Integrating Community Knowledge into Environmental and Natural Resource Decision-Making: Notes from Alaska and Around the World

Elizabeth Barrett Ristroph
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Elizabeth Barrett Ristroph*

Abstract

Community knowledge (including traditional, local, and indigenous knowledge) has a role to play in government agency decisions regarding the environment and natural resources. This article considers the benefits of using community knowledge, as well as obstacles to collecting this knowledge and integrating it with Western science. The article further discusses how federal agencies in Alaska use community knowledge and laws that potentially affect this use (including the Data Quality Act). Finally, the article provides recommendations for agencies to consider in collecting and using community knowledge.

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* Ristroph worked as a North Slope Borough Assistant Attorney in Barrow, Alaska from 2007 to 2011. This article was not written on behalf of the North Slope Borough, and the views expressed are not necessarily those of the North Slope Borough.
I. Introduction

Since the late twentieth century, the terms “traditional (environmental) knowledge,” “local knowledge,” and “indigenous knowledge” have been used to describe sources of knowledge outside of Western science.\(^1\) In this article, I introduce the term “community knowledge” and discuss its role in

\(^1\) See Stacie McIntosh, Incorporating Traditional Knowledge in the Bureau of Land Management’s Planning Process in the National Petroleum Reserve-Alaska, 27 PRACTICING ANTHROPOLOGY 38, 41 (Winter 2005) (discussing the fact that, since the mid-1990s, traditional knowledge has gained popularity and widespread recognition in the academic realm).
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government agency decisions regarding the environment and natural resources. The article is based on a literature review of scientific, legal, and anthropological journals and reports from across the globe, as well as interviews I conducted in Alaska with subsistence hunters, anthropologists, and government agency representatives. The article considers the benefits of using community knowledge as a basis for agency decision-making, as well as the obstacles. It discusses laws relevant to community knowledge and explains how federal agencies in Alaska have been collecting and using this knowledge. Finally, it provides recommendations for agencies and researchers to consider in integrating community knowledge into natural resources and environmental decision-making.

2. I conducted word searches for the English terms “traditional knowledge” and “local knowledge,” the Spanish term “conocimiento tradicional,” the French term “connaissance traditionnelle,” and the Russian term “традиционные знания” on Westlaw, Questia (Online Library of Books and Journals), and the Internet.

3. I am grateful to the following people who allowed me to discuss community knowledge with them: Taylor Brelsford, Anthropologist, URS Corporation; Dee Williams, Ph.D., Anthropologist and Chief of Environmental Studies, Alaska OCS Region, Bureau of Ocean Energy Management (BOEMRE); Taqulik Hepa, Director, North Slope Borough Department of Wildlife Management; Brad Smith, Biologist and Anchorage Field Office Supervisor, National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA); Tami Fordham, Tribal Coordinator, Environmental Protection Agency (EPA) Region 10; Stacie McIntosh, Branch Chief of Resources, Northern Field Office in Fairbanks, Alaska, Bureau of Land Management (BLM); Hanh Shaw, National Environmental Protection Act Coordinator, EPA Region 10; Patty McGrath, Mining Specialist, EPA Region 10 Tribal Waters Program; Ted Rockwell, Senior Advisor for Oil and Gas, EPA Region 10; John Chase, Community Planner, Northwest Arctic Borough; Delbert Rexford, Land Manager, Ukpeagvik Iñupiat Corporation; Johnny Aiken, Whaling Co-Captain and Executive Director of the Alaska Eskimo Whaling Commission; Jewel Bennett, Branch Chief for Conservation Planning, Alaska Division, U.S. Fish and Wildlife Service (FWS); Nora Jane Burns, Village of Kaktovik Liaison and Planning Commission Representative for the North Slope Borough, Kaktovik City Council Member; Craig George, Ph.D., Senior Biologist, North Slope Borough Department of Wildlife; Doug Vincent-Lang, Special Assistant to the Commissioner of the Alaska Department of Fish and Game (ADF&G); Kristi Frankson, Subsistence User and Village of Point Hope Liaison to the North Slope Borough; Lloyd Vincent, Iñupiat Artist, Point Hope; Jack Schaefer, Lands Manager, Tikigaq Corporation; Catherine Villa, Tribal Coordinator, EPA. I acknowledge that the views of these individuals do not necessarily represent the views of the entities for which they work.

4. See infra Parts II and III.

5. See infra Parts IV and V.

6. See infra Part VI.
II. Terminology

There are many names for the kinds of environmental knowledge that do not fit into the framework of Western science. Each has its own nuances. “Traditional knowledge” implies that the knowledge is stuck in time, passed down from generation to generation. While this is often the case, environmental knowledge is ever-evolving and can develop in a single generation. “Local knowledge” suggests that the knowledge is limited to fixed geographic boundaries. But in this modern world with high-speed Internet and people on the move, knowledge is seldom confined to a particular place. “Indigenous knowledge” implies that the knowledge is

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7. The term “Western science” as used here is equivalent to the definition of science developed by Britain’s Science Counsel: “Science is the pursuit of knowledge and understanding of the natural and social world following a systematic methodology based on evidence.” *What is Science?*, *The Science Council*, http://www.sciencecouncil.org/content/what-science (last visited Oct. 4, 2011) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment). This methodology includes objective observation, evidence, experiment, and/or observation as benchmarks for testing hypotheses, induction, repetition, critical analysis, and verification and testing. *Id.* The characteristics of Western science from a legal point of view are similar to the standard for admitting evidence set forth in *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 579 (1993). According to the Court, The evidence must be reliable, that is, the underlying methodology and procedure from which evidence is derived (not the conclusion drawn) must be based on scientific knowledge. . . . In deciding if the testimony is scientifically valid, the court looks to many factors, including whether the theory or technique can and has been tested, whether it has been subjected to peer review, the known or potential rate of error, and whether it has been generally accepted. *Id.* Although my article distinguishes between community knowledge and Western science, there is not always a clear line between the two. See Aranya Siriphon, *Local Knowledge, Dynamism and the Politics of Struggle: A Case Study of the Hmong in Northern Thailand*, 37 J. SOUTHEAST ASIAN STUD. 65, 66 (2006) (questioning “the myth of ‘bipolar’ local/modern knowledge (indigenous/scientific knowledge)’); see also Interview with Craig George, Ph.D., Senior Biologist, North Slope Borough Department of Wildlife, in Barrow, Alaska (Apr. 7, 2011) [hereinafter George Interview] (stating that he sees little difference between traditional knowledge and Western science on the North Slope of Alaska and noting that there are experts and those who lack knowledge; but experts identify the source of their knowledge and admit when they lack knowledge) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment). My article nevertheless treats community knowledge as a distinct body of knowledge, in an effort to demystify this kind of knowledge and encourage its use.

8. See Jennifer Isé & Susan Abbott-Jamieson, *Students Gather Local Fisheries Knowledge as Part of a NOAA Fisheries Education and Outreach Program*, 27 PRACTICING ANTHROPOLOGY 29, 32 (Winter 2005) (describing knowledge of fishermen who began their fishing careers prior to World War II and who are still living and the need to preserve this knowledge).

9. For contrasting definitions of local ecological knowledge and traditional ecological knowledge, see *Susan Charnley, A. Paige Fischer & Eric T. Jones, U.S. Dep’t*
isolated within a particular ethnic group, yet it can be acquired by non-indigenous residents who have settled within an indigenous community.\textsuperscript{10} I use the term “community environmental knowledge” or “community knowledge” to describe all kinds of environmental knowledge that arise from communities, outside the context of Western science. The

\textbf{OF AGRIC., PNW-GTR-751, TRADITIONAL AND LOCAL ECOLOGICAL KNOWLEDGE ABOUT FOREST BIODIVERSITY IN THE PACIFIC NORTHWEST 2 (2008), available at http://www.fs.fed.us/pnw/pubs/pnw_gr751.pdf. The authors state that} [N]ew knowledge is created all the time. This more recent LEK [local ecological knowledge] is defined here as knowledge, practices, and beliefs regarding ecological relationships that are gained through extensive personal observation of and interaction with local ecosystems, and shared among local resource users. Local ecological knowledge may eventually become TEK [traditional ecological knowledge]. \textit{Id.} For another example, see McIntosh, \textit{supra} note 1, at 40. According to McIntosh, Traditional knowledge, as I understand it, is shared and agreed upon direct experience that is passed on from one generation to the next, so that it becomes integrated not only at the community level, but at the cultural level. In contrast, local knowledge represents shared recent experiences; those hypotheses that still need testing and positive correlation before they can truly become “traditional.” \textit{Id.}

\textsuperscript{10} Although a great deal of literature is devoted to knowledge held by indigenous residents, there are many examples of non-indigenous individuals and communities with extensive environmental knowledge. \textit{See, e.g., T. P. Михайлова [T.R. Mikhailova], Традиционные Экологические Знания как Роль Сохранения Биологического Разнообразия Охраняемых Природных Территорий [Traditional Ecological Knowledge and its Role in Biodiversity Conservation in Nature Reserves], in Традиционные Знания Коренных Народов Алтае-Саянской Области Природопользования [TRADITIONAL KNOWLEDGE OF THE INDIGENOUS PEOPLE OF ALTAE-SAYAN REGARDING NATURAL RESOURCE USE] 56, 59 (2009) [hereinafter ALTAE-SAYAN TRADITIONAL KNOWLEDGE], available at http://ethnography.omskreg.ru/res/page00000001203/Files/2.pdf (stating that a study of traditional ecological knowledge held by residents in the Elizovsky, Bystrinsky, and Milkovsky regions of Russia suggests that this knowledge is held not only by indigenous residents, but also by long-time non-indigenous residents); see also CHARNLEY ET AL., supra note 9, at 36 (discussing that the ecological knowledge of farmers and indigenous people in the Pacific Northwest is valuable, “but so too is that of other forest practitioners, who should not be overlooked”); Jason Corburn, Bringing Local Knowledge into Environmental Decision Making: Improving Urban Planning for Communities at Risk, 22 J. PLAN. EDUC. & RES. 420, 423–30 (2003), available at http://remap.ucla.edu/jburke/misc/Corburn_2003.pdf (considering the local knowledge of immigrant residents in a Brooklyn neighborhood regarding the environmental health hazards they face). In Arctic Alaska, where the population is predominately Inupiat Eskimo, there are also examples of “outsiders” who have integrated into the community and acquired knowledge regarding local subsistence practices. \textit{See, e.g., CHARLES D. BROWER, FIFTY YEARS BELOW ZERO (1985) (describing the memoirs of a Yankee whaler living in Arctic Alaska); see also Interview with Kristi Frankson, Subsistence User and Point Hope Village Liaison for the North Slope Borough, in Point Hope, Alaska (Feb. 2, 2011) [hereinafter Frankson Interview] (explaining her experience as a non-native who moved to the village of Point Hope in 1978 after marrying a local resident and became deeply involved in the subsistence culture) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment).
“community” can be largely defined by ethnicity or geography, but it need not be. Community knowledge is based on the observations and personal experiences of community members over long periods of time. It is transmitted informally, often orally, and usually cannot be attributed to a defined source. It usually comes from trial and error rather than the scientific method, although there are examples of community members acquiring knowledge through controlled experiments. It has historically been separate from the knowledge held and disseminated by government agencies, although there have been recent efforts by government agencies to collect and use this knowledge.

11. In the case of many Alaska Natives, knowledge has been transmitted orally for generations over hundreds or thousands of years. See J.C. George et al., An Analysis of Ancient Bowhead Whale Mangtak from Gambell Alaska: What can it tell us?, Scientific Committee Report, International Whaling Commission Meeting, International Convention for the Regulation of Whaling, 2008, at 1, 4, available at http://iwcoffice.org/_documents/sci_com/SC60docs/SC-60-E2.pdf (stating that recovery of thousand-year-old bowhead whale skin and blubber from Saint Lawrence Island kept in old ice cellar validated community knowledge that Saint Lawrence residents had hunted whales for hundreds of years); see also Telephone Interview with John Chase, Community Planner, Northwest Arctic Borough (Feb. 8, 2011) [hereinafter Chase Interview] (stating that indigenous knowledge has only been written recently but is based on oral history that has been passed down for generations) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment).

12. See Alan B. Dixon, Wetland Sustainability and the Evolution of Indigenous Knowledge in Ethiopia, 171 THE GEOGRAPHICAL J. 306, 308 (2005) (declaring that oral communication is often important to transmitting community knowledge and stating that the “exchange of information through informal communication networks plays an important role in facilitating innovation and adaption . . . .”); see also Lawrence D. Kaplan, Inupiat and the Schools: A Handbook for Teachers (1984), available at http://www.alaskool.org/language/inupiaqhb/Inupiaq_Handbook.htm#contents (stating that writing of the Inupiat language of Arctic Alaska did not begin until the missionaries arrived and translated religious materials into the Native languages and that Inupiat writing was not standardized until the 1940s).

13. See Mikhailova, supra note 10, at 56 (noting that each region of the world has a different view on traditional knowledge).

14. See What is Science?, supra note 7 (defining the scientific method as including objective observation, evidence, experiment, and/or observation to test hypotheses, induction, repetition, critical analysis, and verification and testing).

15. See Dixon, supra note 12, at 317 (describing Ethiopian farmers that deliberately experiment with new ideas and practices, such as the spacing of coffee seedlings, herbicides, and fertilizer treatments); see also Karen Brewser & Craig George, Inupiat Knowledge of Selected Subsistence Fish Near Barrow, Alaska 63–64 (2008) (unpublished study) (describing experiments conducted by Arnold Brower, an Inupiat Eskimo born in 1922, to determine whether particular water bodies would support fish) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment).

