IT'S SO GOOD TO BE BACK:
EXPLORATIONS OF SUBSISTENCE IN ALASKA

by

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Abstract

This dissertation explores some aspects of contemporary hunter-gatherer economies in Alaska, with an emphasis on quantitative approaches. Written in manuscript-style, the focus is on four decades beginning about 1980, which coincided with legal recognition of hunter-gatherer activities as "subsistence," and with expanded subsistence data collection efforts. Subsistence is viewed through four theoretical frames: socio-ecological resilience, political ecology, social networks, and food security. Principles of common-pool resource management are reviewed, as are legal frames unique to Alaska that limited possible approaches to management and resulted in a fragmented management systems. In the body of the dissertation, the first article explores trends in rural community populations, wild food harvests, and personal incomes over time, identifies factors associated with subsistence harvests, models subsistence productivity, and estimates road effects on harvests and income. The second article uses household-level social network and economic data from two Iñupiat communities to explore hypotheses designed to test an assumed transition from wild food dependence to market dependence. The third article combines concepts of sensitivity and adaptive capacity drawn from vulnerability literature to explore differences in household characteristics within and between three Alaska communities. The discussion adopts a political ecology approach, introducing narrative discourses of subsistence in Alaska, comparing subsistence narrative discourses with the results the larger body of resilience, network analysis, and food security literature. It demonstrates how the same objective facts could drive competing narratives, and how resource management itself was subject to narrative construction.

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For Susan, Reid, & Grant

"The success of a civilization is measured not just in its aesthetic achievements but also, and surely more importantly, in the duration and quality of life of its citizens."

Niall Ferguson

Preface

Miki Jones had just arrived in Kotzebue on Alaska Airlines' morning flight from Anchorage. Miki wanted to get a few things at the store before catching an afternoon flight to her home in Shungnak – an Iñupiaq village on the Kobuk River – so she called my wife, Susan Georgette. Susan and Miki had known each other for decades. Miki and her family often had helped our family as we traveled by boat to our Mauneluk River camp, only a few miles above the Jones' camp on the Kobuk River. It's what Alaskans do; they help each other. On this particular day, as Susan drove Miki from the airport to the Alaska Commercial Company store, Miki said, "It's so good to be back in civilization again."

To the smattering of tourists who wound up in Kotzebue, "civilization" would not be the first word that would come to mind for a rustic town in Arctic Alaska, far beyond the end of any roads (Figure P-1, Figure P-2). For Kenneth Clark (1969) on the 1960s BBC television show, "Civilisation" was the art and architecture of Western Europe during the last 500 years. For historian Niall Ferguson (2011), "civilization" was a highly complex human system of economic, social, and political institutions essential to functioning cities. In the 1867 Russian-American Treaty of Cession for Alaska, "civilized" referred to those residents of Alaska who were not members of the "uncivilized tribes" (Case and Voluck 2012). Miki's notion of civilization had nothing to do with art or cities or treaties, and Susan thought she knew what Miki meant. It was what one of Susan's other Iñupiaq friends had said about Anchorage: "All those people and no one to feed you."

It made perfect sense, simply as a function of scale. Anchorage had 300,000 people, Kotzebue had 3,000, and Shungnak had less than 300. If you were hungry in Shungnak, it was quite likely someone would know, and feed you. If you arrived by plane, someone would offer you a ride. If you needed a place to stay, someone would find you a place. British anthropologist and evolutionary psychologist Robin Dunbar famously concluded that the human brain could main-

Figure P-1 Kotzebue, Alaska.

tain viable social relations with only about 150 people (Dunbar 1992, 1998). In 2002, we had documented Shungnak's wild food production and distribution network as part of my research for the Alaska Department of Fish and Game (Magdanz et al. 2004). We found that every Shungnak household was connected to at least one other Shungnak household through wild food production and distribution ties, creating a single large network component (Figure P-3). Shungnak households clustered into several cooperative family groups, each well within the bounds of Dunbar's number. The average household had more than 8 wild food relations, and almost 30% of wild food social relations between households were reciprocated.

Shungnak was typical of rural Alaska communities. In 2018, the median community size in Alaska was about 250 people (Alaska Department of Labor and Workforce Development 2019).

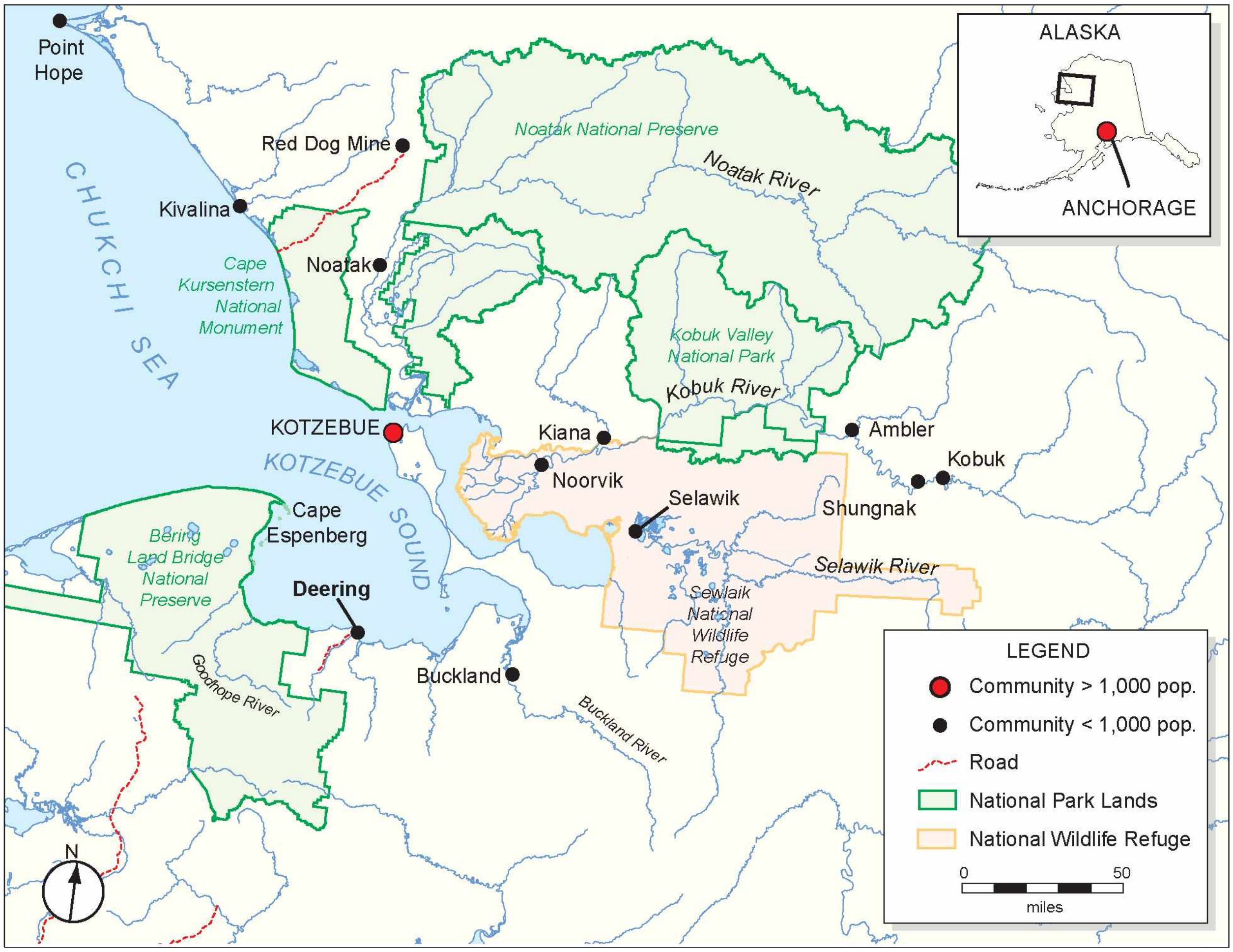

Figure P-2 Northwest Alaska.

Of Alaska's 350 communities, only 3 communities (Anchorage, Fairbanks, and Juneau) had more than 10,000 people. Only 100 communities (mostly adjacent the three cities or along the roads between them) had more than 1,000 people. About a third of Alaska's communities, like Kotzebue and Shungnak, were not accessible by road.

For indigenous Alaskans, the state's small, rural, mostly indigenous communities were welcoming places where peopled looked out for each other and did not expect money for every small service. As Miki's comment suggested and as contemporary research showed, these small Alaska communities were characterized by dense social networks that produced, processed, and distributed wild foods (e.g., Magdanz et al. 2002, Magdanz et al. 2007, Magdanz et al. 2011, Reedy and Maschner 2014, Kofinas et al. 2016). A growing body of work was documenting

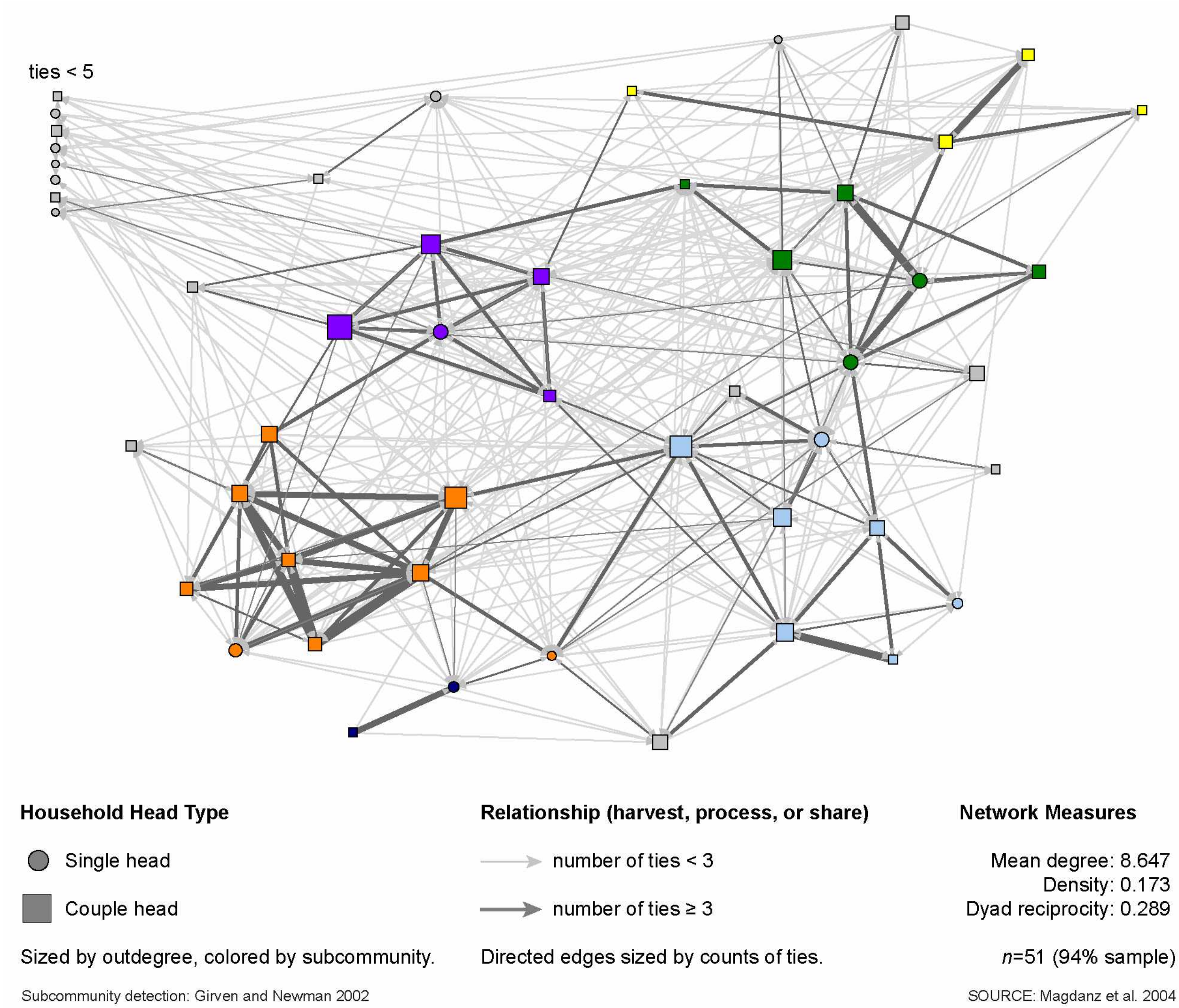

Figure P-3 Subsistence production and distribution network, Shungnak, 2002.

similar wild food production and distribution networks in rural northern Canada (Collings 2011, Dombrowski et al. 2013, Natcher 2015), Russia (Ziker 2007), Nicaragua, (Koster 2011), Bolivia (Hooper et al. 2013), Indonesia (Nolin 2012), Tanzania, (Kasper and Mulder 2015), and Ghana (Chaudhury et al. 2017).

Some worried that face-to-face networks were being replaced by virtual networks on social media, and it was true that in village Alaska even very young children seemed to have their own smart phones. But virtual friends couldn't catch a salmon with you, butcher a moose with you, or share blueberries with you, unless they also were your friends in the traditional sense, people with whom you interacted on a regular and continuing basis. Producing and distributing wild food required a chain of physical contacts between people and resources. While Dunbar-type social networks did exist in modern cities, they existed mostly in neighborhoods, in places of work, in common interest organizations (bridge clubs, bowling leagues, veterans' associations), and among families. There was some evidence that these kinds of social networks were on the decline in the United States (Putnam 1995, McPherson et al. 2006).

One common measure of network structure is density – actual ties divided by all possible ties – and density normally decreases with increases in network size. The density of subsistence food production and distribution networks in Arctic communities was often less than 0.05 (5% of all possible ties were active), but usually that level of density was enough for every household to be connected with at least one source of wild foods (Ready and Power 2018). The density of a Dunbar-type network in a large city – if such a statistic could be estimated – would be vanishingly small simply because cities are so large. In practical terms, this meant that most or all of Anchorage's wild food production and distribution networks would be invisible and inaccessible to village visitors like Miki.

Shungnak was different from Anchorage in another important way. In Shungnak, your meal most likely would include wild foods harvested, processed, and culturally preferred by your hosts, because it was economically practical, ecologically possible, and culturally sustaining to feed one's family primarily by hunting, fishing, and gathering local wild resources. Indigenous people, including Miki's ancestors, had been doing it in northwest Alaska for at least 10,000 years (Dumond 1980, Giddings and Anderson 1986). In 2019, it was still possible to live off the land and waters around Shungnak without engaging the cash economy at all, although no one was actually trying to do so.

In 2019, most rural Alaskans and some urban Alaskans engaged in a "mixed economy," supporting the harvests of wild foods with cash earned from wage labor or self-employment like commercial fishing (Holen et al. 2017). Generally, the economic pendulum swung towards wild foods in rural Alaska where wild food harvests averaged 276 lb per person per year or 176% of the daily protein requirement, and towards market foods in road-connected and urban Alaska where wild food harvests averaged 19 lb per person per year or 12% of the daily protein requirement (Fall 2019). The estimated statewide replacement value of these wild food harvests – valued at $10 a pound – exceeded $450 million a year (Fall 2019). Given that Alaskans spend about $1.4 billion a year on market foods, wild foods comprised about a third of the value of the all foods consumed by Alaskan families (Snyder and Meter 2015). While rural families' economic strategies varied widely (BurnSilver and Magdanz 2019), it was clear that wild foods contributed substantially to food security in Alaska (Meter and Goldenberg 2014).

From my very first trip to Alaska in 1978, I'd been intrigued by the potential futures of Alaska's small indigenous communities. In 1981, I joined the "Subsistence Section," a social science group embedded in the Alaska Department of Fish and Game, later to become the "Division of Subsistence." At the time, newly adopted state and federal laws had defined "subsistence" as the customary and traditional uses of fish and wildlife for personal and family consumption. The laws gave subsistence uses priority over other consumptive uses in times of resource shortages. Exactly what those subsistence uses might be was unclear and was being actively debated (cf. Appendix A). The mission of the newly created Subsistence Section, also embodied in state law, was to scientifically quantify, evaluate, and report information about Alaskan's uses of fish and wildlife to the Alaska public and to the regulatory bodies who determined what uses and areas qualified for the subsistence priority (Fall 1990). Anthropologist Tom Lonner was appointed to lead the new Subsistence Section. "At this beginning point in the life of the Section," Lonner wrote, "the staff understands our task to be the analysis of the relationship of subsistence users to each other and to the resources used" (Lonner 1979). From my perspective, Lonner's ordering of tasks was prescient: first, the relationships among users, and second, the relationships among users and resources.

In 1982, in my first field project for the division, I ran into a problem. With the approval of the small mostly indigenous community of Golovin, Alaska, I was about to administer a comprehensive subsistence survey to each of Golovin's 25 households. The basic survey question asked: "Did your household use moose (salmon, bearded seal, Canada geese) last year?" That seemed simple enough. But a month before my survey was to begin, the regional housing authority delivered 12 prefabricated houses to Golovin. This increased the housing stock from 25 to 37 houses and precipitated a rapid round of "musical houses" as people sorted themselves into new and old houses. Suddenly our basic survey question was not so simple. If I interviewed members of a new house about their household's activities in the "last year," should I ask them to include their activities while living in their old house? If I interviewed members of an old house, should I ask them to include the activities of members who now lived in a new house? Thus, in my very first retrospective survey for the division, it seemed as if one of social science's standard units of analysis – the household – was deeply flawed (Wenzel 1995, 2000).

My (partial) solution was to add a question to the survey: "Who got the moose (salmon, bearded seal, Canada geese) your household used last year?" This scaled responses from the household level down to the individual level, yet maintained connections between the wild food producing and consuming household or households. When I returned from Golovin to my office, I noticed some patterns. For example, households that cooperated to harvest salmon were more likely to also cooperate to harvest other species. And some people produced food for many households. When I showed these patterns to Robert Wolfe, the division's research director, he was quick to recognize that our data were describing social networks. The division's data analyst, Charles Utermohle, worked out the data structures we needed to store and analyze the data. With that, the "household problem" I encountered in Golovin developed into a substantial and continuing interest in network analysis as a method to understand rural Alaska economies.

With support from Don Callaway and Ken Adkisson at the National Park Service, we began to include subsistence network questions in our standard comprehensive surveys in northwest Alaska. Clarence Alexander, Dave Andersen, and Jim Marcotte – all with the Division of Subsistence – joined us in the field to administer those early surveys. In 2002, we released our first technical paper exploring household-level wild food production and distribution networks in

Wales and Deering, in which network graphs made the extent and structure of people's cooperation visible (Magdanz et al. 2002). When we showed our results to community leaders, some asked us to include wild food network questions when we surveyed their community. When we showed our results to respondents in subsequent survey communities, many became more willing to answer our network questions. Don Callaway thought food sharing networks might help explain households' food security status, so he connected us with Janelle Smith, a graduate student in nutrition at the University of Alaska Anchorage. Janelle joined us for comprehensive survey projects in Buckland and Kiana and explored food security among elders (Smith et al. 2009). Mark Nord at the U.S. Department of Agriculture graciously helped me revise the household food security module for us in a subsistence context, and later reviewed our food security results. Polly Wheeler at the federal Office of Subsistence Management – who had explored the role of cash in northern subsistence economies for her Ph.D. dissertation – supported our efforts to use network methods to document customary trade in subsistence finfish in Norton Sound (Magdanz et al. 2007).

Jim Simon, northern regional supervisor for the Division of Subsistence in the 2000s, was interested in including network and food security modules in comprehensive surveys for other communities in northwest Alaska. Jim Fall and David Koster, the division's research director and lead analyst programmer, respectively, were supportive, as was Caroline Brown, Jim Simon's successor. Marylynne Kostick took the lead on food security analysis. A number of resource specialists for the division – Nicole Braem, Beth Mikow, and Brooke McDavid in particular – became network advocates. Subsistence network and food security modules became common features of division surveys (e.g., Brown et al. 2012, Braem et al. 2015, Brown and Kostick 2017). I could name many more people – including people in other organizations like Alex Whiting at the Native Village of Kotzebue; John Chase, Tom *Ukallaysaaq* Okleasik, and Martha Siikauraq Whiting at the Northwest Arctic Borough; Austin Ahmasuk, Eileen Norbert, Jacob Olanna, Caleb Pungowiyi, Sandra Tahbone, and Eric Trigg at Kawerak Inc.; and Taqulik Hepa with the North Slope Borough Division of Wildlife Management – but suffice it to say that many,

many people contributed to the evolving subsistence research program in northern Alaska. I am in debt to them all, including the thousands of unnamed respondents over the life of the Division of Subsistence's research program.

In March 2005, we presented of some of our early network results at the annual meeting of the Alaska Anthropological Association. After the session, Dee Williams approached and introduced himself as the new lead anthropologist for the Minerals Management Service (MMS) in Alaska, later the Bureau of Oceans Energy Management (BOEM). Dee asked whether we would be interested in extending our network research by quantifying flow amounts. Given the scope of the project and logistical challenges, the Division of Subsistence decided to pass on the project, as did the Institute of Social and Economic Research at the University of Alaska Anchorage. But Gary Kofinas at the University of Alaska Fairbanks (UAF) – who had strong professional relations with upper Yukon River and North Slope communities – was interested. Subsequently, BOEM funded the "The Sharing Project" through UAF, Shauna BurnSilver joined as a post-doc, and the Division of Subsistence made me available to the project as a consultant. Working closely with the indigenous villages of Kaktovik, Wainwright, and Venetie, the project successfully estimated the total amounts of core species of wild foods flowing among households in the communities (Kofinas et al. 2016).

The importance of social relationships in the production and distribution of wild foods was hardly a secret to northern scholars working in indigenous communities. Burch (1970, 1988) wrote about trading partnerships and modes of exchange in northwest Alaska. Bodenhorn (2000) documented wild food exchanges between two Iñupiaq families (but did not present her results as a network). Usher et al. (2003) even suggested that someone conduct a wild food network survey – "there has never been a comprehensive survey designed specifically to document the characteristics, activities and flows of the household in an integrated fashion." Commenting about the Division of Subsistence's research program, Dombrowski (2007) lamented that "the household basis of their survey may actually miss some critical elements of redistribution that were less important for the amounts involved than they were for the relations they indicated and made possible." Usher, Dombrowski, and colleagues apparently were unaware that we had been pursuing the network line of research for more than a decade (Magdanz et al. 2002). The problem was that no one in the Division of Subsistence – me included – was trained in network analysis, and we weren't publishing journal articles.

So, in 2012, I resigned from the division to pursue a PhD in natural resources and sustainability through the Resilience and Adaptation Program at the University of Alaska Fairbanks (UAF). My goals were to develop statistical skills to better analyze the wild food production and distribution network data we had collected, and to begin publishing the results in academic journals.

In October of 2012, as a newly enrolled PhD student, I went to a coffee shop near the university to meet with F. Stuart "Terry" Chapin III, an emeritus professor at the University of Alaska Fairbanks (UAF). We had first met about ten years earlier when Terry and I both presented during the Natural Science Foundation's Arctic Forum in Washington, D.C., in 2003. I presented on our Wales-Deering network results, and Terry presented on the Resilience and Adaptation Program (RAP) at UAF. As we met for coffee, my hope was that Terry would serve on my committee, so I pitched some of my ideas and he agreed to serve. By the end of the year, I had recruited three more committee members: Joshua Greenberg, a UAF economist well versed in rural resource issues; Courtney Carothers, a UAF anthropologist who brought a political ecology perspective to Alaska's artisanal fisheries, and Steven Goodreau, a University of Washington anthropologist who helped develop several R packages widely used for social network analysis. The Division of Subsistence hired me back as a graduate student intern, which allowed me to continue to consult on subsistence network projects. In 2013, with Steve's support, I studied network analysis as a visiting graduate student at the University of Washington. Then, in June 2013, I attended the Complex Systems Summer School at the Santa Fe Institute. Throughout the pursuit of my degree, my committee has been supportive in every possible way, most especially in giving me the freedom to pursue my program in the way I thought best.

Everyone mentioned here – and many more – have supported my work over four decades in Alaska. On a flight from Denver to Seattle in 1978, a serendipitous, life-changing seat assignment next to a stranger – Denny Kelso – led eventually to a job with the Division of Subsistence, without which none of this would have happened. At the other end of the continuum, a serendipitous Craigslist housing ad posted by my Kotzebue neighbors John Creed and Susan Andrews resulted in my taking up residence across the street from UAF professor emeritus William Schneider, who became a good friend and served as an ex-officio member of my PhD committee. Shauna BurnSilver, whom I met through the BOEM Sharing Project and who is now a professor of anthropology at Arizona State University, was my most frequent co-author and an ex-officio PhD committee member as well.

Susan Georgette has been my companion for most of my Alaska adventures – scholarly and otherwise – as a life partner and the mother of our two sons, Reid and Grant. Virtually everything I think I might know about life in Alaska has been informed by Susan, Reid, and Grant. Their continuing support has been invaluable, and I will forever be in their debt.

A dissertation envisioned is not a dissertation written, which certainly was true in my case. Nonetheless, I hope there is enough here to suggest how network and food security methods can bring important perspectives to the study of subsistence in Alaska and elsewhere.

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Chapter 1 Introduction

This dissertation explores some aspects of contemporary hunter-gatherer economies in Alaska with an emphasis on quantitative perspectives. The body of the dissertation focuses on four decades beginning about 1980, which coincided with the introduction of formal, legal protections for hunter-gatherer activities under a “subsistence” rubric and with expanded data collection efforts. Data showed that contemporary Alaska hunter-gatherers had a “mixed economy” with three components: (1) subsistence activities, (2) market exchanges, and (3) culturally embedded social relationships sustained by flows of wild food, other goods, and related services (Wolfe 1984, Huskey 2004, BurnSilver et al. 2016). Household engagement in these different components varied widely, and understanding Alaska’s subsistence economies required integrated explorations of all three.

Written in manuscript-style, this dissertation includes two introductory chapters, three article chapters, and a discussion chapter. The first chapter provides an overview of the setting, reviews literature from four theoretical domains (socio-ecological resilience, political ecology, network analysis, and food security), describes my personal contributions to data collection, analyses, and reporting, and summarizes the plan of presentation. The second chapter reviews principles of common-pool-resource management with an emphasis on Alaska, reviews indigenous perspectives, reviews legal frames for managing subsistence hunting and fishing in Alaska, and summarizes the current renewable resource management situation in Alaska.

In the body of the dissertation, the first article explores trends in rural community populations, wild food harvests, and personal incomes over time, identifies factors associated with subsistence harvests, models subsistence productivity, and estimates road effects on harvests and income. The second article uses household-level social network and economic data from two Iñupiat communities to explore hypotheses designed to test an assumed transition from wild food dependence to market dependence. The third article combines concepts of sensitivity and adaptive capacity drawn from vulnerability literature to explore differences in household characteristics within and between three Alaska communities. When I write "we" in this dissertation, the term includes the listed authors for each article, but my work was supported by all the people mentioned in the preface and by many more acknowledged individually in my cited papers.

From 1981 to 2012, I conducted subsistence research funded by state, federal, regional, and tribal government entities, primarily in northern Alaska: the Nome Census Area, the Northwest Arctic Borough, and the North Slope Borough (Figure 1-1). The introduction and discussion draw on my experiences in and literature about northern Alaska. However, local features and events discussed here had analogues throughout Alaska. While environments, cultures, resources, and economies varied across rural Alaska, the legal and theoretical frames did not.

1.1 The Setting

Alaska is notable for its size, intact ecosystems, abundant resources, limited infrastructure, sparse human population, and substantial indigenous populations. Alaska's extreme climate challenged temperate-region technologies (notably agriculture and road-building), which helped insulate indigenous societies from some development impacts.

Alaska's 736,239 people occupied a land area of 1.48 million km^2 for a density of 0.5 persons/km^2 (Alaska Department of Labor and Workforce Development 2019). Sixty-eight percent of Alaskans lived in the Anchorage, Matanuska-Susitna, and Fairbanks census areas, only 6% of Alaska's total land mass. Excluding those areas, the human population density was only 0.17 persons/km^2 or, conversely, 5.8 km^2/person. In mostly roadless northern and western census areas, Alaska Natives comprised a majority of the total population (Figure 1-1). Those areas were home to more than 40% of Alaska's indigenous population, and 84% of the people in the Bethel Census Area identified as Alaska Native alone (Alaska Department of Labor and Workforce Development 2018).

Human harvests of renewable wild resources for personal, family, and community consumption, and for distribution have been features of Alaska's economy throughout >11,000 years of

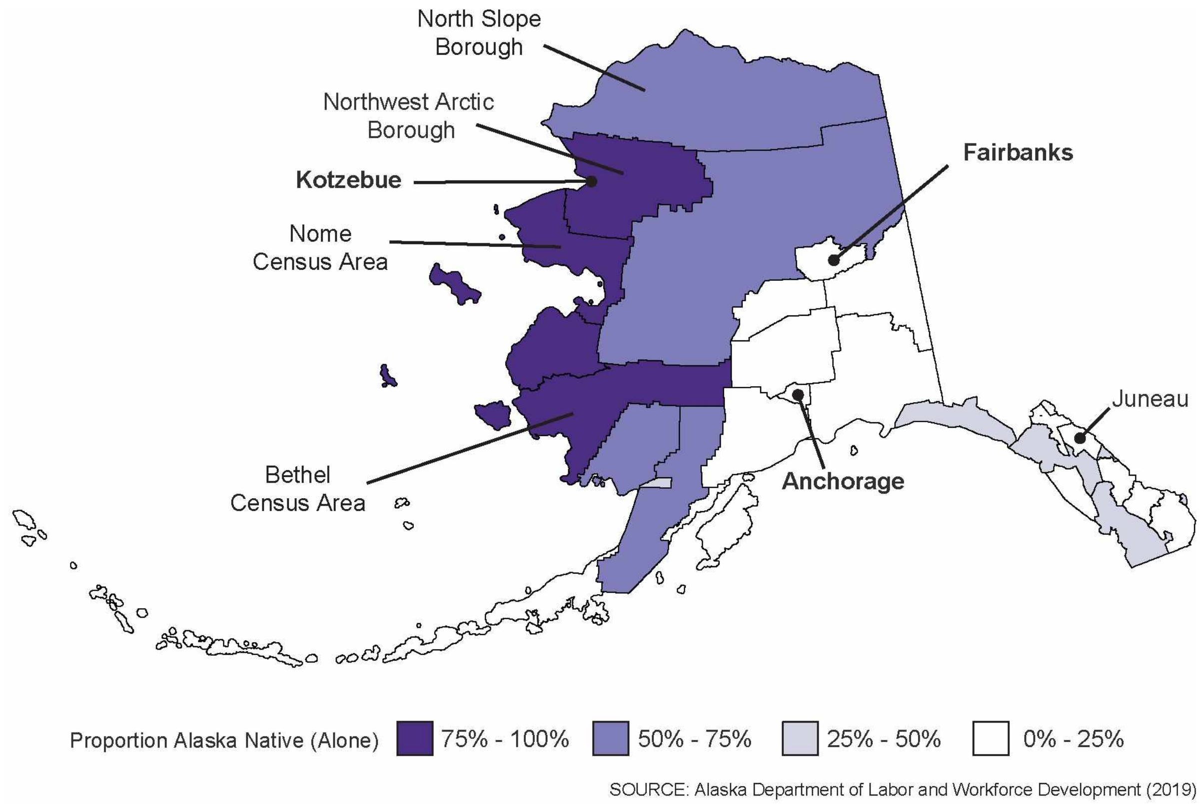

Figure 1-1 Proportion Alaska Native (alone) by borough and census area, 2018.

human occupancy, and continued into the 21st century (Dumond 1980, Halffman et al. 2015, Fall 2016, Holen et al. 2017). During that time, Alaska's people demonstrated remarkable resilience to changing ecological, economic, and social conditions (Hickey 1976, Condon et al. 1995, Wenzel 2009). They adapted to rising sea levels (Hopkins 1967, Giddings and Anderson 1986), colonial appropriations and attrocities (Black 1992, Mitchell 1997), epidemic diseases (Wolfe 1982, Fortuine 1989), changes in resource availability (Burch 1972, Bockstoce and Botkin 1982), losses of jurisdiction over and access to traditional resources and territories (Kancewick and Smith 1990, Burch 1998, Whiting 2004), impacts from industrial development (Kruse et al. 1981, Braund and Kruse 2009), and increased government regulation of hunting and fishing activities (Huntington 1992, Collings 1997, Wenzel 2009). In rural Alaska, perhaps nothing better illustrated that resilience than the continuing harvests of customary and traditional wild foods (Brown et al. 2012, Fall 2016). That resilience and adaptive capacity may never have been more important than it is today, with multiple drivers accelerating ecological change (Markon et al. 2019).

In most of the world, hunter-gatherer economies like those in rural Alaska have been displaced or dismantled in a remarkably short time by colonial, market-driven expansions and appropriations, (Lee and DeVore 1969, Widlok 2016). “Millions died in the hundred years before 1920,” Bodley (2014 [1975]) wrote, “when indigenous peoples were forced to surrender nearly half the globe.” Hunter-gatherers not only lost traditional territories and resources, they lost the emotional and nutritional benefits of harvesting and consuming local wild foods, and they lost myriad social relations inherent in the hunter-gatherer life (Laurance et al. 2001, Popkin 2004, Cassidy and Barnes 2012, Natcher 2015).

Alaska’s indigenous people suffered similar colonial expansions and appropriations: Russian fur seal trade in the 18th century, American salmon trade in the 19th century, multi-national mineral development in the 20th century, and global climate change in the 21st century (Naske and Slotnick 1994, Borneman 2004, Arnold 2009, Chapin et al. 2014). The indigenous population at contact has been estimated at about 74,000 people, but was reduced by epidemic disease and did not reach pre-contact levels until the mid-1980s (Figure 1-2A) (Waring and Smythe 1988, Alaska Department of Labor 1979). The growth in Alaska’s non-indigenous population was punctuated by the Gold Rush and World War II, while the discovery of oil at Prudhoe Bay helped continue the rapid expansion (Alaska Department of Labor 1979). In 1880, indigenous Alaskans comprised 99% of the territory’s population, but during the 1930s immigration to Alaska reduced them to minority status (Figure 1-2B). By 2018, people who identified as Alaska Native only comprised 15% of the state’s population. In 1971, development of the Alaska oil pipeline forced settlement of Alaska Native land claims, resulting in the loss of 89% of traditional Alaska Native territories to federal, state, and private interests and extinguishment of aboriginal hunting and fishing rights (Arnold 1978 [1976]). Scholars have expressed concerns about continuing losses in Alaska of traditional diets, adaptive capacity, contemporary resource rights, and wild resources

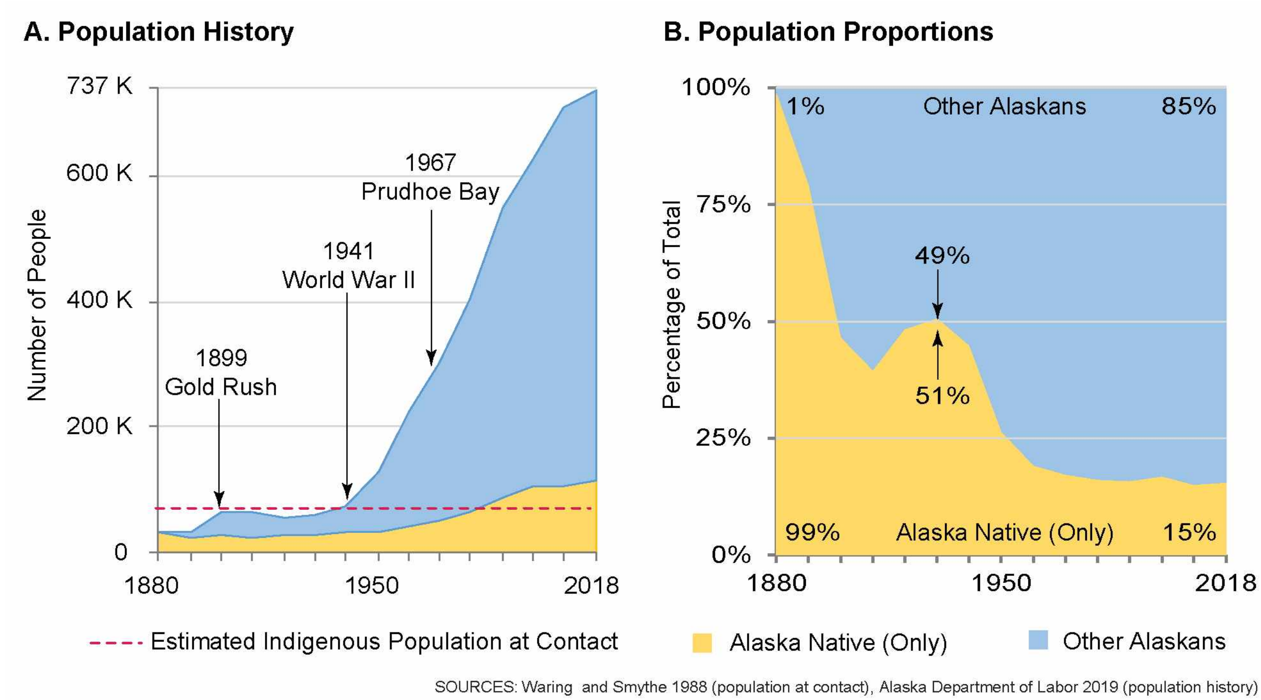

Figure 1-2 Alaska population history and population proportions by origin, 1880-2018.

themselves (Dombrowski 2007, Bersamin et al. 2008, Beier et al. 2009, Carothers 2011, Huntington et al. 2012, Brinkman et al. 2016).

But Alaska had other factors, possibly mitigating. Notwithstanding the oil fields at Prudhoe Bay, most of Alaska north of the Alaska Range was as yet untouched by agriculture, forestry, or mineral development. Northern and western Alaska had a sparse, unevenly distributed human population and a paucity of roads, both functions of the extreme environment. Despite recent budget troubles, Alaska was a wealthy state relative to its population, with a $65 billion sovereign wealth fund that paid annual dividends to every resident (Guettabi 2019). Alaska also had a citizenry deeply committed to wild foods and wild lands, commitments that had been codified in state and federal laws, commitments that seemed to be growing at a national level (Pollan 2006, Meter and Goldenberg 2014, Harrison and Loring 2016).

The most important factor in Alaska Natives' futures may be the continuity of their traditions and territories. In a 1968 survey of the world's surviving hunter-gatherer groups, Murdock (1968) stressed that "their largest concentration is found in aboriginal North America." Many

Alaska Natives still inhabit ancestral territories and have deep and enduring relationships with the land, the waters, the renewable wild resources, and each other. Fully 20% of Alaska's population in 2018 was Alaska Native or American Indian alone or in combination with other ethnicities (Alaska Department of Labor and Workforce Development 2019). More than 100,000 Alaska Natives were shareholders in some of Alaska's largest for-profit corporations, the 12 for-profit Alaska Native regional corporations created by the 1971 land claims settlement (Arnold 1978 [1976], Colt 1991, Poe 2014). As a result of the land settlement, Alaska Native corporations owned about 11% of Alaska's total lands, some of which were selected for their importance to wild food production. In the 1960s, indigenous rights organizations began springing up around the world, leading to a global transformation in the relations between indigenous peoples, states, and nations, including recognition of rights to voluntary isolation by the United Nations (Case and Voluck 2012, Bodley 2014 [1975]:314). In combination, all these factors contributed to unprecedented indigenous political power in post-colonial Alaska, which Alaska Natives used to advance their interests, including access to wild foods (Morehouse and Holleman 1994, Mitchell 2011, Inuit Circumpolar Conference - Alaska 2015, Thornton et al. 2016).

Given these factors, could Alaska's subsistence economies survive while embedded in a modern, capitalist state? In many parts of the world, answers to such questions tended to be qualitative and speculative. In Alaska, researchers have collected granular data from tens of thousands of rural households about their harvests, incomes, and demographic composition for more than thirty years, providing opportunities for quantitative, longitudinal analyses of changing economic circumstances and strategies (Fall 1990, 2016).

1.2 Theoretical Frames

This dissertation explores Alaska's subsistence economies through four theoretical frames. Resilience speaks to a socio-ecological system's ability to absorb shocks while maintaining its essential nature. Political ecology speaks to political processes that bear on ecological systems. Network analysis explores relations among connected entities, an especially useful tool for

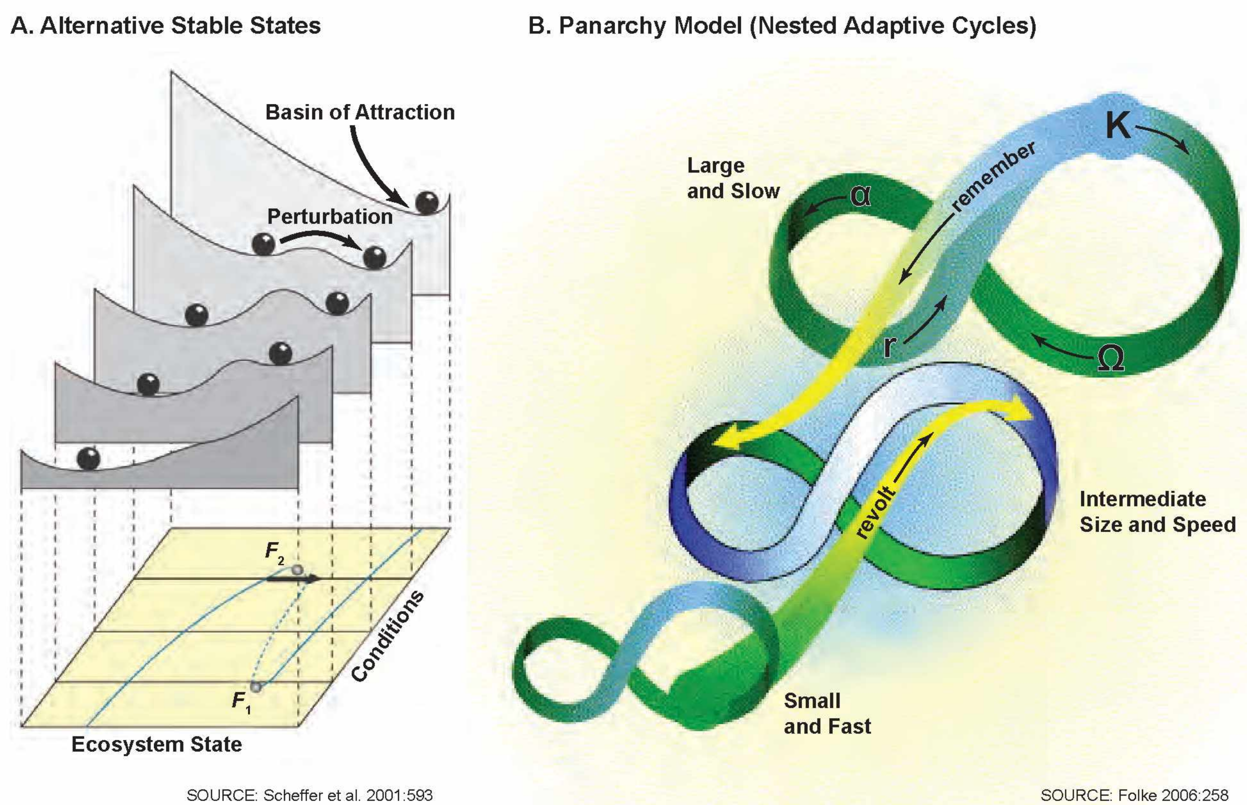

Figure 1-3 Resilience representations of social-ecological systems.

exploring cooperative systems like subsistence production and distribution. Finally, food security provides an outcome variable, measuring whether or not households have dependable access to enough food for active, healthy lives. For each field, we review fundamental ideas and applications in Alaska.

1.2.1 Resilience

Different disciplines – sociology, ecology, psychology, engineering – defined "resilience" in different ways. This dissertation focuses on socio-ecological resilience, defined as "the capacity of a system to absorb disturbances and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks" (Walker et al. 2004). The authors of the Arctic Resilience Report chose a more human-centric definition: "The capacity of people to learn, share and make use of their knowledge of social and ecological interactions and feedbacks, to deliberately and effectively engage in shaping adaptive or transformative social-ecological change" (Carson and Garry 2016:8).

Socio-ecological resistance emerged from a body of work involving both physical and social scientists, notably ecologist C.S. Holling at the University of British Columbia who argued that then-popular equilibrium views of ecosystems provided little insight. Random events can have dramatic effects, Holling (1973) wrote, and "the goal of producing maximum sustained yield may result in a more stable system of reduced resilience." Holling cited the work of Robert May, who was exploring stability in large complex systems through both observation and mathematical models. May (1977) found that ecosystems may possess alternative stable states and "continuous variation in a control variable can produce discontinuous effects." Figure 1-3A provides a schematic representation of such a system, where perturbations cause ecosystem states to cross thresholds among "basins of attraction" potentially resulting in catastrophic shifts in ecosystems. For example, freshwater lakes can absorb increasing nutrient loads and remain clear until a threshold is reached, then shift abruptly from clear water to turbid, a state from which it can be difficult to return (Scheffer et al. 2001).

In the edited volume *Panarchy* (2002:21) , Gunderson, Holling, and colleagues attempted to "integrate the dynamics of change across space from local to regional to global" and "to integrate across disciplines to better understand systems of linked ecological, economic, and institutional processes." "Such a framework is hardly a theory," they cautioned, "rather it is a metaphor to help interpret event and their gross causes." Holling and Gunderson (2002:32-33) identified three key system properties:

- The potential available for change,
- The degree of connectedness between internal controlling variables and processes, and
- The resilience of the systems to shocks.

Resilience theory posited that social, ecological, and economic systems were subject to nested natural adaptive cycles, typically in four-sequential, recurring stages: rapid change in an exploitation stage (r), a growing stasis in a conservation stage (K), rapid change again in a release or collapse stage (Ω), and then gradual renewal or reorganization (α) leading back to the exploitation stage (Figure 1-3B) (Gunderson and Holling 2002 Folke 2006). Under certain conditions, the scale of the adaptive cycle may change, breaking out of the current scale as shown by the “revolt” connection in Figure 1-3B, or employing information stored in the system from a previous scale, as shown by the “remember” connection. Although first articulated in ecology where the canonical example of a release is a forest fire, scholars expanded resilience theory to social and economic systems (Levin et al. 1998). Adaptive cycles often functioned on scales exceeding a human lifespan (“slow variables”), and as a result, human societies may experience natural releases (e.g., forest fire) as disasters rather than inevitabilities and manage unproductive reorganization stages as baseline conditions (Pauly 1995).

An important limitation of the resilience approach was that “resilience” was difficult to measure and evaluate (Batabyal 1998). Resilience scholars borrowed some of their terminology from complex systems theorists, but generally did not adopt the quantitative, model-based approaches of complexity. Like resilience scholars, complexity scholars recognized that complex systems were partially decomposable (Simon 2000), and they sought simple rules that explained behaviors of complex systems or their components (Goldenfeld and Kadanoff 1999, Holland 1992). In this, they have had some success (Girvan and Newman 2002, Watts 2002).

If there was one lesson from complexity and resilience, it was that sustaining common-pool resources was not a search for a single optimal state. At best, sustainability might be seen as a series of social choices among many optimal paths. Uncertainties arising from interactions among system components and from societal values were an integral feature of complex adaptive systems” which made system management a moving target (Biggs et al. 2015). Complex systems were difficult to understand (“analytical complexity”), non-linear and unpredictable (“ontological complexity”) and were perceived to have different meanings, benefits and purposes (“societal complexity”) (Biggs 2015:51-52). Unfortunately, governments tended to rely on a “command and control “model to seek optimal states for selected resources (Holling and Meffe 1996). This was not an effective, sustainable approach (Berkes et al. 1989, Ostrom 1990).

A number of scholars have applied resilience theory to socio-ecological systems in Alaska. For example, Robards and Alessa (2004) noted differences in time scales ("timescapes") between Western resource managers and indigenous resource users. Brown, Kellie, et al. (2015) looked at challenges moose managers face in a habitat with complex patterns of use, fire, and access that created a complex interaction of fast and slow variables. Brinkman et al. (2007) warned that "roads and clear-cuts may represent a cultural trap analogous to ecological traps in which the long term sustainability…is questionable and cultural resilience is diminished." Kofinas et al. 2010 considered the cross-scale challenges anthropogenic climate change pose for Athabascan hunters and fishers in the 21st century. Using household harvest, income, and social network data, Kofinas et al. (2016) explored household adaptive capacity in multiple scenarios of ecologic and economic change. The studies all were intended to contribute to the ultimate goal, as the Brundtland Commission (1987:43) put it, of meeting "the needs of the present without compromising the ability of future generations to meet their own needs."

1.2.2 Political Ecology

Political ecology, as the name implies, presumes that socio-economic and ecological conditions are inextricably linked to political power dynamics. Political ecologists typically explored environmental processes from smallholder perspectives – "a history from below" as Watts (2013 [1983]) put it – working in situations characterized by resource appropriation, power inequities, poverty, and food insecurity. As a community of practice, political ecology was concerned with the dialect between individuals, their productive activity, and nature. Early political ecologists like Piers Blaikie (1985), Harold Brookfield (1987), and Michael Watts (2013 [1983]) rejected ostensibly apolitical explanations for environmental degradation, and advanced explanations that were both political and ecological (Robbins 2012). The link between the two domains was the ability to control narratives, an idea advanced by French philosopher Michel Foucault. As Robbins (2012) wrote:

"Of Foucault's many influential theses, one of the most central was that truth was

> an effect of power, one that was formed through language and enforced social order by seeming intuitive or taken for granted. The key to understanding the character of society was to explore how certain taken-for-granted notions of the world were formed through *discourse* (language, stories, images, terminology) and how certain social systems and practices (medicine, forest, prisons, schools) made them 'true.'" (Robbins 2012:70, emphasis original)

Combining political economy and ecology, political ecologists hoped to address deficiencies of the two individual frameworks with a focus on power dynamics (Biersack 2006, Greenberg and Park 1994).

Although Blaikie (2008) observed that political ecology "has brought both innovative thinking and charges of incoherence," a review of the literature suggested considerable coherence. Beginning with Wolfe (1972), the power nexus of ecology and economy was evident. Watts (2013 [1983]) was more specific about the nature of power: capital relations and expanded commodity production. Greenberg and Park (1994) formulated a somewhat more inclusive definition linking "the distribution of power with productive activity and ecological analysis." Escobar (1998) added a focus on outcomes, on "developing a new paradigm of production." Implicit in political ecology were issues of scale, as Spaeder (2005) explicitly mentioned in his political ecology of co-management in Alaska. In their 2016 article, *The Political Ecology of Cause and Blame,* Stephenson and Stephenson harkened back to the beginnings of political ecology, when Blaikie observed that "peasants destroy their own environment in attempts to delay their own destruction" (Blaikie 1985:29). When power inequities lead to inequitable resource distributions, the proximate causes of ecological disasters were blamed on the small holders, while the appropriations of the elite that created the problem were overlooked.

Selected literature shows a broadening of the field from its original focus on environmental degradation (Blaikie 1985, Blaikie and Brookfield 1987, Watts 2013 [1983]) and from its decidedly Marxist perspective. Working in southeast Asia, James Scott (1977, 1985, 1999) expanded political ecology to consider the conditions, motivations, and mechanisms for state-making.

Scott's Southeast Asian small holders were much better provisioned than those of Blaikie and Watts, but similar power-dynamics were in play. Scott (1999) traces the roots of his work through the early years of political ecology back to the "moral economy" of E.P. Thompson in the early 19th century. Scott's work muted the Marxist underpinnings of early political ecology, especially after the "capitalist triumphalism" in 1989 made failures of Marxist ideology more apparent, but he made clear that power dynamics explored by political ecologists were common in many ideologies.

Political ecology research also evolved to focus on common-pool resource issues, even in the absence of ecological degradation. McCay and Jentoft (1998)) argued that Garrett Hardin's 1968 commons tragedy parable and his privatization solution represented a "thin" understanding of the problem. "This perspective leads to a focus on "community failure" rather than "market failure" as the presumed cause of environmental problems, and hence, to questions about how markets, states, and other external and internal factors affect the capacities of communities and user-groups to respond adequately to environmental change" (McCay and Jentoft 1998). Place-making also emerged in the political ecology literature, focusing on power dynamics, local goals, and non-commodity production (Marsh 1987, Basso 1996). Where global capitalism assumed labor mobility, many people – and especially indigenous people – are deeply rooted in particular places and unwilling to make "rational" decisions to migrate as local economic opportunities fail. These threads of political ecology research were particularly strong in Alaska, where political ecology literature explored consequences of commercial fishery privatization for indigenous communities (Carothers 2008, Carothers et al. 2010, Carothers and Chambers 2012, Lyons et al. 2016).

While Alaska political ecology research fell into broader political ecology traditions, Alaska research settings often were less degraded than other settings because of Alaska's mostly intact ecologies. Where political ecology researchers in Africa faced severe environmental degradation and starvation, political ecology researchers in Alaska faced economic marginalization and food insecurity (Cullenberg et al. 2017, Donkersloot and Carothers 2017, Loring 2016).

1.2.3 Social Network Theory

As social creatures, humans are embedded in a complex web of relations with each other and with resources they acquire, produce, distribute, and consume. For the most part, these relations were not random. Individuals engaged repeatedly with family members, formed cooperative groups, and assembled in communities that included non-kin. Network analysis provided a mathematical approach to recording, illustrating, and analyzing these relations (Moreno and Jennings 1938, de Sola Pool and Kochen 1978). It supported theories to describe interconnected systems in relational terms, such as degrees of connectedness, typologies of structure, structural equivalence, community identification, and diffusion (Borgatti et al. 2009). With roots in mathematical graph theory (Erdős and Rényi 1959), contemporary network analysis spanned disciplines (Butts 2009), and has been applied in sociology (Boorman and White 1976), anthropology (Denham and White 2005), epidemiology (Goodreau 2006), ecology (Estrada and Bodin 2008), biology (Dunne et al. 2002), and economics (Burt 1992, Jackson 2011, Goerner et al. 2009).

Network theory sought fundamental properties common to all connected systems (Barabasi 2012). Examples included Watts and Strogatz's (1998) solution to the small-world problem, Barabasi and Albert's (1999) observation of scale-free, power-law distributions of vertex connectivity, Lansing's (1993) explanations of the functions of water temples in Bali, and Apicella et al.'s (2012) finding of "striking regularities" in networks of Hadza hunter-gatherers, suggesting that such networks "may have facilitated the development of large-scale cooperation in humans."

Modern hunter-gatherers, cooperation theories, and network methods represented an unusually productive convergence of setting, theory, and method. Incentives for cooperation and sharing among hunter-gatherers were strong, as cooperation increased the probability of success, while food sharing reduced the costs of individual failures. Hunter-gatherers' social and economic lives were structured by cooperative food production and distribution, creating complicated yet durable and tractable relations. In addition, modern hunter-gatherer communities usually were remote and isolated, creating naturally bounded populations. These features of hunter-gatherer societies facilitated network analyses, while network methods provided a quantitative approach to cooperation. There was a need for specific, empirical, comparable, micro-level data describing cooperative relationships (Hovelsrud-Broda 2000, Usher et al. 2003, Durlauf and Fafchamps 2005). Food sharing practices among hunter-gatherers have been the focus of considerable research, with network methods playing an important role.

Human behavioral ecologists, especially, see modern hunter-gatherers as a window into the evolution of human behavior (Kaplan and Hill 1985, Hill et al. 1987, Alvard and Nolin 2002, Henrich et al. 2005). Given that cooperation (sharing among kin) and altruism (sharing among non-kin) are costly behaviors, yet pervasive among humans, primates, and social insects, evolutionary theorists from Darwin forward have sought to explain the mechanisms (Dugatkin 2007), a debate that continues (Nowak and May 1992, Nowak et al. 2010, Birch 2013). Explanations include: kin selection, reciprocal altruism, risk reduction, social norms, tolerated theft, costly signaling, and proximity (Kaplan et al. 2005, Nowak 2006).

Sharing food with relatives ("kin selection") increases the likelihood that those individuals (who share some of your genes) will survive, so sharing food with close relative is more likely to contribute to your genetic survival than sharing food with a distant relative or with a non-relative (Hamilton 1964). Observing many instances of human altruism that could not be adequately explained by kin selection, Trivers (1971) suggested that altruistic behaviors could be explained by reciprocity, and not only among humans. At the group or community level, resource sharing also could be seen as a form of risk reduction, insuring against individual failures (Smith 1988, Fafchamps and Gubert 2007). Patterns of sharing motivated by kin selection, reciprocal altruism, and risk reduction could be internalized as normalized social behavior, practiced even in the absence of kin relations and reciprocity. Using economic games, Rand et al. (2012) found evidence that cooperation among humans was not merely internalized, it was intuitive.

Food sharing also has been explained as costly signaling (Gurven et al. 2000, Bliege Bird and Power 2015, Bliege Bird et al. 2018), in which "behavioral or morphological signals were designed to convey honest information" benefiting both signalers and signal recipients (Smith and Bliege Bird 2000). Tolerated theft or demand sharing could develop when the benefits of consuming additional food were worth less to the acquirer than to an unsuccessful harvester (Bliege Bird and Bird 1997). Proximity – the physical distance between alters – might be trivial in theoretical contexts, but in small-scale societies related individuals often live in close proximity. Absent a proximity factor, statistical models might underestimate or overestimate the significance of other factors like kinship (Kasper and Mulder 2015).

A number of northern researchers have employed network methods in subsistence settings. Working with Dolgan and Ngansan in the Taimyr Region of northern Russia, Ziker (2007) found support for kin selection, reciprocal altruism, tolerated scrounging, and cooperative acquisition. Working with Iñuit in the Northwest Territories, Collings (2011) used two-mode network analysis to find evidence of different affiliation strategies depending on whether individuals relied on hunting or wage labor as their primary means of support. Working with Iñuit in Labrador, Dombrowski et al. (2013) also explored interconnections between subsistence and market activities, finding that employed individuals with higher incomes tended to be more central to food sharing networks.

Working with Alutiiq and Aleut/Unangan in the southern Bering Sea in 2009, Reedy and Maschner (2014:317) found hub-and-spoke food production and distribution structures with no traditional analogues. In Reedy and Maschner's study, commercial fishing enterprises served as brokers for traditional foods that had been privatized in the latter 20th century by shifts in commercial fishing policies. Working with the Little Red River Cree Nation of Alberta, Canada, Natcher (2015) employed network methods within a social capital framework, finding that the food system was characterized by a high degree of centrality, where >50% of the wild foods were produced by <3% of the households, suggesting that the removal of a single "super household" would have significant impacts on food flows.

Working with Iñuit in Nunavik, Ready (2016b) found support for several food-sharing models, particularly contingent reciprocity, trade, and costly signaling. On signaling, Ready suggested that "certain patterns of giving…are associated with being elected to local councils, suggesting that generosity is connected to other forms of prestige—notably political influence" (Ready 2016b:138). Ready examined network structures' implications for socio-ecological resilience, and suggested that "resilience emerges as a property of households" rather than the community as a whole. In a subsequent article based on the same research, Ready and Power (2018) found that "food-secure super households have the strongest affiliation with other food-secure, super households," which contradicted the idea that food sharing served to reduce risks associated with harvest failures. Finally, in her unusually thorough study, Ready explored some challenges of using a modified food security protocol to assess household food security in her Iñuit study population (see next section).

