

*Perspective***Values-Based Measures of Impacts to Indigenous Health****Robin Gregory,^{1,*} Doug Easterling,² Nicole Kaechele,³ and William Trousdale⁴**

Values-based indicators of risks to Indigenous health have the potential to improve the accuracy and quality of a wide range of decisions affecting Native lands and cultures. Current health impact assessment approaches often omit important health priorities rooted in the history, social structures, and cultural context of Indigenous communities. Insights and methods from the decision sciences can be used to develop more culturally appropriate and context-relevant health indicators that can articulate and track changes to important dimensions of Indigenous health. Identifying and addressing priority cultural, social, economic, and environmental contributors to the health of Indigenous communities will help to generate better project alternatives and foster more responsive choices.

KEY WORDS: Culture; health; impact assessment; indicators; Indigenous

1. INTRODUCTION

Decisionmakers are belatedly realizing that conventional health impact assessments fail to capture many of the key elements of health important to Indigenous populations.⁵ Residents of Native communities are concerned that inadequate health assessments have permitted resource development projects responsible for the loss of essential ceremonies and knowledge, community disruption, unwanted changes in residents' self-identity, and the destruction of long-standing social relationships. In response, researchers are actively exploring the relevance of new approaches for evaluating the impacts of proposed actions, such as pipeline and mining projects or cleanups of contaminated soils on Tribal lands, on the well-being of Indigenous communities.⁽¹⁾

¹Decision Research, Eugene, OR, USA.

²Department of Social Sciences and Health Policy, Wake Forest School of Medicine, Winston-Salem, NC, USA.

³Nicole Kaechele Consulting, Hagensborg, BC, Canada.

⁴EcoPlan International, Vancouver, BC, Canada.

*Address correspondence to Robin Gregory, 1201 Oak Street, Suite 200, Eugene, OR 97401, USA; tel: (541) 485-2400; robin.gregory.ires.ubc.ca.

⁵We use the terms "Indigenous" and "Native" interchangeably to refer to members of North American nations, tribes, or bands.

We are supportive of these concerns and research initiatives. We also seek to ensure—as non-native researchers experienced in working with Tribal, First Nation, and Metis communities—that health impact assessment methods are defensible from two perspectives: the Indigenous governments and communities they are intended to serve and the federal governments who assert legal or regulatory controls over the approval or denial of actions on Native lands. In our opinion, many well-intentioned current efforts fail from both perspectives and, in some cases, contribute to new problems and impediments with respect to providing an appropriate basis for the conduct of health impact assessments in Indigenous communities.

This article provides a perspective on existing research and practice. We recommend the adoption of principles from the decision sciences to create a structured, values-focused approach to the identification of Indigenous health indicators that will be applicable to communities as well as individuals.

2. LIMITATIONS OF CURRENT INDIGENOUS HEALTH IMPACT ASSESSMENTS

Assessments of health risks to Indigenous communities generally suffer from an overly narrow

conceptualization of “health”—one that emphasizes physiological and disease-based measures.^(2–4) Many institutions dealing with public health endorse the view that health should be thought of as a much broader concept. Nearly 70 years ago, for example, the World Health Organization defined health in its Constitution as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.”⁽⁵⁾ Many other well-established institutions have put forth various definitions of health that include not only physical aspects but also social, cultural, and spiritual dimensions.^(6,7)

Health risk assessments (HRAs) typically are conducted when communities seek to define a baseline level of health or when specific health outcomes (e.g., cancer and noncancer endpoints) are assessed in relation to either past impacts or predicted future effects.⁽⁸⁾ Assessment contexts vary widely: from the cleanup of contaminated soils or waters to impacts resulting from a proposed bitumen pipeline or a new development project. HRAs historically have focused on the effects of increased exposures (e.g., to particulate emissions or a known carcinogen) on the physiological health of representative individuals within the impacted populations. For example, the U.S. Environmental Protection Agency (USEPA) states that “health outcome-oriented indicators—those representing risk management-exposure-dose effects—can provide the most direct evidence that the Agency’s actions have had an effect in protecting human health.”⁽⁹⁾

