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Adaptive governance and the human dimensions of marine mammal management: Implications for policy in a changing North

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ABSTRACT

As climate change has driven dramatic changes in Northern sea ice regimes, marine mammals have gained iconic status around the world reflecting the perils of global warming. There is a tension between policies that have international support like a ban on seal hunting or whaling, and the adoption of adaptive, flexible rules that are likely to work in Northern places. Whereas most wildlife policy focuses on biological information to inform policy strategy, this analysis focuses on the "human dimensions" of Northern marine mammal management. This research examines ways in which human relationships and modes of governance affect conservation success. Standard analyses of risk to animal populations focused on direct sources of take are inadequate to address multi-causal, complex problems such as climate-induced habitat loss or increased industrialization of the Arctic Ocean. Early conservation policy strategies focusing on the moratorium of take have eliminated or reduced such practices as commercialized hunting and high levels of fisheries bycatch, but may be less relevant in an era in which habitats and climate changes are key drivers of population dynamics. This paper argues that effective adaptive policy requires new ways of learning about and governing human interactions with marine mammals. Through an exploration of marine mammal management in three Northern regions (Alaska, Nunavut, and the Finnish Baltic Sea coast), the paper analyzes the extent to which these marine mammal management regimes are practicing adaptive governance, that is, building cross-scale (local to international) understanding while allowing actors at the local scale the flexibility to direct the creation of rules that are ecologically robust and likely to succeed. Lessons are taken from these examples and used to propose selected policy and research recommendations for the marine mammal policy community.

1. Introduction

Many Northern coastal societies share a close interactive relationship with their natural environment. The dynamic feedbacks among the communities, their natural resources, and the social institutions developed to sustain environmental benefits can be described as a social–ecological system, or SES. Marine mammals play an important role in the socioeconomic lives of Northern peoples in terms of food and materials, as well as other intangible benefits. At the same time, many marine mammals are top predators in their ecosystems and thus have an integral role in sustaining high latitude ecosystems. This role can create competition with human users of the same ecosystems and result in complex and contested human–wildlife interactions. Additionally, marine mammals as a class of animals hold a high existence value in many parts of the world (i.e., many people with and without direct interactions with marine mammals receive value simply from knowing they exist). Consequently, marine mammals provide multiple, highly valued "ecosystem services"[1] to different segments of society, and the importance that people assign marine mammals subsequently shapes marine mammal policy choices at the local, state, national, and international levels.

As climate change has driven dramatic changes in Northern[2] sea ice regimes, marine mammals have gained iconic status around the world reflecting the perils of global warming. As noted by Lovecraft and Meek (in their contribution above to this special section), tension

[1] The term "ecosystem services" stems from the field of ecological economics and is an attempt to categorize and quantify the types of benefits humans and the environment receive from ecosystem processes. It is also a concept that makes trade-offs between various benefits explicit. It was successfully used in the United Nations' Millennium Ecosystem Assessment (www.millenniumassessment.org) to evaluate the sustainability of current levels of ecosystem functioning and provisioning in many different parts of the world.

[2] "The North" is defined to include Arctic and sub-Arctic environments with sea ice as an important component of marine mammal habitats.

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results between the demands of balancing international laws and the development of flexible, adaptive institutions suitable for managing resources in a time of rapid change. In short, effective policy may require new ways of learning about and governing human interactions with marine mammals. Past policy strategies focusing on zero take have decreased much commercialized hunting but have not been successful in solving problems or perceived problems involving trade-offs between different ecosystem services (e.g., fisheries and seals; endangered salmon runs and endangered sea lions predating on salmon; and industrialization of coastal environments and marine mammals generally). Because Northern communities are tightly coupled to ecological conditions, and marine mammals and communities are part of enduring social–ecological systems (SESs), new governance strategies are needed that enhance understanding of the system, and thus support the development of rules that are most likely to succeed.

Resource managers and academics have long noted the importance of local participation in governance. The concept of subsidiarity proposes that problems are best solved at the scale of social organization closest to the problem. For instance, if a local community overharvests animals for subsistence, locals are arguably in the best position to foster long-term local norms and monitoring of harvests to prevent scarcity.[3] However, a growing body of literature illustrates the importance of coordination among multiple actors at varying levels of social organization related to policy problems, including the problem of "policy optics," or how the policy will appear to other stakeholders who may have significant influence over policy changes. Many policy problems cannot, in fact, be easily identified or monitored at specific ecological or social scales as their relevant dynamics encompass many scales. For example, the issue of whaling spans local communities' subsistence hunts in small skin boats to industrial-scale whaling operations in addition to wider (meaning external to a particular social–ecological system that produces and takes marine mammals) public opinion on those activities. In tackling these problems the importance of coordination and capacity for cross-scale interactions (e.g., information collection, deliberation, and decision-making) become even more important.

Adaptive governance is a model of governance that builds upon local to global linkages for sustainability. Dietz et al. [1] explain that this model incorporates actors across multiple levels of social organization, recognizing that many different actors in and outside of government play important and sometimes overlapping roles in policy implementation. Adaptive governance can build opportunities for institutional learning and capitalize on the self-organizing capacity of social networks, such as local hunters or community governments. While these are qualities needed in the development and application of flexible rules of marine mammal management in an era of climate change, the charismatic nature of marine mammals and the level of international concern about Arctic marine mammals in particular may complicate institutional reform. In other words, policy changes that could capitalize on local knowledge and contextualized management may not be understood or favored by distant voters, national interest groups or the very government agencies with the mandate to protect marine mammals. For example, recent discussions over the listing of polar bears as threatened under the Endangered Species Act in the United States highlighted debates over the sport hunting policies in Canada for this species without examining the potential benefits of the conservation hunting model as a practice to meet community subsistence and other needs in a way that emphasizes community stewardship, creates incentives for harvest reporting, and maintains interdependence between communities and healthy bear populations [2]. George [3] and Pokiak [4] report that creating a consumptive use value of a potentially dangerous predator like polar bears creates a community incentive to manage human interactions more carefully, and in the past has been reflected in a low number of nuisance kills in Canadian communities.

Working from the principle that adaptive governance could result in better management of marine mammals, this review examines several case studies across the North and analyzes how well existing governance strategies address three variables important to the practice of marine mammal management that can affect successful adaptive governance: the extent to which policy regimes address key drivers of resource sustainability, the effectiveness of cross-scale interactions, and the ability of local actors to self-organize in response to changes in the system. Drawing lessons from each location, management regime, and species, the analysis highlights propositions regarding bridges and barriers to adaptive governance of marine mammals from a circumpolar perspective. The paper begins with an overview of human dimensions of wildlife management as it pertains to marine mammals in the North, followed by an examination of the relevance of adaptive governance concepts in analyzing policy practice and prescribing policy change. Each case is tested for its outcome in relationship to adaptive governance properties. Bridges and barriers to adaptive governance of Northern marine mammals are described across cases, recognizing that adaptive governance does not represent a particular outcome or policy prescription, but rather a goal to strive for in sustaining these resources.

