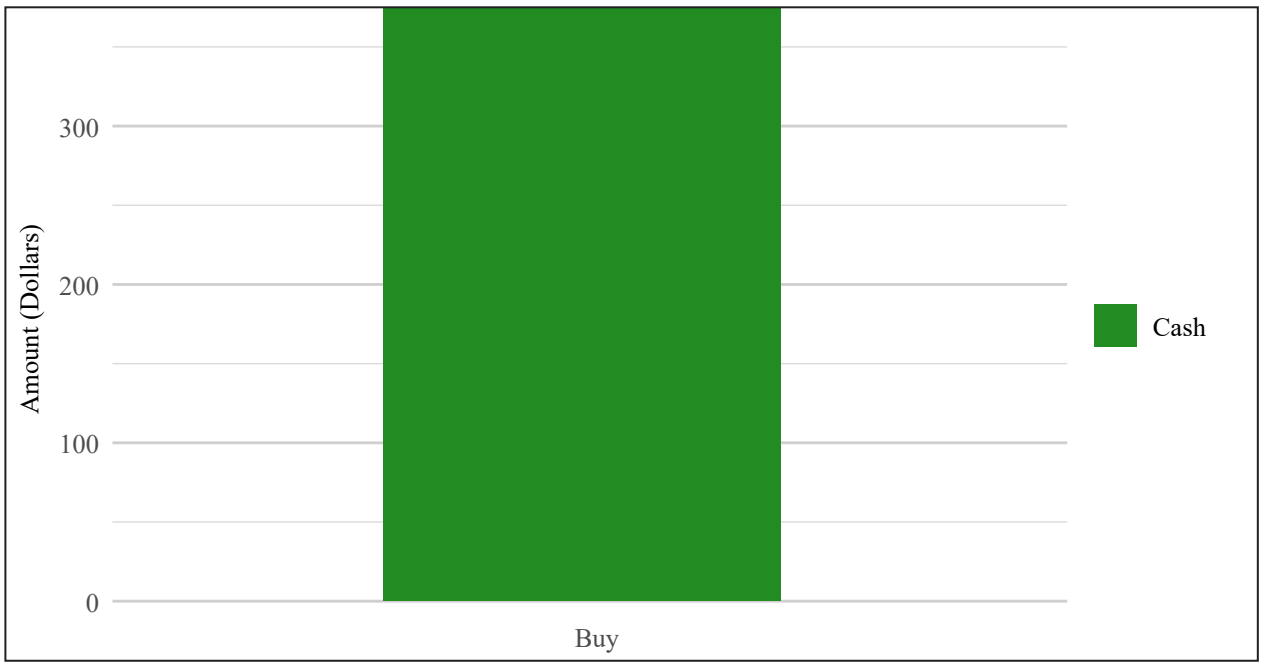


Figure 5-25.–Reported monetary value of salmon bought and sold in customary trade exchanges, Beaver, 2018–2019.

The three different networks explored here each represent different ways people are connected in Beaver and each illustrate how these practices are utilized locally. By looking at the density values, reciprocity, and transitivity we are able to better understand the patterns that exist within these networks and make comparisons between them.

Comparing Salmon Harvests and Uses in 2018 with Previous Years

Harvest Assessments

Researchers asked survey respondents to assess their 2018 salmon harvests in two ways: whether they used more, less, or about the same amount of salmon in 2018 as in the past five years, and whether they got "enough" salmon to meet their needs. These questions are used to understand how a single study year compares to other years and how local residents understand their own need and access to wild foods. Sharing, bartering, and buying wild foods are all ways to increase access to those foods. Answers to these questions demonstrate the continued need for salmon. If their use of salmon was different in 2018 compared to recent years, households were asked to provide reasons why. If they did not get enough salmon, they were asked what kinds and how much more salmon they needed. Additionally, they were asked to evaluate the severity of the impact to their household as a result of not getting enough salmon.

When asked to assess if they got enough salmon in 2018, 62% of Beaver households said they did not get enough, 33% got enough, and 5% did not use salmon (Figure 5-27). Of the 13 households that reported not getting enough, seven said that the impact to their household was minor, two said that it was major, two said that it was severe, and two said that it was not a noticeable impact (Table 5-21). Twelve households reported needing a total of 215 more Chinook salmon and three households reported needing a total of 30 more fall chum salmon (Table 5-22). One household needed additional summer chum, coho, and sockeye salmon. Six households explained what they did differently as a result of not getting enough salmon (Table 5-23). All six households used more commercially available foods and two households used other subsistence foods in place of salmon.

Fifty-seven percent of households reported that they used less salmon in 2018 as in recent years, 24% said they used more, and 19% used about the same amount (Figure 5-28; Table 5-24). Reasons for less resource use are shown in Table 5-25 and reasons for more use are shown in Table 5-26. Of the 12 households that reported less salmon use, 33% (four households) said that they used less because of fishing regulations and 25% (three households) said it was due to weather or environmental conditions (Table 5-25). Five households reported more salmon use in 2018; their reasons for getting more varied widely but included increased resource availability, favorable weather conditions, increased effort, and having more time (Table 5-26).

In 2018, subsistence fishing opportunity for Chinook salmon was provided in Yukon District 5D at half the regulatory schedule using six-inch mesh net gillnets or fish wheels (Carroll and Jallen 2018a). Compared to the year prior, managers provided about half as much opportunity to fish for Chinook salmon in Beaver, and Beaver residents harvested roughly half as many Chinook salmon.[16] Although some households were able to meet their subsistence needs in 2018, the majority were not. As long as Chinook salmon abundance remains depressed and fishing is restricted, many local households will continue to be unable to get the fish they need.

Sharing Assessments

In addition to assessing changes in salmon harvest, Beaver respondents also described how their sharing of salmon has changed in recent years. Comparing sharing for the study period to recent years, 35% of households said they shared less salmon, 30% shared about the same, and 15% shared less (Table 5-27).

16. Fall, James A., Anna Godduhn, Daniel Gonzalez, Lisa Hutchinson-Scarbrough, Bronwyn Jones, Jacqueline Marie Keating, Brooke McDavid, Lauren A. Sill, and Terri Lemons. *In prep.* "Alaska Subsistence and Personal Use Salmon Fisheries 2018 Annual Report." Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. NNN: Anchorage.

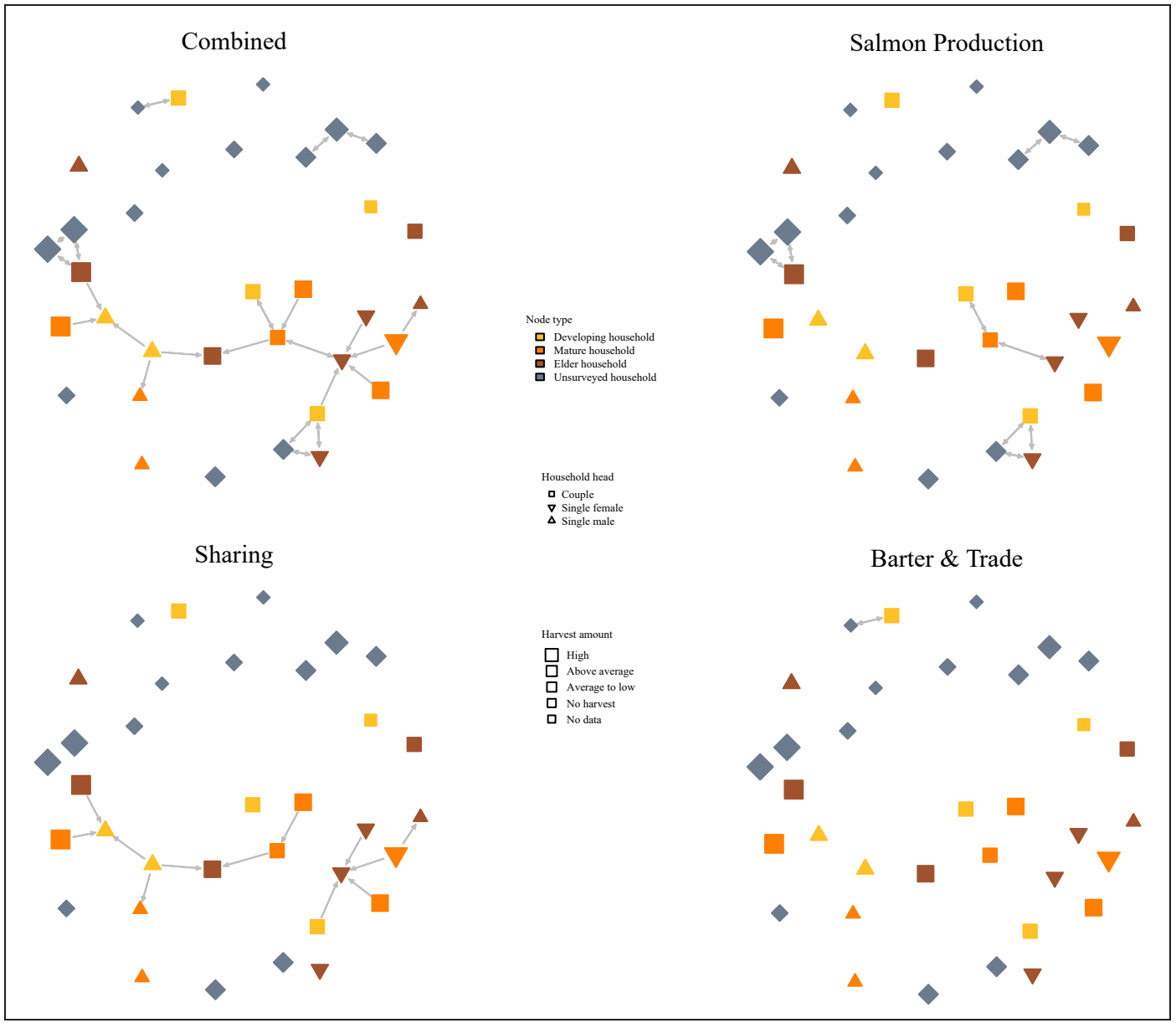


Figure 5-26.–Comparison of exchange networks between respondent households and other local households, Beaver, 2018–2019.

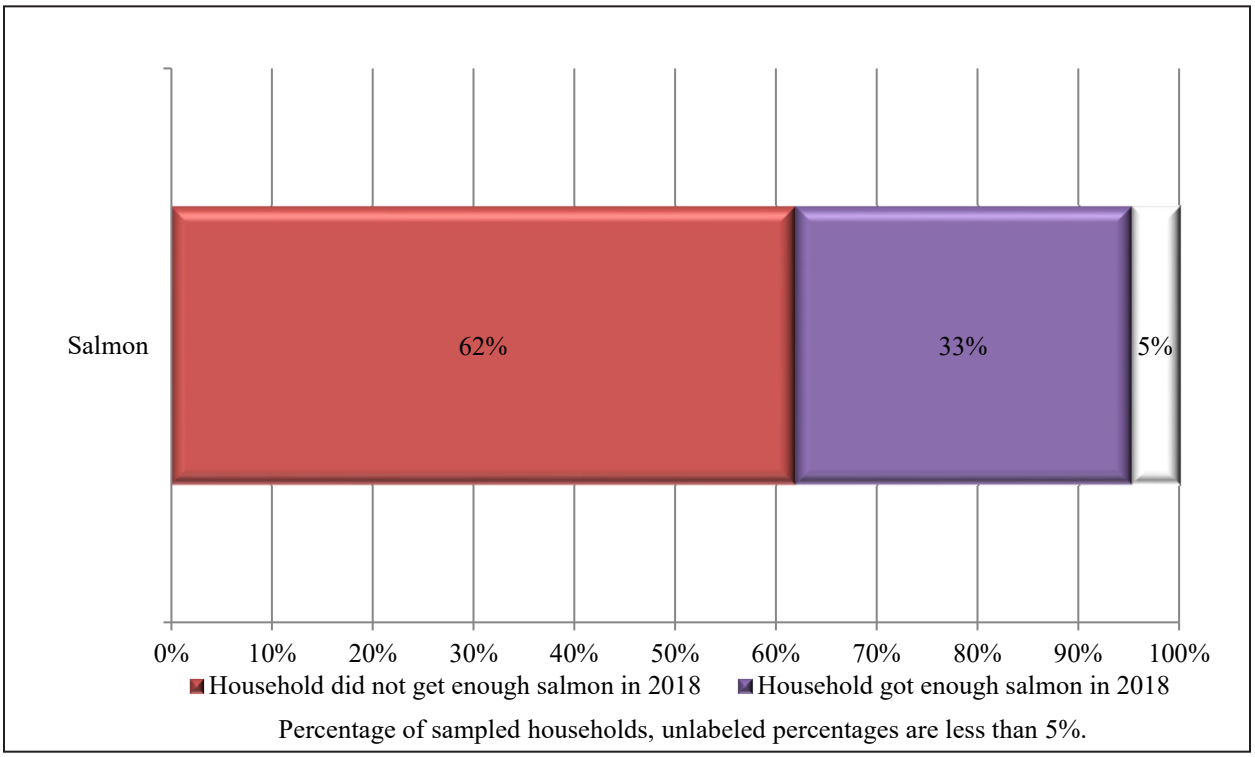


Figure 5-27.–Percentage of sampled households reporting whether they had enough salmon, Beaver, 2018–2019.

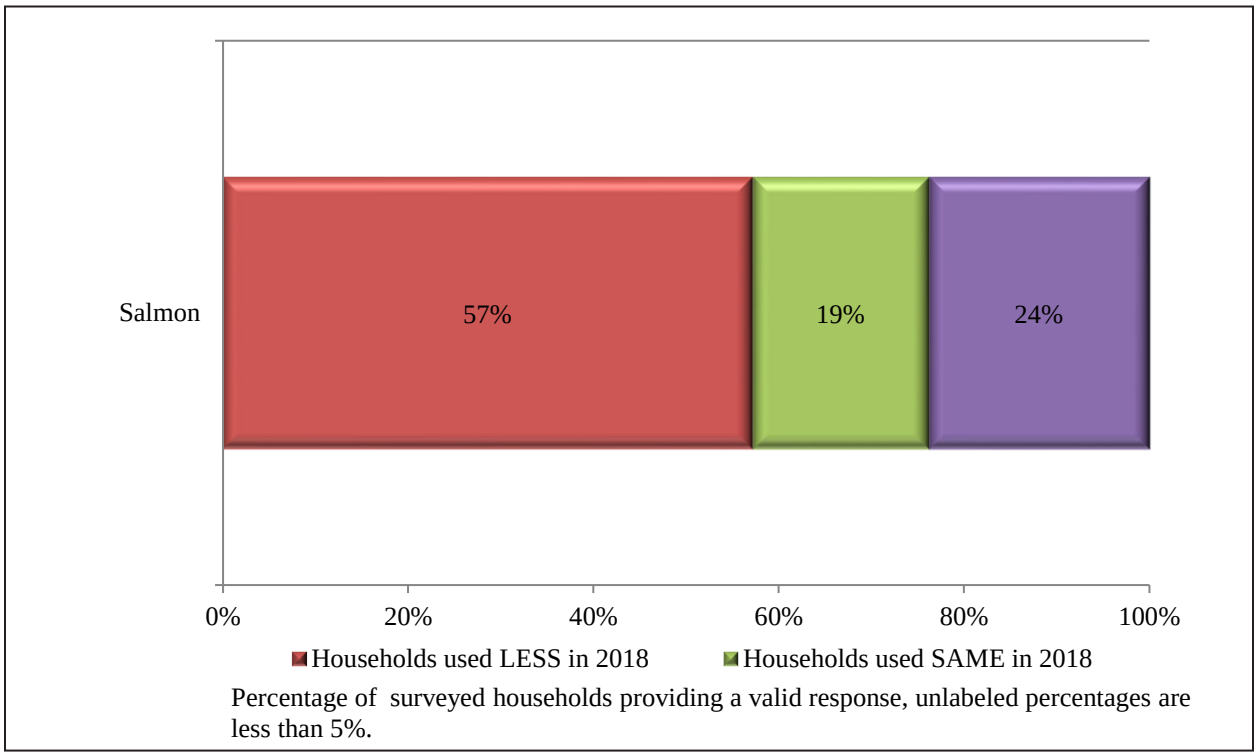


Figure 5-28.–Changes in household uses of salmon compared to recent years, Beaver, 2018–2019.

Table 5-22.–Types and amounts of salmon that sampled households reported needing, Beaver, 2018–2019.

Resource	Households needing	Amount needed	Percentage of households
Chinook salmon	12	215	57.1%
Summer chum salmon	1	20	4.8%
Fall chum salmon	3	30	14.3%
Coho salmon	1	10	4.8%
Other salmon	1	20	4.8%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 5-23.–Things households reported doing differently as a result of not getting enough salmon, Beaver, 2018–2019.

Valid responses[a]	Bought/bartered		Used more commercial foods		Replaced with other subsistence foods		Asked others for help		Made do without		Increased effort to harvest	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
6	0	0.0%	6	100.0%	2	33.3%	0	0.0%	0	0.0%	0	0.0%

-continued-

Table 5-23.–Continued.

Valid responses[a]	Got a job		Obtained food from other sources		Got public assistance		Didn't share as much		Other	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
6	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	16.7%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Includes households failing to respond to the question and those households that never used the resource.

Table 5-24.–Changes in household uses of salmon compared to recent years, Beaver, 2018–2019.

Sampled households	Valid responses[a]	Households reporting use								Households not using	
		Total households		Less		Same		More			
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
21	21	21	100.0%	12	57.1%	4	19.0%	5	23.8%	0	0.0%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response.

Table 5-25.–Reasons for less household uses of salmon compared to recent years, Beaver, 2018–2019.

Valid responses[a]	Households reporting reasons for less use	Family/ personal		Resources less available		Too far to travel		Lack of equipment		Less sharing		Lack of effort		Unsuccessful		Weather/ environment		Working/ no time	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
21	12	2	16.7%	0	0%	0	0.0%	2	17%	0	0%	2	17%	1	8.3%	3	25.0%	2	16.7%

-continued-

Table 5-25.–Continued.

Valid responses[a]	Households reporting reasons for less use	Regulations		Small/ diseased animals		Did not need		Equipment/ fuel expense		Used other resources		Competition		Not enough/ no help		Other reasons	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
21	12	4	33%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	8.3%	1	8.3%	0	0.0%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response and households reporting never using the resource.

Table 5-26.–Reasons for more household uses of salmon compared to recent years, Beaver, 2018–2019.

Valid responses[a]	Households reporting reasons for more use	Personal		Increased availability		Used other resources		Favorable weather		Received more		Needed more		Increased effort	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
21	5	0	0.0%	1	20.0%	0	0.0%	1	20.0%	0	0.0%	0	0.0%	1	20.0%

-continued-

Table 5-26.–Continued.

Valid responses[a]	Households reporting reasons for more use	Traveled farther		More success		Had more time		Store-bought expense		Got/ fixed equipment		Substitue for unavialable resource(s)		Had more help	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
21	5	0	0.0%	0	0.0%	1	20.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response and households reporting never use.

Four households provided reasons for less sharing during the study period all of which were related to not harvesting enough due to reasons such as a lack of fishing equipment, time off work, and because of fishing regulations (Table 5-28). Three households said that they were able to share more salmon due to more successful harvests and more favorable fishing regulations (Table 5-29).

Households were also asked to assess changes to their sharing patterns over a time period of 10 years. Eleven households reported that their sharing patterns have changed over the past decade (Table 5-30). Eight households attributed changes in their sharing to having less salmon available to share. Respondents were asked about which factors have the greatest impacts on salmon sharing. Ten households said that the amounts of salmon they are able to harvest impacts their sharing the most (Table 5-31). Five households said that their sharing is most impacted by fishing regulations, which also affect the amount of salmon harvested. Other factors that affect sharing included cost of fishing, ability to take time off from work, equipment, and weather. Many of the factors that affect sharing are ones that also affect harvest.[17] If people cannot harvest enough fish to meet their own needs, then they have less to share with others.

> When I was a kid, we would get all of our fish we needed, and then we would help people that don't live in the village anymore. Like my mother, my grandma. And we would send them a lot of fish, and just [to] family members all over, but we can't do that anymore because there's not enough fish to help us. (06052019WBQ)

Not only are harvesting households not meeting own their needs, but the households that they would normally provide for are receiving less salmon.

Finally, respondents were asked how their sharing of each type of salmon has changed compared to recent years. Forty-three percent of households said that they shared less Chinook salmon, and 29% said that they shared about the same amount of Chinook salmon as compared to recent years (Table 5-32). Only 5% (one household) reported more sharing of Chinook salmon over time. Other species of salmon are shared less commonly; therefore, fewer changes have been occurred to sharing of those species. Households were also asked if the number of households they share salmon with has changed over time. Thirty-two percent of households said they share with fewer households, 42% share with the same number of households, and no one reported sharing with more households (Table 5-33). One respondent said that "we definitely share less. Less amounts and with less people" (01032020WBQ4). She described that having to choose which people and events are "salmon-worthy" is an uncomfortable feeling because sharing is such an important part of Alaska Native culture and relationships.

Previous Salmon Network Data

A limited amount of previously collected salmon network data from Beaver exist in which to compare to the results of this study. Division of Subsistence conducted household surveys about barter and customary trade exchanges that took place in 2010, but the methods were different; therefore, network graphics cannot be directly compared between the two study years (Brown et al. 2015b). However, general comparisons can be made about rates of participation in barter and customary trade and the types of resources exchanged.

During the 2010 study, Beaver respondents were asked if they had ever bartered and bought or sold salmon. Twenty-seven percent of sampled households said that they had previously bartered subsistence foods, and 7% said that they had ever bought or sold subsistence food. Beaver households reported that salmon and moose are most often given in barter and that caribou, berries, muktuk, seal oil, groceries, and nonsalmon fish were commonly received. Respondents indicated that barter occurs within Beaver and with other communities in the Yukon Flats, as well as with the more distant communities of Venetie and Utqiagvik. In 2010, one household purchased jarred salmon in Fairbanks, and one household said that they sold salmon but did not provide any details about amounts.

Some similarities exist between 2010 results and the results of this study. In each year, a higher percentage of households participated in barter exchanges than customary trade, but only a minority of households in the entire community participated in either. In both years, residents most frequently gave the locally available

17. Brown et al. *In prep.*

Table 5-27.–Changes in the amount of salmon shared compared to recent years, Beaver, 2018–2019.

Resource	Valid responses	Does not share/ uncertain of change		Less		Same		More	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
All salmon	20	4	20.0%	7	35.0%	6	30.0%	3	15.0%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 5-28.–Reasons for sharing less salmon compared to recent years, Beaver, 2018–2019.

Valid responses[a]	Households reporting reasons for less sharing	Family/ personal		Resources less available		Too far to travel		Lack of equipment		Less sharing		Lack of effort		Unsuccessful		Weather/ environment		Working/ no time	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
20	4	1	25.0%	0	0%	0	0.0%	1	25%	0	0%	0	0%	0	0.0%	1	25.0%	1	25.0%

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Table 5-28.–Continued.

Valid responses[a]	Households reporting reasons for less sharing	Regulations		Small/ diseased animals		Did not need		Equipment/ fuel expense		Used other resources		Competition		Not enough/ no help		Other reasons	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
20	4	1	25%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response, and households reporting not sharing, or using the resource.

Table 5-29.–Reasons for sharing more salmon compared to recent years Beaver, 2018–2019.

Valid responses[a]	Households reporting reasons for more sharing	Personal		Increased availability		Used other resources		Favorable weather		Received more		Needed more		Increased effort		Regulations	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
20	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	33.3%

-continued-

Table 5-29.–Continued.

Valid responses[a]	Households reporting reasons for more sharing	Traveled farther		More success		Had more time		Store-bought expense		Got/ fixed equipment		Substitute for unavialable resource(s)		Had more help		Other	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
20	3	0	0.0%	2	66.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Source ADF&G Division of Subsistence household surveys, 2019.

a. Valid responses do not include households that did not provide any response, and households reporting not sharing, or using the resource.

Table 5-30.–Reasons for changes in household sharing patterns over the past ten years, Beaver, 2018–2019 .

Community	Valid responses	Households reporting that sharing patterns changed		Reported reasons							
				Less salmon available to share		Personal reasons for change		Price of gas too high		Sharing depends on harvest	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Beaver	19	11	57.9%	8	42.1%	1	5.3%	1	5.3%	1	5.3%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 5-31.–Factors having the greatest effects on subsistence salmon sharing, Beaver, 2018–2019.