This approach has several important shortcomings when it comes to assessing risks to the health of Indigenous communities. Nearly a decade ago, the USEPA Tribal Science Council, composed of tribal representatives from each of the USEPA regions, declared the inadequacies of human health assessments to be their highest priority.⁽¹⁰⁾ One highlighted shortcoming was the inadequate definition of the risk exposure portion of health assessments. This insight was based in part on work by Harris and Harper,⁽¹¹⁾ who sought to introduce methods into HRAs that would account for differences in the physiological exposure pathways common to many Indigenous peoples who engage in traditional practices such as the harvest and consumption of wild foods.⁽¹²⁾

Community health assessments (CHAs), undertaken by public health specialists for several decades, also have helped to provide a more broadly based definition of health^(8,13) and often include information about the importance of social interactions among individuals within the community. Yet CHAs

rarely provide health information in a form that is appropriate for the identification of impacts, for proposing mitigation to reduce the predicted impacts of actions, or for estimating compensation as a result of past damages. For these tasks, what is needed is not a comprehensive listing of health qualities and status but, instead, a concise summary of the most significant predicted impacts on components of health and a means for tracking changes in them over time. In addition, CHAs often rely on the same physical health measures used in mainstream communities, thus failing to capture the full range of health-related values relevant to members of Indigenous communities.

As one example, a critical component of health for many Indigenous populations is the interconnectedness between community members and the natural environment. Many Native communities view people-nature interactions as the basis for significant cross-generational contact and teaching; food gathering, in particular, is often a family affair, with several generations working together digging clams (along the Pacific coast) or harvesting wild rice (in the U.S. Midwest) or collecting pine nuts (in the Southwest). Yet impacts to traditional practices often are overlooked or minimized in assessments of health risks; although there exists a rich literature dealing with the incorporation of Indigenous community values into land use, adaptation, and restoration decisions,⁽¹⁴⁾ the protection of ecological services is rarely tied directly to measures of community health. As a result, projects that might initially appear to have only minimal impacts to the environment can impose significant losses to cultural continuity and social fabric, particularly when an initiative affects the availability of resources used in ceremonies or adversely impacts sacred sites. In such cases, even “minor” changes to quality can render plants or animals unfit for ceremonies. This adversely affects members of the community and results over time in a loss of knowledge and associated skills.^(15,16)

Several recent initiatives make use of a health impact assessment (HIA) model that seeks to incorporate cultural, social, and distributional concerns as part of an expanded and more responsive health assessment framework.^(17,18) Recent work in Australia, for example, emphasizes the need to recognize cultural diversity and to include a better understanding of the associated impacts.⁽¹⁹⁾ HIAs used to evaluate the health implications of initiatives such as Superfund cleanup sites on Tribal lands typically include some measures of sociodemographics (e.g., poverty,

unemployment) and mental health, including health-related risks to lower-income users of local resources (e.g., subsistence fishers).⁽²⁰⁾

Yet although there are exceptions (as noted in the next section), HIAs typically retain an expert-driven, physiological, and disease emphasis and fail to capture many of the more nuanced cultural or social indicators of Native health. From a methods perspective, most HIAs also prescribe only general frameworks that don't include explicit evaluation techniques that could help Indigenous communities effectively articulate or prioritize their health-related values. For example, Health Canada's HIA guidelines emphasize the importance of "aboriginal health and traditional knowledge" as part of a separate chapter⁽¹⁾ but fail to provide examples of methods that would allow more holistic health assessments to be completed in ways that both community members and government regulators would recognize as legitimate.

These limitations of HRAs, CHAs, and HIAs can be attributed to a number of factors. New, more broadly focused assessment frameworks might be considered unfamiliar or too complicated by health assessors. Regulatory agencies might not yet be prepared to acknowledge or incorporate additional criteria or new methods into their assessments. There also remains controversy about how best to measure nonphysiological aspects of health; although numerous suggestions have been made, standards of practice for identifying and evaluating the nature and magnitude of impacts to social, environmental, and cultural aspects of health have yet to be disseminated.⁽²¹⁾ The fundamental issue, however, is the desire on the part of many government and regulatory agencies to maintain a "one-size-fits-all" process for assessing health impacts, which forces Indigenous communities—along with other marginalized populations—to adopt a partial (and thus misleading) assessment of health impacts that reflects an understanding of physical, cultural, and social relationships at odds with their own experience.

