Journal of Ecological Anthropology

Volume 15
Issue 1 *Volume 15, Issue 1 (2012)*

Article 2

2012

Local Institutions for Subsistence Harvesting in Western Alaska: Assessing their Adaptive Role in the Context of Global Change

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ABSTRACT

This article identifies key types of local institutions rural Alaska Native communities use to manage subsistence resources such as fish, game, and edible plants. Local institutions are the informal rules and norms communities use to manage these and other natural resources. Other scholars have mostly discussed them in the context of how they help subsistence users cope with ecological fluctuations in the abundance of certain species. The study presented here discusses them within a larger context of social and economic change. These local institutions were identified based on personal interviews with 62 active subsistence users in six different Yup'ik communities in the Yukon-Kuskokwim Delta region of Western Alaska. Participant-observation in subsistence activities like fishing and gathering supplemented the interview material. The key local institutions involve resource harvesting, resource processing, and resource sharing. The analysis of interview and observation data show that local institutions help households and communities cope with fluctuations in harvest amounts due to ecological perturbations, formal management regulations, and high fuel prices. Although local institutions can be fragile in the face of market pressures, and rationale for some institutions are not known by the younger generation, the strong role of sharing suggests that Yup'ik local institutions are expected to persist as climatic, environmental, economic, and social change continues.

INTRODUCTION

The Yukon-Kuskokwim Delta region of Western Alaska is a mostly flat, treeless, and seemingly endless expanse of tundra where the landscape is cut anywhere and everywhere by rivers, ponds, lakes, streams, and sloughs. Most outsiders travel to the Yukon-Kuskokwim Delta by plane from Alaska's urban centers such as Anchorage, Fairbanks, or possibly Juneau. Flying low over this area into the regional hub of Bethel, a traveler will occasionally see a tight cluster of buildings that form one of the many small isolated settlements that dot this sparsely populated and remote area of rural Alaska. No matter what time of year one is flying, there are always small groups of people out on the rivers fishing or hunting. This is one of the last few places on Earth where people continue to pursue a hunting-and-gathering way of life on a daily basis. Much of the food rural residents consume in these villages comes directly from the surrounding rivers, seas, or land and not from a local store. Local people call it 'subsistence', and it is more than a way of obtaining meat, fish, and berries – it is a way of life.

Subsistence is also a legal term codified into state and federal laws, which means that rural Alaskan hunters and fishers have to follow formal rules. These dictate where they can harvest, what they can harvest, and when they can harvest (Argetsinger and West 2009). There is constant political tension and frequent conflict over subsistence rights in Alaska (Wheeler and Thornton 2005). Climate change also threatens the subsistence way of life for Alaska Natives. The Arctic is warming more rapidly than other parts of the world and parts of Alaska have warmed 3-4 °C during the winter over the last half-century (ACIA 2004:12). This has affected sea-ice conditions, the timing of freeze-up and break-up for rivers, and the migratory routes of caribou herds (AHDR 2004). Contemporary subsistence also requires cash (Langdon 1991). Yet Alaska Native villages face chronic unemployment and household members are often forced to work in nearby mines, regional hubs such as Bethel, or faraway Anchorage. Work schedules often conflict with subsistence opportunities while gasoline can cost $US8 per gallon or more (Aslaksen et al. 2009).

We are particularly interested in how global change affects subsistence, i.e., noncommercial fishing and hunting (Wolfe and Walker 1987). We use the term 'global change' to refer to the combined challenge of a warming climate, increased dependence on formal employment, the regulation of natural resources, and reliance on fossil fuels (NRC 1999). As Igor Krupnik and Dyanna Jolly (2002) documented for indigenous peoples throughout the Arctic, Alaska Natives feel that the "Earth is faster now." The net effect is that global change is making a subsistence way of life increasingly difficult for rural Alaska Natives (ACIAC 2008; Lee 2002). As evidence, there has been a general out-migration of Alaska Natives from rural to urban areas of the state (Huskey et al. 2004). At the same time, however, rural villages persist and people constantly find local ways to cope with external drivers that are beyond their control.

They do so by devising local institutions, which we define as a broad set of informal rules, norms, and customs that manage small-scale common-pool resources (CPRs) described by Ostrom (1990). Local institutions specify behaviors individuals, households, and communities should follow in order to ensure sustainable use of communal fisheries, forests, grazing lands, or animal populations in order to avoid Garrett Hardin's "tragedy of the commons." They are embedded within larger systems of shared beliefs, practices, or values we can generally call "culture" and are therefore specific to social groups whose members collectively recognize them. Analytically, they are distinct from just "culture" because researchers focus attention on how groups foster adherence, impose sanctions, and transmit knowledge to new members (Ostrom 1990). This enables cross-cultural comparison of these mechanisms among similar institutions. These informal rules emerge, adapt, and change over time as societies encounter environmental or social challenges. The important point is that local institutions do so endogenously due to internal or external stimuli. Formal institutions, on the other hand, are exogenous and are imposed by governments or other external agencies. Local institutions are the result of what is called institutional design, or the purposive implementation of internal socially created rules to govern resource use (Ostrom 1990).

The two concepts **piciryarat** ("the way things are done" or "the qualities of life") and **yungnaqsarat** ("rules of life") together form the foundation for Yup'ik understandings of value and principle that guide proper behavior (Kawagley 2006:5). Collectively, these local institutions comprise a cultural system that regulates subsistence-related activities among the people of the Yukon-Kuskokwim Delta region. Numerous researchers have documented local institutions among indigenous peoples of the Arctic, but our analysis is particularly informed by the work of Brenda Parlee and colleagues (2006). Parlee et al. conducted ethnographic research among the Teetl'it Gwich'in Athabascan peoples of northwest Canada and focused on berry-harvesting. Their work showed how rules vary within each category based on the abundance and distribution of different species. For instance, extended families of Teetl'it Gwich'in own distinct cranberry patches near their cabins. They exercise a loose form of territoriality whereby a certain