Community	Households providing valid responses	Amount harvested		Amount needed		Personal		Cost	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Beaver	17	10	58.8%	1	5.9%	1	5.9%	1	5.9%

-continued-

Table 5-31.–Continued.

Community	Households providing valid responses	Work schedule		Regulations		Equipment		Weather	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Beaver	17	2	11.8%	5	29.4%	1	5.9%	1	5.9%

Source ADF&G Division of Division household surveys, 2019.

Table 5-32.–Changes in amount of salmon shared compared to recent years, by resource, Beaver, 2018–2019.

		Sharing of _____ compared to recent years							
		Does not share/uncertain of change		Less		Same		More	
Resource	Valid responses	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Chinook salmon	21	5	23.8%	9	42.9%	6	28.6%	1	4.8%
Summer chum salmon	21	19	90.5%	1	4.8%	1	4.8%	0	0.0%
Fall chum salmon	21	17	81.0%	1	4.8%	3	14.3%	0	0.0%
Coho salmon	21	20	95.2%	1	4.8%	0	0.0%	0	0.0%
Other salmon	15	14	93.3%	0	0.0%	1	6.7%	0	0.0%

Source ADF&G Division of Subsistence household surveys, 2019.

Table 5-33.–Changes in the number of households shared with, Beaver, 2018–2019.

		Does not share/ uncertain		Less		Same		More	
Community	Valid responses	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Beaver	19	5	26.3%	6	31.6%	8	42.1%	0	0.0%

Source ADF&G Division of Division household surveys, 2019.

resources of moose and salmon. When exchanging resources with households in other communities, Beaver households commonly received a resource unavailable locally or more abundant in another location, such as caribou and marine mammal products. In both 2010 and 2018, respondents purchased salmon in an urban center. In 2018, no Beaver households sold salmon, and only one household did so in 2010. In both study years, respondents described that a strong culture of sharing subsistence foods prevails, and that people primarily exchange foods through sharing.

Concentration of Salmon Harvests Among Households

As previously mentioned, a small number of households typically harvests the majority of a community's total subsistence harvest. Figure 5-29 compares specialization in 2011 to 2018. When Division of Subsistence conducted comprehensive subsistence harvest surveys in Beaver for study year 2011, approximately 16% of households caught 66% of the total salmon harvest. In 2018, approximately 24% of households caught 70% of the total community salmon harvest. The total community salmon harvests were more concentrated in 2010 than during 2018, likely because fewer households harvested salmon. Only 44% of households harvested salmon in 2010 compared to 70% in 2018 (Holen et al. 2012; Table 5-10). Although fewer households harvested salmon in 2010, the estimated salmon harvest amount was more than double the harvest in 2018: 11,116 lb versus 4,277 lb respectively. Chinook salmon fishing periods were restricted in each year (Fall et al. 2013), and mainstem Chinook salmon Canadian border passage estimates were in a similar range each year (JTC 2019). Harvests of other types of salmon were also lower in 2018. The significantly higher harvest in 2011 could be a result of a multitude of factors including differing data collection methodologies between the study years.

Local Comments and Concerns

This section summarizes comments that were recorded at the end of surveys in Beaver. Some households did not offer any additional information during surveys, so not all households are represented in the summary.

Most comments concerned salmon fishing and fishery management. Several Beaver residents expressed how salmon fishing restrictions affect their ability to get the fish they need. They said often when a pulse of fish reaches Beaver, regulations require them to pull their nets out of the water just when they might have a chance to catch some fish. Some residents expressed a desire for longer fishing periods. One survey respondent explained that because of the braided nature of the Yukon River upstream of Stevens Village finding good fishing spots is difficult, and the fish are much more dispersed. Other survey respondents explained that closures or shorter fishing periods mean that fishers have to make more trips to get what they need and therefore have to spend more money on gas. Shortened fishing periods also cause some households to have to fish much later into the season to meet their needs. One survey respondent said that there used to be a month between when he stopped salmon fishing and had to go moose hunting. Now they sometimes fish until only about a week before hunting season. Another survey respondent explained that all the fishing restrictions in recent years deter some households from participating in the fishery.

Conclusion

The socio-cultural and economic systems in Beaver depend on the harvest and sharing of salmon. In longstanding tradition, families work together to harvest salmon. People cherish the time spent together fishing and processing fish because it helps strengthen relationships and allows for traditions to be carried on. Fishing households share the salmon they harvest widely with other households in the community and with friends and family living elsewhere. Cultural values direct Beaver fishers to help provide for those who may not be able to harvest their own salmon, especially elders. Sharing salmon with relatives who live in urban areas helps people stay connected to their home community and their culture. Salmon are also sometimes exchanged for other wild foods, especially for resources that are difficult to obtain or cannot be obtained locally. These types of exchanges typically involve delayed reciprocity. For example, salmon may be shared during the summer and then caribou might be received later in the fall or winter. Neither party has an expectation of receiving, but over time a pattern of sharing back and forth might develop into a barter or

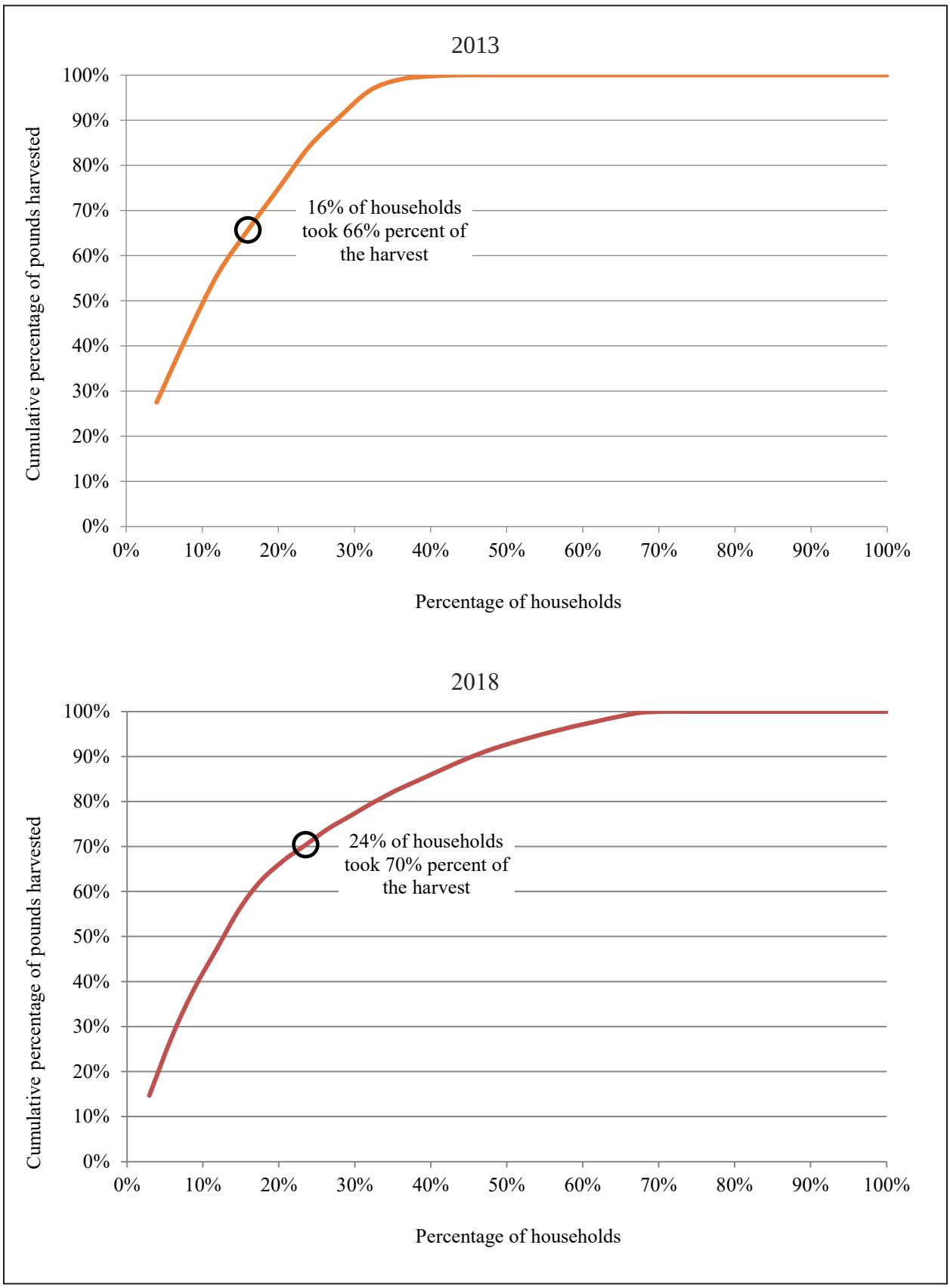

Figure 5-29.–Salmon harvest specialization, Beaver, 2010 and 2018

trade relationship. Much less frequently, small amounts of salmon may be bought or sold, likely because of a need for salmon or a need for cash.

Chinook salmon declines and the concurrent fishing restrictions have greatly affected the entire salmon economy in Beaver. Fishing households that used to provide for many now struggle to provide for themselves. Fishing closures and reductions in fishing periods have decreased fishing efficiency by spreading subsistence fishing effort longer throughout the season , and in turn, increasing costs and needed time off from work. Because fewer salmon are available to share with others, people have to make difficult decisions about who to share with and how much they can afford to share. Some barter relationships are being lost because there is not enough salmon to exchange. Despite the hardships caused by reduced salmon abundance, the production, sharing, and exchange of salmon continues to connect people within Beaver and to others throughout the Yukon River drainage and beyond.

ACKNOWLEDGMENTS

The Division of Subsistence would like to express our sincere gratitude to the Beaver Village Council for their support of this project. We would also like to extend our thanks to our local research assistants, who were extremely helpful during fieldwork. And finally, thank you to everyone in Beaver who took the time to share information with us about salmon; we learned so much fraom your knowledge and experience.

6. EXPONENTIAL RANDOM GRAPH MODELING TO IDENTIFY FACTORS THAT SHAPE SALMON NETWORKS

Drew Gerkey

Previous chapters in this report have visualized the social networks associated with subsistence salmon harvests in each study community and provided quantitative descriptions of their structure. Those chapters also included descriptive statistics that examined how a household's characteristics may influence its position within the network, in turn shaping the overall structure of the network. Although visual and descriptive analysis may suggest associations between household characteristics, network position, and network structure, further analysis is needed to determine whether these associations stand out as reliable predictors of a tie between households. One way to accomplish this is to use inferential statistics. Inferential statistics allow analysts to utilize a sample to generalize about the larger population, such as whether or not households with certain characteristics are more or less likely to have sharing ties with other households, and to test whether associations are statistically significant.

This chapter uses exponential random graph models (ERGM) to further examine cooperative production and salmon sharing networks (see Methods chapter for a more detailed description of ERGM). Sample sizes were too small to use ERGMs for barter and customary trade networks. Additionally, this analysis was limited to focus on households within a study community and the connections among them and excluded ties to households outside the community because households in other communities were not part of the sample. Our analysis uses a standard ERGM that predicts the presence or absence of a cooperative production or sharing tie between two households.

Each ERGM in our analysis includes multiple variables representing household characteristics, such as household harvest productivity, that prior research suggests may affect tie formation in subsistence salmon networks (Wolfe et al. 2010; Kofinas et al. 2016; Brown and Kostick 2017). Because we are modeling the presence or absence of a tie, the estimated effects of each variable in an ERGM represent how the variable affects the probability of a tie between two households. Specifically, the ERGMs estimate the direction and size of the effect for each variable, along with its statistical significance (p-value). The direction and size of estimated effects in an ERGM are reported using an odds ratio.[1] The directions of an effect are indicated as positive, negative, or neutral. Positive values indicate the likelihood of a tie forming, and negative values indicate that ties are not likely to form. Values further from zero indicate an increased positive or negative effect: in other words, a greater probability that a tie will or will not form. Statistical significance is assessed using a p-value, which accounts for the uncertainty around the model's estimate of the size and direction of the effect. P-values less than 0.05 indicate a statistically significant effect. Although there is a tendency in quantitative research to focus on the statistical significance of an estimated effect, the direction and size of the effect also matter. Further, the causal relationship between variables included in an ERGM and tie formation can be difficult to determine. Although terms like "effect" imply that a variable is causing the probability of tie formation to increase or decrease, it is more accurate to say that there is an association in which causality could run in either or both directions, depending on the variable. The sample sizes in this study are similar to those of previous projects by ADF&G and other published studies of subsistence networks throughout the Arctic; however, ERGM results are most accurate with complete sample sizes. Since these ERGM rely on incomplete samples, results should be interpreted using insights from study respondents and previous qualitative research.

In the following sections, we begin by exploring a variety of household characteristics that previous research has indicated may influence whether or not a household participates in cooperative production or sharing of salmon. Then we examine whether or not participation in one type of salmon network, such as cooperative production, is associated with participation in other types of salmon networks, such as sharing.

Household Characteristics that Influence Cooperative Production Networks

As described in earlier chapters, our data on cooperative production networks represent connections between households in each study community that arise when households work together to harvest salmon for subsistence. These networks are "undirected," meaning that ties should be interpreted as a relationship between two households, as opposed to the flow of resources, such as salmon, from one household to another in a "directed" network. Of course, cooperative production strategies likely differ widely within a community, and may involve arrangements where one household gives help to or receives help from another household, rather than each household contributing equally; this complexity is not reflected in our analysis.

Our ERGM for cooperative production starts with the idea that households working together to harvest salmon is a widespread and important component of subsistence. This idea was shared with us during key respondent interviews for this project, and it is echoed in previous studies elsewhere in Alaska by ADF&G and other researchers (Brown and Jallen 2019; Kofinas et al. 2016; Wolfe et al. 2010). We build on this research by focusing on household characteristics that these studies have identified as factors that affect a household's subsistence harvests. Specifically, we analyze: 1) household harvest, 2) household maturity, 3) household type, and 4) participation in commercial fishing. Our goal is to estimate how these characteristics relate to the formation of cooperative production ties, and to understand how these associations shape subsistence salmon networks. Results presented below refer to Table 6-1.

As noted earlier in this report, the amounts of salmon harvested vary widely among households within a community. A small proportion of households have much larger harvests, accounting for the majority of salmon harvested by the community as a whole. This pattern is consistent with previous studies by ADF&G and other researchers (Wolfe and Walker 1987; Wolfe et al. 2010; Kofinas et al. 2016; Brown and Kostick 2017). Our key respondent interviews suggest that cooperation among households is an important strategy that enables households to harvest enough salmon to meet their needs. But how does variation in salmon harvests among households relate to cooperative production networks? Including a variable for household harvest amount in our ERGM allows us to explore whether households who work with others to cooperatively harvest salmon harvest more or fewer salmon than those households who fish independently.

Using our data on cooperative production networks, we can analyze this relationship by estimating how the probability of a cooperative production tie between two households varies along with the amounts of salmon harvested by each household; that is, how likely households are to fish with others based on their harvest level. Specifically, we compare the probability of a cooperative production tie forming for households in the high and above average harvest categories to the probability of a tie forming for households in the lower harvest categories (low to average, no harvest, or missing)[2]. Across all three study communities, we find that the likelihood of a cooperative production tie forming is consistently higher for households in the high and above average salmon harvest categories. For households in the high harvest category, cooperative production ties are 1.3 to 2.6 (slightly more to nearly three times) times more likely than for households with lower harvests. These associations between high harvests and cooperative production ties are statistically significant for Pilot Station, but not for Nulato or Beaver. For households in the above average harvest category, cooperative production ties are 1.5 to 6.1 times more likely than for household with lower harvests, and these associations are statistically significant for both Pilot Station and Nulato, but not for Beaver. Although none of the associations between salmon harvest amount and cooperative production were statistically significant for Beaver, this may be due to the fact that Beaver has many fewer households than the other two communities.

Together, these results support the idea that households that harvest larger amounts of salmon have a higher likelihood of having cooperative production ties with other households. However, the association is

2. Household harvest categories were calculated using the mean household harvest in each community. The upper limit of the above-average harvest category is one standard deviation (SD) over the mean. The high harvest category is any harvest greater than one SD over the mean.

Table 6-1.–Exponential Random Graph Model of cooperative production networks between respondent households and partners within the same community, Pilot Station, Nulato, and Beaver, 2018.

	Community					
	Beaver		Nulato		Pilot Station	
Model terms	Odds Ratio	Standard Error	Odds Ratio	Standard Error	Odds Ratio	Standard Error
Ties[a]	0.02 ***	-0.65	0.01 ***	-0.34	0.001 ***	-0.47
Harvest category[b]						
High	2.47	-0.7	1.3	-0.38	2.58	-0.42
Above average	1.47	-0.88	2.99 ***	-0.19	6.11 ***	-0.32
Maturity[c]						
Mature	0.53	-0.88	1.27	-0.25	1.07	-0.35
Elder	0.36	-0.79	1.09	-0.21	1.38	-0.34
Household head						
Couple	1.22	-0.81	0.99	-0.19	0.72	-0.3
Commercial Fishing	*n/a*	*n/a*	1.2	-0.25	0.67	-0.33
Sharing						
Within study community						
Receive	1.06	-0.31	1.49 **	-0.15	1.36 **	-0.13
Give	0.4	-0.85	1.02	-0.08	1.34 **	-0.14
Other communities						
Receive	0	-3,367.92	0.64	-0.44	0.06 **	-1.22
Give	3.68	-0.87	1.11	-0.09	0.91	-0.22
Barter and customary trade	0	-2,368.57	0.98	-0.09	0.67	-0.56
Akaike Information Criterion	104.91		854.3		434.75	
Bayesian Information Criterion	152.53		928.74		522.45	

Sources ADF&G Division of Commercial Fisheries postseason harvest surveys, 2018; ADF&G Division of Subsistence household surveys, 2019.

a. Exchanges or interactions.

b. Household harvest categories were calculated using the mean household harvest. The upper limit of the above-average harvest category is one standard deviation over the mean. The high harvest category is any harvest greater than one SD over the mean.

c. Developing: age(s) of households head(s) is less than 40 years. Mature: age(s) of household head(s) is 40–59 years. Elder: age(s) of household head(s) is greater than 59 years.

* $p<0.05$
** $p<0.01$
*** $p<0.001$

stronger for households in the above average harvest category than households in the high harvest category. This could indicate that high harvesting households are relatively less reliant on cooperative production than households with above average harvests. Reliance on cooperative production might be affected by other factors underlying larger salmon harvests, such as the number of people actively contributing to subsistence, access to subsistence equipment and fish camps, and money needed to purchase fuel and other supplies. Querying these factors was beyond the scope of this project and would be an interesting direction for additional research.

One factor that may relate to cooperative production networks and the amount of salmon a household harvests is the demographic composition of households. Mature households typically have more adults who are engaged in subsistence, relative to developing or elder households,[3] so we may expect to see demographic factors playing a role in cooperative production networks.

We explored the association between household demography and cooperative production networks by estimating how the probability of a tie between two households varies for mature households, compared to the probability of a tie between other households (developing, elder, and missing). We found no statistically significant associations between mature households and cooperative production ties in any study communities. Similarly, the direction of the associations varied across study communities: mature households were relatively more likely to be involved in cooperative production in Nulato, less likely to be involved in cooperative production in Beaver, and equally likely in Pilot Station. Although these results may imply that demographic factors do not affect cooperative production networks in our study communities, broad categories like mature or developing may not capture the complexities of a household's subsistence needs or productive capacity, or they may not fully represent who lives in a household. Additional research could address this issue by developing more fine-grained measures of household demographic composition, including the numbers of adults and dependent children, as well as the number of household members who are actively engaged in subsistence. However, it is also possible that households of each maturity category are equally likely to participate in cooperative production in part due to intergenerational cooperation within families. Responses from the key respondent interviews support this idea; respondents explained that fish camp settings support cooperative harvesting specifically by bringing together extended families that include people of all ages, knowledge levels, and productivity levels.

Whether household head(s) are a couple or single is another demographic factor that may affect cooperative production networks. Couple households with two adults working together may differ from single households with either a male or female head in terms of their productive capacity and reliance on cooperative production.

Our analysis estimated how the probability of a tie between two households differs for couple-headed households relative to single-headed households. We found no statistically significant associations in any study communities between household type and cooperative production. In Pilot Station, single households were more likely to be involved in cooperative production, while in Beaver couple households were more likely, and no differences were found between couple and single households in Nulato. The absence of any significant associations between household type and participation in cooperative production networks may also reflect the fact that one of the practical functions of fish camps is to pool labor from multiple households in order to accomplish the many tasks associated with harvesting, processing, and preserving salmon. Because these tasks are often difficult for any individual household to accomplish working alone, households of all types need to work together.

Commercial salmon fishing opportunity varies across communities in Alaska and interacts with subsistence in complex ways. In the Yukon River, commercial and subsistence fishing periods are not typically open concurrently; however, fishers are allowed to retain salmon from the commercial fishery for home use if desired. The presence of commercial fishing, however, varies between and within communities. In this study, commercial salmon fishing was a common livelihood for households in Pilot Station, and to a lesser

3. Households are classified by the age(s) of household head(s): less than 40 years for "developing" households, 40–59 years for "mature" households, and greater than 59 years for "elder" households.

extent Nulato, but commercial fishing opportunity was not available in Beaver. Moreover, within a single community, some households may be engaged in commercial fishing, while others are not. Although households that participate in commercial salmon fishing are often also engaged in subsistence, their productive capacity and reliance on cooperation may differ from households that are not.

For Pilot Station and Nulato, we estimated how participation in commercial salmon fishing affected the probability of a cooperative production tie between two households and found no statistically significant associations. In Pilot Station, commercial fishing households were slightly less likely to be involved in cooperative production, while in Nulato commercial fishing households were more likely to be involved; however, in Nulato most households in general cooperatively fished regardless of whether they commercial fished. Commercial fishing is structured differently in these two communities. In Pilot Station and the lower Yukon River, the scale of the commercial fishery is much larger than in the middle river region: more households participate, more commercial openings are available, a wider range of gear is allowed, there is easier access to buyers, and runs of fish are more concentrated and thus more efficient to harvest. Some households supplement their subsistence salmon harvests with fish retained from their commercial catch. Pilot Station commercial fishermen work in crews and harvest commercial salmon cooperatively, a relation not documented in our study. In Nulato, commercial fishing opportunity is more limited, and harvest occurs with fish wheels, which are more easily operated by a single person. This difference in the structure of the commercial fishery in these communities may affect participation in cooperative production in the subsistence fishery. Because Pilot Station fishers are frequently occupied with commercial fishing, they may have less time to spend in fish camps. They also typically have access to their own fishing gear and may have less of a need to share equipment with others in a fishing group.

Household Characteristics that Influence Sharing Networks

In the last section, we discussed how ERGM was used to estimate associations between household characteristics and network structure to describe cooperative networks for the production of salmon; here we use similar modeling to explore the same associations for sharing networks within communities. Sharing networks represent connections between households that gave salmon to others and the household that received the salmon. Our analysis focuses on salmon sharing within each study community and excludes instances when a household's sharing partner was located outside the study community. In contrast to the cooperative production networks, the sharing networks we analyze are directed, which reflects whether a household gave or received salmon from another household. In other words, the ERGM for sharing specifies whether the variables affect the probability of giving or receiving salmon instead of just sharing in general. For consistency, the household characteristic variables included in our sharing network ERGM are the same as those used in the cooperative production ERGM above: 1) household harvest, 2) household maturity, 3) household type, and 4) participation in commercial fishing. We explain the effects of each variable on giving or receiving salmon in the section below. The results are shown in Table 6-2.

Previous studies by ADF&G and other researchers working throughout Alaska suggest that the size of a household's subsistence harvest influences its position in sharing networks (Wolfe et al. 2010; Kofinas et al. 2016; Brown and Kostick 2017). "Super-households"—the small proportion of households with large harvests that are responsible for the majority of a community's total harvest—are typically also very active in sharing networks. We expected households with larger salmon harvests to be more likely to give salmon to other households, and we expected this to be especially true for households with the largest harvests. So, in our ERGM, we compared the probability of a sharing tie going from households in the high and above average harvest categories to the probability of a tie going from households in the lower harvest categories (low to average, no harvest, or missing).

Across all study communities, households in the two highest harvest categories were in fact more likely to give salmon than households in the lower harvest categories. In Pilot Station, households in the high harvest category were twice as likely to give salmon, while in Nulato, they were 15 times more likely. In both communities, these associations were statistically significant. Beaver was an exception, with no significant difference between high harvesters and the lower harvest categories. However, above average harvesters in

Table 6-2.–Exponential Random Graph Model of sharing networks between respondent households and exchange partners in the same community, Pilot Station, Nulato, and Beaver, 2018–2019.

