27th Lowell Wakefield Fisheries Symposium
Alaska Sea Grant

Fishing People of the North

Cultures, Economies, and Management Responding to Change

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Cover photo of southeast Alaska seiner by Gary Freitag.

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About the Proceedings Book and the Symposium

Nineteen peer-reviewed papers are included in this proceedings volume; all were presented at the symposium Fishing People of the North: Cultures, Economies, and Management Responding to Change, September 14-17, 2012, in Anchorage, Alaska. A total of 72 oral presentations and 23 posters were shared at the symposium.

The goals of the Fishing People of the North symposium were to (1) share knowledge of opportunities and constraints that fishing people in northern countries encounter in a time of environmental, social, and economic change; and (2) investigate how diversity in values and livelihoods can be best incorporated into management processes. To meet these goals, oral presentations and posters were solicited for four main themes: Human-Environmental Relationships; Fishing Communities in Transition; Indigenous and Rural Knowledge and Communities; and Governance and Management Issues in the North.

Fishing People of the North was the first Wakefield symposium to focus on the work of social scientists—anthropologists, economists, indigenous knowledge experts, and sociologists, among others. The symposium attracted over 170 participants from Canada, Greenland, Japan, the Northern Mariana Islands, Norway, Russia, and the United States. Attendees reflected a diversity of cultures, backgrounds, occupations, and connections to fisheries.

This symposium provided a forum for scholars, indigenous leaders, fishery managers, fishing families, and others to explore the human dimensions of fishery systems. It was a place for sharing what we have learned across diverse systems, exploring the many questions that remain, and building the relationships necessary for future collaborative opportunities. These resulting proceedings provide a valuable contribution advancing our understanding of how we can more fully characterize the diversity of the people and places that depend on the sea, and how we might better incorporate this diversity into management processes.

The symposium steering committee gave awards to two Ph.D. students from the University of Alaska Fairbanks for their presentations—Zac Hoyt and Megan Peterson. Ten students from several nations competed for the $300 prizes. Travel to the symposium was paid for nine graduate students, and seven students earned their registration fees by working during the symposium sessions.

Details about the symposium Fishing People of the North, including the program, presentation PowerPoints, and abstract book, are available on the symposium website, alaskaseagrant.org/conferences/2011/wakefield-people/.

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NOAA Fisheries, Alaska Fisheries Science Center
North Pacific Fishery Management Council
North Pacific Research Board
School of Fisheries and Ocean Sciences, University of Alaska Fairbanks
World Wildlife Fund

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The Lowell Wakefield Symposium Series and Endowment

Alaska Sea Grant has been sponsoring and coordinating the Lowell Wakefield Fisheries Symposium series since 1982. These meetings are a forum for information exchange in biology, management, and economics of various fish species and complexes, as well as an opportunity for scientists from high-latitude countries to meet informally and discuss their work.

Lowell Wakefield was the founder of the Alaska king crab industry. He recognized two major ingredients necessary for the king crab fishery to survive—ensuring that a quality product be made available to the consumer, and that a viable fishery can be maintained only through sound management practices based on the best scientific data available. Lowell Wakefield and Wakefield Seafoods played an important role in the development and implementation of quality control legislation, in the preparation of fishing regulations for Alaska waters, and in drafting international agreements for the high seas. In his later years, as an adjunct professor of fisheries at the University of Alaska, Lowell Wakefield influenced the early directions of Alaska Sea Grant. The Wakefield Symposium series is named in honor of Lowell Wakefield and his many contributions to Alaska's fisheries. In 2000, Frankie Wakefield (Lowell's wife) made a gift to the University of Alaska Foundation to establish an endowment to continue this series.

Cullenberg, P.J. 2012. Introduction to the Symposium. In: C. Carothers, K.R. Criddle, C.P. Chambers, P.J. Cullenberg, J.A. Fall, A.H. Himes-Cornell, J.P. Johnsen, N.S. Kimball, C.R. Menzies, and E.S. Springer (eds.), Fishing People of the North: Cultures, Economies, and Management Responding to Change. Alaska Sea Grant, University of Alaska Fairbanks. doi:10.4027/fpncemrc.2012.01

Introduction to the Symposium

Paula Cullenberg
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Good morning everyone! Welcome to our 27th Lowell Wakefield Symposium! I am the associate director of Alaska Sea Grant. Alaska Sea Grant is a partnership between the University of Alaska and the National Oceanic and Atmospheric Administration, and works statewide to bring information, education, and technical assistance to Alaskans involved with marine issues.

The international Lowell Wakefield Fisheries Symposium series is named in honor of Lowell Wakefield and his many contributions to Alaska's fisheries. Wakefield, who is regarded as the founder of the Alaska king crab industry, recognized that for the fishery to survive, superb quality seafood products must be provided to the consumer, and resource management must be based on the best available scientific data.

In 2000, Frankie Wakefield, Lowell's wife, made a gift to the University of Alaska Fairbanks to establish an endowment to continue the series that honors her husband's commitment to wise management and utilization of marine resources.

We have a stimulating four days ahead of us. We have 174 people registered for this conference, from 10 states and seven countries. For the next three evenings, we have scheduled interesting events—tonight a poster session and reception here at the Hilton, tomorrow we are hosting Anchorage's first Fishing Poetry/Prose reading at Snow City Café from 7-9 pm, and on Friday we will tour the Sailing for Salmon exhibit at the Anchorage Museum, with an opportunity to meet a fisherman who participated in sailboat harvesting of salmon in Bristol Bay in the 1950s.

I would like to recognize the hard work of the symposium steering committee, and the Alaska Sea Grant staff, for their help in developing this symposium: co-chairs, Courtney Carothers and Keith Criddle, both the University of Alaska Fairbanks, School of Fisheries and Ocean Sciences faculty; Mary Pete, UAF Kuskokwim Campus; Jim Fall with

Alaska Department of Fish and Game; Nicole Kimball, North Pacific Fishery Management Council; Amber Himes-Cornell, NOAA Alaska Fisheries Science Center; Marie Lowe, University of Alaska Anchorage Institute of Social and Economic Research; Charles Menzies, University of British Columbia; Jahn Petter Johnsen, University of Tromsø; and Catherine Chambers and Emilie Springer, both graduate students at UAF. I'd also like to recognize David Christie, director of Alaska Sea Grant and Sea Grant staff members Sue Keller and Adie Callahan.

Alaska Sea Grant also would like to express our appreciation for the financial sponsors of the Wakefield symposium—most have been long-time supporters and are truly critical to the success of the Wakefield symposia. They are the Alaska Department of Fish and Game, NOAA Fisheries Alaska Region, North Pacific Fishery Management Council, North Pacific Research Board, World Wildlife Fund, and Alaska Marine Conservation Council.

Since its inception, the Wakefield symposium series has addressed subjects that are timely and key to the understanding and management of commercially harvested marine species. This symposium, Fishing People of the North, is the first Wakefield meeting to focus on the unique lifestyles and challenges that fishing people face now and will face in the future.

It is a fitting topic for Alaska, since Alaska is a fishing state and we are a fishing people. Last week [September 2011] NOAA Fisheries noted that for the 22nd year in a row, Unalaska/Dutch Harbor is the largest commercial fishing port in the country. Kodiak falls close behind every year as do a number of Alaska fishing communities—Sitka, Naknek, Petersburg, Cordova, Homer, and Seward.

Annually, more than 70,000 people are involved in the commercial harvest and processing of seafood in Alaska. Thousands more are harvesting fish for sport, subsistence, or personal use. I would dare say that the vast majority of Alaskans have some locally harvested fish in their freezers, on their drying racks, or in glass jars or cans on their shelves at any point during the year.

And what makes "fishing people of the north" unique? Well, we know that in the north we face rough weather together, and we face the dark in the winter and the long work-filled days of the summer. And we often face geographic isolation. In Alaska, the majority of our (approximately) 300 communities are not connected to each other by road—they are virtually hundreds of small islands. That can be a hindrance, making it difficult to access capital to expand fishing operations, to access information and educational opportunities, and to access public processes to influence decisions that will impact our lives. But the trade-off is found in the unique quality of life that fishing people often share—a strong sense of community, the ability to see and experience our natural world on a daily basis, and a sense of independence that is not easily replicated.

But we are aware that change comes fast, and anyone involved in fishing knows that change is constant. Through the Fishing People of the North symposium, I hope we will be able to share ways to address change and ensure that fishing remains a healthy, vibrant part of our lives.

Brower Sr., R.H. 2012. Inuit, Global Climate Change, and the Need for Arctic Social Science Policy Processes: Keynote. In: C. Carothers, K.R. Criddle, C.P. Chambers, P.J. Cullenberg, J.A. Fall, A.H. Himes-Cornell, J.P. Johnsen, N.S. Kimball, C.R. Menzies, and E.S. Springer (eds.), Fishing People of the North: Cultures, Economies, and Management Responding to Change. Alaska Sea Grant, University of Alaska Fairbanks. doi:10.4027/fpncemrc.2012.02

Inuit, Global Climate Change, and the Need for Arctic Social Science Policy Processes

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Abstract

The Inuit people are fortunate that our social structure and systems remained relatively intact up to modern times. Since 1977 much has changed, and the environment is still changing rapidly as new developments and national economic interests change. There are three areas of concern where we feel the need to bring in a new dimension of social science research to bridge a gap in arctic research policy processes: trans-boundary pollution, industrialization of the Arctic, and economic change. The re-evaluation of social sciences in the far north needs to be considered in relating to a group of hunter people interacting with mainstream societies and advanced to promote healthy living in a critical time of global climate change for the fishing peoples of the north and all societies affected. As we respond to change, this need for arctic social science policy and processes would influence a positive new social science framework with understandable social values.

Introduction

My Inupiaq Eskimo name is Aniqsuaq. I was born in Barrow, Alaska, but I was raised at Iviksuk about 30 miles south of Barrow in a little community of five sod homes among 18 people. I was the youngest of the community who lived in the old Inupiaq way of life, living off the land. We wore traditional fur clothing and traveled by dog team. In 1954 we walked to Barrow to move there permanently, because the government required us to attend school. I still recall the first English words I ever heard. Who is your name?" my teacher asked. That was my introduction to the modern world.

Inuit circumpolar peoples

We Inuit are an international community sharing a common language, culture, and a common homeland along the arctic coasts of Siberia, Alaska, Canada, and Greenland. Although not a nation-state, as a people, we do constitute a nation. As we Inuit gathered for the first time in Barrow in 1977, the Mayor of the North Slope Borough, Eben Hopson, commented in his address, "Our language contains the memory of four thousand years of human survival through conservation and good management of our arctic wealth." That year, we began the Inuit Circumpolar Council to address the modernization of our arctic environment and its impact on our cultures, economies, and other human dimensions of our arctic systems of survival as a hunter-fisher society. We are fortunate that our social structure and systems remained relatively intact up to modern times. Since 1977 much has changed and the environment is still changing rapidly as new developments and national economic interests change.

I am reminded of an elderly woman, at our 1980 Inuit Circumpolar Conference in Greenland, as she made a comment that put the Inuit global perspective into focus when she said, "Our land is so big, and yet, it is so small." To thrive in our circumpolar homeland, Inuit have the vision to realize we must speak with a united voice on issues of common concern and combine our energies and talents toward protecting and promoting our way of life. Because we are hunting societies who use the arctic marine environment to cull food from the bounty of the sea, we consider the Arctic Ocean as our garden around which our social systems and culture are based. In remote villages our hunting and fishing traditions remain strong. We still hunt seals, walrus, whales, beluga, and the polar bear, and fish for arctic char and other arctic fishes from the land and sea.

Need for social science involvement

The Arctic is an environment that has remained unmolested until the 20th century. However, our social relationship with the outside world is now fraught with unresolved issues that stem from introduction of a modern world and social interactions with new peoples and their cultures. Our social systems are now impacted with new problems and few solutions to resolve the need for modernization of social sciences for the arctic people.

Critical theory is a school of thought that stresses the examination and the critique of society and culture, by applying knowledge from the social sciences and the humanities (http://en.wikipedia.org/wiki/Critical_theory).

I want to address three areas of concern where we feel the need to bring in a new dimension of social science research that hopefully will bridge a missing gap in arctic research policy processes. They are trans-boundary pollution, industrialization of the Arctic, and economic change that impact arctic societies. My point is that there is an important and growing need for the incorporation of social science and policy processes to address human environmental relationships in the far north, in the continuing modernization of our arctic communities and societies.

Trans-boundary pollution

Most people think of the Arctic as one of the last great unspoiled environments on earth. As science advanced to study climate change in the Arctic, we now know our citizens and denizens are highly contaminated. Arctic researchers have discovered that arctic people and animals carry chemicals that in subtle ways may injure the health of people and predators alike. Yet we Inuit and other fishing peoples of the North continue to depend on the arctic food chain for sustenance. The trans-boundary contaminants that our food resources carry may be able to mutate genes, damage cells, and possibly cause cancer among people and animals alike. As we hunt and fish for food we feel somewhat helpless because we know it is an unseen crisis getting worst over time. Yet my good friend from Qaanaaq in Greenland, Uusaqqaq Qujaukitsoq, whom I met on the Monzino Polar Expedition in 1972, would say "peqqinnartoq," it is healthy food. And so it is as compared to store bought, factory processed foods from the south we now purchase in local markets. Our diets of seal, narwhale, walrus, and polar bear are more fitting to our arctic environment, compared to farm raised cows, pigs, and chickens of the south. It is also much cheaper to rely on our own nutritionally balanced arctic natural resources to maintain a healthy body for arctic survival. The shock by modern scientists to find trans-boundary pollutants within our bodies in the Arctic may have initially raised alarm. "Stop eating these foods!" was the outcry. But what about the socio-cultural impacts of switching from a hunter's diet of arctic animals to farm-raised diets that may have chemicals that cause obesity and diabetes among other illnesses foreign to arctic residents?

What I describe here opens the need for application of social sciences and policy development in a new way. I don't mean anthropology—we already have plenty of that going on, but other branches of social research focusing on social processes in microeconomics, and in education based on the struggles and triumphs of daily life of arctic residents. And it is important to address law from the socio-cultural context, so we may understand the moral and ethical aspects of legal policy applied from distance places to the north. New social science research and processes may address innovative environmental relationships to bring about a balance of the common wealth for the northern and southern lex in a critical time of global climate change affecting all arctic residents, especially the fishing peoples of the north.

Industrialization of the Arctic

My second point addresses industrialization of the Arctic. From a hunter and fishing people's point of view, industrialization is a new form of human contamination having a tremendously negative impact in a fragile arctic ecosystem with possible global repercussions. Industrialization of the Arctic has come rapidly all across the circumpolar north. It brings with it a new form of economic imperialism that is multinational in nature. Corporations whose interests surpass the abilities of nation states to extract the enormous wealth of the Arctic, be it oil, minerals, or some other valuable nonrenewable resource, threaten the hunter's lifestyle and the game he depends on for food. Some good and some bad results have emerged in the maelstroms of industrial change where money has taken on a means of survival. As a hunter, like many others in my hometown of Barrow, I have had my share of experiences with government practices and Inuit land-animal relationships through co-management agreements and land claims. But somehow those have resulted in undermining my subsistence way of life, which I wanted to protect. I, together with many others, have participated in government processes resulting in the development of local bureaucracies parallel to those of federal and state governments. In that light, we are faced with a rapid economic shift from our indigenous subsistence economies that are several thousands of years old to modern cash economies across the Arctic. To participate we have had to develop regional governments so we may enjoy the benefits of a modern cash economy resulting from the industrialization of the Arctic—the North Slope Borough, Northwest Arctic Borough, Nunavut, Nunavik, Nunatsiaq, and independence of Kalaalliit Nunat in Greenland.

The social costs are staggering as we struggle to shift our behavior and mental processes to capture this new climate of social change. We have had to shift from the mind of hunter to one of a bureaucrat. As one can see, this relatively new human-environmental climate change is far reaching as it brings to arctic societies new opportunities and constraints in a time of rapid change to the fishing peoples of the north. It opens the door for new sociological research and the development of policy processes in psychological research and its myriad of specialties and treatment of problems of living. This requires an academic response as the challenges in the north are brought about by contact between ancient arctic cultures and industrialization of the Arctic.

Economic change

Lastly, economic changes from a subsistence economy to a cash economy have had a tremendous impact on arctic societies as we switch to public administration and local governments. This is especially so for Inuit across the arctic regions. While each arctic nation state with Inuit populations has treated these arctic residents differently, the overall impact remains the same. Cash economy is totally entrenched in Inuit life at every level from individual to public administration. The greatest impact is visible in the social values and changes that affront Inuit in varying degrees from country to country. For example, instead of the traditional clothing of fur we now buy clothes from stores and look for the latest modern fashion designs. As we developed modern regional governments, we established political systems to address our economic needs. New houses, roads, airports, and many other infrastructures were built. We have moved within a generation from mushing dog teams to a space age where we can track our whereabouts with a global positioning system. All of this takes money.

What is the social cost to do all this? Within a short period of time hunters and fishermen struggle with the thought of continuing to be a breadwinner for the family. In some families, role reversal of the breadwinner has been sorely destructive to the family unit. For example, a wife who works in the office gained retirement and medical benefits. The husband who worked in construction of our government infrastructure building roads, airports, and the like went without benefits as he moved from job to job. He is now without work and cannot hunt. Therefore the role of the breadwinner is reversed. The wife comes home from work and finds the husband is either drunk or has pitifully ignored the children. A large percent of young married couples fail in marriage as a result of coping with a cash economy, especially where jobs are few and far between. It is difficult to carry out subsistence activities without money these days. What results is domestic violence that is on the increase due to the shift from a hunting economy to a cash economy. Occupational inequity, yet not destitution, is on the rise along with its social problems. Economic changes from a subsistence economy to a cash economy should be looked on as an opportunity to combine social sciences. And with their application of policy processes, consider the needs of arctic residents for solutions to improve life in the north.

Conclusions

The re-evaluation of social sciences in the far north needs to be considered in relating to a group of hunter people interacting with the mainstream of societies and advanced to promote healthy living in a critical time of global climate change for the fishing peoples of the north and all societies affected. As we respond to change, this need for arctic social science policy and processes would influence a positive new social science framework with understandable social values.

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In Times of Change: Cultural Responses to the Natural and Social Environment in Nordland, Norway

Harald Beyer Broch
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Abstract

This paper explores how northern Norwegian fishermen conceptualize and adjust to changes in their marine environment during fishing from 11-15 meter long vessels. New species of fish to the area have been fished for commercial purposes during the last 10 years. The current marine adaptation of the fishermen in focus is marked by both cultural creativity and innovations.

Norwegian authorities claim that biodiversity is a political goal and that a strongly regulated harvest is needed if a sustainable fishery is to be achieved. Yet drilling for oil is considered where corals thrive and some of the world's largest fisheries are carried out. Longstanding cultural traditions and a high level of resilience have marked the adaptation of Norwegian coastal fishermen. The paper aims to underline the need to apply ecological and anthropological insights in order to explain this local adaptation to environmental changes.

Introduction: about change, creativity, and innovation

Our setting is a place and a fishing community named Helligvær. Helligvær and the fishermen who have their homes in this island community can be characterized by continued change through recorded and unrecorded history and stories alike (Gudbrandson 1978). The emergent picture includes environmental changes in the weather, flora, fauna, and social comportment. Changing seasons and rapid changes of many kinds are easily noticed and experienced, but often difficult to remember reliably after a relatively brief time has passed. Changes that are moving slowly are hard to detect, but they are there. Yet how they are remembered, what it looked like 40 or 100 years ago is not easily known. When an old fisherman tells his young fisherman son what the world looked like when he grew up, this appears just as another narrative to the youngster. Still, some narratives from the past fit the present modern situation and have become mantras. Draaisma argues that "what happened in the past only matters inasmuch as it enables us to anticipate what lies in store for us" (2004 p. 57). One such story, grounded in memories of past experiences, is that the ocean is vast and there will always be some fish species to fish for. That memory is selective and not always trustworthy is well known; Connerton, however, claims that modern society has a particular problem with forgetting. In a world where many changes happen rapidly it is crucial not to forget about how problems were solved before, and even more crucial to remember mistakes and their consequences (Connerton 2009).

Environmental changes influence humans and trigger cultural adjustment, while the same humans also have an effect on their environments. Such changes are difficult to investigate. This is because of all the interlinked, hard-to-detect components in the cybernetic ecological system that humans are part of, influenced by, and even seek to control.

In this effort to understand complexities, our shared human cognitive apparatus plays games with us. That is because we are categorizing, "moral, believing animals" (Smith 2003); food as opposed to what should not be eaten, pleasant versus foul tastes. What is regarded as fine versus bad weather is contextualized as is greed versus moderation (Gezelius 2004) or rationality. Understanding meaning in the present context is often hampered by the use of vague concepts loaded with positive connotations such as sustainability (Maida 2006) and biodiversity (Kalland 2003). Wilderness is another contested term (Macnaghten 2003) often contextually defined. Wilderness is adored by some, and described by the negative term wasteland, or an "as yet not harvested area" by others. The same holds true for marine wilderness or what may also be termed marine frontiers or forgotten places (Maurstad 2004). The act of naming places and phenomena is not an innocent act (Jepson 2008) nor is the designation of "new realities." It can likewise be argued that environmental discourse is essentially political, shaped by vested interests struggling to control the future, usually the near future that is, and shrouded in a great deal of "expressive propaganda." In contests about reality-testing or defining the right worldview, it matters more to be convincing than to conform to ideal standards of truth and logic. But cultural analysis can demonstrate in what ways arguments are ill-founded and inconsistent.

This brings us to Helligvær, Vestfjorden, and Norwegian small-scale fishermen. Questions related to categories and categorizations matter and influence social interaction and encounters. Biodiversity, species protection, red-listed and blacklisted species, fishing regulations, and sustainability are all concepts proclaimed to receive a high and privileged position on Norwegian local and state authorities' agendas.

Fish farming of salmon and more recently cod may represent a good example of current national rhetoric. Fish farms represent one of the most visual changes along the Norwegian coast. However, the seriousness of environmental impact is contested. Forgotten seems to be the principle of precaution before action, once proclaimed by Bruntland, former prime minister of Norway. Forgotten is often the discourse about the seriousness of marine pollution, spread of environmentally "damaging organisms" (such as salmon lice), and lessons of unintended consequences when humans manipulate ecological systems. Connerton claims that large modern corporations view investment in particular places increasingly as short-term for profit. Thus memories of local identity and alternative ways of environmental adaptation become more and more threatened (Connerton 2009 p. 144). When in summer 2011 fishermen became aware of several so-called monster cods, deformed fish, it was believed they were escaped from cod farms. These monster cods came, for some, to symbolize the bad side of fish farming. But then it was argued that monster cods were nothing new. Now and then "king cods" have always been caught; they too are deformed. This is part of the general context when we now turn to Helligvær in Nordland. It will be argued, through empirical ethnographic evidence, that changes in the marine fauna and social practices are met by significant creativity and innovations, especially by the younger local fishermen. This strongly questions the validity of the historian researcher Jan Vea, who argues that northern Norwegian fishermen are "born" with an identifiable culturally produced mentality. This "cod fishing" mentality, he claims, makes the fishermen reproduce their forefathers' basic value orientation. In short, Vea argues that the fishermen reproduce cultural attitudes running against steady hard work, occupational creativity, and innovations (Vea 2009).

Helligvær: the ethnographic setting

The ethnographic material on which this analysis rests was gathered during participant observation primarily onboard four of the 26 locally owned fishing vessels during fishing activities in the home waters, off the coast of the westernmost Røst Islands of Lofoten and the banks out of Troms County. The fishing vessels are of the "sjark" design with the wheelhouse toward the prow and between 11 and 15 meters long. They were rigged for fishing with halibut lines (gangvad), longlines, gillnets, ocean pots, and jigging machines. Most vessels were prepared for two or more types of gear. During 2006-2007 I was based in Helligvær community; altogether the fieldwork amounts to 15 months.

Helligvær is a fishing-based island community (Clay and Olson 2007) situated by Vestfjorden, in Nordland County, Norway. It takes one hour by high-speed catamaran passenger carrier (hurtigbåt) to reach Helligvær from Bodø, the district capital. The ship arrives three times on each weekday, but only once on Sunday. The community is spread out on six of the 365 tiny islands and islets that together constitute Helligvær, a last inhabited outpost fringing the North Atlantic Ocean. Vokkøy is the largest island and has the highest elevation, reaching 50 meters above sea level. Approximately 100 permanent residents make up the total population. During the summer months and other holiday periods, when visitors move into their vacation homes, the population almost doubles and more of the islands are inhabited.

Helligvær is a vital modern community with such public services as electricity, piped desalinated water, and garbage collected from all households. The majority of the residents, 90, have their homes at Sørværøy. Sørværøy has a school that is attended by 17 students (2006) from grades 1-6, as well as a kindergarten. On this island a general store with mail services is located by the catamaran pier. A fish plant owned by the community and fishermen is also at the pier. This is the main harbor of Helligvær. At Sørværøy a café is open every Saturday where residents gather for coffee, homemade pastry, and cream cakes. The cakes are made by women from the islands on a rotation system. During the summer and other vacation periods the café may be open more days. The community church is in the middle of Helligvær at Storsørøy.

Two generations ago fishing and small-scale farming were the major occupations in Helligvær. Potatoes were grown for local consuming, and grass was grown and harvested where it could be found for winter fodder for a few cows and sheep. A pig or three were also kept by some islanders (Eikvil 1976, Gudbrandson 1978). This adaptation pattern made thorough use of both land and marine resources. As fishing was the basic income-generating activity and an exclusive male occupation, the women had major responsibility for the livestock and were the sole keepers when their husbands were away, occupied with seasonal fisheries. Today no cows are feeding on the ancient pastures. A few families do, however, keep small herds of "Viking sheep" that find almost sufficient fodder year-round on the different islands. Modernity freed Helligvær women from the daily labor with milking and other work in and around the cowshed. None of the former peasants—women or men—expressed that they had ever missed the work with the cows, not even for a short period of time. This "new" situation transformed the obligations of many Helligvær wives more than anyone. Some say they enjoy being home and around the house, caring for their husband and children, and some explained that best of all are the periods when the husband is away fishing. Then it is really peaceful and quiet, a time to relax and socialize with other women. Also, some women commute to Bodø where they have found satisfying work. Most of these women work in the town two or three days every week, and a few catch the boat to and from Bodø every weekday. Also a few resident young men work in Bodø; thus like local fishermen these women and men spend most weekdays away from home. Also part of the current picture are the young women who find it difficult to get jobs at Helligvær and do not want to commute. This is particularly true for mothers of children younger than age four to six. These women complain about the lack of job opportunities on the islands.

Visual signs of long-term and recent changes mark the island landscape, showing the history of social development. Old fields are overgrown with weeds, and barns and cowsheds are empty, with a few serving as storehouses and some falling down. Day visitors and newcomers to the community often marvel at how well the islanders have kept and restored the few old mansions that are beautifully sited and sheltered from the dominating ocean winds. These large wooden houses are built in traditional Nordland style signifying wealth. They were never fishermen's homes but were owned by fish buyers and tradesmen who prospered during the 20 year herring "Klondike" toward the end of the 1800s (Gudbrandson 1978). The islanders seldom tell tourists that these monuments are now bought and restored by rich people who use them as summer and vacation homes.

Helligvær fishermen have always been engaged in small-scale coastal fishing. They used to be among the poorest in Norway, but somehow managed because of a domestic economy where local resources provided daily food. After the Second World War legislation that was introduced in the 1930s improved the situation. They used to think of themselves as deprived but that is no longer the case (Jentoft 2011). This rise from poverty to a formerly unthinkable affluence for a number of successful small-scale fishermen is reflected in many fishermen's homes in Helligvær. The parents and grandparents of the youngest generation of fishermen, approximately 20 to 40 years old, lived in moderate-size houses. Some were partly built from planks and driftwood found along the shoreline.

On one of the islands of Helligvær four houses are located near one other. In the smallest one, in the middle, seven children grew up. That is the home of a mother and pensioned fisherman father, who still occasionally rows his own vessel to get enough fish for a meal or two, called a cooking. His two sons, who also became fishermen, built their homes on the left and right of their parents' home, and about the same size. These sons and their wives had three children each, so their quarters were less cramped than where they spent their own childhood. A little above the three houses the grandson and his wife erected a large, modern, showy, two and a half story house. This serves as an example of how couples in their 30s build their homes in the 2000s. The newest homes are preferably built at higher levels on the islands; the young generation of fishermen want scenic views through their windows. The sheltered locations of the old days are no longer attractive. It is regarded better to build their large houses strong enough and wired to the bedrock to withstand the storms roaring in from the ocean.

This apparent affluence is tied to and a consequence of locally based small-scale fishing. Now in another time of change—climate changes such as rising sea temperatures, alterations in the species that inhabit the ocean, and fish migrations and movement—fishermen are again adjusting. How are local fishermen adapting to these changes and, equally important, how do they view their future as fishermen? What are the obstacles and what is the attraction of fishing based upon? These are questions addressed below, as they are seen and articulated by the fishermen themselves.

Changes in the natural environment

For a start we may ask, how are observable changes in the natural environment that the local fishermen depend on for a living, conceived or understood? Both the fishermen themselves and social scientists who have studied fishing and fishing communities point out that commercial fishers are used to adapting to changing conditions, also called behavioral strategies (van Ginkel 2009). During some years one fish species abounds, and in another season it seems to be absent. Unpredictability is part of fishing life; the fish could be there in good numbers, but stormy weather may force the small vessels to stay at harbor. One of the youngest fishermen in Helligvær repeated during many of our conversations that he was tired of some of his companions often complaining and worrying about the future of small-scale fishing. Like them, he considered coastal fishers as disadvantaged and pressured by Norwegian fishing authorities, who in his opinion favor larger trawlers, Danish seiners, auto longliners, and purse seiners. Yet he expressed youthful certainty in his profession when he said that for those who are not afraid of work there is always a possibility. If the cod (*Gadus morhua*) or saithe (*Pollachius virens*) disappear, there will be redfish (*Sebastes mainus*), monkfish (*Lophius piscatorius*), ling (*Molva molva*), and haddock (*Melanogrammus aeglefinus*) to catch. “There may even be new species that we do not fish now that may be in demand in the future, who knows?” He added that when his father grew up no one in Helligvær could imagine that fishing for monkfish would ever make a profit.

To a certain extent he was right. Temperature measurements show that seawater along the Norwegian coast is warmer now than since reliable measurements were first recorded. Possible consequences of warmer water are also acknowledged and observed by the fishermen. Some alterations in marine ecosystems and animal populations have resulted in new forms of local resource harvest. Thus during the last ten years "new species" have entered the sea around Helligvær, into Vestfjorden and Nordland waters. The first that had economic significance was the crab (*Cancer pagurus*). At Helligvær a few fishermen bought pots and placed them in their home waters. These crabs are regarded as a pest when their crowded presence "destroys" favored locations to place nets for redfish, saithe, and other valuable fish species. During the winter cod fisheries off the Røst Islands it was reported in 2011 that the crabs had invaded certain locations that had been used by net fishers during uncountable generations. As the crab moves northward, the king crab (*Paralithodes camtschaticus*) moves south from the north. King crabs have not reached Vestfjorden yet, but fishermen fear they will arrive there in the not too distant future.

European hake (*Merluccius merluccius*) is another newcomer to this area that has been fished commercially, a fishery that commenced in the early 2000s. It is interesting to note that when new species are targeted for commercial fishing it is usually the skipper of a particular vessel who tries it out during one or a few seasons. This means that the pressure on local fish stocks becomes somewhat divided among different species. It has always been like that, Helligvær fishermen say; some pioneers break new ground although most stick to their old habits, the fishery they know best. The stakes are high when one invests in novel gear and time, trying out a new enterprise. Failure is as common as success and halfhearted attempts seldom bring achievement, successful fishermen say.

About the same time as the first catches of hake were landed, two brothers from Helligvær with no quota left for cod were disappointed with their summer and fall motor-jigging for saithe. They had, however, observed that auto longliners from afar often made good catches of tusk (*Brosme brosme*) in Vestfjorden and adjacent waters. To try for tusk, the brothers bought deepsea fish pots and went to sea, each with his own vessel. Many of their companions smiled at the effort, but not for long, I was told. Good catches were made and the two of them had opened an alternative to the generally slack summer and fall fishing for saithe and halibut in home waters (Fig. 1). The manager of the small local fish plant admitted that it was the tusk that had saved the plant through a couple of economically difficult summer seasons. Still, no one else in the community felt like having a share of their pioneering tusk success. The reason was that dealing with tusk, especially gutting, is laborious.

One of the youngest fishermen of Helligvær can also be regarded as a pioneer. In summer 2007 he explored the home seas for new sites to position monkfish nets, at times when most of his elder colleagues told

Figure 1. Fishing with ocean pots for tusk. The pots are set in series of 30 to 35 at depths from 2.5 to 500 meters.

him this fishing was useless. He managed to find good locations where no one before him had set nets for this species, and he demonstrated to skeptical elders that the monkfish season could profitably be expanded. Part of the success was probably because his gillnets were placed much deeper than customary practice in Helligvær.

This young man, barely 20 years old, was also the first from his home community to take up net fishing for Greenland halibut

(*Reinhardtius hippoglossoides*), although another vessel from Helligvær followed suit when the youngster's plan became known in the community. Recently this youngest of the more successful fishermen in the area has started to explore making viable catches of the bottom-living newcomer from more southern localities, the Norwegian (or prawn) lobster (*Nephrops norvegicus*).

Why is this youngster willing to take risks? And what makes this possible? All newcomers to the small-scale coastal fishing fleet do not experience success. There are no simple answers to the questions why this is so, but it is possible to point to some complex causes that work dynamically together. Like all the other fishermen in the community, the young pioneer has relatives who know the trade well. His father, his father's brother, and his paternal grandfather (all active fishermen) are generally more supportive when it comes to fishing and experimenting than most other fishermen at Helligvær. He received both economic and practical help from these male relatives to buy his first 11 meter vessel. This is important when recruitment to the fleet has generally halted because of dramatically increased entrance costs (Jentoft 2011). Only a few youngsters have relatives who can afford and are willing to offer needed economic support to buy an adequate vessel for full time commercial fishing. This young man and I often talked about success, failure, and risk-taking on our way to and from the fishing grounds, and while fishing at sea. He told me one version when we were alone together, but always adjusted his expression of thoughts according to the audience when these and similar themes were topics of conversation in other contexts. To me he said that he was born with a few advantages not shared by all. First of all, he loved to be at sea more than anything else. He enjoyed fishing (but not with all kinds of gear), that all days are different at sea, the excitement when catches are good, and the thrill of uncertainty of never knowing the result of any day's effort in advance. He said that he was not economically better off than others his age who tried out full-time fishing, but claimed to have two assets that some of his fellow fishermen seemed to lack. This gave him an advantage. He had time enough and enjoyed his work! This meant, he argued, that the one who rows almost every day, even when fishing is slack, will in the end earn more money than others. Success, he maintained with certainty, depends on time spent at sea and the work carried out including continuous maintenance on the vessel when in harbor. Because he did not dwell on earnings per hour when fishing, this gave him time to experiment and explore new possibilities. Everything is changing, the sea and what is there, the commercial worth of different species, and—not least important—laws and regulations, quotas, and seasons allowed to fish. "That is why it not only is fun to do research but also important in my own adaptation as a fisherman," he often told me with a smile.

Another newcomer species of great economic interest, although no fishermen from Helligvær have participated in the fishery so far, is the mackerel (*Scomber scombrus*). In summer 2011 fishing for mackerel in Vestfjorden was considerable, but primarily with seines and vessels larger than those comprising the Helligvær fleet. Mackerel represents another future option for more locally based fishermen in the area. Trolling may be suitable considering the length of Helligvær vessels.

During the summers of 2007 and 2008 it was observed that cod caught around Helligvær were feeding on *Entelurus aeqorus* (stor havnål) and two different species of *Nerophis* (liten og krumsnutet havnål)—*N. ophidion,* and *N. lumbriciformis*. According to Pethon (2005) the latter two are newcomers to our area of interest.

When it comes to questions of biological diversity, sustainable fisheries, and resilient adaptation, Helligvær fishermen share a general habit of rationalization that has been reported from fishing communities far apart. They accept that overfishing has led to stock depletions, that overfishing still may be a problem, and that their future as fishermen is dependent on a sustainable harvest of marine resources. However, they also tend to firmly evaluate their own adaptation as well within acceptable limits to sustain the fisheries far into the future. This view is an important component of the fishermen's self presentation because they wish to appear, like Canadian fishermen and the Norwegians on the west coast studied by Gezelius (2004), as morally engaged persons. Greed is frowned upon, and hard work is morally praiseworthy behavior.

There are fisheries that have led to disastrous reduction and depletion of fish stocks and seafloor destruction. Fishermen operating large trawlers and seiners are not condemned, but the trustworthiness of policymakers who allow, even strongly support, these operations are questioned. If policymakers indeed are concerned about biological diversity, sustainability of fish stocks, and resilient fishing communities, many Helligvær fishermen wondered why they allow bottom-trawling, trawling for plankton, and even allow and support oil exploration on some of the best fishing grounds in the world. And the fishermen also knew why, they told me. Helligvær fishermen generally agree with researchers who claim that it is the big money and investors that rule. These people pay less than moderate attention to the possible environmental problems their activities may cause (McGoodwin 1990, Roberts 2007). Many politicians, however, appear to ride several horses at the same time and get away with it.

Helligvær fishermen are well aware of the complexities of marine ecosystems. Their focus is purely human centered. They know the principles of food chains and that there will be little to fish for human consumption if we manage to significantly reduce—even deplete—the food items that commercially important fish species need in order to grow. Biological diversity, as understood among the fishermen I worked among, triggered both positive and negative associations. Biological diversity may well be evaluated positively in many contexts, and everyone knows that this is a politically correct viewpoint. Helligvær residents accept that fishing regulations are necessary in the present world, although they may not agree about how quotas and restrictions are decided and targeted. At one level the fishermen may agree that biological diversity can be perceived as a common good. Yet there are many exceptions—some species seem to be omitted from the good company with ascribed rights as members of populations, others are blacklisted as intruders or unwanted species in the Norwegian flora and fauna. There is a blacklist and a red list. Black equals evil and red indicates threatened animals. Generally Helligvær fishermen see themselves in a situation of competition for marine resources with nonhuman species. This view sometimes whips up hostile feelings toward what are regarded as competitive fish eaters, especially otters, seals, and cormorants. That some people place the needs of these animals along with whales and sea eagles before human requirements makes little sense among most northern Norwegian fishermen.

What about the future?

There is no full consensus as to future prospects for commercial fishing among Helligvær fishermen. Some of the eldest tend to be pessimistic, not because they fear there will be no fish, but because they are afraid that new rules and regulations will squeeze the small vessels out of the costal fleet, and out of business. Obviously the younger generations who have entered the fishing profession lately are of a different opinion, although they too agree that the most severe obstacles to prosperity for this fleet are in the hands of the fishery policymakers. Two examples are the high price on cod quotas, and restricted fishing on stocks that in their opinion are healthy and numerous. Yet the young fishermen tend to agree with Pauly, who claims that small-scale fisheries have the potential of becoming the fisheries of the future (Pauly 2011 p. 17). Like one of the young skippers often repeated when we talked about fishing in upcoming years, eventually the politicians will understand the situation. He said that small-scale coastal fishers have a low use of energy per kilogram of fish landed compared with larger vessels; they are much less detrimental to the seafloor and organisms living there; and their catches are selective and restricted by the loading capacity of the vessels. And finally this fisherman liked to say he strongly believed in the future because fine and nutrition-rich food will always be in demand. Perhaps he was too optimistic, but he based this optimism on a cultural tradition that favored a resilient adaptation in the sense that fishermen always planned for the unexpected to happen. Admittedly there is one expectation at the base of this history of resilience—that there will always be some species to fish for. Two of the younger fishermen in Helligvær would nod with acknowledgment when Amazonian Indians conceptualize their habitat as an "environment of opportunity rather than one of external constraint, a place of constant unfolding of possibility" (Nuttall 2009 p. 302).

It may be difficult to learn from the experiences of others, and understand the relevance of historical information. When narratives about the past are sought to be woven into the present, comprehension is sometimes hindered by a generation gap. Traditions may have connotations of legitimacy, venerability, and respectability, or old-fashioned insignificance (Lohmann 2000).

One of the youngest skippers in Helligvær wanted to buy a somewhat larger vessel because he felt he could not fish his capacity on the vessel he had. He did well, but often had to return to shore early because of the restricted loading capacity. His father, also an active fisherman, told him to act carefully, not to rush. The father told his son that the previous seasons were quite good, but you cannot predict what comes and there will be loans to handle for both a new vessel and the cod quota you will need. The youngster shook his head; he did not believe that catches of fish would go down in the near future. But the father reminded him about years far gone and said that he even now remembers difficult years when he was still young. There were fish enough, but the market prices went down and in the end no one would buy! The son was not impressed but impatient. He found the information irrelevant. He told his father that this is a different time, a different world.

Interestingly some remembered features from not so distant times, or lessons learned, may be difficult to transfer to upcoming generations embedded in "modernity." This world, they argue, is altogether new; the old ways are outdated. Thus many tales from long ago become little more than entertaining narratives that no longer mirror or shape the contemporary world; they only show how different most things have become. However, the old narratives instill and reinforce respect for the elder and pride in kin-links. The old method of navigation by what is called "med" in Norwegian, a system of triangulation based on landmarks to locate good fishing sites will soon be completely out of use, regarded outdated and redundant. Fishermen from Helligvær older than 40 all learned to find their way in coastal waters by "med"; many of them still carry small notebooks onboard their vessels where significant landmarks are written down by their fathers and grandfathers. Most of the marks were learned by heart and not always given away to anybody. Today the youngest fishermen know a few "med" but do not bother to learn more. They rely on computer technology; as one of them stated, "This is now and this is the future." When computer problems are experienced vessels do not leave the harbor until, for instance, the map-machine is repaired. If there is a computer breakdown at sea the vessel returns to shore to get it fixed. Today the exact positions of good fishing are stored on the hard-disc onboard the vessels.

Two major development schemes are dreaded by probably all living in Helligvær. One is the proposed plan for oil and gas exploration on the narrow shelf around the Røst Islands and Vestfjorden, and the second is the proposal to set up windmill parks at sea.

That there is a need for more energy whether in the form of non-renewable oil and gas or renewable wind energy is accepted. When the question becomes a choice between the harvest of renewable food resources around Røst and Vestfjorden where arctic cod spawn every spring, waters also renowned for some of the largest coldwater coral reefs in the world, most people living in fishing based communities find it unreasonable that this should be difficult. When spokespersons from the oil industry and local and national politicians try to convince concerned Helligvær residents that oil exploration and/or extraction will have no negative consequences for fisheries and marine fauna, they are simply not believed. How can anyone risk damaging such an important spawning location, and vital fishery of arctic cod? Fishermen wonder how it is possible to go for short-term gains when sustainable food resources of superior nutritional value are jeopardized. Yet many say they feel powerless because in their opinion it is the big industries that set the agenda. We may wonder whether this is another example of how modern society forgets (Connerton 2009) or memories of offshore oil disasters are made irrelevant.

In the early fall of 2007, representatives from an energy firm specializing in the construction and operation of windmills sent two representatives to Helligvær. The islanders were told that the company wished to erect eight windmills on one of the islands in the vær. The audience at a public community meeting was told that this location (Helligvær) was chosen because the company wanted to help the community into the future. It turned out that the residents were split in the view of positive or negative implications of having large windmills near their homes. Almost all of the fishermen were in favor of the plan. One of them, a man in his late 40s, explained why. He said that he recognized that there is a lack of available energy in the world and that the situation probably will grow worse in a relatively short time. He was firmly against all oil and gas activities in the Lofoten-Røst area. Likewise he feared ocean windmills because he anticipated that these marine wind parks had to be located at relatively shallow locations and that would be on the fishing banks. Because he made his living from fishing he felt he had to sacrifice the peacefulness of Helligvær. One cannot have it all, he smiled. The ocean was where he was making a living, not the barren small islands of Helligvær.

Winter fishery for arctic cod.

Winter fishing for arctic cod, northwest of Tromsø.

Motor jigging for cod off the Røst islands.

Trying for Greenland Halibut.

Summer fishing for monkfish off Helligvær.

Conclusion

In this article cultural responses to changing marine conditions and the social environment have been highlighted. Helligvær fishermen, especially the youngest, appeared as "pioneers" at a frontier of ecological, economic, and generational changes. This is a new world, the future is here, one young skipper told his father. He referred to computer navigation. Contrary to the general situation some 10 years ago when small-scale coastal fishermen who knew the seascape seldom used maps (Maurstad 2004 p. 284), they currently make extensive, almost continuous, use of the map machine. Information gathering is as important as before when it comes to adjustments to what is conceptualized as a changing environment. Thus the brothers who started to fish for tusk with ocean pots received useful information from the auto longliners by watching them and asking questions. Likewise the young skipper who became a local "pioneer" at the Greenland halibut fishery gathered important information through his father's friendship network among Troms fishermen.

The most striking insight the empirical material offers is how the young fishermen adapt to new times by fishing-cultural creativity and many-sided innovations. This lesson may fly in the face of scholars who hold that small-scale fishermen are hindered from progress by conservative traditionalism, or that northern Norwegian "cod fishermen" should be characterized by an antiprogressive mentality.

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Geopolitics, Arctic Council, and Arctic Resources

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Abstract

Geopolitics will determine the extent that the Arctic Ocean's alleged bounty of natural resources is utilized and in turn the fate of the peoples of the North and their environment. This paper reviews the role of the Arctic Council and some of its limitations. The role of the all-important United Nations Law of the Sea (UNCLOS) is described in the context of both non-arctic and Arctic Council nation states in the Arctic Ocean donut hole (the territory surrounding the geometric center of the Arctic Ocean) and exterior to the extended jurisdictions of the five arctic littoral states. Finally, opportunities the Arctic offers are considered for the nation state of China, as representative of North Pacific countries.

Introduction

The last several decades have seen the Arctic Ocean rise from relative obscurity or benign neglect to a focal point of public and scientific interest. This interest is primarily based upon significant melting of ice cover leading to easier access to resources above and below the arctic seabed. An additional factor is greater access to passages through the ice, which, if viewed from a whole Arctic Ocean perspective, conjures visions of travel between the Atlantic and Pacific oceans without passage through the Panama or Suez canals. Thus, travel distance is cut by thousands of nautical miles. Both access to the resources and travel through the ice has technical difficulties. The rewards of success are expected to be tremendous, causing some to minimize the challenges in search of the rewards. In fact, both arctic and non-arctic nation states are rushing forward as if a pot of gold were at the end of a rainbow. The entire Arctic Ocean is not, however, open to an unconstrained gold rush since there is a sheriff in town, viz., the Arctic Council and the U.N. Law of the Sea (UNCLOS). The rate of change of anthropogenic and natural events inside the Arctic Circle is so rapid that consequences will propagate through the Bering Strait into Alaskan and Russian subarctic regions with great force in unforeseeable ways. It is for this reason that fishing peoples and communities in the subarctic need to remain abreast of events in arctic environments and be prepared to influence events for their regional benefit.

The U.N. Law of the Sea defines the 200 nautical mile exclusive economic zone (EEZ) boundaries allocated to each arctic coastal nation state, leaving a central area outside these boundaries that belongs to no particular arctic nation state (Fig. 1). These boundaries are all measured at the surface of the water. The central area corresponds to a common property area wherein fishing governance is independent of those in the adjacent national EEZ areas. In the North Pacific Ocean, a similar area defined by being outside both the Soviet and American EEZs is known as the Bering Sea donut hole. The management of this donut hole was resolved by multilateral negotiations, with Russia (then the USSR) and the United States being the bilateral leads. Restrictions on fisheries in the Bering Sea donut hole protected the nursery grounds of Alaska pollock, coincidently located within the area. At a practical level, the treaty requirements are being followed by all nations, and the pollock stock has recovered significantly to become possibly the most productive in the world.

This paper focuses first on a non-arctic country's interests, in this case China, in the pot of gold located in the Arctic Ocean donut hole. And, secondarily, it focuses on bilateral agreements between nation states and their EEZs, for access to resources therein. Agreements with Inuit and other indigenous groups, and nation-states, regarding access to local resources will be noted but is likely best left as the subject of a separate paper. The relative positions of the arctic littoral nation states, the Arctic Circle, and the Arctic Ocean donut hole are depicted in Fig. 1**.**

Background

The following background information about arctic governance is presented to facilitate discussion of the principal issues of the paper.

The Arctic Council

The Arctic Council is a high-level intergovernmental non-treaty forum founded in 1996. Its formal objectives are to promote cooperation, coordination, and interaction among arctic nation states. There is a

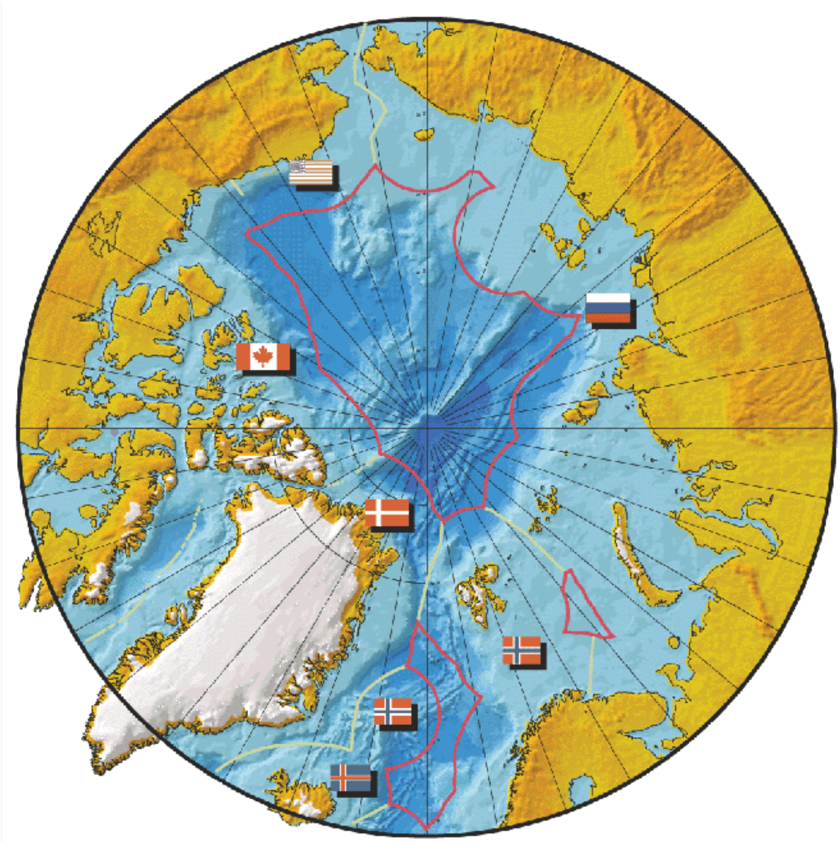

Figure 1. Approximate limits of the Exclusive Economic Zones (EEZs) of the arctic coastal states. Bilateral limits are shown in green, high seas limits in pink. (Macnab and Nielsen 1999.

focus on issues of common interest such as sustainable development and environmental protection. It is not a decision-making body, rather it is a decision-shaping organization having no legal authority.

The **eight permanent members** are nation states with territory inside the Arctic Circle: United States, Russian Federation, Canada, Denmark (via Greenland), Norway, Sweden, Finland, and Iceland. The first five are littoral, i.e., have coastlines on the Arctic Ocean. Decisions are made by consensus.

The **six permanent participants** are all non-nation states: Aleut International Association, Arctic Athabaskan Council, Saami Council, Inuit Circumpolar Council, and Russian Association of Indigenous Peoples of the North. All of these are indigenous, northern peoples. These members may propose cooperative activities. This is a fully consultative body so it is largely unique in its relationship to the nation-states.

Observer status is a broader classification of membership with two different types of membership. The status of **permanent observer** is open to non-arctic nation states. At present, there are six permanent observers: France, Netherlands, Poland, Spain, United Kingdom, and Germany. The status of **ad hoc observer** is the broadest, containing such entities as China, the European Union, Italy, South Korea, and Japan. Other ad hoc observers are non-nation states, indigenous organizations, NGOs (nongovernmental organizations), and IGOs (intergovernmental organizations) such as the Red Cross, International Union for Conservation of Nature, World Wildlife Fund, University of the Arctic, etc.

The regional stakeholders with direct Arctic Circle associations are clearly the most directly affected by and most directly impact the geopolitical realities. In some ways, and the focus here, the non-regional area stakeholders are the most difficult to deal with. It may well be that the current role and structure of the Arctic Council will need to be expanded into a new body designed to cope with some of the coming, urgent issues. A more inclusive model may be needed to permit representation of non-Council members' perspectives and investments. Models of cooperative state structures are well known and accepted under UNCLOS, Article 43, such as that used in the Malacca Strait. Nevertheless, the issue of membership on the Council is currently under active consideration. For example, the applications of both China and the European Union (EU) for permanent observer status are controversial, for different reasons, including political, environmental, and trade issue concerns (Galloway 2011).

An example of an activity of the Arctic Council is its commission of the Arctic Biodiversity Assessment project (H. Metoff, Arctic Council Conservation of Arctic Flora and Fauna, pers. comm.). The Arctic Council also had a major role in the recent signing of an International Maritime Organization (IMO) agreement on safety and rescue in arctic marine waters. IMO is a specialized agency of the United Nations.

The 1987 United Nations Convention on the Law of the Sea (UNCLOS)

The third United Nations Law of the Sea Conference hammered out a convention during 1973-1982 to deal with the large number of recurrent oceanic issues that arose since the prior conference in 1960 (Sohn et al. 2010). The resulting document has over 400 articles containing provisions on 15 major topics. The geographical area covered is over

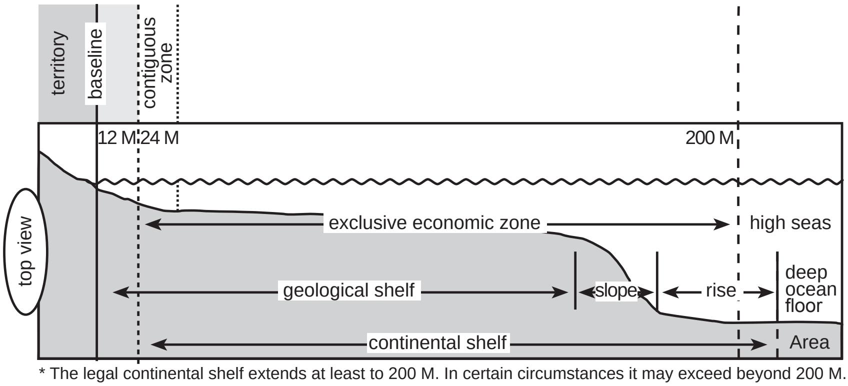

Figure 2. Zones of national jurisdiction. The potential relationship of the EEZ to the continental shelf. (Sohn et al. 2010 p. 12.)

70% of the earth's surface. The coastal states obtained jurisdiction over resources and uses of approximately one-third of the ocean's area primarily via the EEZ concept. The convention set out the rights and uses of coastal states and other states in some of the following maritime zones: internal waters (ports), territorial seas and contiguous zones, exclusive economic zones, and continental shelves. These areas are illustrated in Fig. 2.

The law also covers arctic maritime areas where adjudication will most certainly arise, such as the construction of isolated islands on the high seas (e.g., for oil drilling) and passage through narrow straits. But other issues may not be adequately covered by the law and are uniquely arctic in substance such as whether the measurement of the EEZ must be from the edge of land or from the beginning of permanent ice. It should not be assumed that the 200 nautical mile EEZ measurement at the water's surface corresponds to the same EEZ point on the continental shelf.

The words "continental shelf" embody significant legal interpretation and much of the future action in the Arctic will involve a commission defined in the Law of the Sea, specifically charged to deal with this issue. The Commission on the Limits of the Continental Shelf (CLCS) will pass judgments upon each coastal arctic state's claims to lands extending into the sea from its coastal margin. These claims must be submitted within a 10 year period following ratification of the treaty. Since the United States has signed but not yet ratified UNCLOS, it is not clear how it will submit a claim. Issues such as "oceanic ridges" have yet to be legally defined, but are at the core of some of the Russian

Federation's claims to the benthic areas that extend beyond its 200 nm EEZ (measured at the water's surface)(Trenin and Baev 2010). Whether a new convention or an arctic addendum is needed for UNCLOS or whether future decisions will be based upon precedents remains to be seen. Whatever is decided, it is clear that global warming is raising issues unimagined in 1987 in polar as well as in other areas of the world.

Global warming

The 1992 U.N. Framework Convention on Climate Change addresses some of the issues that will arise, particularly sea level rise, but in the two decades since that meeting much has been learned and will need to be integrated into new law.

Overall, assuming that warming is gradual, the following are predicted/observed (Pachauri and Reisinger 2007):

1. Arctic snow cover is projected to decrease and sea ice to shrink. Arctic late summer sea ice could disappear in the second half of the 21st century.
2. Global average sea level rose at an average rate of 3.1 mm per year from 1993 to 2003 (p. 30).
3. Observed temperature changes in arctic regions ranged from 0.2 to 2.0°C over 1970-2004. Average arctic temperatures increased at about two times the global average in the last 100 years.
4. Projections of a warming of 0.2°C per decade are estimated over the next two decades.

The frequency of abrupt and dramatic climate events will increase around the globe.

By 2100 melting of arctic glaciers alone will have contributed to a sea level rise of about 5 cm, but melting of the Greenland ice sheet may increase that number significantly. The melting will influence access to arctic resources such as availability of wildlife, some of which are sold on world markets and some support local indigenous populations. Availability of minerals, oil, and gas will increase. Reduced sea ice will permit expansion of marine transport through the Arctic, at least in the summer. These and other changes could be simultaneously viewed as major risks as well as opportunities. Fig. 3 depicts some arctic shipping alternatives between the Atlantic and Pacific oceans, in contrast to the Panama Canal route. Of course, increased shipping in arctic routes implies increased risks of maritime accidents.

Figure 3. Three potential arctic routes between the Pacific and Atlantic oceans. (www.nato-pa.int.)

Geography

The delimitation of high seas and seabed boundaries is an important part of understanding current arctic issues, and suggesting what will arise in the future. Highlighted here is a Pacific-arctic centric approach, but a related Atlantic-arctic centric approach is also possible. The sub-arctic Bering Sea lies at the southern boundary of the Bering Strait, which enters into the Beaufort and Chukchi seas at the mouth of the Arctic Ocean. Jurisdictional ownership of these two seas and the Bering Strait is shared by the United States and Russian Federation, whose EEZs intersect. Upon entry into the Arctic Ocean there are five countries (the littoral states) whose EEZs terminate in open ocean and do not overlap. These countries are the United States, Russian Federation, Canada, Greenland (Denmark), and Norway, who together claim about 88% of the arctic surface water, leaving 20% unclaimed (Fig. 1)(Adler 2008, Pew Charitable Trusts 2011). This unclaimed area is known as the Arctic Ocean donut hole.

As noted, ownership of the arctic seabed or the continental shelf is also divided among the same five countries. However, the percent of the total area that belongs to any one country via their EEZ at the surface does not necessarily match the ratios that will exist on the continental shelf areas. The continental shelf areas are defined by UNCLOS Articles 76-85. Several current national claims are being contested. Some littoral countries are currently expending significant funds to carry out seabed research and mapping to support their claims. The prepared claims will be submitted to the U.N. Commission on the Limits of the Continental Shelf. Claims will be adjudicated to determine the ultimate spatial distribution of seabed ownership and thus, most importantly, the spatial distribution of resources of interest among the littoral countries. At the moment, non-littoral and thus non-arctic countries have no claims to arctic resources. But the central area, the Arctic Ocean donut hole, generally exterior to the claimed areas, is a “no-man’s land” where the only rules are found in UNCLOS under the International Seabed Authority (ISB). The ISB, however, applies only to the nonliving resources found there. There has been no test as yet of any scenario where a non-arctic state attempts to access resources, but it is inevitable that a country will wish to do so. This is certainly one way in which a group of nations, e.g., may singly or by pooling their efforts, gain a foothold and access to resources in the central Arctic.

The cross section of surface to benthic areas is illustrated in Fig. 2, where the surface EEZ area and the continental shelf area are shown relative to each other. Note that the EEZ and seafloor areas do not necessarily extend to the same final linear distance from shore. It is upon this basis that the planting of a titanium Russian flag by Duma parliamentarian, Artur Chilingarov, is considered to be a symbolic claim to the

North Pole seafloor. It is generally accepted that the flag was no more a legitimate claim than the planting of an American flag on the moon claimed it for the United States (Gorenburg 2011, Rowe 2011).