2. Global change and implications for marine mammal management

In the last fifty years humans have changed ecosystems more quickly and extensively than at any comparable period of human history and yet we are just beginning to understand the implications [5]. As a consequence, the capacity of the environment to sustain human societies has been altered. Decades of scientific research has established the particular vulnerability of high latitude ecosystems, indicating that climate change is expected to accelerate over the next half-century, contributing to major change in physical, ecological, social, and economic systems [6]. The kinds of changes noted by the Arctic Climate Impact Assessment span the totality of human existence. In other words, the effects of a changing climate will inherently influence the social dynamics of people living in the Arctic across cultural, jurisdictional, geographic, and economic scales.

Climate change poses a particular problem for Arctic peoples whose livelihoods depend directly (through resource harvest and extraction) or indirectly (through secondary job creation and infrastructure) on natural resources because shifts in the climatic variables that drive ecosystem function such as temperature, ocean currents, and snowfall will alter the ability of an ecosystem to continue to provide the ecosystem services (e.g., sea ice as a hunting platform and marine mammal habitat) to the people who depend on them. Major industries operating in the North will also have to adapt to a complex socioeconomic shift as sea ice becomes unpredictable. As climate change forces people to consider their social (e.g., economic, cultural, and political) roles in relation to the environment there is a need to examine the linkages between social systems and their attendant ecological systems.

3. Human dimensions and institutional dynamics

Wildlife management in the North, as in many other places, can be contentious because it involves "messy problems" [7], shaped by

[3] External monitoring and enforcement action can often provoke a short-term response, but multiple studies of community-based resource management by Elinor Ostrom and others demonstrate that local norms are unlikely to develop or be reinforced if external managers maintain control over monitoring and enforcement.

ecological and social forces, or dimensions. While both dimensions are typically addressed in new policy initiatives, expertise is more often brought to bear on gaining ecological understandings of the problem dynamic than investigating social drivers of change. This paper argues for the centrality of addressing social or human dimensions of environmental change when designing or reconsidering the design of resource management systems. The diagnostic, analytical framework of "fit" and "scale" [8] is employed across cases to examine policy dynamics. Building on Folke et al. [9] and Young [10], Young [11] defines fit as the match or mismatch between biophysical dynamics and governance systems, with a focus on how well policy solutions address the particular character of resource stocks and flows. Many fit analyses focus on the design or re-evaluation phase of policy. However, the most critical consideration in conservation policy implementation is arguably the legitimacy of the policy for those subject to the rules. A growing body of research suggests that resource management policy must fit social, as well as ecological, circumstances in order to be successful. In particular the concept of fit in indigenous communities includes fit to cultural norms, local framings of legitimacy, and contemporary social patterns [12–14]. Within the cases presented in this paper, authors focus on identifying social drivers of hunting as a method of analyzing social fit.

The question of scale is also paramount in addressing our cases and the future of their management regimes. *Scale* is an analytic concept useful in analyzing how well policy reflects spatial and temporal dimensions of the object of management [8]. However, scale also affects the framing of policy problems. For example, rather than considering government or policy as a monolithic set of concerns, an analyst would examine how national and local political actors conceptualize problems differently corresponding to their relative position and relationship to the issue. Mansfield and Haas [15] analyze the use of scale in framing the problem of Steller sea lion management in Alaska. The authors found that the national government framed the controversy as a local one between individual fishermen and sea lions and recommended a localized solution. Environmentalists conceptualized the problem as one requiring the revision of the national fishery management regime. The fishing industry rejected a connection between their fishery and sea lions and instead framed the problem as a manifestation of climate change that would require international attention. Scale framing has important implications for determining the "right" level to address the problem at, but also which interests can be seen as relevant to the policymaking process.

One can evaluate scale by researching whether or not institutions focused on the same problem, but operating across different geographic (and social) spaces, and bound to differing time frames, can be relatively effectively navigated by those wanting to understand how they work. The key question is *whether the appropriate geographic and time scales are equitably addressed by those who manage marine mammals.* Consider, for example, the changes over time since the 1900s in how voting majorities and public administrators in Canada and the United States have responded to the issue of polar bear harvests and the effects of climate change on the polar bear habitat. Shifting policies on animal welfare (from sport hunting to a moratorium in the U.S. to new rules on hunting in Canada); the public understanding of climate change (and the corresponding ideas of right and wrong activities in distant parts of the country, regardless of a connection to the drivers of change); and the development of rights of indigenous peoples (laws in place to protect Alaska Native subsistence take or permitting sport hunting in Nunavut) are three key aspects of marine mammal management tied directly to the temporal scale. Simultaneously, activities or actions of management agencies locally, regionally, or nationally, can have direct impacts in other nations and distant locations. Again, considering the polar bear example, the recent Endangered Species Act (ESA) listing in the United States created international pressure to ban sport hunting of polar bears in Nunavut and the import of trophies into the United States, even though Nunavut is governed by very different ecological conditions (e.g., sea ice regimes) and political processes than is Alaska. The suggestion is not that all polar bear populations are equally well-managed, but rather that policy regarding polar bear populations be reflective of ecological and social particulars of the place and system involved [16].

Another example of a difference in local and global management priorities can be found in many Arctic areas where Inuit people have long harvested groups of animals trapped in poor ice conditions. In the late 1980s, a group of grey whales trapped in the ice of off Barrow, Alaska, became the focus on international media as whalers worked to free them by manually opening ice leads with chainsaws. The first instinct of many of the whalers reportedly was to harvest the animals for subsistence as they would traditionally have done [17], but as they did not have quotas for grey whales and were under intense media focus, they instead began to work to free them.

4. Adaptive governance theory

Adaptive governance is a concept developed within institutional theory that focuses on the evolution of formal and informal institutions for the management and use of shared assets, such as common pool natural resources (i.e., resources held and managed in common by a defined group rather than by a government, private interest, or open access) and other environmental goods and processes that provide ecosystem services [18]. The adaptive governance concept addresses both the feasibility of different types of policies and their effectiveness; contributing to a clearer understanding of options for addressing environmental challenges [18–20]. Many authors emphasize adaptive governance as a response to increasingly complex environmental challenges that cannot be solved by single policy actors alone. Scholz and Stiftel describe adaptive governance as "…the evolution of new governance institutions capable of generating long-term, sustainable policy solutions to wicked problems through coordinated efforts involving previously independent systems of users, knowledge, authorities and organized interests" [21].

