USING LAND USE AND OCCUPANCY MAPPING AND GIS TO ESTABLISH A PROTECTED AREA NETWORK IN THE DEH CHO TERRITORY

by

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Introduction

The Deh Cho territory covers 208,385 km^2 of the sub-arctic taiga plains and taiga cordillera ecozones in the south-western corner of the Northwest Territories, Canada.[1] In 2002, the total population of the ten communities in the territory was estimated at 6,926 persons, of whom 4,237 (61.2%) identified themselves as aboriginal.[2] Traditional land use (hunting, fishing, trapping, and plant gathering) continues to be culturally and economically significant for Dene and Metis. For example, wild foods provide between 22% and 36% of total dietary protein in the Deh Cho territory.[3] The ecosystems that support traditional land use are vulnerable to industrial resource extraction, but relatively little petroleum extraction, mining, or logging has taken place in the territory to date.

Figure 1 Location in North America

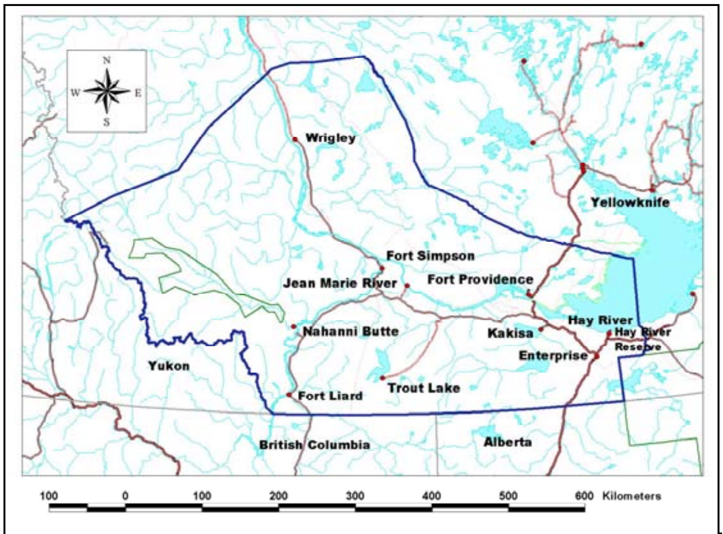

Figure 2 Communities in the Deh Cho Territory

Deh Cho First Nations are a tribal council representing ten Dene First Nations and three Metis locals. Since 1999, the Deh Cho First Nations have been engaged in negotiations with the governments of Canada and the Northwest Territories regarding self-government and ownership of lands and natural resources.

In the past, two other major land use and occupancy mapping projects had been carried out in the Deh Cho territory. Between 1974 and 1983, the Dene Mapping Project undertaken by the Dene Nation. The project produced trail maps for all Dene

[1] The size of the Deh Cho Territory is roughly the same as Great Britain or the State of Utah.
[2] http://www.stats.gov.nt.ca/Statinfo/Demographics/population/popest.html. Statistics for ethnicity in communities with population under 100 (Trout Lake, Nahanni Butte, Jean Marie River, and Enterprise) have been suppressed, but Trout Lake, Nahanni Butte, and Jean Marie are known to be virtually all aboriginal so they are included in the aboriginal total.
[3] O.Receveur et al. 1996. Variation in Food Use in Dene/Metis Communities. Montreal: McGill University, Centre for Indigenous People's Nutrition and Environment.

communities in the Northwest Territories based on a sample of about one-third of all trappers and hunters.[4] Unfortunately, the research methods were not thoroughly documented.

In 1990-91, land use and occupancy mapping was funded through the Northern Land Use Planning Program using research methods developed by the Department of Indian Affairs and Northern Development.[5] In 1996, Deh Cho First Nations contracted Terry Tobias to review 513 maps at 1:250,000 from nine (9) communities. These maps were created by small working groups in each community using very large polygons (areas) to show land use and occupancy as well as animal habitat. Tobias concluded that the results from this project did not meet standards of data integrity, representativeness and validity, and thus were not legally defensible.[6] Anticipating the adversarial environment of negotiations, Deh Cho First Nations set out to document land use and occupancy data that could be submitted as evidence to a court of law.

