11. Traditional Knowledge and Resource Development

DRAFT 1 (Huntington, October 2012)

Introduction

What is today called "traditional knowledge"[1] has been throughout most of human history the primary way that people have understood their surroundings and acted on that knowledge. In much of the world and in many respects, traditional knowledge remains the main source of understanding (e.g., Johannes 1981, Berkes 1999). Scientific knowledge, which we may broadly contrast with traditional knowledge by saying that it derives from formal and explicitly structured inquiry rather than from repeated experience, is simply not available to inform most ways that people interact with their environment (e.g., Johannes 1998). At the same time, where scientific knowledge is available, it is typically regarded as the optimal source of objective and reliable information, with the result that traditional knowledge is pushed aside or regarded as a potential source of data that can be incorporated within a scientific paradigm (e.g., Van de Velde et al. 2003).

Thanks in large part to political and intellectual activism by indigenous peoples' organizations (e.g., Brooke 1993), together with leadership from scholars willing to listen to local expertise (e.g., Ferguson and Messier 1997; Carmack and Macdonald 2008), traditional knowledge has become a popular topic in the Arctic. Many studies have been carried out to document or otherwise examine traditional knowledge, major assessments such as the Arctic Climate Impact Assessment (ACIA 2005) have made space for reviewing or reporting at least some components traditional knowledge, and much has been written about the philosophy, practice, and politics of traditional knowledge (e.g., Agrawal 1995, Cruikshank 1998, Huntington 2005). In one sense, this level of activity has been beneficial, drawing serious attention to systems of knowledge that have served Arctic peoples well through millennia, and that offer alternative ways of looking at the world and the place of humans.

In another sense, the recent emphasis on traditional knowledge has obscured the deeper roots of collaboration between visitors and locals in much of the Arctic. Explorers such as Roald Amundsen were careful to pay close attention to local practices (Amundsen 1908). Laurence Irving recognized the expertise that the Iñupiaq Simon Paneak from the Brooks Range in northern Alaska offered in the field, and acknowledged it publicly by making Paneak a co-author on scientific publications (Irving and Paneak 1954). More troublesome than historical amnesia, the politicization of traditional knowledge as a concept and as a field of practice has made it difficult to offer sensible critiques of when and how traditional knowledge is a valuable resource to draw upon (e.g., the exchange in Gilchrist et al. 2005, Brook and McLachlan 2005, and Gilchrist and Mallory 2007), leading on occasion to papers that posit dire consequences for allowing traditional knowledge to achieve formal standing in legal and regulatory matters (e.g., Howard & Widdowson 1996). When incorporating traditional knowledge becomes a requirement of every study or activity, there is a risk that it becomes an item on a checklist to be noted

[1] Known also by many related terms, such as indigenous knowledge, local and traditional knowledge, traditional ecological knowledge, *Inuit Qaujimajatuqangit*, etc. While there are some differences in how and where these terms are used, the basic idea is similar: knowledge that has been gained by experience and shared among members of a group or community, often across generations. Agrawal (1995) pointed out that neither "traditional knowledge" nor "scientific knowledge" are monoliths, and that most attempts to distinguish one from the other rely on simplistic differentiations that do not hold up to scrutiny. I acknowledge Agrawal's argument, but also retain the distinction between traditional and scientific knowledge as a convenient way of separating two sources of information that are usually thought of differently.

only in passing. This kind of tokenism can be seen where the use of traditional knowledge is required, whether traditional knowledge is likely to be relevant or not.

This chapter examines the ways in which traditional knowledge has been applied to resource development, specifically to identify where further research would be useful. With this in mind, we can divide the practice of engaging traditional knowledge into four categories. First, traditional knowledge is used by its holders in everyday life. This is where it is generated, where it is refined, and where it is first applied. For the most part, and with some exceptions, such practices of traditional knowledge have been ignored by outside researchers (e.g., discussion in Ingold and Kurttila 2000, Nageak 1991). Second, traditional knowledge has been documented by many researchers, either for its own sake as a means of recording valuable information, or as a starting point for further analyses of the physical or biological environment (e.g., Lewis et al. 2009, Weatherhead et al. 2010). There has been much activity in this area, including the development of suitable methods (e.g. Huntington 1998, 2000, Huntington et al. 2004, 2011), recognition of the depth and relevance of traditional knowledge (e.g., Berkes 1999, Mallory et al. 2003, 2006, Fraser et al. 2006), and, as seen in the mention of traditional knowledge in land claims settlements and elsewhere, increasing awareness among the holders of traditional knowledge that what they know has value to others as well.

