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Data Collection and Spatial Analysis for Value Assessment of First Nations Environmental Livelihoods in Northeast British Columbia

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ABSTRACT

Industrialization in Canada influences the environmental livelihood of First Nation (FN) peoples. We developed a spatial survey to examine the livelihoods of three FN communities located in northeast British Columbia. A wildlife harvesting geodatabase was created to assist analyses of harvesting patterns. Hotspot analysis revealed regions most frequently used by FNs for hunting close to FN communities and directional analysis indicated the direction of use. We found that sport hunting outperformed FN moose harvesting and identified the disused area of previous hunting grounds. These findings will assist the British Columbia government regarding the cultural impacts from industrial development in the northeast British Columbia.

1. Introduction

Indigenous people have lived in British Columbia (BC) for more than 10,000 years. They developed societies, cultures, territories, and laws. Today, there are 198 distinct First Nations (FNs) in BC, each with unique traditions and history. As population increased over this time, the exploitation of natural resources increased and this has had a environmental impact on the livelihood of indigenous peoples, particularly those who choose a traditional relationship with the land (Booth & Skelton, 2011).

A Regional Strategic Environmental Assessment (RSEA) was launched in northeastern BC in 2016. This collaboration was among seven Treaty 8 FNs and the Province of BC. This collaboration seeks to generate information regarding cumulative impacts in the Treaty 8 territory that would be used to mitigate potentially adverse impacts on FN rights and

environmentally-based livelihoods. In this context, environmental livelihoods include hunting, fishing, gathering, and other land-based activities.

identify the locations of FN wildlife harvesting. According to our household survey, the impact of sport hunting on moose caused great concern to FNs as

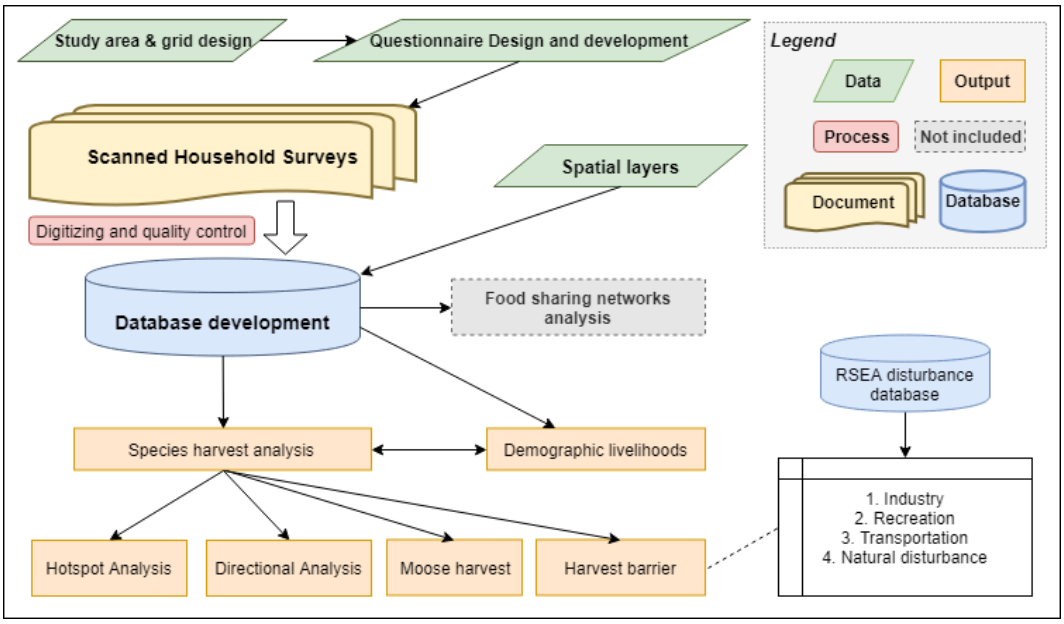

Figure 1 Project flowchart

At the request of the RSEA Management Committee, this project set out to collect and organize information related to the values and traditional land use activities of the three FNs in Northern BC: West Moberly First Nations (WMFN), Saulteau First Nations (SFN), and the McLeod Lake Indian Band (MLIB). To achieve the research goal, a geographic information system (GIS) was used to develop a FN wildlife harvesting geodatabase, analyze harvesting patterns, and investigate the barriers First Nation hunters experience in accessing their traditional lands.