Between 1996 and 2002, the traditional land use and occupancy by harvesters and elders was documented and mapped in eight Deh Cho First Nations member communities:[7]

1. Fort Providence[8] (1996)
2. Nahanni Butte (1997-1999)
3. Liidlii Kue First Nation (Fort Simpson) (1997-1998)
4. Trout Lake (1999-2000)
5. Jean Marie River (1999-2000)
6. Kakisa (1999-2000)
7. West Point First Nation (Hay River) (2000-2001)
8. Wrigley (2001-2002)

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[4] P. Nahanni. 1977. The Mapping Project in M. Watkins (ed.). Dene Nation: The Colony Within. Toronto, University of Toronto Press. pp. 21-27; M. Asch and G. Tychon. 1993. The Dene Mapping Project: Past and Present. GIS '93 Symposium Proceedings. Vancouver, B.C. pp. 731-734. Available at: http://home.istar.ca/~tychon/denep5.htm; Spatial Data Systems Consulting. 1996. Dene Mapping Project Data Conversion Micro-Computer Implementation. Unpublished, prepared for the Dene National Office, Yellowknife.

[5] A. Webster. 1991. Deh Cho Land Use Mapping Project: Final Report. Unpublished, prepared for the Deh Cho Tribal Council; GIS and Special Projects Division. 1993. Community Resource Mapping. Unpublished, prepared for the Department of Indian Affairs and Northern Development, Yellowknife.

[6] T. Tobias. 1996. Organization, Quality, and Potential Utility of the Deh Cho First Nation's Maps, 1991 Northern Land Use Mapping Project. Unpublished, prepared for Deh Cho First Nations, Fort Simpson.

[7] Hay River Reserve and Fort Liard conducted land use and occupancy mapping but chose not to integrate it with the regional database. In 2003, data from the Fort Simpson Metis Local were collected but have not yet been digitized.

[8] Includes data from members of both the Deh Gah Gotie First Nation and Metis Local.

The purpose of the land use and occupancy mapping studies was to develop a rigorous and legally defensible database to support:

1. Lands and Resource Negotiations
2. Land Use Planning/Protected Area Design
3. Environmental Impact Assessment
4. Natural Resource Management

This paper reviews the methods and results from these land use and occupancy studies. Three techniques of density analysis are compared with the objective of identifying the most important lands for protection from industrial resource extraction. The practical application of these data collection and analysis techniques to interim land withdrawals, protected area design, and developing a regional land use plan is discussed.

Methods

Collection of land use and occupancy data was based on techniques developed by Terry Tobias.[9] In each community, target lists of active harvesters or elders were prepared by community members and project staff using Indian Band and Metis Local membership lists, in conjunction with personal familiarity about who were the active or knowledgeable harvesters and elders living in the community. In all communities except Fort Providence,[10] data were collected by Petr Cizek and Herb Norwegian in collaboration with local community researchers.

Using a standardized interview guide, each land user was interviewed about some places where he or she had personally harvested animals or plants, and where they had occupied the land within living memory (i.e. within their lifetime). Interviews were tape recorded to provide a documentary record, but have not yet been transcribed.

Using permanent felt-tipped markers, land use and occupancy information was marked as points, lines, or polygons on transparent acetate sheets geo-referenced to 1:250,000 National Topographic Series maps. In Fort Simpson and Trout Lake, data were marked directly on maps plotted in large format at 1:400,000 using 1:250,000 National Topographic Series digital base data. Each land user produced a unique map, which was coded according to their name, date of birth, location of birth, and mother's maiden name.

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[9] T. Tobias. 2000. Chief Kerry's Moose: A Guidebook to Land Use and Occupancy Mapping, Research Design, and Data Collection. Vancouver, Union of BC Indian Chiefs and Ecotrust. Available at: http://www.nativemaps.org/chiefkerrysmoose/. Tobias delivered a research design and data collection training to Deh Cho researchers, including Petr Cizek, in early 1997.

[10] In Fort Providence, the initial data collection was undertaken by Allan Bouvier and Stephen Kilburn in 1996.

The interview guide consisted of a set of common questions, which were modified to suit each community's unique complement of species, harvesting practices, land uses, and Dene dialect. Trout Lake's detailed interview guide is shown as an example in Appendix A. The following general questions were asked in all communities:

1. Can you show me some *lines* where you set traps or snares and killed fur-bearer animals?
2. Can you show me some *places (points)* where you used or saw traditional traps such as deadfalls, big game snares, spring sticks etc.?
3. Can you show me some *places (points)* where you spent the night on the land in a cabin, lean-to, tent-frame, tent?
4. Can you show me some *places (points or polygons)* where Dene were born, died, or are buried on the land?
5. Can you show me some cultural sites *(points or polygons)* such as a gathering place, healing place, flint quarry etc.
6. Can you show me some *places (points)* where you shot and killed big game (moose, woodland caribou etc.)?
7. Can you show me some *places (points)* where you shot and killed small game (beaver, muskrat, rabbit etc.)?
8. Can you show me some *places (points)* where you shot and killed birds (ptarmigan, ducks etc.)?
9. Can you show me some *places (points)* where you caught and killed fish using a rod, net, ice fishing (jigging) or a night line?
10. Can you show me some *places (points)* where you used or saw a traditional fishing method such as spear, fish trap, willow bark net, gaff, or fish snare?
11. Can you show me some *areas (polygons)* where you gathered berries, medicine plants, other food plants, special wood, or bird eggs?

