USING TRADITIONAL ENVIRONMENTAL KNOWLEDGE AND A GEOGRAPHICAL INFORMATION SYSTEM TO IDENTIFY SITES OF POTENTIAL ENVIRONMENTAL CONCERN IN THE TRADITIONAL TERRITORY OF THE OUJE-BOUGOUMOU CREE

Eric P. VanSpronsen, Leonard J.S. Tsuji, Harry Manson
Department of Environment and Resource Studies
University of Waterloo
Waterloo, Ontario
Canada, N2L 3G1

Joseph Shecapio-Blacksmith and Tommy Rabbitskin
Cree Nation of Ouje-Bougoumou
Ouje-Bougoumou, Quebec
Canada, G0W 3C0

Abstract / Resume

The Cree Nation of Oujé-Bougoumou had concerns about the impact of mining on the environment; thus, a traditional land use study was initiated to document potential sites of concern (SOC) in the Ouje-Bougoumou territory. SOC refers to any site that an individual and/or their family had observed and felt concerned about from an environmental health perspective. Seventy-two head-of-household participated; 42 identified at least one SOC in their interview. A total of 90 SOC were identified corresponding to 73 environmental concerns, and 66 unique SOC; some were identified by more than one person.

La nation crie d'Oujé-Bougoumou est préoccupée des incidences de l'exploitation minière sur l'environnement. C'est pourquoi on a entrepris une étude de l'utilisation traditionnelle des terres afin de documenter les emplacements inquiétants potentiels sur le territoire de la nation crie. Un emplacement inquiétant fait référence à tout endroit observé par une personne ou sa famille qui se préoccupe de la salubrité de l'environnement de l'emplacement. L'étude a engagé la participation de 72 chefs de ménage, dont 42 ont indiqué au moins un emplacement inquiétant au cours d'une entrevue. Les entrevues ont permis de recueillir 73 préoccupations environnementales qui ont cerné un total de 90 emplacements, soit 66 emplacements distincts (certains ont été indiqués par plus d'une personne).

The Canadian Journal of Native Studies XXVII, 1(2007):189-205.