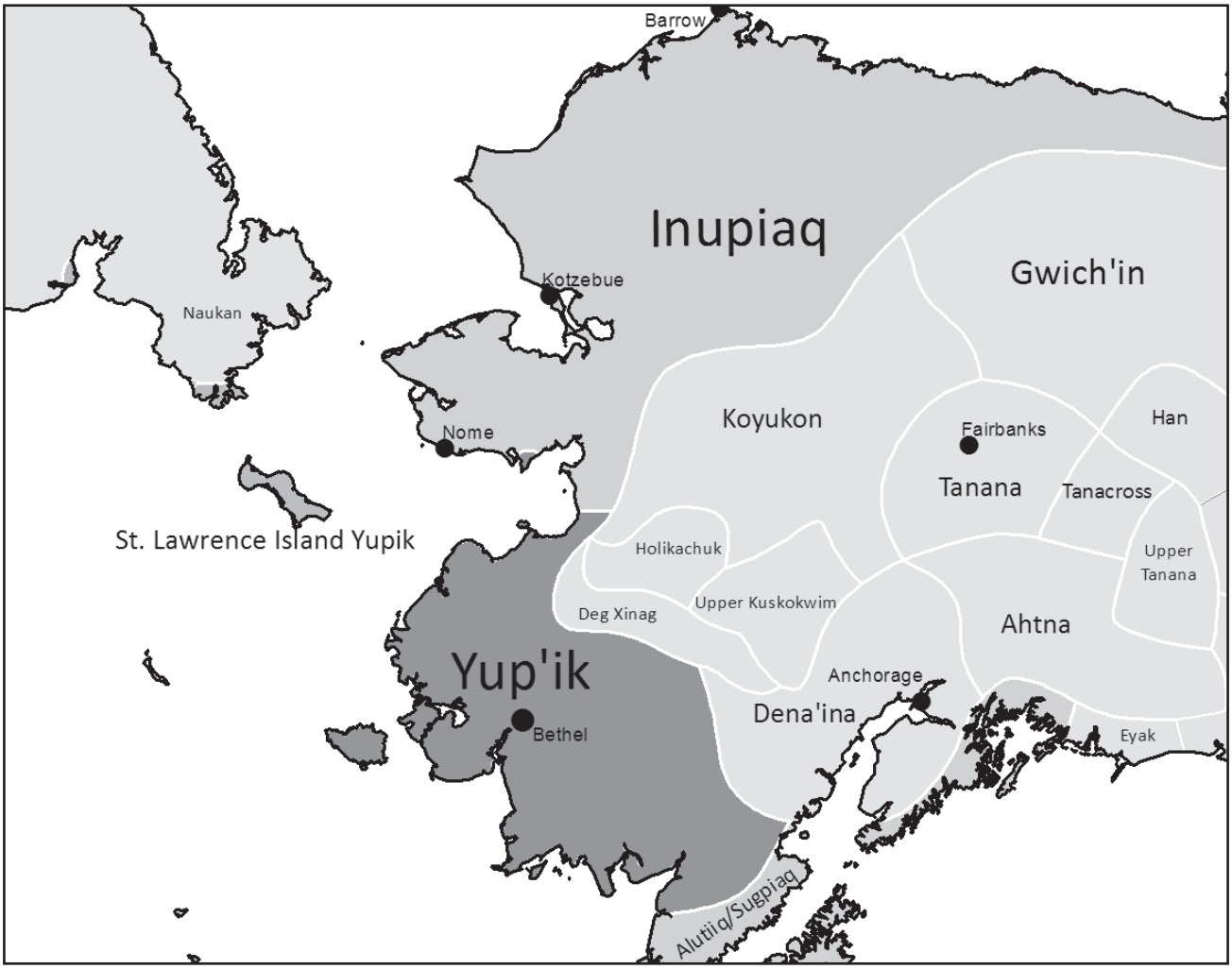

FIGURE 1. Linguistic regions of Alaska based on Krauss et al. 2011.

area is "my grandmother's berry patch" (Parlee et al. 2006:520). If cranberries are especially abundant in a certain patch, others can pick without asking permission. If there are few cranberries, only other extended kin who are invited may pick. These examples illustrate how rules help Teetl'it Gwich'in communities adapt to fluctuating berry abundances.

Our analysis of Yup'ik local institutions is modeled after this approach; we seek to categorize local institutions and identify the aspects of these institutions that play an adaptive role. We discuss three primary categories of local institutions based on:

- Resource harvesting – i.e., the amount of fish and game to be gathered;

- Resource processing – i.e., how fish and game need to be processed according to certain norms; and

- Resource sharing – i.e., the sharing of harvested fish, game, and plants.

We selected these three types of institutions for three reasons. First, they appear prominently in the ethnographic literature concerning Yup'ik subsistence (Andrews 1989; Fienup-Riordan 1986; Fienup-Rior-

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dan 1999; Fienup-Riordan 2000; Kawagley 2006). Second, these institutions often conflict with formal State and Federal regulations for managing subsistence resources (Argetsinger and West 2009; Wolfe 2006). Third, they often play a part in helping households and communities adapt to global change.

THE ENVIRONMENTAL AND ETHNOGRAPHIC SETTING

Our work focuses specifically on the Yup'ik population occupying the lower Yukon-Kuskokwim Delta region. The indigenous peoples of Western Alaska are referred to as 'Yup'ik' (plural Yupiit), a title derived from the words **yuk**, or 'person' and **pik**, meaning 'real' or 'genuine.' Some villages identify themselves as distinctly Cup'ik, with some linguistic and cultural differences.[1] Yup'ik territory extends north-south along the Bering Sea coast from the Alaska Peninsula to Norton Sound and inward along the Yukon, Kuskokwim, and Nushagak Rivers (Figure 1).

Subsistence

While the tundra landscape might appear desolate due to the lack of trees, it is indeed home to a broad spectrum of fauna. Species are generally available for harvest during short periods throughout the year, as most appear only at specific times in the seasonal cycle (Fienup-Riordan 1986). June marks the beginning of the summer fishing season, arguably the busiest time of the subsistence calendar year. Throughout the summer, subsistence fishers intensively harvest various species of salmon: king/Chinook (*Oncorhynchus tsawytscha*); red/sockeye (*O. nerka*); silver/coho (*O. kisutch*); and chum/dog (*O. keta*). They also catch other freshwater fish such as sheefish (*Stenodous leucichthys*), whitefish (*Coregonus nasus*) and others. In August, fish runs begin to slow while berries ripen. During this time, families venture across the tundra to gather blueberries (*Vaccinium alaskaense*), crowberries (*Epetrum nigrum*), and salmonberries (*Rubus spectabilis*) to be frozen for the winter and/or combined with lard and sugar to make **akutaq**. In the fall, men depart from their villages in pairs or groups in search of moose (*Alces alces*), caribou (*Rangifer tarandus granti*), and various water fowl.

Throughout the winter months, fresh food is scarce, and communities must rely primarily on the fish, meat, berries, and greens harvested during the previous summer and fall. There is some limited ice fishing for tomcod (*Microgadus tomcod*) and northern pike (*Esox lucius*). It is critical that a sufficient amount of dried smoked fish has been processed and stored, as failure to do so could result in acute food shortages. Historically, Yup'ik communities often faced starvation and people today consider this a distinct possibility for which they must prepare (Fienup-Riordan 2000).