Seabed resources

Seabed ownership boundaries and UNCLOS environmental law govern exploitation of the nonliving resources. The Arctic is estimated to contain 25% of the world's undiscovered hydrocarbon reserves. Already, 10% of worldwide oil flows from the Arctic and 25% of worldwide natural gas. Of the oil and gas from the Arctic, 80% of the oil and 99% of the gas is from Russian sources.

Issues of ownership aside, the more contentious and compelling issues that will necessitate multilateral negotiations concern access to the resources in the unclaimed areas. As noted above, the ISA has a big but untested role in the areas exterior to the EEZ areas. Part of the concern is the absence of firm environmental rules that every nation must abide by, regardless of their arctic status. Rules must be established to protect arctic environments from the deleterious consequences of resource extraction, whether renewable or nonrenewable and whether the extraction is within a country's EEZ or in an area that is supposed to be governed by the ISA.

Fisheries (bio-) resources.

Fishery resources in the Arctic are a black box, which may contain wonders of essentially untapped riches of living resources in pelagic, midwater, and benthic environments. On the other hand, this may be overly optimistic. Biodiversity or species lists are already developed and will be expanded as more area becomes accessible. For example, the above noted Arctic Biodiversity Assessment project has chapters on marine ecosystems, as well as on freshwater and marine ichthyology. These chapters all tend to have a greater focus on the southern or Canadian side of the Arctic. Spiridonov et al. (2011) is a useful but certainly not encyclopedic description of diversity on the Russian side of the Arctic Ocean.

Fishery resources, however, are more than species lists but consist of resources that replace themselves. The biomass removed by exploitation is replaced by natural recruitment; that is, species are sustainable in time. During times of rapid arctic climate change, diversity changes will also be dynamic. Whether diversity changes will affect the ability of harvested fish to renew themselves is unknown. It is certain, however, that managers of arctic fisheries must also monitor diversity changes. In the case of stock assessments, non steady state models will be a necessity.

Fishery resources are of two types: commercial and small-scale or artisanal. Artisanal, village level, fisheries will continue but at unknown rates, possibly comparable to the rates observed in similar fisheries in southeast Alaska, and in and outside of the Bering Strait. Research is required since it is likely that these fisheries, as well as marine mammal harvests, will change significantly as ice-cover shrinks. Commercial fisheries are extensive in subarctic and arctic Atlantic environments with long histories of assessment. Presently there are no commercial fisheries inside the Pacific Arctic Circle, namely the Chukchi or Beaufort seas.

The subarctic Bering Sea sustains extensive commercial fisheries. Perhaps the most productive in the world is on Alaska pollock, using midwater trawl gear. The Pacific cod fishery, using longline gear, is smaller but also highly productive. Commercial fisheries within the Arctic Ocean on either the Russian or Canadian coasts appear to be modest or small, limited no doubt by the presence of ice over much of the year. However, extensive artisanal fisheries from Inuit (Canada, Greenland, Alaska, Russia), Saami (Russia, Norway), and other indigenous groups do exist focused on both fish and marine mammals inside the Arctic Circle. Artisanal fisheries are usually pursued by extended families in coastal villages, who take fish with low technology gear as well as marine mammals.

Transport and passage

Passage within EEZ claimed and unclaimed areas of the Arctic Ocean is also a key concern. The issues are myriad but those usually noted are:

1. Canada's claim to the **Northwest Passage** and Canada's legal status to refuse passage to an unsafe vessel. The Northwest Passage is really a series of alternative routes through an archipelago of islands, often choked with ice floes. The issue under dispute is whether the passage is via an internal sea or via a strait governed by UNCLOS.

2. The **Northern Sea route** lies essentially within the Russian Federation's EEZ. Passage is tightly monitored by the Russians. Vessels are escorted by icebreakers and a significant fee is charged.

3. The **Central Arctic route** lies very much in unclaimed areas of the Arctic Ocean and is considered especially precarious due to its less well-charted nature.

Fig. 3 shows these routes. Note that the shortest, the transpolar Central Arctic route, may be the least useful due to sea ice, but it remains strategically important since it could be used without submitting to either Russian or Canadian control of coastal routes. An illustrative example of the value of the arctic routes, is the Hamburg to Shanghai trade route. On average, it would be open from April to October and would be 7,100 km shorter than a trip across the Panama

Canal. The first ice-free summer is currently thought to occur in the years between 2013 and 2060.

Issues concerned with vessel movement in the Arctic Ocean are governed by the International Maritime Organization (IMO). The Arctic Council and the IMO together recently brokered the international search and rescue treaty for the Arctic Ocean. This treaty is held up as an indication of the cooperation that is possible for the Arctic. In light of the IMO's responsibility to improve the security and safety of marine shipping, as well as to prevent marine pollution, there is hope that it can address many of the issues that will arise in the near Arctic. Of course the IMO carries out its responsibilities by adopting sanctions. Whether this is sufficient remains to be seen. It is likely that the Arctic Council will next consider the subject of oil spills.

Consequences and implications

One of the functions of the Arctic Council is the facilitation of bilateral and multilateral agreements between Council members and with nations outside of the Council. The search and rescue treaty for accidents at sea is central to the more generalized use of the ocean beyond arctic nations, but the responsibilities would fall on the arctic nations. The importance of such umbrella functions should not be underestimated. For example, it appears that the present Chinese modus operandi is to use its significant capital to fund drilling or construction enterprises with nations that have arctic expertise and access. It may become a common approach for non-arctic nations to pool resources and efforts to gain access to resources. It is likely that IMO measures will become increasingly important to both commercial companies and arctic nations, the prime stakeholders.

In fact, since 88% of the arctic seabed is presently controlled by the five arctic littoral states, the remaining 12%—the Arctic Ocean donut hole—is available to be shared by the rest of the world. Non-arctic nations will likely negotiate bilateral relations with arctic littoral states. The world will see a large increase in the number of contracts as resource availability is clarified. This trend is already visible in off-shore drilling in the Beaufort and Barents seas in the North Pacific and Atlantic, respectively.

As noted, the Chinese government, among many others, has already demonstrated interest in the Arctic's resources (Jacobson 2010). Against the above background UNCLOS will govern issues such as rights of passage across other nations' EEZs. But the degree to which China will follow UNCLOS environmental structures or any that the Arctic Council might propose is problematical. This illustrates an issue likely to arise in the future—the degree to which the Arctic Council will do any more than propose rules. In contrast to many nations, China has not proposed an arctic policy at this time. A policy that includes statements about compliance with Arctic Council rules would be welcomed. China, the European Union, and others have applied for "permanent observer status" in the Arctic Council. While not approved at the 2011 meeting, this is a dynamic national/international diplomatic balance that will have many chapters into the future.

The interconnectedness of decision-making is worth noting. The historic Russian-Chinese bilateral relationship, as it has existed outside of arctic ambitions, is rife with interactions that are cooperative as well as competitive. Ultimately, while the Russia-China axis is particularly dramatic, it is safe to guess whatever happens in the Arctic will be greatly influenced by historical and geographic events that occurred from far outside the Arctic Circle. The other Asian giants, Japan and Korea, can be expected to also seek bilateral relations with the Arctic Five that will also include both accesses to resources as well as transit considerations.

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Planning for Cushioning Japanese Salmon Fisheries against Climate Change Effects

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Abstract

Salmon is an important fishery commodity with global commercial value and one of the most important target species in northern Japan. Global warming is expected to have significant influences on salmon inhabiting subarctic waters. There is a risk that the stability and yield of cold-water fisheries resources will decrease, causing prices to rise and pricing salmon out of the global market. It is necessary to examine strategies for global warming effects from an economic viewpoint.

The results of field investigations and historical analyses on Japanese salmon fisheries identify the cornerstones for building economic strategies and the stability of resource levels and their market prices. Alleviation of climate change effects on salmon fisheries is enabled by a combination of local, regional, and global economic strategies.

Local strategies include saving fishing profits in rich years and using them as funds for lean years, developing local resources to complement regional resources, and maintaining prices of local resources by cooperation between hatcheries, setnet fisheries, and processing industries. Regional strategies include planning the coexistence of hatchery-reared salmon and wild salmon and letting both resources stabilize, and examining methods of raising the return rate of salmon based on joint observations with Russia. Global strategies include planning the differentiation of Japanese salmon by eco-labeling in the global market and expanding the shares of salmon products in the Asian market. The combination of these strategies is likely to help stabilize the livelihood of salmon-dependent fishers, as well as to improve the basis of fisheries management.

Introduction

Chum salmon (*Oncorhynchus keta*) are the most abundant species in Japan. They are important fishery commodities with global commercial value and one of the most important target species in northern Japan. Japanese salmon juveniles spend their first autumn season in the Okhotsk Sea and their first winter season in the northwest Pacific Ocean. Researchers at the Northeast Fisheries Science Center suggested that some fish populations would increase and others decrease as a result of climate change (FISHupdate.com 2010). Climate change affects variability of fish populations.

Salmon is an important fishery resource with global commercial value. Climate change has a marked influence on salmon inhabiting subarctic waters. The stability and catch of cold-water fishery resources decrease due to climate change (or global warming). Climate change causes prices to rise and thus prices salmon out of global markets. Salmon fisheries are one of the most important industries in the Hokkaido and Tohoku regions of northern Japan. Survival of Japanese salmon returns is affected by ocean production in the Okhotsk Sea and the Bering Sea. However, to date we have not been able to predict climate change effects on ocean production. Price and landed value of salmon fisheries change with salmon returns. It is necessary to plan some policies in anticipation of variation of price and landed value. The stability of resources and prices are suggested as the basis for building economic strategies. There are climate change concerns at regional, national, and international levels (Berkes and Jolly 2001). We thought that combinations of local, regional, and global economic strategies could cushion salmon fisheries against the effects of climate change. What kind of strategies do we need for salmon fisheries? For Hokkaido we classified the variability of domestic salmon returns into three patterns, using historical data to discuss the economic effects due to climate change.

Three phases in the roadmap of Japanese salmon enhancement

In Hokkaido, the number of salmon fry released has remained virtually constant since the 1990s (Fig. 1). However, the number of adult salmon returns has been changing since the 1990s. We cannot address the cause of the variability of adult salmon returns in this paper. It is necessary to study economic effects on salmon fisheries and processing industries due to the variability of adult salmon returns. Even if the variability of adult salmon returns were not caused by climate change, it is important to discuss the variability of wholesale prices affected by the variability of landed amounts. We classified the variability of salmon capture into

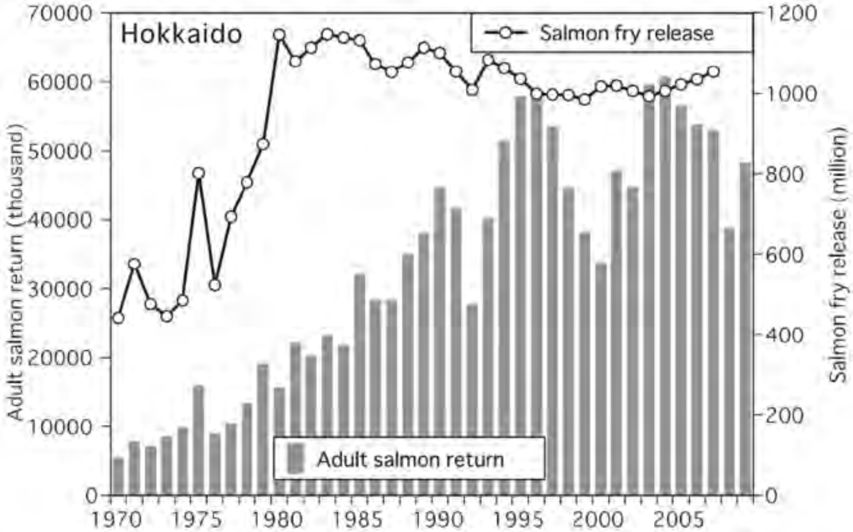

Figure 1. Adult returns and fry release of chum salmon in Hokkaido.

three patterns: rising period, varying period, and declining period, shown in Fig. 2. We used the data on adult and juvenile salmon from the statistics of NASREC (National Salmon Resources Center, Fisheries Research Agency). We used the data of wholesale prices and landed amounts from annual research reports of salmon distribution by the Set Net Fishery Association of Hokkaido.

Results

Three scenarios of salmon capture and local strategies

The variability of adult returns of hatchery salmon (*Oncorhyncus. keta*) in Hokkaido was classified into three variation types from historical data. Rising type (a) was from 1982 to 1990. Varying type (b) was from 1990 to 2003. Declining type (c) was from 2003 to 2008.

(a) Rising type (1982-1990)

Adult salmon captures were rising from 1982 to 1990. Wholesale prices were declining in this period and raw material prices were also declining. Wholesale price is defined as landed salmon price in fish markets. Raw material price is defined as purchase price by the seafood processing industry. Low price products were processed in this

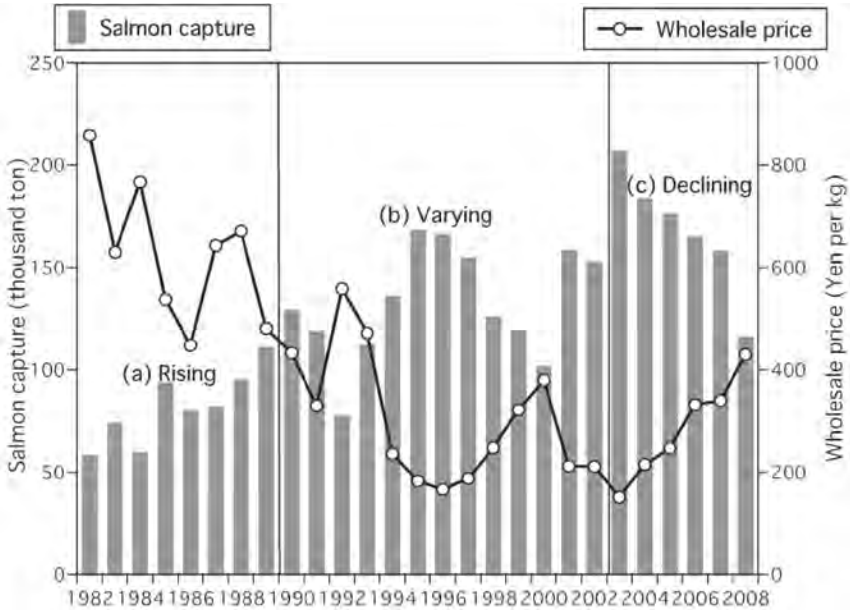

Figure 2. Variability of salmon captures and wholesale prices in Hokkaido.

period. Accordingly domestic and foreign demands of the products were expanded.

(b) Varying type (1990-2003)

Adult salmon captures changed rapidly from decrease to increase from 1990 to 2003. Wholesale prices changed up and down quickly in this period. The increasing periods of wholesale prices were rich years for salmon fisheries. In contrast, the decreasing periods of wholesale prices were poor years for salmon fisheries. In this period, short-term variability of wholesale prices repeats and wholesale price rises after a short-term period of declining wholesale price.

It is important for salmon fisheries to save fishing profits in rich years and to use them as funds for lean years in the varying period. In addition, it is more important that salmon hatcheries, setnet fisheries, and seafood processing industries cooperate to maintain wholesale prices of local salmon resources.

(c) Declining type (2003-2008)

Adult salmon captures were declining from 2003 to 2008. Wholesale prices were rising in this period and raw material prices were also rising. Accordingly, processing cost was increasing. In this period, salmon fisheries must develop local resources to complement regional core resources by farming and ranching technologies. Adult salmon captures turned to increase after 2008.

Global strategy to stabilize salmon prices

One of the most positive methods to stabilize wholesale prices is to expand the consumer market. The expansion of the domestic market and foreign market is expected to increase demand of processed products of salmon, and the expansion of global markets is especially important. Raw materials of Japanese salmon have been exported to China and processed products of Chinese plants have been exported to the European Union and the United States. A part of Chinese processed products made from Japanese salmon was sold at department stores in Shanghai in 2009 (Shimizu 2011). Regarding East Asian countries as an extension of the Japanese market is expected in the future.

Chinese processed products made from Japanese salmon have been sold as wild salmon at supermarkets in Hamburg, Germany (Shimizu 2010). However, there was nothing to show the Japanese brand on the products. Planning the differentiation by eco-labeling to evaluate hatchery salmon in global markets is a necessary approach for the future. As with fishermen, efforts by the processor to improve quality are costly (Babcock and Weninger 2004).

A trigger for Japanese salmon export was the decrease of the wholesale price. Wholesale price was negatively correlated with total salmon catch. As a result, despite recent increases in catches, the total economic yields of salmon have decreased since 1975 (Morita et al. 2006). A low price for mature male salmon caused the wholesale price to decrease. Therefore, this phenomenon was caused by the increase of salmon supply due to domestic salmon production and import volume of salmon in the Japanese domestic market.

As a result of the export of mature male salmon since 2001, the wholesale price of domestic salmon has been rising. The wholesale prices of Japanese domestic salmon were propped up by the export of raw materials to China. The raw materials of Japanese salmon have been processed in China and the products have been exported to the EU. The control of salmon supply by export of Japanese salmon supported the wholesale price in the Japanese domestic market.

Regional strategy to stabilize salmon resources

There are seven regional groups of chum salmon in northern Japan based on genetic structure: five regional groups in Hokkaido and two on the Honshu main island (S. Sato and S. Urawa, NASREC, unpubl. data). For stabilization of salmon captures it is important to maintain regional group returns. Planning the coexistence of hatchery salmon and wild

Table 1. Cost analysis of setnet fisheries in the Kushiro and Tokachi regions.

Average cost per net (2003-2007)	Kushiro region	Tokachi region
Fisheries Cooperative	Konbumori	Taiki
Fisherman per net	11	11
No. of Setnets	13	5
No. of Companies	13	7
Management style	Individual	Cooperative
Capture per net (ton)	259	580
Price per net (Yen per kg)	273	285
Value per net (thousand yen)	64,450	159,170
Variable cost per net (thousand yen)	26,100	73,380
Variable cost ratio (%)	40.5	46.1
Fixed cost per net (thousand yen)	20,300	11,650
Fixed cost ratio (%)	31.5	7.3
Absolute profit per net (thousand yen)	18,050	74,130
Absolute profit ratio (%)	28.0	46.6
Marginal profit per net (thousand yen)	38,350	85,790
Marginal profit ratio (%)	59.5	53.9
Break even point per net (thousand yen)*	34,110	21,580
Break even point ratio of landed value (%)	52.9	13.6
No. of Integrated processing factories	76	2 (1 is operated by Taiki F.C.)

*Break even point=Fixed cost/Marginal profit ratio

salmon in each region is needed to stabilize each regional resource, and letting both resources stabilize is important. In the future, joint observation between Japan and Russia in the Okhotsk Sea is expected to examine the process of growth and survival while salmon juveniles are migrating for feeding. As a result, the development of methods of regional salmon enhancement is expected to raise the return rate of adult salmon.

Local strategy for salmon fisheries management

Almost all Japanese salmon resources have been maintained by hatchery enhancement technology. Hatchery enhancement technology continues to plan on the coexistence of hatchery chum salmon and wild chum salmon. Nowadays studying the combination structure of hatcheries, setnet fisheries, and processing plants is important to find local strategies. Domestic salmon industries in eastern Hokkaido were selected as a case study. Economic conditions of the Konbumori Fisheries Cooperative in the Kushiro region and the Taiki Fisheries Cooperative in the Tokachi region were compared. The operations from landing to distribution through processing in both salmon industries were researched.

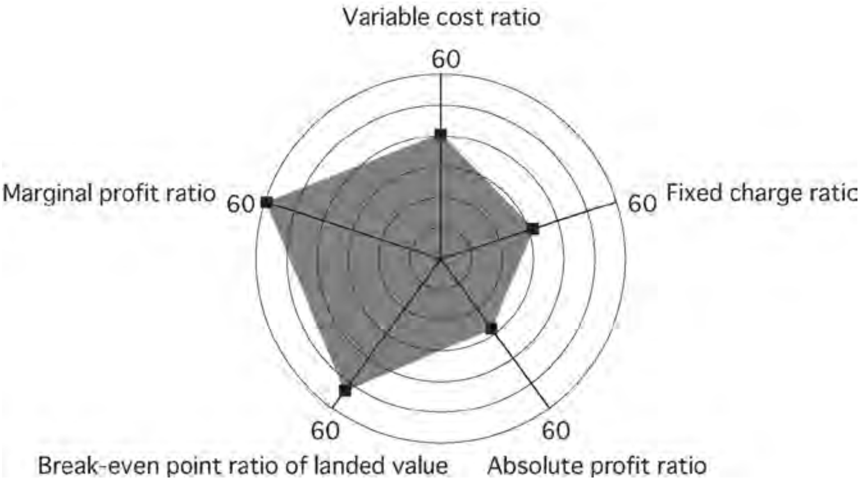

Figure 3. Management efficiency of setnet fisheries in the Kushiro region, eastern Hokkaido.

Salmon fisheries of the Konbumori Fisheries Cooperative were operated under individual management in the Kushiro region. On the other hand, the salmon fisheries of the Taiki Fisheries Cooperative were operated under cooperative management in the Tokachi region. The costs of setnet fisheries in the Kushiro and Tokachi regions were analyzed by using fisheries management data (Table 1). The variability of landed value enormously affected the management of setnet fisheries. Marginal profit (= absolute profit + fixed profit) increased depending on the increase in landed value. Marginal profit decreased in the year when landed volume was less despite the rise of wholesale price. Accordingly, the stability of landed volume was important for the stability of setnet fisheries management. When the break-even point of landed value was high, it was important to reduce fixed cost and increase absolute profit.

Salmon fisheries management was classified into two types. The first type was individual management of the Konbumori setnet fisheries in the Kusiro region. The variable cost was affected by the variability of capture. The variable cost ratio was lower and the marginal profit ratio was higher in the Kushiro region than in the Tokachi region (Fig. 3). In the decreasing period of catches, administration ability affected income of individual management, and the income of each setnet fishery was different. The second salmon fisheries management type was cooperative management of Taiki setnet fisheries in the Tokachi region. The fixed charge ratio was lower and absolute profit ratio higher in the Tokachi region than in the Kushiro region (Fig. 4). Equal incomes

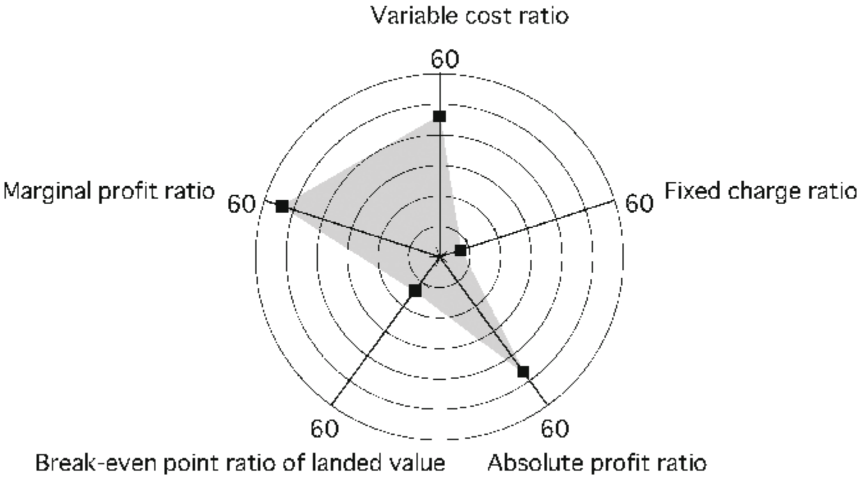

Figure 4. Management efficiency of setnet fisheries in the Tokachi region, eastern Hokkaido.

are guaranteed under each setnet fishery in the decreasing period of catches. Japanese salmon fisheries will be operated under cooperative management to fix cost control if the variability of captured salmon is to continue in the future.

Combination strategies for stability of fishery management

The Tokachi region showed higher variable cost and higher variable ratio than the Kushito region. The Taiki Fisheries Cooperative in the Tokachi region has been operating a salmon processing plant. On the other hand, the Kushiro region showed lower variable cost and a higher marginal profit ratio than the Tokachi region. Many seafood processing plants have been integrated in the Kushiro region. The combination between fishing and processing in the Kushiro region suggested the formation of personal management. A combination of strategies is important to stabilize fisheries management. These strategies are likely to help improve the basis of fisheries management and to cushion against the effects of climate change. In the Tokachi region, the Taiki Fisheries Cooperative approached management stability by cooperative management of setnet fisheries. In the Kushiro region, the Konbumori Fisheries Cooperative approached management stability by integrating processing plants with the cooperative. It is important to build a relationship of trust between salmon fisheries and processing plants. In Alaska salmon fisheries, the salmon strategy debate has not led to meaningful action because there was a huge lack of trust, understanding, and communication between fishermen and processors (Knapp 2002).

Discussion

Combination of local, regional, and global strategy

Local strategies include saving fishing profits in rich years and using them as funds for lean years, developing local resources to complement more regional resources, and maintaining prices of local resources by cooperation between hatcheries, setnet fisheries, and processing industries. Hatchery enhancement cost is supported by a surcharge from setnet fisheries profit. The setnet fisheries profit is supported by distribution to the seafood processing industry. Fishermen must decide how much effort to exert in order to deliver high quality salmon to the processor who purchases his catch (Babcock and Weninger 2004). The seafood processing industry profit is supported by distribution to domestic markets and exports to the global market. In the Japanese salmon industry, a combination of industry is formed by hatcheries, setnet fisheries, and processing industries (Fig. 5).

Regional strategies include planning the coexistence of hatchery-reared salmon and wild salmon and letting both resources stabilize, and examining methods of raising the return rate of salmon based on joint observations with Russia. Global strategies include planning the differentiation of Japanese salmon by eco-labeling in the global market, and expanding the shares of salmon products in the Asian market. The combination of these strategies is likely to help stabilize the livelihood of salmon-dependent fishers, as well as to improve the basis of fisheries management.

Economic relationship among local, regional, and global cooperation

Local cooperation is an economic relationship among hatchery enhancement, the setnet fishery, the processing company, and distribution in local communities. A local unit is a municipality, a prefecture, or a province; it is an aggregate of a local community. Regional cooperation is an economic relationship between countries; for example, Japan and Taiwan, Taiwan and China, and China and Japan. Regional cooperation is approved by the relationship of local cooperation. Global cooperation is an economic relationship between global connections; for example, East Asia and EU, EU and North America, and North America and East Asia. Global cooperation is approved by relationships of regional cooperation. The common aim of these relationships is to establish a complement with each other's community, or each other's country.

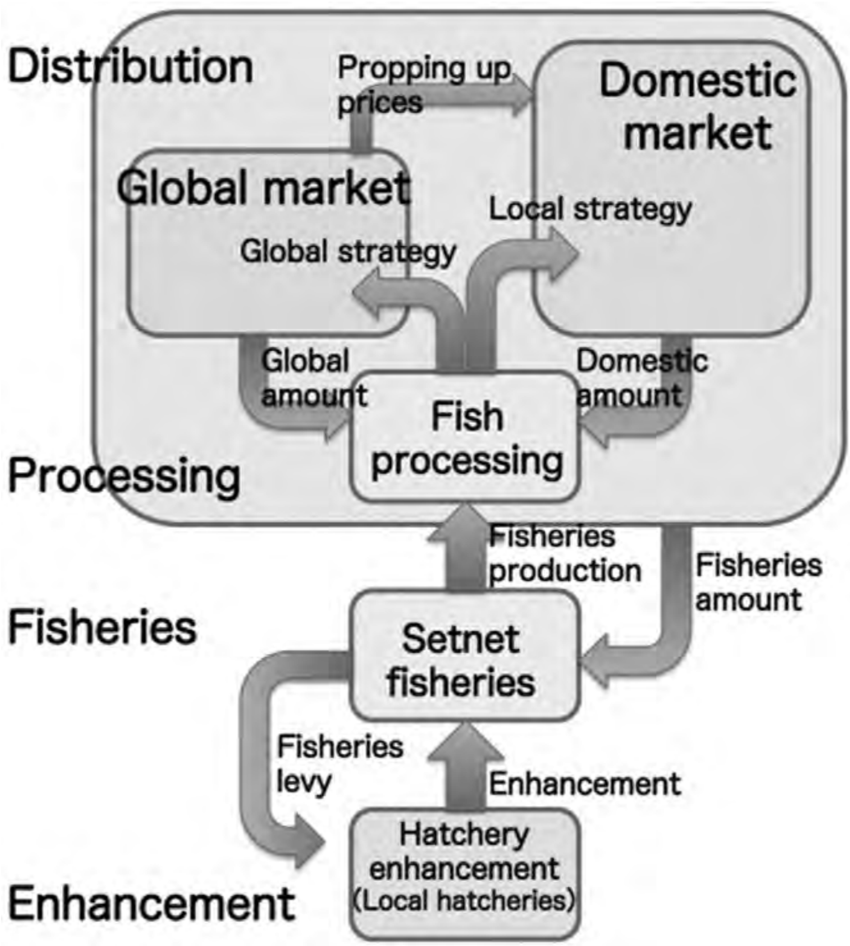

Figure 5. Combination strategy for the Japanese salmon industry.

The economic relationships among local, regional, and global entities act like a web, and are likely to help to cushion against climate change effects.

Acknowledgments

We would like to thank technical researchers of the Tokachi Field Center of NASREC (National Salmon Resources Center) for their research on fisheries cooperatives and processing companies in Hokkaido. We thank the Konbumori Fisheries Cooperative in the Kushiro region and the Taiki Fisheries Cooperative in the Tokachi region for cooperating in this investigation on fisheries management in eastern Hokkaido.

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A Framework for the Preliminary Assessment of Vulnerability of Fishing-Dependent Communities to Climate Change and Variability

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Abstract

Global climate change is projected to have far-ranging effects on the oceans and marine life. In turn, fisheries will likely undergo changes in their distributions and abundance. Coastal Alaska communities are often highly dependent on commercial fisheries, and as a result will likely be vulnerable to climate change. Do they have the capacity to adapt to these changes? The purpose of this project was to construct a framework for a preliminary assessment of the vulnerability of the fisheries-dependent communities in Alaska to climate change and variability. Employing an indicator-based framework, vulnerability is assessed according to the levels of natural, social, and economic capital found in each community. A simple graphical instrument communicates these findings. The communities of Cordova, Kodiak, Petersburg, Seward, and Sitka were assessed to test this method and found to have differing levels of capital and ability to adapt.

Introduction

Climate change and its effects are causing a dramatic and systemic transformation of the world's oceans (Pachauri and Reisinger 2007). Ocean surface temperatures have shown a clear increase in the last 50 years, salinity has weakened in the subpolar ocean regions while increasing in the subtropics (Bindoff et al. 2007), and ocean ecosystems are showing a decrease in primary production and shifts in the spatial distribution of marine species (Fischlin et al. 2007). Fisheries occur in an area where these changes intersect with the natural resources on which humans rely. Alaska landed nearly 2.5 million metric tons of fish in 2006 (Van Voorhees and Pritchard, 2008) and these fisheries represent an income, livelihood, and cultural resource for the 136 Alaska communities "significantly involved in commercial fisheries" as profiled by Sepez et al. (2005). As climate change affects the fisheries on which these communities rely, decision makers will need a range of tools to evaluate impacts and vulnerability to create mitigation and adaptation options (Rosenzweig and Wilbanks 2010). This study developed a quick, cost-effective "first-look" tool for conducting a preliminary assessment of the capacity of fishing communities to adapt to climate change and variability. The preliminary assessment is based on the concept of community capacity and uses indicators built from existing data. The idea was to hold exposure and sensitivity constant while looking at the levels of social, economic, and natural capital found in each community. This allowed the creation of a simple graphic tool to communicate the vulnerability of each community. To test this approach, five Alaska communities were assessed: Cordova, Kodiak, Petersburg, Seward, and Sitka.

Background

Vulnerability, as a framing device, is a way of organizing information to tell a story about an event—a natural disaster, climatic variability, or a fisheries management decision—and its impact on a place and time, the processes that led to the impact, and the human and natural conditions of that place which attenuate or amplify that impact. Vulnerability is defined as a function of three different conceptual components: exposure (the extent to which a place or system is affected by hazards); sensitivity (the responsiveness of a system to hazards); and adaptive capacity (the state of resilience/ability of a system to manage or mitigate its exposure and/or sensitivity) (Turner et al. 2003, Preston and Stafford-Smith 2009).

Historically, literature on vulnerability focused on the exposure of communities to natural hazards (tsunamis, hurricanes) (Wood 2009). Vulnerability has established a strong, evolving presence in climate change research across a variety of disciplines, from impacts on typhoon frequency and intensity (Adger 1999) to social factors influencing community capacity to sustainably manage coral reef resources (McClanahan et al. 2008).

The Intergovernmental Panel on Climate Change (IPCC) (Parry et al. 2007) defines vulnerability to climate change as the degree to which systems—geophysical, biological, and socioeconomic—are susceptible to, and unable to cope with, adverse impacts. Differentiation occurs between the vulnerability of a system (e.g., a nearshore ecosystem);

impacts to the system (e.g., coral reef bleaching); or the physical process that caused the impacts (e.g., thermal changes in the surrounding waters) (Parry et al. 2007). Brooks (2003) conceived a framework study on vulnerability to climate variability and change and makes a distinction between two frequently researched concepts of vulnerability: social vulnerability (the conditions of a system prior to the occurrence of a hazard, comprising variables such as degree of dependence on a resource, demographics, level of poverty); and biophysical vulnerability (the outcome of the hazard and its impacts on the system). The variables comprising social vulnerability shape the biophysical vulnerability of an area by influencing the social preparedness and human response of the system. Similarly, Adger (1999) defined social vulnerability as the exposure of individuals or groups to stress as a result of social and environmental change. This definition further encompasses the social and economic variables that influence vulnerability of a community.

Vulnerability and vulnerability assessments

Different impacts on fisheries occur at the international, national, regional, or community levels, each comprising different variables. At the regional and local organizational levels, impact and vulnerability assessments can begin to uncover the complexity of vulnerability, addressing the questions not only of "whether" but also "where, how, and why" (O'Brien et al. 2004). Allison et al. (2009) provides an investigation into the vulnerability of fisheries to climate change at the national scale, using an indicator-based approach. By comparing 161 countries, their research identifies regions that are highly vulnerable to climate change, based on factors such as the amount of fish in the populations' diets, and the relative importance of fisheries to the national economy. The geographic distribution of fishing-dependent communities along all coasts of the United States indicates a substantially local importance. At a regional or community level, the economic benefits and costs can be substantially magnified relative to the local economy. Reliance on fisheries as the primary source of income and subsistence exposes a community to a higher degree of stress, derived from climate variability and its impacts (Adger 1999).

The vulnerability of a place may be used to describe the impact of hazards on a social system's capacity to adapt and mitigate shocks and changes in a natural system. Schneider et al. (2007) developed criteria that make a system, state, or process qualify as having key vulnerabilities. Researchers, analysts, and decision makers could conduct vulnerability assessments of many different shapes and sizes depending on the criteria used. Vulnerability may be assessed within different value systems and at different spatial and temporal scales, with each component bearing substantial scientific uncertainties. This applies to any judgments on the importance of the system, and the level of risk as perceived within that context. The ability to act upon risks falls disparately across scales of social organization. Vulnerability assessments are highly influenced by these differing perceptions, and value judgments necessarily need to occur. Therefore, as part of the assessment, assumptions and judgments about the risks and importance of systems need to be transparent (Parry et al. 2007).

Community capacity and forms of capital

If decision makers hold the conceptual components of exposure and sensitivity constant, they can then consider the concept of community capacity as a starting point and one method of examining the ability of a community to adapt. Community capacity has been defined (Beckley et al. 2008 p. 60) as the "collective ability of a group to combine various forms of capital within institutional and relational contexts to produce desired results or outcomes." These capitals can take a variety of forms including human, social, economic, and natural capitals. Social capital relates to organizations, collective activities, networks, relationships, and the norms and networks that facilitate collective action (Beckley et al. 2008). Human capital refers to the level of education and skill of the individuals within the community. For this study, they are combined to reflect the relationships and networks that people form and collectively use for positive, constructive purposes.

Economic capital encompasses financial and built assets that go through the community. Financial assets refer to financial resources available to the community as a whole (e.g., municipal budgets, public sector funding, and private sector income) (Beckley et al. 2008). Economic capital also applies to different property rights (harvest leases on timberland, mineral rights, or fishing permits), and physical or built assets (infrastructure that supports communities like roads, water and sewer facilities, power plants, schools, and other public buildings). Businesses can invest into physical capacity through tangible objects such as manufacturing plants, commercial property and buildings, machinery, trucks, and boats.

Natural capital can be defined as "stock (e.g., fisheries) that yields a flow of valuable goods or services into the future" (Costanza and Daly 1992 p. 38) or the abundance and diversity of natural resources, recreational opportunities, and other features of the natural world in a specific location (Beckley et al. 2008).

Climate variability in the North Pacific

Evidence suggests the impacts of climate change will fall disproportionately on polar regions including Alaska (Anisimov et al. 2007). While it is highly certain that the biophysical conditions of fisheries in Alaska are changing, the end-state of these changes is uncertain. This has important implications for fishermen and their communities since they rely on a resource that is so sensitive to climate variability (Badjeck et al. 2009).

Coastal Alaska communities are vulnerable to climate change in a variety of ways, from sea level rise to changes in weather patterns and oceanographic conditions. Large-scale, step-wise shifts in physical and biological variables (termed regime shifts) historically play a large role in the North Pacific ecosystem, influencing species abundance and composition (Hare and Mantua 2000). The biophysical impacts of climate change on fish include a shift in their geographical distribution, in both latitude and depth; 15 of 36 North Sea species shifted latitude and depth with rising sea surface temperatures (Perry et al. 2005). Not only was it found that the mean centers of the fish distributions shift, but the boundaries—the northward and southward extent of the fish populations—shifted toward the pole as well. Also tested and confirmed was that faster life histories, significantly smaller body sizes, faster maturation, and smaller sizes at maturity are characteristics of these shifting species. This suggests these stocks are somewhat adaptive to different climates in the short term. The remaining questions lie in the long-term effects of climate change, including reorganization, changing species interactions, and impacts on abundance. In turn, commercial fishing must adapt to these new ecological states by pursuing different species, changing gear types, and modifying regulations (McIlgorm et al. 2010).

Fishing communities

This assessment occurs at the level of the fishing community. National Standard 8 of the Magnuson-Stevens Fisheries Conservation and Management Act defines a fishing community as a community substantially dependent or engaged in the harvest or processing of fishery resources to meet social and economic needs (Magnuson-Stevens Fishery Conservation and Management Act 2007). In order to develop and select adaptation measures, decision makers must understand what parts of communities are most vulnerable. The complexity and expense of a formal vulnerability assessment over as vast and varying a region as the Gulf of Alaska may be out of reach for government agencies and other organizations. It is pragmatic to develop a scalable, preliminary assessment tool for identifying ports of potential vulnerability, using existing data to develop proxies for measuring vulnerability. This approach, while limited, could be cost-effective and support decision makers.

Methods

This research explored community adaptive capacity of Alaska fishing ports based on the concept of community capitals, and a straightforward way to measure them with indicators capable of identifying both the steady-state situation and any trend in that situation. Ideally, indicators selected should capture a part of social, economic, or natural capital. This approach does not use a composite index as its final product; rather, it is an approach where vulnerability depends on the combination of indicator values. At a basic level, thresholds are set for each indicator and variables measured can be low, moderate, or high. The selection of thresholds is purely subjective. The reliance on existing data favors a disaggregate approach, allowing for the transparent rating of vulnerabilities using disparate units of measurement.

The methodology is quick, simple, efficient, transparent, reproducible, and scalable to a larger pool of communities. The proxies developed take into account the exposure of the fishing ports to impacts on the commercially important species mix at each port and the susceptibility of those species. The selected indicators must allow for identification of potential conditions that heighten or attenuate the exposure of the community to the impacts, including the economic diversity of the community, the proportion of permit holders in the community versus out of the community, etc.

Typology of community vulnerability

The first step in assessing communities is the creation of a classification system of community vulnerability built around the concepts of social, economic, and natural capital. It is the combination and use of these types of capital in each community that lead to resilience or vulnerability. Communities range along a continuum from high to low vulnerability. At a general level, vulnerable communities are unable to cope and operate within a normal range of function after a shock or perturbation.

The vulnerability of a fishing community depends on its exposure to a sensitive fishery, its degree of reliance on that fishery relative to the other fisheries, and its capacity to adapt, based on the condition of its natural, social, and economic assets. This classification of vulnerable communities takes into account these different components of vulnerability. A combination of the community capacity and vulnerability literature provides a basis for outlining the different types of vulnerability (Table 1).

Communicating vulnerability

The final part of this research was to evaluate the effectiveness of a graphical instrument in communicating vulnerability (Fig. 1). The graphic used is a triangle with three regions (representing high, moderate, and low scores) modeled after a natural and recreational resource assessment developed by Cocklin et al. (1990). Each indicator is placed in the appropriate region of the triangle to provide a readily accessible, explicit method of visually ascertaining the level of community

Table 1. Typology of community vulnerability.

	Types of capital		
Class of vulnerability	**Social**	**Economic**	**Natural**
I. High vulnerability	Permit holders are aging, and young people do not own local fisheries permits. The harvesting workforce is inexperienced. The community has little education capacity.	The economy is highly dependent on fisheries. Fixed assets, like boats, are aging and are mostly engaged in one fishery.	Commercially fished species are highly sensitive to climate variability and climate change. There is a lack of diversity in targeted species.
II. Moderate vulnerability	The age of permit holders is in the middle range, with some new entrants taking part in fisheries. The harvest workforce has some experience. There are marginally fewer people with degrees than without.	Fishing is an important component of the economy, but not the only one. Vessels engage in a few different fisheries. Vessels are aging, but with a few upgrades.	On the whole, commercial species are moderately sensitive to climate variability and change. There are a few alternatives within the mix of species.
III. Low vulnerability	There are new entrants into the fisheries, and on average, fishermen are younger. The harvest workforce is experienced. A majority of the community has a college degree.	Fisheries are but one part of a diverse economy. Vessels are engaged in diverse fisheries, and they are newer.	Among commercial species, climate sensitivity is low. There are alternatives to sensitive fisheries.

vulnerability. Comparing the collection of indicators with the typology of community vulnerability (Table 1) allows for a determination of the community's overall vulnerability. This summary ranking is placed at the top of the triangle (Fig. 1).

Social capital indicators

The mean age of permit holders in a community provides a rough indication of generational equity in the fisheries; state permits were used, as there is no available data on the ages of federal fishing permit holders. The Commercial Fisheries Entry Commission (CFEC) publishes data on the mean ages of limited, transferable permits issued for Alaska fisheries by permit and resident type, not by community. For our pur-

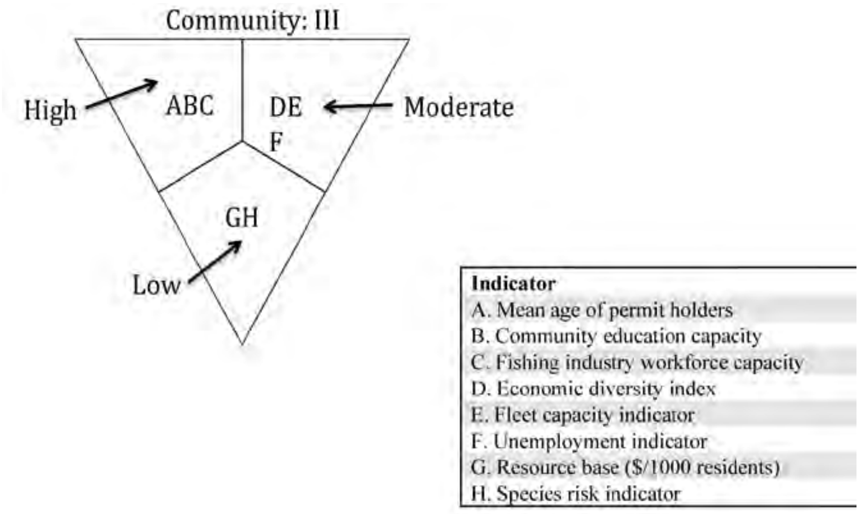

Figure 1. Sample graphic tool.

poses, an imperfect estimation of the age used for this indicator was made using the mean age of the resident type for the permit. Residents of Kodiak, Petersburg, and Sitka are reported as urban; Seward and Cordova are reported as rural. The CFEC decision rule for local and nonlocal designation depends on the Alaska Department of Fish and Game administrative district in which the place is located and the fishery prosecuted (CFEC 2009). For example, if a person holds a permit in the Southeast Salmon Purse Seine Fishery and lives in Petersburg, then they qualify as a rural local. Conversely, if someone from Kodiak holds that same permit, they are considered an urban nonlocal. Some permits are represented more than others in each community. The weighted average is used as the overall mean age of permit holders in the community. The thresholds for high, moderate, and low values are set at equal to or less than 40 years of age, 41 to 50 years of age, and above 50 years of age, respectively.

Crewmembers are an integral part of the fishing sector and any attempt to look at the capital of a fishing community needs to consider them. However, there's a paucity of information on these self-employed commercial fishermen and what is available includes the count of crewmembers by community, the statewide age distribution of license holders by year, and mean and median license longevity of license holders (CFEC 2008b). The capacity of the local crew workforce is defined as the per capita years of crewmember experience for each community. This is calculated as the mean license longevity for the pool of crewmembers for that community, divided by the community population to arrive at the indicator value. Very roughly, this gives a ratio of years of crew experience in fisheries for that community. Thresholds were set: below a ratio of 0.4 indicates high, between 0.4 and 0.8 indicates moderate, and above 0.8 indicates low community vulnerability.

Another aspect of social capital is the level of education found in the community. The education capacity indicator is the percentage of the population of people 25 years of age and over in the community who have attained a post-secondary degree (U.S. Census Bureau 2000). The thresholds are 25% or below is a low capacity, contributing to higher community vulnerability; 50% or below is moderate capacity, contributing to moderate vulnerability; and above 50% points to a high education capacity, contributing to low community vulnerability.

Economic capital indicators

Economic capital indicators measure both fixed and liquid assets of the community. Economic diversity is a measure of the uniformity of employment across all sectors of the community's economy. Diversification is a ubiquitous strategy used to reduce risk of hazards and shocks, and it is referenced in the literature as an economic dimension of vulnerability (Parkins and MacKendrick 2009; J. Sepez, NOAA NWFSC pers. comm.). The Shannon index is used to measure diversity of employment in the community (Pacific Fishery Management Council 2010). A higher index score indicates a more economically diverse community in two ways (more industry sectors and employment in all sectors is relatively even). Communities with values exceeding 3.0 can be considered at a low risk of economic concentration; values between 2 and 3 can be considered at moderate risk of economic concentration; and values lower than 2 are at a high risk of economic concentration. The unemployment rate is an important measure of the economic capital in a community. A comparison of the community's unemployment rate to the state unemployment rate is illustrative and provides a common point for comparison. The three-month average deviation from the monthly state unemployment rate is gathered from the Bureau of Labor Statistics (2010), its resolution is at the borough level, and it is not seasonally adjusted. It is rated on a three-point scale; any average deviation of zero or below (signifying an unemployment rate at or below the state's rate) is considered least vulnerable, a positive difference between 0.1 and 1.5 is considered moderately vulnerable, and any community with a difference of 1.6 or greater is considered a position of high vulnerability.

Physical assets—vessels and gear—play a significant role in fishing. For this study the vessels registered at that homeport are considered a community's fleet; yearly data on vessels by homeport community are available from the CFEC and data come from self-reported vessel registration applications (CFEC 2008a). Several aspects of vessels are reported: physical attributes (length, size, material of the hull); age of the vessel; power of the vessel (in horsepower and fuel type of its engine); vessel refrigeration; and gear types used. It is prudent to assess these attributes as a whole, not piece by piece. The indicator for this was a ranking of low (below 2), moderate (below 3), or high (3 or higher) vessel capacity. A lower capacity contributes to higher community vulnerability, while the inverse is true for higher vessel capacities. The variables for this indicator are chosen as representations of both the physical characteristics of the vessel and of the uses to which the vessels are put. The variables for the indicator are ratio of vessels with refrigeration to those without; mean use count for vessels; and ratio of sum vessel length to sum horsepower of the port. The indicator is the sum of these ratios. Essentially, this indicator is an indirect measure of the inputs directed into the fleet. A higher ratio of boats with refrigeration to those without may indicate that boat owners are investing into their boats. The mean use count for vessels may indicate that vessels are engaged in diverse fisheries, and therefore are less dependent upon one fishery. The length-to-horsepower ratio describes the relationship between the total vessel length and total vessel horsepower for vessels in that port. The relationship between these two inputs is important, as it can signal the productivity of these assets on a foot-by-foot basis. The higher the value of this ratio, the more engine power per foot is available in the fleet. The mean age and length of the vessels in each community are reported as additional features on which to measure the fleet. These are calculated as a weighted mean, as some years are more and less represented in the vessel ages (CFEC 2008a). Vessels with no build year data were excluded from the average. The build year is subtracted from the current year to find the vessel age. The weighting each age received in the mean calculation is the frequency with which that age appears in the vessel data. For these values, it is assumed that a community with older vessels has less capital to use toward building and retaining community capacity. On the processing side of fisheries, shore-based processing plants are the important physical assets, but for reasons of confidentiality, available information on processing plants is scarce. However, the number of processing plants that hold a federal processing permit in a location may be found.

Natural capital indicators

Fish species are a significant—if not the primary—source of natural capital for these communities as they rely on fish for commercial fisheries, yet each port has recreational and subsistence activities on which some in the community rely. This study exclusively looked at commercial fisheries as the source of natural capital. Each port lands a unique mix and abundance of commercially fished species and this allows one to distinguish between each port's exposure to climate variability and change. There are insufficient data and understanding of climate change and fish species responses to perform a quantitative analysis of each fish species' susceptibility to climate change. However, a semiquantitative procedure can be used to incorporate present knowledge of these species into a risk assessment. NOAA has adopted one risk assessment approach (productivity-susceptibility analysis) to gauge the vulnerability of fisheries to overfishing (Patrick et al. 2009, 2010), and with some modification, this approach can also be used to quickly assess climate change risk for these species.

The second natural capital indicator is the scale of the fishing resource base of these communities, consisting of the value of the species per 1,000 residents (Jacob et al. 2010). In this research, a higher resource base value indicates a higher capacity: a value of $10,000 per person and under contributes to a higher vulnerability; between $10,000 and $15,000 per person contributes to a moderate vulnerability; and above $15,000 per person contributes to a low vulnerability.

Results

Based on the abundance of the various capitals in these communities, this study found that Cordova, Petersburg, and Sitka are moderately vulnerable, while Seward was highly vulnerable, and Kodiak has a low vulnerability. Fig. 2 provides a graphic tool displaying the results by community. Table 2 provides a list of community capital indicators, variables, and data sources. Table 3 provides a range of community capital indicator values and corresponding levels of vulnerability. Table 4 provides a summary of individual results by community. For the sake of brevity, a lengthier discussion is provided for Kodiak and Seward; only a summary is provided for remaining three communities.

Kodiak

Kodiak is a community of 6,334 people located on the northeastern tip of Kodiak Island, the largest island of the Kodiak archipelago. The Alutiiq people have inhabited Kodiak Island for approximately 8,000 years (Sepez et al. 2005). In 1882 a cannery was established at the mouth of the Karluk River, beginning a long history of Kodiak's involvement in commercial fishing. The contemporary Kodiak economy is steeped in commercial fishing, including a large processing industry, a diverse fleet, and many commercial fisheries. For the 1,265 limited entry permits issued in 2008, the weighted mean age of the permit holders was 49.2 years. The mean crew license longevity for Kodiak in 2006 was 6.7 years, for 796 license holders. This translates into 0.86 years of crew experience for each resident of Kodiak, considered a high value on the

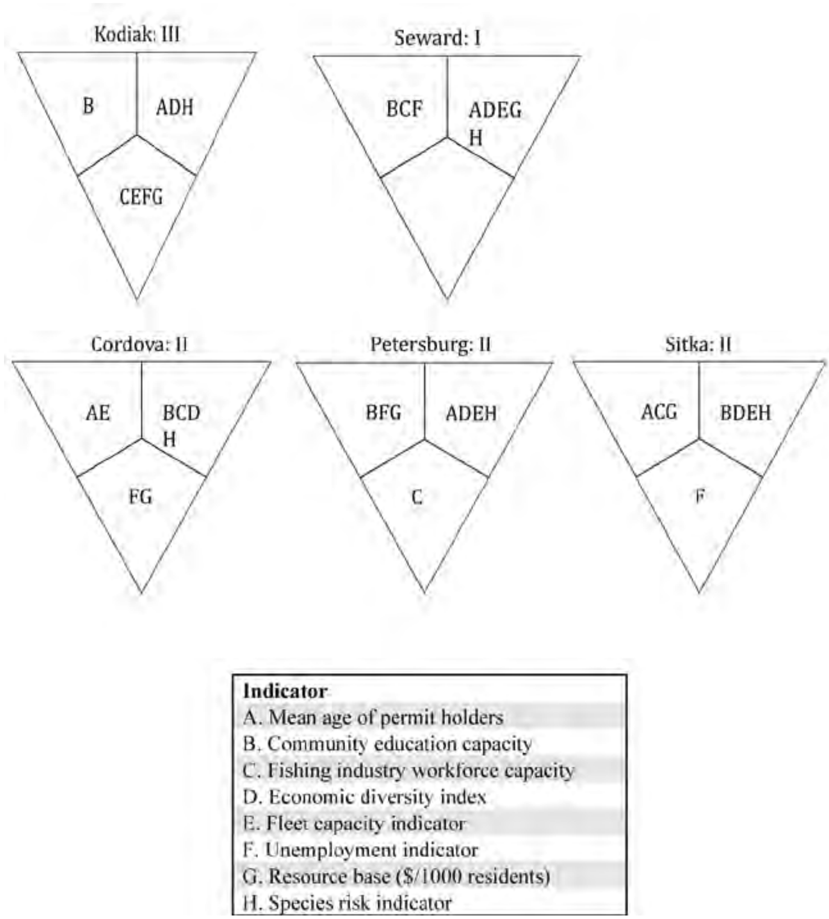

Figure 2. Each community assessment as communicated by graphic tool.

crew capacity scale. This ratio is the highest among the five communities, but has declined since 2001. The education capacity for Kodiak was 0.22, indicating that less than one-quarter of the over-25 years of age population had a post-secondary degree in 2000. The Shannon index value for employment diversity in Kodiak was 2.23, considered to be at moderate risk of being economically concentrated. The unemployment indicator for the Kodiak Borough is –1.1 (Bureau of Labor Statistics 2010), indicating an unemployment rate below the state unemployment rate, and not a source of vulnerability. Kodiak has 553 vessels operating from its port. The mean age of these vessels in 2010 is 26.7 years, with

Table 2. List of community capital indicators, variables, and data source.

Type of capital	Indicator	Variable	Source
Social	Age of permit holders	Mean age of permit holders	CFEC 2008b
	Community education capacity	Education per capita in community	U.S. Census Bureau 2000
	Fisheries workforce capacity	Local crew license longevity	CFEC 2008b
Natural	Resource base	Value per 1,000 residents	CFEC 2008b, The Research Group 2007
	Risk score	Average risk criteria scores	Patrick et al. 2009
Economic	Economic diversity	Employment diversity, Shannon index	U.S. Census Bureau 2000
	Fleet capacity	Length-to-horsepower ratio	CFEC 2008a
		Refrigeration ratio	CFEC 2008a
		Mean vessel use count	CFEC 2008a
		Weighted mean age of vessels	CFEC 2008a
		Weighted mean length of vessels	CFEC 2008a
	Unemployment	Mean 3-month deviation from state unemployment	Bureau of Labor Statistics 2010

a standard deviation of 10.8 years. The mean length of Kodiak vessels is 40.6 feet, with a standard deviation of 27.1 feet. The fleet capacity index for Kodiak is 3.00, indicating a fleet with a high capacity. This is the highest value for the five communities, and can be largely attributed to a high number of boats with refrigeration, and the highest average vessel use count. Vessels in Kodiak are of various lengths, with 202 vessels 26 feet or shorter and 84 vessels that are 60 feet or longer. Kodiak has 12 federal processing permits. It could be claimed that the diversity of Kodiak vessels is a reflection of the richness and abundance of fisheries in the Gulf of Alaska, most accessible from the port of Kodiak. In terms of landings, a yearly average 325 million pounds of fish were landed between 2005 and 2009, for an average yearly value of $120,924,148 (The Research Group 2007). The risk indicator value for pounds landed is 3.16, while the risk indicator value for ex-vessel value is 2.89.

Table 3. Ranges of community capital indicator values and corresponding levels of vulnerability.

Indicators	Low vulnerability	Moderate vulnerability	High vulnerability
A. Age of permit holders	≤40	41-50	>50
B. Community education capacity	≥50%	25%-50%	≤25%
C. Fisheries workforce capacity	>0.8	0.4-0.8	<0.4
D. Economic diversity	≥3	2-3	<2
E. Fleet capacity	≥2	2-3	≥3
F. Unemployment	≤0	0.1-1.5	≥1.6
G. Resource base	≤$10,000	$10,000-$15,000	≥$15,000
H. Risk score	5	3	1

Kodiak is the only community that achieved a rating of low vulnerability using this typology. Kodiak's unemployment rate is lower than the state rate, the resource base is diverse and abundant, and the fleet is diverse and capitalized. There are many crewmembers with plentiful experience. It does suffer from drawbacks in some key areas: it is not a diverse economy relative to the other communities, and the education level of the community is low and this could hurt its chances to diversify in the face of changes in the fisheries.

Seward

Seward is a community of 2,830 people located on Resurrection Bay on the southeast coast of the Kenai Peninsula. Unlike the other four communities, there is little evidence that the area occupied by Seward had a historical Native Alaskan population (Sepez et al. 2005). Russian fur traders and explorers discovered Resurrection Bay in 1792, but the town was not settled until the 1890s, after Alaska was bought by the United States. Because of its ice-free port and access by highway to Anchorage and other Kenai Peninsula communities, Seward is considered a major transportation hub (Sepez et al. 2005). As such, it is highly involved in the tourism industry, hosting an annual 320,000 cruise ship visitors.

For the 111 limited entry permits held in Seward in 2008, the weighted mean age of the permit holders was 46.7 years (CFEC 2009), considered a moderate value on the scale. The mean crew license longevity for Seward in 2006 was 5.8, for 129 crew license holders (CFEC 2008b). This translates into 0.27 years of crew experience for each resident of Seward, considered having weak crew capacity. The education

Table 4. Summary of indicator results by community.

	Indicator score by community				
Indicator	**Cordova**	**Kodiak**	**Peters-burg**	**Seward**	**Sitka**
A. Mean age of permit holders	52.4	49.2	49.1	46.7	50.9
B. Community education capacity	0.30	0.22	0.22	0.22	0.39
C. Fishing industry work-force capacity	0.66-0.72	0.83-0.91	0.70-0.85	0.23-0.30	0.30-0.38
D. Economic diversity index	2.4	2.23	2.31	2.30	2.22
E. Fleet capacity indicator	1.79	3.00	2.42	2.14	2.15
F. Unemployment indicator	−0.2	−1.1	1.6	1.7	−1.8
G. Resource base ($/1,000 residents)	18,368.13	19,091.28	9,708.13	14,229.29	7,054.46
H. Species risk indicator (lb and $)	lb: 3.22 $: 3.08	lb:3.16 $: 2.89	lb: 3.20 $: 2.82	lb: 3.02 $: 2.57	lb: 3.66 $: 3.14

capacity for Seward was 0.22, indicating that less than one-quarter of the over-25 years of age population in 2000 had a post-secondary degree (same as Kodiak and Petersburg). The Shannon index value for employment diversity in Seward was 2.30, comparable to that of Petersburg. This level is considered a moderate risk of being economically concentrated. The unemployment indicator for the Kenai Peninsula Borough, of which Seward is a part, is 1.7, indicating an unemployment rate above the state unemployment rate. This could be considered a point of vulnerability and on the scale is considered to be highly vulnerable.

