

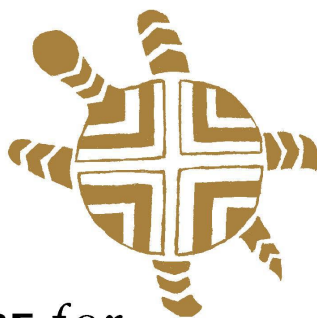
# A Study of the Social and Cultural Construction of Environmental Health Risks in Aboriginal Communities<sup>©</sup>

NHRDP PROJECT NO. 6607-1620-63

BY

J. O'Neil (1)  
B. D. Elias (1)  
A. Yassi (2)  
C. Fletcher (1)  
B. Cohen (1)

University of Manitoba  
Northern Health Research Unit (1)  
Occupational and Environmental Health Unit (2)  
Department of Community Health Sciences  
Faculty of Medicine



**CENTRE** *for*  
**Aboriginal Health**  
**RESEARCH**

For additional copies of this report please contact  
CAHR office at 204-789-3250

July 1997

## **INTRODUCTION**

In 1988, a critical assessment was conducted on how governments and industry address potential health impacts of industrial developments in northern regions of Canada. The Canadian Environmental Assessment Research Council (CEARC) held several regional workshops across Canada to foster discussion on northern and Aboriginal understandings of environmental health issues. Many broad recommendations emerged:

- \* *the health of a community should be understood before a development project is underway;*
- \* *the impacts of an existing industrial site on a community over time should be understood by actually studying whether there is industry-related diseases (such as cancer or lung problems) developing in that community;*
- \* *a communication approach that provides scientific information on contaminants to northern communities should be developed;*
- \* *a constructive and respectful way of understanding what northerners consider to be a danger to their health should be developed.*

This study is a critical response to these recommendations. It examines the cultural basis of risk perception and the importance of local knowledge in changing the assessment and management of health risks.

## **REDEFINING RISK AND ITS MANAGEMENT**

Communities, scientists, governments, industry, and environmental groups have all been involved, in one way or another, in the debate over what is a health risk. Communities and their advocates have recommended that we should respect community perceptions of risk as an important source of knowledge and that they should be given equal weight when a development project is being assessed. It has been proposed that the "public's judgements about risk are

not inferior, but different, and arguably richer than those of the experts"(Fiorino, 1989:296). It has also been recognized that, although communities may face difficulties due to "differing conceptions of risk, lack of resources, poor access to information, and unresponsive government", their involvement is "necessary to make progress in health care and health policy" (Brown, 1992: 278-9)." In other words, their close involvement with professional scientists in socially constructing perceptions of environmental health risks is both a social movement and a new paradigm that constructively challenges the scientific canons of risk assessment and management.

Some risk assessors, according to Shrader-Frechette (1991), have contended that government, science and industry still know what is best, and people who don't trust what they propose or what they do with the environment are misguided, irrational, ignorant, or suffering from mass paranoia. Consequently, scientists, like Paustenbach, have advocated an objective way of assessing risk; a world view that minimizes the importance of diverse accounts which represent a multiplicity of views and interests. The danger of such scientific objectivity is that it restricts people who are not scientists from having any say about the substance of scientific work; a process described as "boundary work" by Jasanoff (1990: 14). When scientists label lay people as non-scientists, they unknowingly construct the perception that lay perceptions have no authority in describing what is a risk to health.

An alternative approach begins with the assumption that both public and scientific perceptions of risks are culturally defined (Douglas and Wildavsky, 1982). Brown and Mikkelsen's (1990) study into toxic waste and community action illustrates how community activists, through resistance, directed scientists toward knowledge previously unavailable. This knowledge has convinced some scientists that they need to adopt a middle ground by

emphasizing better hazard assessments and by promoting the democratic control of environmental risks. Weblar (1992) suggests that such involvement would bring cultural rationality into the risk analysis project. By doing so, risk communications would be based on an analysis of environmental risks that utilized the strengths of both forms of rationality, while attending to their weaknesses.

However, it has been suggested that such a 'communicative synthesis' is not that viable.

Throgmorton (1991: 173) states that:

*I can see more clearly how the tensions and ambiguities associated with the various analytical roles are deeply intertwined with the tensions and ambiguities of modernism and the Enlightenment. 'Communicative synthesis' now strikes me as a modernist solution to the quandaries of modern life, for the 'synthesis' is to seek a 'central plateau' (a place from which one can look but not be seen) from which an analytical team can perfectly and legitimately represent the voices of three quite diverse communities.*

Instead, scientists and policy analysts need to be open to the many interpretations of risk, rather than opting for a central plateau in risk assessment and management. What is being advocated is a post-modern form of risk analysis: one that is open to various local perceptions of risk, including scientific perceptions (Rappaport, 1994). Perspectives which contest the boundaries of science and which resist risk assessment and management activities must be encouraged and incorporated into the risk communication process. By including local knowledge in the risk assessment and communication process, we expand our understanding of the social and cultural context in which the perception of risk occurs (See Bullard, 1994).

## **METHODOLOGY**

This Report describes the results of research in three Aboriginal communities conducted in different regions of Canada. The first case study occurred in Wollaston Lake; a Dene

community located in North-eastern Saskatchewan which has had direct experience with the impacts of uranium mining. The second case study occurred in Kuujjuarapik; an Inuit community located on the Eastern shore of Hudson Bay in Northern Quebec. This community was taking part in a joint Federal-Provincial environmental impact assessment of Hydro Quebec's Great Whale Hydroelectric Project. The third case study was of Sagkeeng First Nation, an Anishnabe community located at the junction of the Winnipeg River and Lake Winnipeg in Manitoba which has experienced hydroelectric development, pulp and paper manufacturing and most recently, a proposal for underground nuclear waste disposal.

Methods included open-ended interviews, participant observation and the administration of a survey in the community. Additionally, we drew upon a number of published sources for information about peoples' impressions about industrial development in general. A number of interviews were also available from other reports on related issues, which were available in the public domain (Ecologistics Limited, 1992; Roy and Fletcher, 1992).

All community governments were contacted at the beginning of the research process and informed of the objectives of this study and how it would be undertaken. On arrival in the community, we met with the respective Chiefs and Mayor, and other council members and Elders to finalize community acceptance of the study. Preliminary copies of Case Study Reports were provided to each community prior to the completion of the Final Report, and comments from community meetings with the Research Associate have been incorporated into all resulting publications.

Prior to the fieldwork, a questionnaire was developed and reviewed for cultural relevance. The questionnaire was translated from English into Dene and Inuktitut. A back translation was conducted by a second interpreter. Questions were revised based on this process. The final

versions covered contemporary cultural patterns (i.e., land use activities and country food consumption) and the following environmental health risk areas: 1) land use activities, 2) everyday living activities, 3) medical treatments/procedures, 4) global environmental impacts, and 5) industrial development dangers.

In Wollaston Lake, a sample of 105 people was interviewed; of which 63% were randomly selected and 37% were enrolled opportunistically. When compared across age, gender, and educational lines, there were no significant differences between the random and the opportunistic group. Of the 105 community people who responded to the survey, 51.4% were women and 48.6% were men. A very large majority of this group (73.3%) were between the ages of 18 and 39 years; 26.7% were 40 years or older.

The survey was administered to 74 adults in Kuujjuarapik. Respondents were identified by a "snowball" approach and efforts were made to have the sample representative of the age structure of the community; 62% of respondents were between the ages of 18 and 39 years, 38% were 40 years or older. Thirty eight of respondents were women and 36 were men. The sample size is approximately one third of the available adult population of Kuujjuarapik at the time of the study.

In Sagkeeng First Nation a stratified random sample of 100 people was drawn from the Band list, of whom 86 % participated in the survey. Forty-eight percent of respondents were women and approximately half the respondents (44%) were under 40 years of age.

In all three communities, in-depth key informant interviews were also conducted with a variety of individuals, many of whom were directly involved in environmental issues. In

Sagkeeng First Nation and Kujjuarapik, transcripts of interviews with Elders about environmental issues were also made available for our analysis.

## **CULTURAL PERCEPTIONS OF ENVIRONMENTAL HEALTH RISKS**

In this Report, we will compare risk perceptions across two domains of environmental threats. The first domain describes cultural perceptions of risks associated with traditional land use activities. The second domain describes perceptions of risks associated with industrial developments in the respective regions. Our intent is to describe general similarities and differences in Denesuline, Inuit, and Anishnabe cultural perceptions of risk, and then to compare these patterns to more specific concerns related to industrial development.

