

# At the Edges of Science: Dissolving Dichotomies and Transforming Power

Lisa M. Cockburn

## Abstract

*Climate change has become an important and politically-charged arena where Western scientific knowledge meets traditional indigenous knowledges. How we react and adapt to the threats and challenges of climate change will depend greatly on the philosophical framework(s) through which we understand the world. Too often, the ability of society to hear and learn from other perspectives and worldviews is blocked by science's dominant position of power. When science and traditional knowledge meet, boundaries can be created, reinforced, or overcome. The positioning of Arctic science, at the edges of the scientific discourse but the centre of the climate change debate, makes it a possible, and politically crucial, location for questioning the foundations and assumptions of science. Based on a discourse analysis of texts and interviews about attempts to bridge scientific and traditional knowledge of climate change in the North, I discuss how the science discourse, coherent and powerful at its centre, views traditional knowledge either as a source of information or as a distinct and very different worldview. At its edges, however, it blurs with both traditional and personal ways of knowing. With more humility and less ideology, science can engage more equitably with alternative ways of understanding and more productively with climate change.*

## Introduction

Following much public debate and amidst ongoing political turmoil, it is now widely accepted that climate change is occurring as a result of the anthropogenic elevation of greenhouse gas levels in the atmosphere (IPCC 2007), and the Arctic region is at the frontlines of experiencing the effects of climate warming (ACIA 2005). For this reason, it has attracted increasing international attention from scientists wishing to better understand the effects of this phenomenon. With global causes and local impacts, climate change is a serious factor affecting the human security of the people of the Arctic (O'Brien 2006), including indigenous peoples who are experiencing climate change mediated through the perspective of traditional worldviews (Krupnik and Jolly 2002). Traditional or indigenous knowledge<sup>1</sup> is increasingly being used in various combinations with conventional science to understand environmental change in the Arctic, and as a possible source of adaptation mechanisms (Bielawski 2005, 955). Thus, the

---

<sup>1</sup> I use the term traditional knowledge (TK), which is the term I found most commonly used in the context of climate change in the Arctic, to refer to both the worldview and philosophical framework (ontology and epistemology) of indigenous peoples as well as the actual pieces of information generated.

Arctic has emerged as a politically charged arena where Western science meets indigenous worldviews.

This paper is based on research conducted in 2007, in which I critically examined attempts at mediating indigenous and scientific understandings of climate change in the Arctic<sup>2</sup>; *how* these worldviews meet, under what circumstances, is a critical factor in determining the future path of how society understands and encounters climate change. Despite the potentials of creating hybrid ways of knowing that cross boundaries such as scale, discipline and worldview, an ongoing history of colonization of indigenous land, knowledge and culture, and the dominant position of the scientific epistemology often result in the dichotomy between science and traditional knowledge (TK) being reinforced rather than bridged. What gets counted or not as knowledge, and who decides, are key locations of power. For example, whose epistemology is used will affect what is found in the natural world as well as how it is described and understood. Although there is much debate and discussion about the most appropriate terminology, ‘traditional’, ‘indigenous’ or ‘local’ (Berkes and Folke 1998; Bielawski 2005; Nuttall 1998; Pálsson 1998), on the term ‘knowledge’ there is an eerie silence, even though its meaning is far from undisputed. When speaking of knowledge, are we speaking of information and specific practices, or are we speaking of ways of knowing, epistemologies, associated ways of living, worldviews? Existing power dynamics are reinforced by ignoring that knowledge itself is constructed through power relations: “power creates knowledge” as well as the reverse (Agrawal 1995, 430). Seemingly well-intentioned goals of preserving indigenous knowledge carry the danger of missing or distorting the essence of traditional knowledge (Agrawal 1995, 428-429). Thus, when science and traditional knowledge meet, the result can be colonization (Nadasdy 1999), integration (Usher 2000), preservation (Agrawal 1995) or recognition of inherent value (Cruikshank 1981). Below I outline the discourses I found emerging around attempts to bridge science and traditional knowledge, and some of the challenges and opportunities of these attempts.