	Community					
	Beaver		Nulato		Pilot Station	
Model term	Odds ratio	Standard error	Odds ratio	Standard error	Odds ratio	Standard error
Ties[a]	0.001 ***	-0.9	3E-04 ***	-0.7	0.001 ***	-0.26
Harvest category[b]						
High (give)	0.12	-1.5	15.47 ***	-0.67	2.13 *	-0.32
Above average (give)	10.01 *	-1.11	8.00 **	-0.72	1.27	-0.32
Maturity[c]						
Mature (give)	4.25	-0.98	4.16 **	-0.47	1.8 *	-0.27
Elder (receive)	1.85	-0.66	1.1	-0.44	1.44	-0.27
Household head						
Couple (give)	0.12	-1.07	0.55	-0.59	2.52 **	-0.31
Single (receive)	5.69 *	-0.74	0.92	-0.44	1.21	-0.27
Commercial Fishing (give)	*n/a*	*n/a*	1.78	-0.68	1.37	-0.28
Reciprocity	*n/a*	*n/a*	*n/a*	*n/a*	12.70 ***	-0.73
Sharing						
Give to other communities	28.17 ***	-0.95	1.15	-0.22	1.61 ***	-0.1
Receive from other communities	0	-1378.39	1.05	-1.05	1.42	-0.31
Barter and customary trade	0.02 *	-1.97	1.45 **	-0.13	0.92	-0.32
Akaike Information Criterion	116.85		297.64		1,033.16	
Bayesian Information Criterion	167.08		373.51		1,121.18	

Sources ADF&G Division of Commercial Fisheries postseason harvest surveys, 2018; ADF&G Division of Subsistence household surveys, 2019.

a. Exchanges or interactions.

b. Household harvest categories were calculated using the mean household harvest. The upper limit of the above-average harvest category is one standard deviation over the mean. The high harvest category is any harvest greater than one SD over the mean.

c. Developing: age(s) of households head(s) is less than 40 years. Mature: age(s) of household head(s) is 40–59 years. Elder: age(s) of household head(s) is greater than 59 years.

* $p<0.05$

** $p<0.01$

*** $p<0.001$

Beaver were 10 times more likely to give salmon, which was similar to Nulato, where they were eight times more likely. In Beaver and Nulato, these associations were also statistically significant, but not in Pilot Station. These results support the idea that both high harvesting "super-households" and households with above average harvests are playing an important role in shaping salmon sharing networks by distributing portions of their harvest to other households in the community.

As with cooperative production, the demographic composition of a household may affect the household's position in sharing networks. For example, key respondent interviews from this project suggested that sharing salmon with elders helps provide food for people who may not be able to harvest as well as a cultural tenet of respect for elders (06052019WBQ2, 06062019WBQ3, 01302020WBQ4, 05132019NUL6, 05132019NUL9, 05072019PQS1, 05112019PQS2, 05112019PQS5). Additionally, previous research suggests that households with more adults active in subsistence may have larger harvests and may be more likely to share salmon with other households in the community (Wolfe et al. 2010). We tested these expectations by comparing: 1) the probability that an elder household received salmon with the probability that other types of households (mature, developing, or missing) received salmon and 2) the probability that a mature household gave salmon with the probability that other types of households gave salmon (developing, elder, or missing) . In all communities, we found that elder households were slightly more likely to receive salmon, but none of these associations were statistically significant. We found mature households were two to four times more likely to give salmon, though this association was not statistically significant in Beaver. Although the results for mature households aligned with our expectations about the relationship between household demographics and sharing networks, the results for elder households did not. However, our model estimates the probability of receiving salmon (or not), rather than the amount of salmon received, so it is possible that elder households receive salmon just as often as other households, but receive more salmon than other households. As noted in the community chapters, average amounts of salmon given to elders were substantially larger than to households without elders (Tables 3-20, 4-19, and 5-18). Another possibility is that households in the study communities are often multi-generational, so there are likely elders living in households that we classified as mature and perhaps even developing, which could explain why we do not observe significant differences in receiving salmon by household maturity. Finally, if sharing salmon is a widespread practice that is important for households of all levels of maturity, then this may explain why elder households do not appear to be more likely to receive salmon than other households.

In addition to household maturity, whether or not household head(s) were a couple or single is another demographic factor that may shape sharing networks. For example, cooperation between coupled household heads could enable larger salmon harvests and facilitate giving salmon to other households, while single-headed households may be more likely to receive salmon.

We estimated the probability that couple households are more likely to give salmon than single households and that single households are more likely to receive salmon than couple households. Our results varied substantially across study communities. In Pilot Station, couple households were 2.5 times more likely to give salmon, and single households were 1.2 times more likely to receive salmon, but the effect was only statistically significant for couple households giving salmon. In Beaver, single households were nearly six times more likely to receive salmon, and this effect was statistically significant, but there was no significant association between couple households and giving. In Nulato there were no statistically significant differences between couple and single households in terms of giving and receiving. Together, these results provide mixed support for our expectations about the associations between household head type and salmon sharing networks. However, our course categorization into only two household head types, couple or single, may not capture enough details about household composition. For example, the needs of a household with a single parent and several children would likely be much different than that of a household that includes only one single adult.

Households that engage in commercial salmon fishing often have access to equipment and labor that can also support larger subsistence harvests. Therefore, we may expect commercial fishing households to have a more prominent role in sharing networks by giving salmon to other households.

We estimated the probability that commercial fishing households give salmon to other households in the community, compared to households that do not engage in commercial fishing. Because commercial salmon fishing was only practiced by households in Pilot Station and Nulato, we do not include this variable in our ERGM for Beaver. We found that in both Pilot Station and Nulato, commercial fishing households were 1.4–1.8 times more likely to give salmon; however, this effect was not statistically significant in either community. Given the low commercial harvests in the study year, the influence of commercial harvest size in this analysis is unclear. The lack of statistical significance may be due to the fact that the ERGM model also includes other variables that may be associated with commercial fishing. For example, the model includes the total subsistence salmon harvest for each household, so the effect of commercial fishing is estimated by comparing households with similar subsistence harvests. If a household's subsistence harvest amount is a primary factor affecting sharing decisions, then whether or not the household engages in commercial fishing may be a less important predictor of sharing decisions, especially when comparing households with similar harvests.

Associations between Cooperative Production, Sharing, Barter, and Customary Trade

The last goal for our ERGM analysis was to explore whether or not participation in one type of salmon network, such as cooperative production, was associated with participation in other types of salmon networks, such as sharing.

To explore associations between the cooperative production network and sharing network, we also included variables in the cooperative production ERGM that represented the number of sharing ties for each household within the study community as well as with partners outside the study community. We also included a variable that represented barter and customary trade ties with any partners regardless of location. This allows us to explore whether households that are more active in cooperative production are also more active in sharing, barter, and customary trade of salmon. Results are shown in Table 6-1.

We calculated the number of times a household reported giving salmon to and receiving salmon from other households within their community, then estimated how the probability of a tie between two households in the cooperative production network was affected by each household's giving and receiving ties. In all study communities, we found that households that received salmon from other households within the community were also more likely to be involved in cooperative production. However, this association was only statistically significant in Pilot Station and Nulato. Households that gave salmon to others in the community were also more likely to be involved in cooperative production in Pilot Station. These results suggest that there may be synergies between cooperative production and sharing, where households actively engaged in one also become involved in the other. Yet, it is difficult to determine from our analysis whether cooperative production leads to increased sharing or vice versa. One possibility is that cooperative production and sharing are both important parts of a subsistence way of life that reinforce each other, leading to the associations we report here.

One of the goals of this project was to examine salmon sharing that occurs with partners located in other communities, either elsewhere in the Yukon River region or throughout the rest of the state. Because sharing outside the community may differ from sharing within the community, we analyzed the association with cooperative production networks external to a community separately than those from within a community by calculating how many times each household gave salmon to and received salmon from someone outside their community. We found that cooperative production ties were less likely when households were actively involved in receiving salmon from people outside the community, though these associations were only statistically significant for Pilot Station. A limited number of connections in the cooperative production network may reflect a variety of factors that limit a household's ability to harvest their own salmon, perhaps making them more reliant on salmon received from people outside their community. Conversely, cooperative production ties were more likely for households that gave salmon to people outside the community, but this association was only found in Nulato and Beaver and was not statistically significant in either community. If more connections in the cooperative production network help a household increase the size of their salmon

harvest, these households may have greater opportunities to share salmon outside the community, just as they share more salmon within the community.

This project focused on barter and customary trade of salmon as distinct forms of exchange, in addition to sharing. Compared to sharing exchanges, barter and customary trade exchanges were much less common. Nevertheless, we estimated how participation in barter and customary trade with partners located within and outside the community affected the probability of a cooperative production tie forming between two households. We found no statistically significant associations, and the direction of the associations varied by community. In other words, households that choose to work cooperatively to harvest and process salmon were not more likely to barter or trade those fish. This suggests that households participate in cooperative production in order to meet the needs of a fishing group more efficiently and not to have excess fish to barter or sell.

In addition to exploring how participation in cooperative production was related to participation in salmon exchanges, we explored associations between the sharing network within the community and sharing networks outside the study community. We included a variable in the sharing ERGM that represents the number of sharing ties each household had with partners outside the study community. Additionally, we included a variable representing barter and customary trade ties with partners in any location. Results are shown in Table 6-2.

Although our models do not examine factors that shape sharing networks with partners outside study communities, we can investigate how a household's sharing outside the community is associated with sharing within the community. Generally, we might expect sharing within and outside the community to have a positive correlation; in other words, households that give more often to partners located outside the community may also be more likely to give salmon within the community. Additionally, households that receive salmon more often from partners located outside the community may be more likely to receive salmon within the community.

Our ERGM estimates how the number of times a household gives salmon outside the community affects the probability the household gives salmon inside the community. Across all communities, we found a positive association between giving salmon outside the community and giving salmon within the community. This association was statistically significant for Beaver and Pilot Station, but not Nulato. Our model also estimates how the number of times a household receives salmon from outside the community affects the probability of receiving salmon from other households within the community. In contrast to giving salmon, we did not find any substantial, statistically significant associations between receiving salmon from households outside the community and receiving salmon from within the community. However, the survey did not explicitly ask respondents to provide information on salmon that they received from within the community and instead relied on other households to report instances of giving, so some information on receiving salmon could be missing.

These results suggest that the social dynamics that influence decisions to give salmon may be similar whether partners are located within or outside the community. Households that are most active in giving salmon within the community appear to be similarly active in giving salmon outside the community. This does not appear to be the case for receiving salmon, perhaps indicating that different social dynamics determine who receives salmon via within-community sharing networks compared to between-community sharing networks. For example, it is possible that people are motivated to give salmon to others within their community to help enhance food security; whereas people are motivated to give salmon to people outside their community to maintain personal relationships and connections to place. Sharing salmon with those outside the local community helps maintain personal and emotional connections to people and place while also enhancing the food security of those living in places where it is difficult to access wild foods. Key respondents provided a wide range of reasons for sharing salmon with individuals outside the local community.

Although sharing salmon and engaging in barter or customary trade for salmon are distinct forms of exchange, key respondent interviews from this project and previous research by ADF&G suggest that they

are often related and operate on a continuum in which one form of exchange can evolve or transition into another (Brown et al. 2017). Therefore, we wanted to explore any possible associations between sharing networks and levels of barter and customary trade. Because there were relatively few instances of barter and customary trade documented in some study communities, we combined exchanges that occurred with partners located within and outside each study community. We did not have any clear expectations about whether barter and customary trade would be positively or negatively associated with giving or receiving salmon, so our ERGM estimates a general association with sharing. Our results differed across communities. Households that engaged in barter and customary trade in Beaver were much less likely to engage in sharing, and this effect was statistically significant. Considering the limited number of barter and customary trade exchanges documented in our survey from Beaver, however, we should be cautious in assigning importance to this association. In Nulato, we found a statistically significant association in the opposite direction: households that engaged in barter and customary trade were more likely to be involved in sharing within the community. This pattern may warrant further investigation in future research. No significant association was found in Pilot Station.

Conclusions

Our statistical analysis of the factors shaping cooperative production networks suggested that households with large subsistence salmon harvests also work together cooperatively with more households. However, households with the highest harvests appear to be less active in cooperative production networks than households with above average harvests. This may result because households with the highest harvests rely primarily on labor and resources provided by their own households and rely less on other households than households with above average harvests. More detailed analysis comparing the demographic and economic profiles of households with high and above average harvests could help answer this question.

Our analysis also indicated an association between participation in cooperative production networks and sharing networks, both within the community and outside the community. Households that are more active in cooperative production are also more active in giving and receiving salmon within the community, suggesting a fundamental link between the cultural practices of producing and exchanging salmon. The association between cooperative production and sharing was different for sharing outside the community. Households that were more involved in cooperative production were more likely to give salmon to people outside the community, while households that were less involved in cooperative production were more likely to receive salmon from outside the community. This pattern suggests that sharing with people outside the community may reflect a household's ability to produce salmon.

Finally, our analysis did not suggest any significant associations between cooperative production networks and the demographic profiles of households. Mature households were as equally active in cooperative production as were developing and elder households. Households headed by a couple were as equally active in cooperative production as were single-headed households. Together, these results may reflect the fact that fish camps are typically composed of people who pool their skills, labor, and resources to accomplish tasks that would be difficult to do alone. Because most (if not all) households need to work with other households, no single type of household is more or less active in cooperative production than another.

The results of our ERGM analysis identify several significant associations between the structure of sharing networks and household characteristics related to subsistence salmon harvests. First, we found that households with high and above average salmon harvests were much more likely to give salmon to other households in the community. This result supports previous research that suggests that "super households" that are responsible for a large percentage of the total harvest in a community are also playing a key role in the circulation of salmon through sharing networks (Wolfe and Walker 1987; Kofinas et al. 2016; Brown and Kostick 2017). Second, we found that mature households are also more likely to give salmon than other types of households. This result is consistent with the idea that activity in sharing networks may vary with household maturity: mature households generally occupy a unique position by both producing large amounts of salmon and giving salmon to more households in the community. Third, we found that households that are more active in giving salmon within the community are also more active in giving

salmon outside the community. This result suggests that although the underlying motivations for sharing within and outside the community may differ, the households that are most active in sharing in both cases are often the same. Finally, although previous research and key respondent interviews from this project suggest that elder households are more likely to receive salmon, we did not find support for this pattern in our models. However, our models estimate the frequency of elder households receiving salmon, rather than the amount of salmon received. On average, elder households in each study community receive more salmon than other households. Currently, tools for estimating the values of network ties with ERGM are not sufficiently developed, so we could not explore this issue further, but this would be an important next step for future research.

In order to evaluate if the patterns found through this analysis are persistent, data would need to be gathered over multiple years. Doing so would account for the variability in salmon abundance and fluctuating harvest levels. When greater opportunity exists for both subsistence and commercial fishing, patterns may differ than those seen in this year when all study communities experienced lower than average harvests.

7. DISCUSSION AND CONCLUSIONS

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Salmon exchange networks occur within the context of complex subsistence economies that are rooted in cultural traditions and unique local factors. The sharing of salmon does not exist in isolation, but rather in a broader network of cooperation and distribution that includes many other wild resources that are either available locally at different times throughout the year or are accessible through exchange networks which exist regionally or more broadly across the state. This study focused on the way salmon are harvested, shared, bartered, and exchanged in small quantities for cash. Although this research concentrated on salmon, the qualitative component of this research, achieved primarily through ethnographic key respondent interviews, inevitably described the broader subsistence exchange context of which salmon are a part.

Patterns of Cooperative Production

Cooperative production refers to the shared effort to harvest and process a resource by a group of individuals or households. It is an integral component of fishing on the Yukon River. Key respondents in each of the study communities described cooperative production in very similar ways. Most often, fishing groups are structured around kinship relations, but members can include close friends or other community members as well. Fishing group membership can also extend beyond the boundaries of the community to relatives in other rural communities or urban areas traveling to the community to help fish during salmon fishing season. Fishing groups often comprised members from multiple generations. Working together cooperatively allows members to spend time with and learn from one another. In this way, cooperative production is an important cultural method for the generational transmission of knowledge and a link to one's heritage. As a respondent in Beaver described, it connects him to "what my ancestors did before me" (06052019WBQ2).

Members of a fishing group often share the labor and cost associated with fishing to increase efficiency. Cooperation allows each member of the fishing group to provide whatever they are best able to, whether it is fishing equipment, expertise, labor, or childcare. The same households commonly work together from year to year, however, annual participation in a fishing group can also vary based on a variety of factors including personal household circumstances, participation in a commercial fishery, or need for salmon. A respondent in Nulato described that as her extended family fishing group grew very large, she was no longer able to get enough fish to meet her household's needs after the group harvest was divided among everyone (05142019NUL1). She decided to leave the fishing group to fish on their own in order to make sure her household had enough fish to get through the winter. Fishing groups are not necessarily static throughout any giving fishing season. For example, members of a fishing group might come and go due to other obligations such as work. Prior research has also documented the variability of fishing groups year to year and even throughout a single fishing season (Brown and Jallen 2019).

Restructuring of fishing groups is commonplace and can happen for the sake of sharing itself. Working together and sharing or dividing the harvest is a way to distribute salmon to others rather than simply sharing with those who are not part of a fishing group. A key respondent in Nulato described this:

> [an individual] is fishing with us [because] she has nobody, she lives alone. She don't have a boat, and it's easier for her to put away her fish and then she'll be [a] big help there too. That's the way we Athabascans work things. Always trying our best to make ends meet up. Always, trying our best to make sure the next person have food put away. (05142019NUL8)

By allowing someone who doesn't have many kinship connections in the community to participate in group harvesting activities, members of this fishing group can ensure that the cultural value of providing to those who have less is maintained. Similarly, a respondent in Pilot Station described how others helped him with fishing when he was unable to fish due to personal health: "We've had help from my brother…he's been fishing for us because…my back was giving out so I had to ask him to fish for us so that we could cut the

fish and smoke them, and then once they had dried up we'd distribute them with my parents and my brothers and sisters" (05122019PQS6).

Fishing group networks were created for this report by using information obtained from the ADF&G Division of Commercial Fisheries postseason salmon harvest survey (Figure 7-1). The patterns observed in each community were highly varied. In Nulato, 92% of fishing households worked with others and very few households fished alone, the highest cooperative effort recorded in a study community.[1] In Pilot Station, households more commonly fished independently: only 39% of households reported fishing cooperatively. In Beaver, half of households fished with others and half fished independently.

In Pilot Station, where there is a robust commercial fishing industry, fishing groups appear to be made of small numbers of households (Figure 3-11). A household in Pilot Station will often fish with one or two other households but those households do not always fish with one another. This pattern appears on the fishing group network diagram as open triangles. Many households in Pilot Station are unconnected to others through harvesting, including many high harvesting households. This may be because many households are heavily involved in the commercial fishery and have the equipment needed to fish on their own. Additionally, the ability to take some of their commercial catch home for subsistence could possibly decrease the reliance on subsistence fishing groups. ADF&G operates a salmon sonar and test net fishery near the community of Pilot Station. Salmon killed in the test fishery are delivered to the community for local use. As described in the Pilot Station results chapter, the test net fishery is a significant source of salmon for numerous households. Access to these fish may reduce the need or desire to harvest salmon independently or with others, especially in years when restrictions on time and gear make salmon fishing a more costly and time-consuming endeavor.

Fishing group structures in Nulato were more interconnected than in Pilot Station. Only five households reported fishing independently (Table D3-2). Although there were several pairs of households who worked together, there were also numerous fishing groups composed of five or more households that all worked together. Occasionally, individual households were connected to more than one fishing group, perhaps indicating that these households worked with different people simultaneously or throughout the season (Figure 7-1).

In Beaver, fishing groups comprised no more than three households, and households were just as likely to fish alone as they were as part of a group. Beaver's small population could mean that there are fewer large extended family groups living in the community and therefore less opportunity to fish together in large groups. Household sizes tended to be smaller in Beaver than in the other communities as well; smaller households may well need fewer salmon each, thus making harvesting on their own more manageable and decreasing the need for large scale production.

Although fishing in groups (cooperative production or harvesting) is a long-standing practice, recent changes to the Yukon River subsistence salmon fishery have affected the way cooperative production occurs, including who is involved in a fishing group and the way the harvest is distributed from the group to others.

Patterns of Sharing

A salient theme that emerged from most respondents in all communities is the importance of sharing as a cultural tenet of subsistence life along the Yukon River. Sharing values existed in each community. Many respondents described being taught to share from a young age. Doing so continued long-standing traditions that increased community survival—traditions that are rooted in cultural values.

Respondents described more specific reasons for sharing, as well. These included sharing salmon with households who need help or do not have the means to get their own salmon, as a way to thank and give respect to elders, to provide salmon to family members in other communities where salmon are inaccessible or less accessible either because of geography or cost, and to provide food for potlatches and other ceremonies. Salmon are also given as a way to "return the favor" to others.

1. ADF&G Division of Commercial Fisheries postseason surveys, 2019 and ADF&G Division of Subsistence household surveys, 2019.

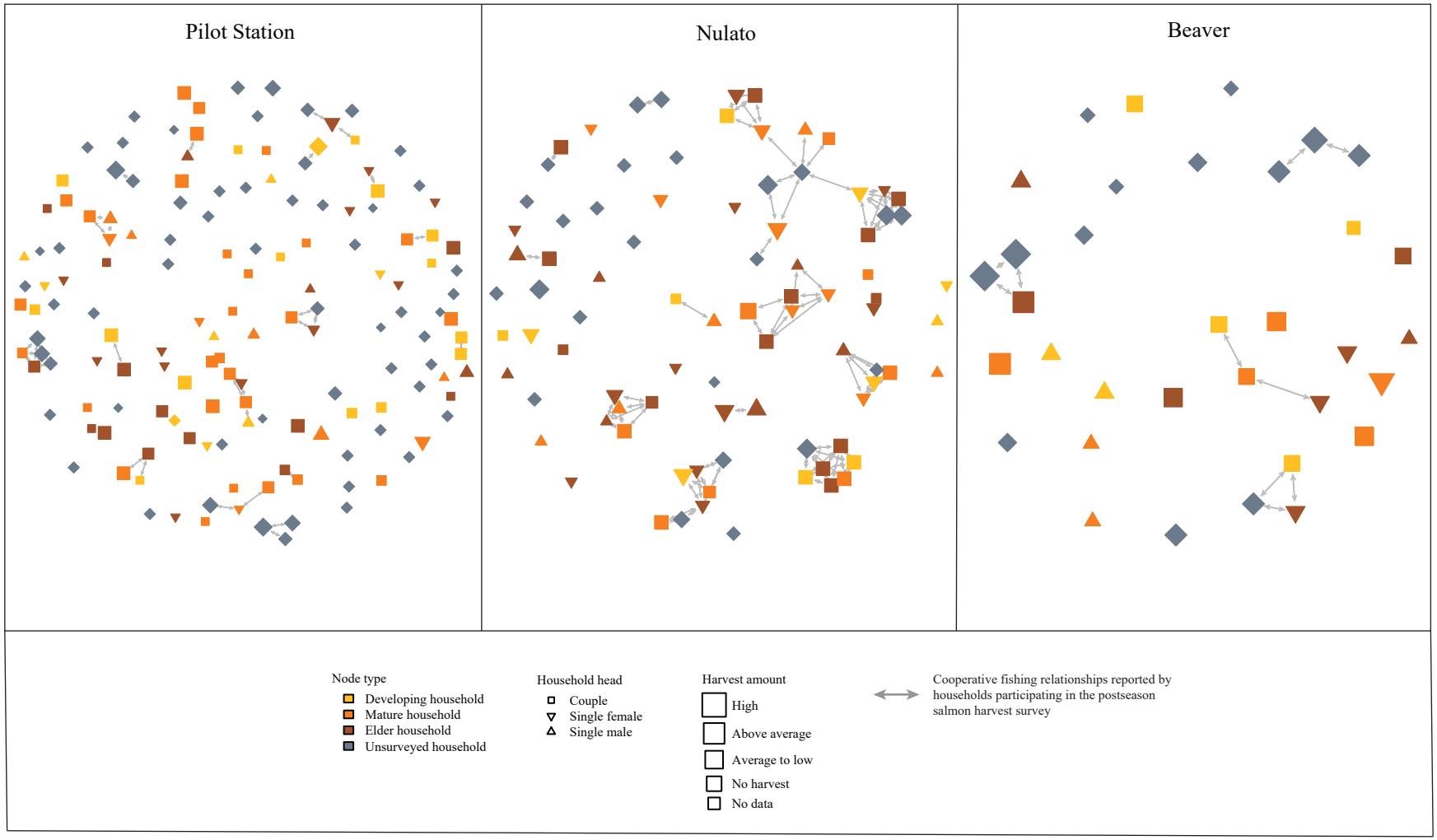

Figure 7-1.–Comparison of cooperative production networks, study communities, 2018.