The earliest successful application of network methods to subsistence economies in Alaska occurred in 1994 in two small Iñupiaq communities – Wales and Deering – on the northwest coast (Magdanz et al. 2002, Reedy-Maschner 2013:17). The survey protocol asked: "During the last year, who harvested, who processed, and who distributed [the seals, caribou, salmon, etc.] that your household used? Figure 1-4 reproduces two figures from the 2002 technical paper. Setting a threshold of three ties, researchers used counts of ties between households to sort households into factions, then manually arranged households to highlight factions and their relations in the graph reproduced as Figure 1-4A. The factions analysis revealed a highly compartmentalized community, where faction membership could be explained by kin selection and kinship structures resembled early 19th century Iñupiaq "local families" described by Burch (1975). The durability of 19th century Iñuit local family structures Magdanz et al. (2002) found in Wales and Deering in 1994 were a contrast to the hub-and-spoke structures Reedy and Maschner (2014) found in Akutan, False Pass, Nelson Lagoon, and Port Heiden in the North Aleutian Basin in 2009.

In Wales, researchers further explored characteristics of households in one local family – Wales A – a figure reproduced here as Figure 1-4B. This local family included five surveyed households, organized around an elder widow who lived with a son and grandson. As shown in the top section of Figure 1-4B, the heads of the other four households included two sons, one

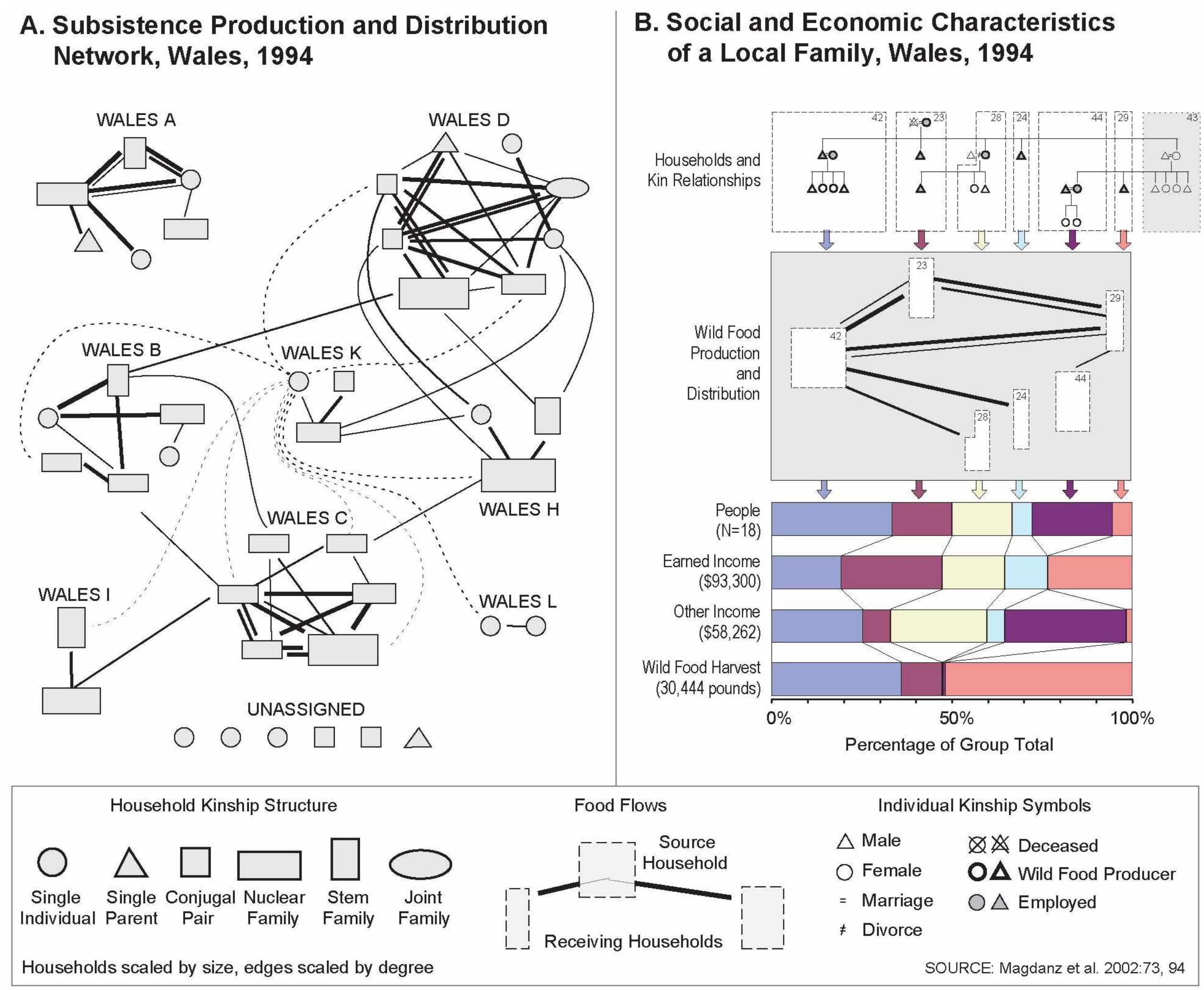

Figure 1-4 Subsistence production and distribution networks, Wales, 1994.

daughter, and one granddaughter. Following each household vertically down through the figure shows how each household was related to other households in terms of kinship, food flows, incomes, and harvests. As shown in the middle section, all the households were connected by food flows, especially by flows from the widow's elder son's household on the left. As shown in the third section of Figure 1-4B, the population, incomes, and harvests of the five households revealed a diverse pattern of economic situations, revealing at least potential risk reduction through resource sharing. The project also explored implications of subsistence food sharing for wildlife management (Magdanz and Utermohle 2005).

Alaska law directed the Division of Subsistence to conduct studies on all aspects of subsistence, including quantifying amounts of food acquired through subsistence hunting and fishing (AS 16.05.094). Alaska fish and game regulations also identified the distribution of subsistence resources as one of eight criteria used to identify customary and traditional uses (5 AAC 9.010). While I initially added network questions to the state's comprehensive subsistence harvest surveys for pragmatic reasons – simply to increase accuracy of harvest reports – network data also were useful in fulfilling the broader set of statutory and regulatory obligations.

After the Wales-Deering study, the division conducted similar network projects in Shungnak, Buckland, and Kiana (Magdanz et al. 2004, Magdanz et al. 2011). In cooperation with Kawerak Inc., the division employed social network methods to describe customary trade in finfish in the Norton Sound and Port Clarence areas, which resulted in a change to state fishing regulations to allow limited non-commercial exchanges of subsistence-caught finfish for cash in those areas (Magdanz et al. 2007).

Most of the division's subsistence network protocols asked about unvalued ties among households. In 2010, the Division of Subsistence, the University of Alaska, and the Native villages of Kaktovik, Venetie, and Wainwright collaborated to collect valued flows among households, the only time such detailed subsistence network data have been collected in Alaska (Kofinas et al. 2016). Figure 1-5 reproduces reduced versions of two figures from the project report. Figure 1-5A illustrates the flows of wild foods, other goods, and related services among Wainwright households, crews, feasts, and other communities. Although the density of the network was low (0.028), this was partly a function of a large network (*N*=220 nodes). As Figure 1-5A shows, every household in Wainwright was connected to at least one other node in the network (mean degree = 6), providing one or more paths for the flows of wild foods. At the core of the Wainwright network, as expected, were three successful whaling crews, who received supplies and donations from households in Wainwright and in other communities, and who distributed whale muktuk and meat to households, feasts, crew members, and captains through a formalized distri-

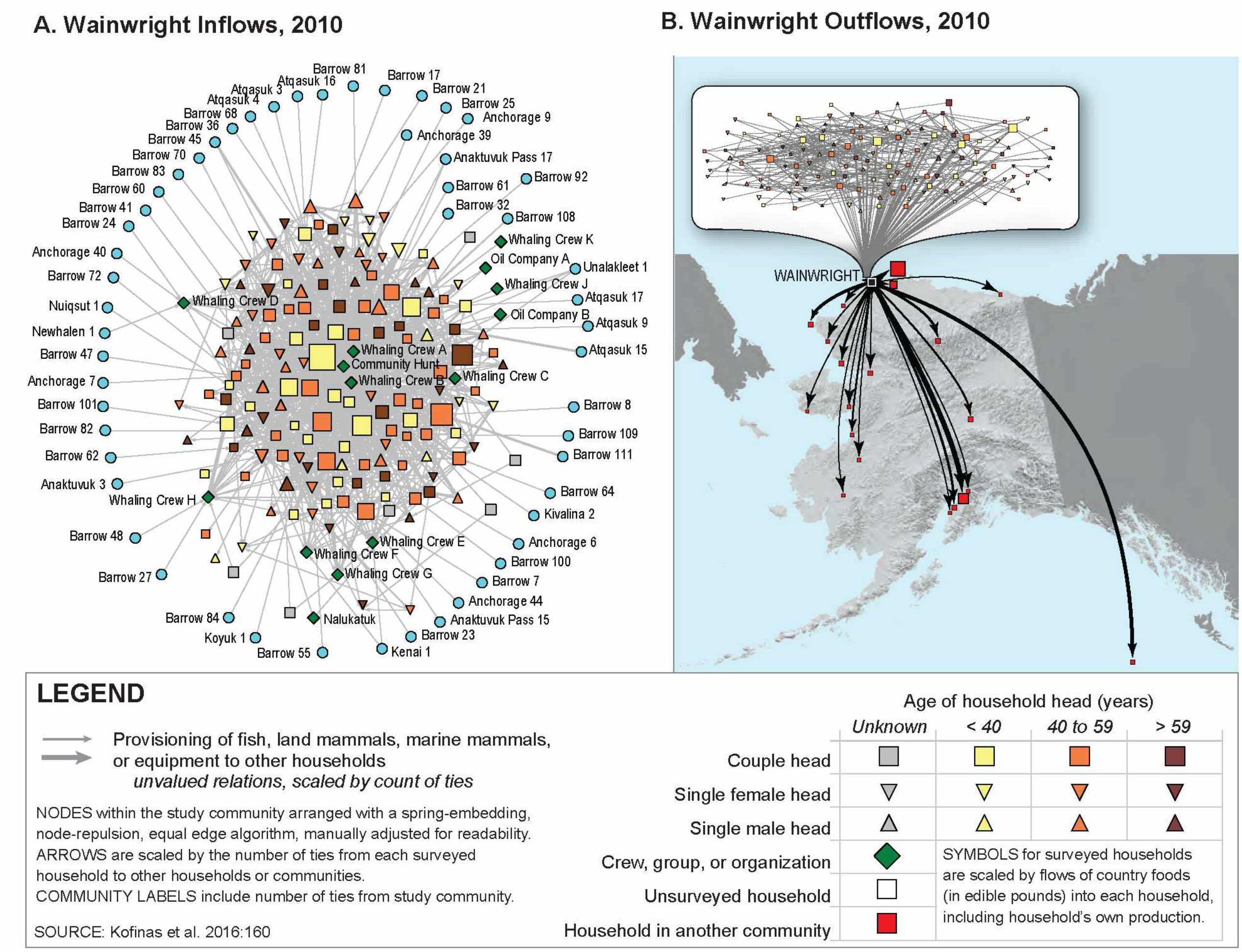

Figure 1-5 Flows of wild foods and related goods and services, Wainwright, 2010.

bution mechanism. Figure 1-5B shows the flow of wild foods out of Wainwright, illustrating how subsistence food flows served to connect communities across Alaska.

The network approach was not without important limitations. Informed consent could be challenging, as respondents typically were asked to identify alters who are not present to give consent. In those situations, it helped to work with small, clearly bounded populations over long periods of time. Consent usually was obtained first at the community, then at the household and individual levels. Most network studies relied on respondent recall, and subject to significant memory error (Nolin 2010:263). One approach to this problem was to collect information from both donor and recipient. This likely would reveal substantial "discordant reporting," in which a relation reported by an ego was not reported by the alter. Kasper and Borgerhoff Mulder (2015:SI 6-7) reported that the mean percentage of mutually reported ties in their data was only 17%, a disconcertingly low value but not inconsistent with my own experience and more likely to be missing data rather than erroneous data. Koster (2011):399) addressed the recall problem by reducing the respondent recall period to 24 hours, collecting daily reports from respondents. Kasper and Borgerhoff Mulder (2015:SI 7) corrected for missing values using a "dummy variable adjustment" technique.

Given that simplification was often necessary for network data collection and analysis, researchers must determine in advance of data collection that relationships being documented were conceptualized in the same way by respondents and researchers, *i.e.* construct validity. Construct validity was challenged when network researchers simplified multiplex relations to a binary network, in part because of the limitations of network analysis software. For example, Kasper and Borgerhoff Mulder (2015:702) developed "a measure of helping scope that gauged cooperation across a broad range of domains (food, health, labor, money, advice, etc.)" and then used that single measure "to test hypotheses about evolutionary mechanism underlying the exchange of food and services."

Hunter-gatherer networks could be sparse. For their Inuit food-sharing network in Canada, Ready and Power (2018):93) reported a network density of 0.042, meaning 4.2% of all possible sharing ties were reported. Commenting on Ready and Power, Gurven and Kraft interpreted this density value to mean country food sharing was very limited. In fact, a density value of 0.04 was not uncommon in hunter-gatherer networks. In Wainwright (Figure 1-5A), a density of 0.028 was sufficient to form a single giant component, meaning every Wainwright household was connected to at least one other household. For limited domains, Kasper and Borgerhoff Mulder (2015:SI 15) reported densities as low as 0.005.

As the number of hunter-gatherer network studies in the literature increased, the ethnographic inclination was to compare networks across cultures (e.g., Ahedo et al. 2019. Comparing networks across cultures, or even across communities within a single culture, was fraught, given that graph-level indices interacted powerfully with network size and density (Anderson et al. 1999). Most of these limitations were tractable. Researchers must construct valid relationships through literature reviews and consultations with potential respondents. When warranted, researchers should collect multiplex relationships in the field, so effects of any simplifications could be evaluated *post-hoc*. Researchers should use appropriate statistical techniques, avoid inappropriate comparisons, and provide benchmarks or context for readers who may not be familiar with network measures.

1.2.4 Food Security

The Food and Agriculture Organization of the United Nations (FAO) defines food security as access by all people at all times to enough food for an active, healthy life (Food and Agriculture Organization of the United Nations 2009). Conversely, food insecurity – not having enough food – was "a complex, multidimensional phenomenon which varies through a continuum of successive stages" (Bickel et al. 2000). In the United States, the US Department of Agriculture (USDA) has been estimating household food security annually since 1995, using responses from a household food security survey module (HFSSM) administered as part of the Census Bureau's community population survey (CPS). From 2016 to 2018, the USDA estimated that on average 88.3% (± 0.2%) of U.S. households were food secure, while on average 89.2% (± 1.7%) of Alaska households were food secure (Coleman-Jensen et al. 2019).

For many researchers, including those in the USDA, food security was intended as a technical measure of whether members of a household had enough food to eat and – when aggregated to community, state, or nation – what proportion of households had enough food to eat (Pinstrup-Andersen 2009). In recent years, though, "food security" and "food sovereignty" have become intensely contested terms in the food systems literature (Patel 2009, Edelman et al. 2014). Jarosz (2014) conceptualized them as "fluid and changing discourses that define the problem of hunger." Food security was both conflated with food sovereignty (Clapp 2014, Carolan 2014), and positioned in opposition to food sovereignty on a political continuum of food regimes (Holt-Giménez and Shattuck 2011).

This dissertation – like the USDA – uses the FAO's technical definition of food security. This section will revisit the contentions over food enterprises, food security, food justice, and food sovereignty before concluding. But first, this section discusses global and national efforts to develop estimates of food security, some limitations of the USDA's household food security survey module, efforts to develop more universal food security tools, and a summary of food security results from the Division of Subsistence's food security research program in Alaska.

1.2.4.1 Estimating Food Security

In a global literature review, Jones et al. (2013) provided a history of food security measurement, described four common food security measurement purposes (national FS estimates, global FS monitoring, household food access, and food utilization), noted that "the validity of a measurement tool is inseparable from the purpose for which it is intended," and commented on "a rather dizzying array of options" for food security estimation. Others conducted similar reviews and reached similar conclusions (Carletto et al. 2013, Smith et al. 2014, Zezza et al. 2017).

Coates, Frongillo, et al. (2006) hypothesized that there existed a "common 'core' to the household food insecurity experience" that went beyond sufficiency and transcended culture. Coates, Wilde, et al. (2006) found that the degree of food insecurity in a Bangladesh population could be estimated equally well with qualitative or quantitative methods. Both approaches had their role, but quantitative approaches had important advantages for large-scale, longitudinal research: replicability, comparability, and efficiency. The USDA introduced its quantitative household food security survey module in 1995, the USAID subsequently developed a modified version of HFSSM that it called the household food insecurity access scale (HFIAS), and Health Canada adopted the HFSSM in 2004 (Nord et al. 2002, Coates et al. 2007, Health Canada 2007). Jones et al. (2013) characterized all these tools as "direct experienced-based measures" in which researchers used questionnaires to "attempt to directly measure families' behaviors and lived experiences of household food security."

Compared with the multiple pages of questions typically required by food frequency questionnaires and by household consumption and expenditure surveys, an experience-based food security tool required as few as six questions (Blumberg et al. 1999). Australia used just two, although two questions may not be sufficient (Butcher et al. 2019). When filter questions were employed, a food security tool built on this model could be administered in a full population in an average of two minutes (Bickel et al. 2000). The reliability of this approach has been verified by a number of researchers (e.g., Frongillo 1999, Derrickson et al. 2000, Opsomer et al. 2003, Melgar-Quinonez et al. 2006). In 2006, a National Academies panel reviewed the USDA program and the HFSSM's performance (Wunderlich and Norwood 2006), commending the agency for its "careful and extensive work," recommending continuation of the program, but also recommending some changes to the wording, order, and interpretations of survey questions. In their global review of FS measurement tools, Jones et al. (2013) noted that while the HFSSM did not "fully capture the experience of food insecurity by all households in all contexts," nonetheless the USDA's "direct, questionnaire-based measurement approach" had the potential to serve "as a common means of measuring food security in low-income countries."

The HFSSM and HFIAS were constructed on the Rasch Model, a particular kind of Item Response Theory model (Baker and Kim 2001 [1985]). To illustrate: The USDA's core FS tool included a series of eight dichotomous ("Y/N") questions that probed for increasingly severe levels of food insecurity, as well as two questions that probed for the frequency and duration of food insecurity, listed in abbreviated form in Figure 1-6. Fully food-secure households would affirm none of the questions, while extremely food-insecure households would affirm all ten. Households were deemed "food secure" if they affirmed two or fewer questions, and "food insecure" if they affirmed three or more questions. If a household affirmed six or more questions, it was deemed to have "very low food security" (Coleman-Jensen et al. 2019). If a household included children, eight additional questions could be asked to estimate food security for children, al-

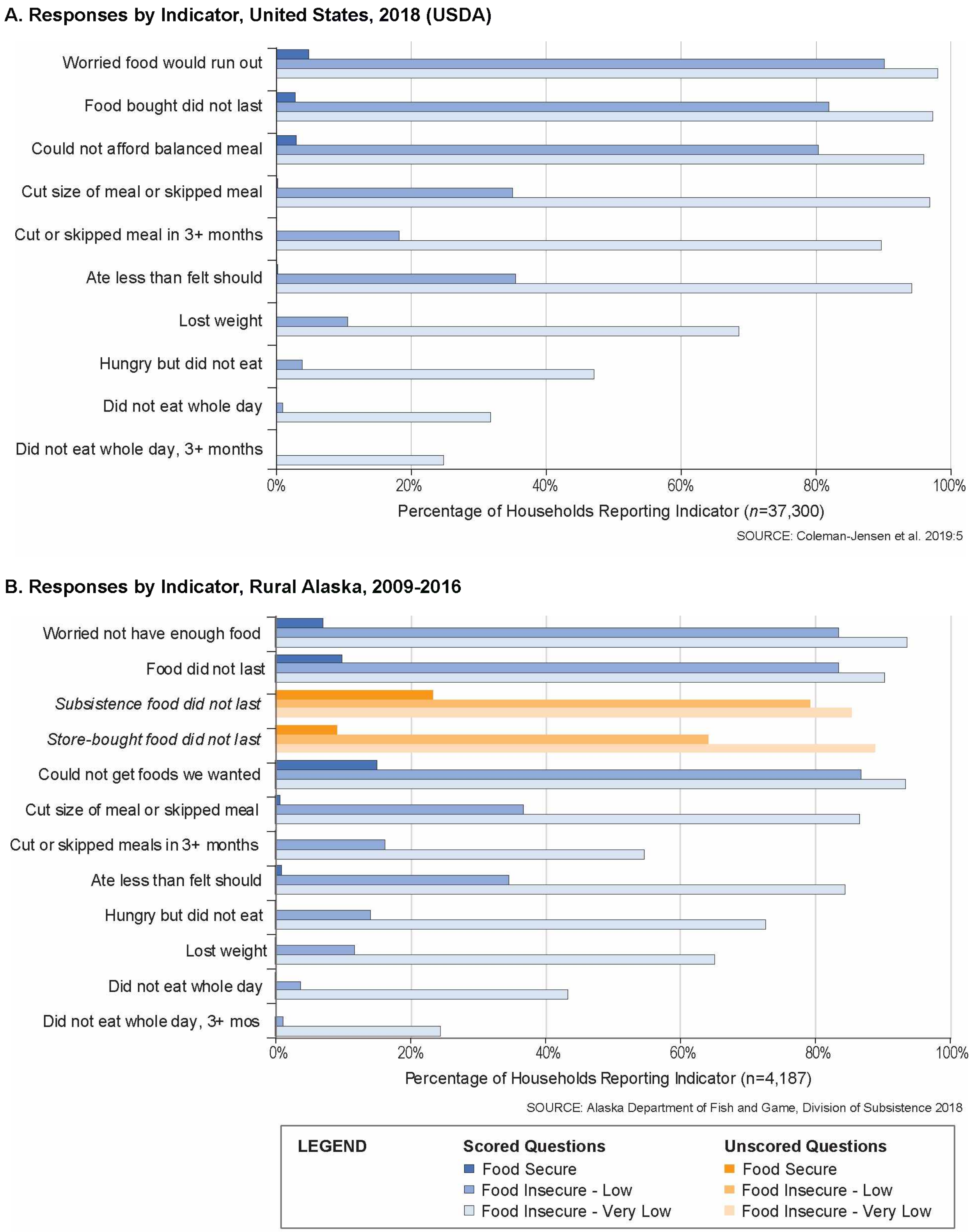

Figure 1-6 Percentage of sampled households reporting food insecurity indicators.

though this were not required for a basic estimate of household food security. Figure 1-6 summarizes the percentages of household in USDA's national sample in 2018 (*n*=37,300) who affirmed each indicator, from those who "worried that food would run out" to those who "did not eat for a whole day" in 3 or more months of the year. As expected, the proportion of households responding to each indicator was lowest among food-secure households and highest among households with very low food security, and the proportion of households responding to successive indicators generally declined as the severity of food insecurity increased.

From a subsistence perspective, the USDA FS tool suffered from two major limitations: (1) it assumed food security was based on access to money, and (2) it assumed food security involved a "balanced" diet. Neither assumption was appropriate for rural Alaska, where people had long thrived without access to money and ate diets rich in protein and oils, limited in fruit and vegetables, and completely lacking in grains or dairy products.

The USAID's Household Food Insecurity Access Scale was an attempt to address these limitations and estimate food insecurity globally by removing the assumptions of money and balanced meals (Coates et al. 2007). The HFIAS was informed by research in Canada by Lawn and Harvey (2003), who replaced "balanced meals" with "healthy meals" but retained the monetary basis for food acquisition. Similarly, in Bolivia and Burkina Faso, Melgar-Quinonez et al. (2006) removed the reference to "balanced meals" and asked about meal skipping and portion size in two separate questions. In Tanzania, Hadley and Wutich (2009) removed items on frequency, changed wording to remove monetary assumptions, and altered meal frequency to map onto the local diet. In what may be the most rigorous and relevant test of the validity of the direct, experience-based tool for food security estimation among indigenous Arctic populations, Egeland et al. (2011) used three different methods to assess food security among 2,595 Inuit in 1,901 households in 36 northern Canadian communities: a modified USDA food security survey module, food frequency questionnaires, and blood biomarkers. "The results provide evidence of the validity of the USDA food security assessment tool for indigenous peoples and highlights the

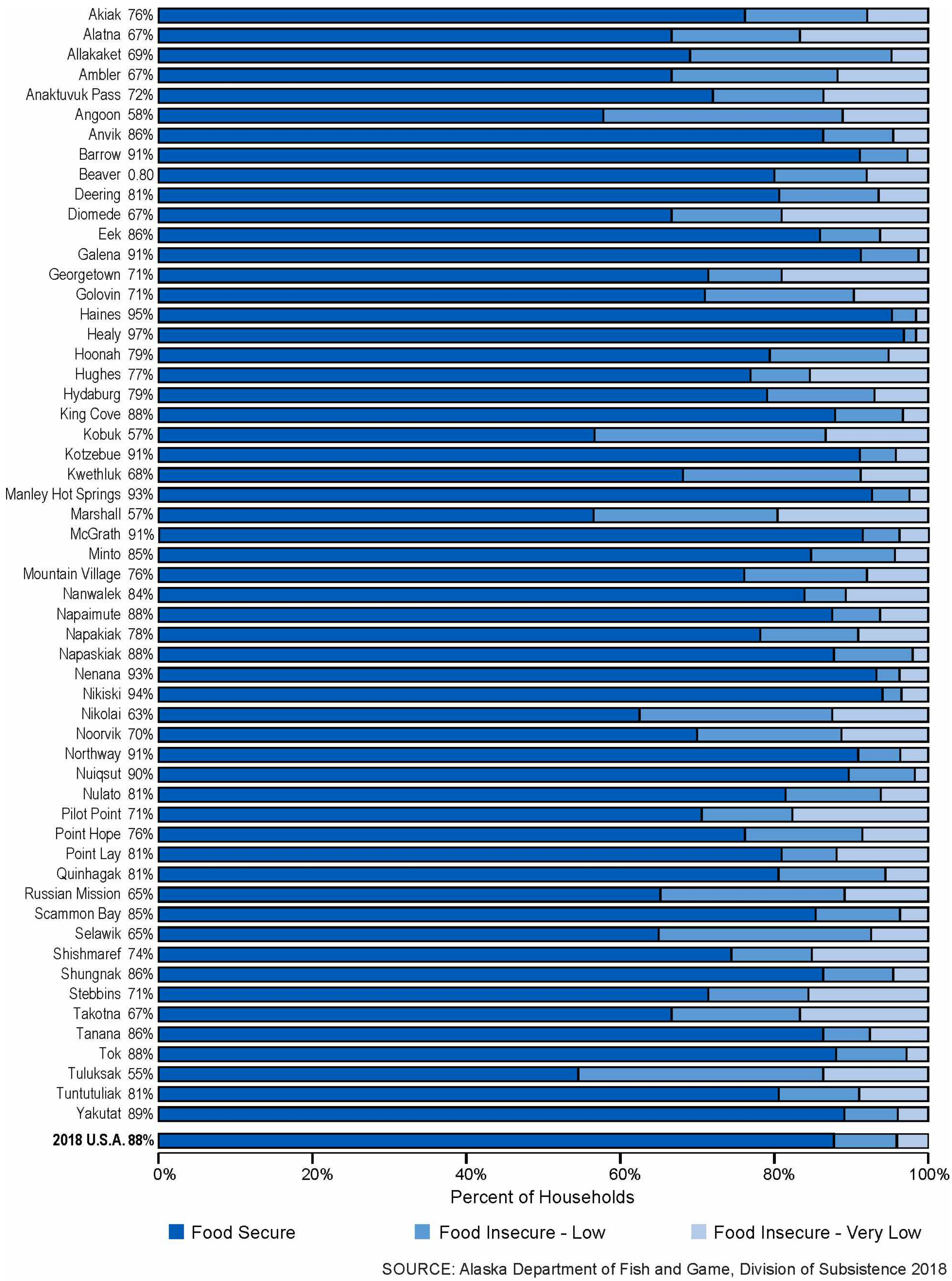

Figure 1-7 Estimated food security in 56 selected rural Alaska communities, 2016.

importance of simultaneously assessing TF [traditional food] consumption, because it could be protective against the impact of food insecurity," Egeland concluded.

1.2.4.2 Food Security in Rural Alaska

In the mid 2000's, the Division of Subsistence became interested in having household-level food security estimates to complement subsistence harvest and other household information. In consultation with the USDA and following the examples of USAID and other researchers, Division of Subsistence researchers modified the questions in the household food security survey module for use with rural Alaska populations, removing references to money and balanced meals. The first successful applications of the division's food security module were in Kivalina and Noatak in 2009 (Magdanz et al. 2010), and then in communities along the Kuskokwim and Yukon rivers (Brown et al. 2012, Brown et al. 2013, Ikuta et al. 2014, Brown, Brenner, et al. 2015, Ikuta et al. 2016).

By 2017, the module had been administered in 99 rural Alaska communities (Fall and Kostick 2018), and the Alaska Legislature tasked the Division of Subsistence with responsibility for food security research in Alaska. Figure 1-7 summarizes food security results from 56 of the 99 surveyed rural Alaska communities. In the example communities, the percentage of food secure households ranged from 55% (Tuluksak) to 97% (Healy), with a community mean of 83.8%. The surveyed communities included an estimated 12,401 households, of which 10,731 (87%) were estimated to be food secure. This level of food security was similar to the USDA estimates for Alaska and for the nation estimates, but that apparent similarity was partly a function of categorization.

Figure 1-6 illustrates similarities and differences in responses from the national and rural Alaska samples. The most obvious difference was the relatively small proportion of U.S. households that affirmed the first three indicators (about 5%, Figure 1.6A), compared with the much larger proportion of rural Alaska households (7% to 15% Figure 1.6B). A household was categorized as "food secure" even if it affirmed as many as two indicators of food insecurity, and it was apparent from the division's results that food-secure households in Alaska were not as food secure as the national sample. Otherwise, Figures 1-6A and 1-6B showed similar patterns.

An important difference between the USDA and USAID tools on one hand, and the Division of Subsistence tool on the other, was the addition of two sub-questions that parsed the source of food insecurity into two components: subsistence food and store-bought food. These responses are shown in orange in Figure 1-6B. Responses to the two sub-questions were not scored and did not affect households' raw scores or food security categories, but did provide additional insight into households' food situations. Perhaps the most interesting responses to the sub-questions were from food-secure households for whom either subsistence food did not last (676 households, 20% of the households in the food-secure category), store food did not last (164 households, 5%), or both types did not last (144 households, 4%). Over the course of the year, these households were running out of one or both types of food, but successfully filling their needs with the other food type. In other words, they were getting sufficient food, but not the foods they wanted. In twice as many households the food that did not last was subsistence food (25% compared with 10%).

Working in Kangiqsujuaq, Nunavik, Ready (2016a) borrowed the two sub-questions from the Division of Subsistence that asked respondents to affirm whether "country food did not last" and whether "store food did not last" and added them to a modified USDA 6-item food security tool. In her sample of 106 households, Ready classified 63 households (59%) as food secure, 22 households (21%) as "food insecure-low," and 21 households (20%) as "food insecure-very low." Ready also found very high rates of affirmation that "subsistence food did not last."

In addition to reporting estimates of food security, Ready assessed the reliability of her food security tool itself. The pattern of Ready's affirmed responses – in particular for the subsistence foods sub-question – was quite different from the expected pattern, suggesting to Ready that the food security tool was not performing well. The internal validity of a Rasch model tool like a food security module can be assessed computing Chronbach's alpha, which varies from 0 to 1 (no correlation to perfect correlation among items) (Bland and Altman 1997). In social science applications, a Chronbach's $\alpha > 0.7$ is considered evidence of a reliable test. Ready calculated Chronbach's α's for three different sets of food security questions; values ranged from 0.80 (with both sub-questions) to 0.84 (without responses to the subsistence sub-question). For the ADF&G data, Chronbach's α was 0.821 for a six-indicator model like Ready's, and 0.865 for the ten-indicator model that ADF&G actually used, both calculated without the sub-questions.

In performing several Rasch Model statistical tests, Ready found that the performance of her food security tool improved if she removed the subsistence sub-question ("subsistence food did not last"). Her statistical analyses and the patterns of affirmations contributed to her conclusion that:

> "Standard assessment tools may do an adequate job of measuring Inuit access to purchased food, but if we are interested in anything more than an exceptionally narrow definition of food security (i.e. one that ignores food preference and the contribution of country food to nutrient intake) then they are clearly insufficient." (Ready 2019)

That was a surprising conclusion, given the extensive validation of modified food security tools in non-market settings, especially by Egeland et al. (2011). The key points, however, were (1) ADF&G's sub-questions were not designed to be scored for food security purposes nor were they expected to conform to the Rasch model, (2) the 6-item food security tool was intended to estimate food security as technically defined, and (3) Egeland likewise was estimating nutritional sufficiency. The purpose of the sub-questions – as discussed above – was to provide insight into households' food strategies. It was possible for a household to report that one or both types of food "did not last" during the study period and to report that "food did last," and to be categorized as technically food secure.

In other words, ADF&G's food security tool seemed to be performing as expected, while responses to the sub-questions provided additional and useful information about household food strategies. High levels of food insecurity did exist in Ready's study community (41% of households were estimated to be food insecure). Nonetheless, in her conclusion that food security assessment tools were insufficient, Ready was conflating "food security" and "food sovereignty."

Different tools available for estimating community-level food sovereignty (Bell-Sheeter et al. 2014), a subject to which we now return.

1.2.4.3 Food Security and Food Sovereignty

"Food sovereignty" and "food security," have become contested terms in food systems literature (Edelman et al. 2014, Jarosz 2014). Food sovereignty speaks to political and economic power dynamics that deprive certain people or groups of people of control over their access to food, either directly from the land or through commodity exchanges. Food security speaks to people's nutritional conditions, where food insecurity results from not being able to obtain enough food. From a political ecology perspective, food security and food sovereignty were both relevant, but food sovereignty was associated with a moral economy where access to food was a human right rather than a commodity and local food production and access were a priority (Edelman 2005, Loring and Gerlach 2015, Tilzey 2017).

Food sovereignty emerged as a political concept from La Via Campesina ("the peasants' way") movement in the 1990s to protest the appropriation of the "food security" domain by states and corporate food enterprises (Desmarais 2002, Patel 2009, Louis 2012, Tilzey 2018), although the term itself originated with a government program in Mexico in 1983 (Edelman 2014). As food sovereignty movements gained momentum, "food security" and "food sovereignty" became intensely contested terms in the food systems literature (Patel 2009, Edelman et al. 2014). "The technocratic understanding of 'food security,' typical of many intergovernmental organizations, has made it a target for food sovereignty activists and sympathetic academics," Edelman et al. (2014) wrote.

Food security was both conflated with food sovereignty and positioned in opposition to food sovereignty on a political continuum of food regimes (Holt-Giménez and Shattuck 2011, Clapp 2014, Carolan 2014). "In the early actions around food sovereignty," Edelman et al. (2014) observed, "activists either used both terms almost interchangeably or asserted that food sovereignty was a prerequisite for attaining genuine food security." Jarosz (2014) conceptualized both terms as "fluid and changing discourses that define the problem of hunger." An early example from the Alaska literature was Thériault et al.'s (2005) argument for food sovereignty in their *Alaska Law Review* article: "The Legal Protection of Subsistence: A Prerequisite of Food Security for the Inuit of Alaska." The conflation of food security and food sovereignty created confusion (Carolan 2014, Jarosz 2014). As Jennifer Clap observed:

> "Abandoning the descriptive concept food security, and then pinning an oppositional normative agenda to it, is not particularly helpful to that broader debate over how to address the gross inequities in today's food system. The concept of food security was in fact originally critiqued by food sovereignty advocates for lacking guidance on how food should be produced, and where it should come from (Patel 2009). Now it is portrayed as having a specific agenda. To complicate matters, both the concepts of food security and food sovereignty have shifted in meaning considerably in recent decades, as Jarosz notes (see also Patel 2009). To perpetuate a binary from two moving targets only adds to the confusion, and risks stifling meaningful debate about different possible agendas to end hunger and create fair and equitable food systems." (Clapp 2014)

Such conflations were not uncommon in food systems literature and had the effect (sometimes the intent) of obscuring (or refuting) the technical definition of food security, especially in the early stages of the food sovereignty movement (Edelman et al. 2014). While the two terms overlapped, there were clear benefits in having both technical and political measures and vocabularies for households' food situations. Asking sub-questions about subsistence and store-bought foods – as the Division of Subsistence did – contributed to food sovereignty assessment without compromising the technical estimation of food security. In 2018, three of the ten questions on the division's food security protocol included sub-questions probing for subsistence and store sources of food insecurity.

1.3 Data Sources and Procedures

In all three results chapters of this dissertation, data were collected using socio-economic surveys administered to Alaska households by my colleagues and me. These surveys were termed "comprehensive subsistence surveys" because they documented all renewable resource species harvested or used by households in the study communities as well as economic and demographic information about households. The nature, scope, and results of the division's research program were described in Fall (1990), Wheeler and Thornton (2005); Wolfe (2005), and Fall (2016).

Appendix 3 includes an example of a comprehensive subsistence survey as administered in 2011 in Selawik, Alaska, by the Division of Subsistence working in collaboration with the Native Village of Selawik and the Northwest Arctic Borough (Braem et al. 2013). I obtained funding for this project, was the principal investigator, supervised data collection on site, and assisted in the analysis. It was my last Division of Subsistence project before resigning to attend graduate school.

The data analyzed in Chapter 3 were publicly available through the Community Subsistence Information System (CSIS) website maintained by the Division of Subsistence (Alaska Department of Fish and Game 2014). They were collected by the Division of Subsistence of Alaska Department of Fish and Game and cooperating tribes, communities, and regional organizations, who administered similar surveys to 18,029 households in 354 community-based projects from 1983 to 2013 (Alaska Department of Fish and Game 2014).

The data analyzed in Chapter 4 and Chapter 5 were collected by the University of Alaska working in cooperation with the tribal governments of Kaktovik, Venetie, and Wainwright, Alaska (Kofinas et al. 2016). The project was funded by the Bureau of Oceans Energy Management, and was commonly known as "The Sharing Project." The study's protocol for research received an approval after review from the University of Alaska Fairbanks Office of Research Integrity (UAF IRB). The IRB required that anonymity of research subjects be adequately protected, and subjects not be exposed to significant risks from participation. All UAF personnel involved in interviewing completed the IAB's Human Subjects Training. The US Office of Management and Budget (OMB) also reviewed and approved the survey instrument (OMB Control Number - 1010-0184).

The Division of Subsistence subscribed to the ethical principles outlined in *Ethical Principles for the Conduct of Research in the North* by the Association of Canadian Universities for Northern Studies (Graham and McDonald 2003). These principles emphasized:

- voluntary participation of communities, households, and individuals without undue pressure and with the right to withdraw from research at any point.
- informed consent from communities and respondents, including identification of sponsors, purposes of the research, sources of financial support, investigators responsible for the research, and explanations of potential beneficial and harmful effects.
- respect for the privacy and dignity of people, including confidentiality of respondents.
- appropriate community consultation at all stages of research, including community review of research results prior to publication and community access to research reports and summaries.
- enhancement of local benefits that could result from research, including local participation in the research process.
- respect for local languages, traditions, and standards
- incorporation of relevant traditional knowledge

1.3.1 Author Contributions

For the article presented in Chapter 3, I personally directed 15 of the included comprehensive surveys, which included training research teams on site, administering some surveys at each site, and reviewing surveys administered by others at ach site. I also developed the social network and food security modules that became standard survey features, and in 2006 reformatted the comprehensive survey instrument now used statewide by the Division of Subsistence. For the analysis in Chapter 3, I obtained an aggregated file of CSIS data from Division of Subsistence

Information Manager and coauthor David Koster, analyzed the data with supervision from coauthors Joshua Greenberg, Joseph Little, and David Koster. I wrote the article, and benefited from reviews by my coauthors and my Ph.D. committee.

For the articles presented in Chapter 3 and Chapter 4, BOEM consulted with me as it sought an institutional home for the project, ultimately selecting the University of Alaska Fairbanks (UAF). UAF then developed a subcontract with the Division of Subsistence for my services. I worked with Shauna BurnSilver and Gary Kofinas to modify the Division of Subsistence's standard comprehensive subsistence survey, which was reviewed and approved by Local Project Advisory Committees in the three study communities. I assisted in research team training and data collection in Ventie and with training in Wainwright. Shauna BurnSilver and I were primarily responsible for data cleaning and data analysis, and contributed extensively to the final project report submitted to the funding agency (Kofinas 2016). Shauna BurnSilver and I were equally responsible for data analysis and writing for the article presented as Chapter 3, in consultation with the listed coauthors. Shauna BurnSilver and I were equally responsible for data analysis and writing for the article presented as Chapter 4.

I was the sole author of the dissertation Preface, Chapter 1, Chapter 2, and Chapter 6. I benefited from comments on this dissertation from Dr. Joshua Greenberg, Dr. Courtney Carothers, Dr. F. Stuart Chapin, Dr. Steven Goodreau, Dr. Shauna BurnSilver, and Dr. William Schneider.

1.4 Plan of Presentation

Chapter 2 extends this introduction with a review of the legal frames for subsistence management in Alaska. Chapter 3 uses aggregated community-level data to provide a longitudinal overview of the economy of rural Alaska, exploring trends in rural populations, harvests of wild foods, and personal incomes at the community level. It extends and refines several subsistence productivity models, and explores the effects of roads on harvests and income. This article was published at the Social Science Research Network website in 2016, and revised in 2019.

Chapter 4 explores uses household level socio-economic data to explore "mixed economies" in two North Slope Borough communities. The article conceptualizes mixed economies as having three components: (1) market exchange, (2) subsistence activities, and (3) culturally embedded social relationships sustained by flows of wild food and other resources. We explore relationships between harvest and income at the household level. This article was published in *American Anthropologist* in 2016 (BurnSilver et al. 2016).

Chapter 5 combines concepts of sensitivity and adaptive capacity drawn from the vulnerability literature to explore differences in household characteristics within and between three Alaska communities. We synthesize market, harvest, and social network variables for each household to construct standardized household magnitude and diversity “scores” illustrating the wide diversity of household sensitivities and adaptive capacities within and between the study communities. This article was published in *Hunter Gatherer Research* in 2019 (BurnSilver and Magdanz 2019).

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Chapter 2 Common-Pool Resources in the Alaska Context
With an Emphasis on Subsistence Governance

Most fish and wildlife in Alaska were common-pool resources (CPRs). That is, they were part of a system "that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use" (Ostrom 1990:30). Common-pool resources in Alaska were subject to competing uses – subsistence, commercial, recreational, and non-consumptive – most of which were subtractive, meaning a salmon harvested for subsistence use was not available for commercial or recreational uses, and creating incentives for allied users to allocate resources toward themselves and away from competing users. These allocations were determined by a variety of institutional arrangements negotiated through political processes including indigenous governance and stewardship, some of which were institutionalized through state and federal laws and constitutions, international treaties, and cooperative agreements. Even for agency professionals, let alone hunters and fishers, institutional arrangements for managing hunting and fishing in Alaska could seem unfathomable.

In *Changes in the Land*, William Cronon (2003[1983]) related a career-defining question his historian father had posed for him: "How did things get to be this way?". To understand "how things got to be this way" in Alaska – how the legal frames for managing subsistence hunting and fishing in Alaska evolved over time and how they became so complicated – this chapter reviews common pool-resource dilemmas and CPR management principles, briefly discusses indigenous land and resource rights in Alaska, and then reviews four watershed political acts that influenced subsistence management: the Alaska Constitution, the Alaska Statehood Act, the Alaska Native Claims Settlement Act (ANCSA), and the Alaska National Interest Lands Conservation Act (ANILCA). It concludes with a summary of the current management situation in Alaska.

2.1 Common-Pool Resource Management

Common-pool resource systems can create perverse incentives for excess resource extractions – benefits of extraction accrue to each individual user while costs are shared by all users – which can lead to a "tragedy of the commons" (Lloyd 1980 [1833], Hardin 1968, McEvoy et al. 1986). "Freedom in a commons brings ruin to all," Hardin argued, and he proposed a remedy: coercion. "To many, the word coercion implies arbitrary decisions of distant and irresponsible bureaucrats; but this is not a necessary part of its meaning. The only kind of coercion I recommend is mutual coercion, mutually agreed upon by the majority of the people affected"(Hardin 1968).

Coercion takes many forms, rarely as benign as Hardin recommended. For nations and states, coercion usually involved strong central control or, increasingly, state-sanctioned privatization. This created order and legibility from the perspective of nations and states, but favored certain uses and users, invited formulaic policy prescriptions ("panaceas"), risked resource sustainability, and turned nature into a commodity (Holling and Meffe 1996, Mansfield 2007, Basurto and Ostrom 2009, Young et al. 2018).

McCay and Acheson (1987), Berkes et al. (1989), Ostrom (1990), and others disputed Hardin's tragedy narrative with counter examples from both subsistence and market situations. Berkes et al. (1989) pointed out that commons tragedies were not a function of commons alone, but also required subtractibility and a *laissez faire* approach to access and use. A source of the "confusion in scientific study and policy analysis," Schlager and Ostrom (1992) noted, was that political economists used the term "common-property resources" indiscriminately to describe a variety of common-pool resource systems characterized by different rules, rights, and property regimes. Ostrom (1990) outlined principles for sustainable management that involved neither strong central control nor privatization (Table 2-1A). Ostrom's principles were not a prescription for what *might* work, rather they were observations of what *had* worked. Bending to the weight of criticism, Hardin (1998) proposed a modification to his 1968 title: "The Tragedy of the *Un-managed* Commons."

Nineteenth century North America was replete with commons tragedies – extinctions and

TABLE 2-1 OSTROM'S PRINCIPLES AND THE NORTH AMERICAN MODEL

A. ELINOR OSTROM'S COMMON-POOL RESOURCE PRINCIPLES

1. Boundaries…

…between Users
Clear and locally understood boundaries between legitimate users and nonusers are present.

…for Resources
Clear boundaries that separate a specific common-pool resource from a larger social-ecological system are present.

2. Congruence…

...with Local Conditions
Appropriation and provision rules are congruent with local social and environmental conditions.

...between Appropriation and Provision
Appropriation rules are congruent with provision rules. The distribution of costs is proportional to the distribution of benefits.

3. Collective-Choice Arrangements

Most individuals affected by a resource regime are authorized to participate in making and modifying its rules.

4. Monitoring…

...Users
Individuals who are accountable to or are the users monitor the appropriation and provision levels of the users.

...Resources
Individuals who are accountable to or are the users monitor the condition of the resource.

5. Graduated Sanctions

Sanctions for rule violations start very low but become stronger if a user repeatedly violates a rule.

6. Conflict-Resolution Mechanisms

Rapid, low-cost, local arenas exist for resolving conflicts among users or with officials.

7. Minimal Recognition of Rights

The rights of local users to make their own rules are recognized by the government.

8. Nested Enterprises

When a common-pool resource is closely connected to a larger social-ecological system, governance activities are organized in multiple nested layers.

SOURCE: Ostrom, Elinor. 2010 Beyond Markets and States: Polycentric Governance of Complex Economic Systems. IN *Les Prix Nobel-The Nobel Prizes 2009*. K. Grandin, ed. Pp. 422. Stockholm: Nobel Foundation.

B. NORTH AMERICAN MODEL OF WILDLIFE CONSERVATION

1. Wildlife resources are a public trust

Challenges include (1) inappropriate claims of ownership of wildlife; (2) unregulated commercial sale of live wildlife; (3) prohibitions or unreasonable restrictions on access to and use of wildlife; and (4) a value system endorsing an animal-rights doctrine and consequently antithetical to the premise of public ownership of wildlife.

2. Markets for game are eliminated

Commercial trade exists for reptiles, amphibians, and fish. In addition, some game species are actively traded. A robust market for access to wildlife occurring across the country exists in the form of leases, reserved permits, and shooting preserves.

3. Allocation of wildlife is by law

Application and enforcement of laws to all taxa are inconsistent. Although state authority over the allocation of the take of resident game species is well defined, county, local, or housing development ordinances may effectively supersede state authority. Decisions on land use, even on public lands, indirectly impact allocation of wildlife due to land use changes associated with land development.

4. Wildlife can be killed only for a legitimate purpose

Take of certain species of mammals, birds, reptiles, and amphibians does not correspond to traditionally accepted notions of legitimate use.

5. Wildlife is considered an international resource

Many positive agreements and cooperative efforts have been established among the U.S., Canada, Mexico, and other nations for conserving wildlife. Many more species need consideration. Restrictive permitting procedures, although designed to protect wildlife resources, inhibit trans-border collaborations. Construction of a wall to prevent illegal immigration from Mexico to the U.S. will have negative effects on trans-border wildlife movements and interactions.

6. Science is the proper tool to discharge wildlife policy

Wildlife management appears to be increasingly politicized. The rapid turnover rate of state agency directors, the makeup of boards and commissions, the organizational structure of some agencies, and examples of politics meddling in science have challenged the science foundation.

7. Democracy of hunting is standard

Reduction in, and access to, huntable lands compromise the principle of egalitarianism in hunting opportunity. Restrictive firearms legislation can act as a barrier hindering participation.

SOURCE:Organ, John F., Valerius Geist, Shane P. Mahoney, Steven Williams, Paul R. Krausman, Gordon R. Batcheller, Thomas A. Decker, Robert Carmichael, Priya Nanjappa, Ronald Regan, Rodrigo A. Medellin, Ruben Cantu, Richard E. McCabe, Scott Craven, Gary M. Vecellio, and Daniel J. Decker. 2012. *The North American Model of Wildlife Conservation.* Bethesda, MD: The Wildlife Society and the Boone and Crockett Club.

near extinctions of native species – a result of unmanaged market hunting. In response, a growing community of conservationists like Aldo Leopold contributed to an approach that came to be known as the "North American Model" (Table 2-1B) (Geist et al. 2001, Prukop and Regan 2005, Batcheller et al. 2010, Organ et al. 2012). The model's first principle was that "wildlife resources are a public trust," a doctrine that dated back to the Institutes of Justinian in the Roman Era. "Under the public trust doctrine, the trustee is the government, the beneficiary is the general public, and the corpus of the trust is the resource to be conserved by the government" (Smith 2016:470). In the United States, the public trust doctrine was judicially rather than legislatively developed (Sax 1970, National Research Council 1999). Geist et al. (2001) argued that the North American Model had turned the Tragedy of the Commons "into a triumph of the commons (Geist 1995), demonstrating that contrary to 'Commons' theory, public ownership of a resource can result in its conservation without abuse." Geist et al. (2001:175) compared the effort to the American Revolution: "The revolution around wildlife likewise occupied the best minds of the time, and generated an equally brilliant solution that swept the continent."

Peterson and Nelson (2017) offered a blistering critique of the North American Model: "One cannot imagine a framing more centered on white male hunters than that contained in this historical overview for the origins of wildlife conservation in the United States and Canada." Peterson and Nelson were joining a growing chorus of NAM critics, who argued that the North American Model perpetuated a colonial settler narrative of American identity, valorized the killing of animals for entertainment, ignored tremendous losses of biodiversity among non-game species, excluded women and indigenous people from the historical narrative, privileged an exclusionary conception of Western science, and fell short of its own purportedly inclusive aims (Clark and Milloy 2014, Feldpausch-Parker et al. 2017, Peterson and Nelson 2017, Eichler and Baumeister 2018, Serfass et al. 2018). As an example of the NAM disregard for hunter-gatherer economies, Organ et al. (2012:18-19) suggested that "pot hunting" (hunting solely for food) was not a legitimate use of wild game under the North American Model. While the North American Model rejected commercial wildlife markets in principle, in practice trapping furbearers for market always had been encouraged and support for Scandinavian-style privatization of big game was growing among state conservation agencies (Twiss et al. 1997, Luke 2001, Robbins and Luginbuhl 2005, Brainerd and Kaltenborn 2010). Moose in Alaska, white-tailed deer in Texas, and even international species like snow geese were among the species considered for privatization (Brainerd and James 2011, VerCauteren et al. 2011, Chitwood et al. 2015).

In the commercial fishing community, depleted stocks and increasing competition the latter 20th century led fishers and managers to reexamine open-access policies that had been the norm since indigenous fisheries had been overrun by settlers, and then to embrace privatization of fully utilized stocks (National Research Council 1999). From a free-market perspective, privatization of commercially utilized fish stocks was a "rational" response to "overuse and abuse of the 'commons'…caused by the failure of markets to give proper signals due to the lack of appropriately specified property rights" (National Research Council 1999:26). Beginning in 1973, the State of Alaska limited entry in 65 commercial fisheries targeting salmon, halibut, herring, crab, sablefish, and several marine invertebrates (Gho 2019). Subsequently, the federal government issued individual fishing quotas in Alaska for halibut, sablefish, and Bering Sea crab, and issued community development quotas for Being Sea pollock. Individual Fishing Quotas (IFQs) were seen as a "possible solution to excess harvesting and processing capacity, stock depletion, and possible ecological disruptions that characterize many managed U.S. fisheries" (National Research Council 1999). Alaska's limited entry program granted transferrable fishing rights to individuals, while the federal IFQs program granted transferrable fishing rights to individuals that included a percentage of the total allowable catch.

As more commercial fisheries were "rationalized," adverse aspects emerged. Privatization resulted in "concentrating ownership, overcapitalizing quotas, blocking the entry of younger fishermen, transferring quota ownership to outsiders and investors, increasing processor control, and hardening class divisions within coastal communities" (Pinkerton and Davis 2015). Adverse aspects of rationalization have been especially apparent in rural Alaska, where "permit holdings by rural residents local to their fisheries have declined by 30%" while the average age of fishermen increased by a decade since state programs began in 1975 (Cullenberg et al. 2017). "The privatization of access rights to commercially harvested fish has been among the most significant regulatory shifts in the contemporary management of Gulf of Alaska and Bering Sea ecosystems," Carothers (2015) wrote. "A majority of fishery participants consider fisheries privatization processes to be a fundamental driver of changing values and lifestyles in Alaska's commercial fisheries."

While open-access policies served the interests of urban sport hunters' interests and rationalization policies served the interest of well-capitalized commercial fishermen, neither approach seemed to align with the interests of rural and indigenous Alaskans who harvested fish and wildlife for subsistence. Open-access policies sustained yields by increasing difficulty and reducing success, making dependence on hunting for subsistence less tenable. Privatization models exposed historically cash-poor rural Alaskans to strong market forces (Cullenberg et al. 2017). Aging indigenous fishermen who earned fishing rights on the strength of their fishing histories found it hard not to sell those rights to wealthy non-local fishers to finance their retirements or other family needs, and younger relatives could not afford to buy them. "If we view marine conservation as stewarding sustainable human-marine connections," Donkersloot and Carothers (2017) wrote, "ITQs become antithetical to conservation because they function as a mechanism for the alienation of local fishing rights embedded in place."

The irony, as Arnold (2009:39) pointed out, was that before contact indigenous Alaskans relied on property rights to protect access to common-pool resources through enforcement of territorial boundaries and recognition of family and clan usufruct rights over harvest areas (Rogers 1979, Price 1990, Burch 1994, Colt 1999). European and American settlers and entrepreneurs treated Alaska as open-to-entry, ignoring indigenous territories and property rights systems (Arnold 2009, Schneider 2018). By 2020, the majority governments had brought commercially valuable fish stocks full circle back to property rights schemes, but with new, mostly non-indigenous owners. Schlager and Ostrom chided economists for ignoring the diversity of real-world, common-pool-resource situations, and for their "blind faith in private ownership, common-property institutions, or government intervention… The valid question is how various types of institutional arrangements perform comparatively when confronted with similarly difficult environments" (Schlager and Ostrom 1992:260). But not all institutional remedies were available to Alaskans. As White (1994) noted, "The Alaska courts have held that the 'common use' of fish and wildlife is entitled to a high degree of constitutional protection."

2.2 The Indigenous Situation

At contact, indigenous Alaskans "possessed unextinguished aboriginal title, which included hunting, fishing, and gathering rights" (Anderson 2007). After the United States purchased Alaska from Russia in 1867 these rights were subjected to "vacillating judicial decisions, ineffective implementation of federal policies, and entrenched political opposition among Alaska's territorial and state leaders to the ideas of aboriginal title and tribal status" (Case and Voluck 2012). Nonetheless, under U.S. law only the federal government could extinguish aboriginal titles, and as long as aboriginal titles existed they clouded title for everyone else (Case and Voluck 2012).

The 1884 Organic Act was one example of the federal recognition of indigenous rights. The Act provided that "Indians or other persons…shall not be disturbed in the possession of any lands actually in their use or occupation or now claimed by them" (quoted in Branson 1978). At the same time, however, the United States was promoting an assimilationist policy that would treat Alaska Natives as citizens, notwithstanding that citizenship was not extended to Indians in the United States – including Alaska Natives –until 1924 (Gruening 1954). As Sheldon Jackson told the Board of Indian Commissioners in 1895: "[W]e have no Indians in Alaska: we have natives… 'We want citizenship right from the start'" (quoted in Mitchell 1997b). Alaska politicians like Ernest Gruening and Bob Bartlett adopted this view, opposing the establishment of Indian reservations or similar grants of land and resource rights to Alaska Natives (Gruening 1954, Haycox 1990). Gruening (1951) argued that the composition of the Alaska Legislature demonstrated Alaska Native progress towards full citizenship, as six members of the 40-member Alaska Territorial Legislature in 1951 were Alaska Natives.

Alaska politicians like Gruening and Bartlett found assertions of indigenous rights "a far-fetched notion at best" (Haycox 2019), and implied that granting citizenship rendered questions of aboriginal rights moot. Many Alaska Natives and their advocates disagreed (Mitchell 2001). As Hensley (1966) put it:

> "Two extreme positions may be taken on this issue by those unacquainted with the legal complexities of the problem. The two positions are held by both Natives and nonNatives. One holds that the Alaska aborigine is simply a citizen of the United States and of Alaska with no more rights than any other citizens – therefore has no more right to land than Alaskan settlers arriving later. The opposing view holds that the Alaskan Indians, Eskimos, and Aleuts – due to their habitation of and use of natural resources have an "aboriginal title" to land and its products which cannot be deprived them without their consent."

Moore (2019) and Arnett (2017) both argued that citizenship and aboriginal rights were not an either/or proposition, nor was citizenship a substitute for Alaska Natives' rights to land, sovereignty, and economic self-determination. Often lost in the discussion was the fact that federal government had – and continues to have – a trust responsibility to Alaska Natives, including a trust responsibility for subsistence (Cohen 2012, Case and Voluck 2012). Morehouse (1992) observed that "Alaska Natives represent an unusually complicated case in the larger context of American Indian policy."

2.3 Alaska Constitution and Alaska Statehood Act (1955, 1958)

In the decades leading up to Alaska Statehood, a persistent theme among Alaskans – indigenous and settlers alike – was resentment for what they saw as federal neglect, appropriation, and exploitation (Arnold 1978 [1976], Mitchell 1997a, Anderson 2007, Arnold 2009, Haycox 2020). Some Alaska politicians used that resentment for the "broader purpose of building a political base for the statehood struggle" (Haycox 1990), which was realized when 55 Alaskans assembled at the University of Alaska in Fairbanks in November 1955 to draft a constitution for the proposed State of Alaska, (Cooley 2017 [1963], Hammond 2011). Venting frustration at Outside cannery interests who had built salmon traps at the mouths of major rivers and decimated local salmon stocks, convention President William Egan told the delegates, "A prime example of federal bungling in the handling of our great resources is our commercial fishery" (Alaska Constitutional Convention 1956).