Governance, as a variant of the term "government", represents a mode of problem-solving operating at multiple levels of society and reliant on different underlying sources of authority [1,22,23]. Hatfield-Dodds et al. [18] contrast the concept of governance with the concept of management, in that management, "…refers to the processes of decision-making, coordination and resource deployment that occur within a given institutional setting, assuming no change in rules and norms." Management involves choosing an effective strategy to achieve policy goals and implementing this strategy through action and technologies [22]. Even though most management systems are not designed to be venues of policy design, it is arguable that the discretionary power many national wildlife agencies have to craft rules, combined with the highly variable environment in which they are managing, makes the analysis of governance all the more important. As Hajer [24] reminds us, implementation of policies by managers on a local level can, in fact, be the start of a new political debate because implementation is not merely a neutral final phase of the policy cycle. Managers are usually implementing policies that are formulated at higher levels or by small "policy communities" that regularly inform particular policy debates. Conflict can arise when implementation plans (e.g., the regulation of seal hunting based on game management policies) encounter the local livelihoods and cultures among which many important drivers are formed.

These drivers often arise from complex interactions and long histories of resource use, while the sector-based policies by necessity have a much narrower focus; these differences often spark conflict [25].

Social–ecological systems are dynamic as societies and environmental conditions change. The growing literature on marine ecosystem management recognizes that management strategies primarily based on acquiring scientific knowledge of ecosystem dynamics, while necessary for informed decision-making, are not sufficient for governing human interactions with the environment [26–28]. An adaptive governance approach pays attention to decision rules for managing under great uncertainties, and reviews policy approaches that do not work in order to experiment with new approaches and/or correct failed ones. Although the adaptive management and adaptive co-management literatures conceptualize experimentation, learning and correction (i.e., "double-loop learning" [29]) within a management framework, it is our experience that most management systems are constrained within institutional frameworks, sets of rules within legal systems, which in order to change, require attention to higher-order changes in authorities, mandates, and bureaucratic discretion. A system that takes information from adaptive management experiments and monitoring and uses it to change policy barriers or gaps is considered to exemplify "triple-loop" learning. Additionally, where organizational cultures constrain adaptation for managing marine mammals under conditions of great uncertainty, organizational change may foster the capacity to innovate and adapt [14].

Importantly, significant policy change that is meant to be more adaptive may be considered risky by various policy actors. These risks may be perceived as budgetary concerns, apprehension over departing from the status quo or even fear of personnel changes. Any governance strategy in a time of unprecedented change to sea ice systems will entail a level of risk; however, to eschew change that may ultimately better serve the purpose of legislative acts (e.g., protecting marine mammals from extinction) is far more precarious.

In terms of Northern marine mammals, the rights of communities to take marine mammals are typically governed within a broader management framework that aims to sustain the marine environment (i.e., harvest levels are allowable below an established threshold of direct take). Dietz et al. [1] outline requirements for adaptive governance of resources that require intense collaboration due to their difficulty in controlling harvests of them: provide necessary information, deal with conflict, induce compliance to rules, provide physical, technical, and institutional infrastructure, and encourage adaptation and change. In the cases below, three aspects of institutional design were analyzed in order to arrive at a relative assessment of the potential for adaptive governance. Aspects include: (1) the extent to which regimes address key drivers of wildlife population change (e.g., hunting, defense kills, and carrying capacity change), (2) whether governance effectively connects actors and their different capacities (e.g., local knowledge and scientific expertise) across spatial scales from local villages to international partners and (3) the level of self-organization of system actors (e.g., user groups and government agencies). We argue that locations with strong indicators of all three aspects hold high potential for adaptive governance in a time of rapid change.

Armitage reminds us that few governance strategies are socially or politically neutral, "[i]nequities are intrinsic to shifting relations of status, power and knowledge, culture and history" [30]. Additionally, each governance approach, as well as its prospects for change, is born of particular historical, socio-political, and institutional experiences. In the analysis below, features of adaptive governance are conceptualized as principles of good government to strive for, rather than a recipe that can be wholesale applied to any challenge. The analysis follows the human dimensions approach in evaluating bridges and barriers to adaptive governance in that we emphasize social, political, and power dimensions affecting the sustainability of resource management, keeping in mind Plummer and Armitage's [31] call for evaluating governance outcomes on the threefold basis of ecological conditions, livelihoods, and processes.

5. Introduction to cases

All four cases come from Northern regions, where marine mammals play direct roles in coastal livelihoods. The relationships communities have with these animals are complex and differ among the cases. These relationships also change throughout time in response to policy shifts, broader public demand, economic opportunities and cultural change as well as to changes in structures and functions of ecosystems. These different drivers translate into different modes of governance, involving different questions of sustainability. For example, the range of motivation for hunting differs between polar bear cases in Alaska and Canada. In turn, the nature of community–bear interactions can affect social organization of local hunters, as well as their interactions with government agencies at various levels. In Finland, seal hunting has faded as a profitable enterprise but sustaining fisheries for Finnish communities has become more difficult with the recovery of the grey seal population, necessitating policy development that explicitly recognizes social and ecological trade-offs in sustaining particular ecosystem services. The narwhal case illustrates the difficulty of self-organization with limited local authority. The cases are similar, however, in that all of them involve cross-scale governance systems triggered by changes in policy by federal and international bodies. Additionally, each case reflects tension in power relations across political scales, from the global to the local.

In this section cases are presented in terms of system dynamics and cross-scale governance. Before proceeding, it should be noted that the rationale for distinguishing between drivers of harvests (i.e., Why do people take a certain amount of animals?) does not necessarily agree with many indigenous worldviews, which tend to be holistic compared to the more compartmentalized scientific understandings. In addition, it is recognized that separating out drivers of complex systems necessarily simplifies them. However, policy prescriptions are typically developed to respond to particular drivers relevant at the time. These understandings can become untested assumptions when the policy is later reauthorized or create untenable situations at the local level. An example of such a disconnect between policy goals and local realities is the fact that until 1994, it was not legal to kill a polar bear in self-defense in Alaska [32].