## **The Discourses of Science and Traditional Knowledge**

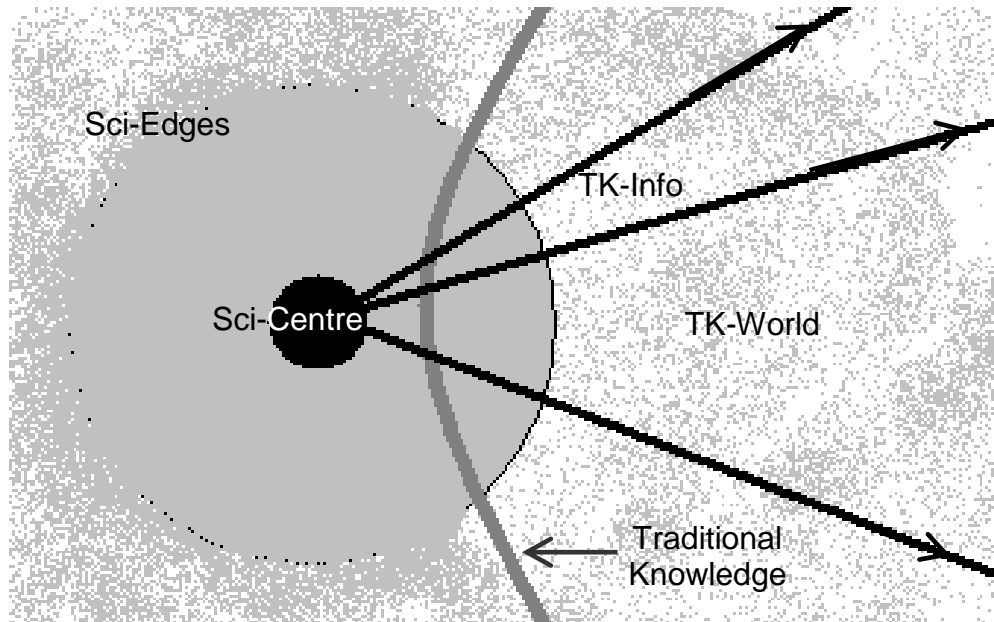
---

<sup>2</sup> This paper is based on my MSc thesis research, in which I conducted a discourse analysis of written publications and qualitative interviews conducted with original researchers working at the intersection of indigenous and scientific knowledge of climate change. Texts (publications and interviews) are listed in Appendix A. For further details on methodology and results, please see Cockburn 2008.

In all the texts I analyzed, science is the discourse the authors are situated in and speaking from. Science is identified as a fundamental part of the Western worldview: we live in a world built by science, and are increasingly reliant on science and technology in our daily lives. Science as experienced in Arctic research, and the biological, physical and social sciences related to climate change, remains firmly within the positivist tradition. The science discourse can be pictured as a spherical continuum, similar to the popular conception of an atom: at its nucleus, definitions are clear-cut and solid, but the further one moves from the centre, the more fuzzy things become (Figure 1). I refer to the science discourse as though it were two discourses, Sci-Centre and Sci-Edges, as at these different ends of the continuum the discourse takes on quite different properties and meanings. Whenever the discourse becomes clearer about what science is, it always converges on the same foundational beliefs and core assumptions (Sci-Centre): valuing objectivity and replicability, using hypothesis testing and measurement (often requiring specialized instruments) to explain causation and improve prediction, and quantifying variability and uncertainty while making generalizations. When science encounters an ‘other’ such as traditional knowledge, the reaction is usually to move toward the safe and identifiable centre of the science discourse, and differences between science and TK are emphasized. This reinforces dichotomies and borders between science, which is “known”<sup>3</sup>, and traditional knowledge, which is “recognized” by its difference from science. For example, science is aimed at “explaining” and “predicting” while traditional knowledge is portrayed as not good at either: instead it “describes” and “observes”. But at Sci-Edges, where boundaries blur, the very distinction between different knowledges – traditional, Western/scientific, and personal/practical – becomes unclear.

---

<sup>3</sup> If not otherwise cited, all single words or short phrases in double quotation marks are taken from the sample of 9 texts I analyzed (Appendix A).



*Figure 1: The Emergence of the Three Discourses.* Science emerges as a coherent discourse easily identified at its centre (Sci-Centre). The lens of the Sci-Centre discourse splits traditional knowledge into two discourses, one in which it is viewed as information and observations (TK-Info) and one in which it is treated as a complete worldview (TK-World). Science is increasingly difficult to distinguish at its edges (Sci-Edges) but the politics of TK can still act to reinforce the dichotomy.