Third, traditional knowledge has been applied to the management of hunting and fishing or to addressing challenges such as climate change (e.g., Huntington et al. 1999, Mymrin et al. 1999, Berkes and Jolly 2001, George et al. 2004, Gearheard et al. 2006, Dowsley 2007, Noongwook et al. 2007). This, too, is a robust area of activity, closely related to documenting traditional knowledge, as many studies have focused on establishing the sizes of populations or the details of local uses to help support sound management and especially the continuation of traditional practices (e.g., Ferguson and Messier 1997, Noongwook et al. 2007). Finally, traditional knowledge has been applied to various aspects of resource development. Here, we refer specifically to the commercial exploitation of mineral as well as living resources. Traditional knowledge has helped identify development prospects and, to a greater degree, been drawn upon for assessing and mitigating environmental impacts associated with industrial activity (e.g., Nakashima 1990, Stevenson 1996, Usher 2000). This category is the focus of this chapter, but the relatively recent surge of activity in this area makes it helpful to refer also to other categories by way of analogy to the case of resource development.

The chapter begins with a review of research and related activities concerning traditional knowledge, particularly as it relates to resource development. Then it examines the ways in which traditional knowledge has been and is being applied in this context, noting where engaging with traditional knowledge is seen to be important for various reasons. Next, it considers how the recent emphasis on traditional knowledge has or has not benefited northern communities, before concluding with the identification of key areas for further research and the prospects for carrying out such studies. It is important to emphasize that this review and analysis is not about traditional knowledge itself, but instead about the policies and practices of studying and drawing upon traditional knowledge in the course of resource development.

Research and related activities concerning traditional knowledge

Scientists have relied on traditional knowledge holders in the Arctic for a long time, whether for support in the field or for insights into the workings of the natural world. Laurence Irving was unusual for his time in acknowledging the intellectual contributions made by his partner Simon Paneak. More typically, the role of local experts was relegated to the acknowledgments or omitted altogether. In the 1970s and

1980s, large-scale studies of land use and occupancy gave more prominence to how well indigenous peoples know their home landscapes, often on a vast geographical scale (e.g., Freeman 1976). From there, it was a relatively short step to documenting observations of animals and other phenomena, and then to discussing animal behavior and other aspects of biology and ecology (e.g., Ferguson and Messier 1997, Berkes 1999, Huntington et al. 1999).

In Alaska, the involvement of the International Whaling Commission in the management of the bowhead whale hunt led first to a political crisis (the hunt was initially curtailed, and then opened again but under a quota system that remains in place today), and then to a vigorous research program to better count the whale stock and learn more about its behavior (Huntington 1992, Albert 2001). The whale census benefitted greatly from the advice of experienced whaling captains, who suggested counting when the sea was covered with ice and also looking farther offshore than could be seen from observation posts along the edge of the landfast sea ice. The result was a much improved—and higher—population estimate, and thus less pressure to reduce or end the hunt. At the time, the fact that this sequence of events depended heavily on "traditional knowledge" was recognized by the participants but not particularly noted in publications or otherwise in the public eye. Only later was the story re-cast in terms of the integration of traditional and scientific knowledge. Nonetheless, it remains a prominent example of the power of collaboration.

In Canada, the work of Nakashima and Murray (1988) in the 1980s, documenting Inuit knowledge of eiders in Hudson Bay, was an early explicit acknowledgment of the expertise held by hunters and the value of studies that tried to access that expertise and make it available for a wider audience. Their example helped spur interest in the field and support for further studies of this kind. It also helped make it acceptable for biologists and others to acknowledge more fully what they had learned from indigenous hunters and how they had used those insights to guide their scientific inquiries and thus learn even more. More studies were undertaken across Canada (e.g., Ferguson and Messier 1997, Lemelin et al. 2010), in Greenland (e.g., Thomsen 1993), in Alaska (e.g., Huntington et al. 1999, Noongwook et al. 2007), and in Russia (e.g., Mymrin et al. 1999), a trend that has continued in most regions.