In March, near-shore ice begins to melt and seal hunting becomes possible for coastal communities. The following month, millions of birds flock to the wetlands to breed and nest—providing locals with an abundant supply of meat and eggs. During this time, families also gather edible greens, most notably marsh marigold (*Caltha palustris*), wild celery (*Heracleum lanatum*), and cow parsnip (*Heracleum maximum*). In June, the fish runs return as expected, and the annual subsistence cycle begins again (Fienup-Riordan 2000).

Geography plays an important role in Yup'ik subsistence because species availability is constrained by ecological habitat. For example, coastal communities can harvest marine mammals such as bearded seals (*Erignatus barbatus*), ringed seals (*Phoca hispida*), and beluga whales (*Delphinapterus leucas*). They can also obtain saltwater species of fish like herring (*Clupea pallasii*) and starry flounder (*Platichthys stellatus*). Tundra areas along the coast do not provide good habitat for large terrestrial mammals such as moose or caribou. These species are found further inland in forested areas. The four species of salmon are ubiquitous throughout the Yukon-Kuskokwim Delta, and all communities harvest some salmon but at different times depending on their upstream migration. To compensate for these differences in the geographic distribution of foods, coastal villages trade seal oil and other marine resources for moose meat and smoked salmon with inland communities. Despite this rich

diversity of species, the abundance of any one food source varies strongly from year to year, and entire populations often crash (Wolfe 2004).

Social Organization

Traditional Yup'ik sociopolitical organization constituted an adaptation to the seasonal cycle and the often unpredictable availability of particular species. Until the 20th Century, the social landscape of indigenous western Alaska was composed of overlapping networks of extended family units consisting of between two and four generations. These economically self-sufficient groups were mobile throughout most of the year, circulating through a number of seasonal sites within a territorial range in order to maximize subsistence output (Fienup-Riordan 2000). This resulted in the establishment of numerous local Yup'ik socioterrotorial organizations in the Yukon-Kuskokwim region that correspond to several closely related family groups that utilize resources within a specific area surrounding a few villages (Shinkwin and Pete 1984). These groups prevented other Yup'ik societies from harvesting within their territory through overt hostility and other cultural means such as trade, ceremonial activities, and place-naming (Andrews 1989). These organizations did not take on the same degree of rigid territorial and political organization as the Iñupiaq nations to the north described by Ernest "Tiger" Burch (1998).

As the Yukon-Kuskokwim Delta became more integrated into the United States and eventually the state of Alaska, Yup'ik people became more sedentary due to the construction of schools, permanent housing, and other types of infrastructure. Subsistence activities became restricted to zones immediately surrounding settlements although people still maintained seasonal fish camps. With the introduction of snowmachines, three-wheelers, and outboard motors in the 1950s, subsistence became much more mechanized and, indeed, revolutionized (Pelto 1973). Hunters and fishers could travel far from their home village using these, but this mechanical mobility also made subsistence much more dependent on external inputs such as fuel, spare parts, and other technologies (see Kawagley 2006). Subsistence is now highly mechanized and requires significant economic investment in order to purchase and maintain the forms of transportation that make it possible. It is also increasingly regulated.

Subsistence follows a domestic mode of production; activities are organized around individual households or groups of extended kin (Langdon 1991; Wolfe 2004). Typically, men fish or hunt while women process the fish or meat. Most families engage in subsistence year-round, investing their wages in gas and equipment (e.g., motors, snowmachines, firearms, and all-terrain vehicles). Thus, while these communities indeed employ cash as a form of capital, it is primarily used to supplement subsistence endeavors (Langdon 1991).

The public sector provides a majority of the employment opportunities available in the villages, which include jobs at local schools, tribal councils, and health clinics. Many individuals seek cash through commercial fishing and trapping; however, this industry accounts for a relatively small percentage of the region's total income (Fienup-Riordan 2000). Because jobs are scarce and store prices high, locally harvested foods are essential to the physical survival of local residents. Surveys conducted by the Alaska Department of Fish and Game in nine delta villages in the 1980s indicated that villagers were harvesting an average of 318.2 kg (700 pounds) of wild foods per person annually (Wolfe and Walker 1987:64). Updated in 2000, this figure remains 269.1 kg (592 pounds) of wild foods per person for the Bethel Census Area (Wolfe 2004:11).

METHODS

This study is based primarily on six weeks of ethnographic fieldwork in six villages of the Yukon-Kuskokwim Delta conducted in May and June of 2008 (Figure 2). These were the communities of Kalskag, Lower Kalskag, Nunapitchuk, Tuluksak, Tuntutuliak, and Chevak. We selected these six different locations because they represent a spectrum of the variety of local subsistence traditions of the Yukon-Kuskokwim

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TABLE 1. Summary of community characteristics.

Community	Environment	Primary subsistence resources	Estimated subsistence harvest (mean kg per household)[1]				Total subsistence (mean kg per capita)[1]	Employment	Socioterritorial group[2]
			Salmon	Non-salmon	Land mammals	Seals			
Chevak	Coastal tundra	Marine mammals, whitefish, salmon	258.4[3]	--[4]	--	77.5[5]	357.7[6]	Local tribes, municipalities, and schools	Qissunarmiut – "People of Qissunaq"
Kalskag	Boreal forest	Salmon, moose, whitefish	258.5[7]	74.1[7]	83.2[7]	0[7]	156.9[7]	Local tribes, municipalities, and schools but also local mining	Qaugkumiut – "Upriver People" mixed with Deg Hit'an
Tuluksak	Boreal forest	Salmon, moose, whitefish	115.1[3]	--	--	--	--	Local tribes, municipalities, and schools	Qaugkumiut – "Upriver People"
Nunapitchuk	Inland tundra	Northern pike, whitefish, salmon	322[3]	369.2[8]	--		316.8[6]	Local tribes, municipalities, and schools	Akulmiut – "People in the Middle"
Tuntutuliak	Coastal tundra	Salmon, marine mammals, whitefish	350.5[3]	562.8[8]	--	30.2[5]	343.6[6]	Some commercial fishing but mostly local tribes, municipalities, and schools	Unegkumiut – "Downriver People"
Lower Kalskag	Boreal forest	Salmon, moose, whitefish	178.6[7]	72.84[7]	70.0[7]	0[7]	84.9[7]	Local tribes, municipalities, and schools but also local mining	Qaugkumiut – "Upriver People"

[1] Estimated harvests for each community are published as "mean amount per household" or "mean amount per capita". If the number of households is known, results have been converted to mean kg per household. If not known, they remain "mean kg per capita" to allow inter-community comparison.
[2] Shinkwin and Pete 1984.
[3] Fall et al. 2009; based on estimates for the communities of Scammon Bay and Hooper Bay.
[4] -- indicates that there is no available published data.
[5] Coffing et al. 1999; Chevak estimates based on data from nearby communities of Hooper Bay; Tuntutuliak estimates based on the nearby community of Quinhagak.
[6] Wolfe and Walker 1987; Chevak estimates based on Scammon Bay; Tuntuliak estimates based on Quinhagak.
[7] Brown et al. 2012.
[8] Ray et al. 2010.