16. See Dixon, supra note 12, at 315 (describing the disconnect between the knowledge of Ethiopian farmers and that of government extension agents); see also Janet C. Sturgeon, Pathways of “Indigenous Knowledge” in Yunnan, China, 32 ALTERNATIVES: GLOBAL, LOC., POL. 129, 132–33 (2007), available at
III. Benefits of Using Community Knowledge in Decision-Making

A. Filling in the Gaps of Western Science

Particularly in remote places like Arctic Alaska, the environmental data compiled by Western scientists are limited. Community knowledge gathered over generations may be far more extensive, particularly on topics such as climate change that require long periods of observation.
Occasional extreme events are likely to become community knowledge, whereas Western science may miss an event altogether because of a short sampling duration.\(^{21}\) Consideration of community knowledge can save Western scientists effort in their research.\(^{22}\)

There are a number of examples in which Western scientists who doubted or disregarded community knowledge have been proven wrong. A well-known example from Arctic Alaska concerns the estimated population of the Western Arctic stock of bowhead whales.\(^{23}\) At that time, Western scientists believed that bowhead whales tended to avoid passing under the ice, preferring to pass through the narrow open water channels (called “leads”).\(^{24}\) A census conducted by the National Marine Fisheries Service (NMFS) in 1978 and 1979 relied primarily on sightings of passing whales by observers standing on shorefast ice near the open ocean.\(^{25}\) The NMFS census estimated the whale population to be between 1,783 and 2,865.\(^{26}\) As a result of this low estimate, the Alaska Eskimo whale subsistence quota was set at zero for 1978.\(^{27}\)

Eskimo hunters believed that the estimate was far below the real number of whales, as many whales were passing unobserved beneath the ice or far offshore.\(^{28}\) The hunters successfully negotiated with NMFS to take over the census, and later, to have it turned over to Alaska’s North

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\(^{21}\) See Henrik Moller et al., Combining Science and Traditional Ecological Knowledge: Monitoring Populations for Co-Management, 9 ECOLOGY & SOC’Y, no. 3, Dec. 2004, at 1, 11, available at http://www.ecologyandsociety.org/vol9/iss3/art2/ (stating that traditional ecological knowledge is more likely to take note of extreme and rare events but Western science methods of research would likely miss the event because of a short sampling duration).

\(^{22}\) See Chase Interview, supra note 11 (suggesting that if a university biologist wants to study ringed seals near a village in Northwest Alaska, the scientist may not find the seals if he does not first consult with the village residents).

\(^{23}\) See generally Thomas F. Albert, The Influence of Harry Brower, Sr., an Inupiat Eskimo Hunter, on the Bowhead Whale Research Program Conducted at the UIC-NARL Facility by the North Slope Borough, in FIFTY MORE YEARS BELOW ZERO 265, 266 (David Norton ed., 2001).

\(^{24}\) See id. (“[B]owhead whales (like most people) were ‘afraid’ of ice and therefore when migrating north in the spring tended to restrict themselves to the rather narrow open water channels (called ‘leads’) in the ice and thereby avoid the ‘dangerous’ ice.”).

\(^{25}\) See id. (discussing the results of the 1978–79 NMFS census effort).

\(^{26}\) Id.

\(^{27}\) See id. (asserting that because of the increase subsistence hunting impacts and the low whale population estimate, the 1978 whale subsistence quote was set at zero).

\(^{28}\) See id. at 268 (stating that hunters were aware of whales swimming through areas of heavy ice, breaking small holes in the ice to breathe).
Slope Borough. Borough biologists formed personal relationships with some of the hunters, which helped facilitate trust and goodwill between the two groups. The biologists relied on these hunters’ knowledge to implement a revised methodology for the estimates. Biologists used aerial surveys as well as passive acoustics that could locate vocalizing whales. The revised census methodology eventually resulted in an estimate of about 8,200 whales, and the Eskimo whaling quota was raised.

B. Unique Communities, Environments, and Forms of Information

Community knowledge is a valuable source of information regarding communities whose diets or lifestyles differ from those of other populations. This is particularly true for Inupiat Eskimos, who still rely on marine mammals and other subsistence foods for a large percentage of their diet. Community knowledge can also inform decisions regarding regions with distinct environmental features (such as national parks).

29. See id. at 269 (documenting negotiations that took place between the AEWC and NMFS to assume the task of taking the census of spring migrating bowheads). While the Borough is a municipality incorporated by Inupiat Eskimos, its Wildlife Management Department includes many Western scientists. Id.

30. See id. (explaining that when the Borough assumed responsibility for taking the spring-migrating bowhead whale census, Eskimo hunters provided advice on best practices for conducting field work).

31. See id. at 270 (stating that the census program was modified based upon suggestions from hunters and other scientists).

32. See id. at 271 (describing the aerial survey and passive acoustic technique used to conduct the census of the migrating bowheads).

33. See id. at 273 (affirming that by incorporating the aerial survey and passive acoustic data, the population was about 8,200 whales).

34. See Corburn, supra note 10, at 428 (explaining that local knowledge can “help capture the information that is often ruled out by professionals . . .”).

35. See Ristroph, supra note 18, at 50–51 (discussing subsistence reliance in Arctic Alaska); see also Patricia Cirone, The Integration of Tribal Traditional Lifeways into EPA’s Decision Making, 27 PRACTICING ANTHROPOLOGY 20, 20 (Winter 2005) (stating that tribal people are concerned that the current EPA risk assessment methodology does not afford a complete accounting of tribal culture, values, and lifestyles).

36. See Chelsea Lynne Aldrich, Shoreline Management at Padre Island National Seashore: An Investigation of Angler Relationships to the Beach, at 95, 102 (Aug. 2009), available at http://repository.tamu.edu/bitstream/handle/1969.1/ETD-TAMU-2009-08-3250/ALDRICH-THESIS.pdf?sequence=1 (unpublished thesis, Texas A&M University) (describing how the community around the Padre Island National Seashore was concerned that the National Park Service was making regulations for the sake of maintaining consistency in regulations and policies in parks nationwide and that these regulations did not reflect the unique environment and users of the National Seashore) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment).
Community knowledge often takes a holistic view of humans in their environment, encompassing aspects outside the models and theories characteristic of Western science. This should enrich decision-making, although the inability of these aspects to fit into a scientific mold may become an obstacle.

C. Increasing Community Trust and Compliance

Some of the conflict between community and scientific knowledge lies in the struggle for power between communities and government agencies. Communities that have no control over decisions made regarding their environment and resources may naturally distrust those who are making the decisions. In these communities, consultations to obtain community

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37. See Seth Appiah-Opoku, Indigenous Beliefs and Environmental Stewardship: A Rural Ghana Experience, 24 J. CULTURAL GEOGRAPHY 79, 80 (2007) (discussing that environmental stewardship implies an acceptance of personal responsibility and management of natural resources); see also Serge Larochelle & Fikret Berkes, Traditional Ecological Knowledge and Practice for Edible Wild Plants: Biodiversity Use by the Raramuri in the Sierra Tarahumara, Mexico, 10 J. SUSTAINABLE DEV. & WORLD ECOLOGY 361, 366 (2003) (noting that viewing humans as interconnected with nature involves a relationship between humans and nature and a respect for natural resources); Erika M. Zimmerman, Essay, Valuing Traditional Ecological Knowledge: Incorporating the Experiences of Indigenous People into Global Climate Change Policies, 13 N.Y.U. ENVTL. L.J. 803, 806 (2005) (describing the holistic nature of indigenous knowledge that includes principles and rules about the interactions of humans with the natural and spiritual worlds).

38. See Namulauulu G. V. Tavana, Traditional Knowledge is the Key to Sustainable Development in Samoa: Examples of Ecological, Botanical and Taxonomical Knowledge, Proceedings of the 2001 Samoan Environmental Forum 19, 20 (2002), http://www.mnre.gov.ws/forum/2001/index.htm (asserting that many of the core contributions that Samoan culture has to offer to the world are in the form of tacit knowledge, which is deeply integrated with traditional values and difficult to articulate); see also Corburn, supra note 10, at 428 (documenting that when community members engage with science, they expand the values knowledge that traditional science often excludes); Bosire Maragia, The Indigenous Sustainability Paradox and the Quest for Sustainability in Post-Colonial Societies: Is Indigenous Knowledge All that is Needed?, 18 GEO. INT'L ENVTL. L. REV. 197, 230 (2006) (explaining that in collecting indigenous knowledge for scientific use, the knowledge may be “scientized” such that only its tangible and reproducible aspects remain; this may lead to near obliteration of the “non-useful” aspects, which, paradoxically, are inextricably intertwined with the tangible, useful aspects).

39. See infra Part III (stating that agencies are weary of making decisions based upon community knowledge since it may not confine to traditional Western science concepts).

40. See Hemant Ojha et al., Knowledge Systems and Deliberative Interface in Natural Resource Governance: An Overview, in KNOWLEDGE SYSTEMS AND NATURAL RESOURCES MANAGEMENT, POLICY AND INSTITUTIONS IN NEPAL 1, 11 (Hemant Ojha et al. eds., 2008) [hereinafter KNOWLEDGE SYSTEMS] (describing the tensions between community and scientific knowledge).

41. For example, Alaska North Slope residents resented FWS’s efforts to manage migratory bird hunting following a 2008 shooting of a bird species listed under the Endangered Species Act, as they felt disrespected and disempowered. See Ristroph, supra
knowledge can increase trust and willingness to comply with agency decisions.\footnote{42}

\textit{IV. Obstacles to Collecting and Using Community Knowledge}

\textit{A. Conflicts between Natural Resource Management Based on Western Science and Based on Community Knowledge and Traditions}

It is no surprise that agencies charged with making decisions based on Western science can be skeptical of community knowledge.\footnote{43} There have long been conflicts between Western and traditional/indigenous systems for managing natural resources and the environment.\footnote{44}

\footnote{42}. See Omer Chouinard, Steve Plante & Gilles Martin, \textit{The Community Engagement Process: A Governance Approach in Adaptation to Coastal Erosion and Flooding in Atlantic Canada}, 31 CAN. J. REG'LS SCI. 507, 510 (2008), available at http://www.csrs-rscr.org/archives/31-3/Chouinard-final2.pdf (expressing that researchers interested in climate-related adaptation measures engaged and interviewed residents from Canadian coastal communities dealing with serious flooding and erosion problems and explaining that the process served to give more credibility to previous research efforts and to strengthen bridges between the community and civil servants); see also \textit{Ю. В. КОЧАГИНА [YU. V. KOCHAGINA], ТРАДИЦИОННЫЕ ЗНАНИЯ ИХ ЗНАЧИМОСТЬ ДЛЯ СОХРАНЕНИЯ БИОРАЗНООБРАЗИЯ КАМЧАТКИ [TRADITIONAL KNOWLEDGE AND ITS SIGNIFICANCE FOR CONSERVING BIODIVERSITY IN KAMCHATKA] 171 (2008), available at http://www.fishkamchatka.ru/proon/monograph2008.pdf (asserting that in Kamchatka, Russia, where there is no natural resource co-management, consultation with local people regarding natural resource decisions has improved trust); Moller et al., \textit{supra} note 21, at 13 (“Involving the harvesters themselves by using their own monitoring methods or inviting their participation and partnership with scientific monitoring is much more likely to lead to the application of the results and altered harvest practice where needed for sustainability.”).}

\footnote{43}. See Telephone Interview with Dee Williams, Ph.D., Anthropologist and Chief of Environmental Studies, Alaska OCS Region, BOEMRE (Feb. 17, 2011) [hereinafter Williams Interview] (using community knowledge requires agencies to come to terms with a component of social science that they may not have previously taken seriously; agencies may view the promotion of community knowledge as an attempt by some stakeholders to dictate the outcome of resource management decisions).

Some of the products of Western colonialism (namely expansive mono-culture production) have proven to be more environmentally damaging than traditional practices that were small in scale and promoted species diversity. On the other hand, some traditional practices based on community knowledge (such as slash-and-burn agriculture) are impractical under modern-day environmental, political, and economic constraints. Extreme climate and demographic changes, particularly those that confront the world in the twenty-first century, can reduce the utility of community knowledge and render certain community practices unsustainable. At the (declaring that the exclusion of Aboriginal knowledge in school curriculums is detrimental to the country); see also Isé & Abbott-Jamieson, supra note 8, at 29 (“Fisheries scientists often dismiss fishermen’s knowledge because they perceive it as anecdotal and it is not collected with quantitative methods and presented in data formats with which they are familiar.”).

45. See, e.g., Tavana, supra note 38, at 22 (describing the traditional Samoan agricultural practice of integrating trees with other crops, which results in favorable soil conditions); see also Craig Segall, Note, The Forestry Crisis as a Crisis of the Rule of Law, 58 STAN. L. REV. 1539, 1550–51 (2006) (describing Indian forestry management under the British empire, in which the Forestry Department sharply restricted customary use while exploiting the forests to produce revenue for the empire; this transformed diverse tropical forests into monocultures of profitable timber species).

46. See Yolanda Cristina Massieu & Francisco Chapela Mendoza, Valorizacion de la Biodiversidad y el Conocimiento Tradicional [Valuing Biodiversity and Traditional Knowledge], in BIODIVERSITY AND TRADITIONAL KNOWLEDGE, supra note 19, at 329, 338 (averring that in the case of slash-and-burn agriculture, demographic pressure may mean that abandoned fields do not have sufficient time to rest and regenerate before they must be used again); see also Maragia, supra note 38, at 232 (stating that indigenous and traditional practices can be difficult in a system of individualized land ownership, where there is no longer opportunity for free movement or expansion). Economic conditions may also hinder the exercise of practices based on community knowledge. See, e.g., CHARNLEY ET AL., supra note 9, at 26 (citing the example of family forest owners in the Pacific Northwest, who recognize the importance of biodiversity but face limited markets for small quantities of logs of diverse sizes and species).