The questions were designed to identify clearly defined land uses that could be mapped with as much precision as possible, within the usual constraints (e.g. scale) of using maps as a data capture tool. With regard to hunting and fishing, this meant that only actual kill sites were documented and that each was mapped as a point. All fish, bird, and mammal categories were mapped as points, not polygons.[11] It was anticipated that having each participant map some of his actual kill sites for each category (e.g., moose) would be, for purposes of analysis and negotiation, more effective than having the participant indicate the entire area (e.g., for moose hunting) as a polygon. It was thought that government negotiators would be more likely to be sceptical about a final set of land use maps that were constructed on the basis of hastily marked, large and often roundish polygons.

Trapping involves many different fur-bearer species and occurs repeatedly over the years along the same routes or traplines. Each individual's trapline was mapped as a series of connected lines. Plant and wood resources (e.g., medicine plants, special woods) tend to be harvested from areas that are much more circumscribed than areas from which hunters and fishers obtain their animals, and for this reason they were mapped as either points or polygons, depending on the size of the area harvested.

[11] The sole exception to this rule is the Fort Providence data, where fish, bird, and mammal harvesting was marked as both points and polygons.

To reduce response burden,[12] no attempt was made to map animal and plant habitat, travel routes, or aboriginal place names. For the same reason, no attempt was made to document the years or seasons when specific land uses took place. In addition, the number of land use categories was kept to a minimum, especially regarding plants and animals. For example, berries were treated as a generic group. Ducks were mapped as single category, instead of by species. Instead of mapping the many kinds of fish, harvest sites by fishing method was documented. These methods were successful in keeping response burden within acceptable limits. Most interviews lasted just over an hour, and some involving very experienced harvesters and elders lasted several hours.

The hard-copy map data were digitized into a computerized Geographic Information System (GIS) using ArcView 3.x software. All data were feature-coded according to land user name, land use type, and community. A set of draft maps was printed and reviewed with community members for inaccuracies and glaring gaps in the data. Changes were made and a final set of large-format maps was printed for each community.

Results

In total, 386 land users were interviewed out of a target list of 531 individuals for an overall study participation rate of 72.7%.

Table 1 Study Participation Rate

Community	Land Users Interviewed	Land Users Targeted	Participation Rate
Fort Providence	73	122	59.8%
Nahanni Butte	51	59	86.4%
Liidlii Kue First Nation (Fort Simpson)	107	120	89.2%
Trout Lake	38	48	79.2%
Jean Marie River	28	37	75.7%
Kakisa	28	29	96.6%
West Point	14	24	58.3%
Wrigley	47	92	51.1%
TOTAL	**386**	**531**	**72.7%**

[12] Response burden occurs if the study participants experience the interview as burdensome. Many land use and occupancy mapping endeavours fail to meet their objectives because they ignore the role of response burden, and design overly ambitious projects.

The total dataset consists of 54,769 data elements, of which the overwhelming majority (85.0%) are land use points.

Table 2 Data Overview

Community	Land Use Points	Land Use Lines	Land Use Polygons	Total Data Elements
Fort Providence	2,809	1,014	857	**4,680**
Nahanni Butte	3,040	90	452	**3,582**
Liidlii Kue First Nation (Fort Simpson)	8,178	2,335	847	**11,360**
Trout Lake	6,798	555	422	**7,775**
Jean Marie River	2,527	148	76	**2,751**
Kakisa	3,714	222	6	**3,942**
West Point	3,225	319	75	**3,619**
Wrigley	16,264	728	68	**17,060**
TOTAL	**46,555**	**5,411**	**2,803**	**54,769**

Analysis

ArcView 3.x GIS software with the Spatial Analyst 2.0 extension was used to analyse data. Data from individual communities were first merged into three common files for points, lines, and polygons to avoid bias in areas of overlap between communities.[13]

For the purposes of analysis, it was necessary to reconfigure data to increase comparability between spatial data types (i.e. points, lines, and polygons). Lines and polygons were converted into point files. Using the "poly to points" extension,[14] lines were converted into points at 1,000 metre intervals with the start point set at 0. The line file, which originally had 5,411 records, became a point file with 84,268 records.

