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Meeting institutional criteria for social resilience: a nested risk system model

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ABSTRACT. Communities of Alaska's North Slope face increased stresses from cumulative effects of industrial development, resource use, and changing cryospheric and socioeconomic conditions. Given these multiple pressures, what avenues exist for citizens and decision makers to exchange knowledge about impacts of oil resource extraction in Alaska, and how do the successes and failures of knowledge exchange affect the resilience of the local social ecological system? We focused our research on the risk management process of Alaska North Slope oil resources, drawing on literature that has grown out of the risk society thesis and concepts of resilience science. We surveyed state and federal initiatives designed to increase local and indigenous stakeholder engagement in science and policy issues because such guidelines and regulations impact on the abilities of local peoples and communities to adapt sustainability strategies. Perceived risks and desired outcomes of stakeholders on the front lines of climate change and resource development should inform regulations that aim to anticipate future impacts and needed adaptation strategies. Integration of local values and perceptions in an adaptive risk management approach is fundamental in resilience-based ecosystem stewardship. The three case studies we have presented show that current provisions fail to equitably include the local and indigenous knowledge of Alaska's North Slope Borough communities in environmental risk mediation in proportion to the scope of risks inherent in current oil development policies. Our findings underscore the need for new, proactive risk management strategies that build on local stakeholders' rationalities on the trade-offs of risks and opportunities.

Key Words: *adaptive capacity; decision making; inclusion; indigenous knowledge; resilience; risk society; social-ecological systems*

INTRODUCTION

Alaska communities face stresses from the effects of climate change, natural resource development, competing land-use needs, and changing social and economic conditions (see, e.g., ACIA 2005, Chapin et al. 2006, McBeath et al. 2008, Kofinas et al. 2010). These challenges will create short- and long-term opportunities and risks; therefore, the cumulative effects from industrial development, resource use, and changing cryospheric conditions require careful proactive adaptation strategies (Hovelsrud et al. 2011). The well-being of rural Alaska communities is closely linked to their natural environment through subsistence hunting and gathering, making these communities especially sensitive to climatic and environmental changes (Kruse et al. 2008). Oil development, although potentially strengthening the local cash economies with income and jobs, also poses direct environmental risks such as potential contamination of the environment, including fish and wildlife. In Alaska, these direct risks threaten subsistence activities for many indigenous communities (Weilgart 2007, Tyack 2008).

Effective risk management strategies potentially increase the resilience of a system by reducing, sharing, and transferring risks and responding to disturbances (Mitchell and Harris 2012). We use the term resilience to refer to social resilience defined by Adger (2000:347) as "the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change." Ecological resilience and social resilience coevolve through a community's dependence on its ecosystem, but the precise synergies between the two are not always clear (Adger 2000). Our research focuses solely on institutional dimensions of resilience as it relates to the social capital and adaptive capacity of communities. There has been criticism leveled against resilience theory for its normative implications (see, e.g., Nadasdy 2007) in that it may be used as a rhetorical tool to reinforce status quo power relations. We refer

to the resilience of North Slope communities as their capacity to secure and sustain the social, economic, and cultural capital needed to achieve their desired futures.

Resilience thinking accepts that risks and uncertainties are inevitable, and effective governance therefore must be adaptive to changes and reflexive in its institutional models (Berkes et al. 2003, Smit and Wandel 2006, Chapin et al. 2009). Contrary to traditional risk models motivated by maximized risk avoidance, in the resilience-based approach to risks, emergent, systemic, and complex risks are expected to cause unanticipated disturbances (Holling 1986). The focus of a resilience risk frame is on strengthening those system properties that increase the adaptive capacity with which the system responds to such exposure. In the case of social resilience, it is largely institutionally determined in the sense that institutions permeate all social systems (Adger 2000). We examined whether institutions are accountable, inclusive, and learning based, as suggested by Lebel et al. (2006), because bridging institutions that create trust, collaborative learning, and resolve conflicts foster resilience (Tompkins and Hurlston 2011).