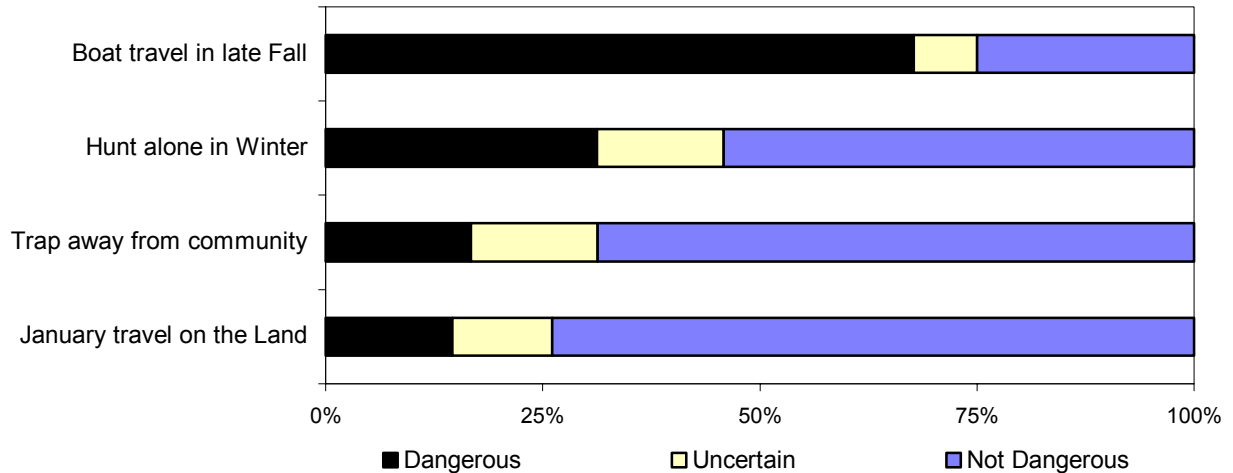
### ***Perception of Risks Associated with Traditional Land Use:***

In Wollaston Lake, we found that traditional land use activities (hunting, trapping, and fishing) continue as a fundamental component of the local culture (O'Neil, Yassi, and Elias, 1996). Dangers associated with such activities are a part of everyday life and the collective memory of the community, especially that of the older generation. In Table 1, a distinct pattern of risk perception associated with a long history of traditional land use (subsistence and commercial) activities is quite apparent. The overall pattern and its direction illustrate that the Denesuline are quite confident in their assessment of danger, which is evident in the relatively low proportion of "uncertain" responses.<sup>1</sup>

*Table 1: Perception of Land Use Dangers in Wollaston Lake (n=96)*

---

<sup>1</sup> We use "uncertain" to designate the Don't know/ No opinion response category on the survey.



A considerable number of respondents (67.7%) perceived fall boat travel as the most dangerous, which is consistent with their knowledge of how unpredictable the weather can be, of boats icing up, and of the instability of the lake in these conditions. This perception is best illustrated by the following field note documenting one Elder's comment on how this knowledge is used to off-set the risks they take to continue a traditional life style:

*By 10 in the evening the winds died down and the lake was relatively calm. After waiting out the storm on an island, they left, and it didn't take long to get to the cabin. He stated that this time of year makes it dangerous to travel, so they have to be careful. But travel they must even though the boats ice up so quickly and the lake can become too rough to travel.*

How such knowledge is used to mitigate the dangers of other land use activities was also evident in other domains. While most respondents (54.2%) perceived hunting alone in the winter as not dangerous, a large minority did regard it as dangerous. This split in perception should not be construed as unusual. One respondent captured this ambivalence in his comment that *"it's fun providing you know what you are doing."* Hunting alone in the winter can be dangerous, if no one else knows where you are, if you are unfamiliar with a particular area,



or if you are not prepared with food and temporary shelter to wait out a storm.

Similarly, a substantial number of respondents (68.7%) agreed that trapping away from the community is not dangerous. Experienced trappers noted, however, that although it is not typically dangerous, it could be. They cautioned that when working a new trap line, the ice could be too thin in some areas of your line, especially around rapids or due to underground springs.

Finally, we inquired into traveling on the land in January and found that a large number of respondents (85.5%) considered this activity as not dangerous. Traveling at this time of year is something community members greatly look forward to. Snowmobiles provide them with a more efficient and cheaper means of traveling to other communities. Indeed, many respondents indicated that they visit other Dene communities more in the winter than in the summer because of greater accessibility. Nonetheless, some respondents cautioned that snowmobiles can break down at any time and that many people may be unfamiliar with landmarks and direction.

The levels of uncertainty (ranging from 7.3% - 14.6%) expressed by respondents for these activities can be interpreted in several ways. Risk perceptions are strongly contextual for the Denesuline; contingent on broader environmental conditions that affect the “risk” of an activity. Uncertainty, in other words, may reflect a cultural rationality which recognizes that risk is best contained by remaining non-committal and open to contingencies and conditions that may affect the safety of a given activity. Uncertainty then may be interpreted positively, as an indication of wisdom and respect for the land, and not as an indication of lack of knowledge.

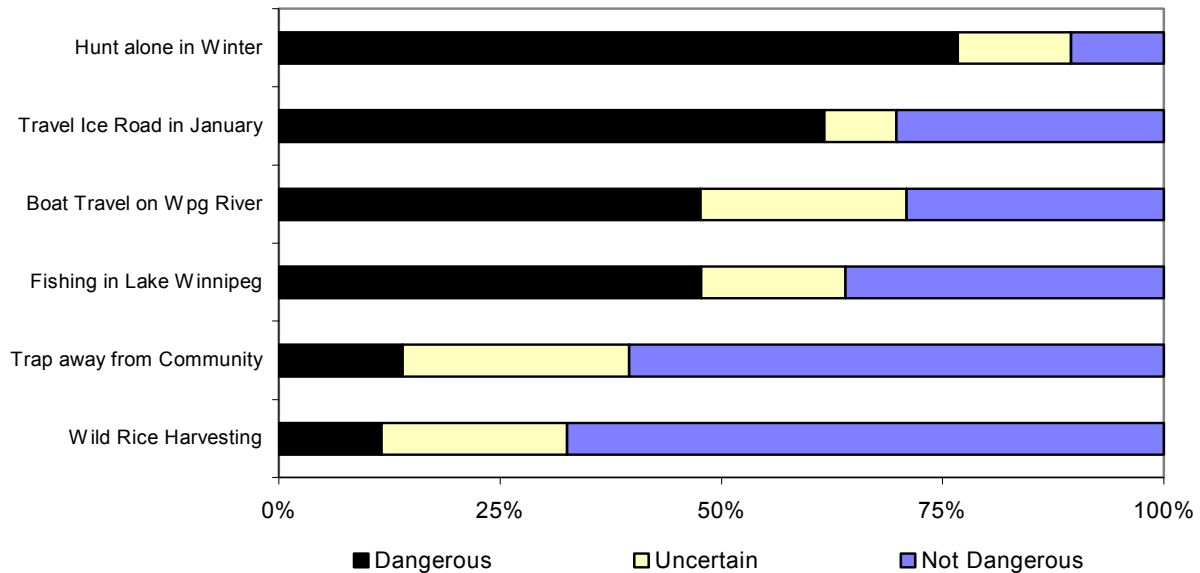
In Kuujjuarapik, decisions on when and where to hunt are contingent on a number of criteria. External factors such as weather conditions, migratory movement of animals and seasonal availability will play significant roles in the itinerary of hunters. Social factors like the

availability of hunting partners, the condition and accessibility of equipment, the amount of time the individual has to hunt, and the shared knowledge about game location will also influence decisions around land use activities. According to several respondents, experience is perhaps the most important factor, which bears on the evaluation of risk in land use activities. An experienced hunter will hunt during any season provided the conditions are adequate, and will have little difficulty facing extremes in temperature or breakdowns in equipment. On the other hand, families generally spend time on the land together in the spring and summer when the climate is the most forgiving, and will frequently establish a semi-permanent camp which they will visit each year. In the winter, extended hunting trips are generally only undertaken by the most experienced hunters, and day trips for fishing and caribou hunting will be made by less experienced hunters and families if the conditions are good. We would then expect that the risks associated with land use activities would be influenced by individual experience, season and, the type of activity.

In Table 2, we see a general pattern that reflects the accumulated experience of many generations of land use by people in the region. Hunting alone was considered a dangerous activity by 62% of those surveyed and only 11% were uncertain about it. The answers concerning the risk of fall boat travel were quite similar with a slightly larger portion uncertain. These questions access strongly promoted norms of land use practice within the community which explicitly underline the danger of hunting alone, something which is rarely done. Several respondents stressed the importance of not hunting alone and said that they had never done so. Similarly, fall boat travel was described as risky because of falling temperatures and less predictable weather in general. In some cases where people responded that hunting alone or fall boating were not dangerous the answers were quantified by describing specific conditions, locations or regularly traveled routes where one would meet other hunters regularly. In these

cases, the not dangerous responses were effectively linking danger with the predictive capacity that comes with experience.

Table 2: Perception of Land Use Dangers in Kuujjuarapik (n=72)



When asking about the perception of land use dangers we were often asked to contextualize the questions. In some cases people found it difficult to abstract a generalized "spring" for example. They tended to ask questions like When in the spring?, Where?, What's the weather like?, etc. We added the qualifier "when the ice is starting to go" to give some context and to examine responses to a situation which would likely be considered dangerous, regardless of individual experience and ability. Other people responded that everything "depends" on, among other things, your knowledge base, age, number of traveling companions and preparedness.

Even the risks associated with berry picking near the community need some contextualization. While 62.5% of people said that it was not a dangerous activity, others cited cases where seemingly innocuous activities had turned dangerous because the people involved did not anticipate a change in the weather or because equipment failed. Additionally, some people felt that berry picking, or more precisely the consumption of berries from near the community, posed some risk as they may have been exposed to dust from the roads, be contaminated by garbage from the dump or sewage from the lagoon.