Arguably, no group in Alaska was more dependent on fish and wildlife in 1955 than indigenous Alaskans. Yet the Alaska Constitutional Convention and the subsequent Statehood Act continued a century long practice by the federal and territorial governments of avoiding resolution of indigenous rights to land and resources while advancing non-indigenous commercial interests (Arnold 2009, Haycox 2019). Indigenous Alaskans– despite their status as citizens – were not well represented at the constitutional convention. While 1 in 5 Alaskans was Alaska Native in 1955, only 1 of 55 elected delegates to the convention was an Alaska Native: Frank Peratrovich of Ketchikan.

The delegates enlisted a young political science professor from the University of Oregon, Vincent Ostrom, to help draft the Natural Resources Article (Allen and Lutz 2009). Aldo Leopold's land ethic and the open-access policies that became the public trust doctrine were well established by 1955, while Vincent and Elinor Ostrom were decades away from articulating their design principles for the managing common-pool resources. In its final form, the Natural Resources Article of the Alaska Constitution included these sections:

> § 3. Wherever occurring in their natural state, fish, wildlife, and waters are reserved to the people for common use.
>
> § 4. Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial uses.

§ 15. No exclusive right or special privilege of fishery shall be created or authorized in the natural waters of the State. [amended in 1972 to allow limited entry in fisheries].

On July 7, 1958, the U.S. Congress adopted the Alaska Statehood Act, approving the new state constitution and admitting Alaska into the Union. Section 4 directed the state to "forever disclaim all right and title to [indigenous] land and property (including fishing rights)." Section 6(b) allowed the state to select a statehood "entitlement" of 102.5 million acres from "public lands." Section 6(e) transferred authority to manage fish and wildlife to the state. Acting quickly on Section 6 and ignoring Section 4, the State of Alaska began selecting lands under the "statehood entitlement," including lands that long had been occupied and/or used by indigenous people. The State of Alaska also assumed responsibility for the management of fish and wildlife resources throughout the state, including resources long used by indigenous people.

Few people recognized "the fundamental contradiction between these two provisions of the act," Haycox (2019) wrote, "but it did not take long for state leaders to understand, for as the state began to make its land selections in 1959, Natives began to protest those selections." In 1961, the state identified land near the Native village of Minto to select for a recreation area accessible by a planned road to Fairbanks. Minto protested and the federal Bureau of Indian Affairs began filing protests on their behalf. The state responded by suggesting that it could select the land and sell it back to Minto Natives, and Minto refused (Naske and Slotnick 1994, Anderson 2019). Similar conflicts developed elsewhere and a federal "Field Committee" was established to study the issues. As Morehouse and Holleman (1994) later observed, "Congress had never clarified Native aboriginal rights to land and resources in Alaska, choosing instead to deal with the issue on a piecemeal basis." With the discovery of massive oil deposits at Prudhoe Bay in 1968 and the subsequent urgency to build a Trans-Alaska Pipeline System north to south across the state, such a piecemeal approach to indigenous land and resource rights was no longer tenable.

2.4 ANCSA and ANILCA (1971, 1980)

Beginning in 1971, the United States embarked on two remarkable socio-economic experiments, transforming relationships among Alaska Natives, the State of Alaska, and the United States, and upending historic power dynamics in fish and wildlife management (Wayburn 1984, Dombrowski 2001). First, to allow construction of a pipeline to carry crude oil from Prudhoe Bay to Valdez, Congress adopted and President Richard Nixon signed the 1971 Alaska Native Claims Settlement Act (ANCSA), launching an experiment in indigenous self-determination and capitalism (Arnold 1978 [1976]). Second, to belatedly fulfill a provision in ANCSA Section d(2), Congress adopted and President Jimmy Carter signed the 1980 Alaska National Interest Lands Conservation Act (ANILCA), launching an experiment to conserve Alaska's subsistence economies in the face of rapid urban population growth and remote industrial developments. The two laws reflected the United States' perpetually conflicted relationship with wild lands and indigenous people: part appropriation and assimilation, part conservation and cultural preservation.

On the one hand, ANCSA formalized the appropriation of 89% of Alaska's lands by the federal and state governments, leaving 11% of Alaska in indigenous hands (Arnold 1978 [1976]). ANCSA created new capitalist institutions (for-profit Native corporations) to manage – on their own, and as private property rather than as Indian territory – what remained of their traditional lands and resources (Strommer and Osborne 2005, Case and Voluck 2012). ANCSA also extinguished aboriginal hunting and fishing rights, extracting a promise from the State of Alaska to provide for Alaska Native subsistence (Kancewick and Smith 1990, Anderson 2016, Thornton and Mamontova 2017). "The Alaska Native Claims Settlement Act (ANCSA) was intended to be a development tool as much as a claims settlement, a way for one of America's poorest minority groups to escape from poverty on a self-determined path" (Colt 2005).

On the other hand, ANILCA placed 106 million acres of federal land in Alaska into conservation status. Because ANCSA had extinguished aboriginal hunting and fishing rights and because it had become clear to Congress by 1980 that the State of Alaska was not providing for subsistence uses as Congress had intended (State v. Tanana Valley Sportsmen's Association 1978, Kancewick and Smith 1990), Congress added a section to ANILCA – Title VIII – that established a rural priority for subsistence uses on federal public lands. ANILCA Sec. 805(d) further provided that the U.S. Secretary of the Interior "shall not implement" federal subsistence management if "the State enacts and implements laws of general applicability which are consistent with, and which provide for the definition, preference, and participation" specified in the federal law (Alaska National Interest Lands Conservation Act 1980). In anticipation of that provision, the Alaska Legislature adopted or amended a series of statutes in 1978 "to clearly establish subsistence use as a priority use of Alaska's fish and game resources" (AS 16.05.090). As long as the state complied with the provisions of ANILCA, then the state could continue to manage subsistence uses of fish and wildlife throughout the state.

In early hearings on the bill, Congress had been inclined to give "highest priority…to allowing continued subsistence uses by Alaska Natives primarily and directly dependent upon the particular resource" (Norris 2002). But Alaska Gov. Jay Hammond "pointed out that under the Alaska Constitution, the State cannot participate in a subsistence management system which would require it to allocate access to subsistence resources on the basis of 'Nativeness' and Congressional support for a Native preference quickly eroded" (Norris 2002). As adopted, ANILCA provided that rural Alaskans had priority over non-rural Alaskans at all times, and when resources were scarce customary and traditional subsistence uses had priority over other consumptive uses like commercial and sport fishing in rural areas of the state.

ANCSA appropriated and assimilated, but also empowered. ANILCA conserved and preserved, but also restricted. Some non-Native Alaskans saw the Native corporations, the new conservation lands and the subsistence priority as nothing more than Native welfare and federal resource appropriations (Turner 1982, Borneman 2004:464). Some Alaska Natives thought they had been robbed (Gallagher 1979:251).

The ANILCA subsistence priority did not apply to Alaska Natives who lived in urban areas, regardless of their dependence on hunting and fishing. Nor did Alaska Natives have the ability to manage subsistence on their (now private) Native lands. That authority rested within a well-established State of Alaska conservation bureaucracy historically dominated by non-indigenous interests (Spaeder 2005). Nor did the subsistence priority apply to small-scale commercial fisheries comprised primarily of rural Alaska Natives, although an Alaska attorney general thought that such commercial fishing might be allowed as "customary trade" (Condon 1981). These outcomes reflected a series of political compromises between state and indigenous representatives, and the details are still sources of controversy (Shapiro 1997, McGee 2010, Somerville 2013).

A politically active segment of Alaska hunters – including some Alaska Department of Fish and Game biologists – were hostile towards the subsistence priority laws. Darrel Farmen, an Anchorage hunting guide and member of the Alaska Board of Game told *Audubon* writer John Mitchell (1979), "Subsistence is bullshit." In 1982, subsistence-priority opponents launched a referendum to repeal the state subsistence priority (Alaska Division of Elections 1982). As a *New York Times* reporter wrote in advance of the election:

> "Native lobbyists led the effort that resulted in passage in 1978 of a state law giving priority to subsistence hunters. Whites opposed the change. When they were unable to get the law repealed by the Legislature, they set the drive for the ballot question in motion. ''We had 2,000 petition circulators on the street,' said Sam McDowell, a leader of the repeal drive. He and his supporters believe that, sooner or later, the law will block their access to fish and game.
>
> "On its face, the law does not favor natives, but opponents of the law believe that it is bound to have that effect. This is because the subsistence hunter must live in a rural, thinly populated area and must be able to show a customary and traditional pattern of hunting or fishing for food. This is almost a definition of the nonurban Alaska native.
>
> "Resentment of the way natives have been able to use Native Claim settlement money for investments often comes up in arguments against the subsistence law. Mr. McDowell, for example, said a few months ago, 'That poor-old-subsistence-native

> concept won't work with me, not when I read every day there they've spent another $20 million for a drilling rig here or a hotel there.'" (Turner 1982)

As it turned out, public support for a rural subsistence priority was strong among the Alaskan public, and the anti-subsistence referendum failed, 58% to 42% (Alaska Division of Elections 1982).

One challenge facing fish and wildlife managers in Alaska before 1980 was the lack of reliable information about subsistence harvests in remote areas of the state. Georgette (1994) estimated that state's formal harvest reporting system under-reported subsistence caribou harvests from the Wester Arctic Herd by an order of magnitude. Schmidt and Chapin (2014) found that twice as many moose were reported on subsistence surveys as were reported on hunter harvest tickets. Subsistence harvest reporting systems did not even exist for important subsistence species that were not deemed important for commercial or recreational purposes, including marine mammals, most non-salmon fish species, and most small mammals. It was impossible to make informed subsistence management decisions when human harvests were largely unknown, so the subsistence statutes enacted in 1978 and 1980 included a state provision to gather, analyze, and disseminate information about "the role of subsistence hunting and fishing in the lives of the residents of the state" (AS 16.05.094) and a federal provision to disseminate data relevant to subsistence, staff the new Regional Advisory Councils, and reimburse the state for its costs to do so (94 STAT. 2424 § 805(b,d,e)).

The purpose of these provisions was to increase the quantity and quality of information about subsistence available to decision makers. Perhaps their most relevant use has been to provide an empirical basis for the determining Amounts Necessary for Subsistence (ANS, discussed in next section). In addition, state and federal subsistence analyses became routine features of state and federal fish and wildlife regulatory meetings, were cited in the academic literature and public media, and contributed to the public discourse about subsistence in Alaska. Somewhat ironically, subsistence data became standard features of federal environmental impact statements for large scale industrial development projects like Pebble Mine (Fall et al. 2006), Donlin Mine

(Brown et al. 2012, Brown et al. 2013, Ikuta et al. 2014, Ikuta et al. 2016), Ambler Road (Braem et al. 2015), and Alaska LNG Pipeline (Jones et al. 2015, Brown et al. 2016). The most intensive single subsistence data collection effort ever conducted in Alaska explored subsistence impacts of the 1989 Exxon Valdez Oil Spill (Fall and Utermohle 1995). These provisions also were responsible for most of the data analyzed in Chapter 3.

State implementation of ANILCA Title VIII required the Alaska Board of Fisheries and Game to adopt new regulations governing subsistence uses. The proposals included in Appendix 1 provide examples of subsistence management options considered by the Boards in 1979. Several options reflected a "welfare" approach to subsistence, limiting subsistence eligibility to persons or families with annual incomes less than ~$10,000 and/or with diets comprised of more than 50% wild foods. There was a proposal prohibiting the use of snowmachines, all-terrain vehicles, or airplanes for subsistence, and a proposal for a blanket subsistence permit with a punitive failure-to-return provision. The more restrictive and punitive proposals were not adopted, but they were indicative of sentiments about subsistence among some residents and employees of the state. The idea that a subsistence priority should be a form of welfare limited to people in poverty has been especially durable. As Sam McDowell's brother, Dan McDowell, wrote in a letter to the editor of the Anchorage Daily News in 1990: "We cannot make the fish wildlife, and other natural resources in America a form of welfare payment to the select few who choose to live in rural areas" (quoted in Kancewick and Smith 1990).

State implementation of ANILCA also required identification of "rural" areas where subsistence would be allowed. The Alaska Boards of Fisheries and Game began that process in 1980, precipitating a continuing stream of lawsuits from Alaskans who found themselves on the wrong side of determinations. In 1985, the Alaska Supreme Court found that "under a statute designed to protect subsistence uses, the board [Alaska Board of Fisheries] has devised a regulation to disenfranchise many subsistence users whose interests the statute was designed to protect" (Madison v Alaska Department of Fish and Game 1985). In 1989, the Alaska Supreme Court's found that the rural priority violated the "common use" clause of the Alaska Constitution (McDowell

v. State 1989), and thus the state was in violation of ANILCA Sec. 805(d) and could no longer implement ANILCA as written.

Democratic Gov. Tony Knowles organized an effort to amend the state constitution to allow the legislature to readopt the rural subsistence priority, and the Republican legislature refused to place the issue on the election ballot (Morehouse 1992). With the state out of compliance with ANILCA sec. 805(d), the Secretary of the Interior moved to assume management of hunting (but not fishing) on federal public lands in Alaska. Athabascan elder Katie John successfully sued in federal court for a priority for subsistence fishing, and subsistence fishing on waters on federal public lands came under federal jurisdiction as well. A subsequent string of Republican governors sued the federal government to reverse federal claims of authority over subsistence fishing in Alaska, and failed (John v. United States 2013). The long series of state and federal court decisions resulted in dual state and federal subsistence management systems, limited the rural priority to federal public lands and adjacent waters, and further diluted the advantages of ANILCA's subsistence priority to Alaska Natives.

Exhaustive accounts of ANCSA, ANILCA, and the major subsistence lawsuits can be found elsewhere. For the moment, it is enough to know that the two laws have been perpetually controversial but also durable. They framed the management of subsistence hunting and fishing in Alaska from 1980 forward and, in many instances, funded the collection of the socio-economic data that this dissertation explored.

2.5 Current Management Situation in Alaska

At this writing, the fish and wildlife management system in Alaska involved at least seven federal agencies within the departments of the Interior, Agriculture, and Commerce; five divisions and sections within the Alaska Department of Fish and Game; two federal management boards, two state management boards, several indigenous marine mammal commissions, a string of cooperative management bodies, and a swarm of state and federal citizen advisory committees. They engaged in somewhat coordinated arrangements to manage one or more types of fishing –

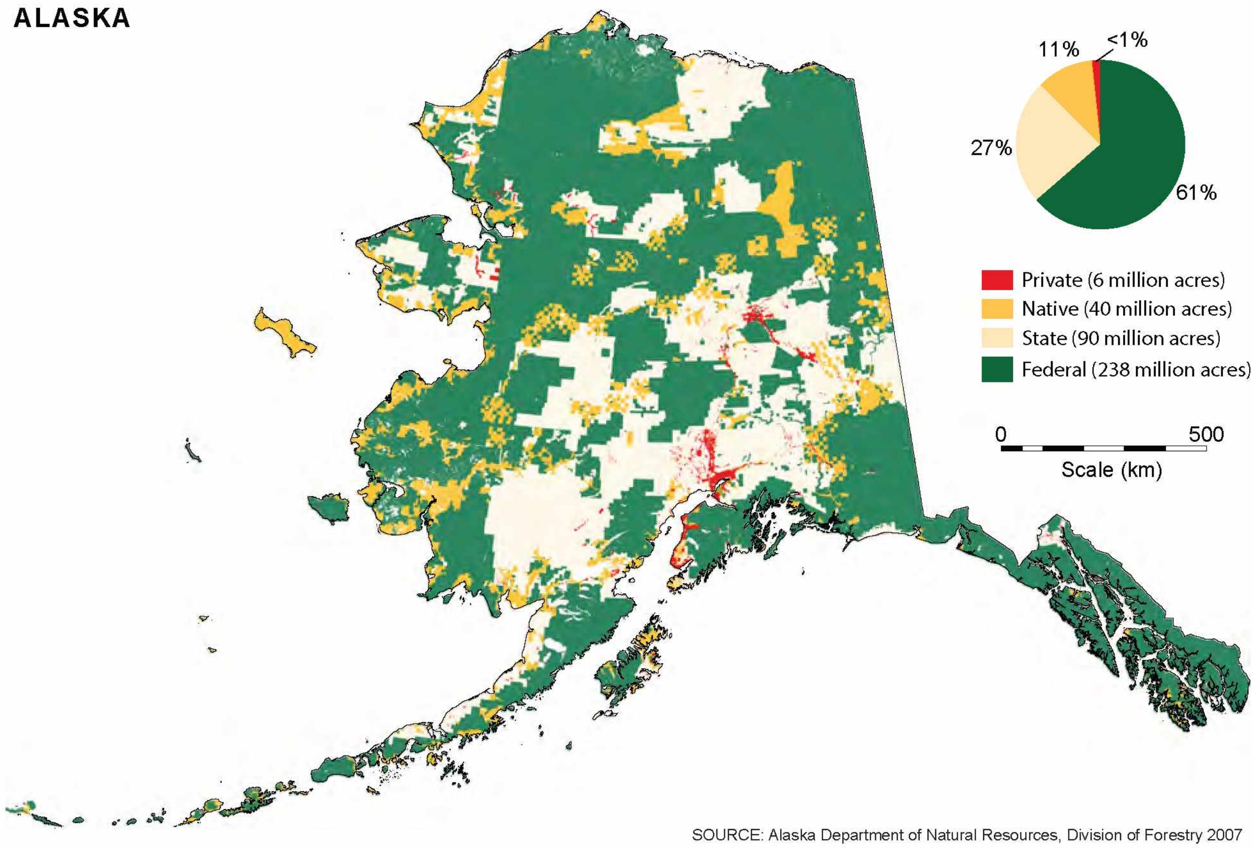

Figure 2-1 Land status in Alaska, by owner/manager.

commercial, sport, subsistence, and personal use – and/or to manage one or more of three types of hunting – sport, guided sport, and subsistence – although State of Alaska regulations did not distinguish between sport and subsistence hunting unless a particular wildlife population was scarce and managed under a user selection process known as "Tier II."

Jurisdiction in any particular management situation was determined by complicated intersections of geography, land ownership, species, and types of use. Figure 2-1 illustrates one dimension of subsistence management in Alaska: land status (Alaska Department of Natural Resources Division of Forestry 2007). The federal government managed subsistence uses on *most* of the federal areas shown in Figure 2-1. The State of Alaska managed subsistence uses in the rest of Alaska, and managed all consumptive non-subsistence uses on all land classes. Notably, the State of Alaska had jurisdiction over hunting and fishing on lands owned by indigenous Alaskans, whether owned collectively or privately, because aboriginal hunting and fishing rights were extinguished by the Alaska Native Claims Settlement Act in 1971 (43 U.S.C. §§ 1601–1629h). For areas or species subject to federal management, access *could* be determined by indigenous status (as it was in the case of marine mammals) and/or rural residency. For areas and species subject to state management, access *could not* be determined by indigenous status or rural residency.

While the state did not limit eligibility to rural residents, it did identify "non-subsistence" around major population centers where customary and traditional uses were deemed extinct. Outside those areas – in essence "rural" Alaska – all Alaska residents were eligible to hunt or fish under subsistence regulations, but only for fish stocks and game populations that were determined by the Alaska Boards of Fisheries and Game to have "customary and traditional" uses.

Figure 2-2 illustrates the subsistence decision tree used by the Alaska Boards of Fisheries and Game to determine how to regulate subsistence and other uses:

- Each board weighed evidence from historical records and from public testimony against eight customary and traditional use criteria in regulation (5 AAC 99.010) to determine whether the stock or population has been used customarily and traditionally for subsistence.
- Each board reviewed information from department staff and considered public testimony to determine whether a harvestable surplus (HS) existed in that stock or population.
- Assuming a harvestable surplus existed, each board reviewed information from department staff and considered public testimony to determine the amount of that stock necessary for subsistence uses (ANS).
- When HS > ANS, multiple uses could be allowed. When HS ≈ ANS, subsistence uses and some non-subsistence uses could be allowed. When HS < ANS, the board would direct the Department of Fish and Game to select among eligible users based on individual histories of dependence on the stock or population and on the availability of alternative resources.

For the most part, the boards made a customary and traditional determination for each fish stock

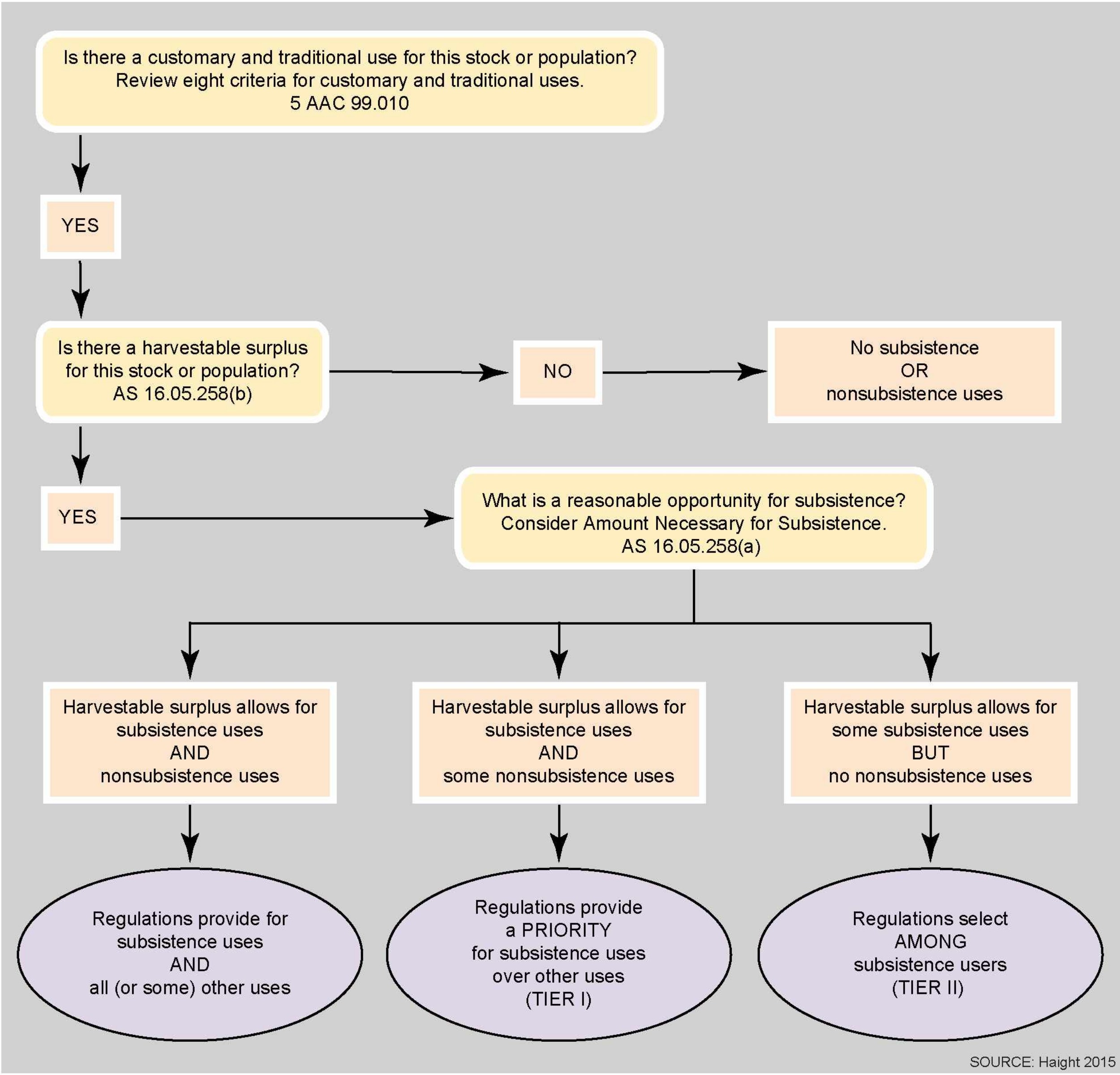

Figure 2-2 Subsistence determination process under state law.

and game population (there were hundreds) and rarely revisited them. Determinations of amounts necessary for subsistence also were revisited rarely, unless use patterns or resource abundance changed substantially. More commonly, the boards reconsidered the ability of a harvestable surplus to provide the amount necessary for subsistence for a particular stock or population, and adjusted regulations in response to fluctuations in resource abundance.

In the universe of institutional arrangements in Alaska, arrangements for subsistence management have been the most controversial, certainly since 1980 (White 1994). Virtually every important subsistence management decision in Alaska – from proposed constitutional amendments to local hunting regulations – has been contested, which helped explain how such complicated institutional arrangements could have developed in the first place.

Given that all Alaska residents were eligible subsistence users on state lands but only rural Alaska residents with customary and traditional uses were eligible users on federal public lands, it was often not possible to provide the same opportunity to hunters and fishers on adjacent lands. Seasons and bag limits on federal lands on one side of a river might be much more liberal than on state lands on the other side of a river (given the much smaller pool of potential users). Federal public lands could be closed entirely to "non-eligible federal users" as was the case in several areas where wildlife populations were depressed. Managers engaged in "mutual adjustments" when possible, as described by Morehouse and Holleman (1994):

> Federal and state managers keep an eye on and coordinate with one another, and in the process accommodate each another and their competing constituencies. They coordinate and accommodate because it is administratively expedient to do so and because they share professional wildlife management norms. But they also coordinate because in order to fulfill their respective constitutional-legal mandates on federal and state lands, they must often regulate overlapping groups of subsistence users, and they must manage common wildlife populations that migrate across jurisdictional boundaries.

Such federal-state resource conflicts were not new, nor were they unique to Alaska (cf. McEvoy 1986:164-165).

Fully describing institutional arrangements and contentions involving subsistence management was far beyond the scope of this dissertation. We have not discussed, for example, the Marine Mammal Protection Act, the Alaska Eskimo Whaling Commission, the Yukon River Salmon Agreement between the United States and Canada, or the migratory bird treaties between the United States, Canada, Japan, Mexico, and Russia. For natural resource conflicts among territorial, federal, and indigenous interests before Alaska became a state, see, for example: Gruening (1954), Mitchell (1997a), and Arnold (2009). For descriptions of subsistence management issues at various points in time since statehood, see, for example: Kelso (1976), Lonner (1979), Caulfield (1992), Huntington (1992), Morehouse and Holleman (1994), Behnke (1996), and Anderson (2019). For recent arguments against current subsistence institutional arrangements (generally to either expand or reduce eligible users, and/or to alter the balance of state, federal, and indigenous authorities), see, for example: Sacks (1995), Somerville (2013), Kimmel (2014), and Anderson (2016). There were many, many other sources.

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Chapter 3 The Persistence of Subsistence in Alaska

An Informal Economy Embedded in a Modern State Undergoing Rapid Change

James S. Magdanz, Joshua A. Greenberg, Joseph M. Little, and David S. Koster

ABSTRACT: This paper explores Alaska's rural economy using community-level demographic, economic, and harvest data aggregated from >18,000 household surveys administered during 354 projects in 179 Alaska communities from 1983 through 2013. We evaluate trends over time, identify factors associated with subsistence harvests, model subsistence productivity, and estimate road effects. We review, replicate, and extend previous statistical models of subsistence productivity, using cross-sectional, pooled-cross-sectional, and unbalanced panel models. Adding a time factor to subsistence productivity models shows time to be weakly influential on per capita harvests relative to other factors, and statistically significant only in the remote rural economic region. Time alone explains <7% of the variation in mean per person harvests and <3% of the variation in mean per person incomes. Using propensity score matching (PSM), we find that being road-connected had substantial negative effects on communities' mean subsistence harvests at the 0.1% level. Estimates of roads' effect on harvests ranged from 31% ±9% to 39% ±7%. In contrast, estimates of roads' effect on communities' mean incomes were not significant in any of four PSM methods. This suggests that building new roads risks tipping newly accessible rural communities into a new regime of lower subsistence harvests without commensurate increases in personal incomes.

KEYWORDS: Alaska, renewable resource management, conservation, subsistence, road impacts, community economy, statistical models

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3.1 Introduction

Accelerating climate change, industrial development, and globalization add to long standing concerns about the viability of traditional economies in the Arctic (Brody 1978, Deman 1982, Morehouse 1989, Chapin et al. 2004, Fauchald et al. 2017). Observers note declining traditional food harvests (Fall 2016), a "nutrition transition" away from local traditional foods towards imported market foods (Bersamin et al. 2008, Kuhnlein et al. 2004), dependence on transfer payments (Knapp and Huskey 1988, Huskey 2004), and climate change impacts (Moerlein and Carothers 2012, Savo et al. 2016, Brinkman et al. 2016, Hamilton et al. 2016, Huntington et al. 2016). In more general terms, the propositions in the literature include: (1) Market and other forces will overwhelm subsistence economies (Murphy and Steward 1956, Berger 1977, Berardi 1998, Cameron 2012, Southcott et al. 2018); (2) competing uses will diminish, displace, or reallocate resources and habitats used for subsistence (Wolfe and Walker 1987, Parlee et al. 2018); and (3) climate change will amplify existing stressors and introduce new disruptions (Grebmeier et al. 2006, Ristroph 2010; Walter Anthony et al. 2018).

Nonetheless, traditional Arctic economies embedded in modern states have been adapting to rapid change (Kruse et al. 1982, Krupnik and Jolly 2002, Robards and Alessa 2004, Tremblay et al. 2008, Martin 2015, Poppel 2017). In Alaska and Canada, individuals and households engage in both subsistence and market pursuits to maximize their well-being (Langdon and Worl 1981, Usher 1981, Wolfe and Ellanna 1983, Lonner 1986, Kruse 1991, Wheeler 1998). Wenzel (1991) reported that Clyde River Inuit "undertook a process of adaptive *bricolage* in which money was treated as a resource" to support wild food harvests, while "the social practice of sharing and reciprocity" remained intact. Traditional wild food distribution networks persisted across the Arctic (Magdanz et al. 2002, Natcher 2009, Collings 2011, Dombrowski et al. 2013, Kofinas et al. 2016, Ready 2018). BurnSilver et al. (2016) observed that "elements of mixed economies observed three decades ago – simultaneous household engagements in subsistence, markets, and traditional social relationships – have proven remarkably persistent." Indigenous commitments to traditional economies remain strong, as exemplified recently by the *Alaskan Inuit Food Security*

Framework report which argued that wild food harvests are "a lifeline and a connection between the past and today's self and cultural identity" (Inuit Circumpolar Conference - Alaska 2015). Langdon (1991) concluded that two Western Alaska Yup'ik Eskimo communities had "attained a special balance in the modern world, but their ability to sustain and reproduce that balance is open to question on many fronts."

Facing declining oil revenues, the Alaska Arctic Policy Commission (2015) expressed concern that "resource development, shipping and tourism will happen across the North, with or without Alaska. The lack of infrastructure and the speed at which global development in the Arctic is occurring should be a call to action – to build and to create." The commission's explicit assumption was that "traditional ways of living" and "robust economic development" could co-exist. Yet others have observed that benefits of remote economic developments have accrued primarily to urban centers, while costs and risks of such development are borne locally (Rogers 1982, Goldsmith 2007).

Evaluating these complex and sometimes conflicting narratives is a challenge. Reliable socio-economic data about remote Arctic regions and their informal economies are hard to come by; frameworks that integrate social and ecological observations are especially rare (Goldsmith 2007; Petrov et al. 2016). The Arctic Social Indicators (ASI) and Arctic Observing System (AOS) projects emphasize harvests of wild foods as a key indicator for ecosystem services, human-nature relations, and overall well-being (Kruse et al. 2008; Kruse 2011; Lee et al. 2015; Poppel 2017), but harvests are a costly indicator. Data collected to implement Alaska's subsistence priority laws and U.S. environmental protection laws (Braund and Kruse 2009; Fall 2016) are rich sources of observations for efforts like ASI and AOS. A singular example is the on-line Community Subsistence Information System (CSIS) established and maintained by Alaska's Division of Subsistence (Alaska Department of Fish and Game 2014).

In this article, we draw on the CSIS and other public sources to assemble and analyze a unique set of community-level demographic, economic, geographic, and subsistence harvest data aggregated from more than 18,000 household surveys administered during 354 projects in 179

Alaska communities from 1983 through 2013. Our assumption is that these data may provide some insight into factors that influence rural mixed economies, into Arctic communities' adaptations to past changes, and into their capacity to adapt to future challenges. Our goals were to: (1) explore population, harvest, and income trends for small- and medium-sized communities in rural Alaska, most of whom depend substantially on wild foods for subsistence, (2) explore factors associated with community-level subsistence harvests, (3) replicate and refine subsistence productivity models, and (4) evaluate effects of road access on harvests and incomes at the community level. An important element of our analyses was a time factor, which was absent from most Arctic subsistence productivity models and nutrition studies.

3.2 Background

In this section, we summarize Alaska's population, the role of natural resources in Alaska's economy, Alaska's system for allocating of fish and wildlife among competing uses, and prior models of subsistence harvests. Wild foods make significant contributions to northern diets, so we briefly review the "nutrition transition" phenomenon observed in rural Alaska and globally among traditional societies. The section concludes with a rationale for the current analyses.

3.2.1 Alaska's Population

Alaska is the largest of the United States (1.48 million km^2) but 48th in population (741,894 people in 2016), giving it by far the lowest population density of any state, only 0.5 persons per km^2 (U.S. Census Bureau 2017). Alaska also is "a state of immigrants; 62% of its residents were born in another state" (Williams 2004). Yet Alaska also has the longest history of human habitation of any U.S. state (Sandberg et al. 2013), and is unique among the U.S. states in having indigenous majorities in two thirds of its census areas, remote rural areas mostly inaccessible by road (Figure 3-1). Waring and Smythe (1988) estimated Alaska's indigenous population at contact (~1740) to have been about 74,000 (Figure 3-2A). By 1880, the indigenous population had been reduced to about 35,000, and did not reach pre-contact levels again until the 1980s.

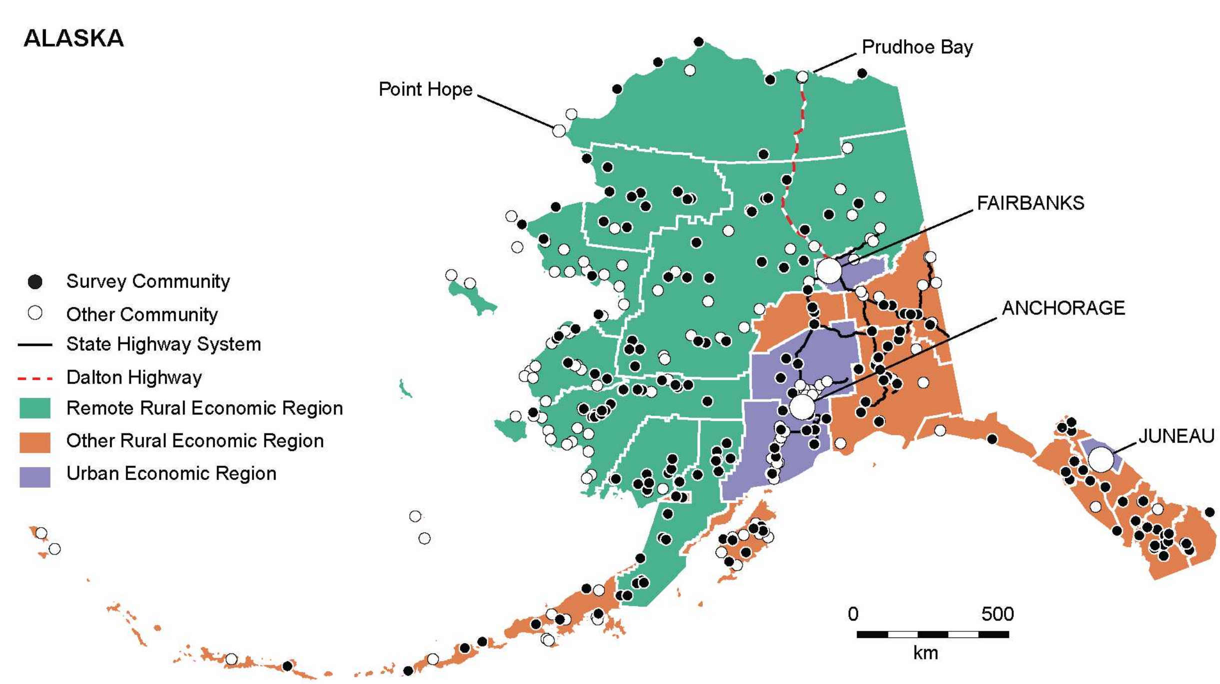

Figure 3-1 Survey communities (n=179) and other communities (n=142) in Alaska. A paved highway system connects Fairbanks, Anchorage, and some smaller southcentral and interior communities. A mostly gravel road connects Prudhoe Bay to the highway system. The remainder of the state remains essentially roadless. Goldsmith (2007) identified three economic regions in Alaska, aggregating census areas based on accessibility and economic characteristics. Although ethnicity was not a stated factor, Goldsmith's economic regions mirror the distribution of Alaska's indigenous population. Alaska Natives (19% of all Alaska residents) are in the majority in sparsely populated, mostly roadless western and northern census areas (69% of the state's total area). Eighty percent of the state's population lives in five urban census areas (with 9% of the state's area).

In 2010, 19% of Alaska's population self-reported as Alaska Native or American Indian (U.S. Census Bureau 2012). The 2010 indigenous population of 138,312 was not yet twice the estimated population at contact (Norris et al. 2012).

Fifty-nine percent of Alaska's population lived in three cities: Anchorage, Fairbanks, and Juneau (Alaska Department of Labor and Workforce Development 2015). Since 1980, populations in Alaska's metropolitan statistical areas have doubled (from 246,230 to 496,578) primarily as a result of migration from other states and from rural Alaska census areas, while populations in rural Alaska have grown much more slowly (Figure 3-2B).

Ethnically balanced community populations were uncommon; community populations

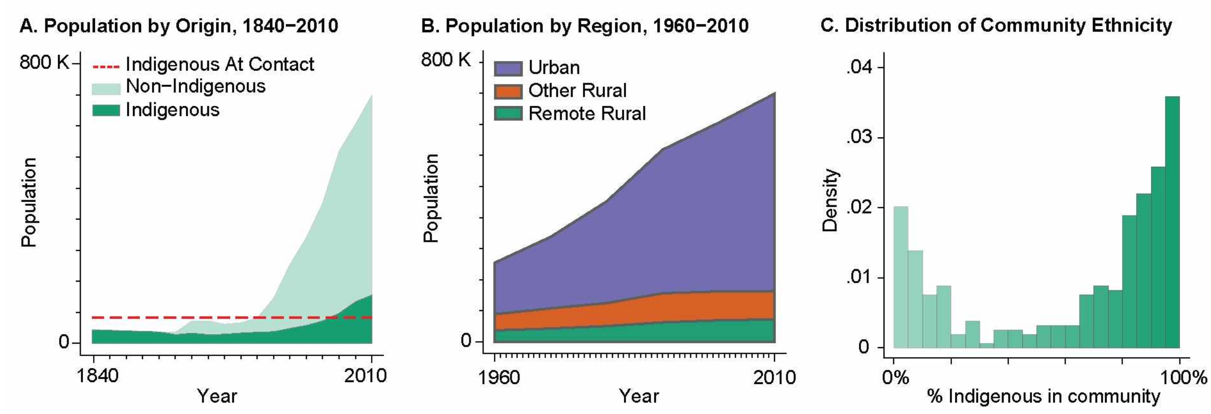

Figure 3-2 Alaska's population history.
(A) Since contact, most of Alaska's population growth resulted from immigration. Indigenous populations did not surpass pre-contact estimates until the 1980s. (B) Since statehood, Alaska's population growth occurred primarily in urban areas. See Figure 1 for regional boundaries. (C) Sampled communities are ethnically bifurcated, either predominantly indigenous or predominantly non-indigenous. Majority indigenous communities are concentrated in the remote rural region of the State.

tend to be either mostly indigenous or mostly non-indigenous (Figure 3-2C). In the remote rural economic region, indigenous majorities were the norm, especially in communities <1,000. In the urban and other rural economic regions, majority indigenous and majority non-indigenous communities occurred in similar proportions. Remote rural indigenous communities usually were situated in ancestral territories. An extreme example was Point Hope, whose residents believe, with considerable justification, that they lived in the oldest continuously occupied site in North America (Jensen 2014).

3.2.2 Alaska's Economy

Renewable natural resources – fish, wildlife, and plants – have been a basic driver of Alaska's economy since people arrived in the New World, although by 2005 commercial fishing, timber, and agriculture contributed only 12% of employment and 8% of Alaska residents' personal income (Goldsmith 2008). Substantial contributions of subsistence harvesting to

Alaska's economy were not included in conventional indicators, however, and must be inferred (Goldsmith 2008).

About a third of Alaska's employment and personal income came from non-renewable resources, but the benefits were not evenly distributed, producing "only modest direct economic benefit for most residents" of remote rural Alaska (Goldsmith 2007, 2008). The largest single source of wage income in remote rural Alaska was the federal government, in what Knapp and Huskey (1988) called "the transfer economy." In the latter half of the 20th century, economic and political developments resulted in higher standards of living throughout the state, though not to the same degree among Alaska Natives as among other Alaskans and other Americans (Martin and Hill 2009). The cost of living in some rural communities was twice that of urban Alaska (McDowell Group 2009), yet rural incomes were 35% less.

Recognizing these geographic differences in economic conditions, Goldsmith (2007) proposed three economic regions for Alaska (Figure 3-1). The "urban" region included the Anchorage, Matanuska-Susitna, Kenai Peninsula, Fairbanks, and Juneau boroughs. The "other rural" region included census areas outside urban areas but along the road system, served by a marine ferry system, or dominated by commercial fishing or military activities. About half the "other rural" communities were accessible by road. The "remote rural" region included the remaining areas in western and northern Alaska, where only 5 of 95 communities were accessible by road. In the remote-rural economic region, three out of four residents were indigenous and non-indigenous residents were concentrated in a handful of regional service centers. The density of the remote rural population in 2014 was only 0.06 persons per km^2, scarcely more than the population density estimated at contact (0.05 persons per km^2). In most communities in remote rural Alaska, subsistence was *the* economy well into the 20th century, so much so that VanStone (1960) could observe that "the basic pattern of subsistence activities at Point Hope today remains much the same as in the pre-contact period."

While subsistence harvests have declined substantially since the 1960s, Alaskans continued to put wild foods on their tables. In 2014, the Alaska Department of Fish and Game estimated that Alaskans harvested 23 million kg of wild foods annually for personal and family consumption, conservatively valued at $200-$400 million using hamburger prices (Fall 2014). Fall (2016) estimated that rural Alaskans harvest 17 million kg of wild food annually, providing 189% of the protein requirement and 26% of the caloric requirement of the rural population. Dollar values and protein content did not begin to capture the role of wild foods in northern cultures. (Wheeler and Thornton 2005, Pufall et al. 2011). Subsistence harvests in Alaska were deemed so important that an Alaska Food Policy Council study concluded that "subsistence foods are a key piece of Alaska's food system" and made "fostering subsistence hunting and related skills" its highest priority (Meter and Goldenberg 2014).

Alaska's reliance on non-renewable resources – oil, gas, gold, lead, zinc, copper, and other minerals – to generate both tax revenue and employment created the potential for conflicts with wild food harvests. While renewable and non-renewable resource extractions can and do coexist, non-renewable resource developments typically reduce areas available for harvesting and alter animal movements (Dau and Cameron 1986, Nellemann and Cameron 1998, Wilson et al. 2016), can make remote areas more accessible to urban populations, and carry at least some risk of catastrophic impacts such as the 1989 Exxon Valdez oil spill. The State of Alaska often promoted remote road development (Panitch 1975, Demer 2013, Oliver 2017), but most Alaska road proposals have been thwarted by economic, environmental, political, and legal constraints (Forgey 2013, Epstein 2016). At this time, several remote road projects were under consideration in Alaska, notably a road to the Ambler Mining District, which one analysis expected would negatively impact subsistence production (Guettabi et al. 2016).

3.2.3 Allocation of Fish and Wildlife

In Alaska, fish and wildlife were common-pool resources subject to multiple uses – subsistence, personal use, sport, and commercial – and typically were allocated through political processes, a source of uncertainty and conflict for users. The vast majority of harvests in Alaska (98% by weight) were commercially caught fish, subsistence accounted for about 1%, and the remainder were taken for sport or personal use (Fall 2016). Allocations were not inconsequential. The ex-vessel value of Alaska's commercial fisheries exceeded $1.8 billion in 2013 (National Marine Fisheries Service 2014). A University of Alaska study estimated the total economic significance of sport fishing in Alaska in 1993 to be "9,236 jobs, $209 million in payroll, and $637 million in sales" (Haley et al. 1999). Were allocations left completely to the market, species with high market value and high demand like salmon, halibut, crab, moose, caribou, and brown bear likely would be allocated primarily to commercial interests, secondarily to sport interests, and entirely away from personal and subsistence uses, an outcome the Alaska public would find unacceptable.

This public sentiment has been codified in laws and treaties, adopted sequentially and negotiated with different interests, resulting in a complicated array of management jurisdictions and authorities, especially for subsistence uses. The 1971 Alaska Native Claims Settlement Act (ANCSA) extinguished aboriginal hunting and fishing rights (Caulfield 1992, Norris 2002, Dombrowski 2007). The congressional conference committee expected "both the Secretary and the State to take any action necessary to protect the subsistence needs of the Natives" which, Kancewick and Smith (1990) and Anderson (2016) argued, did not happen. In 1980, Congress adopted the Alaska National Interest Lands Conservation Act (ANILCA), closing 157 million acres of federal public lands in Alaska to most forms of development. Congress broke with previous U.S. wilderness policies, not only in allowing continued subsistence hunting and fishing in nine new national parks and monuments, but in establishing a subsistence priority for customary and traditional uses by rural Alaskans on all federal public lands in Alaska (Catton 1997). Given the geographic distribution of Alaska's population, ANILCA's subsistence provisions were most beneficial to indigenous Alaskans.

ANILCA's subsistence priority and a similar state priority were not popular with urban Alaskan hunters. Necessarily, some potential users were excluded, usually urban residents, precipitating frequent legal challenges. Alaskans argued about subsistence allocations on the basis of Native rights (Alaska Federation of Natives 2012), states' rights (Alaska Outdoor Council 2015), water rights (Alaska v. Babbitt (Katie John I) 1995), equal access (White 1994), food security

(Thériault et al. 2005; Inuit Circumpolar Conference - Alaska 2015), and freedom of religion (Frank v. State 1979). Indigenous Alaskans plead their case to the International Whaling Commission and the United Nations (Huntington 1989). In response to citizen lawsuits, the Alaska Supreme Court upended state subsistence management (McDowell v. State 1989) and the Ninth Circuit Court affirmed federal subsistence management in waters claimed by the state (John v. United States 2013). When the U.S. Supreme Court heard oral arguments in an Alaska moose hunting case in January 2016 (Sturgeon v. Frost 2016), all three members of Alaska's congressional delegation attended.

McGee (2010), a former Alaska assistant attorney general, called subsistence "one of the most divisive and intractable political issues in Alaska." In the simplest view, indigenous Alaskans, who predominated in rural areas, saw subsistence exclusions and allocations as a battle for cultural survival, while non-indigenous Alaskans, who predominated in urban areas and outnumbered indigenous Alaskans four to one, saw them as a battle for equal rights (Morehouse and Holleman 1994, White 1994; Thornton 1998). In any event, Alaskans continued to harvest wild foods in abundance, at least when they were allowed to do so, and sometimes when they were not (Chance 1990, Huntington 1992, Burwell 2004, Medred 2013,Weymouth 2014).

3.2.4 Subsistence Productivity Models

In 1978, the Alaska legislature created a new section in the Alaska Department of Fish and Game to "conduct studies…on all aspects of the role of subsistence hunting and fishing in the lives of the residents of the state" (AS §16.05.258). By the mid-1980s, the Division of Subsistence's survey program had collected socio-economic data from several thousand households in 93 rural Alaska communities. Using those data, Wolfe and Walker (1987) constructed a statistical model of subsistence harvests, finding that harvests tended to be higher in communities away from urban centers, not connected to Alaska's road system, with higher proportions of Alaska Natives, and with lower personal incomes. In 2003, Wolfe and Fischer found that a weighted 30-mile-radius population density alone was strongly associated with wild food harvests. In 2011, Wolfe et al. constructed an extensive series of statistical models to predict Western Alaska salmon harvests through 2050 for the Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AYK-SSI), incorporating salmon run strength, subsistence salmon demand, and commercial salmon production. “Under many plausible scenarios,” they concluded, “subsistence demand for salmon remains the same or increases.” But they noted that demand was particularly sensitive to human populations, and the high degree of uncertainty of future Western Alaska salmon runs would result in a high degree of uncertainty in harvest projections. Even as the AYK-SSI group was developing its models, weaker salmon runs and associated regulatory restrictions in the Yukon drainage were contributing to declining salmon harvests (Wolfe and Scott 2010). Modeling exercises highlight influential factors in subsistence economies, but also illustrate how resource abundance contributed to unpredictability, at least in the short term.

More recently, Fauchald et al. (2017) presented “a dynamic conceptual model for possible transitions of subsistence-oriented [social-ecological systems] and the major exogenous drivers that might invoke such transitions.” They concluded that traditional Arctic economies continued to fit a provisioning action situation and, despite considerable change, found no evidence for a “broad-scale transition” to an appropriation situation. In other words, subsistence harvesters faced a collective challenge to maintain use, rather than avoid over-use, of subsistence resources.

3.2.5 The Nutrition Transition

Nutrition research provided another perspective on country food harvests. Among traditional societies in the Arctic and globally, health researchers have observed a “nutrition transition” from local traditional foods to processed market foods (Popkin 2004, Popkin and Gordon-Larsen 2004, Kuhnlein et al. 2004, Bersamin et al. 2006, 2008, Egeland et al. 2011, Rosol et al. 2016). Arctic nutrition research also has explored the negative health impacts of consuming market foods or potentially contaminated Native foods (Kuhnlein 1995, Egeland et al. 1998). In some studies, lower consumption levels of traditional foods has been associated with higher rates of food insecurity among Canadian Inuit (Rosol et al. 2011, Huet et al. 2012, Rosol et al. 2016).

Temporal dimensions of the nutrition transition usually have not been quantified in the Arctic nutrition literature, with two notable exceptions. Comparing data collected a decade apart in 18 Canadian Inuit communities, Sheikh et al. 2011 found a significant decrease in the consumption of traditional foods, an increase in the consumption of market foods, and an increase in body mass indices. O'Brien et al. (2016) found that marine food intake among young Alaskan Yup'ik women dropped from the 1960s through the 1990s but has remained constant since the 1990s.

3.2.6 Rationale

In a survey of North American inland fisheries, Cooke and Murchie (2015) noted that "some of the most well-documented aboriginal harvests are in Alaska." Yet longitudinal studies of subsistence harvests were rare, not only in Alaska but globally. For Alaska, only two sets of subsistence productivity models – Wolfe's for Western Alaska salmon and Fauchald's for Alaska and Greenland populations and subsistence harvest – included a time factor (Wolfe et al. 2011, Fauchald et al. 2017). Perhaps because most of Wolfe's work was not in the peer-reviewed literature, Fauchald and colleagues apparently were unaware of Wolfe and colleague's modeling efforts. Wolfe and Walker's (1987) model remained the only multi-factor statistical model of Arctic subsistence productivity in the peer-reviewed literature. As the 2011 AYK-SSI effort demonstrated, projections of future subsistence harvests are inherently uncertain. Nonetheless, understanding the relative influence of various factors – including time – can contribute to resource management and policy decisions. It is important that some of Wolfe's agency work reach a wider audience, and important that his early work be updated and extended with more recent data. Finally, these analyses respond to Southcott et al.'s 2018 call for understanding "how the social and environmental legacies of past resource developments continue to affect northern communities."

TABLE 3-1 ALASKA COMMUNITIES AND THE SURVEY SAMPLE

	Surveyed		Not Surveyed		All[a]	
Community Size	N (row %)		N (row %)		N (col %)	
>10,000 pop.	0	(0%)	6	(100%)	6	(2%)
50 to 10,000[b]	**179**	**(58%)**	**128**	**(42%)**	**307**	**(80%)**
< 50 pop.	37	(53%)	33	(47%)	70	(18%)
All	216	(56%)	167	(44%)	383	(100%)

[a] The total is the number of census designated places (CDPs) identified by the Census Bureau as having populations in 2014, not including "balance of census area" CDPs. The number of populated CDPs varies over time.

[b] "Eligible" communities. A community was considered eligible if it had more than 50 people in any one survey. The sample contains a few observations where a community had less than 50 people in one survey, but 50 or more in another survey. Although communities that never included 50 people are occasionally surveyed, such small places tend to be remote extended family camps or homesteads strung along rural roads with no clear community identity and do not function economically like larger communities (Wolfe and Fischer, 2003). There are no comparable subsistence harvest data for cities.

3.3 Data and Methods

Data were collected by the Alaska Department of Fish and Game, Division of Subsistence, during 18,029 household surveys in 354 community-based survey projects from 1983 to 2013 (Fall 1990; Wheeler and Thornton 2005; Fall 2016; Alaska Department of Fish and Game 2014). For these analyses, the sample was limited to comprehensive surveys in communities with populations between 50 and 10,000 people during at least one survey from 1983 to 2013 (Table 3-1). Each observation consisted of summary data for one community in one year. During the study period 179 communities were surveyed, 98 more than once, creating both a cross-sectional dataset and an unbalanced community panel.

Annual samples of communities were small and purposive, based on geographic, regulatory, development, disaster, or funding considerations. From 2000 to 2009, because of funding considerations, annual samples were sometimes as small as a single community and communities on Alaska's road system were under-represented. Thus, for any given year, sampled communities were rarely representative of the population of small Alaska communities. Over three decades, however, the sample of communities became increasingly complete and representative. Com-

Figure 3-3 The remote northwest Alaska community of Kivalina.
Kivalina is at risk from erosion and rising sea levels. During the study period, the Division of Subsistence conducted three comprehensive subsistence survey projects in Kivalina: 1983, 1992, and 2007. In smaller communities like Kivalina (2010 population, 374), research designs usually called for a census rather than a probability sample.

munities near the median size (189 people) were over-represented; otherwise distributions of community sizes in the sample and in the eligible population were similar (Figure 3-4). Sampled communities were located throughout the state, both on and off the road system, including some small communities in the urban periphery (Figure 3-1).

In smaller communities (<500 people), the typical sampling frame included all eligible households. In larger communities, simple random and stratified random sampling designs were used. The only household eligibility requirement was a minimum residency in the study community (typically 3 months).

The dependent variables were the estimated mean subsistence harvest per person in estimated edible kg or estimated mean personal income adjusted to 2012 U.S. dollars based on the

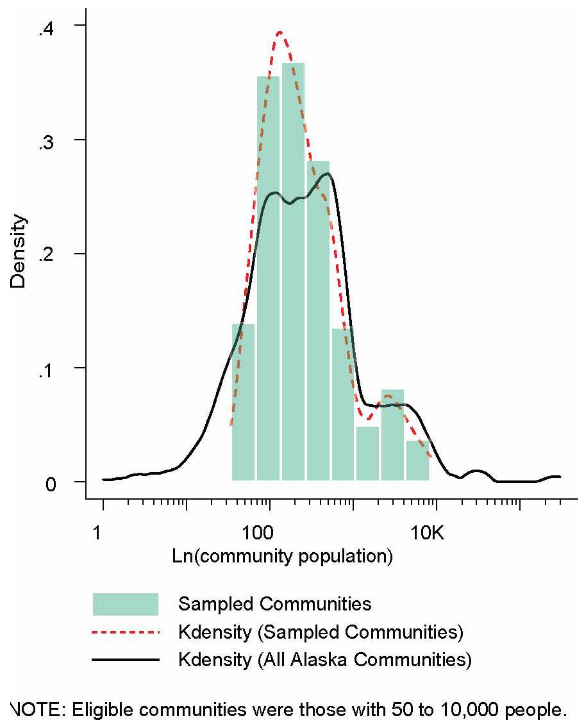

Figure 3-4 Distribution of community sizes in sample and population.

consumer price index for Anchorage. Harvests included all fish, wildlife, and wild plants harvested by a member of the respondent household for personal or family consumption, including members' shares of cooperative harvests with other households. Earned incomes were collected for each individual job held by each person in each household, and unearned incomes (such as public assistance) were collected for each household. Cost of living estimates were not available for most study communities, so incomes were not adjusted for local costs of living. Harvests and incomes were not normally distributed and were transformed to log normal functional forms for regression.

A "road" dummy variable indicated road access to Alaska's highway system. Some communities along Alaska's southern coast were served by a state ferry system; a "ferry" dummy variable indicated passenger ferry access. Following Goldsmith (2007), three dummy variables indicated a community's location in one of the economic regions: urban, other rural, and remote rural (Figure 3-1). While economic regions correlated with some factors in our models, they also capture unobserved factors (explaining an additional 10% of the variation in harvests).

Robust OLS regression was used to test for associations among variables. Observations were bounded estimates rather than measured values, except in 13 projects where all households were sampled. The 95% confidence intervals of harvests were used as analytic weights, giving more weight to more reliable estimates. Cases also were categorized into ten-year periods using pooled-cross-sectional methods with the fixed effect on the year. Ninety-eight communities were surveyed more than once; in those cases, unbalanced panel models were also used for estimation with the fixed effect on the community.

There were no natural experiments (surveys before and after communities were connected to the road system) to further evaluate the influence of road access. However, plausible explanatory mechanisms existed, similar differences existed at all levels of harvests and incomes, and correlations were large and significant. In the absence of experimental data, propensity score matching (PSM) provides a method to estimate a treatment effect (Rosenbaum and Rubin 1983; Becker and Ichino 2002). PSM requires a vector of observed conditions known to be influential, which productivity models provided. For harvests, the observed conditions included economic region, community population, percent indigenous, and mean real income. For income, the income condition was replaced by a harvest condition.

3.4 Results

3.4.1 Trends

We began by exploring trends in community populations, community ethnicity, subsistence harvests, and personal incomes. For all communities in the sample, regressing log normal estimated community populations on year found no significant association (t=-.47, p=.637) (Figure 3-5A). Regressing log normal population on year for pooled 10-year periods and for community panels also found no significant associations. Regressing ethnicity (percent indigenous) on year found no significant associations (t =1.29, p=.198).

Over 31 years, the 179 surveyed communities harvested an annual average of 66,047 kg per study community (median=58,710 kg, range 2,656 to 1 million kg). Per capita harvests in the remote rural region were well above the statewide mean at the beginning of the study period, but over time were expected to decline by about 1.4% a year; this association was significant at the 1% level (t.=-2.76, p=.007, *adj.* r^2=.068). Otherwise, robust regressions of estimated total community harvests and mean harvests per person found no significant associations between log harvests and year. Longitudinal models explained less than 2% of the variation in subsistence harvests (maximum *adj.* r^2=.014).