Alaska Native communities have identified protection of traditional ways of life, food security, health care, and education as their management priorities for the long-term sustainability and health of their communities (see, e.g., AFN 2012a, b). What constitutes accountable, inclusive, and learning-based institutions for the uptake of these future visions and acknowledgment of potential risks? This question is especially timely because the Alaska Arctic Policy Commission's 2013 plans include Alaska Native communities as potential partners in developing Arctic policies and strategies to address a range of issues (AAPC 2013). We examined two previous cooperative agreements designed to mitigate negative impacts of oil resource extraction on the North Slope to evaluate (1) avenues for inclusion of Alaska Native

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communities in the dialogue surrounding risks and (2) feedback from local stakeholders on the performance of the arrangements. Another case study presents the first wave of public movements in Alaska where a concerned public sought to actively partake in the science that informs policy.

We hypothesize that risk society (RS) conditions persist in Alaska pertaining to oil resource policies, with important implications for the shifting political and adaptive capacities of stakeholder groups. RS is the theoretical work of German sociologist Ulrich Beck, proposing a new social order created by the technological risks of modernization (Beck 1992). In RS, the threats that shape society are different from long-standing and more familiar risks, such as natural disasters, in that they are decision contingent and unconstrained in spatial and temporal consequences. Beck termed these modern risks manufactured risks. In other words, the choices we make in employing or bypassing risky technologies determine whether some day we may or may not face disaster. The difference in values between public and expert risk managers is explained by the social construction of risk, or social risk rationality, rather than an objective understanding of risk devoid of normative considerations. In other words, what society views as risky may differ widely from what institutional or organizational structures that govern perceive as risky. The difference between experts and citizens often is in the timing of when risks are first perceived and in the perceived magnitude of consequences. Residents near oil and gas development project sites may have different risk priorities from risk regulators, industry representatives, and the general public. When the public perceives that its own risk rationalities have been excluded from the status quo risk response systems, the public seeks change in policy. The phenomenon of increasing public involvement with expert risk assessments, whereby political dialogue involves individuals and groups formed outside of established political channels, is what Beck (1992) calls subpolitics. We examine three Alaska case studies supported by RS theory and evaluate ways in which an Alaska RS may transition to a resilient society via accountable, inclusive, and learning-based institutions.

BACKGROUND

North Slope stakeholders and the public process

Alaska has 19 organized boroughs functioning as administrative divisions similar to counties in other states of the United States. The North Slope Borough (NSB) is mostly an Arctic tundra ecosystem, covering a vast land area that is roughly 230,000 km², almost the size of the United Kingdom. Its nearly 10,000 residents live in 8 villages, and more than 50% of the population is of Iñupiat Eskimo descent (U.S. Census Bureau 2013). Subsistence hunting, fishing, and gathering are a central part of Iñupiat culture and still provide the bulk of the Eskimo diet (Wolfe 2000 as cited in Magdanz et al. 2002). In our study of the public process, we focused on the inclusion of indigenous knowledge in decision making because the primary stakeholders who occupy the lands of the North Slope are Alaska Natives whose culture and livelihood depend on a subsistence way of life (Weinhold 2010). We considered indigenous knowledge to be the local knowledge unique to a given culture or society (Berkes 2012) and, particularly, the knowledge unique to Alaska Iñupiat peoples.

The NSB contains the largest oil field in the United States at over 213,000 acres (862 km²), receives tax revenue from onshore oil

and gas properties, and depends on these resources for providing basic services and maintaining community infrastructures for residents. Both on- and offshore oil development in Alaska are administered through a multitiered governance process, which includes federal oversight on federal lands and in federal waters, state-federal cooperative arrangements, state and NSB jurisdictions, and local involvement. Alaska State departments accept public comments during the permit-review processes. High-ranking experts, such as the Alaska Department of Natural Resources Commissioner, who handle any public complaints, possess a great deal of discretion in making final determinations on public comments and industry proposals. The only alternative for objection to the commissioner's determination is to seek a legal resolution through the court system.