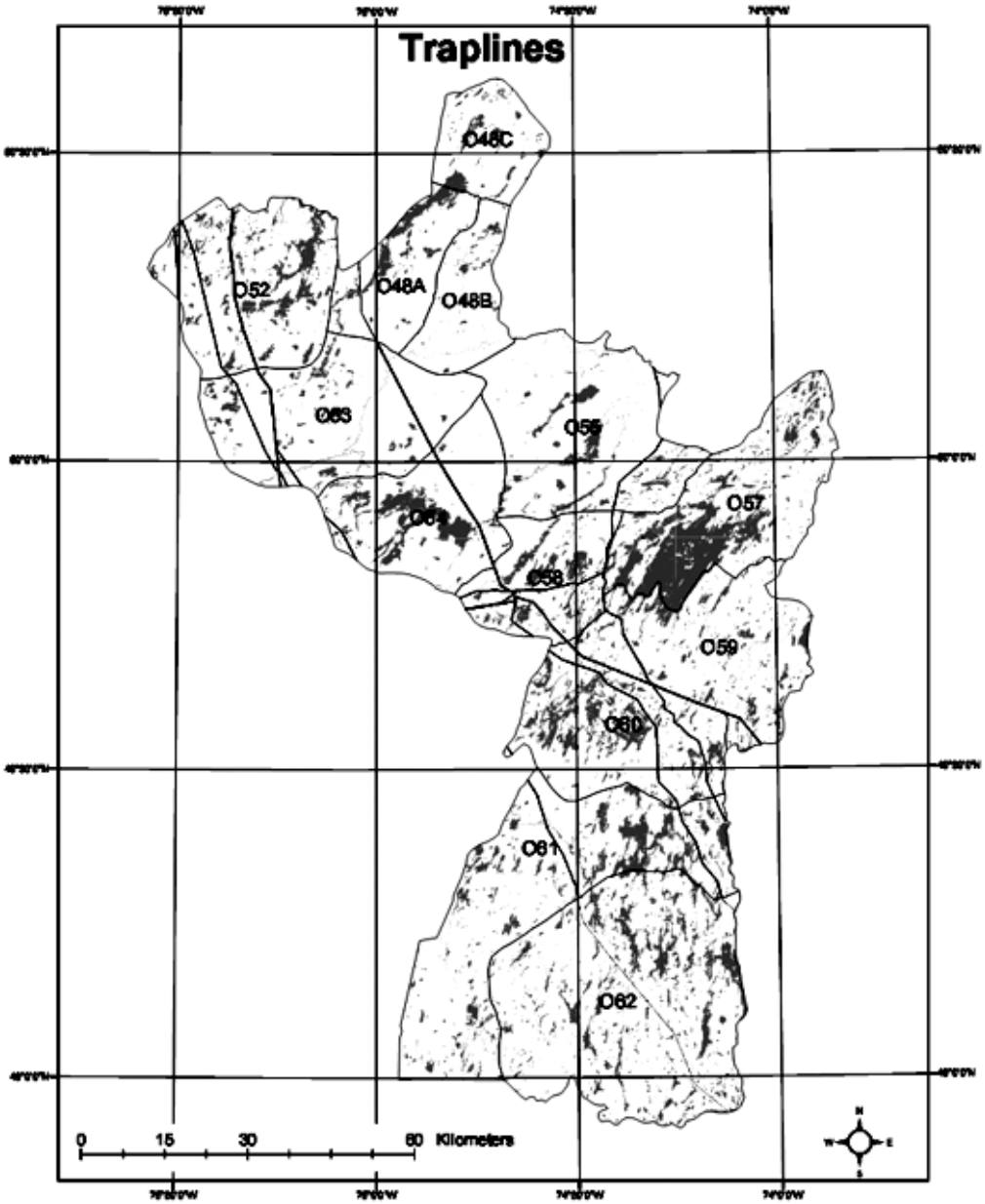
Introduction

The Cree Nation of Oujé-Bougoumou is located in the south-eastern James Bay region of northern Quebec, Canada. Since the early 1950s, the mining industry has extensively explored the traditional territory of Oujé-Bougoumou for various metals (e.g., gold, copper). The result of these explorations has been the establishment of more than 20 mines in the area and seven major relocations of the Oujé-Bougoumou community (Frenette, 1985). After many years of turmoil, the Oujé-Bougoumou community negotiated an agreement that provided for the construction of a permanent village in a location of their choice; construction of the village commenced in 1990 and was completed in 1992. Within 10 years of living in their new community, the Oujé-Bougoumou people became concerned about the health of the fish and animals in a number of their traditional harvesting areas. The people believed that past and present mining activities were having a detrimental effect on the environment and consequently all organisms. As the Oujé-Bougoumou people still practice subsistence harvesting, the people were concerned about environmental health issues related to past and present mining activities (e.g., waste water containment areas) in their traditional territory.

The traditional territory of the Ouje-Bougoumou Cree is composed of 13 traplines (i.e., trapline # 048A, 048B, 048C, 052, 053, 054, 055, 057, 058, 059, 060, 061, 062; Figure 1). A trapline can be defined as a circumscribed area where harvesting and gathering activities of First Nation Cree occur in the James Bay region of northern Quebec, Canada (Feit, 1973, 1986; Speck, 1973; Tanner, 1973, 1983). Harvesting activities in each trapline are supervised by one tallyman/steward/shooting (hunting) boss/"owner" per trapline (Frenette, 1985; Feit, 1989, 1991; Scott, 1986, 1996). A tallyman is recognized by the community as being responsible for wise resource use of a specific trapline (Feit, 1982, 1989). This type of hunting territory system was formally recognized by the Governments of Quebec and Canada in the 1930s (Feit, 1982; Scott, 1982, 1989), and in the Canadian Constitution (1982) through the signing of the James Bay Northern Quebec Agreement of 1975 (Feit, 1989).