Delta (Wolfe 2004). By local subsistence tradition, we mean the unique system of harvesting a particular species using specific technologies due to the ecological, historical, and economic characteristics of a given locality, e.g., the whitefish and northern pike fishery of the inland tundra Akulmiut Yup'ik communities (Andrews 1989). Nunapitchuk is an inland tundra village and its residents have to travel several miles south to catch salmon on the Kuskokwim. Thus, they rely more on local whitefish than salmon. Coastal communities like Chevak and Tuntutuliak have access to marine mammals and hunt seals, beluga whales, and ocean fish. Tuluksak, Kalskag, and Lower Kalskag lie in the forested upper reaches of the Kuskokwim. Their residents harvest mostly salmon, but they also hunt terrestrial animals such as caribou and moose. We chose villages on both the lower und upper parts of the Kuskokwim River in order to investigate the upstream-downstream effects on fishing (Loring and Gerlach 2010; Ebbin 2002). Last, some villages have greater employment opportunities than others, which can affect their dependence on subsistence resources (Langdon 1991). Residents of Tuntuliak lie near the open ocean and can participate in the commercial salmon fishery while people in Kalskag and Lower Kalskag often work in nearby mines. Altogether, these six villages form a representative sample of Yukon-Kuskokwim Delta communities and their subsistence traditions. Table 1 summarizes key characteristics for each village.

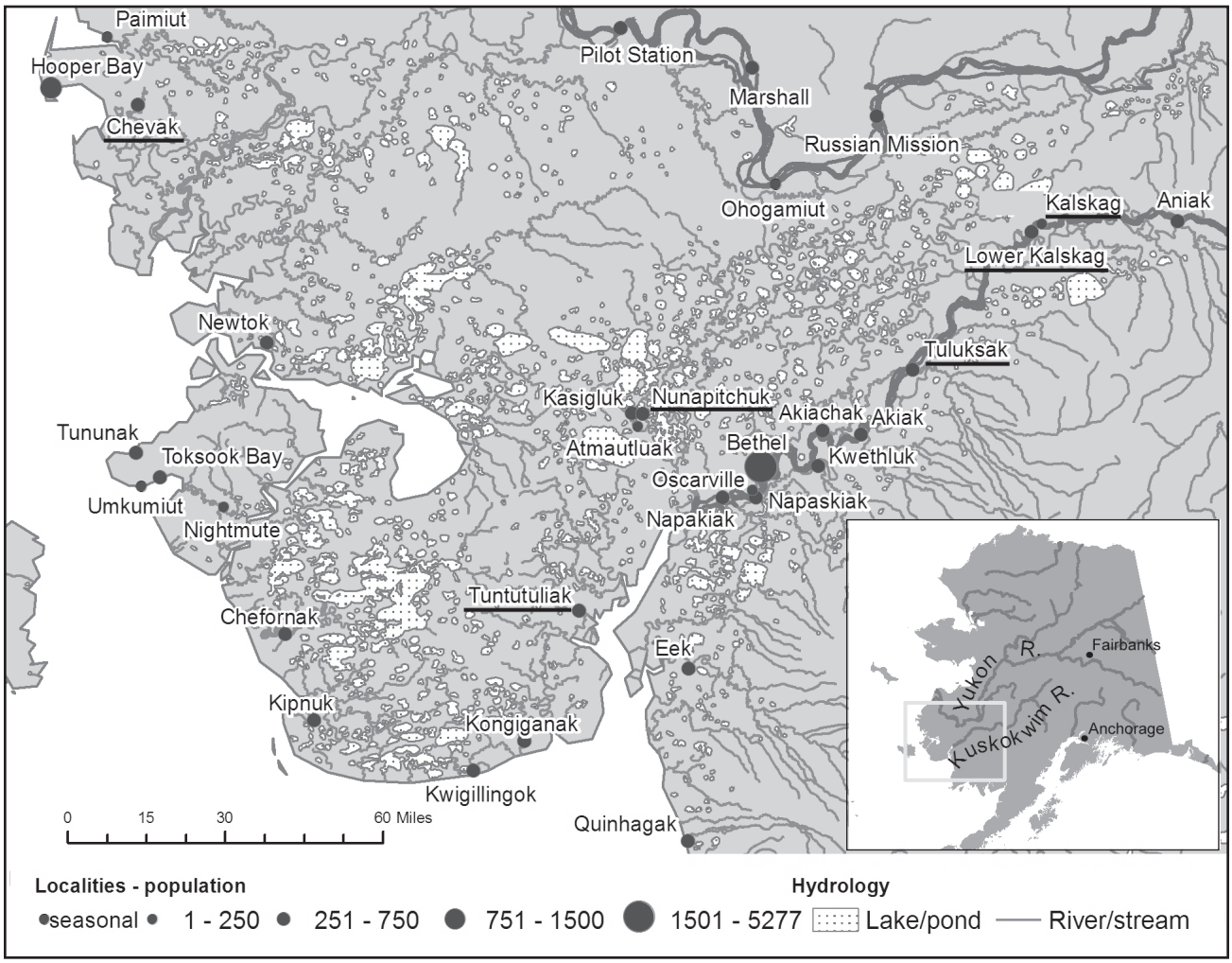

FIGURE 2. Study area with inset map of Alaska and its major rivers—Participating communities are underlined.

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Sample

We used a purposive sampling strategy and sought to speak with individuals who had expert knowledge of subsistence and Yup'ik values. The fieldwork consisted of personal interviews with active subsistence harvesters where we attempted to speak with six broad classes of people within each village. We stratified the sample to include both male and female Elders,[2] male and female middle-aged peoples (25-55 years old), and male and female youth (18-25 years old). There is some evidence a generation gap exists in traditional ecological knowledge between Elders and youth (Ford et al. 2006). Thus, we chose these age groupings to obtain perspectives on how subsistence is changing with each generation. We stratified by gender because men and women typically engage in different subsistence tasks.

TABLE 2.
Interviewees by age and gender.

	Gender	
Age category	**Male**	**Female**
Elder (55+)	13	12
Middle-aged (25-55)	13	9
Youth (18-25)	8	7

Data Collection and Data Management

Using a topic outline to conduct unstructured personal interviews (Bernard 1998:213-215), we informally solicited information on local institutions for subsistence harvesting. The first author (Colin West), a research associate (Uyuriukaraq Ulran), and an undergraduate research assistant (Timothy Argetsinger) conducted these interviews. Ulran translated between Yup'ik, Cup'ik, and English. In total, we interviewed 62 individuals (see Table 2).