Seward has 84 vessels operating from its port. The mean age of these vessels in 2010 is 28.9 years, with a standard deviation of 11.5 years. The mean length of Seward vessels is 36.1 feet, with a standard deviation of 19.5 feet. The fleet capacity index for Seward is 2.14, the second lowest value out of the five communities. Seward's small fleet of vessels has the highest length to horsepower ratio, but is otherwise middling with regard to refrigeration and the average use count of each vessel. While this port is tied to Prince William Sound in both the salmon and the halibut and sablefish fisheries in substantial amounts, it does not seem that permit holders or vessel owners prefer Seward for living in or mooring their vessels. Seward has four federal processing permits. As both an ocean port and a gateway to Alaska's population centers via roadways (and by extension the contiguous United States), illustrates Seward's advantage as a commercial fishing port. For the 36.5 million pounds of fish delivered in Seward, 66% of it was salmon, while 16% and 14% of the landings by weight were halibut and sablefish, respectively (The Research Group 2007). In Seward, as in Petersburg, halibut and sablefish account for 51% and 33% of the value of landings. Salmon accounts for only 15% of the ex-vessel value. The risk indicator value for pounds landed is 3.02, while the risk indicator value for ex-vessel value is 2.57. Obviously, the second indicator score is depressed by the disproportionate role that halibut and sablefish play in the value of Seward's landings. It is important to note the distinct lack of diversity in the species landed in Seward. While salmon, halibut, and sablefish are landed in high numbers in Seward, they represent over 95% of the landings by weight. This lack of diversity in fisheries could indicate a source of vulnerability that is not captured in the other indicators.

Seward is considered a highly vulnerable fishing community. It entirely lacks any indicators that fall into the low category, and is weighed down by a high unemployment rate. Its economy is moderately diverse, but it barely has a fleet, and holds the least permits out of the five communities. In terms of value, of the three species it relies on, two have low productivity scores, indicating a higher risk from climate variability. The crew capacity is lacking, as is the education capacity for the community.

The other three communities

Cordova is a community of 2,434 people located on the southeastern end of Prince William Sound and the western edge of the Copper River. The Alutiiq people first inhabited the area, and in the late 1880s copper miners began to arrive. The city of Cordova was formed in 1909 as a port from which to ship copper ore from the Kennecott Mine on the Copper River, which shut down in 1938. Since then, commercial fishing has been the economic base of Cordova (Sepez et al. 2005). In 1989, the *Exxon Valdez* oil spill hit Bligh Reef, approximately 45 miles from Cordova, causing widespread ecological damage and shutting down the commercial fisheries in the area. Salmon fisheries largely recovered, but the herring fishery has only seen six seasons since 1989 (CFEC 2009). Under this typology, Cordova should be considered a moderately vulnerable community. The vulnerabilities Cordova faces derive from the heavy reliance on a single species (salmon), little diversity in the Cordova fleet, and older permit holders. Cordova is buoyed by a lower unemployment rate than the state rate, and a relatively diverse economy.

Petersburg is a community of 3,224 people located in southeast Alaska on Mitkof Island, at the confluence of the Wrangell narrows and Frederick Sound. Once used as a summer fish camp by Tlingit Indians, this area became a homestead for Peter Buschmann, a Norwegian immigrant and pioneer. In 1910, the city of Petersburg was formed, and since then commercial fishing has been an important, if not dominant, part of the Petersburg economy and Petersburg is one of Alaska's major fishing communities (Sepez et al. 2005). Petersburg is a moderately vulnerable community. Most indicators register as contributing to moderate or high vulnerability. While the unemployment is high relative to the state rate, and the resource base is low per person, the Petersburg economy and fleet are moderately diverse. However, the education capacity is low, and the average age of the permit holders is nearly fifty.

Sitka is a community of 8,835 people located in southeast Alaska, on the west coast of Baranof Island. It is on the shore of Sitka Sound, which opens into the North Pacific. The original inhabitants of the area were Tlingit Indians. The Russian Bering expedition established a trading post and fort there, and by 1808 Sitka was the capital of Russian Alaska. Sitka remained the capital of the Alaska Territory until 1906 (Sepez et al. 2005). Contemporary Sitka has a relatively diverse economy, with only retail trade and educational, health, and social services each exceeding 10% of the workforce (U.S. Census Bureau 2000). Overall, Sitka is a moderately vulnerable fishing community. However, it has some advantages that other communities do not. For one, it has a high education capacity, with nearly 40% of its population having received a post-secondary degree. Second, it boasts a fisheries species mix that is less vulnerable overall, as 34% of the mix is herring, a highly productive species.

Discussion

This preliminary assessment demonstrates that each fishing community has varying amounts of social, economic, and natural capital in reserve from which to draw in order to adapt and cope. The distribution of capacity matters greatly when evaluating a community's vulnerability (Eriksen and Kelly 2007). In addition to use as a community evaluation tool, the assessment framework could be utilized on a regional basis to compare communities. Indicator-based studies allow for a process of measurement and comparability between communities that can be reliable (Jacob et al. 2010). The processes that create or destroy community capacity in one community could be examined for application in another community. However, the indicators developed and selected for this research are not without minor and major deficiencies. Specifically, as Yohe and Tol (2002 p. 26) state, "For most systems, though, climate change and variability over short periods of time fall within a "coping range"—a range of circumstances within which, by virtue of the underlying resilience of the system, significant consequences are not observed."

For the physical asset indicator, the variables used can provide a rough indication of whether a community's fleet is diverse or specialized, aging or young, or somewhere in the middle. The composition of the fleet of boats may signal if and how resources are invested within the fishing industry. However, it is difficult to compare the composition of fleets across communities because each fleet develops around specific fisheries in different geographies. For open water fishing, one tendency is to develop larger, more powerful boats. In sheltered waters, or for fisheries prosecuted exclusively during the calmer summer months, smaller boats will suffice. These indicators are not entirely sufficient tools to describe the level of this type of capital in each community. There are also several shortfalls inherent in the natural capital indicators. First, it is abundantly clear that environmental forcing is not the only factor driving these large marine ecosystems (Stram and Evans 2009). Fishing has a large effect on the resources and their habitat and environment. The effect of management, the reduction of apex predators, the role of market forces, or even fuel costs, all have an effect on the distribution and abundance of fish stocks and fisheries effort (Knapp et al. 2009). These factors and others make it extremely difficult to interpret the results of the natural capital risk indicators. Our interpretations are based on the assertion that life history attributes of different species indicate the potential for different adaptations and reactions to climate variability and change. Each species is uniquely impacted by climate in the long and short run. For example, fast-growing species—pollock, herring—are likely to experience shifts in abundance in a shorter time frame; the interannual variability of abundance of these species is high. On the whole, one of the largest drawbacks in the realm of indicator-based studies is that there is not sufficient sensitivity to the dynamism, texture, and multifaceted nature of communities. For example, consequences arising from the combination of income from natural capital and the other forms of capital are not taken into account in this framework. A positive increase in the abundance of the fisheries may induce further, unsustainable capital investments into the community's fleet, infrastructure, or other forms of economic capital. Furthermore, the labor force may become dependent on the fishing industry, while other areas of the community economy may underdevelop or even atrophy. Hence, these community indicators are likely not useful in identifying the processes that lead to vulnerability (Eriksen and Kelly 2007), rather merely the condition of the community and its capacity to adapt.

One possible resolution to this lack of sensitivity would be following or supplementing this assessment with a more in-depth approach. Should the assessment point to a community of high vulnerability, ethnography could play a role in defining the nature of the vulnerability facing the community. Although social indicator analysis can greatly enhance and streamline community profiling and social impact assessment in fisheries management, ethnography remains an important component in assuring the external validity of the social indicators (Jacob et al. 2010). In-depth ethnography should be conducted when specific communities are extraordinarily impacted by changes in fisheries regulations because the social indicators based on secondary data may be too insensitive to analyze rapidly or soon-to-change situations. Proxies developed in this assessment are precisely that: too insensitive to capture rapidly changing situations.

Yet by holding exposure and sensitivity constant, and looking at the levels of social, economic, and natural capital found in each community (using indicators built from existing data), this framework provides a quick, cost-effective, transparent "first-look" tool for assessing the capacity of fishing communities to adapt to climate change and variability. The simple graphic tool can be used to communicate results to decision makers and communities.

Conclusion

The effects of climate change are innumerable, and will have wide-ranging consequences on fishing communities in the north. Part of the vulnerability of fishing communities to climate change and variability results from the changing availability of the natural capital and part of it results from the community's capacity to absorb change and adapt to different circumstances. Alaska and the North Pacific are rich in natural resources and the projected disproportionate impact of climate change on the polar and subpolar regions justify increased attention to this area. Areas of high human interaction and incorporation within the natural landscape provide an important opportunity to learn more about human and natural system sensitivities to changes in climate conditions and thresholds for continued viability, including possible costs of and limits to adaptation (Rosenzweig and Wilbanks 2010). This study has been a small but helpful contribution to the vulnerability assessment project, currently under way worldwide but focused on the people and natural systems of less-developed countries as they are likely at a more vulnerable disposition from a lack of access to resources (Adger 1999). Further research should be done in Alaska that considers the "ecological, economic, and sociopolitical ramifications of climate change effects" (ADFG 2010 p. 15), not only for improved knowledge of the effects, but also because lessons in coping, adaptation, and capacity building may be transferable to other places around the world.

Acknowledgments

The authors acknowledge that this work was completed for a master's project several years ago. We recognize that there is a growing body of literature in this arena since this work was completed and that this paper does not include it. We do believe that this work adds to this body of literature in its own way and could be a practical resource for Alaska communities. The authors would also like to thank Michael Harte and Bryan Tilt for their critical thinking and unending support.

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Roots and Wings: The Need for Community Transition in the Age of Globalization

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Abstract

This article is about how our images shape our actions in the policy arena. We should entertain as many images as we can imagine, because alternative images give us more policy options. With globalization communities need to be imaginative. For challenges that relate to the protection of the environment, the conservation of marine ecosystems, to eradicating poverty, and to the development of local communities, we need more interdisciplinarity and multi-disciplinarity. We tend to insist on disciplinary boundaries, and thus we do not do communities and policy-makers the service they deserve. Communities and policy-makers have to confront real dilemmas and make hard choices where they cannot always be sure of consequences. They must, as well as they can, strive to find a balance between the policy implications of contradicting perspectives. This is the essence of governance. Governance is the kind of conduct that requires open-mindedness to different perspectives, the willingness to learn from both real world experience and from analytical thinking. The governance of fisheries needs the alternative images that the disciplines of global academia employ, because they would help them see the choices they have to make in a sharper light.

Introduction

During the summer of 2011 one of our national TV channels put cameras onboard the costal steamer *Hurtigruten*, and followed the vessel on a weeklong voyage from Bergen to Kirkenes. The voyage was filmed nonstop with hardly any narration added, and it broke the Guinness World Record for the longest TV program ever. You would think it would be boring. Yet no other TV program in Norway has received such a large number of viewers.

The program was an eye-opener to a lot of Norwegians both in a literal and a figurative sense. An 85 year old man who was interviewed said it was the most wonderful TV program he had ever seen and that he hadn't slept for the whole week. The program provided viewers with a constant flow of images of wonderful natural landscapes in real time as the ship was passing by. They could also observe vibrant communities, where the boat stopped and loaded and unloaded passengers and cargo, and where local people showed up on the wharf with their music and art.

For a few weeks that summer, it was what we talked about. The program brought us into such a good mood—until a hideous thing happened in Oslo and on the island Utøya on July 22. A terrorist killed 77 people and shattered everything. Within a few hours, the image we had of ourselves as a country and a nation brutally changed, probably forever.

What images do

This paper is about our images of the coast, the fishing industry and the fishing community, and what they do to us and what we are because of them. To start with, a few words about what I mean by images: Images are what we read into what we see. They allow us to recognize what we observe. They turn an observable object or event into something that we have an idea of already. Images have consequences for what we do in the real world. When sociologists argue this point they often refer to the so-called Thomas theorem, which states, "If men define situations as real, they are real in their consequences." It is for these reasons that images often turn into self-fulfilling prophesies—as Robert Merton (1948) talked about.

Therefore, governance theorists—and I consider myself one of them—argue that our images should be made explicit. They should not be taken for granted as true representations of the world. They are our own mental constructs, and it is always possible to look at things in different ways. For instance, my colleague Bonnie McCay has argued (McCay 1996) that we should not necessarily look at the resource commons as something that would inevitably turn into a tragedy, as Garrett Hardin (1968) phrased it. What if we looked at the commons as a comedy—to use another ancient theatrical plot as a metaphor? The implication for how we think about overfishing and how we deal with it would be very different if we shift the image from tragedy to comedy. The way one chooses to interpret the imagery is critical to how the situation is perceived and what its meaning is.

I shall run you through a number of similar images about the coast and the community. The argument is the same: it matters how we look at it, regarding how we think about the coast and the community and what policy implications we draw.

Fisheries as a sector or community?

In 1966 Ottar Brox, a now grand old man in Norwegian social science, published a book titled *What Happens in North Norway?* This book came to change the way we view the fishing industry, and indeed our perspective on this region as a whole. At that time, North Norway was more rural than it is today. People typically made a living from combining small-scale fishing with small-scale farming in a household subsistence–oriented economy. The government, however, had their eye on the GDP (gross domestic product). They were concerned about the relative contribution of North Norway to the overall national economy. When compared to other regions, North Norway did not produce as the size of the population would suggest. For the government the answer was industrialization of the fishery and as well as urbanization. The government believed that they would do a favor for the people and the region by helping them move out of scattered fishing communities and into better paid jobs in cities.

Troubled by this policy and what it did to his home fishing community, Brox argued that the government needed a new paradigm. He argued that rather than thinking of North Norway as made up of industries and sectors, they should look at the region as an aggregate of local communities. Instead of moving people out, the government should assist people in creating their own employment. Government should concentrate on improving the conditions on which people made their own choice regarding where to live and what to do. It should support the industry via their communities rather than support the industry directly.

Ottar Brox has for many decades been a prominent figure in public debate in Norway. His story is a good illustration of the case I am trying to make here about images: if you side with the community perspective, Brox is a hero—and he has numerous followers in coastal Norway as well as in the academic community. He is indeed also my hero. But if you look at him from the sector perspective, which leaders in the fishing industry and in government tend to do, he appears to be a hopeless romantic.

The fishing community as an interdependent or a functional system

I have borrowed this conceptual distinction from the French sociologist Raymond Boudon (1981). The "interdependent system" is characterized by competition. Here, people are basically in each other's way. Their relationships do not go very deep. Think of a bus queue, for instance, where a bunch of strangers show up, hoping to get in first to find the best seat. But if everyone tries to be first, chaos and conflict are inevitable. The kind of social system that Garrett Hardin had in mind is obviously such a system. The tragedy of the commons is bound to occur in an interdependent system.

Then consider what Boudon calls a "functional system." Examples would be a business enterprise, a family household, or a soccer team. These are social systems characterized by organization and division of labor where people are members with roles and responsibilities. Here people need to cooperate to realize their goals. The better they know and trust each other, the easier it is for them to do so.

Now, how about a fishing community? What kind of system is it? Is it like a bus queue or a soccer team? In reality it is of course a little bit of both. But let us again, for the sake of argument about images, assume that they are either/or and then think about the policy implications:

If the fishing community is like a bus queue, people are just in each other's way. They do not need each other. The fewer they are the better, as there would be fewer people who have to share the same space and the same resources. Reducing the number of people employed in the fishery can then only be good. For those who remain, the money they bring home will increase. You expect that the community will become increasingly secure; a consolidation process will occur until it has reached equilibrium.

Then think of the fishing community as functional system or as a soccer team: here people rely on each other and therefore have to cooperate. A loss of members would therefore be a problem, as when one player of a soccer team is expelled and the remaining players must carry his task. In the community, a reduction of people will break up social relationships, the social fabric of the community will start to evaporate, and a domino effect may cause the community to collapse. Imagine the community as a fish net, where the knots are people and the threads are social relationships. Then remove one knot, and it leaves a much bigger hole than just the size of the knot. The policy implications of considering the community as one or the other system should come out pretty clear.

Coastal culture as implication or premise

My next concern is the relationship between sustainable fisheries and sustainable communities. What comes first? What is cause and what is outcome? Does the arrow go from a healthy resource to healthy communities, or does it go in the other way? Again, the policy implications of imagining one or the other are profound. This is why:

If you assume that everything must start with the ecosystem, you would tend to believe that as long as you sustain the resource, everything will be fine. Therefore you would need to focus only on the first variable in this causal chain, and the others would follow suit. You do not need to care about coastal communities, as they will take care of themselves provided there is enough fish. Fisheries governance then can be reduced to fisheries resource management and forget about the rest.

Not so if the mechanism works the other way—if community and culture is the premise rather than the outcome. Then one would need to target the community and nurture coastal culture directly, before you can expect to achieve a healthy marine ecosystem. In fact, securing the community will be a necessary condition for securing the ecosystem. How could that be?

In September 2011, I attended a meeting of fishers in Cape Town, South Africa. In debate, a fisher leader stated, “We have two big problems in our fishery: poaching and dysfunctional communities.” He offered many personal observations to explain how the two are related.

Other fishers who spoke up at the meeting attributed the erosion of community and the extensive poaching that was going on to the way fisheries management works in South Africa, especially how rights have been allocated through the institution of the ITQ system (individual transferable quota). “We are no longer the brothers and sisters we used to be. Now we are happy to get rid of each other.” I have often heard similar sentiments expressed by Norwegian fishers about our quota system. The management system, apparently, has transformed the community from a functional to an interdependent system, from a soccer team into a bus queue.

I once gave a talk about these things in the Faroe Islands. There they have a tradition that when people gather on festive occasions, they entertain themselves with what they call the chain dance. The dance is inclusive, everyone is participating. While holding on to each other as they turn, they sing ancient, rhythmic chants, handed down through generations. A song may have more than a hundred verses, typically of a moral content. The lead singer is characteristically called “skipper.” Only the voices and the feet are heard. For participants the dance is exhilarating. It creates a sense of togetherness. As described on a website: “You have to participate, and when it is at its best the chain melts together and you feel a part of something vast.” (http://www.

faroeislands.com/Default.aspx?pageid=9709). The chain dance is to me a beautiful image of a healthy, well-integrated community (http://www.youtube.com/watch?v=wgFa0JJYM0s).

What I dared to say in my talk was, "If you want to secure a healthy fishery, you'd better make sure that you keep up the chain dance tradition." I did not suggest that there is a direct link, only that there is an indirect one. This brings me to my final question: Is globalization good or bad for such cultural traditions in local communities? Will it kill the chain dance? Will people start behaving as in a bus queue?

Globalization as a curse or a blessing?

It would be bad if globalization makes people confused about where they belong and who they are as a community. Neither can it be healthy if the Internet becomes the only place where our children find their sense of morality and community. But is everything about globalization necessarily bad? Can globalization be the wake-up call that fishing communities need?

We obviously need the roots that community provides. We need robust communities that instill in people a solid identity. We also need communities for the permanence and stability they provide. Communities help us stay sane. But we are also dependent on the wings that globalization both grants and requires. We enjoy the modernity and freedom that follow from it. Globalization brings prosperity, science, new technology, cultural exchange. Globalization has brought us human rights, which is now an issue in the debate on how to secure small-scale fisher folk and indigenous peoples globally. Globalization also gave us the Food and Agriculture (FAO) Code of Conduct for responsible fisheries.

Thus, our conclusion must be that we need both community and globalization. One without the other is not a good idea. If you have read Thomas Friedman's *The Lexus and the Olive Tree* (2000) you will be familiar with this argument, the former representing modernity and globalization and the latter tradition and community.

It is a misconception to assume that there is something inherently backward in local communities and in small fisheries. With globalization small-scale fishers can be extremely sophisticated in the way they operate, and how they produce, communicate, and serve markets.

There is hardly any better expression of globalization than mobile phones. In South Africa I learned that small-scale fishers, who are deprived in many ways, are using the mobile phone to access market information. I also learned that they are using them to warn each other off when they see the fisheries inspection coming, which is a good illustration of the ambivalence that comes with globalization. It can be good and bad at the same time in a way that challenges our social values and ethics. I suggest that we now make this into a research issue. How can communities become more competent and proactive in the global world without losing their ability to provide their members with a moral footing, sense of belonging, of home? How can communities turn the threats of globalization into opportunities?

Conclusion

This article is not about fisheries communities per se, but how we think about them. Most of all it is about the consequences of our images—how our images shape our actions in the policy arena.

I argue that we should not stick to just one image, but that we should be willing to entertain as many images as we can imagine, because alternative images give us more policy options. With globalization communities need to be imaginative. But switching between images is never easy, as it tends to make us confused. Images are not right or wrong, only more or less useful. You may remember a well-known drawing—if you look at it in one way can see an old woman, and if you look at it in another way you see a young woman. If you try to see the old and the young woman at the same time, it is simply impossible. And no matter how hard you strive, you will not be able to identify a middle-aged woman. You therefore have to imagine the young and the old one at a time.

Do we then have to choose between the contrasting pairs of images of community that I have discussed here? Would it be impossible to see them all at once? Or could it be that if we only look hard enough, we would be able to see the community as something we have not seen before?

From an analytical point of view, we may have to look at fisheries communities first in one way, and then in another way. It is partly for these reasons that science has been divided into disciplines. When economists look at communities (which they rarely do) they see the bus queue, while sociologists and anthropologists see the chain dance. But disciplinary perspectives are too narrow for the real world. That is also why it can be dangerous to let academics loose in it. They cannot as easily make the same argument in the real world as they make in the classroom.

For those challenges that relate to the protection of the environment, the conservation of marine ecosystems, to eradicating poverty, and to the development of fishing communities, we need more interdisciplinarity. But if we cannot obtain that for the reasons illustrated with the image of the two women, we should at least encourage multidisciplinarity, and then try to harmonize policy initiatives.

In any case, we should all strive harder to know each other's images, because it will make us understand where we come from when we argue things. For that we must talk across disciplinary boundaries more so that we do today. This is not only possible but also worthwhile. Speaking from my own experience, I have not become a biologist from working with biologists, but I think it has made me a better sociologist. I can only hope that it has worked in the same way for those biologists.

Since we tend to insist on disciplinary boundaries, we do not do communities and policy-makers the service they deserve, because they cannot afford to lock themselves into the tunnel vision of disciplines. Communities and policy-makers have to confront real dilemmas and make hard choices where they cannot always be sure of consequences. They must, as well as they can, strive to find a balance between the policy implications of contradicting images.

This, I hold, is the essence of governance. Governance is the kind of conduct that requires open-mindedness to different images, the willingness to learn from both real world experience and from analytical thinking. The governance of fisheries needs the alternative images that the disciplines of global academia employ, because they would help them see the choices they have to make in a sharper light. And that can only be a good thing.

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Changes in the Distribution of Alaska's Commercial Fisheries Entry Permits

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Abstract

A brief overview of changes in the distribution of permanent entry permits in Alaska's limited fisheries is provided in this article. From 1975 to 2010, 79 permit types were issued in 65 fisheries. This article gives statewide data and some fishery-specific data on the number of permit transfers, geographic distribution of permit holders, changes due to permit transfers, changes due to the relocation of permit holders, and the 2010 year-end geographic distribution of permit holders.

Introduction

Alaska entered statehood in 1959 at a time when salmon stocks were struggling due to overfishing. The Alaska Department of Fish and Game (ADFG) strove, with some success, to employ management strategies that allowed for long-term sustainability of Alaska's fishery resources. However, the efforts were not viewed as sufficient to ensure that commercial fishing Alaskans could continue to enjoy a fishing lifestyle and continued economic benefits. In 1972, the Alaskan people amended the state constitution allowing for limited entry. Limited entry in Alaska is a system that requires permits to fish, and in some fisheries such as salmon, allows only a certain number of permits to ensure both sustainability of the fish population and preservation of economic health of the fishery. The following year, the Limited Entry Act was passed, establishing the Commercial Fisheries Entry Commission (CFEC). CFEC is a standalone entity with regulatory authority separated from the administratively attached ADFG. CFEC has approximately 30 employees.

Table 1. Limited permit types.

Year of limitation	Permit types	Cumulative total
1975	19	19
1976	6	25
1977-78	4	29
1980-87	16	45
1988-91	6	51
1997	7	58
1998	10	68
1999-2002	8	76
2004	2	78

Employees include three commissioners, supporting administrative and legal staff, and four units: adjudications, licensing, information technology, and research staff.

If a fishing person of the north wants the privilege to legally fish in Alaska, he or she will need a CFEC permit. While the majority of permits are not limited, over the years many have been (see Table 1). In 1975 the first limitation of 19 salmon fisheries occurred. When fisheries are limited, only a specific set of permits are issued, the majority of which are transferable. Transferable permits allow family members to maintain access to traditional fisheries when permit holders choose to keep the permits in the family. The Alaska Legislature felt this was important; therefore the transferable feature of permits was selected among alternative reallocation approaches. Permits are issued to individuals and are required to be onboard during fishing activities, and leasing of permits is illegal; these two features ensure that fishing activities are not conducted by absentee permit holders. Permits are issued for a specific species, gear type, and geographic region. In some cases the permits specify, along with their type, a specific level of fishing capacity.

The CFEC Research Unit frequently receives requests to query their data sets. One place to find data to better understand who is participating in Alaska's limited fisheries is the CFEC annual publication, *Changes in the Distribution of Alaska's Commercial Fisheries Entry Permits* (Homan 2007, Gho et al. 2011). This publication is more commonly known as the "Transfer Study." The Transfer Study has been produced most years since 1981. There have been a few updates, which first appear in the 2009 and 2010 editions. Some of the updates include PDF bookmarks to quickly navigate the documents, and the online 2010 version includes

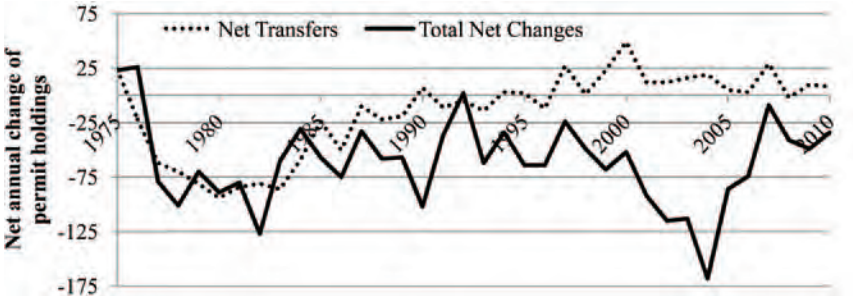

Figure 1. Net annual change in Alaska Rural Local permit holdings overall, and changes due to transfers.

tables in Excel. Data in the Transfer Study publication refer to cumulative results, and it contains a wealth of data presented in time series as well.

Fishing participation requires an abundant amount of recordkeeping by the Alaska Department of Fish and Game. CFEC conducts data sharing with ADFG, which means that CFEC has a wealth of information to draw from to evaluate fishery management outcomes. These data, along with the CFEC proprietary permit file and the federal census data, are used to generate the tables in the Transfer Study. The most recent edition of the Transfer Study includes 38 tables that fill more than 300 pages, plus an executive summary. All of the data in this article are from the Transfer Study.

Residency

The CFEC Research Unit is frequently asked to provide statistics relating to the residency of permit holders. The five most common subcategories used to describe residency status of permit holders are combinations of rural/urban, local/nonlocal, and nonresident. For example, an Alaska Rural Nonlocal would be a permit holder from Kotzebue who fishes in Bristol Bay, and an Alaska Urban Nonlocal might be somebody from Anchorage who fishes in Kodiak.

The residency distribution of permits may change in three ways: permits may be transferred from one person to another; permit holders may change their domicile; or permits may be canceled or removed by CFEC. CFEC is commonly asked questions concerning the distribution of permits held by Alaska Rural Locals. There has been an outflow of permits from Alaska Rural Locals. The black line in Fig. 1 depicts the sum of net changes each year since 1975.

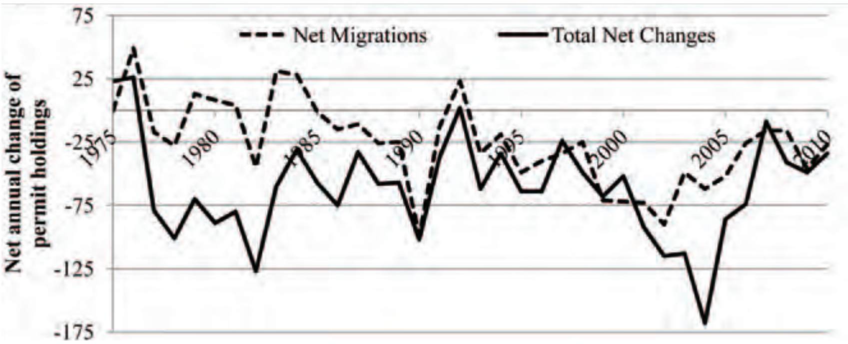

Figure 2. Net annual change in Alaska Rural Local permit holdings due to migration.

Transferred permits contribute to changes in holdings by Alaska Rural Locals as depicted in Fig. 1. The dotted line represents net changes to Alaska Rural Local permit holdings due to transfers. Transferred permits include permits that are sold, inherited, or given away; transfers between family members are frequently gifted. From the late 1970s until the late 1990s many permits were transferred out of the hands of Alaska Rural Locals, but beginning with the late 1990s the net transfers of permits shifted toward Alaska Rural Locals.

Another way permit distribution may change is through migration, as described by the dotted line in Fig. 2. Migration of permit holders occurs when permit holders change their domicile to a different community. An example would be when a Bristol Bay permit holder from Togiak moves to Anchorage; the status of their permit would change from Alaska Rural Local to Alaska Urban Nonlocal. As shown in Fig. 2, migration has had an important effect on Alaska Rural Local permits with a total net loss of permits in the majority of years since 1975. Overall, migration has had a greater influence on the change in distribution of permits held by Alaska Rural Locals than transfers have.

The third redistribution of permits from Alaska Rural Local status is administrative in nature (Fig. 3). Canceled permits typically occur on permits that were issued as nontransferable; these permits are relinquished upon the death of the permit holder, or when the permit holder decides not to renew the permit. Small numbers of other cancellations occur due to criminal actions, administrative or judicial procedures, or voluntary relinquishments. Cancellations of renewable permits are most often offset by reinstated permits in the same year of cancellation with only a very small number transferring in the subsequent year.

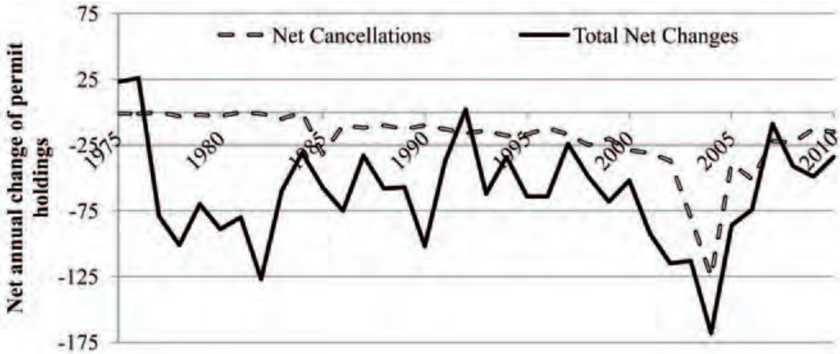

Figure 3. Net annual change in Alaska Rural Local permit holdings due to cancellation.

The overall net change in the distribution of Alaska Rural Local permits from 1975 through 2010 is a decline of 2,203 permits, representing 29% of the permits originally issued to this group. As mentioned earlier, this includes the net effects of transfers, migrations, and cancellations.

Rates of change for individual permit types vary from the overall totals. Presented in Fig. 4 are movements of Alaska Rural Local permit holders due to transfers in two of the salmon permits. Locally held rural permits in the Bristol Bay Set Gillnet permit type saw an exodus due to permit sales, most notably in the 1970s and 1980s. On the other hand, Alaska Rural Locals of these permit types have purchased more permits than they sold in the last decade.

Age of permit holders

The Transfer Study provides statistics on the age of permit holders. The black line in Fig. 5 depicts the mean age of all limited CFEC permit holders from 1975 to present. If no permit holders transferred away their permits, then the average age would have naturally incremented by one each year. If permit holders transferred their permits to individuals older than themselves, the average annual increase would be greater than one. As permits are transferred to a younger generation, the average age decreases in proportion to the age gap of the transfer recipients. This graph takes all three actions into account.

It is often more interesting to look at the extremes; Fig. 5 describes two such examples. Among the greatest rate of increase in age is that of permit holders in the Southeast Urchin Dive fishery. Each year the permit holder average age augments 0.69 due to

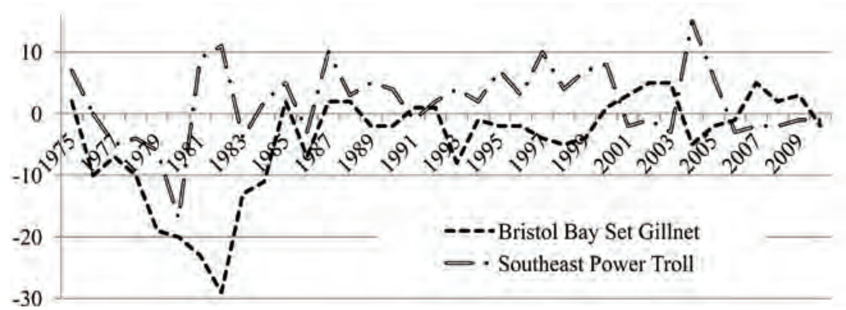

Figure 4. Changes in Alaska Rural Local holdings in two salmon permit fisheries due to transfers.

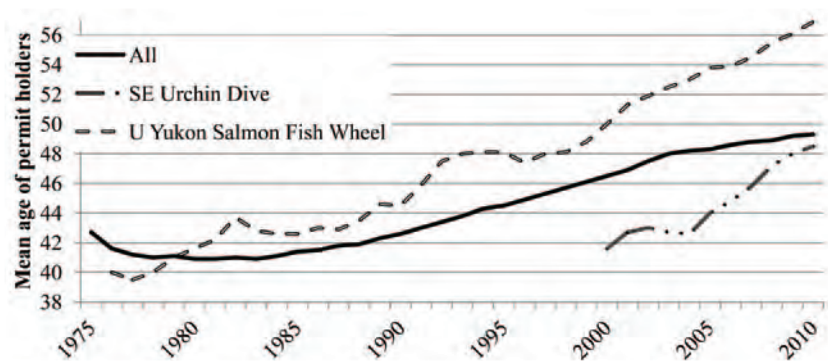

Figure 5. Black line shows mean age of all limited CFEC permit holders from 1975 to present. Dashed line shows two extreme average age increases in permit holders. SE = Southeast U = Upper.

transfers to permit holders (6.9 years in one decade). The Upper Yukon Salmon Fish Wheel permit holder average age have increased just under half at 0.497 per year, but in terms of absolute value over 34 years of limitation the average permit holder has aged 16.9 years. The Southeast Urchin Dive fishery has not been limited for as long as the Upper Yukon Salmon Fish Wheel, hence the shorter line.

Although not as common, some permit holders are consistently transferring to younger fishers (see Fig. 6). For example, the Prince William Sound Sablefish Fixed 35 foot has the smallest rate of change at negative 0.217, aging negative 2.6 years over 12 years. Southeast Red,

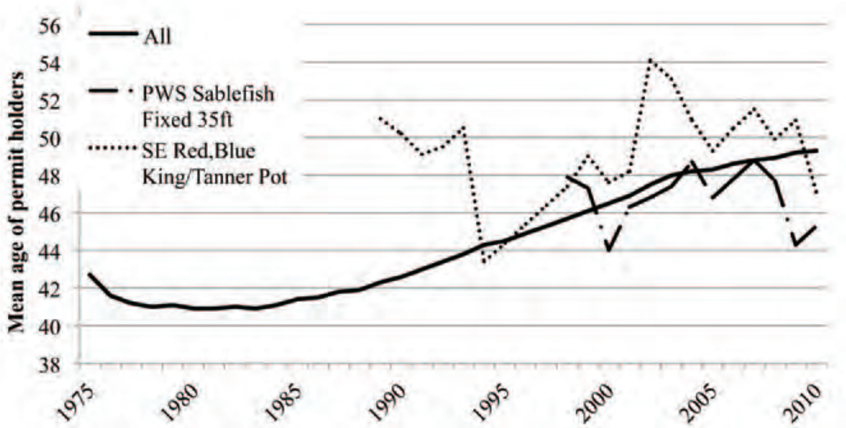

Figure 6. Extreme average age decreases in permit holders. PWS = Prince William Sound; SE = Southeast.

Blue King/Tanner Pot has a negative 3.9 years in just over two decades (21 years), which is a rate of negative 0.19.

Transfer recipient relationships

When permit holders transfer their permits, to whom are the permits going? Data from the Transfer Study can be depicted longitudinally in terms of transfer recipients. When CFEC was crafted by the Alaska Legislature, the crafters wanted to allow fishing people the ability to transfer permits to other family members to support the concept of fishing families; therefore transfers could occur as gifts or inheritances. Since 1980, CFEC has required a survey to be completed for each transfer. These surveys provide information such as the relationship of the transferor and recipient, the value placed on permit sales, the reasons for transfer, etc. About two in five transfers are between family members for all permits transferred since 1980 (see Fig. 7)

The Transfer Study provides transfer data by permit fishery type, a few of which are presented in Fig. 8. Statewide, there were 30,794 transactions with surveys by the end of 2010. The Bristol Bay Salmon Drift permit has the highest count of transactions, roughly one in seven of all transfers, with distributions comparable to statewide distributions. Some permit types differ, for example the Southeast Geoduck Dive permit has a high number of transfer recipients in the "Other" (no prior relationship) category. On a side note, other research I've conducted suggests this fishery exhibits a high level of seasonality in permit sale

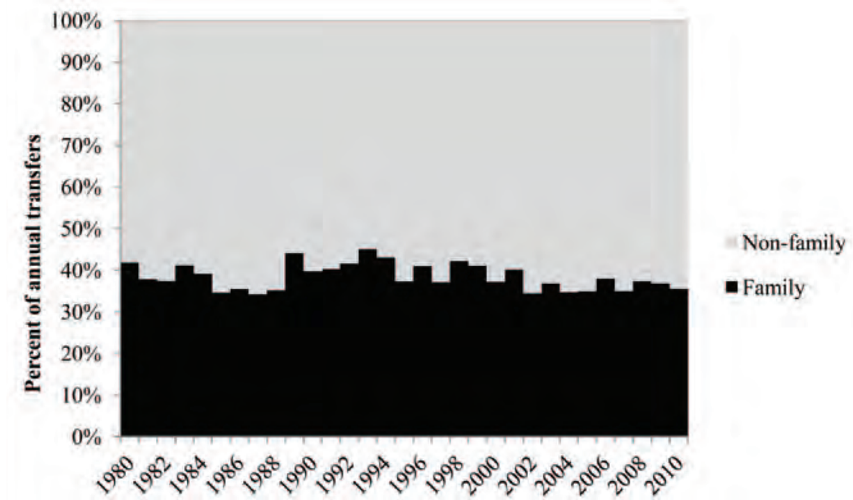

Figure 7. Relationship of permit transferor and permit transfer recipient.

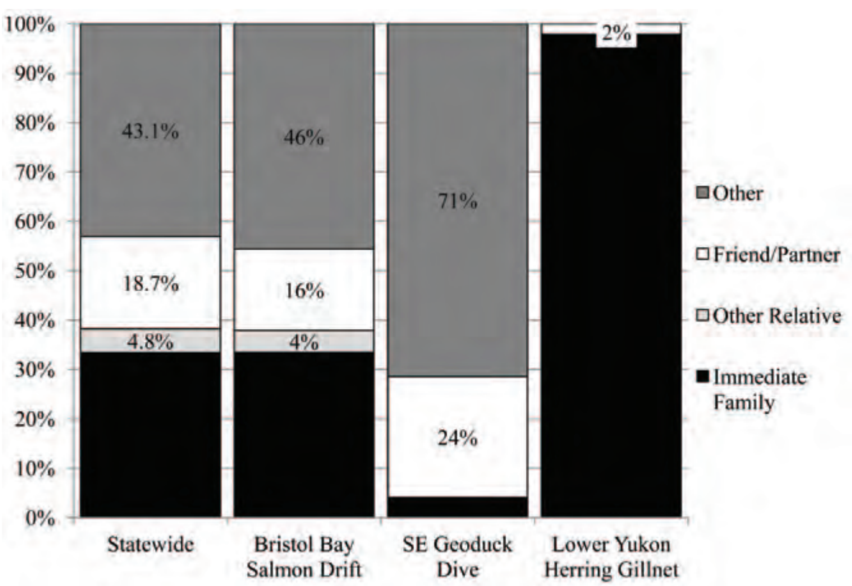

Figure 8. Relationship of permit transferor and permit transfer recipient in specific permit fisheries, 1980-2010. SE = Southeast.

prices, which likely is a corollary of arms-length transactions to strangers. The Lower Yukon Herring Gillnet permit is of a completely different culture: almost every single transfer was to an immediate family member.

In conclusion, the Transfer Study contains a comprehensive repository of information regarding permit holdings of many fishing people of the north. The tables therein describe initial allocation and redistribution of permits to commercial fishing people of Alaska for limited entry permits.

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The Recruitment Paradox: Recruitment to the Norwegian Fishing Fleet

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Abstract

A frequently discussed question in Norwegian fisheries and fisheries media is whether the Norwegian fishing fleet has a recruitment problem. Recruitment of fishers to the fleet has been deemed to be the main future challenge for the Norwegian fishing fleet. However, there are also reports of successful recruitment and few vessel owners seem to be actually facing recruitment problems. Stories told about recruitment and experiences with recruitment do not correspond. Rather than discussing who is correct, I explore the phenomenon of recruitment through discourse analysis. Given the controversies that surround fleet recruitment, are fisheries stakeholders talking about the same phenomenon? If not, then what is recruitment? And what are the consequences of stakeholders viewing and arguing for different versions of recruitment?

Introduction

The Lofoten fishery for spring spawning northeast arctic cod has for centuries been one of the main fisheries in Norway. The community of Henningsvær has for an equally long time been a central fishing village to this fishery, and for centuries the village would be bustling with life during the Lofoten season (Fig. 1).

Due to technological developments, introduction of resource management, and general societal changes, Norwegian fisheries have undergone tremendous changes. One effect of these developments has been a significant decline in the number of fishers. From 1950 to 2010, the number of fishers declined from 68,000 to 10,000 (DoF 2012).

Figure 1. Large number of relatively simple fishing vessels in Henningsvær port, spring 1951. (Sverre A. Borretzen/Aktuell/SCANPIX)

Similarly, participation in the Lofoten fisheries declined from 20,000 in the early 1950s to 4,000 by the turn of the millennium (illustrated by Fig. 2) (SSB 2000).

This trend of decline and its effects on the fishing fleet and coastal communities is heavily debated (Kyst og Fjord 2011). Even after years of reducing participation in the fleet, catch capacity has not been reduced proportionally, and fisheries authorities and organizations agree: there are still too many fishers (WP No. 51 1997-98). At the same time, and in seeming contradiction, there is a general consensus that the fleet has a recruitment problem, as fewer young people are choosing to make a career in fishing and the average age of the fisher is increasing. Thus, there are too many fishers but there are also too few. Sønvisen et al. (2011) termed this the Recruitment Paradox, but they did not elaborate on what this paradox actually entailed. This paper therefore asks: what characterizes the Recruitment Paradox? And what are the policy implications of the Recruitment Paradox?

Even though this paper is set in the Norwegian context, the developments are not unique to Norwegian fisheries—similar developments and debates are taking place across the North Atlantic and North Pacific

Figure 2. Fewer, but more technologically advanced, fishing vessels in Henningsvær port, spring 2011. (Vidar Lysvold)

(Free-Sloan 2004, McDowell Group 2006, Johnsen et al. 2009, Lindsay 2009). In the following section, the theoretical framework, methodology, and data are outlined. This section is followed by the development of the recruitment discourse from the 1950s to 2011, with an emphasis on the period after 1990. In the fourth section, I discuss recruitment challenges after 2000, as well as policy instruments and their implications. This is followed by a brief conclusion.

Theoretical framework, method, and data: recruitment as a discursive object

Recruitment has different meanings. One interpretation, closely related to biology, defines recruitment as "the process of adding new individuals to a population…" (www.merriam-webster.com). Another definition, related to business, describes recruitment as "the process of identifying and hiring the best-qualified candidate…" (www.businessdictionary.com). In this paper, however, recruitment is also something more: it includes the social process preceding an occupational choice (socialization), as well as formal and informal transfer of knowledge. Thus, recruitment may be explained by economic rational behavior, but may also be explained by socially motivated choices within a structure, such as social relations, cooperation, and community (Jentoft and Wadel 1984).

This paper is situated within relational sociology of Actor-Network Theory (ANT). In this perspective, the social network consists of dynamic, heterogeneous networks of relations, which define actors and how actors in a system perform (Law 2000, Latour 2005). The framework of ANT is combined with discourse analysis. Discourse analysis in this context focuses on how actors ally to forward similar interests and how language distributes power (Næss 2003, Latour 2005, Hajer 2012). In terms of recruitment, actors within a social network share similar representations and versions of recruitment and agree on the definition of recruitment and the solutions to the recruitment problem (Mol 2002).

The data material is mainly qualitative, but stems from both secondary and primary sources. White Papers and Green Papers have been crucial documents in this analysis. These are used as anchoring points in the discourse analysis, as they precede policy and include hearings. The Norwegian government publishes declarations (White Papers) about fisheries politics at regular intervals for four to six year periods. These White Papers are ideological and political documents and are not legally binding. In addition, the government produces legally binding Green Papers, which are the basis for laws or for amendments to laws. These documents give a good overview of the debate; all of the White and Green Papers relevant to the employment and recruitment discourse in the period have been included in this study. Along with these government papers, information from newspapers, the Internet, blogs, minutes from meetings, and other sources were used. These were sampled through continuous monitoring of the debate on Norwegian fisheries and recruitment and they are considered in relation to the White and Green Papers.

Primary data were also used. Between May 2010 and June 2011, a total of 31 in-depth, unstructured interviews with 46 fishers (crew and vessel owners) in a number of sites along the Norwegian coast, from Måløy in the south to Båtsfjord in the north, were carried out. The interviews were open-ended questions and interviewees were asked to describe how they were recruited, how recruitment takes place locally, and how changing fisheries operations and structures affect local recruitment.

The main focus of this article is fleet recruitment, but recruitment is a complex and political object closely tied to equally complex and political issues such as employment, settlement, business politics, and regional politics. Thus, it has been necessary to also include these issues in the analysis, with regard to their interactions with the recruitment discourse.

Controversies were followed in the texts (Latour 2005) and the interviews and information was analyzed by looking at controversies and repetition of representations in the discourse (Mol 2002). The practical discourse–analytical approach was three dimensional (inspired by Woodak 2007 and Hajer 2012). First, the different representations of the recruitment discourse were identified, sorted chronologically, and categorized. Second, the supportive actors' discursive strategies were explored, to examine what arguments were carried by whom. And third, as every contemporary discourse is embedded in a context and a history (Woodak 2007), contextual analysis and historical descriptions were included. Hence, although the focus of this paper is on the period since 1990, account of the discourse since the 1950s is given. These descriptions, however, are not intended to be explanations; rather, they are the framework in which the present discourse has unfolded. Thus, through Actor-Network Theory and discourse analysis, I explore the Norwegian fleet's recruitment discourse and the Recruitment Paradox.

The recruitment discourse and its sub-discourses

The following section presents the development of the recruitment discourse. Two sub-discourses were identified: the profitability discourse and the community discourse. The development of the two sub-discourses are presented separately and chronologically.

The profitability discourse

The profitability discourse was identified as early as the 1950s. In short, it argues that there are too many participants in the fishing fleet, causing low profitability, low wages, low rate of fleet renewal, and problems recruiting fishers—particularly fishers who are in demand. Although the instruments applied to secure satisfactory recruitment have changed over time, reduced participation and improved profitability always have been seen as the main solutions.

After World War II, too many fishers in the Norwegian fishing fleet resulted in low profits, and reduction in fleet employment became an explicit political objective (Holm and Johnsen 1990). The policies were effective. The number of fishers declined, but this drop was accompanied by the first reports of recruitment challenges. The solution offered to facilitate recruitment was a policy of improving profitability and reducing financial insecurity (WP No. 62 1953). As a result, the main aim of fisheries policies throughout the 1950s and 1960s was to improve living conditions for fishers and their families through rationalization. However, despite reduced participation, in the late 1960s the coastal fleet was still seen as being too big (Johnsen 2004).

At the end of the 1960s, the spring spawning herring stock collapsed, which resulted in the introduction of concessions in the purse seine fleet in 1973, and a shift in policy focus from the fisher to the fish. Resources became a limiting factor for fleet operations and employment

(Johnsen 2004). Although not directly linked to the profitability discourse, the solutions offered for resource conservation were the same as those offered for profitability improvements: reduced fleet capacity and participation. Hence, resource management proved to be an important ally in the profitability discourse.

The profitability discourse strengthened its position throughout the 1980s, as market economic thinking increasingly dominated politics (Hersoug 1983). As in the 1970s, the fisheries objectives were to maintain settlement patterns and secure jobs (WP No. 93 1982-83). However, whereas in the 1970s these objectives were to be secured through government intervention, in the 1980s they were to be the effects of a market-oriented, efficient and profitable fleet (WP No. 32 1989-90, WP No. 32 1990-91). This can be illustrated by a statement made by the fisheries authorities in the early 1980s (WP No. 93 1982-83:8):

> Secure jobs in the fisheries can in the long run only be achieved by the industry itself through profitable and efficient production…It must be stressed that the fishing industry can only partially contribute to maintaining the main settlement patterns.

So with market orientation, the fisheries sector was relieved of some of its social responsibilities. Meanwhile, the number of fishers continued to decline and the sector was still struggling with poor profitability. There was no apparent recruitment problem, but increased competition from the developing and better-paying petroleum industry led to reports of difficulties attracting qualified crew. Thus, recruitment changed from being purely about acquiring enough crew (quantity) to being also a matter of the qualifications of the recruits (quality). Moreover, to compete, the fleet had to offer competitive wages and work conditions, which in turn called for efficiency and profitability improvements (WP No. 93 1982-83).

Two developments in the early 1990s were to fundamentally change the fisheries and further strengthen the position of the profitability discourse: one was tied to resource conservation and the other to trade policies. First, low quotas and good catchability of northeast arctic cod caused the total quota to be caught by mid-April. A moratorium was put in place (Maurstad 2000). To further deal with overfishing and overcapacity, in the following year fishing rights and quotas were introduced (Johnsen 2005). This effectively reduced the number of fishers, as only those with a certain level of activity in the three preceding years were entitled to a fishing right (Grytås 1992, Maurstad 2000). Second, the Main Agreement was removed (1963). The Main Agreement was a framework agreement between the state and the fisheries regarding annual transfer payments (subsidies). Although the Main Agreement was intended to bring about rationalization and industrialization, it turned into an economic safety net for the fishers, limiting efficiency improvements and maintaining overcapacity (Holm 1995, Standal and Aarset 2002, WP No. 21 2006-2007). The Main Agreement also posed a challenge to international trade agreements, especially with the European Community (EC), which required its abandonment by the end of 1993 (Holm and Johnsen 1990, Holm 1995, Hersoug and Arbo 1997). The reduction in subsidies led to significant structural changes, paid for by the fishers, which also contributed to a decline in participation (Hersoug et al. 2000, WP No. 21 2006-2007).

Even though one-third of the fishers exited the fisheries throughout the 1990s (DoF 2012), the fleet was still seen as having overcapacity (WP No. 51 1997-98, WP No. 20 2002-2003). From an industry perspective, the sector did not have a recruitment problem. Rather, there were still too many actors. Moreover, due to reduced subsidies, the fisheries were no longer expected to be a main carrier of coastal employment and settlement (WP No. 58 1991-92). Fundamental changes in framework conditions called for fundamental changes in the sector. The solutions were rationalization and restructuring of the fleet.

In terms of labor, throughout the 1990s some fleet segments experienced intensified competition with other maritime sectors, particularly for specialized and certified workers (Moy 1996, WP No. 51 1997-98). Thus, it was more important than ever to be able to offer competitive wages and work conditions on modern vessels with high levels of comfort (WP No. 51 1997-98, Nakken 1999, WP No. 20 2002-2003). The fishers on the west coast were used as examples of success, since, according to Lindkvist (Grytås 1995), they

> … managed to restructure when the resources close to shore failed. They built larger boats [offshore trawlers and longline vessels], many with factories onboard. With modern technology, good income and attractive jobs, this fleet managed to recruit young fishers.

At this point, recruitment was increasingly tied to profitability. There were few hopes for increased quotas and overcapacity was still a problem, and there would be limited future demand for recruits (Johnsen 2004). The solution was, as called for by the majority of actors in the fisheries, further capacity reduction and fleet restructuring. A profitable fleet, it was argued, would keep the most qualified fishers and maintain settlement. As the leader of the Fishing Vessel Owners' Association stated (Bakken 1990):

> We have already lost some of the best fishers. They have moved to other countries and signed on other countries' vessels. Thus, coastal communities lose those that contribute to maintaining

> coastal settlement, namely the best fishers. This is done by distributing the fish quotas to as many fishers as possible.

The fisheries objectives in the new millennium were to create a future-oriented and attractive sector in which people along the coast would be willing to invest (WP No. 20 2002-2003). Reduction in fleet capacity, profitability improvements, and value creation were to secure coastal employment and settlement (Participation Act 1999). Because fleet capacity was still perceived as being too high in some segments, the restructuring policies of the 1990s were continued and further developed. Thus, a unit quota system[1] for the fleet over 28 meters was implemented in 2000, followed in 2003 by a structure quota system (SQS)[2] for vessels over 15 meters and a decommissioning scheme for vessels below 15 meters (MFCA 2002-2003). The SQS was expanded in 2006 to include vessels between 11 and 15 meters (WP No. 21 2006-2007). The majority of the stakeholders in the Norwegian fisheries sector supported the restructuring policies. Among those stakeholders were the Norwegian Fishermen's Association (NFA), Fishing Vessel Owners' Association (FVOA), the Directorate of Fisheries (DoF), Norwegian Seafood Federation, various financial and banking institutions, economists, and a number of municipalities and counties, both in the north and the south.

Due to increased labor competition, some supporters reported recruitment problems (NTB 2006). As the FVOA said (Fiskebåtrederen 2006):

> If the fishing fleet shall continue to be attractive and recruit qualified personnel, profitability must improve…so the fleet can offer competitive wages and working schemes. The fishing fleet is doomed to lose the labor competition, from amongst others the state subsidized offshore oil-supply fleet [3], unless measures are implemented that improve profitability. The Fishing Vessel Owners' Association is of the opinion that reducing costs by reducing the number of fishing vessels and increasing earnings on the remaining vessels is the most important contribution to increase profitability of the fishing fleet in the longer term.

[1] In a unit quota system, the annual allowable quota is divided by the number of vessels, and then allocated to each vessel.

[2] The SQS allows two vessels within the same fleet category to merge quotas onto one vessel, as long as the vessel giving up quotas withdraws from commercial fishing.

[3] The net-wage pay system allows employers in the maritime sectors to receive tax refunds for taxes paid by the seamen. This is seen as necessary for Norwegian ships to be able to keep Norwegians on board in light of the competition with foreign shipping companies that have access to cheaper labor (Norwegian Seafarers' Union 2012).

The NFA and the Nordland County chapter of the NFA wanted to take restructuring a step further and suggested including vessels below 11 meters, even if this would lead to fewer coastal fishing vessels. It was argued that this was "necessary in order to secure profitability and recruitment" (Johansen 2010). It was also assumed that expansion of the SQS would

> …secure jobs that to a greater degree will ensure recruitment to this important profession. An active fisheries policy working towards improved profitability and recruitment is important to maintain settlement along the coast, while simultaneously developing other industries (Momyr 2005).

In other words, fisheries policies were to reduce and increase the number of actors, simultaneously.

The SQS was controversial, and in 2005 the Minister of Fisheries and Coastal Affairs (Pedersen, Labor Party) temporarily froze the SQS in order to evaluate it. The evaluation found that Norway as a whole did not experience any socioeconomic problems as a result of the SQS, even if some municipalities could expect adjustment problems, such as short-term labor market problems and long-term changes in settlement. Since capacity was still considered to be too high in some fleet segments, it was concluded that continued restructuring was needed (WP No. 21 2006-2007). The profitability discourse was further entrenched in Norwegian fisheries.

The community discourse

Like the profitability discourse, the community discourse has been around since the 1950s. It argues that the enclosure of the open fisheries commons, rationalization, and fleet restructuring have increased the price of entry, causing recruitment problems and threatening coastal communities. Moreover, the discourse argues that socialization into the profession through the milieu of local fisheries is essential for successful recruitment. The community discourse was most prominent in the 1970s when the fisheries political objectives temporarily had an increased focus on community, with the coastal fleet in a central role (WP No. 18 1977-78, Hersoug 1983). Traditional recruitment mechanisms—socialization through the milieu of local fisheries—were recognized as important for recruitment into the profession (Jentoft and Wadel 1984). However, the increased dominance of market economic thinking in the 1980s caused the community discourse to gradually lose its standing. Simultaneously, despite reduced numbers of fishers the sector was still struggling with low profitability. But more importantly, in this perspective, a number of coastal communities were having trouble maintaining their populations (WP No. 93 1982-83).

As discussed in the previous section, the stock collapse of the northeast arctic cod and the reduced role of the Main Agreement in the 1990s contributed to significant changes in Norwegian fisheries, reducing participation. The situation was dramatic for the fleet, the land industry, and coastal communities. As the minister in the municipality of Karlsøy in Troms (northern Norway) said (Veigård 1990):

> The crisis affects individuals and now affects so many that the whole local community is shaken to its foundations…The fishers here are proud people, accustomed to fend for themselves and live by what they are able to create with their own hands. Now, they lose their self-respect. They feel that they are not worth anything, as they have to seek social security…

In the same municipality, the number of foreclosures[4] increased. In the 1970s there were 50 to 60 foreclosures per year, but in 1989 this increased to over 600 (Veigård 1990).

Traditional recruitment mechanisms and informal transfer of fisheries knowledge were still important in the 1990s (Ministry of Fisheries 1995), but the northeast arctic cod stock collapse is thought to have significantly weakened, or even eliminated, these mechanisms. Seeing how fishers were struggling financially, the stock collapse acted as a further deterrent for youth to enter the fisheries. In addition, low quotas forced vessel owners to limit the size of their crew, and combined with the reduced number of local vessels, effectively limited the opportunities for young fishers (Gerrard 1993, Alvheim 1998). Instead, youth increasingly sought work in other sectors, often outside the local community. As a small-scale fisher in Finnmark (the northernmost county in Norway) said (Alvheim 1998:120):

> …I have had a boat for many decades, but if youth want to fish they have no possibilities to do so, because there are so few boats here. We have a permanent crew and are reluctant to take on young boys.

The gradual removal of the Main Agreement also affected coastal communities, as it transformed fisheries from a heavily subsidized sector to an economically efficient sector. Prior to 1990, restructuring bills were sent to the state, but after 1990 the tab was picked up by the fishers (Hersoug et al. 2000). Thus, resource considerations and reduced subsidies changed the framework conditions, which fundamentally

[4] The process of foreclosure in this context refers to foreclosure auction, alternative financing, or temporary arrangements in which the borrower is forced to pay mortgages over an extended time (www.wikipedia.org).

changed the sector and the fisheries-dependent coastal communities. In turn, these developments weakened the community discourse.

The declining number of fishers continued throughout the 1990s, but more importantly, coastal populations also continued to decline. It was argued that recruitment to the fisheries was so low in some communities that it threatened the existence of the communities (Seglsten 1994, Rein 1999). One challenge was that it was difficult to "recruit youth into an insecure occupation where the chance to obtain a decent annual wage [was] minimal" (Jensen 1996). It was also expected that the recruitment problem would be further exacerbated by low birth rates in the 1970s and 1980s and increased formalization of the senior secondary school system in the 1990s (Reform 94). The change in the secondary school system was seen as undermining the traditional recruitment mechanisms, because it kept youth from being socialized into the fisheries. The formal school system was not expected to be able pick up the slack (board member of the Sami National Association in Hamnvik 1994). From a community point of view, it was feared that the few would become fewer.