2. Methods and Data

A flowchart of project activities is shown in Figure 1. We developed household survey of wildlife harvesting and food sharing networks. Then we digitized and geocoded the survey data in ArcGIS to prepare the database. Hotspot and directional analysis were used to

moose was their main food source. Therefore, the pressure that sport hunting asserted on FN moose harvesting was investigated. Last, the RSEA disturbance database was used to study the hunting barriers identified by FN participants. The geodatabase and analysis results will be released in a publicly accessible Web GIS platform shortly.

2.1 Study area

Figure 2 shows the study area (outlined in red) located within the territory covered by Treaty 8. As shown in Figure 2, the main community of SFN has a population of 380 people and 125 households (Statistics Canada, 2016a), is situated in northeastern BC at the east end of Moberly Lake. The WMFN has a population of 140 people and 40 households (Statistics Canada, 2016b) and is located just west of the SFN. The MLIB, has a total population of 87

people and 45 households (Canada, 2016c), is located to the south of SFN and WMFN on Highway 97. As data concerning the MLIB is still being processed, we discuss only results regarding the SFN and the WMFN.

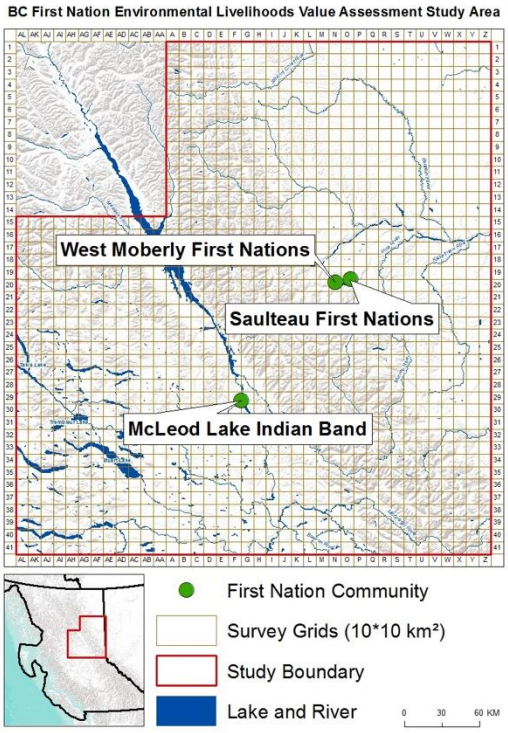

Figure 2 Study area map

To assess the geographical distribution of land use and hunting efforts, the study area was overlaid with a contiguous 10x10 km² grid to record harvesting in the questionnaire.

2.2 Questionnaire design and survey conduct

The survey was divided into three sections: Section 1 identified household demographic information, including the number, age, gender, and employment of household occupants. Section 2 focused on wildlife harvesting. The number, types, and locations of animals and plants harvested by households during the preceding year (according to memories of male and female heads-of-households) were recorded on a modified 10x10 km² grid over the study area (Figure 2). Previous research has shown the recall of FN hunters to be detailed and accurate (Jones, Andriamarovololona, Hockley, Gibbons, & Milner-Gulland, 2008). Section 3 identified cooperative food sharing networks. The methods and results for section 3 are described in Bogdan and Li (2019).

Various interview methods were employed, including key informant interviews, on-the-land interviews (also called transect walks), and sharing circles.

Ethical considerations for this study were addressed in accordance with procedures outlined by the University of Saskatchewan's Behavioural Research Ethics Board (Beh-Reb) and approval for this study. In addition to those requirements, a Data Sharing and Confidentiality Agreement was signed by all parties contributing to this research. This agreement makes clear that confidential information will be generalized to a point where the sensitivities are eliminated (e.g. identified spiritual sites, grave sites, moose licks will be generalized to a polygon that indicates cultural sites or moose hunting area to the extent possible) in order to make it available solely for the implementation of project results. No information developed through this project will be used in a manner that violates the confidentiality concerns of participating community members.