These interviews were transcribed and entered into a text analysis program, ATLAS.ti 5.0 (Muhr 2004). In some cases, interviews were also translated from Yup'ik into English by Uyuriukarag Ulran and Marie Meade. Using ATLAS.ti, an undergraduate research assistant, (Connor Ross - the second author) coded passages of the interview transcripts.

Fieldwork also involved going out on the land to fish and gather wild foods in both the summer and winter. We participated in ice-fishing for smelt and tom cod (Chevak), set-net fishing for king salmon (Tuluksak), set-net fishing under the ice for needlefish (Chevak), set-net fishing for herring (Chevak), drift-net fishing for king salmon (Nunapitchuk), greens gathering (Tuntuliak), and wild egg gathering (Chevak). This participant-observation helped us gain insights on subsistence practices to supplement interview data. Last, we briefly visited each community to meet with tribal council members to inform them of the project's goals and obtain official permission to interview community members.

Analytical Procedures

The qualitative data analysis of the interview material was conducted using digital transcripts of all 62 interviews. In terms of scope, we only sought to broadly identify descriptions of local institutions (our one major theme) and then identify sub-sets of particular categories of local institutions (or subthemes). We report here only on the three categories of harvesting, processing and sharing. Once all of the transcripts were entered into ATLAS.ti, two of the researchers (West and Connor) selected a representative sample of ten complete transcripts, read through them entirely, and independently identified text passages that referred to local institutions broadly and also to specific local institutions. Next, we compared our results and together developed definitions for the general theme of local institutions and the subthemes of particular categories that were consistent with

both of our preliminary analyses. Based on these definitions, we developed a codebook including these definitions, criteria for including text passages, and some examples drawn directly from the initial sample. These definitions and codebook were used to code the rest of the transcripts. The coding was hierarchically organized into only two levels: general local institutions and specific categories.

We also developed a list of face-sheet categories including village, gender, and age-group. These also became codes within the ATLAS.ti database enabling us to query all transcripts by several characteristics in order to retrieve text blocks by local institution category. Thus, for example, we could search for text blocks of "sharing" by "young" and "males" including "all" villages and retrieve examples from transcripts with these identifying characteristics. We used this procedure primarily to identify key quotes by individuals that clearly reflected how people talk about local institutions. These passages helped us assess how institutions play an adaptive role as people face challenges in obtaining subsistence foods especially as we reflected on our participant-observation data.

RESULTS

In our analysis of the interview data, we identified numerous examples of the three types of local institutions (resource harvesting, resource processing, and resource sharing). These were also consistent with local institutions described in earlier ethnographic works by Fienup-Riordan, Wolfe, and other authors. In the following analysis, we describe these institutions and explain their role in adapting to global change.

Resource Harvesting

Informal rules regarding the quantities of food to be gathered vary depending on the type of resource in question. When collecting eggs, it is common practice to leave one or two remaining in the nest (see Fienup-Riordan 1999). This ensures that a new generation will be born and thus, the species will continue to flourish. In the case of salmon, which constitute the bulk of the local diet, individuals gauge how much to catch based on the amount consumed by themselves and their families during the previous year. Adjustments are made to account for shortage or surplus. A young woman in Tuntutuliak explained:

> *I estimate like, how we did the last summer, and then if we had leftover or if we were short. I add or keep it the same, like on the fish—it's hard on the birds and the other wildlife, but on the fish, that's how I usually do it (U-09—50:2—MF).*

Because of the volatile nature of species availability, some emphasize the importance of gathering as much of a given resource as possible while it is readily accessible. An Elder couple in Tuntutuliak elaborated on this:

> *…another thing I was taught—not to catch more than what I needed or the family needed. But there's another thing that we were also taught—catch as many as your limit in a short time, because if you wait then you're going to miss the fish run or the salmon berries are going to be gone (U-05—47:7—EM).*

Throughout the summer, locals enjoy eating fresh salmon. Simultaneously, they work tirelessly to smoke, dry, and/or freeze most of what they catch in preparation for the coming winter. Regardless of the quantity of food gathered and stored, households must consume conservatively because unexpected conditions may arise. Consistently harsh winter weather could severely limit locals' capacity to gather seasonal species. In such cases, the people must depend solely on that which was gathered during the summer. As explained by a male Elder in Lower Kalskag:

> *You know, just because you catch them, dry them, and they're ready to eat, doesn't mean you have to eat them right away. You have to try to think of what's ahead of you. You know, we don't really know what tomorrow's going to be or what next week's going to be. Unless we're stuck and can't get nothing flown in, when the weather is bad, so we rely on things we put away (L-01—17:4—MM).*

These institutions regarding harvest amounts help communities adapt to global change. Wildlife populations fluctuate wildly and warming in the Arctic