While the number of fishers declined and the average age increased, the fisheries political objectives of the 1990s remained more or less stable in the new millennium. The fleet was still considered to have an overcapacity and restructuring policies were further developed through the unit quota and the structural quota systems (WP No. 20 2002-2003, WP No. 21 2006-2007). But restructuring policies were highly controversial. Representatives of small-scale fisheries and Sami interest, as well as a number of smaller northern Norwegian municipalities, raged against the system and demanded its withdrawal (Johansen 2002). The SQS was said to "gather fishing rights in a few hands" and negatively affect coastal settlement (Jakobsen and Horn 2004). A number of actors in the fisheries, including politicians from various local political parties (the Conservative Party, the Coastal Party, and the Center Party), were skeptical of the effects upon employment and settlement (Fiskeribladet 2005, Vestå and Sundheim 2006). The government was also accused of only "thinking big" (Nygård 2003):

> If all small-scale adjustments are made unprofitable…what will be left on the coast? Some fishing industry will be left; but significantly fewer, highly automated and less labor intensive. It means a considerable loss of jobs.

Similarly, the mayor (Jakobsen, Conservative Party) in the town of Hammerfest in Finnmark stated in 2005 that (Fiskeribladet 2005):

> I am skeptical of the SQS for the fleet below 15 meters. Fishing rights may become too expensive. I worry about the conse-

> quences upon recruitment. We must be careful of unleashing a system in which the small-scale fishers in the fjords feel unjustly treated.

The argument was that the fleet below 15 meters, as the most labor-intensive fleet segment, had to be shielded from further downscaling in order to avoid job losses. With experience of entry limitations in the 1990s, the authorities expected that the SQS could negatively affect recruitment, as access itself became a valuable commodity (NOU 2006:16). Moreover, increased capitalization of the sector could intensify fishing operations.

> When it comes to restructuring, it is good business for those that buy rights and then sell them for a big personal gain, at the expense of their communities. Communities are being drained… But I also see the other side of restructuring. Young people are leaving the boats. Restructuring has led to such large debts and quotas that they are never able to take time off, which puts an inhuman strain upon crew members (Bladet Tromsø 2006).

As mentioned in the previous section, due to serious controversies the Minister of Fisheries and Coastal Affairs (Pedersen, Labor Party) chose to evaluate the SQS in 2005. Despite hopes for the abandonment of the system, the evaluation favored the SQS. And since overcapacity still existed in some segments, the system was continued and expanded (WP No. 21 2006-2007), which further weakened the community discourse.

However, one development in the new millennium brought the community discourse back to the negotiating table, at least temporarily. Since 2005, ethnic and local perspectives had gained room in resource management debates, due to a new law dealing with rights to terrestrial aread and inland aquatic resources in Finnmark (Finnmarksloven 2005). Subsequently, rights to saltwater fishing in Finnmark were evaluated in 2008. This review found that people living in the fjords and along the coast of Finnmark had legal rights to fish off the coast of Finnmark (NOU 2008:5). Although the document was about fishing rights, it could very well have been about recruitment, as the committee leader said (NOU 2008:397):

> [A]t the committee hearings, it has been strongly argued that there is a need for new and effective measures to ensure recruitment. People at the meetings have been concerned that the 'coastal fisher is about to die out' and that 'in ten years, there will be no fishers left in our fjord'. This has been a common

theme…all around the coast of Finnmark. Perhaps this is the most frequently and most unanimously discussed issue at the hearings.

It was felt that the existing restructuring policies were destructive to Sami communities, as they left no space for boats and fishers that were maintaining the traditional "home-fishing" (The Sami Parliament in NOU 2008:5:46). The evaluation tried to reestablish the fisheries sector as a bearer of coastal employment, settlement, and culture. In terms of recruitment, it was argued that special fishing rights for the population of Finnmark would allow small-scale fishers to continue fishing and thereby secure employment and settlement (NOU 2008:5:367). The document was seen by many actors, such as Sami interests and small-scale fishers, as a "new era for the coast" (Gustavsen 2011). Other actors, such as the NFA, saw it as a threat (Ballari 2008).

Recruitment in the new millennium: challenges, instruments, and implications

Recruitment in relation to restructuring policies in the new millennium was such a heavily debated topic that in 2005 the Prime Minister's Office requested an evaluation of the recruitment situation in the fishing fleet (Prime Minister's Office 2005). Although some vessels had to settle for crew with lower competency and skills, or use foreign labor, the evaluation concluded that that there was no serious fleet recruitment problem and that limited interventions would suffice. Moreover, interventions to facilitate recruitment, particularly of vessel owners, were to some degree in conflict with the intentions of restructuring policies. It was, however, recognized that for the survival of the sector, young fishers and vessel owners had to enter the business (MFCA 2006, NOU 2006:16, MFCA 2008).

According to the evaluation, recruitment challenges in the new millennium had two main aspects: recruitment of crew and recruitment of vessel owners. In the offshore fleet and the larger coastal fleet, recruitment challenges were tied to recruitment of crew with special competencies, such as skippers, navigators, and engineers. These fleet segments were competing for this type of labor with other maritime industries, particularly the oil-supply fleet (Sandberg and Olafsen 2006). As an offshore vessel owner explained (Offshore vessel owner no. 5, 2011, pers. comm.):

> We had big problems [getting certified crew] in 2006, as many left for the oil-supply fleet. We had to use crew without formal qualifications... It is a challenge to get mates, as many do not have the proper papers. Presently, we lack two mates. Two-thirds of the fleet lack one or two crew members. We could use foreigners….

In the small-scale coastal fleet, recruitment of vessel owners is the main challenge, as restructuring has led to fewer local boats and increased price of entry. As one of the leaders of a local branch of the NFA said (Coastal vessel owner no. 16, 2011, pers. comm.):

> For the youth the ambitions are there, but it is difficult to get in, to buy a vessel with quota. Today it is difficult for youth to get experience, even in the summer. The land industry is closed. It was easier to enter before.

Recruiting crew is not a widespread problem in the small-scale coastal vessels, as they use small crews. Where lack of crew exists, it has often been resolved by "skipper-fishing" (skippers crewing for each other) or the use of foreign labor (Coastal vessel owner no. 4, 2010, pers. comm.). But there were reports of challenges recruiting crew, usually due to the lack of interested local youth. As one vessel owner complained (Coastal vessel owner no. 12, 2011, pers. comm.):

> My son is taking over the fishing business, but the problem is that he has nobody to fish with. The youth here do not want to participate. The recruitment system is destroyed. No youth left in the milieu.

Despite claims that there was no pressing recruitment problem, the Ministry of Fisheries and Coastal Affairs (MFCA) established two direct, temporary, and limited schemes to aid recruitment of vessel owners. One was direct financial aid to buy vessels with quotas in the market (establishment grants) and the other was allocation of free quotas in the closed fisheries to young fishers with vessels (recruitment quota) (Prop. 1 S 2009-2010). The sector was split on what would be the best measure. The dividing line was similar to that described in the discussion above. The profitability discourse argued for establishment grants and opposed recruitment quotas. It argued that recruitment quotas would undermine years of restructuring and threaten the recent positive developments in fleet profitability (Nordland NFA 2010). The community discourse opposed establishment grants, as these would be absorbed easily by the ordinary market and further increase prices of quotas. They called for free recruitment quotas for youth in order to avoid further capitalization of the fleet and large individual debts (NCFA 2008). Founded in different discourses and different ideologies, the two recruitment measures contradict each other. Establishment grants try to limit the number of actors in the fleet, whereas recruitment quotas try to increase the number of actors. This is also the manifestation of the Recruitment Paradox.

After years of debate there is still no clear, coherent recruitment policy. Due to political unwillingness or perhaps inability, we end up with recruitment policies heading off in different directions: recruitment for industry development and recruitment for community development. And the solution to the recruitment challenge in one discourse is the root of the problem in the other. In the profitability discourse, restructuring and improved profitability through fewer fishing units is promoted as the solution to recruitment problems. In the community discourse, restructuring and fewer fishing vessels lead to increased entry prices and the disintegration of the traditional recruitment mechanisms, causing recruitment problems.

Although the discourses are presented separately here, they are not in fact completely separate. Representations of the profitability discourse are not completely absent among proponents of the community discourse. Profitability and wage-paying ability are also important factors for recruitment to the smallest coastal fleet (Coastal vessel owner no. 3, 2010, pers. comm.; Coastal fisher no. 6, 2011, pers. comm., Coastal vessel owner no. 7, 2011, pers. comm.). Similarly, representations of the community discourse are not completely absent among advocates of the profitability discourse. Since most offshore fishing companies have sprung out of local communities and see local community as important for their business, they often make conscious decisions to buy services and land catches locally (Offshore vessel owner no. 14, 2011, pers. comm.; Offshore vessel owner no. 17, 2011, pers. comm.). As one offshore vessel owner said: "Local community is important for legitimacy. Too few actors may lead to a poor future for the business."

Conclusion

So, we return to where we started: Figs. 1 and 2 in the introduction. In 1951 there were, according to the profitability discourse, too many fishers and too little profit. In terms of the community discourse, however, the situation was more desirable as there was a thriving fisheries milieu. Sixty years later, the situation may be more in line with the profitability discourse: fewer actors and improved profits (DoF 2009). However, in the perspective of the community discourse there are now too few actors, negatively affecting fleet recruitment and the vitality of communities. In short, the two pictures illustrate the Recruitment Paradox: too many versus too few!

What are the policy implications of these findings? One result of the Recruitment Paradox, as mentioned above, is that there is no one clear and coherent recruitment policy. On one hand, recruitment policy tries to satisfy the industry's demand, whereas on the other hand, policy tries to satisfy community demands. So, we need to ask what fisheries and recruitment policies we actually want. Do we want a recruitment policy that is geared toward creating a profitable fleet or vital communities, or perhaps a bit of both? If recruitment and people are merely the means to achieve fleet profitability, then that needs to be explicitly stated. Or, if recruitment is to be managed by social indicators and to contribute to vital communities and social capital, this should also be expressed explicitly. The bottom line, however, is that whatever policy direction is chosen, we should be aware of its consequences.

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Participation and Resistance: Tribal Involvement in Bering Sea Fisheries Management and Policy

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Abstract

Bering Strait region tribes and tribal organizations have recently become more involved in federal fisheries management and policy in the northern Bering Sea. This involvement has focused on the issues of salmon bycatch in the pollock fishery, the management of the Northern Bering Sea Research Area, and National Marine Fisheries Service research activities.

Tribes and tribal organizations have both participated in and resisted the current management regime through involvement in North Pacific Fishery Management Council meetings, planning workshops, informal meetings, tribal consultations, and other activities in attempts to effect management and policy that reflects tribal concerns. This paper outlines some of the successes and problems tribes have encountered while trying to work with National Marine Fisheries Service and the North Pacific Fishery Management Council on Bering Sea fisheries issues.

Introduction

Bering Strait region tribes have faced a number of important marine management issues over the past several years. The tribes and Kawerak, Incorporated (Kawerak), in conjunction with several other Alaska Native and other organizations, have been struggling to become involved in the policy and decision making processes for Bering Sea issues. This paper reviews some issues and ways in which Bering Strait tribes have participated, or attempted to participate, in northern Bering Sea federal marine management, and ways in which they have resisted the current

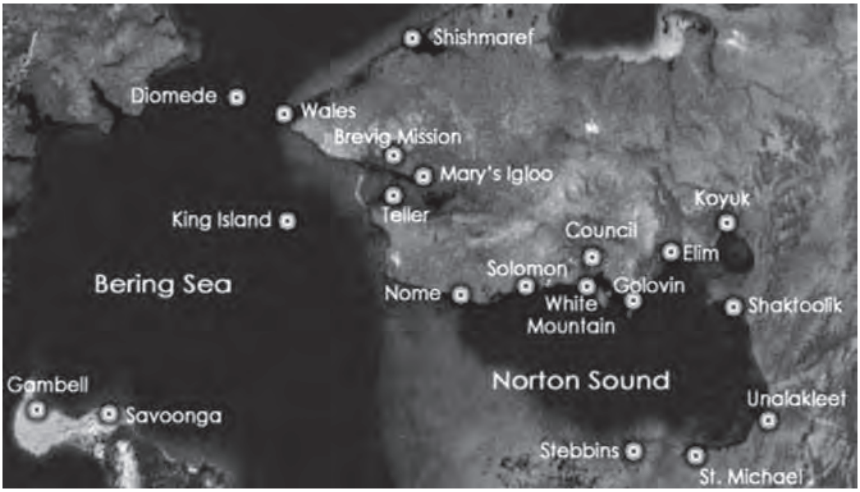

Figure 1. Bering Strait communities with federally recognized tribes.

regime (many tribes from other regions of Alaska have also participated in many of the issues described below). Following this, I outline some major problems that tribes and agencies/bodies involved have faced, and offer some solutions to how all parties can move forward in a positive manner. This discussion is limited to the National Marine Fisheries Service (NMFS) and the North Pacific Fishery Management Council (Council), as they are the two primary bodies involved in the major issues of concern to Bering Strait tribes.

The Bering Strait region of Alaska is the traditional territory of Iñupiaq, Yup'ik, and St. Lawrence Island Yupik peoples and is the contemporary home of 20 federally recognized tribes (see Fig. 1). The Alaska Native residents of the Bering Strait are highly reliant on the natural resources of the region for their cultural, spiritual, nutritional, and economic sustenance—particularly marine resources. Kawerak is the Alaska Native nonprofit for the Bering Strait region and collaborates with tribes in the region on many issues, including the marine policy and management issues discussed here.

Issues of concern to tribes

While Bering Strait region tribes have previously engaged with NMFS and the Council on other topics, over the past several years three major issues in the Bering Sea have caused great concern to Bering Strait tribes, issues in which they have attempted to become meaningfully and consistently involved. These issues are Chinook salmon bycatch in the Bering Sea pollock fishery, chum salmon bycatch in the Bering Sea pollock fishery, and the Northern Bering Sea Research Area. Tribal involvement in these three issues has led to an additional, broader tribal concern about the process, content, and results of tribal consultations in general.

Chinook and chum salmon are caught in high numbers by the pollock fishery in the Bering Sea (NMFS 2009a, 2011a). These salmon are considered "bycatch" because they are a prohibited species within the pollock fishery and so cannot be retained. These salmon are typically thrown back into the ocean already dead, or close to it. Tribes are unhappy and dismayed about this massive waste of salmon, many of which would have returned to rivers in the Bering Strait region, and tribes have been working to get the bycatch of salmon reduced. Genetic research has shown that as much as 87% of Chinook salmon bycatch and 21% of chum salmon bycatch originate from western Alaska stocks (e.g., Guthrie et al. 2012, Kondzela et al. 2012). Tribes consider both of these estimates to be significant, in terms of Chinook and chum salmon fish that would have returned to western Alaska river systems to assist in meeting escapement goals, for spawning, and to be caught by tribal members for subsistence.

The Northern Bering Sea Research Area (NBSRA) is an area from approximately St. Matthew Island north to the Bering Strait, which has been temporarily closed to bottom trawl fisheries since 2008 (NMFS 2011b). The NMFS Alaska Fisheries Science Center (AFSC) was tasked by the Council to draft a research plan for the NBSRA before it is reopened to bottom trawl fisheries, or some other action is taken. This work has been on hold since June 2011 when the Council directed the AFSC to compile background information on the northern Bering Sea, including previous and ongoing research, the effects of bottom trawl studies, the results of community and science workshops held in 2010 and 2011, and other information that was lacking in the outline of the draft plan (NMFS 2011c). The issue of bottom trawl fisheries potentially moving north into the northern Bering Sea is of great concern to Bering Strait tribes, as are the NMFS-directed bottom trawl research activities that took place inside the boundaries of the NBSRA in 2010 and additional research that may take place within the area in the future (NMFS 2010b, Bullard 2010a).

An overarching concern that has developed through tribal involvement in the three issues (Chinook and chum bycatch and the NBSRA) is tribal consultation. Tribal attempts at, and participation in, consultation have led to deep dissatisfaction with how NMFS and the Council approach the process, about the role that tribes play in Bering Sea resource management, and how tribal concerns are incorporated into decision making processes.

The requirement for consultation with federally recognized tribes is primarily outlined by Executive Order 13175 and applies to the development or promulgation of "regulations, legislative comments or proposed legislation, and other policy statements or actions that have substantial direct effects on one or more Indian tribes, on the relationship between the federal government and Indian tribes, or on the distribution of power and responsibilities between the federal government and Indian tribes" (Federal Register 2000). This requirement was recently reiterated by President Obama in a Presidential Memorandum issued in 2009 (Federal Register 2009). An existing Department of Commerce policy, "American Indian and Alaska Native Consultation and Coordination Policy," issued in 1995, also applies to the agencies within the department (DOC 1995). When it comes to issues that may affect tribal resources, tribes are not simply another "stakeholder"; they have special status as sovereign governments, which is why special provisions like Executive Order 13175 and others exist.

Bering Strait region tribes have engaged in tribal consultation with multiple agencies in a variety of formats for many years. From the perspective of Bering Strait region tribes and Kawerak, tribal consultation is, at its root and most simply, about forming and maintaining relationships between sovereign governments (that will hopefully also become partners and collaborators). This view, which I elaborate on below, was formally outlined during a "NMFS and Tribal Representatives Workgroup" meeting in November 2009 (NMFS 2009b), as well as through discussions with NMFS staff during formal and informal consultations over the past several years (e.g., NMFS 2010a, 2011d). Additional descriptions of some of these meetings and elaboration on the points below can be found in the meeting minutes and the NMFS response to the meeting (e.g., NMFS 2009b,c). Tribal consultation, in the view of Bering Strait tribes, should consist of an ongoing and meaningful relationship between a tribe and a federal agency that has the mutual objective of collaboration, should not be "issue-based" and should be maintained even during periods when there are no major issues of contention. Consultation on particular issues must also be timely; if it is not timely, collaboration and consideration of ideas are not feasible for either party. Other components of consultation include two-way communication, accountability, consistency (in policies, procedures, staff, etc.) and must involve decision makers (tribal and federal government). Tribes have also suggested other specific and basic steps that agencies and tribes can take to ensure that a consultation relationship is successful (such as following up on letters, etc.).

Because tribal consultation is federally mandated, because tribes have familiarity with the process from working with other federal agencies, and because consultation was only happening at the most basic level (i.e., a form letter on a specific issue would be mailed to 600-plus tribes, Alaska Native Claims Settlement Act corporations, and tribal organizations), when they began to seriously engage with NMFS and the Council in 2008, tribes have pursued this process more aggressively than most other possible routes of engagement. In taking this route, as noted, tribal consultation itself has emerged as a separate major issue of concern for Bering Strait tribes that want to work with NMFS and the Council on marine management issues.

The relationship between NMFS and the Council also has been a matter of contestation during tribal involvement with NMFS issues. The North Pacific Fishery Management Council (along with the other seven regional councils) was created by the Magnuson-Stevens Fishery Conservation and Management Act. The councils develop management plans and regulations for fisheries within their jurisdictions, which are then forwarded to and enacted and enforced by NMFS. The Council is, therefore, developing policy and regulation that directly impacts tribes and tribal resources and has "jurisdiction" and "primary responsibility for groundfish management" (NPFMC n.d.). While Bering Strait tribes believe that the Council should be required to formally participate in consultations, the Council and NMFS have operated under the belief that the Council is not an "agency" as defined in Executive Order 13175 and associated regulations (see Federal Register 2000 p. 67249, Oliver 2011a). Kawerak and tribes have requested, multiple times, that NMFS provide a written legal opinion on this matter, and even the Council itself has asked NMFS to clarify the situation (Oliver 2011b).

As a federal agency, it is clear that NMFS is required to carry out tribal consultation. While the determination of the Council's status relative to consultation is debatable (e.g., see Balsiger 2011a), the fact is that they refuse to formally engage in the process (e.g., Oliver 2011b). The reason this is important, and is such a large concern to Bering Strait tribes, is that the Council is intimately involved in the policy and decision making process (which NMFS eventually implements and enforces) (e.g., Eagle et al. 2003, NPFMC 2008). Though technically Council decisions about fisheries management and policy must be approved by the Secretary of Commerce, Council recommendations are almost never abrogated by the Secretary, making the Council the de facto decision maker. Despite the power that the Council has over decisions that may significantly impact tribes and tribal resources, the Council is not held to the tribal consultation mandate. Partly as a result of significant pressure from Bering Strait region tribes and other tribes and organizations, the Council created a Rural Outreach Committee in late 2009. While not tribal consultation, and though the committee has no specific focus on tribes, the creation of this committee (and the setting aside of funds for its work) has been a small improvement in the process of communication between entities. Because of a Council motion in 2010, NMFS also has begun to give the Council formal updates about tribal consultation (see NPFMC 2010, Balsiger 2012), though the Council is not required to consider or respond to the information in these reports.

Tribal consultations to date

Since 2008, when Kawerak and Bering Strait tribes began to seriously engage with NMFS and the Council on issues of concern, there have been three formal tribal consultation meetings, as well as other requests for consultation that are described briefly below. The first formal tribal consultation in January 2009, in Nome, Alaska, focused on Chinook bycatch. Five tribes, Kawerak, and NMFS staff participated in this consultation and Council staff attended as observers (this is the only formal consultation meeting that Council staff attended). Tribes were generally satisfied with that first attempt at consultation; tribes expressed their concerns about Chinook bycatch, about being left out of the process of developing alternatives, and about NMFS's lack of understanding of tribal consultation. Following the meeting, however, tribes were not contacted by the agency for any kind of follow-up or response to concerns.

In October 2009 the Native Village of Unalakleet requested an additional consultation meeting to continue to develop the relationship between tribes and the agency and to discuss salmon bycatch, the status of the Northern Bering Sea Research Area, and the principles of ecosystem management. Nine tribes, Kawerak, and NMFS AFSC staff participated in this consultation in February 2010 in Unalakleet, Alaska. Follow-up from this meeting was also lacking and over the long term tribes have been disappointed in the lack of a continuing relationship. Additionally, the week after the Unalakleet consultation, tribes participated in a workshop focused on the NBSRA where they learned information about upcoming research they had not been consulted on and which they had not been notified of during the formal consultation meeting. Following this, in March 2010, 15 Bering Strait tribes requested consultation with NMFS regarding research activities planned in the northern Bering Sea. NMFS did not respond to these requests for consultation and informally denied that they were required to carry out tribal consultation on research activities (Raymond-Yakoubian 2010).

Most recently in June 2011, a third tribal consultation meeting took place via teleconference, on chum salmon bycatch, in response to consultation requests by six Bering Strait tribes. This consultation meeting was followed up by a teleconference in October 2011 when NMFS provided additional information to tribes and others on issues discussed at the June meeting. During consultation tribes specifically requested a hard cap on chum salmon bycatch in the pollock fishery, which has not been fully addressed by NMFS. Consultation on chum salmon bycatch also has highlighted confusion surrounding the relationship between NMFS and the Council. After NMFS participation in the June consultation the NMFS Alaska Region administrator wrote a letter to the chair of the Council asking the Council to address tribes' recommendation for a chum salmon hard cap (Balsiger 2011b). Several tribes had also requested consultation with the Council on this issue and the Council's response to tribes was that they needed to carry out consultation with NMFS (Oliver 2011b). Tribal members are frustrated, to say the least, when they are told that they can formally consult only with NMFS, but then NMFS asks the Council to address the issue tribes are concerned about, and the Council, in turn, treats tribes like they are any other stakeholder. Unfortunately, tribes are being compelled to consult with a body (NMFS) that cannot take action on or resolve many of their major concerns, such as Chinook and chum salmon hard caps. As a result, some tribes and tribal members feel that consultation with NMFS is not true tribal consultation because it does not include decision makers from the federal government side.

Forms of participation and resistance

Tribes have approached these topics of concern in a variety of ways. Below I elaborate on different ways that tribes have engaged in the issues, as well the problems that have arisen. I discuss Chinook and chum salmon bycatch together. In attempts to engage NMFS and the Council on bycatch issues Bering Strait region tribes and Kawerak have formally requested tribal consultations and have fully participated in the Council process. Collectively we have spent large amounts of money to travel to multiple meetings to provide testimony to the Council and its Advisory Panel and Scientific and Statistical Committee. Tribal representatives who travel to these meetings and provide testimony are often not engaged by Council members (i.e., through questions following their testimony) and often describe leaving meetings feeling as though they have wasted their time and resources (Raymond-Yakoubian 2008-2012). These feelings are amplified for tribal representatives when they see that fishing industry representatives are given literally hours in front of the Council to discuss their views, solutions, and opinions on the bycatch issue (tribes requested additional time in front of the Council for the June 2011 meeting in Nome where chum bycatch was discussed, but were denied it). Tribal expert testimony is also often viewed as anecdotal by the Council, despite the fact that many such representatives are there speaking on behalf of their entire tribe and their views and observations are endorsed by them. Feelings of disappointment and frustration with the process are further affirmed when Council decisions greatly differ from tribal recommendations. For example, tribes virtually unanimously recommended a 30,000 hard cap on Chinook salmon bycatch in the pollock fishery, but the Council set the cap at 60,000 in conjunction with an industry incentive program. While the consultation process does not ensure that agency decisions will reflect tribal desires, in this case the consultation process did not even address tribal concerns. As a result of these and other problems many tribal representatives are no longer willing to spend their time and effort attending Council meetings to participate in that particular process.

There are also some positives, in terms of the tribal consultations that have taken place on salmon bycatch. The first is that a few meetings have actually taken place, and the second is that two of these meetings have been face-to-face consultations. Kawerak and tribes strongly believe that formal consultation meetings must take place in person, particularly at this early stage in the development of relationships between Bering Strait tribes and NMFS. Also, there are some NMFS staff who, though extremely limited in their influence and power, do not take tribal concerns lightly. On the other hand, the agency as a whole has not taken its consultation mandate very seriously. Until Bering Strait region tribes and organizations began forcing the issue, tribal consultation on the part of NMFS primarily consisted of sending a form letter out to tribes (as noted above). The agency has frequently been slow to respond to requests for consultation and has not responded to all requests. Additionally, the staff that have been assigned to deal with consultation (for example, a fisheries economist) have no formal training or experience with consultation (as of March 2012) and are allotted only a certain amount of their work time to spend on it (Raymond-Yakoubian 2008-2012).

True tribal consultations are government-to-government and include individuals with decision-making authority. As noted above, many tribes believe that consultations with NMFS do not meet this standard because of the NMFS-Council relationship. However, even for those who do accept such consultations as being government-to-government, the NMFS staff present at consultations do not always meet this criteria of "decision makers." The participating agency staff also frequently rotate between meetings and teleconferences, and tribes have to repeat their concerns and background on the issues to inform the inexperienced staff present that have been tasked to work with tribal concerns (see participant lists for consultations, in NMFS 2010a, 2011d,e; Raymond-Yakoubian 2008-2012). Overall, the formal tribal consultations have not been timely or meaningful on salmon bycatch. These are just some of the problems with the way the consultation process has been proceeding to date.

In terms of the Northern Bering Sea Research Area, Bering Strait tribes and Kawerak have participated in several meetings and workshops about the issue, have written formal correspondence to the agency and Council, and provided oral testimony to the Council.

Tribes and tribal organizations also participated in a Community and Subsistence Workshop organized by NMFS Alaska Fisheries Science Center (the entity creating the NBSRA Research Plan) in which tribes shared local and traditional knowledge about the NBRSA with the agency (NMFS 2010b). This knowledge was shared despite the fact that the agency's goals and purpose for establishing the NBSRA and a research plan for it have been at times ambiguous.

Tribes have requested, and when no response was forthcoming, demanded that NMFS conduct formal tribal consultation on the issue of "research activities" carried out or sponsored by the agency. This was a direct result of the NMFS lack of compromise about the 2010 bottom trawl research survey in the northern Bering Sea, within the boundaries of the NBSRA. Rather than making a good faith effort and carrying out consultation, NMFS indicated their belief that they are not required to carry out tribal consultation on research activities—or at the very most that such a responsibility is debatable—and in actual practice have not conducted this consultation (despite formal requests from tribes). Communications from NMFS have included the explicit belief (Raymond-Yakoubian 2010, Bullard 2010b) that they are not required to, as well as implicit indications (Karp 2010) that the issue might be debatable; in practice, they have not carried out consultations on this issue. It is the tribes' view that NMFS is required to (Bullard 2010b). In the face of what is at most a debate, NMFS' decision not to proceed with a good faith effort in carrying out consultation regarding research activities has been detrimental to the incipient and already shaky relationship between Bering Strait tribes and NMFS. Tribes plan to make additional requests for tribal consultation on this issue directly to the Secretary of Commerce and to publicly protest any additional similar research in the northern Bering Sea that is not preceded by timely and meaningful tribal consultation activities. This is not because, as some within the agency believe, that tribes are opposed to research or that tribes do not understand the research that the agency does. Neither is true, but tribes do want to be fully informed about research activities, have the opportunity to collaborate with the agency on some research, and help determine whether the research is appropriate in their traditional territory.

Bering Strait tribes are extremely concerned about the implications and repercussions of the research the agency conducts, particularly in the northern Bering Sea. Related to this, it is important to tribes that agency scientists are aware of and acknowledge the implications of their research, rather than saying that it is simply research and science, and that researchers have no control over how the results of their work will be used by the agency, the fishing industry, or others (Raymond-Yakoubian 2010). In 2010 Bering Strait tribes passed formal resolutions requesting the agency to postpone the bottom trawl survey until consultation was carried out. Tribes subsequently passed resolutions stating that they were opposed to the expansion of bottom trawl fisheries into the northern Bering Sea, in their traditional marine hunting territory and the critical habitat for many of the species they depend on for subsistence. Many tribes are very disappointed and dissatisfied with how things have proceeded regarding the NBSRA, and some have declared that they will no longer meet with the agency or share information with them.

Tribes have also pursued other methods for engaging issues. For example, tribal organizations like Kawerak, as well as tribes, have sought and obtained funding for their own research projects, outreach, and other activities. These funds support several ongoing social science projects, the majority of which are directly related to marine resources. Bering Strait tribes and Kawerak have also formed new coalitions with groups that have similar interests, and strengthened existing relationships. Some tribes and organizations have decided to bypass NMFS and the Council to try to work directly with industry. Tribes and tribal organizations also work directly with academic or independent scientists on research projects and in developing policy and management recommendations. Additionally, tribes are attempting to get seats on governing bodies, including the Council, to ensure a more balanced membership and that tribal concerns are fully heard and considered.

Suggestions for building agency-tribal relationships

Kawerak and Bering Strait region tribes have offered numerous suggestions to NMFS and the Council to improve and expand the existing relationship and to address tribal concerns. Below are examples of recommendations from Kawerak and Bering Strait tribes.

Consultation in general

NMFS and the Council must embrace the consultation process and the government-to-government relationship. This entails not just a change in attitude and approach, but also taking concrete steps toward improvement, some of which are described below. Major relationship building needs to occur and many tribes have already attempted, or shown their interest in developing, ongoing engagement with NMFS and the Council.

Staffing

For several years Kawerak and tribes have requested that NMFS Alaska Region hire a tribal liaison. This position is common in most federal agencies; the Department of Commerce, within which NMFS is housed, has a tribal liaison position. NMFS, however, has consistently refused to create such a position within their agency, citing lack of funding. This reason does not satisfy tribes, however. The Alaska Fisheries Science Center and NMFS Alaska Region together have well over 300 staff. Tribes believe that it is more than reasonable to request that one of these staff positions be dedicated to a liaison position. This would greatly improve the good will between tribes and the agency, and assist in many other ways such as streamlining communication between parties. Other staffing concerns expressed by tribes in the context of the issues discussed above include the lack of sufficient anthropologically trained staff within both NMFS Alaska Region and the Council. Such staff are needed for assisting the agency and Council in assessing and understanding the importance of and impacts to subsistence foods and subsistence culture from salmon bycatch, research activities, etc. Neither the AFSC nor the Council has anthropologists on staff. The responsibility for writing documents, such as the environmental justice, cumulative effects, and subsistence-related sections of policy and management documents has fallen to staff with training in fisheries economics or other fields.

Funding

NMFS needs to set aside funds for the specific purpose of carrying out their tribal consultation mandate. Ironically, the Council has actually set aside funds for similar work—for outreach to communities. Bering Strait region tribes are certainly pleased that the Council has set some funding aside, but remain extremely concerned that the Council and NMFS do not take formal consultation as part of their mandate. Tribes have also requested that NFMS collaborate with them in the conduct of research—social science and biological research—and that more funds be set aside for such community based work.

Research

This suggestion has several components. The first is to allow the existing NMFS Alaska Region noneconomic social science staff (currently one person) to participate in the consultation process and in the writing of environmental and other documents that are used in agency and Council decision making processes (i.e., social impact, subsistence, environmental justice, and other components of analyses). This will help ensure that tribal concerns are more fully understood and addressed. Additionally, the noneconomic social science and other research staff should be encouraged to develop and conduct research that is responsive to tribal concerns. The agency should also sponsor research that would be conducted directly by tribes or tribal organizations or in collaboration with the agency, as noted above. Such projects would be an excellent opportunity to help build capacity within tribes, tribal organizations, and communities and would provide an important conduit for the two-way sharing of knowledge that tribes desire.

Consultation process

Bering Strait region tribes have repeatedly requested that NMFS formalize their consultation process and protocols and the Council's role in that process. Tribes have made direct comments to the agency on what they believe consultation should consist of and what an appropriate process would be, but the agency has followed through on very few of the recommendations (e.g., NMFS 2009b,c; 2010a). Also, though tribes do not agree with the Council's assessment that they are not required to carry out consultation, tribes have still offered some interim suggestions such as formalizing a process whereby NMFS communicates tribal concerns to the Council much earlier in the process (as noted above, the Council has adopted a reporting protocol) and some kind of accountability for addressing those concerns (this has not yet been dealt with). The Department of Commerce recently issued its draft American Indian and Alaska Native Consultation and Coordination Policy (Federal Register 2012). Though it includes no specific guidance as to how Department of Commerce agencies should carry out consultation, there is nothing that would prevent NMFS and the Council from developing (in collaboration with tribes) a more detailed set of guidelines, expectations, and policies for carrying out consultation.

Conclusion

The current situation is that in order to, possibly, have their concerns taken into consideration, tribes must participate in two separate processes, neither of which function according to their needs or acknowledge their unique relationship to the federal government (these being some kind of engagement with NMFS and the Council process). The bottom line is that by not embracing consultation, NMFS and the Council have forced all parties into a reactionary stance from which little that is positive or lasting can come. Bering Strait tribes will continue to pursue policies, research, and management goals that acknowledge and protect subsistence resources and traditional cultural practices. Despite the problems and difficulties discussed here, Kawerak and Bering Strait region tribes remain very interested in working with NMFS and the Council to develop the trust and relationships necessary to move forward on these and many other issues that are just coming to light in the northern Bering Sea and that have the potential to have substantial direct effects on tribes in the region.

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New Challenges to Research on Local Ecological Knowledge: Cross-Disciplinarity and Partnership

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Abstract

Since the turn of the century, local ecological knowledge (LEK) has been recognized not only as potentially valuable to resource management and science, but increasingly integrated into legislative texts, regulatory structures, and research. Based on experiences from social science and marine science projects on LEK in Porsanger Fjord in Finnmark, we reflect on challenges and limitations of LEK research and cross-disciplinary collaboration. Our reflections lead us to question the different ways in which local ecology is understood and researched by different disciplines. With changing attitudes and perspectives that cast LEK as knowledge that can be integrated with science, the question of how different disciplines integrate LEK and use it in their research is emerging as a problematic issue. Our argument is that ship with community-based institutions is crucial for the accountability and legitimacy of LEK research, and for facilitating dialogue and coproduction of knowledge by scientists and local resource-users.

Introduction

Integration of local ecological knowledge (LEK) with science for the purpose of improving management of local resources has long been a challenge for science. It is argued that social scientists too often limit themselves to "demonstration studies," and that there are few examples of actual successful integration of LEK with science (Davis and Ruddle 2010). Others argue that the lack of successful examples is a result of the different power relations between local knowledge holders and managers, where knowledge is produced by "centers of calculation" that tend to extract and distill knowledge in appropriative ways (Nadasdy 1999). A call for better research practices, collaborative approaches, and rigorous methodologies seem to be the recommended medicine (Nadasdy 1999, Neis et al. 1999). In the Norwegian context, a set of new legal instruments has emerged only in the last few years, obliging scientific advice to include experience-based knowledge, and management systems to take into account the needs of local communities in making regulatory measures (Marine Resource Act, 2008; Nature Management Act, 2009). With these new instruments, where authorities and science have started practicing LEK integration, many barriers to the "integration project" (Soto 2006) have already been overcome in Norway. One successful example has been conducted by the Directorate of Fisheries, where scientists and managers used a map-based survey to collect data on the whereabouts of spawning areas and marine resources that have been observed by fishers. In spite of the favorable circumstances, however, there are few examples of cross-disciplinary research on LEK that include not only observations of resources at a particular time but also local knowledge on relations between species, and how resources have changed across temporal and spatial scales. Why is this?

In the following, we first give an introduction to research on local ecological knowledge, and then present previous research on fjord ecology, politics, and management in Finnmark, north Norway. We go on to discuss barriers and challenges to LEK research, using the Fávllis research network as an example.

Research on local ecology and local ecological knowledge

In the 1980s, studies of local ecological knowledge were still a relatively marginal field within social anthropology. Milton M.R. Freeman (1985), Fikret Berkes (1988), Harvey Feit (1973), and Robert E. Johannes (1981) were early proponents of traditional/indigenous/local ecological knowledge as relevant to management of natural resources. In the early 1990s, references to traditional ecological knowledge (TEK) as a "system of knowledge, practice, and belief" epistemologically different from scientific knowledge (Berkes 1993) became part of the international discourse on the environment, especially after the Rio Conference on Environment and Development in 1992 (Principle 22 of the Rio Declaration, Chapter 26 of Agenda 2 and Articles 8 and 10 of the Convention on Biological Diversity). While TEK is frequently used as more or less a synonym to LEK, TEK is usually defined as knowledge handed down from earlier generations, thus underlining its temporal aspect (Berkes 1993). For the purpose of this paper, we choose to use LEK, referring to experience-based knowledge, continually derived from fishing practices within a community of fishers in the same area. LEK, as we understand the term, emphasizes the spatial aspect of knowledge about the environment in a resource user's (and in this case particularly fishers') vicinity, without discrimination between traditional knowledge and contemporary knowledge derived from fishers' continuous interaction with a changing marine environment. Although it has been argued that the divide between folk and scientific knowledge should be dismantled (Agrawal 1995), we maintain that there is an important difference between all types of knowledge in the way that they are produced. When scientists collect LEK and attempt to integrate it, the LEK is produced in a different context and results in different products from its in situ context.

Methodological discussions on LEK integration point to the fact that LEK research always involves a transformation of local knowledge into a decontextualized and constructed form of knowledge that is removed from its local context. Davis and Ruddle (2010) therefore call for greater attention to methodological rigor in LEK research to ensure quality and compatibility of LEK with science. The collection of LEK, however, also has ontological implications. Holm (2003) for instance argues that instead of collecting and integrating knowledge that is already there, LEK researchers and in particular researchers on fishers' ecological knowledge are creating "FEK," which is the refined knowledge product made to fit scientific standards. FEK here refers to local ecological knowledge and traditional knowledge among Sami fjord fishers.

Recognizing the constructed nature of LEK and that greater importance should be attached to how LEK and FEK research is organized, Bjørkan recommends another approach to LEK research. In her recent doctoral thesis on fishers' knowledge integration in the Norwegian fisheries science advisory system, she advocates a move toward understanding how local knowledge production is organized "so that responsibility for knowledge is distributed in apprehensive and sound ways" rather than focusing on why LEK is being ignored (Bjørkan 2011 p. 238). Thus, our understanding of LEK as opposed to scientific knowledge emphasizes the different ways in which knowledge is practiced and organized in institutions or in social contexts and networks, in addition to the means by which it is produced by local fishers.

The consequence is that we need to rethink how LEK is produced or coproduced also by science and not only by fishers, and how this production is organized. A rarely discussed challenge is the question of whether it is possible to produce a coherent scientific body of knowledge that accurately represents "the ecosystem." The assumption behind most LEK research, and research on biodiversity in general, seems to be that there is a truth out there about the total content of an ecological system in an area, and that it can be reached and represented through more research and better methods, collection of LEK among them. Natural and social scientists, however, do not use the same tools to investigate, and often end up with different results from research on the same field. Too often it is assumed that natural scientists hold the true representation of nature, while social scientists are better capable of representing social systems, and thus disciplinary boundaries are rarely crossed. In LEK research, there are attempts not only to cross those boundaries but also to integrate, a task that is already challenging enough within the walls of research institutions. The case is more likely that different disciplines are producing different versions of ecosystems and that locals' observations and knowledge do not add up to a coherent, single system of "knowledge, practice, and belief" (Berkes 1993). If it is the case that different methodologies produce different realities (see for instance Law and Urry 2004), the challenge of "integrating LEK with science and management" may go beyond methodological fixes. How can we then hope to reach a common understanding of the socio-ecological relationships we are all hoping to contribute to? In this paper, we focus on challenges to research on local ecology in a setting where various disciplines and research institutions are at work in the same marine environment. We ask whether the greatest obstacles to LEK integration are (1) an inability to organize scientific knowledge production in a coherent way, and (2) scientific assumptions about the feasibility of accurately representing local ecology as one coherent ecosystem through integrating different knowledge forms and research practices.

Traditional/local ecological knowledge among Sami fjord fishermen in northern Norway was addressed by Eythórsson (1993) in a paper based on a fieldwork in the community of Lille Lerresfjord in Finnmark in 1989-90. The rural fjord communities in Finnmark are in most cases originally coastal Sami settlements, characterized by an extensive form of mixed economy based on seasonally abundant marine resources and marginal animal husbandry. During the nineteenth century, Norwegians and Finns settled in many fjord areas, and as a result of Norwegian assimilation policy, Sami language and culture became marginalized (Eythórsson 2008). Since the 1980s, a political revitalization of Sami identity has taken place in some of the fjord districts and in recent years, the coastal Sami have voiced claims for indigenous rights to marine resources in the fjords (Brattland 2010). However, the general trend for most of these districts is toward economic marginalization and depopulation, partially caused by dwindling resources and industrialization of the fishery.

The focus of Eythorsson's original paper was on local taxonomy and migration routes for cod, and how fishermen differentiate between cod populations spawning at different sites. Its point of departure was that local cod populations at the time were unrecognized by marine biologists and fisheries management in Norway. The consequences of a lack of recognition of local cod populations became strikingly clear in 1989-

90, when the poor state of the Northeast Atlantic cod led to a full stop in the cod fishery on April 18, 1989, though the rest of the year. The following year, individual quotas for cod were introduced in the small-scale fisheries, effectively closing the fishing commons and excluding most of the small-scale fishermen in communities like Lille Lerresfjord, where Eythórsson did his research in 1990. The variations in the state of local cod populations, harvested by small-scale fishermen, were not and could not be taken into account as no stock assessments had been done on these populations. Corresponding to the works of Berkes, Johannes, and others, the paper concluded that local and traditional knowledge could (and should) be used as a supplement to scientific knowledge for the purpose of ecologically sound and socially just management of common property resources such as marine fish.

Integration of LEK was advocated at the time because mismanagement of Northeast Atlantic cod had led to the full stop in the cod fishery in 1989, also including fjord fisheries on local cod populations. While there was open access to the fishery until 1990, the lines of conflict ran between local small-scale fishers and large and medium nonlocal vessels fishing with herring purse seine (1950-1969), Danish seine for cod (1970s and 80s), and purse seine for saithe/coalfish (1950s-1990s). In the 1950s and 1960s, local fishers protested against the industrialized herring-fry fishery, which they considered ecologically hazardous and disruptive to the small-scale fishery (Eythórsson 1998). A Danish seine is similar to a small trawl net; it consists of a conical net with two long wings with a bag where the fish collect. Fjord fishers considered fishing with Danish seine on spawning grounds a threat to local cod populations. After the collapse of the herring stock in 1969, the protests were directed toward seine fisheries for cod and saithe, calling for protection of local spawning grounds against fishing with active gear. The Norwegian Fishers' Association (NFA), which was in a position to define the fisheries agenda at the time, generally disapproved of the local protests, especially if they were voiced by Sami organizations (Eythórsson 2003). Since the implementation of vessel quotas in 1990 and the growth of new marine industries competing with fisheries in the coastal zone, the focus has turned toward issues of access to the fishery and the effects of salmon farming and ecological changes on fjord ecosystems. The Sami Parliament, established in 1989, has also entered the Norwegian fisheries discourse, and directed it toward the issue of greater local control and management of resources based on Sami fishing rights in fjord and coastal areas in Finnmark (NOU 2008 p. 5).

The Finnmark fjords have changed since 1989-90. There are few fishers left compared to the late 1980s when there was almost open access to the fjord fishery and it constituted the backbone of local economies. While there were fish buyers in almost every fjord community in the 1980s, very few are still operating today. As coastal cod populations are currently at risk and coastal cod is managed as an endangered stock, there are less cod in the fjords and fishers have invested in larger and more efficient fishing vessels that are able to fully exploit coastal resources to fish up their cod quotas. There has been a reduction in abundance of other species as well, except from the Pacific red king crab introduced by the Russians in the 1960s, which has become the dominant species in the eastern fjords in Finnmark since the turn of the century. Although this invasive species is harmful to the seafloor and probably a transformative agent in fjord ecosystems in Finnmark at large, the crab fishery has been a relief for many of those fishers who are still active. The arrival of red king crab is the latest addition to socio-ecological change in Porsanger, where kelp forests have been depleted by sea urchins since the early 1980s, and populations of coastal seals increased in the late 1980s, all evidence of changes in the ecosystem from the pre-1980s norm. Local fishers argue that if the fisheries authorities had only listened to them, the ecological changes would not have been so dramatic and local cod stocks would still have been viable. With growing conflicts between different fisheries and new marine industries, LEK has been repeatedly referred to as instrumental in ensuring sustainable management of resources in northern Norway.

Porsanger—a scientific laboratory

The Fávllis research project (2008-2010) represented a return to research on local ecological knowledge among coastal Sami fishermen in the same region, in Porsanger Fjord (Fig. 1). This project, conducted by the Centre of Sami Studies at the University of Tromsø and the Norwegian Institute for Cultural Heritage Research, focused on change in socio-ecological systems, as experienced by the fishermen (Andersen 2011, Eythórsson 2011, Brattland 2012). In a socio-ecological system different groups of human and natural actors have interacted at different spatial, temporal, and organizational scales to shape the history of fish and fisheries (Murray et al. 2006). As a socio-ecological system, the Porsanger Fjord was particularly interesting, and it turned into the focus area of both the Fávllis project and a fjord ecology research project by the Institute of Marine Research because of the ecological changes in the post-1990 period. The collapse of the Porsanger cod fisheries started with the “seal years” 1986-89, when a large number of harp seals fed on local cod stocks in the fjord. The changes in the fjord ecology during these years were abrupt and had serious consequences for the fishery. Consequently, the local management discourse has focused on the causes and possible reversibility of these changes. In the following, a closer introduction to the marine science and our social science research on Porsanger are given, with an emphasis on the Fávllis project.

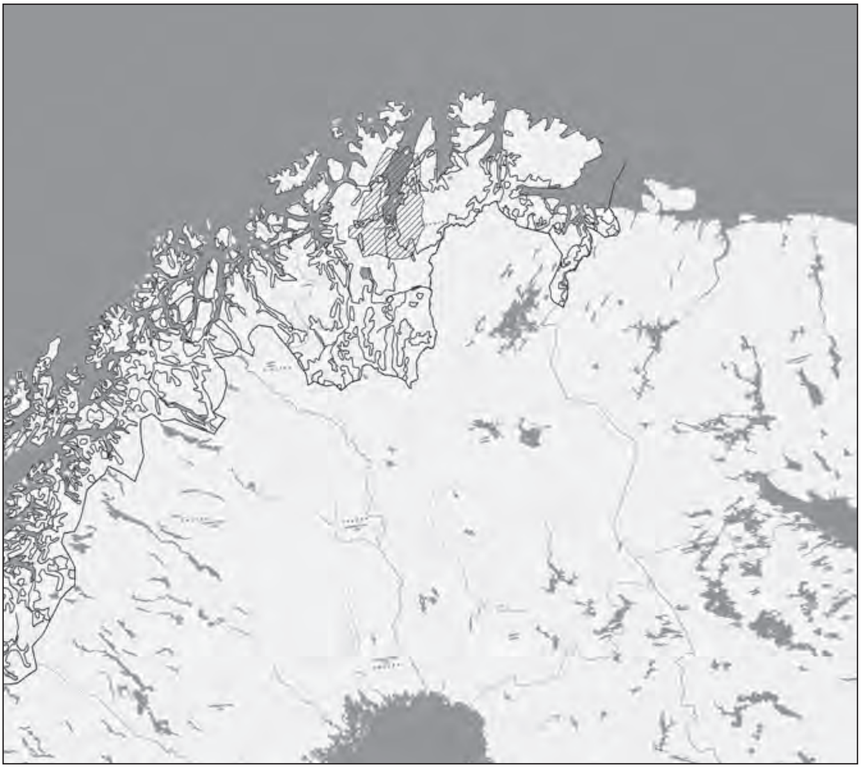

Figure 1. Porsanger Fjord (hash marks) in northern Norway.

Marine science on Porsanger

The Institute of Marine Research (IMR) has collected data on fish populations in inshore coastal and fjord areas since 1992, complementing previous data on fish stocks in the Barents Sea. Porsanger has become the focus of research since 2008, when it was chosen as a national laboratory for research on fjord ecology with transfer value to research on other fjords (IMR 2008, 2009b). The goal of the IMR Epigraph program is to increase the knowledge base on dynamics and structure of fjord ecology and biodiversity. This entails investigating interactions between seals, cod, king crab, and ecological factors such as climate change in the fjord. As our aim was to complement scientific knowledge and local knowledge, the Fávllis project also organized a partnership with the program. Two marine biologists have collaborated, not directly in the data collection, but in forming the interview guide and in discussing the results from interviews. They have also presented their research on coastal cod and red king crab to fishers in local meetings and engaged in discussions with local people, on their own or in collaboration with the Fávllis project. Our idea was to complement local knowledge and existing biological knowledge about ecological changes in the fjord, represented by regular trawl samplings. Perhaps not surprisingly, there were some challenges involved in this exercise. The biological data are configured to stock assessment, the timeline is limited as the surveys started assessing fjord areas only from 1992 onward, and trawl surveys follow a grid pattern to cover the same routes every year (Mehl et al. 2010). To compare LEK on the same spatial and temporal scales as the biological data was feasible only at the points where survey data intersected with fishers' observations. The Epigraph project outputs are research articles and popular science on fish stocks, marine mammals, and ecology in general. The Fávllis project collaboration became an incentive for the marine biologists to analyze their survey data in more detail, and try to establish a more comprehensive picture of the biomass data complemented with local knowledge.

A local research station has been set up by the Institute of Marine Research to carry research on fjord ecology further (IMR 2009a). The research station monitors the fjord environment in terms of temperature changes, and contributes to data on arctic biodiversity such as polar cod and species of kelp as remnants from colder periods in the innermost part of the Porsanger Fjord (Christiansen and Fevolden 2000). Scientifically, there is thus a move toward research on local ecology where local fishers are to a small degree included in the scientists' research, and outputs are presented as new and unique contributions to knowledge on fjord ecology.

The Fávllis project

The ambitions of the Fávllis project were to document local knowledge on ecological change over several decades, and the role it played in the near collapse of local fisheries since the 1980s. For this purpose, the Porsanger Fjord seemed to be an ideal case. We wanted to collect LEK without losing the sociocultural context, the relationship between ecosystem and the social world, or the role of people in the ecosystem. To avoid co-optation of local knowledge and to ensure that the holders of LEK would remain in control over interpretation and use of their knowledge, we included a local institution as a research partner. A research partnership was established with the Coastal Sami Resource Centre (CSRC) in Porsanger, an institution with two employees, established by a local initiative in 2002. Another objective was to complement our results with biological research, by collaborating with marine biologists at the Institute for Marine Research (IMR). Our intention was to compare or complement their research data with LEK from the Fávllis project. Finally, we intended to make our results relevant and available for management institutions, by presenting them in the form of digital maps and a database where LEK would be presented as dynamic rather than static. The Fávllis research project published a book containing what fishers said about changes in local ecology, traditional knowledge on fishing grounds and reflections on the consequences of management regulations for local identity and culture (Andersen and Persen 2011). A paper by Brattland included in her Ph.D. thesis focused on the role of TEK in overfishing of the local cod stocks using map-based fishers' career interviews as the main material (Brattland 2012).

Collection and production of LEK

LEK is usually collected through semi-structured interviews, focusing on spatial and temporal changes during fishers' careers, for instance asking them about their observations from different fishing vessels and points of observing the ecosystem (Neis et al. 1999). We used semi-structured interviews to capture observations of spatial and temporal changes in local ecological resources relative to what we called socio-ecological events. In the selection of persons for interviewing, we relied on our local partner to find knowledgeable people to represent observations and interpretations of ecological change in the fjord. The sample of informants included retired as well as active fishers, a geographic distribution between inner and outer districts of the fjord, and different fisheries adaptations (economic, spatial, and temporal). In order to represent a prolonged timeline of ecological change and changing fisheries strategies, it was important to include retired fishers. Gender was not a major issue, but in order to include women's narratives on socio-ecological change in the fjord, four women were interviewed as a part of a sample of 19 interviews.

The topic for the interviews was marine ecological change, the point of departure being how the abundance of different marine species had changed during the fishing career of the informants. Narratives were produced to set ecological change in a social context, in relation to changes in fishing technology, fishing regulations, fish markets, and within fishing communities. The narratives represented socio-ecological knowledge rather than strictly ecological knowledge. This in turn, meant that socio-ecological knowledge had to be operationalized as an analytical concept, in terms of which elements of social change were relevant to ecological change (and vice versa), within a defined spatial and temporal frame. Our idea was to reconstruct an extended timeline of ecological change in the Porsanger Fjord for the last 50 years. There are few historical and statistical sources on ecological change as seen from a local perspective, but from the CSRC archives the project had access to audio files and transcriptions of interviews conducted from 1970 to 1990. The CSRC studied these interviews along with other historical sources and provided a historical context to project narratives (Birkely 2011).

To structure the socio-ecological history presented in fishers' narratives, and help their memory, we asked informants to relate to predefined milestones in the socio-ecological history of the fjord, in order to construct a timeline representing long-term socio-ecological change as well as significant events of abrupt change. Based on our knowledge about the history of the fjord we started out with four milestones: (1) The conflict over the industrialized herring-fry fishery in the 1950s and 1960s, culminating in the collapse of the North Atlantic herring stock in 1969. (2) The conflict on gear-regulations in the fishery for cod on local spawning grounds in the 1970s and 1980s. (3) The collapse of the local cod fishery, following the seal-years in 1986-89 and the implementation of quota system in 1990. (4) The in-migration of red king crab, from about 2000. In practice, fishers tended to relate mainly to (3), the collapse of the fishery in 1986-1990, talking about the times before and after the seal-invasion, which culminated in 1987.

The spatial dimension, in terms of changes in abundance of different species in different parts of the fjord, as well as changes in the spatial pattern of fishing, were also addressed in the interviews. Borrowing indigenous land use and occupancy mapping methods and resource mapping methods from Tobias (2010) and others (Brody 1983, Murray et al. 2008), we used a map-biography approach during some of the interviews. This produced an image of fishers' spatial fishing patterns in the seascape during their fishing careers, which could be compared to recent resource mapping by the Directorate of Fisheries representing observations of spawning areas and fishing grounds. As the CSRC had already conducted a collection of Sami place names for fishing grounds in the fjord, this made it possible to keep track of changes in fishers' use of the fjord over a longer period of time.

Results

Ideally, the Fávllis project should have ended up with a comprehensive narrative of socio-ecological history for the fjord, including a 50-year timeline of the socio-ecological history of fjord environments and communities seen from a local perspective. A series of films was made which brought out the sorrow related to loss of traditions connected to saithe, cod, flounder, and other species that local residents used to catch before they started disappearing (Seljevold 2011). In two papers the movements of fishers on fishing grounds in Porsanger were tracked, demonstrating how fishing patterns changed with increasing use of technology (Brattland and Nilsen 2011, Brattland 2012). Porsanger was compared to fisheries in other fjords, characterizing the Porsanger fisheries as one extreme end of a diversity of current coastal Sami adaptations (Brattland 2012). Porsanger fishers have adapted to the new system and integrated themselves in increasingly cybernetic relations with technology and fisheries management institutions (Johnsen et al. 2009).

We ended up with a model of how a comprehensive picture of the socio-ecological history of the fjord can be assembled. The model consists of two parts: creation of socio-ecological narratives and partnership with local institutions. In addition are the research products such as articles and films created by researchers.

Socio-ecological narratives

The categories developed through coding of the transcribed interviews (using NVivo 9 software) provide a database with socio-ecological narratives focused on specific ecological events, and theories about socio-ecological causes and effects of these events. The narratives on observed ecological changes include information on management-relevant topics like species that have decreased in numbers, disappeared or moved, abandoned spawning grounds; changes in harvesting patterns between fjord and coastal fishing areas; and inference and reflection on causes and effects of ecological/socio-ecological events. In creating the narratives, we have separated between fishers' first-hand observations, second-hand observations, inferences, reflections, and interpretations of what they have seen, following Usher (2000) and others in order to categorize knowledge items from the interviews. For instance, one central narrative derived from the interviews is about the seal invasion, as told by the fishers from their own perspective. The narrative is the aggregate result of the codes relating to "the seal invasion 1987-1989" in all of the interviews.

A short version of the narrative on the effects of the seal-invasion on the fisheries in the Porsanger Fjord is that a great number of harp seals came to the fjord in late 1986, and stayed there for about two years. Many seals got entangled in gillnets, and gillnet fishing became impossible. Fishers observed that the cod changed their behavior to avoid the seals, seeking refuge on deeper grounds and did not appear on the usual spawning ground in Olderfjord in March-April 1987. In fact cod have never returned to that spawning ground after the seal invasion. From second-hand observations, fishers can tell that in the 1987 spawning season, huge catches were taken by fishing vessels from the outer coast, using Danish seine in deep waters at the outlet of Porsanger Fjord. A contextual point here is that Danish seine was not allowed in the inner parts of the fjord during the spawning season. The fishers explain what they think may have happened by inference from both first-hand and second-hand observations, as well as after-the-fact reflection: the cod that used to spawn in Olderfjord was a distinct population of fjord cod that returned to the spawning ground every year. Prior to the seal invasion it was under great pressure from gillnet fishing, but the gillnets select out the biggest spawners and this was important for the survival of the population. As the cod changed behavior to avoid the seals in 1987, the population was concentrated in the outer parts of the fjord, and easily available for catch by Danish seine. According to the fishers, since Danish seine is non-selective, the Olderfjord spawning population was wiped out in a matter of weeks.

When mapping the fishers' careers in the seascape, the consequences of the seal invasion and the introduction of the vessel quota system in 1990 can be seen in the abandonment of the innermost part of the fjord as an important fishing area (Fig. 2).

The seal invasion narrative can be used as a guideline for tracking the movements of fishers in the seascape and comparing other fishers' careers and the socio-ecological histories of other fjords or even the health of the Porsanger system relative to the socio-ecological history of other coastal areas (Ommer 2007).

Local partnership

The Coastal Sami Resource Centre was not only a door-opener for selecting informants, but also participated in the choice of focus for the research as well as in data collection. The CSRC also contributed to and published a volume of project papers (Andersen and Persen 2011), and organized local meetings and a final project conference where results from the project were presented to fishers and the local public. The partnership contract also entitles the local partner to keep all records and analysis from local data collection for further use. The main outcome from our collaboration was that both parties learned from each other, thus enabling the CSRC not only to document TEK and LEK, but also to create new knowledge and innovations through the partnership. An example of this is the joint work with further development of a website for displaying local knowledge such as land and seascape use. The CSRC had already created a database with names on fishing grounds at the time the Fávllis project arrived, and this was developed to include videos and narratives from the project. Our experience is that local partnership is crucial, for practical reasons as well as for ethical reasons. It has made data collection easier, contributed to the legitimacy of research in the community, and not least facilitated feedback and dialogue with local residents through meetings and seminars where research results were presented and discussed. In addition, our engagement with the CSRC has initiated a learning process also on the local level about scientific research on fjord and coastal environments.