In response to the concerns of the Oujé-Bougoumou community and a preliminary environmental health study (Covel and Masters, 2001), a comprehensive health study was initiated in the fall of 2002. This study assessed the general health status of the people of Ouje-Bougoumou including body burden of metals (e.g., mercury, lead, arsenic, copper, selenium) and organochlorines (e.g., PCBs, DDT – there was some indication that these compounds may be an issue in the region; Laliberté and Tremblay, 2002) and compared results to a control community, Nemaska (Dewailly et al. 2005). The Ouje-Bougoumou health study was

Figure 1
The 13 Traplines That Make up the Traditional Territory of the Ouje-Bougoumou Cree (Tsuji et al. 2007)



completed in August of 2003 and concluded that the metals that would be signatures of the mine wastes were at normal levels in the Oujé-Bougoumou people; however, methyl mercury, PCBs and DDT levels were elevated and comparable to those reported for Inuit of northern Canada (Dewailly et al. 2005). Other contaminants that were found to be of concern were lead and cadmium; however, the sources of these toxic metals in First Nation communities have been shown to be primarily associated with the use of leaded ammunition (e.g., Tsuji and Nieboer, 1997; Tsuji et al. 1999, 2001) and smoking, respectively (Dewailly et al. 2005). Taking into account that the metals associated with mining activity in the Ouje-Bougoumou traditional territory were found not to be of concern, other environmental contamination issues were raised. Thus, a recommendation that arose from the Oujé-Bougoumou health assessment report was that an integrated risk assessment (IRA) would be appropriate, because this holistic approach would take into consideration not only the health of the Oujé-Bougoumou people, but also the health of the environment (Figure 2).

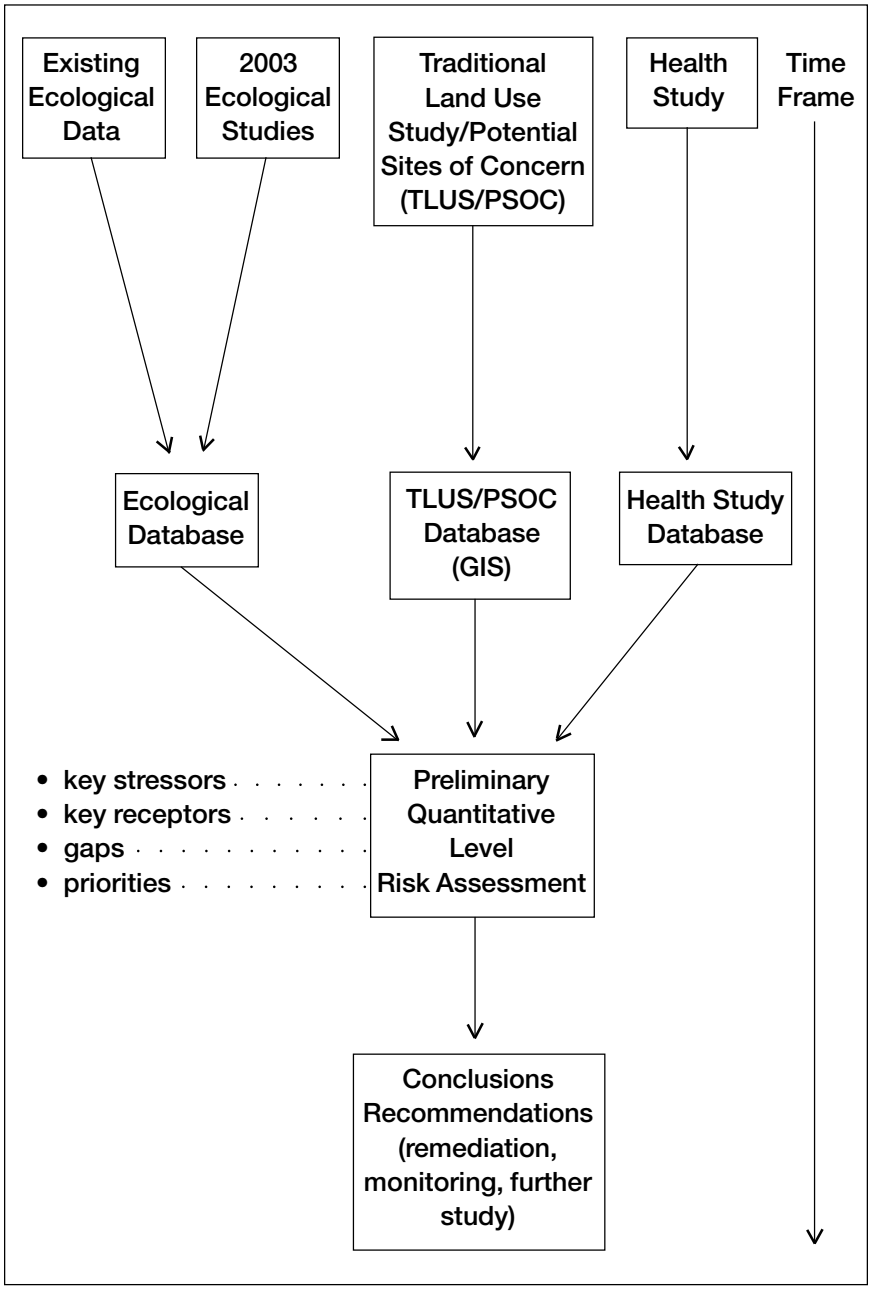
The IRA includes the completed Oujé-Bougoumou *Exposure and Preliminary Health Assessments* project (Dewailly et al. 2005), the environmental database project (to be completed – an assessment of all environmental studies already conducted in the Oujé-Bougoumou territory), and a traditional land use study (TLUS). The TLUS was proposed and conducted in response to concerns voiced by Oujé-Bougoumou people during community meetings in the summer of 2002 with respect to two different environmental issues: i) traditional land use in the Oujé-Bougoumou region as related to potential exposure to contaminants from mining sites; and ii) other potential sites of concern (SOC) that have not been previously documented in the Oujé-Bougoumou territory (e.g., old dump sites, discarded oil drums). In this paper, we identify and document SOC in the traditional harvesting area of the Ouje-Bougoumou Cree using traditional environmental knowledge (TEK) and western science as complementary sources of knowledge. For the purpose of this paper, SOC refers to any site that an interviewee and/or their family had observed and felt concerned about from an environmental health perspective in their traditional harvesting territory. This study represents one part of the larger TLUS conducted in the community of Oujé-Bougoumou, Quebec.