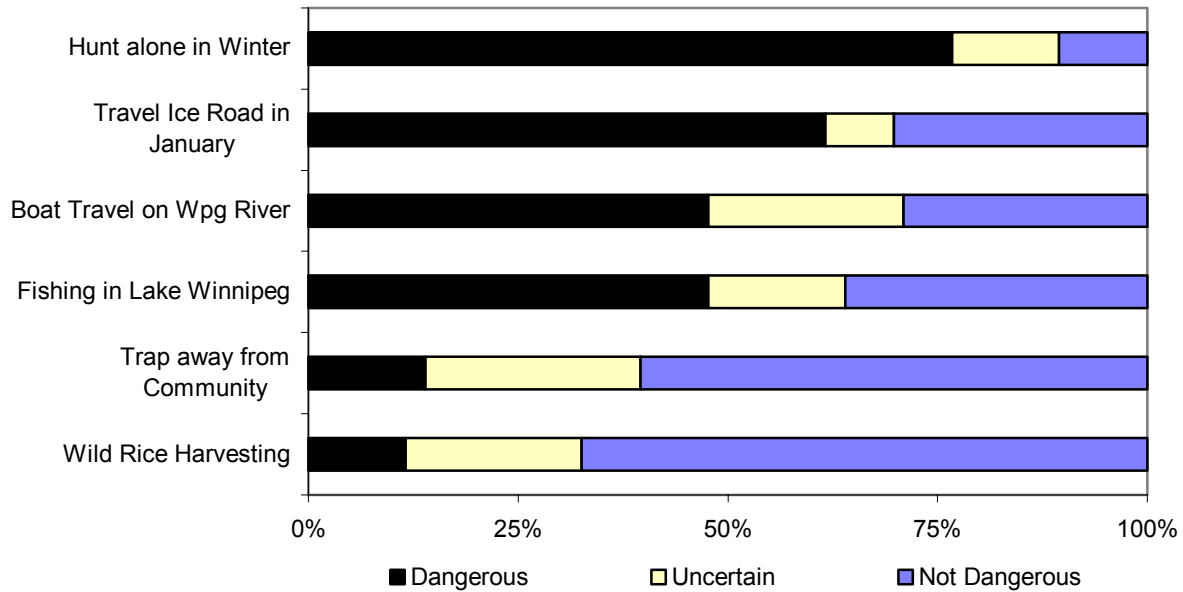
The pattern of responses to the land use danger questions suggests two things: the first is that it is difficult to offer a universal assessment of risk for a given situation when numerous factors must be taken into consideration. The second is that context is critical in making judgments about danger, which points to the importance of individual experience in the social construction of risk. The case study of Sagkeeng First Nation makes this clearly evident.

In Sagkeeng, our study suggests a very significant decline in traditional land use activities. Development impacts, from government policy to the construction of hydroelectric dams, has minimized traditional land use. Nevertheless, it is apparent that traditional land use activities have persisted over time. Nearly everyone indicated that land use activities were important before the building of the pulp and paper mill, including logging (90.7%).

Traditional activities, whether practiced or not, are part of the collective memory of the community. Even those who do not participate directly, share in the discourse associated with these activities. Table 3 illustrates the perception of dangers associated with land use activities. The overall trend indicates that community members are confident in their knowledge of dangers associated with specific land-use activities. In some cases, however, the range of

uncertainty and degree of danger expressed is difficult to discuss without accounting for development impacts on traditional activities.

*Table 3: Perception of Land Use Dangers in Sagkeeng (n=86)*



Traveling on the ice road in January, for example, is a dangerous activity according to 61.6% of respondents. Indeed, fluctuating water levels on the river, due to hydroelectric developments, make the ice unstable, and logging trucks have broken through the ice, resulting in the loss of life. Boat travel on the Winnipeg River is also another activity impacted by this development, which perhaps accounts for why 47.7% of respondents indicated that this activity was dangerous.

The respondents' perception of fishing dangers illustrates the importance of hunting and fishing knowledge in the context of climatic change. In this community, a large majority (76.7%) considered hunting alone as dangerous. Forty-seven per cent considered fishing on Lake

Winnipeg as dangerous as well. However, thirty-six per cent indicated that it was not. In this community, fishing on Lake Winnipeg is a traditional activity that has a long history. Community members are fully aware of weather fronts, and the impact high winds can have on the lake. The small amount of uncertainty expressed clearly indicates the confidence community members have in assessing the dangers of these activities.

Trapping and wild rice harvesting solicited another type of response. The majority (respectively 60.5% and 67.4%) felt that these activities were not dangerous. In Sagkeeng, community members have developed a familiarity over time of the area around their trap lines. This is also true for wild rice harvesting. Community members return to the same lake year after year to harvest rice, but their method of transportation has changed, minimizing the danger of travelling to wild rice areas (e.g., the use of trucks instead of canoes).

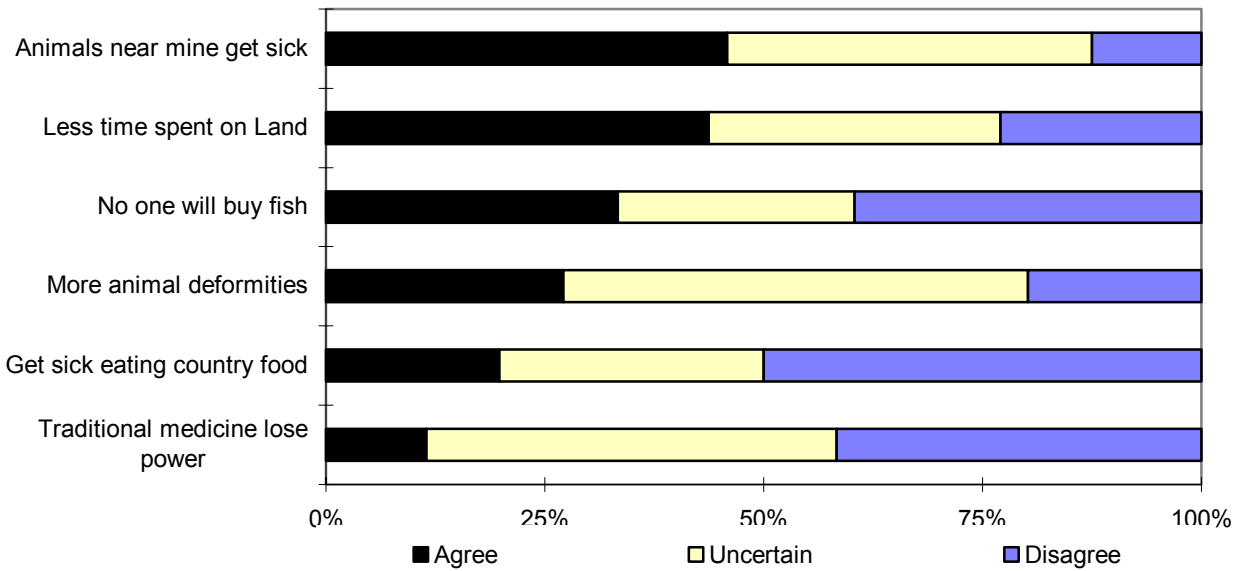
### *Perceptions of Risks Associated with Development*

Development related activities in each of the three regions generated a different pattern of risk perceptions that are nonetheless consistent with an underlying cultural rationale of remaining open to contingency and context. Uncertainty increases, but again seems consistent with a general cultural strategy of remaining non-committal when confronted with unpredictable situations.

In Wollaston Lake, uranium mining has generated a number of environmental health concerns over the past decade or so, but community members are not uniform in their perceptions of these risks. In Table 4, there is considerable variation in the extent to which

people agree with statements made about the impacts of uranium mining on land-use activities.

*Table 4: Agreement concerning Development Impacts on Land Use in Wollaston Lake (n=96)*



Agreement, however, is strongest for statements that suggest that the physical presence of the mine may have a direct impact on the health or behavior of animals. However, there was less concern that people who consume plants and animals from the mining region will get sick. This finding suggests that while most people are concerned about the direct effects of uranium mining on the local ecology, they are less concerned that their own health may be affected by their continued consumption of plants and animals that may have been affected by mining activities. Our ethnographic work suggests that many people have a high level of confidence in their ability to recognize diseased or otherwise affected plants and animals. Traditionally, Denesuline hunters avoided taking animals that appeared “abnormal,” and likely continue to use similar empirical criteria in order to distinguish potentially “dangerous” animals, that if consumed might make them sick.

Uncertainty remains relatively constant in the 25 to 35% range, and likely reflects the underlying cultural rationality of risk perception. Since Denesuline knowledge of animal behavior and well-being is rich and detailed, many respondents are likely unwilling to commit themselves to a statement that does not include the myriad of contingencies and contextual factors that could account for changes in the behavior or health of an animal population.