The "poly to points" extension could not be used to create a regularly spaced grid of points, since it only converts the perimeter of a polygon to points. Instead, the "feature density" extension[15] was used to create a floating point raster grid with a 1,000 metre (1 km^2) cell size, where the total polygon area covering each grid cell is expressed as a ratio of square kilometres of land use area per square kilometre.[16] Then, the "raster to vector point" extension[17] was used to convert the centroid of each grid cell to a point. The polygon file, which originally had 2,803 records, became a point file with 17,193 records retaining the density value as an attribute of each point.

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[13] During preliminary analysis, density analysis was conducted for individual communities creating grids of ordinal categories ranked as low, medium, high, and very high. When the analyses from individual communities were combined using an arithmetic overlay, unusually high rankings were assigned for areas of overlap between communities while unusually low ranking were assigned for areas used by a single community.

[14] http://arcscripts.esri.com/details.asp?dbid=946943583 and http://www.quantdec.com/

[15] http://arcscripts.esri.com/details.asp?dbid=12441 and http://www.commenspace.org/

[16] These density ratios range from one polygon partially covering a grid cell to multiple polygons covering a grid cell. This calculation was conducted in Albers Equal Area Conic projection (GRS 80, Central Meridian 122°W, Ref Lat 62.5°N, SP1 60°N, SP2 65°N) with the output grid extent set to the polygon file.

[17] http://arcscripts.esri.com/details.asp?dbid=10627

The two resulting point files were merged with the original point file to create one final land use point file with 148,016 records. Density analysis was then carried out using quadrat and kernel methods.[18] The quadrat method simply counts the number of data elements within each grid cell. The kernel method counts the number of data elements in a radius surrounding each grid cell and then applies a probability function to smooth the differences between adjacent grid cells. Both methods end up producing a density value of number of land use activities per square kilometre. Two variations of the quadrat method were applied. In total then, three analyses of the data were undertaken.

The quadrat method involved using the "polygridcreator" extension,[19] to create a vector grid with a cell size of 1,000 metres (1 km^2) and another vector grid with a cell size of 10,000 metres (100 km^2).[20] Using the "spatial join" function, the unique identifiers for each grid cell were joined to the combined land use point file. A summary table was then created for each grid by adding the number of land use activities within each grid cell. This table was then joined to the grid files and the grids with no land use activities were deleted. A normalized density, expressed as the number of land use activities per square kilometre, was calculated by dividing the number of land use activities in each grid cell by the grid cell's area.

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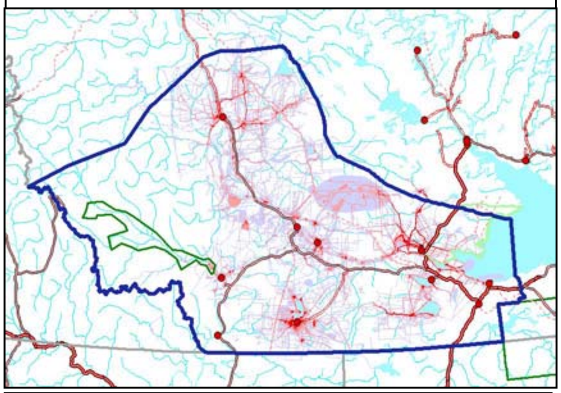
[18] T.C. Bailey and A.C. Gattrell. 1995. Interactive Spatial Data Analysis. London, Longman. Summarized in: http://www.spatial.maine.edu/~beard/Lectures/Lecture%206%2003.pdf
[19] http://arcscripts.esri.com/details.asp?dbid=12902
[20] The vector grids were created in Albers Equal Area Conic projection (GRS 80, Central Meridian 122°W, Ref Lat 62.5°N, SP1 60°N, SP2 65°N) with the output grid extent set to X Max = 500,000 m, X Min = -500,000 m, Y Max = 500,000 m, Y Min = –500,000 and then re-projected into geographic decimal degrees.