Methods and Analyses

Questionnaire

The data were collected through administration of a questionnaire (with open-ended questions and maps of their respective traditional

Figure 2
Visualization of the Oujé-Bougoumou Integrated Risk Assessment (TLUS, Traditional Land Use Study; PSOC, Potential Sites of Concern; GIS, Geographical Information System; Anonymous, 2002)



harvesting areas) that was designed in partnership with the Cree Nation of Oujé-Bougoumou. The data collected can be classified as TEK. As stated by the Dene Cultural Institute, "TEK is a body of knowledge and beliefs transmitted through oral tradition and first-hand observation. It includes a system of classification, a set of empirical observations about the local environment and a local system of self-management that governs resource use" (as cited in Stevenson, 1996).

The field work was conducted during July and August of 2003 to ensure the majority of the potential participants were in the community and not in the bush participating in cultural activities. Potential participants for the study were the heads of households in the Oujé-Bougoumou community and were potential harvesters (>18 years of age). All households in the Oujé-Bougoumou community were approached to participate in the study. Contact was attempted a minimum of three times to ensure all potential participants had equal opportunity to participate. Households that did not harvest in the Oujé-Bougoumou traditional territory were excluded from the study, including both First Nation families with traditional hunting grounds outside of the Oujé-Bougoumou traditional territory, households where all members were non-Native, and households that did not partake in harvesting activities. At the request of the Ouje-Bougoumou Band, special emphasis was put on ensuring all tallymen from the 13 traplines of the Ouje-Bougoumou Cree were interviewed. This request was made because tallymen have historically possessed specialized knowledge of their respective territories; in the past, the talleymen knew all activities that were carried out on their land by other community members, non-Natives, and industry (Feit, 1973, 1982, 1986; Scott, 1982, 1986).