Contextual factors, for instance, may include perceptions of activities that are associated with the presence of the mining industry, but not necessarily directly connected to uranium and the risks of radiation. For example, the perception of fewer people spending time on the land is strongly associated with stories of "bad white men." The stories describe the killing of Dene men by "bad white men," the stealing of their food, the abduction of their children, and the destruction of their camps. During a recent EIA hearing, the Chief of the community (Joint Federal-Provincial Panel on Uranium Mining Transcript, 1993) cautioned the mining companies and the Panel Members that the belief in "bad white people" still exists and generates fear in the Athabasca:

*... it's more or less that they have the safety of living [here] instead of living out there again. So it has created also a psychological disturbance for the trappers, hunters, [and] fishermen.*

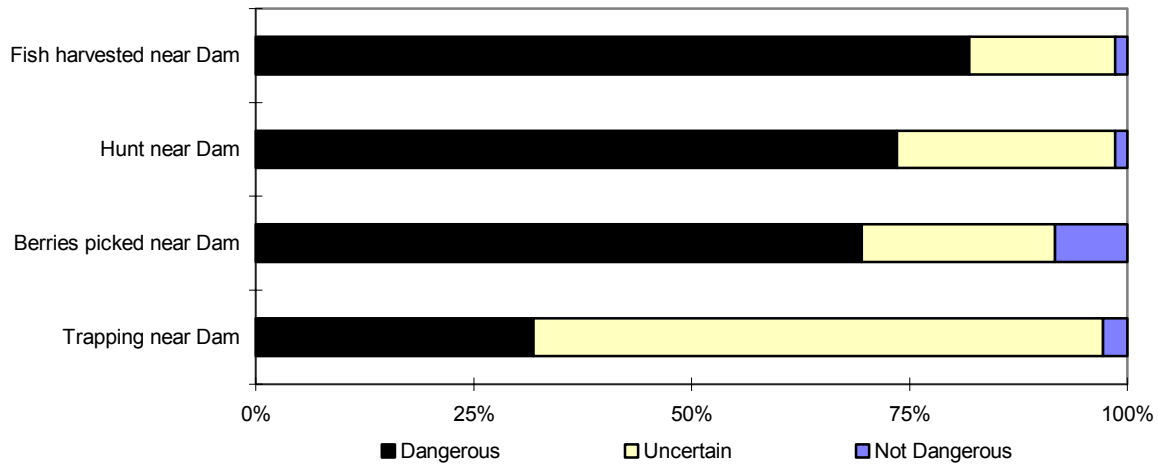
There are also many reasons why fish are not purchased. The decline in fishing, for example, has been strongly tied to economic factors (i.e., increased fishing and transportation costs). Needless to say, there are some people who are concerned with how markets will perceive the quality of their fish not only now, but also in the future as mining activity increases. On the other hand, most people (50%) are of the opinion that they would not get sick if they eat country food, but 30% were uncertain. This uncertainty was evident for other country foods and increased for mining impacts on traditional medicines. Overall, it appears that there is a



pattern of similarly shared perceptions, which illustrates that members of this community continue to have confidence in their ability to detect change, yet they remain sensitive to the uncertainty of environmental risks.

In the Kuujuarapik case study, perceptions of risk in land use activities are also strikingly different from those associated with the establishment of a hydroelectric dam and reservoir. Nearly everyone in Kuujuarapik has some knowledge of the mercury issue. It is pervasive in community level discussions about the impacts of the La Grande Project which is understood to be analogical to what can be expected in the case of the Great Whale project; an expectation shared by Hydro Quebec (1993: 261). Discussions about the effects of mercury are also persistent in the various media. The discourse around mercury is the principal factor in the association of danger with the Great Whale project. Eating fish caught near a dam was considered to be dangerous by more than 80% of respondents.

Table 5: Perception of Development Impacts in Kuujuarapik (n=72)

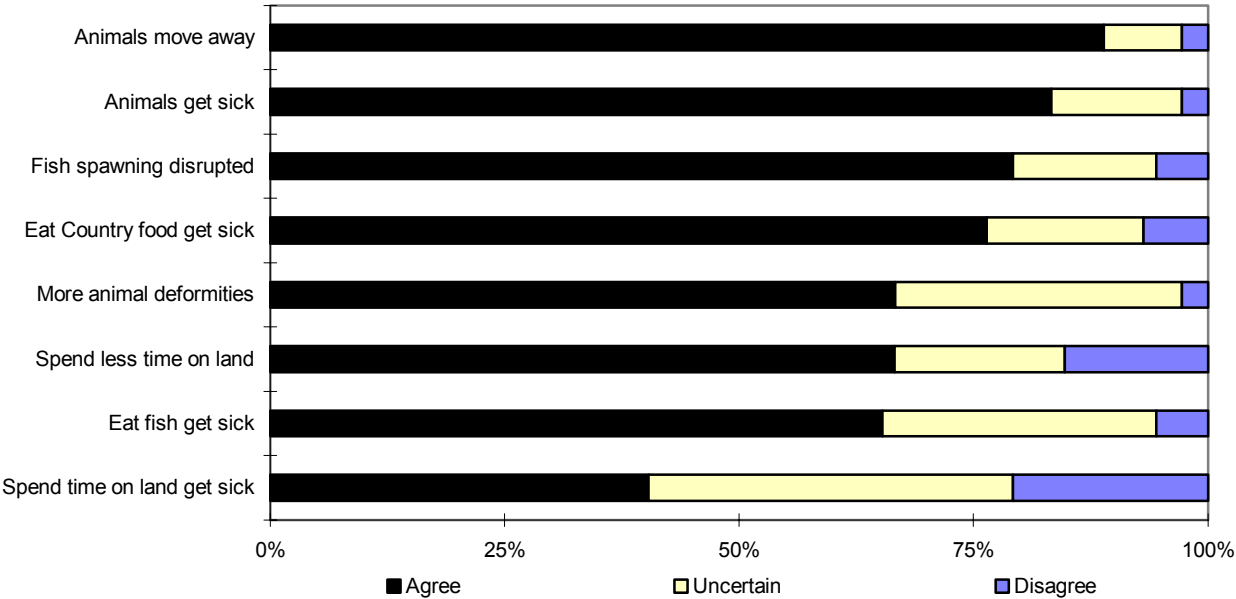


Similar response rates were given to both the hunting and berry picking near the dam questions as well. In one instance a respondent stated that hunting near a dam was not

dangerous because he would continue as a form of protest against the project in its entirety. In this case at least, "not dangerous" is a protest response that in fact signals the overall danger of the project. In the case of trapping near the dam we see a different response entirely with more than 65% of respondents uncertain. This likely reflects two co-related factors. The first is that fur bearing mammals that are trapped are not normally eaten (Inuit hunters trap mainly fox) and hence the vector for risk to the individual - consumption of contaminated meat - is avoided. It is also likely that some proportion of the uncertain segment is reflecting a no experience category. Relatively few people in Kuujjuarapik have a lot of experience with trapping and virtually none have experience trapping near hydro dams.

In Table 6, the levels of concurrence with statements concerning Hydro dam development impact on land use activities are presented. Only 2.8% of respondents disagreed that animals near the dam would move away from it or get sick as a result of being close to the dam, while 88.9% agreed with the statement. Slightly more people were uncertain about the possibility of animal sickness resulting from their proximity to the project than about the likelihood of their changing territory (13.9% and 8.3% respectively). Similarly, 79.2% of respondents agreed that fish spawning would be disrupted by the project with 15.3% uncertain. Each of these questions addresses the perception of broad ecological conditions and accesses widely held understandings of animal behaviors and responses to human influences on natural conditions. To paraphrase respondents observations on these effects; animals always move in response to people so we can therefore expect them to avoid high activity areas around the dams. Those that do not move will undoubtedly be influenced by the changes, in some cases producing sickness. Fish have less overall mobility than land animals and will have no choice but to have spawning disrupted by the damming.

Table 6: Agreement concerning Development Impacts on Land Use in Kuujuarapik (n=72)



The statement regarding frequency of birth defects in animals, fish and birds addresses a specific type of effect on animal populations that can result from industrialization. Responses to this statement show a higher degree of uncertainty (30.6%) than the more general

behavioral questions, perhaps because of the relatively infrequent appearance of birth deformities and subsequent lack of direct knowledge people have of them.

Three statements inquired about the possibility of human sickness as a result of eating animals caught near the site of development. The general trend in the responses to these statements is that the level of uncertainty is variable while the proportion of people disagreeing with the statement stays consistently low. The statement concerning people who eat a lot of country food getting sick was agreed to by more than three quarters of respondents while the one concerning sickness from eating fish was agreed to by 65.3%. This would seem at odds with the presence of a wealth of scientific information disseminated within the community on mercury contamination in fish populations.

So why is it that fish as a source of sickness is less frequently agreed to than the more general country food category? We offer two interpretations to this question. The first is that the less specific category of "country food" may address a generalized framework of resistance to the development within the community. The specific forms of impacts may be less well acknowledged within the community than a conceptual understanding of country food as a source of health, which is endangered by hydroelectric development. The second is that the nature of scientific information is at odds with local ways of understanding risk. The scientific information is predictive and odds based, and may not offer a clear understanding of the relationship between mercury, fish and people. Mercury contamination became one of the key issues of the debate around the suitability of the project and one that received considerable media attention. Perhaps the presence of so much information which is at times contradictory and quite often difficult to assimilate leads people away from a concrete opinion about the effect and towards a "wait and see" contingency which is reflected in the responses to the

uncertain category. This interpretation does not account for the high rate of dangerous responses associated with eating fish in the previous table, however. Results to these questions, while highly concordant, retain some ambiguity.

The final sickness statement, "people who spend time on the land will get sick", provoked a different pattern of response than the others. Here, less than half of the people agreed with the statement, almost an equally large proportion was uncertain and slightly more than 20% of people disagreed. Responses to this statement point to the understanding in the community that the health risks posed by hydroelectric development are largely associated with the consumption of affected animals. Regardless, 40.3% still agreed that health could be affected by travel on the land if the project were undertaken. The response to this question is probably closely linked to the high proportion of people who agreed that fewer people would want to spend time on the land as a result of hydro development (66.6%). This last question may address a general sense of rupture between people and the land base, which could result from development.