2.3 Database development

Excel was used to organize data in preparation for analysis. A double data entry method was used to ensure accuracy. The preliminary tables of

harvest, demographic, and economic data were then reviewed and verified by FN research coordinators.

Household harvest surveys were geocoded using ArcGIS. As plant harvest data is still being processed, we discuss here only results regarding animal harvest. Harvest animal counts were converted to edible food weight. These were calculated at species, household, and community levels and mapped accordingly to harvest locations on the 10x10 km^2 grid.

An RSEA dataset that included transportation, oil, gas, power, mining, forestry, agricultural, fire, pests, and recreation sites was included. These layers were used to analyze how transportation, industry, recreation sites, and natural disturbances affected harvesting.

2.4 Spatial Analysis

After the harvest location maps were produced, ArcGIS spatial analysis tools were deployed to investigate animal harvesting patterns.

Hotspot analysis: Centroids were extracted from the 10km survey grids for geostatistical analyses. Empirical semivariogram and Moran's I from ArcGIS were used to reveal the spatial autocorrelation pattern present in the dataset. Kernel density map was created in ArcGIS to visualize the harvest hotspots (quartic kernel, radius of 20km, alpha channel applied).

Moose harvest: The BC Government shared historical licensed sport hunters' reported moose kills per management unit (MU). The FN moose harvesting was spatially aggregated by the MUs to compare with sport hunting to study how FNs' moose hunting was affected by sport hunting.

Hunting barrier analysis: Survey participants identified the grids where they used to hunt but currently do not hunt. The results were integrated with the RSEA dataset of industry, recreation sites, and transportation to visualize how disturbances affect FN hunting patterns.

3. Results

3.1 Harvesting locations and composition

To study FN animal harvesting attempts, we mapped the total harvest weight by grid. SFN harvests mainly occurred on the northeast side of the Rocky Mountains, whereas WMFN harvests occurred further south and on both sides of the Rocky Mountains. We grouped the harvested animals into four classes (large mammals, small mammals, fish and birds) and mapped all classes to further investigate the harvesting patterns in SFN and WMFN. As a larger community, the SFN's food harvest was correspondingly higher than WMFN, whereas the WMFN's harvesting was more diverse with a higher percentage of fish and a lower percentage of large mammals. These maps were not shown here because of confidentiality concern.

3.2 Harvesting hotspot analysis

Empirical semivariogram showed the range value of 98km for the harvesting dataset (weight in kg). Moran's I suggested significant aggregation pattern (Z-score=22.0, $p<0.01$). Kernel density map was rendered to further illustrate the hotspots of FN harvesting. The hotspot map showed a similar pattern with both SFN and WMFN harvesting near their communities and farther north. They were expected to have hotspots near their communities due to the spatial proximity of their communities. We suspected, and later

confirmed by First Nation collaborators, that the northern hotspots (200 km north of the SFN and WMFN communities) are the result of changing of wildlife habits caused by industrialization.

3.3 Moose harvest

As the main food source for FNs, moose were used as an example to illustrate the pressure of sport hunting asserted on SFN and WMFN. Historical sport hunting data shows that on average 1000 moose were killed in the nearby 16 MUs yearly (Figure 4). In 2017, sport hunters killed roughly twice as many moose than the FNs in the nearby five management units. Most of the sport hunting occurred on the east side of the study area, where SFN and WMFN are located (Figure 3).