METHODOLOGY

Because human agency is crucial to the adaptive capacity and resilience of communities to respond to change (Kofinas et al. 2010, Brown and Westaway 2011), we evaluate three case studies seeking the connections between the changing nature of risks, the challenges of incorporating indigenous knowledge with science, policy disputes, and resilience. We rely on RS theory in a qualitative analysis of North Slope cooperative agreements for the management of oil extraction risks to demonstrate the links between growing awareness of risks, public distrust, and subpolitical challenges to risk definitions. To this end, we draw on three case studies prepared from archival materials and interviews with key informants. The first case study examines the Alaska Native Science Commission (ANSC) and the Alaska Eskimo Whaling Commission (AEWK) to demonstrate the earliest examples of subpolitical push by Alaska Native communities to reassert themselves over risk definitions. This case study highlights the role of competing risk definitions in Alaska subpolitics and establishes the presence of RS in Alaska. The second case study examines the controversy around the state's now dissolved Coastal Management Program and the political battle over coastal resources throughout its tenure. The third case study assesses the North Slope Science Initiative (NSSI), a federal initiative designed to coordinate research and to monitor environmental impacts of oil development on subsistence activities, with an explicitly stated federal mandate for the inclusion of traditional local knowledge (U.S. Congress 2005). This last case study revolves around perceptions of power and control exerted through the construction of science onto those most affected by its expertise.

We frame each case study from an RS theory to identify any gaps between institutions and their publics and then comment on any links that may exist with community resilience. The case studies note whether the cooperative arrangements therein are inclusive, accountable, and learning based before we conclude with recommendations for adapting risk management institutions to better fit these criteria.

CASE STUDIES

Case 1: the subpolitics of inclusion—the Alaska Eskimo Whaling Commission and the Alaska Native Science Commission

The AEWK, a group of whaling captains from the 11 whaling communities of Alaska's Arctic coast, was first organized in 1977 in response to a ban on both commercial and subsistence takes of bowhead whales (*Balaena mysticetus*) when local Iñupiat

believed scientific data on the whale population was inaccurate. The International Whaling Commission (IWC) implemented the ban without consultation with local whaling experts, estimating the Western Arctic bowhead population as significantly lower than estimated by local whalers (Freeman 1989). Independent scientific analysis later proved the IWC's estimate to be wrong (Freeman 1989, Case and Voluck 2002), and the ban was lifted on aboriginal subsistence whaling. Today, the AEWEC allocates the IWC's annual strike quota among the 11 whaling villages. The AEWEC continues to advocate for Iñupiat Eskimo subsistence whaling and has been preserving marine whale resources by negotiating conflict avoidance agreements with oil companies to mitigate industrial interference with whale migration patterns and subsistence harvest activities.

The history of the AEWEC exhibits subpolitical traits. The environmental risks from human activities that preoccupied a global audience and grew various environmental movements during the 1970s ultimately resulted in the antiwhaling sentiments that pushed for the whaling ban (Freeman 1989). The conflicting risk perceptions that resulted between a community of resource users and a governmental body motivated bottom-up political action. The AEWEC merits a mention in the nascent-stage RS context in Alaska as a group that has, over the years, grown into a successful organization whose expertise is invaluable to the social resilience of the region.

Another textbook example of subpolitics surfaced from the 1993 Workshop on Arctic Contamination convened by the Interagency Arctic Research Policy Committee in Anchorage, Alaska. The workshop revealed that the vast majority of Arctic contaminants are the products of industrial and agricultural activities (IARPC 1993). Experiments from the Cold War era, such as Project Chariot, as well as radioactive waste dispersed through oceanic currents have polluted Alaska's soil, waters, and wildlife (IARPC 1993). Project Chariot, proposed in 1958 by the U.S. Atomic Energy Commission, called for the detonation of nuclear devices 30 miles (48 km) from the Iñupiat village of Point Hope to create a deep-water harbor in the Chukchi Sea. Although the plan was never realized, radioactive materials were released to test their effects on tundra systems (O'Neill 1994). Unexplained changes in human and wildlife health, scientific evidence of harmful contaminants, and a lack of an information clearinghouse of environmental issues were great concerns for Alaska Native communities (IARPC 1993).

Alaska Native representatives expressed their desire to participate in research stating that the close cultural and physical proximity to their communities often makes them the first observers of problems (IARPC 1993). However, the workshop lacked a context of trust (Phillips 1993), and it ultimately motivated the Alaska Native community to prepare a position paper calling for involvement in science investigating Alaska Native lives and environment (ANSC [date unknown]). In the fall of 1993, the Alaska Federation of Natives passed a unanimous resolution to establish the ANSC. The ANSC has since worked to integrate Alaska Native participation and knowledge into research, science, and the policy processes.