Initial contact was made with potential participants by phone or by a home visit when a phone was not available at home. Appointments were scheduled to be conducted either at the field coordinator's office in the community's healing center or at the interviewee's house. The field coordinator conducted all interviews with the help of an assistant, a respected member of the Oujé-Bougoumou community. The assistant also provided translation when necessary. The questionnaire was administrated orally by the field coordinator and all SOC were recorded on a map (generated from 1:50,000 NTS maps). Specific details about the sites were recorded on paper by the field coordinator. Information was acquired through an open-ended question, asked in two stages: i) Have you seen any sites that you or your family members are concerned about in your traditional hunting territory? and ii) If so, please identify them on this map and describe why you or your family members feel they are of concern.

Land-Use Maps

The maps used were provided by the Oujé-Bougoumou Forestry Department. During the planning phase of the study, community members insisted that these maps be utilized as the participants were familiar with their scale and detail. Community members identified which trapline map(s) would be appropriate for the interviewing process. The maps were printed such that one trapline fit exactly onto one sheet of 34" by 44" plotter paper to allow for the majority of an entire interview to be completed on one map. Features on these maps included identifiable characteristics, such as, hydrology, topology, roads, power lines and some mines.

The Geographical Information System

The spatial information collected as part of the interview process was used to develop a comprehensive traditional land use geospatial database. The TEK database is geospatial in nature as respondents were asked to locate SOC on each of the printed maps corresponding to each of the activities identified during the interview. The various sites identified physically on each map were then translated to a series of spatial data themes corresponding to points, lines and areas using ArcGIS version 8.3 and the digital versions of the base maps as a reference. Sites were entered by manually digitizing the relevant areas identified by the participants. Relevant spatial information varied with respect to geometry and in many cases spatial information was related to various natural features, such as, surface hydrology and topography as well as anthropogenic features (e.g., hydro lines, logging roads). As such, separate spatial themes for area, line and point SOC were digitized. Each theme was coupled with a personal geodatabase containing attribute information gathered from each interview and built within Microsoft Access. The geodatabase was multi-tiered and relationships were built around a primary data table that identified a single record for each activity identified in the interview. Each record in the activity table was associated with the feature ID number (FID #) of the relevant shape identified by the participant on physical maps of the area and digitized using the GIS. Other information contained within the activity table included the interview number, the chronological number of the site identified during the interview, and the particular type of the SOC.

Various codes were developed to identify a particular SOC (Table 1). Because many of the participants are active in similar regions of the traditional territory, many of the sites of concern within the database were identified by more than a single participant. SOC were mapped

Table 1
Summary of the Potential Sites of Concern (SOC) by Category

Code	Type	Number of Identified SOC	Number of Environmental Concerns
1. Mining			
Mfu	Future Mining	1	1
Mpr	Present Mining	20	11
Mpa	Past Mining	9	5
Ww	Wastewater Ponds	3	2
Wwd	Wastewater Discharge	1	1
2. Industrial			
De	Development	2	2
Ac	Abandoned Camp	3	3
As	Abandoned Site	1	1
Ed	Environmental Disturbance	1	1
Co	Commercial	7	7
Tr	Transportation	1	1
3. Hazardous Waste			
Pc	Petroleum Chemicals	5	5
Dr	Drums	9	9
DrO	Oil Drums	6	5
Drf	Fuel Drums	4	2
Se	Sewage	1	1
Ir	Industrial Residue	2	2
Ot	Other	3	3
4. Non-Hazardous Waste			
Lf	Landfill	6	6
Ga	Garbage	2	2
5. Unknown (uk)		3	3
	Total:	**90**	**73**

using ArcGIS 8.3. This was achieved by coupling the database with the GIS, linking the attribute information with the spatial data and associating a relationship between the FID in the spatial data and the corresponding identification in each a-spatial record. Relevant information was then identified by querying for all SOC within each of the point, line and area themes. SOC corresponding to each relevant spatial theme were then mapped by co-displaying the SOC with the various traplines within the Oujé-Bougoumou traditional territory and classifying each area based on the corresponding SOC type code.