47. See Ristroph, supra note 18, at 64–65 (regarding the impact of climate change on traditional knowledge in Arctic Alaska); see also Braund, supra note 18, at 1 (“Because of changes to the Arctic marine environment, particularly related to climate change, this review focused on [traditional knowledge] for the last 20 years as older [traditional knowledge] may not apply accurately to today’s marine environment.”).

48. See Dixon, supra note 12, at 319 (stating that current land shortages in Ethiopia appear to have prevented farmers from applying ancestral knowledge of important techniques such as crop diversification, manuring, and fallowing, which would arguably sustain crop production at much higher yields); see also W.H. Thomas, One Last Chance: Tapping Indigenous Knowledge to Produce Sustainable Conservation Policies, 35 FUTURES 989, 995 (2003), available at http://www.sprep.org/att/IRC/eCOPIES/Countries/Papua_New_Guinea/42.pdf (“Any policy for the conservation of cultural and biological diversity must deal with the political realities of incorporating mobile autonomous people, into the global economy of a world with an expanding population, facing a shortage of arable land.”); Korchagina, supra note 42, at 97 (suggesting that traditional knowledge is not equipped to address circumstances of contemporary development); Abelardo Juep Bakuants, Rescate del Conocimiento
same time, climate change may also reduce the utility of some models used by Western scientists to project species populations and environmental conditions.49

B. Spiritual Aspects of Knowledge

Even though a community’s knowledge may not directly conflict with Western science, it can be difficult to fit the knowledge into the constructs

Tradicional y Biológico para el Manejo de Productos Forestales no Maderables en la Comunidad Indígena Jameykari, Costa Rica [Reclaiming Traditional Biological Knowledge for the Management of Non-Timber Forest Projects in the Indigenous Community of Jameykari, Costa Rica], at 29 (2008) (unpublished thesis, Tropical Agriculture Research and Higher Education Center), available at http://orton.catie.ac.cr/repdoc/A1961e/A1961e.pdf (describing the indigenous Jameykari of Costa Rica and their respect for resources, although the traditional use of non-timber products by both indigenous and non-indigenous residents has resulted in some cases of species loss as the demand for resources increases); Jules R. Siedenburg, Local Knowledge and Natural Resource Management in a Peasant Farming Community Facing Rapid Change: A Critical Examination 7 (University of Oxford QEH Working Paper Series, Working Paper No. 166, 2008), available at http://www3.qeh.ox.ac.uk/RePEc/qeh/qehwps/qehwps166.pdf (questioning the ability of farmers to adapt natural resource management practices when once-abundant resources suddenly become scarce; some farmers may have knowledge of what must be done to cultivate or conserve resources, while others may not). But see Ricardo Pérez Aviles et al., El Conocimiento Popular, Campesino e Indígena desde Abajo, El Caso Pueblo [Folk Knowledge, Rural and Indigenous People from Below, The Case of Pueblo], in BIODIVERSITY AND TRADITIONAL KNOWLEDGE, supra note 19, at 425 (stating that knowledge responds to changes in people’s relationship to nature and the environmental problems caused by human activity); see also Winona LaDuke, Traditional Ecological Knowledge and Environmental Futures, 5 COLUM. J. INT’L ENVTL. L. & POL’Y 127, 130 (1994) (arguing that large populations are not incompatible with traditional management practices; “previous North American indigenous populations were substantially higher than they are now”); Interview with Taqulik Hepa, Director, North Slope Borough Wildlife Director, in Barrow, Alaska (Apr. 1, 2011) [hereinafter Hepa Interview] (stating that Arctic people are adapting to the changing migration patterns of Arctic animals and knowledge is evolving; Iñupiat Eskimos are able to continue to go whaling even if the ice is thinner, although they must adjust to a shorter season and take extra precautions) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment).

of Western science and the regulatory system that agencies use. The difficulty may arise from the interconnectedness of a community’s knowledge with its traditional values, practices, and stories. Particularly for indigenous knowledge, there may be no distinction between the tangible and the intangible, the religious and the secular, or the individual and the community.

50. See Charnley et al., supra note 9, at 14 (“[A]ccounts of community knowledge are rarely framed in a manner that addresses scientific questions relating to forest management.”); see also Taylor Breitsford, “We have to Learn to Work Together”: Current Perspectives on Incorporating Local and Traditional/Indigenous Knowledge into Alaskan Fishery Management, 70 AM. FISHERIES SOC’Y SYMP. 381, 385 (2009) (suggesting that agencies may be hesitant to fund projects that include the study of spiritual beliefs, as these beliefs appear to have limited applicability to resource management decisions).

51. Federal migratory bird hunting regulations applicable to Alaska are an example. See 50 C.F.R. § 92.31 (2011) (listing Region-specific regulations). These regulations provide for a 30-day hunting closure on the North Slope during the summer, in accordance with traditional practices. Id. But the setting of specific dates for the closure has been problematic, since closure traditionally began when birds started to pair up and the rivers melted. See Hepa Interview, supra note 48. This may occur earlier or later in a given year, depending on the weather. Id. The North Slope Borough Fish and Game Committee proposed regulations under which closure would begin when North Slope hunters observed the birds pairing up, but FWS did not accept the proposal. Id.

52. See Víctor Reyes-García, Conocimiento Ecológico Tradicional para la Conservación: Dinámicas y Conflictos [Traditional Ecological Knowledge for Conservation: Dynamics and Conflicts], 107 PAPELES 39, 47 (2009), available at http://www.fuhem.es/media/ecosocial/file/Proyecto%20Cultura%20y%20Ambiente/Art%C3%ADculos/conocimiento%20ecologico%20tradicional_V.REYES-GARCIA.pdf (noting that the Apache’s ecological knowledge is transmitted via diverse forms, including myths, prayers, and ceremonies); see also Zimmerman, supra note 37, at 825 (suggesting that indigenous people view traditional ecological knowledge as their way of life and that the spiritual and sustainable aspects of this knowledge cannot be separated); Frankson Interview, supra note 10 (describing traditional practices associated with preparation for whaling, including prayer and cleaning one’s cellar); Interview with Nora Jane Burns, Village of Kaktovik Liaison and Planning Commission Representative for the North Slope Borough, Kaktovik City Council Member, in Kaktovik, Alaska (Feb. 16, 2011) [hereinafter Burns Interview] (declaring that Iñupiat Eskimo elders tell stories containing traditional knowledge and showing how the knowledge plays out in real life; the culture, stories, and knowledge are all mixed together) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment).


54. See E. A. Belgibaev [E. A. Belgibaev], Образовательный Ресурс в Сфере Сохранения Биоразнообразия Алеут-Саянского Экорегиона: Региональный Компонент [Educational Resources in Biodiversity Conservation in the Altai-Sayan Ecoregion: Regional Component], in ALTAE-SAYAN TRADITIONAL KNOWLEDGE, supra note 10, at 14 (asserting that among the Altai-Sayan people of Russia, practical knowledge is closely aligned with religion and myth); see also IPACC Workshop, supra note 44, at 30 (stating that, for the San tribe of Southern Africa, there is no line between culture, faith, and knowledge).
Agencies generally cannot process or use spiritual aspects of knowledge in the same manner as other forms of data. C. Identifying Proper Sources of Community Knowledge

Not everyone in a community necessarily has community knowledge. Power structures in a community can mean that researchers ignore those who have more in-depth knowledge in favor of those with higher status (or louder voices). Women have different kinds of knowledge than men, and in some cases they are the principle holders of community knowledge. Yet women may be reluctant to speak, and women’s participation may not even be sought.

55. See Korchagina, supra note 42, at 72 (declaring that traditional knowledge is made up of knowledge, ethical norms, and personal memories—it is inseparable from personal recollections).
56. See Bennett Interview, supra note 18 (maintaining that there is currently no way for Western science to incorporate the emotions and spiritual aspects associated with traditional practices; this does not make the spirituality or the practices illegitimate—just difficult to capture).
57. See Siedenburg, supra note 48, at 2, 10–11 (citing example of farmers in rural Senegal and Tanzania, some of whom removed all trees from their fields, while others retained or cultivated trees); see also Telephone Interview with Brad Smith, Biologist and Anchorage Field Office Supervisor, National Marine Fisheries Service (NMFS) (Mar. 11, 2011) [hereinafter Smith Interview] (suggesting that it is difficult for NMFS to determine what Native comments are correct because of the tendency in Alaska Native culture not to question what different community members say, resulting in differing comments) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment); Telephone Interview with Doug Vincent-Lang, Special Assistant to the ADF&G Commissioner (Mar. 9, 2011) [hereinafter Vincent-Lang Interview] (stating that agencies struggle with knowledge coming from a single person who could be inaccurate; to address this, ADF&G gives more weight to information supplied by village corporations than to that provided by a single person) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment).
58. See Hilary Warburton & Adrienne Martin, Natural Resources Institute, Local People’s Knowledge in Natural Resources Research, SOCIO-ECONOMIC METHODOLOGIES FOR NATURAL RESOURCES RESEARCH, BEST PRACTICE GUIDELINES 3 (1999), available at http://www.nri.org/publications/bpg/bpg05.pdf (citing examples of people with knowledge who have been ignored by researchers because of power structures).
59. See Pérez Aviles, supra note 48, at 420 (explaining that women are the main holders and guardians of traditional knowledge).
60. See Warburton & Martin, supra note 58, at 7–8 (stating that, in some communities, men answer researchers’ question for women, although women might have more knowledge about farming).
61. See Carla Guerrón-Montero, Marine Protected Areas in Panama: Grassroots Activism and Advocacy, 64 HUMAN ORGANIZATION 360, 368 (2005) (describing the implementation of a marine protected area in Panama, in which there was little effort to incorporate the participation of women).
D. Limited Scope of Knowledge

Just as Western science has not penetrated all areas of the earth, community knowledge is limited to particular places and environmental circumstances. Community members may not be familiar with areas beyond what they use or with conditions that take place during times in which they are not hunting. This limits the extent to which the knowledge can be generalized and universally applied.

E. Loss of Knowledge

Loss of community knowledge is associated with loss of the language associated with the knowledge, lack of written records, insistence on formal (Western-style) education, loss of access to traditional land and

62. See Moller et al., supra note 21, at 11 (suggesting that sampling at different places or at non-harvest times of the life cycle may be necessary to investigate harvesting and other population impacts).

63. See Charnley et al., supra note 9, at 14 (“[Community knowledge] is not easy to generalize at different scales or at widely varying locations. . . . Trying to gain access to it in written form and treating it as a set of technical facts to be applied to forest management problems elsewhere is inappropriate.”); see also Lazrus & Sepez, supra note 18, at 35 (declaring that community knowledge in the NOAA Fisheries Alaska Native Traditional Environmental Knowledge Database “can be primarily useful to reflect local environmental and social conditions; however without an explicit link to place, the reflection is blurred”).

64. See, e.g., Alonso Mielgo, El Conocimiento Tradicional Aplicado al Manejo de las Huertas en Andalucía [Traditional Knowledge Applied to Garden Management in Andalucia], in Introducción a la Agroecología como Desarrollo Rural Sostenible [Introduction to Agro-Ecology as Rural Sustainable Development], at 303 (G. Guzmán, M. González de Molina, & E. Sevilla eds., 2000), available at http://www.cifae.es/archivos/publicaciones/23.pdf (noting that species names are a component of community knowledge as they give insight on how species are classified); see also Tavana, supra note 38, at 21 (“Deterioration of language has serious implications for the Samoan culture: when elders die, the language, cultures and knowledge die with them.”); George Interview, supra note 7 (stating that the loss of language means loss of this knowledge).

65. See, e.g., Reyes-García, supra note 52, at 52 (citing M. Lizarralde, Biodiversity and Loss of Indigenous Languages and Knowledge in South America, in On Biocultural Diversity: Linking Language, Knowledge, and the Environment (L. Maffi ed., 2001)) (stating that the loss of traditional values is a leading cause of the loss of traditional ecological knowledge); Juep Bakuants, supra note 48, at 2 (asserting that the study of community knowledge and environmental management in Jameykari, Costa Rica, an indigenous community, suggests that community knowledge is disappearing in part because there is no written record).

66. See, e.g., Reyes-García, supra note 52, at 53 (citing R. Sternberg et al., The Relationship between Academic and Practical Intelligence: A Case Study in Kenya, 29 Intelligence 410 (Sept.–Oct. 2001)) (attributing the loss of traditional ecological knowledge to the acculturation caused by formal education).
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resource use areas,\textsuperscript{67} social change,\textsuperscript{68} and movement toward a market economy (through which Western or store-bought products substitute for traditionally made or harvested products).\textsuperscript{69} The degree to which Alaskan community knowledge is retained varies, depending on the immersion of an individual or family in the traditional culture\textsuperscript{70} and native language.\textsuperscript{71} But overall, it appears that a gap is emerging between the knowledge held by older generations and that of younger generations.\textsuperscript{72}

\textsuperscript{67}. See, e.g., CHARNLEY ET AL., supra note 9, at 19, 34 (describing loss of knowledge regarding forest resources in the Pacific Northwest, in part due to increased privatization).