Nakashima and Murray's work was in the context of the James Bay Hydro Project, assessing impacts of large-scale river diversions on the waters of Hudson Bay and, in this case, the eiders that inhabited those waters. The James Bay Hydro Project acknowledged the role of traditional knowledge in environmental assessment (e.g., Mailhot 1993), an application of traditional knowledge explored as well by Stevenson (1996) in the Northwest Territories. For the most part, however, the stated purpose of traditional knowledge studies related more to wildlife management, as in the case of the Alaska bowhead whales, than to resource development.

Not long after traditional knowledge became a topic of academic as well as practical interest, other scholars began providing commentaries on the nature of traditional knowledge and then on the political and sociological context in which traditional knowledge studies were carried out. Specifically, critics noted that the documentation of traditional knowledge and calls for its use in resource management typically entailed taking that knowledge out of its own context (e.g., Cruikshank 2001), comparing it with scientific sources (at times under the guise of "validating" traditional knowledge by making sure it agreed with scientific knowledge), and then using it to claim that management decisions were done in cooperation with local hunters and thus culturally legitimate (e.g., Nadasdy 1999, Spaeder 2007). A chief component of such critiques was the observation of unequal power relations between government

agencies and trained scientists on one hand, and indigenous hunters with little expertise in bureaucratic processes on the other (e.g., Nadasdy 2003, Tyrrell 2008).

Further criticism centered around the legitimacy of comparing knowledge or attempting to confirm or refute one system of knowledge in terms of the other (e.g., Cruikshank 1998, 2001). Not surprisingly, the attempts to critique scientific knowledge for failing to match traditional knowledge were typically confined to anecdotes and informal interactions among traditional knowledge holders and those who sought to identify with them, whereas the evaluations of traditional knowledge in scientific terms were often published in scientific journals (e.g., Gilchrist et al. 2005). This is not to say that no comparisons are valid, nor that traditional knowledge is always correct, but simply to underscore the point that power relations between practitioners of traditional knowledge and practitioners of scientific research or government resource management are unequal, and that this inequality has a bearing on how traditional knowledge is used.

Despite these potential pitfalls, indigenous organizations have continued to advocate greater use of traditional knowledge in science, in resource management, and in resource development, especially for environmental impact assessment and mitigation. To date, however, little research has been done to examine how traditional knowledge is actually used in practice in resource development and environmental assessment. There are some examples, as noted in the next section, but documentation is typically sparse, and the degree to which information from traditional knowledge influenced the outcomes has not been evaluated.

The application of traditional knowledge to resource development

In Canada, the James Bay Hydro Project was an early example of attention to traditional knowledge in the planning and impact assessment of resource development. The project dammed several major rivers flowing into James and Hudson Bays to generate electricity, affecting the lands and waters of Cree and Inuit. Nakashima (1990) and Mailhot (1993) conducted studies or examined the role of traditional knowledge in environmental assessment for this project.

Building on that example, the Inuvialuit Final Agreement in the Northwest Territories and Yukon established five co-management boards to govern wildlife management, fisheries management, and environmental impacts (Smith 2001). The last of these is covered by the Environmental Impact Screening Committee and the Environmental Impact Review Board. As with the other co-management bodies, membership on these two is divided evenly between Inuvialuit (appointed by the Inuvialuit Game Council) and government (territorial and federal). The work of the boards is supported by a Joint Secretariat based in Inuvik. Subsequent land claims agreements in northern Canada have incorporated similar provisions, giving at least some mention to traditional knowledge and establishing co-management bodies in one form or another. In this region, community conservation plans developed in each of the six Inuvialuit communities identify important areas where resource development and other intensive non-local human activity should be limited or prohibited, a useful contribution of traditional knowledge to the management of development activities that may affect local practices and the species and habitats that support those practices.

Other land claims agreements in northern Canada have had similar provisions for the use of traditional knowledge and the establishment of co-management or local management bodies (e.g., the Gwich'in Comprehensive Land Claim Agreement in 1992, the Sahtu Dene and Métis Comprehensive Land Claim

Agreement of 1993, the Champagne and Aishihik First Nations Final Agreement in 1995, and others that followed).