Income estimates were available for 279 of the 354 projects. Mean community income per household was $58,823 (median=$54,988, range $9,336 to $170,213). Regressing income over year found no significant association between total community income and year (t=-1.52, p=.130). Two models found significant associations for mean income per person over year. Mean income per person was expected to decline 1.2% annually in a cross-sectional model (Figure 3-5C). A pooled cross-sectional model suggested that these declines occurred later in the study period; real incomes in the decade from 2000 through 2009 were expected to be 19% lower than in the 1980s, the base decade (t=-1.90, p=.059), and to be 21% lower in the most recent decade (t=-2.88, p=.004). Individual communities experienced many different income trajectories, perhaps to be expected in a state where the three major sources of income –petroleum, mining, and fisheries – historically have been boom and bust. Longitudinal models explained less than 3% of the variation in incomes (maximum *adj.* r^2=.029).

3.4.2 Community and Regional Factors

Variations in harvests and incomes suggested influential factors other than time. Here, we explore community and regional factors.

Total community harvests and incomes scaled with community populations, as expected.

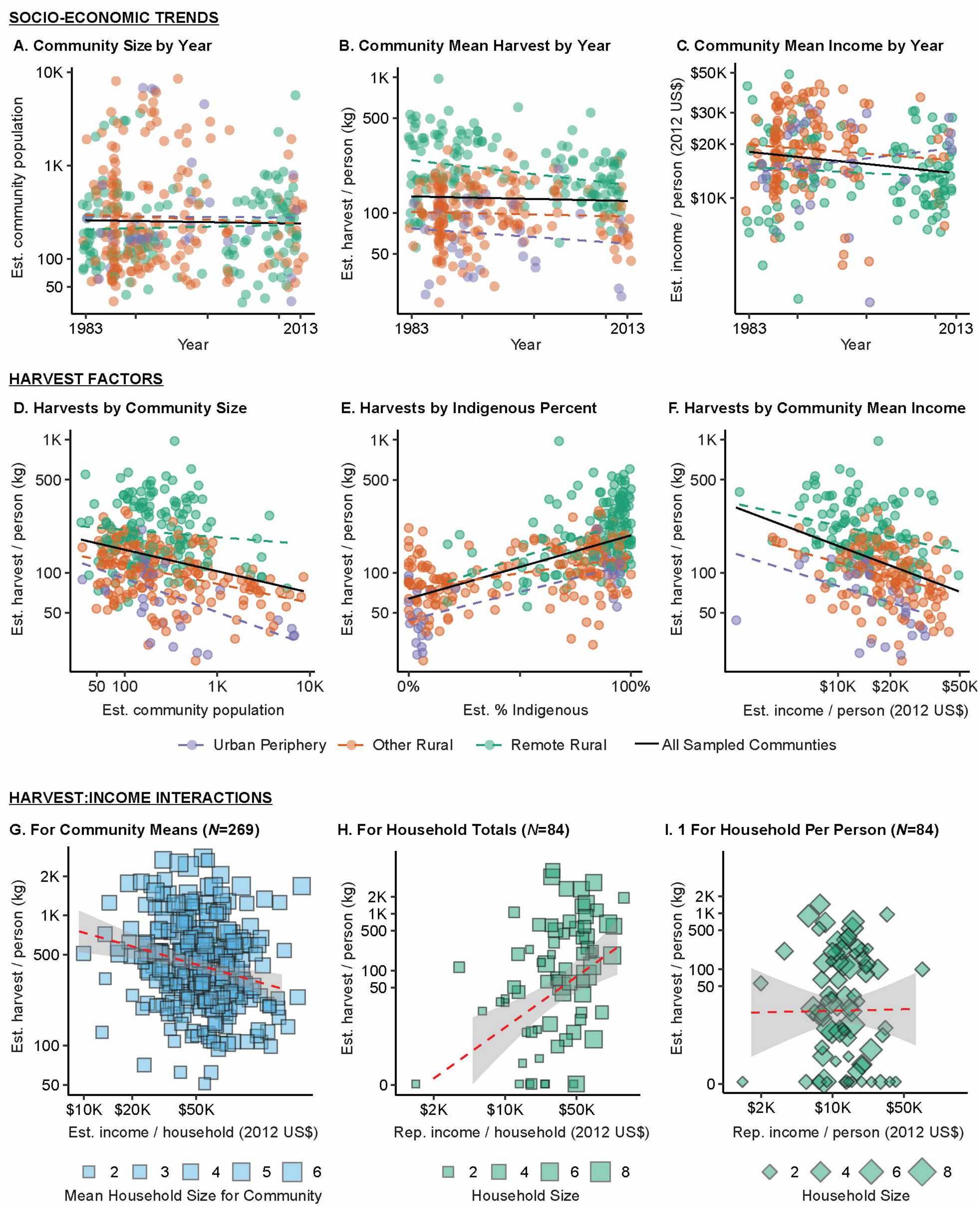

Figure 3-5 Trends, factors, and interactions among income, harvests, and populations. For all observations, (A-B) trends were not significant or (C) weakly negative. Harvest associations with (D) population, (E) indigenous proportion, and (F) incomes varied. Harvest income interactions were sensitve to scale: (G) community, (H) households, and (I) person.

Total community harvests increased by 0.8% for each 1% increase in community population, and community size alone explained 72% of the variation in total harvests. Expected total personal income also increased, at a slightly higher rate, 1.1% for each 1% increase in community population. On average, people in smaller communities (<1,000 people) harvested twice as much subsistence food per person (169 kg) as people in larger communities (79 kg). On the other hand, people in larger communities had 63% more personal income ($27,674 per person) than people in smaller communities ($16,991). While community size had a positive influence on both total harvests and income, community size had a negative influence on mean per capita harvests and a positive influence on mean per capita incomes. As community size increased, per capita harvests were expected to decline by about 0.1% per year for each 1% increase in community size (Figure 3-5D), while per capita incomes were expected to increase by about 0.2%. Both associations were significant at the 1% level.

Ethnicity was negatively associated with community size. The indigenous proportion of a community was expected to decrease by 1% for each 9% increase in population ($t.$=-5.86, p<.001). Other than community size, ethnicity was the most influential demographic variable, explaining almost 35% of the variation in mean harvest per person ($adj.\ r^2$=.347). Mean subsistence harvests per person were expected to increase by 1% with each 1% increase in the proportion of indigenous people in the population ($t.$=12.73, p<.001) (Figure 3-5E). Finally, community incomes and harvests on a mean-per-capita-basis were negatively associated. For 269 projects with valid income observations, community mean harvests per person decreased by 4.3% for each 10% increase in community mean income per person (t=-3.95, p<.001) (Figure 3-5F).

However, interactions between harvests and incomes were sensitive to the level of aggregation, as illustrated in Figure 3-5G to Figure 3-5I, which show associations between household mean harvests and incomes for all study communities (Figure 3-5G, negative), between households' reported harvests and incomes in a single community (Figure 3-5H, positive), and between household per capita harvests and incomes in the same community (Figure 3-5I, no association). Across all communities, household mean harvests decreased by 2.5% for each 10% increase in community mean income per household. In a single study community, household total harvests increased by 14% for each 10% increase in household income (t=3.94, p<.001). And in the same community, the harvest-income association disappeared entirely when harvests and income were controlled for household size (t=.05, p<.963). In Figure 5H and Figure 5I, note that about a quarter of the households, across the full range of incomes, reported no subsistence harvests. This was typical, as certain households – elders, teachers, disabled, or otherwise dysfunctional households – did not harvest their own subsistence foods but relied on distributions from other households.

3.4.3 Access and Regional Factors

Access was a defining feature of life in rural Alaska, and was an important factor distinguishing the remote rural, other rural, and urban economic regions. Roads and ferries facilitated the movement of people, goods, and services, typically reducing the cost of living. Roads and ferries also facilitated access to rural hunting, fishing, and gathering areas, increasing potential competition. Of the 179 sampled communities in this study, 105 (60%) in this study were accessible only by air; the remainder were accessible from urban hubs by road or marine ferry.

Figure 6 explores differences in mean harvests and incomes per person between communities connected to Alaska's highway system ("on-road") and other communities ("off-road"). Harvests and real incomes were similarly distributed in off-road and on-road groups, but harvests were higher and incomes were lower in the off-road group (Figure 3-6A, Figure 3-6C).

Regardless of road status, harvests increased from the urban to the other rural to the remote rural region, and regardless of economic region, harvests decreased from off-road to on-road communities (Figure 3-6B). The difference was especially large between the urban periphery and other rural regions on one hand, where median harvests were 109 kg and 117 kg per person, respectively, and the remote rural region on the other hand, where the median harvest was 187 kg per person.

For income, the interaction of road and region was less straightforward (Figure 3-6D). In

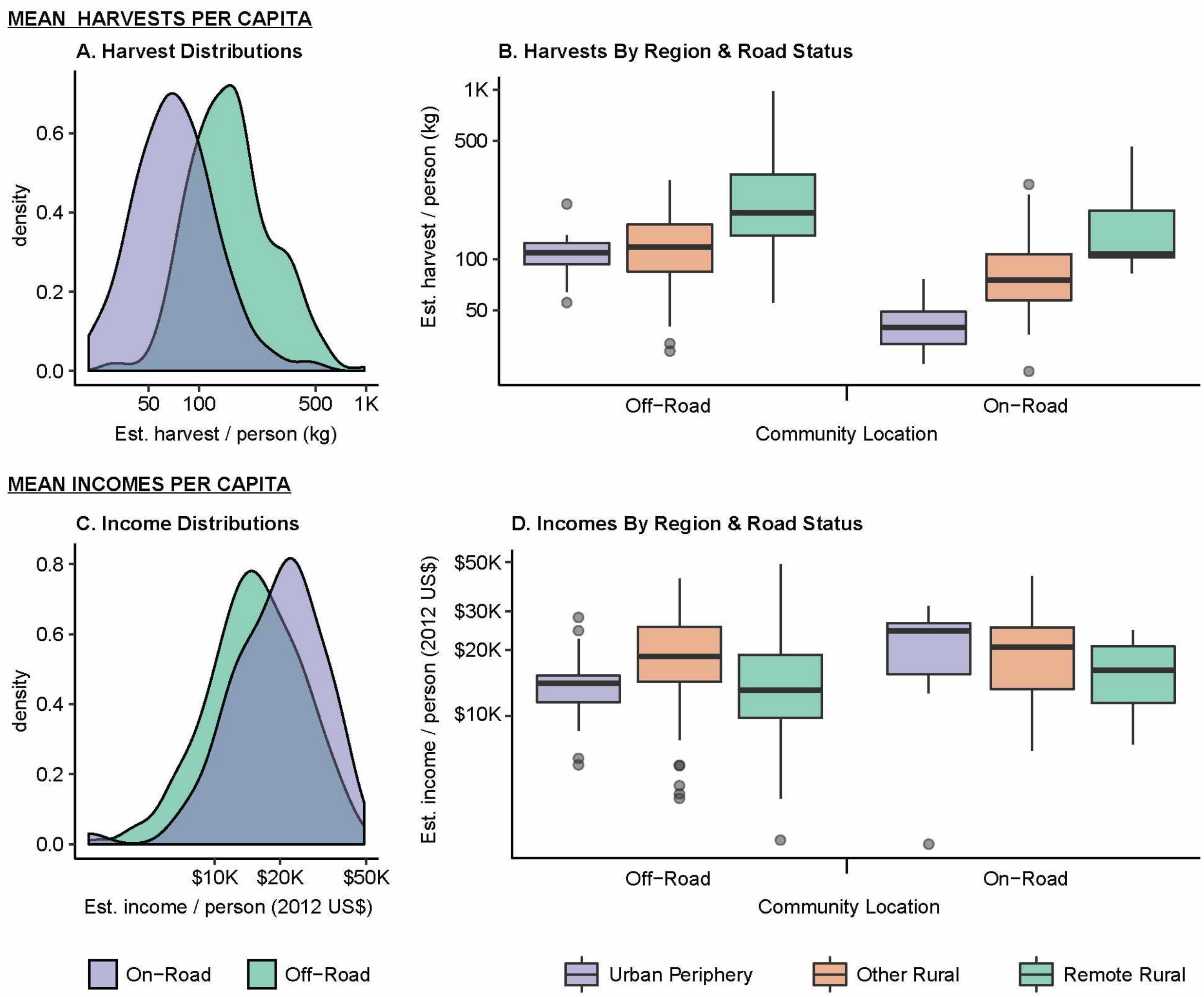

Figure 3-6 Distributions of harvests and incomes by region and road status.
(A) Mean harvests per person were similarly distributed in off-road and on-road communities, but substantially higher off-road. (B) Estimated harvests increased stepwise from urban to other rural to remote rural regions in both two road categories, and decreased from off-road to on-road within each region category. (C) Mean incomes per person also were similarly distributed, but lower off-road. (D) Region and road were not as strongly associated with incomes as with harvest, especially off-road. In on-road communities, incomes decreased from urban, to other rural, to remote rural communities.

communities off the road system, the highest median incomes ($18,613) were found in the other rural region, not the urban region. Median incomes in off-road communities were similar for the urban region and remote rural region ($14,092 to $13,149), but the high cost of living in remote rural communities (as much as 250% of Anchorage's cost of living) eroded their purchasing power. In communities on the road system, median incomes declined from the urban region to the other rural region to the remote rural region (\$24,391 to \$20,557 to \$16,467), the inverse of harvests but not as pronounced.

To further explore the influence of road access, we selected a subsample of small, communities (<1,000 people) in the "other rural" economic region, controlling for three influential factors: regional location, community size, and ethnicity (Table 3-2). The other rural economic region, with 139 observations in 35 on-road and 28 off-road communities, was well suited to the exercise. Of the 63 communities with fewer than 1,000 residents and known ethnicities, 28 had indigenous majorities, and 35 had non-indigenous majorities. Indigenous majority communities were much more likely to be off-road (20 of 28 communities. Mean harvests per person in indigenous communities were 23% lower on-road than off-road, and mean incomes were 7% lower on-road than off-road. Non-indigenous majority communities were more likely to be on-road (23 of 35 communities). Mean harvests per person in non-indigenous communities were 20% lower on-road than off-road, and mean incomes were 26% higher on-road than off-road. Thus, for people living in majority non-indigenous on-road communities, lower harvests were at least partly compensated for by higher incomes, on average.

Off the road system, mean harvests in small indigenous majority communities were slightly larger than in small non-indigenous communities (139 kg compared with 127 kg, +8%), while incomes were slightly lower (\$17,964 compared with \$18,238, or -2%). Harvests per person were negatively associated with incomes per person for both indigenous communities (t=-2.61, p=0.012) and non-indigenous communities (t=-3.29, p=0.005). On the road system, differences in harvests and incomes were substantially larger. Small indigenous majority communities on the road system still had a substantial advantage in subsistence harvests (107 kg compared with 76 kg, +29%), but an even more substantial disadvantage in market pursuits (average \$16,631 compared with \$22,974, -38%). On the road, associations between harvest and income were not significant for either community group (t=1.60, p=0.132; t=-1.13, p=0.271). Being in a small

TABLE 3-2 POPULATION, HARVESTS, AND INCOMES BY ETHNICITY AND ROAD STATUS

	mean	sd	median	obs.
Majority indigenous (*n* =28)				
Estimated community population				
Off Road	227	211	130	65
On Road	208	133	191	21
Mean harvest per person (kg)				
Off Road	139	49	136	65
On Road	107	49	100	21
Mean income per person				
Off Road	$17,964	$7,992	$16,764	65
On Road	$16,631	$9,355	$12,923	21
Majority non-indigenous (*n* =35)				
Estimated community population				
Off Road	171	158	102	20
On Road	312	239	210	33
Mean harvest per person (kg)				
Off Road	127	42	116	20
On Road	76	31	68	33
Mean income per person				
Off Road	$18,238	$5,902	$17,870	20
On Road	$22,974	$8,102	$22,378	33

NOTE: Limited to 63 small communities (<1,000 people) in "other rural" region. The other rural region is the only economic region with a sufficient number of communities in both road categories. The urban economic region has only 5 off-road communities; the remote rural region has only 3 on-road communities.

community on the road system seemed to magnify harvest and income inequalities between indigenous and non-indigenous Alaskans.

3.4.4 Harvest Models

We replicated several Wolfe models with the addition of new rural cases from survey research and the exclusion of urban cases from other sources. While none of the coefficients' signs changed and most of Wolfe's original factors remained significant, the explanatory power of the 1987 model fell from 78% to 42% (*adj.* r^2=.420), and the explanatory power of the 2011 model fell from 81% to 42% (*adj.* r^2=.424). We then evaluated alternative models, adding the economic regions identified by Goldsmith to the cross-sectional model, adding a pooled cross-sectional model, and adding an unbalanced community panel model.

Table 3-3 summarizes three models of subsistence productivity: (A) a simple cross section, (B) a pooled cross section, and (C) a community panel. The three models include the same

TABLE 3-3 SUBSISTENCE PRODUCTIVITY MODELS

	Ln(mean harvest per person, edilble kg)		
	(A) Cross Section	(B) Pooled Cross Section	(C) Unbalanced Community Panel
Year	-.015 ***		-.006 *
	(4.50)		(2.26)
1983-1989 (base)			
=1 if 1990-1999		.095	
		(1.33)	
=1 if 2000-2009		-.320 ***	
		(3.52)	
=1 if 2010-2013		-.367 ***	
		(4.19)	
Urban region (base)			
=1 if other rural	.520 ***	.524 ***	.575 ***
	(5.18)	(5.25)	(4.53)
=1 if remote rural	1.085 ***	1.167 ***	.857 ***
	(10.11)	(10.54)	(7.49)
Air access only (base)			
=1 if road access	-.445 ***	-.371 ***	-.626 ***
	(4.59)	(3.87)	(7.15)
=1 if ferry access	-.189	-.140	-.305 **
	(1.66)	(1.23)	(3.20)
=1 if road & ferry	-1.119 ***	-1.076 ***	-1.053 ***
	(7.13)	(7.25)	(11.96)
Ln(income per person)	-.218 ***	-.248 ***	-.216 ***
	(3.82)	(4.84)	(3.46)
Ln(percent indigenous)	.011	.011	.022
	(1.12)	(1.04)	(1.90)
constant	7.376 ***	7.462 ***	7.305 ***
	(13.07)	(14.88)	(11.73)
N of observations	260	260	196
r^2	.626	.646	.600
r^2 within			.040
r^2 between			.650
adj. r^2	.614	.632	
AIC	288.3	277.8	
BIC	320.3	317.0	

Robust OLS. Analytic weight=95% CI of harvest. Absolute value of t statistics in parentheses.
* Significant at 5%, ** Significant at 1%, *** Significant at 0.1%

TABLE 3-4 ESTIMATED EFFECTS OF ROAD ACCESS ON HARVESTS AND INCOME

	n treat.	*n* control	ATT[1]	Standard Error	*t*
Ln(mean harvest per person)					
Nearest neighbor	68	125	-.376 ***	±.083	4.521
Radius matching	68	125	-.493 ***	±.068	7.283
Kernel matching	68	125	-.417 ***	±.065	6.442
Stratification matching	67	126	-.388 ***	±.064	6.093
Ln(mean income per person)					
Nearest neighbor	68	30	-.050	±.114	.438
Radius matching	60	111	.047	±.090	.527
Kernel matching	68	111	-.057	±.086	.663
Stratification matching	53	126	-.133	±.085	1.567

[1] Average Effect of Treatment (ATT) was calculated by propensity score matching, where "the propensity score is the conditional probability of assignment to a particular treatment given a vector of observed conditions" (Rosenbaum and Rubin 1983). See text. Bootstrapped standard errors.

* Significant at 5%, ** Significant at 1%, *** Significant at 0.1%

independent factors (except decades replace years in the pooled cross section), and each model explained at least 60% of the variation in mean harvests per person. Across the three models, the signs of the coefficients were the same and the magnitudes were similar.

Economic region was very influential, significant at the 0.1% level in every model for every region. Expected harvests in communities in the other rural region were 68% (Model A) to 78% (Model C) higher than communities in the urban region. In the remote rural region, expected harvests were 136% (Model C) to 221% (Model B) higher than in the urban region.

All three models showed significant negative associations with time. Mean harvests per person were expected to decline by 1.5% for each additional year in the cross-sectional model, and 0.6% per year in the community panel model. Mean harvests in the third and fourth decades of the study period were expected to decline by 27% and 31% over the base decade (1983-1989). Road access was strongly associated with lower harvests in all three models; harvests in communities accessible by road were expected to be 31% lower (Model B) to 47% lower (Model C) than in communities not accessible by road. Ferry access was significant only in the community panel (Model C), where it was associated with a 27% decline in expected harvests. Communities accessible by both road and ferry – of which there were only four in the sample – had expected harvests 67% percent less than other communities.

Mean harvests per person were significantly associated with mean incomes, though the influence is not strong. For each 1% increase in income, mean harvests were expected to decrease 0.2% in all three models. Ethnicity, which was a very influential factor of Wolfe and Walker's 1987 model, was not significant in the alternative models, most likely because ethnicity influences were being captured by economic region and access dummies. If regional and access factors was removed from the alternate cross-sectional model, ethnicity became both influential and significant (t=3.73, p<.001).

3.4.5 Road Effects

In the absence of experimental data to evaluate roads' influence, propensity score matching (PSM) provides a method to estimate a treatment effect. PSM requires a vector of observed conditions known to be influential, which productivity models provided. For harvests, the observed conditions included economic region, community population, percent indigenous, and mean real income. For income, the income condition was replaced with a harvest condition. Table 3-4 summarizes the results.

All four PSM methods found that roads had significant and substantial negative effects on subsistence harvests at the 0.1% level. Estimates of roads' effect ranged from a reduction of 31% ±9% (nearest neighbor) to 39% ±7% (radius matching). In contrast, estimates of roads' effect on income were not significant in any of the four matching methods.

3.5 Discussion

Statistical models Alaska have identified factors influential on subsistence harvest levels, including geographic location, community size, personal income, ethnicity, resource abundance, and road access. Some factors are slow to change (*e.g.* community size, ethnicity) or do not change at all (geographic location). Adding a time factor showed time to be weakly influential on per capita harvests relative to other factors, and significant only in the remote rural economic region during the study period. The analyses suggest a diverse and persistent social-ecological system, where the most immediate challenge may not be declines in subsistence harvests but declines in real personal incomes, exacerbated by increases in the cost of living. One might expect that shocks –the doubling of fuel prices in the early 2000's – would result in increased migration from rural to urban Alaska. While net negative migration continued in rural Alaska, Martin et al. (2008) found no "systematic, empirical evidence that fuel prices, by themselves, have been a definitive cause of migration." This all suggests that rural Alaska populations remain committed to subsistence production and the productive capacity of Alaska's subsistence economy remain intact.

In 2017, Fauchald et al. drew on common-pool resource theory to propose a conceptual model of subsistence productivity and to investigate "if and how exogenous drivers could trigger broad scale transitions in subsistence-oriented SESs in the Western Arctic." Some of their findings were consistent with previous statistical models. However, they did not statistically model most of the factors in their conceptual model, likely because it would have been difficult and costly to assemble the necessary data. While governance was not a factor in their models nor the focus of their paper, governance ultimately determined which of the multiple pathways for SES transitions would be taken. Fauchald et al. illustrated this point with their comparisons of resource commercialization across nations.

When demand is high and subtractablity exists, any allocation inevitably involves some form of exclusion (Schlager and Ostrom 1992). Fauchald et al. observed that it can be "difficult and costly to control resource-access of potential users." Exclusions often were viewed as a governance function, but exclusions can be natural features, as in the Arctic where substantial natural barriers limited access to subsistence resources. Building a new road in the Arctic is a difficult and costly undertaking; no major new roads were built in Alaska during our study period. In the case of commercial fishing, Arctic Alaska lacked infrastructure for estimating fish populations and managing commercial fishing – another difficult and costly enterprise – necessary to sustain commercial fishing. Restrictions on commercialization were, at least in part, prudent responses to the costs of sustainable resource management. The result in Alaska, as Fauchald et al noted, was "relatively few local regulations of subsistence hunting." In other words, some exclusions were natural features without overt costs, but with considerable value for subsistence production.

The models help focus our attention on influential factors potentially subject to rapid change. We consider three such factors here, all of which have governance dimensions: subsistence priority laws, resource abundance, and road access. Subsistence priority laws were designed to be both exclusionary and influential, and their influence can be inferred from models of harvests and incomes. Resource abundance was influential when stocks or populations were fully utilized, and has been modeled (Wolfe et al 2011). Road access has been modeled and found to be highly influential. Often, these factors interacted, as when road access increases resource exploitation.

The lack of a significant change in subsistence harvests in the other rural region from 1983 to 2013, despite the doubling of Alaska's urban population, suggested subsistence priority laws were having an effect. The explanation likely resides in exclusionary effects of both subsistence priority laws and roads. Ostrom's (2010) first principle of sustainable common-pool management was enforceable boundaries. The ANICLA provision limiting subsistence opportunities to local rural residents of areas with customary and traditional uses created an enforceable *de jur* boundary, but not a closed class of users (users could move into and out of rural communities). The end of the road system functioned as a *de facto* boundary between urban Alaska and rural communities. These boundaries mimicked some functions of pre-contact indigenous land tenure systems described by Burch (1972, 1998, 2005, 2006) and Ray (1967) for northwest Alaska, which limited access to traditional territories occupied by allied families and societies. Nonetheless, subsistence priority provisions in Alaska were subject to rapid change, as illustrated by legal actions such as McDowell v. State (1989) and John v. United States (2013).

Responding to changes in resource abundance was a fundamental function of fish and wildlife management. In Alaska, the state constitution mandates that renewable resources be managed for maximum sustained yield. Federal agencies operated under similar principles. When declines in resource abundance made restrictions necessary to comply with conservation mandates but harvestable surpluses still existed, subsistence laws provided priorities for subsistence uses over other consumptive uses. Such restrictions were intended to be temporary, the availability of alternative resources was to be considered, and a primary management goal was to restore depressed fish stocks or wildlife populations to previous levels of productivity.

Such provisions were not inherent in road building. The decision to build a road typically was subject to a lengthy public process. Once built, however, a new road was not a temporary condition to be amended or managed (like flawed law or a depressed salmon stock), but a permanent new system state (like a dam). Road proponents sometimes argued that access would be limited, but the history of Alaska's Dalton Highway showed that road access limits could be difficult to maintain. Open access also is consistent with the Alaska Constitution, which encourages "the settlement of its land and the development of its resources by making them available for maximum use consistent with the public interest."

In 2015, the Alaska Arctic Policy Commission argued that a "lack of transportation infrastructure" challenged community viability in Alaska. Subsequently, Alaska's governor announced that extending the state road system to Utqiaġvik (Barrow) at the northern tip of Alaska would be one of the state's top seven infrastructure priorities (Oliver 2017). In addition, the Alaska Industrial Development and Export Authority (AIDEA) proposed a new 211-mile-long gravel road be constructed to provide access to the Ambler Mining District, promising to limit access to industrial traffic (Bureau of Land Management Bureau of Land Management 2017). Similar road building efforts are underway in the Canadian Arctic (Parlee et al. 2018), while the "Soviet North is a perfect example of the transformations of the built environment due to an accelerated modernisation agenda" (Schweitzer et al. 2017) . Building new roads to previously remote communities typically is a sudden and irreversible event. Our analyses suggested that, in Alaska at least, building such roads risks tipping rural communities into a new regime of lower subsistence harvests without commensurate increases in personal incomes. The analyses provide empirical support for Berger's (1977) assertion that "it is an illusion to believe that the (Mackenzie Valley) pipeline will solve the economic problems of the north."

We agree that a nutrition transition has occurred, as well as a subsistence harvest transition (with a structural break when snowmobiles replaced dog teams). However, the "nutrition transition" framing implies a baseline of traditional life, and diverts attention from what has persisted to what has not. It implies that indigenous food adaptations have been flawed no matter how rational individual choices might have been, a framing embraced by Alaskans opposed to subsistence priorities. Condon et al. (1995) chose to conceptualize subsistence in a more pragmatic fashion: "essentially a way to make a living in the Arctic given limited cash resource and employment opportunities." Social, economic, and political changes required young adults, they argued, to "rely upon new strategies for supporting themselves and their families." Yet these same young adults still viewed "land-based harvesting as central to a sense of Inuit identity." Subsistence could not have persisted for three decades in Alaska without recruiting young harvesters.

Finally, potential impacts of climate change on subsistence economies have received much attention in the literature. While we did not model the influence of climate change, that door is open. Declines in resource abundance and changes in resource migrations, as others have noted, could pose substantial direct risks. Indirect risks come as retreating sea ice potentially expands opportunities for transportation, fisheries, and mineral industries (Arctic Council 2009; National Petroleum Council 2015), efforts complicated and made unpredictable by Arctic governance challenges (Berkman and Young 2009). Ideally, future research would merge local, longitudinal socio-economic data with local longitudinal geophysical data, so climate impacts could be modeled at the community level.

3.6 Conclusion

When the U.S. Congress adopted the Alaska National Interest Lands Conservation Act in 1980, it identified four threats to subsistence: (1) Alaska's increasing population, (2) sudden declines of some wildlife species, (3) increased accessibility of remote areas, and (4) unprincipled harvests of fish and wildlife. Adding time factors to statistical models suggested that subsistence priority laws were having their intended effect: to protect subsistence uses from adverse competition. Subsistence economies in Alaska did not seem to be "failing" (Deman 1982), nor were rural Alaska communities in an inevitable, irreversible decline (Morehouse 1989).

Regardless of whether the issue was resource allocation, industrial development (including commercial fisheries), transportation infrastructure, or Arctic governance itself, observing socio-economic conditions in the Arctic has never been more important. Reliable local socio-economic observations in the Arctic required persistent and consistent measures, in cooperation with or entirely by local community observers over long periods of time. Supporting existing observation systems and mining existing datasets would seem to be a productive approach.

3.7 Acknowledgements

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Chapter 4 Are Mixed Economies Persistent or Transitional? Evidence Using Social Networks from Arctic Alaska

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ABSTRACT Two opposing narratives describe future prospects for mixed economic livelihoods in Alaska and the broader Arctic. On the one hand, Arctic anthropologists have written about the emergence of persistent mixed economies in Native communities. A second narrative echoes modernization assumptions and assumes that "subsistence is dying," mixed economies are transitional, and Native communities are headed inevitably toward full market dependence. We provide evidence that mixed economies are not transitional. Mixed economies have three components: households engage in (1) market exchange, (2) subsistence activities, and (3) culturally embedded social relationships sustained by flows of wild food and other resources. Using household-level social network and economic data from two Iñupiat communities spanning 30 years, we explore hypotheses designed to test an assumed transition to market dependence. If transition assumptions hold, households with high engagement in the cash economy will have low engagement in subsistence production and diminished social relationships. Results do not support this narrative of change. Although there is considerable variability in household harvest, income, and social relationships, those highly engaged in market activities are also disproportionately involved in subsistence activities, sharing, and cooperation. Beyond broad narratives, an assessment of underlying processes and conditions supporting persistent mixed economies is warranted.

KEYWORDS Alaska, vulnerability, sensitivity, adaptive capacity, network analysis

1 The candidate (James Magdanz) participated during all stages of the BOEM Sharing Project that collected the contemporary data for this paper, most notably by introducing network analysis methods to the study of subsistence in Alaska. James Magdanz collaborated fully on the design of the Sharing Project instrument, the training of local researchers, the cleaning and analysis of the data, and the drafting of the manuscript.

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On May 12, 2015, Alaska Governor Bill Walker signed a new Arctic policy into law (Alaska Statutes 44.99.105). Synthesizing two years of stakeholder meetings by the Alaska Arctic Policy Commission, the policy recognizes the indigenous majority in the Alaskan Arctic, whose "physical and spiritual well-being depends on protecting the bountiful lands, rivers, and seas of the Arctic." The policy's focus, though, is "to uphold the state's commitment to economically vibrant communities sustained by development activities," and it emphasizes extractive natural resource development.

The policy echoes a specific narrative about Arctic development and indigenous peoples. As the Arctic melts, new natural resource opportunities and transportation corridors are fueling economic growth that could benefit indigenous and other Alaskans alike (Alaska Arctic Policy Commission 2015). Indigenous subsistence societies—overwhelmed by poverty, eroding cultural values, climate change, declining wildlife, and development impacts—are seen as particularly in need of this development (O'Malley and Orlinsky 2015).

Modernization theory was a cornerstone of 1950s and 60s anthropology, including Arctic anthropology (Chance and Trudeau 1963; Murphy and Steward 1956; VanStone 1960). It suggested a logic by which market and cultural acculturation would inevitably transition Arctic groups away from subsistence-based livelihoods. Now largely discredited within the discipline, moderization themes are still tacitly expressed in economic and policy discussions and by the media. For example, Morehouse (1989) argued that subsistence declines required market expansions to maintain community economic viability. Chabot (2003) suggested that continued sharing between households would reflect poverty conditions, not cultural identity or choice. Medred (2013), a widely-read Alaska journalist, put it bluntly: "Subsistence itself is dying beneath a population boom and the changing views of an evolving society." But for many Arctic scholars, this "dying subsistence" narrative is not persuasive.

In this paper, we explore a counter-narrative to market transition: persistent mixed economies (Langdon and Worl 1981; Lonner 1986; Wenzel 1991; Kruse 1991; Usher 1981). The recent Arctic Human Development Report describes indigenous communities as maintaining subsistence production within traditional social structures, exploiting new economic opportunities, and creating increasingly complex socio-economic dynamics (Nymand Larson and Fondahl 2014; see also Poppel and Kruse 2010). While people work for cash, they remain hunters and fishers, and engage in a moral economy of sharing and cooperation around food and other resources (Bodenhorn 2000). They also invest income in subsistence supplies and better equipment, and negotiate work schedules to fit seasonal subsistence patterns (Kruse 1986; Langdon 1991). Wolfe and Walker (1987) advanced the proposition that 30% of a community's households produce 70% of a community's wild foods, a pattern subsequently observed throughout rural Alaska (Wolfe et al. 2009). These "super-households" presumably, produced beyond their needs to provision others (Wolfe et al. 2009).

Though often described as a critical component of mixed economies, food redistributions could only be presumed because they are rarely quantified (see Harder and Wenzel 2009). Synthesizing economic, harvest and network data helps clarify which narrative – gradual market transition versus persistent mixed economies – better reflects Arctic communities today. We collected network, harvest, and economic data in 2009–10 in two Alaskan Iñupiat communities and compared patterns to existing data across three decades. If mixed economies are persistent, we would expect

1 substantial harvests of wild food and redistribution among households, structured by social relationships;

2 no declines in households' mean subsistence harvests or social relations over time; and,

3 strong engagement of higher-income households in subsistence production.

4.1 Study Site and Design

Wainwright and Kaktovik are isolated Iñupiat whaling communities with Alaska Native majorities (95% and 88% respectively), unconnected to Alaska's road system and accessible only by air (Figure 4-1). Residents harvest wild foods from land, rivers, and ocean. Hunting and

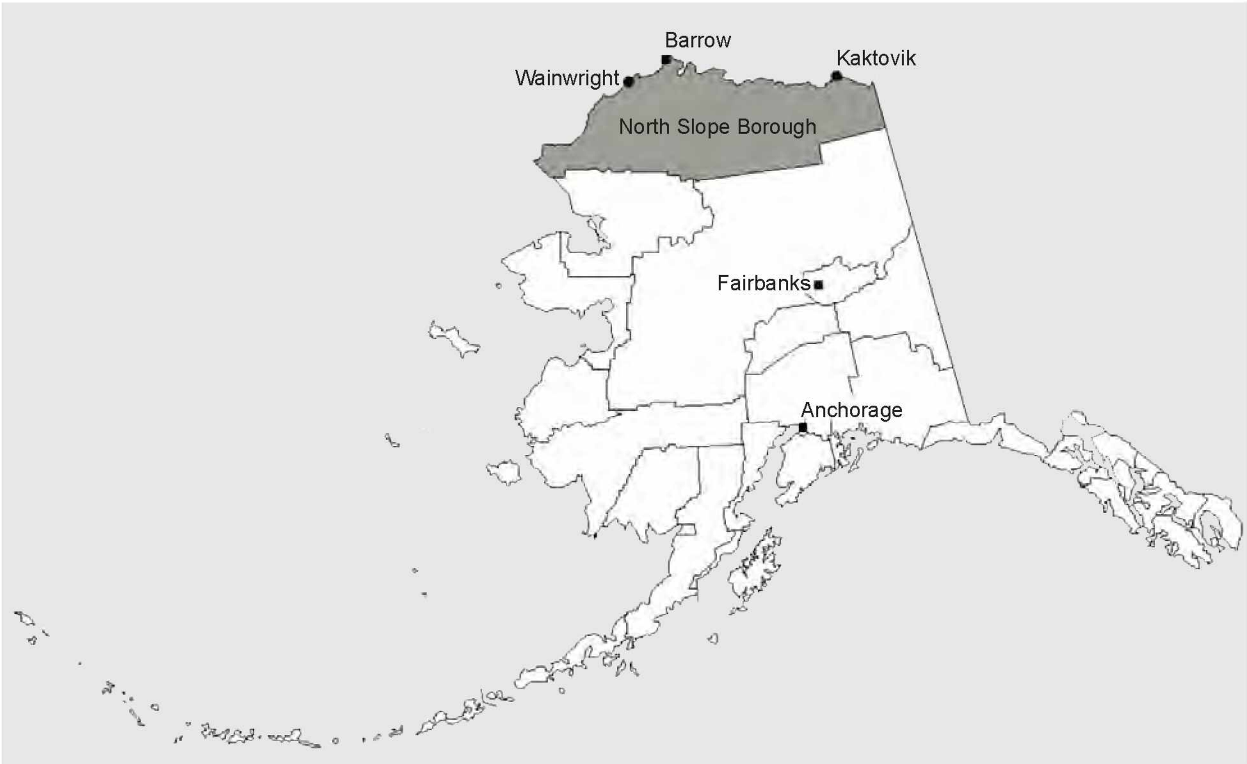

Figure 4-1 Map of Alaska with the two study communities, Kaktovik and Wainwright.

fishing activities typically involve cooperation among multiple households. Bowhead and beluga whale production is more complex, involving cooperation by virtually all capable community-members and ritualized food distributions through shares and feasts.[1]

We collected data through ethnographic interviews and a comprehensive household survey. Following Bender (1967) and Usher et al. (2003), "households" were defined as individuals co-resident within a dwelling who cooperated on domestic functions. Only 4% of sampled households included non-kin. We administered surveys to heads of 146 Wainwright households (96% of all households) and 69 Kaktovik households (80%).[2] Respondents estimated annual income from employment, pensions, dividends, and public assistance, including annual dividends from the Alaska Permanent Fund and Native for-profit corporations.3 We used US Census data and two earlier harvest studies (Kruse 1991; Kruse et al. 1982) to compare income and harvest over time.

Using social network methods, we represented flows of wild food and non-food resources between households over a 12-month period. Interviews with local hunters, elders, and community members allowed us to identify locally resonant relationships and key species (Table 4-1). For example, respondents distinguished sharing—receiving food without a specific expectation of return—from helping shares—food received based on contributing labor, equipment, or supplies to the subsistence efforts of others. Survey respondents identified households or whaling crews who provided wild food, goods and services to the respondent's household for each combination of species and social relation. By aggregating these connections across each community we constructed valued and directed multiplex social networks in which households, whaling crews, and other organizations are nodes connected by valued and unvalued edges (flows and ties, respectively; see Borgatti et al. 2009). To estimate a household's subsistence harvest, we summed valued inflows from household members' own harvesting, cooperative harvest relations, and community harvests. Unvalued ties reflect non-food contributions such as labor, equipment, and supplies (Table 4-2).

4.2 Results

Table 4-1 sums flows and counts ties for all relations and eight resources in each community for a 12-month period. Households' "own hunting" provided only 25% and 21% of total flows in Wainwright and Kaktovik, respectively, highlighting the continued importance of social relations in structuring wild food flows. Table 4-1 also illustrates the substantial contributions of social relations unique to whaling (e.g., feast, crew and helper shares). Findings mapped closely onto previous results from Nelson (1969) and Bodenhorn (2000).

4.2.1 Diachronic Trends

Between 1977 and 2010, indicators of subsistence engagement—per capita harvests, giving food away, and receiving food from others—showed either no trend or increased engagement (Table 4-3). Per capita harvest and income both increased at similar rates from 1987–2009. In 2009–10, engagement with both economic sectors was substantial; estimated average annual per capita

TABLE 4-1 AGGREGATED FLOWS OF WILD FOOD AND CONTRIBUTIONS FOR ALL SOCIAL RELATIONSHIPS BY COMMUNITY

Relation	Total Flows and Ties - All Resources[1]			
	Wainwright (*n*=146)		Kaktovik (*n*=70)	
Valued Flows (Non-Whale)				
Own hunting	102,587	lbs	47,813	lbs
Cooperative hunting shares	112,117	lbs	42,441	lbs
Shares for helping[2]	13,294	lbs	5,435	lbs
Sharing	40,646	lbs	19,943	lbs
Trading	1,807	lbs	407	lbs
Purchase	1,341	lbs	23	lbs
Valued Flows (Beluga and Bowhead Whale)				
Cooperative Hunting Shares (Beluga only)			9,700	lbs
Shares help (Whaling crew contributors)	8,470	lbs	5,113	lbs
Sharing	3,825	lbs	12,443	lbs
Crew Shares	50,146	lbs	50,107	lbs
Towing Shares	14,156	lbs	965	lbs
Captains Shares			14,255	lbs
HH Shares	29,331	lbs	349	lbs
Captain (Small) Feasts	5,325	lbs	2,849	lbs
Nalukatuk	20,622	lbs	6,795	lbs
Trading	416	lbs	73	lbs
Sum of All Flows	404,084	lbs	223,615	lbs
Unvalued Ties				
Processing (between households)	444	ties	496	ties
Shared Cash	36	ties	36	ties
Lent Equipment	157	ties	109	ties
Repaired Equipment	62	ties	53	ties
Contributions (to Hunting)				
Labor	266	ties	114	ties
Ammuntion	32	ties	19	ties
Cash	19	ties	6	ties
Gasoline	83	ties	38	ties
Equipment	125	ties	28	ties
Food/Supplies	73	ties	37	ties
Sum of All Ties	1,297	ties	948	ties

[1] *Note: Food is represented in edible pounds and contributions are counts of different kinds of ties.*
Common species hunted in both villages were bowhead, beluga, bearded seal, caribou, and geese.
Unique hunted species were as follows: for Wainwright, smelt and ducks; for Kaktovik, Dall sheep and Arctic char.

TABLE 4-2 NETWORK TERMINOLOGY FOR WILD FOOD FLOWS AND CONTRIBUTION TIES

Network Ties Represent:	Direction of Ties: Incoming Ties to HH	Direction of Ties: Outgoing Ties to HH
Valued flows (*summed flows of species by relation – lbs of food*)	inflow	Outflow
Unvalued ties (*counts of contributions by relation – no. of ties*)	indegree	outdegree

TABLE 4-3 CHARACTERISTICS OF WAINWRIGHT AND KAKTOVIK MIXED ECONOMIES THROUGH TIME

Year	1977	1980	1987	1988	1990	2000	2009
Kaktovik							
HHs employed/harvests (% HHs)	86%			66%			82%
Gave food (% HHs)	66%			67%			84%
Received food (% HHs)	84%			76%			100%
Per capita harvest (lbs)			328.0				871.8
Per capita income ($)					$10,078	$22,031	$31,809
Wainwright							
HHs employed/harvests (% HHs)	74%			79%			82%
Gave food (% HHs)	46%			70%			84%
Received food (% HHs)	65%			65%			99%
Per capita harvest (lbs)			507.9				704.6
Per capita income ($)					$9,095	$16,710	$27,820

TABLE 4-4 MEAN HARVEST AND INCOME RELATIONSHIP, BY HARVEST-INCOME CATEGORY

Harvest x Income Categories		No. of HHs	Harvest (lbs)		Income ($)	
			X̄	(median)	X̄	(median)
Wainwright						
Low harvest	Low income	22	21.0	(0.0)	38,127	(40,912)
	Med income	13	147.8	(25.0)	81,113	(82,755)
	High income	9	173.2	(122.0)	134,102	(150,638)
Med harvest	Low income	15	1,065.3	(965.0)	33,037	(34,032)
	Med income	15	1,160.1	(1,014)	78,238	(80,395)
	High income	15	1,083.2	(897.0)	131,375	(123,253)
High harvest	Low income	7	4,813.1	(3,737.0)	34,350	(37,965)
	Med income	17	4,360.2	(3,458.0)	74,850	(73,633)
	High income	20	5,901.1	(4,266.0)	155,545	(143,075)
Kaktovik						
Low harvest	Low income	9	29.0	(3.0)	34,386	(34,671)
	Med income	6	44.0	(29.0)	71,365	(65,851)
	High income	6	30.0	(0.0)	146,084	(133,868)
Med harvest	Low income	5	959.0	(924.5)	24,263	(22,650)
	Med income	9	1,413.4	(1,704.0)	73,595	(74,160)
	High income	8	696.0	(634.5)	126,852	(124,188)
High harvest	Low income	5	3,463.3	(3,337.5)	37,800	(41,323)
	Med income	6	6,452.0	(4,407.0)	85,161	(88,714)
	High income	10	7,800.0	(5,133.0)	123,678	(119,187)

subsistence harvests were 872 lbs. in Kaktovik and 705 lbs. in Wainwright, while estimated average annual per capita incomes were $31,809 and $27,820, respectively. At the household level, neither harvest nor social engagement declined as employment and income rose.

4.2.2 Household and Income Relationships: 2009–2010

Consistent with Wolfe and Walker (1987), 30% of Wainwright and 23% of Kaktovik households accounted for 70% of harvested food flows. Pearson correlations between harvest and earned income were weakly positive ($r = 0.256$, $p < 0.01$ [Wainwright], $r = 0.123$, N.S. [Kaktovik]), and marginally stronger for harvest and gross income inclusive of dividends and assistance ($r = 0.283$, $p < 0.01$ [Wainwright], $r = 0.219$, N.S. [Kaktovik]). Observed harvest-income relationships varied widely but high-income households did not cluster at low harvest levels (see Supplemental Figure 4-1 for more detail).

We divided households in each community into income and harvest terciles. A Kendall's Tau-b analysis (3x3 comparisons of low, medium, and high ranks) indicated that households with higher incomes were likely to harvest more in Wainwright ($r\tau = .262$, $p < .001$ ($N = 133$)).[4] The relationship in Kaktovik was similar, but not significant ($r\tau = .216$, $p = .058$ ($N = 64$)). Patterns indicate that high-income households produce more—not less—wild food, but there is heterogeneity in harvest-income relationships.

We explored this heterogeneity by overlaying harvest and income terciles to create nine harvest-by-income groups (Table 4-4). Most low-harvest households were also low-income, whereas most high-harvest households were high-income. Seven low-income households in Wainwright and five in Kaktovik were categorized as high-harvest, suggesting that income is not a necessary condition to be a "super-household."

Given a market transition, higher incomes would be associated with decreased harvests. Household means and medians across the nine harvest-income categories in the study communities provided no evidence of that pattern (Table 4-4). Within low- and medium-harvest categories, income-harvest relationships were mixed. But in the high-harvest categories, as mean incomes increased, mean harvests increased. The association was especially strong in Kaktovik (see Supplemental Figure 4-2). Households in the high-harvest, high-income category accounted for 85,804 lbs (52.3%) of total subsistence harvest in Kaktovik and 118,019 lbs (42.2%) in Wainwright.

4.2.3 Social Relationships in the Mixed Economy

Figure 4-2 presents summed flows of food (inflow and outflow of lbs) and contributions (indegree and outdegree of contribution ties) for whales and all other species for the nine

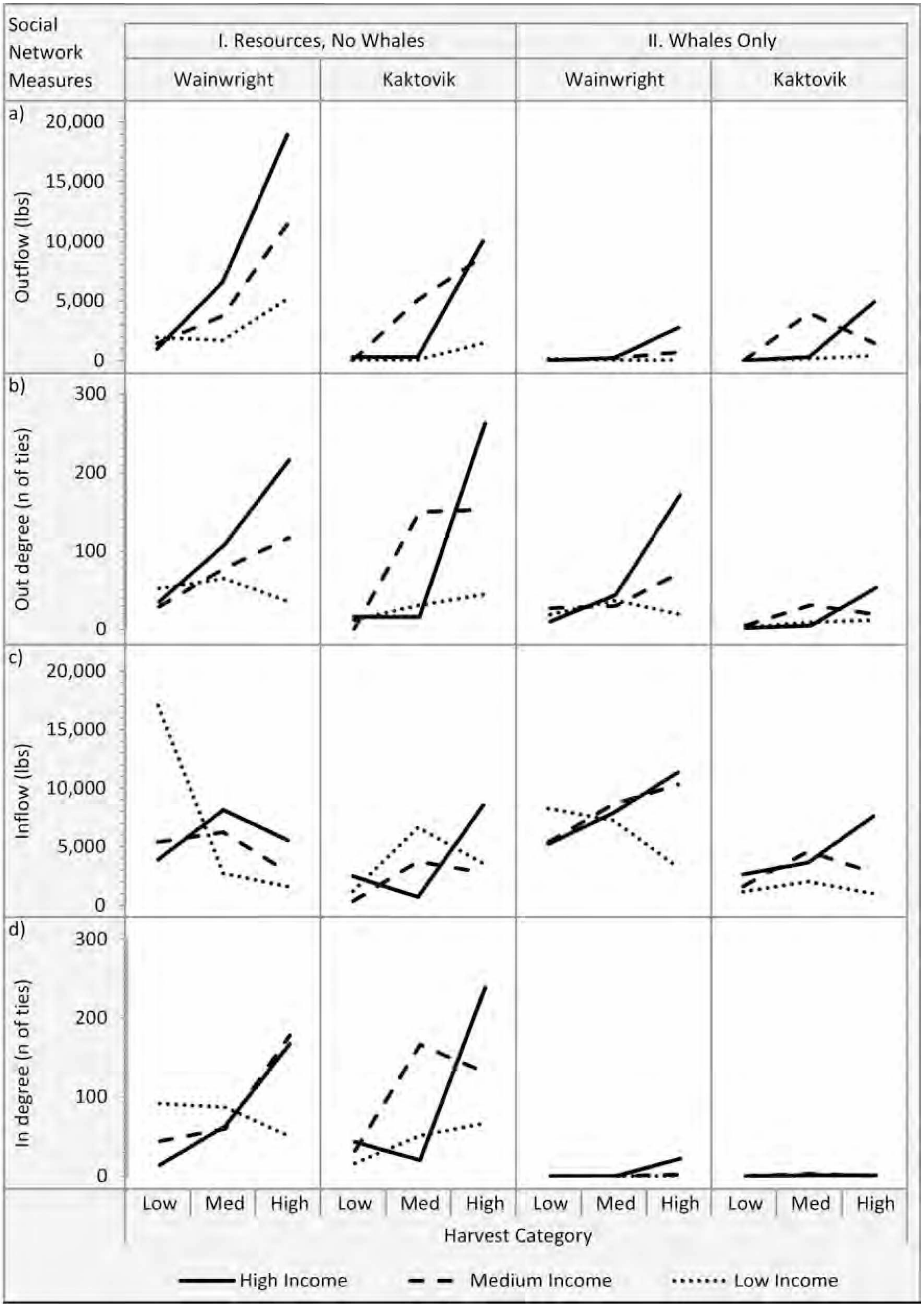

Figure 4-2 Magnitude of social relationships by income and harvest categories.
The magnitude of social relationship represented as summed outflows of food and outdegree ties (a–b) and food inflows and indegree ties (c–d) for harvest-income groups.

income-harvest groups. High-income households were not less engaged in subsistence social relationships than low-income households. High-harvest, high- and middle-income households had the highest outdegree for whale and non-whale food and contributions (Figure 4-2a-b and see Supplemental Table 4-1). High-harvest households with little income provided some food to others. Low-harvest, low- and middle-income households provided some contributions but almost no food, as they had little to redistribute. Low-harvest, high-income households gave little food or contributions, but outflows across other groups were mixed. High-harvest, high- and middle-income households also had the highest indegree for non-whaling contributions from other households (Figure 4-2c-d). In both communities whaling indegree contributions were low, as contributions go to crews to support whaling efforts, not households. Low-harvest, low-income households in Wainwright received considerably more food than any other group, and in Kaktovik, the second most on average. High- and medium-harvest households received more whale, and active harvesting households, regardless of income, received more non-food contributions than others.

4.3 Discussion and Conclusion

In the study communities, elements of mixed economies observed three decades ago—simultaneous household engagements in subsistence, markets, and traditional social relationships—have proven remarkably persistent. Wolfe and Walker's (1987) "super-household" pattern endures. Both income and per capita harvest have increased through time, and high-income households remain disproportionately high-harvest households. Unlike Dombrowski and colleagues' (2013) findings in a Canadian Arctic community, we found that high-harvest, low-income households gave wild foods to other households (although less than those with high incomes). On average, low-harvest, low-income households received the most food by weight, but also contributed to others, indicating continued subsistence engagement. As Langdon (1991) and Wheeler and Thornton (2005) noted, significant heterogeneity of choices, roles, and responsibilities observed within these mixed economies belies the simplistic narrative that subsistence is dying in an inexorable march towards the market.

The vitality of mixed economies in the Arctic depends—as Alaska policy states—on continued access to bountiful lands, rivers, and seas. Alaskan native communities face many challenges: climate change, subsistence regulation, high costs of imported food and fuel, substance abuse, high suicide rates, and transformative technologies like television and the internet. But over the centuries, they have weathered Yankee whalers, epidemic disease, declining caribou, and gold miners, not to mention multinational oil companies (Haley 2004). When the state and nation attempted to appropriate Native lands for the Alaska Oil Pipeline, Alaska Natives negotiated a settlement comparable to the "national independence gained by third-world peoples" (Gaffney 1982, 136). Through these upheavals, they maintained strong cultural identities while raising their standards of living, no small feat in a state where "oil and gas development…provides roughly 90% of state general fund revenue" (Alaska Arctic Policy Commission 2015, 6). Given uncertain Arctic futures, current persistence of Alaska mixed economies does not guarantee their future persistence. Yet market engagement has not persuaded Iñupiat to transition away from core social, economic, and subsistence elements of mixed northern livelihoods. Ultimately, beyond grand narratives of either transition or persistence, a more nuanced consideration of processes and conditions characterizing mixed economies is warranted.

4.4 Acknowledgements

We sincerely thank our survey respondents, the Native Village of Kaktovik, the Wainwright Traditional Council, Dr. Matthew Berman (University of Alaska Anchorage) for archival data analyses, Dr. James Simon and Pamela Amundson (Alaska Department of Fish and Game), Taqulik Hepa and Mike Pederson (North Slope Borough Department of Wildlife Management), as well as anonymous reviewers who provided valuable comments on the manuscript. Bureau of Ocean Energy Management, US Department of the Interior funded the "Sharing Project" (OMB

Control # 1010-0184). Partial support provided by Alaska EPSCoR NSF (#OIA-1208927), and Arctic Social Science, National Science Foundation (ARC-0909570).

4.5 Notes

1 Whaling activities are unique from other subsistence activities, as they are organized around established crews (bowhead), flexible hunting groups (beluga), and community-wide distribution efforts. Bowhead shares are distributed to crew members, to "crew helpers," to households at commensal feasts, and among households through sharing. See Bodenhorn 2000 and Kishigami 2013 for a detailed discussion.

2 Human subjects approval was granted by the University of Alaska Institutional Review Board.

3 Alaska residents receive an annual dividend from the Alaska Permanent Fund, supported by oil and gas revenue. The Federal Alaska Native Claims SettlementAct (1971) (43U.S.C.A. 1601 et seq.) created 12 regional corporations and over 200 village-level corporations that pay annual or biannual stakeholder dividends.

4 Non-local teachers were removed from this and subsequent analyses.

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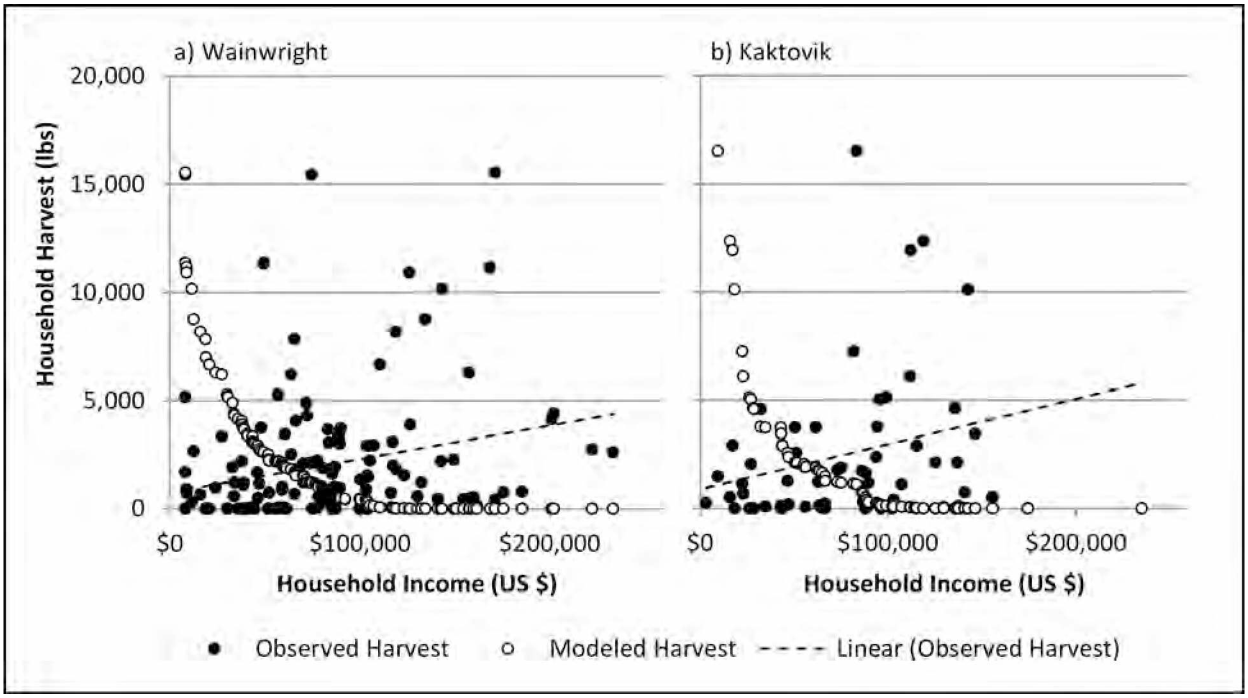
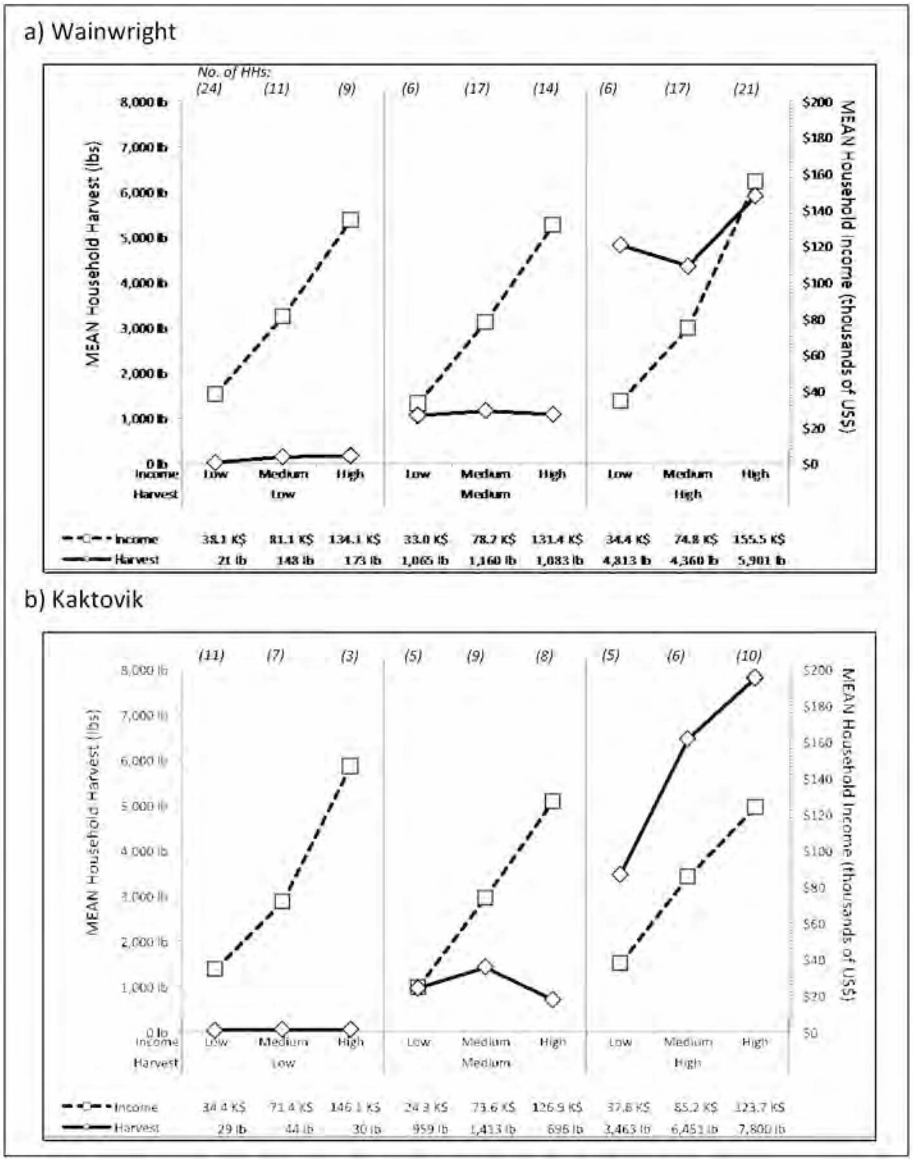
4.7 Supplemental Materials



Supplemental Figure 4-1 Observed and expected harvest-income distributions.
If the assumed transformation to a market economy was occurring, we would expect high income households to harvest at low levels. We tested this assumption by inverting the observed household harvest distribution and matching it to observed household incomes (i.e., in each community we assigned the highest reported harvest to the household with the lowest reported income, etc., until the lowest reported harvest was assigned to the household with the highest income). The new combined harvest-income distribution is termed an expected distribution. Observed (closed circles) and expected (open circles) harvest-income relationships do not match, and observed harvest-income relationships vary widely. High-income households do not cluster at low harvest levels.