The 1980s saw the beginning of an increased recognition of the value of traditional ecological knowledge to contemporary resource management (see, e.g., Nelson 1982, Feit 1988, Berkes

1993). This larger political trend helped rationalize the ANSC's financial backing by the U.S. National Science Foundation during its first decade. Nevertheless, the genesis of the commission is rooted in subpolitics induced by the social and cultural gaps in technocratic science and motivated by the need to improve risk-science relations.

The histories of the AEWEC and the ANSC underline the need for inclusive risk management processes that value local expertise. The AEWEC's past illustrates the important role of socio-cultural contexts in risk management (see also Gjernes 2008, Donatuto et al. 2011). Sensitivity to scale in commons management is another crucial concern in managing transboundary risks (Hirsch 2006), as was confirmed in the aftermath of the international whaling ban. The aim of comanagement is not only to achieve inclusion, but also to "engage different ways of knowing in the continuous process of problem solving" (Feldman et al. 2006:93). This process is the learning-based institutional criterion of managing for resilience mentioned earlier, and the ANSC has proved that Alaska Native communities actively sought such a role. Institutions of management in both cases showed accountability through either policy reversal or funding of the subpolitical entity. It remains a challenge, however, to design processes that build institutions on inclusive and learning-based principles.

Case 2: the subpolitics of accountability—Alaska Coastal Management Program

Despite great advancements in technologies employed in oil extraction and despite environmental protection policies enacted at nearly all levels of government, the potential for environmental hazards related to oil and gas development remains. NSB residents are consumers of both the benefits and risks of oil resource extraction. Although the majority of borough residents have supported onshore oil development, offshore oil projects frequently draw opposition. Iñupiat culture relies heavily on ocean resources such as the bowhead whale, bearded seal (*Erignathus barbatus*), ringed seal (*Phoca hispida*), spotted seal (*Phoca largha*), and the Pacific walrus (*Odobenus rosmarus divergens*) and has been successful in adapting to and managing the risks associated with the use of these resources (George et al. 2004, Fienup-Riordan and Carmack 2011).

Iñupiat interests gained support through the Alaska Coastal Management Program (ACMP), passed by the Alaska legislature in 1977 that created a voluntary partnership with the federal Coastal Zone Management Act of 1972. The program was intended to facilitate economic development, while protecting coastal resources and their uses. Its 35 coastal districts in Alaska were largely made up of borough-level governments. Each coastal district developed its own coastal management plan, creating policies that aligned with each district's goals and objectives for development in its own area. Once approved by state authorities, these district plans became part of the ACMP review process. The NSB created its original plan in 1988. Under this plan, the uptake of indigenous knowledge within the ACMP showed promise. For example, the AEWEC effectively participated in the program's consistency review process and proved instrumental in stopping a flawed project from moving forward, when, during a consistency review process, it demonstrated that the designs for a drilling structure on an ice island were inadequately prepared to withstand the ice forces in the area (AEWEC 2005).

Responding to charges on behalf of prodevelopment stakeholders that duplicate standards had resulted in delayed permitting, the Alaska state legislature mandated significant changes to the ACMP consistency review process in 2003. In the reformed ACMP, borough governments no longer had authority to adopt policies that addressed air- and water-quality concerns through the Alaska Department of Environmental Conservation, and such policies were excluded from the consistency review process. Compounding this narrowed scope of local input was the removal of language authorizing coastal districts to designate areas where subsistence activities have priority over all nonsubsistence uses.