Discussion

Today's challenges for research on LEK are different from the 1980s: it is no longer enough to say that there is some interesting

Figure 2. Three Porsanger fishers' careers showing concentration on abandoned fishing grounds prior to 1987 and current fishing activity (polygons) mapped by the Directorate of Fisheries. Map by Frøydis Strand and Camilla Brattland, Fisheries College, University of Tromsø.

knowledge out there that should be somehow considered. LEK is already being collected and produced in different ways, as the summary of the Fávllis project and the Epigraph program has shown. The Fávllis project was able to provide a longer historical perspective on social change in coastal Sami communities and changes in how management and the scientific community relate to local ecological knowledge. However, instead of integrating research efforts, the social scientists produced research on the human and political side of the changes in Porsanger Fjord, while marine scientists produced knowledge on ecological relations and species, building up a knowledge base on which to base management decisions. The impact of the increasing research effort on Porsanger was different, however. While science on fjord ecology from Porsanger was included as a reason to be cautious about fishing for coastal cod in a law proposal by the Norwegian government (Prop. St. 70 L 2011-2012), LEK on resources in the fjord does not receive the same attention. The intentions of the Norwegian government are contrary to the scientifically dichotomic outputs from Porsanger Fjord as a site of immense research effort over several years. These intentions are part of a larger development in which resource governance is moving toward recognition and realization of the potential of LEK in fisheries management and mapping of fjord ecology and marine biodiversity in Norway (Directorate for Nature Management 2007). Why has LEK not been integrated with science to a greater degree in Porsanger, and why are the research outputs from scientific disciplines on the same fjord still so different? In the following, we investigate which barriers to LEK integration remain in the present context.

Power relations

There are many factors that seem to work in favor of increased integration of local ecological knowledge with science. Asymmetrical power relations have been pointed to as a major barrier that prevented local knowledge from making much difference in management of fisheries and marine environment in the twentieth century. Eythórsson's 1993 paper was written in a context of political opposition to the newly implemented vessel quota system in 1990, when criticism from fjord fishers and the Sami Parliament against the state regulatory system was at its highest level. The call for integration of LEK in management can be seen as one expression of frustration over the fact that the management system had not adapted regulatory measures to local contexts, but rather included all of the fjords as if the ecological situation were the same everywhere. In the Norwegian context, fjord fishermen had little voice in the Norwegian Fishers' Association, and there was no arena where they could engage in a dialogue with management authorities (Eythórsson 2003). LEK was seen as one of the keys to change and transform the power relations themselves—if fishers were included as knowledgeable, they would gain in power instead of being ignored by the powerful.

During the last decade, power relations have indeed changed, but not through integration of local ecological knowledge. Rather, new independent associations of coastal fishers, fjord fishers, and coastal Sami fishers are making their voices heard (Norwegian Association of Coastal Fishers established in 1987; Fjord Fishers'Association founded in 2007; and Bivdi, Coastal Sami Fisheries Organisation established in 2005). The Ministry of Fisheries is now required to consult the Sami Parliament on fisheries regulations that affect the coastal Sami, and these consultations represent an arena where the concerns and interests of coastal Sami and other fjord fishers can be discussed directly with the Ministry. There has also been increased attention to the issue of fjord fisheries as a result of proposals from the Coastal Fishing Committee for Finnmark (NOU 2008 p. 5). The committees' proposals included reopening the fisheries commons for the coastal population in Finnmark, based on traditional use rights and indigenous rights of the Sami people, as well as a new regional management institution for the coastal fisheries in Finnmark. These proposals were not implemented by the government, but certain concessions were made in terms of access to the fishery, additional quotas to small-scale fishermen, permanent closure of the fjords for large vessels and active gear, and a new advisory committee on fjord regulations. In sum, the position of fjord fishers in relation to political institutions has improved, despite the fact that the number of fjord fishers has severely declined in the last two decades. Also, the position of the Sami people as represented through the Sami Parliament has improved, and Sami political goals regarding fisheries have to some degree become integrated in fisheries management (Sami Parliament 2004).

Scientific and managerial recognition of LEK/TEK for management and planning

Compared to the situation in 1989-90, the attitude toward the relevance of research on LEK/TEK was more positive in 2008-2010, within the scientific community as well as in management institutions. During the last two decades, LEK and TEK have gradually become household concepts in various policy documents on environmental management and impact assessments. There is an apparent agreement that integration of local knowledge as part of the basis for management and planning is desirable and useful. The Institute of Marine Research and the Directorate of Fisheries have recognized the significance of separate populations of cod in the fjords; there is now a separate assessment of coastal cod, but not for each fjord population of cod. Since 2004, Directorate of Fisheries has prohibited Danish seine in the fjords in order to protect these populations. Marine scientists also have become more open to collaborative research, including local fishers in their projects. Moreover, fjord ecology has recently become a field of research for the Institute for Marine Research. Some of the changes in a research approach can be attributed to international trends toward ecosystem-based management, biological diversity, and the turn toward marine spatial planning and marine protected areas (MPAs) in fisheries management. The increased attention to marine space, rather than fish stocks in the fjords, is also triggered by growing conflicts between fisheries and aquaculture. This is reflected in the claims for indigenous fishing rights on behalf of the coastal Sami as well as the need for preservation of marine resources in the fjords as a necessary basis for the viability of coastal Sami culture voiced by the Sami Parliament. These claims were considered illegitimate in the late 1980s, but are now recognized as a legitimate part of the fisheries agenda (Eythórsson 2003). Brattland (2012) characterizes the integration of Sami political goals in Norwegian governance as an "ethnic turn" in environmental and fisheries management, especially since 2005 when large parts of Finnmark County were transferred from state ownership to the Sami and Norwegian population in Finnmark in common. As a result, there is likely to be more pressure on the government to fund research on fjord ecology, and also to include local knowledge as a legitimate part of the management process.

There is also an increased demand for LEK from planning and impact assessment efforts. All coastal municipalities are now required to work out coastal zone plans, zoning marine space according to different uses, while considering biological diversity, cultural heritage, and environmental values. This also applies to impact assessments for aquaculture and other changes in seascape use. The role of local/traditional knowledge in these processes is defined in the Act of 19 June 2009 No 100 Relating to the Management of Biological, Geological and Landscape Diversity (Nature Diversity Act). In sum, the political recognition of LEK as a valuable knowledge source has never been as favorable as in the present context in Norway, and the marriage of ecosystem-based approaches to management with research on local fjord ecology sets a wholly different context for LEK research compared to the early 1990s. Neither power relations nor political skepticism to the inclusion of LEK as a valid basis for management decisions are as large barriers as they used to be. What other challenges are there, then, that result in what we have described for Porsanger Fjord?

Cross-disciplinary collaboration

Our experience from trying to compare and integrate science and local knowledge on the fjord ecosystems is that there is little overlap between the two, not necessarily because of epistemological differences, but rather because the data represented different spatial and temporal scales and very different methods. Until recently, marine scientists have concentrated on fish stocks and large-scale ecological systems such as the Barents Sea, and the research on fjord ecology that started in the 1990s is limited in scope and cannot produce long time series. The experience-based knowledge of local fishermen, on the other hand, is limited to their harvesting space, and the distribution of different fish species within that space. Fjord fishermen can recollect long-term trends and events of ecological change throughout their fishing career or even back to the time of their fathers and grandfathers, which brings a much longer time perspective on ecological change in the area. To represent their experiences is challenging, however, and to integrate it with marine science even more so.

Another obvious difference between marine science and our project is the relationship to power and management institutions. Local knowledge has for a long time been regarded as anecdotal, undocumented, or irrelevant, and there are few, if any, arenas for real dialogue between marine science and local knowledge. When LEK is collected and presented in scientific ways it is more credible for managers. However, the product most likely to be consumed by the management system is the data from the Institute of Marine Research. These constitute an image of a thoroughly different fjord and a different ecosystem from those in the Fávllis project. Instead of being rare and special, and full of biodiversity, the Fávllis project presented a fjord with disappearing fish and a local fishery on the verge of disappearing. Socio-ecological narratives are told from a point of view where loss of resources is connected to sorrow, while data on temperatures and reductions in the size of fish are answers to scientific curiosity and perhaps even joy of finding new and unique habitats.

As implied in the introduction, research on LEK and on local ecology are not producing the same realities. How can we produce coherent stories from the Porsanger Fjord, and is it even feasible and desirable? The solution, which may seem obvious with the benefit of hindsight, lies in the development of knowledge in partnership with local people—not only of socio-ecological knowledge, but also of knowledge derived from interaction with marine scientists. Our approach is currently that our local partner, the Coastal Sami Resource Centre, takes on the responsibility of managing the database and maps, and using them as appropriate in a database on the Porsanger Fjord landscape available on the CSRC website. In this way, the ownership of data and control over its further use stays with the local partner. The presentations of socio-ecological history in our interviews represent a contribution to local history and documentation of cultural heritage, subjects that are central to the goals of the CSRC to, among other things, vitalize coastal Sami heritage and identity.

We believe that this is a way to empower the community in terms of engagement in management and planning processes in Porsanger.

If local institutions are enabled to manage their own narratives, it can facilitate a real knowledge exchange instead of assimilation of local knowledge by science. At present, however, the limited resources and capacity at the CSRC in Porsanger are a major restriction for its opportunities to act as an active counterpart to research and management institutions.

Conclusion

In this paper we have discussed the challenges related to a construction of different worlds in interaction between locals and scientists. From our experiences with the Fávllis project, our observation is that the greatest challenge to integration of LEK with science in the Norwegian context is cross-disciplinary cooperation between marine and social sciences. The framework, political intentions, and power relations are all in place, but there is a lack of cooperation between those who do the research. Without cooperation, the potential of LEK-science integration cannot be realized. Instead of looking for barriers to the integration of two epistemologically different bodies of knowledge (Soto 2006), we should rather look for conditions that facilitate institutional cooperation and cross-disciplinary collaboration in partnership with local knowledge producers.

Is there a way to create common worlds that can hold all perspectives, instead of competing ones? We believe that disciplinary boundaries are part of the problem, as well as the lack of links between local knowledge institutions and scientific disciplines. It is therefore imperative to build competence and capacity in local institutions to make them able to participate in the knowledge game now taking place. It is not only about making local knowledge available to management, but being able to manage that knowledge locally and exercise a certain degree of control over how it is used externally.

In this situation, good research practice and institutional contracts in studies of local knowledge from all parties seems more important than ever. We believe that with a partnership approach, where local institutions are responsible coproducers of knowledge along with cross-disciplinary networks, local knowledge will make a difference, not only for resource management and planning, but also for developing and maintaining knowledge in local institutions and networks.

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Resisting the Imminent Death of Wild Salmon: Local Knowledge of Tana Fishermen in Arctic Norway

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Abstract

In 2009 the Norwegian Directorate of Nature Management warned that the Atlantic salmon population in the Tana River in arctic Norway was dramatically reduced. Active measures had to be taken to prevent extinction. Local fishermen protested against this description of the cause of events. On fishing expeditions, expert claims were continuously discussed. Such conversations were, and are, a substantial part of everyday conversation among local fishermen. In this article, the fishermen's conversations are used as an entry into particular aspects of local knowledge, its relational nature, and the implicit epistemological politics. As their witness, during hours of fishing and conversing, I observed how the fishermen scrutinized scientific knowledge claims. They didn't just question and compare the expert's knowledge claims with what they themselves knew. Significantly, the fishermen made comparisons of how knowing was done. The ongoing conversations of the fishermen enacted a resistance more complex than was visible at first sight. Positing fisheries science as the "Other," local knowledge was enacted and assembled as fluid and heterogeneous, including numerous unequal and loosely assembled entities.

Introduction

In the years 2009-2010 the Norwegian Directorate of Nature Management and related environmental institutions all claimed the urgent need to protect the wild Atlantic salmon populations in the Tana River in arctic Norway. According to environmental authorities, active measures had to be taken to prevent a further decline of local salmon species. In the Tana Valley, many fishermen did not agree with this description. In their opinion, ebbs and flows in the fishing populations were part of life. Fishing restrictions were therefore an unwelcome prospect. As the Directorate attempted to reduce both the fishing time and the number of fishermen on the river, protests came in many forms. This article is about the fishermen's ongoing commentary on the experts' predictions of the state of the Tana River Atlantic salmon populations. I wish to make these daily conversations, undertaken in the course of fishing and other salmon-related practices, my point of access into local ecological knowledge (LEK).

Although a substantial number of the population along the Tana River in Finnmark consider themselves to be Sami, many are not so clear on their ethnic identity. There are also a number of non-Sami, Kvæn, and Finnish along the river. I therefore choose not to engage in a discussion regarding differences between indigenous knowledge (IK) and local ecological knowledge.

All of us who work with groups that rely on centrally governed natural resources will recognize this kind of ongoing commentary of an expert's opinions. In this text, I suggest that these conversations offer *particular* insights into local knowledge. Local knowledge may, as we all know, complement scientific knowledge. For the last three decades, many fishery scientists have substantially benefited from the collaboration with fishermen (Ludwig et al. 1993, Johannes 1993, Mackinson 2001). Fishermen, for example, have contributed to fish science on subjects central to their professional exercise, such as observations of fish behavior and distribution, as well as feeding habits, habitats, and fish movements (Johannes 1993, Eythorsson 1993, Mackinson and Nøttegård 1998, Pinkerton 1989, Mackinson 2001, Aswani and Lauer 2006).

Articles on such exchanges of knowledge provide the impression of that local knowledge being in a form immediately available to science. In this article, I am interested in less specific kinds of local knowledge, the kinds that scientists, at least in the Tana River, show little interest in. There are several reasons why this knowledge is not of interest to fish scientists: part of it relates to its form, which is not specific enough to suit scientific purposes. However, this knowledge does, in my opinion, provide us with insights into the particular *nature* of a local knowledge. By use of the interface between science and fishermen's knowledge, this chapter provides insight into local Tana fishermen's epistemology, to how the fishermen know what they know, and what the fishermen think about how scientists and fishery managers know what they know. These insights are useful for purposes such as understanding processes of the collaboration between experts and local knowledge holders (Ween and Riseth 2011), preparing the grounds for co-management structures (Pinkerton 1998), or the joint planning of future regulation (Pinkerton 1989, Berkes and Folke 2000).

The ethnographic material that this article is built upon is assembled from fishing expeditions on the Tana River. It highlights the intersectionality and relationality of local knowledge, as local knowledge is produced and practiced in dynamic adaptive processes (see Berkes 1999, Davidson-Hunt and O'Flaherty 2007). Knowledge is ordered, according to Law and Mol, by structured routine performances that make cause-and-effect relations, and cluster elements and attributes in assemblages (1994: 643). These assemblages often emerge as entangled. I make notes of the topographies of knowledge displayed in the fishermen's accounts, and the materialities involved (Verran 2002). Local knowledge not only responds to changes in the local environment or to technological innovations, but also engages with other knowledge practices, such as fish management or fish science. In my ethnographic material, the fishermen's conversations made apparent the complexities of the present knowledge interfaces: how such sites may not necessarily involve smooth mergers, but could involve rubbing or even clashes (Law 2007). In this material, the rubbing involved in these interfaces makes epistemological politics visible, as the fishermen with me as witnesses attempted to translate, comment, and object to what they perceived to be expert knowledge claims (Roth 2005).

To my argument it is significant that these ongoing reflections are acts of resistance in more than one way. First, they manifest an objection to the hierarchical relations between scientific knowledge and local knowledge. While scientific knowledge, as already described, is regularly employed to verify the accuracy of local knowledge (Davidson-Hunt and O'Flaherty 2007), local knowledge is here applied in similar acts of "Othering," to confirm or discredit scientific knowledge. Second, as I will show, the fishermen not only question *what is known*, i.e., the expert claims that salmon are disappearing, but also *how* scientists and other experts come to know what they know. Let us turn to the Tana River.

Salmon trouble in the Tana River

Its size and its salmon populations make the Tana River the third largest Atlantic salmon river in the Northern Hemisphere. Along with other key salmon rivers in Norway, it has been protected from salmon farming (NOU 1999: 9). Originating in the far north of Finland and Norway, smaller rivers join up in Tana Valley to form the border between the two nations. Its position as a border river partly explains why the Tana has always been special, both in a Norwegian and a Finnish context. It has also made the regulation of the river cumbersome. The management of the salmon fisheries is a matter of international negotiations. Its management has moreover been complicated by its particular colonial as well as its postcolonial recent history. Colonial relations at the turn of the 19th century made Norwegian authorities introduce a particular kind of user rights for those who farmed land adjacent to the river. Farming, as proper sedentary life, was encouraged by the state and the king. In 1888 such practices became rewarded with the right to fish with nets and for commercial purposes. Provided that the household produced hay for one cow (2000 kg), one member of the household was given the right to fish with nets for commercial purposes. The people in the remaining population were only allowed to fish with rods. In the 1970s the holders of net fishing rights, called *Laksebreveiere*, became powerful stakeholders, many of whom consider themselves to be Sami. Some three decades later, management of the Tana River changed again with the establishment of the Finnmark Estate (FEFO). When this independent legal body was formed in 2005, the land and resources in the county of Finnmark were handed over to its inhabitants in recognition of the unlawfulness of the state appropriation of Finnmark, as well as the indigenous rights obligations of the Norwegian state (International Labour Organization 169) (Ween and Lien 2012). Following up on the obligations of the Finnmark Act (2005), negotiations to establish local fishery management were started in 2008 and were completed in 2010 with the establishment of the Tana Fiskeforvaltning (Local Fisheries Management). During this process of regulatory changes, negotiations with Finland over the regulation of salmon fisheries were placed on hold. Fishery regulations on the border stretch of the river have effectively not changed since 1989.

Local fishermen on the Norwegian side, however, have experienced several restrictions to their fishing times and fishing practices since the 1980s. The fishing season is becoming shorter, fewer salmon fishing lots are renewed, and several restrictions on fishing gear have been introduced (Niemelä et al. 2009, Ween 2010). Despite these restrictions, there are no bag limits in any kind of salmon fishery on the river. The Tana River is also one of the very few salmon rivers in Norway where net fishing is still legal. The salmon here are fished with pursed seine along the coast and in the fjords; they are fished with standing nets in the river too, as well as by local rod fishermen and visiting anglers.

When I first came to Tana in May 2009, the future death of Tana wild salmon was prophesied with increasing frequency by natural scientists and environmental institutions[1] (see also Niemelä et al. 2009). According to the County Councillor's Environmental Protection Office, catch reports from 2009 were less than 30 tons, and the average fish weight was a meager 3.27 kilos. To the scientists, this showed a dramatic decrease in the large salmon that the Tana River previously had been so famous for (Niemelä et al. 2009). According to Statistics Norway, the 2009 catch implied an almost 50% decrease from the year before (http://www.ssb.no/elvefiske/). Comparing the 2009 catch with the top seasons in the 1970s, when catches could be up to 250 tons, it further underlined the alarming nature of the situation (Niemelä et al. 2009).

Knowledge transfers

As the reader has learned from the previous passage, fishing is engaged in the Tana River from multiple knowledge positions. People fish with nets, with rods, trolling from boats, or they practice angling from the riverbank. Locals also engage in fishing from different knowledge positions: some fishermen work for environmental institutions, some are researchers, some are experts in Sami salmon practices, others are year-round professional fishermen, while some simply fish for the joy of it. Sometimes, the way you fish tells other people who you are. But as is the case with Finnmark, generally identity is continuously negotiated (Kramvig 2005). Some communities are more Sami and others are less so. But with the exception of a couple of villages, the lower ends of the river are considered less Sami than the villages farther up the river past the main village, Tana bru.

In the Tana Valley, during the summers salmon fishing is what men do. Most other aspects of life stop in the last week of May when the salmon season starts, and will not start again until it ends on August 1. Although other activities take over after salmon fishing in this annual cycle, conversations about salmon are ongoing: people sum up the season's fishing experiences, they compare with previous years, talk about big catches, small catches, they exchange stories of sales, and particularly the experiences from the 1970s when an entire house could be furnished from the sale of a small catch. They retell stories of past fishermen and their skills. People recall fabulous salmon meals and seasonal conflicts with tourist anglers. As the winter returns, people repair their nets, tie new flies, and make strategies on how to improve their catch in the coming season.

When the dramatic decreases in the salmon catches were announced, along with the need to further regulate salmon fishing, many kinds of communication took place. There were political and legal initiatives, some of which I was also involved in as an anthropologist.[2] These moments of intense political process were, however, not the only times when local fishermen communicated with environmental institutions and researchers: representatives of fishermen's organizations participated in advisory capacities to the Directorate of Nature Management (DN). When new laws and regulations were proposed by the Directorate or the Ministry of Environment (MD), fishermen and their organizations participated in public hearings. Fishermen also communicated with the Sami Parliament, to influence the Sami Parliament's responses to such hearings.

Information travels the other way too. However, information from the fishermen to scientists and fishery managers tended to be of a more specific nature. To exemplify, fishermen are obligated to report fishing catches to Statistics Norway[3]; they send fish scale samples[4] to the County Councillor's Environmental Protection Office and communicate with researchers, such as myself. The exchanges between fishermen and environmental authorities are, in other words, of a different nature to the communication between environmental institutions and the fishermen. The information provided by local fishermen was and is often responses to suggested regulations, or specific information: catch statistics, scale samples, and local knowledge of particular phenomena, all offering particular aspects of salmon-ness (for similar descriptions, see Mol 2002, Asdal 2004). As is often the case with exchanges between interest groups and experts, it is not always clear to all parties what is communicated. Communication does not always come across as intended and what is received is at least partly coincidental (see also Asdal 2004: 33).

Methodology

Now that I have accounted for the many kinds of exchanges taking place between experts and local fishermen, and the many positions that such knowledge exchanges take place from, I can return to the more *informal* conversations taking place in the course of fishing and other salmon-related practices. This paper is written on the basis of three summers of fieldwork, most of which were spent fishing or engaging in other salmon-related activities with local Tana fishermen. The ongoing conversations that I use as my empirical material are a routine part of salmon practices in everyday life.

In the course of all of these fish-related activities, people remember and discuss the environmental institutions' claims of the dwindling salmon population and the proposed new regulations of salmon fishing. In my description of these routine performances, I keep in mind Law and Mol's perspective on how knowledge is structured through routine performances that make cause-and-effect relations, which cluster elements and attributes in assemblages (1994: 643). Practically, I make notes of how fishermen take their cues from ongoing interaction with animal life, environment, technologies, and economies, as well as how they debate or confirm each other's interpretations. From my privileged position I am introduced to, and am able to introduce the reader to, salmon assemblages of the Tana River.

Interspecies relations

Local fishermen partly blame seals and other marine predators for the receding numbers of salmon in the river. In their stories, the seal is often described as a great salmon hunter. Environmental authorities, on the other hand, classify the seal as an endangered species. Only very limited seal hunting is allowed. The fishermen argue that the Directorate of Nature Management's ban on seal hunting and its protection of other marine predators have directly contributed to reductions in salmon stock. In their view, environmental authorities should reduce the number of marine predators instead of reducing the number of salmon fishermen:

> We are in a boat near the river basin. In the next boat, the oarsmen point to a seal on the riverbank and say: Someone saw a seal at Båtseng the other day. Alf, who is holding the hand net, nods in response to his companion: In Luftjok too, some even say it is so bad you see them in Karasjok.
>
> …Moving our gear onto a boat in Båteng, halfway up the river, Lars explains to me: When the salmon migrates up the river, it will stop at the delta, and again under the bridge for 3 days to acclimatize and adjust to the fresh river water. That's when they are vulnerable to the seals. Same thing when the smolt goes down: it has to get past the seals on the way out to sea.
>
> …From his beach in the fjord, Otto points to places out in the sea while he explains: It is not just that the seal eat the salmon when they migrate up the river. In the 1970s we had an invasion of harp seal on the coast. The salmon just wouldn't come in. They saw the seal and left again.

By introducing the seal, the fishermen question what they see as the rationale behind the current regulations, that is, the assumption that they themselves are the greatest predators. The seal is, however, not the only predator the fishermen include; other marine predators are connected with the salmon in open networks:

> …From outside his cabin in the fjord, Rolf points to the sandbanks: When there is a lot of sand eel [tobis, *Ammodytes tobianus*], the goosander [*Mergus merganser*] will eat that, but when there is no tobis, the goosander eats a lot of smolt. There are thousands of them now here in the river delta.
>
> …Where I hunt moose, Nils explains to a politician: There is a salmon ladder that the otter uses as a hiding place. One morning when I was there to hunt, he took two salmon, dragged them onto land, ate some of the belly of one, and a bit of the liver on the other. He left the rest. Otters are formidable hoarders…

In these fragments of stories, the fishermen follow the salmon as they migrate from the sea into the river, and out again. On its travels, the salmon is pictured encountering seals and other predators. Through these statements, the fishermen argue that the environmental authorities should look beyond relations between man and fish. A multitude of nuanced relations are evoked, tracing the existence of multiple, complex interspecies relations.

Unlike the "objectness" (see also Ingold 2011) that the fishermen associate with fishery managers, animals are visualized interchangeably as both individual and multiple: masses of tobis are no longer present for salmon to eat, and the otter is introduced as a particularly ruthless animal that behaves differently from what biologists consider to be otter behavior. Seen together, these statements emphasize numerous connections, where many animals meet in such ways that it defies possibilities of prediction.

Non-animal agency in interspecies relations

Fishermen's concerns with unpredictable interspecies relations (including both animals and people) also include environmental institutions. It is not just that these institutions do not, in the fishermen's opinion, see the complex and heterogeneous assemblages that influence salmon populations, but that they also directly intervene in local ecologies by protecting particular species, such as seal, otter, goosander, and pike:

> …When I was young, we used to shoot the common seal, one fisherman says evenly. He looks at my face to judge my reaction: Seals tasted great. From my childhood, I also remember eating eagle soup.

> …It isn't just the seals, Isak commented. On the nature reserve in the delta, there are endangered predators, such as the otter, goosander, sea eagles, and the great black beaked gull. When they are protected, their numbers increase dramatically.

In these stories, the fishermen voice implicit criticisms of what they perceive to be a sectorial ordering practice in environmental institutions. In the fishermen's opinion, salmon management should not be considered separate from the protection of endangered predators. To the fishermen, such sectioning into separate nature management regimes prevents the involved institutions from observing that what biologists consider to be a fine-tuned, natural balance of interspecies relations was once supervised and managed by local fishermen up until recently. What biologists and nature management institutions see as efforts toward achieving a balanced local ecology, is to local fishermen an intervention in the local human-salmon relations.

Natural cycles or nature catastrophes

In 2009 the Directorate of Nature Management (DN) mentioned climate change as an increase in river temperature, which could be one of the possible causes of the decreasing numbers of Tana Atlantic salmon. The fishermen had a number of conflicting opinions about the reality of climate change. To many, long-term, natural fluctuations in weather temperatures were natural, not man-made. They were also cyclical, not escalating. This lack of acceptance of man-made changes not only applied to climate change, but also to expert assertions that the current reduction in Tana salmon stock was caused by the recent decades by overfishing:

> ...While discussing salmon with members of the Sami Parliament, Geir tried to explain: There have always been natural fluctuations, both in terms of climate and in terms of salmon populations.
>
> ...I am fishing with a net fisherman who is also a respected municipal environmental manager. Ole asks: How can they know about what is normal? The researchers have only been here for 10 years. It takes seven years from when the smolt is hatched until it returns. So, there are 7 good years or 7 bad years. We believe in that, he says, in acknowledgment of the worldview he grew up with. As we carry the dead fish to be cleaned on the riverbed, he adds: We have had black years before. Did you know, in 1904, there was only one salmon caught in Levajohk?

These statements emphasize that to the fishermen, long-term presence is a necessity to understand cyclical relations in nature. In the far north, the cycles of seasons are crucial, like Ingold and Kurttila (2000) have also observed. As these statements indicate, other natural cycles are central too, such as 7-year cycles of salmon life, or the more unpredictable and longer cycles of a milder and cooler climate. By drawing on collective memories of other time-places, local fishermen position themselves as holders of other memories than those available to the experts. Evoking the memories of fathers and grandfathers, these fishermen insist that remembrance can also be an act of engagement with tradition. The other time-places that they access through their families' collective memories relativize the yardsticks held up by experts. By use of such a variety of narrative paths, expert knowledge was destabilized.

The agency of climate, weather, and water

Although many fishermen did not perceive climate change as a relevant explanation to the current state of the salmon stock, many agreed that there were changes occurring that might have specific effects upon the salmon.

> …A cold summer night, I watched Jakob attach a new spoon [a fishing lure used for trolling, shaped like a spoon] and recast his line: Climate definitely has an impact, he nodded. We had such limited amounts of snow last winter; there weren't a real spring flood. We haven't had one for several years, really.
>
> …Leaning on his tractor, Tor took time to explain to me the need for a real flood: The flood is necessary to clean out the sedimentation and deposits in the river bed, to enable the salmon to spawn.
>
> …As we drank coffee on his balcony overlooking the Tana, Simon explained to me: Lack of water can cause eggs to be laid bare and thereby drying out. Likewise, when we have frost in the late autumn, the river freezes, and we have really hard ice. In the last couple of years, we have had mild weather and rain in November. Then, of course, the ice breaks. This steel ice scrubs the riverbed and destroys the vulnerable eggs that were laid earlier in the autumn.

These stories add new forms of actors to local salmon assemblages. What fishermen perceived as the cause-and-effect relations prescribed by the environmental institutions was contested through stories with exquisite detail of the agency of weather and water. Weather and water were included in ways that were predictable and unpredictable, desirable, and unwanted. Weather and water were connected in open, unstable networks: the salmon eggs *could* be affected by the debris gathering in the river when the spring flood fails to show, the lack of water in the shallow pools, or the structure and consistency of ice in warm periods in the early winter. The experiences recounted were all based on multisensory, personal experiences (Ingold and Kurttila 2000). As in the recounting of interspecies relations, these immersions in micro-world details enacted a kind of knowing connected with continued engagement and belonging.

Laws of nature versus slippery flesh

Salmon fishermen not only objected to the narrow and clear-cut assemblages with which they believed the experts ordered the salmon, but also objected to the techno-scientific salmon itself. They deconstructed what they saw as expert models of salmon behavior serving as the foundation for predictions of behavior and numbers. They felt that these estimates and predications were not open to the irregularities of salmon behavior. In this way, they contested what they saw as the environmental institutions' faith in laws of nature, the perceptions of salmon as being bound by instinct, and its predictable behavior from one year to another throughout a life cycle:

> Over a delicious salmon lunch, Fred and Anna talked among themselves: How can they know how many salmon there are in the river? Last year, they said there wouldn't be any big salmon. This year, they said there wouldn't be any small salmon. But we got plenty of big salmon last year and this year has been pretty normal.
>
> ...This time, Jakob is fishing with nets. I have just asked him where in this part of the river the salmon will move upward. He politely explains: Salmon don't always swim in the same places. It's like the trout: when there is pollution in the mountain lakes, the trout spends more time in the rivers. People then think there are less trout, but it's not really true. Same thing with the salmon, with increased pollution, particularly in this end of the river, the salmon swims more in the middle.
>
> ...I meet Lars midwinter. He arrives on his tractor to tell me the story of his life as a sea salmon fisherman. Who knows where we get fish in the fjord? Lars answers my question with another rhetorical one: Sometimes, the fish swim much deeper in the water, then we won't get any fish. Who knows why it swims so deep? Maybe it has something to do with a change in currents, or maybe it is just where the food is.

More than any other salmon assemblage, these stories enact other realities, where salmon is imbued with agency (for similar descriptions, see Fienup-Riordan 1990, Peace 1996). The salmon can perceive danger, can react to environmental changes, and is able to change plans. The salmon introduced to me by local fishermen was able to surprise; it was smarter, more flexible, and adaptable, was sensitive, and took notice of other influences that we might not factor in. Furthermore, it was also more open to individual whims and reciprocated human actions (for descriptions of similar phenomena, see Ingold 2006).

In these conversations, the hypothetical, abstract, stimulus-response-based models associated with the experts were positioned against daily close encounters with salmon. In contrast to the techno-scientific salmon, the salmon evoked was messier (Law 2004) and the assemblages it was part of were more open (see Barad 1996, Ingold and Kurttila 2000, Ingold 2006).

The absence of the sea

Local fishermen objected to what they saw as limitations in the environmental institutions' view of salmon travels and salmon lives. In these stories, opposition to this nearsightedness was brought out. These stories noted that salmon mainly spend a substantial portion of their life at sea. To the fishermen, there was little help in regulating salmon fishing in the river, if experts did not pay attention to what happened in the sea. The fishermen were convinced that the number of fish farms on the Norwegian coast and the size and quantity of industrial fishing, including what was fished for fishmeal production, dwarfed the consequences of local salmon fisheries:

> Knut, an older sea salmon fisherman, says: In the old days, we used to be pleased when there were lots of sea lice. When the salmon is troubled by the sea lice, it swims almost up on the beach, rubbing its tummy against the seaweed. Then, all the fish would swim straight into our nets.
>
> …Anders' knife opens the salmon belly and its gut falls out. He points to its stomach contents. See, it has been eating haddock and look how thin it is. Haddock is only salmon food when the tobis and the herring are gone. It's not just that the fish no longer find enough food in the ocean; such fishing has other consequences too. Species like tobis live off sea lice grubs, then, of course, the balance is upset. Maybe salmon smolt is becoming more vulnerable to the sea lice?
>
> …Jonas shows me the documents he has collected and explains: This winter's tobis fishing off the coast of Finnmark is worth 750 million kroner. Some years ago, floes of pollock were lined up along the coast. Now, there is nothing. Pollock boats aren't fishing anymore. Tobis is fished in the North Sea to and processed as feed for the salmon farming industry. The more fish farming, the more fishing. Blue whiting too. They catch the tobis before it comes into the fjord. Salmon eat tobis, and so does the sea

> trout. The sandbanks in the delta used to shimmer when the sun reflected on the beached dead tobis.
>
> …Rune explains to me: Forty years ago, we were fishing 400 tons of salmon here in the fjord, and these days just half of it. There are hardly any sea salmon fishermen left. The salmon cottages are rotting. How can it suddenly be our fault when there is none of us left?

Here, salmon was part of assemblages that involved other fish as well as postwar industrialization, expansive fish farming, and the scale and efficiency of international fisheries. (The volume of production of Norwegian farmed salmon has doubled from 2004 to 2009, up to 860,000 tons.) Economies were given agency too, in their capacity to define natural resource priorities. The absence that the fishermen saw in the expert's perspectives, of the effects of these other economies was made present with insistence. Moreover, the consequences were made visible in the landscape as well as in the salmon flesh. More than the other stories, these made moral calls of the perceived judgments that experts made.

Situated numbers

As previously mentioned, Tana fishermen contributed to the production of the scientific knowledge employed by environmental institutions. Since the 1970s, Tana fishermen have reported their annual catches to Statistics Norway, and they have sent samples of fish scales to the County General's environmental office. For some years, other parts of fish such as heads or stomachs have also been submitted for analysis. Tana fishermen do, moreover, report and return radio tags when these are found on the fish they catch. However, contrary to what one may assume, Tana fishermen's participation in the production of scientific facts did not make them more respectful of science:

> The chairman of the laksebreveier zone explained: To count how many salmon there are in the river, the scientists do samples, they estimate what they see in that camera at Utsjok Bridge, and they dive and count spawn in water pools in the autumn. They radio tag a quantity of salmon, and we get paid to return to transmitters. One of his mates around the campfire chips in: God only knows how many of those transmitters are found in deep freezers around. The other guys around the campfire snigger.

> …Amund shakes his head: What is this spawning capacity target[5] that they continually are so worried about? It is just a line someone has drawn on a white piece of paper!

> …While we are wrestling the hand net loose from a tree in the riverbed, the men in the boat become cheerful: I normally report zero fish, regardless, says one. Yes, says the other, but I suppose some fishermen would report a larger catch than they actually got. Both men laugh.

> …Well, you know, says the sea salmon fisherman as he dishes up a beautiful fish meal. The senior advisors in DN are all anglers, and so are those two from NINA [Norwegian Institute for Nature Research] with the salmon project there.

In these statements, the obligatory catch reports to Statistics Norway and the facts calibrated from these numbers are discussed. These statements underline the sociality of numbers as all other kinds of information exchanged. Here, Tana fishermen demonstrated that they were never fooled by the objectiveness and singularity of numbers. The fishermen reconnected the numbers with their actual collection. Numbers were connected with knowing people and the history of the institutions that authored them. In these salmon assemblages, numbers and graphs were brought back into the community of practice of which they were part (Bowker and Star 1999). Through such strategies, numbers were given motivations and the ability to act, for example, by the increasing urgency they brought into being (see Asdal 2004).

Conclusion: salmon knowledge

"Something has to be done to save the Tana wild salmon before it is too late." This message was delivered with increasing intensity by the Ministry of Environment, the Directorate of Nature Management, the Finnmark County General's Environmental Protection Office, and a number of fish biologists. In this article, the prophesied death of wild salmon is described as a case of intersecting knowledge practices. Local fishermen's reflections over how these knowledge practices clash have been approached as a site providing a privileged view of the topology of local salmon knowledge practices (Roth 2005).

Are the fishermen right in arguing, for example, that the seals eat more salmon than the experts are willing to admit? When fishermen oppose what they perceive to be expert knowledge, they communicate something *more* than disagreement with specific scientific facts. With their stories, the fishermen not only questioned and compared the expert's knowledge claims with what they themselves knew, but significantly made comparisons of how knowing was done. In their stories, new comparisons, new agencies, more nuanced connections, and greater intimacy with other species were performed. In the fishermen's stories, knowledge claims were made heterogeneous by introducing more detail and more actors: predators, cyclical changes, weather, water, and the environmental institutions themselves. Locals insisted on introducing multiple time-places, and other time-places than those with which the environmental institutions, in the fishermen's opinion, operated. Facing the techno-scientific salmon, a new, more slippery, order-defying salmon was introduced. The fishermen, in other words, opposed a knowledge practice that made claims to knowing based upon what they felt were singular causal relations, which excluded culture from nature; which saw knowledge as fixed, static, and something that can be represented in graphs and numbers; and finally which denied the political and personal nature of knowledge production. On the one hand, the fishermen's assemblages included a certain fluidity in the knowledge assembled, a looseness in the entities connected, and a lack of pre-given difference between the inside and the outside of the knowledge assembled (Mol 2002: 65). In a very similar manner to Verran's (2002) description of attempted conversations between Aboriginal people and environmental scientists, the fishermen's comments serve to reveal the hidden and the deleted, being messy in ways that both acknowledge other times and places and which make the accumulation of power in the scientists' generalizations.

I suggest that the fishermen enacted an epistemological difference. They not only questioned the knowledge claims in themselves, but also the knowledge community in question and their foundations. The question of how they know what they know served to actualize and articulate how we know what we know as different styles of reality making (Law and Mol 1994).

As suggested by the last paragraph, these knowledge practices also enacted embodiment, locality, and belonging. Viewed together, the fishermen's stories were about political subjectivities and claiming the right to disagree. There are many kinds of resistance involved in these stories. From fishing boats, hierarchies were transgressed, and local knowledge was placed in position to question environmental expertise (Agrawal 1995, Smith 1999, Kohn 2005). The stories reposition local knowledge and techno-scientific knowledge as equal, or they even place science practices in the category of the Other. As the fishermen's stories illustrate, however, the we-ness performed remained fluid and heterogeneous. Salmon were assembled in ways that made room for contradictions and disagreements that related to political subjectivities, claims to status, Sami-ness, non-Sami-ness, education, experience, and skill. As shared in collective memory, stories of salmon serve to enable and affirm shared worlds of experience.

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Endnotes

1 This was described in local newspapers and other media: http://www.finnmarken.no/lokale_nyheter/article4452996.ece, http://www.tanalaks.no/index.php?option=com_contentandtask=viewandid=209andItemid=2andPHPSESSID=4d5rd0bo6ke55ntsl4k292vgs5

2 I participated in the writing of a report commissioned by the Finnmark Commission, the legal body instituted to identify rights claims to land and resources in Finnmark.

3 Fishermen have been obligated to report catches since 1992 (Niemelä et al. 2009).

4 They sent fish scaled samples to the fish scale project that has been ongoing cooperation between the County Councillor's Environmental Protection Office and The Finnish Game and Fisheries research institute (RKTL) since the 1990s (Niemelä et al. 2009).

5 No: Gytekapasitetsmål, calculated from the annual catch statistics.

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The Aha Moku: An Ancient Native Hawaiian Resource Management System

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Abstract

Over the last 40 years, there has been movement for Hawaiian Native people to return to being a Kanaka Maoli. Kanaka Maoli are guided by an ancient chant with generational knowledge. In the ancient system, experts were brought together to create a council to ensure that management of the resources would continue to provide for the people at its fullest potential. This was called the Aha Moku, a system that has defined areas within each island, puts the resource first, and makes use of respectful protocols. In 2007, following several statewide gatherings where resource generational knowledge was shared, the Aha Moku process was introduced as legislation in Hawaii as Act 212. The Act would ensure that the people of their respective Moku were allowed to be part of resource management decisions that affect their Moku. Today Kanaka Maoli continue to work with legislators to formally recognize the Aha Moku system. Federal agencies that have embraced the system include the U.S. Army Corp of Engineers in Hawaii, the Western Pacific Regional Fishery Management Council, and Haleakala National Park.

Introduction

It is difficult to write a scientific manuscript for a people's cultural belief and social structure. Using a "Western science format" to measure or even statistically show an ancient practice is impracticable. It is especially difficult to use a scientific format with knowledge that has been relayed through oral history. What was written was censored, changed, and even misunderstood. When our Native Hawaiian people were exposed to the truth on what has happened to our culture, it became the mission for some Native Hawaiian people today to instinctively bring back our traditional ways. These traditions have been proven to work. The last 232 years of Western influence has led our Native Hawaiians to near extinction, including a complete ban of our language, practices, traditional culture, and most importantly, our management of natural resurces.

Kanaka Maoli and the Kumulipo

There has been movement, over the last 40 years, for our Native people to return to being a Kanaka Maoli (Kah-NAH-kah Mah-OH-lee). In very general terms, Kanaka Maoli is a Native Hawaiian.

The Kanaka Maoli are guided by an ancient chant called the Kumulipo (Koomoo-LEE-poh). This ancient chant, with over 2,000 verses, has been passed from generation to generation since the beginning of our people. We call this passing of knowledge from one generation to the next "generational knowledge."

The timeline defining the beginning of our people has been debated among the scientific and Native communities. However, the sacred Kumulipo has been referred to as our "creation chant" or "the beginning of our time." This chant profoundly describes how, what, when, where, and why Native Hawaiian resources and people came into existence. The Kumulipo probes deep by explaining how things became livable for our people.

The feats of our spiritual beliefs are complicated and cannot be explained in a single document such as this. However, it is important to understand that our belief is that the natural resources are always first priority. Our people believe that people are to be the guardians of theses resources, and the best guardians of resources are those who depend on them.

The Kumulipo inventories, guides, and reflects the importance of what truly defines our culture. It is our beginning, our roots, our responsibility, and our honor. It separates us from others, and this is okay. Accepting that we are different is good. It leads to mutual respect. It is when we ignore that we are different and force our ways onto others that leads us to division.

Aha Moku

A series of gatherings, called Puwalu (poo-VAH-loo), occurred on the island of Oahu in 2005, 2006, and 2007. The Puwalu brought Kanaka Maoli from the Hawaiian Islands together to share our generational knowledge. Knowledge was shared between farmers, fishermen, medicinal leaders, aquaculturists, spiritual leaders, hula experts, resource managers, gatherers, and teachers of our traditions.

One Kanaka Maoli, the late John Kaimikaua, a hula master from the island of Molokai, shared his knowledge of an ancient system called Aha Moku (Ah-hah-MOHkoo). He left us a message that forever will change our views of what being Kanaka Maoli really is. He left us the Aha Moku prophecy as it was passed on to him; it is the foundation for our being in existence today.

The Aha Moku system is an ancient concept that was created during a time when our Native people were so abundant that the management of resources was inevitable. Management methods developed in a way that was so natural that it can be described as instinctive. Once our Kanaka Maoli understood that the goal for our survival is to put our natural resources first, it was easy to understand the concept of the Aha Moku.

Ancient spiritual leaders observed that the fresh waters from land that meet the salt waters of the ocean were a natural phenomenon. The baby fish that were spawned in these waters were so abundant that they appeared as a mass that moved back and forth, like a cloud cutting through the sky. These baby fish were known as “kiole” (key-OHleh). When the spiritual leaders looked onto the land, they saw that the abundance of people mirrored this cloud of fish. It was decided then, that a resource management system was needed, hence the creation of the Aha Moku system.

“Aha,” in simple terms, is a natural fiber cord woven from smaller cords, so precise that each smaller cord shares the workload when the larger cord is in use. Metaphorically, it is more complex. The smaller cords of the Aha represent persons who are experts. In our Puwalu these were the farmers, fishermen, medicinal leaders, etc.

In the ancient system, these experts were brought together to create a council of experts. The council would combine their observational and generational knowledge to ensure that management of the resources would continue to provide for the people at its fullest potential. The experts came together, evenly sharing the workload, focusing on their responsibilities, making the Aha strong.

In many instances, restrictions were placed to protect resources and allow for natural reproductive cycles to occur. The people followed protocols for these restrictions to observe natural processes and gain valuable knowledge to be passed to the next generation. Our people knew that nature, unlike people, has no protocols.

Hawaii is made up of many islands. The eight larger islands are commonly known as the “main Hawaiian Islands”: Maui, Molokai, Lanai, Kahoolawe, Oahu, Kauai, Hawaii, and the privately owned island of Niihau. Every area on each of these islands is different, as tiny as they may be. Each island has different areas that are dry, wet, windy, rocky, with mountains, wetlands, shoreline cliffs, beaches, sand, etc. The

Figure 1. The 12 Moku on the island of Maui, Hawaii. Northernmost, clockwise: Kaanapali, Wailuku, Hamakua Poko, Hamakua Loa, Koolau, Hana, Kipahulu, Kaupo, Kahikinui, Honuaula, Kula, Lahaina.

amount of freshwater within these areas will differ, and therefore the resources and styles of fishing will differ.

"Moku" are regional boundaries on each island formed to ensure that the protocols that were placed among the people were applicable for that area. When these Moku were established they included five common elements: land, shoreline, ocean, water, and air (to include celestial bodies and heavens). For example, the island of Maui has 12 Moku (Fig. 1). Once the Moku were established, then, like the Aha cord, smaller land divisions known as Ahupuaa (ah-hoo-poo-AH-ah) were placed within the Moku to evenly share the workload. Each individual and each family would be responsible for their role in managing the resources within the Ahupuaa.

An important point to make is that the people of each Moku set their appropriate resource management protocols. Each Moku had their site-specific Aha councils to ensure that the balance between nature and people was intact and properly functioning. Equally important, the people of each Moku had mutual respect for the resources, and the people in other Moku were respectful of the protocols for that Moku.

The result of putting together the "Aha" with the "Moku" creates an adaptable, site-specific protocol for managing resources. Aha Moku is based on observational knowledge of our resources and is passed to the next generation through oral history.

Aha Moku and the Kumulipo

Together with the Kumulipo, Aha Moku provides the best guidance for the care of the resources. Kanaka Maoli of today reference the Kumulipo that was used as the guide in the past, is still used today, and is to be used in the future. The Aha Moku is the system that evenly balances the amount of care and responsibility needed to ensure that the natural resources continue to provide the life-sustaining materials that we need to survive.

The natural resources that are found only in our Hawaiian Islands are what defines us as Kanaka Maoli. These resources give us our culture. This is explained to us by our ancients in the Kumulipo. It was the foundation for our Aha Moku system. The Kumulipo tells us that the resources extend from the depths of the oceans to the heavens in the sky. It tells us that what is reflected on land is mirrored by what is in the ocean, such as the iiwi (ee-EE-vee), a forest bird with a long curved beak, and the hinalea iiwi (hee-nah-LAY-ah ee-EE-vee), an ocean fish with an extended jaw. Therefore, our actions on land will impact the ocean as well as the heavens. The responsibilities of each Aha Moku council expand from the heavens to the depth of the ocean. It is all connected, like the smaller cords that make up the Aha; it all has roles to keep, or the Aha begins to break.

Aha Moku today

In June 2007, the Aha Moku process was introduced as legislation and referred to as Act 212. The Act was authored by Senator Kalani English, Representative Mele Carroll, and Senator Russell Kokubun and was signed into law by then Hawaii Governor Linda Lingle. The purpose of Act 212 was to create an Aha Moku commission consisting of eight members, one to represent each main Hawaiian Island. The Act would ensure that the people of their respective Moku were allowed to be part of the resource management decisions that affect their Moku.

Act 212 also established a governor-appointed Aha Kiole Advisory Committee. The committee is referred to as Kiole. (This "Kiole" is not to be confused with the ancient meaning of "kiole" that refers to the spawned baby fish. It is a legislative term given for the eight committee members). The committee was tasked to go out and share the Aha Moku system, inventory the areas, and recruit participants. This was an inclusive process for people of all races, since this was based on generational knowledge of our culture and resources, and not race.

The Aha Kiole Advisory Committee submitted a report on actions, activities, and terms to the Hawaii State Legislature in 2009, the original sunset date for the Committee. The sunset date for the committee was extended to June 30, 2011 to finalize the report. The report is presently with the Hawaii State Legislature.

Legislation is currently being drafted to formally recognize the Aha Kiole Advisory Committee's report. The report is not acknowledged because of political discrepancies. There are challenges in convincing local government and private conservation groups that the Aha Moku is an inclusive system that recognizes and considers all stakeholders.

Other adversities arose from this process. One example was the misconception of the role of the Aha Kiole. Some took this as a title with authority, rather than a representative. This perceived entitlement drew barriers with the community. The Aha Moku system is a community-based system and the misconception of entitlement divided people. The role of being the experts or the Aha Moku councils is responsibility, not a title. Those who shared the Aha Moku system with personal agendas, or pushed there ideas forcefully, created division in the communities. This is a result of not putting the resources first.

The Puwalu participants continue to work with legislators to formally recognize the Aha Moku system. Federal agencies have already optionally embraced the system. These include the U.S. Army Corp of Engineers in Hawaii, Western Pacific Regional Fishery Management Council, and Haleakala National Park.

Being part of the Aha Moku system is a major responsibility. For Kanaka Maoli, once the true meaning of our role as Native Hawaiians is realized, the responsibility for caring for our resources is given to us at birth. Once we say we are Kanaka Maoli then we must put our resources first. It was the way of our ancients, which is the reason why we are still alive today.

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Indigenous and Ecological Knowledge for Understanding Arctic Char Growth

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Ulukhaktok, Northwest Territories, Canada

Abstract

This community-driven mixed methods project identifies key environmental indicators of changes in growth of arctic char (*Salvelinus alpinus*) using both quantitative (ecological) and qualitative (indigenous knowledge) data, by linking community-based monitoring, local expert indigenous knowledge, and ecological knowledge. Arctic char is a staple subsistence resource for Inuvialuit on Banks and Victoria islands in Northwest Territories, Canada. In recent years, significant climate variability and change have been observed in the area, raising concerns about how this variability will affect subsistence resources. Residents in communities are the first to directly observe these changes in the local climate and the resultant effects on their land, water, and animals. Centuries of knowledge and observations about the environ-

ment and natural resources exist among Inuvialuit hunters and fishers. Indigenous knowledge can complement our scientific understanding of environmental variability and change and its effects on arctic species. Community-based monitoring provides an opportunity to better understand the current status of arctic species and can form the basis for understanding and preparing for future changes in arctic species in light of climate variability and change effects. Using a mixed methods approach to research is one way in which ecological and indigenous knowledge bases can be brought together to complement one another and provide a more thorough understanding of northern fish species in a changing environment.

Introduction

Residents in the communities of Sachs Harbour and Ulukhaktok in the Inuvialuit Settlement Region (Fig. 1) have observed unprecedented and rapidly changing environmental conditions in the land, water, and weather surrounding their communities over the past two decades. Observations of climate variability and change in the two communities include higher seasonal temperatures, changes in precipitation patterns, and changes to wind conditions and storm events. It is hypothesized by local residents and scientists (Reist et al. 2006, Wrona et al. 2006) that these effects will impact many species including arctic char (*Salvelinus alpinus*), a northern fish that has been a part of the Inuvialuit culture and diet for over a thousand years and still plays an important role in the lives of northern people today.

The harvesting of country foods, including freshwater and anadromous fishes, is an important part of Inuvialuit life, culture, and human health (Furgal and Seguin 2006). Subsistence fisheries in the Canadian north contribute toward the need for fish protein in local communities (Berkes 1990) and provide omega-3 fatty acids in the fish oils that have been shown to provide protection against diseases and illnesses (Berner and Furgal 2005). People in northern communities who eat country foods have a healthier diet than those who eat store-bought foods and are provided with the nutrients they need (Nuttall 2005). Eating local country foods also provides important cultural, social, and economic benefits (Nuttall 2005). Accordingly, arctic char is an important subsistence and nutritious food for the Inuvialuit (Berkes 1990, Stephenson 2004).

Regional increases in climate variability and change outside the range of historical locally observed conditions in combination with the resulting effects on the local environment, flora, and fauna can lead to impacts on local fish habitats including alterations to biogeochemical processes, water temperature regimes, bank erosion, primary and secondary productivity, and trophic structure (Wrona et al. 2006).

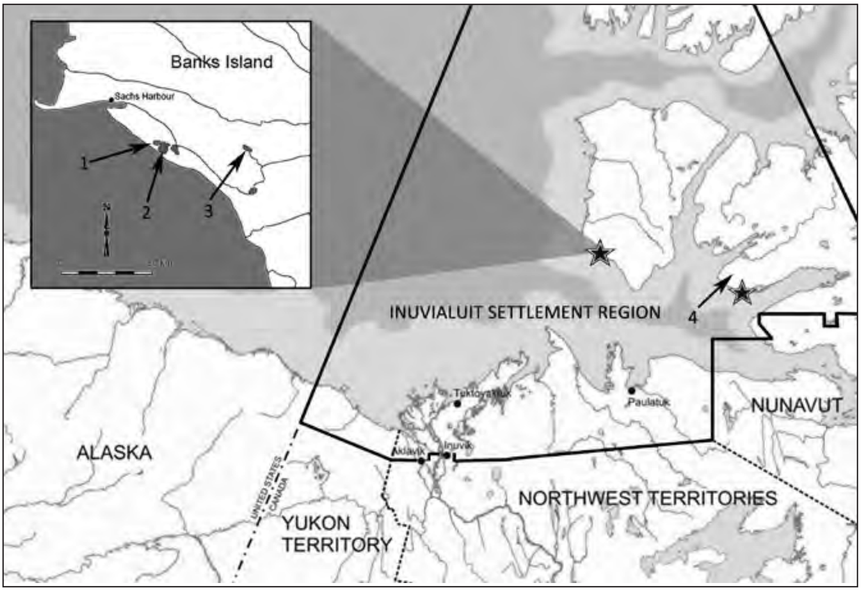

Figure 1. Map of the Inuvialuit Settlement Region, outlined by the solid line. The study areas Sachs Harbour (Banks Island, left star) and Ulukhaktok (Victoria Island, right star), in the Northwest Territories, are highlighted. The four study lakes are (1) Kuptan, (2) Middle, (3) Capron, and (4) Ikahavik.

Indirect secondary effects on arctic freshwater and anadromous fishes could result in changes to fish size and numbers, fish body and meat condition, and changes in anadromous behavior (Reist et al. 2006). Local residents will have to adapt to the outcomes of these secondary effects, which have the potential to alter or lessen the potential use of the resource, change the quality of their fish meat, and as a result change access to healthy country foods (Berner and Furgal 2005, Reist et al. 2006).

The importance of arctic char to communities in the Inuvialuit Settlement Region, and the impending effects of a changing environment outside of locally observed norms, necessitate effective long-term community-based monitoring to gather systematic information to detect changes in and make decisions about the resource. Arctic community residents are often the first to observe local changes as they happen and are currently the best individuals to consistently monitor these changes over long time scales. Community-based monitoring supports opportunities for both local study and the collection of scientific data to inform the ongoing inquiry into how environmental stressors affect northern fish (Riedlinger and Berkes 2001, Furgal et al. 2006, Laidler 2006). Residents in the community of Sachs Harbour, concerned about the effects of climate variation on their arctic char resource, requested the creation of a community-based monitoring plan. Residents felt it was important to include in the monitoring plan (1) indigenous knowledge (IK), because the resource user and local residents have extensive, first-hand knowledge about the environment and char, and (2) scientific sampling to obtain a clear picture of how the environment is affecting arctic char in their region.

A mixed methods research design was chosen to integrate the extensive first-hand knowledge of the local experts—who observe the environment and the char on a continuing basis over several decades—with ecological research methods. It is an approach to research combining quantitative and qualitative methods, focusing on integration of the two forms of knowledge (Creswell 2009). The inclusion of indigenous observations and knowledge is important to complement the knowledge gained from scientific sampling that occurred for a few weeks each year of the project. A mixed methods approach is also important when working with communities to include insights and input from local expert fishers in all phases of the research design, parameter selection for scientific sampling, data collection, and data analyses, as well as to determine their needs for community-based monitoring.

The mixed methods approach structures the collection, analysis, and triangulation (i.e., verification by comparative analyses) of quantitative (biological and ecological data) and qualitative (IK gathered through social research methods) data (Creswell 2009). In working at the interface between the two sources of data and knowledge, the following research questions were examined:

1. What are key climatic and environmental indicators (drawn from both science and Inuvialuit knowledge) that can forecast changes in local arctic char growth?

2. How is resident arctic char growth in the western Arctic influenced by char trophic position, lake morphometry, and water chemistry? And will this change?

3. Are these indicators feasible for use in arctic char community-based monitoring programs in Inuvialuit communities?

The overall goal of this study was to examine new ways of monitoring local arctic char populations that utilize the resources and knowledge of scientists and local residents to create effective, long-term, community-based monitoring programs.

Methods

Mixed methods research design

A mixed methods design (Creswell 2009) to the research was taken. Specifically we used a parallel concurrent triangulation design with sequential steps. This method was chosen to study annual arctic char growth in relation to local annual environmental conditions. We used contemporary biological and ecological sampling methods to gather quantitative data on annual arctic char growth and condition as well as fish habitat, concurrently with social science research methods to gather IK on char condition in relation to environmental variables. These two perspectives support a more robust understanding of arctic environments and northern fish ecology. Using a parallel concurrent triangulation design, quantitative and qualitative data were gathered and analyzed separately and then brought together through a process of triangulation to determine whether the data sets complemented, corroborated, or contradicted one another with respect to the same parameters (Furgal et al. 2006, Creswell 2009, Furgal and Laing 2012). Triangulating on answers to the research questions was achieved by reiterating in sequential steps the process above to determine new parameters or questions for study needed to explain phenomena observed in previous steps. Areas where the two knowledge bases converge on an explanation of observed phenomena are where the science and IK complement one another. Areas where the knowledge bases diverge results in new questions or phenomena to be examined. And in areas where the knowledge triangulates, the result is a new and more in-depth understanding synthesized from both knowledge bases.

The local expert fishers in Sachs Harbour and Ulukhaktok were directly involved in research design and determination of study locations and environmental and ecological parameters for scientific sampling (Fig. 2a-d). Local assistants were trained in scientific sampling methods (Fig. 2b) and worked with the researcher throughout the project to sample all fish habitat parameters and to collect data from fish caught in scientific nets and local subsistence catches (Fig. 2c and 2d).

Qualitative methods

Because this research was conducted with the communities and used local expert knowledge, it was critical to include local residents in every phase of the research, and attempt to understand and experience the shared knowledge as well as possible. This was aided by the inclusion of local assistants in data collection and interpretation, and in participation in land-based activities such as fishing practices.

A review of previously documented Inuvialuit knowledge literature from the region was conducted, which included recorded community interviews, researcher interviews, and Inuvialuit government and com-

Figure 2. Images showing stages in the qualitative research process: (2a): An elder from Sachs Harbour draws his fishing and travel locations on the map during an IK interview. (2b): Researcher and a local assistant are teaching each other about biological sampling methods and local knowledge about fish, respectively. (2c): Researcher with two elders from Sachs Harbour during an interview at a commonly used fishing location. (2d): Fishing trips with local fish experts were conducted to understand how the resource is used.

munity documents. Scoping sessions and semi-directed interviews (Creswell 2009) using participatory mapping (IFAD 2009) (Fig. 2a) were conducted with local fish and environment experts (Davis and Wagner 2003). Interviews were digitally recorded and transcribed. All transcriptions were verified by participants whenever possible to ensure transcription reliability (Creswell 2009). A grounded-theory approach (Charmaz 2006) was used in the qualitative data collection and analysis. Grounded theory is a method of examining knowledge in which the researcher derives general theories about study topics grounded in the perspectives of the interviewees (Creswell 2009). The knowledge shared by local experts was analyzed by the researcher for common thematic groupings of emergent patterns in the IK interviews (codes).

These codes were used to identify key local expert observations of changes of in arctic char growth in the area and to identify key indicators or cues of direct and indirect associations between environmental conditions and char growth (Charmaz 2006). Coding was verified by an independent researcher. Participants in both communities validated coding and knowledge analyses completed by the researcher during follow-up visits.