Supplemental Figure 4-2 Relationship between mean harvest and income.
Relationship between mean harvest and income across nine harvest-income categories for a) Wainwright and b) Kaktovik. Graphed values represent means for harvest-income groups.

SUPPLEMENTAL TABLE 4-1 CALCULATED MEANS, BY HARVEST-INCOME CATEGORY

Harvest x Income Categories		No. of HHs	Means – Core Resources, No Whales: Outflow ($\bar{x}$ lbs.)	Means – Core Resources, No Whales: Outdegree Contributions ($\bar{x}$ no. ties)	Means – Core Resources, No Whales: Inflow ($\bar{x}$ lbs.)	Means – Core Resources, No Whales: Indegree Contributions ($\bar{x}$ no. ties)	Means – Whales Only: Outflow ($\bar{x}$ lbs.)	Means – Whales Only: Outdegree Contributions ($\bar{x}$ no. ties)	Means – Whales Only: Inflow ($\bar{x}$ lbs.)	Means – Whales Only: Indegree Contributions ($\bar{x}$ no. ties)
Wainwright										
Low Harvest	Low Income	22	946.0	10.8	277.6	8.4	138.9	8.6	567.5	1.1
	Med Income	13	672.0	6.9	167.4	10.5	41.9	4.3	606.2	0.1
	High Income	9	739.9	5.0	227.8	7.1	3.6	2.7	462.4	0.0
Medium Harvest	Low Income	15	438.2	7.2	542.6	4.2	14.2	2.9	526.5	0.0
	Med Income	15	249.4	5.2	416.1	4.0	13.8	2.0	575.7	0.0
	High Income	15	113.4	4.3	181.4	5.8	3.8	2.5	482.3	0.0
High Harvest	Low Income	7	109.4	3.9	432.6	1.6	0.0	1.1	580.8	0.0
	Med Income	17	110.8	2.2	416.0	3.4	0.4	2.1	414.4	0.0
	High Income	20	87.4	2.4	774.9	4.2	6.9	0.9	375.5	0.0
Kaktovik										
Low Harvest	Low Income	9	911.3	23.9	776.4	21.7	449.5	4.8	692.3	0.1
	Med Income	6	1452.5	25.5	463.3	21.8	243.7	3.2	464.5	0.0
	High Income	6	365.1	11.3	892.9	16.8	101.0	3.0	250.3	0.0
Medium Harvest	Low Income	5	77.5	4.0	180.3	5.0	73.8	1.3	912.3	0.3
	Med Income	9	508.2	15.0	375.2	16.6	399.4	3.1	458.7	0.3
	High Income	8	9.0	3.9	831.7	6.4	20.5	1.1	252.4	0.1
High Harvest	Low Income	5	49.9	2.7	411.8	7.2	0.0	0.3	439.5	0.0
	Med Income	6	0.0	0.2	55.1	5.3	0.0	0.8	270.3	0.0
	High Income	10	8.5	1.3	134.0	1.8	0.1	0.3	130.3	0.0

Chapter 5 Heterogeneity in Mixed Economies: Implications for Sensitivity and Adaptive Capacity

Shauna BurnSilver and James S. Magdanz[1]

ABSTRACT In a "mixed economy," households embedded in communities simultaneously engage in the cash economy, pursue some aspect of subsistence, and remain connected to each other through a culturally rich set of sharing and cooperative relationships. In Alaska and the circumpolar north, mixed economies show signs of persistence despite significant challenges, and have become a cultural touchstone for what it means in the present day to be, for example, Iñupiat or Gwich'in. Contemporary research on mixed economies highlights common patterns, such as the role of cash in sustaining subsistence, and the importance of 'super-households' in food production and distribution. However, similarities at the community level can obscure important differences at the household level. Combining concepts of sensitivity and adaptive capacity drawn from vulnerability literature, this paper explores differences in household characteristics within and between three Alaska communities. Two communities are coastal Iñupiat (Wainwright and Kaktovik), and one is interior Gwich'in (Venetie). Findings illustrate significant heterogeneity in households' livelihood strategies, capabilities and available assets. Differences within and between communities suggest areas of emerging inequality relevant to ongoing discussions of well-being and sustainability across a changing circumpolar north.

KEYWORDS Arctic, mixed economies, subsistence hunting, cash economy, social networks

1 The candidate (James Magdanz) participated during all stages of the BOEM Sharing Project that collected the data for this paper, most notably by introducing network analysis methods to the study of subsistence in Alaska. James Magdanz and Shauna BurnSilver were equal contributors to the analyses for this paper and to the manuscript.

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5.1 Introduction

Contemporary hunter-gatherer groups face a host of political, economic, and sociocultural changes, challenging access to historic homelands, cultural identities and lifeways. Influenced by shared history, ecology, and in some cases geographic isolation, coherence around common resource-based livelihood strategies remains core to the livelihoods and identities of many contemporary hunter gatherers. However, increasing engagement with markets and entry into national and international governance spheres translates into new livelihood landscapes, economic choices and opportunities. Ideas about "a good life" also vary as people choose, and/or are pushed, to engage with new ways of making a living.

As historic hunter-gatherer groups combine hunting and gathering with market-based income generation, mixed or hybrid economies are a widespread result. Evidence suggests that hunter-gatherers continue to find meaning in traditional lifeways and values even as diverse subsistence-market livelihood combinations emerge (Wheeler & Thornton 2005, Lu 2007, Gibson-Graham 2008, Svizzero & Tisdell 2015, BurnSilver et al 2016). Research with hunter-gatherer households has focused on processes by which market integration occurs (Godoy et al 2005a), and its potential effects on hunter-gatherer health (Blackwell et al 2009; Urlacher et al 2016), well-being (Godoy et al 2005b), sharing relationships (Behrens 1992; Franzen & Eaves 2007; Gurven et al 2015) and cultural identity (Doughty et al 2010). These studies highlighted variable outcomes of market integration for indigenous groups, both positive and negative (Godoy et al 2005b).

Household-level empirical studies frequently caution that, as people engage with markets and social norms of sharing and exchange are disrupted over time, economic and social outcomes within communities will become increasingly heterogeneous, and less equal. Community-scale vulnerability studies grounded in a social-ecological systems framework emphasize a similar finding (Armitage 2005; Ford et al 2008). Despite these very different theoretical perspectives (evolutionary anthropology, livelihoods research and vulnerability) and levels of analysis (household to community), findings on emerging diversity seem to converge.

In this paper, we suggest that evaluating patterns and outcomes of change for contemporary hunter-gatherers requires examining the diversity of activities, experiences, and capabilities pursued by households within communities. Based on a range of variables for three Alaskan communities (two Iñupiat and one Gwich'in), we use concepts from the vulnerability literature to compare profiles of sensitivity and adaptive capacity at community and household scales at one point in time. We expect comparisons of community and household patterns will tell different stories of livelihoods, assets and resource dependence. Examining these patterns has applied and theoretical implications for thinking about change impacts.

5.1.1 Vulnerability and mixed hunter-gatherer economies

Within the frame of social-ecological systems, vulnerability has emerged as an approach for characterizing changes and their effects on people and landscapes across scales (Turner et al 2003; Eakin & Luers 2006; Smit & Wandel 2006; Adger 2006). Vulnerability is framed as a negative attribute, where susceptibility to harm emerges from the combination of exposure, sensitivity and adaptive capacity (Adger 2006). Exposures are internal or external social, political, economic and biophysical drivers, characterized in terms of their frequency, duration and intensity. Sensitivity (S) is an indicator of how exposures affect system entities (Ford et al 2006; Gallopin 2006; Berman et al 2016), typically defined as a level of expected response to exposures, contingent on observed patterns of dependence on, or use of particular resources (Adger 2006). Adaptive capacity (AC) emerges from either resources or capabilities from which adaptations and investments are possible (Adger & Vincent 2005; Adger 2006). Adaptive capacity scholarship draws from a sustainable livelihoods framework to describe assets in five categories of capital; economic, human, natural, infrastructure, and social (Sen 1981; Scoones 1998; Ellis 2000).

Ruiz-Mallen et al (2017) note that vulnerability studies of non-agricultural livelihoods are rare at any scale of analysis, but household and community scale examples for historic hunter-forager populations are found in the literature. Ruiz-Mallen et al (2017) used household level data from Tsimane communities (Ecuador) to explore how market access and conservation policy shaped profiles of adaptive capacity to climate change. Wong and Godoy (2003) examined whether economic development increased economic vulnerability for Tawahka horticultural/ forager communities (Honduras). Natcher (2015) applied social network analysis in three Dene communities (Canada) and illustrated potential vulnerability of local food sharing practices based on skewed household production and social capital attributes. These studies utilized vulnerability and adaptive capacity constructs, but without addressing household sensitivity.

Community scale vulnerability analyses for indigenous hunter-gatherer groups are more common (see Maru et al 2014). This is particularly true in the Arctic, where vulnerability theory has been at the forefront of climate change and sustainability research (Watson et al 1997, ACIA 2005, McCarthy et al 2005, Petrov et al 2017). Community analyses seek to identify who or what is vulnerable, given historical response strategies, existing constraints and current change trajectories (Ford & Smit 2004; Hovelsrud & Smit 2010; Petrov et al 2017). Researchers approach "community vulnerability" differently, but typically represent community-scale risks and outcomes by scaling up individual or group experiences drawn from literature review, community dialogues and workshops, focus groups or individual interviews (ie hunters, elders, women or youth) (Nickels et al 2002; Armitage 2005; Ford et al 2006; Furgal & Sequin 2006, Ebi & Semenza 2008 ; McNeeley & Shulski 2011).

Community-focused research has raised awareness of climate change impacts on arctic Arctic groups and contributed to the development of vulnerability concepts and methods. However, there are potential trade-offs. While conceptually rich, these analyses often are based on small, potentially non-representative samples. As such, they risk transforming the diversity of intra-community experiences into a one-dimensional "community" vulnerability, thereby strengthening stereotypical conceptions of indigenous hunter-gatherers as uniform victims of change (Cameron 2012). Community "vulnerability" framing casts entire groups as equally "at risk" "defenseless", "exposed", and potentially incapable of adapting to changes (Haalboom & Natcher 2012). This is particularly problematic when findings from one location are generalized to the experiences and vulnerabilities of other "Arctic communities" (Fergal & Sequin 2006; Poppel et al 2007). More recently researchers using a vulnerability frame in the Canadian Inuit context have highlighted emerging inequalities within communities and promoted the need to account for this diversity (Ford et al 2006; Ford et al 2008; Ford & Pearce 2010).

5.1.2 Arctic Mixed Economies

Concurrent scholarship on arctic mixed economies highlights cultural and economic patterns underlying livelihood diversity within communities. Research over six decades has documented that indigenous subsistence economies remain "mixed" (Langdon & Worl 1981; Kruse 1991; Thornton 2001; Wheeler & Thornton 2005; Larsen & Fondahl 2014). Households within communities frequently combine: 1) hunting, fishing and gathering activities, with 2) employment and transfer payments from the cash economy, and 3) sharing and cooperative strategies that distribute wild foods, cash, and equipment among families and communities. Wolfe et al (1987) described the "30:70" pattern of subsistence production for rural Alaska communities, whereby 30% of households produced 70% of subsistence foods. The pattern persists in Alaska (Wolfe et al 2009) and Canadian mixed subsistence-cash economies (Natcher 2015), and has attenuated over time. BurnSilver and colleagues (2016) and Natcher (2015) (and contributions to this issue) found that "super-households" accounted for greater than 90% of harvested wild foods in some communities. High producing households are key givers of wild food and non-food resources (Baggio et al 2016; Kofinas et al 2016) and, interestingly, are often high-income households as well. Within communities, distributions of subsistence, employment and social connectedness are not uniform (BurnSilver et al 2016).

Lonner (1980, p. 5) articulated interrelationships between culture, subsistence and the market in Arctic mixed economies as producing not only goods and services, but also social forms inclusive of non-monetary and psychic rewards. Early studies, however, emphasized particular aspects of mixed economies, eg production and harvest (NSB, ADFG), economic change (Kruse 1991), and sharing (Damas 1972, Wenzel 1995). More recent work seeks to represent the processes and flows that structure contemporary mixed economies (Harder & Wenzel 2012; Dombrowski et al 2013, Natcher 2015, Baggio et al 2016; Ready & Power 2018). Greater economic differentiation may result in the concentration of productive resources in fewer hands and increased economic inequality through time (Ford et al 2006; Collings 2011; Harder & Wenzel 2012; and see Wenzel this issue). Understanding how diverse livelihood strategies intersect with skewed productivity and social connectedness patterns in communities helps address the question: Given change, what do observed patterns and constellations of activities and assets suggest about the sensitivity and adaptive capacity of households?

5.1.3 Conceptualizing Sensitivity in Mixed Economies

The concept of sensitivity is typically less of a focus in household level vulnerability analyses and is primarily based on the level of dependence on specific resources. We propose that the intersection of two characteristics – livelihood diversity and magnitude – more clearly distinguish sensitivity in Arctic mixed economies (Figure 5-1).

This intersection yields four conceptual sensitivity categories that suggest how households might experience economic or climatic change. In quadrant 1, "high sensitivity", households draw few resources from few sources at low magnitudes. Conversely in quadrant 4, "low sensitivity", households draw multiple resources from many sources at high magnitudes. In quadrant 3, the "unbalanced" scenario, households draw few resources from few sources, but at high magnitudes. A household primarily dependent on wild foods with no wage earners might be more sensitive to harvest disruptions, while a household dependent on wage income might be more sensitive to market disruptions such as job losses or declining oil prices. Finally, in quadrant 2, the "spread thin" scenario, households draw many resources from many sources, but at low magnitudes. Here, low returns are expected to contribute to sensitivity, as households in quadrant 2 might easily tip into quadrant 1 ("high sensitivity") if conditions change.

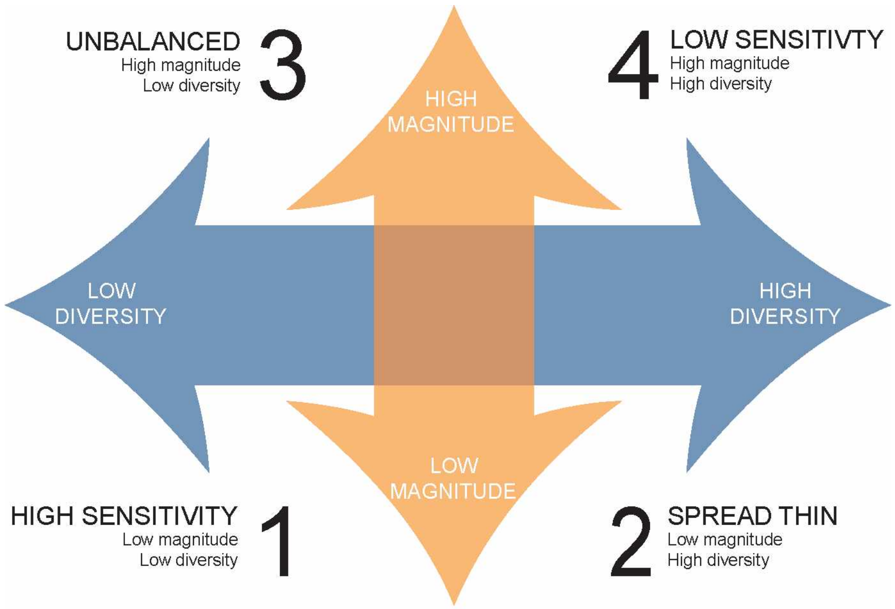

Figure 5-1 Two dimensions and four quadrants of sensitivity.
Diversity is defined as the breadth of engagement across multiple livelihood strategies, for example, wild food harvesting, income generation, and social relationships (ie with other households). Magnitude is defined as levels of returns from wild food harvests, income sources, and social relationships.

5.2 Setting

Data for these analyses were collected with residents of three remote, northern Alaska communities as part of a 4-year project focused on understanding relationships between sharing, cooperation, vulnerability and resilience (Kofinas et al 2016).

Kaktovik (Qaaktuġvik) is located on Barter Island, a traditional gathering place and trading center for Iñupiat along Alaska's Arctic coast (Figure 5-2). The contemporary community formed in the early 1950s, after the United States built a radar station, and was incorporated as the City of Kaktovik in 1971. Wainwright (Ulġuniq) is on the coast of the Chukchi Sea, home to the Utukamiut (people of the Utukok River) and Kukmiut (people of the Kuk River). In 1904, the Alaska Native Service built a school at the current site, attracting Iñupait from smaller settlements. Venetie (Viinihtaii) was established as a permanent community in 1895 on the Chandalar

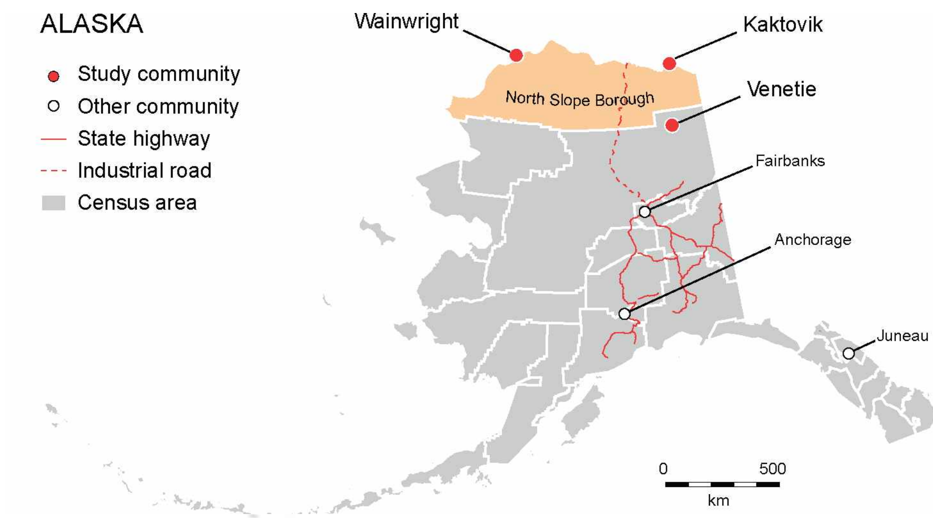

Figure 5-2 Alaska and the study communities.

River, within the traditional territory of the Natsit band of Gwich'in Athabascan (Osgood 1934, Caulfield 1983).

Historically, all three communities depended on hunting, fishing, and gathering. These traditions are a vital part of their identities today; estimated wild food harvests range from 124 kg to 321 kg per person per year (Kofinas et al 2016). Kaktovik and Wainwright access marine, river and terrestrial environments along the treeless Arctic coast, while Venetie accesses river and terrestrial environments characterizing Alaska's interior boreal forest. Engagement in a subsistence life goes beyond harvest. Many households in northern communities contribute processing labour, and food and non-food resources are redistributed among households through distinct social relationships (Bodenhorn 2000, Magdanz et al 2002, BurnSilver et al 2016, Kofinas et al 2016). Wainwright and Kaktovik are bowhead whaling communities, which occurs based on a complex set of social relations (eg crew, towing and captains' shares, Nalukatuq and captains' feasts).

Continuous contact dates from the mid 19th century, when Yankee whalers established shore-based whaling stations in the Arctic, and when the Hudson Bay company established a trading post on the upper Yukon. Kaktovik, Wainwright and Venetie have a long history of mix-ing subsistence and market-based activities. In 2009-10, 86% of Wainwright, 84% of Kaktovik and 91% of Venetie households had at least one member employed during the 12-month study period. Recent development has focused on mineral and oil extraction rather than agriculture or settlement. No community is road accessible; local surface transport is by boat in summer and snowmobiles in winter. Year-round gravel airstrips suitable for small aircraft provide passenger, mail, and freight services. In 2010, Kaktovik had 239 people, Wainwright 556, and Venetie 166, of whom 89%, 90% and 92% were indigenous, respectively.

These communities are located in different environments and have different cultural and political histories, capital and governing outcomes. All were the focus of assimilation efforts through education and fought for local governing authority and land rights (Arnold 1978). When Alaska Native land claims were settled in 1971, Kaktovik and Wainwright elected to participate, becoming shareholders in the for-profit Arctic Slope Regional Corporation (ASRC). ASRC communities formed the North Slope Borough, a state-chartered government with authority to tax oil and gas infrastructure on borough lands, providing the basis for significant capital investments such as water and sewer services. In contrast, Venetie opted out of the land settlement and with Arctic Village received title to 1.8 million acres, which is owned and managed by the Native Village of Venetie Tribal Government. Venetie households have neither water nor sewer infrastructure, but speak with significant pride regarding their level of control over territorial decisions and governance.

5.3 Methods

The basic unit of data collection and analysis was the household, co-resident individuals cooperating on domestic functions (Bender 1967, Usher et al 2003). After 12 months of work in communities and key informant interviews, data were collected in 2009-10 with household surveys designed to elicit multiple dimensions of mixed economies: household harvests, incomes, demographics, and flows of food and other resources accessible to households through diverse social relationships. Household heads described how they received seven to

TABLE 5-1 RELATION COUNTS AND FLOWS BY PROVISIONING CATEGORY AND COMMUNITY

	Wainwright*			Kaktovik*			Venetie*		
	Count	Kg	Col %	Count	Kg	Col %	Count	Kg	Col %
Self									
Own - harvest	380	46,718	25.5%	322	21,685	21.5%	404	15,550	37.0%
Cooperative									
Share - Cooperative Harvest	821	50,855	27.7%	480	23,919	23.7%	453	10,555	25.1%
Share - Captain's	0	.	0.0%	15	6,466	6.4%	0	.	0.0%
Share - Crew Member	173	22,746	12.4%	156	22,728	22.5%	0	.	0.0%
Share - Towing	29	6,421	3.5%	3	437	0.4%	0	.	0.0%
Cooperative Subtotals	*1,023*	*80,022*	*43.7%*	*654*	*53,551*	*53.0%*	*453*	*10,555*	*25.1%*
Social									
Sharing	584	20,172	11.0%	445	14,196	14.1%	590	9,425	22.4%
Share - Household	208	13,304	7.3%	2	159	0.2%	0	.	0.0%
Share - Helper	88	5,839	3.2%	87	4,567	4.5%	108	6,193	14.7%
Share - Helper (Whaling)	53	3,842	2.1%	21	2,225	2.2%	0	.	0.0%
Nalukatuq	223	9,354	5.1%	49	3,082	3.1%	0	.	0.0%
Small Feast	220	2,415	1.3%	160	1,292	1.3%	0	.	0.0%
Trading	25	1,008	0.6%	15	217	0.2%	7	44	0.1%
Purchase	31	608	0.3%	2	10	0.0%	14	235	0.6%
Social Subtotals	*1,432*	*56,543*	*30.9%*	*781*	*25,749*	*25.5%*	*719*	*15,897*	*37.8%*
All Relations	**2,835**	**183,283**	**100.0%**	**1,757**	**100,985**	**100.0%**	**1,576**	**42,002**	**100.0%**

* Flows are calculated for core resources by community. Wainwright: Bowhead and beluga whales, bearded seal, smelt, geese, ducks, caribou. Kaktovik: Bowhead and beluga whales, bearded seal, artic char, caribou, dall sheep, geese. Venetie: caribou, moose, geese, ducks, grayling, salmon, berries, bearded seal, bowhead and beluga whales.

ten core subsistence species, the amounts of wild food received (converted to edible kg), and their engagement in non-food-related exchanges including equipment, ammunition, labour and supplies (converted to counts of resource types) over a 12-month period. Researchers collected household data in teams (one local and one non-local interviewer). Community-level analyses are based on aggregations of household-level data. Household response rates were high: Kaktovik 80%, Wainwright 96%, and Venetie 92%.

Resulting data describe not only each household's own circumstances, but also networks of production and distribution, in which resources and services flowed from individuals (alters, sources, aggregated into their households of residence) into respondent households (egos, sinks). Table 5-1 summarizes frequencies and total flows across a range of social relationships identified as important by communities. While the survey asked only how food flowed into households, high response rates meant that a majority of source households also were interviewed, so out-flows from cooperating households could be calculated. This described substantially complete, valued, directed networks of wild food production and distribution for each study community.

Although 23 non-resident households occupied by teachers and public safety officers were surveyed, they are not included in our analyses, leaving a total of 275 households (133 in Wainwright, 62 in Kaktovik and 80 in Venetie). Certified teachers and PSOs are contracted and seasonal and tend to be less engaged in community life (see Kofinas et al 2016 for a discussion).

5.3.1 Analyses

We selected 13 household attributes – which emerged from key informant and household interviews and literature reviews – as the basis for analyzing household-level sensitivity and adaptive capacity in communities (Table 5-2). Sensitivity is generally considered a negative attribute, while adaptive capacity is a positive household characteristic, and reflects access to assets that might promote flexibility or response to exposures.

We standardized the 13 attribute values across all three communities using the proportion of maximum scaling method (POMS), which maintains the proportions of the absolute differences in attribute values (Little 2013).

$$\text{POMS}=[(\text{observed}-\text{minimum})/(\text{maximum}-\text{minimum})]$$

Given unequal variances in our samples we applied one-way ANOVA and post-hoc Tamhanes T2 tests to compare standardized attribute values across communities.

To examine patterns in household sensitivity and adaptive capacity attributes within these mixed economies, we assigned households in each community to one of nine harvest-income groups. Household income included employment-based income, as well as dividends (eg from

TABLE 5-2 HOUSEHOLD ATTRIBUTES

Household attribute *AC Asset category*		**Description**	**Unit**
Sensitivity			
HH	Household Harvest	Total household harvest of all core resources	log(kg)
IF	Social Inflow %	Percentage of total household inflow (kg) stemming from social relationships (sharing, shares, trading)	Proportion
HI	Household Income	Total household income from all sources over 12 months (employment, dividends and assistance)	log(USD)
EW	Months Employed, Women	(Total months worked by female household members) / (number of employed female household members)*	Ratio
EM	Months Employed, Men	(Total months worked by male household members) / (number of employed male household members)*	Ratio
Adaptive capacity			
Human assets			
ED	Household Education	Highest educational attainment of household head**	Categorical
HP	Hunters & Processors	Hunters and processors within household	Count
PR	Producer Ratio	Producer Ratio: 1-(n of dependents)/(n of productive age individuals), where: dependents <18 yrs, producers >= 18 yrs	Ratio
Infrastructure/financial assets			
SE	Summer Equipment	Summer equipment owned by household (*eg* ATVs, boats)	Count
WE	Winter Equipment	Winter equipment owned by household (*eg* snow machines)	Count
Natural assets			
CR	N of Core Resources	Core resources hunted/fished/gathered by household	Count
Social assets			
AI	Adjacent Inflow	Sum of all flows of food adjacent to sink	log(kg)
HD	Household Degree	Household degree (inclusive of food and non-food resources)	log(count)

* Full-time job =1.0 mo., Part-time job=.75 mos., On-call job= .25 mos.

** Education categories: 1=Grade School, 2=Jr. High School, 3=High School or GED, 4=Some College or Associate Degree, 5=College Degree and Above

TABLE 5-3 MAGNITUDE AND DIVERSITY SCORE COMPONENTS

	Magnitude score		**Diversity score**	
	Variable	Unit	Variable	Unit
Cash	Household income	dollars	*N* of income types	Count
Subsistence	Household harvest	kg	*N* of core resources	Count
Social relations	Inflow of wild food	kg	Household indegree	Count

the Alaska Permanent Fund and Native corporations) and assistance programs (eg food stamps, unemployment). We ranked households by harvest and income in each community and divided each into terciles (low, medium, high), then overlaid the two distributions. Nine harvest-income groups result, reflecting diverse levels of engagement by households in the cash economy and harvesting.

Uneven distributions of harvests and incomes within communities cause the number of households in each harvest-income groups to vary (see Supplemental Table 5-1). High income and harvest and low income and harvest groups comprised 39% of the study sample across communities (16.2% and 16.6% each). This distribution is important in thinking about the numbers of households with distinct AC and S characteristics.

Radar graphs illustrate patterns of similarity and difference in sensitivity and adaptive capacity attributes. We first overlay mean standardized values for each attribute and all three communities. We then compare standardized values for attributes for nine harvest-income groups visualized in two ways: 1) overlaying the nine harvest-income groups by community, and 2) overlaying communities by harvest-income group.

To explore sensitivity (Figure 5-1), we incorporated additional household attributes and calculated magnitude and diversity scores (Table 5-3). Households with diverse income sources, harvests, and social relations received high diversity scores. Households with high incomes, high harvests, and high social inflows received high magnitude scores. In each community, households were categorized as either "low" or "high" for magnitude and diversity, resulting in scale measures (mean scores), categorical measures (low-high) for magnitude and sensitivity for each

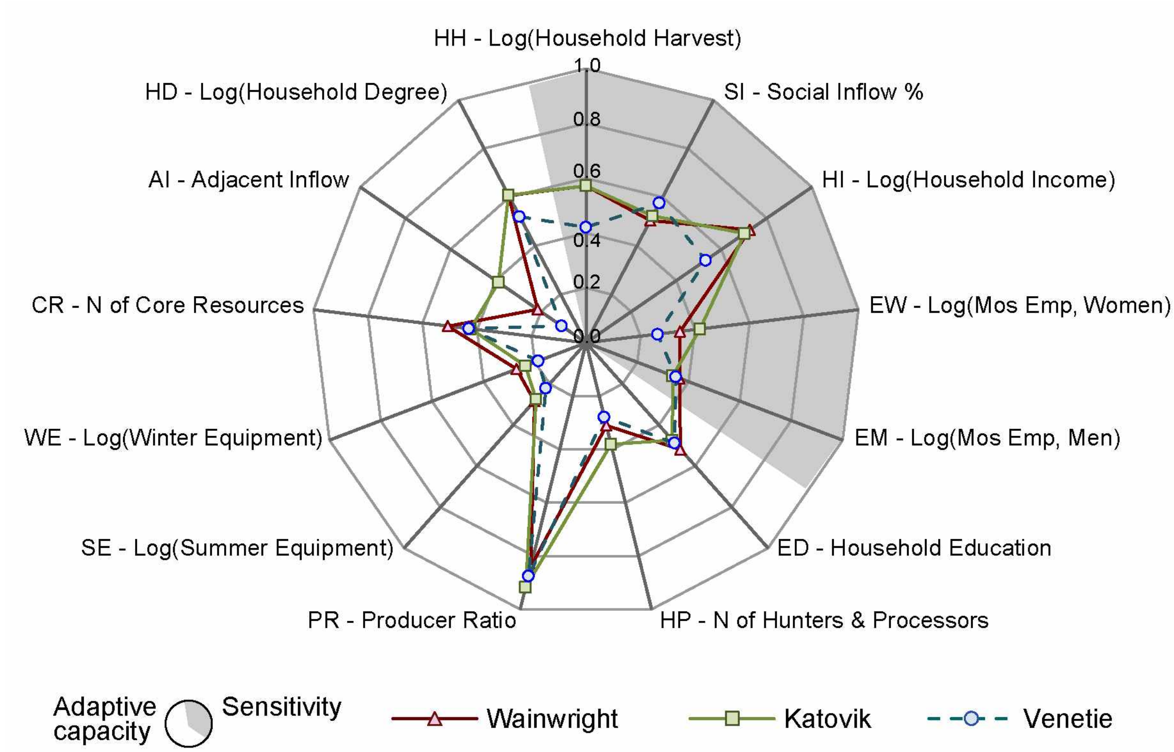

Figure 5-3 Sensitivity and adaptive capacity attributes by community.

household, and four sensitivity quadrants (Figure 5-1). Network graphs assembled using Net-Draw highlight associations among network positions and sensitivity categories.

5.4 Results

A visual comparison of sensitivity and adaptive capacity variables at the community level illustrates that mean attribute values for Interior Venetie are lower than for Coastal Wainwright and Kaktovik, except for social inflows (Figure 5-3). A one-way ANOVA reinforces visual impressions, and identified statistically significant differences among community means for 8 of 13 attributes (Table 5-4). Tamhane's T2 post hoc tests confirm that Venetie households had lower harvests, lower household income and fewer ties with other households than households in either coastal community. Venetie households had lower mean female employment and fewer hunters and processors than Kaktovik households, and fewer pieces of winter equipment than Wainwright households. Kaktovik households had a higher average productivity ratio than

TABLE 5-4 ANOVA AND POST-HOC COMPARISONS OF HOUSEHOLD ATTRIBUTES

	Wainwright (*N* =133)	Kaktovik (*N* =64)	Venetie (*N* =80)	F Statistic	Post Hoc[β]
Attributes	Mean (SD)	Mean (SD)	Mean (SD)		Tamhanes 2
Household Harvest	0.57 (0.31)	0.57 (0.29)	0.42 (0.28)	7.39 **	1>3*, 2>3*
Household Income	0.73 (0.15)	0.7 (0.15)	0.53 (0.16)	42.69 **	1>3*, 2>3*
Mos Empl, Women	0.35 (0.32)	0.43 (0.34)	0.26 (0.32)	4.13 *	2>3*
N of Hunt & Proc	0.31 (0.18)	0.38 (0.27)	0.28 (0.17)	4.76 *	2>3*
Producer Ratio	0.84 (0.19)	0.92 (0.13)	0.88 (0.16)	4.35 **	2>1*
Winter Equipment	0.27 (0.25)	0.24 (0.26)	0.20 (0.20)	3.17 *	1>3*
Adjacent Inflow	0.21 (0.14)	0.39 (0.23)	0.11 (0.09)	51.60 **	2>1>3*
Household Degree	0.61 (0.11)	0.62 (0.17)	0.52 (0.17)	11.14 **	1>3*, 2>3*

Only significant attributes are shown. Significance Levels: * p<0.05

[β] 1=Wainwright, 2=Kaktovik, 3=Venetie

Wainwright households. Adjacent inflows were significantly different across all communities with Kaktovik highest and Venetie lowest.

Differences in adaptive capacity and sensitivity attributes are evident, particularly between coastal and interior communities, although community-level mean values inevitably mask variability within and among communities. We explore potential variability across sensitivity and adaptive capacity attributes and profiles for household harvest-income groups within and among communities.

5.4.1 Sensitivity Patterns

5.4.1.1 Sensitivity Attributes

Of the five sensitivity attributes analyzed, one represents harvest engagement (HH), one the strength of social relationships (SI), and three describe activities within the cash economy (HI, EW and EM). Because harvest (HH) and income (HI) were used to group households, mean group values for these attributes varied in expected ways, with some important differences in magnitudes of HH and HI (Figure 5-4 and Supplemental Tables 5-1 and 5-2).

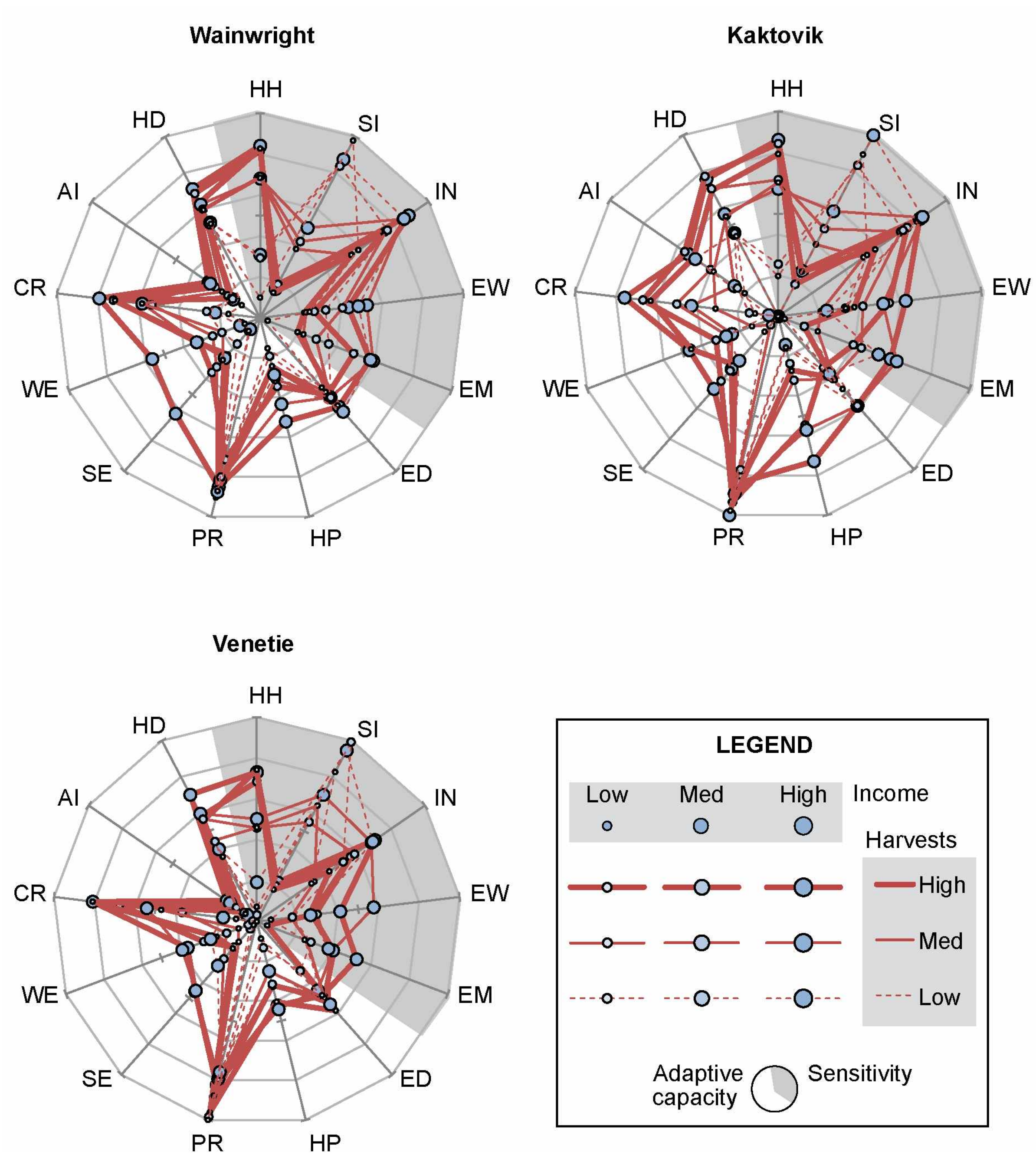

Figure 5-4 Sensitivity and adaptive capacity attributes by community.

In all communities, mean incomes for high- and medium-harvest groups were similar, but the income gaps between medium and low harvesters doubled. In real terms, mean harvests for high harvest-high income groups were ~280x in Wainwright and Kaktovik and 600x higher in

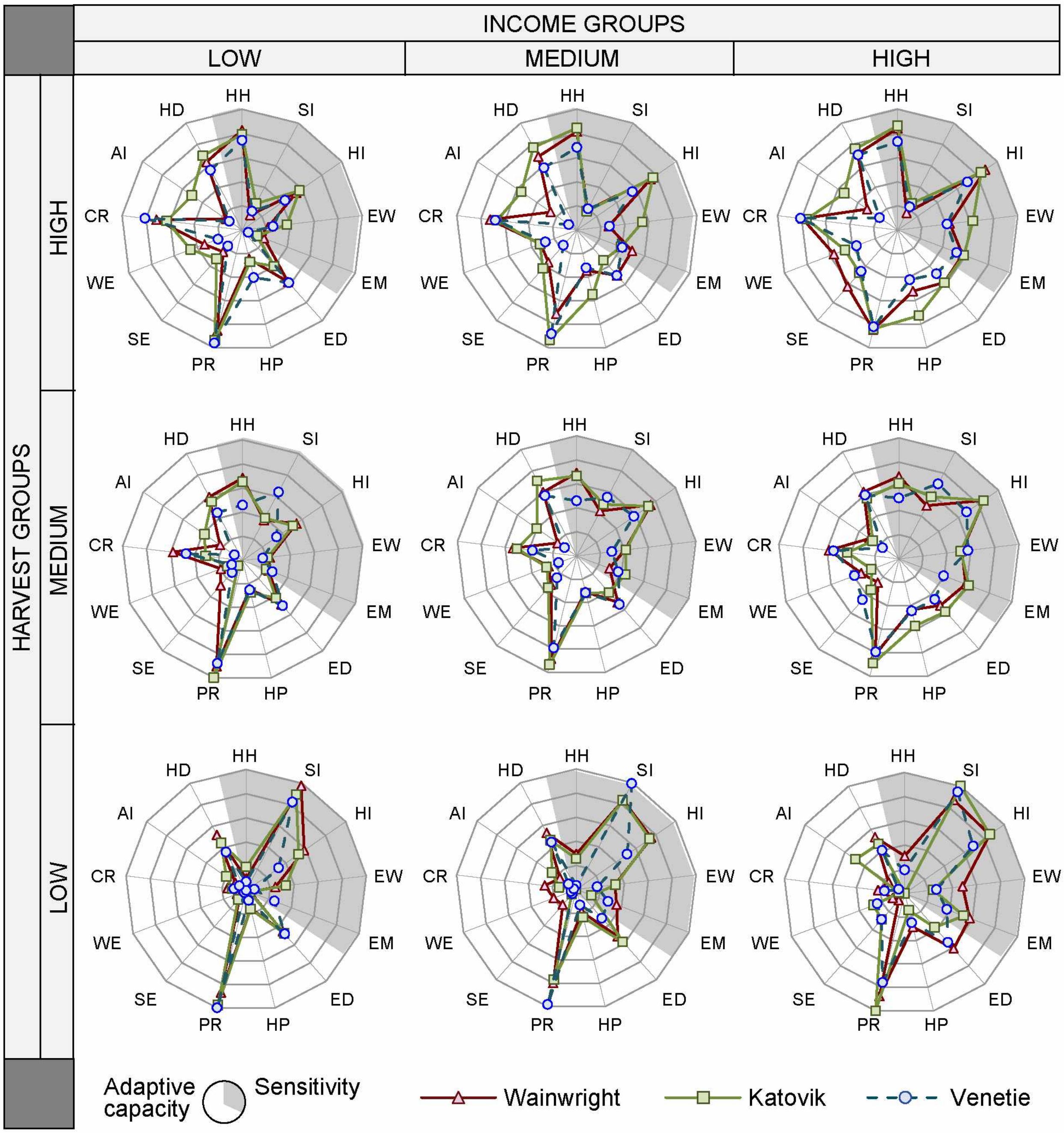

Figure 5-5 Sensitivity and adaptive capacity attributes by group and community.

Venetie than mean harvests for low harvest-low income households. Mean harvests of high and medium harvest groups in Venetie were low relative to the same groups in coastal communities.

Values for the SI attribute also clustered by harvest category, but mean social inflows were inversely related to harvest in all communities. Households in the three low-harvest groups

TABLE 5-5 NUMBER OF HOUSEHOLDS BY SENSITIVITY QUADRANT AND COMMUNITY

	Wainwright		Kaktovik		Venetie		All	
	N	%	*N*	%	*N*	%	*N*	%
1 High sensitivity	47	35%	23	37%	32	40%	102	37%
2 Spread-thin	19	14%	8	13%	8	10%	35	13%
3 Unbalanced	19	14%	7	11%	8	10%	34	12%
4 Low sensitivity	48	36%	24	39%	32	40%	104	38%
All households	**133**	**100%**	**62**	**100%**	**80**	**100%**	**275**	**100%**

received most of their wild foods (82-99%) from social relationships. High-harvest groups received proportionally much less (13-25%), and medium-harvest households were intermediate (37-70%). Income levels did not predictably differentiate inflow patterns for low harvesters. Wainwright low harvest-low income households received the highest proportion of food through social flows, while in Venetie, medium and high-income households did. In real terms however, mean inflows to low-harvest households were low overall. In Wainwright, mean social inflows to high-harvest households were 5.3 times greater than that of low-harvest households (2698 kg compared to 505 kg), and Kaktovik and Venetie patterns were even more skewed (15 times greater in Kaktovik, 3559 kg compared to 234 kg; and ~13 times greater in Venetie, 1228 kg compared to 98 kg). Social relationships therefore represented a critical means of accessing wild foods for low-harvest households.

Economic attributes (IN, EW and EM) varied widely across harvest-income groups, but results clustered largely by income. There was remarkable similarity in the distribution of income in coastal communities relative to Venetie, where mean incomes for all harvest-income combinations were lower (Supplemental Table 5-2). Particularly in Venetie, there was more overlap between employment ratios of different income groups, but high income groups in this community still had higher employment ratios for women and men.

5.4.1.2 Sensitivity Profiles and Quadrants

We approached sensitivity in two ways. Figure 5-5 overlays harvest-income group means for each community's sensitivity attributes. Sensitivity patterns vary across groups, with striking differences between high harvest and income households compared to low harvest and income households (top right vs. bottom left). The inverted pattern of harvest and income and dependence on social inflows is clear. However, sensitivity patterns for other harvest-income groups are more mixed. Here, consideration of sensitivity as emerging from a combination of diversity and magnitude of dependence is useful.

After calculating magnitude and diversity scores across the three study communities (Table 5-3), we ranked households by their magnitude and diversity scores, and sorted households into four sensitivity quadrants (Figure 5-1). The proportions of households that sorted into the four sensitivity quadrants were comparable (Table 5-5). Overall, seventy-six percent of households sorted into either the "high sensitivity" or "low sensitivity" groups, while the remaining 24% sorted into either the "spread-thin" or "unbalanced" groups. Across communities, magnitude scores ranged from .129 to .644, while diversity scores ranged from .192 to .976 (Supplemental Table 5-3).

Figure 5-6A to Figure 5-6C illustrate the ranges of diversity and magnitude scores, as well as how scores mapped onto the four sensitivity quadrants. Figure 5-6D compares the ranges of scores by community. Diversity scores were similar across communities, but magnitudes were substantially lower in Venetie. In every community, a strong positive correlation emerged between magnitude and diversity (Wainwright $r=.554$; Kaktovik $r=.676$, Venetie $r=.740$, all significant at the $p<.01$ level).

Figure 5-7 overlays membership in sensitivity quadrants on the nine harvest-income groups. Patterns diverge within communities, but diverge in consistent ways across communities, eg 93% of low sensitivity households have high or medium harvests and incomes, while 91% of high sensitivity households have medium or low harvests and incomes. Unbalanced and spread-thin households are more widely dispersed across harvest-income groups. Spread-thin households are

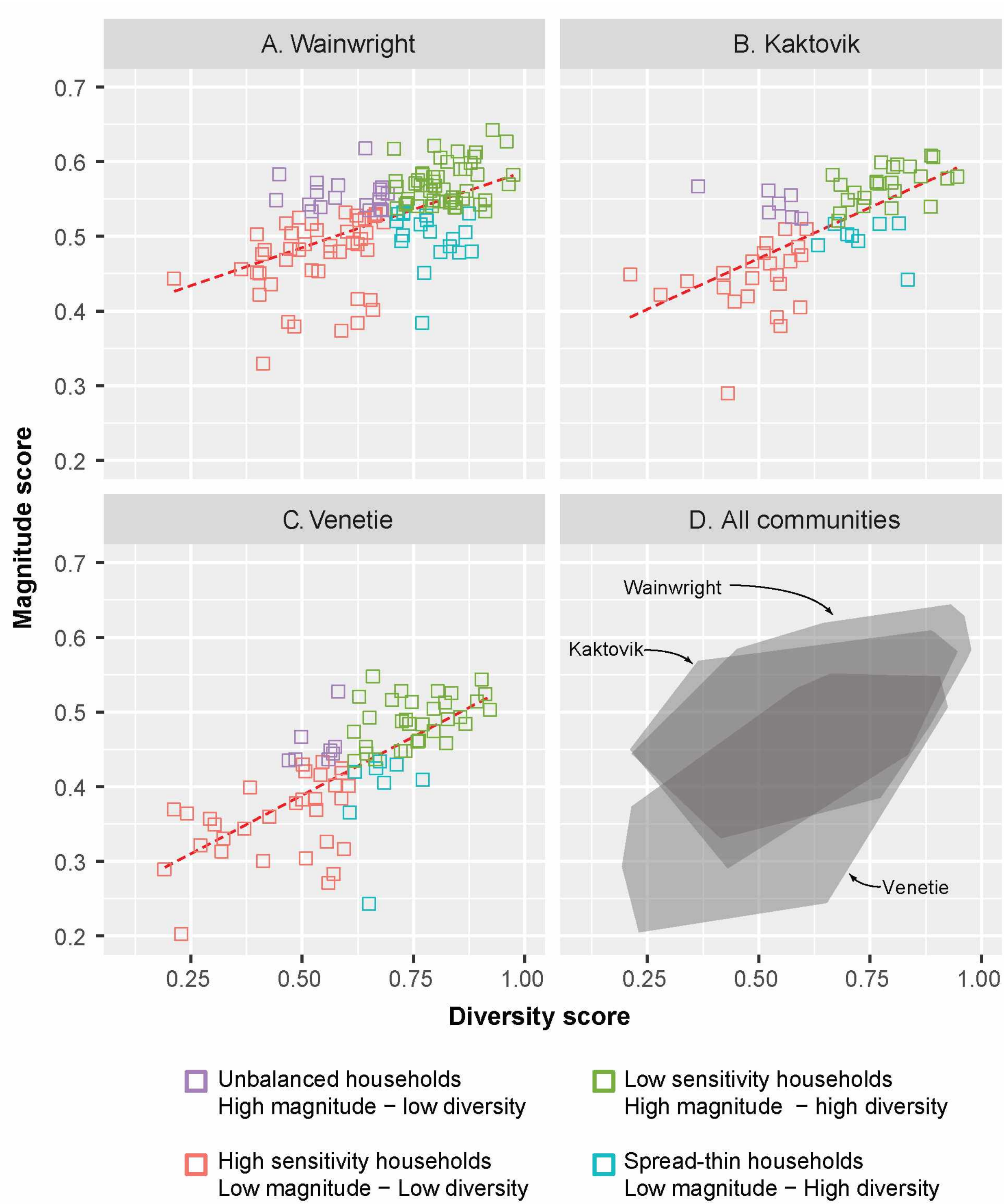

Figure 5-6 Households sorted into sensitivity quadrants by magnitude and diversity.

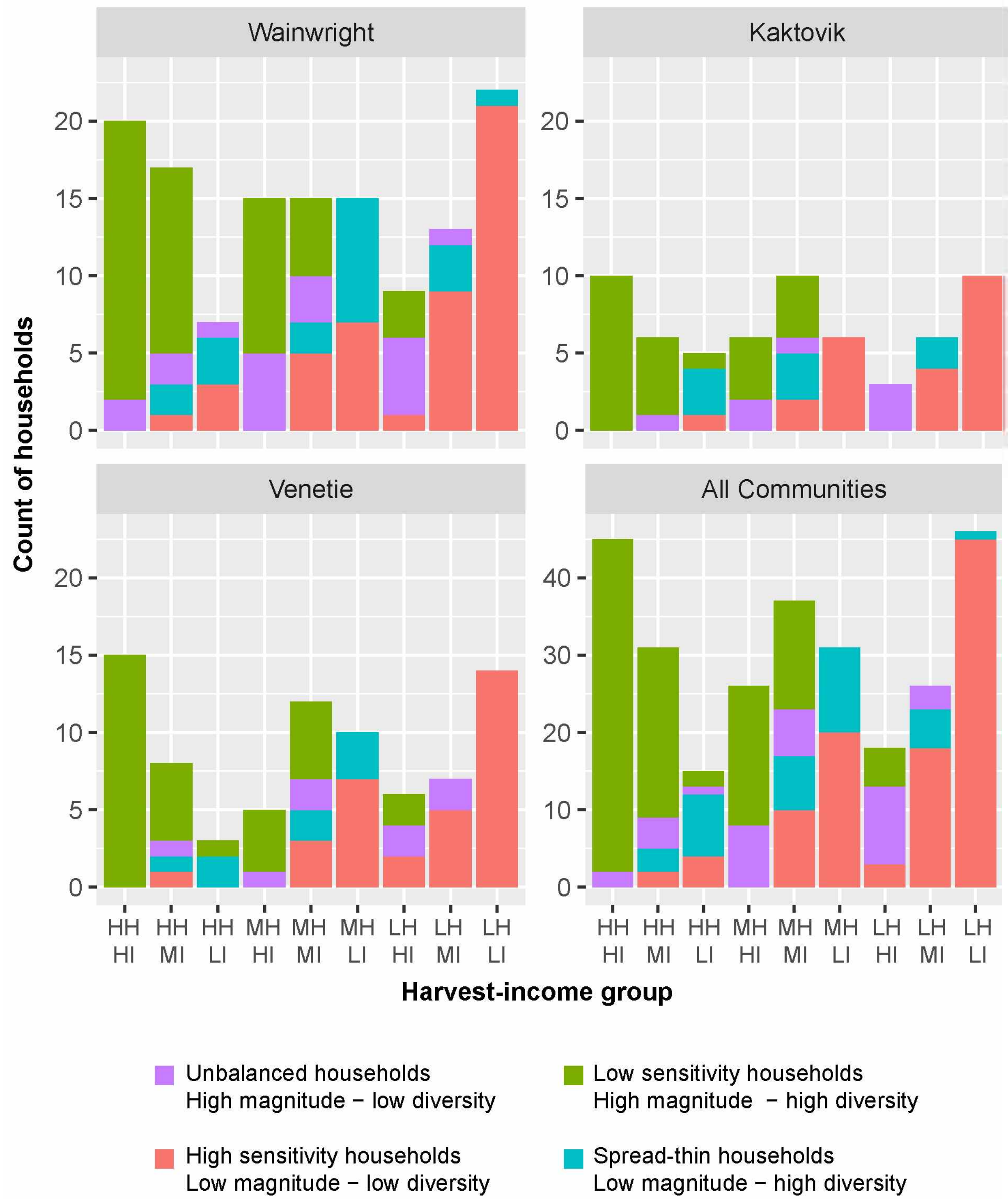

Figure 5-7 Number of households by sensitivity quadrant and harvest-income group.

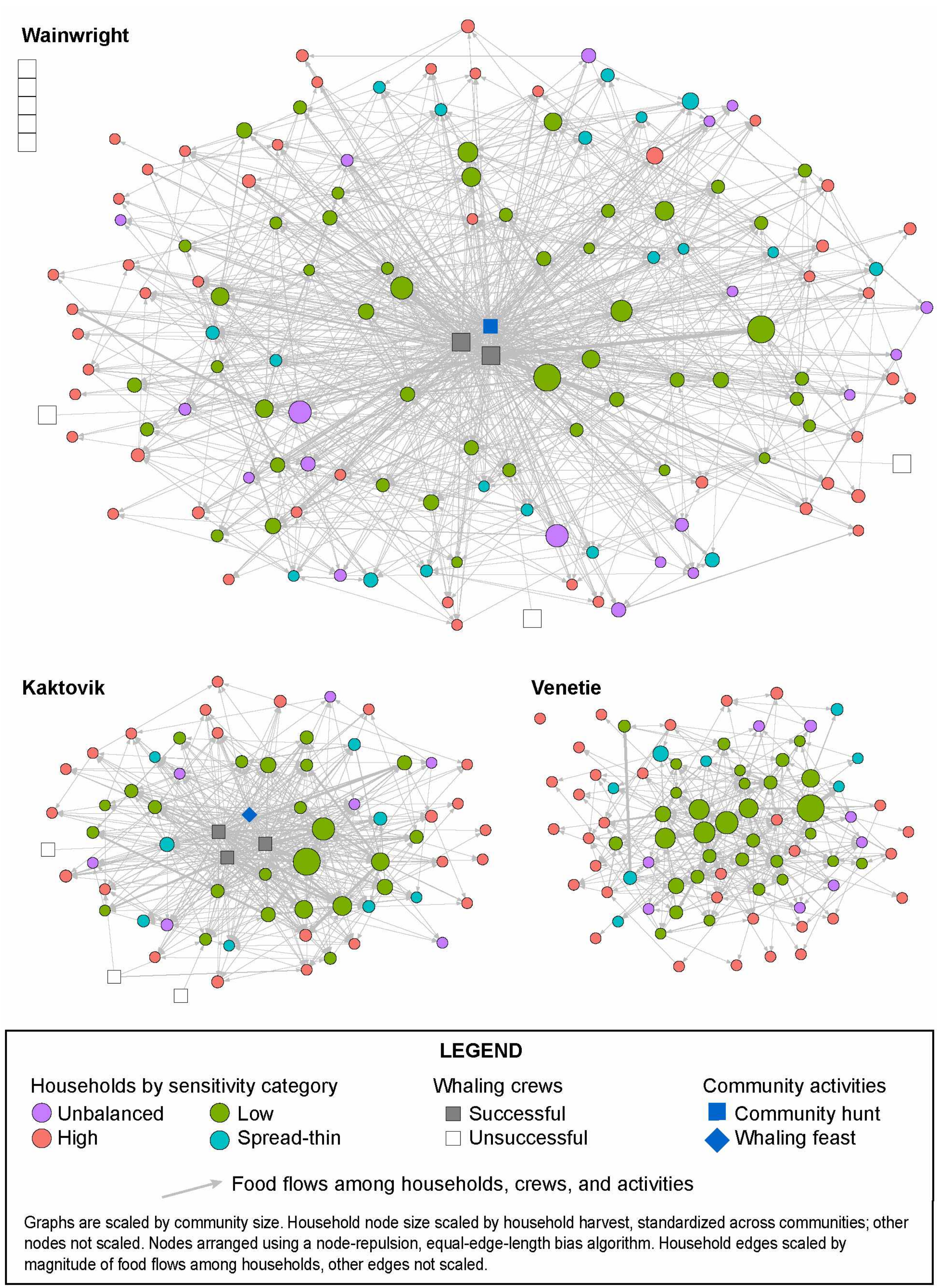

Figure 5-8 Wild food flows in Wainwright, Kaktovik, and Venetie.

most likely to be in the medium-harvest, low-income group (31%). Unbalanced households are most likely to be in the low-harvest, high-income group (29%), households heavily dependent on high paying (and rare) jobs. Magnitude and diversity metrics illustrate a variety of household economic strategies, suggesting household sensitivities would depend on the nature and extent of exposures. Figure 5-8 locates households, crews, and community hunts in the wild food networks of each community, where network position is a function of connectedness (eg degree) and household harvest. High-sensitivity households appear on the periphery, weakly connected to the community, while low sensitivity households appear in the core, strongly connected to the community.