This study documented the relationship between sharing partners by asking respondents how they knew or were related to those with whom they shared (Table 7-1). In all communities, giving salmon to family members, or extended kin relations, whether within the local community or in a different community, constituted the majority of relationships between giving partners. In Pilot Station, 87% of sharing relationships were between family members; similarly, 85% were between family members in Nulato and 96% in Beaver. Whether these relatives who were given salmon lived within the community or outside the community varied by study community (Table 7-2). In Pilot Station, giving salmon occurred most frequently with family who also lived in Pilot Station (70%; Table 3-19). In Nulato, the opposite was true: 77% of the relatives who were given salmon lived in other communities (Table 4-19). In Beaver, equal numbers of giving ties were with relatives in Beaver and those living elsewhere (Table 5-17). These trends could be related to community demographics and geography. In Pilot Station, the community population has been increasing rapidly over time (Figure 3-4), while in Nulato and Beaver the population has been declining since the 1990s (figures 4-3 and 5-4). These trends are consistent with regional patterns in the Yukon River delta and rural Interior Alaska. Perhaps there is increasing demand for fish within Pilot Station as the community grows; whereas there may be more connections to urban areas in the other two communities because community members have moved to urban centers. Alternatively, it could be that easier access to regional urban hubs like Fairbanks via direct flights from Nulato and Beaver simplifies sending salmon and makes it a more common practice.

A number of studies have described the role that kinship and values play in determining sharing relationships (Magdanz et al. 2002; Lee 2002; Brown et al. 2017; Langdon 2021; Harder and Wenzel 2012). 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 in the community who are in need, they are fulfilling cultural values." Our results support Lee's assertation and previous findings that the practice of sharing resources in primarily Alaska Native communities is often conducted through complex kinship responsibilities but can also extend to unrelated households to strengthen relationships and foster community health by supporting those in need.

Despite the differences in frequency of sharing to other communities observed between the three study communities (Table 7-1), key respondents from each described the importance of sharing salmon with family members who no longer live in the community (06052019WBQ2; 01302020WBQ4; 06062019WBQ1; 05132019NUL2; 05132019NUL3; 05132019NUL9; 05072019PQS1; 05112019PQS2; 05122019PQS3). Sharing salmon with people living elsewhere can help them remain connected to their home communities despite moving to or being born in town or in another community. Sharing subsistence foods, or Native foods, maintains cultural connections as well as supports these individuals during times of transition.

The sharing of salmon with elders was also documented through household surveys. In Beaver, the majority of sharing relationships were with elder households (74%), but in Nulato and Pilot Station the majority of sharing relationships were with other household types (28% and 27% were to elders, respectively; Table 7-1). In within-community networks, elder households had the highest average number of receiving ties and also received larger amounts of salmon on average than developing or mature households (tables D3-6, D4-5, and D5-7). Although some elders do live alone, households are often multigenerational. Elders commonly live with other relatives but may not be considered the head of the household. Therefore, it is possible the rate of sharing with elders is much higher than reported.

Salmon are not only shared with other households, but also commonly shared at community events (Table 7-2). The overall amounts of salmon shared at events varied by community, ranging from 4% of the total amount of salmon shared in Pilot Station to 30% of the salmon shared in Beaver. In all three communities, more salmon were shared to potlatches than to other events (tables 3-17, 4-14, and 5-15), except in Nulato, where slightly more households shared salmon to a unique community event called Midzeyh okko than to potlatches. Occasionally, respondents in this study also noted bringing salmon home from events, but more commonly, salmon shared at events is consumed at the event by those who attend.

These results demonstrate and confirm important aspects of exchange patterns in Yukon River communities. First, that providing food, especially salmon, to kin is central in understanding who wild food is harvested

Table 7-1.–Relationships between partners in sharing exchanges, Pilot Station, Nulato, and Beaver, 2018–2019.

	Has the giving household shared with the receiving household in the past?			Was the receiving household an elder household?			Was the giving household related to receiving household?			Did the receiving relative also live in the study community?		
Community	Yes	No	Unknown	Yes	No	Unknown	Yes	No	Unknown	Yes	No	Unknown
Beaver	76%	24%	0%	74%	26%	0%	96%	4%	0%	50%	50%	0%
Nulato	95%	5%	0%	28%	72%	0%	85%	15%	0%	23%	77%	0%
Pilot Station	88%	9%	3%	27%	73%	0%	87%	11%	2%	70%	30%	0%

Source ADF&G Division of Subsistence household surveys, 2019

Table 7-2.–Reported amount of salmon shared, by exchange partner, Pilot Station, Nulato, and Beaver, 2018–2019.

	Pilot Station		Nulato		Beaver	
Exchange partner	Amount (lb)	Percentage of community total	Amount (lb)	Percentage of community total	Amount (lb)	Percentage of community total
Local households	5,818.5	86%	2,296.5	33%	319.1	27%
Other communities	725.9	11%	3,592.2	52%	514.3	43%
Events	240.9	4%	1,028.5	15%	364.7	30%
Total	6,785.3	100%	6,917.2	100%	1,198.0	100%

Source ADF&G Division of Subsistence household surveys, 2019.

for. Secondly, providing traditional foods such as salmon to relatives who have moved outside of the local community is commonplace and accounts for much of the food distribution that occurs. Third, taking care of elders and others who cannot get the salmon they need is a cultural ethic and expectation that continues even in times of low abundance or increased management restrictions. Finally, salmon and other wild foods are commonly shared at ceremonies and community events.

In Pilot Station, summer chum salmon were shared most frequently, followed by Chinook salmon and fall chum salmon (Table 3-14). In Nulato, residents shared Chinook salmon most often, but also commonly shared fall chum salmon (Table 4-15). In Beaver, Chinook salmon was the only species widely shared by residents; however, some sockeye salmon was shared as well (Table 5-13). These patterns represent local food preferences and reflect the difference species available to harvesters in each community. In all study communities, salmon shared with others was processed in a variety of ways. Smoked and dried salmon and well as whole and unprocessed salmon were the most commonly shared types.

When households fish for salmon, the amount they harvest also typically accounts for additional salmon beyond their immediate household's needs, or in other words, what they need to fulfill social obligations. In each study community, a portion of households only access salmon because they receive it from others. For example, 16% of households in Nulato used salmon but did not harvest any (Table 3-11). Increasing fishing restrictions and declines in Chinook salmon abundance have had a significant effect on people's ability to share salmon with others because fishers have a more difficult time meeting even their own subsistence salmon needs. If fishers are unable to harvest salmon their ability to share salmon is diminished.

Several key respondents described that even when they are not able to harvest as much salmon as they want or need, that they still try to share (06062019WBQ3; 05132019NUL3; 05122019PQS6). However, in these cases they must modify with whom they share, the number of households they share with, or the amounts of salmon they share.. Respondents described how difficult it can be to limit with whom they share. In times of salmon scarcity, fishers may first choose to reduce sharing with more distant relatives and friends before close family and elders (05132019NUL3; 06062019WBQ1). In Pilot Station, one fisher said that people are generally understanding. "It's really harsh…they expect [salmon] like every year, and I said 'Oh man, I'm sorry, it was so slow' and all that. 'Didn't get to cut enough. Plus the gas price,' you know, and so. Even I give them half a bag and explain to them and say that, they understand" (05122019PQS3).

Often the best quality salmon is saved for sharing at events or with guests. "When people from the outside come into Beaver, my mom would sometimes remind me, you know, like when visitors come into your village you need to give them the best" (01302020WBQ4). This respondent said that her mother does this even if she does not have much and even if the guests are not particularly close to you. She described a year when they were barely able to harvest any fish, but her mother still insisted on cooking an entire Chinook salmon for some political figures who visited the community. She says that her mother taught her: "You don't let people come into your village and not cook for them."

Not only does sharing with other households change when fewer salmon are harvested, but sharing salmon for events and gatherings is also affected.

> All the Native communities have potlatch events. And it's always a Native custom to share the foods at these events. The sharing of king salmon is not as open as it used to be when Fish and Game started restricting king salmon. But what's happening is that the Native families are sharing with the guests [who come from other communities and stay] in the household, instead of at the community events. (05072019PQS1)

The ability to share other species of salmon when there is not enough Chinook salmon harvested depends largely on the availability and quality of other species, as well as local preferences. This varies by region of the river and likely between communities in the same region. For example, in Pilot Station and Nulato, a large percentage of the total community salmon harvest is made up of species other than Chinook salmon: summer chum salmon in Pilot Station and fall chum salmon in Nulato (Table 7-3). However, further upriver

Table 7-3.–Salmon harvests, study communities, 2018.

	Pilot Station	Nulato	Beaver
Salmon	4,754.9 ind	2,897.7 ind	656.2 ind
Summer chum salmon	3,487.1 ind	192.4 ind	7.9 ind
Fall chum salmon	619.5 ind	911.5 ind	146.2 ind
Coho salmon	64.9 ind	465.9 ind	11.3 ind
Chinook salmon	583.4 ind	1,327.8 ind	375.1 ind
Sockeye salmon	0.0 ind	0.0 ind	115.6 ind
Total community harvest	23,537.9 lb	18,162.4 lb	4,277.2 lb
Salmon per household	175.7 lb	229.9 lb	125.8 lb
Salmon per capita	36.9 lb	81.5 lb	48.9 lb

Sources ADF&G Division of Commercial Fisheries postseason harvest surveys, 2018; ADF&G Division of Subsistence household surveys, 2019.

in Beaver, there are no summer chum salmon and fall chum salmon quality is typically too poor to consider the fish for human consumption, so residents rely more heavily on Chinook salmon.

Barter and Customary Trade

The exchange of subsistence foods and other items, both locally and through inter-regional networks, is a longstanding customary and traditional practice that is not exclusive to any particular Alaska Native culture or region. However, exchange practices are shaped by local cu stoms and norms that can vary throughout a region as large as the Yukon River drainage. The terms "barter" and "customary trade" have specific legal definitions that do not encompass the full complexity of how resources are exchanged in practice.

All key respondents interviewed for this study described exchanging resources in a way that is not consistent with common interpretations of the legal definition of barter. Instead of negotiating what constitutes a fair exchange of resources, an individual may give a wild food to another person, and days, weeks, or months later will receive something in return, or what is typically described as "delayed reciprocity" (Munn 1986; Sahlins 1972). While the legal definition does not eliminate the possibility of a delayed return of goods, it also does not explicitly include an extended time frame. Because different wild foods are harvested and available at different times throughout the year, the flow of food during these exchanges is also spread out across time. In all three communities, the majority, if not all the barter transactions occurred with partners who lived outside the local study community. Additionally, the salmon that was bartered was almost always exchanged for another wild resource that was available at a time of year outside of the normal salmon fishing season (tables 3-21, 4-21, and 5-20). Taken together, these two points suggest that delayed reciprocity was occurring in nearly all instances in this study where one resource was exchanged for another. As a result, there can be slippages in how community members define their exchanges as legal barter versus just sharing at different times of the year unless there is a specific reference to the need to reciprocate. Asking respondents to report on the "barter" exchanges in which they participated instead of or in addition to reciprocated instances of sharing may have unintentionally limited the survey responses. However, respondents still provided many examples of how salmon is exchanged for other goods and resources (tables 3-21, 4-21, and 5-20). They also noted that actual barter, in which two parties agree upfront to trade something, does sometimes happen, but they stated that it is much less common than delayed reciprocity, which is a form of sharing.

One of the most common reasons noted by respondents to engage in barter or exchange was to trade resources they have easy access to or a relative abundance of for resources that they do not have (06052019WBQ2; 01302020WBQ4; 05122019PQS6). This likely shapes why survey respondents bartered with people living in other communities (tables 3-21, 4-21, and 5-20). Additionally, respondents characterized their participation

in these exchanges as simply returning a favor after someone shared food or provided assistance to them in some way.

The frequency of barter transactions varied between the study communities. Nulato survey respondents reported many more barter exchanges than in the other two communities: 25 versus only five in Pilot Station and three in Beaver (tables 3-21, 4-21, and 5-20). The relationships between barter participants also varied and strongly influenced local exchange patterns. Like sharing, instances of barter or exchange often occur between people who are related to one another. In Pilot Station and Beaver, all the barter exchanges were between relatives, but in Nulato, only 33% of barter exchanges occurred between family members. Nulato respondents most commonly bartered with friends. Whether or not an exchange partner lived within or outside of the local community shaped local exchange patterns in unique ways as well. For example, Nulato respondents reported bartering with people living in urban communities as well as within their own community and other rural communities. Beaver and Pilot Station respondents only bartered with residents of other rural communities.

Salmon are exchanged for a wide variety of items. In all cases but one, salmon were given by respondents in the study communities and other items were received (tables 3-21, 4-21, and 5-21). Most commonly, salmon were exchanged for other wild foods, especially ones that are not available locally, but salmon were also exchanged for market goods and labor. Additionally, multiple species of salmon were exchanged in this study. Chinook salmon were most commonly exchanged in Beaver and in Nulato, but residents of Nulato also traded fall chum salmon for other resources. In Pilot Station, summer chum salmon were most commonly traded but respondents also reported trading Chinook and fall chum salmon. A single household in Beaver was the only household in all the communities to report receiving salmon. They received sockeye salmon. Survey results showed that salmon were always exchanged for something other than salmon, but an ethnographic respondent in Pilot Station said that sometimes different types of salmon might be traded between different communities in different parts of the river (05122019PQS6).

Some key respondents also characterized the decline in Chinook salmon and an increase in fishing restrictions as having a negative effect on trade networks. For instance, one respondent in Beaver described how salmon used to be a reliable resource that Beaver residents would harvest and could trade more widely for other resources, such as caribou and marine resources that are not locally available (06052019WBQ2). When Beaver residents are not able to harvest enough salmon for their own needs, residents are not able to afford to send much salmon to others and in return are not as likely to receive these other types of resources. He also explained that some Beaver residents are starting to fish for or buy salmon from outside the Yukon River, such as from the Copper River. Another respondent in Pilot Station described how some families in that community are looking to other regions of the state, outside the Yukon River drainage, to get their Chinook salmon (05112019PQS5). However, she was unclear if families are traveling to other regions to fish or if they are bartering or trading for Chinook salmon from those regions.

Previous research has shown that customary trade occurs in all regions of the Yukon River on a small scale, and when compared to sharing and barter, is the least common type of exchange (Brown et al. 2017; Kofinas et al. 2016). Our results show similar patterns. Very few instances of customary trade were reported in any of the study communities during the study year, and very few households reported participating in this exchange type (tables 3-21, 4-21, and 5-20). In Pilot Station and Beaver, survey respondents only purchased salmon strips at the Alaska Federation of Natives convention (AFN) in Anchorage from people they did not know. The largest amount purchased was $175. Customary trade is the only type of exchange for which respondents reported a "stranger" as an exchange partner. In Nulato, however, customary trade occurred solely within Nulato. Although two of the seven exchange partners identified in customary trade exchanges were listed as "strangers" respondents may have been protecting the confidentiality of the partnership. Other details, such as amounts of cash, and amounts of fish exchanged, were also reported as "unknown." The remaining relationships identified by Nulato respondents were all with elders either within the family or outside of the family. One possibility for this could be that cash is part of the subsistence economy and is used as a resource to be exchanged like wild foods (cf. Wheeler 1998, discussed in more detail below). For elders, who may no longer be harvesting or processing much wild foods themselves, cash becomes a

convenient way to reciprocate during an exchange. In this way, Nulato's patterns of customary trade fit that of sharing and barter and uphold earlier findings, discussed below, that exchanges occur along a continuum. The largest amount bought or sold in Nulato was $50 of salmon. Although key respondents all described customary trade to occur on an occasional basis, it is possible that the complex legalities of customary trade could have prevented some survey respondents from reporting exchanges.

Respondents described a variety of reasons to engage in customary trade. Elder respondents recalled the historical selling of salmon to regional stores and barges traveling the Yukon River (06062019WBQ1, 05132019NUL3, 05112019PQS2). Money made would be used to buy supplies for the winter. Another respondent recalled her mother selling a little bit of salmon for gas money so they could travel by boat in the summer (06062019WBQ3). In current times, small amounts of salmon may still be sold to recoup some of the costs of fishing and obtain needed supplies. Sometimes subsistence foods like jarred salmon or dry meat are purchased to give as gifts for special occasions when a household does not have enough of their own to share (01302020WBQ4). Sometimes cash may be given as a gift to thank fishers for salmon given and may only represent a fraction of the commercial value of the fish.

Overall, respondents described that customary trade transactions are typically small in scale. In the past when salmon were more abundant some respondents described knowing of others who sold larger amounts. Law enforcement efforts curtailed some of those cases, and one respondent in Pilot Station also said that he has heard elders speak to people selling salmon in the past, asking them to no longer do so (05122019PQS6). Residents in all communities said that the most common occurrences of larger-scale customary trade happen at AFN.

The decline of Chinook salmon abundance has affected fishers' ability to harvest the salmon that they need. There was no consensus among respondents on how this has affected customary trade practices, but one respondent from Beaver said that it is now more common to buy fish from other areas of Alaska that still have abundant salmon runs.

> We buy a lot of fish from people from places that still get fish, like the Copper River. You know, different tributaries that get fish, we'll buy strips and stuff. And it almost feels dirty. It does. But that's what we need to do in order to get the food that we love. Since we can't fish our own, we have to buy it from our neighbors. (06052019WBQ2)

He also said that the price to purchase salmon strips has drastically increased.

Some respondents felt that customary trade is self-regulated by social and cultural norms that prohibit making a profit from subsistence foods (01302020WBQ4; 06062019WBQ3). Others felt that there should be a dollar amount limit put in regulation to make the regulations more clear and allow for small-scale buying and selling to legally take place (01302020WBQ4).

Comparison with Prior Studies

Previous research by ADF&G throughout Alaska has identified patterns of harvest inequality in subsistence harvests at the household level, where a small proportion of households within a community are responsible for a large proportion of the community's total harvest. Wolfe (1987) referred to this pattern as the "30:70 Rule," based on analysis of data from communities in different regions of Alaska that show that roughly 30% of households typically harvest about 70% of the total subsistence resources in a community. This is referred to an harvest specialization. After recognizing that this pattern is widespread throughout rural Alaska, the Division of Subsistence now includes harvest specialization analysis for nearly all harvest studies.

Although previous studies typically examine subsistence harvest inequality, or specialization, using data from multiple species, our analysis is limited to salmon harvests, which were the focus of this project. We would expect that harvests would be more specialized for a single resource than for all resources. Still, we can compare inequalities in subsistence salmon harvests from our study communities with the general pattern represented by the 30:70 rule. In Pilot Station, Nulato, and Beaver harvest specialization for salmon

was more concentrated than for all species but within the typical range found throughout Alaska: 70% of the total salmon harvested by the community were produced by the top 16% of households in Pilot Station; 69% of the total salmon was produced by the top 22% in Nulato; and 70% of the total salmon harvest was produced by the top 24% in Beaver (figures 3-8, 4-8, and 5-9). Previous research documented that regional salmon harvests in the Yukon River drainage became increasingly more specialized after the 2009 Chinook salmon crash.[2] Our dataset only allows us to compare salmon harvest specialization between the 2018 study year with one previous study year in each community. In doing so, we did not find significant changes in harvest specialization (Figures 3-28, 4-29, 5-29); however, these data are from study years following the 2009 salmon crash and do not allow us compare to earlier years when salmon harvesting was less restricted.

One important implication of these persistent inequalities in subsistence harvests among households within a community is the way they may influence the distribution of resources within the community. Previous research by ADF&G and others suggests that households with the largest harvests often play a central role in distributing resources throughout the community (Wolfe et al. 2010; Kofinas et al. 2016; Brown and Kostick 2017). Other research has shown that community salmon harvests are becoming more specialized as Chinook salmon harvests have declined due to reduced abundance and increased fishing restrictions.[3] In many cases, households with limited opportunities to harvest for themselves may rely on these households to provide them with subsistence foods, whether through sharing, barter, or customary trade. Sharing by highly productive households with less productive households increases access to subsistence resources for households in need and effectively reduces the inequalities in subsistence use within a community. In this way, sharing may enhance the resilience of subsistence economies at the community level by ensuring that the factors limiting opportunities for some households to harvest for themselves do not prevent these households from accessing the many material, cultural, and spiritual benefits of subsistence foods. At the same time, sharing by highly productive households may reflect inter-generational dependencies within extended families and provide opportunities to enhance social capital. In order to better understand the relationship between a household's subsistence harvest productivity and the social networks involved in the production and distribution of subsistence foods, we need to investigate how these vary according to the demographic, economic, and social characteristics of households.

Our project contributes to this goal in several ways. The first contribution builds on previous research that suggests key characteristics influencing a household's subsistence harvest productivity. We used descriptive statistics to show the average salmon harvests for different household types in each community. Previous studies have suggested a range of household characteristics, including the age and marital status of household heads, the numbers of adults who participate in subsistence, the numbers of dependent children, income levels and engagement with commercial fishing and other sectors of the market economy, and the presence of elders (Wolfe et al. 2010; Kofinas et al. 2016; Brown and Kostick 2017). Although we were not able to investigate all of these characteristics, we focused our analysis on household maturity, household head type, and participation in commercial fishing. We found that mature households typically have larger salmon harvests than developing or elder households (with the exception of Nulato; tables 3-12, 4-12, and 5-11).[4] We did not find consistent support for the idea that households headed by a couple harvested more salmon than those headed by a single male or single female. In Pilot Station, couple households did have larger harvests, but in Beaver harvests by couple households were slightly less than single female households, and in Nulato there were no substantial differences among couple and single households. Similarly, results for commercial fishing differed between the two communities where it was practiced: in Nulato, households engaged in commercial fishing had lower average harvests, while in Pilot Station, these households had substantially larger harvests. Together, these results provide some support for the idea that subsistence

2. C.L. Brown, A. Trainor, B.M. McDavid, J.S. Magdanz, and G. Rakhmetova. In prep. Patterns and trends of salmon harvest and use in the Yukon River drainage, Alaska, 1990–2014. Alaska Department of Fish and Game, Division of Subsistence Technical Paper No. 442. *Hereinafter, Brown et al. In prep.*
3. Brown et al. In prep.
4. Households are classified by the age(s) of household head(s): less than 40 years for "developing" households, 40–59 years for "mature" households, and greater than 59 years for "elder" households.

harvests vary according to the characteristics of households, but these characteristics appear to have unique effects in each community, with the possible exception of household maturity. Additional analysis that uses a multivariate, inferential statistical approach to estimating associations between household characteristics and subsistence salmon harvests could provide a more nuanced assessment.

Our second contribution focused on the role of household characteristics in shaping social networks related to subsistence salmon harvests. We used exponential random graph models (ERGMs) to estimate how these household characteristics shape social networks involved in the cooperative production and sharing of salmon in each study community. Our analysis also provided support for the idea that highly productive "super households" play a central role in both salmon production and sharing networks. In all study communities, we found that households with high and above average harvests were more likely to engage in cooperative production and more likely to share salmon. This result suggests a synergy between social relationships that facilitate production and distribution, where the most productive households leverage social relationships in the context of cooperative production to generate larger subsistence salmon harvests, then distribute their harvests throughout the community via social relationships. Although the same set of highly productive households are central to both the production and distribution networks, the social relationships they draw on for cooperative production differ from those involved in distribution. Although cooperative production networks feature small groups of households that often share connections with one another, sharing networks branch out from these groups and connect the community as a whole. This result highlights the unique insights that can arise from studying subsistence salmon harvests as social networks. Rather than considering households as independent from one another, the social network approach identifies specific ways that households rely on one another during key phases of subsistence harvests, from production to distribution. Visualized at the community level, these social networks also illustrate why subsistence is seen as a fundamental part of the cultural identity of people in our study communities and throughout Alaska. Cultural identities and the social practices, norms, and values that underlie them are formed and maintained by people in a community and passed on across generations through social relationships. When people in Pilot Station, Nulato, and Beaver work together at fish camp or share the fruits of their labor with other people within and outside their community, these social relationships are sustained.