The TK discourse emerges through opposition with science, and is split into two distinct discourses according to how Sci-Centre sees and defines it: one that deals with the information generated by traditional knowledge (TK-Info), and one that attempts to address traditional knowledge as a complete worldview (TK-World) (Figure 1). Huntington (2005) discusses how the very question of what traditional knowledge is, may be more a reflection of the various disciplinary perspectives and interests that researchers bring with them, than anything actually inherent to traditional knowledge itself. Both TK discourses can only exist when contrasted with Sci-Centre; at its edges, all three dissolve into interconnected experiences and interactions that shape individual ways of knowing the world.

TK-Info focuses on the material side of traditional knowledge and the observations it produces, rather than the means by which this knowledge was gathered or created. The Arctic is seen in a global context, a significant “canary in the mine” of climate change. The role of TK is thus to translate theoretical scientific ideas and models into what is materially happening on the local scale, and it is science’s role to scale back up to the global. Traditional knowledge is a

valuable source of information from which useful parts can be isolated and documented, a “valid approach” that is “listed alongside” various scientific methods such as experimentation, simulation, modeling, and remote sensing. Extraction of the parts of TK seen as most compatible with science and most relevant and useful to environmental management has become common in response to demands that TK be incorporated into policies affecting indigenous communities. Despite appeals to stop viewing traditional knowledge as simply another form of data to be integrated into the framework of scientific resource management or climate change research, these trends continue in the TK-Info discourse, and even when researchers aim to treat traditional knowledge as an equally valid source of knowledge, the framework in which the comparisons are made remains that of science. While it may seem politically expedient and beneficial to all to find easier ways of incorporating TK into decision-making processes previously based exclusively on science (Usher 2000), the categories researchers choose still “reflect more about their own societies than those which they propose to study” (Cruikshank 1981, 71).

As traditional knowledge has become a key area of interest in climate change sciences, some see it as providing not only information, but also more holistic perspectives and approaches that incorporate humans and culture into environmental systems (Berkes 1998; Bielawski 1997). TK-World includes a broader conceptualization of what TK is, including reference to its spiritual nature, and emphasis on its subtlety, complexity, and diversity. In the ontology of the TK-World discourse, interactions and relationships are primary, allowing for the legitimate existence and importance of elements that may not be fully known or knowable: even the ethereal can be an actor. Importantly, the phenomenon of climate change itself is not taken for granted as an actor in this discourse: there is more hesitation, and acknowledgement that it is itself a creation emerging from the discourse of science rather than traditional knowledge. When traditional knowledge is discussed as a worldview, including not only the body of knowledge but the ontology and epistemology that yielded it, differences are emphasized. TK and science are seen as having distinctly different, separate ontologies, and translation is cited as necessary before dialogue can occur. TK is seen as bodily, frequent, communal, alert to change, holistic, intuitive, multifaceted, culturally based, and as not separating humans and nature. In the TK-World discourse, there is a greater emphasis on the local spatial scale than in the science-driven TK-Info discourse. Climate research is global, but traditional knowledge is local; knowledge is linked to the land rather than divided into disciplines. Global changes in politics and attitudes regarding development have

important local effects, yet research agendas are set by science and driven by politics at regional and global levels.

How the meetings between traditional knowledge and science are conceptualized is closely related to the framework within which research is conducted. Generally, the more reduced the concept of TK (for example extracted observations treated as discrete pieces of data), the better it is seen to work with (and within) science. Traditional knowledge is described as being replicable, practical and observation-based, just like science. Conversely, as the TK-World discourse demonstrates, efforts to increase the validity and status of traditional knowledge in its own right often result in reinforcing the dichotomy between science and TK. As the perceived value of having access to TK has increased, indigenous people, speaking from the claim that their historical connection to the land has not been lost through the dichotomies of modernity, have asserted what rights they could from the ownership of this knowledge (Agrawal 1995, 420). Although the TK-World discourse emphasizes the blurring of the human/nature dichotomy, and speaks of “ever-shifting and ephemeral” boundaries of ice-edges, ecosystem types and indigenous territories, the TK/science dichotomy is still reinforced. Political implications of who gets the power of having traditional knowledge cause differences to be emphasized, and TK is often described through contrast with science.