5.4.2 Adaptive Capacity

5.4.2.1 Adaptive Capacity Attributes

Turning now to the eight adaptive capacity variables, six attributes varied across harvest-income groups and communities, while two diverged very little (Figure 5-4). Across communities, but particularly in Kaktovik, high and medium harvesting households with high incomes had more active harvesting and processing labour (HP – human capital), and low harvest- low and medium income groups had less. However, 93%, 86% and 89% of low harvest households in Wainwright, Kaktovik and Venetie, respectively, had at least one active processor or hunter (as reported by self or others).

Summer and winter equipment (SE and WE) represent both infrastructure and economic assets available to households. Across communities, high values for these attributes were linked to higher mean harvest and income. For example, in Wainwright, there is a large gap between average ownership of seasonal equipment by high harvest-high income households and other groups (Supplemental Table 5-2) that in real terms represents a difference of 3.0 and 2.8 pieces of equipment owned by this group compared to 1.4 for winter and summer owned by the next closest groups (Supplemental Table 5-2).

The number of core resources harvested, fished or gathered (CR, a form of natural capital) in all communities was ordered high to low by harvest tercile. In all communities, high harvest and income groups pursued the most resources (Supplemental Table 5-1), a result potentially linked to available transportation (SE and WE above) and available income for gas, etc.

Inflows of adjacent households (AI) represent potentially accessible wild food resources between connected alter households, so could act as a form of "stored" social capital. Mean AI for communities were significantly different, with Kaktovik highest. Figure 5-4 illustrates the difference is due to high mean AI for the three high and two medium harvest (medium and low income) groups in this community. High harvest-high income groups also had the highest AI in Wainwright and Venetie, but the range of mean values was narrower. Lower AI values could stem from lower harvests overall or a higher frequency of connections between alters with diverse inflow values. Kaktovik results suggest that households from high harvest groups are tightly connected to other high harvesters. Similarly, low AI in Venetie could reflect lower overall harvest values. Household degree (HD) also reflects social capital. Similar to core resources, household degree was clustered by harvest from high to low, with income groups ordered randomly within harvest terciles.

Two attributes representing human capital within households varied little across harvest-income groups or between communities. Ninety-five and 92% of household heads in Wainwright and Venetie, respectively, had achieved a high school diploma or passed the equivalent General Educational Development test (GED). Kaktovik had a wider range of educational attainment across groups (73% finished high school or achieved some college education). There were not clear relationships between ED, income or harvest.

The PR attribute indicates the ratio of productive aged individuals within households compared to dependents. PR values were negatively correlated with household size in all communities (Spearman's Rho = -.564, -.694 and -.786 in Wainwright, Kaktovik and Venetie, respectively; $p<.01$). However, attribute values were insensitive to harvest-income characteristics.

5.4.2.2 Adaptive Capacity Profiles

Having higher AC values is positive for households, as more assets imply greater flexibility to cope with changes. Moving in Figure 5-5 from high to low harvest (top to bottom) and high to low income (right to left), AC assets steadily shrink. Differences between mean asset values for high harvest and income compared to low harvest and income groups in Figure 5-5 are particularly striking. AC profiles at the top right are robust across all assets. In contrast, the AC profiles of low harvest groups are close to zero except for the HD, PR and ED attributes. The PR and ED attributes varied little across harvest-income groups and communities. Low harvest households clearly had less labour, equipment, hunted/fished/gathered resources, fewer highly productive alters and fewer ties with others. Household degree (HD) declined by harvest tercile, but the three low harvest groups in communities are not entirely isolated. Low harvest households maintained ties with others across income categories (Wainwright - high income=21, medium=23 and low=20 ties; Kaktovik - high=23, medium=17 and low=13 ties; Venetie – high=11, medium=16 and low=10 ties). Harvest-income groups in Venetie had lower mean values for most assets than coastal communities. This was particularly true for low harvest and income households.

In combination, figures 5, 6 7 illustrate the wide range of mean values for combined S and AC attributes for household groups. We did not set out to quantify the distribution of sensitive and adaptive capacity in communities. However, clearly household groups with fewer assets on average and so lower adaptive capacity, also have either higher sensitivity, or tend to have a combination of unbalanced or spread-thin sensitivity. Household sensitivities, capabilities and assets within these three mixed economies exhibit significant diversity.

5.5 Discussion

In this paper, we explored livelihood strategies, assets and capabilities at community and household scales in three, remote Arctic communities. These Iñupiat and Gwich'in communities represent mixed economies in which people employ a variety of economic strategies, and hunt, fish, gather, and cooperate to access wild foods and other resources. As our starting point, we took the findings of multiple community-scale vulnerability studies, which suggested economic and climatic changes in the Arctic are leading to greater livelihood diversity over time (Ford et al 2008), with corresponding implications for economic (in)equality and other social and health outcomes (Fergul & Sequin 2006, Dow et al 2006). Then, we explored livelihood diversity at less-than-community scales using quantitative household-level data, applying two constructs from the vulnerability literature – sensitivity and adaptive capacity – to systematically explore emerging livelihood patterns across a range of social and economic attributes.

At community-scales, results highlighted similarities between Wainwright and Kaktovik on the Arctic coast, compared with Venetie in the Arctic interior (Figure 5-3, Table 5-4). Magnitudes of harvests, incomes (sensitivity attributes) and adjacent inflows and household degree (AC attributes) were significantly higher in the two coastal communities, hinting at greater sensitivity and lower adaptive capacity in Alaska's interior. Additional sensitivity analyses identified that Venetie livelihood activities were comparable in terms of diversity, but the magnitude of resources flowing into interior households was low relative to coastal communities (Figure 5-6). These differences are not unexpected, given greater industrial activity and employment opportunities on the North Slope, as well as a coastal resource base that includes whaling and straddles both marine and terrestrial environments.

At less-than-community scale, sorting households into nine harvest-and-income groups revealed a wide range of values on sensitivity and adaptive capacity attributes (Figures 5-5). Variability in income and harvests highlighted other persistent relationships between employment, subsistence labour, cooperative ties and better access to equipment characteristic of Inupiaq and Gwich'in life (Kruse 1991, Caulfield 1983) Low-harvest groups depended more on social inflows for access to wild foods than high-harvest groups. They also received far less wild food in real terms, but sharing of wild foods clearly increased equity of access in communities. Harvest and income group comparisons across the 13 attributes emphasize that community-scale comparisons are insufficient for thinking about vulnerability in Arctic mixed economies. Other studies of contemporary hunter-gatherers (Lu 2007 for Shuar communities), and researchers working with non-hunter gatherer populations (eg Eakin & Bojorquez-Tapia 2008 for Mexican small-scale agriculturalists, BurnSilver 2016 for Maasai pastoralists) also make this point.

At the household scale, we conceptualized and quantified potential sensitivity across three domains of mixed economies – subsistence harvest, employment/income, and social relations – as a function of both magnitude and diversity (Figure 5-6 and Table 5-5). The exercise revealed a bifurcated distribution of sensitivity, three out of four households sorted into either high or low sensitivity quadrants, with the remaining quarter of households similarly distributed into the unbalanced and spread-thin quadrants. In all three communities, magnitude and diversity were strongly associated (explaining 31-52% of the observed variation, depending on the community).

Finally, we explored an expanded definition of sensitivity (Figure 5-7). Harvest-income groups and sensitivity quadrants agreed at the extremes, but for households in the middle of the harvest-income distribution, diversity/magnitude scores provided a more nuanced perspective on the sources of household differences. The relative size of specific sensitivity or adaptive capacity categories is less important than appreciating that households may be sensitive for many reasons and category membership is not fixed in time. Compared with adaptive capacity, sensitivity to change has been under-thought at the household level in the Arctic and elsewhere. In a mixed economy – where households pursue diverse economic strategies in multiple economic domains – magnitude alone is insufficient to represent "sensitivity as dependence". Magnitude and diversity co-vary, giving rise to different types of sensitivity.

In this paper we deliberately did not evaluate specific exposures, changes or opportunities affecting Wainwright, Kaktovik and Venetie. There has been a tendency to focus on climate change as the dominant driver affecting Arctic indigenous communities (Larsen & Fondahl 2014, McCarthy et al 2005; Brinkman et al 2016). Climate change undoubtably has great potential to disrupt infrastructure, species distributions, and harvest patterns - such as in Wainwright having solid multi-year ice on which to land a spring bowhead whale. But emphasizing climate ignores other existing issues, including cultural, health, economic, industrial, and political challenges

(Cameron 2012). Relative to the historic boom and bust cycles of Alaska oil, gas, and industrial development, climate change is relatively slow. Future vulnerability work that identifies – with communities – relevant household-level attributes and the constellation of exposures and opportunities of greatest concern would highlight context-specific diversity of experiences in communities that defines outcomes of change.

While our results suggest inequality of access to food, hunting resources and income, our data are limited to one time point. We cannot know how these economies will change or how flexibly households are able to respond to opportunities and challenges. Spread thin and imbalanced households – or for that matter even low sensitivity/high AC households - may tip into other conditions as they experience challenges and opportunities. Migration from northern Alaska villages to regional or urban centers occurs, but decisions are mitigated by subsistence engagement, age, gender and economic conditions and some northern villages have also experienced net in-migration over time (Huskey 2009). While social relationships play an important role in accessing resources (Lin 2001) and adaptation (Adger 2003), a point echoed in our analyses (Figure 5-8), Letki (2008) and Putnam (2007) emphasize that emerging economic heterogeneity could signal future declines in social cohesion.

Similar to consistent calls made by many hunter-gatherer researchers (Wong & Godoy 2003, Godoy et al 2005a, Davies et al 2014, Maru et al 2014), the Arctic needs robust longitudinal and cross-community research comparing linked cultural, social, economic, and harvest patterns. Social network methods are emerging as a methodologically sophisticated way to bridge social, economic, and subsistence dimensions of mixed livelihoods. These approaches facilitate understanding of processes and dynamics that structure or mitigate inequalities and risk within mixed economies over time. While vulnerability analyses may describe conditions at one point in time, resilience approaches require this temporal and dynamic lens on change. Both approaches have been criticized as overly normative, a-cultural and mute on issues of power and equity (Nadasdy 2007, Cameron 2012). Mixed methods approaches that integrate ethnography with empirical research can speak to the narratives of northern cultural identity and well-being that are ultimately the foundation on which mixed economies and livelihoods will persist and thrive.

Indigenous hunter-gatherer groups have long been portrayed as adaptive and flexible as they engaged with challenging environments. Community vulnerability and resilience narratives often under- or over-emphasize the capabilities of hunter-gatherers to adapt. Narratives that portray modern hunter-gatherers as homogeneous ultimately do a disservice to hunter-gatherer engagement in and responses to processes of dynamic change.

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5.7 Supplemental Materials

SUPPLEMENTAL TABLE 5-1 MEAN VALUES – UNTRANSFORMED SENSITIVITY AND ADAPTIVE CAPACITY ATTRIBUTES

Harvest	High			Medium			Low			
Income	High	Medium	Low	High	Medium	Low	High	Medium	Low	*All*
Wainwright										
N	20	17	7	15	15	15	9	13	22	*133*
Sensitivity attributes										
HH	5900	4360	4813	1083	1160	1065	173	148	21	*2101*
SI	16	19	14	50	42	38	87	84	98	*50*
HI	155,545	74,850	34,350	131,375	78,238	33,037	134,102	81,113	38,127	*85,442*
EW	4.8	2.7	2.4	6.0	4.8	3.4	5.6	3.0	2.2	*3.8*
EM	7.5	6.3	2.7	7.4	3.3	3.2	7.5	4.6	0.3	*4.6*
Adaptive capacity attributes										
ED	3.3	3.0	3.3	3.1	3.1	2.9	3.4	3.1	2.8	*3.1*
NP	7.3	4.8	3.4	6.1	4.3	3.4	4.0	2.7	2.1	*4.3*
PR	0.3	-0.3	0.4	0.2	0.5	0.6	0.4	0.1	0.4	*0.3*
SE	3.0	1.4	1.0	1.1	1.1	1.2	0.3	0.6	0.3	*1.2*
SW	2.8	1.2	1.4	1.2	0.9	0.7	0.3	0.7	0.3	*1.1*
CR	5.6	5.1	5.0	4.1	3.7	4.1	1.6	1.8	1.1	*3.5*
AI	38,104	32,748	20,360	36,733	23,668	28,052	19,834	20,318	13,476	*26,520*
HD	57.2	48.7	34.7	38.0	29.9	30.3	20.9	23.4	19.5	*34.7*
Kaktovik										
N	10	6	5	6	10	6	3	6	10	*62*
Sensitivity attributes										
HH	7932	6258	3094	675	1174	881	0	37	28	*2482*
SI	25	18	25	58	48	40	100	83	89	*52*
HI	122,337	85,160	35,638	130,373	70,966	27,359	144,737	75,747	31,244	*76,931*
EW	7.3	6.3	4.0	5.4	6.2	2.3	3.0	3.6	5.6	*5.3*
EM	6.9	4.7	0.9	7.8	6.0	2.5	10.0	1.2	0.2	*4.2*
Adaptive capacity attributes										
ED	3.3	2.3	2.6	3.3	2.6	2.7	2.5	3.3	2.9	*2.9*
NP	10.2	7.7	3.8	8.0	4.5	3.8	2.0	3.3	2.2	*5.3*
PR	0.3	0.7	0.7	0.5	0.7	1.0	1.0	0.0	0.9	*0.6*
SE	1.9	2.2	1.2	1.2	1.4	0.2	1.0	0.2	0.3	*1.1*
SW	2.1	1.3	2.0	0.8	1.2	0.5	1.0	0.0	0.0	*1.0*
CR	5.3	4.7	4.4	3.0	3.5	2.2	0.3	1.0	0.8	*3.0*
AI	66,409	68,828	62,301	32,386	49,812	47,587	61,212	30,085	24,724	*48,031*
HD	77.9	95.2	53.4	25.5	65.1	25.5	33.3	17.3	12.8	*46.9*
Venetie										
N	15	8	3	5	12	10	6	7	14	*80*
Sensitivity attributes										
HH	2196	1318	3316	205	125	143	12	1	4	*719*
SI	22	20	18	70	55	64	95	99	83	*58*
HI	63,657	30,918	16,363	58,922	34,218	11,876	61,811	25,037	10,515	*34,608*
EW	4.9	3.9	2.3	8.5	3.0	1.7	2.9	1.8	1.6	*3.2*
EM	7.3	4.4	0.3	5.5	3.3	3.0	6.3	2.2	1.9	*4.0*
Adaptive capacity attributes										
ED	2.9	3.0	3.3	2.8	3.2	3.0	3.2	2.3	2.9	*3.0*
NP	5.9	4.5	5.7	6.2	4.4	3.5	3.5	1.9	1.2	*3.9*
PR	0.2	0.5	0.8	0.1	0.1	0.5	-0.1	0.9	1.0	*0.4*
SE	1.8	0.5	0.7	1.6	0.8	0.5	1.0	0.1	0.1	*0.8*
SW	1.4	0.9	0.7	1.4	0.5	0.3	0.8	0.1	0.0	*0.7*
CR	5.7	4.8	5.7	3.8	2.6	3.3	1.2	0.1	0.7	*3.0*
AI	22,279	10,176	15,962	19,994	15,012	10,272	7224	9579	8281	*13,408*
HD	55.5	30.6	32.3	30.8	25.3	15.7	10.8	15.6	10.4	*26.4*

*See Table 2 in main text for key to abbreviations

SUPPLEMENTAL TABLE 5-2 MEAN VALUES – STANDARDIZED AND TRANSFORMED SENSITIVITY AND ADAPTIVE CAPACITY ATTRIBUTES

Harvest	High			Medium			Low			
Income	High	Med	Low	High	Med	Low	High	Med	Low	*All*
Wainwright										
N	20	17	7	15	15	15	9	13	22	*133*
Sensitivity attributes										
HH	0.84	0.82	0.83	0.68	0.69	0.68	0.31	0.29	0.10	0.57
SI	0.16	0.19	0.14	0.50	0.42	0.38	0.87	0.84	0.98	0.50
HI	0.88	0.74	0.54	0.85	0.75	0.54	0.85	0.76	0.58	0.73
EW	0.43	0.27	0.22	0.53	0.41	0.23	0.48	0.32	0.24	0.35
EM	0.57	0.49	0.20	0.59	0.29	0.23	0.58	0.36	0.04	0.36
Adaptive capacity attributes										
ED	0.58	0.50	0.57	0.52	0.52	0.48	0.61	0.52	0.45	*0.52*
NP	0.52	0.34	0.24	0.43	0.31	0.24	0.29	0.19	0.15	*0.31*
PR	0.85	0.71	0.86	0.82	0.88	0.90	0.87	0.80	0.87	*0.84*
SE	0.62	0.36	0.24	0.26	0.32	0.28	0.07	0.17	0.08	*0.28*
SW	0.56	0.32	0.33	0.33	0.25	0.19	0.11	0.20	0.08	*0.27*
CR	0.79	0.72	0.71	0.58	0.53	0.58	0.22	0.26	0.16	*0.51*
AI	0.31	0.26	0.16	0.30	0.19	0.23	0.16	0.16	0.11	*0.21*
HD	0.71	0.69	0.64	0.63	0.60	0.60	0.53	0.53	0.52	*0.61*
Kaktovik										
N	10	6	5	6	10	6	3	6	10	*62*
Sensitivity attributes										
HH	0.86	0.84	0.79	0.62	0.67	0.65	0.00	0.26	0.20	0.57
SI	0.25	0.18	0.25	0.58	0.48	0.40	1.00	0.83	0.89	0.52
HI	0.84	0.77	0.58	0.85	0.73	0.51	0.87	0.74	0.53	0.71
EW	0.63	0.55	0.37	0.52	0.42	0.21	0.24	0.33	0.33	0.42
EM	0.59	0.39	0.13	0.62	0.43	0.21	0.52	0.14	0.03	0.34
Adaptive capacity attributes										
ED	0.58	0.33	0.40	0.58	0.41	0.42	0.38	0.58	0.48	0.47
NP	0.73	0.55	0.27	0.57	0.32	0.27	0.14	0.24	0.16	0.38
PR	0.84	0.93	0.94	0.89	0.93	1.00	1.00	0.77	0.98	0.92
SE	0.47	0.42	0.32	0.34	0.35	0.06	0.29	0.06	0.10	0.27
SW	0.46	0.33	0.45	0.24	0.27	0.14	0.27	0.00	0.00	0.24
CR	0.76	0.67	0.63	0.43	0.50	0.31	0.05	0.14	0.11	0.41
AI	0.54	0.56	0.50	0.26	0.40	0.38	0.49	0.24	0.20	0.39
HD	0.76	0.77	0.70	0.57	0.70	0.55	0.57	0.46	0.44	0.62
Venetie										
N	15	8	3	5	12	10	6	7	14	*80*
Sensitivity attributes										
HH	0.73	0.69	0.74	0.50	0.46	0.46	0.19	0.03	0.07	0.42
SI	0.22	0.20	0.18	0.70	0.55	0.64	0.95	0.99	0.83	0.58
HI	0.70	0.56	0.43	0.68	0.58	0.34	0.69	0.51	0.33	0.53
EW	0.41	0.27	0.26	0.58	0.30	0.17	0.27	0.18	0.07	0.26
EM	0.52	0.40	0.05	0.40	0.37	0.26	0.37	0.28	0.25	0.35
Adaptive capacity attributes										
ED	0.48	0.50	0.58	0.45	0.54	0.50	0.54	0.32	0.48	0.49
NP	0.42	0.32	0.40	0.44	0.32	0.25	0.25	0.13	0.09	0.28
PR	0.82	0.88	0.96	0.79	0.79	0.88	0.76	0.98	1.00	0.88
SE	0.46	0.17	0.18	0.45	0.24	0.13	0.29	0.05	0.02	0.22
SW	0.36	0.28	0.21	0.39	0.16	0.10	0.24	0.05	0.00	0.19
CR	0.81	0.68	0.81	0.54	0.37	0.47	0.17	0.02	0.10	0.43
AI	0.18	0.08	0.13	0.16	0.12	0.08	0.06	0.08	0.07	0.11
HD	0.70	0.58	0.56	0.60	0.57	0.45	0.40	0.44	0.36	0.52

*See Table 2 in main text for key to abbreviations

SUPPLEMENTAL TABLE 5-3 STANDARDIZED MAGNITUDE AND SENSITIVITY SCORES, BY QUADRANT AND COMMUNITY

	Wainwright				Kaktovik				Venetie				All Communities			
	Min	Med	Max	Sdev	Min	Med	Max	Sdev	Min	Med	Max	Sdev	Min	Med	Max	Sdev
Low sensitivity (high magnitude - high diversity)																
Magnitude	0.535	0.569	0.644	0.028	0.522	0.573	0.609	0.024	0.439	0.495	0.553	0.032	0.439	0.551	0.644	0.045
Diversity	0.708	0.816	0.976	0.069	0.668	0.789	0.948	0.081	0.619	0.755	0.923	0.091	0.619	0.798	0.976	0.083
Unbalanced (high magnitude - low diversity)																
Magnitude	0.535	0.553	0.619	0.021	0.525	0.545	0.568	0.018	0.440	0.451	0.533	0.031	0.440	0.544	0.619	0.046
Diversity	0.444	0.644	0.694	0.084	0.366	0.548	0.597	0.077	0.471	0.563	0.583	0.045	0.366	0.573	0.694	0.080
Spread thin (low magnitude - high diversity)																
Magnitude	0.385	0.507	0.534	0.036	0.443	0.503	0.518	0.025	0.248	0.420	0.439	0.064	0.248	0.495	0.534	0.060
Diversity	0.714	0.781	0.882	0.057	0.635	0.719	0.837	0.070	0.609	0.672	0.773	0.052	0.609	0.729	0.882	0.074
High sensitivity (low magnitude - low diversity)																
Magnitude	0.331	0.483	0.533	0.049	0.291	0.449	0.511	0.048	0.129	0.367	0.438	0.068	0.129	0.440	0.533	0.076
Diversity	0.214	0.535	0.685	0.106	0.214	0.519	0.610	0.102	0.192	0.503	0.606	0.138	0.192	0.516	0.685	0.122
Community scores																
Magnitude	0.331	0.535	0.644	0.058	0.291	0.520	0.609	0.067	0.129	0.439	0.553	0.083	0.129	0.507	0.644	0.081
Diversity	0.214	0.708	0.976	0.158	0.214	0.652	0.948	0.165	0.192	0.608	0.923	0.181	0.192	0.666	0.976	0.170

Chapter 6 Summary and Discussion
The Construction of Subsistence Narratives

"Subsistence," Morehouse and Holleman (1994) wrote, "may be the most deeply divisive issue in Alaska since statehood… The conflict of fundamental values – equal rights versus cultural survival – is likely to continue indefinitely, no matter what the courts or legislatures may do." Rather than resolve value conflicts, Morehouse and Holleman suggested, Alaskans "can focus on the material or economic problems of resource conservation and allocation, which, unlike value conflicts, are more susceptible to compromise." Since long before statehood, Alaskans have been doing exactly that, choosing to make pragmatic compromises or being forced to accept compromises imposed by administrators and legislators and judges (cf. Kancewick and Smith 1990, Mitchell 1997, 2001, Hensley 2014). Those compromises, however, were deeply unsatisfying to many Alaskans. Few seemed to be abandoning their fundamental values (cf. Somerville 2013, Citizens' Advisory Commission on Federal Areas 2017, Anderson 2019), and many often were receptive to subsistence narratives that reinforced their beliefs.

This final chapter summarizes the results chapters of this dissertation. Then it applies a political ecology perspective to subsistence economies in rural Alaska, deconstructing two influential Alaskans' subsistence narratives using results from this dissertation and the broader literature. The discussion also briefly illustrates how the same observations could drive competing narratives, and concludes with a discussion of how resource management itself was subject to narrative construction.

6.1 Summary of Results

This dissertation described certain aspects of contemporary mixed economies in rural Alaska, finding generally persistent community populations, subsistence harvests, and personal incomes, yet also finding diverse community and household situations. In Chapter 3, the data suggested that one of the most important challenges facing rural Alaska communities in the last 30 years has not been declining subsistence harvests, but stagnant personal incomes amid rising costs for imported fuel and other goods. The lack of a significant change in subsistence harvests in the mostly road-connected “other rural” region from 1983 to 2013, despite the doubling of Alaska’s urban population, suggested that subsistence priority laws were having an effect. There also was strong evidence that road access had a large negative impact on subsistence harvests, but weak evidence for any impact on personal incomes. It was noted that the ANICLA provision limiting subsistence opportunities to local rural residents of areas with customary and traditional uses created an enforceable de jur boundary, but users could move into and out of rural communities so it was not a closed class. The ends of the road system functioned as a de facto boundary between urban Alaska and rural communities.

Chapter 3 also focused attention on influential factors which potentially could influence subsistence production. Some factors were “slow” or unchanging variables – geographic location, ethnicity, mean income. Other factors were “fast” variables subject to abrupt change – subsistence priority laws, natural resource abundance, and road access – and had governance dimensions. The governance dimensions involved legislatures, courts, and management agencies. A single court decision could upend subsistence priority laws, as did McDowell v. State (1989). Resource declines, such as the recent steep declines in Chinook salmon abundance in the Yukon and Kuskokwim watersheds, could precipitate large changes in harvests and harvest distribution patterns among local households (Brown et al. 2019). A single road, such as the proposed 211-mile road to the Ambler Mining District in northwestern Alaska (Bureau of Land Management 2019), could open large portions of remote rural census areas to access by urban populations.

Chapter 4 focused on the mixed economy phenomenon in two Inuit communities, and introduced another variable, social relations. Researchers measured flows of subsistence foods among households through 16 discrete social relations (own harvests, cooperative harvests, sharing, crew shares, etc.), and found that households’ own harvests provided an average of 21% of total food flows in Kaktovik and 25% in Wainwright. The balance of households’ subsistence foods was obtained through cooperative social relations.

While the two communities analyzed in Chapter 4 could not provide the same level of statistical confidence as the 179 communities analyzed in Chapter 3, findings in Chapter 4 were consistent with findings in Chapter 3. Per capita harvests and incomes over time were not decreasing. The data did not support the market transition hypothesis in which subsistence harvests decreased with increases in income. Instead, households' subsistence harvests tended to rise with incomes, a positive (albeit weak) association. Outflows of subsistence foods tended to increase and inflows of subsistence food tended to decrease with increases in household harvests and income. In other words, higher income households tended to harvest more and give away more. Lower income households tended to harvest less and receive more. These were expected patterns, but had not previously been documented empirically for subsistence-based communities.

Chapter 5 explored sensitivity and adaptive capacity at household scales in three northern Alaska communities using a range of variables and concepts from the vulnerability literature. Household sensitivity to economic or ecologic shocks was conceptualized in two dimensions – magnitude and diversity – resulting in four sensitivity quadrants. Magnitude was measured and standardized across three variables – income, harvests, and social relations – and averaged to provide a household magnitude score. Diversity was measured and standardized across three related variables – income types, resource types, and indegree (count of wild food ties from other households) – and averaged to provide a household diversity score. Households with high magnitude and diversity scores were considered to have low sensitivity. Conversely, households with low magnitude and diversity scores were considered to have high sensitivity.

Kaktovik, Venetie, and Wainwright exhibited similar levels of diversity, but different levels of magnitude. In all three communities, three out of four households sorted into either high or low sensitivity quadrants, with the remaining quarter of households similarly distributed into the unbalanced and spread-thin quadrants. In all three communities, magnitude and diversity were strongly associated (explaining 31-52% of the observed variation, depending on the community). In all three communities, high sensitivity households occupied peripheral positions in subsistence networks, while low sensitivity households occupied the core positions, even though social relations were only one of the three measured dimensions of sensitivity (Figure 5-8).

The bifurcated distributions of sensitivity categories pointed to inequalities of access to food, cash, and social capital among households, a relatively unexplored dimension of rural Alaska economies. Social network methods emerged as a methodologically sophisticated way to bridge social, economic, and subsistence dimensions of mixed livelihoods.

6.2 Why Narratives?

In 2012, the National Academy of Sciences (NAS) convened two colloquiums on "The Science of Science Communication" (Fischhoff and Scheufele 2014). Despite generous funding for science and unprecedented international collaborations among scientists, the organizers noted, "worrying minorities of the general public reject conclusions that are widely accepted in the scientific community." Participants noted that scientific debates "often blur the lines between the science that is being debated and the political, moral, and legal implications that come with its societal applications" (Scheufele 2014). In polarized political environments, Jamieson and Hardy (2014) suggested, science is best served "if scientists eschew advocacy" while presenting results clearly and if possible in "a visual form that involves the audience in drawing its own conclusions." Fiske and Dupree (2014) observed that even "Aristotle knew that communication is not just about logic and knowledge, but also about emotions and values," implying that scientists needed to work not only on demonstrating competence but also on gaining trust.

The NAS colloquiums explored the fundamental role of narratives ("storytelling") in science communication. "Narratives offer increased comprehension, interest, and engagement" for nonexpert audiences, yet the intrinsically persuasive nature of narratives can raise ethical issues (Dahlstrom 2014). "Well-crafted narratives can…confer undue credence on stories lacking a scientific foundation" (Fischhoff and Scheufele 2014). Given new information, people were more likely to try "to force it into [their] already established narratives" than to consider it on its merits (Gross 2018). And network science has shown how human social motives can be combined with

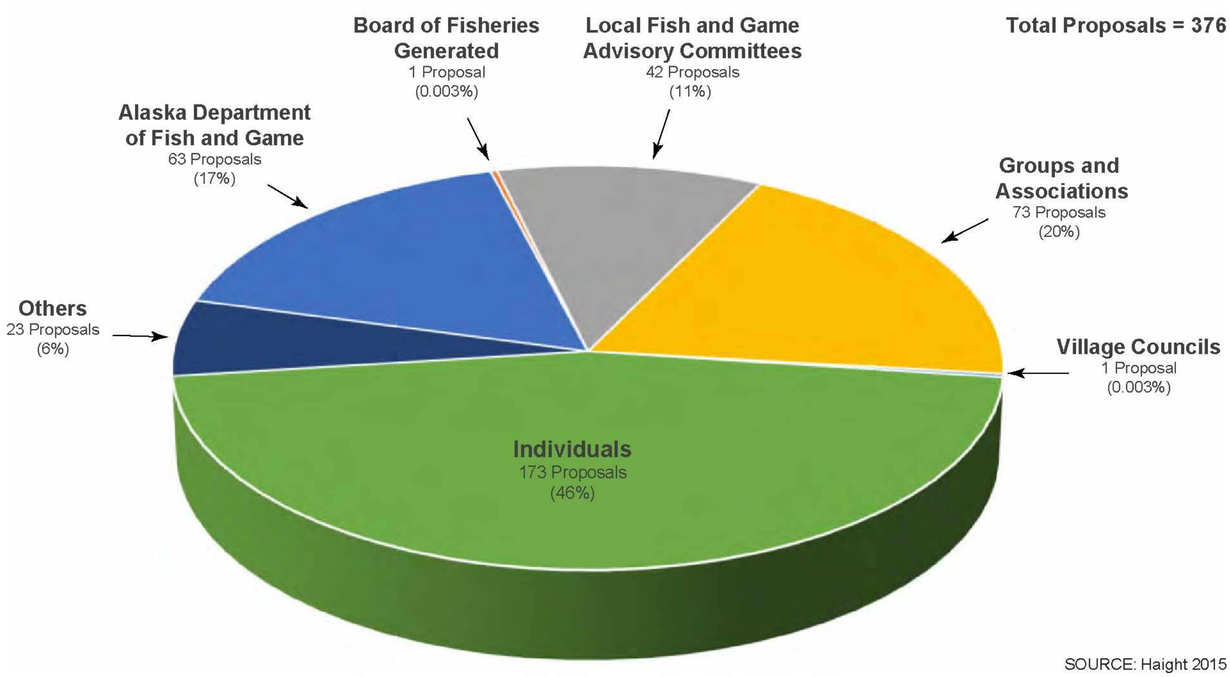

Figure 6-1 Sources of regulatory proposals to the Alaska Board of Fisheries, 2013-2014.

structured influence processes like social networks to achieve social influence at large scales (Contractor and DeChurch 2014).

Political ecologists have observed that the power to control narratives creates a link between the political and ecological (Robbins 2012), and this was true for Alaska. By design, in law, and in popular discourse, Alaska's citizens had important roles in managing Alaska's fish and wildlife resources (Alaska Legislature 2016). Any Alaskan could submit proposals to change hunting or fishing regulations, and hundreds did so every year (Haight 2015). Figure 6-1 illustrates the sources of proposals in one board cycle in the state system. In the state system regulatory authority rested with two state boards, while in the federal system regulatory authority was conditionally delegated to 12 Regional Advisory Councils. Either way, the fate of public proposals was decided in public forums, with testimony from the public, and by (federal) regional advisory councils or (state) Boards of Fisheries and Game whose politically appointed members usually were consumptive resource users. Council and board members had difficult jobs, making decisions that could reallocate resources worth millions of dollars among different uses, or restrict resource access for users with generational-scale histories of use. Subsistence priority laws provided guidelines for these decisions, which insulated council and board members from political pressures to some extent, but also could reduce political support among non-subsistence users for the laws themselves.

When issues were especially contentious – Area M salmon, Nelchina caribou – protestors sometimes demonstrated outside meetings, public testimony could go on for days, and regulatory decisions often were front-page news (cf. Gay 2004, deMarban 2006). Given the high stakes and public nature of fish and wildlife management in Alaska, it seemed inevitable that competing parties would construct narratives to influence resource decisions (cf. Simon and Clark 2019). One positive consequence of state and federal provisions for the collection and dissemination of reliable subsistence information was that the data made it easier to evaluate narratives of subsistence resource use in rural Alaska.

Still, evaluating those narratives could be difficult for the Alaska public, given that subsistence narratives might conflict with (or reinforce) deeply held beliefs and were difficult to verify from personal experience. It was less expensive for a resident of Anchorage or Fairbanks to vacation in Hawaii than to visit a remote Alaska village like Shungnak. Consequently, urban Alaskans rarely visited rural Alaska unless they had a business or recreational purpose. Rural Alaskans usually did have opportunities to travel to Anchorage or Fairbanks for meetings, medical care, or shopping, yet they were much less likely to visit remote rural regions other than their own for the same reason, high travel costs. These information imbalances could make it difficult for Alaskans to evaluate narratives about resource uses in other parts of their own state.

6.3 Narratives of Rural Alaska

Of interest in this dissertation were narratives Alaskans were telling themselves about rural Alaska situations, and whether they were fact-based or self-interested. Alaskans' narratives often contrasted urban and rural situations, where urban Alaska was seen as prosperous, developing, self-sufficient, and ethnically diverse, while rural Alaska was seen as disrupted, decaying,

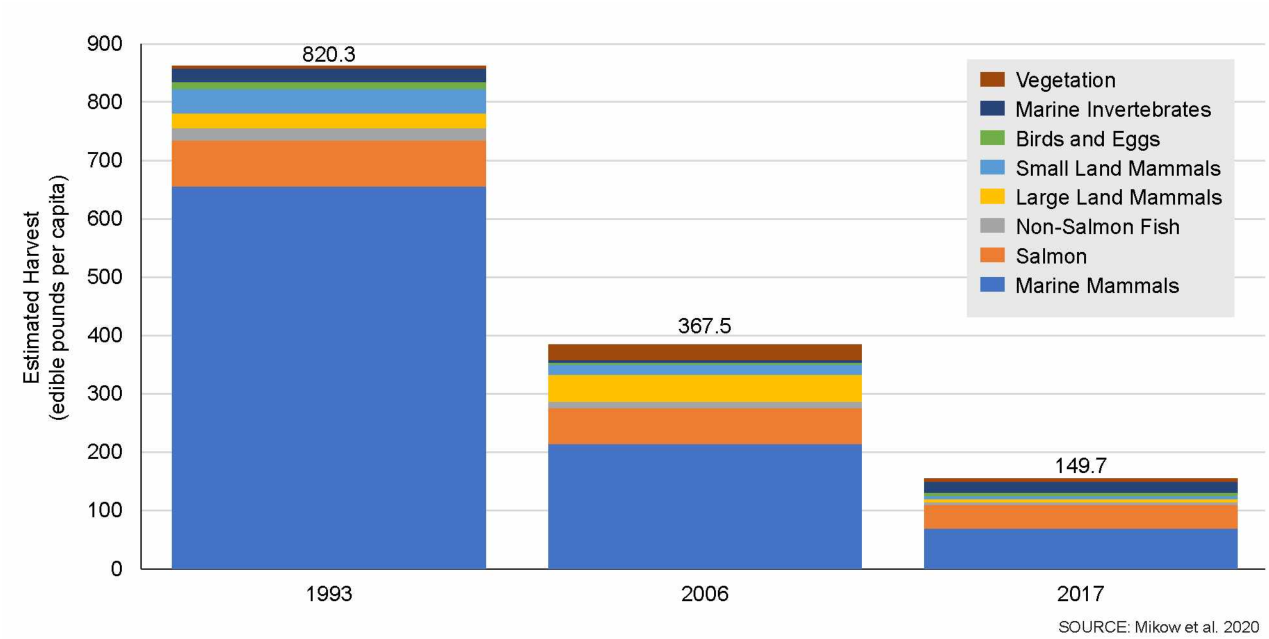

Figure 6-2 Estimated subsistence harvests by residents of Wales, Alaska, 1994, 2006, 2017.

dependent, and indigenous. Subsistence often was a central feature of these narratives, usually written from urban perspectives.

When it came to indigenous and subsistence situations in rural Alaska, narratives often were discouraging. For example, in June 2019 U.S. Attorney General William Barr declared a public safety emergency in rural Alaska to address concerns about the lack of police and high rates of family violence in rural Alaska (deMarban 2019). In January 2020, the Division of Subsistence published results of a third decennial comprehensive subsistence survey in Wales, Alaska, finding large declines in harvests over time, from an estimated 820 lbs. per capita in 1994 to only 149 lbs. per capita in 2017 (Mikow 2020). Wales depended heavily on marine mammals, which in turn depended on a stable ice platform and in 2017 the Bering Sea ice pack was at record lows. It was not surprisingly, then, that the largest declines in Wales' harvests were for marine mammals (Figure 6-2). In 2018, concerned about climate change and disappearing sea ice, an Iñupiaq mother in Unalakleet wrote in *The New York Times* about "The Bearded Seal My Son May Never Hunt" (Ivanoff 2018).

These narratives were based on observable, verifiable facts and reasonable expectations.

<table>
<tr><th>A. University of Alaska Economist</th><th>B. Former Alaska Governor</th></tr>
<tr><td>"Village Alaska no longer has a traditional, local-exchange economy based on subsistence activities, extended kin relationships, and sharing, though these traditional elements survive in modified forms. Nor has Village Alaska been integrated into the market economy, though cash and imported goods are indispensable there. The economy of Village Alaska is instead an inconsistent and tenuous mix of subsistence, market, and government transfer elements, with the latter providing the greatest share of material support in most villages. The function of the transfer economy is to fill some of the more obvious gaps left by the erosion of the subsistence economy and the absence of a market economy. Instead of being in transition to a self-sustaining economy and society, Village Alaska appears to be collapsing."</td><td>“Of the over 200 villages in Alaska, few have viable economies. Private sector jobs are exceedingly scarce. As a consequence, unemployment in Alaska is perennially the nation’s highest. By contrast to many Alaskan villages, Appalachia is affluent. With their burgeoning growth, Alaskan communities find it increasingly difficult to subsist off adjacent lands or waters. Accordingly, many villages are heavily reliant on government spending.”</td></tr>
</table>

Figure 6-3 Examples of rural-facing subsistence naratives from influential Alaskans.

There was another type of narrative about subsistence rural Alaska, less factual and more speculative. These could be proscriptive, implying a need for regulatory or policy changes or that rural Alaskans were deficient in some way. In academic literature, examples of narratives of this kind included Rogers (1969), Deman (1982), and Morehouse (1989). In popular literature, examples included Hammond (2011), Medred (2013), Searles (2016), and Mitchell (2019). Figure 6-3 presents two subsistence-related narratives of conditions in rural Alaska, one from an economist (Morehouse 1989), and one from a politician (Hammond 2011). While these narratives were not the newest examples, they were from influential Alaskans and popular subsistence discourse has not changed that much since they were published. The following brief sections isolate and consider individual propositions inherent in these narratives in light of results from this dissertation and in relation to the larger literature.

6.3.1 Proposition: Traditional Local-Exchange Economies No Longer Exist

In the first narrative (Figure 6-3A), economist Thomas Morehouse (1989) asserted that “village Alaska no longer has a traditional, local-exchange economy based on subsistence activities, extended kin relationships, and sharing, though these traditional elements survive in modified forms." If any finding should resonate from this dissertation and from the broader body of literature on subsistence networks, it was that local exchange economies in rural Alaska were robust. At least in Wales and Deering where the question was formally explored and in Shungnak were the author once lived, subsistence networks were structured very much along traditional kinship lines (Magdanz et al. 2002, Magdanz et al. 2004). The structure of subsistence production may the single most enduring aspect of traditional economies in Alaska, yet that structure was invisible to most visitors. Figure 6-4 graphs the subsistence network in Venetie, Alaska, in 2010, showing flows within and beyond the community itself. The data behind the network graph formed the basis for the analyses in Chapter 5, yet the network graph alone provided a powerful refutation of the no-exchange assertion. All three communities in the Sharing Project – Wainwright, Kaktovik, and Venetie – were tightly bound together by subsistence exchanges.

The Sharing Project also found that about a fourth of wild food flowing into Wainwright households was a result of household members' own harvests (Figure 6-5A). About a quarter of the wild food came into households as shares from cooperative hunting with members of other households, and about a third came from various social relations associated with the whaling complex. Venetie, lacking the North Slope whaling complex, was more typical of rural Alaska communities (Figure 6-5B). In Venetie, slightly more than a third of households' wild food inflows were from the household members' own harvests. In all three Sharing Project study communities, a majority of the food flowing into households involved social relations with other households, both local and non-local. Collecting the valued flow data necessary to make these calculations was expensive and time-consuming, so they do not exist for other rural Alaska communities. Yet there was every reason to believe that similar patterns of subsistence food flows existed in other rural Alaska communities, given that virtually every rural Alaska subsistence food network documented by the Division of Subsistence exhibited similar structures.

Subsistence networks in the past almost certainly were more dense. Communities in the past tended to be smaller, at times a single extended family, and network density tends to increase

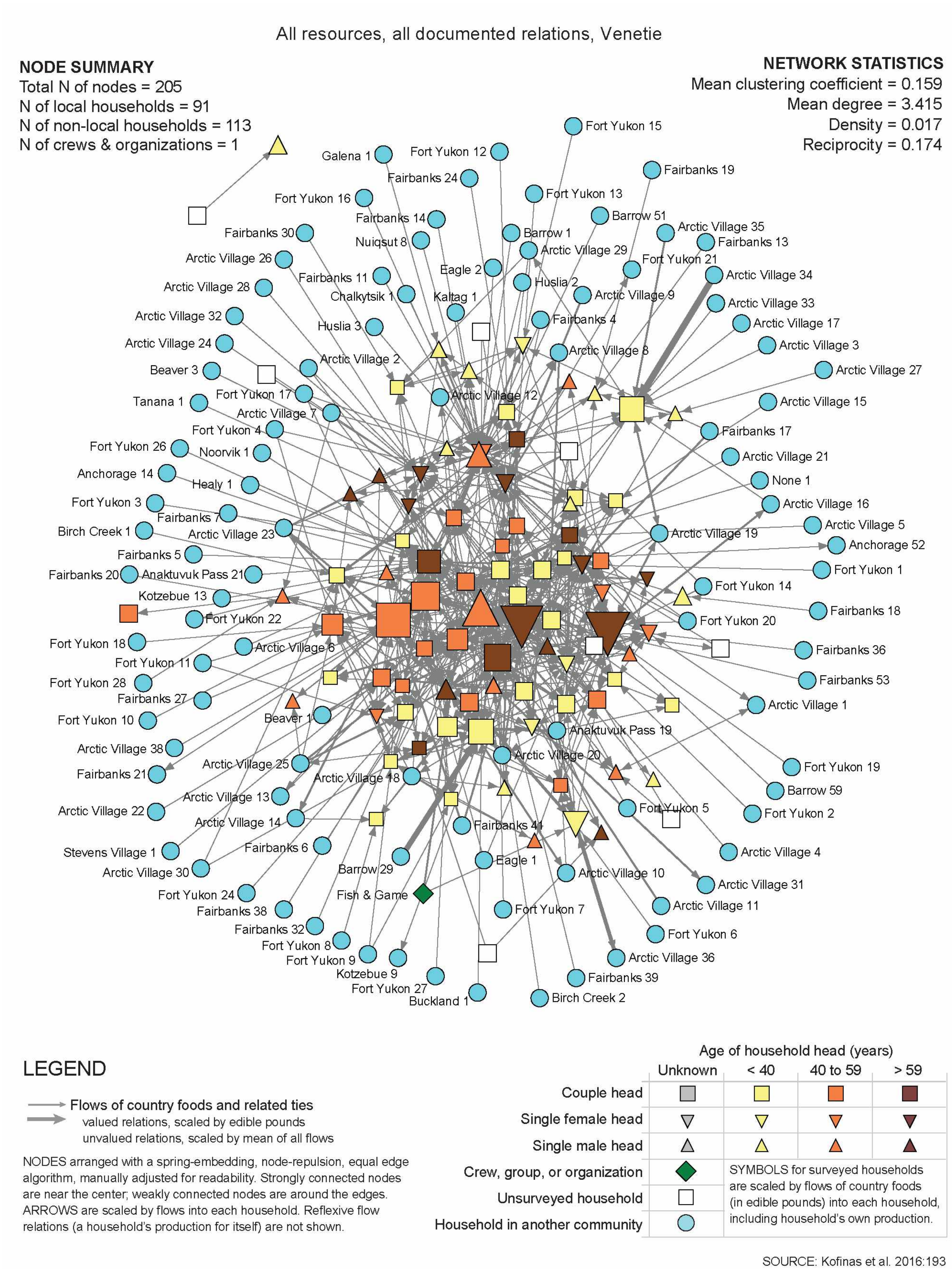

Figure 6-4 Subsistence network, Venetie, 2010.

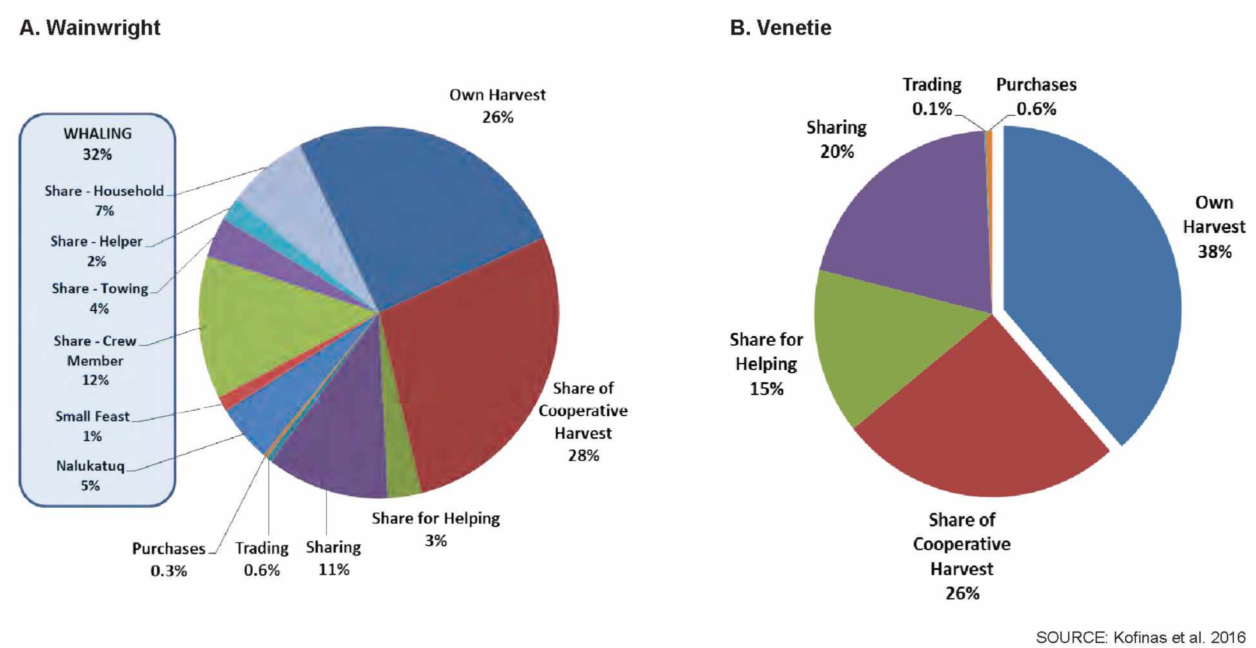

Figure 6-5 Flows of wild foods by social relation, Wainwright and Venetie, 2010.

with decreases in network size (Anderson et al. 1999, Dunne et al. 2002a). When Morehouse wrote his lament in 1989, quantitative subsistence network data had not yet been collected. His assertion that there was no longer "a traditional local-exchange economy based on subsistence activities" could only have been speculation. It simply was not true.

6.3.2 Proposition: Economy is an Inconsistent and Tenuous Mix

Morehouse asserted that rural Alaska economies were "an inconsistent and tenuous mix of subsistence, market, and government transfer elements." Given natural variations in renewable resource abundance, the boom-and-bust nature of inevitably terminal industrial-scale non-renewable resource development, and the political nature of government programs, each sector of the rural Alaska economy could indeed be inconsistent and tenuous. As an Alaska Federation of Natives report stated in 1989: "The idea that private sector economic development is merely a matter of time and capital becomes increasingly implausible. Villages in the region are remote from markets: lack arable land, timber, energy and mineral resources; are saddled with high labor, energy, transportation, and communication costs and must contend with a dearth of local markets and a scarcity of investment capital" (Alaska Federation of Natives 1989). From a rural household perspective, then, the most relevant question was: How can we best adapt to this challenging environment?

In this dissertation, especially in Chapter 5, it was clear that households and communities in rural Alaska's mixed economies employed diverse economic strategies within a dense web of social and economic connections. In the ecological resilience literature, diversity, redundancy, connectivity, and experimentation were seen as enhancing ecosystem resilience (Biggs et al. 2012). In social contexts, Leslie and McCabe (2013) noted, "response diversity can be seen at multiple scales (e.g. household, village, region) and response diversity at one scale may act synergistically with or contrary to the effects of diversity at another scale." In the rural Philippines, Fafchamps found a similar dynamic, where intra-village, risk-sharing networks protected individuals and households from economic shocks (Fafchamps and Lund 2003, Fafchamps and Gubert 2007). Ecologists and economists both have found that higher connectivity and compartmental structures in networks of relations – features observed in the local family groups in Wales and Deering – increased network robustness and reduced the propagation of shocks (Dunne et al. 2002b, May et al. 2008).

A diversity of short-term engagements and compartmental structures might be sound strategies for adaptive resilience at multiple scales in the challenging ecologies and economies of rural Alaska. Households were not equally successful in this endeavor, making local exchange networks even more important to rural Alaskans' well-being. While it was true that each sector of the rural Alaska economy could be inconsistent and tenuous, conventional narratives of dysfunction overlooked households' abilities to change economic strategies in an ongoing pattern of adaptive responses (Robards and Alessa 2004, Brinkman et al. 2007).

6.3.3 Proposition: Burgeoning Growth Makes Subsistence Difficult

Former Alaska Gov. Jay Hammond (2011) asserted that "burgeoning growth" made subsistence "increasingly difficult" for Alaska's small rural communities (Figure 6-3B). Yet the analyses in

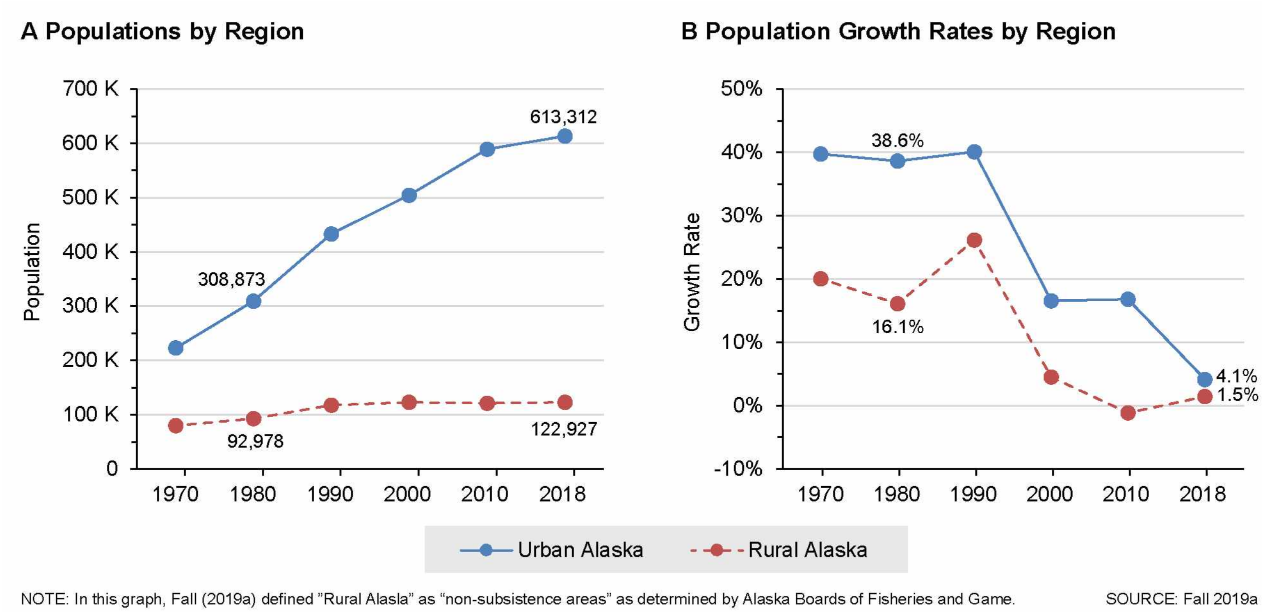

Figure 6-6 Alaska populations and growth rates by region, 1970-2018.

Chapter 3 found no significant change in rural community sizes during the study period (1983-2013). This was consistent with population estimates from the Alaska Department of Labor and Workforce Development (2019) summarized by Fall (2019). Alaska's population growth has been occurring almost exclusively in urban areas (Figure 6-6). From 1980 (when Congress adopted ANICLA) to 2018, populations in urban areas of Alaska (areas around Anchorage, Fairbanks, Juneau, Kenai, and Ketchikan designed as "non-subsistence" areas by the Boards) grew by from 308,878 to 613,312 (+98%), while populations in the remainder of Alaska grew from 92,978 to 122,927 (+32%). Rural and urban population growth rates were highest in the decade from 1980-1990 (+40% in urban areas, +26% in rural areas) and then growth rates declined. Since 2000, rural populations increased by a total of 364 people (+0.3%) or 20 people per year (+0.02%), while urban populations increased by 108,944 people (+21.6% or +1.2% per year).

Community and regional population trajectories varied, and annual variations were influenced more by migration than by births and deaths (Hamilton and Mitiguy 2009). Among rural census areas between 2001 and 2019, the highest growth rates were seen in the Gulf Coast

(9.6%) and Southwest (8.6%) regions. The Bethel Census Area was growing more rapidly than most rural areas and was cited in popular narratives lamenting rural population growth (cf. Medred 2013), but the Bethel Census Area was not typical of rural Alaska.

In Kivalina, the rural Alaska community with by far the longest time series of reliable subsistence information (six estimates, starting in 1962), per capita harvests decreased by half after the dog team era and continued a slower decline since the early 1980s. Interestingly, local population growth was such that the total community harvest over more than half a century – including the dog team era, was basically a flat line (Magdanz et al. 2010). The narrative that burgeoning rural population growth was making subsistence increasingly difficult was not supported.

6.3.4 Proposition: Transfer Economy Fills Gaps

Morehouse (1989), Knapp and Huskey (1988), Hammond (2011), and others have expressed concerns about the role of transfer payments in the rural Alaska economy. As Morehouse put it, "the function of the transfer economy is to fill some of the more obvious gaps left by the erosion of the subsistence economy and the absence of a market economy." This proposition was more politically charged than some others, given that some people understood "transfer payment" to be code for "welfare" and some saw the subsistence priority itself as a form of welfare for Alaska Natives (Kancewick and Smith 1990).

By "transfer economy" Morehouse, Knapp, and Huskey meant an economy with limited opportunities for investment, which can offer only limited employment and support a limited population, similar to Leven's (1986) "remote economy." Knapp and Huskey's (1987) transfer economy included (1) transfer payments to individuals and households like food stamps, unemployment, general welfare, and (2) government-funded public services, whether directly funded (like health care, education, transportation) or indirectly subsidized (like school lunches, bypass mail, loan programs). Evaluating the "transfer economy" proposition involved several aspects: the type of transfers, the magnitude of transfers, the sources of the transfers, and the application of transfers to the "gaps" in the rural economy.