5.1. Case one: polar bears in Barrow, Alaska

People and polar bears (*Ursus maritimus)* have a long history of co-habitation in Alaska. Although relationships with bowhead whales are a dominant cultural experience shaping historical and contemporary life in Iñupiaq villages on the North Slope of Alaska, polar bears have played significant roles as well. Bears figure in stories, populate village histories, and show up in cold-weather clothes (and other handicrafts) such as parkas. Bears play greater economic roles in villages with higher rates of unemployment, as handicrafts from a polar bear may bring in important supplemental household income. Polar bear goods are also produced in larger towns such as Barrow, where some skins sewers have become well-known for their expertise in working with bear skins. Traded whole skins were a valued commodity prior to the national 1972 Marine Mammal Protection Act, after which they were outlawed. Some hunters have remarked that it is ironic that skins were traditionally considered trade goods even prior to colonial times, but now are considered a wasteful use of polar

bears because they do not meet the government's test for a "significantly altered" use.

5.1.1. Drivers of harvesting

Polar bears in Alaska are hunted under two primary modes: (1) subsistence as a primary motivating factor and (2) subsistence hunt as an opportunity ancillary to public safety. A third, less common mode is a safety kill without recovery of materials (such as skin and claws) or meat. In other species an animal shot but not recovered would be "struck and lost"; in polar bears such an occurrence may be considered (by community members) as a subsistence hunt, a defense of life and property shooting, or an illegal kill depending on circumstances around the kill and community norms. Bear skins, claws, and meat are consumed locally though handicrafts may be sold to American residents. If the bear is killed in defense, the skin may not be desired for use if it is outside the typical subsistence season. In the last decade, the harvest has generally been below the voluntary quota established through the 1988 Inuvialuit-Inupiat Polar Bear Management Agreement in the Southern Beaufort Sea [33]. Official harvest reporting shows several trends: larger harvests in heavy ice years, and lower harvests after the adoption of a sport hunting ban in Alaska following the Marine Mammal Protection Act of 1972 [33].

In 2008, the U.S. Fish & Wildlife Service, a national-level wildlife agency, listed the polar bear (throughout its range, the entire North) as a threatened species under the United States Endangered Species Act, with the finding that polar bears could be endangered within the foreseeable future if trends in sea ice, and the corresponding degradation of habitat, continue. The debate over this listing primarily addressed whether or not models of summer sea ice decline had sufficient validity to accurately predict habitat conditions [34]. A secondary consideration was the strength of the evidence tying summer sea ice decline to bear population decline in Arctic, rather than sub-Arctic putative populations (e.g., see Glenn [35]). As subsistence hunting pressure in Alaska was not considered a significant driver of polar bear population declines, rules affecting hunting in Alaska were not changed when new ESA rules were developed [36]. In the years since the listing, new population estimates have been released [37], which would require a reduction in hunting pressure under provisions of the Marine Mammal Protection Act (MMPA). A further consideration in the coming years will be any additional conservation goals adopted under a recovery[4] strategy. Any adaptive management regime adopted for polar bears under these new conditions will require close coordination between the government and the whole communities if they are to be effective since negative human–bear interactions require a community-level response in addition to the current co-management model based on government staff interactions with individual polar bear hunters.

5.1.2. Dynamics of cross-scale governance and self-organization

Polar bear harvests were regulated by the state of Alaska until pre-empted by the 1972 Marine Mammal Protection Act (MMPA) at which time polar bear responsibility was transferred to the U.S. Fish & Wildlife Service. The United States also uses the MMPA to satisfy its obligations under the 1973 international Agreement on the Conservation of Polar Bears. Under the MMPA, Alaska Natives have been exempted from direct regulation (e.g., quotas) unless the government finds the related population of animals to be depleted or the harvest to be wasteful. The challenge for managers and hunters has been to develop mutually agreed upon rules that define wasteful uses (for a similar discussion in walrus, see Robards and Joly [38]). Co-management of polar bears in Alaska has developed out of the common desire to reduce conflict in interpretations of these and other rules. Several cross-scale linkages exist for polar bear management in Alaska. The first is the Nanuuq Commission, a co-management body formed in 1994, mobilized by polar bear hunting communities in response to a proposed treaty between the United States and Russia, regulating the harvest of the Chukchi Sea polar bear population. The commission was developed from a pre-existing network of walrus hunters in the Chukchi Sea region, who had formed in the 1970s to play an active role in walrus management [39]. Each village tribe within the Chukchi Sea polar bear range authorizes one representative, who is tasked with sitting on the board and engaging a two-way exchange of information between government managers and village hunters. Under the terms of the treaty, managers and hunters from both countries co-manage the shared Chukchi Sea population [40]. Because the Nanuuq Commission has been so much involved in building Russian management capacity through the whole treaty development and ratification process (1997–2006), network building in Alaskan villages has not been a primary activity of the commission in the past decade. Network activity flourished in Barrow around particular events such as the development of the Inuvialuit-Iñupiat agreement, but as Nanuuq commissioners as of 2008 did not have a role in implementing polar bear hunting or reporting rules, there has not been a motivating factor that would sustain a local network. Small groups of friends that go polar bear subsistence hunting, or act as bear guards for businesses and government, are linked to each other, but not necessarily connected to co-management activities [14].

The North Slope Borough, a regional-level government, has been the lead Alaska Native agency for the implementation of the Inuvialuit-Iñupiaq agreement for the conservation of the Southern Beaufort Sea polar bear population [41]. Both partners are advised by a technical committee staffed by borough and Inuvialuit biologists as well as government agency staff. The committee gives advice, but it is up to the agreement commissioners to adopt or reject the advice. The U.S. Fish & Wildlife Service has invested significant support in transborder conservation activities. The agreement establishes the authority for a voluntary quota to be applied to hunters within the Southern Beaufort Sea polar bear population area. In the United States, the borough is responsible for observing the quota and acting to keep harvests within the quota parameters. Most years' harvests have been under the quota. A more contentious activity is the requirement under the MMPA for reporting harvests. The U.S. Fish & Wildlife Service seeks to cooperatively implement this rule but the content of the rule and the design of its implementation are not subject to debate and negotiation, reducing the possibility of adapting the rule to local contexts or experimenting with different forms of harvest assessment [14].

The second key cross-scale linkage is the connection between the regional government entity (located in Barrow)—the North Slope Borough Department of Wildlife Management and the U.S. Fish & Wildlife Service, which has regulatory authority for monitoring and mitigating human–bear interactions. These two actors discuss management issues and have through time shared some management responsibility for safety patrols and hazing nuisance bears. Local officials, however, are limited in several respects. As of 2008, local officials were not legally empowered to move or drug and move bears. Bears sleeping in populated areas were potential hazards, and become the problem of local police and safety officials. Villages and work camps (e.g., oil and gas industry or researchers) have direct links to managers through local polar bear plans with communication protocols. Research and management biologists

[4] The ESA does not give guidance in regards to species that are threatened by climate change, a driver that is not amenable to short- or medium-term mitigation. Recovery plans have been established for few other species similarly threatened by climate change, those plans have focused on the reduction of disturbance.

are also linked to villages through periodic visits, personal relationships, and institutions that require data collection, such as harvest reporting, and permit conditions for development in polar bear habitat. Some villages have begun to develop polar bear plans, highlighting planning for tourism and mitigating bear–human interactions through activities such as careful disposal of marine mammal remains after a successful hunt so that they do not attract bears into town; however, these programs do not typically have significant funding to maintain momentum. The North Slope Borough has historically funded village polar bear patrols to keep "problem bears" away from human settlements but has not been able to afford the program in the recent past due to budgetary constraints. In 2008, Barrow's bear patrol service was limited to the town only and was an on-call service. More recently, federal funding has become available once again.