Our project also examined sharing networks that extend beyond the study communities. We found that flows of salmon between households in each study community and partners living outside the community are heavily unbalanced: much more salmon flowed out of than into the study communities. This pattern is consistent with the idea that people in Pilot Station, Nulato, and Beaver are primarily sending salmon to people in other communities who lack access to this resource. Comparing the number of sharing exchanges and the amounts of salmon given by location, we found that the majority of salmon flows into urban centers linked to each study community (Anchorage for Pilot Station, Fairbanks for Nulato and Beaver; tables 3-18, 4-20, and 5-16). In many cases, these transfers of salmon are going to family members who have migrated from a study community to urban centers. Data from key respondent interviews suggest that these transfers provide a personal connection to their home through the unique taste of traditional foods as well as more practical dietary and nutritional benefits. In addition to these rural-to-urban sharing exchanges, we also documented a secondary pattern of exchanges with people living in other communities in the Yukon River region and even other parts of Alaska (figures 3-19, 4-17, and 5-18). Although these rural-to-rural sharing exchanges are less frequent and involve smaller amounts of salmon, they play a similarly important role in maintaining social relationships across distance. Based on insights from key respondent interviews, they may also reflect traditional forms of exchange between communities with access to different subsistence resources. Together, these two patterns of exchange illustrate the expansive geographic scale of subsistence salmon distribution networks and the many ways different regions of Alaska are inter-connected by the flows of subsistence resources, particularly the strong connections between rural and urban communities.

Our project's focus on documenting social networks within rural communities and beyond builds on recent studies by ADF&G, including a project in Bristol Bay and the Alaska Peninsula (Hutchinson-Scarbrough et al. 2020). With a few exceptions, the methods used to collect data on subsistence harvests and social networks related to cooperative production and sharing within the community, sharing outside the community, and barter and customary trade were similar for the two projects. This provides opportunities

for comparison. As we found in the Yukon River communities, social networks involved in cooperative production in Bristol Bay and Alaska Peninsula communities involved small groups of households that all worked together to harvest salmon, and these groups were linked through sharing networks that connected most or all households within the community. Similarly, sharing networks beyond the study communities in the Bristol Bay and Alaska Peninsula project showed the same two patterns, with a primary rural-to-urban flow of salmon out of study communities and a secondary rural-to-rural flow of salmon among other communities in the region and elsewhere in Alaska. If additional research projects in other parts of Alaska continue to collect data on amounts of subsistence foods shared outside of a community using a similar methodology, we may be able to determine whether these two patterns are widespread and whether they apply to subsistence resources other than salmon.

For two of the communities in this study, Pilot Station and Nulato, previous studies collected data about salmon production and sharing ties (Ikuta et al. 2013; Brown et al. 2015). Although the methodologies between those earlier studies differed from this study, a cursory comparison of the results is still possible by comparing the overall number of salmon ties. For Nulato, residents harvested about half as much salmon in 2018 as they did in 2010. There were more unconnected households in the network in 2018 as well. However, the number of unique ties remained similar, and the density increased. Despite harvesting much less salmon, the number of times salmon was shared was similar but the increase in the number of unconnected households may indicate that sharing was more limited to those with close social relations. For Pilot Station, similar amounts of salmon were harvested in 2013 and in 2018. The number of unique ties and connected households increased between the two years, as did the number of households within the community. Network density in Pilot Station was lower than in Nulato, perhaps a reflection of the different fishing profiles of the communities and the presence of a full commercial fishery in Pilot Station.

Continuum of Exchange

Academic scholars as well as state and federal policymakers have attempted to concretely define different types of exchange practices. However, more recent ethnographic research has continued to show that practices of cooperation and exchange are better understood on a continuum where there are often "grey areas" between these various practices. For instance, Brown et al. (2017) concluded that sharing, barter, and the small-scale selling or buying of salmon are rarely distinct from one another: that is, all exchanges that take place on the continuum are based on the norms of sharing, and therefore, isolating a single exchange or transaction and labeling it as barter or customary trade often removes the culturally embedded context in which the exchange occurs.

Barter events are difficult to isolate because they often contain an element of delayed reciprocity that is guided by a number of complex considerations. Considerations such as time, resource availability, and social obligation are not captured in the legal definition of barter. The legal definition of barter does not include a temporal scale and thus, does not adequately capture how barter exchanges typically occur in Yukon River communities where an element of delayed reciprocity is often present. For example, the acceptance of a gift may prompt a recipient to "return the favor," thus pulling individuals into a continuing cycle of reciprocation over time. Several respondents supported this idea (06062019WBQ1; 06062019WBQ3; 01302020WBQ4). A participant in an exchange may believe they are simply sharing salmon with another person or household, but because of social considerations, the receiving participant may immediately give something in return. Although this does fit the legal definition of barter, and is a common example captured in study results, the legal definition does not account for the difference in intentions between two participants of an exchange or how social considerations both prompt individuals to provide for others and also compel individuals to participate in a type of exchange they were not necessarily expecting (cf. Mauss 1990rep.).

> Barter? No, we don't barter. What they do is, you know, we give them salmon and they thank us, but later on. For me, when we go someplace and come home, when moose season is open, there's some moose in the porch that's already there. No, just a big thank you. No, my cousin down in Anchorage, he sends us gifts for sharing. (05122019PQS3)

Similarly, when a recipient of wild foods such as salmon feels inclined to give something in return but only has cash to give, an initial sharing exchange can quickly turn into customary trade as legally defined. Exchanges that involve small amounts of cash and are legally defined as customary trade often occur because cash is given as a reciprocal resource in a sharing event. As noted in Brown et al (2017), the legal distinction between barter and customary trade appear to rely on the assumption that cash is singular among resources as a medium of exchange and one that "signals a shift in the relationship between exchange particpants" (2017:102). In contrast, Wheeler (1998) argued that in subsistence economies, cash does not always play this role and cannot always be considered outside of a suite of other exchangeable resources. However, although the statutory definitions provide a protective structure for these long-standing practices so fundamental to subsistence economies, the regulations that guide enforcement efforts do not account for the social considerations and complexities that exist when exchanging wild foods.

This is the first network study to concurrently document the entire exchange continuum, which includes production, sharing, barter, and customary trade. Results further expand our understanding of the continuum to include more than exchange practices by incorporating cooperative production of salmon. The harvest and processing of salmon is both time and labor intensive and typically requires expensive equipment and money for gas. Extended families and friends share resources and work together to make the production of salmon more affordable and efficient. Salmon that are harvested are then distributed amongst those who contributed in various ways to the production effort, whether they contributed labor, money, or equipment. Under legal definitions, it could be argued that use of equipment was bartered for salmon, or that by giving money to contribute to the fishing effort, someone purchased salmon through customary trade. This could be problematic for local residents who could be cited for participating in customary trade.[5]

Although residents report engaging in barter and customary trade less frequently than sharing in the three study communities, barter and customary trade remain important methods of distributing and receiving wild foods that maintain cultural values such as providing for those who are in need, providing for elders, and maintaining cultural connections to those who have moved away, in a similar way that sharing does.

There are certain similarities regarding patterns of salmon exchange throughout the Yukon River region. However, the frequency of barter and customary trade events, opinions about the morality or justification for customary trade, with whom salmon is exchanged, and reasons for participating in various types of exchange can differ greatly by individual or household and by community. This is consistent with our findings from prior work (Brown et al. 2017): that the way these exchange practices operate in individual communities differs in part because of the local norms and customs that are practiced in those communities. This further enforces the idea that customary trade practices among Yukon River communities defy singular characterization and that broad regulatory constraints on these practices, specifically customary trade, are less effective than a more nuanced approach.

Management Implications

Social network analysis has implications for effective resource management, especially as key resources for Yukon River communities, such as Chinook salmon, decline. At the most basic level, documenting salmon networks visually depicts the fundamental reality of subsistence-based economies: that subsistence is more than just harvesting. Consequently, managing harvest opportunity has broad implications beyond the harvesting households. A management decision that reduces harvest time or limits allowable gear types, for example, will likely be felt not only by the harvesters but by nearly all the households within a region and, more than likely, by households throughout the state who may be connected to Yukon River salmon networks. If management does not account for the role of sharing and exchange more broadly, the wellbeing of Yukon River communities will be in jeopardy, and other unintended social and resource management consequences will emerge. Successful management of a fishery depends on understanding how communities experience and respond to management decisions.

5. Although customary trade is recognized as a customary and traditional practice, until the Board of Fisheries takes it up for the Yukon River region and defines its limits, participation in customary trade by selling salmon harvested from state-managed waters remains illegal.

The state managers in theYukon River Management Area use amounts resonably necessary for subsistence (ANS) ranges for each salmon species in assessing whether reasonably opportunity has been provided. The Alaska Board of Fisheries adopts ANS ranges into regulation as one metric to help them determine whether the subsistence fishing regulations are providing a reasonable opportunity for success in harvesting fish for subsistence uses (see AS 16.05.258). The ANS for Yukon River Chinook salmon is currently 45,000–66,704 fish (5 AAC 01.236). Between 2009 and 2018 the ANS for Chinook salmon has not been met (Fall et al. 2020). Creating the ANS range for salmon species on the Yukon River required relying on decades of community harvest estimates produced by the ADF&G Division of Commercial Fisheries, excluding those years when restrictions were in place.[6] Thus, the ANS ranges reflect harvest patterns that fully support robust exchange networks. Although Yukon River salmon networks were not systematically documented before Chinook salmon run sizes declined, ethnographic testimony in this study suggests that sharing was more widespread and less limited to close kinship ties. Some respondents discussed having to share less, limit who they shared with, or even switch from sharing to other forms of exchange such as barter or limited customary trade (01302020WBQ4; 05142019NUL1; 05132019NUL3). However, sharing, as discussed above is the primary way that Yukon River communities ensure that all community members are provided for. It could be argued that reductions in harvest opportunity affect nonharvesting households more than fishing households because they do not have direct access to salmon themselves and rely on sharing to access the resource. In times when harvest is limited, fishers cannot adequately provide for others as they typically would. Considering the broader effect of reduced harvest opportunity to all households in Yukon River communities will be necessary if salmon abundance remains depressed and declines continue. Historically, the Yukon River fisheries managers have never implemented household harvest quotas or issued subsistence permits which limit the number of salmon a household can harvest, although subsistence permits that limit harvest have been implemented in other subsistence fisheries such as on the Kuskokwim River (ADF&G Division of Commercial Fisheries 2021a). If household quotas are ever considered as a management tool on the Yukon River, there must be a system in place whereby nonfishing household's needs are also accounted for, such as designating someone in another household to fish for them.

Respondents in all study communities described the sharing of salmon at ceremonies and events in their community. Salmon from personal harvest is often gifted to the event, either to be consumed by attendees at the event or to be distributed and taken home. Currently, the ability to harvest salmon for ceremonial uses is not specified in regulation; however, during subsistence salmon closures managers have exercised thier discretionary authority to allow the harvest of a limited number of salmon for ceremonies or potlatches. The ability for communities to harvest a few salmon for ceremonial purposes, especially in times that households are not able to fish to meet their own needs, can at least provide a small degree of access to this resource, a continuation of certain traditions involving salmon, and a way for people to come together and share salmon in a communal way.

Throughout Division of Subsistence research, the giving and receiving of wild foods is a well-documented pattern that results in nearly all households within a community using wild foods even if a much smaller portion harvest them. In this way, sharing is ubiquitous. Network analysis shows that sharing occurs within communities, and also with people living in other communities, especially regional urban communities such as Anchorage or Fairbanks. Sharing with others, especially family members, does not decrease when someone moves away to another community. On the contrary, the motivation, desire, or obligation to share wild foods with those who have left the local community may actually increase. Providing traditional wild foods to those individuals is a way to maintain cultural connections especially when access to wild foods decreases for the recipient in their new location. Therefore, regulations that put geographic limitations on the exchange of wild foods, such as limiting exchanges to occur only between rural residents, are at odds with how exchange practices occur between rural communities and relatives who move to urban areas.

Although the network analysis in this study examined the way salmon was distributed through sharing, barter, and customary trade, the ethnography and survey results in this report described the role that other wild resources also hold in exchange networks. For example, salmon were often exchanged, either through barter or delayed reciprocity, for other wild resources such as moose, caribou, seal oil, or muktuk (tables 3-21, 4-21, and 5-20). Sharing, barter, and customary trade that take place throughout the year, outside of

fishing seasons, also support the wellbeing and food security of Yukon River communities by increasing access to wild foods. As one respondent noted:

> When we're bountiful we share…The sharing of foods and things we hunt and catch plays a big part in our culture…Women, but also men that don't fish, that can't fish, that don't have boats, don't have the means to do so, we would help them out. I mean we still do when we can. But most of the time we can't anymore. And it's really killing our culture. (06052019WBQ2)

Previous comprehensive subsistence studies have documented that when a household is not able to harvest enough of one species or resource, that a household will try to fill that void with increased harvest of other resources or replace wild foods with more store-bought foods (Brown et al. 2017; 2015; Ikuta et al. 2016).[7] However, the ability to do this likely affects households very differently depending on the flexibility and means they have to target other resources, as well as the availability of other subsistence resources. Additionally, even if households are able to harvest other species or buy store-bought food, this replacement does not account for the cultural effects that not harvesting a preferred species has on families and communities at large.

Currently, the management of salmon and the management of caribou or moose, for example, are handled entirely separately from one another. Limited harvest opportunity or even complete closure of the Chinook salmon subsistence fishery currently has no bearing on the management decisions or opportunity that is provided for other resources in the following fall or winter seasons. Without a more holistic approach and consideration of the seasonal nature of subsistence harvesting, of the need to make up low harvest of one keystone species with the harvest of another, and of the need to have enough wild foods to support and maintain a robust exchange network, the management of Alaska resources falls short of meeting the subsistence needs of Alaska residents. Additionally, in this study we found that respondents who reported not getting enough Chinook salmon either replaced that with other wild foods or bought more commercial foods from the store (tables 3-28, 4-28, and 5-23). Substituting store-bought foods for salmon may have significant negative implications for cultural wellbeing and nutritional health. Shifting resource management of individual species to a management systemthat considers the complexity of subsistence harvests as a whole would be a radical change to current management regimes; however, in order to successfully mitigate the effects of a declining resource, such as Chinook salmon, such considerations are warranted. Ensuring that local communities can harvest enough wild food to support their exchange networks and provide for nonharvesters is critical and essential to fully understanding and supporting how subsistence economies operate. If management policies can be adjusted to make it easier to replace the loss of salmon with other wild foods and to exchange wild foods more freely, negative effects to cultural and nutritional health could be mitigated.

As Chinook salmon runs on the Yukon River continue to decline, management actions to conserve these fish are increasing. The harvest of salmon, particularly Chinook salmon, is becoming more concentrated; fewer households are harvesting the majority of the salmon for their communities. This concentration may put additional pressures on the distribution networks as more households rely on shared fish from others. Households who continue to harvest will face increasing pressure to provide for those who are no longer able to fish themselves and as harvests continue to decline, these households may face difficult decisions about who to share with and how much to share. From the ethnography documented in this report, we know that the way sharing occurs is culturally bound and guided by local norms. Consequently, it is difficult to predict how decisions about sharing may change. Sharing with a smaller network of other households, reducing the quantity that is shared in a particular exchange, sharing less frequently throughout the year or limiting sharing to others either within or outside of the local community are a few ways in which sharing patterns may change in the future. Additionally, the concentration of fishing effort has and will continue to create more vulnerabilities in communities that rely heavily on a small number of fishers to provide salmon for everyone.

Additionally, the stability of other salmon species is also uncertain. In recent years, fall chum salmon have also experienced dramatic fluctuations in abundance (JTC 2021). Unexpected weak runs of fall chum

salmon occurred from 1998 through 2002 because of poor production and marine conditions. From 2000 through 2006, Yukon River fall chum salmon were designated a stock of yield concern. During the decline, subsistence fishing for fall chum salmon was greatly reduced or closed altogether to meet escapement goals and obligations under the Yukon Salmon Agreement of the Pacific Salmon Treaty. In 2020, fall chum salmon populations crashed again. Returns of this species represented the worst fall chum salmon run ever recorded; unlike the declines in the early 2000s, the 2020 run coincided with an extremely weak run of Chinook salmon as well, making species replacement in the upper portions of the river impossible. Although summer chum salmon have historically had more reliable returns and enough harvestable surplus to support a subsistence fishery in the lower and middle river, and a commercial fishery in the lower river, abundance of any species is never guaranteed. At the time of this writing, the 2021 summer chum salmon return is the lowest on record (ADF&G Division of Commercial Fisheries 2021b). Consequently, salmon exchange networks will continue to be affected because fewer salmon are available for distribution and harvesters are forced to reconsider how, when, and with whom they will share. Without the ability to harvest and share enough salmon, the cultural and nutritional needs of Yukon River communities will continue to be unmet.

Recommendations for Future Research

Continued research about harvest and exchange of salmon and other wild foods will enhance understanding of these practices and enable better insight into how subsistence production and distribution networks change over time and respond to fluctuations in resource abundance. Conducting longitudinal network studies in select communities on an annual basis and in communities from various regions of the river would be necessary for analyzing changes over time. Alternatively, postseason salmon harvest surveys that are already conducted annually in most Yukon River communities could easily be modified to efficiently collect network information.

Research has continued to show that the distribution of wild foods from rural communities to urban communities is commonplace; however, all past research has been from the perspective of rural residents and their role in subsistence networks. Conducting research with residents of urban areas could help researchers and managers better understand howsome urban residents are connected to rural Alaska communities , and how customary and traditional subsistence practices are carried out by urban Alaskan residents. Such inquiry could increase understanding of the degree to which urban residents support rural residents for subsistence related activities and whether urban residents return to rural communities to participate in subsistence activities.

Future research could also explore correlations between household or community food security scores and network position or structure, and help evaluate whether certain household and network characteristics lead to increased food security.

Research methods used in future projects should continue to be adapted to most accurately capture patterns of cooperation in harvest and processing activities and exchange of resources. The way in which exchange practices are asked about should be carefully considered, especially the distinction between delayed reciprocity and barter.

Cooperative fishing networks could be documented in more detail than they were in this study by separating the roles of harvesting, processing, and providing support or equipment. In the lower Yukon River, research could compare commercial and subsistence cooperative production networks. For both cooperative production and exchange networks, more fine-grained measures of household demographic characteristics could be utilized in future studies to better investigate the relationships between household demography and participation in cooperative production and exchange. Similarly, connections between additional socio-economic factors and salmon harvests could be further explored. Such characteristics could include the number of people actively contributing to subsistence, access to subsistence equipment and fish camps, household income, money needed to purchase fuel and other supplies, and numbers of adults, dependent children, and elders in a household. Including these additional factors, as well as using valued ties (pounds

of salmon given or received), in ERGM analysis could improve model outputs and produce more significant results.

Finally, if managers do choose work towards more holistic management, where subsistence resources and practices are considered together rather than apart from one another, interdisciplinary research will be critically necessary to broaden the understandings of how community needs, resource availability, and environmental change and interplay with one another. Taken together, these recommendations build towards a more nuanced understanding of subsistence economies and exchange practices.

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APPENDIX A–OSU COOPERATIVE AGREEMENT

Alaska Department of Fish and Game

Division of Administrative Services

P.O. Box 115526

Juneau, AK 99811-5526

Cooperative Agreement Number 19-057

Title: Subsistence salmon networks in Yukon River communities

Between:

Alaska Department of Fish and Game

Division of Subsistence

and

Oregon State University

I. AUTHORITY:

This cooperative agreement is made and entered into between the Alaska Department of Fish and Game, Division of Subsistence (hereinafter referred to as "ADF&G" or "the Department") and the Oregon State University, Office for Sponsored Research and Award Administration, 312 Kerr Administration Building, Corvallis, Oregon 97331 (hereinafter referred to as "OSU"). ADF&G enters into this cooperative agreement under the authority of AS 16.05.050(13) and AS 36.30.850(b)(20).

This agreement provides support for a project titled "Subsistence salmon networks in Yukon River communities". The project is a cooperative venture coordinated by ADF&G and funded by an ANILCA 809 agreement with the U.S. Fish and Wildlife Service, Office of Subsistence Management (OSM).

II. PURPOSE OF THE AGREEMENT:

ADF&G received funding to document the harvest and use of salmon in 3 communities along the Yukon River: Pilot Station, Nulato, and Beaver, each of which has a unique regional sharing pattern as identified during previous studies carried out by project researchers. Salmon are harvested under different state and federal regulations, some of which address the exchange of subsistence resources. The goal of this project is to provide information on how the exchange of salmon operates within social networks and how those networks function within salmon-based Yukon River subsistence economies. Understanding how the social obligations of sharing that underpin subsistence economies drive harvest will help State and Federal managers anticipate fluctuations in subsistence harvests in order to develop locally meaningful and effective regulations, especially in times of low abundance. A description of the way salmon move throughout these networks will be useful in the allocation and management of subsistence resources.

This agreement supports OSU's involvement in this project for the analysis of network data in Yukon River communities. This partnership with OSU ensures comparability with other subsistence network research in Alaska, including the description and analysis of the subsistence salmon network in Bristol Bay.

III. OBJECTIVES:

The objectives of this agreement are:

A. Using a social network survey and building on documented harvest data from the fall 2018, systematically document the scope of and local characteristics of exchange in Pilot station, Nulato, and Beaver, paying attention to exchanges both within and between communities;

B. Using the assembled social network data as an empirical framework, conduct indepth ethnographic interviews about exchange practices, including amounts and species shared, relationships between people who shared wild food, decision making factors that structure sharing, the ceremonial context of exchange, forms of exchange, such as sharing, barter, and customary trade, perceptions of change in the environment and how these affect exchange practices, and perceptions of change in exchange practices over time; and

C. Contribute to local capacity building by utilizing a framework of community involvement in research.

D. Summarize research findings and data analysis in a project final report.

The research will employ two integrated social science data gathering methods: systematic household surveys and key respondent interviews. Building off post-season harvest data from 2018, the survey will also record different types of exchanges (sharing, barter, and customary trade). Survey data will be collected in all 3 communities in spring 2019. The ethnographic research for this project will include anthropological methods of semi-structured key respondent interviews framed around the topics listed above and developed in consultation with the tribal councils and other knowledgeable community members. Researchers will attempt to conduct 5-10 interviews per community, also in spring 2019. Data analysis of both datasets will occur between May 2019 and March 2020.

The project will be carried out by Subsistence Resource Specialists at the ADF&G Division of Subsistence and researchers from OSU. Primary responsibilities shared between partners will include administering the surveys, interviewing key respondents, analyzing the network surveys and key respondent interview data, and writing the draft final report. ADF&G will work to get community approval, arrange for local research assistants, and conduct community review meetings at the end of the project.

IV. TERMS OF THE AGREEMENT:

This agreement begins September 1, 2018, and ends June 30, 2021.

V. PROJECT CONTACTS:

OSU (DUNS 053599908)

Dr. Drew Gerkey, Assistant Professor
Department of Anthropology
238 Waldo Hall
Corvallis, OR 97331
Ph: (541) 737-3793
Email: drew.gerkey@oregonstate.edu

ADF&G (DUNS 809387475)

Alida Trainor, Subsistence Resource Specialist
Division of Subsistence
1300 College Rd
Fairbanks, AK 99701
Ph: (970) 328-6115
alida.trainor@alaska.gov

VI. FINANCIAL CONSIDERATIONS:

The total amount of this agreement shall not exceed ($82,661.00) during the course of the project period (expires June 30, 2021). ADF&G will distribute funds in accordance with the following budget:

Year	Professor and Graduate Student Cost	Travel	Markup/Indirect (47%)	Total
FY19	20,915	5,993	12,647	**39,555**
FY20	14,941		7,022	**21,963**
FY21	10,260	4,123	6,760	**21,143**
Total	**$46,116**	**$10,116**	**$26,429**	**$82,661**

Submitted invoices will detail financial information for the completed portion of the project and adequately document the expenses incurred for direct and indirect costs. All invoices will include a detailed listing of expenses by budget category and a signed certification. All costs will be supported by source documentation, which will be made available to ADF&G upon request.