In Sagkeeng First Nation, we found that risk perceptions, in general, illustrate a cumulative knowledge of impacts. In Table 7, the majority responded affirmatively that developments have negatively effected traditional activities. Some variation is evident within activities and between developments. Pulp and paper impacts, however, appear to solicit a slightly higher response, with the exception of wild rice harvesting which is directly impacted by hydroelectric developments. Events occurring in the community at the time of the research are possible factors influencing this opinion.

*Table 7: % Perception of Negative Effects on Land Use Activities, comparing Pulp & Paper Impacts and Hydroelectric Impacts (n=86)*

Land Use Activities	Pulp & Paper Impacts			Hydroelectric Impacts		
	Yes	Uncertain	No	Yes	Uncertain	No
Berry Picking	76.7	17.4	5.8	68.6	16.3	15.1
Fishing	88.4	11.6	0	84.9	10.5	4.7
Hunting	82.6	16.3	1.2	74.4	17.4	8.1
Harvesting Wood Fuel	76.7	17.4	5.8	68.6	16.3	15.1
Wild Rice Harvesting	76.7	14.0	9.3	77.9	14.0	8.1
Trapping	82.4	14.1	3.5	76.7	15.1	8.1
Logging	74.4	18.6	7.0	72.1	16.3	11.6

Uncertainty in risk perception is quite different in Sagkeeng First Nation than in the other two case studies. Only a small percentage (ranging from 10-19%) of respondents expressed uncertainty in their understanding of development related risks. In this community, awareness of hazards is strongly associated with a political discourse of resistance to development. Community demonstrations and meetings against Abitibi-Price and Manitoba Hydro are regular occurrences in this community. The perception of risk has developed over a long period, as community residents resisted cumulative impacts on their community. For example, Elders' accounts, in this community, clearly illustrate the cumulative affects of development along the Winnipeg River:

*Before they built the dams, we were talking our language; before the white man came, we were talking our language. Ever since they came, we are steadily losing everything. The kids today can't even talk their own language. These power dams are destroying [many] things.*

*There is lots of diabetes, before there was none. No one from our people had any heart attacks. No [one had] cancer. The only thing that killed a few of our people was T.B., but our people cured themselves. That is why our people are dying lots today. Over the years, the white people have poisoned our water, [and] the fish and other river animals we eat. They have caused a chain reaction of sorts. The rabbits are sick. The moose are getting sick too.*

*Not only that, way over there, the Dryden Ontario Paper Company in dumping pollution into the English River. Pinawa [AECL] dumps pollution into the Winnipeg River. Abitibi Price dumps into the Winnipeg River. The English*

*River flows into the Winnipeg River system. In the end here, we get all that pollution. That is what we should also talk about.*

*The water is a very dangerous because you didn't know where the currents are anymore. One day they will be here, the next day somewhere else. The dams make the water rise and fall all the time. I repeat. The water is no good to drink. The rapids are not at work anymore. [They] killed the rapids with their dams. Our creator did not put the rapids there for nothing. They kept the water fresh and clean. The rapids, our creator put there, were blocked by the white man. Now our people do not have good water. [Elder 1]*

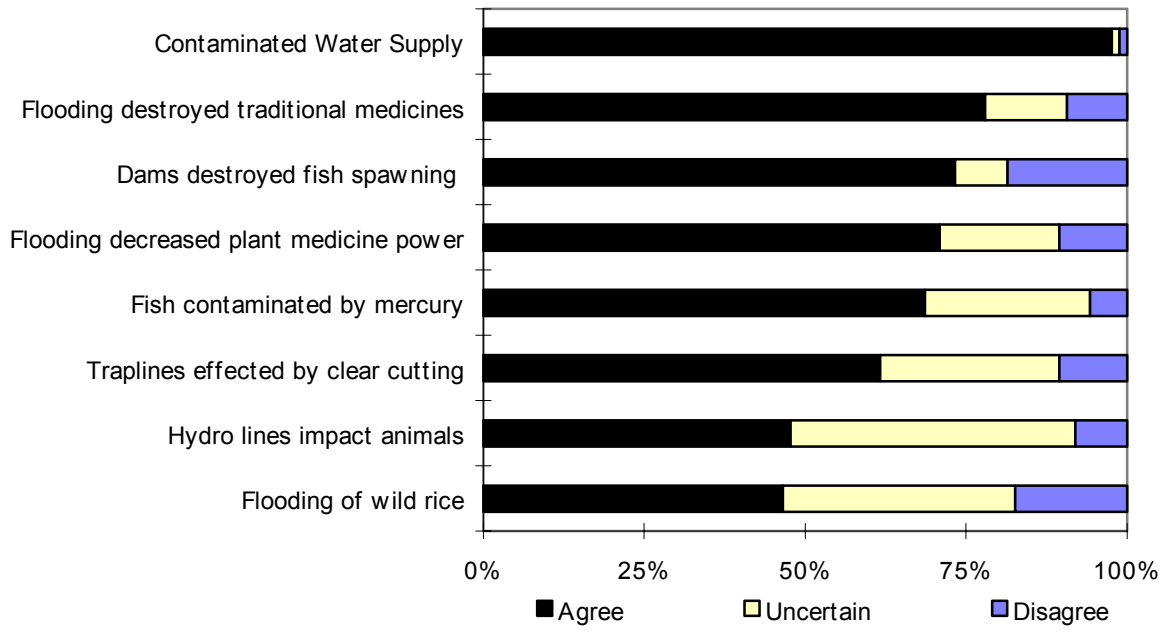
*... You have to blame them [hydro companies] to a degree only ... Now look at the white people ... They are permitted by law to pollute our river, our drinking water. Not only Abitibi [is polluting]. Everybody that lives upstream, powerhouses, golf courses, department of highways, are all polluting. [Elder 3]*

*... We have the paper mill, Abitibi-Price, Manitoba Hydro, we have TanCo, which mines tantalum, and we have Atomic Energy of Canada Ltd., which is self-explanatory (i.e., nuclear products). As well as farmers who use fertilisers, which eventually leaches into the groundwater and the various areas of the watershed that feed the Winnipeg River ... Hydro developments in northern Manitoba affect us as well. [Elder 5]*

*The highways department pollutes not only the water, they pollute the environment with their chemicals. You walk around the bush close to the road and you will see partridges laying dead. Hydro pollutes with erosion, then they pollute through the spraying of their transmission lines to prevent growth. Abitibi pollutes by spraying chemicals too and then they pollute by burning coal, by sewage. [Elder 4]*

The Elders' assessment of risk indicates that, although development impacts may have eroded participation in traditional land use activities, experience with development has forged a form of local indigenous knowledge of development impacts, as described in Table 8.

*Table 8: Sagkeeng Agreement with Statements concerning Development Impacts on Land Use (n=86)*





Respondents, overwhelmingly, agreed that the spill contaminated their water supply, contrary to scientific perceptions. Although government and industry acknowledged that Busan-52 did spill into the river, they argued that there was no physical evidence of potential health risks. Community residents, on the other hand, argued that the mere presence of such a toxic chemical in their water supply was a health threat. It is likely that the extreme adversarial context in which this perception occurred, accounts for the high level of agreement on the potential health risks and low levels of uncertainty.

Similar views were expressed about debris in the Winnipeg River. The vast majority (82.6) agreed that debris from the forestry industry and hydro developments had affected the setting of nets. The following comments illustrate this point:

*We found a lot of dead animals, dead logs, in the nets. Where the dead animals came from, I don't know. They [may have] washed down the tributaries, the side rivers, caused by some high water and the spraying of their (white people's) chemicals. It occurred from the 1950s till today.*

*They flooded the land all over the place above the dams. You even see plywood and square timbers sometimes. The water is dirty now ... We used to leave our nets in the river for a few nights and days at a time. Now one night is even too long for the nets. They get full of slime overnight ... You will find anything in the nets now. White people caused this pollution.*

There was also considerable agreement concerning the impact of floodwaters and pollution on traditional medicines. Over 75% indicated that floodwater had destroyed traditional medicines, and for 70%, the power of these medicines had decreased with pollution. Elders contended that this affect is indisputable, but often overlooked by scientists and government. The following comment summarizes one Elder's account of impacts on traditional medicines:

*Along the shores of the Winnipeg River, there were all kinds of berries. Now there is very little. Just about all the berry bushes [have] washed away. ... There was wild ginger, [one of the most common traditional plant medicines used in the area], just about anywhere on the shoreline ... Even the little creeks that run into the Winnipeg River don't have any more wild ginger.*

There was also much agreement over impacts on fish. Seventy-three per cent of respondents agreed that flooding severely affected spawning areas, at rapids on the river and along creek beds. This agreement decreased somewhat (68.6%) when respondents considered mercury contamination of fish found in the Winnipeg River. Uncertainty also increased from 8.1 to 25.6 percent. According to one respondent, hydro dams have increased levels of organic mercury in fish, but *we don't know the levels and we can't see it*. Several studies occurred in the community at the time of this research, and one study assessed the impact of various contaminants on the fish. Preliminary results presented to the community suggested that organic mercury is present, but no health advisories have been issued. Damage to fish spawning areas, however, is something community members directly observed on a day to day basis, as the following comments illustrate:

*Where the Great Falls dam is, my husband, worked somewhere there. When hydro blasted the rock, we could see fish, mostly sturgeon getting tossed out of the water. They looked like a bunch of wood being tossed in the air. There was dead fish all over the water. That is why I say they destroyed a lot of the spawning areas for fish.*

*The dams covered their original spawning areas. Look at McArthur Falls. Sturgeon never used to spawn there. Now there are some [fish] that spawn there. I think that the fish try to spawn below these dams, but when they lay their eggs, if the water is released, then the eggs are destroyed by all the turbulence from these dams. It goes back to the white man again. He is destroying everything.*

Respondents shared similar perceptions (69.8%) about fluctuating water levels, unpredictable water currents, and riverbank erosion. According to community members, the land, at one time, gradually sloped towards the river, but now it drops off in vertical cliffs, and more land is lost each year from fluctuating water levels. Indeed, most of the garden plots have disappeared into the river, and there is a concern that a graveyard will follow. The instability of the riverbanks has also affected fishermen and recreational boaters. Many can no longer launch or dock their boats safely. Riverbank instability has also created uncertainty (20.9%).