A fundamental premise of the co-management system is that the indigenous or local members are holders of traditional knowledge and thus bring with them the values, perspectives, and insights inherent to that system of knowledge. Decisions are therefore based on both scientific knowledge (presumably represented by government agency personnel as well as available publications) and traditional knowledge. In practice, scientific knowledge is more readily available via publications, and it is unlikely that even the most experienced among the indigenous participants can in fact provide from his or her own experience all the relevant traditional knowledge needed to inform a given decision about resource development. And yet, each person can rarely bring more than his or her experience, because little is formally documented and available to a wider audience. Nonetheless, the system provides a formal mechanism for the direct involvement of traditional knowledge holders in the oversight of resource development, a practice that does not exist outside of Canada (e.g., Usher 2000).

In Nunavut, the territorial government has emphasized traditional knowledge (known in Nunavut as *Inuit Qaujimajatuqangit* or IQ) and its documentation and use in resource management and resource development. This work stems from the Nunavut Land Claims Agreement and is often carried out as part of the Inuit Impact and Benefit Agreements that must be completed for each development project. The Nunavut Wildlife Management Board, the Nunavut Planning Commission, and other institutions of public governance in the territory have invested in traditional knowledge studies, the creation of a traditional knowledge database, and other such steps to facilitate greater use of IQ. In practice, although much basic research has been carried out, the results are harder to see. Few studies have been made public, and the implementation of the policy of utilizing IQ has been criticized in various ways over the years. Consistent with the Inuvialuit experience, Bonesteel (2006) observed that real progress on the incorporation of IQ into governance will require more Inuit holding positions of senior management in government, where they can both put the policies into practice and also apply their own knowledge to the decisions they make.

In Alaska, traditional knowledge has gained visibility over the past two decades, and is now mentioned in many environmental impact assessments, science plans, and other such documents. The Environmental Impact Statement for the Northstar oil prospect in the Beaufort Sea (U.S. Army Corps of Engineers 1999) was one of the first to make a concerted effort to document and incorporate traditional knowledge. Subsequent attention to traditional knowledge has perhaps fallen short of expectations in indigenous communities and of what may be possible (e.g., Holland-Bartels and Pierce 2011), but much work continues to be done. Building on this experience, the Bureau of Ocean Energy Management recently highlighted its efforts to document traditional knowledge and to incorporate the results of such studies into its decision-making process (BOEM 2012). That document includes an interview with Fenton Rexford, Tribal Administrator for the Native Village of Kaktovik. Rexford emphasizes the importance of government-to-government[2] consultation as a means of ensuring that traditional knowledge is given its proper role in resource management decisions, again consistent with experiences in Canada.

The government-to-government consultation process in Alaska led to the documentation of traditional knowledge for the U.S. Environmental Protection Agency's (EPA) permitting process for discharges from oil and gas platforms in Cook Inlet, southern Alaska. The tribes of the region asked that traditional

[2] Under U.S. law, tribal governments enjoy a government-to-government relationship with the federal government, and as such are entitled to formal consultation on matters that affect them, such as resource development in nearby lands and waters.

knowledge of the impacts of such discharges play a role in the decision that was to be made. The EPA hired a consultant to conduct interviews in the Cook Inlet tribal communities and report the findings. The results described the dependence of tribal members on clean waters in the Inlet, so that the fish, marine mammals, seabirds, and other food they obtained from the sea were healthy and nutritious, allowing tribal members to carry on their traditional cultural practices. While important to the overall context of resource development in the Inlet, this information was not directly relevant to the formulation of technical regulations concerning discharges. The tribes were successful in that they attained a role for traditional knowledge in the overall permitting process, but less successful in that the influence of traditional knowledge on the ultimate decision created an indirect role for tribal governments rather than a direct one, as is the case for Inuvialuit in Canada. The EPA has, however, continued to invest in traditional knowledge studies on the North Slope of Alaska, also in regard to offshore oil and gas activity (e.g., Stephen R. Braund & Associates 2011).

Not all resource management and resource development agencies are open to the application of traditional knowledge to their decisions. The Scientific and Statistical Committee of the North Pacific Fisheries Management Council, for example, has been skeptical about the reliability of traditional knowledge and its objectivity when it comes to setting and allocating fishing quotas (e.g., Scientific and Statistical Committee 2010). This reluctance is expressed in terms of a need to maintain the highest scientific standards, as is appropriate when considerable economic interests affecting tens of thousands of people are at stake. At the same time, the standards for peer review seem to make an *a priori* distinction between scientific knowledge (subject to careful scrutiny but assumed to be objective and reliable) and traditional knowledge (assumed to be unreliable until "verified and validated"). While there is no doubt that traditional knowledge can be flawed and that it can entail a conflict of interest among those who have a stake in the resulting resource management or resource development decisions, the suggestion that traditional knowledge must be verified and validated (presumably within a scientific paradigm, rather than, say, through review by appropriate peers) appears to be an unusual case in the Arctic today.