\textsuperscript{68}. See, e.g., Juep Bakuants, supra note 48, at 2 (stating that community knowledge is disappearing in part because youth are focused on western lifestyles); IPACC Workshop, supra note 44, at 10 (affirming that, as youth look towards urban life, there is a loss of traditional knowledge among the San tribe of southern Africa); Frankson Interview, supra note 10 (describing the loss of spiritual and social significance associated with the traditional practice of making skin boats for whaling); Interview with Delbert Rexford, Land Manager, Ukpeagvik Iñupiat Corporation, in Barrow, Alaska (Feb. 8, 2011) [hereinafter Rexford Interview] (stating that youth are attuned to technology and not engaging in subsistence activities as much as before).

\textsuperscript{69}. See, e.g. Ibarguen Tinley & Chapela Mendoza, supra note 19, at 303 (stating that traditional knowledge and practices in Mexico, aside from having pre-Columbian roots, are influenced by modern technology and respond partially to capitalist market incentives and globalization); Reyes-García, supra note 52, at 54 (citing two independent studies that found that the more integrated into a market a society was, the less traditional ecological knowledge it had); Pricette Dovonou-Vinagbè & Omer Chouinard, Gestion Communautaire des Ressources Naturelles au Bénin (Afrique de l'Ouest): le Cas de la Vallée du Sitatunga [Community Management of Natural Resources in Benin (West Africa): The Case of the Sitatunga Valley], 12 ÉTUDES CARIBÉENNES at ¶53 (Apr. 2009), http://etudescaribeennes.revues.org/3630 (describing challenges to community management in south Benin: as residents transfer from a traditional agrarian economy to an individualistic cash economy, traditions and values formerly allotted to the wetlands have almost disappeared); Juep Bakuants, supra note 48, at 15 (declaring that resources traditionally used solely for subsistence purposes are now used at least in part for commercial uses).

\textsuperscript{70}. See Burns Interview, supra note 52 (stating that families that are still hunting continue to pass down knowledge about traditional skills (i.e., skinning and sled-making), but other families are not passing down as much information); see also Chase Interview, supra note 11 (suggesting that someone growing up in an Eskimo community would probably have more traditional knowledge, depending on how much emphasis the person’s family puts on traditional knowledge).

\textsuperscript{71}. See Frankson Interview, supra note 10 (stating that because knowledge is tied to language, it is more difficult to understand Inupiat concepts spoken in the English language because the Inupiat terms are more definitive); see also Rexford Interview, supra note 68 (stating that when the younger generation talks about whaling, some of the meaning is lost because they are speaking in English instead of Inupiat).

\textsuperscript{72}. See Brelsford Interview, supra note 20 (stating that the traditional stewardship values in Alaskan indigenous communities are not embraced by all but have not disappeared and that there are gaps in knowledge between youth and elders).
F. Reluctance to Share Knowledge

A community may be reluctant to share its knowledge with researchers and government agencies. In Alaska, there are various reasons for people’s reluctance to share traditional knowledge, one of which is the sense that community knowledge has long been dismissed by Western scientists and agencies. This resentment has eased as agencies have shown more interest in community knowledge.

A second reason relates to distrust of outsiders and the government—particularly the federal government and law enforcement agents. Some villages have refused to participate in studies because of concerns that law enforcement agents could find out about illegal harvests. There is also a concern that environmental organizations will use information (particularly about whaling) against local hunters.

A third reason pertains to intellectual property rights, even when community knowledge is gathered for use in government decision-making.

73. See id. (stating that there is a sense that community knowledge has long been derided and dismissed in what amounts to an assault on the dignity of community elders); see also Frankson Interview, supra note 10 (maintaining that if people knew their knowledge was valued, they would be more forthcoming in sharing it).

74. See Bennett Interview, supra note 18 (stating that on the North Slope, provided there is not a threat of law enforcement, people are willing to share information and are glad that someone is interested in their knowledge); see also Brelsford Interview, supra note 20 (proposing that in the twenty-first century, people may be more upset about their knowledge being left out of a decision-making process than they would be about having the knowledge out in the public domain).

75. See Smith Interview, supra note 57 (averring that, in Alaska, because there is a history of animosity toward the federal government, it can be hard to channel public meetings in a productive direction).

76. See Brelsford Interview, supra note 20; see also Rexford Interview, supra note 68 (stating that, in general, North Slope residents are reluctant to share information with outsiders and are deterred by the aggressive approach of some law enforcement officers); Email from Catherine Villa, Tribal Coordinator, EPA, to author (Feb. 4, 2011) [hereinafter Villa Email] (stating that people may have a mistrust of the government and want to know why community information is needed and how it will be used) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment).

77. See Brelsford Interview, supra note 20.

78. See Interview with Johnny Aiken, Whaling Co-Captain and Executive Director of the Alaska Eskimo Whaling Commission, in Barrow, Alaska (Feb. 8, 2011) [hereinafter Aiken Interview] (expressing concern that environmentalists could use information regarding the number of whale strikes (whales struck but not landed) to campaign for a reduction in the whaling quota).

79. See Brelsford Interview, supra note 20 (noting that “intellectual property” concerns exist, although this term is rarely used in the context of Alaskan traditional ecological knowledge). Brelsford has only seen one instance in which long-term royalties were requested for the use of traditional ecological knowledge. Id.
rather than for a commercial venture. A community may be concerned that once knowledge enters the public domain, it can be exploited without any recognition of the community’s rights to the knowledge. If a published study reveals the location of community hunting and fishing sites, outside hunters may begin using these sites.

A fourth reason relates to the lack of compensation and community benefit. There may be little incentive to share knowledge unless it is in the community’s interest to do so—for example, if sharing knowledge leads to shared management or at least the protection of community resource use. At the individual level, people may be unwilling to take time out of their day to talk with researchers unless they are adequately compensated (even though the knowledge is supposed to be used to make better decisions concerning community resources).

80. An example of a conflict regarding intellectual property rights is a project through which the Minerals Management Service (MMS) funded a village native corporation to collect over 3,000 records containing community knowledge. The corporation ultimately did not share the records with MMS due to disputes over the right to control the information. See Williams Interview, supra note 43.

81. See Pérez Aviles, supra note 48, at 424 (indicating that under Mexican law, there are no legal means to protect community knowledge without losing the value of the knowledge as cultural patrimony and community heritage; the knowledge becomes capital rather than a patrimony); see also Cirone, supra note 35, at 20 (describing the struggle between tribes’ privacy rights and laws providing for freedom of information); Interview with Jack Schaefer, Lands Manager, Tikigaq Corporation, in Point Hope, Alaska (Feb. 2, 2011) [hereinafter Schaefer Interview] (referring to occasion in which the federal government got information regarding local people’s land occupancy and suggesting that this information was misused in a later federal oil and gas lease sale) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment); Williams Interview, supra note 43 (stating that informants may not be willing to provide knowledge without some control over how it is used and that informants may feel exploited).

82. See Brelsford Interview, supra note 20 (suggesting that if a study provides insight into where animals are likely to be, people may worry that others will encroach on their hunting or fishing sites); see also George Interview, supra note 7 (stating that a book regarding community knowledge on North Slope fish was not published, as there was a concern that sport hunters could come to the area and use community fishing sites).

83. See Emily Walter, R. Michael M’Gonigle & Céleste McKay, Fishing Around the Law: The Pacific Salmon Management System as a “Structural Infringement” of Aboriginal Rights, 45 McGill L.J. 263, 310 (2000), which states the following:

In community-based systems, local and traditional knowledge is harnessed more effectively to provide a wider range of inputs into stock assessment and other policy functions. Community-based regimes also allow harvesters to turn their energies to improving instead of beating the system, such that compliance is enhanced and problems with poor estimation of effort, which have confounded stock assessors under the present system, are ameliorated.

84. See Jon Isaacs, Use of Traditional Knowledge in the Northstar Oil Development EIS, Presentation in North Slope Borough (NSB) Traditional Knowledge Workshop, in Anchorage, Alaska (Sep. 6, 2007) (stating that the U.S. Army Corps of Engineers attempted to incorporate community knowledge from the Barrow, Nuiqsut, and Kaktovik villages in an Environmental Impact Statement (EIS) for the Northstar offshore Arctic development; while
A fifth reason relates to spirituality and religious privacy. Where community knowledge is inseparable from spirituality, communities may not want their religious practices to be discussed with outsiders.

A final reason relates to the difficulty of inter-cultural communication. In collecting community knowledge, both the informant and the person collecting information must stretch beyond their normal means of communicating. This requires patience, practice, and goodwill on the part of all involved.

V. Laws Affecting the Use of Community Knowledge

While Canadian laws and international agreements call for the use of community knowledge in environmental and natural resource decision-making, many residents were pleased with the effort, one village declined to participate without compensation (on file with the Washington and Lee Journal of Energy, Climate, and the Environment); see also Williams Interview, supra note 43 (stating that informants may feel exploited even though their knowledge is being gathered in order to make better decisions concerning their land).

85. See Brelsford Interview, supra note 20 (discussing the sensitive nature of religious privacy and how it is intertwined with traditional knowledge).

86. See id.

87. See Williams Interview, supra note 43 (stating that there are many cultural and communication challenges to collecting traditional knowledge; it can be difficult for a researcher to get a substantive answer to a question rather than a story).

88. See id.

89. See Brelsford Interview, supra note 20 (stating that all methods of collecting data presume goodwill and that if there is a lack of goodwill, no one will participate).

90. Canada has some specific statutory provisions for integrating community knowledge, although they are permissive rather than mandatory. Article 42(j) of the Canada Oceans Act, R.S.C. 1996, c. 31, allows the Minister of Fisheries and Oceans to “conduct studies to obtain traditional ecological knowledge for the purpose of understanding oceans and their living resources and ecosystems.” Canada Oceans Act, R.S.C. 1996, c. 31. Section 16.1 of the Canadian Environmental Assessment Act says that “[c]ommunity knowledge and aboriginal traditional knowledge may be considered in conducting an environmental assessment.” Canadian Environmental Assessment Act, R.S.C. 2003, c. 37. There has been difficulty in enforcing, standardizing, and monitoring the use of community knowledge in environmental assessments, however. See Graham R. Statt, Tapping Into Water Rights: An Exploration of Native Entitlement in the Treaty 8 Area of Northern Alberta, 18 CAN. J.L. & SOC’Y 103, 104 n.3 (2003) (suggesting that there has been difficulty with enforcing, standardizing, and monitoring the full consideration of traditional ecological knowledge among federal environmental assessment panels). Some aboriginal people still feel that their participation in environmental assessments is too limited. See Pat Larcombe, Determining Significance of Environmental Effects: An Aboriginal Perspective, Winds and Voices Environmental Services Inc., Research and Development Monograph Series (2000), available at http://www.ceaas.gc.ca/default.asp?lang=En&n=072A8227-1&offset=2&toc=show (recounting Aboriginal people’s suggestion that “[d]etermination of significance should be [expanded] to include effects significant to Aboriginal peoples, and not be limited . . . ”). Two Canadian provinces provide for the incorporation of community knowledge into
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making, there is no law or agreement requiring its use in the United States. Still, several United States laws are relevant to agencies’ use of community knowledge.

A. Data Quality Act

The Data Quality Act, enacted in 2000 as a short rider to a spending bill, may affect how federal agencies can use community knowledge in decision-making. The Act requires the Office of Management and Budget (OMB) and other federal agencies to establish guidelines “ensuring and maximizing the quality, objectivity, utility, and integrity of information . . . disseminated by [the agency].” The act further requires agencies to provide a mechanism allowing for complaints to correct information that does not apply with agency guidelines.

The guidelines of the federal agencies that are largely responsible for making decisions regarding natural resources and the environment do not address “community,” “traditional,” “local,” or “indigenous” knowledge.


91. See infra Appendix (listing agreements and declarations calling for the use of community knowledge in environmental decision-making).

92. See generally infra Part IV, §§ A–D (discussing current laws affecting community knowledge, but finding no specific law mandating the use of community knowledge).

93. See infra Part IV, §§ A–D, and Part V (outlining several U.S. laws pertaining to agencies’ use of community knowledge).


95. OMB guidelines state that, in general, scientific and research information that has “been subjected to formal, independent, external peer review” is regarded as presumptively objective. Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies, 67 Fed. Reg. 8,452, 8,454 (Feb. 22, 2002). The guidelines provide that the presumption of objectivity “is rebuttable based on a persuasive showing by the petitioner in a particular instance.” Id. at 8,459.

96. Data Quality Act, supra note 94, § 515(a).

97. See id. § 515(b)(2)(B) (establishing mechanisms by which individuals may correct information that does not apply with guidelines); see also id. § 515(b)(2)(C) (requiring agencies to report such complaints and actions to resolve the complaints to the Office of Management and Budget).

The guidelines refer only to scientific knowledge that is collected according to standard procedures and/or peer reviewed. For example, the National Oceanic and Atmospheric Administration (NOAA) collects data “according to documented procedures or in a manner that reflects standard practices accepted by the relevant scientific and technical communities.” Deviations from NOAA procedures “occur only if valid scientific reasons exist for such deviation[s].”

The prospect of being challenged for using community knowledge that is insufficiently objective or peer-reviewed may hinder agencies from relying on this source of knowledge. On the other hand, the lack of a peer

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99. See Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by the Environmental Protection Agency, supra note 98 (requiring that “major scientifically- and technically-based work products . . . related to Agency decision should be peer reviewed”).