### **Boundaries Fraying at the Edges**

Because of the atomic nature of the science discourse and the splitting of the TK discourse based on its encounters with the lens of Sci-Centre, defining and boundary creation are of prime importance. Defining assumes that there is something real with specific fixed properties to define, and is also at its heart political, since “boundaries are interested instances of power, specific constructions, with real material consequences” (van der Tuin 2006, 8). The desire to demarcate separation is closely linked to the reductionism of positivist science; drawing boundaries around something becomes easier the more isolated it is from its surroundings or context. A line on a map representing a boundary may look clean and crisp, but actually stand in that place on the land and it disappears entirely. Thus, the farther and more obviously different traditional knowledge is from science, the easier it is to identify and accept. For example, one participant described the relative ease of defining TK in a remote indigenous community whose traditional culture and practices of subsistence have remained relatively untouched by influence from

Western society. As communication flow increases and indigenous communities become more ‘westernized’, attempts to demarcate what is TK work to reinforce boundaries. Researchers also describe interaction between TK and science as more productive, open, and enjoyable at the personal level, but more difficult at higher levels. One reason may be that at this human-scale, at the edges where scientists meet communities on the frozen tundra, dichotomies and boundaries are less easy to maintain. In the Sci-Edges discourse, it is discussed how Arctic scientists would historically seek out elders’ advice, with this individual interaction meaning the TK/science dichotomy was much less pronounced than it is now that science has become more “equipment dependent” and “laboratory mystical”. Yet Arctic science remains different from other sciences, still dwelling on the edges. Far from funding sources and the urbanization of Western society, scientists live and work in close proximity with indigenous communities and the Arctic land. Arctic science shifts away from the Sci-Centre discourse as it becomes more pluralistic and participatory and opens to traditional knowledge. Unlike the TK-Info or TK-World discourses, in the Sci-Edges discourse far less attention is paid to defining boundaries. It is only when we look at TK and science through the reductionist and boundary-creating tendencies of Sci-Centre that they seem so different, but at the edges of science, traditional knowledge and society, it becomes much less clear where TK ends and personal knowledge begins, where science ends and TK begins.

The blurring of the Sci-Edges boundary is further highlighted by the traditional knowledge found within science itself. Especially at older research institutes, the long time depth of inter-generational, oral natural history knowledge linked to the landscape is now threatened by the increasingly fast collection and accumulation of data due to modern technology. Interview participants noted that technical understandings increasingly displace practical observation and understanding, as there are limits to how much information the human mind can store and process. This shines light on the importance of the narrative element of science: the sense-making stage, where the scientist tells the story of what the data means, emphasizing some parts, justifying omissions and errors, and forming a coherent story. Because science seeks to understand through studying parts of the whole, these pieces of understanding must eventually be re-integrated in order to be practically useful. Traditional knowledge conceptualizes relationships rather than isolated parts, and thus is much more than the collection of observations or data that the TK-Info discourse would treat it as; it is “fully developed scenarios” which already make

sense and have meaning without the additional analysis and interpretation that scientific data requires. The question arises of how traditional knowledge differs from “what any of us knows about our surroundings”. As one participant put it, “I have my own TK passed on from generation to generation, for the land where I live, so I like to think that I have a far wider view than just being constrained in my thoughts by normal science”. Two participants spoke about mediating their own experiences of climate change, their scientific worldview, and knowledge passed down from their parents (“my mother was right”). All spoke of observations accumulated over their lifetime linked to their experiences of the places they have lived. While climate change science is globally situated, personal knowledge is like traditional knowledge, local and spatially specific. However, in the discourse of Sci-Centre, knowledge becomes legitimate through the scientific method; things can be known because they are published, not because they are experienced. Science becomes a barrier between individuals and the world, as researchers’ anecdotal evidence or experience does not fit comfortably within the bounds of Sci-Centre. These interpretations and opinions get relegated to a “comments” column in a table (e.g. Huntington *et al.* 2004, 21), or are otherwise carefully segregated from the ‘facts’ and empirical observations. This is the scientists’ personal equivalent of traditional knowledge, but it must first be converted into ‘real’ science by running it through the scientific method, sterilizing it of bias and calibrating it with measurements, before it is considered valid.