By contrast, proponents of the Pebble Mine, a major mining project in southwestern Alaska, have commissioned a number of studies to assess potential impacts to the region and especially its rich salmon runs (www.pebbleresearch.com). One of the studies focused on subsistence and traditional knowledge (Chapter 23 of the study available at the website above), and was carried out by the same company that conducted the assessment of cultural resources (Chapter 22) and assisted with the assessment of socioeconomics (Chapter 21). The report on subsistence and traditional knowledge emphasizes subsistence data, which is also the case for a report prepared by the same contractor for the EPA for northern Alaska (Stephen R. Braund & Associates 2011). In fall 2012, the Keystone Center is running a series of independent science panels to review the studies commissioned by the Pebble Partnership. One of these will look specifically at the traditional knowledge studies that have been undertaken. In short, "traditional knowledge" as a general concept is being taken seriously, but the definition of what constitutes "traditional knowledge" is still unclear. The impact that traditional knowledge studies have on final decisions is similarly unclear at this point.

In Greenland, the governance system is different. In 1979, Denmark's colonial administration ended with the granting of a home rule system to the island and its inhabitants. In 2009, the Greenland Government's powers were expanded under the Act on Greenland Self-Government. In principal, Greenlanders now manage their own affairs, and in that sense, the questions of power relations between managers and managed should disappear. In practice, however, there remains a gap between government agency personnel, typically university educated, and hunters and fishers, still practicing

variations on traditional practices. Power relations are still uneven, and actual reliance on local observations and understanding remains an emerging practice in Greenland, even if it has long been supported in theory by the Greenland Government (1999). A significant feature of the Greenland experience, however, is that greater involvement of local hunters and fishers has led to more rapid management action (e.g., Danielsen et al. 2005), a notable point when it comes to the application of traditional knowledge alongside local participation.

In terms of resource development, however, decisions in Greenland remain largely top-down (Huntington et al. 2012). Environmental impact assessment is a developing field in Greenland (Hansen and Kørnøv 2010), and so the role of traditional knowledge is still uncertain, as is the role of "civil society" in Greenland's internal affairs (Aqqaluk Lynge, pers. comm., 2010).

Benefits to northern communities

Resource development offers economic benefits to northern communities, and also entails risks of environmental, social, and cultural disruption (e.g., AMAP 2010). Anything that can help maximize benefits and minimize risks is a plus. The greater use of traditional knowledge in resource development planning and regulation is often promoted on the grounds that it will improve outcomes, while also offering economic communities while studies are carried out, e.g., via payments to participants. There is also a benefit associated with having one's knowledge respected, with being acknowledged as an important contributor to collective understanding and sound decision-making. For people who have often been ignored in the process of setting regulations or making major decisions, this latter benefit should not be underestimated.

These benefits are real, in the sense that one can point to examples where local engagement has produced all of these outcomes. But they are also theoretical, in the sense that it remains unclear how widespread these benefits are and whether what has been accomplished is really the realization of the full potential of traditional knowledge to contribute to resource development and its regulation.

Through co-management boards, institutions of public governance, and other mechanisms, Arctic peoples have become increasing engaged in the process of making decisions that concern the lands, waters, and species they use. This engagement ranges from providing advice to actually making the final decisions. What role traditional knowledge plays in the actions of local members of such bodies is not clear. How often the use of traditional knowledge has led to better decisions is similarly unknown. Whether co-management approaches lead to real engagement of indigenous peoples on their own terms, or to some degree of co-optation as decisions are given the semblance but not the substance of local input, remains to be evaluated.