100. NOAA Guidelines, supra note 98.

101. Id.

102. See Williams Interview, supra note 43 (indicating that the government is constrained by the Data Quality Act to meet objective evidentiary standards, which must be applied to all information used in decision-making; it is sometimes difficult for assertions of traditional knowledge to measure up to this). Complaints and challenges have been filed under the Data Quality Act against agencies on a wide range of decisions regarding natural resource and environmental issues. See Data Quality Petitions by Agency, Center for Regulatory Effectiveness, available at http://thecre.com/quality/petitions.html (listing petitions for information received by the various agencies under the Data Quality Act); see also David S. Caudill, Images of Expertise: Converging Discourses on the Use and Abuse of Science in Massachusetts v. EPA, 18 VILL. ENVTL. L.J. 185, 200 (2007) (stating that many proposed regulations are challenged with claims that the scientific evidence is flawed or otherwise imperfect). Thus far, however, federal courts do not appear to have used the Data Quality Act as a basis for invalidating agency decisions regarding natural resources or the environment. See, e.g., McKeen v. U.S. Forest Service, 615 F.3d 1244, 1259 (10th Cir. 2010) (claiming that, based on the Data Quality Act, the National Environmental Policy Act, and the Administrative Procedure Act (APA), Forest Service action was found to be not arbitrary and capricious); see also San Luis & Delta-Mendota Water Authority v. Salazar, 760 F.Supp.2d 855, 959–64 (E.D. Cal. 2010) (pronouncing that APA barred review of claim that FWS failed to apply Data Quality Act in drafting biological opinion under Endangered Species Act; Data Quality Act did not provide private right of action); Family Farm Alliance
review process for community knowledge may mean that it can be used without any peer review. Many agencies continue to collect community knowledge and incorporate it into their work and may see the Data Quality Act as not directly applying to this type of knowledge.

B. ANILCA

The Alaska National Interest Lands Conservation Act (ANILCA) “enables rural residents who have personal knowledge of local conditions and requirements to have a meaningful role in the management of fish and wildlife . . . .” The Act requires the Secretary of the Interior to undertake subsistence use studies that seek data from local residents.

Under the authority of ANILCA, five federal agencies, the Federal Subsistence Board (comprised of the Alaska heads of the five agencies), and ten Regional Advisory Councils manage subsistence on

v. Salazar, 749 F.Supp.2d 1083, 1,091–92 (E.D. Cal. 2010) (asserting that makeup of peer review panel was committed to FWS's discretion, precluding judicial review of challenge to peer review brought under the Data Quality Act; further, the act contained no substantive standards respecting peer review, and OMB guidelines disclaimed that its contents created any enforceable rights).

103. See Smith Interview, supra note 57 (stating that traditional knowledge can be used by NMFS without peer review because there is no peer review process for this type of knowledge).

104. See Bennett Interview, supra note 18 (affirming that the Data Quality Act has not affected her work with FWS, which is more descriptive and less concerned with the level of precision or repeatability); see also Telephone Interview with Stacie McIntosh, Branch Chief of Resources, BLM (Apr. 18, 2011) [hereinafter McIntosh Interview] (asserting that the Bureau of Land Management is not directly involved in the collection of data (particularly numeric data) and is thus less affected by the Data Quality Act) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment); Telephone Interview with Ted Rockwell, Senior Advisor for Oil and Gas, EPA Region 10 (Mar. 25, 2011) [hereinafter Rockwell Interview] (suggesting that to the extent the Data Quality Act does apply to community knowledge, it can be addressed by having the community review a report before it is finalized) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment).


106. See id. § 3122 (requiring the Secretary to consult with and make use of the special knowledge of local residents engaged in subsistence use and make the results of this research available).


108. These include the USDA Forest Service and four Department of Interior agencies: the Bureau of Indian Affairs, the Fish and Wildlife Service, the National Park Service, and the Bureau of Land Management.
federal lands in Alaska.\textsuperscript{109} The Regional Advisory Councils consist of agency representatives as well as residents who are knowledgeable about subsistence and other uses of fish and wildlife resources in their region.\textsuperscript{110}

The Office of Subsistence Management (within the U.S. Fish and Wildlife Service) was created to support the Federal Subsistence Board, the Regional Advisory Councils, and the Fisheries Resource Monitoring Program (“the Program”).\textsuperscript{111} The Program sponsors harvest pattern studies and the collection/analysis of community knowledge,\textsuperscript{112} which provides context for understanding harvest information and interpreting biological and environmental phenomena.\textsuperscript{113}

\textbf{C. Executive Order on Environmental Justice}

A 1994 executive order on environmental justice\textsuperscript{114} seems to encourage the collection of community knowledge, as it requires federal agencies to ensure greater public participation and improve research and data collection on the environment of minority and low-income populations.\textsuperscript{115}

Even before the executive order was issued, the U.S. Environmental Protection Agency (EPA) established the National Environmental Justice Advisory Council to address environmental justice issues.\textsuperscript{116} The Council’s

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\item[109.] See Polly Wheeler & Amy Craver, Office of Subsistence Management and Issues and Challenges of Integrating TEK into Subsistence Fisheries Management, \textit{27 Practicing Anthropology} 15, 15 (Winter 2005) (explaining that the state of Alaska is divided into ten geographic regions, each having a Regional Advisory Council).
\item[110.] See id. (describing the Regional Advisory Councils as being made up of local residents who represent sport, commercial, and subsistence hunting and fishing interests).
\item[112.] See Wheeler \& Craver, \textit{supra} note 109, at 15 (explaining the processes used by the Fisheries Resource Monitoring Program to provide information on community harvest estimates at local fisheries).
\item[113.] See id. at 16 (regarding information gathered from the Fisheries Resource Monitoring Program).
\item[115.] See id. at 7,629 (requiring agencies to identify and address health and environmental effects of their activities on minority populations and low-income populations).
\end{enumerate}
\end{footnotesize}
suggestions for public involvement include recognizing community knowledge.\[117\]

D. Executive and Secretarial Orders on Tribal Consultation

A 2000 executive order on tribal consultation may similarly encourage the gathering of community knowledge from tribes, although it does not require any action beyond consultation.\[118\] Each agency has its own approach to this consultation,\[119\] and many have developed specific guidelines.\[120\]

Many agencies or divisions had provisions for consultation even prior to the executive order. EPA’s National Environmental Justice Advisory Council developed a guide on consultation with Indian tribal governments,\[121\] listing the recognition of community knowledge as a guiding principle to provide for public participation.\[122\] Agencies within the Department of Interior developed guidelines pursuant to a 1993 Secretarial

Advisory Council (NEJAC) in order to obtain independent advice and recommendations from all stakeholders involved in the environmental justice dialogue.”).


119. See id. § 5(a), § 7 (requiring each agency to establish an accountable consultation process).


122. See id. at 48 (suggesting the importance of community knowledge to building successful partnerships).
Order requiring consultation with tribal governments whenever tribal resources could potentially be affected by a proposed agency action.\textsuperscript{123}

A Secretarial Order by the Secretaries of Interior and Commerce\textsuperscript{124} provides for tribal consultation in regards to the Endangered Species Act.\textsuperscript{125}

Several sections call for the use of tribal traditional knowledge in federal and tribal land management.\textsuperscript{126} A question-and-answer document by the Fish and Wildlife Service (FWS) explains the role of traditional knowledge under the order:

The use of the best scientific evidence available does not preclude the consideration of other factors that would shed light on the scientific evidence at hand. . . . Traditional knowledge might inform the Services on the times, seasons, conditions, etc., of such behavior pattern which has been observed since time immemorial by an Indian tribe.\textsuperscript{127}

Alaska tribes are covered by a separate order,\textsuperscript{128} which provides for participation by Alaska Natives in “research design, data collection and use of traditional knowledge.”\textsuperscript{129}

\textsuperscript{123} See Secretarial Order No. 3175, Departmental Responsibilities for Indian Trust Resources, November 8, 1993 (clarifying the responsibility of the Department of the Interior to ensure that the resources of Indian tribes are identified, conserved, and protected).


\textsuperscript{125} 16 U.S.C. §§ 1531–44; see also Secretarial Order No. 3206, supra note 124, § 4 (“Because of the unique government-to-government relationship between Indian tribes and the United States, the Departments and affected Indian tribes need to establish and maintain effective working relationships and mutual partnerships to promote the conservation of sensitive species . . . and the health of ecosystems upon which they depend.”).

\textsuperscript{126} See Secretarial Order No. 3206, supra note 124, § 4, Appendix § 3(C–D) (requiring the Fish and Wildlife Service to provide notification to affected tribes as soon as the Service is aware that a proposed federal agency action may affect tribal rights or tribal resource trust and seeking to involve tribes in conserving and expanding the tribal resource trust).


\textsuperscript{128} See Secretarial Order No. 3206, supra note 124, § 7 (Alaska) (finding a need to study the implementation of the Act to preserve the ability of Alaska Natives to take species for subsistence purposes; providing for a supplemental order to be issued following further study); see also Secretarial Order No. 3225, Endangered Species Act and Subsistence Uses in Alaska (Supplement to Secretarial Order No. 3206) (2001) (defining the application of Secretarial Order No. 3206 in Alaska, establishing a consultation framework relative to the subsistence exemption in the Endangered Species Act, and reiterating the government-to-government consultation requirements relative to overall implementation of the Act in Alaska).
VI. Federal Agency Collection and Use of Community Knowledge in Alaska

Although most federal agencies have only recently begun to recognize the importance of community knowledge in natural resource and environmental decision-making, there has long been an awareness of its significance in Arctic Alaska. Early white settlers of the area relied on the knowledge of Inupiat Eskimos as a matter of basic survival. Inupiat knowledge of the Arctic environment and its extreme conditions gradually came to be recognized as beneficial to the work of government scientists at the Naval Arctic Research Laboratory in the 1960s.

The early 1980s bowhead whale censuses were pivotal in the recognition of community knowledge, as Eskimo whalers were able to demonstrate the validity of their knowledge about bowhead whales. Research and documentation of Alaskan community knowledge has grown rapidly since then, and government agencies (particularly the former Minerals Management Service (MMS)) and EPA have attempted to integrate this knowledge into their decision-making.

MMS’s 1996 Environmental Impact Statement (EIS) regarding a proposed oil and gas lease sale in the Beaufort Sea was one of the first EISs to identify and incorporate community knowledge. The U.S. Army Corps of Engineers’ 1999 EIS for the Northstar field in the Beaufort Sea was

[129] Secretarial Order No. 3225, supra note 128, § 3 (outlining the Department of the Interior’s plan to include Native Arctic Alaskans in “all aspects of the management of subsistence species that are candidate, proposed or listed species under the ESA . . .”).

[130] See infra Part V, §§ A–F (detailing the long-standing awareness in Alaska of the importance of community knowledge to environmental decision-making).

[131] See Aiken Interview, supra note 78.

[132] See generally Karen Brewster, Native Contributions to Arctic Science at Barrow, Alaska, 50 ARCTIC 277 (Sep. 1997) (relating the experiences of the Inupiat community in activities at the Naval Arctic Research Laboratory); see also Aiken Interview, supra note 78.

[133] See Brelsford Interview, supra note 20.

[134] See e.g., Williams Interview, supra note 43 (referring to studies conducted by MMS/BOEMRE); see also Telephone Interview with Tami Fordham, Tribal Coordinator, EPA Region 10 (Mar. 25, 2011) [hereafter Fordham Interview] (referring to studies conducted by EPA) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment); Braund, supra note 18, at 1–3 (citing studies of traditional knowledge conducted by federal agencies).

[135] See Braund, supra note 18, at 2 (stating that based on the input of North Slope communities, the Final EIA revised “Information to Lessees” and standard leasing stipulations, added an option to defer leasing in an area important to bowhead whales, and incorporated information dealing with the effect of noise and sources of traditional knowledge (citing Beaufort Sea Planning Area, Oil and Gas Lease Sale 144: Final Environmental Impact Statement, MMS 96-0012, U.S. DEP’T OF THE INTERIOR MINERALS MGMT. SERVICE V-2 (1996), available at http://www.alaska.boemre.gov/ref/EIS%20EA/Beaufort_FEIS_144/96_0012Vol2.pdf)).

among the first EISs to use community knowledge as the basis for distinguishing among environmentally preferable alternatives.\textsuperscript{137} Additional use of community knowledge by federal agencies in Alaska is discussed below.\textsuperscript{138}

\textbf{A. MMS/BOEMRE}\textsuperscript{139}

MMS/BOEMRE has extensively funded projects to collect community knowledge from subsistence hunters in Alaskan communities.\textsuperscript{140} It has used this knowledge to identify issues, assess impacts, mitigate development, monitor impacts, and determine whether to defer leasing an area until a later time (but not to determine which areas should be leased).\textsuperscript{141}

\textbf{B. EPA}

EPA Region 10 (which includes Alaska) has facilitated the collection of community knowledge in connection with various water discharge permits,\textsuperscript{142} including those for Red Dog Mine,\textsuperscript{143} Cook Inlet General District, Alaska (1999) \textsuperscript{137}See Braund, \textit{supra} note 18, at 1.
\begin{itemize}
  \item This information is based largely on interviews; it is not intended to be a comprehensive representation of how federal agencies in Alaska work with community knowledge. \textit{See infra} Part V, §§ A–F.
  \item MMS was reorganized in May 2010, and the relevant office for environmental reviews is the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE).
  \item \textit{See Williams Interview, supra} note 43 (regarding examples of projects BOEMRE has funded, including collecting information from Point Lay; an agreement with ADF&G to produce “biographical jukeboxes”; a project demonstrating that local experts contributed to improving understanding arctic cisco; an attempt to develop a community traditional knowledge database; and a study to research bowheads).
  \item \textit{See Mike Burwell & Dee Williams, Accommodating Traditional Ecological Knowledge (TEK) in MMS EIS Analysis and Decision Making, NSB Traditional Knowledge Workshop, in Anchorage, Alaska (Sep. 6, 2007) (listing the MMS’s uses of community knowledge); \textit{see also} Williams Interview, supra} note 43 (indicating that community knowledge does not determine whether or not a lease sale should occur because this is primarily a political decision about national priorities).
  \item \textit{See Telephone Interview with Hanh Shaw, EPA, NEPA Coordinator, Mining Specialist (Mar. 25, 2011) [hereafter Shaw Interview] (listing studies for which EPA collected community knowledge) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment). Section 402 of the Clean Water Act provides for EPA to issue general permits under the National Pollutant Discharge Elimination System for effluent discharges. \textit{See 33 U.S.C. § 1342(a)(1) (“Except as provided in sections 1328 and 1344 of this title, the Administrator may, after opportunity for public hearing, issue a permit for the discharge of any pollutant, or combination of pollutants . . . ”)}.\textsuperscript{144}
  \item \textit{See Authorization to Discharge Under the National Pollutant Discharge Elimination System for Teck Alaska, Inc., Red Dog Mine, Permit No.: AK-003865-2 EPA}
\end{itemize}

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Permit, and the forthcoming Beaufort Sea and Chukchi Sea Oil and Gas General Permits. Community knowledge is generally not used to make quantitative decisions, such as effluent limits. It is more often used in a qualitative sense to determine the areas in which certain discharges should not occur or whether a certain type of discharge should not be authorized.