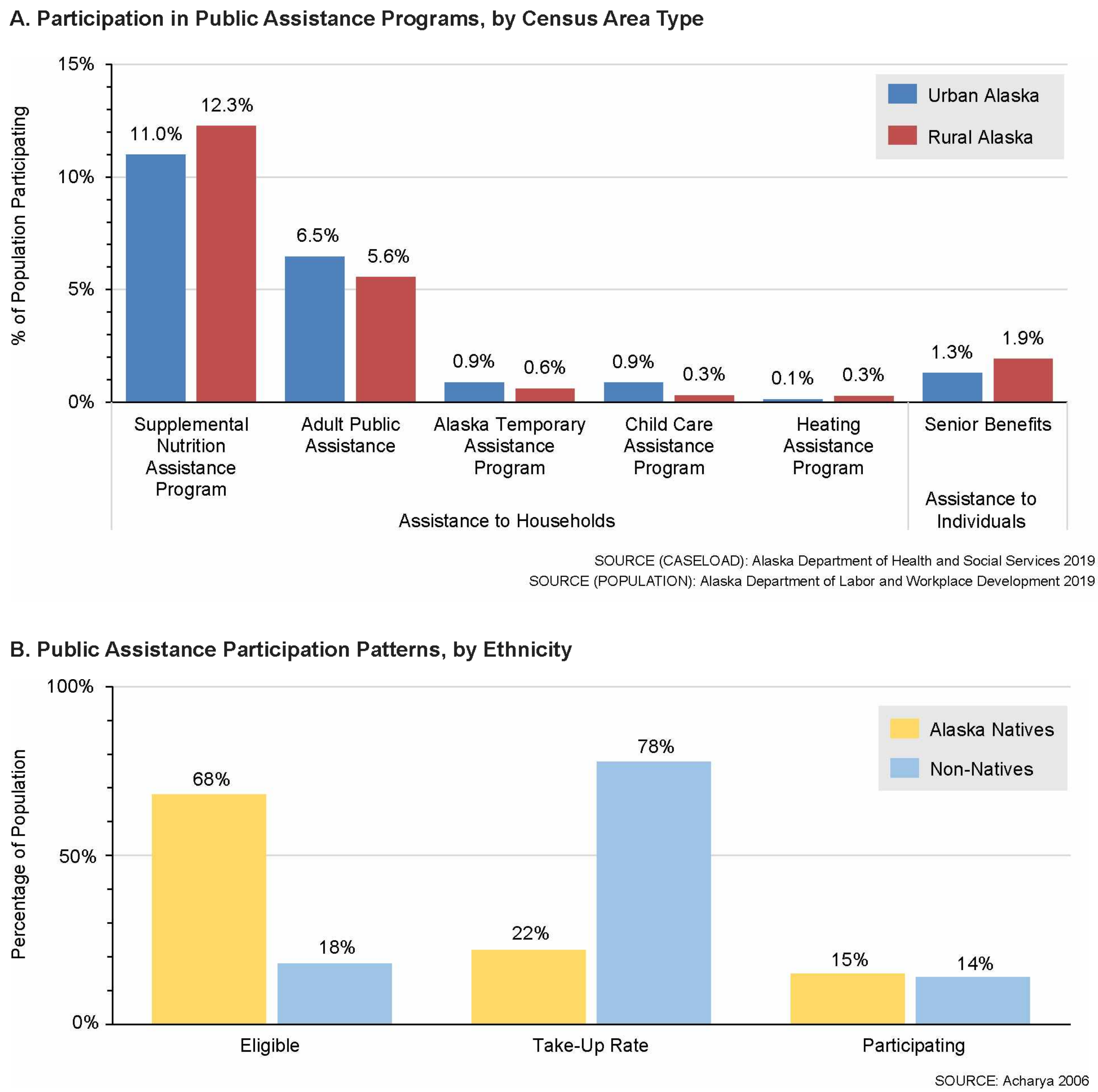

Figure 6-7 Patterns of participation in public assistance programs, by area and ethnicity.

Figure 6-7A summarizes the percentage of households and individuals in urban and rural Alaska census areas receiving different types of transfer payments from Alaska Department of Health and Social Services (2019). Differences in participation between urban and rural areas were not large, 1% to 2%. Figure 6-7B explains why public assistance participation rates were so similar in urban and rural Alaska, despite higher rates of poverty and unemployment in rural

Alaska. Alaska Natives were almost four times more likely to be eligible for public assistance (68% for Natives compared with 18% for Non-Natives), while Alaska Natives were four times less likely to actually take up public assistance (22% of eligible Natives enrolled) versus 78% of eligible Non-Natives) (Acharya 2006). As a result, almost exactly the same percentage of Native and Non-Natives actually participated in the programs, 15% versus 14%, which is consistent with 2019 estimates in Figure 6-7A. Acharya studied the economic incentives that affected Native decision making, concluding that "the Native community…has…a completely different culture that does not seek out the individual acquisition of welfare benefits." Acharya also noted that "the low take-up rate for the Alaska Native community most closely resembles the low take-up rate for white Americans living in rural communities in the lower 48 states," suggesting that low take-up may be a rural phenomenon throughout the country.

Figure 6-8 summarizes sources of household incomes for three small upper Kobuk River communities in 2012, used here as an example (Braem et al. 2015). Public assistance programs for individuals and households accounted for an estimated 14% of total income to households, on average. Note that Figure 6-7 reports percentages of households receiving each type of public assistance, while Figure 6-8 reports percentages of income received as assistance. Perfectly comparable data were not readily available, but neither figure suggested that rural Alaska was substantially more dependent on public assistance than urban Alaska.

In their Western Alaska example in 1987, Knapp and Huskey more concerned about the second aspect of the transfer economic, as public sector funding for basic services like education, transportation, and health care accounted for two thirds of the income to the region, and had increased by a factor of three since 1964. Similar high levels of funding for public sector services in rural Alaska has continued. In the three example communities in Figure 6-8, earned income from public sector jobs in local government (31%), services (21%), state (3%) and federal government (1%) contributed about 56% to total household income in the three study communities. The example communities are in the NANA Region, home to the Red Dog Mine which employees NANA Regional Corporation shareholders. Some of the earned income (but not all) in Figure

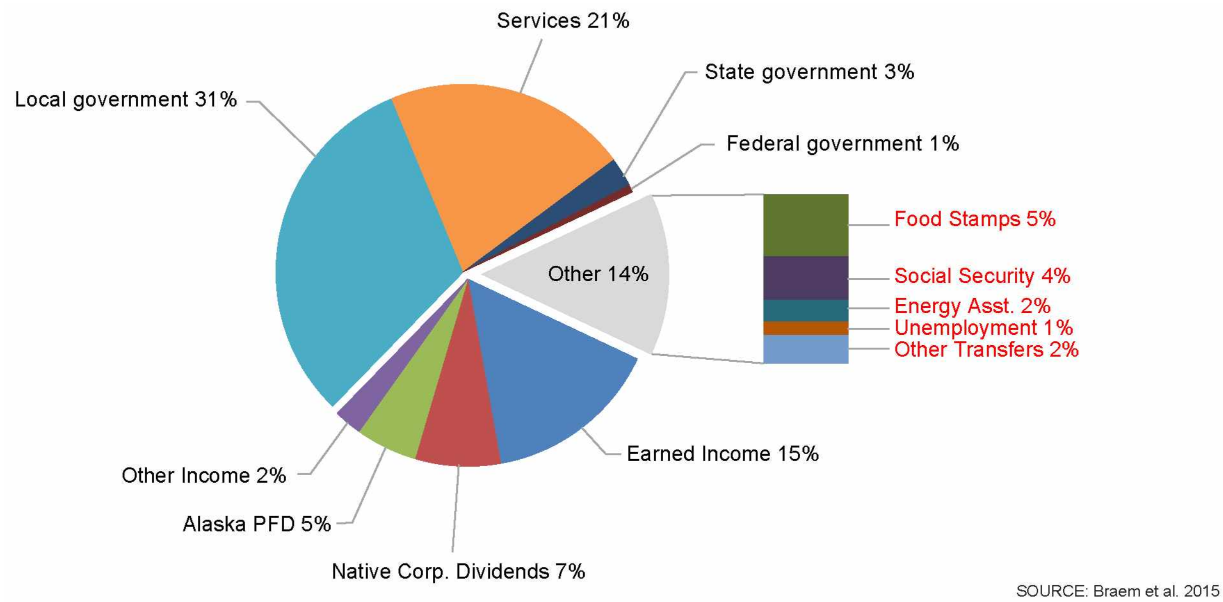

Figure 6-8 Income sources reported by households, Ambler, Kobuk, and Shungnak, 2012.

6-8 comes from private employment such as Red Dog Mine, and some (but not all) of the Native Corporation dividends come from corporate earnings at Red Dog Mine. Together, earned income and dividends accounted for 22% of income, less than half the amount provided by public sector sources.

Here the transfer proposition became much more complicated. Red Dog Mine paid an annual $25 million in lieu-of-taxes payment to support local education in the Northwest Arctic Borough. People who worked in public education would be considered local government employees, and their earnings would then be counted as part of the "transfer economy." In the same way, Knapp and Huskey (1988) noted that the State of Alaska captured "enormous resource rents" from Prudhoe Bay. But these were not counted as part of the transfer economy until a small portion was cycled through state government and sent back to the rural Alaska to support public services. For that matter, Knapp and Huskey considered the one billion dollars paid to Alaska Natives in the Alaska Native Land Claims Settlement Act to be "a major one-time transfer" to Alaska Natives, but they did not consider the transfer of title to 89% of Alaska's land mass to the federal government to be a "transfer" to the government. Then, when some fraction of that rent was transformed by the government into public services and sent back to rural Alaska, it was recharacterized as part of the "transfer economy." Colt (2005) also viewed ANCSA as a transfer payment, rather than a land claims settlement, and considered natural resource asset sales as cash windfalls rather than profits "because the Native Corporations did not buy the land."

The irony was self-evident, making fraught the idea that urban Alaska was supporting a "transfer economy" in rural Alaska. As Goldsmith (2008) wrote, "Remote rural Alaska is also the location of much of the natural resource production that supports the urban areas, including petroleum on the North Slope, mining in the Northwest Arctic, and fishing in Southwest Alaska. Some of these activities are integrated into their regional economies, but others are conducted as enclaves with little or no local economic links."

In the course of his field work into public assistance payments to Alaska Natives, Acharya described an encounter with an unemployed, cash-poor Alaska Native in St. Paul, Alaska, who twice gifted him with fresh halibut to take home after his visit. "This display of kindness," Acharya wrote, "was something I would never have imagined… This man who had used electric blankets because he could not afford heat, was offering me his own fish. He found it even stranger that I was touched by this action, which to him was a normal way of life."

The proposition that the transfer economy in rural Alaska was filling "some of the more obvious gaps left by the erosion of the subsistence economy and the absence of a market economy" rested on flawed assumptions that the subsistence economy was in fact eroded, and on flawed definitions of what constituted "a transfer economy" in the rural Alaska context.

6.3.5 Proposition: Village Alaska Appears to Be Collapsing

In his assertion that "village Alaska appears to be collapsing," Morehouse may have been influenced by an Anchorage Daily News (1988) series, "People in Peril," that described social dysfunction (especially alcohol related-violence) in rural Alaska and won the Pulitzer Prize in Public Service in 1989. Morehouse also may have been influenced by a subsequent, related report, "A Call for Action," from the Alaska Federation of Natives (1989). Unfortunately, social

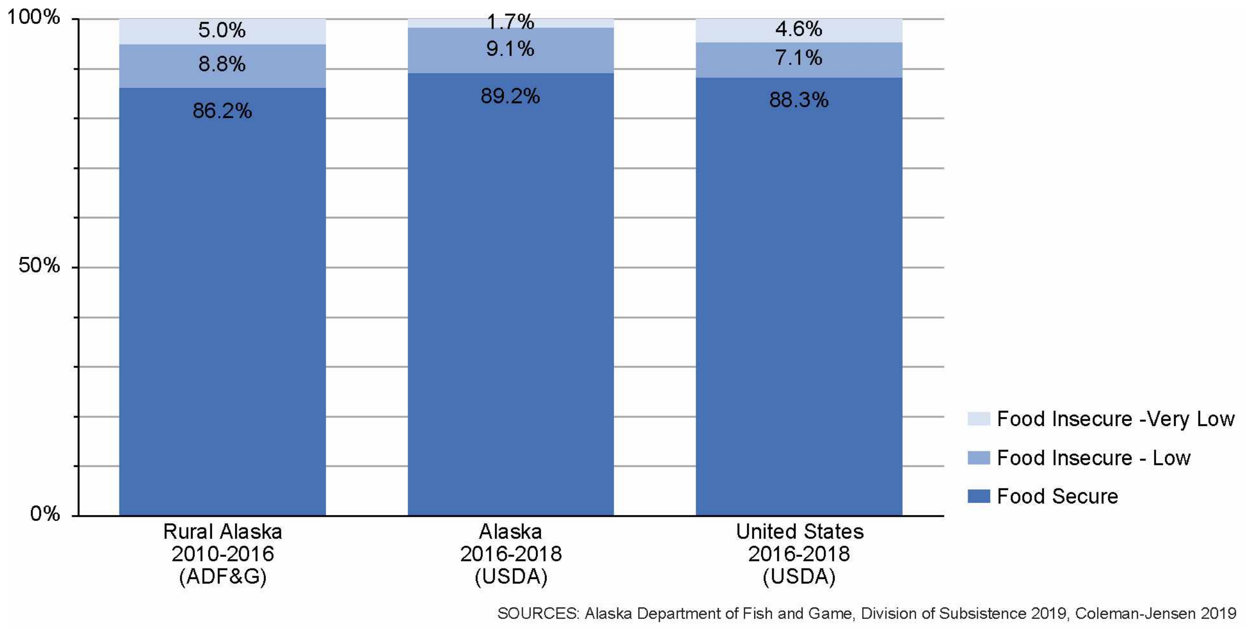

Figure 6-9 Estimates of food security in rural Alaska, Alaska, and the United States.

dysfunction in Alaska was a true and enduring narrative. Twenty years before Morehouse, Rogers (1969) was so discouraged by rural Alaska situations that he urged "a large but highly intelligent relocation of population from these areas [villages] if a natural out-migration does not take place." Thirty years after Morehouse, Mitchell (2019), would write: "Too many Natives living in rural villages meet their material needs through government transfer payments... Economic dependence engenders low self-esteem that contributes to the cycle of depression, alcohol abuse, violence and death."

Yet despite well documented social dysfunction, there also was evidence of high functioning, in particular, from food security estimates. ADF&G's food security research program found that the proportion of food secure households in rural Alaska (86%) was only 3% lower than in Alaska as a whole (89%), and only 2% lower than in the United States as a whole (Figure 6-9).

As Mitchell and others noted, some rural Alaska Natives moved from smaller communities into regional and urban centers. Migration from rural to urban areas over the past 50 years served to reduce growth rates in many areas of rural Alaska (Leask et al. 2001). Further, rural Alaska women were more likely to move to urban areas than rural Alaska men, which further reduced rural population growth rates (Hamilton and Seyfrit 1994, Martin 2009). It seemed rural Alaskans were not being pushed out of rural Alaska by, for example, extreme fuel prices, rather they were being pulled out of rural Alaska by economic and educational opportunities in Alaska's cities (Martin et al. 2008).

Yet it was also true that many more people chose to stay rather than leave rural Alaska. The Survey of Living Conditions in the Arctic provided some insight into why. "Subsistence activities in the Arctic are highly important as a contribution to the consumption possibilities, and highly important for cultural identity," Poppel and Kruse (2009) wrote. "The fact that it is difficult to distinguish between the two aspects of subsistence activities reflects the intertwined nature of culture and economy in the Arctic." Life in rural Alaska was not without serious challenges, but the narrative that "village Alaska appears to be collapsing" was not supported.

6.4 Narrative Construction

Chapter 4 explored two opposing narratives heard in Alaska: (1) a narrative of persistent subsistence within a mixed economy, and (2) a narrative of transition from subsistence to market dependence. Longitudinal data for two North Slope communities supported the persistence hypothesis. Here, we explore how the larger, statewide dataset from Chapter 3 could be used to advance either narrative. The simple (and simplistic) hypothesis is: Subsistence harvests will decrease with increases in incomes.

The final three panels of Figure 3-5 explored the associations between subsistence harvest and household income at three scales of analysis, and are reproduced here as Figure 6-10. In all three panels of Figure 6-10, the x-axis is income (ln) and the y-axis is subsistence harvest (ln), but the scales of analyses vary. In panel A – the community-scale analysis – mean household harvests declined by 2.5% for each 10% increase in mean household income. In panel B – the household-scale analysis – households' total harvests increased by 14% for each 10% increase in households' total incomes. In panel C – the individual-scale analysis – households' per capita harvests were not associated with households' per capita incomes.

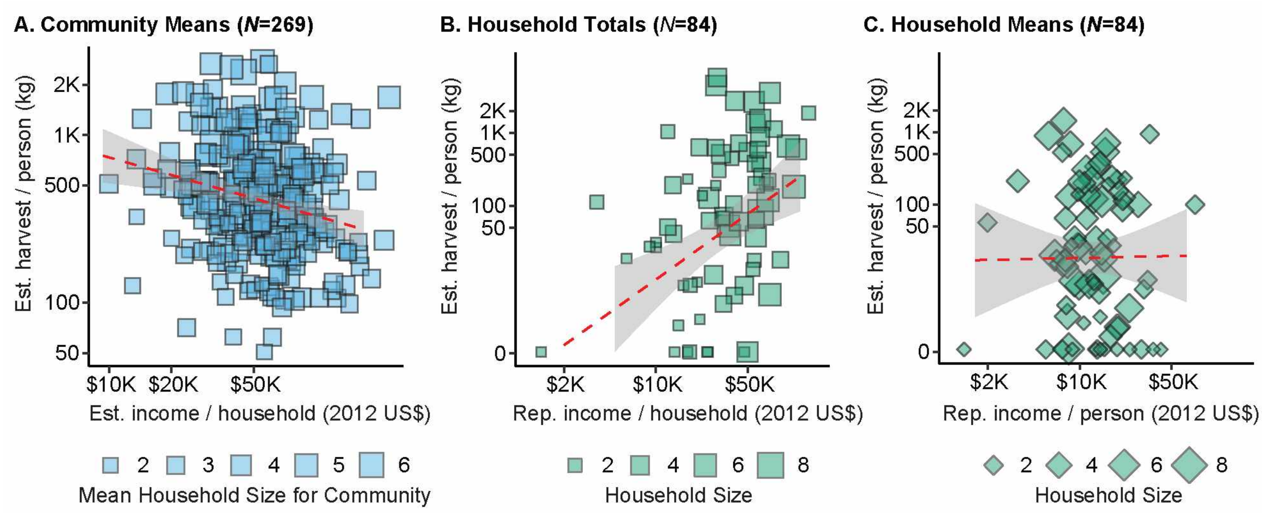

Figure 6-10 Interactions of harvest and income at difference scales of analysis.

In a political setting, those who favored income limits on a subsistence priority would emphasize the analysis in panel A, and those who opposed income limits would emphasize the analyses in panel B. Of the three associations in Figure 6-10, only the positive association in panel B was statistically significant (t=3.94, p<.001). Although Panels B and C only include data from a single community, data from other communities supported a positive harvest-income association. Working with data for indigenous households in 67 rural Alaska communities, Wolfe et al. (2009) found significant positive correlations of household harvest (log) and household income (log) for all six indigenous culture groups represented in the data, and for all households (r=.345).

6.5 Narratives of Management

Common-pool resource management itself was subject to narrative construction. Some critics considered the North American Model of Wildlife Conservation to be more narrative than science. As Eichler and Baumeister (2018) wrote: “By perpetuating a settler colonial narrative of American identity, privileging an exclusionary conception of Western science, and elevating sport hunting over other forms of legitimately relating to nonhuman animals, the NAM falls short of its own purportedly inclusive aims." One way to evaluate such criticisms was to compare the North American Model to other approaches to CPR management. Chapter 2 described three:

- Elinor Ostrom's common-pool resource principles (Ostrom 1990, 2010b),
- The North American Model of Wildlife Conservation (Geist et al. 2001, Organ et al. 2012),
- Fisheries rationalization (National Research Council 1999).

Hunter-gatherers in Alaska contended with all three approaches. On federal public lands, they hunted and fished under a system modeled on Ostrom's principles. On state, Native, and private lands, they hunted under a system informed by the North American Model. Finally, in both federal and state commercial fisheries, hunter-gatherers who participated in certain (salmon, halibut, sablefish) artisanal commercial fisheries were thrust into various rationalization schemes.

Of the three approaches, only Ostrom's principles (Table 2-1A) were universal. Ostrom's principles could be applied to subsistence fishing and hunting, recreational fishing and hunting, and commercial fishing or, for that matter, irrigation systems. Ostrom's principles also were notable – in contrast to the other two approaches – for what they did not do:

- Ostrom's principles did not advocate or require a certain property rights regime. The NAM advocated for wildlife resources to be a public trust. Rationalization granted fishery allocation ownership rights to individuals.
- Ostrom's principles did not presume which resource uses were legitimate. The NAM advocated, for recreational hunting, against wildlife markets, and against subsistence hunting. Rationalization was applied only to commercial fishing and created new commercial markets for fishing quotas.
- Ostrom's principles did not advocate for particular harvest methods. The NAM advocated for fair-chase hunting methods, which were inherently inefficient when food was the object of the hunt. Rationalization was designed to foster more efficient harvests by eliminating excess gear and reducing derby fishing.
- Ostrom's principles recommended collective-choice arrangements, where users of the resource

were authorized to participate in rulemaking. Both the NAM and rationalization were predicted on rulemaking by central governments, although mechanisms for public involvement in that rulemaking were substantial.

Except for their approaches to rulemaking, the fishery rationalization and the North American Model were at opposite poles: for or against individual rights to resources, for or against commercial markets, and for or against efficient methods. While proponents of the North American Model saw it as promoting democracy and equality, and proponents of rationalization saw it as promoting safety and efficiency in commercial fishing, both were in fact allocation systems intended to benefit favored users. For indigenous hunter gatherers in Alaska, the allocative counterpart to the North American Model and commercial fisheries rationalization was the subsistence title of the Alaska National Interest Lands Conservation Act, which created the rural subsistence priority.

In her work on common-pool resources, Ostrom focused on the fundamental conditions and processes that could sustain common-pool resources in any situation. She saw the common-pool-resource dilemma – rational actions by individuals lead to suboptimal outcomes – as a collective-action problem, and noted that "human actors are able to solve some (but definitely not all) collective action problems on their own without external rules and enforcement imposed from the outside" (Ostrom 2010a). She focused on structural variables that were more likelihood to result in successful collective actions. For common-pool resources, these were: (1) fewer participants, (2) heterogeneous participants, (3) face-to-face communication, (4) information about past actions, (5) individual connections, and (6) ability to enter or exit voluntarily.

These six variables mapped well onto the rural subsistence priority in ANILCA, which reduced eligible users to local rural residents who were likely to be in similar social, cultural, and economic situations, were likely to know each other, were free to participate in subsistence or not, and were free to move into or out a local rural areas where the priority applied. So while the rural priority itself was allocative – and Congress intended it to be so – collective-action research suggested that ANILCA's mechanism for implementing the rural priority was likely to succeed.

This was less true for the State of Alaska subsistence management system, because the pool of potential subsistence users included all residents of the state. The potential number of participants was higher than in the federal system, face-to-face communication among participants was more difficult, and individual connections were less common. For these reasons, collective-action research suggested, the state's approach to subsistence management was less likely to succeed than the federal approach.

Proponents of the North American Model emphasized the "democracy of hunting" and "egalitarianism in hunting opportunity," tenets that both the NAM and the rural subsistence priority violated. In a situation with competing user groups – subsistence hunters, recreational hunters, hunting guides – growing at different rates, "equal" allocations resulted in reallocation of resources to the fastest growing user group. As we have seen, urban populations had been growing at double-digit rates since 1970, while rural population grew at half the rate, and then slowed to essentially zero growth after 2000. So an "equality" approach had the effect of reallocating resources to the growing population of urban recreational hunters.

From an indigenous perspective, the fundamental conceit of the North American Model narrative was that the wildlife conservation disasters of the 19th century were created by euro-American commercial markets for wildlife, by wholesale euro-American appropriations of indigenous lands and resources, and by euro-American attempts to terminate indigenous cultures. Its proponents congratulated themselves for rectifying conservation disasters their ancestors had created, while allocating resources to a select consumptive user group and actively obstructing attempts by indigenous people in the 20th and 21st centuries to regain control over access to their traditional foods. Examples from Alaska include the extinguishment of aboriginal hunting and fishing rights in the Alaska Native Claims Settlement Act, and the fierce opposition to the rural priorities in the state subsistence law and the Alaska National Interest Land Conservation Act.

Nonetheless, in practice, individual Alaskans seemed to understand the logic of Ostrom's principles, such as boundaries, collective-choice arrangements, nested governance, and collective choice arrangements. The Alaska Board of Game, for example, created local registration hunts

Figure 6-11 Members of the Western Arctic Caribou Herd Working Group, 2019.

in both rural and urban areas that erected somewhat permeable barriers to access for non-local residents while complying with constitutional provisions for common use. The Alaska Board of Fisheries created a committee system – later adopted by the Board of Game – that fostered collective decision making by users and managers. Federal, state, tribal, and public representatives supported and served on cooperative management boards like the Migratory Bird Co-Management Council and the Western Arctic Caribou Herd Working Group (Figure 6-11). The U.S. Department of Commerce actively supported efforts by the Alaska Eskimo Whaling Commission to manage Alaska's bowhead whale hunts.

Alaska was still small enough – in human terms -- that people with diverse interests were still able to work together towards reasonable solutions. They did what Morehouse and Holleman

(1994) suggested, focusing "on the material or economic problems of resource conservation and allocation" even while their fundamental values differed.

6.6 Conclusions

In politics and in management, narratives could be more persuasive than facts. The "village is collapsing" narrative reflects one of the most durable narratives about hunter-gatherers, namely, that market economies were evolutionary superior to subsistence economies and that subsistence economies eventually would "evolve" to the "higher" form and be absorbed by euro American market economies and cultures (Morgan 1877, Taylor 1937, cited in Bodley 1994). Using Mundurucú rubber tappers in Brazil and Algonquin fur trappers in Canada as their two case examples, Murphy and Steward (1956) described this as an "evidently irreversible" process beginning when indigenous cultures became involved in mercantile, barter economies, began producing local goods for market (rubber and fur, in their case examples), and ultimately reorganized with nuclear families as the stable socio-economic unit, replacing the extended family structures found in the subsistence economy.

This assimilation hypothesis rested on assumptions of euro American cultural and economic superiority, ignored colonial appropriations of lands and resources, and ignored the durability of indigenous cultures, especially indigenous cultures who still had access to traditional lands and resources, as did those in Alaska. It was clear from the data in this dissertation that village Alaska still had a traditional, local-exchange economy, that rural populations were not burgeoning, that the transfer economy was not filling "obvious gaps left by the erosion of the subsistence economy," and that village Alaska had not collapsed. A majority of eligible Alaska Natives eschewed public assistance, while the public sector "transfer economy" proposition rested on urban-centric definitions of what constituted transfers. The most tenuous aspects of the rural economy were more likely to be market failures than subsistence failures. Considering the high degree of social dysfunction in rural Alaska, responses to the food security protocols suggested that rural Alaska households were managing surprisingly well.

Wolfe (1984) explored how a Yukon River Yup'ik society integrated the commercial production of salmon into a traditional pattern of subsistence hunting and fishing, without replacing or eroding the hunter gatherer economy. Wheeler (1998) used data from four case-example Athabaskan communities to challenge "the model which separates the subsistence and cash sectors of the economy, and instead considers cash from the local perspective, as one of many resources." Yet policy makers have been slow to consider Wolfe and Wheeler's perspectives, and the result has been deeply flawed narratives with potent allocation consequences.

When a member of the public had three minutes to testify to the Board of Fisheries or the Board of Game, a well-told personal story was more likely to be remembered than a table of numbers. If the person testifying was an expert – a biologist, an anthropologist, an economist, or political leader – their narratives could determine policy outcomes. Disciplines were not equally powerful. Fishery management fixated on economics and biology to the exclusion of other sciences. Fortunately, anthropologists have been conducting critical examinations of community-level impacts of "rationalization" in commercial fishing (cf. Mansfield 2007, Carothers and Chambers 2012), while economists have been adopting more wholistic views of Arctic economies (cf. Taylor et al. 2016, Glomsrød et al. 2017).

In a thin and playful book, Father Michael Oleksa (2005) explored the nature of cultures in Alaska. "Culture is more a view than a thing," he wrote, "it is invisible to us… While we may apply cultural constructs to make sense of reality, they are invisible to us while we are using them – which is nearly all the time." He compared cultures to sports. Football players do not play nine innings, and baseball players do not tackle each other. Where Alaskan politicians and economists valued independence and self-reliance, indigenous Alaskans valued community cohesion and cooperation. That may help explain how Alaska politicians and economists, on the one hand, and Native leaders and anthropologists, on the other hand, could construct such contrary narratives of rural Alaska.

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Appendix A Proposed Regulatory Changes Governing Subsistence Uses

of Fish and Game Resources

Alaska Boards of Fisheries and Game, 1979

ALASKA BOARDS OF FISHERIES AND GAME PROPOSED REGULATORY CHANGES

GOVERNING SUBSISTENCE USE OF FISH AND GAME RESOURCES,

ADVISORY COMMITTEE BYLAWS AND REGIONAL RESOURCE COUNCILS,

TO BE CONSIDERED IN ANCHORAGE, ALASKA, FROM DECEMBER 1, THROUGH DECEMBER 2, 1979

In March 1979, the Board of Game and Board of Fisheries adopted regulations providing for the creation of six resource management regions. After listening to extensive public testimony, the Boards deferred action on setting precise geographical boundaries for these regions until December 1979. This was done to allow Local Fish and Game Advisory Committees and the public at large the opportunity to advise the Boards on setting regional boundaries. The regional boundary proposals included in this packet are submitted without recommendation. The Boards have assembled these choices to help the public see the general areas concerned and stimulate public comment. Regional fish and game councils, composed of the chairmen of the Local Fish and Game Advisory Committees within the region, will use the same boundaries as the resource management regions.

In March 1979, the Joint Boards heard testimony from a broad cross-section of the public regarding regulation of subsistence. It was determined at that meeting that it was not yet appropriate to adopt much of the specific regulatory action that was proposed at that meeting. Instead, a comprehensive policy statement was adopted by the Boards. (See Game Regulations, p. 7, and Subsistence Fishing Regulations, p. 7). The proposals on subsistence presented for public review in this packet are some of the same proposals originally presented in March 1979. The Boards would like to hear new comments from the public on barter, qualifications for subsistence use, etc., to determine if regulatory action is needed at this time. The Boards emphasize that these options have been assembled without recommendation.

The proposals on subsistence included in this packet are only options. The Boards may accept or reject these proposed changes or may develop alternatives based on the subject matter set forth in the legal notice published in compliance with the Administrative Procedure Act. Copies of the legal notice may be obtained from regional offices of the Department of Fish and Game, or may be obtained by writing the Boards of Fisheries and Game, Subport Building, Juneau, Alaska 99801. Proposed regulations to implement the subsistence law have the potential to affect commercial and recreational uses.

Pursuant to the Administrative Procedure Act, public comment is invited on the proposed changes. At the public hearing, commencing December 1, at 1:30 p.m., comments may be offered orally or in writing. Written comments may be submitted in advance of the hearing and should be sent to the Boards of Fisheries and Game, Subport Building, Juneau, Alaska 99801, to be received on or before November 16, 1979. Adherence to the November 16 deadline will assure Board members of more time for study and, therefore, fuller consideration of comments submitted by the public. The Boards urge that all persons whose interests may be affected by the proposed changes not hesitate to offer comments.

SUBSISTENCE

1. 5 AAC XX.XXX. UNLAWFUL POSSESSION OF FISH OR GAME. Prohibit the possession of unlawfully taken fish and game resources.

The proposed regulation reads as follows:

5 AAC XX.XXX UNLAWFUL POSSESSION OF FISH OR GAME. It is unlawful for any person to possess or transport on, to, or across State or private lands any raw or unprocessed subsistence or sport caught fish, game or parts thereof, that have been taken, possessed or transported in violation of State law.

Justification: It is anticipated that the State Boards of Fisheries and of Game will establish regulations for the conservation and use of fish and wildlife species in various parts of the State that reflect the general welfare of the populations concerned. Because fish and wildlife populations cross jurisdictional boundaries, as into international waters or onto Federal enclaves where regulations may be in effect that are not accurately aligned with overall population welfare. Therefore, it is important that the Boards be able to effect regulations that ensure compatible uses of fish and wildlife in areas not under direct control of the state.

Proposed by: Staff

2. 5 AAC. XX.XXX. SUBSISTENCE REPORTS REQUIRED. Provide that failure to submit subsistence reports will result in ineligibility for a subsequent permit.

The proposed regulation reads as follows:

5 AAC XX.XXX. SUBSISTENCE REPORTS REQUIRED. Failure to comply with subsistence reporting requirements of this chapter will result in ineligibility for a subsistence permit for that activity in the next calendar year. A permittee who fails to comply with the reporting requirements provided by regulation will be ineligible to receive a permit during the next calendar year. The permit applicant demonstrates to the issuing officer that failure to report was due to (a) loss in the mail, or (b) accident, sickness or similar circumstances. The permit applicant shall have the burden of proving any excusable failure to report, and that he took all reasonable measures to insure that the report was mailed certified mail, return receipt requested, or personally delivered. A person aggrieved by denial of a permit under this section may request a hearing pursuant to AS 44.62.360 et. seq.

Justification: It is important that all permittees report their success and other informaion required on a permit, since analysis of harvests and decisions regarding closures, extensions, or continuations of any use depends on this information. This is particularly true in hunts like the western arctic caribou where a maximum quota is established. Persons jeopardizing the entire system by failing to report should not be allowed to participate the following season.

Proposed by: Staff

3. 5 AAC XX.XXX. DEFINITIONS. Define the term barter as the term is used in the exchange of subsistence taken fish or game for other resources and materials, and present optional restrictions governing the barter of these substances.

The proposed regulation reads as follows:

5 AAC XX.XXX. DEFINITIONS. Unless specified otherwise by the subsistence regulations in this chapter, the following definitions apply:

(1) "barter" means the exchange or trade of subsistence taken fish and game or their parts for:

(A) other fish or game or their parts;

(B) other food or for nonedible items other than money if the exchange is of a limited and noncommercial nature;

One or more of the following options may be used to further define barter:

(1) barter may occur only between subsistence users; or

(2) barter may occur only between subsistence users domiciled within the same regulatory area (or other geographical portion of the State); or

(3) bartered fish and game or their parts may not be transported out of the State; or

(4) the following species may be only bartered for other fish and game species: salmon, rainbow trout, moose, sheep, caribou or their parts; or

(5) prohibit the exchange or trade of fish and game for nonedible or manufactured items in areas where this use has not occurred in recent years; or

(6) fish and game or their parts and other items exchanged or traded shall not be sold; or

(7) barter for non-food items may not exceed a total value of $500 in any year (or $250, $1000, etc.); or

2.

(8) no more than 25 percent (or 15%, 50%, etc.) of a subsistence user's total take of any species may be bartered; or

(9) fish and game or their parts may be bartered for tools, fuel, shelter and transportation items, but if such items are processed the total value of such items may not exceed $____; or

(10) if the edible portions of any species are utilized for human or animal consumption, then the nonedible parts of those species may be bartered without limit; or

(11) any food or clothing item may be traded or exchanged for any fish and game species or their parts without limit;

(12) the following manufactured items may not be exchanged or traded for fish and game or their parts: fuel, outboard motors, transportation vehicles, etc.; or

(13) manufactured goods may only be used for barter if they are essential for the maintenance of tools, shelter or means of transportation already possessed by the subsistence user; or

(14) other specifications as may be determined by regulation of the Boards.

Justification: A definition of "barter" is required for compliance with the subsistence law. Also, regulatory options are presented for placing additional restrictions on bartering for the purpose of preventing waste or damage to the fish and game resources and circumvention of management programs. There is concern that the present definition of barter may encourage greater effort and utilization beyond traditional personal use requirements by some subsistence users. This could adversely affect the subsequent harvests available to all user groups and frustrate the State's ability to give preference to traditional subsistence users.

Proposed by: Joint Boards of Fisheries and Game

4. 5 AAC XX.XXX. DEFINITIONS. Define the term barter.

The proposed regulation reads as follows:

5 AAC XX.XXX. DEFINITIONS. "Barter" means the exchange or trade of fish and game and plants or their parts taken or possessed under applicable subsistence regulations. Bartering shall be limited only to the exchange or trade of other fish and game and plants or their parts taken or possessed for subsistence use under provisions of these regulations. Such fish and game and plants or their parts taken or possessed for subsistence uses and subsequently bartered may not be sold or offered for resale.

Except that the edible meat of walrus, seal, sea lion and whales and the ivory of walrus and the baleen of whales that have been substantially altered by native Eskimo or Indian handicraft such as by carving or scrimshawing may be sold.

"Substantially altered" for the purpose of this section means that any ivory or baleen taken or possessed for subsistence uses that are to be sold shall first have been rendered into such a state either by carving or scrimshawing so as to recognizably change its form or appearance from its original state. Etching only of the artist's name could not be considered being "substantially altered."

Justification: We would prefer no sale of subsistence taken items be allowed at all but realize that certain privileges have already been given. This proposal allows for the sale of some items under conditions.

In the past we have had concern as to baleen in particular not being altered at all, other than the inscription of a name scratched in somewhere. This would require more both for ivory and baleen.

Proposed by: Department of Public Safety

5. 5 AAC XX.XXX. DEFINITIONS. Define the meanings of the terms "customary and traditional uses" as these terms are used to identify those individuals who may engage in subsistence hunting and fishing.

The following options are presented, alternatively or in any combination, to define or implement a definition of "customary and traditional uses":

(1) a specified time of prior residency by an individual or family in the entire State or in any portion of the State in which the subsistence use occurs, for example 12 months, 5 years or 10 years prior residency may be required; or

(2) an individual or family must have taken the fish and game resource in question for 3 out of the last 5 years, (or 10 out of the last 15 years, etc.); or

(3) the user of fish and game resources which currently predominates in the regulatory area in question; or

(4) limitation on methods and means of harvesting fish and game resources for subsistence uses, for example prohibit or restrict use of certain types of fishing gear, aircraft, snowmachines, road and all-terrain vehicles; or

(5) other requirements as may be considered appropriate or necessary by the Boards.

Justification: In 1978, the "subsistence law" was enacted. This law provides that "...it is in the public interest to clearly establish subsistence use as a priority use of Alaska's fish and game resource, and to recognize the needs, customs, and traditions of Alaskan residents." The law also provides that "Whenever it is necessary to restrict the taking of game to assure the maintenance of game resources on a sustained yield basis, or to assure the continuation of subsistence uses of such resources, subsistence use shall be the priority use."

This proposal is being submitted by the Joint Boards to allow public comment on a wide range of possible interpretations of terms in the subsistence law that may be used to determine subsistence use eligibility and preference.

The Board offers the options in this proposal without recommendation. The Board has not approved or rejected these proposals and will not take action on any of them, or on any other proposal, until the December Board meeting.

Subsistence eligibility and preference criteria will often differ between various areas and, in fact, may not be required if the fish and game populations are healthy and subsistence uses are afforded the priority use under current regulations.

Proposed by: Joint Boards of Fisheries and Game

6. 5 AAC XX.XXX. DEFINITIONS. Define the meanings of the terms 1) "customary and direct dependence upon the resource as the mainstay of one's livelihood"; 2) "local residency"; and 3) "availability of alternate resources" as those terms are used individually or collectively as criteria for the Board to establish restrictions, limitations or priorities for consumptive uses of fish and game resources.

The following options are presented, alternatively or in any combination, to define or implement a definition of the above terms:

(1) subsistence taken fish and game must comprise more than 50 percent (or 25%, 75%, etc.) of an individual's or family's diet including consumption by domestic animals; or

(2) subsistence taken fish and game must comprise a majority of the food consumed in a community or regulatory area; or

(3) adjusted gross income must be less than $5,000 for the preceding year (or $8,000, $10,000, etc.) or average less than $5,000 (or $8,000, $10,000, etc.) for the three preceding years

(A) this could be applied to individuals, families or all the individuals and families within a community or regulatory area; or

5.

(B) adjusted gross income may be similar to the Federal poverty guideline income levels for Alaska, as follows:

1977 Family Size	1977 Adjusted Gross Income
1	$ 3,940
2	5,210
3	6,480
4	7,750
5	9,020
6	10,290

For families with more than 6 members, add 1,270.00 for each additional member.

(4) individuals utilizing or capable of utilizing fish or game taken under commercial or recreational regulations may be given lesser preference for subsistence use of these resources; or

(5) availability of processed food, for example individuals living in remote areas where there are no stores or where store inventories become periodically exhausted may have greater preference for subsistence uses of fish and game; or

(6) availability of other fish and game resources, for example individuals having less opportunity to harvest other species of fish and game may receive a greater preference for subsistence use of a particular intensively exploited fish and game species; or

(7) a specified time of prior residency by an individual or family in the regulatory area in which the subsistence use occurs, for example 12 months, 5 years, 10 years prior residency may be required; or

(8) residency in the regulatory area in which the subsistence use occurs; or

(9) distance between place of residence and the harvest area, for example a greater subsistence use preference may be given to individuals living closer to where the resource is harvested; or

(10) other requirements or standards as may be considered appropriate or necessary by the Boards.

Justification: In 1978, the "subsistence law" was enacted. This law provides that "...it is in the public interest to clearly establish subsistence use as a priority use of Alaska's fish and game resource, and to recognize the needs, customs, and traditions of Alaskan residents." The law also provides that "Whenever it is necessary to restrict the taking of game to assure the maintenance of game resources on a sustained yield basis, or to assure the continuation of subsistence uses of such resources, subsistence use shall be the priority use."

6.

This proposal is being submitted by the Joint Boards to allow public comment on a wide range of possible interpretations of terms in the subsistence law that may be used to determine subsistence use eligibility and preference.

The Board offers the options in this proposal without recommendation. The Board has not approved or rejected these proposals and will not take action on any of them, or on any other proposal, until the December Board meeting.

Subsistence eligibility and preference criteria will often differ between various areas and, in fact, may not be required if the fish and game populations are healthy and subsistence uses are afforded the priority use under current regulations.

Proposed by: Joint Boards of Fisheries and Game

7. 5 AAC XX.XXX. Develop criteria for determining whether individuals are eligible to participate in subsistence uses of fish and game resources under the terms of any regulatory definitions or implementing the statutory language governing subsistence hunting and fishing.

The following examples, individually or in combination, may be considered by the Boards:

(1) an individual or member of his immediate family must have returned game harvest tickets for the affected species in at least 3 out of the last 5 years; or

(2) an individual or member of his immediate family must have purchased a hunting, trapping or sport fishing license in at least 3 out of the last 5 years; or

(3) an individual or member of his immediate family must have returned a completed record of fish captured under authority of a permit in at least 3 out of the last 5 years; or

(4) an individual or member of his immediate family must be listed as having harvested the affected species in at least 3 out of the last 5 years in records mentioned by the department; or

(5) for species and/or regulatory areas which do not require completion of catch records or licensing by regulation or law:

(A) an affidavit signed by two persons with personal knowledge of the applicant's hunting and fishing activities; or

(B) an affidavit signed by a local advisory committee member, magistrate, city or village council authority or other local authority affirming the hunting or fishing activities; or

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(6) the adjusted gross income may be determined from Federal and/or State Income Tax Return forms or an affidavit from the individual; or

(7) other criteria considered to be appropriate or necessary by the Boards.

Justification: In 1978, the "subsistence law" was enacted. This law provides that "...it is in the public interest to clearly establish subsistence use as a priority use of Alaska's fish and game resource, and to recognize the needs, customs, and traditions of Alaskan residents." The law also provides that "Whenever it is necessary to restrict the taking of game to assure the maintenance of game resources on a sustained yield basis, or to assure the continuation of subsistence uses of such resources, subsistence use shall be the priority use."

This proposal is being submitted by the Joint Boards to allow public comment on a wide range of possible interpretations of terms in the subsistence law that may be used to determine subsistence use eligibility and preference.

The Board offers the options in this proposal without recommendation. The Board has not approved or rejected these proposals and will not take action on any of them, or on any other proposal, until the December Board meeting.

Subsistence eligibility and preference criteria will often differ between various areas and, in fact, may not be required if the fish and game populations are healthy and subsistence uses are afforded the priority use under current regulations.

Proposed by: Joint Boards of Fisheries and Game

8. 5 AAC 96.210(6) Interior Alaska: All lands, and fresh waters within the areas designated by the Game Management Units 21, 24, 25, 20, 12, 19D, and 19C, as described in the 1979 regulations, 5 AAC 90.010.

Justification: Utilization of these proposed boundaries will insure proper resource management in the Interior region.

Proposed by: Tanana Chiefs Conference, Inc.

8

9. 5 AAC 96.210. FISH AND GAME RESOURCE MANAGEMENT REGIONS. For the purposes of conservation and management of the fish and wildlife resources of the state there are created six fish and game resource management regions, the exact boundaries of which shall be established by the Board of Fisheries and the Board of Game, acting jointly, no later than December 31, 1979. The regions shall encompass the following general areas, including all lands, fresh waters, and adjacent marine waters under the jurisdiction of the state:

(1) Southeast Alaska. The Southeast Alaska mainland and islands northward and westward from Dixon Entrance to Cape Suckling, and the adjacent coastal water seaward to the limit of the state's jurisdiction;

(2) Southcentral Alaska. The area drained by water flowing into the Gulf of Alaska, Prince William Sound, and Cook Inlet from Cape Suckling westward to Cape Douglas at the base of the Alaska Peninsula, including all coastal islands north of Shuyak Island and the adjacent coastal water to the limit of the state's jurisdiction, and the area lying south of the rim of the Alaska Range and Wrangell Mountains.

(3) Southwest Alaska. The part of the Alaska Peninsula and adjacent mainland which drains into the Pacific Ocean and west side of Shelikof Strait from Cape Douglas to False Pass and into Bristol Bay from the King Salmon River drainage to False Pass; Shuyak, Afognak, Kodiak, Trinity, Chirikof, and Shumagin Islands, and all other adjacent offshore islands; the Aleutian Islands and the Pribilof Islands; and the adjacent coastal water seaward to the limit of the state's jurisdiction.

(4) Western Alaska. The area northward and northwestward from the King Salmon River drainage, including all land drained by water flowing into Bristol Bay, the land within the boundaries of the Calista Regional Corporation, Nunivak and St. Matthew Islands, all other islands along the coast, and the adjacent coastal water seaward to the limit of the state's jurisdiction.

(5) Arctic Alaska. The land included within the boundaries of the Bering Straits and the Northwest Alaska Native Association Regional Corporations, the North Slope Borough, the islands of Little Diomede and St. Lawrence, other coastal islands, and the adjacent coastal water seaward to the limit of the state's jurisdiction.

(6) Interior Alaska. The land encompassing the drainages of the Yukon and Kuskokwim Rivers northward from the boundary of the Southcentral Region, eastward from the boundary of the Western Region, eastward and southward from the boundary of the Arctic Region, and extending to the United States-Canada border.

Proposed by: Boards of Fisheries and Game

9.

Appendix B Customary and Traditional Use Criteria ("8 Criteria")

5 AAC 99.010. Boards of Fisheries and Game Subsistence Procedures

5 AAC 99.010. Boards of fisheries and game subsistence procedures

(a) In applying a subsistence law, the Board of Fisheries and the Board of Game will provide for conservation and development of Alaska's fish and game resources according to sustained yield principles.

(b) Each board will identify fish stocks or game populations, or portions of stocks or populations, that are customarily and traditionally taken or used by Alaska residents for subsistence uses by considering the following criteria:

(1) a long-term consistent pattern of noncommercial taking, use, and reliance on the fish stock or game population that has been established over a reasonable period of time of not less than one generation, excluding interruption by circumstances beyond the user's control, such as unavailability of the fish or game caused by migratory patterns;

(2) a pattern of taking or use recurring in specific seasons of each year;

(3) a pattern of taking or use consisting of methods and means of harvest that are characterized by efficiency and economy of effort and cost;

(4) the area in which the noncommercial, long-term, and consistent pattern of taking, use, and reliance upon the fish stock or game population has been established;

(5) a means of handling, preparing, preserving, and storing fish or game that has been traditionally used by past generations, but not excluding recent technological advances where appropriate;

(6) a pattern of taking or use that includes the handing down of knowledge of fishing or hunting skills, values, and lore from generation to generation;

(7) a pattern of taking, use, and reliance where the harvest effort or products of that harvest are distributed or shared, including customary trade, barter, and gift-giving; and

(8) a pattern that includes taking, use, and reliance for subsistence purposes upon a wide diversity of fish and game resources and that provides substantial economic, cultural, social, and nutritional elements of the subsistence way of life.

(c) When circumstances such as increased numbers of users, weather, predation, or loss of habitat may jeopardize the sustained yield of a fish stock or game population, each board will exercise all practical options for restricting nonsubsistence harvest of the stock or population and may address other limiting factors before subsistence uses are restricted below the level the board has determined to provide a reasonable opportunity. If all available restrictions for nonsubsistence harvests have been implemented and further restrictions are needed, the board will eliminate nonsubsistence consumptive uses, and reduce the take for subsistence uses in a series of graduated steps under AS 16.05.258(b)(4)(B) - the "Tier II" distinction - by distinguishing among subsistence users through limitations based on

(1) the customary and direct dependence on the fish stock or game population by the subsistence user for human consumption as a mainstay of livelihood; and

(2) repealed 2/23/2014;

(3) the ability of the subsistence user to obtain food if subsistence use of the stock or population is restricted or eliminated.

History Eff. 5/30/82, Register 82; am 1/17/91, Register 117; am 5/15/93, Register 126; am 2/23/2014, Register 209

Authority: AS 16.05.251, AS 16.05.255, AS 16.05.258

Appendix C Survey Example

Comprehensive Subsistence Survey

Selawik, Alaska, 2011

C.1 Summary of Survey Methods

This appendix includes a comprehensive subsistence survey administered to a stratified random sample of 61 households in Selawik, Alaska, between October 6 and October 14, 2011 (Braem et al. 2013). This survey included demographic, harvest, and income questions that were asked by the Division beginning in the early 1980s, as well as network questions that were first asked in 1994 and food security questions that were first asked in 2009. It was typical of Division of Subsistence surveys administered after 2009.

Data analyzed in the body of this dissertation were collected by teams of agency researchers, university researchers, and local research assistants. Surveys typically were administered to heads of households by paired researchers (one agency or university researcher and a local research assistant). Surveys typically required from 30 minutes to 2 hours.

C.2 References

Braem, N. M., Fox, P., Magdanz, J. S., and Koster, D. S. 2013. *Subsistence Harvests in Northwest Alaska: Selawik, 2010-2011: Alaska Department of Fish and Game, Division of Subsistence.*

COMPREHENSIVE SUBSISTENCE SURVEY

NORTHWEST ARCTIC CIAP

SELAWIK, ALASKA

PRINTED 2011-10-03

STUDY YEAR: October 1, 2010 to September 30, 2011

PHOTOS COUTESTY SELAWIK NATIONAL WILDLIFE REFUGE

This survey is used to estimate subsistence harvests and to describe community subsistence economies. We will publish a summary report, and send it to all households in your community. We share this information with the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service and the National Park Service. We work with the Federal Regional Advisory Councils and with local Fish and Game Advisory Committees to better manage subsistence, and to implement federal and state subsistence priorities.

We will NOT identify your household. We will NOT use this information for enforcement. Participation in this survey is voluntary. Even if you agree to be surveyed, you may stop at any time.

HOUSEHOLD ID:		
COMMUNITY ID:	SELAWIK	303
INTERVIEWER:		
INTERVIEW DATE:		
START TIME:		
STOP TIME:		
	DATA CODED BY:	
	DATA ENTERED BY:	
	SUPERVISOR:	

COOPERATING ORGANIZATIONS

DIVISION OF SUBSISTENCE
ALASKA DEPTARTMENT OF FISH & GAME
KOTZEBUE, AK 99752
800-478-3420

NATIVE VILLAGE OF SELAWIK
Box 59
Selawik, AK 99770

SELAWIK NATIONAL WILDLIFE REFUGE
U.S. Fish & Wildlife Service
Kotzebue, AK 99752

NORTHWEST ARCTIC BOROUGH
CIAP Subsistence Project
Kotzebue, AK 99752

Page 1

NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

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 October 1, 2010, and September 30, 2011, WHO were the head or heads of this 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?	Except for school or military service, has this person always lived in Selawik?	*If person has NOT always lived in Selawik…* WHEN did they LAST move here?	From WHERE did this person move?	Where is this person's birth home?*	TOTAL years lived here?
ID#	circle	relation	circle	circle	age	circle	year	community in Alaska, OR state in the US, OR country		years
HEAD 1	Y N		M F	Y N		Y N				
NEXT enter spouse or partner. If 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				
BELOW, enter children (oldest to youngest), grandchildren, grandparents, or anyone else living full-time in this household.										
PERSON 3	0		M F	Y N		Y N				
PERSON 4	0		M F	Y N		Y N				
PERSON 5	0		M F	Y N		Y N				
PERSON 6	0		M F	Y N		Y N				
PERSON 7	0		M F	Y N		Y N				
PERSON 8	0		M F	Y N		Y N				
PERSON 9	0		M F	Y N		Y N				
PERSON 10	0		M F	Y N		Y N				
PERSON 11	0		M F	Y N		Y N				
PERSON 12	0		M F	Y N		Y N				
PERSON 13	0		M F	Y N		Y N				
PERSON 14	0		M F	Y N		Y N				

* "BIRTH HOME" means the place this person's PARENTS WERE LIVING when this person was born.

PERMANENT HH MEMBERS: 01 **SELAWIK: 303**

Page 2

NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

HOUSEHOLD PARTICIPATION

HOUSEHOLD ID

This page asks about your household members' participation in subsistence activities, such as fishing, hunting, gathering, or processing subsistence foods.

Starting with the first head of household, and thinking just about LAST YEAR, did this person...

Repeat for each person in the household. Responses should be on the same row on the left and right pages.

	Fish		Big Game		Marine Mammals		Birds & Eggs		Plants & Berries	
	...try to fish or shellfish?	...process fish or shellfish?	...hunt for or try to trap land animals?	...process land animals?	...hunt for marine mammals?	...process marine mammals?	...hunt for birds or gather eggs?	...process birds or eggs?	...gather berries or plants?	...process berries or plants?
ID #	*circle each activity reported for each person, make no mark in other cells*									
HEAD	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
1										
NEXT, enter participation for spouse or partner. If household has a SINGLE HEAD, leave HEAD 2 row BLANK.										
HEAD	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
2										
BELOW, enter participation for children, grandchildren, grandparents, or anyone else living full-time in this household.										
PERSON 3	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
3										
PERSON 4	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
4										
PERSON 5	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
5										
PERSON 6	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
6										
PERSON 7	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
7										
PERSON 8	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
8										
PERSON 9	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
9										
PERSON 10	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
10										
PERSON 11	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
11										
PERSON 12	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
12										
PERSON 13	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
13										
PERSON 14	try to catch fish or shlfsh?	process fish or shlfsh?	hunt for land animals	process land animals	hunt for marine mamls	process land animals	hunt or gather birds or eggs	process birds or eggs	gather berries or plants	process plants
14										

PERMANENT HH MEMBERS: 01

Page 3

NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

EMPLOYMENT STATUS

HOUSEHOLD ID

INCLUDE EVERY PERSON 16 YEARS AND OLDER ON THIS PAGE, EVEN IF THEY DO NOT HAVE A JOB!

This page asks about jobs and income. We ask about jobs and income because we are trying to understand all parts of the community economy. Many people use wages from jobs to support subsistence activities. Starting with the first head of your household, what job or jobs did he or she have last year?

For each member of this household born before 1995, list EACH JOB held last year. For household members who did not have a job, write: RETIRED, UNEMPLOYED, STUDENT, HOMEMAKER, DISABLED, etc. There should be AT LEAST one row for each member of this household born before 1995 (this includes anyone who is 16 years old or older).

order	role	res.	Person Code from page 2 (00)	What kind of work did he or she do in this job? (job title*)	For whom did he or she work in this job? (employer)	In the past year, what months did he or she work in this job? (circle each month worked)	WORK SCHEDULE...** FULL TIME / PART TIME / SHIFT - FULL TIME / ON-CALL, VARIES / SHIFT - PART TIME (circle one)	In the past year how much did he or she earn in this job? (gross income***)
1ST JOB						J F M A M J J A S O N D	FT PT SF OC SP	$ / Yr
1	6	910100000						
2ND JOB						J F M A M J J A S O N D	FT PT SF OC SP	$ / Yr
2	6	910100000						
3RD JOB						J F M A M J J A S O N D	FT PT SF OC SP	$ / Yr
3	6	910100000						
4TH JOB						J F M A M J J A S O N D	FT PT SF OC SP	$ / Yr
4	6	910100000						
5TH JOB						J F M A M J J A S O N D	FT PT SF OC SP	$ / Yr
5	6	910100000						
6TH JOB						J F M A M J J A S O N D	FT PT SF OC SP	$ / Yr
6	6	910100000						
7TH JOB						J F M A M J J A S O N D	FT PT SF OC SP	$ / Yr
7	6	910100000						
8TH JOB						J F M A M J J A S O N D	FT PT SF OC SP	$ / Yr
8	6	910100000						
9TH JOB						J F M A M J J A S O N D	FT PT SF OC SP	$ / Yr
9	6	910100000						
10TH JOB						J F M A M J J A S O N D	FT PT SF OC SP	$ / Yr
10	6	910100000						

* If a person FISHES COMMERCIALLY or is otherwise SELF-EMPLOYED, list that as a separate job. For job title, enter COMMERCIAL FISHER, CARVER, SEWER, BAKER, etc. Work schedule usually will be ON CALL. For gross income from self-employment, enter revenue minus expenses.

If a person does not earn money from any kind of work, enter RETIRED, UNEMPLOYED, DISABLED, STUDENT, or HOMEMAKER or other appropriate description as the job title. Leave employer, months worked, schedule, and gross income blank.