Not surprisingly, calls continue for the creation of alternatives to current health impact assessment frameworks. Physical aspects of health are arguably the most straightforward to measure (e.g., life expectancy, increases or decreases in the incidence of various diseases, and rates of health-related events). Social well-being, continuity of cultural practices, connectedness to the land, and other factors that figure into Indigenous conceptualizations of health

are much harder to link to concrete and reliable measures. The challenge is to define a concise and easily understood set of health indicators that can summarize the social, spiritual, and cultural health impacts of actions and help to generate new alternatives that will avoid, or at least reduce, adverse impacts on Indigenous health.

3. CONSTRUCTING INDICATORS OF IMPACTS TO INDIGENOUS HEALTH

Any helpful set of health indicators will, by design, fall short of a comprehensive depiction. In ecology, for example, there is a growing recognition of the need for "standardized environmental accounting units" to identify valued ecosystem services.⁽²²⁾ In medicine, many hospitals now recognize the benefits of simple checklists that provide a quick summary of the main things to get right when undertaking surgical or other procedures.⁽²³⁾ Indicators are simplistic by design; they seek to identify the more important concerns associated with an action and to aid decisions by ensuring that significant impacts are highlighted and measured in a manner that can reveal changes over time.

Drawing on earlier work in the decision sciences, indicators of impacts to Indigenous health should meet four primary criteria:⁽²⁴⁾ be sufficiently comprehensive to identify the different components or objectives of concern; distinguish among the different types and levels of health impacts; bound the range of anticipated health impacts, in light of project alternatives and uncertainties; and highlight those health concerns most important to the Indigenous community, in light of the specific decision context at hand. A variety of techniques can be used to identify an appropriate set of health indicators, including values hierarchies (organizing more specific value expressions under general headings), influence diagrams (graphical representations of relationships among key factors), and brainstorming among community members (e.g., asking: What information would you like to have to monitor changes over time?).⁶ When suitable natural metrics don't exist, constructed scales are often useful and can jump-start a more comprehensive dialogue among community members about health concerns that are likely to be impacted by an action. One

⁶In some cases it will be helpful to identify multiple measures of the same concern in order to capture the differing perspectives of community residents concerning the health impact in question.

example comes from an Aboriginal community where members' health was adversely affected by changes to a river due to construction of a hydroelectric dam.⁽²⁵⁾ Protection of traditional values—composed of fishing, hunting/trapping, and gathering—was one of six fundamental objectives noted by participants. As part of estimating compensation payments to the Native settlement, five-point constructed scales were developed and impacts were compared for the “without reservoir” and “with reservoir” cases. The quantitative analysis of impacts was supported by the presentation of comments from Elders and community members. For example, one Elder commented about reductions in fishing opportunities by saying: “This river feeds a lot of people. It used to be white fish would come in... now they look like snakes.”

In other cases proxy measures may be required to include important social or cultural considerations. For example, consider a Native community whose lands are to be crossed by a proposed railway carrying coal to a new marine port. The community is worried about health effects and cultural losses related to reduced use of a sacred site due to increased noise and emissions, but is understandably hesitant to reveal the site's location. One proxy indicator, useful for comparing different siting alternatives, could be the distance of the rail line from the site; Level 1 (negligible) effects would be associated with developments more than 1 km from any sacred site whereas Level 4 (high) impacts would be associated with distances of less than 100 m. Although proxy measures speak only indirectly to the nature of the health effects, they may effectively succeed in protecting those cultural practices most at risk without (as in this example) divulging information that the Indigenous community prefers to keep confidential.

4. MEETING THE CHALLENGE OF ASSESSING INDIGENOUS HEALTH IMPACTS

Carrying out assessments of Native health impact is challenging for several reasons. A first challenge is to address issues of trust and ensure that study methods are developed in concert with community representatives and agreed to by the Indigenous Governing Council. In many cases this means having a legal *materials and data sharing and ownership agreement* in place.⁽²⁶⁾ Close partnerships with local health and planning staff will aid in the development of data-sharing and confidentiality agreements.⁽²⁷⁾

Trust issues also influence the willingness of community members to participate and their openness in sharing knowledge relevant to community health.⁽²⁸⁾ In this respect, it is important to be clear about the analyst's role as a person with knowledge of methods in contrast to the knowledge of health-related values that comes from community members.