Since the 2003 reforms, many coastal districts have protested what they saw as an industry-tailored program designed to diminish the role of local knowledge. The NSB and other coastal districts pushed for a legislative change to restore the authority of coastal districts. Alaska house bill 74 and its companion senate bill 4 introduced in January 2009 proposed a number of amendments to the ACMP, such as reaffirmation of district enforceable policies, creation of a Coastal Policy Board to represent and reflect the diversity of regional and state agency interests, and inclusion of subsistence in ACMP objectives (State of Alaska 2009). Both bills failed to pass, with rural lawmakers pushing for the bills but meeting strong opposition from the oil and gas industry (Delbridge 2010). North Slope-based subpolitical groups reacted with increased litigious opposition to proposed oil projects. The AEWC together with a number of environmental groups filed suit against the Mineral Management Service, now Bureau of Ocean Energy Management, the federal agency in charge of environmental impact assessment, to halt a Shell offshore project on grounds that the environmental risks were not well assessed (Crag Law Center 2007). Two years later, the AEWC and the Iñupiat Community of the Arctic Slope filed a second lawsuit to stop the Shell project, again on grounds of insufficient risk assessment (Joling 2009). In 2010, the U.S. district courts ruled in favor of the plaintiffs, requiring further studies on environmental impacts. The supplemental information was provided by the Bureau of Ocean Energy Management and approved by the courts in 2011, but the plaintiffs immediately filed an appeal. In January 2014, the federal appeals court ruled in favor of Alaska Native groups concluding that the Department of the Interior's environmental study failed to properly consider the full scale of oil production that would result (Demer 2014), consequently halting Shell's plans for Arctic drilling.

As of 1 July 2011, Alaska's participation in the voluntary National Coastal Zone Management program was discontinued because of an inability of the Alaska governor and state legislature to agree on passing an extension. The differing risk rationalities had become apparent as coastal districts supported reauthorization while industry representatives remained opposed to a plan. As a result, Alaska became the only coastal state in the United States without a coastal zone management plan. In response, Alaska activists, largely united under the Alaska Sea Party, placed Proposition 2 on the 2012 ballot calling for the restoration of the ACMP with additional protections for local interests through the creation of the Alaska Coastal Policy Board in the state Department of Commerce, Community and Economic Development (DCCED). The plebiscite proposed that the board be composed of 9 locally nominated public members from each

coastal region, to be appointed by the governor, and state agency commissioners from the departments of Natural Resources, Environmental Conservation, Fish and Game, and DCCED. The ballot was rejected by a vote of 46,678 "yes" to 76,440 "no" (38% to 62%). The funding differences in campaigning for and against the bill were substantial with the opponents spending US\$1.5 million to make the case that a management plan would hinder development projects statewide (Demer and Hopkins 2012). News coverage after the ballot indicated that many people voted "no" because they supported some coastal management and expected the state legislature to pick up the debate over the original ACMP and reinstate it. This has not happened.

The production of risks and unintended side effects in an RS are no longer accepted as inherent. Rather, political conflicts emerge around liability and institutional management (Mythen 2004). Borough and state officials must be accountable to the public, especially when the potential for harm to health and culture exists. Currently Alaska's coastal management does not satisfy the pillars of resilience-focused institutions. Institutions that are not accountable, inclusive, and learning-based may be putting social resilience at risk by making public discourse inefficient and leaving resource decisions to courts in lengthy legal battles.

Case 3: the subpolitics of learning-based institutions—the North Slope Science Initiative

A concerned public's insecurities regarding the government's competence to control risks often motivate political initiatives concerning scientific issues, and in response, political leaders often establish advisory bodies to regain public trust (Elmose and Roth 2005). This seemed to be the case when the NSSI was formally authorized by Congress as a multiagency, long-term initiative through the Energy Policy Act of 2005 (U.S. Congress 2005). The NSSI was collectively conceived by federal, state, and local governments as an entity to monitor the effects of a rapidly changing climate in the North Slope and to support climate-based and oil and gas development decisions (NSSI 2009). The NSSI has two bodies: an Oversight Group composed of the heads of all agencies involved in land management on the North Slope and a Science Technical Advisory Panel composed primarily of science experts. The dozen or so members of the Science Technical Advisory Panel initially included one Alaska Native elder and one scientist with a social sciences background, with the rest of the group coming from the physical and natural sciences. This ratio has not changed much over the years, except that there are no social scientists on the panel. The fact that the Arctic Slope Regional Corporation gained inclusion in the initiative, instead of the Iñupiat Community of the Arctic Slope, the regional Alaska Native tribe, became an issue of contention because of the complex history of Alaska Native rights, and it is at the heart of this case study.