Quantitative methods

Field sampling to examine fish habitat characteristics among the study lakes included the following data collection: percent bank erosion; water chemistry (total suspended solids, total dissolved solids, pH, nutrients, metals); lake bathymetry; and plankton abundance and size diversity. By determining if there are similarities and differences in fish habitat within and among the study lakes, interpretation of the resulting patterns supports either lake-specific or regional climate-driven changes in arctic char growth within a given year.

Otoliths (fish ear bones) and a suite of other biological samples and measurements including length, weight, gonad weight, maturity, sex, parasite load, and stomach contents were collected from arctic char from study lakes near Sachs Harbour and Ulukhaktok (Fig. 1). Arctic char age and annual growth analyses are being conducted using age-specific otolith back-calculation (Kristofferson and Klemetsen 1991, Høie et al. 2008). This technique determines annual growth in individual fish (Fig. 3), which is then compared to the previously chosen environmental parameters (Power et al. 2000, Kristensen et al. 2006, Chavarie 2008). Von Bertalanffy growth curves were estimated using historical arctic char otoliths collected by Fisheries and Oceans Canada in 1993-94 from the Banks Island study lakes, using the following equation:

$$E\,[L\,|\,t] = L_{\infty}[1 - e^{-k(t-t_0)}]$$

where L is the length of the char at age t, L_{∞} is the maximum expected size of the char in the population, t_0 is a coefficient that adjusts the model to correct for the initial fish size, and k is a growth coefficient (Isely and Grabowski 2007).

Similarities in a given year of growth across a range of age classes across all study lakes would indicate a regional rather than a lake-specific phenomenon. Anomalous climate conditions in that year may be an indicator of the link between climate and fish growth.

Preliminary analyses

Local experts in Sachs Harbour reported extensive knowledge and understanding about fish condition, size, numbers, feeding, and migra-

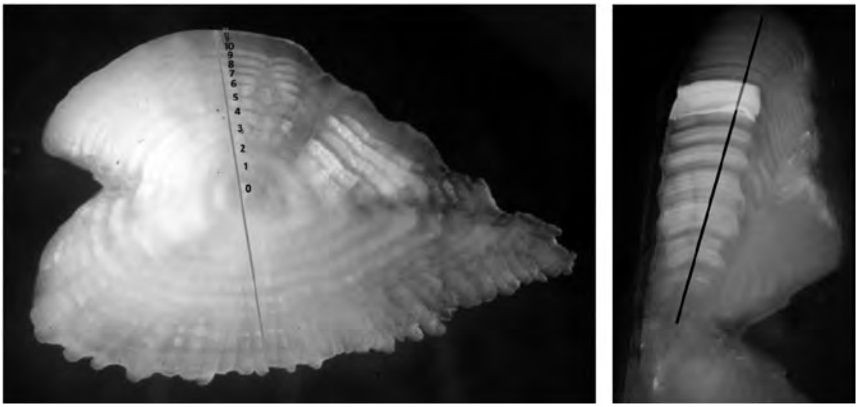

Figure 3. Whole arctic char otolith (left). Fish age (13 years for this individual) can be determined, similar to using tree rings. Dark gray line shows sectioning plane. Sectioned otolith (right) from a Middle Lake arctic char 16 years of age. Black line shows path used for back-calculation measurements that in turn are used to infer fish growth in each year of life. The highlighted annulus (on the right) represents a single year of fish growth.

tion. Local experts also provided a detailed understanding of changes in local climate and environmental conditions and how these changes affected both arctic char and char habitat. Figs. 4 and 5 present emergent theme (code) diagrams from the qualitative data showing the breadth of knowledge on the topics of fish, fishing, and environmental variability and change in the region of Sachs Harbour. An example of an emergent theme of an environmental condition that has the potential to affect lake resident arctic char growth is sea ice. Local experts observed noticeable changes in sea-ice conditions around the same time other changes to the lakes and fish were occurring. Low sea-ice coverage in nearby ocean environments can lead to more open water. Open water in the sea environment has a lower albedo than sea ice, resulting in the absorption of more solar radiation which has the potential to lead to warmer water (Barber et al. 2008). Reduced sea ice and warmer ocean waters could lead to warmer ambient air temperatures and perhaps increased precipitation, which in turn could result in warmer conditions in the local landlocked lake environments. Therefore regional sea-ice coverage is a parameter relevant for consideration in arctic char community-based monitoring programs.

The preliminary results of the quantitative analyses of scientific data showed differences in water chemistry, percent bank erosion, and

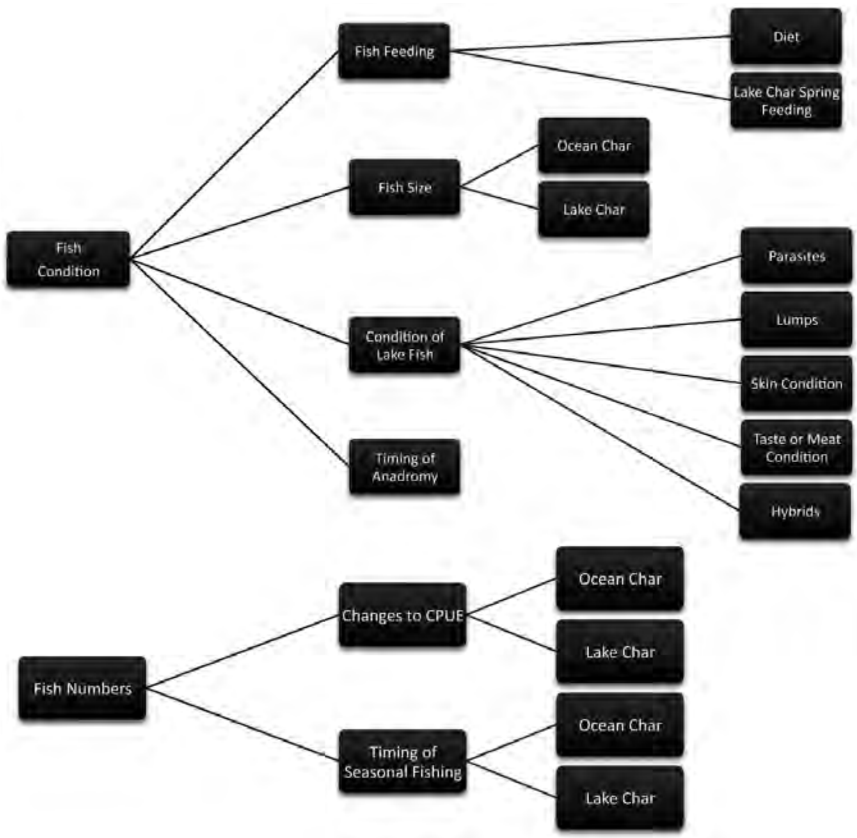

Figure 4. Diagram showing the emergent themes (codes) from the indigenous knowledge (IK) and the breadth of knowledge and understanding from local experts about arctic char growth and condition obtained from the analyses of IK interviews in Sachs Harbour, Northwest Territories. Theses codes were used to determine scientific sampling parameters to examine fish condition and growth. CPUE is catch per unit effort. Lake char refers to landlocked arctic char. Ocean char refers to anadromous arctic char.

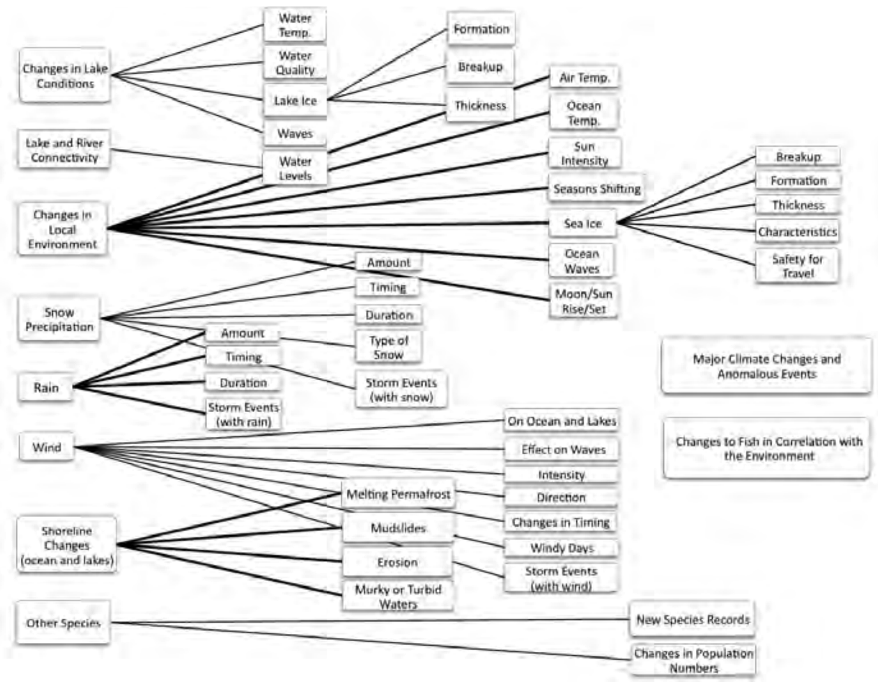

Figure 5. Diagram showing the emergent themes (codes) from the indigenous knowledge (IK) and the breadth of knowledge and understanding from local experts about environmental factors that affect arctic char growth, obtained from analysis of IK interviews in Sachs Harbour. These codes were used to identify indicators or cues of direct and indirect associations between environmental conditions and char growth.

lake volume and depth among the study lakes near Sachs Harbour. Arctic char diet and parasite load also varied among the study lakes, despite their close proximity to one another. The von Bertalanffy growth curves (Fig. 6) estimated from otoliths collected from Kuptan, Middle, and Capron lakes in 1993-94 showed the populations in each lake fit expected growth patterns, but there are differences among the three populations in the maximum size attained by the char and the age at which the maximum size was reached. The knowledge shared in the IK interviews complements the scientific findings of the effect of local lake environment on arctic char growth; interview analyses show that local experts have observed char from each of the study lakes to have different maximum sizes. The two knowledge bases complement one another, indicating that local lake environment does have an effect on arctic char growth.

Preliminary results of the otolith back-calculation for char captured in 2008-2009 show a large increase in growth in a single calendar year approximately 10 years earlier, across a range of age classes in both Middle ($n = 18$) and Capron ($n = 15$) lakes (Fig. 3, top right image, annulus highlighted in dark gray). The knowledge shared in the IK interviews complements the scientific findings of changes in arctic char growth with interview analyses showing that changes to landlocked char sizes occurred approximately a decade before the start of this research. This change in lake char sizes prompted the community to request the implementation of an arctic char community-based monitoring plan. The IK interview analyses as well as previous IK documented in research projects (Riedlinger and Berkes 2001, Nichols et al. 2004) showed that major climate and environmental changes occurred around the same time, including late sea ice formation, warmer air temperatures, and major shifts in storm and precipitation events. The change in char growth in different study lakes around the same year observed in both knowledge bases indicates that regional climate-driven changes in arctic char growth may be occurring. Lake habitat and environmental parameters determined through ecological and indigenous knowledge are currently being analyzed in association with that year of observed increased growth in order to test links between char growth and climate.

Discussion

To date the project has developed a more comprehensive understanding of the local lake ecosystems and environmental factors influencing char growth in this region than previously existed. This resulted from linking scientific quantitative data sets with qualitative data gathered from local experts and IK holders. The iterative process used to bring together qualitative and quantitative data, using a concurrent parallel mixed methods design with triangulation, is developing a more holistic

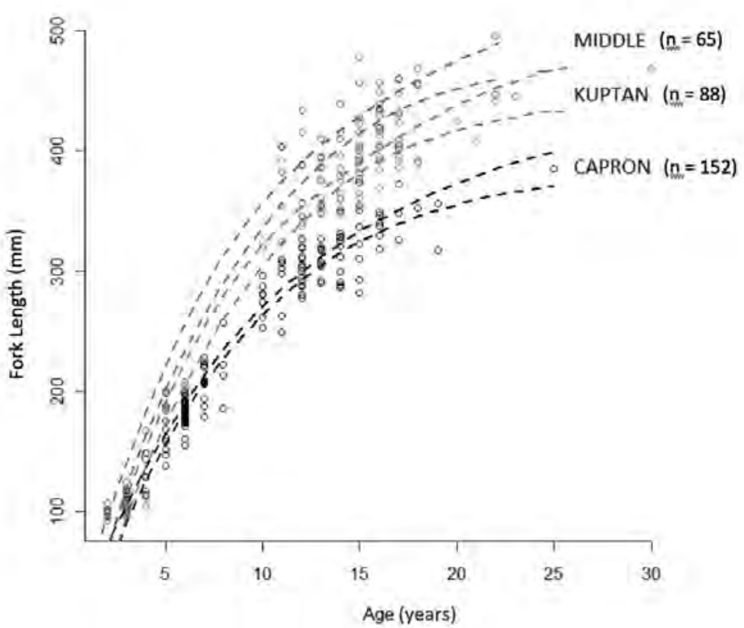

Figure 6. Von Bertalanffy growth models for arctic char from the three study lakes on Banks Island using data from 1993-1994. The two dashed lines for each lake represent the 95% confidence intervals (Middle, Kuptan, and Capron lakes).

approach to the study and identification of environmental parameters that could affect char growth. The parallel concurrent triangulation design of the research project has determined that sea-ice conditions, ambient air temperatures, and precipitation may play a role in lake resident arctic char growth. Incorporating these parameters into the arctic char community-based monitoring plan will provide further understanding of a complex and changing ecosystem in support of the management of the local fishery. The preliminary results of the quantitative analyses showed concordance with the indigenous knowledge and community observations of recent changes. Many more areas of agreement between the two knowledge bases are being identified in the ongoing analyses in this project.

Community members from Sachs Harbour and Ulukhaktok have observed local environmental and unprecedented climate conditions and variability including unpredictable and rapidly changing weather patterns, large increases in summer and winter ambient air temperatures, significant permafrost degradation and erosion, major changes to the local sea-ice and water conditions including thinner sea ice in winter and a lack of ice floes in summer, changes to freshwater flow regimes, new species occurrences, and species not normally seen in this area showing up in higher numbers including beluga whales and Pacific salmon. It is crucial that monitoring of the arctic char resource take place because of its importance to the Inuvialuit people and the increasingly dynamic nature of the environment in which they live.

Ultimately, this information is needed for the management of arctic char stocks harvested by Inuvialuit communities. The results of the research and creation of the Sachs Harbour community-based arctic char monitoring plan will provide data for management decisions to be made by local hunters and trappers committees and co-management boards. Further analyses using the mixed methods process will expand our understanding of local environmental indicators of change that are effective and feasible for use in arctic char community-based monitoring plans in these communities. The approach developed here, and lessons learned, may be used as a model in other arctic communities in the future.

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Subsistence Density Mapping Brings Practical Value to Decision Making

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Abstract

Identifying marine areas of significance for subsistence is crucial for preventing future conflicts between coastal communities and marine-based industries, which are expected to increase in the Arctic. Development can have both positive and negative effects on the communities that occupy the area. Although development may bring economic activity to economically depressed rural areas, development that disrupts subsistence has potential to affect food security, traditional practices, and well being of Indigenous communities. In order to examine areas of temporal and spatial overlap between development and subsistence, maps of Indigenous marine use are needed. The Bering Sea Sub-Network (BSSN) endeavors to address this need as one of its objectives. BSSN, community-based research, uses semi-structured interviews to gather quantitative, qualitative, and spatial data on subsistence activities in eight Indigenous communities bordering the Bering Sea, in the Russian Federation and the United States (Alaska). An innovative subsistence mapping technique, which utilizes the kernel density function in Geographic Information Systems (GIS) and a time series of data, is being used to display subsistence use locations at the equal interval scale. The purpose of this article is to demonstrate the

utility of this technique in research and the decision-making realm. An example is provided from Gambell, Alaska, in the Bering Strait region, where commercial vessel traffic is expected to increase.

Introduction

The Arctic is warming at almost twice the rate of the rest of the world (ACIA 2004, IPCC 2007) causing significant losses in arctic sea ice extent and thickness (NSIDC 2011). An increasingly ice-free Arctic has attracted interests in oil and gas development, mining, commercial fishing, and commercial shipping (AMAP 2007, Arctic Council 2009). But these areas are not voids to be filled. Indigenous peoples continue to depend on these relatively undisturbed ecosystems for subsistence as they have since time immemorial. Development can have both positive and negative effects on the Indigenous communities that occupy the area. Although it may bring economic activity to depressed rural economies, activities that disrupt subsistence have potential to affect food security, traditional practices, and well being of Indigenous communities. Tools are needed to better plan for coexistence of economic development with minimal disruption to subsistence activity. Sustainable development in the Arctic that benefits communities and industries will require precise planning that incorporates both spatial and temporal components.

A subsistence mapping methodology is needed that is specifically designed to address the decision making and research needs of a changing Arctic. This methodology needs to produce "intensivity" maps to address decision-making needs, protect the confidentiality of individual harvest areas, include a temporal component, and have the capacity to incorporate input from limitless respondents. Research needs include the ability to spatially compare harvest use areas through time and build correlations among harvest use areas and environmental conditions. The purpose of this article is to introduce an innovative subsistence mapping methodology employed in community-based research that fulfills these needs using an example from Gambell, Alaska.

The *Arctic Marine Shipping Assessment 2009 Report* (Arctic Council 2009) identifies arctic natural resource development and regional trade as the drivers for future arctic marine shipping activity. It identifies a need for "Regional analyses of traditional marine use patterns (spatial and seasonal) for application in the development of strategies and measures to reduce potential conflicts and impacts of multiple users of arctic waterways." The report goes on to say, "There is insufficient information to identify with any precision the likely effects of marine shipping for most arctic communities." In many rural areas available information about Indigenous marine use is inadequate to plan for future expansion of shipping, although this is an issue that concerns

Indigenous groups and is likely to affect many arctic communities (Cameron 2012).

There are an estimated 100,000 Aleut, Chukchi, Cup'ik/Yup'ik, Inupiat, Koryak, Kamchadal, Itelman, and Siberian/St. Lawrence Island Yupik people living in coastal communities around the Bering Sea, in both the Russian Federation and United States (Alaska). The area was occupied between 10,000 and 30,000 years ago during the last ice age, as reduced sea levels allowed people from Eurasia to cross the Bering Land Bridge. Today's communities are generally characterized as rural, with little built infrastructure. Access is often by small plane or boat. Subsistence remains a predominant way of life in many communities.

The Bering Strait lies between the Russian Federation (Chukotka) and the United States (Alaska). It is one of the narrowest sea lanes in the world (53 miles at its narrowest). All vessels traveling between the Arctic Ocean and Pacific Ocean are channeled through the Bering Strait. The area is bordered by several rural, Indigenous communities with members who depend on the resources provided by the sea (Ahmasuk and Trigg 2008, Gofman and Smith 2011). Because of the potential for spatial overlap of these two conflicting uses (shipping and subsistence) the Bering Strait region has been identified as particularly vulnerable to an increase in shipping activity (Brigham et al. 2008, Arctic Council 2009).

Traffic in the Bering Strait has increased from 245 vessels in 2008 to 325 in 2010 (Bucknell 2011) and it is expected to continue to increase into the future (Arctic Council 2009). The U.S. Coast Guard (USCG) has recognized the need to modify current vessel routing measures, and public meetings are being held in the area as part of the Port Access Route Study: In the Bering Strait (Federal Register 2010).

Concerns over increased shipping activity include the effects to marine mammals, which are an important subsistence food resource. Marine mammals are sensitive to the acoustics from ship traffic (Wartzok et al. 2003, NRC 2005). Bowhead whales *(Balaena mysticetus)* have been observed to alter their migratory routes to avoid noise sources (Richardson et al. 1995). They are also susceptible to accidental collisions with large vessels (Reeves et al. 2012). Walrus *(Odobenus rosmarus)* and ice-dependent seals are likely to flush from ice haul-outs when approached by vessels (Fay et al. 1984, Jansen et al. 2010) making them less available to hunters. Because of this the continued availability of subsistence food concerns local people (Brigham et al. 2011).

Gambell, Alaska: An example

Gambell, Alaska, United States, is one of the Indigenous communities that will likely be affected by increased shipping activity. The village of Gambell is located on the northwest cape of St. Lawrence Island and is about 36 miles from the Chukchi Peninsula in the Russian Far East.

Gambell's population of around 649 is more than 95% St. Lawrence Island Yupik (U.S. Census 2000). The area has a rich cultural history and residents are some of the estimated 1,500 speakers of St. Lawrence Island Yupik. The Yupik name for St. Lawrence Island and Gambell is Sivuqaq. Residents are heavily dependent on subsistence resources for nutritional and cultural value. Access is by small plane or boat, which makes fuel and store-bought food expensive. Per capita income in Gambell is $8,764 and 30.6% of families live below the poverty line (U.S. Census 2000). BSSN respondents reported that only 19.5% had full-time work, while 42.4% were unemployed. Subsistence foods are consumed at least one day per week by 98.8% of the population and every day of the week by 29.1% of the population (Ahmasuk and Trigg 2008). In Gambell, 94% of the harvested subsistence resource is composed of marine mammals, which include bowhead whale *(Balaena mysticetus)*, three species of seal *(Erignathus barbatus, Phoca largha, Pusa hispida)* and Pacific walrus *(Odobenus rosmarus divergens)* (Ahmasuk and Trigg 2008).

Subsistence activity in this area is facing many challenges. A discussion of the effects of increased shipping in the Bering Strait would be incomplete without considering the cumulative effects of a warming Arctic, since consequences of direct and indirect effects on subsistence hunting practices are heightened by their interaction (Ford et al. 2006, Hovelsrud et al. 2008).

There is evidence that a major ecosystem shift is taking place in the northern Bering Sea (Overland and Stabeno 2004, Grebmeier et al. 2006). The northern Bering Sea is in the heart of the Pacific walrus distribution. Warming water temperatures are causing a change from arctic to subarctic conditions, causing some species ranges to shift northward (Mueter et al. 2010). In particular the benthic zone is warming, reducing the fitness of the benthic species that walrus prey upon (Grebmeier et al. 2004). These data suggest that the prey base for walrus is declining. The negative effects on walrus could pose additional hardship to the residents of Gambell. ACIA (2004) observes that, "changes in species' ranges and availability… present serious challenges to human health and food security."

Sea ice is an important platform for hunting, travel, and butchering marine mammals in this area. The extent and thickness of sea ice has changed drastically in the last 10 years (NSIDC 2011). BSSN community-based research in Gambell shows that 84% of respondents ($n = 49$) have observed a change in ice condition during the past 10-15 years (Gofman and Smith 2011). In interviews residents elaborated by saying that changes in sea ice required them to travel farther, was more dangerous, shortened the hunting season, was increasingly unpredictable, and caused difficulty in butchering (Gofman and Smith 2011).

Subsistence or use and occupancy mapping

Subsistence mapping, also known as use and occupancy mapping, is a unique field that joins social science research methods with cartography. It is frequently used to establish Indigenous use of resources and occupancy (Tobias 2009). These maps may be used in negotiating territorial boundaries and resolving conflicting resource uses. Due to the legal implications of subsistence maps they often remain confidential in nature even after the conflict has been resolved, and little has been published in the way of methodology. As of 2004 there were no best practices in this field (Elias 2004), although Tobias (2009) may be emerging as such a resource. Of the resources that have been published dealing with methodology (Ellanna et al. 1985; Tobias 2000, 2009) none deal specifically with the marine environment. This is a relatively new area of study and a variety of methodologies have been used.

In Figs. 1-4 some theoretical examples of subsistence mapping methodologies are presented. All of these techniques have been used to map subsistence except for the density map in Fig. 4, although density maps have been used to display other human uses or values. Density mapping has been used on point data to map the relationship of fishing communities to a particular resource area (St. Martin 2008, St. Martin and Hall-Arber 2008), community landscape values (Alessa et al. 2008), and patterns of recreation use (Schumacher et al. 2000, Landre 2009).

Spatial subsistence data are commonly symbolized as points or polygons. Points commonly denote specific harvest locations, such as kill site, while polygons are better suited to denote search areas. The maps in Figs. 1-4 were created from similar theoretical data. The points displayed in Figs. 3 and 4 were created from the centroids of the polygons used in Figs. 1 and 2. Figs. 1 and 2 were created from the same data in the form of polygons; Figs. 3 and 4 use the same point data, but in both cases the method of display is different.

Subsistence maps fall under two main categories, "extensivity" and "intensivity" (Tobias 2009). An extensivity map depicts "the geographic extent of use and occupancy" (see Fig. 1). In contrast an intensivity map depicts "various measures of the relative importance and value of different areas for use and occupancy" (see Figs. 2, 3, and 4). Methodology must correspond to the purpose of the map (Ellanna et al. 1985) and each methodology has its advantages and disadvantages.

Extensivity maps (Fig. 1) protect the confidentiality of individual harvest locations and are easy to understand. They are frequently utilized to provide a snapshot of information on use during a certain time period (for examples see Magdanz et al. 2010). Extensivity maps are created by drawing a line around all reported harvest areas. They present the maximum extent of the area used. These types of maps display subsistence use areas as nominal data, meaning it either is or is not a harvest use area, and a black line separates the two. This limits their

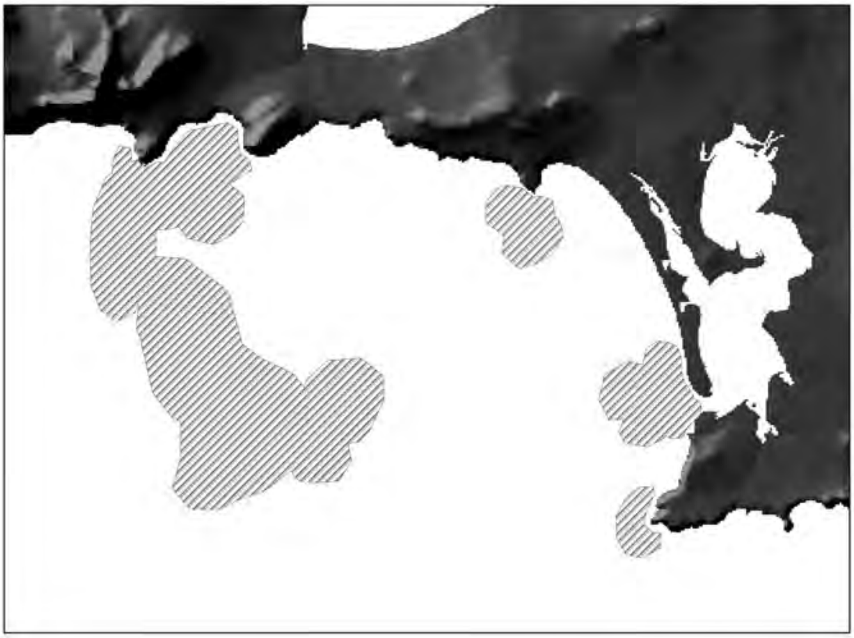

Figure 1. A theoretical example of an extensivity map displaying the maximum extent of subsistence harvest areas. For examples refer to Magdanz et al. 2010.

use in the decision-making realm as relative value within the harvest use area is not displayed leaving little room for negotiation.

Unlike the extensivity map's display of nominal data, an intensivity map displays subsistence use on an ordinal scale from more to less (Figs. 2, 3 and 4). This has been accomplished using overlapping polygons (Fig. 2), hodgepodge (Fig. 3), and density mapping (Fig. 4). For examples of overlapping polygons refer to SRBA 2010. These maps are created from polygons. A graduated color is applied to overlapping polygons, so that areas with more overlap are darker than those with little or no overlap. Fig. 3 is presented as an example of what a hodgepodge map would look like for three different species. The symbol denotes the species harvested. For examples of a hodgepodge map refer to Tobias 2009. While these intensivity maps are excellent at clearly displaying where people harvest, and providing ordinal data for use in decision making, they do not protect the confidentiality of respondents' harvest locations. Individual harvest locations are clearly displayed although they are not connected with the respondent. Fig. 4 is an example of a

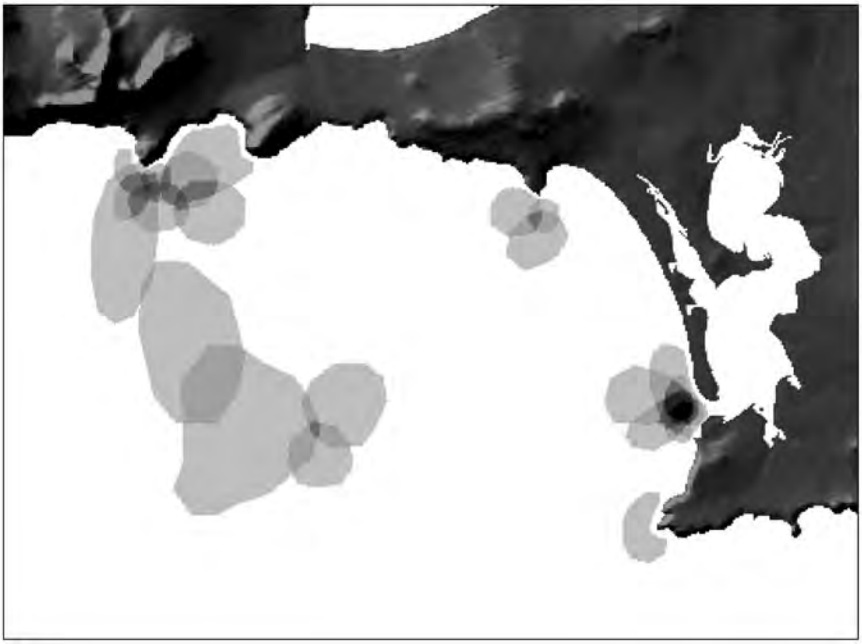

Figure 2. A theoretical example of an overlapping polygon map displaying subsistence areas. For examples refer to SRBA 2010. This map was created from the same polygons as in Fig. 1. A graduated color is applied, so areas with more overlap are darker than those with little or no overlap. This is an intensivity map.

density map. Both Figs. 3 and 4 use the same point data, but in Fig. 4 a density analysis is done in GIS to display the relative value of areas. In this example map the points are displayed as a demonstration, but in practice the points would not be displayed.

The purpose of intensivity maps is to display the relative value of some variable. These maps are well suited to decision-making as they allow for value-based negotiations. Disadvantages include the presentation of potentially sensitive data and difficulties associated with measuring the value of a landscape resulting in misinterpretation or misuse.

The maps in Figs. 1-4 do not reflect the seasonal nature of subsistence activity, which limits their use in decision-making. Because of harsh winters in the Bering Sea, many projects are likely to be more active during summer months (i.e., shipping), so maps that display activity by season, or by month, are more applicable for decision making in this area.

Figure 3. A theoretical example of a Hodgepodge map. For examples refer to Tobias 2009. This was created from point data where different symbols denote the actual kill site for different species.

Scope and methods

The Bering Sea Sub-Network: A Distributed Human Sensor Array to Detect Arctic Environmental Change (BSSN) is an international community-based observation alliance for the Arctic Observing Network (National Science Foundation award ARC #0856774). BSSN is a four year project that builds on a two year pilot. The project is currently in its third year. To date, the network is composed of eight Indigenous communities bordering the Bering Sea in the Russian Federation and Alaska. In Russia participating communities are Nikolskoye (Western Aleut/Unangas), Tymlat (Koryak), and Kanchalan (Chukchi); and in Alaska participating communities include Gambell, (Siberian Yupik), Savoonga (Siberian Yupik), Togiak (Central Yup'ik), St. George (Eastern Aleut/Unangan), and Sand Point (Eastern Aleut/Unangan). This paper includes an example from Gambell, which is on St. Lawrence Island in the Bering Strait region. Although each of these communities is unique, they have many similarities. None are connected to a road system, which makes

Figure 4. A theoretical example of a density analysis done in GIS applied to the same point data as the hodgepodge map Fig 3. For examples refer to St. Martin 2008 and St. Martin and Hall-Arber 2008. This is an intensivity map. Points are included for demonstration purposes only and would not be included in practice.

store-bought food expensive. All communities are dependent on subsistence resources from the productive Bering Sea.

As BSSN is a community-based research and monitoring effort, community research assistants (CRAs) were hired from the community and trained to conduct semi-structured interviews with subsistence harvesters twice a year for four years. A steering committee member was also nominated by the community to guide the research within that community.

Purposive sampling was aimed at capturing a majority of the high harvesting households in a community. Community records were used to compile a complete list of residents, and then community experts reviewed the list, identifying households and high harvesters. A high harvester was defined as someone who has lived and harvested in that community for at least 15 years. One high harvester from each household was chosen to be interviewed, based on experience. Based on that list the interview response rate for Gambell was 57% (95 people) for the first year of the project.

Interviews produced three types of data: quantitative, qualitative, and spatial. The focus of this paper is on the spatial data that was collected from September 2009 to August 2010. At the start of the interview respondents were given an introduction to the project and an opportunity to ask questions. Respondents were given two maps as part of the interview and asked to circle areas where they had harvested bowhead whale, walrus, seal (bearded, spotted, and ringed), and salmon during the previous six month time period. Respondents were encouraged to draw locations with the level of detail that they were comfortable with as confidentiality was an issue. Both small-scale (1:1,500,000) and large-scale (1:375,000) maps were used. Maps were created by BSSN staff and included a hill shade, rivers, the village, and other prominent landmarks. Interviews usually took from 20 minutes to an hour depending on the number of species harvested, and number of locations used to harvest.

A kernel density analysis was used to aggregate all drawn harvest locations. Conceptually a density analysis is a smooth, curved surface fitted over point or line features, intended to reveal spatial patterns. The surface value is the most accurate at the location of the point and diminishes with increasing distance from the point, reaching zero at the search radius distance from the point. The kernel density analysis is based on the quadratic kernel function described in Silverman (1986, p. 76, equation 4.5).

Each map was digitized in GIS and corresponding data from the survey were entered into the attribute table. Polygons were selected based on reported months that the harvest took place (September, October, and November) and species harvested. Because the concern is over the effects of shipping to marine mammal availability, subsistence areas for bowhead whale, walrus, and seal were included in this analysis.

Because drawn harvest locations that are extremely large generally lower the data quality (Tobias 2009), measures were taken to systematically deal with large polygons. Areas farther than 1 km from major rivers and areas 2.5 km from the ocean were excluded from analysis, since all species in this analysis are harvested in the marine or river environment and the inclusion of land areas was assumed to be inaccurate. Distances of 1 km and 2.5 km were selected because often land areas adjacent to water are important for travel or butchering.

Some respondent's drawn locations were disproportionately large and if a density analysis was run without accounting for the size of the polygon, larger polygons would carry more weight because they contain more points. A value was assigned to each polygon by using the formula below:

Weighted Value = Constant/Area

These polygons were then converted to raster using the weighted value. This gives each polygon equal weight in the density analysis, regardless of the area of the polygon. Overlapping areas were summed to create a value for each pixel. The grid was converted to points reflecting the pixel value and a kernel density analysis was run. Pixel size was set at 250 m^2. Search radius was 5,000 km^2. The resulting grid was reclassified, excluding zero, using equal interval into 10 classes.

Results

Fig. 5 displays subsistence harvest use areas for bowhead whale, walrus, and seal from September, October, and November 2009 overlaid with shipping routes from the same months in 2004 (Arctic Council 2009) and 2009 (Marine Exchange of Alaska, 2011, unpubl. data, www.mxak.org). Of the 95 respondents 23 had harvested whale, walrus, or seal during fall (September, October, and November), so the map was created based on input from those 23 respondents.

The density analysis employed in Fig. 5 creates an abstraction based on respondent-drawn polygons. It is akin to draping a blanket over a jagged pile of rocks—what remains is the surface of the blanket. While the surface of the blanket, or the abstraction created by the density analysis, is not the same as the drawn locations in pure form (the rocks), it reflects the essence of individual use areas, revealing trends and hotspots within the spatial data.

By incorporating this mapping methodology the scale of measurement (Stevens 1946) is converted, from nominal, as with the extent maps (Fig. 1) to equal interval. This means that each adjacent shade of color is an equal interval of more or less subsistence activity within the abstraction of the density analysis.

Pale blue speckled areas in Fig. 5 are the maximum extent of respondents' harvest use areas. In the density analysis, larger outlying polygons were valued so close to zero that they disappeared within the reclassification. These areas are important to display, to gain an appreciation for the distances that people travel and potential overlap, but are outliers within the density analysis.

Including the temporal component in subsistence mapping can allow the examination of direct temporal overlap, in addition to spatial overlap, of conflicting uses. From this map areas of direct spatial and temporal overlap are apparent. In 2009 the only actual overlap occurs in the blue area. Shipping data from 2004 are also included, to demonstrate that there is potential for much more spatial overlap within the fall season. Right now vessels are free to go where they like. In 2004,

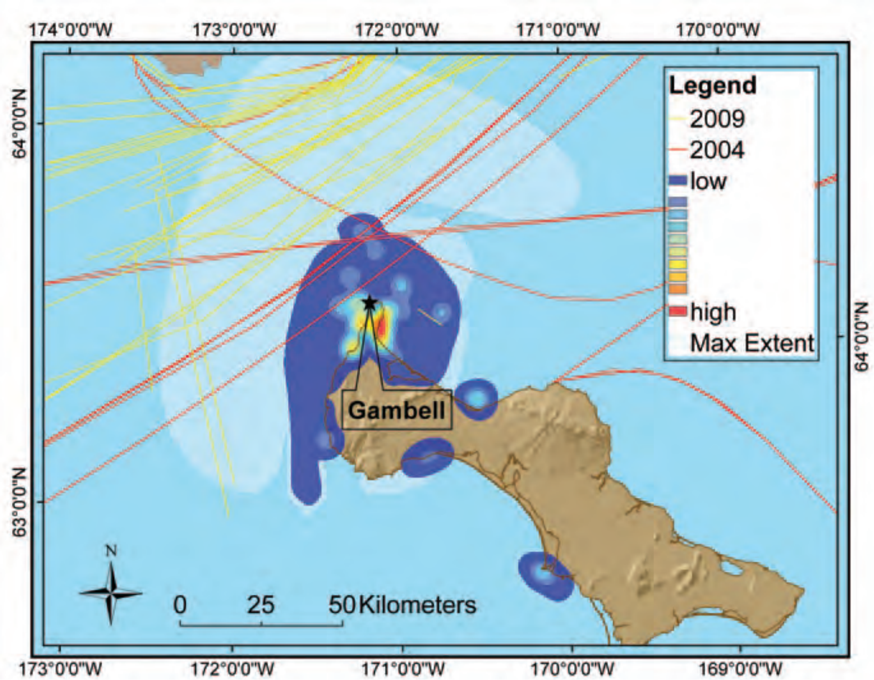

Figure 5. **This map is an example of the subsistence density mapping methodology presented in this paper. It displays subsistence harvest areas for fall 2009 overlain with shipping routes from fall 2004 and fall 2009. The map includes input from 23 residents of Gambell, Alaska. A kernel density analysis was used to display subsistence areas on an equal interval scale. Harvest areas for bowhead whale, walrus, and three seal species are shown for fall 2009. They are overlain with shipping routes from fall 2004 (Arctic Council 2009) and from fall 2009 (Marine Exchange of Alaska, unpubl. data, www.mxak.org). On this map areas of direct spatial overlap are apparent where the red and yellow lines cross subsistence areas. Areas of direct spatial and temporal overlap are also apparent where the short pale line overlaps the blue area. This map was created by M. Fidel as part of the Bering Sea Sub-Network research, funded by the National Science Foundation, ARC #0856774 and implemented by the Aleut International Association and the University of Alaska Anchorage, Resilience and Adaptive Management group.**

ships came closer to Gambell and there is quite a bit of overlap, even into the light blue areas.

The reasons that the ship routes differ from 2004 and 2009 are unknown, but may include environmental factors, such as sea ice or weather, or they may be due to different methodologies employed in the shipping data. The 2004 shipping data are from the Arctic Marine Shipping Assessment (Arctic Council 2009), an Arctic Council led study that relied on self-reporting by all arctic states. In these data one line is a shipping route, and may represent more than one ship passage. The 2009 shipping data were from the Marine Exchange of Alaska, a nonprofit maritime organization that tracks vessels through Automatic Identification Systems. Each line represents a single passage of a single ship. All vessels on international voyages greater than 300 tons, and those not engaged on international voyages greater than 500 tons, are required to transmit real-time location information, which is stored in a database. Many smaller vessels also transmit information voluntarily, but it is unknown what portion of the small vessel fleet is included in the database. In the 2009 data many smaller ships may not be accounted for, which could explain why there are fewer routes displayed near Gambell.

Discussion

Because the density analysis is an aggregation and abstraction of individual use areas, the confidentiality of individual harvest use area is protected. Instead of displaying individual subsistence areas, the density analysis provides a picture of community subsistence use in a particular season.

Polygons are successfully used in a density analysis. When thinking of areas used for harvesting or searching for a particular species during the past six months respondents' are much more likely to visualize these places as areas, instead of points or lines, which are typically used as inputs into a density analysis. In this way the methodology is better able to accommodate perceptions of harvest use areas.

Fig. 5 displays subsistence activity overlain with shipping routes. From this map shipping routes with high and low potential for disrupting subsistence activity are clear. Examining subsistence activity utilizing an interval scale is especially suited to decision making where the goal is to reduce "conflicts and impacts" (Arctic Council 2009). These maps can empower community decision makers to examine each project and determine the level of disruption that is acceptable. The process allows weighing the potential benefits, with potential costs. Different projects will have different characteristics: some may be extremely disruptive to subsistence activity and benefit the community very little, while some may be less disruptive and directly benefit the community with economic development.

There is a great interest in this type of mapping from entities including the U.S. Coast Guard (USCG) and the Shell Oil Company. Shell Oil has requested the maps for use in their oil spill response planning. The USCG has also requested the maps. As part of the USCG work on the Port Access Route Study: In the Bering Strait (Federal Register 2010) a community meeting was held in Gambell by USCG officials (Captain Adam Shaw and Lieutenant Faith A. Reynolds, Project Officer) in March 2011 to determine the need for modifications to current vessel routing measures. During this meeting Iver Campbell (BSSN Steering Committee member from Gambell) gave a copy of the BSSN maps to USCG officials. In a conversation with Lieutenant Reynolds in July, the maps were said to be "very useful" when considering modifications to shipping lane regulations. When Iver Campbell was asked about his thoughts on the maps in May 2012, he said, "I think they are going to be very useful in working with Shell Oil and the Coast Guard." In both instances the utility of the maps was emphasized.

Incorporating the equal interval scale into subsistence mapping allows researchers to perform more complex spatial analyses, such as correlations, regressions and analysis of variance, which are not possible with nominal and ordinal scales. In a changing Arctic, correlations and regressions can be particularly valuable when examining change over time and the relationship among subsistence harvest locations and environmental conditions. Geographically weighted regressions (Fotheringham et al. 2002) could be particularly useful. Analysis of variance could be useful when examining spatial change to subsistence resulting from changing climatic conditions or encroaching development.

Lifelong subsistence use areas may be extremely large and complex. Within these lifetime use areas people are likely to focus harvest activity in certain areas based on season and other changing environmental conditions, such as sea ice or storm frequency. By including a temporal component into subsistence mapping this variation can be examined along with spatial and temporal intersect of conflicting uses. This is extremely important in decision making when the goal is to reduce potential impacts and conflicts.

Limitations

Density maps are an abstraction of survey data and there is potential for them to be misinterpreted. In the output of the density analysis, the number of people who use the red areas of "high use" is not immediately clear. From the data, the greatest overlap is of 11 polygons and the lowest is 1. This information could be useful to ground the density analysis in real numbers, making the map less abstract.

A response rate of ≥90% is desirable to create intensivity maps (Tobias 2009), which in many larger, remote communities may be difficult and costly to obtain. The map in this example has a 57% response rate, which includes data from the first project year of a four year project. This is a recognized issue that we hope to improve upon in coming years. The maps presented are intended as an example of a methodology, not final results. Qualitative data from the project have yet to be analyzed, but could help validate the maps and add depth to our understanding of the maps.

As BSSN subsistence maps fall into the category of intensivity maps, which are a measure of some value, it is important to recognize the scope of that measure of value (Tobias 2009) as "measures of intensity should not be equated with valuation" (Ellanna 1985). These maps display areas that were used for harvesting by respondents during a specific time frame. Interviewers were trained to inquire about areas used to search and/or harvest certain species during the previous six month period. As such the results do not incorporate any other measure of value, of which there could be many (catch per unit effort, duration of use, harvest potential, long-term efficiency, long-term accessibility, productivity, ideological/spiritual value, etc.). This analysis doesn't take into account the effects of shipping on marine mammals, such as disruption of migratory routes, access to forage, and other impacts. They should not be used in isolation as a measure of value.

Conclusion

The subsistence mapping technique presented here was created for two main purposes: to provide a tool that could empower communities in decision making, and as a research tool to examine change or variation over time. It is unique in some aspects. A density analysis is applied to subsistence harvest data using polygons, and the reclassification creates maps representing subsistence activity on an equal interval scale.

BSSN subsistence maps provide insights into direct spatial and temporal overlap of development and subsistence activity. They are a representation of where respondents have gone during a certain time period, which is relevant and valuable in the decision-making realm especially toward the goal of reducing spatial and temporal conflict of subsistence and development. The color display using the equal interval scale makes them valuable in decision making, particularly when dealing with encroaching development. The maps are one tool of many that may be employed by communities at the policy-making table to protect subsistence.

In a changing Arctic, more precise decision-making tools are needed to broker win-win situations. The subsistence mapping methodology presented here is one such tool. It is uniquely suited to decision making and research needs in this area.

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Local and Scientific Knowledge of Freshwater Seals in Iliamna Lake, Alaska

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Abstract

In response to resident's concerns about the absence of information on the status of the freshwater seals found within Iliamna Lake, the tribal/village councils of Iliamna, Kokhanok, and Newhalen, in partnership with Bristol Bay Native Association, the University of Alaska Anchorage, and the National Marine Mammal Laboratory have gathered baseline information on the seasonal shifts in abundance and distribution of the unique freshwater seal population, and documented subsistence use patterns and local and traditional knowledge (LTK). To assess harvest levels and changes in subsistence use patterns, local research assistants conducted subsistence household surveys, two key respondent interviews, and 15 mapping exercises in 2010 and 2011. These data were compared to subsistence household survey data collected by Alaska Department of Fish and Game researchers in 2004 and 2005. LTK about seal abundance and habitat use in Iliamna Lake gathered during subsistence household surveys and mapping exercises was also compared with abundance data obtained through aerial surveys flown prior to spring ice breakup, during seal pupping and molting periods, and prior to fall ice formation. Aerial surveys suggest that seal abundance and use of the lake is highly variable seasonally, a pattern that

was not reported during interviews. In 2012, this project expanded to include Pedro Bay, Levelock, and Iguigig, and is now working to gather more detailed LTK through semi-structured key respondent interviews. Ultimately, we will integrate aerial survey and LTK information, so that an accurate synthetic understanding of the role of seals in the human and lake ecosystem can be developed.

Introduction

Residents of the six communities (Pedro Bay, Kokhanok, Iliamna, Newhalen, Igiugig, and Levelock; Fig. 1) located along the shores of Iliamna Lake and the Kvichak River are predominantly of Central Yup'ik or Dena'ina Athabascan descent, although a variety of other cultural groups are represented (VanStone 1967, State of Alaska 2011). For generations, these peoples have traditionally harvested freshwater seals from the lake and surrounding waters (Fall et al. 2006, Krieg et al. 2009, Holen 2009). Recently, community members have expressed concern about the lack of available data on the health status and abundance of the lake's freshwater seal population, and the impact that environmental changes might have on their ability to continue to sustainably practice their traditional and customary uses of freshwater seals in the future. These concerns are growing as a result of increased mineral exploration and potential development pressures in the region (Parker et al. 2008, Holen 2009), as well as uncertainties about the potential impact of climate change in the Arctic and subarctic (Grebmeier et al. 2006, Moore and Huntington 2008).

The Iliamna and Kokhanok Village Councils and the Newhalen Tribal Council brought these concerns to the Bristol Bay Native Association (BBNA) in the mid 2000s. BBNA is a regional nonprofit tribal consortium whose Natural Resources Department provides support to member tribes in research, education, and outreach to enhance local involvement in the management of natural resources such as marine mammals. In response to these requests, BBNA partnered with the University of Alaska Anchorage (UAA) and the National Marine Mammal Laboratory (NMML) to develop a tribally initiated cooperative research program designed to gather local and traditional knowledge (LTK) about the seals in Iliamna Lake, to combine LTK with information on seal abundance and distribution in the lake as determined from aerial surveys, and to begin to develop a more nuanced understanding of the dynamics of Iliamna Lake's seal population. The LTK portion of the study plan involved working with trained local research assistants (LRAs) who would gather information on subsistence use patterns through (1) a harvest survey similar to that employed by Alaska Department of Fish and Game (ADFG; Fall et al. 2006, Krieg et al. 2009); (2) a mapping exercise in which locals indicated key areas of Iliamna Lake used by seals;

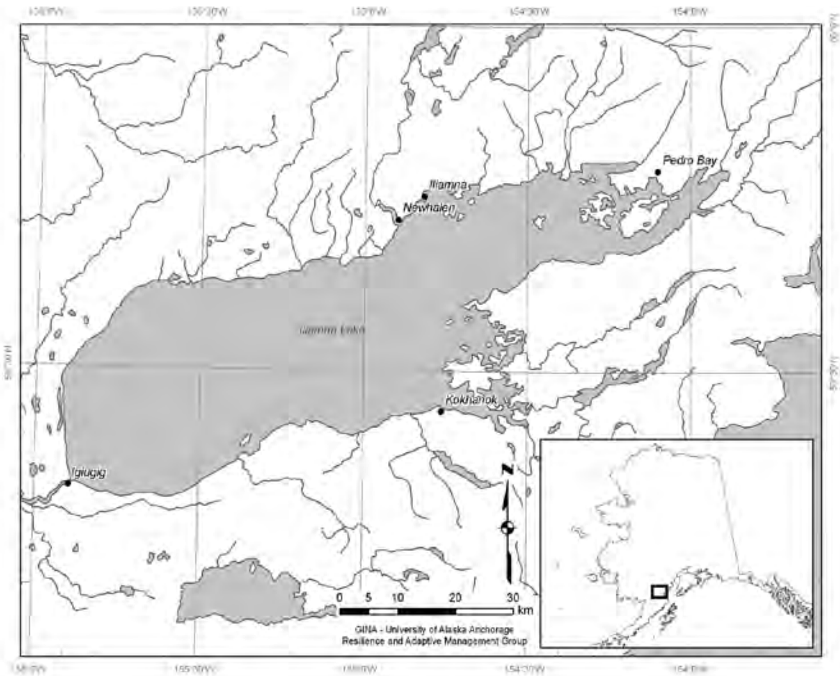

Figure 1. Iliamna Lake, Alaska, with local communities indicated. The head of the Kvichak River is in the lower left at Igiugig; its mouth is in Bristol Bay. Levelock is located along the shores of the Kvichak River 10 miles inland from Bristol Bay.

and (3) semi-structured oral interviews to capture additional LTK about the freshwater seals. This approach was presented to, and officially approved by, the councils of Iliamna, Kokhanok, and Newhalen.

The seals within Iliamna Lake are unique as there are only five lakes with resident freshwater seal populations in the Northern Hemisphere: Lake Baikal (approximately 85,000 seals) and Lake Lagoda (approximately 3,000 seals) in Russia; Lake Saimaa (approximately 270 seals) in Finland; Lac des Loups Marins (120-600 seals) in Canada; and Iliamna Lake in Alaska (maximum number seen hauled out is 242 seals) (Everitt and Braham 1980, Smith et al. 1994, Rice 1998). The Baikal, Lagoda, and Saimaa Lake seals are all closely related to ringed seals (*Pusa hispida*) (Rice 1998), while the Lac des Loups Marins seals are a subspecies of harbor seals (*Phoca vitulina mellonae*) (Smith et al. 1994). Currently, it is unclear whether the Iliamna Lake freshwater seal population consists of harbor seals (*Phoca vitulina*), spotted seals *(Phoca largha),* or a mix of both species; determining species identity is a focus of interviews, aerial surveys, and biosampling efforts. Worldwide, and in Alaska, freshwater seal populations are recognized as particularly vulnerable to the effects of climate change and encroaching human impacts due to their small population sizes and limited distributions (Laidre et al. 2008, Veron et al. 2008, Allen and Angliss 2011). In addition, seals may play a structuring role in lake ecosystems due to their high trophic level (Williams et al. 2004, Frank et al. 2007, Moore and Huntington 2008) , and can also be an important subsistence resource for local human populations (Haynes and Wolfe 1999, Katzenberg 1999, Wolfe et al. 2009). This is particularly true in Iliamna Lake, where the freshwater seals have been an important subsistence resource for generations, and where local residents possess significant, but as yet not formally documented, information about the freshwater seal's abundance, distribution, behavior, and health (Fall et al. 2006, Krieg et al. 2009, Holen 2009).

The baseline scientific data on the freshwater seals in Iliamna Lake is extremely limited: between 1984 and 2008, only 20 aerial surveys assessing freshwater seal abundance were flown (Withrow and Yano 2010), and of these 16 occurred during the August molt period when the largest number and proportion of seals were expected to be hauled out (Huber et al. 2001, Boveng et al. 2003) (Fig. 2). These surveys indicate that the population is small: historical counts range from a low of 20 to a high of 242 animals hauled out (Mathisen and Kline 1992, Small 2001, Withrow and Yano 2010). Because little survey effort had been devoted to spring or summer assessments prior to the start of this project, there were no published accounts of seasonal shifts in freshwater seal abundance, distribution, or reproductive status. However, this type of data is important for assessing whether the population is closed (i.e., self-sustaining with no movement of animals between Iliamna Lake and the larger Bristol Bay populations of spotted and harbor seals), or occasionally connected to nearby seal populations in Bristol Bay through migration along the Kvichak River. Understanding the source population and degree of isolation of the Iliamna freshwater seals is critical, because the impact of a given level of subsistence harvest on the freshwater seal population is determined, in part, by the overall population size. The harbor seal population in Bristol Bay is declining slightly, and may soon be recognized as a unique population within the larger Alaska stock which could impact management decisions (Baur et al. 1999, O'Corry-Crowe et al. 2003, Allen and Angliss 2011). And while the Bristol Bay spotted seal population is thought to be stable, spotted seals are recognized as vulnerable to climate change (Laidre et al. 2008, Moore and Huntington 2008, Allen and Angliss 2011).

Therefore the major aims of this research were (1) to gather LTK about the use and sharing of freshwater seal resources, and the seal's population ecology; (2) to conduct aerial surveys to document seasonal

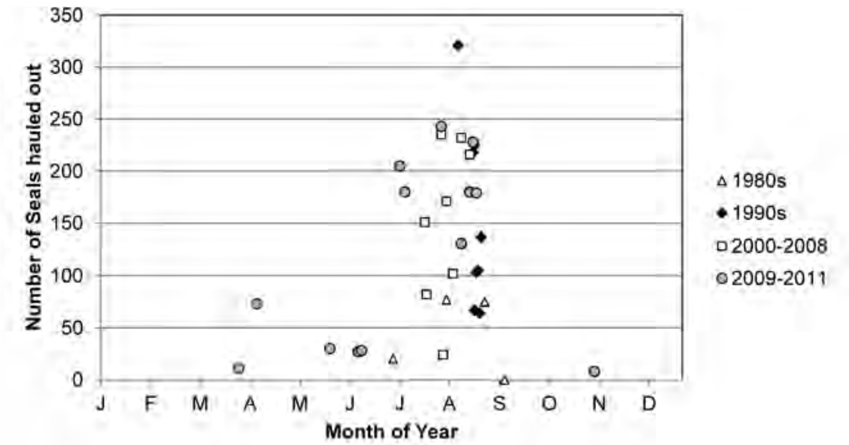

Figure 2. The total number of seals observed during aerial surveys conducted over the past three decades. The survey month is indicated by its first letter. Data collected prior to this project are reported in Mathisen and Kline 1992, Small 2001, and Withrow and Yano 2010.

patterns in freshwater seal abundance and habitat use; (3) to combine data obtained from aerial surveys and local interviews into an integrated picture of freshwater seal abundance and behavior; and (4) to communicate the knowledge gained to all users and managers of the resource so that freshwater seal populations can remain a healthy component of both the wild and anthropogenic components of the Iliamna Lake ecosystem.

Materials and methods

Subsistence surveys and local and traditional knowledge

As this project was developed in collaboration with, and endorsed by, village and/or tribal councils, we worked directly with the councils of Iliamna, Kokhanok, and Newhalen to identify village residents who were interested in participating in the research project as local research assistants (LRAs). Once selected and hired by BBNA, these LRAs were provided training on seal biology, interview techniques, research protocols, and ethics by BBNA and UAA through a combination of in-person, online, and teleconference sessions. Subsistence household surveys, key respondent interview questionnaires, and mapping documents were developed by consensus through consultations with researchers from UAA, ADFG, BBNA, and members of the project communities. The design of these documents ensured that data generated by this project would be comparable to subsistence household survey data previously collected from the region by the ADFG Division of Subsistence (Fall et al. 2006, Krieg et al. 2009). The UAA Institutional Review Board approved the project, all participating personnel, survey documents, and consent forms.

In each of the project communities, LRAs worked with the village/tribal councils to develop a list of all occupied households, and these households were approached by LRAs. At that time, the LRA explained the overall project, and obtained written consent for participation from the interviewee. Residents were free to decline to participate in the study, and if they agreed, the LRA administered the subsistence household surveys orally; surveys were filled out by the LRA rather than being left with the household for later completion. These surveys gathered information on household size and ethnicity, whether the household had hunted, received, or used seal products in the past year, and whether the household usually hunted, received, or used seal products (year not specified). Details of when and where hunting took place were requested, as was information on perceptions about the health and abundance of seals. In addition, respondents were encouraged to voice any anecdotes about seals in the lake, or concerns they had about seals or the research, and the LRA recorded these comments on the subsistence household survey forms. During the subsistence household survey, respondents were also asked if they were willing to indicate on maps where they observed seals hauled out and, if hunters, where they harvested seals. In this mapping exercise, respondents indicated areas of the lake where seals were commonly sighted on land and in the water. Map information was integrated qualitatively (i.e., all areas identified by respondents pooled) to produce seasonal summaries of seal locations and regions where important behaviors and hunting occurred. Areas identified as seal haulout regions in 2010 were reviewed and overflown during aerial surveys flown in 2011.

Results from the subsistence household surveys were input into Microsoft Access by Jennifer Burns, and survey response rates and findings were summarized for each community and survey year. Survey coverage (percent of households and people that responded) was calculated relative to the U.S. Census data (number of households and residents within each community), as reported by the State of Alaska (2011). Household totals from the census were only slightly (1-5 households) larger than the totals provided by the councils. Harvest totals were calculated for each community, and were assumed to be a minimum value for the total harvest from the lake, as not all hunting communities or households participated. Village totals were compared to those from

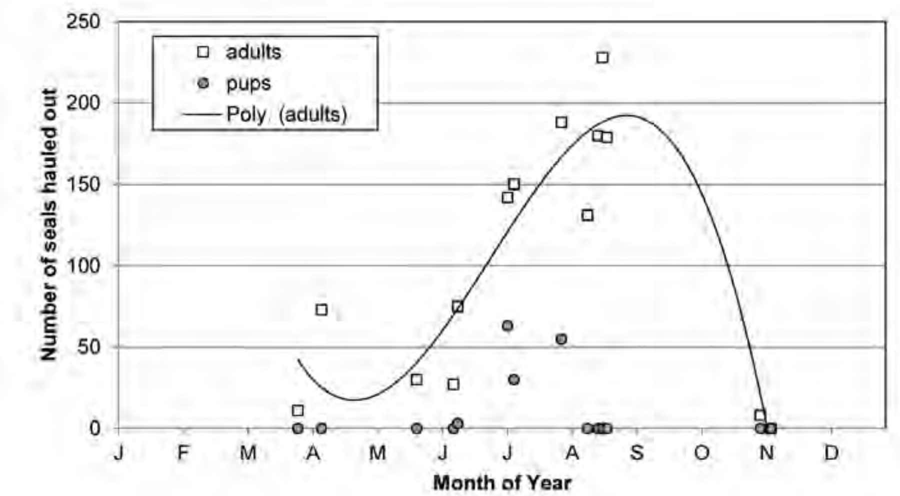

Figure 3. The total number of pups and adults observed hauled out during aerial surveys conducted in 2009-2011. Survey month is indicated by its first letter. The line represents the best-fit polynomial ("Poly.") curve of expected number of adult seals hauled out during the survey.

previous ADFG subsistence household surveys which were derived using similiar methodologies (Fall et al. 2006, Krieg et al. 2009).