Results

Participation Information

Of the 158 houses in the Oujé-Bougoumou community, three had no residents during the field work period. Of the remaining 155 households, 125 (according to Band personnel) participated in traditional activities in the Oujé-Bougoumou traditional territory. All 125 households were approached to participate in the study resulting in 71 (56.8%) completed head-of-household interviews, one (0.8%) partly completed interview, 14 (11.2%) households declining participation, and 39 (31.2%) having a minimum of three attempted contacts. Of the 72 head-of-household participants, 21 (29.2%) were female and 51 (70.8%) were male. The average age of the participants was 39.5 (female, 38.6; male, 39.9). All 13 tallymen were also interviewed and all were male with an average age of 53.9 years.

Potential Sites of Concern

Of the 72 study participants, 42 (58.3%) identified SOC in their interviews. The average age of respondents that identified SOC was 45 years of age. Of the participants that identified SOC in their interview, the average was 2.09 SOC per interview with a range of 1 to 6. A total of 90 SOC entries were made in the GIS database, corresponding to 73 environmental concerns (Table 1) and 66 unique SOC; several SOC were identified by more than one person. The average number of SOC for the 13 traplines is 6.08 per trapline (range, 0 to 19).

As an example of the data gathered, the SOC identified in Oujé-Bougoumou Traplines O60, O61 and O62 are spatially displayed in Figure 3, with their corresponding SOC numbers. A written summary of the SOC for the three traplines found in Figure 3 is provided in Table 2. All SOC identified for all traplines plus the written summaries are found in the Appendix.