** WORK SCHEDULE

FT - Fulltime (35+ hours/week)	1
PT - Parttime (<35 hours/week)	2
SF - Shift (2 wks on/2 off, etc.)	3
OC - On Call, Irregular	4
SP - Shift - part time	5
-- - Unemployed	0

*** GROSS INCOME is the same as TAXABLE INCOME on a W-2 form. Self-employment, enter revenue -

EMPLOYMENT: 23 **SELAWIK: 303**

Page 4

NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

OTHER INCOME

THIS PAGE IS ONLY FOR INCOME THAT IS NOT EARNED FROM WORKING | HOUSEHOLD ID

Between OCTOBER 1, 2010, and SEPTEMBER 30, 2011…
…Did any members of your household receive a dividend from the Permanent Fund or a Native Corporation?.. Y N

IF NO, go to the next section on this page.
If YES, continue below…

DIVIDENDS	Did anyone in your household receive income from ______ in 2010? (circle one)	TOTAL amount all members of your household received from ______ in 2010. (dollars)
ALASKA PERMANENT FUND DIVIDEND (32)	Y N	$ /YR
NATIVE CORPORATION DIVIDENDS (13)	Y N	$ /YR

Alaska PFD IN 2010
1 PFD = $1,281
2 PFDs = $2,562
3 PFDs = $3,843
4 PFDs = $5,124
5 PFDs = $6,405
6 PFDs = $7,686
7 PFDs = $8,967
8 PFDs = $10,248
9 PFDs = $11,529
10 PFDs = $12,810
11 PFDs = $14,091
12 PFDs = $15,372

Regional Corporations	*Per Share*
NANA Regional Corp.........................	*$ 14.00*
Arctic Slope Regional Corp................	*$ 64.26*
Bering Strait Native Association.........	*$ 2.35*
Village Corporation(s)	***Per Share***
...	*$ -*

Between OCTOBER 1, 2010, and SEPTEMBER 30, 2011…
…Did any members of your household receive OTHER income such as SENIOR BENEFITS or UNEMPLOYMENT?.............................. Y N

IF NO, go to the next page.
If YES, continue below…

		Received? (circle one)	Total Amount? (dollars)
EMPLOYMENT RELATED	UNEMPLOYMENT (12)	Y N	$ /YR
EMPLOYMENT RELATED	WORKERS' COMP (8)	Y N	$ /YR
EMPLOYMENT RELATED	SOCIAL SECURITY (7)	Y N	$ /YR
EMPLOYMENT RELATED	PENSION & RETIREMENT (5)	Y N	$ /YR
EMPLOYMENT RELATED	DISABILITY (31)	Y N	$ /YR
EMPLOYMENT RELATED	VETERANS ASSISTANCE (35)	Y N	$ /YR
ENTITLEMENTS	FOOD STAMPS (QUEST CARD) (11)	Y N	$ /YR
ENTITLEMENTS	ADULT PUBLIC ASSISTANCE (3)	Y N	$ /YR
ENTITLEMENTS	SUPPLEMENTAL SECURITY INCOME (SSI) (10)	Y N	$ /YR
STATE BENEFITS	ENERGY ASSISTANCE (9)	Y N	$ /YR
STATE BENEFITS	ALASKA SENIOR BENEFITS (LONGEVITY) (6)	Y N	$ /YR

		Received? (circle one)	Total Amount? (dollars)
FAMILY & CHILD	TANF *(say "Tanif," used to be AFDC)* (2)	Y N	$ /YR
FAMILY & CHILD	CHILD SUPPORT (15)	Y N	$ /YR
FAMILY & CHILD	FOSTER CARE (41)	Y N	$ /YR
OTHER	FUEL VOUCHERS	Y N	$ /YR
OTHER	MEETING HONORARIA *(not per diem*)*	Y N	$ /YR
OTHER	OTHER *(describe)*	Y N	$ /YR
OTHER	OTHER *(describe)*	Y N	$ /YR

** per diem covers travel expenses, and is not counted as income.*

Scratch paper for calculations

for ______ weeks =
for ______ months =

for ______ weeks =
for ______ months =

Senior benefits of $125 per month for 12 months = $1,500 per elder
Senior benefits of $175 per month for 12 months = $2,100 per elder
Senior benefits of $250 per month for 12 months = $3,000 per elder

OTHER INCOME: 24 | **SELAWIK: 303**

Page 5

NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

RETAINED COMMERCIAL HARVESTS

HOUSEHOLD ID

1. Do you or members of your household USUALLY participate in commercial fisheries?.................... Y N

2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household PARTICIPATE in a commercial fishery?.................... Y N

IF the answer to QUESTION 2 is NO, go to the subsistence harvests section.

IF the answer is YES, continue on this page…

During the last year,* did you or members of your household….

IF "…keep some from commercial catch" is YES, ask questions below…

Please estimate how many fish ALL MEMBERS OF YOUR HOUSEHOLD removed from commercial harvests for personal use during the last year.

Include COMMERCIALLY HARVESTED fish that members of this household gave away, ate fresh, fed to dogs, lost to spoilage, or got by helping others. If helping others, report ONLY THIS HOUSEHOLD'S share.

Insert names below in blanks above	…fish commercially for ________? *COM FISH?*	…keep some ________ from your COMMERCIAL CATCH for your own use or to share? *KEEP?*	Was the ________ that you kept INCIDENTAL CATCH? *That is, NOT a target species in the fishery* *INCI?*	How many were removed for your OWN USE? *number*	How many were removed for your CREW? *number*	How many were removed to give to OTHERS? *number*	Units *** *specify*	*comments*
CHUM SALMON *Qalugrauq* 111,000,001	Y N	Y N	Y N					
PINK SALMON *Amaqtuq* 114,000,001	Y N	Y N	Y N					
CHINOOK SALMON *Iqalsugruuk* 113,000,001	Y N	Y N	Y N					
SOCKEYE SALMON *Aqalugrauq* 115,000,001	Y N	Y N	Y N					
COHO SALMON *Qalugrauq* 112,000,001	Y N	Y N	Y N					
SHEEFISH *Sii* 125,600,001	Y N	Y N	Y N					
CRABS *Putuvak* 501,000,001	Y N	Y N	Y N					
HERRING 120,200,001	Y N	Y N	Y N					
HALIBUT 121,800,001	Y N	Y N	Y N					
	Y N	Y N	Y N					

RETAINED COMMERCIAL HARVESTS continued on next page…

* "LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.
** "USE" includes harvesting, processing, eating, trading, feeding to dogs, etc.
*** UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.

NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

RETAINED COMMERCIAL HARVESTS

HOUSEHOLD ID

...RETAINED COMMERCIAL HARVESTS continued from previous page.

During the last year,* did you or members of your household....				*IF "...keep some from commercial catch" is YES, ask questions below...* Please estimate how many fish ALL MEMBERS OF YOUR HOUSEHOLD removed from commercial harvests for personal use during the last year. *Include COMMERCIALLY HARVESTED fish that members of this household gave away, ate fresh, fed to dogs, lost to spoilage, or got by helping others. If helping others, report ONLY THIS HOUSEHOLD'S share.*				
	...fish commercially for ________?	...keep some ________ from your COMMERCIAL CATCH for your own use or to share?	Was the ________ that you kept INCIDENTAL CATCH? *That is, NOT a target species in the fishery*	How many were removed for your OWN USE?	How many were removed for your CREW?	How many were removed to give to OTHERS?	Units ***	
Insert names below in blanks above	*COM FISH?*	*KEEP?*	*INCI?*	*number*	*number*	*number*	*specify*	*comments*
	Y N	Y N	Y N					
	Y N	Y N	Y N					
	Y N	Y N	Y N					
	Y N	Y N	Y N					
	Y N	Y N	Y N					
	Y N	Y N	Y N					
	Y N	Y N	Y N					
	Y N	Y N	Y N					
	Y N	Y N	Y N					
	Y N	Y N	Y N					

During the last year, did your household fish COMMERCIALLY for any other kind of fish?.. Y N

IF YES, enter the name in a blank row above, and answer the questions in that row.

* "LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.

** "USE" includes harvesting, processing, eating, trading, feeding to dogs, etc.

*** UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.

COMMERCIALLY HARVESTED RESOURCES: 03 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: SALMON

HOUSEHOLD ID

1. Do you or members of your household USUALLY fish for salmon for subsistence?...................... Y N

2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO FISH FOR salmon?...................... Y N

IF the answer to QUESTION 2 is NO, go to the SALMON summary page.
IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household….

- …use[2] _________?
- …receive _________ from someone in another household or community?
- …give _________ to someone in another household or community?
- …try[2] to harvest _________? *TRY includes looking, even if you got none*

IF ...try to harvest is "YES," ask questions below...
INCLUDE salmon that members of this household gave away, ate fresh, fed to dogs, lost to spoilage, or got by helping others. If fishing with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.

Please estimate how many salmon ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year. How many were...

Insert names below in blanks above	*USE?*	*REC?*	*GIVE?*	*TRY?*	Caught with a SET NET	Caught with a DRIFT NET	Caught with a SEINE NET	Caught with a FISH WHEEL	Caught with a ROD & REEL[3]	Caught with OTHER GEAR	Units[4]	How many OF THOSE were used just for dogfood?
					number harvested by each gear type						*specify*	*number*
CHUM SALMON *Qalugrauq*	Y N	Y N	Y N	Y N								
111,020,000												
PINK SALMON (HUMPIES) *Amaqtuq*	Y N	Y N	Y N	Y N								
114,000,000												
CHINOOK SALMON (KINGS) *Iqalsugruuk*	Y N	Y N	Y N	Y N								
113,000,000												
SOCKEYE SALMON (REDS) *Qalugrauq*	Y N	Y N	Y N	Y N								
115,000,000												
COHO SALMON (SILVERS) *Qalugrauq*	Y N	Y N	Y N	Y N								
112,000,000												
SALMON - UNKNOWN *Qalugrauq*	Y N	Y N	Y N	Y N								
119,000,000												
	Y N	Y N	Y N	Y N								
	Y N	Y N	Y N	Y N								
	Y N	Y N	Y N	Y N								

During the last year, did your household use any other kind of salmon?...................... Y N
IF YES, enter the name in a blank row above, and answer the questions in that row.

DON'T FORGET MAP! ***Refer to data collection maps and mapping instructions to map salmon.***

1 *"LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.*
2 *"USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.*
3 *"ROD AND REEL" includes fish caught in open water with a hook and and a line attached to a rod or a pole. Jigging through the ice is "other gear."*
4 *UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*

NON-COMMERCIAL SALMON: 04 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

SUBSISTENCE SUMMARY: SALMON

HOUSEHOLD ID

If this household did NOT USE or HARVEST salmon last year, go to the ASSESSMENT section below.
Otherwise, continue with the network questions…

SUBSISTENCE NETWORK

During the last 12 months…

SALMON		*Enter HH ID, with most important sources first. INCLUDE this household if members caught or processed salmon for this household. For other Selawik households, enter HH ID. For other communities, enter name of other community.*									
role	*resource*										
Who CAUGHT the SALMON your household used?											
1	110,000,000										
Who PROCESSED the SALMON your household used?											
2	110,000,000										
Who else SHARED SALMON with your household?											
3	110,000,000										
Who TRADED SALMON with your household?											
3	110,000,000										

ASSESSMENTS

110,000,000

To conclude our salmon section, I am going to ask a few general questions about salmon.

During the last 12 months

…did your household use LESS, SAME, or MORE salmon than in recent years?........ X L S M

If LESS or MORE… *X = do not use*

WHY was your USE of salmon different?........ 1 2

During the last 12 months

…did your household spend less, same, or more TIME trying to get salmon than in recent years?........ X L S M

If LESS TIME or MORE TIME… *X = do not harvest*

Why was your EFFORT different for salmon?........ 1 2

During the last 12 months

…did your household GET ENOUGH salmon?........ Y N

If NO…

What KIND of salmon did you need?........

WHY did your household NOT get enough salmon?........ 1 2

SUMMARY OF SALMON: 66, 67 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: WHITEFISH

HOUSEHOLD ID

1. Do you or members of your household USUALLY fish for whitefish for subsistence?........ Y N

2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO FISH FOR whitefish?........ Y N

IF the answer to QUESTION 2 is NO, go to the next harvest page.

IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household.... …use[2] ________? …receive ________ from someone in another household or community? …give ________ to someone in another household or community? …try[2] to harvest ________? *TRY includes looking, even if you got none*

IF ...try to harvest is "YES," ask questions below...

INCLUDE whitefish that members of this household gave away, ate fresh, fed to dogs, lost to spoilage, or got by helping others. If fishing with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.

Please estimate how many whitefish ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year. How many were...

Read names below in blanks above	USE?	REC?	GIVE?	TRY?	Caught with a SET NET	Caught with a DRIFT NET	Caught with a SEINE NET	Caught with a FISH WHEEL	Caught with a ROD & REEL[3]	Caught with OTHER GEAR	Units[4]	How many OF THOSE were used just for dogfood?
					number harvested by each gear type						*specify*	*number*
BROAD WHITEFISH *Siyyuiḻaq, Qausriḻuk, Qalupiaq* 126,404,000	Y N	Y N	Y N	Y N								
HUMPBACK WHITEFISH *Qaalġiq, Ikkuiyiq* 126,408,000	Y N	Y N	Y N	Y N								
LEAST CISCO *Qalusraaq, Aŋuutituuq, Qalutchiaq* 126,406,060	Y N	Y N	Y N	Y N								
ROUND WHITEFISH *Quptik* 126,412,000	Y N	Y N	Y N	Y N								
BERING CISCO *(uncommon)* 126,406,040	Y N	Y N	Y N	Y N								
UNKNOWN WHITEFISH *Qalupiaq* 126,499,000	Y N	Y N	Y N	Y N								
	Y N	Y N	Y N	Y N								
	Y N	Y N	Y N	Y N								
	Y N	Y N	Y N	Y N								

During the last year, did your household use any other kind of whitefish?........ Y N

IF YES, enter the name in a blank row above, and answer the questions in that row.

DON'T FORGET MAP! ***Refer to data collection maps and mapping instructions to map whitefish.***

1 *"LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.*
2 *"USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.*
3 *"ROD AND REEL" includes fish caught in open water with a hook and and a line attached to a rod or a pole. Jigging through the ice is "other gear."*
4 *UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*

NON-SALMON FINFISH: 06 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: OTHER FISH

HOUSEHOLD ID

1. Do you or members of your household USUALLY fish for other fish for subsistence?........ Y N

2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO FISH FOR other fish?........ Y N

IF the answer to QUESTION 2 is NO, go to the next harvest page.

IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household….

…use[2] ________? | …receive ________ from someone in another household or community? | …give ________ to someone in another household or community? | …try[2] to harvest ________? *TRY includes looking, even if you got none*

IF ...try to harvest is "YES," ask questions below...

INCLUDE other fish that members of this household gave away, ate fresh, fed to dogs, lost to spoilage, or got by helping others. If fishing with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.

Please estimate how many other fish ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year. How many were...

Read names below in blanks above	USE?	REC?	GIVE?	TRY?	Caught with a SET NET	Caught with a DRIFT NET	Caught with a SEINE NET	Caught with a FISH WHEEL	Caught with a ROD & REEL[3]	Caught with OTHER GEAR	Units[4]	How many OF THOSE were used just for dogfood?
					number harvested by each gear type						*specify*	*number*
SHEEFISH *Sii* 125,600,000	Y N	Y N	Y N	Y N								
NORTHERN PIKE *Siilik* 125,500,000	Y N	Y N	Y N	Y N								
BURBOT (MUD SHARK) *Tittaliq* 124,800,000	Y N	Y N	Y N	Y N								
DOLLY VARDEN (TROUT) *Qalukpik* 125,006,000	Y N	Y N	Y N	Y N								
GRAYLING *Sulukpaugaq* 125,200,000	Y N	Y N	Y N	Y N								
SMELT *Iłqaugniq* 120,400,000	Y N	Y N	Y N	Y N								
SAFFRON COD (TOMCOD) *Uuġaq* 121,010,000	Y N	Y N	Y N	Y N								
HERRING *Ugsrugtuuq* 120,200,000	Y N	Y N	Y N	Y N								
	Y N	Y N	Y N	Y N								

During the last year, did your household use any other kind of other fish?........ Y N

IF YES, enter the name in a blank row above, and answer the questions in that row.

DON'T FORGET MAP! ***Refer to data collection maps and mapping instructions to map other fish.***

1 *"LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.*
2 *"USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.*
3 *"ROD AND REEL" includes fish caught in open water with a hook and and a line attached to a rod or a pole. Jigging through the ice is "other gear."*
4 *UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*

NON-SALMON FINFISH: 06 **SELAWIK: 303**

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SUBSISTENCE SUMMARY: FISH OTHER THAN SALMON

HOUSEHOLD ID

If this household did NOT USE or HARVEST fish other than salmon last year, go to the ASSESSMENT section below.
Otherwise, continue with the network questions…

SUBSISTENCE NETWORK

During the last 12 months…

WHITEFISH

Enter HH ID, with most important sources first.
INCLUDE this household if members caught or processed whitefish for this household. For other Selawik households, enter HH ID. For other communities, enter name of other community.

role	resource										
Who CAUGHT the WHITEFISH your household used?											
1	126,400,000										
Who PROCESSED the WHITEFISH your household used?											
2	126,400,000										
Who else SHARED WHITEFISH with your household?											
3	126,400,000										
Who TRADED WHITEFISH with your household?											
3	126,400,000										

During the last 12 months…

OTHER FISH

Enter HH ID, with most important sources first.
INCLUDE this household if members caught or processed other fish for this household. For other Selawik households, enter HH ID. For other communities, enter name of other community.

role	resource										
Who CAUGHT the OTHER FISH your household used?											
1	960,300,500										
Who PROCESSED the OTHER FISH your household used?											
2	960,300,500										
Who else SHARED OTHER FISH with your household?											
3	960,300,500										
Who TRADED OTHER FISH with your household?											
3	960,300,500										

ASSESSMENTS

120,000,000

To conclude our fish other than salmon section, I am going to ask a few general questions about fish other than salmon.

During the last 12 months
…did your household use LESS, SAME, or MORE fish other than salmon than in recent years?... X L S M
If LESS or MORE… *X = do not use*
WHY was your USE of fish other than salmon different?....................... ________ 1
________ 2

During the last 12 months
…did your household spend less, same, or more TIME trying to get fish other than salmon than in recent years?.............................. X L S M
If LESS TIME or MORE TIME… *X = do not harvest*
Why was your EFFORT different for fish other than salmon?................ ________ 1
________ 2

During the last 12 months
…did your household GET ENOUGH fish other than salmon?.. Y N
If NO…
What KIND of fish other than salmon did you need?.............................. ________
WHY did your household NOT get enough fish other than salmon?....... ________ 1
________ 2

SUMMARY OF FISH OTHER THAN SALMON: 66, 67 **SELAWIK: 303**

NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: MARINE INVERTEBRATES

HOUSEHOLD ID

1. Do you or members of your household USUALLY get marine invertebrates for subsistence, such as PUTUVAK, IVILUQ, or any other marine invertebrates?............ Y N
2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO GET marine invertebrates?............ Y N

IF the answer to QUESTION 2 is NO, go to the MARINE INVERTEBRATES summary page.

IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household….

- …use[2] ________?
- …receive ________ from someone in another household or community?
- …give ________ to someone in another household or community?
- …try[2] to harvest ________? *TRY includes looking, even if you got none*

IF …try to harvest is "YES," ask questions below…

Please estimate how many marine invertebrates ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year.

INCLUDE marine invertebrates that members of this household gave away, ate fresh, lost to spoilage, or got by helping others. If harvest with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.

Insert names below in blanks above	*USE?*	*REC?*	*GIVE?*	*TRY?*	How many did your HH get? *amount*	Units[3] *specify*	*comments*
KING CRAB *Putuvak* 501,008,000	Y N	Y N	Y N	Y N		GAL	
TANNER CRAB *Putuvak* 501,012,000	Y N	Y N	Y N	Y N		GAL	
CLAMS *Iviluq* 500,600,000	Y N	Y N	Y N	Y N		GAL	
MUSSELS *Avyak* 502,000,000	Y N	Y N	Y N	Y N		GAL	
OTHER INVERTEBRATES 509,900,000	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	

During the last year, did your household use any other kind of marine invertebrates?............ Y N

IF YES, enter the name in a blank row above, and answer the questions in that row.

DON'T FORGET MAP! ***Refer to data collection maps and mapping instructions to map marine invertebrates.***

1 *"LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.*
2 *"USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.*
3 *UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*
4 *UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*

MARINE INVERTEBRATES: 08 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

SUBSISTENCE SUMMARY: MARINE INVERTEBRATES

HOUSEHOLD ID

If this household did NOT USE or HARVEST marine invertebrates last year, go to the ASSESSMENT section below.
Otherwise, continue with the network questions…

SUBSISTENCE NETWORK

During the last 12 months...

SHELLFISH		Enter HH ID, with most important sources first. INCLUDE this household if members caught or processed shellfish for this household. For other Selawik households, enter HH ID. For other communities, enter name of other community.									
role	resource										
Who GOT the SHELLFISH your household used?											
1	231,000,000										
Who PROCESSED the SHELLFISH your household used?											
2	231,000,000										
Who else SHARED SHELLFISH with your household?											
3	231,000,000										
Who TRADED SHELLFISH with your household?											
3	231,000,000										

ASSESSMENTS

500,000,000

To conclude our marine invertebrates section, I am going to ask a few general questions about marine invertebrates.

During the last 12 months
…did your household use LESS, SAME, or MORE marine invertebrates than in recent years?.. X L S M
If LESS or MORE… *X = do not use*
WHY was your USE of marine invertebrates different?.......................... 1 2

During the last 12 months
…did your household spend less, same, or more TIME trying to get marine invertebrates than in recent years?.................................. X L S M
If LESS TIME or MORE TIME… *X = do not harvest*
Why was your EFFORT different for marine invertebrates?.................. 1 2

During the last 12 months
…did your household GET ENOUGH marine invertebrates?.. Y N
If NO…
What KIND of marine invertebrates did you need?................................
WHY did your household NOT get enough marine invertebrates?......... 1 2

SUMMARY OF MARINE INVERTEBRATES: 66, 67 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: LARGE LAND ANIMALS

HOUSEHOLD ID

1. Do you or members of your household USUALLY hunt large land animals for subsistence, such as TINIIKAQ, TUTTU, or any other large land animals?.......... Y N
2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO HUNT large land animals?.......... Y N

IF the answer to QUESTION 2 is NO, go to the next harvest page.
IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household…. …use[2] ________? …receive ________ from someone in another household or community? …give ________ to someone in another household or community? …try[2] to harvest ________? *TRY includes looking, even if you got none*

IF …try to harvest is "YES," ask questions below…
Please estimate how many large land animals ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year.
INCLUDE large land animals that members of this household gave away, ate fresh, fed to dogs, lost to spoilage, or got by helping others. If hunting with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.

Insert names below in blanks above	*USE?*	*REC?*	*GIVE?*	*TRY?*	SEX	October	November	December	January	February	March	April	May	June	July	August	September	Unknown	Units[3] *specify*
MOOSE *Tiniikaq*	Y N	Y N	Y N	Y N	BULL														IND
					COW														IND
211,800,000					UNKNOWN														IND
211,800,001																			
211,800,002																			
211,800,009																			
CARIBOU *Tuttu*	Y N	Y N	Y N	Y N	BULL														IND
					COW														IND
211,000,000					UNKNOWN														IND
211,000,001																			
211,000,002																			
211,000,009																			
BLACK BEAR *Qiġñiqłaq, Pisruktuaq*	Y N	Y N	Y N	Y N															IND
210,600,000																			
BROWN BEAR *Akłaq*	Y N	Y N	Y N	Y N															IND
210,800,000																			
DALL SHEEP *Ipniaq*	Y N	Y N	Y N	Y N															IND
212,200,000																			
MUSKOX *Umikmiaq*	Y N	Y N	Y N	Y N															IND
212,000,000																			
	Y N	Y N	Y N	Y N															IND

number killed in each month

During the last year, did your household use any other kind of large land animals?.......... Y N
IF YES, enter the name in a blank row above, and answer the questions in that row.

DON'T FORGET MAP! ***Refer to data collection maps and mapping instructions to map large land animals.***

1 *"LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.*
2 *"USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.*
3 *UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*

LAND MAMMALS: 10 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: SMALL LAND ANIMALS

HOUSEHOLD ID

1. Do you or members of your household USUALLY hunt small land animals for subsistence, such as AQU, PALUQTAQ, UKAILLAITCHIAQ, UKALLIQ, or any other small land animals?........ Y N
2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO HUNT small land animals?........ Y N

IF the answer to QUESTION 2 is NO, go to the next harvest page.

IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household….
…use[2] ________? | …receive ________ from someone in another household or community? | …give ________ to someone in another household or community? | …try[2] to harvest ________? *TRY includes looking, even if you got none*

IF …try to harvest is "YES," ask questions below…

Please estimate how many small land animals ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year.

INCLUDE small land animals that members of this household gave away, ate fresh, fed to dogs, lost to spoilage, or got by helping others. If hunting with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.

Insert names below in blanks above	*USE?*	*REC?*	*GIVE?*	*TRY?*	October	November	December	January	February	March	April	May	June	July	August	September	Unknown	Units[3] *specify*	Number Used For Food or for Food & Fur
BEAVER *Aqu, paluqtaq*	Y N	Y N	Y N	Y N														IND	
220,200,000																			
MUSKRAT *Kigvaluk*	Y N	Y N	Y N	Y N														IND	
222,400,000																			
SNOWSHOE HARE *Ukaillaitchiaq, ukalliq*	Y N	Y N	Y N	Y N														IND	
221,004,000																			
ARCTIC HARE *Ukallisugruk*	Y N	Y N	Y N	Y N														IND	
221,002,000																			
PORCUPINE *Illuqutaq*	Y N	Y N	Y N	Y N														IND	
222,600,000																			
PARKA (GROUND) SQUIRREL *Siksrik*	Y N	Y N	Y N	Y N														IND	
222,802,000																			
MARMOT *Siksrikpaq*	Y N	Y N	Y N	Y N														IND	
221,800,000																			
TREE SQUIRREL	Y N	Y N	Y N	Y N														IND	
222,804,000																			
	Y N	Y N	Y N	Y N														IND	

number killed in each month

During the last year, did your household use any other kind of small land animals?........ Y N

IF YES, enter the name in a blank row above, and answer the questions in that row.

DON'T FORGET MAP! *Refer to data collection maps and mapping instructions to map small land animals.*

1 *"LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.*
2 *"USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.*
3 *UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*

LAND MAMMALS: 10 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: FUR ANIMALS

HOUSEHOLD ID

1. Do you or members of your household USUALLY hunt or trap for fur animals for subsistence, such as QAPVIK, QAPVAITCHIAQ, or any other fur animals?.................... Y N
2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO HUNT OR TRAP FOR fur animals?.................... Y N

IF the answer to QUESTION 2 is NO, go to the LAND ANIMALS summary page.

IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household….
…use[2] ________? | …receive ________ from someone in another household or community? | …give ________ to someone in another household or community? | …try[2] to harvest ________? *TRY includes looking, even if you got none*

IF …try to harvest is "YES," ask questions below…

Please estimate how many fur animals ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year.

INCLUDE fur animals that members of this household gave away, ate fresh, fed to dogs, lost to spoilage, or got by helping others. If hunting or trapping with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.

Insert names below in blanks above	*USE?*	*REC?*	*GIVE?*	*TRY?*	October	November	December	January	February	March	April	May	June	July	August	September	Unknown	Units[3] (*specify*)	Number Used For Food or for Food & Fur
WOLVERINE *Qapvik* 223,400,000	Y N	Y N	Y N	Y N														IND	
WOLF *Amaguq* 223,200,000	Y N	Y N	Y N	Y N														IND	
MARTEN *Qapvaitchiaq* 222,000,000	Y N	Y N	Y N	Y N														IND	
LYNX *Nuutuiyiq* 221,600,000	Y N	Y N	Y N	Y N														IND	
RED FOX *Kayuqtuq* 220,804,000	Y N	Y N	Y N	Y N														IND	
ARCTIC FOX *Qusrhaaq* 220,802,000	Y N	Y N	Y N	Y N														IND	
OTTER *Pamiuqtuuq* 221,200,000	Y N	Y N	Y N	Y N														IND	
	Y N	Y N	Y N	Y N														IND	
	Y N	Y N	Y N	Y N														IND	

number caught in each month

During the last year, did your household use any other kind of fur animals?.................... Y N

IF YES, enter the name in a blank row above, and answer the questions in that row.

DON'T FORGET MAP! *Refer to data collection maps and mapping instructions to map fur animals.*

1 *"LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.*
2 *"USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.*
3 *UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*

FURBEARERS: 14 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

SUBSISTENCE SUMMARY: LAND ANIMALS

HOUSEHOLD ID

If this household did NOT USE or HARVEST land animals last year, go to the ASSESSMENT section below.
Otherwise, continue with the network questions…

SUBSISTENCE NETWORK

During the last 12 months…

MOOSE

Enter HH ID, with most important sources first.
INCLUDE this household if members caught or processed moose for this household. For other Selawik households, enter HH ID. For other communities, enter name of other community.

role	resource										
Who KILLED the MOOSE your household used?											
1	211,800,000										
Who PROCESSED the MOOSE your household used?											
2	211,800,000										
Who else SHARED MOOSE with your household?											
3	211,800,000										
Who TRADED MOOSE with your household?											
3	211,800,000										

During the last 12 months…

CARIBOU

Enter HH ID, with most important sources first.
INCLUDE this household if members caught or processed caribou for this household. For other Selawik households, enter HH ID. For other communities, enter name of other community.

role	resource										
Who KILLED the CARIBOU your household used?											
1	211,000,000										
Who PROCESSED the CARIBOU your household used?											
2	211,000,000										
Who else SHARED CARIBOU with your household?											
3	211,000,000										
Who TRADED CARIBOU with your household?											
3	211,000,000										

ASSESSMENTS 200,000,000

To conclude our land animals section, I am going to ask a few general questions about land animals.

During the last 12 months
…did your household use LESS, SAME, or MORE land animals than in recent years?.. X L S M
If LESS or MORE… *X = do not use*
WHY was your USE of land animals different?...................................... ________ 1
________ 2

During the last 12 months
…did your household spend less, same, or more TIME trying to get land animals than in recent years?... X L S M
If LESS TIME or MORE TIME… *X = do not harvest*
Why was your EFFORT different for land animals?.............................. ________ 1
________ 2

During the last 12 months
…did your household GET ENOUGH land animals?.. Y N
If NO…
What KIND of land animals did you need?.. ________
WHY did your household NOT get enough land animals?...................... ________ 1
________ 2

SUMMARY OF LAND ANIMALS: 66, 67 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: MARINE MAMMALS

HOUSEHOLD ID

1. Do you or members of your household USUALLY hunt marine mammals for subsistence?.. Y N

2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO HUNT marine mammals?.. Y N

IF the answer to QUESTION 2 is NO, go to the MARINE MAMMALS summary page.
IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household….
…use[2] ________? | …receive ________ from someone in another household or community? | …give ________ to someone in another household or community? | …try[2] to harvest ________? *TRY includes looking, even if you got none*

IF ...try to harvest is "YES," ask questions below…
Please estimate how many marine mammals ALL MEMBERS OF YOUR HOUSEHOLD killed for subsistence uses during the last year.
INCLUDE marine mammals that members of this household gave away, ate fresh, fed to dogs, lost to spoilage, or got by helping others. If hunting with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.

Insert names below in blanks above	USE?	REC?	GIVE?	TRY?	October	November	December	January	February	March	April	May	June	July	August	September	Unknown	Units[3] *specify*	*comments*
					number killed in each month														
BEARDED SEAL *Ugruk* 300,802,000	Y N	Y N	Y N	Y N														IND	
RINGED SEAL *Natchiq* 300,810,000	Y N	Y N	Y N	Y N														IND	
SPOTTED SEAL *Qasigiaq* 300,812,000	Y N	Y N	Y N	Y N														IND	
SEAL OIL *Ushruk* 300,899,000	Y N	Y N	Y N	Y N														IND	
BELUKHA WHALE *Sisuaq* 301,602,000	Y N	Y N	Y N	Y N														IND	
BOWHEAD WHALE *Agviq* 301,606,000	Y N	Y N	Y N	Y N														IND	
WALRUS *Aiviq* 301,400,000	Y N	Y N	Y N	Y N														IND	
	Y N	Y N	Y N	Y N														IND	
	Y N	Y N	Y N	Y N														IND	

During the last year, did your household use any other kind of marine mammals?.. Y N
IF YES, enter the name in a blank row above, and answer the questions in that row.

DON'T FORGET MAP! *Refer to data collection maps and mapping instructions to map marine mammals.*

1 *"LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.*
2 *"USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.*
3 *UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*

MARINE MAMMALS: 12 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

SUBSISTENCE SUMMARY: MARINE MAMMALS

HOUSEHOLD ID

If this household did NOT USE or HARVEST marine mammals last year, go to the ASSESSMENT section below.
Otherwise, continue with the network questions…

SUBSISTENCE NETWORK

During the last 12 months…

SEALS		*Enter HH ID, with most important sources first. INCLUDE this household if members caught or processed seals for this household. For other Selawik households, enter HH ID. For other communities, enter name of other community.*									
role	*resource*										
Who KILLED the SEALS your household used?											
1	300,800,009										
Who PROCESSED the SEALS your household used?											
2	300,800,009										
Who else SHARED SEALS with your household?											
3	300,800,009										
Who TRADED SEALS with your household?											
3	300,800,009										

During the last 12 months…

WHALES		*Enter HH ID, with most important sources first. INCLUDE this household if members caught or processed whales for this household. For other Selawik households, enter HH ID. For other communities, enter name of other community.*									
role	*resource*										
Who KILLED the WHALES your household used?											
1	301,600,009										
Who PROCESSED the WHALES your household used?											
2	301,600,009										
Who else SHARED WHALES with your household?											
3	301,600,009										
Who TRADED WHALES with your household?											
3	301,600,009										

ASSESSMENTS

300,000,000

To conclude our marine mammals section, I am going to ask a few general questions about marine mammals.

During the last 12 months
…did your household use LESS, SAME, or MORE marine mammals than in recent years?.. X L S M

If LESS or MORE… *X = do not use*

WHY was your USE of marine mammals different?.............................. 1 2

During the last 12 months
…did your household spend less, same, or more TIME trying to get marine mammals than in recent years?...................................... X L S M

If LESS TIME or MORE TIME… *X = do not harvest*

Why was your EFFORT different for marine mammals?........................ 1 2

During the last 12 months
…did your household GET ENOUGH marine mammals?.. Y N

If NO…

What KIND of marine mammals did you need?....................................

WHY did your household NOT get enough marine mammals?............. 1 2

SUMMARY OF MARINE MAMMALS: 66, 67 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

HARVESTS: DUCKS

HOUSEHOLD ID

1. Do you or members of your household USUALLY hunt ducks for subsistence, such as UGIIHIQ, IVUGASRUGRUK, or any other ducks?.................... Y N
2. During the last year (between JANUARY 1, 2009, AND DECEMBER 31, 2009), did you or members of your household USE or TRY TO HUNT ducks?.................... Y N

IF the answer to QUESTION 2 is NO, go to the next harvest page.

IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household.... …use[2] ________? …receive ________ from someone in another household or community? …give ________ to someone in another household or community? …try[2] to harvest ________? *TRY includes looking, even if you got none*

IF ...try to harvest is "YES," ask questions below… Please estimate how many ducks ALL MEMBERS OF YOUR HOUSEHOLD killed for subsistence uses during the last year. *INCLUDE ducks that members of this household gave away, ate fresh, lost to spoilage, or got by helping others. If hunting with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.*

Insert names below in blanks above	*USE?*	*REC?*	*GIVE?*	*TRY?*	January February November December WINTER	April May June SPRING	July August SUMMER	September October FALL	Season of harvest unknown	Units[3]
					number killed in each season				*number*	*specify*
WIGEON *Ugiihiq* 410,236,000	Y N	Y N	Y N	Y N						IND
TEAL *Qaiñiq* 410,232,060	Y N	Y N	Y N	Y N						IND
MALLARD *Ivugasrugruk* 410,214,000	Y N	Y N	Y N	Y N						IND
PINTAIL *Ivugaq, Kurugaq* 410,220,000	Y N	Y N	Y N	Y N						IND
SHOVELER *Aluutaq* 410,230,000	Y N	Y N	Y N	Y N						IND
BLACK SCOTER *Tuuŋgaaġruk* 410,228,020	Y N	Y N	Y N	Y N						IND
SURF SCOTER - 410,228,040	Y N	Y N	Y N	Y N						IND
WHITE-WINGED SCOTER *Killalik* 410,228,060	Y N	Y N	Y N	Y N						IND
BUFFLEHEAD *Nunuqsiiġiiḷaq* 410,202,000	Y N	Y N	Y N	Y N						IND
GOLDENEYE 410,210,000	Y N	Y N	Y N	Y N						IND

DUCKS continued on next page…

1 "LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.
2 "USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.
3 UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.

BIRDS AND EGGS: 15 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

HARVESTS: DUCKS

HOUSEHOLD ID

DUCKS continued from previous page…

During the last year,* did you or members of your household….
…use** ________? | …receive ________ from someone in another household or community? | …give ________ to someone in another household or community? | …try** to harvest ________? *INCLUDE looking, even if you got none*

IF …try to harvest is "YES," ask questions below…
Please estimate how many ducks ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year.
INCLUDE ducks that members of the household gave away, ate fresh, lost to spoilage, or got by helping others. If hunting with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.

Insert names below in blanks above	*USE?*	*REC?*	*GIVE?*	*TRY?*	January February March April WINTER	May June SPRING	July August September SUMMER	October November December FALL	Season of harvest unknown	Units ***
					number killed in each season				*number*	*specify*
CANVASBACK 410,204,000	Y N	Y N	Y N	Y N						IND
SCAUP *Qaqłutuuq* 410,226,000	Y N	Y N	Y N	Y N						IND
COMMON EIDER *Mitiqliqruaq* 410,206,020	Y N	Y N	Y N	Y N						IND
KING EIDER *Qiŋalik, qiŋalik (Barrow)* 410,206,040	Y N	Y N	Y N	Y N						IND
SPECTACLED EIDER *Qavaasuk (Barrow)* 410,206,060	Y N	Y N	Y N	Y N						IND
STELLER'S EIDER *Igniqauqtuq (Barrow)* 410,206,080	Y N	Y N	Y N	Y N						IND
HARLEQUIN *Saġvam tiŋmiaq* 410,212,000	Y N	Y N	Y N	Y N						IND
)NG-TAILED DUCK (OLDSQUA\ *Aahaaliq* 410,218,000	Y N	Y N	Y N	Y N						IND
	Y N	Y N	Y N	Y N						IND
UNKNOWN DUCKS 410,299,000	Y N	Y N	Y N	Y N						IND
	Y N	Y N	Y N	Y N						IND
	Y N	Y N	Y N	Y N						IND

During the last year, did your household use any other kind of ducks?........ Y N

IF YES, enter the name in a blank row above, and answer the questions in that row.

** "LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.*
*** "USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.*
**** UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*

BIRDS AND EGGS: 15 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: GEESE

HOUSEHOLD ID

1. Do you or members of your household USUALLY hunt geese for subsistence, such as KIGIYUK, NIGLIK?, or any other geese?.......... Y N
2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO HUNT geese?.......... Y N

IF the answer to QUESTION 2 is NO, go to the next harvest page.
IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household…. …use[2] ________? …receive ________ from someone in another household or community? …give ________ to someone in another household or community? …try[2] to harvest ________? *TRY includes looking, even if you got none*

IF …try to harvest is "YES," ask questions below… Please estimate how many geese ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year. *INCLUDE geese that members of this household gave away, ate fresh, lost to spoilage, or got by helping others. If hunting with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.*

Insert names below in blanks above	*USE?*	*REC?*	*GIVE?*	*TRY?*	January February November December WINTER	April May June SPRING	July August SUMMER	September October FALL	Season of harvest unknown	Units[3]
					number got in each season				*number*	*specify*
WHITE FRONTED GEESE *Kigiyuk* 410,410,000	Y N	Y N	Y N	Y N						IND
CANADA GEESE *Iqsraġutilik* 410,404,080	Y N	Y N	Y N	Y N						IND
BRANT *Niġliġnaq, niqliqnaurat* 410,402,000	Y N	Y N	Y N	Y N						IND
CACKLERS *Niglik?* 410,404,040	Y N	Y N	Y N	Y N						IND
EMPEROR GEESE *Liġliqpak* 410,406,000	Y N	Y N	Y N	Y N						IND
SNOW GEESE *Kaŋuq* 410,408,000	Y N	Y N	Y N	Y N						IND
	Y N	Y N	Y N	Y N						IND
	Y N	Y N	Y N	Y N						IND
	Y N	Y N	Y N	Y N						IND
	Y N	Y N	Y N	Y N						IND

During the last year, did your household use any other kind of geese?.......... Y N
IF YES, enter the name in a blank row above, and answer the questions in that row.

1 *"LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.*
2 *"USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.*
3 *UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*

BIRDS AND EGGS: 15 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: OTHER BIRDS

HOUSEHOLD ID

1. Do you or members of your household USUALLY hunt other birds for subsistence, such as AQARGIQ, TATTIRGAQ, or any other other birds?.......... Y N
2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO HUNT other birds?.......... Y N

IF the answer to QUESTION 2 is NO, go to the next harvest page.

IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household….

…use[2] ________? | …receive ________ from someone in another household or community? | …give ________ to someone in another household or community? | …try[2] to harvest ________? *TRY includes looking, even if you got none*

IF …try to harvest is "YES," ask questions below…

Please estimate how many other birds ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year.

INCLUDE other birds that members of this household gave away, ate fresh, lost to spoilage, or got by helping others. If hunting with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.

Insert names below in blanks above	*USE?*	*REC?*	*GIVE?*	*TRY?*	January February November December WINTER	April May June SPRING	July August SUMMER	September October FALL	Season of harvest unknown	Units[3]
					number got in each season				*number*	*specify*
PTARMIGAN *Aqargiq* 421,804,990	Y N	Y N	Y N	Y N						IND
SPRUCE GROUSE *Napaaqtum aqargiq* 421,802,020	Y N	Y N	Y N	Y N						IND
SANDHILL CRANE *Tattirgaq* 410,802,000	Y N	Y N	Y N	Y N						IND
TUNDRA SWAN *Qugruk* 410,604,000	Y N	Y N	Y N	Y N						IND
WHIMBREL *Kukukiaq* 411,009,040	Y N	Y N	Y N	Y N						IND
	Y N	Y N	Y N	Y N						IND
	Y N	Y N	Y N	Y N						IND
	Y N	Y N	Y N	Y N						IND
	Y N	Y N	Y N	Y N						IND
	Y N	Y N	Y N	Y N						IND

During the last year, did your household use any other kind of other birds?.......... Y N

IF YES, enter the name in a blank row above, and answer the questions in that row.

1 "LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.

2 "USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.

3 UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.

BIRDS AND EGGS: 15 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: EGGS

HOUSEHOLD ID

1. Do you or members of your household USUALLY gather eggs for subsistence, such as DUCK EGGS, SWAN EGGS, or any other eggs?................ Y N
2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO GATHER eggs?................ Y N

IF the answer to QUESTION 2 is NO, go to the BIRD & EGG summary page.

IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household….

…use[2] ________?

…receive ________ from someone in another household or community?

…give ________ to someone in another household or community?

…try[2] to harvest ________? *TRY includes looking, even if you got none*

IF ...try to harvest is "YES," ask questions below…

Please estimate how many eggs ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year.

INCLUDE eggs that members of this household gave away, ate fresh, lost to spoilage, or got by helping others. If gathering with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.

Insert names below in blanks above	*USE?*	*REC?*	*GIVE?*	*TRY?*	How many did you gather? *amount*	Units[3] *specify*	*comments*
DUCK EGGS	Y N	Y N	Y N	Y N			
430,200,000							
GEESE EGGS	Y N	Y N	Y N	Y N			
430,400,000							
SWAN EGGS	Y N	Y N	Y N	Y N			
430,600,000							
GULL EGGS	Y N	Y N	Y N	Y N			
431,212,990							
SHORE BIRD EGGS	Y N	Y N	Y N	Y N			
431,099,000							
UNKNOWN EGGS	Y N	Y N	Y N	Y N			
439,900,000							
	Y N	Y N	Y N	Y N			
	Y N	Y N	Y N	Y N			
	Y N	Y N	Y N	Y N			
	Y N	Y N	Y N	Y N			IND

During the last year, did your household use any other kind of eggs?................ Y N

IF YES, enter the name in a blank row above, and answer the questions in that row.

1 *"LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.*
2 *"USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.*
3 *UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*

BIRDS AND EGGS: 15 **SELAWIK: 303**

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SUBSISTENCE SUMMARY: BIRDS & EGGS

HOUSEHOLD ID

If this household did NOT USE or HARVEST birds & eggs last year, go to the ASSESSMENT section below.
Otherwise, continue with the network questions…

SUBSISTENCE NETWORK

During the last 12 months…

BIRDS

role	resource	*Enter HH ID, with most important sources first. INCLUDE this household if members caught or processed birds for this household. For other Selawik households, enter HH ID. For other communities, enter name of other community.*									
Who GOT the BIRDS your household used?											
1	430,000,000										
Who PROCESSED the BIRDS your household used?											
2	430,000,000										
Who else SHARED BIRDS with your household?											
3	430,000,000										
Who TRADED BIRDS with your household?											
3	430,000,000										

During the last 12 months…

EGGS

role	resource	*Enter HH ID, with most important sources first. INCLUDE this household if members caught or processed eggs for this household. For other Selawik households, enter HH ID. For other communities, enter name of other community.*									
Who GOT the EGGS your household used?											
1	121,200,002										
Who PROCESSED the EGGS your household used?											
2	121,200,002										
Who else SHARED EGGS with your household?											
3	121,200,002										
Who TRADED EGGS with your household?											
3	121,200,002										

ASSESSMENTS

400,000,000

To conclude our birds & eggs section, I am going to ask a few general questions about birds & eggs.

During the last 12 months
…did your household use LESS, SAME, or MORE birds & eggs than in recent years?..X L S M
If LESS or MORE… *X = do not use*
WHY was your USE of birds & eggs different?...................................... 1
2

During the last 12 months
…did your household spend less, same, or more TIME trying to get birds & eggs than in recent years?..X L S M
If LESS TIME or MORE TIME… *X = do not harvest*
Why was your EFFORT different for birds & eggs?................................ 1
2

During the last 12 months
…did your household GET ENOUGH birds & eggs?.. Y N
If NO…
What KIND of birds & eggs did you need?...
WHY did your household NOT get enough birds & eggs?...................... 1
2

SUMMARY OF BIRDS & EGGS: 66, 67 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: BERRIES

HOUSEHOLD ID

1. Do you or members of your household USUALLY pick berries for subsistence, such as AQPIK, KIKMIÑÑAQ, or any other berries? .... Y N
2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO PICK berries? .... Y N

IF the answer to QUESTION 2 is NO, go to the next harvest page.

IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household….	…use[2] ________?	…receive ________ from someone in another household or community?	…give ________ to someone in another household or community?	…try[2] to harvest ________? *TRY includes looking, even if you got none*	IF ...try to harvest is "YES," ask questions below… Please estimate how many berries ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year. *INCLUDE berries that members of this household gave away, ate fresh, lost to spoilage, or got by helping others. If picking with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.*		
Insert names below in blanks above	*USE?*	*REC?*	*GIVE?*	*TRY?*	How many did you pick? *amount*	Units[3] *specify*	*comments*
SALMONBERRY *Aqpik* 601,016,000	Y N	Y N	Y N	Y N		GAL	
BLUEBERRIES *Asriavik* 601,002,000	Y N	Y N	Y N	Y N		GAL	
CRANBERRIES *Kikmiññaq* 601,004,000	Y N	Y N	Y N	Y N		GAL	
BLACKBERRIES *Paunġaq* 601,030,000	Y N	Y N	Y N	Y N		GAL	
RASPBERRIES *Tunŋaum asriaq* 601,020,000	Y N	Y N	Y N	Y N		GAL	
CURRANTS *Niviŋŋaqutaq* 601,012,000	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	

During the last year, did your household use any other kind of berries? .... Y N

IF YES, enter the name in a blank row above, and answer the questions in that row.

1 *"LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.*
2 *"USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.*
3 *UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*

PLANTS: 17 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: GREENS

HOUSEHOLD ID

1. Do you or members of your household USUALLY pick greens for subsistence, such as SURA, UKPIK, QUSRIMMAQ, or any other greens?........ Y N
2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO PICK greens?........ Y N

IF the answer to QUESTION 2 is NO, go to the next harvest page.

IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household…. …use[2] ________? …receive ________ from someone in another household or community? …give ________ to someone in another household or community? …try[2] to harvest ________? *TRY includes looking, even if you got none*

IF …try to harvest is "YES," ask questions below… Please estimate how many greens ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year. *INCLUDE greens that members of this household gave away, ate fresh, lost to spoilage, or got by helping others. If picking with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.*

Insert names below in blanks above	*USE?*	*REC?*	*GIVE?*	*TRY?*	How many did you pick? *amount*	Units[3] *specify*	*comments*
WILLOW LEAVES *Sura, Ukpik* 602,031,000	Y N	Y N	Y N	Y N		GAL	
STINKWEED *Sarġiiq* 602,044,000	Y N	Y N	Y N	Y N		GAL	
WILD RHUBARB *Qusrimmaq* 602,006,000	Y N	Y N	Y N	Y N		GAL	
ESKIMO TEA *Tilaaquiq* 602,018,000	Y N	Y N	Y N	Y N		GAL	
WILD CELERY *Ikuusuk* 602,032,000	Y N	Y N	Y N	Y N		GAL	
FIREWEED *Pamiuqtaq, Quppiqutaq* 602,042,000	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	

During the last year, did your household use any other kind of greens?........ Y N

IF YES, enter the name in a blank row above, and answer the questions in that row.

1 *"LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.*

2 *"USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.*

3 *UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.*

PLANTS: 17 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

SUBSISTENCE HARVESTS: OTHER PLANTS

HOUSEHOLD ID

1. Do you or members of your household USUALLY get other plants for subsistence, such as MASRU, FIREWOOD, or any other other plants?........ Y N
2. During the last year (between OCTOBER 1, 2010, AND SEPTEMBER 30, 2011), did you or members of your household USE or TRY TO GET other plants?........ Y N

IF the answer to QUESTION 2 is NO, go to the next BERRIES & GREENS summary page.

IF the answer is YES, continue on this page…

During the last year[1], did you or members of your household….
…use[2] ________? | …receive ________ from someone in another household or community? | …give ________ to someone in another household or community? | …try[2] to harvest ________? *TRY includes looking, even if you got none*

IF …try to harvest is "YES," ask questions below…
Please estimate how many other plants ALL MEMBERS OF YOUR HOUSEHOLD got for subsistence uses during the last year.
INCLUDE other plants that members of this household gave away, ate fresh, lost to spoilage, or got by helping others. If harvest with or helping others, report ONLY THIS HOUSEHOLD'S share of the harvest.

Insert names below in blanks above	*USE?*	*REC?*	*GIVE?*	*TRY?*	How many did you get? *amount*	Units[3] *specify*	*comments*
ESKIMO POTATO *Masru* 602,009,000	Y N	Y N	Y N	Y N		GAL	
ROSE HIPS 602,036,000	Y N	Y N	Y N	Y N		GAL	
FIREWOOD 604,000,000	Y N	Y N	Y N	Y N		CORDS	
FIREWOOD (SLED LOAD)						SLED LOAD	*If UNIT is sled or boat load, enter sizes per load!* *N of LOGS = LENGTH= DIAMETER=* *In coding, convert boat and sled loads to CORDS.*
FIREWOOD (BOAT LOAD) 604,000,000						BOAT LOAD	*If UNIT is sled or boat load, enter sizes per load!* *N of LOGS = LENGTH= DIAMETER=* *In coding, convert boat and sled loads to CORDS.*
	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	
	Y N	Y N	Y N	Y N		GAL	

During the last year, did your household use any other kind of other plants?........ Y N

IF YES, enter the name in a blank row above, and answer the questions in that row.

1 "LAST YEAR" means between OCTOBER 1, 2010, and SEPTEMBER 30, 2011.
2 "USE" includes harvesting, processing, eating, trading, feeding to dogs, etc. "TRY" includes looking, hunting, fishing, or any attempt to get.
3 UNITS will differ by species and situation. Units may be pounds (lbs), individuals (ind), portions of individuals (1/4), buckets, sacks, tubs, etc.

PLANTS: 17 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

SUBSISTENCE SUMMARY: BERRIES, GREENS, & FIREWOOD

HOUSEHOLD ID

If this household did NOT USE or HARVEST berries, greens, & firewood last year, go to the ASSESSMENT section below.
Otherwise, continue with the network questions…

SUBSISTENCE NETWORK

During the last 12 months...

BERRIES & GREENS

role	resource	*Enter HH ID, with most important sources first. INCLUDE this household if members caught or processed berries & greens for this household. For other Selawik households, enter HH ID. For other communities, enter name of other community.*									
Who PICKED the BERRIES & GREENS your household used?											
1	601,000,000										
Who PROCESSED the BERRIES & GREENS your household used?											
2	601,000,000										
Who else SHARED BERRIES & GREENS with your household?											
3	601,000,000										
Who TRADED BERRIES & GREENS with your household?											
3	601,000,000										

During the last 12 months...

FIREWOOD

role	resource	*Enter HH ID, with most important sources first. INCLUDE this household if members caught or processed firewood for this household. For other Selawik households, enter HH ID. For other communities, enter name of other community.*									
Who PICKED the FIREWOOD your household used?											
1	602,042,002										
Who PROCESSED the FIREWOOD your household used?											
2	602,042,002										
Who else SHARED FIREWOOD with your household?											
3	602,042,002										
Who TRADED FIREWOOD with your household?											
3	602,042,002										

ASSESSMENTS

600,000,000

To conclude our berries, greens, & firewood section, I am going to ask a few general questions about berries, greens, & firewood.

During the last 12 months
…did your household use LESS, SAME, or MORE berries, greens, & firewood than in recent years?... X L S M
If LESS or MORE… *X = do not use*
WHY was your USE of berries, greens, & firewood different?................ 1 2

During the last 12 months
…did your household spend less, same, or more TIME trying to get berries, greens, & firewood than in recent years?........................ X L S M
If LESS TIME or MORE TIME… *X = do not harvest*
Why was your EFFORT different for berries, greens, & firewood?......... 1 2

During the last 12 months
…did your household GET ENOUGH berries, greens, & firewood?... Y N
If NO…
What KIND of berries, greens, & firewood did you need?.......................
WHY did your household NOT get enough berries, greens, & firewood? 1 2

SUMMARY OF BERRIES, GREENS, & FIREWOOD: 66, 67 **SELAWIK: 303**

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NORTHWEST ARCTIC CIAP – COMPREHENSIVE SURVEY, 2010

FOOD SECURITY

HOUSEHOLD ID

The questions on this page have been asked all over the United States to find out if Americans have enough to eat. We would like to know if people in your village have enough to eat. I am going to read you five statements about different food situations. Please tell me whether EACH statement was true for your household (HH) in the last 12 months.

Think about all your household's food, both subsistence and store-bought…

STATEMENT 1. We WORRIED that our household would not have ENOUGH FOOD.

In the last 12 months, was this OFTEN true, SOMETIMES true, or NEVER true for your household?.................... [1] Often True [2] Sometimes True [3] Never True HH2

STATEMENT 2. The food we had JUST DID NOT LAST, and we could not get more.

In the last 12 months, was this OFTEN true, SOMETIMES true, or NEVER true for your household?.................... [1] Often True [2] Sometimes True [3] Never True HH3

STATEMENT 3. We could not get the foods we wanted to eat because of a LACK OF RESOURCES.

By "lack of resources," we mean your household did NOT have what you needed to hunt, fish, gather, or buy food.

In the last 12 months, was this OFTEN true, SOMETIMES true, or NEVER true for your household?.................... [1] Often True [2] Sometimes True [3] Never True HH4

Now, think just about your household's SUBSISTENCE food…

STATEMENT 4. The SUBSISTENCE food we had just did not last, and we could not get more.

In the last 12 months, was this ever true for your household?.................... N Y ?

If YES, in which months did this happen?.................... J F M A M J J A S O N D

Now, think just about your household's STORE-BOUGHT food…

STATEMENT 5. The STORE-BOUGHT food we had just did not last, and we could not get more.

In the last 12 months, was this ever true for your household?.................... N Y ?

If YES, in which months did this happen?.................... J F M A M J J A S O N D

If Statement 1, Statement 2, AND Statement 3 were NEVER TRUE, go to the next page.

If Statement 1, Statement 2, OR Statement 3 was SOMETIMES TRUE or OFTEN TRUE, continue on this page…

In the last 12 months, did you or other adults in your household ever CUT THE SIZE OF YOUR MEALS OR SKIP MEALS because the HH could not get the food that was needed?.................... N Y ? AD1

If YES, how often did this happen?.................... [1] Almost every month [2] Some months… [3] Only 1 or 2 months

In the last 12 months, did you or other adults in your household ever EAT LESS THAN YOU FELT YOU SHOULD because the HH could not get the food that was needed?.................... N Y ? AD2

In the last 12 months, were adults in the HH ever HUNGRY BUT DID NOT EAT because there was not enough food?.................... N Y ? AD3

In the last 12 months, did adults in the HH LOSE WEIGHT because there was not enough food?.................... N Y ? AD4

In the last 12 months, did you or other adults in your household ever NOT EAT FOR A WHOLE DAY because there was not enough food?.................... N Y ? AD5

If YES, how often did this happen?.................... [1] Almost every month [2] Some months… [3] Only 1 or 2 months

FOOD SECURITY: 201 SELAWIK: 303

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NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

CUSTOMARY TRADE

HOUSEHOLD ID

The Selawik IRA Council wanted us to ask about purchases and sales of subsistence foods.
During the last 12 months, have you or someone in your household BOUGHT or SOLD subsistence foods?............................ Y N

IF the answer is NO, go to the next page.
IF the answer is YES, continue on this page…

During the last 12 months, what kind of subsistence foods did members of your hosuehold buy or sell?

What kind of subsistence food was bought or sold?	How was this food processed?	Did your HH buy or sell this food?	How MUCH of THIS subsistence food did your household buy or sell?		How much was paid for this food?	Did the other person live in Selawik?	*If "NO"…* WHERE did the other person live?
species name	*process*	*circle one*	*amount*	*units*	*dollars*	*circle one*	*community*
		BUY SELL			$	YES NO	
		BUY SELL			$	YES NO	
		BUY SELL			$	YES NO	
		BUY SELL			$	YES NO	
		BUY SELL			$	YES NO	
		BUY SELL			$	YES NO	
		BUY SELL			$	YES NO	
		BUY SELL			$	YES NO	
		BUY SELL			$	YES NO	
		BUY SELL			$	YES NO	
		BUY SELL			$	YES NO	
		BUY SELL			$	YES NO	
		BUY SELL			$	YES NO	
		BUY SELL			$	YES NO	

CUSTOMARY TRADE: 202c **SELAWIK: 303**

NORTHWEST ARCTIC CIAP COMPREHENSIVE SURVEY, 2010

SURVEY SUMMARY

HOUSEHOLD ID

ASSESSMENTS: ALL RESOURCES

0

To conclude our survey, I am going to ask a few general questions about ALL SUBSISTENCE RESOURCES.

Last year…

…did your household use LESS, SAME, or MORE subsistence resources than in recent years?.......... X L S M

If LESS or MORE… *X = do not use*

WHY was your use different?............ 1 ________ 2 ________

Last year…

…did your household spend less, same, or more TIME trying to get subsistence resources than in recent years?.......... X L S M

If LESS TIME or MORE TIME… *X = do not harvest*

Why was your EFFORT different for ?.......... 1 ________ 2 ________

Last year…

…did your household GET ENOUGH subsistence resources?.......... Y N

If NO…

What KIND of subsistence resources did you need?.......... ________

WHY did your household NOT get enough all resources?.......... 1 ________ 2 ________

How would you describe the impact to your household of not getting enough all resources last year?.......... …not noticable? (0) ...minor? (1) ...major? (2) severe? (3)

Did your household do anything DIFFERENTLY because you did NOT get enough all resources?.......... Y N

IF YES…

What did your household do differently?.......... 1 ________ 2 ________

QUESTIONS, COMMENTS, CONCERNS

Do you have any questions, comments, or concerns?

ASSESSMENTS OF ALL RESOURCES & COMMENTS: 30, 66 SELAWIK: 303

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INTERVIEW SUMMARY

HOUSEHOLD ID

BE SURE TO FILL IN THE STOP TIME ON THE FIRST PAGE!!!!

Use this space for interviewer's comments about survey, especially factors that might have affected the household's responses.

BE SURE TO FILL IN THE STOP TIME ON THE FIRST PAGE!!!!