A second challenge is to ensure that measures of health impact have the potential to result in real improvements to the current and future health of community members. This means that the impact measures should be understood by, and be acceptable to, the Indigenous community and the courts or government regulators in ways that can influence both community health decisions and formal risk or impact assessments. This requirement can result in a tension between oral or qualitative measures of Native health and more formal written or quantitative data. As noted earlier, constructed indicators are often helpful in bridging this gap; for example, work with the St'at'imc Nation of southwestern British Columbia addressed the fundamental community health and well-being concern of “stewardship” for a managed river by connecting a five-point “stewardship scale” with visual images and narrative testimony from community members.⁽²⁹⁾

A third challenge involves introducing decision science techniques for identifying health priorities. Too often, analysts consider their job complete once a list of health indicators is in hand. Yet judgments of relative indicator importance, based on the anticipated range of impacts, are always (implicitly or explicitly) part of the decision structure. In our experience, the usefulness of indicators in aiding community health decision making is greatly enhanced when assessments of relative importance can be made. However, finding ways to elicit importance rankings, for example using swing-weighting techniques or paired comparisons, can be challenging: Indigenous communities will want to ensure that the added quantification clarifies rather than obscures their input, whereas governments and industry will need to be responsive to the more qualitative aspects of health measures (e.g., Elders' narratives).

Several promising initiatives meet these challenges and seek to implement a community- and values-based approach to the construction of Indigenous health impact indicators. The three examples discussed here come from different countries (Canada, New Zealand, and the United States) but share a commitment to facilitate meaningful participation and input from the local Indigenous

community into health assessment processes and to influence related resource management decisions.

A first example comes from a Native community in Canada prohibited for part of one season from using its traditional fishing grounds; it is now seeking damages from government regulators. Using a values-based, multi-method approach, the emphasis of this ongoing study is to understand health impacts on the community due to the absence of salmon catches (in addition to any direct economic losses related to declines in fishing incomes or the need to purchase substitute foods). Information collected from individual interviews and community workshops led to the identification of nine main categories of health-related losses (see Table I); these include cultural (e.g., ceremonial quality, cultural traditions), social (e.g., community togetherness), and emotional concerns in addition to changes in physical health. Several community members talked about the health effects of stress and worry along with reduced quality of life due to feelings of depression and embarrassment (e.g., lacking traditional foods to give to visitors).⁽³⁰⁾ Other individuals emphasized the links to social identity, that not being able to fish meant the loss of a “way of life.”

Each health category was further described using a performance measure along with a constructed scale (showing endpoints of the range of possible effects) and visual aids. The specific health impacts of the fishing season in question were characterized by comparing two scenarios, the actual fishing season when access was limited and the most likely case for the same year if normal fishing had been allowed. Individuals were asked to weight the relative importance of the nine health categories in light of the range of health effects estimated to have taken place. This was done with input from the Governing Council using two well-established methods: swing weighting and scaled pair-wise comparisons.⁽³¹⁾ Results highlighted the declines in individual, family, and community health associated with the loss of fishing opportunities.

In New Zealand, a “participatory and consultative” health impact assessment led by the Ministry of Health⁽³²⁾ sought to combine the insights of Maori community members with those of outside health experts trained in HIA methods. The resulting “Whanau Ora” health assessment provides a values- and community-focused methodology intended to help policymakers predict a broad range of potential health impacts associated with proposed actions.

Four aspects of health were highlighted, using “measureable indicators” to identify and contrast health impacts: physical, mental, family and community, and spiritual. Key social and cultural factors included family connections, cultural participation, links to cultural resources, social cohesion, and the expression of cultural values and practices.

Unlike many HIAs, which only provide lists of health determinants, the Whanau Ora assessment approach explicitly seeks to identify which criteria are either of most concern to stakeholders or affect the largest number of people. In line with related research,⁽³³⁾ guidance is provided by estimating the likelihood and severity of the health impact along with its distribution across the Maori population, the anticipated time scale of effects, and the extent to which practical mitigation actions can be undertaken to reduce or avoid adverse health impacts.