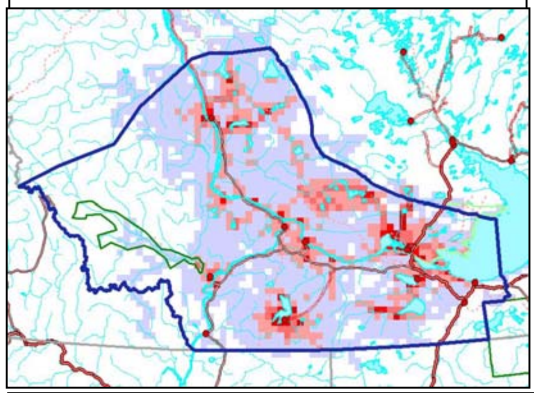
Figure 3 shows the quadrat density based on a 1,000 metre (1 km^2) grid and Figure 4 shows the quadrat density based on a 10,000 metre (100 km^2) grid. The density values within the grids were classified based on standard deviation.

Figure 3 Quadrat Density with 1,000 m Grid



Symbol	Value	Label
	0 - 2.77	-1 - 0 Std. Dev.
	2.77	Mean
	2.77 - 7.06	0 - 1 Std. Dev.
	7.06 - 11.35	1 - 2 Std. Dev.
	11.35 - 15.64	2 - 3 Std. Dev.
	15.64 - 116.34	> 3 Std. Dev.

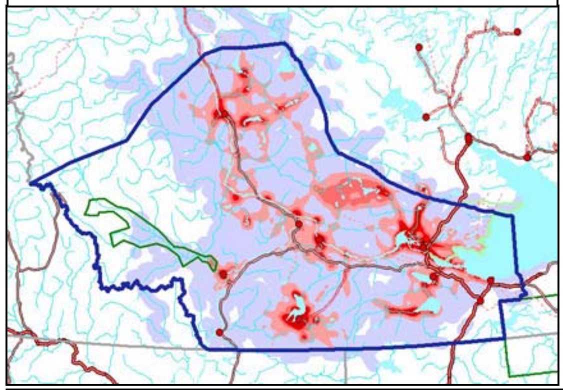
Figure 4 Quadrat Density with 10,000 m Grid



Symbol	Value	Label
	0 - 0.92	-1 - 0 Std. Dev.
	0.92	Mean
	0.92 - 2.42	0 - 1 Std. Dev.
	2.42 - 3.91	1 - 2 Std. Dev.
	3.91 - 5.4	2 - 3 Std. Dev.
	5.4 - 14.99	> 3 Std. Dev.

The kernel density analysis (Figure 5) was carried out using the "calculate density" function[21] with a 1,000 metre (1km^2) grid, with the population field set to the land use point attributes, with the search radius set to 10,000 metres, and with the area unit density set to number of land use activities per square kilometre.[22] The "calculate density" function produced a floating point raster grid, which was converted to an integer raster grid by multiplying the density values by a factor of 1,000,000 using the "map calculator" function. The integer grid was then converted to a vector grid using the "raster to vector polygon" extension,[23] and the values were divided again by a factor of 1,000,000 to produce a density value of number of land use activities per square kilometre. The density values within the grids are classified based on standard deviation.

Figure 5 Kernel Density with 1,000 m Grid and 10,000 m Search Radius



Symbol	Value	Label
	0 - 0.78	-1 - 0 Std. Dev.
	0.78	Mean
	0.78 - 2.15	0 - 1 Std. Dev.
	2.15 - 3.51	1 - 2 Std. Dev.
	3.51 - 4.87	2 - 3 Std. Dev.
	4.87 - 20.92	> 3 Std. Dev.

Summary statistics for the three types of density calculations are shown in Table 3.

Table 3 Summary Statistics for Densities (Number of Land Use Activities Per Square Kilometre)

Type of Density Analysis	Grid Area (km^2)[24]	Min	Max	Mean	Median	Standard Deviation
Quadrat 1,000 m (1 km^2) grid	56,534	0.0001	116.34	2.77	2.00	4.29
Quadrat 10,000 m (100 km^2) grid	169,200	0.01	15.00	0.92	0.41	1.49
Kernel 1,000 m (1 km^2) grid, 10,000 m search radius	199,590	0.000001	20.92	0.78	0.31	1.36

The total grid area covered by the quadrat density at 1,000 metres (1 km^2) is smallest because the small grid cells capture land use activities at a fine scale, excluding areas where are no land use activities are documented. The total grid area covered by the quadrat density at 10,000 metres (100 km^2) is larger as land use activities are captured at a coarser scale. The total grid area covered by the kernel density is largest of all due to the 10,000 metres search radius.