In responses to our inquiries, village/tribal councils, community members, and LRAs also identified potential key respondents—persons who, based on their experiences, might be willing to provide more detailed information about the seals by participating in a more in-depth LTK interview. The selected key respondents had a depth and breadth of knowledge based on years of observational or hunting experiences. It was the intent to conduct semi-structured key respondent interviews following the subsistence household surveys or at a later date that was more convenient for the participant. Unfortunately LRAs were able to complete only two such interviews prior to the end of their BBNA employment period. Additional funding secured in 2011 allowed LTK interviews to be restarted in 2012, but results from the first interviews were not available in time for this analysis.

Aerial surveys

Aerial surveys were flown from a twin-engine Piston Commander 680 operating at 200-300 m altitude. All surveys were led by David Withrow with additional participation by Jennifer Burns and project

LRAs as available. Aerial surveys were authorized under a Marine Mammal Protection Act permit issued to NMML. All aerial surveys (see Fig. 3 for dates) were flown in the mid-afternoon, when the number of seals hauled out was expected to be highest (Mathews and Kelly 1996, Simpkins et al. 2003, Bengtson et al. 2007). During each aerial survey, all locations where seals had previously been recorded during aerial surveys (Mathisen and Kline 1992, Small 2001, Withrow and Yano 2010), or where mapping exercises suggested seals were located, were overflown. At least once each year following ice-melt, the entire lake coastline and the complete length of the Kvichak River, which connects Iguigig in the southwest corner of the lake to Bristol Bay, were surveyed. During surveys when the lake was ice-covered, the northwest side of the lake was searched, and all detected areas of open water and leads were overflown to determine if seals were present. Wintertime seal haulout locations identified by village residents in the mapping exercise were also overflown.

In each survey, the flight path was recorded via GPS, and all seals sighted were digitally photographed using a SLR camera with zoom lens. Collected metadata included the date, time, and GPS coordinates when the photo was taken. Photos were then imported into an image analysis program, markers generated for each seal and the total number of marks automatically tallied to produce the total count per location. Only seals on land were counted. The total count for the aerial survey was the sum of the number of seals on all haulouts. Pups were identified by size, shape, color, and location relative to other individuals.

Results

Subsistence surveys and local and traditional knowledge

The subsistence household surveys for calendar years 2009 and 2010 were administered to a large proportion of the households in both Kokhanok (more than 75%) and Newhalen (more than 50%), but data coverage for Iliamna was poor (less than 20%; Table 1). The LRA selected by the Iliamna village council did not approach many households (15/39), and of those 60% declined to participate in the survey; a much higher decline rate than in either Kokhanok (5%) or Newhalen (12%). No explanation for this low participation was provided, despite inquiries.

Among households that participated in the household subsistence survey, approximately 33% indicated that someone from that household usually hunted seal (no year specified), with a slightly smaller fraction indicating that they hunted in the previous calendar year (Table 2). Because not all individuals within each household self-identified as hunters, hunting within the communities is conducted by a smaller

Table 1. Results of the subsistence household surveys (SHS) for 2009 and 2010.

Community	Kokhanok census[a]	Kokhanok SHS 2009	Kokhanok SHS 2010	Newhalen census[a]	Newhalen SHS 2009	Newhalen SHS 2010	Iliamna census[a]	Iliamna SHS 2010
Population (coverage)	170	127 (75%)	140 (82%)	190	106 (56%)	97 (51%)	109	19 (17%)
Households (coverage)	52	41 (79%)	40 (77%)	50	29 (58%)	27 (54%)	39	6[b] (15%)
Ethnicity (% Alaska Native)	90%	93%	93%	92.1%	94%	95%	66.9%	47%
Avg household size	3.27	3.1	3.5	3.75	4.1	3.6	2.79	3.2

[a]Census and ethnicity data for each community are from the Alaska Community Database Community Information Summaries, http://www.commerce.state.ak.us/dca/commdb/CF_CIS.htm.

[b]15 households were approached, with nine declining to participate in the survey.

Table 2. Percent of households that usually hunt (no year specified), and a breakdown showing the pattern of use of freshwater harbor seals by household in the previous calendar year (PCY).

Community	Usually hunt	PCY: hunted	PCY: hunted successfully (# seals)	PCY: used	PCY: received	PCY: shared
Iliamna 2010	33%	33%	0% (0)	17%	0%	0%
Kokhanok 2009	27	20	7 (7)	51	46	29
Kokhanok 2010	30	15	3 (1)	60	58	18
Newhalen 2009	24	24	14 (6)	55	52	34
Newhalen 2010	22	15	7 (2)	70	63	30

proportion of individuals than the household percentages indicate. However, seal hunting is clearly an important activity, as the proportion of households reporting freshwater seal use in the previous year was higher than the proportion reporting that someone within the household hunted. This difference is likely due to a strong harvest-sharing component, as approximately half the households indicated in the survey that they received some seal in the past calendar year (Table 2). Comments recorded during the subsistence household survey indicated that individuals typically received seal fat or seal oil; sharing of seal meat was not mentioned. Most households within the communities are ethnically Alaska Native (Table 1), and Alaska Native households were the only ones that reported harvesting or using seals; the few (five) surveyed households that did not have any Alaska Natives did not report hunting, using, or receiving seal. However, this was also true of some (15.8%) of the Alaska Native households.

There was a notable difference in the harvest levels reported for 2009 and 2010 (see Table 2). In 2009, respondents from Kokhanok and Newhalen reported harvesting a total of thirteen seals, while in 2010 only three seals were reported as harvested by residents in these two communities. While more seals were taken when the lake was ice-covered, seals were also harvested when the lake was ice-free. No harvest was reported for Iliamna. To determine the species of seals inhabiting the lake we requested tissue samples from harvested freshwater seals. Since spring 2011, 10 samples were provided; these samples have been sent out for genetic analysis but results are not yet available.

LRAs recruited some subsistence household survey participants (eight from Kokhanok, six from Newhalen, one from Iliamna) with significant LTK about freshwater seals to complete a mapping exercise in which they indicated seal haulouts, feeding, and hunting locations on preprinted maps after completing the survey. Results indicated that all seal haulout locations were covered during aerial surveys. Hunting areas identified through interviews and mapping include most of the major haulout sites, with some differences in focal hunting location among the villages. Hunters from both Iliamna and Newhalen targeted seals on rocks near the villages, on Seal Island and the surrounding bars and shoals, and inside Pedro Bay. In contrast, while hunters from Kokhanok also targeted seals on Seal Island and the surrounding rocks, they hunted in areas adjacent to Tommy Point and inside Kokhanok Bay as well, areas not used by hunters from Iliamna or Newhalen. In addition, the mapping exercise indicated that seals were frequently present in the Iliamna, Newhalen, and Gilbralter rivers, all of which drain into the lake and support anadromous salmon runs (Hauser et al. 2008).

Aerial surveys

Thirteen aerial surveys were conducted between July 2009 and July 2011 (Fig. 3). The total number of seals seen in the lake ranged from a few seals in April and November (2010: 11 and 8 adults, respectively), to many more seals during the August molt period (peak of 228 seals 8/22/09, Fig. 3). Seal pups were observed in the lake in late July and early August 2010 and in June and July surveys in 2011 (Fig. 3); but by late August 2011 surveys, pups could not reliably be distinguished from adult animals based on size or pelage color. During aerial surveys conducted when the lake was largely or completely open water (June-November), seals were located on several offshore rocky and/or sandy islands at the northeast end of the lake, in areas previously identified by NMML biologists and interviewees. During the July 2010 survey, the complete length of the Kvichak River was flown but no seals were observed in the river.

During April surveys in 2010 and 2011 when the lake was completely ice covered, seals were seen hauled out along the edges of small polynyas that appeared to be maintained by current flow over nearshore shallows. This differed from the information gained during the mapping exercise, and from responses to informal questions asked by the authors when in the lake communities. These inquiries suggested that seals were most commonly located along predictable pressure cracks that run approximately north-south across the lake. However, during the April surveys these cracks were not open but instead solidly frozen, perhaps requiring seals to seek other areas of open water. Haulouts used by seals when the lake was not ice covered were overflown in April 2010 and 2011, but were found unoccupied, without signs of seal activity or evidence of leads or open water. In April 2011, the flight path was extended to the mouth of the Kvichak River. There were polynyas and leads at the mouth of the river and extending downstream, but the river was still largely ice covered. No seals were observed in the river or in the southwest end of the lake.

Discussion

Aerial surveys have shown that the number of seals observed in Iliamna Lake varies greatly throughout the year, with the largest number of seals observed during the late August molt period. However, the peak August counts have changed little over the past three decades (Mathisen and Kline 1992, Small 2001, Withrow and Yano 2010), suggesting that the population size is relatively stable. However, because counts have not been corrected to account for the number of animals in the water at the time of the surveys due to the lack of appropriate correction factors for the freshwater lake habitat (Simpkins et al. 2003, Bengtson et al. 2007), direct comparison of numbers is problematic, and any conclusions about the size or status of the population of freshwater seals within Iliamna Lake must remain speculative. Still, the large seasonal shifts in number of freshwater seals observed hauled out in the lake suggests that the population is not closed, and that some seals seasonally migrate into the lake from Bristol Bay (Withrow et al. 2011).

Despite the apparent seasonal movement of seals into Iliamna Lake, seals are present in the lake throughout the year, with local respondents reporting seeing and/or hunting seals along pressure ridges, cracks, and polynyas throughout the winter months. In addition, a breeding population exists within the lake, with pupping occurring in June and July concurrent with the seal pupping season in nearby Bristol Bay (Jemison and Kelly 2001, Withrow et al. 2011). While this project provides the first photo-documentation of pups in Iliamna Lake, one interviewee stated that hunting does not occur within the lake in midsummer so as to not disturb pups, suggesting that locals have been aware of pups in the lake for long enough that a traditional practice has developed. While additional aerial and LTK surveys are needed to determine the precise reproductive timing for freshwater seals in Iliamna lake, if one assumes a four week nursing period (Schulz and Bowen 2004), pupping likely peaks in early July, with most pups weaned in August. Since Bristol Bay spotted seals whelp in March (Jefferson et al. 1993), this suggests that the lake is occupied by harbor seals rather than spotted seals. Additionally, one tissue biosample collected from a lake seal harvested in 2008 by an Alaska Native hunter and analyzed by NMML geneticists indicated that the animal was a male harbor seal (Kelly Robertson, NOAA Southwest Fisheries Science Center, pers. comm.). Ten more tissue samples from harvested seals provided by hunters to the authors in 2012 will be analyzed by the same laboratory.

Both aerial surveys and key respondent mapping efforts indicate that seals haul out primarily on small islands in the northeast section of the lake during the open water season, and that these locations have been stable for the past several decades. Since aerial survey efforts focus only on areas where the seals haul out, mapped reports of seals foraging nearshore, at river mouths, and in salmon nets are the best current information on aquatic behavior patterns. Village residents indicate that they regularly hunt freshwater seals along polynyas and cracks in the ice in winter, indicating that these habitats are frequented by the seals. This study is the first to systematically search for seals when the lake is still iced over, and thus the first to "officially" record such use (Withrow et al. 2011). Overall, aerial survey findings agree with LTK, with neither aerial surveys nor residents suggesting that seals inhabit the lower two-thirds of the lake. However, the lake is quite large and small numbers of solitary seals may occasionally occur in locations not frequently visited by lake residents or overflown by aerial surveys.

Information gathered from subsistence harvest surveys and LTK interviews suggests that Iliamna Lake seals are healthy and in good condition. Seal fat and oil is a favored resource, and seals in the lake are prized for their fat. Several interviewees commented that the freshwater seals were larger and fatter, and that their coats were softer, than saltwater seals harvested in Bristol Bay. This agrees with previous descriptions of seal condition reported by ADFG researchers (Fall et al. 2006, Krieg et al. 2009, Holen 2009). Respondents thought this might be due to the seal's food source, and seals were noted to be picking fish from subsistence nets in the Newhalen and other rivers that drain into Iliamna Lake. Certainly, salmon are a key prey species during the summer salmon runs, but the large variety of freshwater fish in Iliamna Lake are likely primary prey items for those seals that remain in the lake during winter months (Mathisen et al. 2002, Hauser et al. 2008).

Regarding their use as a subsistence food source, freshwater seals are reported by the interviewed locals to be similarly available or less available now than in the past. This was not attributed to a decline in seal abundance in the lake, but appeared to be due to changes in the hunting activities of lake residents. Only 45% of the surveyed households that attempted to hunt seals in the past year were successful, and only one of the surveyed households took more than one seal. Comparisons of harvest levels and seal use patterns between this study and those conducted by ADFG in Newhalen and Iliamna in 2004 (Fall et al. 2006) and Kokhanok in 2005 (Krieg et al. 2009) suggest that use and sharing of seal resources has not declined, but remains high. However, the percentage of households surveyed that attempted to and/or successfully harvested seals in 2009 was slightly lower than reported in 2004 and 2005 (Fall et al. 2006, Krieg et al. 2009), with the harvest total for 2010 the lowest of all. It is difficult to determine the cause of these differences as the 2004-2005 surveys did not cover all lake communities within a single year, and so totals are not directly comparable. However, the 2009 and 2010 data can be directly compared, as survey coverage rates were similar within the two villages in each year, and harvest surveys were completed by the same LRA in both Newhalen and Kokhanok. Comments volunteered during the subsistence harvest surveys indicate that seals are hunted only if needed, and that several households still had seal oil from the previous year and thus did not need to hunt. Other survey respondents commented that they were too busy to hunt, and/or that fuel and ammunition prices were high. This echoes earlier findings that economic and time constraints imposed by high hunting costs and low hunting success has an influence on subsistence harvest patterns in the region (Holen 2009). An assessment of the potential impact of the current subsistence harvest on the freshwater seal population requires better information on the size of the resident seal population, the degree of connectivity with the larger Bristol Bay population, and relative proportion of resident and immigrant (if there are such) seals taken in subsistence harvests.

Conclusions

This project has demonstrated that combining LTK and Western scientific techniques can improve our understanding of freshwater seal ecology and identify areas needing additional research. For example, subsistence harvest surveys and mapping efforts confirmed that aerial surveys were covering all seal haulout locations, while also identifying areas used by foraging seals that had not previously been documented by Western science. At the same time, aerial surveys gathered precise data on the minimum population size in the lake, and quantified seasonal shifts in abundance and the presence of pups in the lake—data not well reported during subsistence harvest surveys or mapping exercises. Finally, integrating the survey data with subsistence harvest surveys and respondent interviews highlighted the need to expand the project to communities along the Kvichak River to gather information on seal movements between the lake and Bristol Bay, while continued outreach and educational efforts have led to more biosamples becoming available for genetic analysis.

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Community Interpretations of Fishing Outside Legal Regulations: A Case Study from Northwest Russia

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Abstract

Salmon fishing has become a key local resource in several villages on the White Sea coast as a result of post-socialist transformations in Russia. Management of this resource was heavily regulated by the state during Soviet times. The situation changed after the collapse of the socialist regime, when fishing for salmon individually became more easily available. Depending on whether they are local or incomers, people tend to ascribe different values to salmon as a resource. Both groups are involved in the commodification of salmon. Incomers, however, tend to focus more on a commercial meaning of salmon. Although local people also ascribe high commercial value to salmon, they attribute noncommercial meanings to it at the same time. Local people share fishing resources with others more generously compared to incomers. In this paper I look at the difference in meanings ascribed to salmon by local people and incomers, as it reveals itself in people's attitudes toward fishing outside legal regulations.

Introduction

Salmon fishing has become a key local resource in several villages on the White Sea coast in northwest Russia after the collapse of the socialist regime. Management of this resource used to be heavily regulated by the state during the Soviet period. The situation changed after the end of Soviet rule, as fishing for salmon individually became more easily accessible.

Depending on whether they are local or incomers, people tend to ascribe different values to salmon as a resource. Both groups are involved in the commodification of salmon. Incomers, however, tend to focus more on a commercial meaning of salmon. Although local people also ascribe high commercial value to salmon, they attribute communal meanings to it at the same time. By "communal" I mean those aspects of resource significance that reflect local values and habitual ways of dealing with things in the village. One such value is disinterested sharing of resources with others. By "commercial" I imply those qualities of resources that can bring material profit. In this paper, I look at the difference in attitudes toward salmon among local people and incomers, as it reveals itself in people's attitudes toward fishing outside legal regulations.

I relate my research findings to insights from literature on compliance in natural resource harvesting (Forsyth et al. 1998, Muth and Bowe 1998, Dietz et al. 2003, Gezelius 2004, Hauck 2008), with a particular focus on the role of morality in fishing outside legal regulations (Wilson 2002, Gezelius 2004). I explore these themes within a context of post-socialist transformations in the remote Russian countryside.

The paper introduces the place where I conducted fieldwork and comments on my methodology. This is followed by a section on the history of salmon fishing in the area. Next I discuss the variety of people's attitudes toward illegal fishing and introduce a distinction between communal attitudes toward salmon fishing as expressed by local people, and commercial attitudes as expressed by incomers. In the final section of the paper, I situate my research findings in a wider context of post-socialist transformations in Russia.

Research context and methodology

The paper is based on data that I collected in several villages on the White Sea coast in northwest Russia throughout 2005-2011. I made about 15 fieldwork trips to different villages, of no longer than two months each. I had a part-time job as well as other commitments during that time and therefore could not conduct a long-term continuous fieldwork. I spent about 20 months in the field altogether. I do not provide further geographic details or names of villages for the sake of confidentiality, as I touch upon a sensitive subject such as fishing outside official regulations. I use a collective designation "the village" throughout the text.

People living in the village belong to a local group of Russians who traditionally have been called "Pomors," from Russian "po moriu" which means "by sea." The name has been historically applied to Russians living along the White Sea and Barents Sea coasts. Pomors are considered to share certain economic and cultural features that distinguish them from other Russians. Russian people first came to the White Sea coast in the middle of the 11th century, attracted by fishing and hunting opportunities (Ushakov 1972).

The process of Russian people settling and resettling in the area of the White Sea coast continued over a long period of time, and encompassed vast territories. Therefore no single Pomor identity formed and the name was used differently from one area to another. In the course of the 18th century, the name Pomors was extended to all Russian people living along the White Sea coastline (Bernshtam 1978 p. 78).

In the village, hardly a day passes without somebody visiting or leaving the place. There are two main groups of incomers: people who have relatives or friends there and people who do not. Among the latter, there are mainly fishermen and tourists. Not reflected in official statistics, this population dynamic reveals itself in collective designations such as "mestnyi" (means local) or "priezzhii" (means incomer), which describe people's positions in relation to the village and which people sometimes use to draw distinctions between each other.

In this paper, I differentiate between local people and incomers as the two groups reveal different attitudes toward salmon as a resource. By local people I mean those who live in the village permanently, or are former permanent villagers who now come to the village for temporary visits. Incomers are people who come from elsewhere and are not kin or close friends to anyone in the village. They can be both permanent dwellers and temporary visitors. There is no rigid opposition between the two groups; they are not homogeneous and there are differences within each group. However, it is secondary to the main difference between attitudes toward fish among local people and incomers.

I collected most of my ethnographic data through participant observation. My daily life in the village mainly consisted of participating in people's quotidian activities, such as walking, fishing, having tea, and socializing. During my stay in the village I also recorded public events, interviewed people, and conducted informal conversations on various village matters.

I paid particular attention to the role of salmon in the village and to how people obtain fish and share it with others. In the course of fieldwork, my own status in the village shifted from that of a guest to that of a friend. The shift was reflected in changed ways of obtaining salmon. In the beginning, people would often come to me a few days before my departure and give me fish to take home. As I kept returning to the village, people gradually stopped giving me fish like that and if I wanted to take home some salmon, I had to make a specific effort to obtain it.

The word salmon is hardly ever used by people in the village. Instead, they normally say "fish," as the following example from my fieldwork illustrates:

Walking through the village in the afternoon in early December I meet Tania, a young woman in her late twenties. Tania stops for a smoke and a chat. After we habitually exchange our opinions on weather Tania says: the fish is coming now. “What fish?” I ask. Tania looks at me in astonishment, “Are you stupid?” I feel rather embarrassed and hesitatingly ask, “You mean… salmon?” “Of course!” she replies.

Examples of this kind helped me to gain further insight into the role of salmon in villagers’ everyday lives.

“Without fish, there would be nothing here!”

The role of salmon fishing in the local economy

People in the village say, “without fish, there would be nothing here.” The fish that attract the majority of incomers to the village today have been the main attraction of the area for centuries. Lajus (2008) makes the point that salmon fishing has never been a means of subsistence for Pomors, but rather a source of living as they traded fish for other goods. Pomors maintained very close contacts with their agricultural past; they traded fish to buy grains and other food that constituted an integral part of their diet.

The fishing season in the village usually starts in late May, lasts through summer, and finishes in late autumn. During this period salmon come into the river from the White Sea and travel upstream. Peaks of the fish run are during the high water period from late spring until the end of June and from the end of August until middle or late autumn. Salmon fishing in the village has always been done both in the river and at sea. While in the past sea fishing was on a larger scale compared to the river, nowadays it is the other way around. There are not enough people or equipment such as big boats and longlines to carry out extensive fishing at sea.

Before the Soviet period, fishing was done by individuals within a community and by monasteries (Lajus et al. 2010). For sea fishing, the coastline was divided into sectors called “toni” (plural of “tonia”), which were distributed among fishermen. Each tonia had a specific name. It included part of the sea, a stretch of coastline, and houses. With the start of the fishing season in spring those fishermen who possessed a tonia moved with their families from the village down to the coast and lived there in a fishing house until the end of the season in the autumn. Often several families shared a house. Fishing was done with the help of longlines. Several longlines were set up one after another, starting from the shore and perpendicular to it and stretching out toward the open sea. Usually fishing was a job for the men, whereas women were busy with work around the house such as cooking or looking after children. However, it was not uncommon that women were involved in fishing too, when there were no men in the family who could do that.

Fishing in the river was carried out both collectively and by individual families. The collective method of fishing employed a fence with several traps in it that was set up across the river during the low water period, which usually lasted through July and August. The fence was designed in such a way that it was possible to alternate blocking and unblocking the way for fish up the river. People in the village today say that in the past, fishermen used to block it every other day. The fence was set up by the village community. Individual fishing was done using different types of nets. One way consisted of going down the river in two boats with people holding a net between them. Other types of nets were set up in the river perpendicular to the bank with a trap at the end of each. A fish going upstream would reach the wall, go along it, and finally enter a trap.

The Soviet rule introduced the kolkhoz system in the village in the late 1920s, which eliminated private enterprise and established collective farms instead. Fishing was done on the same fishing grounds but by appointed brigades instead of self-organized individuals. All catch went to the collective farm. Families involved in sea fishing could consume caught fish to feed themselves throughout the fishing season. Fishing with individual nets, however, was forbidden and anyone caught doing it was prosecuted. There were strict control and heavy fines for poaching during the Soviet period. Throughout the 20th century the number of toni used along the coast continually decreased, and by the end of the century most of them were abandoned. Salmon sea fishing today is done only near the shore.

After the collapse of the Soviet system, the collective farm in the village remained. However, the scale of fishing carried out by the farm has significantly decreased due to the deterioration of equipment, outflow of labor force to the city, and reduction of quotas. At the same time, the scale of illegal fishing has skyrocketed. This is due to a number of factors, including (1) a high level of unemployment, which made people look for alternative ways of earning money; (2) post-socialist transformations brought multiple opportunities for the commodification of resources in Russia, and salmon in particular has become a unique local resource with potential to bring relatively large and quick profits; and (3) the deterioration of established systems of state management and control made illegal fishing easier compared to during the Soviet period.

Who has the right to catch illegal fish?

In the 1990s, a system of licensing was introduced in the village. Now anyone who wants to fish salmon must buy a license. The quota is determined by a scientific institution that provides biological data for sustainable fishing in the area. One part of the quota is for sale. Within that, local people have a certain number of licenses allocated to them. The other part of the quota goes to the fishing tourism industry.

Fishing salmon without a license is therefore illegal in the village and is considered to be poaching. However, everyone knows that people largely ignore this law, locals and incomers alike. Parallel to state legislation in the sphere of fishing, there exists an informal moral economy of fishing in the village where people follow their own ideas of what they can fish and when. Wilson (2002) argues that in a situation when the state imposes regulations in resource management from outside and above, without considering interests of local population, people feel entitled to use resources according to their own moral rules. A similar logic might be at work here too, as people in the village often complain that officials do not know local fishing conditions and impose regulations that are inadequate for the local context.

The current situation of people's attitudes toward fishing salmon without a license in the village is more complex, however, and is a result of a combination of factors. First, people feel entitled to local fish resources because they live there permanently and because their ancestors lived in this place for centuries. Next, most people in the village do not have material means to obtain salmon legally anymore or buy permits on a regular basis. The system of licensing for fishing in the village is targeted toward sport fishermen who fish for leisure, and is very unfavorable for commercial fishing. Thus, the overall fishing quota for villagers is rather limited. Also, each permit gives its holder only the right to fish for a fixed number of hours in one day and at a fixed location on the river. There is no system of giving out licenses that would cover a fishing season or a whole year, as practiced in other parts of the world. Therefore, even though the price for a permit is less for local people than for incomers, the current license system makes it almost impossible for local people to legally make a living from fishing salmon. Zharkov argues that a radically different system of licensing, "the one that would include a range of single, seasonal and other types of permits, would create an army of law-abiding fishermen who are currently forced to fish outside legal regulations" (Zharkov 2010 p. 90).

Finally, salmon is an important aspect of local identity. For example, it is still presumed in the village today that there must always be salmon on the table when people get together on important occasions, such as a child's birth or a wedding. People may also fish for salmon occasionally because it is always handy to have some in store and then serve it if a guest visits. When guests leave, hosts often also regard it as their obligation to supply guests with fish. Having the right of access to salmon is thus part and parcel of being local and therefore people feel they need to find ways of accessing this resource[1].

[1] The previous three paragraphs, as well as the section on methods, are included in the article "Without fish, there would be nothing here: Attitudes to salmon and identification with place in a Russian coastal village," which I submitted to the *Journal of Rural Studies* at the time of writing this paper (Nakhshina 2012).

Procuring salmon became an acute problem in the village after the deterioration of the kolkhoz system in the early 1990s, following the collapse of the socialist state. Although fishing salmon outside the kolkhoz was prohibited during Soviet times as well, people still had access to salmon, as most families were involved in kolkhoz fishing and could always take some fish home from the collective catch. Furthermore, fish other than salmon used to be sold in the kolkhoz shop at low prices, which reduced demand for more precious fish species to some extent. But there are no fish available in village shops anymore. Because very few people fish within the kolkhoz today and thus very few have direct access to salmon, and because licenses are expensive to buy, many people fish without authorized permission.

The question of people's motivations for poaching has been recognized as key for understanding and solving the problem of illegal resource harvesting. Research has demonstrated that complexity of motives for poaching covers reasons as diverse as to pertain to economics, tradition, morality, and lifestyle (Forsyth et al. 1998, Muth and Bowe 1998). Moreover, an individual fisher would often express a mixture of motives when questioned about his illegal activities. What still needs wider recognition is cultural and regional specificity of motivations for illegal fishing.

People's ambivalence regarding poaching on the White Sea coast is reflected in the multiplicity of meanings that the word "poaching" has acquired in the area. The word "poaching" (brakon'erstvo), when used in the local context, is often subject to emotional and ethical concerns, due to its strong negative connotations. People's definition and use of the word poaching is ambivalent and context-dependent. Overall, it is closely intertwined with the sense of being local.

There is a local slang term for a poacher, "brek," abbreviated from the full word "brakon'er." When people in the village distinguish poaching from just fishing, two interrelated factors are often at play: the amount of fish caught and the purpose of the fishing. If a person regularly catches a lot of salmon in order to sell it and earn money, he is called brek. If he or she occasionally fishes salmon for food or to cover some extra expenses, this person is hardly ever attributed the status of a poacher. Such people, however, can be still called "brakon'ery" by elderly women in the village who do not fish themselves. The age factor is as important here as gender. Thus, one wouldn't hear such an opinion about younger people from middle-aged women or elderly men, who themselves fish.

In his comparative research on fisheries compliance in small-scale fishing communities in Norway and Canada, Gezelius found that in both cases scale and purpose of poaching were important for the extent of informal sanctions applied to illegal fishers (2004 p. 620). Thus, people who caught moderate amounts and in order to provide food or minimal existence for their families were not generally condemned by the community, whereas those who caught a lot on a commercial basis faced informal communal sanctions.

The way the word brek is understood is also connected to a person's belonging to the village. People who live in the village permanently tend not to attribute the word poacher to other permanent dwellers who are involved in fishing without a permit. At the same time, such fishermen are more likely to be called poachers by people who come to the village only for the summer and who do not fish themselves. Further, those who are not local and who come to the village to fish without a license may have their own definition of a poacher. For example, there is a man who resides in town but comes to the village to fish for salmon without a permit on a very regular basis. In local people's opinion, he is a poacher. However, the man in question does not agree with this on the grounds that for him, poachers are only those who fish illegally in the upper reaches of rivers where salmon go for spawning. Extracting spawn in large quantities to produce caviar, they significantly undermine the salmon population. The man thus defines poaching in a way that is narrow enough to allow him to escape the category. Whenever we had a discussion about poaching, he referred to his childhood when he used to come to the village often. By making this reference, he claimed to be considered as belonging to the village, which would justify his involvement in fishing there.

The word poaching thus does not have a single interpretation among people in the village and is inseparably linked to the sense of localness. Incomers involved in illegal fishing are more likely to be placed in the category of poachers than permanent dwellers, as the latter seem to have more rights to local resources, at least on the level of everyday moral reasoning. The ambivalence around poaching continues at the level of authority. On the one hand, both permanent dwellers and incomers that are involved in fishing without licenses are equally considered poachers by the kolkhoz administration and fishing inspectors who regularly patrol the river. On the other hand, even within this institution of formal control there is a differentiated approach to those involved in illegal fishing. I once talked with a man from town who was sent to the village as a fishing inspector for several months. He said that at least in their brigade they have a differentiated approach to poachers and if they see local women or elderly people fishing, they would not touch them. "I have seen how people live here… Nothing would happen if they catch a fish or two. And anyway, they are locals and it is their river in the end," concluded the inspector. Forsyth (1998) registers a similar ambivalence among game wardens in southwest Louisiana in their attitudes toward poachers. Wardens seem to apply greater enforcement effort to those who poach for money or entertainment purposes, while being more sympathetic to those who poach because of financial need or because they consider game taking as part of their tradition (Forsyth 1998 p. 35).

My observations have shown that among fishermen in the village, it is more often incomers who poach salmon on a large scale. Local people seem to be more concerned about the future of local fish and therefore have a less exploitative attitude toward fish resources stock. Furthermore, local people are more willing to share fish with others compared to incomers. At the same time, this difference usually remains unspoken and requires attention to subtle nuances in ways that people treat fishing resources for it to be revealed.

Communal versus commercial attitudes toward salmon

I suggest that there is distinction between communal attitudes toward salmon fishing as expressed by local people, and commercial attitudes as expressed by incomers. By “communal” I mean those aspects of resource significance that reflect local norms and habitual ways of dealing with things in the village. By “commercial” I imply those qualities of resources that can bring material profit. Arguably, local people in the village tend to focus on the communal side of salmon fishing, whereas incomers concentrate on the commercial side. I do not mean to essentialize “communal” and “commercial” as pertaining to some timeless conditions, but rather distinguish them on the following, historically specific grounds.

First, the distinction between commercial and communal attitudes refers to the period of social and economic transformations in Russia from the late 1980s onward. This brought multiple opportunities for the commodification of resources, which encouraged the development of commercial attitudes toward them. In the village, incomers are involved in the commodification of salmon on a much larger scale compared to locals. Arguably, the communal aspect of salmon as a resource is of greater concern to local people, whereas incomers are primarily concerned with the commercial aspect of it.

Second, I distinguish between communal and commercial attitudes along the line of “old” versus “new,” or alternatively “traditional” versus “nontraditional,” according to a wider public perception of the region. Communal attitudes correspond to those values that have been associated with traditional Pomor culture in public opinion, literature, and mass media. These associations originate in the second half of the 19th century, when the Pomor way of life was featured in literary descriptions and was subsequently romanticized by the wider public. These values include, for example, disinterested aid to strangers and generous sharing with others.

People living along the White Sea coast have also been habitually associated with hospitality toward strangers. In popular opinion, they consider it an honor to take in a guest and provide them with free accommodation and food. Today, housing is a very acute problem in the village as there are not enough buildings to accommodate everyone who wishes to come. A house in the village thus serves as a potential source of income, because there is always a high demand for accommodation in the village. Still, local people refused to take any money from me to pay for accommodation when I stayed with them during fieldwork. When I mentioned my intention to pay for accommodation to my hosts, they told me the following: "If you give us money, you'd better forget the road to our house. You are our guest, and that's it." At the same time, when I stayed in the house of incomers in the same village, the hosts accepted the rent.

One of the reasons for the distinction between locals and incomers in their attitudes toward local resources is that people who come to the village from elsewhere are cut out of the history of local relations. As a result, they do not share in the communal aspects of the meaning of local resources. This allows them to engage in the commodification of resources in a rather unproblematic way. Local people, on the other hand, are deeply embedded in the history of habitual ways of behaving in the village, which prevents them from commodifying resources.

People themselves refer to these distinctions, albeit in different words. Local dwellers sometimes remark that the quality of life in the village has become generally worse with the influx of strangers from cities. Furthermore, some villagers say that things in the village today are done for money and that people are not as hospitable as before. Many local people generally disapprove of the excessive focus on accumulating money or other material resources in order to improve individual conditions. Similar attitudes have been observed in farming areas of Russia toward the private farmers who emerged as a result of the privatization reforms of 1991 (e.g., Hivon 1998, Miller and Heady 2003). The reasons for the disdainful attitude toward money in certain contexts are rooted in Soviet ideology. In one study of a Russian village, Paxson (2005) notes that money can be an especially uncomfortable form of capital, one of the reasons being that "the symbolism of 'money' inherited a great deal of negative resonance during the Soviet period. Within the ideology of socialism, the lust for money [...] was seen as one of the special sins of the capitalist enemy" (2005 p. 69). Incomers, for their part, comment on local people's unwillingness and inability to make money from the rich resources the area has on offer. They might blame local people for the poor state of their houses and for the neglected condition of the village in general.

The distinction between communal and commercial attitudes to fishing resources among White Sea coast fishermen echoes the distinction that Gezelius (2004) makes between two morals, of subsistence economy and of monetary economy, in his comparison of small-scale fisheries in Norway and Canada. Both cases reveal that illegal fishing of moderate amounts for food purposes or to provide necessary means of survival does not face any significant informal sanctions within the community, whereas large scale illegal fishing aimed at earning money is condemned for being motivated by greed and is followed by informal communal sanctions. Gezelius connects this distinction to the moral meanings of money and food more generally arguing that food fishing is perceived as morally safe, while monetary fishing is seen as morally perilous (2004 p. 625-626).

On the White Sea coast, this distinction occurs primarily along the local/incomer axis. What makes the Russian case different from Gezelius' comparison is that there is no such a strong sense of community in villages on the White Sea coast. After economic hardships hit the area in the 1990s, people have been largely concerned with their individual survival. There is no outspoken and shared acknowledgment of poaching as a threat to common good and consequently little public condemnation of illegal fishing, although some people might express their concerns in private conversations. Furthermore, since many people fish illegally on a commercial scale in order to provide a living, it is difficult to draw a line between moderate harvesting that is just enough to provide a decent living, and excessive greedy extraction of resources in this case.

Yet another nuance is that the state plays a role of a common enemy for fishers on the White Sea coast, which unites people in their illegal activities that challenge official rules. According to people, the state has left them to survive on their own. Current Russian legislation in the sphere of salmon fishing is targeted at well-off urban dwellers who fish for leisure and does not take into account interests of small-scale traditional fishers. As a result, state legislation and its enforcement are not perceived as legitimate, which allows many people to justify their illegal fishing. Legitimacy of those who impose rules of resource use has been recognized as one of crucial conditions for effective resource governance (Dietz et al. 2003 p. 1909). Hauck develops this question further, reminding us that "the law itself needs to be questioned, including how it is defined, and by whom" (2008 p. 636). In the case of the White Sea coast fisheries, it is crucial to take into account the Soviet and post-Soviet history to understand the current state of legislation and power relations in the sphere of resource harvesting.

Conclusion

In this paper, I have looked at the difference in attitudes toward salmon between local and incoming populations in a coastal village in northwest Russia. In a concluding remark, I would like to situate my research findings within a wider context of post-socialist transformations in Russia. I suggest that the specific post-Soviet conditions in Russia have intensified the difference in people's attitudes toward local resources. In particular, free-market opportunities seized Russia after the collapse of the Soviet state and made possible the commodification of local resources on a scale that had been unthinkable before. The scale skyrocketed both in terms of the size of profits that it was now possible to generate, and in terms of the number of people who could engage in business activities. While people who come to the village from elsewhere seize the opportunity of marketing salmon in a rather unproblematic way, local people often follow certain moral restrictions that prevent them from commodifying salmon on a large scale.

The deterioration of established systems of state management and control, and the inefficient implementation of newly emerged legislation regarding resource use in post-Soviet Russia, have led to a situation in which access to resources is often regulated through informal arrangements. In these arrangements, different actors including local people, incomers, administration, and law enforcement officers operate with both legal and moral interpretations of fishing outside legal regulations.

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The Western Alaska Community Development Quota Program: Supporting the Advancement of Bering Sea Communities

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Abstract

The Western Alaska Community Development Quota (CDQ) Program is widely viewed as one of the most successful rural development programs ever undertaken in Alaska. Established by the North Pacific Fishery Management Council in 1992, this innovative federal community and economic development program provides its 65 eligible communities with a share of the Bering Sea–Aleutian Islands commercial fisheries. The primary goal of the CDQ Program is to encourage fisheries-related economic development in rural western Alaska communities, and to help build the infrastructure required to support long-term participation in the fishing industry.

For nearly 20 years, residents of western Alaska, through six nonprofit CDQ entities or community coalitions, have implemented the CDQ Program in an effort to overcome the geographic isolation, high cost of living, high unemployment, and limited economic opportunity that make this area one of the most economically challenged in the United States.

The CDQ entities work both independently and through partnerships to generate revenues from the Bering Sea–Aleutian Islands commercial fisheries, which make it possible to invest in community, human, and economic capital in rural western Alaska. By balancing these investments, eligible communities are provided resources and assets to create employment opportunities with sustainable sources of income, giving residents more control over their economic future.

The discussion will highlight some of the successes realized through the CDQ Program; illustrate the positive impacts of CDQ invest-

ments, programs, and jobs to member villages; and discuss how CDQ entities are responding to challenges faced by western Alaska.

Introduction

The Western Alaska Community Development Quota (CDQ) Program was implemented in 1992 under the direction of the North Pacific Fishery Management Council (NPFMC). An integral component of the nation's fisheries management, the NPFMC is one of eight regional councils authorized by the Magnuson-Stevens Fishery Conservation and Management Act, an important law governing the management of living marine resources in the United States. The Councils make policy recommendations to the U.S. Secretary of Commerce and the National Marine Fisheries Service, the federal technical and enforcement agency (NPFMC 2011a,b).

In response to the growing political concern for western Alaska's inability to participate in Bering Sea–Aleutian Islands fisheries due to the capital-intensive nature of the industry, Alaska representatives of the NPFMC in 1991 introduced the idea that a portion of the Bering Sea–Aleutian Islands pollock allocation be awarded to communities of western Alaska. Part of the division of the pollock fishery between the inshore and offshore sectors, the NPFMC action was the official start of the CDQ program. The CDQ program was eventually given permanence by its addition to the Magnuson-Stevens Act in 1996.

The intent of the CDQ program's authorizing legislation was to provide participating western Alaska communities with the ability to support lasting participation in the fishing industry, create opportunities for employment, increase industry capital, develop infrastructure, and build stronger economies (NRC 1999).

CDQ program overview

Some of the most abundant and productive fisheries in the world, particularly for groundfish, halibut, salmon, and crab, can be found in the Bering Sea region off the coast of Alaska (NRC 1999). Valued at over $1 billion annually, Alaska's fisheries are the source of over half the total volume of fish landings in the U.S. (NPFMC 2011b). The fishing industry is the largest private sector employer in Alaska (Oliver 2005). In 2011, the fishing industry was the fourth largest revenue generator for the state next to the oil industry, and taxes on corporate income and tobacco products, respectively (State of Alaska 2011).

A fundamental component of coastal communities' existence in rural Alaska is having access to the abundant marine resources in our state. Subsistence and commercial fishing are the backbone of the rural economy in Alaska. Therefore, it is critical to the economic and cultural survival of these communities to have access to these fisheries to provide local residents with employment opportunities that generate a reasonable income, while allowing residents to maintain their culture and traditional way of life. Sustainable, productive fisheries generate jobs for Alaskans, revenues for coastal communities, and a robust statewide economy. The CDQ Program empowers residents of western Alaska to participate in the Bering Sea–Aleutian Islands groundfish, halibut, and crab fisheries, allows communities to leverage existing levels of fisheries utilization, and helps transform the economies and quality of life in 65 communities on the coast of the Bering Sea.

Participating CDQ program communities are annually allocated a percentage of the annual fish harvest, or quota, of certain commercial species. The quota allocation percentage is drawn from the total allowable catch assigned annually by the NPFMC (NRC 1999). In order to participate in the CDQ program, communities must have met four criteria: (1) located within 50 nautical miles of the Bering Sea coast; (2) recognized by the U.S. Secretary of the Interior as a Native village under the Alaska Native Claims Settlement Act (ANCSA Public Law 92-203); (3) residents must have conducted at least half of their commercial or subsistence activities in the Bering Sea–Aleutian Islands subregions; and (4) the community could not have previously established harvesting or processing capacity sufficient to support substantial participation in the Bering Sea–Aleutian Islands groundfish industry (WACDA 2007b). A list of these communities and their respective populations is provided in Table 1.

Eligible CDQ communities organized themselves into six community groups or coalitions, commonly referred to as CDQ entities or groups (NRC 1999). Each of these community coalitions, including the Aleutian Pribilof Islands Community Development Association (APICDA), Bristol Bay Economic Development Corporation (BBEDC), Central Bering Sea Fishermen's Association (CBSFA), Coastal Villages Region Fund (CVRF), Norton Sound Economic Development Corporation (NSEDC), and the Yukon Delta Fisheries Development Association (YDFDA), are nonprofit organizations that operate independently with separate governance structures. Each CDQ group uniquely interprets and considers local need in their respective regions, develops its own approach, and tailors its programs to meet the goals of the CDQ program (NRC 1999). Table 1 designates the CDQ communities by CDQ entity.

The CDQ communities are required to use earnings generated by prosecution of the allocated fish quota to further economic development in their regions by investing in fisheries-related industries, infrastructure, and education. At the onset of the CDQ program, due to the capital-intensive nature of the Bering Sea fishery, the CDQ groups formed partnerships with established fishing corporations to harvest their quota (NRC 1999). Earnings, in the form of royalty payments,

Table 1. U.S. Census 2010 data summary of CDQ communities and corresponding population by CDQ entity (U.S. Census Bureau 2011, WACDA 2007b). See text for abbreviations.

CDQ entity	Community	Population
APICDA	Akutan	1,027
	Atka	61
	False Pass	35
	Nelson Lagoon	52
	Nikolski	18
	St. George	102
BBEDC	Aleknagik	219
	Clark's Point	62
	Dillingham	2,329
	Egegik	109
	Ekuk	No data available
	Ekwok	115
	King Salmon	374
	Levelock	69
	Manokotak	442
	Naknek	544
	Pilot Point	68
	Portage Creek	2
	Port Heiden	102
	South Naknek	79
	Togiak	817
	Twin Hills	74
	Ugashik	12
CBSFA	St. Paul	479
CVRF	Chefornak	418
	Chevak	938
	Eek	296
	Goodnews Bay	243
	Hooper Bay	1,093
	Kipnuk	639
	Kongiganak	439
	Kwigillingok	321
	Mekoryuk	191
	Napakiak	354

Table 1. (continued)

CDQ entity	Community	Population
CVRF	Napaskiak	405
	Newtok	354
	Nightmute	280
	Oscarville	70
	Platinum	61
	Quinhagak	669
	Scammon Bay	474
	Toksook Bay	590
	Tuntutuliak	408
	Tununak	327
NSEDC	Brevig Mission	388
	Diomede	115
	Elim	330
	Gambell	681
	Golovin	156
	Koyuk	332
	Nome	3,598
	St. Michael	401
	Savoonga	671
	Shaktoolik	251
	Stebbins	556
	Teller	229
	Unalakleet	688
	Wales	145
	White Mountain	190
YDFDA	Alakanuk	677
	Emmonak	762
	Grayling	194
	Kotlik	577
	Mountain Village	813
	Nunam Iqua	187
Total population		27,702

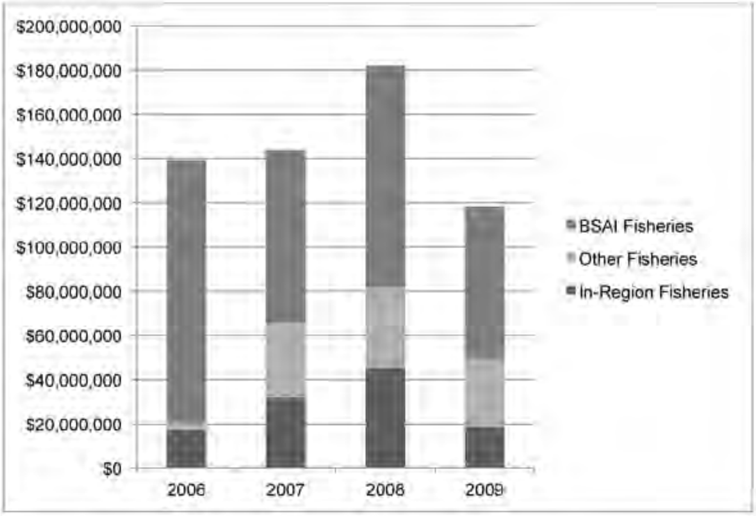

Figure 1. CDQ aggregated economic investments (WACDA 2009).

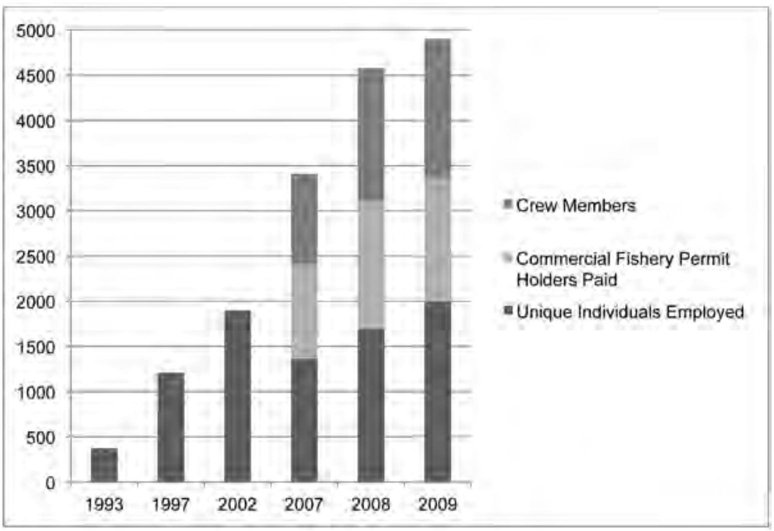

Figure 2. CDQ aggregated employment and fishery workforce (WACDA 2009). Total jobs for 2007-2009 reflect two methodological changes: wage and salary jobs are reported based on unique social security numbers of employees rather than on the number of jobs for which an individual may have been hired; the fishery workforce supported by the CDQ program (based on ex-vessel payments to permit holders) are included for the first time.

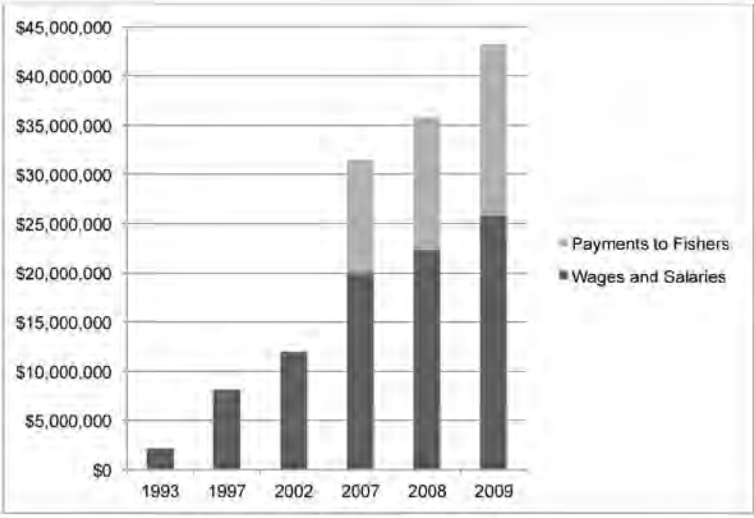

Figure 3. CDQ aggregated wages, salaries, and payments to fishers (WACDA 2009).

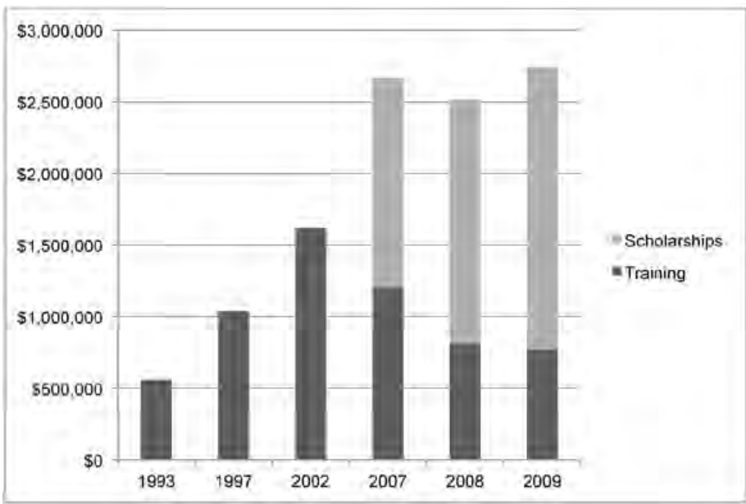

Figure 4. CDQ aggregated training and scholarship expenditures (WACDA 2009). Training and scholarship opportunities and expenditures were reported in aggregate prior to 2007.

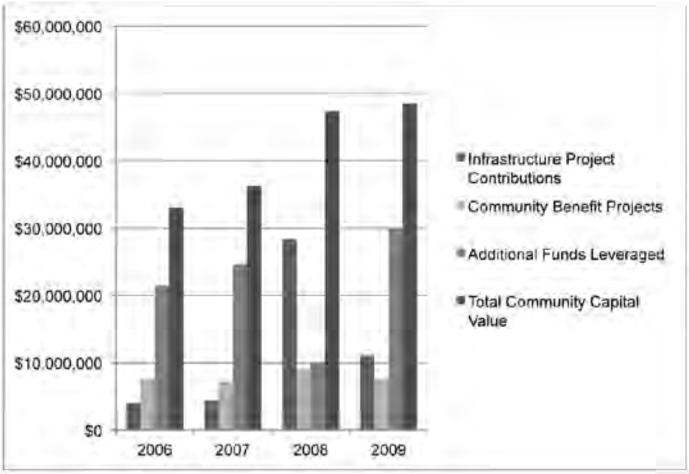

Figure 5. CDQ aggregated community capital investments (WACDA 2009).

were generated from these harvesting partners. Today, in addition to forming and maintaining industry partnerships, the CDQ groups make direct investments in fisheries, community development activities, and human capital to deliver the promise of the CDQ Program (WACDA 2007a).

Though the CDQ entities operate independently with separate governance structures, they also work together through the Western Alaska Community Development Association (WACDA), an independent nonprofit trade association. Authorized by amendments to the Magnuson-Stevens Act in 2006, WACDA, or the CDQ Panel as it is also called, collectively represents the six CDQ entities. WACDA is governed by a six-member board of directors, one representative from each of the six CDQ entities. The CDQ Panel administers those aspects of the program not otherwise addressed in federal statute. A unanimous vote of all six members is required (WACDA 2007a).

CDQ program benefits

A combination of royalty income generated from the lease of CDQ allocations and income generated by economic investments in Bering Sea–Aleutian Islands commercial fisheries make it possible for the CDQ groups to implement the goals of the CDQ program: to develop sustainable and diversified local economies in participating communities in rural western Alaska. In addition to Bering Sea–Aleutian Islands fisheries investments, the CDQ entities make investments in local and regional fisheries-related development projects that include loans to fishermen to expand local commercial fishing operations and construction of seafood processing facilities, which create local jobs and opportunities in fish processing, marketing, and distribution (NRC 1999). Information relating to recent economic investments by CDQ groups can be found in Fig. 1.

Each CDQ entity provides education, employment, and training opportunities to prepare residents for job opportunities, skill development, and career advancement. Job creation, a major component of the CDQ program, is a primary goal of each of the CDQ entities. The employment opportunities provided by the CDQ program are industry-wide and include not only fishermen, but also welders, electricians, and other skilled trades, vessel captains, crew, processors, plant managers, and the support staff required to operate fishing vessels and inshore and offshore processing facilities. The CDQ program also employs accountants, project managers, and staff required to support operations, marketing, sales and distribution, and regulatory and executive level management. A sampling of CDQ employment and wage information can be found in Figs. 2 and 3 (WACDA 2009).

Examples of education and training opportunities include scholarships for post-secondary and vocational education, student loan forgiveness; internships within the CDQ organizations, sponsorship of intern positions with other community or regional organizations, support of preschool and K-12 education programs, sponsoring or providing community training opportunities, and providing training opportunities for direct employees of the CDQ organizations. Recent scholarship and training investments by CDQ entities are depicted in Fig. 4 (WACDA 2009).

Through partnerships with state, federal, and local governments and other regional organizations, the six CDQ entities also leverage available funding for community capital investments that increase the eligible CDQ communities' capacity to govern, provide basic services, and improve living conditions in western Alaska. Community capital investments take many forms, including seed, matching, or completion grants to municipal governments, tribal entities, and nongovernmental organizations (NGO) in CDQ villages for infrastructure projects, facilities, municipal government, and NGO operations, equipment, environmental or energy-related programs and projects, and educational programs and support. For detailed data on recent CDQ community capital investments, see Fig. 5 (WACDA 2009).

Looking to the future

While the benefits of the CDQ program have been significant, western Alaska villages have weathered substantial challenges since the program was established. Fluctuations in worldwide fish prices have a profound impact on those who depend on the Alaska fishing industry for their livelihoods. The impact of climate change threatens the very existence of some CDQ villages—from declining sea ice to coastal erosion and the disappearance of subsistence food sources. Double-digit unemployment remains standard in the smallest, most remote communities. Escalating energy and fuel costs continue to add a burden to the cost of living in western Alaska (WACDA 2009).

The CDQ program represents a substantial opportunity and an important asset in responding to the challenges faced by western Alaska. The investments, jobs, and programs created by the six CDQ entities are having positive impacts, providing hope for CDQ communities and residents, and will continue to play a vital role in the future economic development of western Alaska (WACDA 2009).

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Economic Transition in Western Alaska Communities: Traditional Salmon Fishery Dependence and Emerging Groundfish Fishery Dependence

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Abstract

Many western Alaska communities have traditionally depended on salmon resources that support commercial and subsistence fisheries. Those traditional salmon fisheries have been a primary income source and have provided necessary funds to support subsistence harvest activities that ensure the primary food supply. However, many western Alaska salmon runs have resulted in economic disasters in the past, and several salmon fisheries are now restricted or closed due to poor in-river returns. Some decline in salmon runs is thought to be affected by high-seas bycatch of salmon in the federal groundfish fisheries.

In 1992, the Community Development Quota (CDQ) Program within federally managed groundfish fisheries of the Bering Sea and Aleutian Islands was enacted. This program established six regional CDQ holding entities, representing 65 communities within 50 miles of the Bering Sea, and allocated to them a portion of Bering Sea and Aleutian Islands groundfish and crab harvest. Revenue earned by CDQ entities has led to increased ownership of harvesting and processing assets. In addition, the CDQ entities have utilized CDQ-derived revenues to make infrastructure investments, provide employment training, and provide scholarships in their region.

This paper explores economic dependencies on Kuskokwim Region salmon fisheries, CDQ program effects on Kuskokwim regional economies, and emerging differences between views of traditional salmon-based commercial and subsistence users and views of CDQ-based groundfish beneficiaries. This analysis is conducted within the context

of past Chinook salmon Prohibited Species Catch actions and ongoing chum salmon Prohibited Species Catch actions in the Bering Sea and Aleutian Islands CDQ and non-CDQ pollock fisheries.

Introduction: Chinook salmon bycatch management in the federal pollock fishery

In the mid-1990s, the National Marine Fisheries Service (NMFS) implemented regulations recommended by the North Pacific Fishery Management Council (Council) to control the bycatch of Chinook salmon taken in the Bering Sea pollock fishery. These regulations implemented the Chinook Salmon Savings Area (CSSA), and mandated year-round accounting of Chinook salmon bycatch in the trawl fisheries. The Council started considering revisions to Chinook salmon bycatch management in 2004 when information from the fishing fleet indicated that it was experiencing increased rates of Chinook salmon bycatch following the regulatory closure of the CSSAs. These new bycatch patterns were the impetus, in 2002, for participants in the pollock fleet to develop a voluntary rolling hotspot system inter-cooperative agreement to attempt to reduce Chinook salmon bycatch and prevent triggered closure of the CSSA. There followed an exemption to CSSA closures for the voluntary rolling hotspot system inter-cooperative agreement that was first implemented through an exempted fishing permit in 2006 and 2007. The voluntary rolling hotspot system exemption was adopted formally by regulatory action in 2008.

Despite the efforts of the voluntary rolling hotspot system inter-cooperative agreement the Bering Sea pollock fishery by-caught record numbers of Chinook salmon in 2007 (NMFS 2009). The events of 2007 heightened the call for consideration of a binding hard cap on Chinook salmon bycatch in the pollock fishery and the Council undertook analysis of a large, complex suite of alternatives. The Council took final action in April 2010 with the adoption of a hard cap (47,591) and performance standard that became effective in January 2011 (CFR 2011). The regulation included sector allocations and other detailed provisions that may be reviewed in the implementing regulations.

The analysis of the alternative set, which was principally conducted by the authors and James Ianelli of the Alaska Fisheries Science Center, was contained in an Environmental Impact Statement, Regulatory Impact Review, and Initial Regulatory Flexibility Analysis (NMFS 2009). That analysis included a substantial community outreach effort largely consisting of meetings in rural tribal communities potentially affected by Chinook salmon bycatch. This effort was principally conducted by Diana Stram and Nicole Kimball of the Council staff, with participation by several Council members. Throughout the outreach meetings, the critical importance of Chinook and other salmon to western Alaska people and villages was made very clear. The undeniable reality is that the very way of life in many villages depends heavily on salmon harvests for subsistence lifestyle and food supply, and on commercial salmon harvests to provide cash income that is also critical to providing fuel and equipment necessary to conducting subsistence activities. This reality is exemplified in the following quote from the Bering Sea Elders Advisory Group.

> "Our subsistence practices and, specifically, ties to salmon go beyond commercial value or the monetary replacement cost of food. The English language term "subsistence" is not in our Yupik language and does not describe the totality of our ties to salmon.
>
> Traditionally, Alaska Native peoples derive their food, nutrition, ethics, and values of stewardship, languages, codes of conduct, stories, songs, dances, ceremonies, rites of passage, history, and sense of place and spirituality from the lands, waters, fish, and wildlife they have depended on for millennia. Many White persons imagine that subsistence is merely the act of an individual going hunting or fishing. Subsistence, in actual fact, is a complicated economic system and it demands the organized labor of practically every man, woman, and child in a village. There are countless tasks, such as maintenance of equipment…, preparing the outfit for major hunting and fishing expeditions…, dressing thousands of pounds of fish…, sharing harvest of meat and fish with other communities." (Bering Sea Elders Advisory Group 2009)

An integral part of Council process is public testimony. Given the importance of the proposed action, a great deal of public testimony was expected to focus on the importance of Chinook salmon to subsistence and commercial users in western Alaska. Also expected was testimony from participants in the pollock fishery that would be impacted by the proposed action. These participants included vessel operators, pollock fishery crew, processors, and leaders of pollock fishery–dependent communities. As expected, a substantial amount of public testimony was heard from all these groups; however, a somewhat unexpected perspective was also provided by a large number of representatives of the coastal Kuskokwim region villages that are part of the Community Development Quota (CDQ) organization called the Coast Villages Region Fund (CVRF). A large number of CVRF representatives testified that pollock fishery revenues are critical to the economic survival of their Lower Kuskokwim coastal communities. While they also testified to the importance of Chinook salmon, for traditional subsistence use as well as commercial revenue, they made it quite clear that great care must be

Figure 1. Kuskokwim management area and salmon run assessment projects.

taken by the Council so that its action would not irreparably harm the pollock fishery and specifically the CVRF CDQ allocation and associated revenue from the pollock fishery.