Community members are now concerned with the safety of young people and their families along the banks, as one respondent indicated:

*Look at the shorelines yourself, the steep banks are a danger. I can't let my grandchildren play there anymore. When we were kids we could play there, but not our grandchildren. You go to the edge of the bank and some places it is 20 feet down.*

Fluctuating water levels have created unstable, year round conditions, which have adversely affected subsistence, commercial and recreational use of the river. Indeed, water currents have been especially unpredictable for the inexperienced resource users. In some cases, accidental deaths have occurred, as one official sadly pointed out:

*Last summer there was a death that I personally attribute to higher, faster water flows at noon hour. That's when the kid died ... He was in a boat that apparently had a leak in it, and he got out. Because of the higher levels, I think, he couldn't swim out of the currents. If you swim in the morning, it's all right. The water's calm. If you swim between the hours of two to four or five o'clock even, you're still safe. If you swim after seven o'clock, you're safe. But if you swim at noon or at supper, which are the most popular times to use the river or any recreational area, well then you're placing yourself in danger.*

When asked about the affect clear cutting had on trapping, 61.6% of respondents indicated that trap-lines are affected, but 27.9% expressed uncertainty. Community members are aware that forestry operations can reduce availability of some fur-bearers due to loss of habitat (e.g. the Pine Martin), the destruction of trails, and increased harassment of wild life. Some cut over areas, however, can improve habitat for some fur-bearers. This uncertainty is perhaps indicative of the need to know all the contingencies related to trapping areas, and the type of fur-bearers affected. Respondents pointed out that we should have assessed the affect of flooding on trapping. According to community members, fluctuating water levels have also produced a negative affect on their right to trap:

*When we trapped sometimes, we would find our traps underwater, sometimes on the shoreline - a ways from the water. These dams make the water go so high and low, so they destroyed a living for us. We don't hardly trap any more.*

In this table, we also see that uncertainty increased for statements assessing the permanent flooding of traditional wild rice areas (36%), and the health of animals along hydro transmission corridors sprayed with herbicides to control plant growth (44.2%). In the Whiteshell area, water levels fluctuate from year to year, temporarily flooding wild rice areas, which accounts for the increase in uncertainty.

When asked whether new pollution technology at the mill would improve water quality, respondents were split (44.2% respectfully). Responses were similar (38% split) when asked whether moving the water treatment facility upstream would improve water quality. What is most interesting, comparatively speaking, is that uncertainty increased for technology that improves access to treated water (22.1%), but remained low for improved quality of discharged wastewater from the mill (11.6%). The respondents appeared more confident in providing an opinion on something that is embedded in law (effluent levels) and potentially enforceable, than on government promises contingent on future funding.

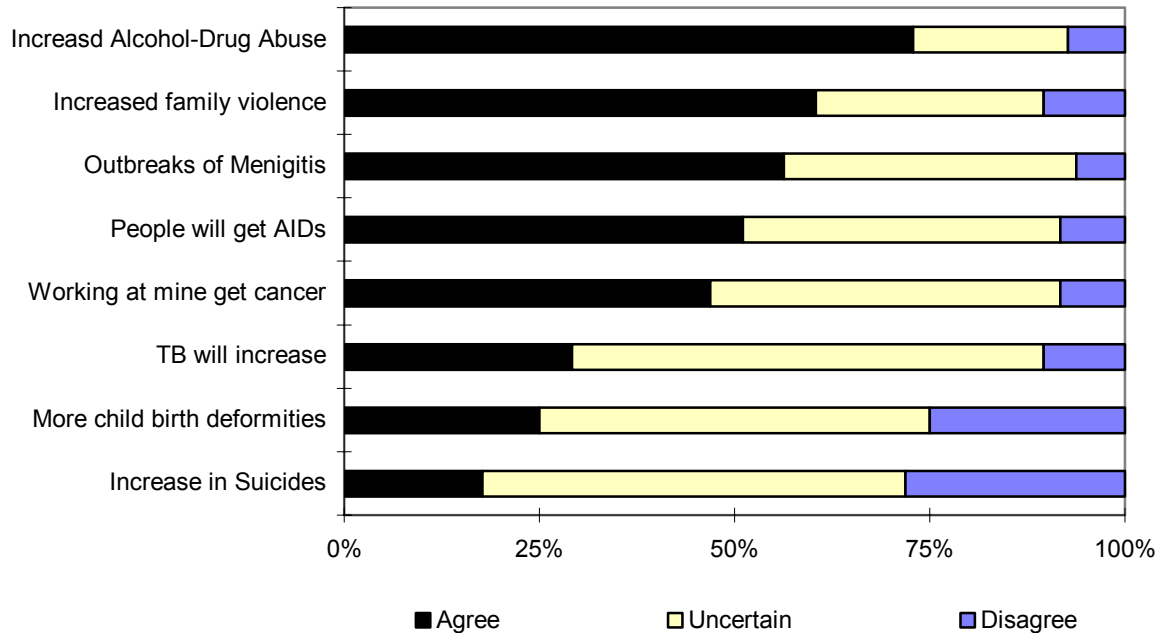
Overall, survey results reveal a pattern of knowledge that reflects a history of assessing cumulative impacts. They also illustrate an overall pattern of resistance to development. By contextualising risk perception through political resistance, traditional cultural approaches to understanding risk are rendered less important than an assertion of self-governing rights in environmental control.

### *Perceptions of Development Impacts on Community Health*

Table 9 describes risk perceptions related to changes in community health in Wollaston

Lake. Once again, a similar pattern of perception emerges; as concern decreases, uncertainty increases. Agreement about risk is highest on the indicators that have been experienced first hand and where there is broad historical experience.

Table 9: Agreement concerning Development Impacts on Community Health in Wollaston Lake (n=96)



For instance, the Denesuline are no strangers to impacts associated with the boom and bust- cycle of resource development. In 1982, the milling and mining operations at Uranium City closed, and by 1986, town status was abandoned when the population had dropped to less than two hundred. A recent study noted the impact of this closure on one of the northern Saskatchewan communities (Ecologistics Ltd., 1992):

*[T]here was a 50% increase in population with families returning from Uranium City. The alcohol and violence became so bad that Medical Services Branch refused to put a nurse in the community for 19 months.*

Knowledge of this problem is consistent with this community's experience with alcohol

abuse and family violence. Community members associated these problems with the cyclical nature of sudden increases in household earnings due to the employment of a family member, followed by a sudden decrease in earnings when they are not employed, and the emotional upheaval this situation creates.

Community respondents also shared the concern that some infectious diseases would persist or even increase with increased mining activities. Most people (56.3%) agreed that there would be more outbreaks of meningitis. However, a large minority (37.5%) was uncertain if this would actually be the case. It is important to note that outbreaks of infectious diseases have long been associated with increased contact with Western society. At the same time, public health discourse has focused attention on the threat of infectious diseases. This discourse has been integrated into local knowledge and is drawn upon by some to explain cumulative impacts of mining as illustrated by the following comment:

*Everything around the mine that comes out of D-Zone causes disease. If one person gets it, the next person who they come in contact with would get it. It's contagious. Everything around D-Zone will be diseased.*

This linkage of infectious diseases to the socio-economics of uranium mining was also made for specific sexual transmitted diseases such as AIDS. The majority of the respondents (51.1%) agreed that the incidence of AIDS might increase due to uranium mining developments, but many (40.6%) were still uncertain. Community members appeared to know that uranium mining is not a direct cause of AIDS per se, but some believe that uranium mining has opened up the north to southerners that may bring the disease up with them.