[21] The kernel density formula in Spatial Analyst is described in: B.W. Silverman. 1989. Density Estimation for Statistics and Data Analysis. London, Monographs on Statistics and Applied Probability, Chapman & Hall. p. 76. http://nedwww.ipac.caltech.edu/level5/March02/Silverman/paper.pdf

[22] These calculations were conducted with the output raster grid extent set to match to extents of the vector grids at X Max = 500,000 m, X Min = -500,000 m, Y Max = 500,000 m, Y Min = –500,000

[23] http://arcscripts.esri.com/details.asp?dbid=10627

[24] Includes only grid cells that have land use activities.

The quadrat density at 1,000 metres ($1km^2$) has the greatest range in density values since it has a fine enough grid scale to cover very small slivers of polygons, but also includes clusters of very dense land use activities. The quadrat density at 10,000 metres ($100\ km^2$) has a smaller range because the coarse grid scale calculates the number of land use activities within a larger area, resulting in lower densities. The kernel density has a range that falls between those of the quadrat densities because the search radius smoothes the variation between cells. However, it also has the lowest minimum density value because the search radius covers data outliers adjacent to cells with no documented land use activities.

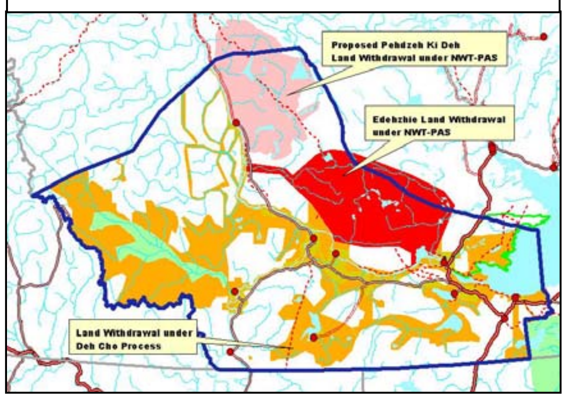
The quadrat density at 1,000 metres ($1km^2$) has the highest mean and median, reflective of its high maximum, again due to the fine grid scale. The quadrat density at 10,000 metres ($100\ km^2$) has lower mean and median, reflective of the coarse grid scale that creates relatively low density values. The kernel density has the lowest mean and median of all due to the very small density values generated by the search radius along the data outliers.

The quadrat density at 1,000 metres ($1km^2$) has the highest standard deviation caused by the variations between in the number of land use activities captured by the fine scale cells. The quadrat density at 10,000 metres ($100\ km^2$) has the next lowest standard deviation caused by the relatively low densities within the coarse scale cells. The kernel density has the lowest standard deviation due to the smoothing from the search radius.

Discussion

The land use and occupancy data and preliminary density analyses, combined with existing natural resource data,[25] were used to negotiate a series of interim land withdrawals in the Deh Cho territory. Lands shown in Figure 6 were withdrawn through a federal Cabinet Order-in-Council under the Territorial Lands Act for a period of five years. This allows time for a land use plan to be developed and protected areas to be established. These land withdrawals legally prevent the issuance of any new land sales, land leases, mineral rights, or timber authorizations.

Figure 6 Land Withdrawals



[25] The Deh Cho Atlas contains 47 GIS datasets obtained from government agencies and converted into a common data format on CD-ROM. The hard-copy product contains 21 thematic maps describing abiotic, biotic, and cultural resources. A. Udell and P. Cizek. 2001. Deh Cho Atlas Version 1.0. Unpublished, prepared for Deh Cho First Nations, Fort Simpson. In 2003, the Deh Cho Land Use Planning Committee updated this to the Deh Cho Atlas Version 2.0b with 39 thematic maps. See: www.dehcholands.org

In November 2002, an area of 25,233 km^2 (red) was withdrawn for the Edehzhie candidate protected area through the NWT Protected Area Strategy. In August 2003, an area of 70,718 km^2 (orange) was withdrawn through the Deh Cho Process lands and self-government negotiations. Coupled with the existing Nahanni National Park Reserve (green) at 4,828 km^2, the land withdrawals represent an inter-connected protected area network covering 48.4% of the Deh Cho territory. The World Wildlife Fund recognised this as a globally significant conservation achievement through its international "Gift to the Earth Award". Discussions are still underway to withdraw lands for the proposed Pehdzeh Ki Deh candidate protected area (pink) near Wrigley.