OSU will submit an invoice for cost-reimbursement based on monthly invoices to ADF&G, who will remit payment within 30 days of receipt of invoice. Payment made upon acceptance of deliverables, as follows:

1. OSU will assist ADF&G with administration of household harvest surveys and key respondent interviews in study communities of Pilot station, Nulato, and Beaver. January – May 2019: $39,995

2. OSU will assist ADF&G with analysis of key respondent interview and household survey social network data. July 2020 – March 2020: $21,963

3. OSU will assist ADF&G with writing draft final report. July 2020 – June 2021 (20%) - $21,143

VII. FEDERAL COMPLIANCE REQUIREMENTS:

1. Political Activity – Federal funds cannot be used for partisan political purposes of any kind by any person or organization involved in the administration of federally assisted programs.

2. Civil Rights – No person shall, on the grounds of race, color, national origin, age, or handicap, be excluded from participation in or be subjected to discrimination in any program or activity funded in whole or in part by federal funds.

3. Allowable Costs/Cost Principles – 2 CFR Part 225, "Cost Principles for State, Local, and Indian Tribal Governments" (OMB Circular No. A-87) establishes principles and standards for determining costs for Federal awardees carried out through grants, cost reimbursement

contracts, and other agreements with State and local governments and federally-recognized Indian tribal governments (governmental units). A cost is allowable for federal reimbursement only to the extent of benefits received by federal programs, and costs must meet the basic guidelines for allowability, reasonableness, and allocability.

4. Drug-Free Workplace Act – OSU, by signing this agreement, certifies that they will provide a drug-free workplace.

5. Debarment/Suspension – OSU, by signing this agreement, certifies that neither it, nor its principals or subcontractors is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from federal financial assistance programs or activities.

6. Audits – OSU acknowledges that 100% of the funding for this agreement is from the Federal Fish and Wildlife Service, OSM Project 18-252, CFDA 15.636. OSU acknowledges that receipt of federal funds may create audit requirements under OMB 2 CFR 200.

VIII. GENERAL PROVISIONS

1. Nothing in this agreement shall obligate any party in the expenditure of funds, or for future payments of money, in excess of appropriations authorized by law.

2. Each party shall be responsible only for the acts, omissions, or negligence of its own officers, employees or agents and agrees to hold the other harmless, to indemnify the other, its officers, agents and employees from any and all liability, actions, claims, losses or damages that may be asserted by any person or entity arising from, during, or in connection with the performance of the work described in this Agreement, when such liability, action, claim, loss or damage results from the action of that party in the course of this Agreement. OSU's compliance with this provision is limited to the extent permitted by the Oregon Tort Claims Act (ORS 30.260 – 30.300).

3. Both parties agree to comply with all applicable federal or State laws regulating ethical conduct of public officers and employees.

4. Each party will comply with all applicable laws, regulations, and executive orders relative to Equal Employment Opportunity.

5. Nothing herein is intended to conflict with federal, state, or local laws or regulations. If there are conflicts, this agreement will be amended at the first opportunity to bring it into conformance with conflicting laws or regulations.

6. Policy and position announcements relating specifically to this cooperative program may be made only by mutual consent of the agencies.

7. The effective date of this agreement shall be September 1, 2018.

8. The termination date of this agreement shall be June 30, 2021. However, either party may terminate its participation in this agreement by providing to the other party notice in writing 30 days in advance of the date on which its termination becomes effective.

   In addition, either party may terminate this Agreement, immediately upon notice to the non-terminating party, or at a later date as may be established in the notice, upon the occurrence of any of the following events:

   a. The terminating party fails to receive funding, appropriations, limitations, allotments, or other expenditure authority sufficient to allow the terminating party, in the exercise of its reasonable administrative discretion, to meet its obligations under this Agreement;

   b. Federal or state laws, regulations, or guidelines are modified or interpreted in a way that: in the case of ADF&G, either the purchase of services by ADF&G under this Agreement is prohibited, or ADF&G is prohibited from paying for services from the planned funding source; or in the case of OSU, the services provided under this Agreement are no longer allowable; or

   c. The non-terminating party is in material breach of any covenant, warranty, obligation or other provision under this Agreement and fails to cure such breach within 30 days of the terminating party's written notice to the non-terminating party notifying the non-terminating party of the breach.

9. All notices or other communications under this Agreement shall be directed to the persons listed below. Notices must be in writing and, unless otherwise expressly set forth in this Agreement, shall be delivered in person, by email, first class mail, fax, registered or certified mail, or overnight delivery Service to the other party at its respective address, email address, or fax number set forth below. All notices are effective upon receipt by the party to be notified.

To ADF&G:	**To OSU:**
Alaska Department of Fish and Game Subsistence Resource Specialist III Attention: Alida Trainor 1300 College Rd Fairbanks, AK 99701 907-328-6115 alida.trainor@alaska.gov	Oregon State University, Office for Sponsored Research and Award Administration Attention: Patricia A. Hawk, Asst. VP for Research 312 Kerr Administration Building 1500 SW Jefferson Way Corvallis, OR 97331 Tel: 541.737.4933 sponsored.programs@oregonstate.edu
	Notices only to:
Alaska Department of Fish and Game Subsistence Administrative Assistant III 1300 College Rd Fairbanks, AK 99701 pam.amundson@alaska.gov	Office for Sponsored Research & Award Administration Attention: Patricia A. Hawk, Asst. VP for Research Oregon State University 312 Kerr Administration Building Corvallis, OR 97331-2140

	Tel: 541.737.4933 Fax: 541.737.3093 sponsored.programs@oregonstate.edu

10. No party may assign any of its rights or delegate any of its duties under this Agreement, voluntarily or involuntarily, whether by merger, consolidation, dissolution, or operation of law, or any other manner, except with the prior written consent of the non-transferring party. The non-transferring party shall not unreasonably withhold its consent.

11. A free exchange of research and assessment data among agencies is encouraged and is necessary to insure the success of these cooperative studies.

12. The relationship of ADF&G and OSU under this Agreement shall be that of independent contractors and neither party shall be deemed, nor hold itself out as being, a partner, joint venture, or principal and agent of the other. Neither party shall have the authority to take any actions, or make any statements, representations or commitments that are binding on the other party, except as explicitly provided for herein or otherwise authorized in writing by the other party.

13. This agreement may be amended by mutual written consent of the parties.

14. The parties certify and represent that the individual(s) signing this Agreement has been authorized to enter into and execute this Agreement on behalf of ADF&G and OSU respectively, under the direction of each party's governing body, commission, board, officers, members, or representatives and to bind their respective agencies.

15. If any provision of this Contract is determined to be invalid, illegal or unenforceable, the remaining provisions of this Contract remain in full force and effect if the essential terms and conditions of this Contract for both parties remain valid, legal and enforceable.

16. This Agreement may be executed in several counterparts (facsimile or otherwise) all of which when taken together shall constitute one agreement binding on all parties, notwithstanding that all parties are not signatories to the same counterpart. Each copy of this Agreement so executed shall constitute an original.

17. THIS AGREEMENT CONSTITUTES THE COMPLETE, FINAL AND EXCLUSIVE AGREEMENT BETWEEN THE PARTIES WITH RESPECT TO THE SUBJECT MATTER HEREOF. THERE ARE NO UNDERSTANDINGS, AGREEMENTS OR REPRESENTATIONS, ORAL OR WRITTEN, NOT SPECIFIED HEREIN REGARDING THIS AGREEMENT. THIS AGREEMENT SUPERSEDES ALL PRIOR OR CONTEMPORANEOUS CONTRACTS, WARRANTIES, AGREEMENTS, REPRESENTATIONS OR UNDERSTANDINGS, IF ANY, WRITTEN OR ORAL. NO WAIVER, CONSENT, MODIFICATION OR CHANGE OF TERMS OF THIS AGREEMENT SHALL BIND EITHER PARTY UNLESS IN WRITING, CLEARLY IDENTIFIED AS A WAIVER, CONSENT, MODIFICATION OR CHANGE OF TERMS OF THIS AGREEMENT, AND SIGNED BY THE PARTY AGAINST WHOM IT IS TO BE ENFORCED. ANY SUCH WAIVER, CONSENT, MODIFICATION OR CHANGE SHALL BE EFFECTIVE ONLY IN THE SPECIFIC INSTANCE AND FOR THE SPECIFIC PURPOSE GIVEN.

IX. Approving Signatures:

For Oregon State University:

CTW Vickie Watkins

Vickie Watkins
Grant and Contract Officer

4/8/2019
Date

For the Alaska Department of Fish and Game:

Lisa Olson, Director
Division of Subsistence

4-11-19
Date

Samantha Gaddis, Deputy Director
Division of Administrative Services

4/10/19
Date

FED FWS Sub Salmon Networks in the Yukon
Oregon State University
COOP 19-057
OSU14196

Reduction per Amendment One

		Fund		Dept		Unit		Appr Unit		Obj		Function		Program		Phase
$(22,000.00)	=	1004	-	11	-	7030	-	110701002	-	3061	-	7011730637	-	7011730637	-	F19034

319510

Amendment One

Cooperative Agreement Number 19-057
Title: Subsistence Salmon Networks in Yukon River Communities

Between:
Alaska Department of Fish and Game
Division of Subsistence
and
Oregon State University

II. Financial Considerations are amended as follows:

The total amount of this agreement shall not exceed $60,661.00 during the course of the project period (expires June 30, 2021. ADF&G will distribute bunds in accordance with the following budget.

Year	Professor and Graduate Student Cost	Travel	Markup/Indirect (47%)	Total
FY19	-	-	-	-
FY20	10,242.60	1,873.37	5,694.51	17,810.48
FY21	25,027.01	4,123.00	13,700.50	42,850.52
Total	**35,269.61**	**5,996.37**	**19,395.01**	**60,661.00**

All other terms and conditions of the original contract remain the same.

Signatories:

Oregon State University

Vickie Watkins
Vickie Watkins

11/17/2020
Date

Alaska Department of Fish and Game

Lisa Olson
Division of Subsistence

11-17-2020
Date

Melissa Hill, Deputy Director
Division of Administrative Services

11-17-2020
Date

APPENDIX B–SURVEY FORMS

Appendix B-1.–ADF&G Division of Commercial Fisheries Yukon Area Postseason Harvest Survey

Use ID: Map Page: Data Entry: Error Check:

Date of Survey _____
Interviewer _____
Person Interviewed _____
Relation to HH _____

HHID# Community:
Head of Household:
Significant Other:
Mailing Address: Phone#

CONFIDENTIAL INFORMATION - 2018 Yukon Area Post-Season Subsistence Salmon Harvest Survey

Coastal District (Hooper and Scammon Bay) – District 2

1. **We would like to make sure we have the correct name and address for your household.**

Head of Household_____ Permanent Note_____
Mailing Address_____ Telephone_____
Significant Other_____ Permanent Note_____

2. **How many people live in your household?**_____

3. **Did anyone in your household harvest salmon for subsistence use OR keep fish for subsistence use from commercial fishing?**
Yes_____ No_____

Harvest includes catching or cutting salmon. If household retained fish from commercial openings, or subsistence fished, complete all of PART 1. Otherwise go to PART 2.

Adult household member declined to be interviewed. [ ] Reason given: _____

4. **May I have your salmon catch calendar?** Yes ____ No ____ Already mailed ____ (Entire harvest on calendar? _____)
___Didn't get one

PART 1: HOUSEHOLDS THAT CAUGHT SALMON

5. **How many total salmon did <u>you or your fishing</u> GROUP catch?**
SUMMER CHUM _____ FALL CHUM _____ COHO _____ PINK _____ CHINOOK _____

6. **How many households helped to catch these fish?** _____ (Names) _____
_____

*7. **How many total salmon did <u>your household</u> harvest for subsistence purposes? What district(s) were they from?**
(Include <u>only fish caught by this household</u>, not the group, <u>includes fish kept from commercial periods</u> and <u>lost fish</u>.)

Coastal/Ocean 1 2 3 4A 4B 4C 5A 5B 5C 5D (Ft Yukon ↑ or ↓) **Innoko R.** Koyukuk R. Tanana R..

Area_____ CHINOOK♦_____ SUMMER CHUM♦_____ FALL CHUM_____ COHO_____ PINK _____
Area_____ CHINOOK♦_____ SUMMER CHUM♦_____ FALL CHUM_____ COHO_____ PINK _____
Total (two areas) CHINOOK♦_____ SUMMER CHUM♦_____ FALL CHUM_____ COHO_____ PINK _____

8. **What is your household's main fishing GEAR?** (1= catches the most salmon, 2 = secondary)
SET NET_____ DRIFT NET_____ FISH WHEEL_____ DIPNET_____ B. SEINE_____ H&L_____ OTHER_____

♦ <u>8A.</u> H**ouseholds that harvested ♦<u>Chinook salmon</u> or ♦<u>summer chum</u>: enter <u>number</u> caught by mesh size or gear type.**
CHINOOK: 4"_____ 6"_____ 7.5"_____ F.WHEEL_____ OTHER/NOTE _____
S. CHUM: 4"_____ 6"_____ 7.5"_____ F.WHEEL_____ DIPNET_____ B. SEINE_____ OTHER/NOTE_____
Gear comment (needed gear, able to get enough fish, etc.): _____

9. **Did you commercial fish?** Yes____ No ____ **Did you keep any fish from commercial fishing?** Yes____ No ____
CHINOOK _____ SUMMER CHUM _____ FALL CHUM _____ COHO _____ PINK _____

10. **Did your household "LOSE" any salmon? (e.g. to bears, birds, flies, disease, injury, etc.)** (____ None lost)
(If fish was fed to dogs then it was not lost; include on Q18) **Ensure lost fish were included in harvest** Q7)
Number of fish and reason(s) for LOSS: _____

11. **Did your household SHARE the salmon catch with any other households?** (names, species and numbers)
_____
_____
_____

12. **How many salmon did you KEEP for <u>your household's</u> use? ("Harvest" minus fish "shared" and "lost")
CHINOOK _____ SUMMER CHUM _____ FALL CHUM _____ COHO _____ PINK _____

Coastal District (Hooper and Scammon Bay) – District 2

Rite in the Rain

HHID: Head of Household:

PART 2: TO BE ASKED OF ALL HOUSEHOLDS

****13. Was your household GIVEN any salmon? Yes ____ No ____** Code: S=Subsistence, C=Commercial, T=Test Fish

Code: _____ Fishermen/Project (Name) _____

CHINOOK _____ SUMMER CHUM _____ FALL CHUM _____ COHO _____ PINK _____

Code: _____ Fishermen/Project (Name) _____

CHINOOK _____ SUMMER CHUM _____ FALL CHUM _____ COHO _____ PINK _____

14. Did your household catch any OTHER FISH besides salmon? Yes _____ No _____

(Harvest numbers should include from September/October of last year to now. Large whitefish are 4 pounds or greater.)

Large whitefish: BROAD _____ HUMPBACK _____ SMALL WHITEFISH (Cisco, Round whitefish) _____

SHEEFISH _____ BURBOT _____ PIKE _____ BLACKFISH _____ GRAYLING _____ EELS (Lamprey) _____

TOMCOD (Saffron) _____ HERRING (NUMBER **OR** POUNDS)_____ ROE ON KELP (POUNDS)_____

Other Fish Notes (note if pounds or number) _____

15. How many DOGS (including puppies) does your household have? _____ (if "none" go to question 19)

16. Do you feed WHOLE salmon to your dogs? Yes _____ No **_____** Only Feed **SCRAPS** ____ (if "No" go to question 19)

17. Were any of the salmon put up for the dogs from the commercial fishery? Yes _____ No _____

18. Estimate harvest of salmon put up for dogs this year by fishery (numbers should represent WHOLE FISH, not scraps):

(Subsistence) CHINOOK _____ SUMMER CHUM _____ FALL CHUM _____ COHO _____ PINK _____

(Commercial) CHINOOK _____ SUMMER CHUM _____ FALL CHUM _____ COHO _____ PINK _____

19. Do you have any questions or comments? How did this year compare to last year? Did you get enough? _____

_____

_____

_____

_____

_____

_____

Do you want someone to call you back? _____

THANK YOU! THIS INFORMATION IS USED TO DOCUMENT THE SUBSISTENCE SALMON HARVEST WITHIN THE YUKON RIVER DRAINAGE AND TO TRY TO ENSURE THERE WILL BE ENOUGH SALMON FOR THE FUTURE.

Surveyor Comments:

Reminder: How many people live in this Household? _____ Please verify correct address and phone numbers

Official Use - This area is to be filled in by Fish and Game.

HOUSEHOLD'S TOTAL SUBSISTENCE SALMON CATCH (Totals from question *7)

CHINOOK _____ SUMMER CHUM _____ FALL CHUM _____ COHO _____ PINK _____

HOUSEHOLD'S TOTAL SUBSISTENCE SALMON USE (Add totals from questions **12 and **13)

CHINOOK _____ SUMMER CHUM _____ FALL CHUM _____ COHO _____ PINK _____

Complete Survey _____ Partial Survey _____ No Survey _____

Rite in the Rain

SALMON NETWORKS

PILOT STATION, ALASKA

YUKON RIVER
SALMON NETWORKS

From May 15, 2018 to December 31, 2018

printed: 2019-05-02

Exchange and sharing of subsistence-caught fish and wildlife is fundamental to subsistence-based economies in Alaska. This not only allows wild food to be distributed among households and communities but is also an important social and cultural practice. Documenting the exchange of salmon will help managers and regulatory authorities better understand this customary and traditional practice, and more specifically, understand how declining salmon abundance and increased fishing restrictions may be affecting households' abilities to get the salmon they need through these exchange networks.

This survey is voluntary and confidential. You may stop at any time. No names will be recorded on this survey. This information is strictly for research purposes and will not be used for enforcement of any kind.

HOUSEHOLD ID:		
COMMUNITY ID:	273	273
INTERVIEWER #1:		
INTERVIEWER #2:		
INTERVIEW DATE:		
START TIME:		
STOP TIME:		
DATA CODED BY:		
DATA ENTERED BY:		
SUPERVISOR:		

Photo by

Photo by

ALASKA DEPARTMENT OF FISH AND GAME
1300 COLLEGE RD
FAIRBANKS, AK 99701
907-459-7321

HOUSEHOLD MEMBERS

HOUSEHOLD ID

First, I would like to ask about the people in your household, permanent members of your household who sleep at your house. This includes students who return home every summer. I am NOT interested in people who lived with you temporarily, even if they stayed several months.

Last year, that is, between May 15, 2018 and December 31, 2018 WHO were the head or heads of your household?

Is this person answering questions on this survey?		How is this person related to HEAD 1?	Is this person MALE or FEMALE?	Is this person an ALASKA NATIVE?	How OLD is this person?	Where were parents living when this person was born?	How many years has this person lived in Pilot Station?	SALMON	
								FISH FOR	PROCESS
ID #	*(circle)*	*(relation)*	*(circle)*	*(circle)*	*(years)*	*(AK city or state)*	*(number)*	*(circle)*	*(circle)*
HEAD 1	Y N		M F	Y N				Y N	Y N
1									
NEXT enter spouse or partner. If a household has a SINGLE HEAD, leave HEAD 2 row BLANK and move to PERSON 3.									
HEAD 2	Y N		M F	Y N				Y N	Y N
2									
BELOW, enter children (oldest to youngest), grandchildren, grandparents, or anyone else living full-time in this household.									
PERSON 03	Y N		M F	Y N				Y N	Y N
3									
PERSON 04	Y N		M F	Y N				Y N	Y N
4									
PERSON 05	Y N		M F	Y N				Y N	Y N
5									
PERSON 06	Y N		M F	Y N				Y N	Y N
6									
PERSON 07	Y N		M F	Y N				Y N	Y N
7									
PERSON 08	Y N		M F	Y N				Y N	Y N
8									
PERSON 09	Y N		M F	Y N				Y N	Y N
9									
PERSON 10	Y N		M F	Y N				Y N	Y N
10									
PERSON 11	Y N		M F	Y N				Y N	Y N
11									
PERSON 12	Y N		M F	Y N				Y N	Y N
12									
PERSON 13	Y N		M F	Y N				Y N	Y N
13									

PERMANENT HH MEMBERS: 01 **PILOT STATION: 273**

HARVEST REVIEW: SALMON

HOUSEHOLD ID

Last fall, the Department of Fish and Game sent surveyors to your community to collect information on the harvest of salmon. Our survey includes questions on how salmon harvested by households in 2018 were, shared, traded, or were sold for cash. Before we get into those questions, we wanted to first verify that our records of your households fishing activities in 2018 are complete and accurate.

Did you or any member of your household participate in a commercial fishery in 2018?..... Y N

Note to Surveyor: If the household harvest data from 2018 indicate NO FISHING ask the NON-HARVESTER questions, if the household IS A FISHING HOUSEHOLD, skip this section and go on to the HARVESTER questions in section 2 below. If the household was not surveyed go to section 3 at the bottom of this page.

1 - HOUSEHOLDS THAT DID NOT HARVEST OR RETAIN FROM COMMERCIAL FISHERY *(According to the post season survey)*

Our records from the fall 2018 survey indicate that your household DID NOT harvest salmon in 2018, is that accurate?..... Y N

→ if YES, then skip the rest of this page and proceed to the NEXT PAGE of this survey.

→ **if NO, then,**

→ How many _____ did members of your household harvest in 2018?

CHINOOK	SUMMER CHUM	FALL CHUM	COHO	OTHER (Specify) _____

Follow-up. Do these numbers include salmon retained from commercial fishing for home use?

→ Is there any reason you can think of that might explain why the incorrect information was recorded for your household?

_____

_____

→ Skip to the ASSESSMENTS questions on the next page.

2 - HOUSEHOLDS THAT DID HARVEST OR RETAIN COMMERCIAL SALMON FOR HOME USE *(According to the post season survey)*

Check this household's records, fill in harvest amounts below for each species and verify the amounts –

Our records from the fall 2018 survey indicate that members of your household harvested,

_____ Chinook _____ Summer chum _____ Fall chum _____ Coho _____ Other (_____)

Do these numbers look accurate to you?..... Y N

→ if YES, then skip the rest of this page and proceed to the NEXT PAGE of this survey.

→ **IF NO, then**

→ How many _____ did members of your household harvest in 2018?

CHINOOK	SUMMER CHUM	FALL CHUM	COHO	OTHER (Specify) _____

Follow-up. Do these numbers include salmon retained from commercial fishing for home use?

→ Is there any reason you can think of that might explain why the incorrect information was recorded for your household?

_____

_____

3 - HOUSEHOLDS THAT DID NOT PARTICIPATE IN THE POST SEASON SURVEY.

Thinking about the 2018 SALMON fishing season, …

Did members of your household harvest salmon or retain commercial salmon from home use? Y N

If yes, how many did you harvest?

CHINOOK	SUMMER CHUM	FALL CHUM	COHO	OTHER (Specify) _____

SALMON: 04 **PILOT STATION: 273**

ASSESSMENTS: SALMON

HOUSEHOLD ID

3 - ASSESSMENTS: SALMON 110000000

Thinking about the 2018 SALMON fishing season, …

… did your household use LESS, SAME, or MORE other fish than in recent years? ..... X L S M

IF LESS or MORE … X = do not use

WHY was your use different? 1 2

…did your household GET ENOUGH salmon?..... Y N

If NO…

HOW MUCH MORE salmon did your household need?

Chinook *(amt)* Summer Chum *(amt)* Fall Chum *(amt)* Coho *(amt)* Other (Specify) *(amt)*

How would you describe the impact to your household of not getting enough other fish last year? *.. not noticable?* (0) *… minor ?* (1) *… major?* (2) *... Severe?* (3)

Did your household do anything DIFFERENTLY because you did NOT get enough SALMON?..... Y N

IF YES…

What did your household do differently?..... 1 2

If you usually fish in a group with other households, has the portion of the group harvest that your households takes home changed over time? Y N

…IF YES, WHY?

SALMON: 04 **PILOT STATION: 273**

EXCHANGE NETWORKS: SALMON

HOUSEHOLD ID

If this household did NOT USE or HARVEST salmon last year, SKIP this page.

Otherwise, continue with exchange network sections starting below…

Sharing is an important way in which people access the wild foods they need. It is also an imporant social and cultural practice. We'd like to learn more about sharing so that we can better understand the role that sharing plays in increasing access to salmon. I will ask you about your sharing exchanges, but I will not record any names on this survey. (Show network diagram)

Since last fishing season, did you share (give) salmon to any other households INSIDE Pilot Station besides those that you fished or processed with? …… Y N

… IF YES, who did you share with?