The idea of paying local participants in traditional knowledge studies has becoming increasingly accepted, though is far from universal. This source of income is one clear benefit, at least to those who are selected to take part, but such payments typically account for the time taken during an interview or workshop, rather than the depth of expertise being offered. Researchers and research assistants conducting the project (who may also be local residents) are more often paid a regular wage or salary, and thus typically earn far more than those who are interviewed. To be fair, this discrepancy reflects the amount of work required of each side, as the researcher had to obtain funding, manage the project, analyze responses, and write up the results. Nonetheless, the person being interviewed has accumulated his or her expertise over a long period. So what is the appropriate rate of compensation for that expertise? And are community members given opportunities to play larger roles in the planning,

conduct, and follow-up of such projects? In other words, how do actual payments reflect potential payments, and to what degree is this benefit being achieved from the point of view of local residents?

Finally, ample anecdotal evidence suggests intangible benefits such as increased pride, self-respect, and community standing as a result of being recognized as an expert and a valuable contributor to an important task. But this benefit has not been examined formally, nor have potential drawbacks been considered, such as the difficulty of standing out in societies that value humility and cooperation over spotlights and personal ambition. Co-management approaches have been criticized for creating two classes in communities that previously did not make such distinctions, at least not as formally (e.g., Caulfield 1997).

Research Needs and Prospects

The battle to establish traditional knowledge as a respectable field of study has been won. Many studies of traditional knowledge have been funded, many articles written, and much recognition provided in terms of stated expectations about the inclusion of traditional knowledge in Arctic research, management, and policy. This advance extends to the application of traditional knowledge to resource management especially, but also to some extent to the resource development. None of these steps is without some resistance and controversy, but the balance of both theory and practice is undoubtedly on the side of greater inclusion of traditional knowledge.

What remains to be seen is how secure these gains are. With the growing political clout of Arctic indigenous peoples, it seems unlikely that traditional knowledge will fade from its current prominence. At the same time, however, there remains a gap between rhetoric and outcomes, and the failure of traditional knowledge studies and applications to deliver on the promises of their advocates would undermine at least some of the gains made in the past two or three decades. Enough experience has been accumulated by now to allow an evaluation of what the study and engagement of traditional knowledge have actually provided to communities, managers, and others; what obstacles need to be addressed; and what approaches have been most effective in realizing the potential benefits of engaging a different system of understanding in making sound decisions. Here, I suggest six inter-related areas for further study, to better understand how far the field of traditional knowledge has come, and which avenues are most promising for further growth. While these questions focus on the role of traditional knowledge in resource development, experiences in resource management may shed additional light where resource development cases are few or otherwise difficult to study.

How has traditional knowledge influenced resource development in the Arctic?
A great deal of effort has gone into promoting the idea that traditional knowledge has a lot to offer and should, as a matter of justice to indigenous peoples or of intellectual openness, be fully engaged in making important decisions that affect Arctic peoples and their environment. The result has been a widespread effort to, at a minimum, conduct studies and include mention of traditional knowledge in environmental impact assessments and the like. Many of these efforts, however, have not been publicly reported, and for those that have, little has been done to evaluate whether in fact the attention to traditional knowledge has led to recognizable differences in decision outcomes. In other words, is the attention given to traditional knowledge having an impact? If so, what is the nature of that impact, and how has it been achieved? If not, what barriers appear to be blocking the path towards greater use of traditional knowledge? A review of major development projects in Arctic areas in the past decade would help shed light on this question, and ideally would point the way to models for realizing the greatest benefits from applying traditional knowledge to meeting the challenges of Arctic resource development.

What is the role of power relations in determining if and how traditional knowledge influences decision outcomes?

Part of the rationale for greater inclusion of traditional knowledge in research and in management is that it can help address the power imbalance between representatives of the dominant society and members of marginalized communities. Through land claims settlements, co-management, and other political achievements, many Arctic peoples have made substantial strides in the past few decades towards greater influence over their own futures. But, the resources available to government and industry remain far greater than those commanded by most indigenous governments and organizations. Comparing the availability of scientific information and traditional knowledge offers a case in point: far more scientific studies than studies of traditional knowledge have been published or otherwise reported, and thus are available for reference when making decisions. The inclusion of traditional knowledge holders on co-management boards is a welcome development, but even when represented in equal numbers, they are likely to lack the institutional support available to other members of the co-management bodies. In this view, traditional knowledge risks being treated as a source of data to be used in a scientific paradigm, rather than as a coherent system of understanding in its own right. Sufficient case studies are available to allow a comparative analysis of power relations and outcomes, to better understand the degree to which power imbalance is an obstacle to greater acceptance of and reliance on traditional knowledge in the resource development arena.