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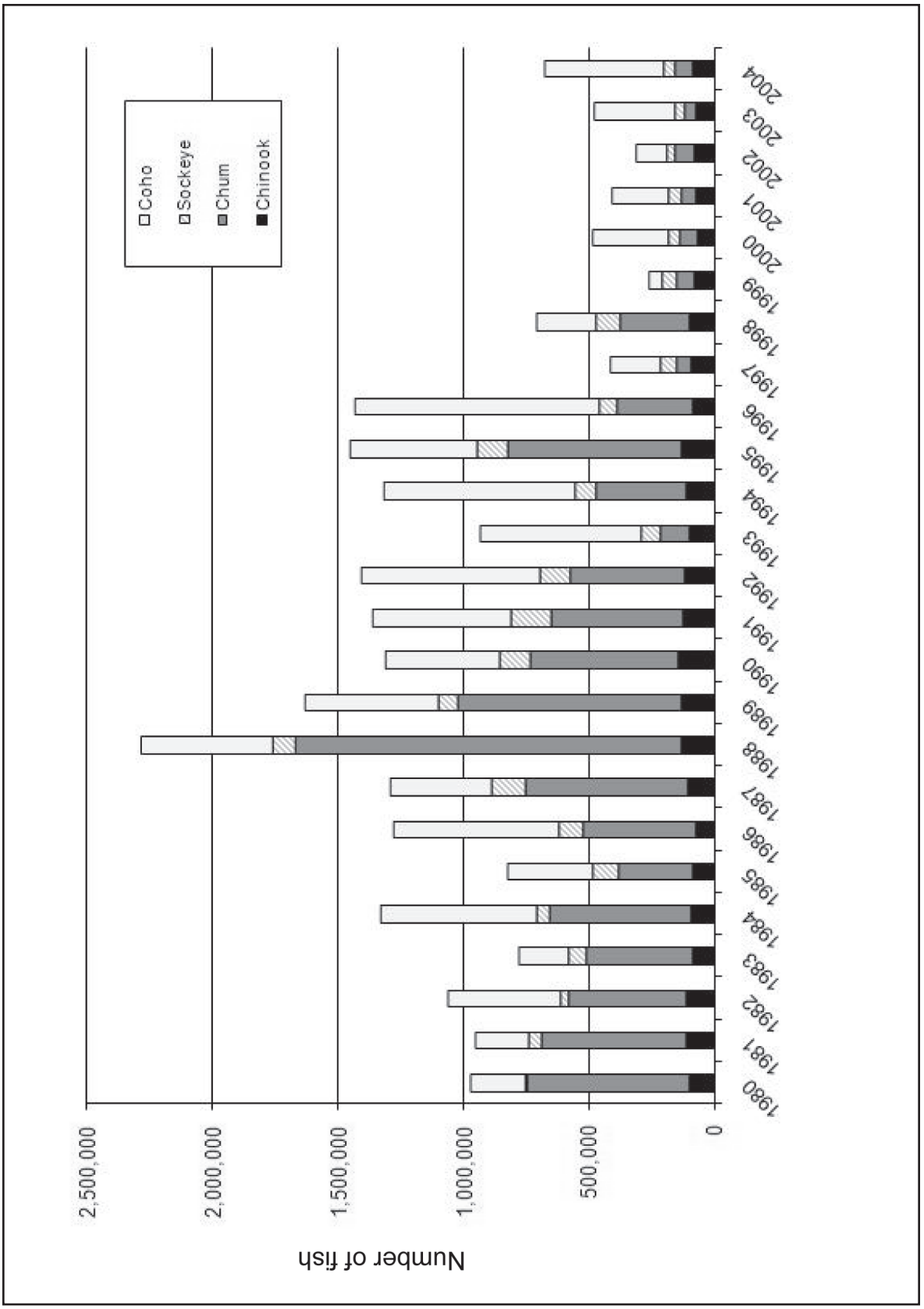

FIGURE 3. Total Kuskokwim River salmon harvests, 1980 to 2004—adapted from Howe and Martin 2009.

can potentially cause steep declines in species or even cause extinctions (ACIA 2004). The individual limits households use prevent local over harvesting. Aggregated across communities along an entire river, the annual total subsistence harvest of salmon is well below the minimum sustainable escapement (MSE) target used by fishery biologists (Loring and Gerlach 2010). Thus, local institutions that govern household behavior ultimately keep harvests within sustainable limits for an entire fish or animal population. Nonetheless, these local institutions conflict with the ever-increasing formal management regime.

Kuskokwim chum salmon stocks crashed in 1997 (Figure 3), and this ushered in a host of regulations for salmon fishing on the river, which was previously largely unregulated. One of these concerns 'windows,' where the subsistence fishery is closed for a certain period before and after the opening of the commercial salmon fishery on the Kuskokwim. There are also limits on the net size, which restricts the size of the mesh used for certain species of salmon. Last, one of the game units for moose hunting was closed during our fieldwork.

These formal regulations interfere with local institutions and prevent local people from harvesting any salmon. In 2009, Alaska Department of Fish and Game closed the subsistence king salmon fishery on the upper Yukon River, which seriously jeopardized the food security of numerous villages (Loring and Gerlach 2010). Quotas and bag limits for moose are considered especially onerous because they do not take into account that a single individual may hunt or fish for a large extended family—not just his own household (Magdanz et al. 2002).

The window closures for salmon on the Kuskokwim can interfere with local subsistence. People time their fishing trips in order to coincide with work schedules and also tides. Thus, the river may be closed on a weekend or at a time when fishers had already planned to go out. Salmon travel up-river in pulses, and a pulse of one species may be passing by villages at precisely the time that subsistence fishing is forbidden. Thus, they lose the opportunity to catch king salmon due to the timing of the run and the windows. This is a particular concern in Nunapitchuk because the village lies 32 km from the Kuskokwim and there is no local salmon. It takes nearly two hours by boat to reach the river and one fishing trip costs nearly US$100 in gas. Thus, their fishing trips take a great deal more advanced planning and cost more money. Residents reported that they had purchased the gas, requested time off from work, and traveled all the way to the Kuskokwim only to find that the Alaska Department of Fish and Game window had closed. Thus, they had to return all the way home without any king salmon and did not have the resources to travel out again to catch the next pulse. Some were unable to harvest any kings that year.

Local institutions regulating how much to harvest were largely the same across all communities and age groups. People on the lower Kuskokwim felt there was more tension between formal regulations and traditional rules because the river is actively monitored in this area. Alaska Department of Fish and Game planes fly up and down the river during the window closures and the agency closely watches moose hunts. We found that Chevak and communities in the upper Kuskokwim are less affected by official regulations. Chevak is very far away from Bethel and located on a minor river. It lies outside the zone of active surveillance for the Alaska Department of Fish and Game or the U.S. Fish and Wildlife Service (USFWS). Thus, formal regulations regarding harvest quotas mostly affect communities on the lower Kuskokwim and especially Nunapitchuk.

Resource Processing

Women with whom we spoke discussed rules for processing far more often than men. This is due to the fact that women do almost all the cutting, hanging, and drying of fish. Subsistence foods are not only critical to the physical survival of village residents, but are also an essential aspect of Yup'ik cultural identity. Thus, it is not surprising that many of the local institutions currently in practice are intended

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to encourage respectful treatment of the resource. According to the Yup'ik worldview, humans and animals are inextricably engaged in a reciprocal relationship in which animals offer their bodies to those who demonstrate appropriate reverence (Kawagley 2006). Animals are capable of intuiting human thought, speech and action, and thus people must be intensely aware of their conduct, both internal and external (Fienup-Riordan 2000). In particular, individuals must not waste meat, as this is especially offensive to the animal, which is believed to have voluntarily sacrificed itself to the hunter or fisher.

In addition to the precept that people shouldn't harvest more than they need, it also is essential to harvest only what can be processed. While men are careful not to over harvest, women are expected to promptly cut up and preserve all that is gathered so that none of it spoils. Thus, the amount a hunter or fisher can catch is constrained by the processing capacity of the women in his family group. As a middle-aged woman in Chevak reported:

> *…there are sayings that whatever my husband catches I have to take care, and not let them sit and go to waste, or not share, and if I didn't do that then it'll have a big impact on me and my family…Like if my husband went out hunting and he brings it home and I don't take care of it, it goes to waste and we throw it away…then he's not going to hunt anymore because of that (C-02—MF).*

A woman's negligence could result in rotten meat, a loss of motivation on the part of her husband, and ultimately, the refusal of animals to submit to the hunter.