### **Boundaries Reinforced until Power Rebalanced**

For there to be a true meeting of the potentials of traditional knowledge and science, the balance of power between them must first be addressed. Comparison within the framework of science inevitably results in TK appearing less reliable and accessible when compared with scientific data. For example, in “the objectivity/subjectivity of data, and whether they can be independently verified” (Riedlinger and Berkes 2001, 323) TK falls short, as science’s way of evaluating reliability is very different from the importance TK places on the identity of the knowledge holder. But what if, instead of deriving the categories of evaluation from a scientific worldview, there was a category of, for example, ‘relational integration’: the difficulty or ease of understanding the data in the context of the world? Here, traditional knowledge would excel. As one interview participant suggested, even our *imaginings* are so restricted by our worldview that we have great difficulty finding ways to conceptualize or comprehend the nature of



traditional knowledge. By choosing the parts of TK that will be used, extracting information from a broader worldview and calling that information traditional knowledge, science in the TK-Info discourse retains the power to decide what knowledge is.

Re-balancing power can occur through strengthening and empowering traditional knowledge, and/or by opening science to honest self-reflection and critique. To date, more attention has gone to the former, the politically charged agenda of revaluing TK, as evidenced in both the TK-Info and TK-World discourses. When the motivation for integrating TK and science is political, there can be too much historical baggage and not enough time for a real meeting of these different worldviews. In the TK-Info discourse, the sense of urgency surrounding climate change is a central justification for treating traditional knowledge as observations and pieces of data rather than entering the lengthy process of recording, translating, interpreting and comprehending indigenous worldviews. But this simply cannot go on: “Traditional Ecological Knowledge researchers, insofar as they focus exclusively on the methodological difficulties of integrating distinct knowledge systems, help to obscure the power relations that shape the production and use of the knowledge they study” (Nadasdy 1999, 15). In the TK-World discourse, it is noted that rushing the process of including TK in development plans, environmental impact assessments, or climate change research can lead to increased mistrust on the part of traditional knowledge holders about the motivations of researchers expressing interest in their knowledge. There are concerns of how the TK will be used in political circles, that it may end up being used against the interests of the community, even if it is not totally misunderstood or misrepresented. Conversely, the politicization of traditional knowledge can also contribute to lack of credulity on the part of some scientists, who feel that the emphasis being placed on TK is due to a current political fad rather than real merit.

However, strengthening the power of traditional knowledge holders will only get the dialogue so far, and misses deeper lessons that could help science to become more useful and responsive to current problems such as climate change, for example when encountering uncertainty (see Cockburn 2008 for further discussion). Attempts to bridge the divide between TK and science thus require a thorough reflexive analysis of the foundational assumptions and methods of science itself. Objectivity is a subject of tension at Sci-Centre, because at some point it must be admitted to be an ideal rather than an absolute: personal judgment always comes into the picture (a point that feminist science studies scholars have been making for many years; see

Harding 1991; Haraway 1991). Formulating hypotheses is identified as the most crucial part of the research process in determining what you will find: the questions asked are influenced by culture, and science is no exception. Both traditional knowledge holders and scientists equally choose what to observe, basing their choice on personal needs or disciplinary goals, respectively; both are “locked up in a particular natural or cultural world, driven by genetic make-up, ecological context, superstitious beliefs, or local concerns” (Pálsson 1998, 51). This inevitable subjectivity suggests it may be better to acknowledge our subjective position rather than try to escape from or obscure it. This is a core argument in Haraway’s (1991, 188) “feminist objectivity”, which she names “situated knowledge”: if we clearly acknowledge our embodied subjectivity, we can actually be more objective than when we deny any bias or body and act as a “conquering gaze from nowhere”. In the Sci-Edges discourse, personal judgment is seen as playing an important role when considering any findings, whether it be how far an indigenous hunter can actually see or how finely a scientist can discriminate between lines on a remote sensing chart. When bias is inevitable, it is best to be aware, open and honest about it.