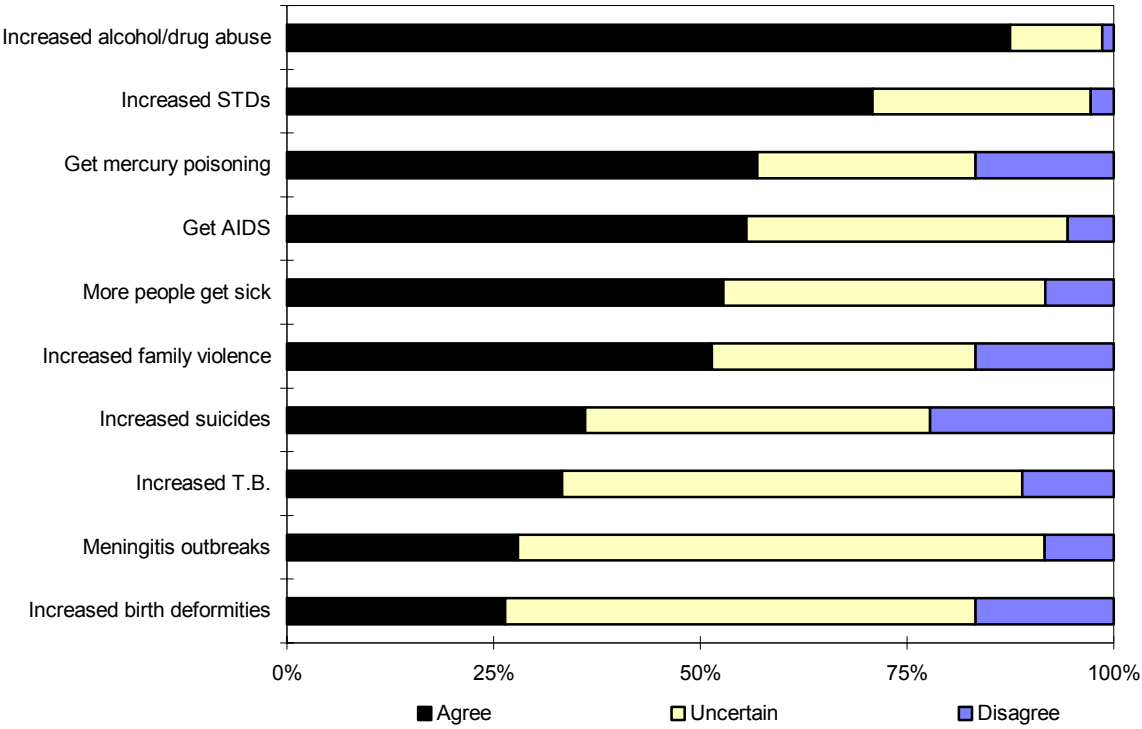
Respondents, however, were divided over whether people working at the mine are at increased risk for cancer. Nearly half (46.9%) agreed, whereas 44.8% were uncertain. Respondents that agreed were aware of the link between cancer and radiation exposure

whereas others were not sure because they had not had direct experience with a case of cancer that could be attributed to uranium mining exposure.

The trend toward high uncertainty continued with statements projecting increases in "Child birth deformities" (50%), "Suicides" (54.2%) and "Tuberculosis" (60.4%). This suggests that the community has had little direct experience with these problems (an interpretation supported epidemiologically). In the absence of tangible evidence of the problem occurring, people in the community remain non-committal about risk.

Perceptions of community health risks associated with hydroelectric development in Kuujjuarapik are presented in Table 10. Here we see considerably more variability in response rates and in particular higher degrees of uncertainty. Most people agreed that alcohol and drug abuse in the community would increase as a result of development (87.5%). Here people frequently made links between the increased income from jobs, the presence of more people from outside the community and the increased availability of drugs and alcohol.

Table 10: Agreement concerning Development Impacts on Community Health in Kuujjuarapik (n=72)



The second statement most frequently agreed to (70.8%) concerned the likelihood of increased rates of STDs as a result of hydro development. Here people made reference to experiences with other construction projects where STDs seem to have been introduced to the community by workers from the south. The question of STDs is one that provokes some concern for many people. Elders have said that before there were regular contacts with white people there were no STDs. Again we see that people in the community place disease and risk into a historical context, which focuses on interactions between Inuit and southerners. Presently, the issue of AIDS is receiving a lot of attention in the north and condoms are widely available in public places. While fewer people agreed that the project could influence AIDS rates in the community than those who agreed that it could influence STD rates, they were still a majority (55.6%) and almost all of the remainder were uncertain (38.8%). The difference



between STDs and AIDS response rates may reflect the lower direct knowledge people have with the latter illness.

Three other statements in this table were agreed to by a majority of respondents. A little over half of the respondents (55.6%) agreed that people who work at the project would get mercury poisoning, 52.8% felt that more people in the community would get sick, and 51.4% felt that family violence would increase as a result of the project. This last statement represents a different order of experience by linking decreased social harmony to development. In several cases people underlined the association between powerlessness to stop development with an increase in family violence. When we look at the responses to the statement concerning increases in suicide we see the most divergence in responses. Roughly one third of people responded affirmatively, 41.7% were uncertain and 22.2% disagreed. Suicide is perhaps the most painful issue for northern communities to deal with and one that is difficult to resolve. The divergence in responses to this statement may reflect the overall uncertainty that people have in comprehending and stopping this most serious of problems.

The final three statements in this table are marked by a majority in the uncertain response category. The relationship between TB, Meningitis, birth deformities and industrial development are not commonly discussed in the community although the local experience with epidemic disease is considerable. Clearly people have not considered links between these diseases and hydroelectric development to the same extent that they have formed opinions around the effects on the natural environment and mercury poisoning for example.

Overall, the findings of the Kuujjuarapik survey suggest that there is a high degree on concordance in the community about the effects of hydroelectric development on the natural environment and on the possible health effects to people who consume animals from the

land. Less consistent are the responses to statements concerning social problems and disease issues within the community. In these questions there is substantially more variability of response and much higher rates of uncertainty.

In Sagkeeng First Nation, there is also a high degree of agreement concerning development impacts and their association with public health outcomes. The community, however, politicized their perception of risk as part of a general strategy to assert the right to self-government. The following event, attended by one member of the research team, illustrates the importance of understanding the politicization of risk perception.

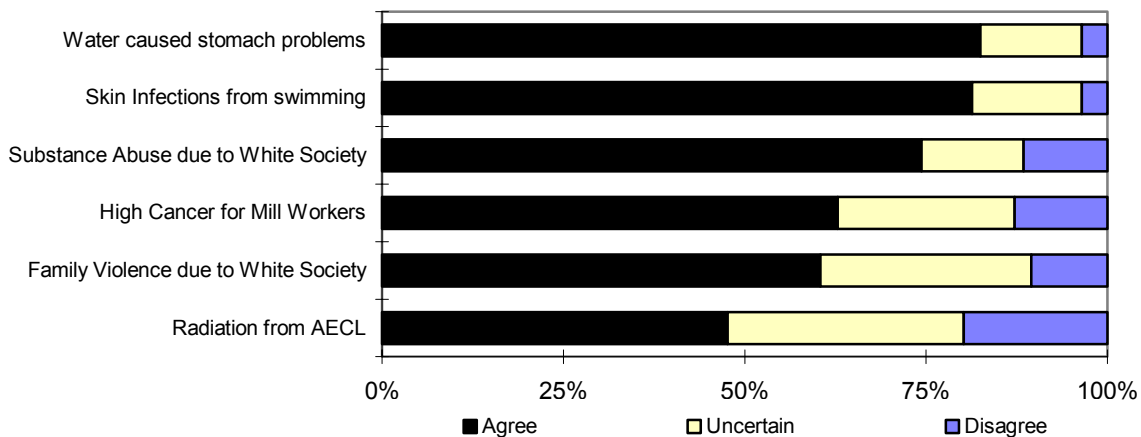
At the time of the research, a notice was circulated throughout the community notifying members of an emergency meeting scheduled to discuss water quality problems in Sagkeeng. The following is the text of this notice, which directly associates specific health outcomes with exposure to an insecure water source:

*The Sagkeeng Health Commission will be holding an emergency meeting at the Sagkeeng Arena Complex on Thursday, August 18, 1994 from 1:00 PM to 5:00 PM to discuss the serious problem of “water quality and safety.” This meeting is open to all members and we urge you to attend and share your concerns. Members of the Health Commission have been approached by an increasing number of Sagkeeng people who are deeply concerned about the rise of skin rash and stomach ailments affecting our children. Many others have expressed concern about additional chemical spills into our river by Abitibi. We believe that there are more problems with our children and our elders because of the water and we would like people to come out and speak about them. How will Sagkeeng deal with this serious matter? How will Sagkeeng ensure that our children and elders receive safe, clean water? How will Sagkeeng ensure that a proper, water delivery system is immediately established? We need your input so please make every effort to attend.*

At this meeting, health officials were present to discuss direct impacts on health, but also had to contend with the indirect impacts, such as heightened awareness of health issues in general. In Table 11, direct effects over-shadowed two major indirect effects often associated

with increased development. In the other case studies, we noted that respondents ranked “increased alcohol and substance abuse” and “increased family violence,” as the community health outcomes of greatest concern. In this community, these problems ranked significantly behind more direct health concerns associated with a contaminated water supply.

*Table 11: Sagkeeng Agreement with Statements concerning Development Impacts on Community Health (n=86)*



Instead, skin and gastrointestinal problems were of more concern during the research period. Respondents overwhelmingly agreed (ranging from 81.4% to 82.6%) that tap water, river water, and water polluted by sewage can cause health problems. Respondents were less certain about the relationship between water quality and chronic health conditions, although nearly half of respondents did agree that there might be a causal relationship between cancer and water taken upstream near the pulp mill. This inference is most probably a product of the increased awareness of the link between health conditions and chemicals entering their water supply, regardless of whether the link is bio-medically or toxicologically valid. When we contextualized the risk as an effect experienced by mill workers, agreement nearly doubled. Sixty-two per cent were of the opinion that workers at the mill were at risk of developing

cancer. This link is largely due to a perception that workers tend to receive higher exposures to chemicals in the workplace. Respondents also expressed concern over the potential impact of radiation, associated with activities conducted at the Atomic Energy Commission of Canada research facility located upstream in Pinawa. Forty-seven per cent agreed that the community should be concerned, but again many (32.6%) were uncertain. At the time of the research, respondents were just beginning to become aware of the many risks associated with radiation.