C. NOAA/NMFS

In Alaska, NOAA/NMFS maintains the Alaska Native Traditional Environmental Knowledge Database, a catalog of quotes and paraphrases from published literature, videos, and pre-existing interviews relevant to the management of natural marine resources. The database was created in response to public comments received on a 2001 Environmental Impact Region 10 (March 1, 2010), available at http://www.epa.gov/region10/pdf/permits/npdes/akak0038652-fp-030110.pdf (noting that traditional knowledge was used in the review conducted pursuant to the National Environmental Policy Act). Through its contractor (Steve Braund), EPA Region 10 collected information from local tribes suggesting that a mining road had caused a change in caribou migration. See Telephone Interview with Patty McGrath, Mining Specialist, EPA Tribal Waters Program (Mar. 25, 2011) [hereinafter McGrath Interview] (on file with the Washington and Lee Journal of Energy, Climate, and the Environment). Western science (based on satellite tracking) did not prove or disprove this information. Id. EPA nevertheless relied on the community’s information to suggest that mining slurry be conducted through a buried pipeline, as opposed to being trucked on a road. Id.

144. See Fact Sheet for Authorization to Discharge Under the National Pollutant Discharge Elimination System for Oil and Gas Exploration, Development and Production Facilities Located in State and Federal Waters in Cook Inlet, Alaska Permit No.: AKG-31-5000 EPA Region 10, at 47–49 (effective Feb. 23, 2006) (interviewing members of local tribes led to uncovering concerns about catastrophic environmental events and discharge of contaminants). For the Cook Inlet General Permit, EPA documented concerns from tribal members regarding the potential for environmental impacts from oil and gas operations, the overall decline in the population of important food species and in the quality of the species harvested, and the effect of tidal currents on discharges. Id. EPA agreed that additional information should be gathered regarding the fate of oil and gas discharges and required two new studies on the potential impacts of discharges. Id. Also, EPA expanded the area in which discharge was prohibited to 4,000 meters. Id.

145. See Braund, supra note 18 (reviewing previously conducted studies on traditional knowledge (particularly studies conducted by MMS) to identify data gaps related to traditional knowledge of the Chukchi and Beaufort seas).

146. See Shaw Interview, supra note 142.

147. See id.


149. See Lazrus & Sepez, supra note 18, at 33 (describing the database).
Statement suggesting that traditional ecological knowledge was inadequately considered.\textsuperscript{150}

Since NOAA/NMFS acknowledged the value of community knowledge in the bowhead whale census, it has enjoyed some credibility in Alaska’s Eskimo communities.\textsuperscript{151} Inupiat Eskimo knowledge plays a role in the Cooperative Agreement NOAA/NMFS has with the Alaska Eskimo Whaling Commission (AEWC), which accords Eskimo whaling captains a role in managing the bowhead whale hunt.\textsuperscript{152}

Community knowledge also plays a role in NOAA/NMFS’s decisions to issue incidental harassment authorizations (IHAs) for development that may incidentally impact marine mammals.\textsuperscript{153} NOAA/NMFS must consider whether the proposed development will impact the availability of marine mammals for subsistence purposes; and availability is informed by hunters’ observations regarding the location and behavior of marine mammals.\textsuperscript{154}

\textbf{D. FWS}

FWS does not have a specific system for working with community knowledge, although this knowledge has been used to bolster biological assessments and provide context.\textsuperscript{155} Community knowledge can help

\begin{footnotesize}
\begin{enumerate}
  \item See id. at 33–34 (expressing the importance of public comments to the creation of the Database).
  \item See Aiken Interview, supra note 78 (describing the trust between NOAA/NMFS and the native community arising from their cooperation in the 1980s whale censuses and the NOAA Cooperative Agreement with the Alaska Eskimo Whaling Association).
  \item See id. (referring to the Cooperative Agreement between the National Ocean and Atmospheric Administration and the Alaska Eskimo Whaling Commission, as amended 2008).
  \item See Smith Interview, supra note 57 (explaining that Alaska Natives were able to get regulations permitting Incidental Harassment Authorization (IHA) amended in 1996 so that an authorized activity must provide for “the least practicable adverse impact on . . . the availability of the species for subsistence uses”); see also 50 C.F.R. § 216.107 (outlining procedure for issuance of incidental harassment authorizations); Small Takes of Marine Mammals; Harassment Takings Incidental to Specified Activities in Arctic Waters; Regulation Consolidation; Update of Office of Management and Budget (OMB) Approval Numbers, 61 Fed. Reg. 15884-01 (Apr. 10, 1996) (providing for the regulation of incidental harassment authorizations in Arctic waters).
  \item See Smith Interview, supra note 57 (describing the role of community knowledge in determining whether an activity will have an impact on subsistence for purposes of issuing an incidental harassment authorization under 50 C.F.R. 216.107). At the same time, just because one hunter says the whale is spooked does not mean a whole program is going to be shut down; there is a need to quantify observations. Id.
  \item See Bennett Interview, supra note 18 (explaining that community knowledge can be included in the background discussion of a biological assessments to give the assessment a more complete context); see also Smith Interview, supra note 57 (explaining that biological assessments required by Section 7 of ESA are a good opportunity to present and use community knowledge).
\end{enumerate}
\end{footnotesize}
determine the direction of a new assessment or where information should be gathered.\textsuperscript{156} Community knowledge is also relevant to the work of the Office of Subsistence Management, the branch of FWS that assists with the implementation of ANILCA.\textsuperscript{157}

\textbf{E. BLM}

The Bureau of Land Management’s (BLM) 1998 EIS for the northeast portion of the National Petroleum Reserve—Alaska (NPRA)\textsuperscript{158} was perhaps BLM’s first attempt to include more than just Western scientific data in the analysis of effects and impacts.\textsuperscript{159} It contains quotes from local residents and an appendix written by the North Slope Borough mayor.\textsuperscript{160} A later EIS on the northwest portion of NPRA incorporates sections entitled “Community Traditional Knowledge of Effects on Resources and Harvests” based on information BLM received from public meetings on the North Slope.\textsuperscript{161}

BLM continues to collect community knowledge on NPRA through its Subsistence Advisory Panel, which is composed of residents from North Slope villages.\textsuperscript{162} The Panel “advises the BLM on how subsistence

\begin{itemize}
  \item \textsuperscript{156} See Bennett Interview, \textit{supra} note 18.
  \item \textsuperscript{157} See supra Part IV.B.
  \item \textsuperscript{159} See McIntosh, \textit{supra} note 1, at 39 (discussing BLM’s response to public commentary on the need for traditional knowledge).
  \item \textsuperscript{160} \textit{See Northeast NPRA Final IAP/EIS 1998 Record of Decision, supra} note 158 (containing review and analysis on comments received and an appendix authored by Mayor Ben Nageak).
resources, uses, and users may be impacted by oil and gas exploration and development in the NPRA.”

**F. North Slope Borough**

The North Slope Borough is not a federal agency, but it has had a significant role in development planning regarding Arctic natural resources.

The Borough has used community knowledge in combination with Western science in land use permitting and rezoning for petroleum development. For example, in 2000, community knowledge indicated that a proposed oil and gas development project would take place near an area that was important for caribou calving. Community knowledge further


166. The Meltwater Prospect (east of the National Petroleum Reserve—Alaska) was approved by the North Slope Borough Assembly through Ordinance No. 1975-6-41, An Ordinance Amending the Official Zoning Map of the North Slope Borough for the Area Generally Known as the Meltwater Prospect to be Rezoned from Conservation District to Resource Development District (adopted Jan. 17, 2001).

167. See [Gordon Brower, Integrating Traditional Knowledge in Permit Reviews, NSB Traditional Knowledge Workshop, in Anchorage, Alaska (Sep. 6, 2007)](http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm) (describing the
indicated that pipelines associated with the project could hinder caribou movement into the area.\textsuperscript{168} Borough biologists conducted research using radio collars to determine movement patterns and areas of high caribou concentrations.\textsuperscript{169} Based on this information and community knowledge, pipelines were required to be at least seven feet high to facilitate caribou passage.\textsuperscript{170}

The Borough has also had success in using subsistence representatives with community knowledge to guide new oil and gas development or development in areas where subsistence takes place.\textsuperscript{171}

\textit{VII. Recommendations for Obtaining and Using Community Knowledge}

Agencies that do not yet have protocols for collecting and using community knowledge should develop them.\textsuperscript{172} These protocols could be integrated into the information quality guidelines that agencies are required to issue under the Data Quality Act. Below are some general suggestions.

\textit{A. Knowledge Collection}

The most practical method for knowledge collection depends on the time and resources an agency has to invest in the collection.\textsuperscript{173} Generally, the more time an agency spends getting to know a community and gaining its trust, the more successful the collection of community knowledge will
Also, collection is more likely to be successful when it involves community members working in partnership with Western social scientists trained in inter-cultural communication.\textsuperscript{175} The involvement of community members (or those who have assimilated into and learned from a community) in data collection can help overcome the tendency to distrust “outside” agencies or researchers.\textsuperscript{176} Also, community members may be more successful than outsiders at gathering tacit information that would otherwise be lost in the communication gap between the community and those seeking the knowledge.\textsuperscript{177}

In some cases, community members are uniquely qualified to obtain the desired information.\textsuperscript{178} Agencies may consider offering grants to

\textsuperscript{174} See McIntosh, supra note 1, at 41 (explaining that for a study on North Slope fish, BLM researchers spent multiple days meeting with local experts, in an effort to get to know these informants and convey the importance of the project and the researchers’ dedication); Wheeler & Craver, supra note 109, at 18 (“[I]nvestigators that generally have the greatest success in bridging the gap between TEK and western science tend to have long-term relationships with the people and community with whom they are working . . . .”); Brelsford Interview, supra note 20 (stating that longer ethnographic studies conducted by researchers who live in the community have generally yielded better results); see also Chase Interview, supra note 11 (suggesting that researchers should consult with a community to obtain knowledge before conducting research there; obtaining knowledge requires gaining the community’s trust, which takes time and rapport).

\textsuperscript{175} See CHARNLEY ET AL., supra note 9, at 33 (stating that collaboration may require the assistance of people trained in ethnographic methods, as well as those schooled in the language of both Western science and the knowledge of the particular community involved, as many scientists and managers lack the formal training to facilitate participatory research and monitoring processes); see also McIntosh, supra note 1, at 41 (claiming that the lack of employees trained in social science research needs to be addressed; in the Alaska division of BLM, there are few staff anthropologists compared to the large number of biologists); Brelsford Interview, supra note 20 (describing the need for local people to be involved in data collection).

\textsuperscript{176} See CHARNLEY ET AL., supra note 9, at 13 (“Some people are reluctant to share their knowledge, however, because of concern that others will not use it responsibly or in a manner that benefits the knowledge holders.”).

\textsuperscript{177} See Corburn, supra note 10, which states the following:

The information provided by the subsistence anglers—most of whom were immigrants, non-English speakers, and fearful of talking with outsiders—was an example of the kind of tacit information that only local people could accurately gather. When community members surveyed the anglers, with whom they shared a common language, cultural heritage, socioeconomic background, and immigration status, many of the anglers’ fears and disincentives to participate were allayed. \textit{Id.} at 429.

\textsuperscript{178} See Hepa Interview, supra note 48 (describing NOAA’s involvement of North Slope whalers in a project to tag endangered right whales near the Aleutian Islands; North Slope hunters, who currently tag bowhead whales in a non-invasive way, are knowledgeable as to how to approach a whale without spooking it).
community organizations so that they can conduct the research themselves.¹⁷⁹

Specific methods that agencies have used to collect community knowledge in Alaska include semi-directed group interviews (which may use maps to stimulate conversation about environmental observations),¹⁸⁰ workshops, and ethnographic field surveys conducted by ecologists in cooperation with social scientists.¹⁸²

Another method to generate information involves the use of an integrated scientific panel from a mix of western scientists and community members holding community knowledge. The panel works together to jointly address specific resource management problems by analyzing existing data and developing recommendations for how to manage natural resources.¹⁸³

A relatively low-cost method that does not involve the collection of new information is the review of testimony from previous workshops and

¹⁷⁹ See Fordham Interview, supra note 134 (stating that tribes have told EPA they would like to collect information themselves, and EPA is considering how this may be done); see also Rexford Interview, supra note 68 (explaining that FWS provided a grant to the Native Village of Barrow, but there was friction because FWS was viewed as prioritizing its own needs above those of the Native Village).