How do holders of traditional knowledge view their experiences in influencing resource development?

Both the proponents of using traditional knowledge and those who are trying to meet those expectations have claimed success in much of the work done to date. When these claims have been made on behalf of the actual holders of traditional knowledge, however, their foundations are not clear, as few if any attempts have been made to assess how the participants in traditional knowledge studies or management activities feel about their experiences. Has reality matched their expectations when they first became involved? Are they satisfied with the outcomes they have seen? Do they have recommendations for improvements? Without direct input from this diverse group, it is impossible to develop a complete picture of the state of current use of traditional knowledge in resource development. The results, however, must be treated with caution, as the holders of traditional knowledge may have few alternatives with which to compare their own experiences. As noted in the previous question, imbalance of power can lead to reduced expectations and, potentially, satisfaction with suboptimal results. The potential for co-optation must be kept in mind as participants' views are interpreted.

What infrastructure is needed, and what is available, to support the wider engagement of traditional knowledge?

The generation, dissemination, and archiving of scientific knowledge is supported by considerable infrastructure, in the form of research agencies, scientific journals, conferences, professional associations and networks, data systems, and more. Some of this is accessible to traditional knowledge, at least when documented as part of the wider scientific enterprise. Less is available for traditional knowledge on its own terms, a deficit that includes the use and perpetuation of traditional knowledge as a way of life. When scientists participate in, say, an environmental impact assessment, they can readily access large amounts of data and information to address key questions and allow careful analyses. When traditional knowledge holders participate in the same exercise, they are often on their own, or at best have far fewer resources to draw upon. Assessing the significance of this deficit and identifying what is needed to better support traditional knowledge holders can help traditional knowledge play a larger and more consistent role in resource development.

How do indigenous proponents of the use of traditional knowledge view progress to date?
Many indigenous leaders have called for greater use of traditional knowledge in research, resource management, and resource development. These calls have resulted in formal language in land claims agreements, research plans, and environmental impact assessments. It is less clear, however, that the gains in recent years have achieved the aspirations of those leaders, nor that the use of traditional knowledge was, in itself, the ultimate goal. Documenting traditional knowledge, as with generating scientific findings, is typically a slow and laborious process. Resource development typically requires a considerable amount of information on many topics. There is unlikely to be time to conduct new studies on demand as decisions take shape. Co-management approaches offer an alternative, adding traditional knowledge holders to the decision-making group rather than simply trying to insert their knowledge into a decision-making process. If the end goal is greater influence over decisions that affect their future, then indigenous leaders are likely to want to shape the outcomes, not just the information that is put in. Use of traditional knowledge is an input, not necessarily an outcome, and it seems unlikely that indigenous leaders will long be satisfied with advocating for better inputs. Understanding where political leadership is likely to go next will be important in determining what kinds of studies are most needed. Otherwise, the research community is left trying to anticipate indigenous aspirations rather than knowing with confidence what those aspirations are.

How well suited is traditional knowledge for resource development decision-making?
The basic premise of using traditional knowledge in resource development is that it has something unique to add. It is less clear what, exactly, that "something" is. Traditional knowledge holders are intimately familiar with their lands and waters, and with the species they use as well as aspects of the ecosystems that support those species. Resource development decisions, especially concerning environmental impact assessments, have become a highly technical, specialized field. The translation of traditional knowledge into such technical analyses is problematic at best. More often, traditional knowledge seems to call into question some of the assumptions upon which resource development is based: that mitigation is possible, that environmental impacts can be anticipated and contained, that it is possible to develop resources and protect intact ecosystems and cultures. Relegating traditional knowledge to a short commentary on technical points in an environmental impact assessment appears to miss the larger opportunity to re-consider the human-environment relationship. This is not to say that traditional knowledge and resource development are always in opposition, but merely that the nature of traditional knowledge needs to be better understood in order to apply it most effectively to making sound decisions concerning resource development. Much has been written comparing and contrasting traditional and scientific knowledge, but most of this has been done in the abstract, as lists of different principles. An analysis in concrete terms, examining the entire decision-making process and assessing where traditional knowledge most directly addresses both the premises and the technicalities of those decisions, would make a significant advance in our understanding of how one system of knowledge can be brought to bear on a process based on another system of knowledge.

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