	GAVE TO HOUSEHOLDS INSIDE THE COMMUNITY									
	HHID	Relationship? (Friends, Family, Other?)	Elder HH Y / N	Species	Amount Given	Units	Processing Type	Number of Duplicate exchanges	Have you ever given salmon to this hh in the past?	NOTES
1			Y N						Y N	
2			Y N						Y N	
3			Y N						Y N	
4			Y N						Y N	
5			Y N						Y N	
6			Y N						Y N	
7			Y N						Y N	
8			Y N						Y N	
9			Y N						Y N	
10			Y N						Y N	
11			Y N						Y N	
12			Y N						Y N	
13			Y N						Y N	
14			Y N						Y N	
15			Y N						Y N	

NOTE: Include only those salmon you GAVE TO households INSIDE Pilot Station.

Did your household receive salmon from the test fishery in 2018?..... Y N

IF YES…

How many _____ did your household get from the test fishery in 2018?

CHINOOK	SUMMER CHUM	FALL CHUM	COHO	OTHER (Specify) _____

EXCHANGE NETWORKS FOR SALMON: 67 **PILOT STATION: 273**

EXCHANGE NETWORKS: SALMON

HOUSEHOLD ID

If this household did NOT USE or HARVEST salmon last year, SKIP this page.

Otherwise, continue with exchange network sections starting below…

Since last fishing season, did you share (give) salmon to any other households OUTSIDE Pilot Station besides those that you fished or processed with? …… Y N

… IF YES, who did you share with?

GAVE TO HOUSEHOLDS OUTSIDE THE COMMUNITY

	COMM NUM	Relationship? (Friends, Family, Other?)	Elder HH Y / N	Species	Amount Given	Units	Processing Type	Number of Duplicate exchanges	Have you ever given salmon to this hh in the past?	NOTES
1			Y N						Y N	
2			Y N						Y N	
3			Y N						Y N	
4			Y N						Y N	
5			Y N						Y N	
6			Y N						Y N	
7			Y N						Y N	
8			Y N						Y N	
9			Y N						Y N	

NOTE: Include only those salmon you GAVE TO households OUTSIDE Pilot Station.

Since last fishing season, did you receive salmon from any other households OUTSIDE of Pilot Station besides those that you fished or processed with… Y N

… IF YES, who did you receive from?

RECEIVED FROM HOUSEHOLDS OUTSIDE THE COMMUNITY

	COMM NUM	Relationship? (Friends, Family, Other?)	Elder HH Y / N	Species	Amount Given	Units	Processing Type	Number of Duplicate exchanges	Have you ever received salmon from this hh in the past?	NOTES
1			Y N						Y N	
2			Y N						Y N	
3			Y N						Y N	
4			Y N						Y N	
5			Y N						Y N	
6			Y N						Y N	
7			Y N						Y N	
8			Y N						Y N	
9			Y N						Y N	

NOTE: Include only those salmon you RECEIVED FROM households OUTSIDE Pilot Station.

EXCHANGE NETWORKS FOR SALMON: 67 **PILOT STATION: 273**

EXCHANGE NETWORKS: SALMON

HOUSEHOLD ID

…continued from previous page

Since last fishing season, did your households give salmon to a community event or feast, such as a potlatch?..... Y N

… IF YES

		GIVEN away				
	Event type	Species	Amount Given	Units	Processing Type	NOTES
1						
2						
3						

Since last fishing season, did your households receive salmon from a community event or feast, such as a potlatch?..... Y N

… IF YES

		RECEIVED				
	Event type	Species	Amount Given	Units	Processing Type	NOTES
1						
2						
3						

Compared to recent years, would you say the amount of salmon you SHARED since the last fishing season is LESS, about the SAME, or MORE? L S M ?

If LESS or MORE, why was your SHARING different? _____

Have your household's sharing patterns changed over the past 10 years?..... Y N

IF YES, How? _____

Has the amount of _____ your household shares changed over time?

CHINOOK	SUMMER CHUM	FALL CHUM	COHO	OTHER (Specify) _____
L S M X	L S M X	L S M X	L S M X	L S M X

X = Does not share

Has the number of households you share with changed over time? L S M X

X = Doesn't share

Overall, what factors have had the greatest impact on your salmon sharing patterns?

_____

_____

_____

_____

Do you have any other comments related to the sharing of salmon? _____

_____

_____

_____

EXCHANGE NETWORKS FOR SALMON: 67 **PILOT STATION: 273**

BARTER AND CUSTOMARY TRADE OF: SALMON

HOUSEHOLD ID

If this household did NOT USE or HARVEST salmon last year, SKIP this page.

Otherwise, continue with exchange network sections starting below…

Although sharing is the most common way salmon is exchanged, there are other traditional ways that salmon can be exchanged such as barter or customary trade. "Barter" refers to trading a subsistence food for something else (other wild foods, supplies or other non-cash items). "Customary trade" refers to exchanging subsistence foods for small amounts of cash. These are also important ways in which people can access the wild foods or supplies they need. We would like to better understand the role these types of exchanges play in increasing access to salmon and other resources and compare that to the role that sharing plays.

BARTER

Since the last fishing season, did anyone in your household exchange (give or receive) salmon for other subsistence foods, or other goods or services? Y N

… IF YES, could you describe those?

	HH ID	or	COMM NUM	Relationship? (Friends, Family, Other?)	Elder HH Y / N	Have you bartered with this hh in the past?	GIVEN away: Species / item	Amt Given	Units	Processing type	RECEIVED: Species / item	Amt Received	Units	Processing type
1					Y N	Y N								
2					Y N	Y N								
3					Y N	Y N								
4					Y N	Y N								

CUSTOMARY TRADE - BUY

Since the last fishing season, did anyone in your household PAY cash in exchange for salmon? ..... Y N

… IF YES, could you list your purchases?

	HHID	- or -	Community	Relationship? (Friends, Family, Other?)	Elder HH Y / N	Have you bought salmon from this hh in the past?	CUSTOMARY TRADE (BUY): Species / Item	Amount Bought	Units	Processing Type	Cash given $
1					Y N	Y N					
2					Y N	Y N					
3					Y N	Y N					

CUSTOMARY TRADE - SELL

Since the last fishing season, did anyone in your household RECEIVE cash in exchange for salmon? ..... Y N

… IF YES, could you list your sales?

	HHID	- or -	Community	Relationship? (Friends, Family, Other?)	Elder HH Y / N	Have you sold salmon to this hh in the past?	CUSTOMARY TRADE (SELL): Species / Item	Amount Sold	Units	Processing Type	Cash received $
1					Y N	Y N					
2					Y N	Y N					
3					Y N	Y N					

Do you have any comments about the barter or customary trade of salmon in your community? Or in general?

EXCHANGE NETWORKS FOR SALMON: 67 **PILOT STATION: 273**

COMMENTS

HOUSEHOLD ID

DO YOU HAVE ANY QUESTIONS, COMMENTS OR CONCERNS?

INTERVIEW SUMMARY:

DON'T FORGET TO FILL IN THE STOP TIME _____

COMMENTS: 300 **PILOT STATION: 273**

APPENDIX C–INTERVIEW PROTOCOL

SALMON NETWORKS SEMI-STRUCTURED INTERVIEW GUIDE

Name: _____ Birthplace: _____

Birth date: _____ Community of Residence: _____

A note to respondents: Today we are going to discuss your knowledge and experience with the Yukon River salmon fisheries. we are particularly interested in your knowledge of the way Chinook salmon is shared and exchanged in your community. These common exchange practices are well documented historically, but there is little known about how they exist in Yukon River communities today. Are you the person in your household who is charge of sharing and exchanging salmon?

With your consent, we will record this interview to ensure we document this conversation accurately.

Personal fishing history

- What are your first memories of fishing? In what ways did you participate?
    - Who did you fish with?
    - Where did you fish?
    - What kind of gear did you use?
- When did you first start fishing independently as an adult? What year was it? How old were you?
    - 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?
- How has fishing changed since you began fishing?
    - Timing?
    - Gear?
    - Species targeted?

- Do you fish with other people?
    - How do you divide up the salmon you catch together?
    - How do people contribute to the fishing effort? What forms of assistance do various people provide that make it possible for you to fish?
    - Has this changed? Or, what factors change this from year to year?

Assessing Household Needs

- How does your household decide how many salmon are needed in a given year?
- Who makes the decisions about how many salmon to harvest?

- Do you provide salmon to other people and does that affect how you determine what you need?
- Is there a typical amount your household needs each year?
    - What happens if you do not get what you need?
- Are you a commercial fishing household? [FOR PILOT STATION ONLY]
    - Do you ever keep some salmon from your commercial catch? How do you decide when and how many salmon to keep for your own use?
    - Has this changed at all since you've been commercial fishing?

Sharing

- Who do you share with?
    - Does this change from year to year?
    - What factors contribute to your decisions about sharing?
    - How long have you been sharing the salmon you catch with others?

- Do you regularly receive salmon from other households that are simply sharing with you?
- How much do people rely on (how important is it) sharing to get subsistence foods? How would you characterize the significance of sharing in your community? Or outside of it?
- Are there community events or potlatches that you contribute food to? Do you consider this sharing?
- Is there a type of salmon that is most commonly shared? If so, why is this fish significant for sharing? Has this changed?

- Do you share with people outside of your community?
    - If so, what are the reasons you choose to share salmon with these people?
    - How are you related? (friends, family etc?)
    - How do you get your salmon to people living in other communities? Is there a cost associated with that? If so, who pays?
    - Do people from other communities share with you?

- How is the salmon you share typically processed?
- Do you ever plan for harvesting extra to share?
- Have fishing restrictions changed the way you share salmon? How?

Sometimes there is confusion over these terms because when we think of trading, we don't always think of money. In some places trade and barter are used interchangeably. In state and federal law however, customary trade means the exchange of subsistence foods for cash while barter means the exchange of one food for another or one food for another resource.

This interview is going to include questions on both customary trade and barter so we want to make sure we are both on the same page about these terms. Throughout the interview I'll repeat the definitions so neither of us get confused.

Participation in the exchange continuum on the *community* level

- When you share with someone is it common for the recipient to give you something in return? Immediately or at a later time?
- Do people distinguish between sharing and barter?
    - When people exchange one food for another food or good, what is most commonly exchanged?
- Do people in your community make the distinction between barter (trading salmon for another good such as gas or meat) and customary trade (selling or buying salmon)?
- Do people ever sell or buy food from each other?

- How much do people rely on buying subsistence foods? How much do people rely on bartering them?
  [Some additional details you could gather on barter and customary trade]

    - Why are these foods exchanged more than others?
    - How is this food usually processed?
    - How much does this food usually cost? (in terms of both cash or fair barter)

Participation in barter and customary trade on the *household* level

Barter

- Do you ever exchanged subsistence resources for something else (other than cash)?
- Do you every give [actual] gas for the salmon you receive?
    - If yes, are you considered part of the fishing effort? If no, why do you provide gas?
- Do you every receive gas for the salmon you give or share?
    - If yes, how do you consider that person's role in your fishing effort? Is it something you rely on in order to fish or is it a form of compensation for your efforts?

[Be clear about whether it is actual gas or gas money, whether respondents even see the distinction]

- What factors contribute to your decisions to barter?
- When did you first begin bartering subsistence foods?
- How do you decide what a fair exchange is?
- Is the barter of subsistence caught fish important to your household? In what ways?
- Is bartering salmon something you do regularly or occasionally? How frequent?
- Have fishing restrictions changed the way you barter salmon? How?

Buying

- Do you ever buy salmon from others?
- What are some reasons that you buy salmon?
- How is the fish processed when you buy it?
- Do you buy salmon from someone in your community or somewhere else?
- Is buying salmon something you do regularly or occasionally?
- When you buy salmon do you ever give it to other people? How? (share with them, barter it for another food or something other than cash? Sell it?)
- Have fishing restrictions influenced your buying practices or the cost of salmon? How?

Selling

- Do you ever sell some of your salmon?

(If respondent does not sell, skip to community opinions section)

- When did you first start selling subsistence-caught salmon?
- How do you decide how much you will sell? Has this changed for you over time? How?
- How is the fish you sell processed?
- What do you use the money you make from selling salmon used for?
- On average how much money do you make from selling salmon or other fish each year?
- Do you usually sell salmon to people in your community? To people outside your community?
    - Does the cost of fish change depending on who you are selling to? Why?
    - Do you ever travel outside of your community to sell salmon or other fish? Where do you go? How often?
- Earlier we talked about how you decide how many fish you try to harvest. Do you ever plan for harvesting extra to either barter or sell?
- Are there any factors that would deter you from selling fish you caught?
- Is the sale of subsistence caught fish important to your household? In what ways?

- Have fishing restrictions changed the way you sell salmon? How?

Community Opinions

- Generally,
    - How do they feel about buying it? Selling it?
    - Are there circumstances that make buying or selling more or less favorable?

Regulations and restrictions

Earlier research on customary trade showed us that people from all parts of the Yukon River sell salmon; it is not only done by people in just one part of the river. Further, while it is not currently legal on the Yukon River, it is recognized as a customary and traditional subsistence practice in the state subsistence statute. Selling fish as customary trade IS legal in other parts of the state when residents have asked the Board of Fish to consider legalizing it through the Board of Fish process (northwest Alaska, southeast Alaska)

- Are you familiar with the regulations concerning customary trade?
- Do you feel that the regulations take into account the needs of subsistence users? If you were asked to revise the CT regulations, what recommendations would you make?
- Do you think there should be a dollar amount cap or limit on customary trade?
    - What do you think should be the dollar amount to limit customary trade?

APPENDIX D–ADDITIONAL TABLES

Appendix Table D2-1.–Conversion factors, Yukon River Salmon Networks

Resource	Unit	Processing	Conversion Factor
Wild resources			
Salmon (unspecified)	Individual	Whole, unprocessed	5.3 lb
Salmon (unspecified)	Pint	Dried/smoked/stripped/kippered (including jarred)	0.75 lb
Chum salmon (unspecified)	Gallon	Dried/smoked/stripped/kippered (including jarred)	4.8 lb
Chum salmon (unspecified)	Individual	Baked/cooked/boiled (prepared)	3.36 lb
Chum salmon (unspecified)	Individual	Dried/smoked/stripped/kippered (including jarred)	3.36 lb
Chum salmon (unspecified)	Individual	Fillet	3.63 lb
Chum salmon (unspecified)	Individual	Whole, unprocessed	4.48 lb
Chum salmon (unspecified)	Pint	Dried/smoked/stripped/kippered (including jarred)	0.6 lb
Chum salmon (unspecified)	Plastic bag (shopping bag)	Dried/smoked/stripped/kippered (including jarred)	12 lb
Chum salmon (unspecified)	Pound	Dried/smoked/stripped/kippered (including jarred)	1 lb
Chum salmon (unspecified)	Quart	Dried/smoked/stripped/kippered (including jarred)	1.5 lb
Summer chum salmon	Fillet	Baked/cooked/boiled (prepared)	1.36 lb
Summer chum salmon	Gallon	Dried/smoked/stripped/kippered (including jarred)	4.8 lb
Summer chum salmon	Gallon	Fillet	6 lb
Summer chum salmon	Gallon	Salt fish	5.1 lb
Summer chum salmon	Individual	Baked/cooked/boiled (prepared)	3.36 lb
Summer chum salmon	Individual	Dried/smoked/stripped/kippered (including jarred)	3.36 lb
Summer chum salmon	Individual	Whole, unprocessed	4.48 lb
Summer chum salmon	Quart	Dried/smoked/stripped/kippered (including jarred)	1.13 lb
Fall chum salmon	5-gallon bucket	Baked/cooked/boiled (prepared)	22.5 lb
Fall chum salmon	Cup	Dried/smoked/stripped/kippered (including jarred)	0.28 lb
Fall chum salmon	Cup	Raw, gutted (with skin and bones)	0.38 lb
Fall chum salmon	Fillet	Baked/cooked/boiled (prepared)	1.36 lb
Fall chum salmon	Fillet	Fillet	1.81 lb
Fall chum salmon	Fillet	Raw, gutted (with skin and bones)	1.81 lb
Fall chum salmon	Gallon	Dried/smoked/stripped/kippered (including jarred)	4.8 lb
Fall chum salmon	Individual	Baked/cooked/boiled (prepared)	3.36 lb
Fall chum salmon	Individual	Dried/smoked/stripped/kippered (including jarred)	3.36 lb
Fall chum salmon	Individual	Fillet	3.63 lb
Fall chum salmon	Individual	Raw, gutted (with skin and bones)	4.12 lb
Fall chum salmon	Individual	Whole, unprocessed	4.48 lb
Fall chum salmon	Pint	Baked/cooked/boiled (prepared)	1.31 lb
Fall chum salmon	Pint	Dried/smoked/stripped/kippered (including jarred)	0.56 lb
Fall chum salmon	Pint	Raw, gutted (with skin and bones)	0.75 lb
Fall chum salmon	Pound	Dried/smoked/stripped/kippered (including jarred)	1 lb
Fall chum salmon	Quart	Dried/smoked/stripped/kippered (including jarred)	1.13 lb
Fall chum salmon	Quart	Not reported	1.13 lb

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Table D2-1.–Page 2 of 3.

Resource	Unit	Processing	Conversion Factor
Coho salmon	Gallon	Dried/smoked/stripped/kippered (including jarred)	6.5 lb
Coho salmon	Individual	Dried/smoked/stripped/kippered (including jarred)	3.58 lb
Coho salmon	Individual	Fillet	3.63 lb
Coho salmon	Individual	Raw, gutted (with skin and bones)	4.77 lb
Coho salmon	Quart	Dried/smoked/stripped/kippered (including jarred)	1.63 lb
Chinook salmon	Cup	Dried/smoked/stripped/kippered (including jarred)	0.41 lb
Chinook salmon	Fillet	Baked/cooked/boiled (prepared)	3.1 lb
Chinook salmon	Fillet	Dried/smoked/stripped/kippered (including jarred)	3.1 lb
Chinook salmon	Fillet	Fillet	4.14 lb
Chinook salmon	Fillet	Raw, gutted (with skin and bones)	4.14 lb
Chinook salmon	Gallon	Dried/smoked/stripped/kippered (including jarred)	4.8 lb
Chinook salmon	Gallon	Fillet	6 lb
Chinook salmon	Gallon	Salt fish	5.1 lb
Chinook salmon	Individual	Baked/cooked/boiled (prepared)	6.21 lb
Chinook salmon	Individual	Cubed meat, no bones	8.28 lb
Chinook salmon	Individual	Dried/smoked/stripped/kippered (including jarred)	6.21 lb
Chinook salmon	Individual	Fillet	8.28 lb
Chinook salmon	Individual	Heads	1.32 lb
Chinook salmon	Individual	Not reported	8.28 lb
Chinook salmon	Individual	Raw, gutted (with skin and bones)	8.28 lb
Chinook salmon	Individual	Salt fish	7.03 lb
Chinook salmon	Individual	Whole, unprocessed	8.28 lb
Chinook salmon	Pint	Baked/cooked/boiled (prepared)	0.81 lb
Chinook salmon	Pint	Dried/smoked/stripped/kippered (including jarred)	0.81 lb
Chinook salmon	Pint	Raw, gutted (with skin and bones)	1.02 lb
Chinook salmon	Plastic bag (shopping bag)	Fillet	12 lb
Chinook salmon	Pound	Bellies	1 lb
Chinook salmon	Pound	Dried/smoked/stripped/kippered (including jarred)	1 lb
Chinook salmon	Pound	Fillet	1 lb
Chinook salmon	Pound	Raw, gutted (with skin and bones)	1 lb
Chinook salmon	Quart	Baked/cooked/boiled (prepared)	1.63 lb
Chinook salmon	Quart	Dried/smoked/stripped/kippered (including jarred)	1.63 lb
Chinook salmon	Quart	Fillet	2.03 lb
Chinook salmon	Quart	Not reported	2.03 lb
Chinook salmon	Quart	Raw, gutted (with skin and bones)	2.03 lb
Chinook salmon	Quart	Roe	2 lb
Sockeye salmon	Fillet	Fillet	1.85 lb
Sockeye salmon	Gallon	Dried/smoked/stripped/kippered (including jarred)	4.8 lb
Sockeye salmon	Individual	Fillet	3.69 lb
Sockeye salmon	Individual	Whole, unprocessed	3.69 lb
Sockeye salmon	Pint	Dried/smoked/stripped/kippered (including jarred)	0.56 lb
Sockeye salmon	Quart	Baked/cooked/boiled (prepared)	1.13 lb

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Table D2-1.–Page 3 of 3.

Resource	Unit	Processing	Conversion Factor
Herring roe	Quart	Whole, unprocessed	4 lb
Black bear	Pound	Cubed meat, no bones	1 lb
Caribou	Gallon	Dried/smoked/stripped/kippered (including jarred)	3.75 lb
Moose	Gallon	Cubed meat, no bones	5 lb
Moose	Pound	Cubed meat, no bones	1 lb
Moose	Quart	Dried/smoked/stripped/kippered (including jarred)	0.94 lb
Spotted seal	Pound	Whole, unprocessed	1 lb
Seal oil	Pint	Whole, unprocessed	0.88 lb
Seal oil	Quart	Not reported	1.75 lb
Whale (unspecified)	Gallon	Whole, unprocessed	5 lb
Whale (unspecified)	Pound	Whole, unprocessed	1 lb
Whale (unspecified)	Quart	Cubed meat, no bones	1.25 lb
Bowhead whale	Gallon	Cubed meat, no bones	5 lb
Blueberries	Gallon	Whole, unprocessed	6 lb
Salmonberries	Quart	Whole, unprocessed	5.4 lb
Blackberries	Gallon	Whole, unprocessed	5.4 lb
Other goods and services			
Cash	Dollars	-	$1.00
Gas	Gallon	-	$7.00
Honey	Pint	-	$25.00
Groceries	Gallon	-	$10.00
Ride to harvest	Not applicable	-	No conversion
Room and board	Not applicable	-	No conversion
Maintenance and repair services	Not applicable	-	No conversion
Plucking geese	Not applicable	-	No conversion

Source ADF&G Division of Subsistence, 2019.

Appendix Table D2-2.–Comparisons of ADF&G Division of Commercial Fisheries and Division of Subsistence salmon harvest estimates, Pilot Station, 2018.

Resource	Reported harvests from DCF surveys	Households providing corrected harvest information on network survey		Households contacted only by network survey		Households reported as not fishing on postseason survey, but reported harvest on network survey		Total adjusted combined reported harvest[a]	DCF total harvest estimates[b]	Final adjusted harvest estimates[c]	Difference
		Number	Harvest adjustment amount	Number	Harvest amount	Number	Harvest amount				
Salmon	3,782	2	-30	7	648	4	213	4,613	6,309	4,755	-1,554
Summer chum salmon	2,874	1	-42	7	405	3	146	3,383	4,401	3,487	-914
Fall chum salmon	409	1	15	7	140	3	37	601	1,127	619	-508
Coho salmon	51	0	0	7	9	1	3	63	122	65	-57
Chinook salmon	448	2	-3	7	94	4	27	566	659	583	-76
Sockeye salmon	0	0	0	7	0	0	0	0	0	0	0

Source ADF&G Division of Commercial Fisheries, postseason salmon surveys, 2018 and ADF&G Division of Subsistence household network surveys, 2019.

a. Reported harvest after adjustments made based on additional harvest data collected during Division of Subsistence surveys.

b. Estimated total community harvest estimated by DCF using postseason harvest survey data only.

c. Estimated total community harvest estimated by Division of Subsistence using postseason survey data and additional household survey data.

Appendix Table D2-3.–Comparisons of ADF&G Division of Commercial Fisheries and Division of Subsistence salmon harvest estimates, Nulato, 2018.

Resource	Reported harvests from DCF surveys	Households providing corrected harvest information on network survey		Households contacted only by network survey		Households reported as not fishing on postseason survey, but reported harvest on network survey		Total adjusted combined reported harvest[a]	DCF total harvest estimates[b]	Final adjusted harvest estimates[c]	Difference
		Number	Harvest adjustment amount	Number	Harvest amount	Number	Harvest amount				
Salmon	2,355	9	441	0	0	2	68	2,861	2,635	2,898	263
Summer chum salmon	207	1	-17	0	0	0	0	190	248	192	-56
Fall chum salmon	783	4	117	0	0	0	0	900	882	912	30
Coho salmon	210	2	190	0	0	1	60	460	223	466	243
Chinook salmon	1,155	8	151	0	0	2	8	1,311	1,282	1,328	46
Sockeye salmon	0	0	0	0	0	0	0	0	0	0	0

Source ADF&G Division of Commercial Fisheries, postseason salmon surveys, 2018 and ADF&G Division of Subsistence household network surveys, 2019.

a. Reported harvest after adjustments made based on additional harvest data collected during Division of Subsistence surveys.

b. Estimated total community harvest estimated by DCF using postseason harvest survey data only.

c. Estimated total community harvest estimated by Division of Subsistence using postseason survey data and additional household survey data.