Because waste is considered highly offensive to the resource, people are encouraged to utilize as much of the animal as possible. A young woman in Tuntutuliak told us:

> *We have to use everything, not including the guts of the subsistence we catch. We try to use all the remaining (U-09—50:1—MF).*

In general, all meat and organs save for the intestines and in some cases, head, are consumed.

It is important for one to demonstrate deference not only through proper action, but also in thought and speech. Conflict over the resource, both tacit and openly articulated, is believed to bring about food shortages in the future. An Elder woman in Tuntutuliak emphasized this point:

> *…when we were growing up we were also taught that you aren't supposed to complain or…make a big thing out of game animals or fish, because if that happens, if there's a disagreement between groups…that particular species would be gone (U-05—47:9—EM)*

For example, one participant conjectured that intragroup controversy generated by official legislation resulted in a sharp decline in the salmon population (see Kofinas 2005). In this scenario, the Alaska Department of Fish and Game had divided the Kuskokwim River commercial fishery into two discrete districts to allow for escapement; subsequently, conflict between the two ensued. This male Elder in Tuntutuliak explained:

> *… when that happened, it became upriver versus downriver, you know, fighting over the resource. The downrivers claiming that upriver's hurting the species or they're being treated unfairly…And it seems like that's when the commercial fishery went down (U-08—49:8—MM).*

Similarly, an Elder woman from Kalskag attributed salmon scarcity to the divisive attitudes and behavior that began to pervade the community following the introduction of a salmon roe market.

> *…it even get worse when it was coming up in the mid-60s, when the Japanese…had some kind of cannery down in Bethel. And they were also buying salmon roes, you know, fish eggs. Then when they did that, everybody up here, the men got greedy for the money. So they hurry up and rip off—they didn't even eat the salmon…they were getting just the fish eggs out and they were throwing in the river. Because of that, just taking things for money…And fish decline fast all the way down (K-06—15:8—EM).*

This quote reveals how local institutions can break down due to market pressures and shows that they

are potentially fragile. If external demand grows for particular subsistence products like roe and legal protection relaxes, there is a strong possibility that self interest could again undermine prescriptions against over-harvesting.

Subsistence strategies are flexible, and communities target multiple species throughout the seasonal round. If one salmon run fails in the summer, households are able to make up this shortfall with whitefish in the winter (see Langdon 1991). Historically, there have been cases of multiple harvest failures in the Yukon-Kuskokwim Delta. Because the lower reaches of the Yukon-Kuskokwim Delta are low-lying, they are very vulnerable to fall and spring flooding. People used to store smoked salmon in seal oil and seal skins in underground pits. In November of 1931, widespread floods wiped out these stores (Fienup-Riordan 1986:25-27). This flooding also prevented residents from ice-fishing for whitefish because the flood disrupted the river channel. When Yup'ik households face starvation, they consume less-desirable freeze-dried fish they may have buried in permafrost many years ago (Kawagley 2006:59-60). Our interviewees emphasized that such famines such as these will occur again in the future, and people have to be prepared. Excess food must be put away, not thrown away. Also, people must be humble and willing to eat unappetizing foods, such as freeze-dried fish that is several years old, in order to survive.

Climate change could potentially increase the frequency and severity of seasonal flooding (ACIA 2004). One resident of Chevak recounted a story of how an ice dam on their river in the spring prevented them from traveling to the coast to hunt seals. It also caused their river to begin flooding the village. This occurred at a time when winter food stores were running low and people became very worried about seasonal famine. Village men traveled down to the river to assess its condition and they discovered a small pod of beluga whales that had surprisingly swum inland and became trapped behind the ice dam. They harvested the beluga and saved the community from starvation. The man explained that the beluga had "given themselves" to the village because everyone continually treated all fish and animals with respect.

These narratives and stories underscore the importance of respecting fish and animals. People are told not to waste and also to avoid talking about the resource unnecessarily. In extreme cases, like roe-stripping, wasting fish can lead to population collapse. This local institution was ubiquitous among all communities and across all age-groups. Among younger people, however, we often specifically asked them to explain why they should harvest only what they need. They could rarely answer this and usually stated simply, "that is what the Elders tell us." Only older participants could articulate why harvests should be limited, perhaps because they have directly experienced the consequences of over-harvesting, such as the period associated with roe-stripping. Ecologically, respecting fish and animals is an institution that has helped communities adapt to population fluctuations because it prevents over-harvesting.

RESOURCE SHARING

Of the local institutions we have identified, those concerning the distribution of food were the most frequently and thoroughly discussed by participants. Sharing serves a variety of social, cultural, and practical purposes. It establishes and maintains social relationships; acts as an expression of gratitude towards the resource; assists in diversifying the local diet; and ensures that all members of the community are sufficiently fed. Given its multitude of functions, it is not surprising that sharing is ubiquitous amongst the Yup'ik people of the Yukon-Kuskokwim Delta. It takes place daily and in a variety of forums.

Younger people frequently discussed the importance of sharing their "first catch," which is a boy's first successful hunt or a girl's first successful gathering endeavor. In such a situation, a celebration is held in which the meat or berries collected are distributed among the village Elders or the entire community (depending on the size of the harvest). As one middle-aged man in Lower Kalskag recounted:

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> *When I first caught a moose, I never even see the meat. I never see any part of it. We have a tradition: when you first catch something, it goes to the Elders. You don't take nothing. Your first catch, any kind of animal, it goes to the Elders in the town in the village. Or to the people (L-01—17:16—MM)*

Subsequently, throughout one's life, his seasonal first catch is given to an Elder or Elders in a somewhat less formalized manner.

A given hunter or fisher usually gathers enough to feed his entire household. This frequently includes immediate as well as extended family members, many of whom assist in the gathering and processing. A middle-aged man in Chevak explained:

> *…whatever we catch, we're always told to share it with family or anyone that needs it. Usually we decide to share with family first, even extended family, and it's just shared evenly with everyone. And if there isn't very much, we just do what we can to share it evenly (C-05—5:13—MM).*

While those who are employed have considerably fewer opportunities to engage in subsistence themselves, they generally contribute much of their earnings to supplement their family's gas and equipment purchases (Fienup-Riordan 1986; Langdon 1991; Wolfe 2004). Others limited in their subsistence abilities include Elders, the ill or injured, widows, and orphans. Culturally, there exists a strong sense of obligation to provide for such vulnerable individuals; even those from outside of one's extended family group are provided with food. An Elder woman in Tuntutuliak elaborated on this:

> *We have to share the food we have; we can't be misers, not for only one. The widows/widowers were taken care of too. Orphaned kids were thought of and fed in cases where they lost their parents (U-10—51:3—EM).*