## **Conclusion**

Science shares many of the underlying beliefs and assumptions that have led to the current climate crisis, and as long as science remains the basis for policy and societal action regarding climate change, we must critically question it in order to avoid repeating past environmental and cultural wrongs. Thus, the reduction of TK to fit within scientific frameworks is negative for both science and traditional knowledge, and if it continues, represents a serious missed opportunity for society to expand its perspective and possibly find new ways of dealing with challenges like climate change. At the same time, the legitimacy of science’s colonization/dismissal of other ways of knowing the world is coming into question. The goal of making science more socially relevant is seen clearly in Northern studies, where multi-disciplinarity has flourished (Heininen 2004, 19); what unites this field is not theoretical traditions but the actual spatial area of the Circumpolar North, where humans and land are still intimately connected, and which global threats such as climate change has shown to be inescapably linked to the rest of the world.

As Pálsson (1998, 64) suggests, while “it may be tempting either to submit to the populist notion that privileges the indigenous or to contribute to the opposite enterprise, the reproduction of the master narrative of science”, perhaps a wiser and more productive approach would be to

“search for an egalitarian discursive framework”. If we can start to view science as simply one approach of many, then it can be integrated with any number of different worldviews without the imposition of Sci-Centre’s values of objectivity and reductionism. This is crucial, because neither traditional knowledge nor science alone will be enough to fully address climate change. Both scientists and local communities are looking for answers, and it is by working together that each is most effective. Human-scale interaction is vitally important to success, as decisions at this level are more likely to be ruled by what is practical than what is the dominant paradigm. In true community-based research where the community is involved in all stages of research, indigenous TK holders identify gaps in knowledge which they want science to fill, so that science can act as a resource for traditional knowledge as much as TK acts as a source of information and understanding for science. The Sci-Edges discourse allows combinations of knowledge and practices from both science and TK. Although the framework may still appear to be science-oriented, it is porous, and traditional knowledge’s worldview can enter and hybridize. When this occurs on a level playing field that does not privilege one worldview over another, science loses its ideological status as inherently better, more objective, or more able to discover the truth than any other philosophical framework. This relinquishment of power also allows the Sci-Edges discourse to be less politically cautious with traditional knowledge than either of the two TK discourses.

By working to expand the middle ground between these worldviews to become all ground, the focus shifts from goals and outcomes to processes and interactions, allowing more productive and open interplay between scientists, indigenous peoples, policy-makers, and other actors. The emerging new stages of dialogue and decision-making in the North, such as the Northern Research Forum and the Arctic Council (see Heininen 2004) offer fruitful ground for the development and expansion of frameworks in which science and traditional knowledge can both realize their potentials. The Arctic is a political periphery, and in the case of climate change is portrayed as especially victimized, the area that is being affected first and hardest while remaining relatively powerless to do anything but adapt. However, the very circumstances that seem to contribute to its marginalization may also empower it to act as a central hub in challenging and developing the philosophical basis of science and Western society. In the globally focused TK-Info discourse, climate change is portrayed as a teacher about nature, and the Arctic a laboratory. But, in the more locally anchored TK-World discourse, climate change

teaches us about ourselves and how we interact with and understand the world; it is here that the true untapped potential of the Arctic lies.