The quality of the land use and occupancy data was crucial to Deh Cho First Nations success at the land withdrawal negotiations. These adversarial and often acrimonious negotiations lasted almost two years with sessions on a monthly basis. Deh Cho negotiators assumed control of the agenda by using a laptop computer and digital projector to display GIS maps at each session. By displaying the raw land use and occupancy data overlayed on the density analyses, Deh Cho negotiators quickly convinced their federal counterparts to consider all the areas ranked as "high" and "very high" in the 10,000 metre (100 km^2) quadrat analysis as a minimum starting point for the land withdrawal.[26] Although many people admired the aesthetics of the kernel density analysis, it was not relied upon in the negotiations as the actual number of land use activities in a particular cell could not be counted using simple arithmetic.

Deh Cho First Nations voluntarily provided the Deh Cho Atlas with all the natural resource data to the federal negotiators,[27] but they apparently did not have the technical capacity to use it. While it was relatively easy to convince the federal negotiators to withdraw areas with high densities of land use and occupancy, it was more difficult to convince them to expand the land withdrawals to include sensitive watersheds, ecologically significant areas, and critical wildlife areas. Fortunately, as part of compiling the Deh Cho Atlas, associated scientific reports dating as far back as the 1960's had been collected. Due to the loss of scientific capacity at government agencies and the closure of libraries, most of these reports had been neglected and forgotten. Copies were provided to the federal negotiating team with the request that the reports be reviewed by federal scientific staff at the Department of the Environment and the Department of Fisheries and Oceans. In the end, all documented ecologically significant areas and critical wildlife habitat were withdrawn. The whole Trout Lake watershed was withdrawn, but some portions of the South Nahanni and Kakisa watersheds remain unprotected.

The density analyses of traditional land use and occupancy, combined with more thorough analyses of natural resource data, now provide a basis for the development of a detailed land use plan, where the current land withdrawals may be revised or modified. In applying the different density analyses, land use planners will have to address the

[26] The 1,000 metre (1 km^2) quadrat analysis was used to identify lands for forestry opportunities that would not conflict with land use and occupancy, where only the sub-surface would be withdrawn.
[27] The actual land use and occupancy data and density analysis remained confidential and were used only for display during negotiations.

coarseness of the grid and whether it is better to protect a smaller numbers of large tracts or larger numbers of smaller tracts (i.e. the SLOSS problem – Single Large or Several Small protected areas).[28] Additional density analyses of kill sites for individual species or groups of species will be developed from the traditional land use data. Finally, mapping of traditional ecological knowledge of wildlife habitat, which has recently been completed, will be combined with the traditional land use data to provide a more complete picture of wildlife ranges and critical habitat areas.

Conclusions

These results demonstrate how rigorous land use and occupancy mapping combined with the analytical power of GIS can assist First Nations in their struggle for self-determination regarding lands and resources. Achieving these results required sustained effort, financial support, and political commitment over eight (8) years. When the first mapping projects were initiated in 1996, community members and political leaders were somewhat sceptical, especially since past projects had produced such limited benefits. People became more enthusiastic as draft maps were reviewed, density analysis was demonstrated, and final maps were delivered to each community. Also, as maps were presented at regional meetings, neighbouring communities became more interested and a snowball effect was created.

It was significant to have a well-known Dene harvester and a fluent South Slavey speaker as an integral team member and advocate. While working as Assistant Negotiator for the Deh Cho First Nations, Herb Norwegian conducted much of the data collection and served as lead contact with communities. Extensive community meetings were required to initiate research projects, review draft map products, and discuss approaches to land withdrawals. Between 1999 and 2003, the team held at least 116 public meetings in eleven (11) communities related to lands and resource issues.

Through short training courses with regionally relevant and pre-formatted data, GIS technology is quickly being adopted by Deh Cho First Nations members. All Deh Cho communities have been provided with ArcView3.x software, the Deh Cho Atlas, and their own land use and occupancy data on CD-ROM. Deh Cho community members have used land use and occupancy data for diverse and unanticipated applications such as boundary negotiations with neighbouring communities, forest fire management, and search-rescue. In some communities, research projects on place names, travel routes, historic sites have been initiated as a follow-up on the land use and occupancy mapping. This could lead to many interesting explorations in multi-media mapping (linking digital sound, images, and video to GIS maps) and landscape visualization (viewing three-dimensional topographies).

[28] M.E. Soule and J. Terborgh. (eds.) 1999. Continental Conservation: Scientific Foundations of Regional Reserve Networks. Washington D.C., Island Press.

With the power of desktop computers continuing to increase exponentially, with GIS software becoming easier to use, and with the recent mass distribution of free data on the Internet (e.g. LANDSAT satellite imagery, Canada Geobase digital elevation models), the many exciting opportunities for grass-roots empowerment in lands and resource management will continue to multiply.