Some believe that acts of charity will inevitably be reciprocated; attending to the needs of others guarantees that one will in turn receive during a time of desperation. In this sense, sharing functions as an informal insurance mechanism. A man from Tuluksak in his 30s stated:

> *…Sometimes, nature doesn't provide; it doesn't give us meat. But there are other sources and where a person cannot catch, other people, other families, will come in to give. Some people can keep it in memory, that this person had give them some, and in return while we're not thinking about it, they'll give us something (T-07—40:16—MM).*

Those who were unsuccessful or unable to obtain enough in gathering a particular food often engage in trade in order to acquire the desired resource. This is explained by an Elder woman in Lower Kalskag:

> *…Last couple years, they couldn't catch any moose. Just had bum luck. And our relatives shared their catch and gave us so much…Or sometimes I talk to one of my relatives and we exchange, like, a pack or fish for a pack of meat. That we will have something else to eat instead of just fish (L-03—19:6—EF).*

Individuals share not only food, but gas, equipment, and cash. Because a relatively small proportion of village residents are employed, pooling of monetary resources is essential to the continuing success of subsistence operations. Generally, the family's highest-yielding hunters and fishers do not hold jobs and thus are able to devote a majority of their time to gathering food (see Magdanz et al. 2002). In the past, these people would have paid for subsistence-related expenses with money made from commercial salmon harvesting. Now, however, high gas prices combined with a relative decrease in the price of salmon have recently rendered commercial fishing unprofitable. Also, commercial fishing requires formal permits that are expensive. Thus, wage earners and salaried employees must contribute increasingly larger amounts of their income.

Widespread sharing plays an adaptive role in the context of ecological and socioeconomic stress. As the abundance of different species fluctuates, vulnerable families receive subsistence foods from high-producing families. When formal regulations close salmon fisheries or restrict moose hunts, the few households who can harvest salmon or moose share with those who cannot. This happens within villages

and between communities. During our fieldwork in 2008, the Alaska Department of Fish and Game temporarily closed the king salmon subsistence fishery in the middle portion of the Yukon River north of our study area. We saw kin from affected villages traveling to their relatives on the Kuskokwim and receiving dried smoked kings. They were packing these bags of fish on to local bush planes and taking them back to Yukon communities. Residents of the Yukon-Kuskokwim Delta have become increasingly reliant on external goods and services for several generations. This can make some people dependent on assistance from the outside and vulnerable to the increasing costs associated with heating oil and gasoline (Kawagley 2006). Sharing, however, can help people cope with external shocks.

We learned of two examples of this in Chevak. One man told us that the attacks of September 11, 2001, caused all flights in the United States to be grounded. In Western Alaska, they were grounded for two weeks. This prevented local stores from obtaining groceries and their stocks dwindled. Other villages faced serious food security problems during this time. But Chevak, he said, was just fine. People shared all of their recently harvested dried smoked fish with those households who mostly buy food. Another person told us it can cost over $US1000 per month to heat their home with stove oil in Chevak. Because it is a tundra village, the only alternative to stove oil is driftwood, which has to be dragged from the river up to people's homes. This person and his neighbor take turns hauling driftwood with their boats and four-wheelers. If one man does not have the time or money for gas, the other shares his wood with the former's family.

Like harvest processing, local institutions associated with harvest sharing were ubiquitous across all communities, genders, and age groups. Sharing ensures that all people have some subsistence food at all times regardless of declining species abundances, rising gas prices, or other socioeconomic shocks. Of all the local institutions, sharing appears to be the most robust and enduring.

CONCLUSION

Yup'ik communities of the Yukon-Kuskokwim Delta continue to speak their language and actively pursue a subsistence way of life, which means they have maintained their cultural and linguistic integrity more than other Alaska Native groups (Langdon 1991). Consistent with this vitality, we find that local institutions described by earlier ethnographers persist. Across villages, Yup'ik rural residents continue to harvest, process and share subsistence resources according to the same belief system as their parents and grandparents. Some researchers argue that such institutions should be the basis for formal management (Menzies 2010) or the foundation for co-management (Kofinas 2005). Others caution that the rapid and abrupt pace of climate change in the Arctic may be making local institutions less effective and relevant under contemporary circumstances (Ford and Smit 2004). In some cases, local institutions play primarily an ecological role and help indigenous arctic peoples manage subsistence resources as their abundance fluctuates (Parlee et al. 2006). Our case study shows that Yup'ik local institutions also help households and communities cope with regulatory restrictions, unemployment, and high fuel prices. Thus, they play an important role in Yup'ik adaptation to global change.

The ways in which Yup'ik subsistence users harvest, process, and share are deeply embedded in their cultural and spiritual belief systems. Because of these dimensions, it is difficult to see how they could be used as the basis for formal biological, legal, or even cooperative management (i.e., "co-management"). They could in fact become just another tool to legitimize state bureaucratic authority and control as members of indigenous communities participate in management councils or stakeholder meetings without actually changing the relations of power (Nadasdy 1999). The local institutions we have documented are very general, pervasive, and enduring. Unlike the case of Igloolik in the Canadian Arctic (Ford et al. 2006), we detected little indication that they are declining between generations. This is probably

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because Yup'ik communities maintain strong ties to their traditional culture and language. Thus, intergenerational knowledge is transferred between Elders and youth especially through actively participating in subsistence activities. Harvesting, processing, and sharing rules apply to all species and were remarkably similar among the different local subsistence traditions. For these reasons, we predict that Yup'ik local institutions will continue to be maintained despite continued or even intensified climatic, environmental, and social change.

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ACKNOWLEDGMENTS

The authors would like to thank the communities of Chevak, Kalskag, Lower Kalskag, Nunapitchuk, Tuluksak, and Tuntuliak who welcomed us into their homes and shared their stories with us. We acknowledge the invaluable help of Uyuriukaraq Ulran, Marie Meade, and Tim Argetsinger, who helped with fieldwork and translation. Special thanks goes to Suzanne Sharp, Lance Howe, and Jim Murphy. who helped make this research possible. This research was part of the "Salmon Harvests in Artic Communities: Local Institutions, Risk and Resilience" project funded by the National Science Foundation's Human and Social Dynamics Program (AOC-0729063). Suggestions by the three anonymous reviewers greatly improved this article.

NOTES

1. Residents of Chevak, one of the villages in which we worked, strongly identify as Cup'ik and emphasize differences between their language and Central Yup'ik. They also emphasize their cultural and historical differences from other Yup'ik groups. For the sake of simplicity, we refer to all peoples of the stud as "Yup'ik."
2. We use the term Elder with a capital 'E' in recognition of their elevated status in Yup'ik society. Elders were generally above the age of 60 and communities helped us identify these individuals. In Yup'ik cultural terms, Elders are older people who no longer engage in subsistence activities.

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