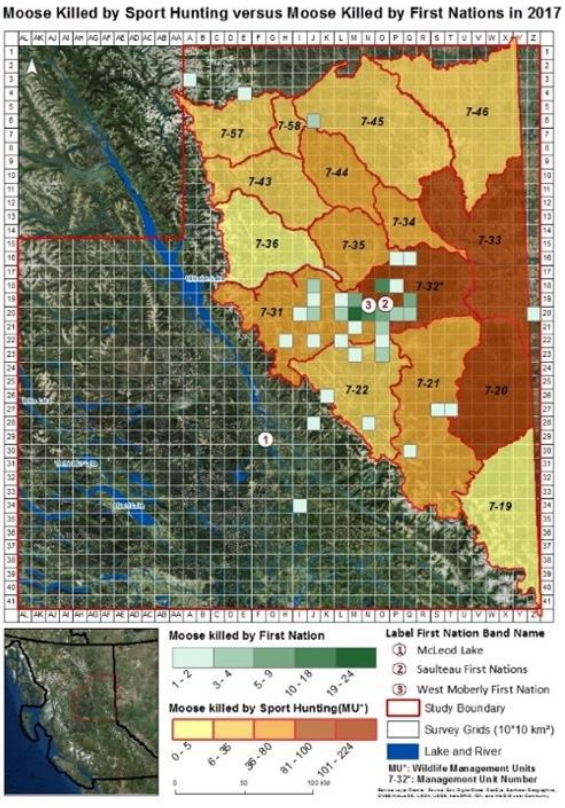

Figure 3 Map of moose killed by sport hunting versus FNs' wild game in the surrounding 16 MUs.

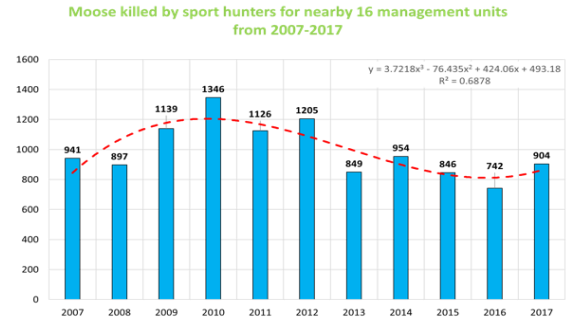

Figure 4 Moose killed by sport hunters in the nearby 16 MUs from 2007-2017.

3.4 Harvest barrier

Figure 5 represents hotspots where people have expressed concerns about harvesting activities. The greatest concerns were near FN communities and toward the south. The results will be combined with the RSEA dataset of industry, recreation sites, and transportation to visualize how disturbances affect FN hunting patterns.

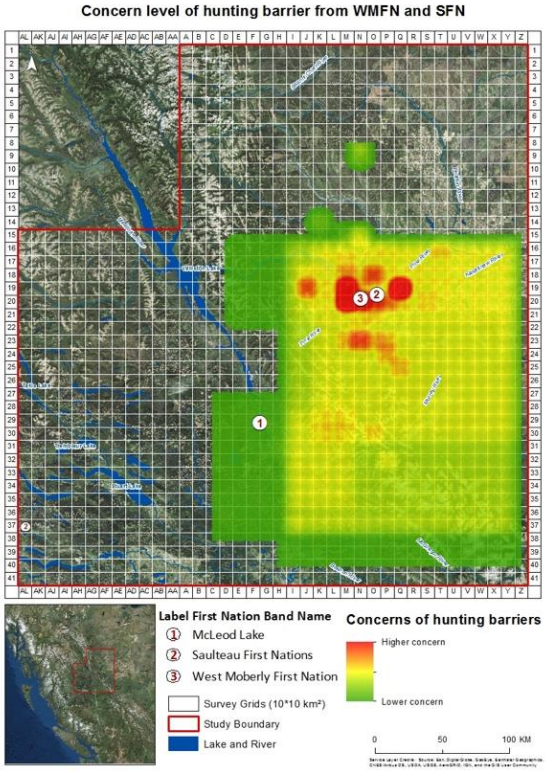

Figure 5 Concern level of FNs for hunting barrier.

4. Conclusion

To assess the livelihood of FNs in an ecologically sensitive region in northeastern BC, this study conducted structured surveys and developed a comprehensive geodatabase. Data collection and publishing respect the *Data Sharing and Confidentiality Agreement*. Trust and relationship building were an anticipated outcome of this collaborative process. The spatial analyses allow researchers to answer important questions for the RSEA. SFN and WMFN exhibited similar harvest hotspots, where significant hunting occurred close to their communities. Our findings represent an opportunity for FNs to protect vital aspects of their land-based culture and to work with the Government of British Columbia in a more meaningful and informed manner concerning future planning decisions.

Acknowledgements

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