Appendix Table D2-4.–Comparisons of ADF&G Division of Commercial Fisheries and Division of Subsistence salmon harvest estimates, Beaver, 2018.

Resource	Reported harvests from DCF surveys	Households providing corrected harvest information on network survey		Households contacted only by network survey		Households reported as not fishing on postseason survey, but reported harvest on network survey		Total adjusted combined reported harvest[a]	DCF total harvest estimates[b]	Final adjusted harvest estimates[c]	Difference
		Number	Harvest adjustment amount	Number	Harvest amount	Number	Harvest amount				
Salmon	428	1	6	2	32	2	113	579	478	656	178
Summer chum salmon	7	0	0	2	0	0	0	7	8	8	0
Fall chum salmon	129	0	0	2	0	0	0	129	142	146	4
Coho salmon	0	0	0	2	10	0	0	10	0	11	11
Chinook salmon	292	1	6	2	20	2	13	331	328	375	47
Sockeye salmon	0	0	0	2	2	1	100	102	0	116	116

Source ADF&G Division of Commercial Fisheries, postseason salmon surveys, 2018 and ADF&G Division of Subsistence household network surveys, 2019.

a. Reported harvest after adjustments made based on additional harvest data collected during Division of Subsistence surveys.

b. Estimated total community harvest estimated by DCF using postseason harvest survey data only.

c. Estimated total community harvest estimated by Division of Subsistence using postseason survey data and additional household survey data.

Appendix Table D3-1.–Number of nodes by type and network, Pilot Station, 2018–2019.

	Network				
Node type[a]	Any	Fishing	Sharing	Barter	Customary trade
Sampled household	90	56	85	5	1
Other local household	59	16	15	0	0
Other community	20	0	19	3	1
Event	9	n/a	9	n/a	n/a
Test fishery	1	n/a	1	n/a	n/a
Total	179	72	129	8	2

Source ADF&G Division of Subsistence household surveys, 2019 and Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. A node is household or other entity that engages in social interactions.

Appendix Table D3-2.–Number of ties between sampled households and other nodes by type of tie, Pilot Station, 2018.

	Number	
Node type	Unique ties[a]	All ties[b]
Another local household	122	164
An event	27	33
The test fishery	68	102
A household in another commnity	49	80
Total	266	379

Source ADF&G Division of Subsistence household surveys, 2019 and Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. Relationship between two households or entities.

b. Total number of exchanges or interactions.

c. Household or other entity that engages in social interactions.

Note Tie counts exclude loops for households that fish alone.

Note Direction of tie matters for sharing exchanges.

Appendix Table D3-3.–Number of ties between sampled households and other nodes by type of tie, Pilot Station, 2018.

	Number	
Node type	Unique ties[a]	All ties[b]
Another local household	122	164
An event	27	33
The test fishery	68	102
A household in another commnity	49	80
Total	266	379

Source ADF&G Division of Subsistence household surveys, 2019 and Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. Relationship between two households or entities.

b. Total number of exchanges or interactions.

c. Household or other entity that engages in social interactions.

Note Tie counts exclude loops for households that fish alone.

Note Direction of tie matters for sharing exchanges.

Appendix Table D3-4.–Reported number of sharing ties by type of salmon and processing, Pilot Station, 2018–2019.

Processing type	Type of salmon							All types of salmon
	Chinook	Summer chum	Fall chum	Chum (unspecified)	Coho	Sockeye	Unknown	
Given								
Baked or cooked	4	7	1	1	0	0	0	13
Dried/Smoked/Stripped/Kippered (incl. jarred)	21	31	4	15	0	0	0	71
Filleted	14	0	1	3	0	0	0	18
Salt fish	2	0	0	0	0	0	0	2
Unknown processing type	0	13	0	4	0	0	4	21
Whole, unprocessed	23	38	18	4			1	84
All processing types	64	89	24	27	0	0	5	209
Received								
Baked or cooked	1	0	0	1	0	0	0	2
Dried/Smoked/Stripped/Kippered (incl. jarred)	5	9	2	5	0	1	1	23
Filleted	0	0	0	0	0	1		1
Unknown processing type	0	0	0	0	0	0	1	1
All processing types	6	9	2	6	0	2	2	27

Source ADF&G Division of Subsistence household surveys, 2019.
Note Fish received from the test fishery are not included.

Appendix Table D3-5.–Reported number of sharing ties between respondent households and others, by exchange partner, Pilot Station, 2018–2019.

Processing type	Exchange partner			All exchange partners
	Local household	Another community	Event	
Giving				
Baked or cooked	4	1	8	13
Dried/smoked/stripped/kippered (including jarred)	26	37	8	71
Filleted	17	1	0	18
Salt fish	2	0	0	2
Unknown processing type	18	2	1	21
Whole, unprocessed	60	19	5	84
All processing types	127	60	22	209
Receiving				
Baked or cooked	*n/a*	0	2	2
Dried/smoked/stripped/kippered (including jarred)	*n/a*	15	8	23
Filleted	*n/a*	1	0	1
Unknown processing type	*n/a*	0	1	1
All processing types	*n/a*	16	11	27

Source ADF&G Division of Subsistence household surveys, 2019.
Note Fish received from the test fishery are not included.

Appendix Table D3-6.–Mean receiving and giving ties and amount exchanged in sharing networks, by household category, Pilot Station, 2018–2019.

		Networks							
		Between local households				Between Pilot Station households and households in other communities			
		Receiving[a]		Giving		Receiving		Giving	
Household characteristic	Number of households	Mean ties[b] (number)	Mean amount (lb)	Mean ties[b] (number)	Mean amount (lb)	Mean ties[b] (number)	Mean amount (lb)	Mean ties[b] (number)	Mean amount (lb)
Harvest category[c]									
High	17	0.35	44.74	2.18	152.38	0.24	5.18	0.88	20.6
Above average	22	1	104.51	1.05	71.55	0.09	1.09	0.45	10.41
Low to average	13	0.85	55.18	1.08	98.81	0.31	6.05	0.15	5.51
No harvest	38	0.68	13.77	0.37	9.72	0.05	0.28	0.18	1.97
Maturity[d]									
Developing	24	0.58	7.12	0.62	20.36	0.21	3.32	0.33	5.84
Mature	37	0.73	17.3	1.46	118.58	0.11	1.1	0.46	11.94
Elder	28	0.82	116.62	0.57	10.26	0.11	2.89	0.25	4.63
Unknown	1	1	224	3	655.13	0	0	2	14.4
Household head type									
Couple	56	0.68	53.1	1.23	62.67	0.18	3.41	0.39	10.09
Single Female	19	0.84	27.03	0.58	40.14	0.05	0.51	0.21	1.41
Single Male	12	0.58	44.21	0.33	73.58	0	0	0.25	7.09
Unknown	3	1.33	94.21	1.33	221.14	0.33	0.37	1.67	16.28
Commercial fishing									
Yes	55	0.8	69.19	0.65	37.8	0.05	0.21	0.35	5.61
No	5	0	0	0.8	11.26	0	0	0.2	4.97
Unknown	1	0	0	1	0	1	66.6	0	0

Source ADF&G Division of Subsistence household surveys, 2019 and ADF&G Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. Respondents did not report receiving salmon within the community. Values in these columns are based on what other households reported giving to these receving households and should be considered minimum values.

b. Total instances of giving or receiving.

c. Household harvest categories were calculated using the mean household harvest (160.8 lb). The upper limit of the above-average harvest category is one standard deviation (SD) over the mean (437 lb). The high harvest category is any harvest greater than one SD over the mean.

d. Developing: age(s) of households head(s) is less than 40 years. Mature: age(s) of household head(s) is 40–59 years. Elder: age(s) of household head(s) is greater than 59 years.

Appendix Table D3-7.–Descriptive statistics for salmon networks at three different scopes, Pilot Station, 2018–2019.

Scope	Network	Nodes[a]			Ties		Pounds of salmon exchanged	Descriptive network statistics			
		Local Households	Connected Nodes	Unconnected Nodes	Unique ties[b]	Total ties[c]		Components[d]	Density[e]	Reciprocity[f]	Transitivity[g]
All connections											
	Combined	149	112	37	270	379	11,991	2	0.009	0.29	0.27
	Cooperative production[h]	149	43	136	35	35	*n/a*	16	0.002	1	0.58
	Sharing	149	100	50	230	338	11,751	1	0.007	0.03	0.17
	Barter and trade	149	6	169	5	6	240	5	0	1	0
Connections between local households											
	Combined	149	99	50	124	164	5,843	12	0.006	0.5	0.39
	Cooperative production[h]	149	43	106	35	35	*n/a*	16	0.003	1	0.58
	Sharing	149	84	65	88	127	5,819	11	0.004	0.05	0.2
	Barter and trade	149	2	147	1	2	24	1	0	1	0
Connections between local households and households in other communities											
	Combined	149	31	118	50	80	1,143	6	0.002	0.19	0
	Sharing	149	30	120	46	76	927	7	0.002	0.04	0
	Barter and trade	149	4	161	4	4	216	4	0	1	0

Source ADF&G Division of Subsistence household surveys, 2019 and Division of Commercial Fisheries post-season harvest surveys 2018.

a. Household or other entity that engages in social interactions.

b. Social relationship between two households or entities.

c. Total number of exchanges or interactions.

d. The number of clusters of connected actors in a network.

e. The proportion of observed ties in the network relative to all possible ties.

f. The proportion of ties that go in both directions between a pair of nodes relative to the total number of ties in the network.

g. The relative number of triangles in the network compared to total number of connected node triplets.

h. Cooperative production ties do not include ties to households in other communities.

Appendix Table D4-1.–Number of nodes by type and network, Nulato, 2018–2019.

Node type[a]	Network				
	Any	Fishing	Sharing	Barter	Customary trade
Sampled household	62	47	52	18	4
Other local household	24	14	8	1	3
Other community	20	0	16	8	0
Event	9	n/a	9	n/a	n/a
Total	115	61	85	27	7

Source ADF&G Division of Subsistence household surveys, 2019 and Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. A node is household or other entity that engages in social interactions.

Appendix Table D4-2.–Number of ties between sampled households and other nodes by type of node, Nulato, 2018–2019.

Node type[c]	Number	
	Unique Ties[a]	All ties[b]
Another local household	117	254
An event	81	247
A household in another commnity	78	154
Total	276	655

Source ADF&G Division of Subsistence household surveys, 2019 and Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. Social relationship between two households or entities.

b. Total number of exchanges or interactions.

c. Household or other entity that engages in social interactions.

Note Tie counts exclude loops for households that fish alone.

Note Direction of tie matters for sharing exchanges.

Appendix Table D4-3.–Number of ties between sampled households and other nodes by type of tie, Nulato, 2018.

	Number	
Network	Unique ties[a]	All ties[b]
Fishing	197	197
Own production	5	5
Cooperative production	192	192
Sharing	190	394
Give	158	354
Receive	32	40
Barter	38	50
Customary trade	12	14
Buy	6	8
Sell	6	6
Total	437	655

Source ADF&G Division of Subsistence household surveys, 2019 and Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. Social relationship between two households or entities.

b. Total number of exchanges or interactions.

Note Direction of tie matters for sharing exchanges.

Appendix Table D4-4.–Reported number of sharing ties by type of salmon and processing, Nulato, 2018–2019.

Processing type	Type of salmon					All types of salmon
	Chinook	Summer chum	Fall chum	Chum (unspecified)	Coho	
Given						
Baked or cooked	29.0	0.0	17.0	0.0	0.0	46.0
Bellies	1.0	0.0	0.0	0.0	0.0	1.0
Dried/smoked/stripped/kippered (including jarred)	145.0	5.0	55.0	1.0	2.0	208.0
Filleted	16.0	0.0	3.0	0.0	1.0	20.0
Roe	1.0	0.0	0.0	0.0	0.0	1.0
Unknown processing type	6.0	0.0	0.0	0.0	0.0	6.0
Whole, gutted	27.0	0.0	38.0	0.0	1.0	66.0
Whole, unprocessed	6.0	0.0	0.0	0.0	0.0	6.0
All processing types	231.0	5.0	113.0	1.0	4.0	354.0
Received						
Baked or cooked	5.0	0.0	1.0	0.0	0.0	6.0
Dried/smoked/stripped/kippered (including jarred)	19.0	0.0	5.0	1.0	0.0	25.0
Filleted	1.0	0.0	0.0	0.0	0.0	1.0
Unknown processing type	2.0	0.0	1.0	0.0	0.0	3.0
Whole, gutted	3.0	0.0	1.0	0.0	0.0	4.0
Whole, unprocessed	1.0	0.0	0.0	0.0	0.0	1.0
All processing types	31.0	0.0	8.0	1.0	0.0	40.0

Source ADF&G Division of Subsistence household surveys, 2019.

Appendix Table D4-5.–Mean receiving and giving ties and amount exchanged in sharing networks, by household category, Nulato, 2018–2019.

		Networks							
		Between local households				Between Nulato households and households in other communities			
		Receiving[a]		Giving		Receiving		Giving	
Household characteristic	Number of households	Mean ties[b] (number)	Mean amount (lb)	Mean ties[b] (number)	Mean amount (lb)	Mean ties[b] (number)	Mean amount (lb)	Mean ties[b] (number)	Mean amount (lb)
Harvest category[c]									
High	5	0.2	1.34	1.8	322.95	0	0	2.2	223.76
Above average	24	0.08	23.64	0.46	18.84	0.04	0.14	1.08	68.65
Low to average	14	0.5	13.99	0.29	16.39	0.14	3.51	1.21	47.49
No harvest	19	0.21	15.22	0	0	0.05	0.53	0.42	8.81
Maturity[d]									
Developing	11	0	0	0	0	0	0	0.36	20.59
Mature	20	0.2	3.13	0.6	35.45	0.15	1.26	1.25	62.83
Elder	31	0.32	32.14	0.39	51.21	0.03	1.2	1.06	68.24
Household head									
Couple	26	0.15	25.56	0.38	16.51	0.04	0.13	1.19	52.02
Single female	23	0.22	11.56	0.43	17.59	0.09	0.96	1.04	59.32
Single male	13	0.38	9.89	0.31	112.51	0.08	2.86	0.54	67.84
Commercial fishing									
Yes	10	0.1	1.86	0.5	4.68	0.1	1	1.7	40.34
No	51	0.25	20.4	0.37	44.11	0.06	1.03	0.86	61.96
Unknown	1	0	0	0	0	0	0	1	35.13

Source ADF&G Division of Subsistence household surveys, 2019 and ADF&G Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. Respondents did not report receiving salmon within the community. Values in these columns are based on what other households reported giving to these receiving households and should be considered minimum values.

b. Total instances of giving or receiving.

c. Household harvest categories were calculated using the mean household harvest (211 lb). The upper limit of the above-average harvest category is one standard deviation over the mean (375.4 lb). The high harvest category is any harvest greater than one SD over the mean.

d. Developing: age(s) of households head(s) is less than 40 years. Mature: age(s) of household head(s) is 40–59 years. Elder: age(s) of household head(s) is greater than 59 years.

Appendix Table D4-6.–Descriptive statistics for salmon networks at three different scopes, Nulato, 2018–2019.

Scope	Network	Nodes[a] Local Households	Nodes[a] Connected Nodes	Nodes[a] Unconnected Nodes	Ties Unique ties[b]	Ties Total ties[c]	Pounds of salmon exchanged	Descriptive network statistics Components[d]	Density[e]	Reciprocity[f]	Transitivity[g]
All connections											
	Combined	86	71	15	308	522	8,373	2	0.032	0.67	0.48
	Cooperative production	86	56	58	96	96	n/a	11	0.015	1	0.86
	Sharing	86	60	30	187	394	7,290	1	0.015	0.19	0.03
	Barter and trade	86	23	83	25	32	1,083	6	0.004	1	0
Connections between local households											
	Combined	86	63	23	131	141	3,256	4	0.031	0.95	0.76
	Cooperative production	86	56	30	96	96	n/a	11	0.026	1	0.85
	Sharing	86	28	58	24	33	2,296	7	0.003	0	0.25
	Barter and trade	86	13	73	11	12	960	2	0.003	1	0
Connections between local households and households in other communities											
	Combined	86	42	44	80	227	3,784	3	0.008	0.31	-0.01
	Sharing	86	40	50	66	207	3,661	3	0.006	0	0
	Barter and trade	86	11	87	14	20	123	5	0.003	1	0

Source ADF&G Division of Subsistence household surveys, 2019 and Division of Commercial Fisheries postseason harvest surveys 2018.

a. Household or other entity that engages in social interactions.

b. Social relationship between two exchange partners.

c. Total number of exchanges or interactions.

d. The number of clusters of connected actors in a network.

e. The proportion of observed ties in the network relative to all possible ties.

f. The proportion of ties that go in both directions between a pair of nodes relative to the total number of ties in the network.

g. The relative number of triangles in the network compared to total number of connected node triplets.

Appendix Table D5-1.–Number of ties between sampled households and other nodes by type of tie, Beaver, 2018.

	Number	
Network	Unique ties[a]	All ties[b]
Fishing	12	12
Own production	12	12
Cooperative production	12	12
Sharing	37	56
Give	35	54
Receive	2	2
Barter	2	3
Customary trade	1	3
Buy	1	3
Sell	0	0
Total	52	74

Sources ADF&G Division of Subsistence household surveys, 2019 and Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. Social relationship between two households or entities.

b. Total number of exchanges or interactions.

Note Tie counts exclude loops for households that fish alone.

Note Direction of tie matters for sharing exchanges.

Appendix Table D5-2.–Number of nodes by type and network, Beaver, 2018–2019.

	Network				
Node type[a]	Any	Fishing	Sharing	Barter	Customary trade
Sampled household	21	17	17	2	1
Other local household	13	7	0	1	0
Other community	11	1	10	1	1
Event	8	n/a	8	n/a	n/a
Total	53	25	35	4	2

Sources ADF&G Division of Subsistence household surveys, 2019 and Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. A node is household or other entity that engages in social interactions.

Appendix Table D5-3.–Number of ties between sampled households and other nodes by type of node type, Beaver, 2018.

	Number	
Node type[c]	Unique ties[a]	All ties[b]
Another local household	23	25
An event	12	24
A household in another commnity	17	25
Total	52	74

Sources ADF&G Division of Subsistence household surveys, 2019 and Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. Social relationship between two households or entities.

b. Total number of exchanges or interactions.

c. Household or other entity that engages in social interactions.

Note Tie counts exclude loops for households that fish alone.

Appendix Table D5-4.–Descriptive statistics for salmon networks at three different scopes, Beaver, 2018–2019.

Scope	Network	Nodes[a]			Ties		Pounds of salmon exchanged	Descriptive network statistics			
		Local households	Connected nodes	Unconnected nodes	Unique ties[b]	Total ties[c]		Components[d]	Density[e]	Reciprocity[f]	Transitivity[g]
All connections											
	Combined	34	25	9	50	72	1,357	3	0.023	0.41	0.19
	Cooperative production*	34	12	41	10	10	n/a	4	0.007	1	0.67
	Sharing	34	17	18	37	56	1,207	4	0.013	0	0.06
	Barter and customary trade	34	4	47	3	6	150	3	0.002	1	0
Connections between local households											
	Combined	34	24	10	23	25	321	3	0.03	0.65	0.36
	Cooperative production	34	12	22	10	10	n/a	4	0.018	1	0.67
	Sharing	34	14	20	12	14	319	2	0.011	0	0
	Barter and customary trade	34	2	32	1	1	2	1	0.002	1	0
Connections between local households and households in other communities											
	Combined	34	8	26	15	23	671	4	0.009	0.24	-0.01
	Sharing	34	8	27	13	18	524	5	0.007	0	0
	Barter and customary trade	34	2	41	2	5	147	2	0.002	1	0

Source ADF&G Division of Subsistence household surveys, 2019 and Division of Commercial Fisheries postseason harvest surveys 2018.

a. Household or other entity that engages in social interactions.

b. Social relationship between two exchange partners.

c. Total number of exchanges or interactions.

d. The number of clusters of connected actors in a network.

e. The proportion of observed ties in the network relative to all possible ties.

f. The proportion of ties that go in both directions between a pair of nodes relative to the total number of ties in the network.

g. The relative number of triangles in the network compared to total number of connected node triplets.

Note Cooperative production ties do not include ties to households in other communities.

Appendix Table D5-5.–Reported number of sharing ties by types of salmon and processing, Beaver, 2018–2019.

Processing type	Type of salmon					All types of salmon
	Chinook	Summer chum	Fall chum	Coho	Sockeye	
Giving						
Baked or cooked	14.0	0.0	0.0	0.0	0.0	14.0
Dried/smoked/stripped/kippered (including jarred)	7.0	0.0	0.0	0.0	0.0	7.0
Filleted	3.0	0.0	0.0	1.0	3.0	7.0
Heads only	1.0	0.0	0.0	0.0	0.0	1.0
Whole, unprocessed	22.0	0.0	0.0	0.0	3.0	25.0
All processing types	47.0	0.0	0.0	1.0	6.0	54.0
Receiving						
Baked or cooked	0.0	0.0	0.0	0.0	1.0	1.0
Dried/smoked/stripped/kippered (including jarred)	1.0	0.0	0.0	0.0	0.0	1.0
All processing types	1.0	0.0	0.0	0.0	1.0	2.0

Source ADF&G Division of Subsistence household surveys, 2019.

Appendix Table D5-6.–Reported number of sharing ties by processing and exchange partner type, Beaver, 2018–2019.

Processing type	Exchange partner			All exchange partners
	Local household	Another community	Event	
Given				
Baked or cooked	0.0	0.0	14.0	14.0
Dried/smoked/stripped/kippered (including jarred)	1.0	5.0	1.0	7.0
Filleted	2.0	3.0	2.0	7.0
Heads only	1.0	0.0	0.0	1.0
Whole, unprocessed	10.0	8.0	7.0	25.0
All processing types	14.0	16.0	24.0	54.0
Received				
Baked or cooked	*n/a*	1.0	0.0	1.0
Dried/smoked/stripped/kippered (including jarred)	*n/a*	1.0	0.0	1.0
All processing types	*n/a*	2.0	0.0	2.0

Source ADF&G Division of Subsistence household surveys, 2019.

Appendix Table D5-7.–Mean receiving and giving ties and amount exchanged in sharing networks, by household category, Beaver, 2018–2019.

		Networks							
		Between local households				Between Beaver households and households in other communities			
		Receiving[a]		Giving		Receiving		Giving	
Household characteristic	Number of households	Mean ties[b] (number)	Mean amount (lb)	Mean ties[b] (number)	Mean amount (lb)	Mean ties[b] (number)	Mean amount (lb)	Mean ties[b] (number)	Mean amount (lb)
Harvest category[c]									
High	3	0	0	1.33	21.95	0	0	2.33	145.72
Above average	3	0.67	24.84	0.67	30.36	0	0	0	0
Low to average	11	0.73	17.71	0.55	14.74	0.09	0.41	0.36	7.01
No harvest	4	0.5	12.42	0	0	0.25	1.2	0	0
Maturity[d]									
Developing	6	0.5	10.97	0.67	17.94	0.33	1.55	0.5	12.04
Mature	7	0.3	16.56	0.86	27.15	0	0	0.86	53.29
Elder	8	0.88	17.16	0.25	2.67	0	0	0.25	8.62
Household head									
Couple	11	0.27	14.3	0.55	15.77	0.18	0.85	0.73	32.32
Single female	4	1	11.55	0.75	11.55	0	0	0.5	36.69
Single male	6	0.83	19.25	0.5	16.56	0	0	0.17	2

Source ADF&G Division of Subsistence household surveys, 2019 and ADF&G Division of Commercial Fisheries postseason salmon harvest surveys, 2018.

a. Respondents did not report receiving salmon within the community. Values in these columns are based on what other households reported giving to these receiving households and should be considered minimum values.

b. Total instances of giving or receiving.

c. Household harvest categories were calculated using the mean household harvest (213.8 lb). The upper limit of the above-average harvest category is one standard deviation (SD) over the mean (522 lb). The high harvest category is any harvest greater than one SD over the mean.

d. Developing: age(s) of households head(s) is less than 40 years. Mature: age(s) of household head(s) is 40–59 years. Elder: age(s) of household head(s) is greater than 59 years.