A brief history of aboriginal title and land selections since 1959, when Alaska became the 49th state of the United States, merits our overview. In 1968, good-quality oil was discovered in the Prudhoe Bay area in quantities never before seen in the Western Hemisphere (McBeath et al. 2008). The planned 800-mile-long (1287 km) cross-Alaska pipeline route would span areas of Alaska Native land claims as well as federal lands, requiring congressional resolution of unresolved Native land rights. Subsequently, the 1971 Alaska Native Claims Settlement Act

endorsed land title to 44 million acres (178,062 km²) and approximately US\$1 billion, to be managed by 13 for-profit Alaska Native regional corporations. Communal aboriginal claims of Alaska Native peoples were converted into private property rights through shares of stock in more than 200 various Native regional, village, and group corporations (Case and Voluck 2002, Dayo and Kofinas 2010). Residents of some areas with an otherwise homogenous cultural base found themselves divided into multiple corporations and therefore divided as shareholders with vested interests in separate corporate entities (Case and Voluck 2002). NSB communities hold shares in the Arctic Slope Regional Corporation, which holds title and subsurface rights to nearly 5 million acres (20,234 km²) of land.

The 2005 Energy Policy Act explicitly states that the NSSI is to maintain and improve public and agency access to contemporary and traditional local knowledge (U.S. Congress 2005). It then specifies that the federal government shall enter into a cooperative agreement between state and borough agencies and the Arctic Slope Regional Corporation, a for-profit Alaska Native corporation. The Arctic Slope Regional Corporation was granted membership to the NSSI because it is the largest private landowner in the region (NSSI [date unknown]), but there have been questions as to the potential role it may also fulfill as an agent of traditional knowledge within the NSSI. In its *Cover Letter to Tribal Preclusion White Paper* (Steve Sumida, 2005, on file with author, *unpublished manuscript*), the Alaska Inter-Tribal Council voiced strong objections to the membership of the Arctic Slope Regional Corporation, likening it to “political ethnic cleansing.” The Inter-Tribal Council raised a number of objections, for example that the NSSI relies on a knowledge-generating scheme that is ignorant of indigenous ways of knowing. In addition, they noted that when an Alaska Native regional corporation is charged to study the effects of petroleum development on Alaska Native culture and subsistence, especially when that corporation itself is a petroleum producer, it is stepping into the shoes of tribes. The Inter-Tribal Council demanded that the region’s tribal government be consulted as a superior local agent of Alaska Native culture and knowledge.

One of the founding purposes of the NSSI was to bridge the gaps between indigenous knowledge and science on the effects of oil development, as well as coordinate and coproduce scientific data across scientific and cultural boundaries. Exclusion of the traditional regional Native tribe from this process endangered the competence of the entire enterprise and provoked distrust in local communities. Indigenous knowledge must be a core component of any learning-based institutions that inform North Slope policies. Other ways of knowing promote new and alternative strategies to complex problems by thinking outside of the box and through heterogeneous ideologies (Elmose and Roth 2005).

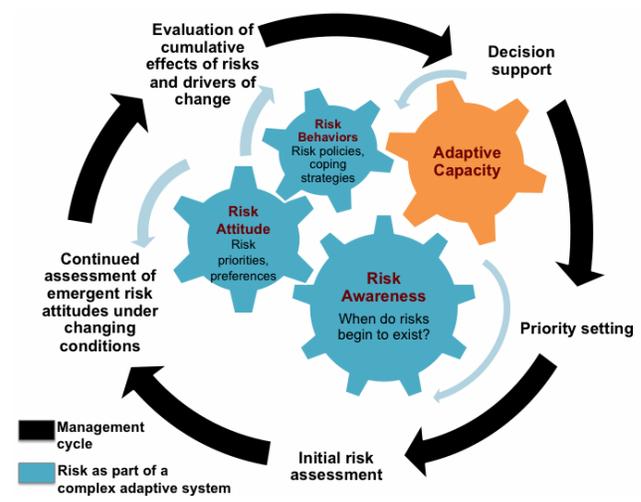
DISCUSSION

A remarkable dichotomy in an RS is that human agency is at once the cause of and the solution for manufactured risks. Although these risks are by-products of choices we make about what technologies we employ and how we manage resources, it is also through better decision making that we may foster resilience. The many social, cultural, and economic contexts of risk experience, however, shape risk perception in a highly complex dynamic social system (Eiser 2001), resulting in diverging opinions. The three

case studies demonstrate the difficulties faced by institutions of management in trying to include multiple sources of knowledge in decision making and to meet the demands of stakeholder groups.