The policy regimes for Alaskan and Northern Canadian polar bear populations are linked through the 1973 International Agreement and the Marine Mammal Protection Act (MMPA) of 1972. Although for a time, the U.S. government allowed citizens to bring back polar bear skins from well-managed Canadian populations under the MMPA, these rules were pre-empted by the 2008 listing of the bear as a threatened species throughout its range, with potentially strong economic effects in Nunavut. This decision may affect the scale of management in Canada, in that contextualized Canadian management regimes developed on a regional ecosystem basis cannot mitigate the national-level American decision to disallow trade unless a statutory change is made.

5.2. Case two: polar bears in the Baffin Bay region of Nunavut

Historically, polar bears have figured prominently in Inuit shamanism, mythology, and other oral and material culture and continue to be held in high esteem today. In 1968 quotas were introduced to the Eastern Canadian Arctic as part of worldwide concern for the species, rather than because of specific information on Inuit overhunting polar bears in the region. Today, Inuit in Nunavut territory harvest polar bears for four reasons: subsistence, fur trade, sport hunting, and defense. These reasons are so interconnected as to erase the possibility of discussing them independently. For example, the skin of a bear killed for subsistence may well be sold in the fur trade or to non-Inuit visitors, while the meat of a bear killed in the sport hunt will be distributed throughout the hosting Inuit community via traditional food sharing networks. Bears killed for defense are counted in the community quota and the meat and hide are also typically used for community benefit. In all cases both the meat and hide will be used.

5.2.1. Drivers of harvesting

The sport hunt is often portrayed in non-Northern media as a key driver of the polar bear harvest. This is not the case. Each Nunavut community receives a hunting quota, which can be used for any of the four types of harvest. A community designates how the hunting tags that make up the quota can be used. Typically only between 20% and 30% of the total tags are devoted to sport hunting. The rest are distributed to community members for subsistence hunting (some of which may be used for defense, and in most cases the hides are sold in the fur trade).

Subsistence makes up the majority of the polar bear harvest and is the main driver of the harvest (with the sale of hides as an added benefit). Interest in subsistence hunting of polar bears is due to many factors. For example, the physical activity of hunting is prized by some hunters, and in some communities the meat is considered a delicacy and is highly valued, especially among older generations. But the hunt is bound up in more general cultural tenets. In Inuit tradition the community, hunter and animals are tied together. If a hunter receives the gift of an animal, he must share it with community members. If the community and hunter show appropriate respect, hunters will hopefully receive more meat in the future. All animals are considered sentient and aware of the thoughts, intentions and actions of humans, even at remote locations. Inappropriate behavior may be punished by the animals in both passive (e.g., avoidance of hunters) and active fashions (e.g., attacking people or property). Hunters are encouraged to harvest animals that present themselves in order to show respect for the gift that is offered and avoid straining the relationship between the community and the animal species in question.

Conducting a sport hunt, though economically valuable, at least to some members of the community, is problematic in this cultural context. In some communities, such as Clyde River, the ethics of hunting for a trophy are questioned. The opportunity cost to community hunters of losing some tags to the sport hunt can also be a major concern. With only 15–45 tags per community, and 200–300 or more adult men (and some women) potentially interested in going hunting, the chances of getting a tag can be low. In some communities, such as Qikiqtarjuaq and Clyde River, women are entered in tag draws, and if assigned a tag, are routinely accompanied by their husbands or male relatives. This strategy increases the hunting opportunities for the household and extended family. Men also hunt in small parties, and older men typically help their younger relatives in the hunt. Even with these strategies however, a hunter may have to wait 5 or more years between hunts. Every tag "lost" to local hunters through its assignment to the non-local sport hunt is thus keenly felt by the hunters of the community. As a result, the community sport hunt is frequently reviewed and reorganized to reduce the opportunity costs and increase the monetary and other benefits to community members.

5.2.2. Dynamics of cross-scale governance and self-organization

Canada is signatory to the 1973 Agreement on the Conservation of Polar Bears [42]. Within Canada, provinces and territories have jurisdiction over polar bears, and the current national status of the polar bear is "Special Concern". Should the status of polar bears be uplisted in Canada to Threatened (i.e., considered more at risk than currently), federal agencies would have greater authority in management and would be required to create a recovery plan. The system's key vulnerability is that publics from Southern Canada (i.e., major population centers) and environmental non-governmental groups may try to block sport hunting, not realizing that sport hunting is not a key driver of population viability.

In 1968, the Northwest Territories instituted hunting quotas to conserve polar bear populations and began a research program, often collaborating with neighboring jurisdictions both within and outside of Canada to conduct ecological and population studies [43]. In 1999 Nunavut territory separated from the Northwest Territories, but kept the same management structure for this species. The government of Nunavut and its co-management partners collect Traditional Ecological Knowledge (TEK) and scientific data on each of Nunavut's 12 polar bear populations, set quotas specific to each population as well as general harvest rules for the whole territory (such as protecting female bears in dens) [44]. Each of Nunavut's three regions divides population quotas amongst the communities whose traditional hunting grounds include the population area under question. Communities may negotiate their share of the quota at the regional level and also make arrangements amongst themselves to trade or share hunting tags with communities within the same bear population area. Communities divide their quota amongst their hunters, make all decisions involving sport hunting, and can set community rules, such as tag holding periods, hunting seasons, or the designation of hunting areas.

The system also aims to correct for errors by being flexible in terms of the quota. If communities have an over harvest situation they may "pay back" tags in future years, or conversely may save tags and potentially use them in the future. This allows community members to make mistakes, such as in the sex of the bear, without severe penalties. Within communities, hunters and government wildlife officers work together to enforce quotas and act as bear monitors if bears are spotted near town. Typically such bears are chased away, but if they become a pest and threaten humans they may be harvested as defense kills. Such bears are still counted towards the community quota. This structure allows considerable space for community self-organization. Communities are free to set many of their own hunting rules, and may negotiate the borrowing or sharing of tags between communities that harvest from the same population. Communities do feel vulnerable, however, to the keen interest of environmentalists in other parts of Canada or the world.