### **LOCAL KNOWLEDGE AND RISK PERCEPTION**

We have identified a variety of patterns of risk perception in Wollaston Lake, Kuujjuarapik and Sagkeeng First Nation. In this section, we describe local knowledge processes and contrast them with scientific accounts of environmental impacts. Additionally, we review the role of locally available sources of information about environmental change in shaping risk perception by people in the community.

There is a growing appreciation in the scientific community for what was once considered folk knowledge. A number of traditional ecological knowledge projects in Aboriginal communities around the country demonstrate the contribution that local knowledge makes in broadening our understanding of impacts on wildlife populations (Kuhn and Duerden, 1991).

In many cases Aboriginal hunters have easily been able to clarify points of animal behavior, ecology and status on which biologists and others have incomplete information. While it is important to understand the status of animal populations, it is equally important to consider the relationship between the animal and the human. In contrast to the reductionist approach of science, people in Kuujjuarapik, Wollaston Lake, and Sagkeeng First Nation did not tend to see an animal or species as a conceptual isolate but rather as a series of interactions between

other animals and people. In this sense the scientific discourse on environmental impacts, which centers on the definition of territory into discrete units, of ecosystems, marine environments or drainage basins, species and so on, runs against Aboriginal comprehension of nature. In this view all ecosystems are linked, as are all animals. Terrestrial mammals will walk on the ice surface, drink from lakes and will be eaten by other animals, which cover equally large territories. Rain falls on the land and the water without respect to boundaries and marine mammals will move at their own will anywhere in the environment. It is from this perspective that people feel that local source contaminants will be transported far from origin causing the flora and the fauna to be affected.

From this perspective there is little doubt as to why many people view scientific assessment of impacts on animal populations from development with skepticism. For many Aboriginal peoples, the imposition of quotas and other restrictions on their harvesting of wildlife are, at best, misguided acts of badly informed administrators and, at worst, blatant attempts to control and change the Aboriginal lifestyle through the assessment of wildlife populations for purely political purposes. Risks to wildlife come not from natural phenomena like hunting but from the irrevocable unnatural destruction of habitat. In contesting the development of hydroelectricity and uranium mining, people in Kuujjuarapik, Wollaston , and Sagkeeng First Nation Lake are also questioning the legitimacy of southern understandings of the dynamics of the natural world.

## **CONCLUSIONS**

In this paper, we have described a distinct pattern of perception regarding traditional land use activities and community health risk. A pattern that suggests that the Denesuline, Inuit, and

Anishnabe have long practiced cultural risk assessment, management, and communication activities. It appears that traditional land use knowledge is used to mitigate the dangers of land use activities, providing caution is exercised. Reliance on this knowledge has created confidence in that community members are quite secure in their ability to assess an impact to their health, especially when they draw upon traditional knowledge.

Small but nonetheless considerable levels of uncertainty also suggest that perception is context specific, and that it can converge with other cultural knowledge systems, like those of Western society. Relatively high levels of uncertainty also suggest that uncertainty in risk perception is part of a cultural approach to survival and should be viewed positively. However, there is also a great amount of uncertainty and divergence in opinion when people lack either historical or recent experience with a potential environmental health threat. To some extent, Western explanations are adopted and adapted when they are compatible with local cultural understandings. However, uncertainty is enhanced when local cultural and Western explanatory frameworks are either in conflict, or, as is usually the case, simply unconnected.

Risk perception is therefore a product of several key factors. First, traditional cultural understandings of risk include relatively high levels of uncertainty that place positive value on remaining open to contingency and context. Second, when particular health problems are significant to the community, these problems are likely to be strongly associated with general environmental threats. Third, people maintain a high level of confidence in their ability to detect problems in their food and other “traditional activities,” and are relatively resistant to external information which may suggest health risks. Finally, uncertainty as a positive traditional value when compounded with conflicting, scientific information creates enormous ambiguity in risk perception.

When comparing the three case studies for policy implications, several points emerge. The Sagkeeng case study suggests that the longer a community is involved in resisting environmental threats, the more politicized the issues become, with a resulting decrease in uncertainty around associated social health risks. A decrease in uncertainty usually means that perceptions of danger increase.

Comparison of the three case studies also suggests that risk perceptions shift from a more traditional approach based on an awareness of context and contingency, to an approach consistent with general political opposition to escalating threats to the community's political autonomy, when industrial development activities ignore or insult local knowledge. This shift was particularly apparent in Sagkeeng First Nation where the long history of opposition to a series of environmental threats has resulted in a marked increase in perceptions that industrial activities are dangerous to the health and well-being of the community.

However, although this comparative study suggests that perceptions of danger increase in a political context of high resistance, all three case studies confirm the general finding that local Aboriginal approaches to risk perception place high value on remaining open to contingency and context. People in all three communities tend to be unwilling to make definitive statements about potential dangers associated with various aspects of industrial activities without full knowledge of the particular circumstances. This general approach is highly consistent with traditional cultural approaches to risk management in everyday life. It stands in marked contrast to both scientific approaches which value certainty and uniformity in risk assessment (despite often conflicting evidence), and to the general Western cultural approach which tends to be highly symbolic and ideological rather than grounded in the specifics of each case.

These results suggest several particular recommendations for those involved in risk assessment and management of environmental threats in Aboriginal communities. First, the general framework currently is to consider the problem of uncertainty and resistance as one of lack of accessible scientific information in Aboriginal communities. Efforts to “simplify” scientific information for community consumption are currently the dominant approach in the risk communication environment and are expected to solve the problem of resistance and uncertainty in Aboriginal communities. This study suggests these efforts are a monumental waste of resources and are likely to have little positive benefit for impacted communities. Indeed, we suggest that if anything, this approach to risk communication will likely produce the opposite effect of increasing resistance to industrial developments, as perceptions of associated dangers are likely to increase in the context of political resistance to the colonizing effects of forms of knowledge which are viewed as state supported. Instead, risk communication strategies which value local cultural approaches to risk assessment, will approach the instrumental task of risk management as a process of demonstrating respect for local understandings which situate environmental threats holistically in both an ecological and historical sense. In practical terms, the problem is not one of fostering simple scientific understandings in Aboriginal communities, but one of fostering simple cultural understandings among scientists.



## REFERENCES

Brown, P., "Popular Epidemiology and Toxic Waste Contamination: Lay and Professional Ways of Knowing," *Journal of Health and Social Behavior*, Vol. 33 (September), 1992.

Brown, P. and Mikkelsen, E.J., *Toxic Waste, Leukemia, and Community Action*, Berkeley: University of California Press, 1990.

Bullard, R.D. *Dumping in Dixie: Race, Class, and Environmental Quality*, Boulder, Colorado: Westview Press, 1994.

Canadian Environment Assessment Research Council (CEARC). *Human Health and Environmental Impact Assessments: A working paper based on discussion at the first three of four regional workshops*. September 12-13, 1989. Halifax, Nova Scotia.

Douglas, M. and Wildavsky, A., *Risk and Culture*. Los Angeles: University of California Press, 1983.

Ecologistics Limited. *Assessing Cumulative Effects of Saskatchewan Uranium Mine Development. Prepared for the Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan*. December, 1992.

Fiorino, D. J., "Technical and Democratic Values in Risk Analysis," *Risk Analysis*, Vol. 9, No. 3, 1989. p. 296.

Jasanoff, S., *The Fifth Branch: Science Advisors as Policy Makers*, Cambridge, Massachusetts: Harvard University Press, 1990.

Johnson, B.B. and Covello, V.T. (eds.). 1987. *The Social and Cultural Construction of Risk*. Dordrecht: D. Reidel Publishing Company.

Joint Federal-Provincial Panel on Uranium Mining. *Transcript of the Public Hearings held by the Joint Federal-Provincial Panel on Uranium Mining Development in Northern Saskatchewan on the Cluff Lake, McClean Lake and Midwest Venture*. April 14, 1993.

Kuhn, R. G. and Duerden, F., A Review of Traditional Environmental Knowledge: An Interdisciplinary Canadian Perspective. *Culture*. Vol. 16(1), 1996: 71-84.

O'Neil, J., Yassi, A., and Elias, B.D., *Cultural Environmental Health Risk Perception in the Canadian North*. Circumpolar Health 96. Proceedings of the 10th International Congress on Circumpolar Health, Anchorage, Alaska (U.S.A.), May 19-May 24, 1996.

Paustenbach, D.J., *The Risk Assessment of Environmental and Human Health Hazards: A Textbook of Case Studies*, New York: John Wiley & Sons, 1989.

Rappaport, R.A., Toward a Postmodern Risk Analysis, *Risk Analysis*, Vol. 8(2), 1994.

Shrader-Frechette, K.S., *Risk and Rationality: Philosophical Foundations for Populist Reforms*, Berkeley: University of California Press, 1991.

Throgmorton, J.A., The rhetorics of policy analysis, *Policy Sciences*, Vol. 24: 153:179.

Webler, T., and Rakel, H., and Ross, R.J., "A critical theoretic look at technical risk analysis," *Industrial Crisis Quarterly*, Vol. 6, 1992.