Figure 1 represents the model envisioned by the authors for an inclusive, accountable, learning-based management process. It takes into account the complex processes that shape risk attitudes and behaviors and, ultimately, the adaptive capacity of communities.

Fig. 1. Risk and adaptive capacity as parts of a complex adaptive social system.



In our model for collaborative, adaptive risk management, a local risk subsystem operates as part of the greater risk management system. This risk subsystem encompasses community concerns, recognized risks, and ideas about needed actions, projects, and assets to be deployed in managing for healthy futures. Although it operates within a larger complex management system, and as such it is subject to rules and regulations from external authorities, it is also autonomous to a great extent with its own expert knowledge and values. The various stages of the risk subsystem at the local level, i.e., risk awareness, risk attitude, and risk behavior, correspond to risk identification, risk assessment, and risk treatment activities, respectively, at the macromanagement level. During this cycle, a community identifies, processes, and prioritizes risks through formal and informal processes according to cultural values, present and future priorities, and the availability of resources. The macromanagement cycle at each phase includes and reflects these priorities and needs in decision making. The stages of decision making build on initial priority setting and continued assessment of emergent uncertainties, risks, and changing risk attitudes based on any new information, trends, or drivers of change as they may come to affect the community.

The AEWC case began with a risk management framework that was completely exclusive of the local risk subsystem. The ANSC formed under a more open public process because the risk-assessing Workshop on Arctic Contamination included Alaska Native representatives. However, the trust between the Alaska Native community and state and federal actors eroded to such an extent, because of a lengthy history of disenfranchised risk

definitions, that cooperation was impossible. The AEWC and the ANSC exist today as ambassadors of the community risk subsystem, but their expertise is underrepresented and underutilized, as revealed in the NSSI and ACMP case studies.

The prereform ACMP had great potential to be a solid foundation for a successful, adaptive risk management program, while the NSB, through its political power and skill, was able to connect the community risk subsystem with the greater management cycle. Since the program sunset, however, there has been a great disconnect between the two risk systems. The NSSI had the potential to link different ways of knowing into learning-based risk institutions. Unfortunately, the founding federal mandate did not invest sufficient resources in making indigenous knowledge accessible or did not consider it sufficiently important to make that investment.

CONCLUSION

As the effects of global climate change make Arctic ecosystems more vulnerable (ACIA 2004), it is essential that guidelines and regulations that impact the abilities of local peoples and communities to adapt sustainability strategies are adapted to constantly changing conditions. Governance institutions are a vital part of adaptive capacity at the local level because institutions can either aid or obstruct a community's access to various resources or the implementation of vital adaptive strategies (Matthews and Sydneysmith 2010, Kofinas et al. 2013). The continuance of a public institution in democratic societies is based on social recognition that it is a permanent solution to a problem, wherein expert science produces the consensus regarding problem solving (Beck 1997). In an RS, public consent cannot be taken for granted because new groups challenge institutional authority and status quo expert findings (Beck 1997). Although a community risk subsystem too fosters a diverse set of opinions and rarely a total consensus on issues, when policy discussions involve locally supported processes and experts who build cultural distinctions into solutions, there is more likely to be consent in support of management decisions (Curtis and Hauber 1997, Armitage et al. 2007). This may lessen the incidences of subpolitical actions and litigious negotiations.

The unpredictability of problems in an RS comes with transaction costs, requiring the public to participate more actively in scientific debates (Elmose and Roth 2005). Our conceptual model envisions nested systems of risk management that satisfy the criteria for inclusive, accountable, and learning-based institutions that promote social resilience. The goal of the system is to foster and enhance the abilities of communities to anticipate and plan for changes, opportunities, and risks, as well as foster adaptive capacity and resilience.

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/issues/responses.php/6944>

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