¹⁸⁰ Interviewers should be cognizant of the cultural preferences of those they interview. People from the Iñupiat Eskimo tradition many prefer to take their time and give a well thought-out answer, which makes unplanned interviews difficult. People may also prefer to talk in groups rather than one-on-one interviews. And women may tend to talk less when in groups with men; they may be more comfortable by themselves. See Frankson Interview, supra note 10; see also CHARNLEY ET AL., supra note 9, at 14 (noting that community members may prefer to share knowledge through shared experiences or conversation as opposed to written communication).

¹⁸¹ See Wheeler & Craver, supra note 109, at 16 (recommending that, because interviews alone cannot capture all aspects of community knowledge, investigators use prompts such as maps and drawings as a means of eliciting information and for providing further explanation).

¹⁸² See RITA A. MIRAGLIA, TRADITIONAL ECOLOGICAL KNOWLEDGE HANDBOOK: A TRAINING MANUAL AND REFERENCE GUIDE FOR DESIGNING, CONDUCTING, AND PARTICIPATING IN RESEARCH PROJECTS USING TRADITIONAL ECOLOGICAL KNOWLEDGE (1998) (outlining methods for systematically gathering community knowledge, including interviewing “key respondents” (people especially knowledgeable about a topic); holding meetings in which several knowledge holders discuss a topic in depth; investigating archives, data bases, and other written materials; and making visits to communities and participating in subsistence and other activities); see also Brelsford, supra note 50, at 383–88 (chronicling and analyzing the effectiveness of efforts to incorporate traditional knowledge into Alaskan fishery management, including regional workshops and intensive ethnographic fieldwork); Hepa Interview, supra note 48 (explaining that workshops about specific topics (such as ice or fish) where agency representatives join with scientists and hunters have been successful).

¹⁸³ See CHARNLEY ET AL., supra note 9, at 18 (citing the example of the Alaska Beluga Whale Committee, which is comprised of Native Alaskans who hunt beluga whales and government agency biologists and managers).
public hearings regarding development projects over many years. While testimony at these hearings is largely focused on community concerns, it is also a source of community knowledge related to development and natural resources. There is a wealth of records from meetings on the North Slope over the past three decades, and many residents feel that this information is ignored. Agencies should review this information before attempting to gather additional knowledge.

B. Data Quality Control

Given that not everyone in a community has the kind of knowledge an agency or researcher may be seeking, it is essential that knowledgeable people be identified and consulted. Agencies should engage in systematic (and documented) processes to identify community experts, not unlike qualifying expert witnesses in court. These experts could then be certified.

184. See Braund, supra note 18, at 2 (drawing information from previous studies of community knowledge, public testimony, subsistence mapping, and harvest data studies for an EPA study of community knowledge pertinent to environmental conditions in the area of the Chukchi and Beaufort Seas).

185. See id.

186. See Aiken Interview, supra note 78 (stating that public meeting attendees share their knowledge about caribou, whales, and birds, but the knowledge seems to be ignored, as if the government hears only what it wants to hear).

187. See generally Braund, supra note 18 (reviewing previously conducted studies on traditional knowledge (particularly studies conducted by the former Mineral Management Service) to identify data gaps related to traditional knowledge of the Chukchi and Beaufort seas). Several databases regarding community knowledge exist in Alaska, including the Alaska Traditional Knowledge and Native Foods Database developed by the Alaska Native Science Commission and the Institute of Social and Economic Research (ISER). See, e.g., ALASKA TRADITIONAL KNOWLEDGE AND NATIVE FOODS DATABASE, http://www.nativeknowledge.org/login.asp (last visited Oct. 4, 2011) (providing resources for the community and information on foods and contaminants) (on file with the Washington and Lee Journal of Energy, Climate, and the Environment).

188. See McGrath Interview, supra note 143 (stating that the EPA must ensure that it talks to a sufficient number of knowledgeable people in the community; villages and tribal governments can assist in pointing out these knowledgeable people); Chase Interview, supra note 11 (noting that, to collect knowledge for a project that maps subsistence use sites, the Northwest Arctic Borough will be going to the seven Borough villages and consulting with tribal and city administrators there to find out who in the area is actually doing subsistence hunting); Williams Interview, supra note 43 (explaining that an agency must avoid both of two extremes—the idea that everything everyone in the community says is relevant and valid and the idea that the community has nothing to contribute).

189. See Wheeler & Craver, supra note 109, at 16 (“While there is a tendency among some investigators to want to protect the identity of local experts, this can be counterproductive, as fisheries managers (among others) are often interested in what qualifies someone as an expert, and specifically, how or why were they selected to be interviewed.”); Williams Interview, supra note 43 (stating that a qualified social scientist must engage in a systematic process to identify experts and must document the process used).
as community knowledge sources for future projects. Community knowledge experts could also serve as “peer reviewers” of information that agencies collect in community workshops and other forums. This could help alleviate the sense that agencies are only hearing what they want to hear.

Another mechanism to increase reliability is to compare data collected for a particular project with data collected from previous planning efforts. Statements that are repeated over time are more likely to be reliable.

190. North Slope subsistence stakeholders have expressed concern about ensuring the reliability of the community knowledge that agencies gather. At a 2007 conference, one suggestion was to certify elders as experts to assure quality data is given, as opposed to hearsay. See Management Challenges and Benefits Section, NSB Traditional Knowledge Workshop, in Anchorage, Alaska (Sep. 6, 2007) (recording commentary from a participant that it is difficult to know whether the information shared at a public hearing is just hearsay and the suggestion that elders be certified as having knowledge). In southern Africa, national governments and non-profit organizations have developed mechanisms to certify indigenous hunters as having knowledge regarding the large mammals that they track. See IPACC Workshop, supra note 44, at 5 (describing efforts and challenges associated with certifying hunters from the local San tribe as trackers). In South Africa, the Skills Development Act 97 of 1998 (S. Afr.) provides for a program to certify trackers. See id. at 22 (outlining requirements to become a registered tracker). The program has increased the willingness of national park managers to work with indigenous trackers. See id. at 10 (providing insight from indigenous trackers trained as trackers and guides and national parks’ increased willingness to work with them). CyberTracker Conservation, a non-profit, has also developed a tracking certification. See id. at 24 (asserting that CyberTracker Conservation, launched in 1994, enforces certification standards for tracking).

191. See Hepa Interview, supra note 48 (suggesting that communities be involved in data gathering (i.e., conducting fieldwork and interviews) as well as in reviewing results and draft reports (a form of peer review)); see also Chase Interview, supra note 11 (referring to a joint effort between his community and non-profit group to map subsistence use areas to help guide development; suggesting that the maps could be “peer reviewed” by community members).

192. See Aiken Interview, supra note 78 (recalling public meetings, where most people who comment want to share their knowledge about caribou, whales, and birds, but the traditional knowledge seems to be ignored, as if the government hears only what it wants to hear); see also Frankson Interview, supra note 10 (declaring that at public meetings, federal agencies usually say that it is important to consider traditional knowledge, but this seems like a charade or a formality; the government does not seem concerned with the spirituality connected to traditional knowledge—it is not ever discussed). EPA Region 10’s contractor enlists community members to assist him in interviews of other community members; he then sends notes from the interviews back to the community for verification and approval before giving them to EPA. See Fordham Interview, supra note 134. These techniques avoid the potential for sensitive and/or inaccurate information becoming part of the public record.

193. See McIntosh Interview, supra note 104 (describing BLM’s success using testimony from multiple planning efforts and considering what people say over and over again).
C. Processing and Using Data

Once data is collected, it may be presented in agency documents in the form of excerpts from public comments or interview transcripts.\footnote{194} While this helps preserve the holistic and unique nature of the information, it does not integrate the observations into the data used to make decisions.\footnote{195}

Summarizing the information by topic and comparing it with scientific data may be a more useful approach.\footnote{196} As is the case with Western science, an individual observation must be considered in the context of other data obtained at different times under different circumstances.\footnote{197}

Decision-makers should consider compiling information into a database, with key words coded to allow for searches on particular locations, species, or socio-cultural dimensions.\footnote{198} The database could indicate whether information has been validated by personal observations and the informant’s qualifications for providing the knowledge. A piece of information that appears repeatedly in the database is likely to be more reliable, particularly when the information is based on personal observations by those in regular contact with the environment.\footnote{199}

Databases may have the effect of fragmenting information or disrupting the format in which it is conveyed,\footnote{200} although this may be

\footnote{194} See Wheeler & Craver, supra note 109, at 17 (describing one approach used by the Fisheries Subsistence Monitoring Program).

\footnote{195} See McIntosh, supra note 1, at 40 (questioning whether the use of community members’ quotes in an EIS really serves to incorporate traditional knowledge in the plan; suggesting that these quotes represent recent observations and hypothesis-generating statements rather than the collective body of traditional knowledge).

\footnote{196} See Wheeler & Craver, supra note 109, at 17 (describing how summarizing by topic and using biological information for comparison purposes has been more useful in fisheries management).

\footnote{197} See id. at 19 (“[R]esearchers that employ a variety of data collection methods . . . generally collect and provide the most useful information for use in management.”).

\footnote{198} See Brelsford, supra note 50, at 386 (outlining several efforts to create databases containing traditional knowledge). North Slope Borough Senior Biologist Craig George keeps a database in which he records environmental observations he collects from North Slope residents, noting the name of the observer, the date, time, species, location, whether the knowledge is a personal observation or something communicated, and any other details. See George Interview, supra note 7.

\footnote{199} See McIntosh, supra note 1, at 41 (reviewing a study in which several elder fishermen and women with a detailed knowledge of the area are interviewed extensively about local fish populations).

\footnote{200} See Lazrus & Sepez, supra note 18, at 36 (describing how some community knowledge is relayed in an anecdotal or storytelling format, making it difficult to put in a database); see also McIntosh Interview, supra note 104 (claiming that databases may take away from the full picture such that information is misconstrued).
overcome if the database is used as a foundation for conducting additional research or interviews to extend the information in a focused area. Ideally, the best way to use community knowledge is not to simply paste it into a document or inject it into a database but to allow those with community knowledge to actually participate in natural resources and environmental decision-making. Effective co-management regimes allow for the input of community knowledge at every step of the decision-making process.

D. The Need for Mutual Benefit and/or Compensation

Communities are more willing to share information when they can see the benefits of doing so. Examples of community benefits include opportunities to participate in decision-making, employment opportunities, and cooperating agency status for environmental impact statements. Further, community members need assurance that they will

201. See Brelsford, supra note 50, at 385–86 (detailing how the U.S. Army Corps of Engineers compiled a searchable database for a review of the Northstar project based on community knowledge collected from North Slope public meetings over several years and then used the database as a starting point for supplemental interviews with North Slope whaling captains); see also Wheeler & Craver, supra note 109, at 17 (stating that databases may be useful as a repository for information and “can provide a wealth of information for additional analysis”).

202. See McIntosh Interview, supra note 104 (expressing desire to allow those with actual community knowledge be a part of the decision-making process as regarding natural resources and the environment).

203. See Brelsford Interview, supra note 20 (explaining that co-management regimes allow the knowledge-givers to see what happens with their knowledge and to participate in the decision-making and outcome).

204. See IPACC Report to the U.N Permanent Forum on Indigenous Issues Concerning African Hunter-Gatherers’ Lands, Territories Natural Resources and Traditional Knowledge of Biodiversity, 3 (Feb. 11, 2008), available at http://www.ipacc.org.za/uploads/docs/HUGAFO_IPACC_UNPermanentForumReport.pdf (discussing Namibia’s allowance of traditional hunting and quota-controlled commercial hunting, through which “poaching is apparently reduced and communities benefit from the [sic] both the revenue from commercial and the experience and nutritional advantages of traditional hunting”); see also Burns Interview, supra note 52 (explaining how subsistence hunters will share information with FWS when it is in their interest to do so, in order to protect subsistence hunting).

205. See Brelsford Interview, supra note 20 (detailing how institutional arrangements where communities have permanent standing (like AEWC) give communities more reason to contribute knowledge, as they can participate in the decision-making and see what happens with their knowledge).

206. See Rexford Interview, supra note 68 (asserting that there has been a relatively good relationship between FWS and the community of Kotzebue (in the Northwest Arctic Borough), where FWS provides opportunities for employment).

207. Different agency regulations provide different eligibility criteria for serving as a cooperating agency. Under the Council on Environmental Quality regulations, a cooperating
not be penalized for sharing information with researchers. To encourage the sharing of accurate information regarding hunting and harvest patterns, research and law enforcement functions should be conducted separately.\textsuperscript{208}

Regardless of whether communities are given a role in managing natural resources or development projects, community members should be compensated for contributing their time and knowledge (as would any expert providing scientific knowledge).\textsuperscript{209} Payment should be significant enough to demonstrate respect for the knowledge.\textsuperscript{210}

Compensation is relatively simple to arrange when private sector entities are funding the knowledge collection.\textsuperscript{211} It is more difficult when public agencies with limited funding are conducting research, although some agencies have found ways to compensate people in the form of door prizes for attending public meetings.\textsuperscript{212}

\begin{footnotesize}
\begin{enumerate}
\item[208.] See Brelsford Interview, supra note 20 (stating that while conducting research, he discovered illegal hunting, which he could not report to law enforcement agencies).
\item[209.] See Charnley et al., supra note 9, at 33 (describing a research project in which harvesters of non-timber resources in the Pacific Northwest were compensated for participating in research at a rate slightly higher than that which they made from commercial sales of their harvest); see also Shaw Interview, supra note 142 (describing how EPA contractor Steve Braund offers informants an honorarium for their time); Williams Interview, supra note 43 (stating that BOEMRE pays informants for their time, usually with elevated rates for elders and other regional experts).
\item[210.] See Brelsford Interview, supra note 20.
\item[211.] See \textit{id}. (stating that compensation is relatively easy when private sector entities are footing the bill for the knowledge collection, but harder when public agencies are involved).
\item[212.] \textit{Id}.
\end{enumerate}
\end{footnotesize}
INTEGRATING COMMUNITY KNOWLEDGE

Not all communities have concerns about intellectual property rights associated with community knowledge. But since the issue can be contentious, an agreement on the ownership of data, payment of project participants, and participant anonymity or credit should be reached prior to conducting research.