Some of the more noteworthy SOC identified by community mem-

Figure 3
Potential Sites of Concern (SOC) Map for
Traplines O60, O61 and O62

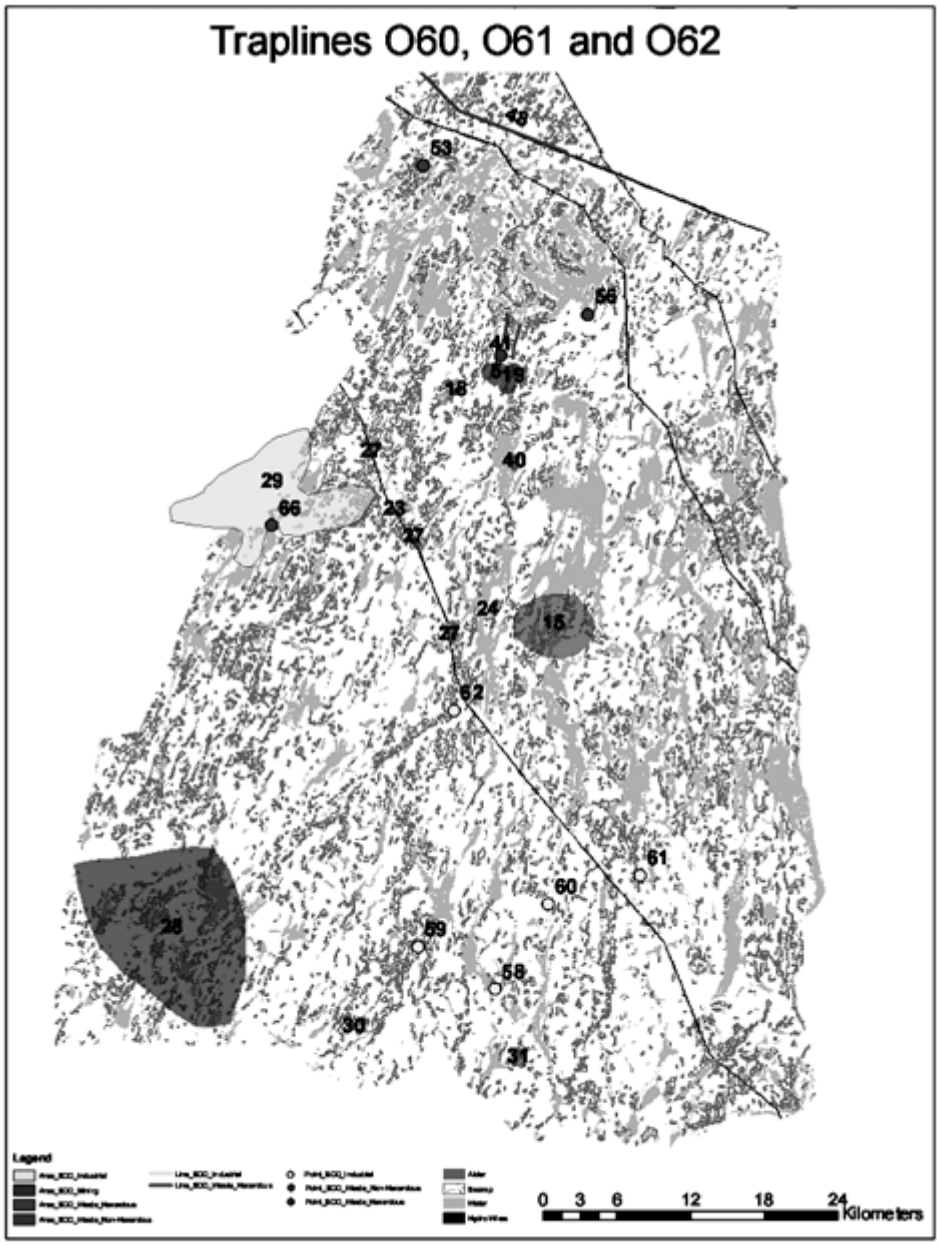


Table 2
Potential Sites of Concern (SOC) Identified in Traplines O60, O61 and O62

SOC Category	Numbers in Figure 2	Description
Mining	5, 18, 19	This category includes all past, present, and future mining sites as well as waste-water and tailing ponds associated with the mines
Industrial	24, 29, 58, 59, 60, 61, 62	This category includes all industrial and commercial sites such as forestry camps, hydro stations and saw mills
Hazardous Waste	27, 28, 30, 40, 41,48, 53, 56, 66	This category includes all sites that have been identified as being associated with hazardous waste such as oil and fuel drums and industrial residues
Non-Hazardous	15, 23, 31	This category includes all sites that have been identified as being associated with nonhazardous waste such as landfill sites and garbage dumps
Unknown	none	This category includes all sites that have been identified on the map, but the site descriptions are missing

bers include: i) sites with buried 45-gallon drums that leak oily substances to the surface; ii) lakes around specific commercial operations that have turned orange-red in colour; and iii) lakes that have an oily film on them after the area has been deforested.

Discussion

In the published literature, participation rates for TLUSs have been reported in the range of 40-70% (Ames, 1977a; Ames, 1977b; Berkes, 1995). Our participation rate of 57% falls into this range. It should be noted that every attempt was made to include all eligible households in the Oujé-Bougoumou study.

It is clear from the present study that many sites exist within the Oujé-Bougoumou traditional territory that are of concern from an environmental health perspective; moreover, ~60% of the reported SOC were not directly related to mining activities (Table 1). Using TEK to document

SOC, by entering them into a GIS database, will allow the data to be incorporated into the Oujé-Bougoumou IRA (Figure 2). TLUS data (especially harvest data when overlain SOC and known sites of concern geospatial data) can be used to identify potential key stressors and receptors in the environment, identify gaps in knowledge (e.g., potential routes of human exposure) and set priorities for action. In this manner, the SOC data generated by the present study (in concert with the harvest data) can help link the ecological database (when it is available) with the human health and exposure assessments projects (Dewailly et al. 2005), ultimately leading to an environmental health risk assessment of mine waste residues and other sources of contaminants in the Oujé-Bougoumou traditional territory.