A third example comes from the Swinomish Indian Tribal Community in the northwestern United States. The Swinomish, like other Coast Salish Tribes, are fishing, hunting, and gathering peoples, although in recent decades both the quantity and quality of local resources have diminished due to shoreline development, climate change, and contamination.⁽³⁾ Several of the authors have worked closely with Tribal members, conducting over 100 interviews and several workshops to gather information on priority community health considerations related to risks from oil spills and sea level rise.

Six main indicators of Indigenous health have been identified (see Table II): community connection, natural resource security, cultural use, education, self-determination, and balance. Performance measures were developed to help communicate and monitor changes over time in terms of three components identified for each health indicator. For example, the indicator “natural resources security” is defined in terms of quality, access, and safety. One tribal participant stated that when the resources “are sick, we feel that sickness and it affects us too. We have a reciprocal relationship with them.”⁽³⁴⁾ Through a series of workshops, community members refined these health indicators, provided input to form a baseline health and well-being snapshot of the current community, ranked the relative importance of the different health indicator components, and identified which indicators were considered most important to the protection of community health in light of specific threats.

Table I. Indicators of Native Health Losses, Southwestern British Columbia

Value	Description	Measure/ Scale
Physical health	Eating salmon, physical activity of harvesting and processing fish	Poor—great
Ceremonial quality	Availability of fish for village ceremonies and funerals and feasts	Lacking—fulfilling
Psychological health	Absence of frustration and anger	Angry—satisfied
Emotional health	Absence of embarrassment, shame	Embarrassed—proud
Fairness / equity	Being treated differently by government regulators	Treated unfairly—fairly
Trust	Confidence in government decision making and management	Uncertain—confident
Economic cost	Cost of replacement foods	Dollars (\$)
Cultural and traditional opportunities	Lost opportunities to teach, learn, share, or process foods	Few—many opportunities
Social and community togetherness	Prospering as a group, looking after each other	Isolation—working together

Source: Personal communication, EcoPlan International.

Table II. Coast Salish Indicators of Indigenous Health

Community connection: Members actively participate in community functions and help each other, particularly in connection with the harvest, preparation, storage, and sharing of natural resources (work, sharing, family)
Natural resources security: Local natural resources (air, water, land, plants, and animals) are abundant, accessible, and support a healthy ecosystem(s) and healthy human community (quality, access, safety)
Cultural use: The community is able to perform its cultural traditions in a respectful and fulfilling way using the local natural resources (respect/stewardship, practice)
Education: Knowledge, values, and beliefs are actively passed from elders to youth (knowledge, elders, youth)
Self-determination: Communities develop and enact their own healing, development, and restoration programs; the community trusts and supports its government (healing/restoration, development, trust)
Balance: Community members maintain connections to meaningful locations, confident that their health and the health of the next seven generations can voluntarily adapt to changes, temporary or permanent, and strongly connect with who they are in positive ways (sense of place, identity, resilience)

Note: All indicators are shown using constructed scales, e.g., poor to excellent.

Source: <http://www.swinomish-nsn.gov/ih/>

5. DISCUSSION

It is widely accepted that Indigenous peoples in the United States and Canada experience a disproportionate burden of ill health as compared to the nonaboriginal population.^(35,36) It is also well documented that Indigenous concepts of health and well-being do not readily translate to a Western paradigm.^(1,10) As a result, standard physical health assessment methods based on disease and dose-response frameworks fail to be responsive to the broader definition of health typically used within Indigenous communities, one that emphasizes family and social networks as central to the definition of health and that includes the many connections to a variety of social, environmental, and cultural considerations.

This article highlights two primary limitations of current impact assessment procedures for Indigenous communities. First, many measures of Indigenous health impacts retain an overly narrow, Western-science focus on the physical health of the individual. A more culturally appropriate assessment of Indigenous health impacts would incorporate a

broad-based definition of health that includes both physiological and nonphysiological measures relevant to individuals, families, and communities. Second, many recommended approaches to evaluating Indigenous health impacts are ambiguous and partial, leading to confusion and frustration on the part of community members as well as project proponents, policy analysts, and government or judicial decisionmakers. A shift to more defensible health indicators—ones that are easily understood, unambiguous, and measurable—would make it far easier for Native communities to evaluate actions in ways that are more likely to promote effective alternatives for reducing or avoiding the associated adverse health impacts.