E. Integrating Community Knowledge and Western Science

Many sources suggest that community knowledge and scientific knowledge, when combined, can achieve what neither could do on its own. Combining disparate sets of knowledge is a challenge, but it is one that agencies have always faced (whether the knowledge comes from mechanical engineers and hydrologists or communities). There is a need for all types of knowledge to be on reasonably equitable footing, even if they are not easily reconcilable.

An agency should not simply disregard community knowledge when it seems to be in conflict with scientific findings. Rather, the agency should search for the root of a conflict, considering whether it results from different viewpoints or missing information, and gather more information if possible. Further discussion or scientific research may prove community knowledge correct or at least explain the basis for the knowledge.

213. See Miraglia, supra note 182, at 11–12 (indicating that different communities may want different agreements regarding ownership of data and acknowledgement of individual respondents).

214. See id. at 11 (describing a protocol for using community knowledge in Exxon Valdez oil spill restoration projects which recommends that details of the research (such as ownership of data, participant consent, payment of project participants, and participant anonymity or credit) be negotiated with each community prior to conducting research).

215. See, e.g., Ram Chhetri, Culturally Embedded Knowledge in Irrigation: People’s Ways of Thriving in a Himalayan Village, in KNOWLEDGE SYSTEMS, supra note 40, at 135, 153 (concluding that the case study suggests that local and scientific knowledge combined can do more than either can alone); see also Maragia, supra note 38, at 247 (“[I]ndigenous knowledge could contribute to sustainable development if it is both de-essentialized and combined with Western science and technology.”); Moller et al., supra note 21, at 8–10 (discussing how to use scientific and traditional knowledge together to better monitor populations).

216. See Rockwell Interview, supra note 104.

217. See id.

218. See Hepa Interview, supra note 48.

219. See Rockwell Interview, supra note 104 (suggesting that when community knowledge conflicts with Western science, it must be considered whether the difference results from different viewpoints or missing information).

220. See Hepa Interview, supra note 48 (stating that an example is the 2010 scientific research confirming that bowhead whales can smell (something the Inupiat people have been saying for many years)); see also Smith Interview, supra note 57 (giving an example where community knowledge initially did not appear to make sense, but later was clear: a hunter explained that because of climate change, when he shoots a seal it sinks five feet into the
In some cases, an agency may not be able to integrate community knowledge and Western science at all because the agency lacks the connecting science or resources. The community’s concern should still be noted and respected, even if it cannot be resolved.

F. Knowledge and Spirituality beyond the Realms of Western Science

As discussed above, there are many aspects of community knowledge that do not “fit the grid” of Western science-based decision-making. Sometimes, this results from an overemphasis on specific, rigid models that only account for certain types of information. But even when models are not involved, capturing the holistic and sometimes intangible nature of community knowledge can be challenging.

Anthropologists with experience collecting community knowledge suggest that the knowledge should be recorded in its entirety and in its own configuration. The spirituality and traditional stewardship practices suggest that the knowledge should be recorded in its entirety and in its own configuration.
that are often interlaced with community knowledge should be recorded not only for their cultural value, but also for their pragmatic implications.\textsuperscript{227} Communities are more likely to adhere to decisions and laws that affect their environment if these decisions and laws are consistent with community values.\textsuperscript{228} This is true not only with indigenous communities, but also in Western culture.\textsuperscript{229} Some of the most heralded Western scientists are those who have forged an emotional connection between science, the environment, and the well-being of our society.\textsuperscript{230}

\textsuperscript{226} Many communities have clearly articulable conservation values that form the basis for stewardship practices. See T. E. Goncharova [T.E. Goncharova], Традиционные Знания Народов, Проживающих на Территории Республики Коми, в Области Природопользования [Traditional Knowledge of People Living in the Komi Republic Regarding Natural Resource Use], in \textit{ALTAE-SAYAN TRADITIONAL KNOWLEDGE, supra} note 10, at 30 (describing stories and legends of Komi hunting, fishing, and gathering containing knowledge relating to the concept of biodiversity conservation); \textit{see also} Belgibaeu, \textit{supra} note 54, at 14 (describing traditional conservation practices of the people in the Altai-Sayan region of Russia, including a prohibition on shooting young female animals and birds, particularly those with offspring, and a prohibition on shooting certain species of birds); Brelsford, \textit{supra} note 50, at 384 (describing a study in which a tribal elder described selective fish harvest practices ensuring that pregnant females were freed from the weir to continue upstream to spawn; study discussing the Tlingit practice of placing fallen logs and sculpting pools to provide a “welcoming” habitat for salmon returning to spawn); LaDuke, \textit{supra} note 48, at 129–30 (describing the game management of Timiskaming tribe of the Great Lakes Region: the tribe kept track of game populations to regulate harvest levels, avoiding depletion of the stock, and the killing of game was regulated by each family); Segall, \textit{supra} note 45, at 1545 (discussing the role of social convention in natural resource management); \textit{see also} Joseph Elizeri Mbaiwa, \textit{Tourism, Development, Rural Livelihoods, and Conservation in the Okavango Delta, Botswana, at} 140–41 (Aug. 2008) (Ph.D. dissertation, Texas A&M University), available at http://repository.tamu.edu/bitstream/handle/1969.1/ETD-TAMU-3064/MBAIWA-DISSERATION.pdf?sequence=1 (citing examples of pre-colonial social conventions in Botswana observed by community members: breeding animals were not hunted, hunting expeditions were controlled by the chief on behalf of his community, hunting targeted old male animals, and, after a hunt, the community shared meat until the meat was finished); Chase Interview, \textit{supra} note 11 (stating that Eskimos have timeframes for hunting and gathering bird eggs; gatherers leave some eggs behind in the nest); Hepa Interview, \textit{supra} note 48 (describing how for thousands of years, Arctic people have had rules for each type of animal hunted, based on the traditional values of respect for nature, sharing, spirituality, and cooperation; these rules ensure good hunting); Rexford Interview, \textit{supra} note 68 (detailing how the Inupiat do not hunt caribou or seal in their breeding seasons).

\textsuperscript{227} \textit{See} Brelsford Interview, \textit{supra} note 20 (noting that there is a pragmatic value in stewardship traditions, even if they are framed in religious terms).

\textsuperscript{228} \textit{See} Brelsford, \textit{supra} note 50, at 385 (“[T]he Ahtna and Tlingit studies promote the possibility of new hybrid models for conservation and management, building jointly on these rich and long-standing traditions and values alongside western science and management.”).

\textsuperscript{229} \textit{See} Bennett Interview, \textit{supra} note 18 (suggesting that we may have no reason to care about science if there is no emotional connection to link the science to ourselves).

\textsuperscript{230} \textit{See} id. (describing the work of Rachel Carson, Aldo Leopold, and Carl Sagan—scientists who made science relevant to the public through their moving works of literature).
It is clear that agencies must base their decisions on knowledge that is subject to demonstration or proof, as opposed to unsubstantiated belief or emotion.\textsuperscript{231} But this does not prevent agencies from treating the spiritual aspects of community knowledge with respect.\textsuperscript{232} Respect entails maintaining a record of all the knowledge a community shares and informing the community whether and how this knowledge is incorporated into a decision.\textsuperscript{233}

\textbf{VIII. Summary and Conclusion}

Although it is not specifically addressed in U.S. law, there is a role for community knowledge in government agency decisions regarding the environment and natural resources. Not only does this knowledge supplement gaps in Western science, it helps build trust in an agency and may increase compliance with the agency’s decisions.

Agencies in Alaska have been working to increase their use of community knowledge. Still, there are challenges to collecting this knowledge and integrating it with Western science. Community knowledge may not neatly fit into the constructs of Western science and the regulatory system that agencies use, particularly when it has a spiritual component. Also, communities may be reluctant to share their knowledge, and there are areas in which knowledge is limited or has been lost.

Agencies should develop protocols for collecting, recording, processing, and applying community knowledge and for addressing conflicts or disconnections between this knowledge and Western science.

\begin{footnotesize}\begin{enumerate}
\item See Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 590 (1993) ("[T]he word ‘knowledge’ connotes more than subjective belief or unsupported speculation."); Henry v. Milwaukee Cnty., 539 F.3d 573, 588 (7th Cir. 2008) ("A court that permits a state (or for that matter a federal agency) to make decisions influenced by intuitions about what the data ultimately will show must insist that the state (or agency) find out whether those intuitions are sound or simply superstitions." (citing Bechtel v. FCC, 10 F.3d 875 (D.C. Cir.1993))).
\item See Chase Interview, supra note 11 (stating that if a researcher or agency would come to the community with more respect, it would make a difference—people would be more willing to help the researcher or agency); see also Rexford Interview, supra note 68 (declaring that the Inupiat have always had a spiritual link to the land and renewable resources; agencies can recognize this by having a respectful attitude and making comments in a culturally sensitive manner). North Slope residents have felt that FWS has not been sufficiently culturally sensitive or respectful of what the community has to say about their hunting practices and the status of threatened migratory bird species. See Hepa Interview, supra note 48 (questioning why agencies are listing species based on models rather than what local people say); see also Rexford Interview, supra note 68 (noting that FWS did not seem to believe the North Slope community’s knowledge about migratory birds).
\item See Management Challenges and Benefits to Using Traditional Knowledge Interactive Discussion, NSB Traditional Knowledge Workshop, in Anchorage, Alaska (Sep. 6, 2007) (discussing the need to provide feedback to communities as to how their knowledge was used).
\end{enumerate}\end{footnotesize}
INTEGRATING COMMUNITY KNOWLEDGE

The best methods for data collection involve anthropologists as well as community experts. When agencies work in a respectful partnership with community members to evaluate community knowledge, integrate it with Western science where possible, and apply it to decisions, the outcomes are better for all involved.
Appendix, International Agreements, and Declarations

Since the 1992 United Nations Summit in Rio de Janeiro, there has been recognition of the value of community knowledge and the need for greater local and indigenous autonomy. The following table contains a non-exclusive list of international agreements and declarations calling for the use of community knowledge (usually referred to as traditional knowledge) in environmental and natural resource decision-making.

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235. In addition to the conventions listed in the Appendix, see World Bank, Operational Directive 4.20, art. 8, 71 (Sept. 1991), available at http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2003/05/01/000160016_20030501182633/additional/862317580_200306204005416.pdf (“[I]dentifying local preferences through direct consultation, incorporation of indigenous knowledge into project approaches, and appropriate early use of experienced specialists are core activities for any project that affects indigenous peoples and their rights to natural and economic resources.”).
<table>
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<th>Agreement or Declaration and Citation</th>
<th>Excerpt (all emphasis added)</th>
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<tr>
<td>Convention on Biological Diversity, June 4, 1992, 31 I.L.M. 818 art. 8(j).</td>
<td>“Each contracting Party shall, as far as possible and as appropriate . . . respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices.”</td>
<td>U.S. has not signed 236</td>
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<th>Agenda 21, art. 14.26, U.N. Doc A/Conf.151/26 (1992), available at <a href="http://www.un.org/esa/dsd/agenda21/">http://www.un.org/esa/dsd/agenda21/</a></th>
<th>“The objectives of this programme area [Improving farm production and farming systems through diversification of farm and non-farm employment and infrastructure development] are . . . [t]o enhance the self-reliance of farmers in developing and improving rural infrastructure, and to facilitate the transfer of environmentally sound technologies for integrated production and farming systems, including indigenous technologies and the sustainable use of biological and ecological processes, including agroforestry, sustainable wildlife conservation and management, aquaculture, inland fisheries and animal husbandry.”</th>
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<td>Id., at art. 26.3</td>
<td>“In full partnership with indigenous people and their communities, Governments and, where appropriate, intergovernmental organizations should aim at fulfilling the following objectives: (a) Establishment of a process to empower indigenous people and their communities through measures that include: . . . iii. Recognition of their values, traditional knowledge and resource management practices with a view to promoting environmentally sound and sustainable development.”</td>
<td>Non-binding</td>
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<tr>
<td>United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, art. 16 (1992), available at <a href="http://www.unccd.int/convention/text/convention.php">http://www.unccd.int/convention/text/convention.php</a>.</td>
<td>“The Parties agree . . . to integrate and coordinate the collection, analysis and exchange of relevant short term and long term data and information to ensure systematic observation of land degradation in affected areas . . . . To this end, they shall, as appropriate: . . . (g) . . . exchange information on local and traditional knowledge, ensuring adequate protection for it and providing appropriate return from the benefits derived from it, on an equitable basis and on mutually agreed terms, to the local populations concerned.”</td>
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<td>Id. at art. 17</td>
<td>“The Parties undertake . . . to promote technical and scientific cooperation in the fields of combating desertification and mitigating the effects of drought . . . . To this end, they shall support research activities that: . . . (c) protect, integrate, enhance and validate traditional and local knowledge, know-how and practices, ensuring, subject to their respective national legislation and/or policies, that the owners of that knowledge will directly benefit on an equitable basis and on mutually agreed terms from any commercial utilization of it or from any technological development derived from that knowledge.”</td>
<td>Non-binding</td>
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