The source of contamination for individuals with elevated body burdens of specific contaminants, as established in the health study database, can be explored by examining their major harvesting areas (and species harvested) in relation to SOC and identified areas of contamination; that is, areas of overlap can be ascertained for different layers in the GIS database that correspond to harvesting activities and any SOC and identified areas of contamination. If trends are determined between a number of participants and the proximity of their harvesting activities to a specific SOC, environmental testing could be conducted to confirm if the site is a source of the contamination. This is especially important to the Oujé-Bougoumou community as the environmental source of PCBs and other persistent organic pollutants such as DDT has not been definitively identified (Dewailly et al. 2005). However, the socially and culturally-rooted custom of sharing of wild game in James Bay Cree (Feit, 1986, 1991; Scott, 1989, 1996; Tanner, 1973) may obscure any of these potential associations. In addition, linking of the data from the three Oujé-Bougoumou projects (ecological database, TLUS, health study; Figure 1) may be hindered due to confidentiality of data issues, especially with respect to the human health study.

Recommendations that come out of this part of the TLUS project are that site verifications for SOC with the global position system (GPS) should be conducted by Oujé-Bougoumou Band personnel, to ensure the accuracy of the sites in the GIS database, only after the SOC have been prioritized. Prioritizing identified SOC is especially important with respect to optimal use of limited resources. Once the existing ecological database for the Oujé-Bougoumou territory has been collected and collated, data from the published literature can be overlain onto the layer containing the SOC to investigate whether elevated levels of contaminants in the environment can be attributed to any of the SOC identified in the present study.

These SOC would have been undocumented if TEK and western science had not been used in a complementary fashion as suggested by several researchers (Hobson, 1992; Tsuji, 1996; Tsuji and Ho, 2002). By using both knowledge systems (TEK and western science), a more complete understanding of potential sources and routes of exposure may be obtained for the Oujé-Bougoumou region, as well as physical hazards. Thus, First Nation as well as government groups will have more data on which to make informed decisions that may potentially impact First Nation culture, health and socio-economic status. Indeed, potential sources of contamination (and physical hazards) have been identified by the land users themselves and the means to address their concerns are available. The importance of community involvement cannot be overemphasized. Participants were thankful for the opportunity to express their concerns for their land in a formal setting where they were guaranteed that the information would be documented and reported.

Lastly, as summarized by Berkes et al (1994), land use studies have commonly been used to document Native land claims, fulfill environmental impact assessments, document harvests in terms of their nutritional contributions, socioeconomic importance and cultural value, and a few studies have addressed how harvesting contributes to regional economies and how traditional pursuits link to sustainable development strategies. However, an area of application that has not been adequately addressed is the potential of utilizing Native land use studies to document sites of environmental concern. To our knowledge, only three studies of this type have been conducted: 1. The Kinney et al. (1997) study used a GIS to encode existing PCB data and superimpose it over residential locations to identify potential sites of exposure. TEK was not used. 2. Tsuji et al. (2001) used TEK to identify SOC as related to buildings and material originating from a contaminated radar line site, Mid-Canada Radar Line Site 050, in the Western James Bay region of northern Ontario, Canada. While TEK was used to document SOC, western science was needed to confirm the presence or absence of contaminants at these sites; both types of knowledge were used to provide information not available to the other system of knowledge. 3. In the Tsuji et al. (2006) Anderson Island study, land use data were collected, collated and overlaid onto known contaminant spatial data and identified potential routes of contaminant exposure for people of Fort Albany First Nation. Harvesting data identified the need to sample terrestrial receptors (e.g., snowshoe hares, *Lepus americanus*), water (e.g., a spring on the contaminated site) and the aquatic ecosystem surrounding the contaminated area. Taking into account that many Native communities in North America are located near (or downstream from) contaminated areas

(Kinney et al. 1997), environmental health studies (such as described above) that utilize both TEK and western science in a complementary fashion should become more common in the future.

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Acknowledgements

We would like to thank Chief & Council of the Cree Nation of Oujé-Bougoumou for support of the project and all members of the Oujé-Bougoumou community who participated. Special thanks to Anna Bosum, Kenny Mianscum (and his family), and Paul Wertman for their contribution to the success of the project.