5.3. Case three: narwhal in Nunavut

Narwhal (*Monodon monoceros*), a small toothed whale endemic to the Arctic, are hunted by Inuit in Greenland and the Eastern Canadian Arctic. Scientific knowledge of narwhal life parameters and abundance is highly uncertain, but Canadian sub-stocks of the Baffin Bay population are relatively large and are not thought to be at risk of over-exploitation by subsistence hunting [45].

5.3.1. Drivers of harvesting

Drivers of narwhal hunting fall into either of three broad categories: economic; social–cultural; and ecological. Narwhal hunting lends itself to economic analysis. The primary economic driver is subsistence. *Maqtak* (whale hair, skin, and blubber) is consumed by humans, and as it reduces the demand for store-bought food, it has an associated replacement value. Food that is procured through hunting may therefore be considered "cash-in-kind" [46]. Narwhal hunting may also yield a tusk, if the harvested animal is male. The tusk, which is commonly between 0.5 and 3 m long, is sold to international markets for $500–$1000 (Cdn) per meter, depending on the length and condition [47]. Rarely, a male narwhal will develop two tusks—a narwhal skull with two tusks may sell for $50,000 (Cdn) or more. In a region where unemployment rates and the cost of living are high, and where formal employment opportunities are few, income derived from harvesting is an important supplement. The cash return associated with tusks is a driver – more male narwhal are harvested than female [45] – but there is nothing to suggest that the term "subsistence" should imply "just-for-food", although this is a common misinterpretation [46]. As aforementioned, food itself can be considered an economic return. Furthermore, there is an established tradition of selling tusks to finance harvesting, which can be costly, given the price of equipment and supplies necessary for participation.

Social–cultural drivers are perhaps less tangible (for an outsider at least), but they are no less relevant. Narwhal hunting, for many Inuit, is an expression of cultural identity. Whaling links elders with youth and is a vehicle for cultural continuity—it is a test of knowledge, skill, strength, endurance, courage, and respect. The act of hunting, and the subsequent sharing of proceeds, bolsters and reaffirms social networks. In short, hunting links Inuit with each other, with their cultural heritage, and with their environment [48].

Lastly, there is an ecological motivation for hunting narwhal. Some Inuit and other indigenous peoples subscribe to a wildlife management paradigm where hunting is thought to increase the relative abundance of the species hunted. This conception is at odds to conventional resource management that typically aims to limit biological removals to below the assumed population growth rate.

5.3.2. Dynamics of cross-scale governance and self-organization

Since 1999 (2001 in Arctic Bay) five communities in Nunavut have been participating in an "experimental" community-based narwhal management (CBNM) program. The program was first implemented on a trial basis, for three years, and was extended for an additional five years in 2002. The goals of the program are to (1) improve the accuracy of harvest data—participating communities are required to self-report all narwhal landed and struck-and-lost and (2) reduce struck-and-lost rates and wastage through the development of by-laws and young-hunter education programs. Community-based narwhal management links community-level Hunters' and Trappers' Organizations (HTOs) vertically with Regional Wildlife Organizations, the Nunavut Wildlife Management Board, Nunavut Tunngavik Inc., and the Department of Fisheries and Oceans (DFO). Under the new system HTOs draft and enforce by-laws to manage aspects of the hunt related to quota allocation (i.e., who harvests, where, when, and how), but the Nunavut Wildlife Management Board and the Department of Fisheries have retained the power to set, remove, and vary quotas (e.g., how many). Although some decision-making powers previously held by the territory and the state have been devolved to HTOs, community by-laws may contextualize but may not conflict with the existing federal legislation (i.e., the Fisheries Act and the Marine Mammal Regulations enabled thereby).

5.4. Case four: grey seals and sustainable fisheries in Finland

The grey seal (*Halichoerus grypus)* population in the Baltic Sea declined throughout the 20th century, with a real risk of extinction [49]. In response, grey seal conservation sentiment grew strongly in the 1970s and 1980s and even the remaining small harvest was banned. The total protection of seals and improved environmental conditions in the sea drove a surprisingly rapid change in the population trend. Since the late 1980s the population has grown rapidly. The population was thus saved, but the competition with fisheries emerged as a counter effect. In the late 1990s, Finland legalized a hunt for grey seals *again* as a response to fishermen's complaints regarding the economic damage seals were causing to coastal fisheries. Fishermen argued for renewed hunting not only to reduce the number of seals. Importantly, fishermen sought a renewed hunt to make seals afraid of humans, thereby protecting fishing grounds.

The present mode of seal hunting is linked to the old tradition of seal hunting at least in some parts of the country. In these areas there are attempts to normalize game hunting of seals. One indicator of a normalized hunt is that the raw materials (meat, blubber, skin, and fur) of the animal are utilized. There is some demand for seal products like oil-based paint made from seal blubber, but in comparison to high costs of hunting it does not make hunting an economically viable activity. Those who participate in the hunt do so primarily for recreation.

5.4.1. Drivers of harvesting

The number of harvested seals is regulated by a quota that has been gradually increasing, currently (2009–2010) at 1050 grey seals per year. *The quota* is a key *regulatory* driver of harvests. Seal hunting brings very little economic returns to hunters and, therefore, the seal hunt is a recreational activity. As with other game species, seal hunters in Finland must make use of the seals they harvest. The actual number of seals taken has varied between 160 and 360 (mean = 168) in recent years (2004–2008), which indicates that the quota is not, in fact, limiting the hunt. As the hunting is a hobby, the hunters' willingness to invest their time and resources in this very difficult hunt is the real driver. The hunt was reintroduced not only as a game species sport hunt, but also to control the damage caused by the

species as a pest to the more highly valued ecosystem service creating fisheries. The extent of *damage caused by seals* is thus one of the drivers, since that is the chief argument for resuming the hunt. Vulnerability of fishing methods to seal-induced damage is contributing to the problem. In this respect, the *fishing technology* and its development are one of the drivers. Many resources have been invested in technological innovations to reduce the damage, with some limited success. Economic impacts of the damage have been decreased by compensation schemes both regarding the damage to nets and the loss of fish caught. Such schemes make the seal-induced economic losses more bearable.

The attitude of the public could also be seen as a driver. When the grey seal hunting was reintroduced there were some protests by the environmental groups, but as the grey seal population has been growing fast arguments against the hunting on the basis of nature conservation have not surfaced very strongly. Environmental groups have been concerned about hunting methods and favor human methods. Interestingly, animal rights activists have not opposed the seal hunt in Finland.