At the center of this health assessment debate are philosophical and ethical questions concerning fundamental dimensions of health. The development of more accurate health indicators for Native communities will help to broaden and inform a range of human health analyses, whether as part of community baseline assessments, environmental impact assessments, or re-visioning efforts undertaken by

Native and non-Native leaders. To achieve these goals, Indigenous health indicators need to identify and carefully articulate community health priorities that are often considered “intangible” or “invisible” and either omitted from conventional health assessment frameworks or relegated to a second-tier “to be considered later” category. In a recent essay addressing global sustainable development goals, Shepherd and colleagues⁽³⁷⁾ advocate the use of decision analysis concepts and techniques to establish an open-access library of measurable sustainability indicators; this article makes a similar argument in the context of decisions whose consequences are likely to impact the health of Indigenous communities.

In our view, it is past time for adoption of values-focused approaches to health impact assessment that give special attention to the history, social structures, and cultural context of Indigenous communities, while at the same time anticipating the needs of policymakers, government agencies, and project developers. By recognizing, respecting, and evaluating cultural, social, and environmental values as contributors to the health of Indigenous communities, better alternatives can be created and more responsive choices can be made, both within Native communities and society at large.

ACKNOWLEDGMENTS

The work described in this article was funded in part through an award from the U.S. National Library of Medicine, National Institutes of Health (Grant 1R24LM011809-01) to Decision Research. Although the authors warmly thank Jamie Donatuto, Julian Gonzalez, Barbara Harper, Melissa Poe, and Terre Satterfield for many helpful discussions on these topics, the views expressed in the article are those of the authors alone.

REFERENCES

1. Health Canada. Canadian Handbook on Health Impact Assessment. Ottawa, Ontario: Health Canada, 1999.
2. Arquette M, Cole M, Cook K, Lafrance B, Peters M, Ransom J, Sargent E, Smoke V, Stairs A. Holistic risk-based environmental decision making: A native perspective. *Environmental Health Perspectives*, 2002; 11:259–264.
3. Donatuto J, Satterfield T, Gregory R. Poisoning the body to nourish the soul: Prioritising health risks and impacts in a Native American community. *Health, Risk & Society*, 2011; 13:103–127.
4. Wolfley J. Ecological risk assessment and management: Their failure to value indigenous traditional ecological knowledge and protect tribal homelands. *American Indian Culture and Research Journal*, 1998; 22:151–169.
5. WHO. Constitution of the World Health Organization. New York: World Health Organization, 1946. Available at: http://www.who.int/governance/eb/who_constitution_en.pdf.
6. Stiglitz J, Sen A, Fitoussi J-P. Report by the Commission on the Measurement of Economic Performance and Social Progress. Paris: Commission on the Measurement of Economic Performance and Social Progress, 2009. Available at: www.stiglitz-sen-fitoussi.fr/documents/rapport.anglais.pdf.
7. WeD-QoL Toolbox. Bath, UK: Wellbeing in Developing Countries Research Group, 2013. Available at: <http://www.welldev.org.uk/research/methods-toolbox/toolbox-intro.htm>.
8. Bond A. Lessons from EIA. Pp. 131–142 in Kemm J, Parry J, Palmer S (eds). *Health Impact Assessment*. Oxford, UK: Oxford University Press, 2004.
9. Peterson D. Framework for Assessing the Public Health Impacts of Risk Management Decisions. Washington, DC: U.S. Environmental Protection Agency Office of Research and Development, February 15, 2008.
10. Paper on Tribal Issues Related to Tribal Traditional Lifeways, Risk Assessment, and Health & Well-Being: Documenting What We’ve Heard. Washington, DC: National EPA Tribal Science Council, April 2006.
11. Harris S, Harper B. A Native American exposure scenario. *Risk Analysis*, 1997; 17(6):789–795.
12. Turner N. *Earth’s Blanket: Traditional Teachings for Sustainable Living*. Seattle, WA: University of Washington Press, 2005.
13. Minkler M. *Community Organizing and Community Building for Health*. New Brunswick, NJ: Rutgers University Press, 1997.
14. Berkes F. *Sacred Ecology: Traditional Ecological Knowledge and Resource Management*. Philadelphia, PA: Taylor and Francis, 1999.
15. Turner NJ, Gregory R, Brooks C, Failing L, Satterfield T. From invisibility to transparency: Identifying the implications. *Ecology and Society*, 2008; 13. Available at: <http://www.ecologyandsociety.org/vol13/iss2/art7/>.
16. Manseau M, Parlee B, Ayles GB. A place for traditional ecological knowledge in resource management. Pp. 141–164 in Berkes F, Huebert R, Fast H, Manseau M, Diduck A (eds). *Breaking Ice: Renewable Resource and Ocean Management in the Canadian North*. Calgary, Alberta: University of Calgary Press, 2005.
17. Fehr R. Environmental health impact assessment: Evaluation of a ten-step model. *Epidemiology*, 1999; 1:618–625.
18. Bhatia R. *Health Impact Assessment: A Guide for Practice*. Oakland, CA: Human Impact Partners, 2011.
19. Harris P, Spickett J. Health impact assessment in Australia: A review and directions for progress. *Environmental Impact Assessment Review*, 2011; 31:425–432.
20. Daniell W, Gould L, Cummings BJ, Childers J, Lenhard A. *Health Impact Assessment: Proposed Cleanup Plan for the Lower Duwamish Waterway Superfund Site [final report]*. Seattle, WA: University of Washington, Just Health Action and Duwamish River Cleanup Coalition/Technical Advisory Group, September 2013. Available at: http://deohs.washington.edu/sites/default/files/research/HIA_final_report_10-15-13_low_res.pdf.
21. Satterfield T, Gregory R, Klain S, Roberts M, Chan K. Culture, intangibles and metrics in environmental management. *Journal of Environmental Management*, 2013; 117:103–114.
22. Boyd J, Banzhaf S. What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics*, 2007; 63:616–626.
23. Gawande A. *The Checklist Manifesto: How to Get Things Right*. New York: Metropolitan Books, 2009.
24. Keeney RL, Gregory R. Selecting attributes to measure the achievement of objectives. *Operations Research*, 2005; 53: 1–11.