Acknowledgements

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APPENDIX A –

Trout Lake (Sambaa K’e Dene Band)
Traditional Land Use and Occupancy Study Interview Guide

INTRODUCTORY QUESTIONS

1. Write down the land user’s name and number on the map.
2. What year were you born?
3. Where were you born?
4. What is you mother’s maiden name?

We are asking only for your own information not information that you know about other Sambaa K’e Dene band members.

We are asking for information about how you used the land throughout your whole life. We do not need information about your land use when you lived in or were visiting another community.

TRAPPING/SNARING

Can you show me some *lines* where you set traps or snares and killed animals?

T – Trapping and Snaring – ehdzoo
S – Snaring Only (Rabbits and Squirrels) – xóo

Can you show me some *places (points)* where you used or saw traditional traps such as __________?

DF – Deadfalls – dechį ehdzoo
BGS – Big Game Snare – tłuh
SS – Spring stick – edehtłíh
GT – Gun Trap – tthik’ih ndíts’įhge

OCCUPANCY

Can you show me some *places (points)* where you spent the night on the land in a ____________?

CB – Cabin – kǫ́ę́
LT – Lean-to – tsumį́
TF – Tent-frame – limbáa dechį
TS – Tent Site – limbáa k’é
OF – Open Fire – ts’ęh kǫkéh
CV – Cave – ndéh goyiih kǫ́ę́

Can you show me some *places (points or polygons)* where Dene were born, died, or are buried on the land?

BU – Burial Site – dene tth'ené thela
BP – Birth Place – gots'ı̨́lı̨ (dene gų́lı̨) k'é
DP – Death Place – dene húle k'é
TBU – Traditional Burial – dene dahthets

Can you show me some cultural *sites (points or polygons)* such as _____________?

FCA – Food Cache (Above Ground) – daht'oh
FCG – Food Cache (On Ground) – etsa
GP – Gathering Place – kéats'edídeh k'é
FP – Forbidden Place – ats'etı̨ íle k'é
FQ – Flint Quarry – tłehgoh (mbehgaa)
HP – Healing Place – ndats'ejie k'é

HUNTING

Can you show me some *places (points)* where you shot and killed__________?

Big Game

M – Moose –golǫ
C – Woodland Caribou –mbedzih
D – Deer – yátǫ́nia
BB – Black Bear – sah dendítłe
GB – Grizzly Bear –sahcho
BS – Bison –Dehı̨tah goejide
CG – Cougar – nódacho

Small Game

BE – Beaver –tsá
MR – Muskrat – tehk'áa
RB – Rabbit – gah
LX – Lynx – nóda
PP – Porcupine – k'ahe
GH – Groundhog – k'ųę
SG – Squirrel (ground) – dlóo
SF – Flying Squirrel – edhée
WV – Wolverine – nóghaa
WF – Wolf – dígahe
FH – Fisher – nohtheecho
OT – Otter – námbée
MK – Mink – tandaatłee
MT – Marten – nohtee
FX – Fox – nogée

CT – Coyote –dígahe tselaa
SK – Skunk – nozíı
WS – Weasel – nambaa

<u>Bırds</u>

CK – Chıcken – dıh
PT – Ptarmıgan – k'ámbaa
DK – Duck – chı
LN – Loon – tútsı
GS – Geese – xah
CR – Crane – deh
SW – Swan – gahmba
PC – Pelıcan – tę̨cháa
OW – Owl – mbehddhįį

FISHING

Can you show me some *places (poınts)* where you caught and kılled fısh usıng a ___________?

FR – Rod – jıh dechį
FN – Net – mį́h
FI – Ice Fıshıng (jıggıng) – tę yııh daets'eʔah
NL – Nıght lıne – jíh

Can you show me some *places (poınts)* where you used or saw a tradıtıonal fıshıng method such as a ___________?

SP – Spear – ehtį́h (thųh)
FT – Fısh Trap – éh tehthtǫ
WBN – Wıllow Bark Net – k'át'ue mį́h
FG – Gaff – dahʔah
FSN – Fısh Snare – łuu xóo

GATHERING

Can you show me some *areas (polygons)* where you gathered plants such as ___________?

BR – Berrıes – jíe
MP – Medıcıne Plants – dene ndáídíh
OP – Other Food Plants – ndéh ts'ęh mǫhshéts'etįh
EG – Eggs – eyáhtth'ené
SW – Specıal Wood – dehį mbet'óhodéʔá