5.4.2. Dynamics of cross-scale governance and self-organization

The grey seal is protected in the European Union (EU) by the Habitats Directive, which establishes Finland's conservation duties as an EU member state. The Habitats Directive is in turn implementing the International Bern Convention on the Protection of Wildlife in Europe. Another important international agreement is the recommendation for the protection of seals in the Baltic Sea given under the Convention on the Protection of the Marine Environment of the Baltic Sea Area (HELCOM). The latest development in the European Union legislation was to ban the trade of all seal products within the EU. Finland and Sweden were granted exemptions to continue small-scale trade in their domestic markets. Selling of seal products is also permitted when the products come from traditionally conducted hunts by Inuit and other indigenous communities to ensure their subsistence. This exemption applies to the indigenous peoples of the Inuit homeland in Alaska, Canada, Greenland, and Russia. Canada strongly condemned the ban. Even though the ban on seal products does not stop seal hunting in Finland, it does have broader aspects as it inhibits development of a Finnish seal export market.

The Finnish policy regarding the seals is strongly guided by its international obligations (EU and HELCOM). Nationally the implementation has taken two concrete forms: designation of protected sites for seals and the regulation of hunting. Protected sites are meant to provide undisturbed haul-out sites for seals while the seal population protection obligations have been met through hunting restrictions. There are open and closed hunting seasons and regional quotas that to a large extent determine when, where, and how many are killed. On a national level the Finnish seal policy is outlined in the recently published management plan for the marine seals in Finland [50]. The management plan splits the Finnish sea area into three seal management areas. Each rather large area has specific protection goals and thus the focus of management of seals is becoming more region-specific. The policy change is interesting in terms of scale effects. Earlier the policy has not, in fact, made spatial differentiations as clearly. The only regional aspect was allocation of the hunting quota between eight game management districts that form the regionalized game management administration for all hunting and game species management. The allocation took into account how many seals and respectively how much seal damage occurred in the districts, but the districts were not defined according to seals' natural range of movement. The new broader regional thinking as presented in the national management plan aims to correct the mismatch.

There are spatial dynamics on more local levels as well as in how the interaction between seals and coastal fishing materializes in different coastal locations in Finland. The interaction is influenced by the geography of the area (shallow/deep coast; archipelago/exposed coast; short ice period/long ice period), abundance of seals, and dependence on fishing and fishing technology used. What kind of mitigation measures are introduced and how strictly they are technically defined has important implications on how they play out in different locations. From this perspective in turn, it can be argued that regionalization of seal management to three large areas can be taking too broad a perspective.

There is a local example in Finland of self-organization and cross-scale interactions pertaining to the seal-fishery controversy. In the west coast of Finland along the Gulf of Bothnia a group of actors started to build collaboration to mitigate problems that the seals were causing for the fishery. In the late 1990s regional fishery, hunting and conservation authorities and organizations began discussions that resulted in a joint project by 2001. The project's goals were to reach a common understanding of the problem, to reduce the damage caused by the seals, and to frame the seal fishery as a renewable resource. The project organized different activities in the region and published the region's own action plan [51]. The project aimed to channel available national or EU level resources to regionally meaningful actions, a classic case of multi-level governance [52]. The action plan that the project launched as the final output made a strong statement towards higher level actors (on the national level and in HELCOM) to reorganize seal management and conservation in the Baltic Sea area. Their plan promoted more regionalized management by (a) splitting the Baltic Sea into two large areas in which the seal issue would be handled separately and (b) to strengthen capacities of sub-national level, regional management.

The project envisioned a relevant scale that did not exist before their activities. There were possibilities and certain capacity already existing on regional (sub-national) level, but that materialized only through the project's conceptualizations [53]. The project created a new forum for discussions and collaborations that have continued even after the project ended. The project formed thus a new intermediate level between the national level policies and the most local level of coastal fishing and seal hunting. The project directed many activities to support the local level actors, but still the fishermen's responses were ambiguous towards the project. On the one hand, many did appreciate its activities, but on the other hand, some project objectives important for the project partners were not known by the fishers and some did not even accept them. The national seal management plan launched in 2007 actually does create a more region-specific perspective on seal management as was recommended by the regional project, but without decentralizing decision-making powers to the regional scale. Grey seal management will still be handled as a national question, but with more regional sensitivity.

6. Adaptive governance and sustainable outcomes

An evaluation of the cases for their characteristics of adaptive governance is listed in Table 1. In each case, a sample of bridges and barriers to adaptive governance is presented, followed by a general conclusion of the potential for adaptive governance for that case. In all cases, institutional imbalances of power restrict the ability of localities to self-organize institutional responses that involve the most contentious aspects of marine mammal management: allowable harvest amounts and/or to what use the animal is put to. In many ways, the grey seal case has the highest potential for adaptive governance because the Baltic Sea population is robust and growing while the Finnish government is responsive to regional economies and international obligations. A regional informal initiative showed capacity to deal with the controversy in a

Table 1
Bridges and barriers to adaptive governance among cases.

	Self-organization		Cross-scale management		Institutional learning/responses to key drivers		Adaptive governance
Cases	Bridges	Barriers	Bridges	Barriers	Bridges	Barriers	Potential
Alaska polar bear	Regional self-org. capacity is high	Harvest assessment top-down	New policy tools to enhance local authorities	Top-down rules affect local self-organization	Good working knowledge of bear population dynamics	Learning about social system is predominantly single-loop	*Medium*, if partners focus on areas of agreement and develop more effective conflict resolution mechanisms
Nunavut polar bear	Local organizational capacity is high	Dissonance in core and peripheral values	Salience of issue	Pressure from external stakeholders against conservation hunting	Good adaptive responses to new conditions from territorial to local levels	Integration of some types of TEK are problematic	*Medium*, if integration of TEK is systematized; international debate challenges sustainability
Nunavut narwhal	Local organizational capacity is high	Framework for by-laws is static	Co-management structures are well-developed at regional and federal levels	Top-down rules	Flexible quota allocation	Inflexibility in quota in response to population dynamics	*Medium*, if community-based management could enhance its experimental focus
Grey seal	Regional organizational capacity has been demonstrated	Lack of formal power or recognition	Finnish government willing to consider regional interests	EU directives; the current Baltic Sea seal management arrangements	Many technological advances to reduce seal predation	Mitigation measures are not contextualized to local problem	*Medium–high*, if fishermen are participating and regime is responsive to their interests and if long-term adaptation of the fishery is supported

constructive, multi-stakeholder fashion—another requirement for adaptive governance. However, seal population management in Finland lacks officially recognized regional bodies that could legally take responsibilities if such were to be delegated. Making adaptive governance operational would imply institutional changes, but such are not being discussed at the time being. In the case of narwhal management, federal legislation constrains the adaptive capacity of local management options because there is not much room to experiment with different approaches that may have greater local legitimacy.