25. Gregory R, Trousdale W. Compensating aboriginal cultural losses: An alternative approach to assessing environmental damages. *Journal of Environmental Management*, 2009; 90:2469–2479.
26. Harding AK, Harper B, Stone D, O'Neill C, Berger P, Harris S, Donatuto J. Conducting research with tribal communities: Sovereignty, ethics, and data-sharing issues. *Environment Health Perspectives*, 2012; 120:6–10.
27. Williams T, Hardison P. Culture, law, risk and governance: Contexts of traditional knowledge in climate change adaptation. *Climatic Change*, 2013; 120:531–544.
28. Failing L, Gregory R, Harstone M. Integrating science and local knowledge in environmental science and local knowledge in environmental risk management: A decision-focused approach. *Ecological Economics*, 2007; 64:47–60.
29. Gregory R, Failing L, Harstone M, Long G, McDaniels T, Ohlson D. *Structured Decision Making: A Practical Guide to Environmental Management Choices*. Chichester, West Sussex, UK: Wiley-Blackwell, 2012.
30. Personal communication with: Native community members. Vancouver, Canada: EcoPlan International, 2014.
31. von Winterfeldt D, Edwards W. *Decision Analysis and Behavioral Research*. New York: Cambridge University Press, 1986.
32. Whānau Ora Health Impact Assessment. Wellington, New Zealand: New Zealand Ministry of Health, 2007.
33. Tipa G, Nelson K. Introducing cultural opportunities: A framework for incorporating cultural perspectives in contemporary resource management. *Journal of Environmental Policy & Planning*, 2008; 10:313–337.
34. Personal communication with: Swinomish elder, 2014.
35. Adelson N. The embodiment of inequity: Health disparities in aboriginal Canada. *Canadian Journal of Public Health*, 2005; 96:S45–S61.
36. Quick look. U.S. Department of Health and Human Services, Indian Health Service, 2014. Available at: <http://www.ihs.gov/newsroom/factsheets/quicklook/>.
37. Shepherd K, Hubbard D, Fenton N, Claxton K, Luedeling E, deLeeuw J. Development goals should enable decision-making. *Nature*, 2015; 523:152–154.