The testimony by CVRF provided a somewhat unexpected perspective on the emerging importance of the pollock fishery, and other CDQ revenue, in CVRF communities. The testimony also leads to the question of whether CVRF communities that have traditionally been highly dependent on salmon have shifted their dependence to pollock, crab, and other groundfish allocated to them under the CDQ program. This paper explores the question of evolving fishery dependence in the coastal Kuskokwim area by first documenting historic Kuskokwim area economic dependence on commercial salmon fisheries. Second, the benefits this region received from their CVRF CDQ organization are discussed. The paper concludes with a discussion of the lead author's observations regarding the impact of the CDQ program on pollock fishery dependence and on whether the CDQ program has diminished the importance of, and traditional dependence on, salmon resources.

Table 1. Local residents who bought commercial crew licenses, Yukon region, Alaska, 2004-2009.

Borough/census area	2004	2005	2006	2007	2008	2009
Bethel census area	583	654	536	582	524	609
Wade Hampton census area	526	643	447	727	557	477
Local resident total	1,109	1297	983	1,309	1,081	1,086
Region's harvest total	2,733	2,738	3,134	3,045	2,707	2,986

Source: Alaska Commercial Fisheries Entry Commission as reported by Alaska Department of Labor and Workforce Development. Printed with permission. http://labor.alaska.gov/research/seafood/seafood.htm

Kuskokwim commercial salmon fishery management and harvests

The Kuskokwim management area includes the Kuskokwim River drainage, all waters of Alaska that flow into the Bering Sea between Cape Newenham and the Naskonat Peninsula, as well as Nelson, Nunivak, and St. Matthew islands (Fig. 1). Kuskokwim area Chinook and chum runs and harvests declined significantly through the late 1990s. In 2000, the Alaska Board of Fisheries designated Kuskokwim River Chinook and chum salmon as stocks of yield concern because of the chronic inability to maintain near average yields despite specific management actions taken annually (Burkey et al. 2000). By 2005, and through 2007, more restrictive management and perhaps improved ocean survival resulted in near record runs, which led to the in January 2007 lifting of the stock of yield concern finding, for both Chinook and chum (Linderman and Bergstrom 2006). Since 2007, Chinook and chum runs have increased, as have harvests and fishery total value.

Historic socioeconomic dependence on salmon resources in the Kuskokwim region

Salmon fisheries have historically contributed substantially to Kuskokwim area earned income from both harvesting and processing activities. Table 1 shows an Alaska Department of Labor and Workforce Development (ADOLWD) analysis of local resident crewmembers by census areas with the region defined by ADOLWD as the Yukon Delta region. The Yukon Delta region includes the communities, boroughs, and census areas associated with the fisheries of the lower Yukon River

Table 2. Residents who fished their permits, Yukon region, Alaska, 2004-2009.

Borough/census area	2004	2005	2006	2007	2008	2009
Bethel census area	676	693	658	691	662	621
Wade Hampton census area	520	547	545	539	472	408
Local resident total	1,196	1,240	1,203	1,230	1,134	1,038
Region's harvest total	1,055	1,092	1,048	1,006	897	987

"Region's harvest total" represents total fishermen who fished in the region's fisheries.

Source: Alaska Commercial Fisheries Entry Commission as reported by Alaska Department of Labor and Workforce Development. Printed with permission. http://labor.alaska.gov/research/seafood/seafood.htm

area (Wade Hampton census area), and the Kuskokwim area (Bethel census area). Overall, in the Yukon Delta region 1,086 crew licenses were purchased in 2009 with 609 from the Bethel census area; however, nearly three times that many crew participated in the region's fisheries. Commercial salmon permits that are actively used in the area's fisheries are shown in Table 2. In the Yukon Delta region 1,038 permit holders were active in 2009, with 987 of these having fished in the region and 621 from the Bethel census area.

Fig. 2 depicts salmon fishery gross earnings by Yukon Delta region resident permit holders by community, as tabulated by ADOLWD. None of the communities in the region have gross earnings by resident permit holders in excess of $1 million from the salmon fisheries. However, earnings from salmon fishing are spread throughout many communities in both the Wade Hampton and Bethel census areas and this graphic shows the importance of salmon fishery revenue throughout the region. Salmon fisheries of the Yukon Delta region have had an increasing total harvesting workforce (permit holders and crew) over the past several years (Table 3). In 2005, workforce in the set-net salmon fishery peaked at 3,226 workers. The total workforce for the region is slightly larger than the set-net number, and it is not clear from the ADOLWD analysis of CFEC data what fishery contributes the additional workforce. Total gross earning of permit holders improved from low values in the early 2000s, due to poor harvests, to more than $4.5 million (nominal) in 2006. (Most of this increase is due to increased harvests; however, Chinook salmon prices increased by approximately 12% and chum salmon prices decreased by approximately 7% between 2002 and 2006.) Set net permit holder revenue declined in the late 2000s as both

Figure 2. Yukon Delta region salmon harvesting gross earnings of resident permit holders by community, 2009. Alaska Department of Labor and Workforce Development. Printed with permission. http://labor.alaska.gov/research/seafood/seafood.htm

Chinook and chum salmon harvests were constrained by poor Yukon Chinook runs. As discussed below the Kuskokwim area had record 2009 total revenue, which is masked by the combined treatment of the Yukon and Kuskokwim in the ADOLWD analysis.

Table 4 shows Yukon Delta region annual fish harvesting employment numbers by species from monthly totals, also tabulated by ADOLWD. Salmon fisheries dominate overall employment in the region (Table 4), with the greatest employment in the summer months of June, July, and August. In 2009, for example, 1,812 individuals were engaged in fish harvesting activity in July, compared to the monthly average of 399. Groundfish, halibut, and herring fisheries also provide harvesting employment in the region. Of note is that there is little or no fish harvesting employment in the region from October through April. Thus, nearly all fish harvesting–related income occurs from May through September and is heavily dependent on salmon fisheries.

Table 5 provides estimated seafood processing employment, percent of nonresident workers, and percent of nonresident earnings in the Yukon Delta region. The total worker count in the Yukon Delta region seafood processing sector declined during the early 2000s, as

Table 3. Fish harvesting employment and gross earnings for set-net and total workforce, Yukon Region, Alaska, 2003-2009.

Year	Gear type	Total estimated workforce[a]	Total gross earning of permit holders[b]	Percent of gross earnings by nonresident permit holders
2003	Set-net	1,713	$1,890,795	ND
2004	Set-net	2,214	$3,240,140	ND
2005	Set-net	3,226	$2,908,123	ND
2006	Set-net	3,108	$4,384,238	ND
2007	Set-net	3,099	$3,557,034	ND
2008	Set-net	2,830	$2,686,837	ND
2009	Set-net	2,517	$2,155,988	ND
2003	Total	919	$2,939,374	ND
2004	Total	1,805	$4,517,680	ND
2005	Total	3,814	$3,576,085	ND
2006	Total	3,327	$4,404,286	ND
2007	Total	3,721	$4,786,208	ND
2008	Total	3,366	$3,552,485	ND
2009	Total	3,020	$5,941,948	ND

[a]Workforce refers to the number of fishermen fishing permits plus crewmembers needed for the permits they fish. Regional crewmember counts are estimates derived by applying a crew factor to catch data.

[b]Gross earnings, or revenue, are currently the most reliable data available, but are not directly comparable to wages as expenses have not been deducted.

ND: Nondisclosable.

Source: Alaska Commercial Fisheries Entry Commission as reported by Alaska Department of Labor and Workforce Development. Printed with permission. http://labor.alaska.gov/research/seafood/seafood.htm

commercial salmon harvests declined, but worker count rebounded to a period high in 2009 with 831 total workers. Nonresident workers were a relatively small percentage, about 5%, in recent years. Seafood processing wages are estimated at approximately $1.8 million in 2005 and increased steadily to $4.7 million in 2009, with nonresident wages accounting for 22% of the total in 2009.

Kuskokwim area processing capacity

Western Alaska, including the Kuskokwim area, has historically suffered from inconsistent and/or limited processor presence, capacity, and operations. This history is riddled with processing business failures,

Table 4. Annual fish harvesting employment by species, Yukon region, Alaska, 2003-2009.

Year	Salmon	Herring	Halibut	Groundfish	All species
2003	3,610	118	0	0	3,728
2004	4,012	108	0	0	4,120
2005	4,838	88	593	63	5,608
2006	4,496	33	0	112	4,641
2007	4,188	0	821	111	5,152
2008	3,952	0	780	0	4,786
2009	3,864	0	609	39	4,580

2006 halibut fishing employment data were not available when this table was made. 2005 monthly halibut figures were used as a proxy for 2006 and are part of the 2006 "All species" calculation.

Source: Alaska Commercial Fisheries Entry Commission as reported by Alaska Department of Labor and Workforce Development. Printed with permission. http://labor.alaska.gov/research/seafood/seafood.htm

replacement by other ventures, and more failures. In response to the problem of processing plant failure, the University of Alaska Anchorage Institute for Social and Economic Research studied the problem and in 2001 published the workbook, *A Village Fish Plant: Yes or No*?; they revised and reprinted it in 2008 (Knapp and Reeve 2008).

The processing capacity problem has existed in the Kuskokwim area for many years. Commercial salmon harvests and revenue have been constrained in recent years since severe run declines and harvest restrictions occurred in the early 2000s. The 2003 Annual Management Report for the Kuskokwim region highlighted this problem with the following statement: "Limited processor capacity, low prices and low fishing effort dominated the season," (ADFG 2005). As Chinook and chum runs improved in the mid-2000s, processing capacity did not recover sufficiently to result in unconstrained harvests. For example, the 2006 Kuskokwim management strategy indicates that most commercial fishing periods were expected to occur as alternating half district openings to accommodate processing limitation (ADFG 2007). In 2007, a lack of processing capacity and commercial interest, and continued poor chum salmon market conditions, resulted in no commercial openings in June and July during the bulk of the Chinook, sockeye, and chum salmon runs (ADFG 2010). Processor constraints in the Kuskokwim area were not fully overcome until the 2009 season, when new processing capacity and buying stations were fully implemented by Coastal Villages Seafoods, a subsidiary of Coastal Villages Region Fund. This development and its implications for the region are discussed further below.

Table 5. Seafood processing employment, Yukon region, Alaska, 2000-2005.

Year	Total worker count	Percent nonresident workers	Wages	Percent nonresident wages
2003	459	5.4	ND	15.7
2004	468	4.9	ND	11.5
2005	557	5.0	$1,762,231	18.5
2006	486	5.3	$1,051,618	16.5
2007	583	9.9	$2,019,965	18.7
2008	789	15.7	$3,416,563	20.4
2009	831	7.6	$4,704,665	22

ND: Nondisclosable.

Source: Alaska Commercial Fisheries Entry Commission as reported by Alaska Department of Labor and Workforce Development. Printed with permission. http://labor.alaska.gov/research/seafood/seafood.htm

The Western Alaska Community Development Quota Program

The Western Alaska Community Development Quota (CDQ) Program is an economic development program associated with federally managed fisheries in the Bering Sea and Aleutian Islands (BSAI). Regulations implementing the CDQ program designate a portion of the fishery quotas for exclusive use by eligible western Alaska villages. The purpose of the program is to provide western Alaska communities the opportunity to participate and invest in BSAI fisheries, to support economic development in western Alaska, to alleviate poverty and provide economic and social benefits for residents of western Alaska, and to achieve sustainable and diversified local economies in western Alaska. A total of 65 villages are authorized under section 305(i)(1)(D) of the Magnuson-Stevens Fishery Conservation and Management Act to participate in the program. These communities participate in the CDQ program through six nonprofit corporations (CDQ groups), which manage and administer the CDQ allocations, investments, and economic development projects. The Coastal Villages Region Fund (CVRF) is the CDQ organization for the coastal communities of the lower Kuskokwim area and has 20 member communities (Table 6).

The percentage of each annual BSAI catch limit allocated to the CDQ program varies by species and management area. The CDQ program was implemented by the Council and NMFS in 1992 with allocations of 7.5% of the pollock total allowable catch (TAC). Allocations of halibut and sablefish were added to the program in 1995. In 1996, authoriza-

Table 6. Western Alaska Community Development Quota Program, Coastal Villages Region Fund, eligible Communities.

CDQ communities, listed north to south
Scammon Bay
Hooper Bay
Chevak
Newtok
Tununak
Oscarville
Napaskiak
Napakiak
Toksook Bay
Nightmute
Mekoryuk
Tuntutuliak
Chefornak
Eek
Kipnuk
Kongiganak
Kwigillingok
Quinhagak
Goodnews Bay
Platinum

Source: CDQ communities map, available at http://alaskafisheries.noaa.gov/cdq/cdq_mapto-print.pdf.

tion for the CDQ program was added to the Magnuson-Stevens Act by the U.S. Congress. In 1998, the Council expanded the CDQ program by adding allocations of the remaining groundfish species, prohibited species, and crab. Currently, the CDQ program is allocated portions of the groundfish fishery that range from 10.7% for Amendment 80 species (Aleutian Islands Pacific ocean perch, BSAI Atka mackerel, BSAI flathead sole, BSAI Pacific cod, BSAI rock sole, BSAI yellowfin sole) and 10% for pollock to 7.5% for most other species. Allocations for these various species are distributed throughout the Bering Sea and Aleutian Islands management areas.

NMFS further allocates pollock, other groundfish, crab, and prohibited species quota among the six CDQ groups based on recommendations made by the State of Alaska in 2005. The 2006 revisions to the Magnuson-Stevens Act fixed the percentage allocations for each fishery at the 2006 levels. A review of each CDQ group's continued eligibility for these allocations will occur in 2012 and every 10-year period thereafter.

Annual CDQ allocations provide a revenue stream for CDQ groups through various channels, including the direct catch and sale of some species and the leasing of quota to various harvesting partners. CDQ groups receive royalty payments on each allocation harvested by a partnering firm. Since the CDQ program was implemented, individual groups have used royalty revenue to support the goals of the CDQ program. Royalty revenues support CDQ projects, which encourage sustainable fishery-based economic development in the region or promote the social development of a community or group of communities that are participants in a CDQ program (e.g., infrastructure development, employment, and training programs). Pollock royalties are a very important source of CDQ program revenues that directly fund investments and expenditures in western Alaska. Pollock royalties have historically represented about 80% of the total annual royalties from the CDQ allocations, and the value is estimated to have reached $50.3 million in 2007 (NMFS 2009).

Revenue from investments

CDQ projects are not limited to fishery development. Section 305(i)(1)(E)(iii) of the Magnuson-Stevens Act states that CDQ groups may make up to 20% of their annual investments in non-fishery related projects within the region. Individual CDQ groups invest in community capital projects such as village infrastructure projects, medical clinics, and environmental programs and projects. Regional investments by CDQ groups have expanded the state and local tax base. In 2008, the economic activity generated by the CDQ program contributed over $1.5 million in state and regional taxes and fees in addition to the aggregated community capital investments of $17.6 million (WACDA 2008).

Although all participants in the CDQ program are nonprofit corporations, earnings are derived from distributions received from investments in companies and vessels. Since implementation of the CDQ program, individual groups have made large capital investments in vessels, infrastructure, processing capacity, and specialized gear. Local programs purchase limited access privileges in a fishery and acquire equity position in existing fishery businesses including halibut, sablefish, and crab. Revenue from such investments has exceeded royalty income since 2004, with direct income accounting for 59 to 65% of revenue annually. In 2008, the six CDQ groups had total revenues of approximately $190 million, of which approximately 65%, or $123 million, was derived from revenue sources other than royalties (WACDA 2008). In 2008, the six CDQ groups held approximately $559 million in assets and they invested more than $180 million in fisheries and fishery related projects, primarily in the Bering Sea and Aleutian Islands (WACDA 2008).

Coastal Villages Region Fund revenues and investments

The Coastal Villages Region Fund (CVRF) earns royalty based revenues from the harvesting of its CDQ allocations, principally from pollock. These royalties amounted more than $15 million in 2009. The reported value of CVRF cumulative royalties from 2000 to 2009 approached $140 million. Since 2000, and as royalty revenue has increased, CVRF has dramatically expanded its investments in fisheries related infrastructure and capacity. As a result, income from investments has risen dramatically from near zero in 2000, to more than $25 million in 2009. Cumulative investment income from 2000 through 2009 approached $180 million. CVRF indicates that through 2009 these royalties and investments generated nearly $80 million in infrastructure-based benefits and a similar amount of program related benefits, for a cumulative total benefit of just over $160 million, throughout the coastal Kuskokwim area (CVRF 2009).

Among the investments CVRF has made are multiple investments in fishing vessels, with current ownership in eight salmon fishery tender vessels, one pollock trawl vessel, five crab vessels, and three longline vessels. In addition, CVRF has invested heavily in local salmon and halibut processing facilities throughout the region. CVRF owns Coastal Villages Seafoods' eight salmon and halibut processing plants, and CVS completed construction of the $40 million Goodnews Bay regional processing plant, located in Platinum, prior to the 2009 season. In 2009 alone, more than $4.7 million was spent completing the Goodnews Bay plant and, as an independent peer reviewer noted, this represents a subsidy to salmon processing using pollock and other CDQ revenues. The Goodnews Bay plant, along with greatly expanded tendering capacity, allowed CVS fishers to harvest just over four million pounds of salmon from the Kuskokwim River, Quinhagak, Goodnews Bay, and Togiak. According to the CVRF 2009 annual report, "At no time during the season were any limits placed on CVS fishers. The total ex-vessel value of the salmon purchased from fishers in 2009 was a record $1,850,288." … "The new plant allowed more salmon to be harvested (No Limits!) and allowed approximately $1 million in additional wages to be paid to CVS employees in 2009." Thus, for perhaps the first time in a decade, processing capacity did not constrain harvests in the lower Kuskokwim for CVS fishers.

CVRF investments and development of processing infrastructure have created considerable employment opportunities for residents of the region. Coastal Villages Seafoods reportedly employed 400 processors, 600 harvesters, and 500 crewmembers in 2009, with the Goodnews Bay plant adding 126 new jobs. In addition, CVRF investments in vessels provided 135 crew positions in its pollock operation, 60 longline crew positions, and 30 crab crew positions. In all, CVRF reports 634 individuals earned $7.8 million through their employment program in 2009.

In addition to harvester, processor, and crew wages that have resulted from CVRF investments in local fisheries infrastructure, considerable investments have been made in support of local harvesters. CVRF owns 17 community centers, formerly called fisheries support centers, which provide professional space to maintain boats, motors, and fishing gear. These centers are also available for use as repair facilities for snowmachines, four wheelers, and other equipment necessary in village life as well as providing a local meeting and gathering place.

CVRF also developed several educational and training programs that directly or indirectly support local fisheries. These include educational scholarship programs for vocational and university studies as well as internships in processing plants, corporate offices, and within the science and management organization, such as the Alaska Department of Fish and Game. Other training opportunities critical to the region's fisheries include aviation, construction, heavy equipment operation, and welding services. In addition, training with computer software, driving, and emergency medical and first aid have been offered. Other programs, such as a Youth to Work program, collaborative research on salmon assessment and enhancement, safety training, tax assistance, and cash advances to fishermen all promote locally based salmon fisheries. There are many other aspects of the CVRF programs that the interested reader can see on the CVRF website (http://www.coastalvillages.org/).

While the CDQ program, and specifically CVRFs program, is intended to support economic and social development activities in eligible communities, many non-CDQ communities in western Alaska benefit from the economic development projects. Fishermen and community members from non-CDQ villages utilize the infrastructure, including maintenance and repair facilities, and training available as a result of CDQ revenues. In addition nonmember fishermen contribute catch to CDQ processing plants, and residents of nonmember communities gain employment in CDQ related projects. For example, in 2008, CVRF estimated that 16% of its fish processing employees were residents of non-CDQ communities (CVRF 2008). In addition, CVRF operates a salmon buying station in the community of Bethel, which is not a CVRF community, and operates tender vessels to support upriver fishing activities.

Summary and conclusions

Historically, the lower Kuskokwim region of western Alaska has been socially and economically dependent on salmon resources to support a socioeconomic system based on subsistence and commercial salmon harvests. The Kuskokwim region has, as have many regions in western Alaska, experienced serious declines in both Chinook and chum salmon runs through the early 2000s, which resulted in extensive harvest restrictions. Stocks did rebound through the mid to late 2000s; however, low real prices for salmon and high operating (fuel and transportation) costs limited the ability of processors to reestablish themselves. As a result, harvests were constrained by processor capacity in several years. During this time, CVRF experienced continually growing revenue from royalties on its CDQ allocations of groundfish, crab, and halibut. CVRF uses these royalties to fund investments in vessels in the groundfish, crab, and longline fleets operating off Alaska. These investments provide significant employment and earning opportunities to residents of CVRF member communities in the non-traditional fisheries of the Bering Sea. Further, revenue from royalties and investments have been used by CVRF to provide education and training opportunities, community support centers, financial assistance, and myriad other community support programs.

CVRF communities have clearly benefited substantially from CDQ royalties and investment income. When faced with potential restrictions on the federal pollock fishery aimed at reducing bycatch of Chinook salmon, which is arguably a historically critical species to the region, they adopted the slogan "Pollock Provides" and provided extensive testimony before the Council that highlighted the importance of pollock and Chinook salmon.

The testimony raises the question of whether the fishery-dependent communities of the lower Kuskokwim region have switched their dependence from traditional salmon fisheries to dependence on CDQ groundfish fisheries. After all, "Pollock Provides" sends a fairly strong message. To answer the question, this paper documents the Kuskokwim region historical economic dependence on commercial salmon fisheries and identified the impact that CVRF royalties and investments have had on the communities of the region. While it is true that significant employment and earnings opportunities have been created through investments in Bering Sea fishery operations, significant investments also have been made to support the local salmon fishery of the lower Kuskokwim region. These investments include salmon and halibut processing facilities as well as completion of a $40 million regional processing plant in Goodnews Bay that now provides the region with consistent salmon tendering and processing. These investments resulted in no limits on salmon harvesting and record salmon landings and earning in 2009. Along with the investments, CVRF has developed support centers that provide for locally derived maintenance of boats, motors, and gear. They have provided financial assistance in the form of advances to fishermen, and education and training opportunities that support the local fishing industry. Thus, CVRF has begun to develop a locally based workforce that is building experience and knowledge through CVS operations as well as through education and training opportunities. Building such local business experience and knowledge is critical to the successful sustained operation of locally owned salmon processing facilities in the region.

The investments CVRF has made in local salmon fisheries infrastructure and support has rejuvenated the local commercial salmon fishery. As shown in Alaska Department of Labor and Workforce Development data, salmon fisheries are critically important in the region due to the broad scale of participation and income derivation from commercial harvests. It is also important to note that commercial salmon revenue supports and sustains the subsistence way of life.

Thus, while residents of the CVRF communities who testified before the Council recognize a need to reduce salmon bycatch in the federal pollock fishery, they caution that such measures need be considered with care to find the best ways to do so without threatening CVRF revenue. This is likely due to the fact that "Pollock Provides" revenues are directly reinvested into the communities and their residents (CVRF 2009). As demonstrated herein, these investments enhance the long-term sustainability of salmon harvesting and processing and have rejuvenated the salmon based economy of the region. Thus, while it is clear that CVRF communities directly benefit from the CDQ revenue, it is not the case that they have become dependent on federal CDQ fisheries as a replacement for their traditional dependence on salmon fisheries. Rather, they have used the benefits of the CDQ program to enhance their salmon fisheries and through these enhancements have created a local fisheries infrastructure that hopefully will thrive well into the future regardless of whether CDQ revenues remain at present levels or decline as a result of reduced fish stocks as ocean conditions change in the future.

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Offshore Profits, Onshore Communities: A Historical Perspective on the Effects of Federal Law on Subsistence Salmon Fishing in Bristol Bay, Alaska

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Abstract

Subsistence fishing in the Bristol Bay region of Alaska has persisted for centuries, changing with time and technology but remaining central to the culture and economy. This paper, based on a master's thesis, examines effects of federal legislation on subsistence salmon fishing in Bristol Bay, with a particular focus on the Magnuson-Stevens Fishery Conservation and Management Act and the Community Development Quota program. Looking at conflicts over natural resources by examining Alaska statehood, the Alaska Native Claims Settlement Act, the Alaska National Interest Lands Conservation Act, and the Community Development Quota program within the Magnuson-Stevens Act, the paper analyzes how federal laws have treated subsistence, and how members of the Bristol Bay community viewed them. For the residents of the region, and Alaska Natives in particular, Alaska statehood, ANCSA, and ANILCA profoundly affected management of the aquatic resources of the region and commercial, subsistence, and sport fisheries of the area that made use of those resources. Subsistence salmon fishing in particular, a fundamental aspect of life in Bristol Bay, often suffered under federal legislation that ignored it, prohibited it, or failed to address the particular nature of salmon. Interviews, legislative history, law review articles, agency technical papers, and historical and anthropological sources examine the effects of each federal law at the

national, state, and local level, and the paper analyzes how subsistence users fared compared to other fishing interests. Lessons from the creation of the CDQ program, advocated by local interests, inform concluding observations about the core role of salmon in the region, and the potential for competing interests to join forces against threats to this iconic resource.

Introduction

For the past 40 years, subsistence has been at the center of conflict over natural resource use, management, and allocation among state and federal managers, Alaska Natives, Alaska residents, and "outsiders" with an interest in Alaska. In particular, the allocation and use of aquatic and coastal resources have been the focus of many of these conflicts, and Bristol Bay has seen its share. Although fishing was one of the primary forces behind the movement for Alaska statehood in the first half of the twentieth century, advocates never addressed the interface of commercial and subsistence fishing. In 1971 and 1980, Congress passed two major laws that dealt with Alaska lands and resources, the Alaska Native Claims Settlement Act (ANCSA) and the Alaska National Interest Lands Conservation Act (ANILCA). Both federal laws directly and indirectly affected the practice of subsistence throughout Alaska, as did numerous actions by the State Legislature and regulations of the Alaska Department of Fish and Game (ADFG). For Bristol Bay, these and other national policies have not entirely resolved decades-long conflicts over the iconic salmon that shape the culture of the region.

In passing ANCSA and ANILCA, Congress intended to clarify relationships and resource and land use rights among Alaska Natives, Alaskans, the State of Alaska, and the federal government. In doing so, they stepped into an already complicated landscape. By trying to avoid allocations and assignment of rights on a racial basis, they made these relationships even more troublesome and fueled conflicts between urban and rural Alaskans and between Alaska Natives and Alaska non-Native residents. In the subsistence and commercial fishing sectors, these conflicts simmered for a decade and were never resolved.

This paper looks at the complicated history of salmon in the Bristol Bay region through the lens of environmental history. The intent is to synthesize federal law, fishery management practice, and a historical and anthropological view of Alaska Natives in southwestern Alaska in order to explain the evolution of a dispute over coastal and aquatic resource use and allocation that continues today. Following a summer of field observations of salmon fishing in Dillingham, Ekuk, Aleknagik, Nushagak, and environs, the research used both previously published interviews and interviews conducted by the author, legislative history, law review articles, agency technical papers, and published historical and anthropological secondary sources to examine the effects of each federal law at the national, state, and local level. The research was originally published as a master's thesis, and was subsequently adapted to the poster format for the 2011 Lowell Wakefield Symposium in Anchorage, Alaska, Fishing People of the North: Cultures, Economies, and Management Responding to Change. The focus of this paper is the federal legislation that was enacted in response to local concerns, namely the Community Development Quota (CDQ) program. The discussion explores how diverse cultures can sometimes clash but also collaborate to preserve and protect the salmon that provide the lifeblood of the Bristol Bay region.

The scene: Bristol Bay

In summer, the Bristol Bay region of Alaska is full of color: the bright crisp blue of a clear sky, the murky gunmetal gray of choppy seas, the emerald green of the forest after the daily rain, the brilliant fuchsia of fireweed, the pinks and golds of sunsets and sunrises that blur together, the bright reddish-pinks and purples of berries, the silvery-blue of freshly caught salmon, or the red and green of a spawning salmon, and then the coral pink flesh of a salmon fillet. Bristol Bay is a place of astounding beauty and a reminder of nature's awesome presence. Impervious mountains loom tall to the north and east, while the waters of the bay that change constantly with the tide and the weather stretch out to the west. Boats of all sizes grace the horizon, but no matter their true size they seem small in comparison to the vastness of the landscape. The shrill cry of shorebirds rings out over nets, fishing boats, and canneries.

Fishing is the foundation of the regional economy, and the majority of the region's approximately 4,000 residents are employed by the commercial fishing industry, as cannery workers, support staff, or fishermen (Sepez et al. 2005). In 2010, the population of Dillingham, the economic center of the Bristol Bay region, was 2,329 with 55.9% of the population identifying themselves as Alaska Native. In 2008 the unemployment rate was 7.11%, with 11.7% of Dillingham residents living below the national poverty line (ADEC 2010). The average national unemployment rate was 5.82%, with 13.2% of the national population living in poverty (BLS 2008, Bishaw and Renwick 2009). Beyond its role in the economics of the region, fishing is at the heart of the local culture. Subsistence, the customary and traditional harvest and use of natural resources for oneself and one's family, is widely practiced in Bristol Bay. However, defining subsistence is no simple task. Myriad legal definitions exist in federal and state law, and given the cultural, ecological, and geographic diversity of Alaska, the meaning of subsistence often changes from community to community (Wolfe 2004). In the Bristol Bay

Figure 1. Salmon drying on racks, circa 1919, Naknek River, Alaska. University of Alaska, Digital Photo Archive.

region, it is difficult to draw bright lines between commercial fishing, subsistence fishing, and sport fishing, which provides income for guides and fishing lodges and food for the angling public. At the surface level, commercial fishing is the harvest of resources for sale, and subsistence is harvest for personal use. But commercial fishermen will often keep some of their catch for personal use, and many residents use the same sites, the same gear, and the same fishing practices for both commercial and subsistence catches (Andrews, Ekuk, pers. comm. 2009) For many Alaskans, and Alaska Natives in particular, the meaning of subsistence is much deeper than simply putting food on the table. It represents a symbiotic relationship with the natural world rooted in respect for all things (Fienup-Riordan 2000, 2002, 2005b).

People have practiced subsistence for thousands of years and continue to do so today. It is deeply rooted in all Alaska Native cultures, and the Yup'ik of southwestern Alaska are no exception. In the Bristol Bay region, however, subsistence is not only important to Alaska Natives. The geographic isolation of the region limits access to nonlocal fresh foods. This fact, combined with the demographic predominance of Alaska Native people and their cultures, has influenced the non-Native inhabitants of the area from the first days of European contact with the

Figure 2. Salmon strips hanging inside a smokehouse, Ekuk, Alaska. Photo courtesy of the author.

Russians. Today non-Native and Native residents practice subsistence in much the same way (see Figs. 1 and 2) (Wolfe 2004, Blume 2010).

In Dillingham, for example, many people set out their nets at Kanakanak Beach, a few miles west of town. At low tide, the net is laid out on the beach with one end anchored above the tideline and the other below it. As the tide comes in, so do the salmon, which get caught in the net. When the tide goes out, the salmon are left behind. The fish then need to be picked from the net and processed. Traditionally, strips of salmon were dried and smoked in smokehouses. Many families still maintain smokehouses today, others use electric smokers, and still others can or fillet and air-dry or freeze their catch. Regardless of how it is processed, salmon figures prominently in the diets of locals throughout the year (Blume 2010).

The Bristol Bay region was inhabited by indigenous peoples thousands of years ago. Today several distinct Alaska Native groups can be found in southwestern Alaska, including Central Yup'ik, Athabaskan, Inupiat, Alutiiq, and Aleut peoples. The Yup'ik are the most prevalent in the Bristol Bay region, and it is widely accepted by anthropologists that they are descended from people who crossed the Bering Land Bridge thousands of years ago (Library of Congress 1999). The Bristol Bay region itself has been populated for at least the past 9,000 years (Branson 2007). The Native communities there first encountered "outsiders" in the mid 1700s when Russians began exploring the North American continent. The Russians established several trading posts and missions throughout the Bristol Bay region including one at Nushagak Point, directly across the northern end of the bay from Dillingham. Alaska Natives had steady contact with Russian traders, settlers, and missionaries until Russia sold Alaska to the United States in 1867 (VanStone 1967, Naske and Slotnick 1979). Although the influx of other cultures has vastly changed the cultural composition of the area, the Yup'ik have preserved and perpetuated many of their traditions. Subsistence practices permeate daily life throughout the region (Wright et al. 1985; Fienup-Riordan 2000, 2002, 2005b; Wolfe 2004).

The Yup'ik traditionally believe that everything in the universe has a spirit: people, plants, animals, even rocks and water. They view themselves as stewards of the natural world involved in a reciprocal relationship with all things: the better care they take of their environment, the better care it will take of them. This need for balance requires people to adhere to certain rules, chiefly respect. This means respect toward human members of the community and to the animals the Yup'ik hunt in order to provide for their communities throughout the year. Even today subsistence practice reflects the importance of respect for the natural world (Fienup-Riordan 2000, 2002, 2005a,b).

The importance of subsistence, and the stake that Alaska Natives have in preserving it, not only economically but culturally, is illustrated in the public stands that leaders from Bristol Bay have taken on economic development proposals that would affect the natural resources on which their communities depend. If subsistence were simply an economic activity, it could be replaced with cash jobs from oil and mining and other economic development. But leaders from Bristol Bay have spoken against such proposals consistently for three decades, and continue to do so today. In December 2006, the Bristol Bay Native Association sent a letter to the governor opposing oil and gas development in Bristol Bay, saying, "We rely on exceptional and irreplaceable resources for survival and we are not willing to risk them." (Samuelson et al. 2006). Throughout Bristol Bay's history, its residents—Native and non-Native alike—have fought to preserve their access to natural resources, particularly salmon, the lifeblood of the region.

Alaska statehood, ANCSA, Alaska State law, and ANILCA's attempts to resolve disagreements over the definition and scope of subsistence still left western Alaskans, particularly Alaska Natives and the residents of Bristol Bay, at a disadvantage in terms of enjoying the use of their traditional coastal and aquatic resources.

Salmon and statehood

Management of Alaska's fish resources was a major driving force behind the movement for statehood. Prior to statehood, the federal government managed Alaska's fisheries (King 2009). In Bristol Bay and the Bering Sea, the majority of catchers and processors were from outside Alaska, from cities such as San Francisco and Seattle, and some were from outside the United States (Burg 1982). With the industry dominated by outside parties, it was difficult for Alaskans to utilize their home's most lucrative resource. While Alaskans were struggling to compete in the commercial fishing industry, Alaska Natives were also fighting for their piece of the pie, not only with outside parties, but also with their fellow white Alaskans, who despite their disadvantages, enjoyed greater access to commercial fishing enterprises than their Native counterparts (Troll, Dillingham, pers. comm. 2009).

With statehood came a multitude of improvements to fishery management in Alaska. Control shifted from the federal government to the state, and the Alaska constitution provided equal access for all Alaskans to the state's multitude of natural resources, including fish (Harrison 2002). Immediately following statehood, the state made sustaining fish populations and perpetuating the fishing industry two of its top priorities. Under state management, fish populations such as salmon, previously shown in rapid and disastrous decline, rebounded to commercially viable levels, although the fishery still experienced highs and lows. The Alaska Department of Fish and Game wrote of this period, "Bristol Bay production fell into a five-year cycle of booms and busts." (King 2009).

The local nature of subsistence

Lawmakers at the state and federal level failed to grasp the inherently local nature of subsistence culture. Attempts to legislate natural resource use and allocation nationally did not work for Alaskan society. Far from homogeneous, Alaska is a diverse amalgam of geography, climate, people, and politics. While federal lawmakers did incorporate many recommendations of Alaska Natives, including those of the Alaska Federation of Natives Commission delegates, and tried to accommodate local customary and traditional use patterns, many commentators argue that ANCSA and ANILCA did not satisfactorily settle the issue of subsistence (Ward Ford 1997). Furthermore, while Congress acknowledged "customary and traditional use patterns" in the language of the law (ANILCA §803 1980), this acknowledgment looked at the idea of tradition through a narrow historical lens and failed to see the evolution of subsistence practices and the incorporation of technological advances. As James Fall notes, "what subsistence laws generally fail to do is recognize that 'traditional' uses in the 21st century require some cash investments (equipment, fuel, etc.), and viability of local economies requires access to subsistence resources and cash." (James Fall, ADFG, pers. comm. 2010). Anthropologists discuss this combination of cash jobs and subsistence use as a "mixed economy" and have used statistical models to quantify the contribution of wild resources to family and community income (Wolfe and Walker 1987).

Added to the issues facing fishery management in this period, the state, like the federal government before it, continued to exclude Alaska Natives from decision-making and failed to address effectively the issue of subsistence fishing. The Subsistence Division of ADFG was not created until 1978; delays in conveyance of lands and resolution of federal withdrawals continued from 1972 through 1989 because of the state's failure to enact a statute or constitutional amendment that was consistent with ANILCA's subsistence definition. Challenges have kept subsistence in the news and the courts to this day. The federal government took over management of subsistence activities on federal lands and inland waters within the federal parks, preserves, and other withdrawals in 1999. The state has maintained management on state lands, and in state marine waters. The separate programs and approaches have given rise to recent demands by Alaska Native groups for resolution (Krieg 2009).

Western Alaskans and federal fishery management

As Alaska was trying to rebuild its salmon fisheries, leaders in the state and elsewhere around the nation wanted to move foreign fishing fleets out of U.S. waters to provide more fishery resources for American fishermen. In 1976, Congress enacted a law that overhauled the entire country's fishery management system. The Magnuson Fishery Conservation and Management Act "claims sovereign rights and exclusive fishery management authority over most fishery resources within the U.S. EEZ [Exclusive Economic Zone], an area extending 200 nautical miles from the seaward boundary of each of the coastal state." (MSFCMA 2007, 16 U.S.C. 1801 et seq. 1976; Federal Register 1983). The act also established a system of regional councils to take charge of fishery management on a more localized basis. For western Alaskans and the residents of Bristol Bay, the North Pacific Fishery Management Council (NPFMC) was created to handle affairs concerning commercial fisheries throughout federal waters off the shores of Alaska. The NPFMC role with regard to the salmon fishery, which is managed by the state through ADFG, is to develop management strategies for the marine fisheries regulated by the council to attempt to minimize interception and bycatch of salmon (NPFMC 2010a). At that time this region was the source of a quarter million dollars in fishery value, most of it salmon, and the highest value landings of any state (NMFS 2010).

The NPFMC refined the fishery management policies in federal waters off Alaska, allowing the industry to grow and flourish during the 1980s. In particular, groundfish fisheries such as pollock, cod, and halibut expanded in the Bering Sea (Bernstein et al. 2002). These offshore fisheries, which operate in the treacherous waters of the North Pacific, require significant investment by participants in the form of vessels, equipment, and capital. The economic requirements of these fisheries were not compatible with western Alaska Natives' economic realities, so the industry boomed with virtually no participation from them (WACDA 2008). The first discussion of carving out a share for coastal communities of Western Alaska took place during the debates over 1990 amendments to the Magnuson Act (Subcommittee on Fisheries and Wildlife Conservation and the Environment of the Committee on Merchant Marine and Fisheries, 1989). During those deliberations, community leaders tried to make the case for access to the lucrative resources of the Bering Sea.

Frustrated by their inability to participate in the lucrative and rapidly growing fishing industries on the Bering Sea and Aleutian chain, western Alaskans believed their input should be included in discussions about management of resources that they used as well as the commercial fleet (King 2009). In the years 1985-1989 the pollock fleet earnings grew from $5 million to more than $187 million. In 1989, the U.S. catch of salmon, valued at nearly $650 million, was caught mostly in Alaska (NMFS 2010). For the residents of the Bristol Bay region the number of fishing permits used by residents during the 1989 season totaled 1,766; the number for non-residents was 1,060. Despite nonresident fishermen having significantly fewer active permits than the local fishermen, 1989 was the first year when nonresident fishermen came close to equaling the total catch of the residents (Blume 2010). Over the next 20 years the gap widened between the total catch for nonresident salmon fishermen and the total catch for resident salmon fishermen, with the nonresidents taking the lead. As the date for reauthorization of the Magnuson Act approached, western Alaska fishermen were feeling increased pressure from nonresident fishermen on their traditional fishing grounds, while simultaneously finding it impossible to access new grounds (WACDA 2008).

At the time of the hearings on the reauthorization of the Magnuson Act in the late 1980s, western Alaska fishermen had few forums in which to discuss their frustrations and few advocates who could air their grievances in the forums that were available to them. While some served in an advisory capacity in committees of the North Pacific Fishery Management Council, they did not actually sit on the council and so had no official role in decision-making. The first Alaska Native was appointed to the NPFMC in 1980 from southeast Alaska. The first Alaska Native resident of Bristol Bay to be a voting member joined the council in 1993 and served until 2002. Another Alaska Native from Bristol Bay was appointed in 2002 and served until 2005. The current chairman of the council (Eric Olson) is an Alaska Native originally from the Bristol Bay region (NPFMC 2006, 2010b)

In the late 1980s, the residents of western Alaska saw an opportunity to enter into a multibillion dollar industry and took it upon themselves to see that it happened. When western Alaskans were finally able to bring their issues before Congress, they did not use highly financed lobbyists or the chief executive officers of major fishing corporations. The people themselves went before the Subcommittee on Fisheries and Wildlife Conservation and the Environment, men such as state Senator John Binkley formerly of Bethel, Alaska, who lived and fished in the places they were describing to the members of the subcommittee.

First they saw the damage unregulated fishing by foreign fleets inflicted upon the natural resources they relied on not only to make a living but also to feed their families. In 1989 Binkley testified: "We feel limited in our ability in Alaska. We see frustration when we see foreign governments out really stealing food from the mouths of our subsistence fishermen. We are angry and concerned about that, but we are frustrated in that we don't have the control over how that is resolved. So we rely on your help back in Washington to solve that problem." (Binkley 1989a). As the groundfish industry transitioned from foreign to American fleets, coastal residents saw the same reckless use of fish populations by their fellow Americans, as onshore and offshore processing plants and their separate fleets raced to obtain as much product as possible in order to stay afloat.

In his prepared testimony, Henry V.E. Mitchell of the Bering Sea Fishermen's Association, one of the organizations established to advocate for CDQs wrote, "Not only have the fishermen of our region suffered impacts from other fisheries through directed or indirect catch of our traditional species, we have been unable to participate in the expansion of the groundfish fisheries during the rapid Americanization." (Mitchell 1989). Throughout all of this, the residents of western Alaska had little say in how Alaska's fish resources were managed and allocated by federal bodies, and no way of securing their own economically viable access to those resources. Senator Binkley wrote, "The large boats needed to participate in these fisheries require huge capital investments that have not been available for the most part to nearby coastal communities who have had a historic interest in participating in these fisheries." (Binkley 1989b). Western Alaskans had to watch as outsiders profited from fish populations off their coast, and caught and discarded salmon their communities had relied on for thousands of years. Their grassroots-level organization produced compelling testimony but it was not enough to convince members of Congress of the need to enact CDQ programs in the 1990 amendments. As a result, western Alaskans took their concerns and their proposal to the NPFMC.

As the offshore fisheries continued to grow, so did disputes over which catch sector got how much of the catch and where to process it. As the conflict worsened, two opposing sides emerged: one in favor of onshore processing, the other in favor of offshore processing. The dispute intensified over time with charges, counter-charges, and litigation (Schaefer and Wilson 1992). Finally the NPFMC voted to recommend a 65-35 split. In 1992, the U.S. Department of Commerce approved the recommendation that "35 percent of the Bering Sea fish harvest in 1992 should be reserved for Alaska-based fishing boats and shore-based processing plants." (Schaefer and Wilson 1992). Attached to the regulation was a provision for western Alaska communities located along the Bering Sea coast that guaranteed them access to the billion-dollar groundfish fishery (U.S. Department of Commerce 1993).

The program had roles for the federal government, the State of Alaska, the NPFMC, and regional organizations that were formed to write development plans for communities in their regions. The plans had to be approved by the Secretary of Commerce, and would be financed using the estimated income from sales of their groundfish quota as capital (NMFS 1992). According to the rules, "communities could use the CDQ reserve by harvesting the fish with their own vessels and selling or processing the fish, or by entering into partnerships with harvesting vessels that would pay the CDQ communities in return for harvesting the communities' pollock allocation" (NMFS 1992). Initially, the development projects were to be only fishery related. The regulations also set criteria for participation. In the 1992 rule, a community had to be located within 50 nautical miles from the Bering Sea (except communities in the Gulf of Alaska and North Pacific). A community also needed to be certified as a Native village under ANCSA whose residents conduct more than half their commercial or subsistence fishing effort in the Bering Sea and do not have harvesting or processing capacity to participate in the offshore groundfish fisheries. The regulation provided for a program "in concept" from 1992 through 1995.

As the renewal process required for the CDQ continued existence approached, community and industry leaders lobbied Congress to make the CDQ law rather than just regulation, legally cementing its place within the management regime of Alaska's commercial fisheries. They were successful in getting a CDQ section incorporated in the 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act. The law established "a western Alaska community development quota program under which a percentage of the total allowable catch of any Bering Sea fishery is allocated to the program." (MSFCMA 2007, 16 U.S.C. 305). This guaranteed participants in the program a place within the burgeoning fisheries in the Bering Sea and Aleutian chain. However, not all Alaska communities were eligible for participation in the CDQ program, and Congress retained the rules that determined which communities qualified. Congress adopted the language from earlier regulations that granted access primarily on the basis of geography. Although the letter of the law does not state that the CDQ program is for the benefit of Alaska Natives, the criteria exclusively qualified western Alaska communities whose residents were predominantly Alaska Native.[1]

The first two criteria restricted access to communities located "within 50 nautical miles" from Alaska's coastline excluding the coast of the Gulf of Alaska and the North Pacific [MSFCMA, § 305 (i)(1)(B)(i-ii)]. Criteria (iv) referenced ANCSA in requiring that qualifying participants be identified as Native villages under that law. It was in criteria (v) that subsistence was mentioned. It stated that a participating community must "consist of residents who conduct more than one-half of their current commercial or subsistence fishing effort in the waters of the Bering Sea or waters surrounding the Aleutian Islands" [MSFCMA, § 305(i)(1)(B)(v)].

The CDQ Program and western Alaska communities

On paper, the CDQ program guarantees western Alaskans a role in the many commercial fishing industries of the Bering Sea and Aleutian chain. But the value of the program to the residents of western Alaska, and particularly places like Bristol Bay, goes far beyond business ventures. By ensuring western Alaskans' participation in commercial fisheries, the CDQ program also protects their ability to practice traditional subsistence. According to the Western Alaska Community Development Quota Program, the program has "generated more than $240 million in wages, payments to fishers, and scholarships and training benefits" (WACDA 2008) In 1997, then Alaska Governor Tony Knowles called the CDQ program a "grassroots" development program that exceeded all initial expectations: "Prior to CDQs, virtually none of the value of the Bering Sea groundfish resource stayed in western Alaska. Since its inception in 1992, the CDQ program has generated over $86 million for the development of the western Alaska economy, including over 4,000 jobs with $18 million in wages. CDQ groups have also invested in dozens of seafood industry projects and ventures with over $55 million in assets. They have invested millions more in education and training programs." (ADFG 1997).

Of the 65 qualified communities in the CDQ program, 17 are in the region of the Bristol Bay Economic Development Corporation, which has similar boundaries to the Bristol Bay Native Corporation. BBEDC is one of six regional organizations that qualified communities created to manage the CDQ program and develop projects that responded to the needs and desires of their citizens. Recognizing the geographic, cultural, and resource diversity of Alaska, the CDQ program allows individual communities to determine on which community development projects they will spend their share of the region's funds. In the Bristol Bay region BBEDC has undertaken a variety of projects that benefit its communities, from fishery related infrastructure to education and health care. It is notable that although the money generated by community development quotas comes from offshore fisheries such as pollock and crab, the BBEDC has invested the money back into salmon fisheries.

In 2006, for example, the *Bristol Maid*, an ice barge, took to the waters of Bristol Bay. The barge is able to bring flake ice to the salmon fishermen at the point of harvest. In order to maintain freshness, fishermen need to keep their catch chilled from the time it is brought onboard to the time it offloads at the processor. In addition, fishermen have an added financial incentive in the form of a bonus that many buyers pay for chilled fish. In 2007, Bristol Bay sockeye salmon fishermen earned on average more than 16% above the ex-vessel price (BBEDC 2007). By having the ice brought to them, or at least brought significantly closer, Bristol Bay fishermen are able to ensure a fresher product that earns them more money (BBEDC 2006a,b).

Despite the fact that the Bristol Bay area is home to one of the country's most profitable fisheries, many of BBEDC's community development projects are not directly related to fishing. For several years, BBEDC has offered internships and scholarships for area youth. Internships are available outside the Bristol Bay region with companies owned by BBEDC, but are also available within regional communities not only with the corporation's various enterprises but also with other organizations that in one way or another benefit the communities, such as museums, clinics, and schools (see Fig. 3) (BBEDC 2006a,b; 2007). In Ekwok, CDQ funds have contributed to the construction of a new 1,600 square foot clinic. Ekwok sees hundreds of visitors every year due to its location on the Nushagak River, a prime location for fishing and other outdoor activities. Residents of nearby villages such as New Stuyahok and Koliganek, as well as visitors and local residents, will now have access to quality health care, thereby improving their quality of life (WACDA 2008).

Although BBEDC is relatively new, its mission to encourage sustainable use of local natural resources by local communities is hardly new. Alaska Natives, and the Yup'ik in particular, have been surviving on salmon and the other resources of the region for thousands of years. In an interview, BBEDC president Robin Samuelson stressed the importance of subsistence not only to himself personally, but to his organi-

Figure 3. A Dillingham student working on a summer internship at the Sam Fox Museum, Dillingham, Alaska. Experiences such as this are funded by BBEDC. Photo courtesy of the author.

zation, and to his community. However, when asked directly whether he would consider subsistence to be the region's number one priority, he replied, "No. Escapement comes first." (R. Samuelson, BBEDC, pers. comm. 2009).

Current fishery management requires that a certain number of salmon "escape" capture in either commercial or subsistence nets before the season can begin. The idea is that by allowing a healthy percentage of the population to return to their spawning grounds to reproduce, the future of the species, and thus of the fishery, is ensured. This process is called escapement, and though its modern application has foundations in fishery management science, it reflects the fundamental principles of traditional Yup'ik belief: respect for the natural world in all its forms, sharing, reciprocity, and stewardship (Fienup-Riordan 2000, 2002, 2005a,b).

The vast majority of Bristol Bay residents are employed in one way or another by the fishing industry. At the same time, most residents practice subsistence (Wright et al. 1985, Wolfe 2004). These two ways of using the same resources are inextricably intertwined in the lives of the region's people. During the salmon seasons, many families not only put money in the bank with their catch, but they also put food on the table—quite literally—in the form of the day's catch. Kay Andrews, a fisherwoman out of Dillingham, joked that in her family they keep the best king salmon for their own table (see Figs. 4 and 5) (Kay Andrews, Dillingham, pers. comm. 2009). Even though the commercial salmon fishery is not included in CDQ programs, BBEDC and the residents of the Bristol Bay region have taken the funds generated by the offshore CDQ and put them back into their communities in such a way as to preserve, protect, and promote the salmon culture of their region. CDQ monies built not only the ice barges that service the driftnet fishermen on the water, but also ice machines onshore at Ekuk for commercial and subsistence setnet fishermen to use (see Fig. 6). Every summer BBEDC sponsors salmon camp for regional youth to learn about salmon, from life cycles to population management and escapement. Through the CDQ, a law intended to protect western Alaskans' interests in offshore commercial fishing industries, the residents of Bristol Bay have used their return from those offshore fisheries to revitalize traditional knowledge and subsistence practice related to salmon.

The CDQ program was not universally lauded. Like any piece of legislation, it had its share of opponents, from both within and outside of the state. At the time of its inception, some criticized the program for its initial limitation to only fisheries projects, a shortcoming that was addressed and corrected in the 2006 amendments to the Magnuson-Stevens Act, which led to projects such as the construction of the clinic at Ekwok.

Figure 4. Kay Andrews, center, and two of her daughters, after picking a setnet at fish camp, Ekuk, Alaska. Photo courtesy of the author.

The CDQ also faced particularly vocal opposition from outside commercial fishing interests and the state of Washington. The Washington Department of Fish and Wildlife officially adopted a policy stance opposing the CDQ because it created local rights at the expense of out of state fishermen (WDFW 1996).

More recently, the CDQ program has been criticized for investing in for-profit enterprises and then not paying income tax on landings and on profits of those enterprises started by the nonprofit CDQ entity. In 2009, the Norton Sound Economic Development Corporation decided to pay taxes to the state and federal governments on CDQ revenues, while other CDQ groups asserted their nonprofit organizations should not have to pay taxes (Loy 2009). BBEDC was one of the corporations opposed to paying taxes on their income. Robin Samuelson said, “It would be devastating for us to pay taxes as a nonprofit on the social programs we’re delivering to the people in our region… Do we want to start taxing the Red Cross? I don’t think so. All we have is fishing.” (Loy 2009).

While the CDQ profoundly affected western Alaska communities’ abilities to participate in the lucrative groundfish industry, its economic benefits only indirectly helped protect subsistence rights. Today, subsis-

Figure 5. Patrick Chiklak repairs a net after picking it clean of salmon, Ekuk, Alaska. Photo courtesy of the author.

tence in Bristol Bay continues to be threatened by overfishing by both foreign and domestic fleets, oil, gas, and mineral developments in the region, and the loss of traditional cultural knowledge in the onslaught of contemporary American culture.[2]

For the residents of the Bristol Bay region, Alaska statehood, ANCSA, and ANILCA had a profound impact on the natural resources of the region and the commercial, subsistence, and sport fisheries of the area that made use of those resources. Subsistence fishing in particular, a fundamental aspect of life in Bristol Bay, suffered under federal legislation that ignored it, or failed to address the interface of subsistence and commercial fishing.

Figure 6. The Bristol Bay Economic Development Corporation constructed this ice machine out of cargo containers to provide fresh ice to fishermen at fish camp in Ekuk, Alaska. The ice keeps the fishermen's catch fresh, which in turn nets a higher profit when the fish are sold to the cannery. Photo courtesy of the author.

Conclusion

While Alaska statehood may have resolved fishery management conflicts between the state and federal government, it mostly benefited white Alaskans and did little to recognize the importance of fishing to Alaska Natives, including the Yup'ik people of Bristol Bay. ANCSA, on the one hand, compensated Alaska Natives for their interest in land, but on the other hand ANSCA created a corporate structure for ownership of lands and investment in for-profit economic enterprises that the community lacked the experience and expertise to pursue successfully. Furthermore, ANCSA extinguished aboriginal title in Alaska, impeding Alaska Natives' ability to engage in subsistence activities often essential to their survival, physically and culturally. Only with the passage of ANILCA in 1980, and Title VIII within the law, were issues regarding subsistence use of federal lands resolved. However, Title VIII left some subsistence issues unresolved, specifically those regarding fishing in state waters such as Bristol Bay. As a result, the residents of Bristol Bay were left in much the same place as they had been prior to the passage of ANILCA. These pieces of federal legislation attempted to resolve disagreements over the definition and scope of resource use in Alaska, but still left western Alaskans, particularly the Native residents of Bristol Bay, at a disadvantage in terms of enjoying the use of their traditional coastal and aquatic resources (ANCSA 1971, ANILCA 1980). Despite the many positive effects of the CDQ program on western Alaska communities, the fact remains that it was not designed to protect or preserve subsistence practices.

The federal government oversees the majority of Alaska land, but this land is interspersed with state lands and lands held by the Native corporations created under ANCSA. Boundaries between one kind of land and the next are difficult to keep straight. Both coastal and inland waters of the state fall under state or federal jurisdiction and sometimes both. Most important, the resources in question do not recognize boundaries and move through these fluid jurisdictions. The tripartite distribution of authority over resources often results in conflict among leaders from all sides. All four of the laws addressed here, plus state laws, provide some means for the people of Bristol Bay to participate in the oversight and management of the resources so integral to their ways of life.

By trying to define subsistence in federal legislation, Congress described, at the national level, an activity that is local and conducted differently from region to region, and from community to community. Furthermore, while Congress acknowledged "customary and traditional use patterns" in the language of the law, this acknowledgment looked at the idea of tradition through a narrow historical lens and failed to see the evolution of subsistence practices and the incorporation of technological advances. Statehood, ANCSA, and ANILCA took the practice of subsistence and homogenized it. The federal government came closer to understanding the complexities of culture in Alaska when it created the CDQ program. By organizing the program at the local level, communities are able to put resources into areas of the most significance to them, economically and culturally. More important, in the most recent revision of the CDQ program, Congress actually put the decision-making power into the hands of the CDQ local entities, removing the necessity of secretarial approval of local plans. Because of this it has been particularly successful in the Bristol Bay region. Even though the Bristol Bay CDQ makes its money from the harvest of offshore resources such as cod and pollock, BBEDC puts CDQ money into salmon (commercial and subsistence). The creation of the CDQ program, advocated by local interests, demonstrates the core role of salmon in the region.

Alaskans who practice subsistence do not just want to protect their access to food and materials, they want to preserve a way of life rooted in thousands of years of tradition, and deeply connected to their identities. Teaching subsistence practice is as much about passing down values, beliefs, and history as technique for catching fish. As Timothy Wonhola said, “We have our heritage. We’ve got our pride. We’ve got to protect that along with the land because once our subsistence way of life is gone, it is gone.” (Berger 1985). Without understanding the culturally significant link between subsistence and identity, lawmakers cannot hope to create laws that adequately protect subsistence rights.

National legislative efforts to resolve disagreements over the definition and scope of subsistence still left western Alaskans, particularly Alaska Natives and the residents of Bristol Bay, at a disadvantage in enjoying the use of their traditional resources. It took a grassroots movement of fishermen in western Alaska to advocate for changes in federal law and level the playing field between Native Alaska fishermen in Bristol Bay and fishermen from outside. Securing access to the commercial fisheries through the CDQ program helped protect continuing subsistence use of coastal and aquatic resources for Alaska Natives in the region.

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Endnotes

1 Native people have been the subject of federal legislation that both advanced and restricted their opportunities. While a discussion of the decades-long balancing act over application of the 14th Amendment of the U.S. Constitution to such race-based programs and laws is beyond the scope of this paper, it is noteworthy that a comparable CDQ program for Western Pacific communities, enacted at the same time and modeled on the Alaska CDQ program, specifies eligibility based on several criteria, including the following: “consist of community residents who are descended from the aboriginal people indigenous to the area who conducted commercial or subsistence fishing using traditional fishing practices in the waters of the Western Pacific region.” [MSFCMA 2007, § 305 (i)(2)(A)].

2 In a discussion of salmon fishing by the Nushagak Advisory Council related to proposals before the Alaska State Board of Fisheries, area residents pointed out the pros and cons of allowing driftnet subsistence fishing where previously only set net subsistence fishing had been allowed. According to Robin Samuelson, who opposed allowing the more efficient drift gear, “real subsistence users control what they get. Inexperienced fishermen don’t know how to harvest fish and the potential for over-harvesting would lead to waste.” Other members were concerned about commercial users encroaching on the subsistence fishery (ADFG 2009).

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Cultures, Economies, and Management Responding to Change

Nineteen peer-reviewed articles are included in the proceedings of the 2011 symposium, Fishing People of the North: Cultures, Economies, and Management Responding to Change. Authors present research in the disciplines of anthropology, biology, and economics on fishing communities in Alaska, Hawaii, Canada, Russia, Japan, and Norway. Among many topics the papers present cultural responses to climate change effects, and transitions in fishing communities regarding permits, quotas, and target species. Articles also cover using local knowledge to preserve a fishery and to map subsistence patterns, and tribal involvement in fisheries management. Contributors share ways to address change and ensure that fishing remains a healthy, vibrant part of northern coastal communities.

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