Both polar bear cases are constrained by intense international interest in polar bear conservation (as for marine mammals in general). In Alaska, adaptive governance is somewhat constrained by a lack of local authority to experiment with harvest assessment methods. Listing the polar bear throughout its range, the U.S. Fish & Wildlife Service allowed itself to establish rules that will affect conservation practices beyond its own shores. It already maintains this right through the Marine Mammal Protection Act, though the ESA has different institutional strategies to affect trade that may harm polar bears.

The two polar bear regimes in the U.S. and Canada are intrinsically linked through the Agreement on the Conservation of Polar Bears, as well as the Inuvialuit-Iñupiaq Agreement and American rules around trade in bear skins. The regimes also differ, however, in several important respects. Although the Canadian regime struggles to incorporate indigenous knowledge into decision-making, there are formal channels to do so. American efforts to incorporate indigenous knowledge have mostly been aimed at building a greater understanding of polar bear dynamics and have not, for the most part, tried to systematically incorporate indigenous knowledge into setting harvest limits or defining wasteful practices. In both cases, the regimes have not formalized methods for adaptively revising policy processes. In fact, all regimes presented fail to track indicators of policy process effectiveness with the aim of adaptation to new circumstances or reforming known process failures.

The Canadian polar bear case illustrates an adaptive governance model that is predominantly vulnerable to non-local public opinion. The model is adaptive because it forgives communities if the quota is exceeded by "banking" or "loaning" tags in future years. As long as information on the resource is collected, analyzed, and acted upon the system works well because changes to the resource, like environmental change, can be detected through a combined framework to incorporate indigenous knowledge and science. The quotas are then modified based on these multi-part assessments. Populations of bears in Northern Canada experience different ice regimes, driving differing levels of vulnerability to global warming. These regional differences require a cross-scale approach.

The Finnish grey seal case provides an example of a problematic and complex human–wildlife interaction. The basic problem is that seals cause economic losses to fisheries, but there does not seem to be an easy solution. The reintroduction of seal hunting has not significantly reduced the damage to fisheries. In addition, technical solutions that can reduce the damage to some extent are available only to specific fisheries. The way forward is to find ways to promote the coexistence of seals and fishermen in coastal ecosystems, which at present is a difficult task. This problem requires a long-term, adaptive approach to dealing with a messy problem that pits two legitimate, but very different interests on various levels (e.g., local fishermen and international conservation needs). The present policy does satisfy concerns related to conservation of the population, while local capacity to live with seals can be improved by increasing local legal flexibility in responses to the problem, as it is not uniform to all of coastal Finland. Here the flexibility does not only concern hunting regulations, but even more importantly the development and support of adaptive capacity for fisheries as seal-induced damage to fisheries cannot be separated from the grey seal population management objectives. In this respect devolution of (some of) the powers and resources would enhance such development as seal management considerations could be embedded in the broader context of social–ecological interactions rather than a stand-alone population management plan. Currently there are not any local organizations that could take the responsibility and here again an adaptive governance approach would require institutional reform rather than simply adding new management approaches

under existing institutions. However, fishermen cannot afford to wait for the slow adaptation and evolution of new institutions, which emphasizes the need of exactly such support and resources that can help in adaptation to the changed environment. In this respect the necessary damage compensation is not sufficient if at the same time the activities to develop the fishery (e.g., seal-exclusion nets) are neglected. This finding suggests that a governance arrangement's long-term capacity to learn and adapt becomes as important as short-term outcomes of decisions. The recovery of large whale populations on the West Coast of the United States and their increase in interactions with fisheries and shipping vessels is a similar case where the change in competing uses of resources and space will likely require a new approach (e.g., marine spatial management and ecosystem-based management) beyond population assessment and limiting unintentional take [54].

A key governance challenge is to address the very different interests involved in human–wildlife interactions. The cases show that human–wildlife interactions pertaining to marine mammals in the North are characterized by local peoples' close relations to nature (and these mammals) since the people have highly resource dependent livelihoods and lifestyles. At the same time the marine mammals that are charismatic top predators have a high conservation value, which gives these animals a high status in conservation policies and attract keen interests of non-local publics, especially of conservation organizations. In a democratic society, these interests are legitimately considered in informing conservation policy but policy options favored by such interests may be incompatible with Northern peoples' cultural, social, and economic realities.

The very different and sometimes incompatible interests and approaches to human–wildlife relations at different scales pose a difficult governance dilemma. On the one hand, the best governance arrangement in terms of reaching relevant decisions to guide local level human–wildlife interactions would require devolution of decision-making authority to community-based organizations. On the other hand, governance regimes should be able to address wider societal interest in species protection and animal welfare. This dilemma points strongly to a need for governance arrangements to enhance cross-scale rule-making capacity. This type of rule-making requires very open and transparent decision-making with robust interactions between stakeholders at various scales of social organization. The increased transparency and investments on enhancing deliberation will require time and resources, but will critically increase the governance arrangement's capacity to deliver informed and robust decisions that acknowledge the pluralism of different interests towards human–wildlife interactions. In the United States, the overwhelmingly negative public opinion of marine mammal hunting requires a careful framing of policy options to emphasize an ecosystems service approach that recognizes Alaska Native rights to subsistence hunting. Without this recognition, Alaskan subsistence-based communities have little to gain from engaging in policy debates with external interests. For their part, indigenous communities have occasionally had to resort to legal action to protect their rights. Overall, however, national agencies in the United States have done fairly well at balancing their trust responsibilities to wildlife and indigenous communities.

Finally, the existence of legitimate stakeholders at different scales with very different interests complicates sustainability assessments. What are the criteria or the indicators to assess sustainability of marine mammal management after acknowledging the legitimate existence of stakeholders at the local level and on a societal level? One key task of adaptive governance is to discuss and develop assessment criteria. The difficulty in distinguishing among adaptive governance rankings in the cases presented here suggests more sensitive tests should be developed. Raudsepp-Hearn et al. [55] propose a focus on trade-offs among ecosystem services, a perspective developed in the United Nations' Millennium Assessment that recognizes the plurality of values, from livelihood to cultural to existence, that humans express towards ecosystem use. A focus on ecosystem services also shifts arguments over governance objectives from the domain of moratoriums to the domain of population viability within ecosystems. The population viability approach would also allow societal interests to weigh in on broad goals; specific adaptive management techniques could be left to local community and government agents with the working knowledge of the management context in order to foster sustainability.

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