### **List of Abbreviations**

IPCC: Intergovernmental Panel on Climate Change

Sci-Centre: the centre of the science discourse

Sci-Edges: the edges of the science discourse

TK: traditional knowledge

TK-Info: the “traditional knowledge as information” discourse

TK-World: the “traditional knowledge as worldview” discourse

## References

- ACIA. (2005). *Arctic Climate Impact Assessment*. Cambridge: Cambridge University Press.
- Agrawal, Arun. (1995). Dismantling the divide between indigenous and scientific knowledge. *Development and Change*, 26, pp. 413-439.
- Berkes, Fikret. (1998). Indigenous knowledge and resource management systems in the Canadian subarctic. In: Fikret Berkes and Carl Folke (eds) *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge: Cambridge University Press, pp. 98-128.
- Berkes, Fikret and Carl Folke. (1998). Linking social and ecological systems for resilience and sustainability. In: Fikret Berkes and Carl Folke (eds) *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge: Cambridge University Press, pp. 1-25.
- Bielawski, Ellen. (1997). *Aboriginal Participation in Global Change Research, Northwest Territories, Canada*. Global Change and Arctic Terrestrial Ecosystems, Springer, New York.
- Bielawski, E. (2005). Indigenous Knowledge. In: Mark Nuttall (ed) *Encyclopedia of the Arctic, Volume 2*. New York: Routledge, pp. 950-955.
- Cockburn, Lisa M. (2008). *Boundaries and Agency in Climate Uncertainty: Encountering Traditional Knowledge at the Edges of Science*. Pro-gradu Thesis, University of Lapland, Rovaniemi, Finland.  
<http://olos.ulapland.fi/onayte/julkinen/upl.php?c=ONAYTE&f=6351.pdf>.
- Cruikshank, Julie. (1981). Legend and Landscape: Convergence of Oral and Scientific Traditions in the Yukon Territory. *Arctic Anthropology*, 19(2), pp. 67-93.
- Haraway, Donna. (1991). *Simians, Cyborgs and Women: The Reinvention of Nature*. New York: Routledge.
- Harding, Sandra. (1991). *Whose Science? Whose Knowledge?: Thinking from Women's Lives*. Cornell: Cornell University Press.
- Heininen, Lassi. (2004). Importance of interplay between science and Politics when Building New Stages. In: *Negotiating Futures – States, Societies and the World: Proceedings of the International Conference*. University of Latvia, pp. 15-24.
- Huntington, Henry P. (2005). “We Dance Around in a Ring and Suppose”: Academic Engagement with Traditional Knowledge. *Arctic Anthropology*, 42(1), pp. 29-32.
- IPCC. (2007). *Summary for Policymakers of the Synthesis Report of the IPCC Fourth Assessment Report*. Valencia, Spain: Intergovernmental Panel on Climate Change Secretariat.

[http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4\\_syr\\_spm.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf) (Accessed November 21, 2007).

Krupnik, Igor and Dyanna Jolly. (2002). *The Earth is Faster Now: Indigenous Observations of Arctic Environmental Change*. Fairbanks, Alaska: Arcus.

Nadasdy, Paul. (1999). The Politics of TEK: Power and the “Integration” of Knowledge. *Arctic Anthropology*, 36(1), pp. 1-18.

Nuttall, Mark. (2002) (1998). *Protecting the Arctic: Indigenous Peoples and Cultural Survival*. London: Routledge.

O’Brien, Karen. (2006). Are we missing the point? Global environmental change as an issue of human security. *Global Environmental Change*, 16, pp. 1-3.

Pálsson, Gisli. (1998). Learning by fishing: practical engagement and environmental concerns. In: Fikret Berkes and Carl Folke (eds) *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge: Cambridge University Press, pp. 48-66.

Usher, Peter J. (2000). Traditional Ecological Knowledge in Environmental Assessment and Management. *Arctic*, 53(2), pp. 183-193.

## **Appendix A: Texts used in Analysis**

### **Publications**

Bielawski, Ellen. (2003). Nature Doesn't Come as Clean As We Think It: Dene, Inuit, Scientists, Nature and Environment in the Canadian North. *Sciences Across Cultures: The History of Non-Western Science*, Vol. 3, Dordrecht, Netherlands: Kluwer Academic Publishers.

Huntington, Henry, Terry Callaghan, Shari Fox, and Igor Krupnik. (2004). Matching Traditional and Scientific Observations to Detect Environmental Change: A Discussion on Arctic Terrestrial Ecosystems. *Ambio Special Report* 13, pp.18-23.

Krupnik, Igor. (2002). Watching Ice and Weather Our Way. In Igor Krupnik and Dyanna Jolly (eds) *The Earth is Faster Now: Indigenous Observations of Arctic Environmental Change*. Fairbanks, Alaska: Arcus, pp. 156-197.

Norton, David W. and Allison Graves Gaylord. (2004). Drift Velocities of Ice Floes in Alaska's Northern Chukchi Sea Flaw Zone: Determinants of Success by Spring Subsistence Whalers in 2000 and 2001. *Arctic*, 57(4), pp. 347-362.

Riedlinger, Dyanna and Fickret Berkes. (2001). Contributions of traditional knowledge to understanding climate change in the Canadian Arctic. *Polar Record*, 37(203), pp. 315-328.

### **Interviews**

Bielawski, Ellen. In-person interview. Edmonton, AB, 26.03.07.

Callaghan, Terry. Telephone interview. Abisko, Sweden, 27.02.07.

Huntington, Henry. Telephone interview. Eagle River, Alaska, 05.03.07.

Norton, David. Telephone interview. Barrow, Alaska, 06.03.07.