WILDLIFE INFOMETRICS INC.

MODELING

Pine Lichen Winter Range Capability and Terrestrial Lichen Habitat Unit Creation for the Tweedsmuir-Entiako Caribou Herd Study Area

VIKTOR J. BRUMOVSKY[1]

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[1]Wildlife Infometrics Inc., PO Box 308, Mackenzie, BC, V0J 2C0, wild_info@cablerocket.com

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ABSTRACT

This project sought to create updated Pine Lichen Winter Range (PLWR) capability ratings and new Terrestrial Lichen Habitat (TLH) units for a part of the Tweedsmuir-Entiako caribou (*Rangifer tarandus caribou*) herd's range. This was a necessary analytical component to aid establishment of Ungulate Winter Ranges for this caribou herd, as well as to bring the habitat modeling for this area in line with the procedures being used for the Mackenzie and Fort St. James Timber Supply Areas (TSA). It was found, through application of the Caribou Habitat Assessment and Supply Estimator (CHASE) modeling techniques, that previous PLWR mapping in the study area was flawed. This error was corrected and the new results indicate more of the study area has a high capability of producing 'preferred' PLWR for caribou. The PLWR identified by this project is almost exclusively in the Sub-Boreal Pine-Spruce (SBPS) biogeoclimatic zone, mostly as a result of updated modeling procedures that use biogeoclimatic subzones as a surrogate for potential snowpack development during winter. TLH units were produced based on the PLWR capability in accordance with the procedures developed for the Mackenzie and Fort St. James TSAs. The results of this project are intended to aid the British Columbia Ministry of Water, Land and Air Protection in establishment of habitat management objectives for the Tweedsmuir-Entiako caribou herd.

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INTRODUCTION

Caribou (*Rangifer tarandus caribou*) management in the Entiako and Laidman Lake Resource Management Zones (RMZ) has often been a focus of attention in land use planning (Sulyma *et al.*, 2002). The caribou herd that is present in this area is known as the Tweedsmuir-Entiako herd. From the late 1980s to the early 1990s, Cichowski (1993) and Cichowski and Banner (1993) performed extensive work in identifying habitat and corridors used by the herd.

The continuing work in identification and mapping of habitat aids in creating management objectives for this herd at a time when much of its range is being altered by the current mountain pine beetle (*Dendroctonus ponderosae*) epidemic (Sulyma *et al.*, 2002).

Our objectives were to apply the Caribou Habitat Assessment and Supply Estimator (CHASE; McNay *et al.*, 2003) as a means to identify high quality Pine Lichen Winter Range (PLWR). Subsequently, this mapped PLWR was then to form the basis for further analysis to identify Terrestrial Lichen Habitat (TLH) units which form a fundamental unit in setting management objectives for Ungulate Winter Range (UWR).

STUDY AREA

The study area for this project was located in the Vanderhoof Forest District approximately 150km southwest of the village of Vanderhoof (Figure 1). More specifically, work was focused on the Laidman Lake and Entiako RMZs as defined by the Vanderhoof Land and Resource Management Plan (LRMP; Anonymous 1997).

This area was part of the Nazko Upland ecosection of the Central Interior (Cei) ecoprovince. Within the study area there were three biogeoclimatic zones with a total of five subzones (Meidinger and Pojar 1991):

- Nechako moist very cold subzone of the Engelmann Spruce-Subalpine Fir Zone (ESSFmv1)
- Moist cold subzone of the Sub-Boreal Pine – Spruce Zone (SBPSmc)
- Dry cool subzone of the Sub-Boreal Spruce Zone (SBSdk)
- Babine moist cold subzone of the Sub-Boreal Spruce Zone (SBSmc2)
- Kluskus moist cold subzone of the Sub-Boreal Spruce Zone (SBSmc3)

All of these zones were distributed widely throughout the study area with the exception of the SBSdk subzone which occurred only in the northern reaches of the study area and occupied fewer than 2000ha.

In addition, all of these zones possess a continental climate characterized by cold winters (Meidinger and Pojar 1991). The ESSF zone, having the highest elevation, receives the greatest quantities of snow. The SBPS and SBS have similar seasonal characteristics though the SBPS is slightly drier with lower mean daily temperatures in the summer.

Topography for the study area varies. The western portion exhibits flat to gently rolling terrain. The Laidman Lake RMZ in the east has mountainous relief including the Fawnie Range.

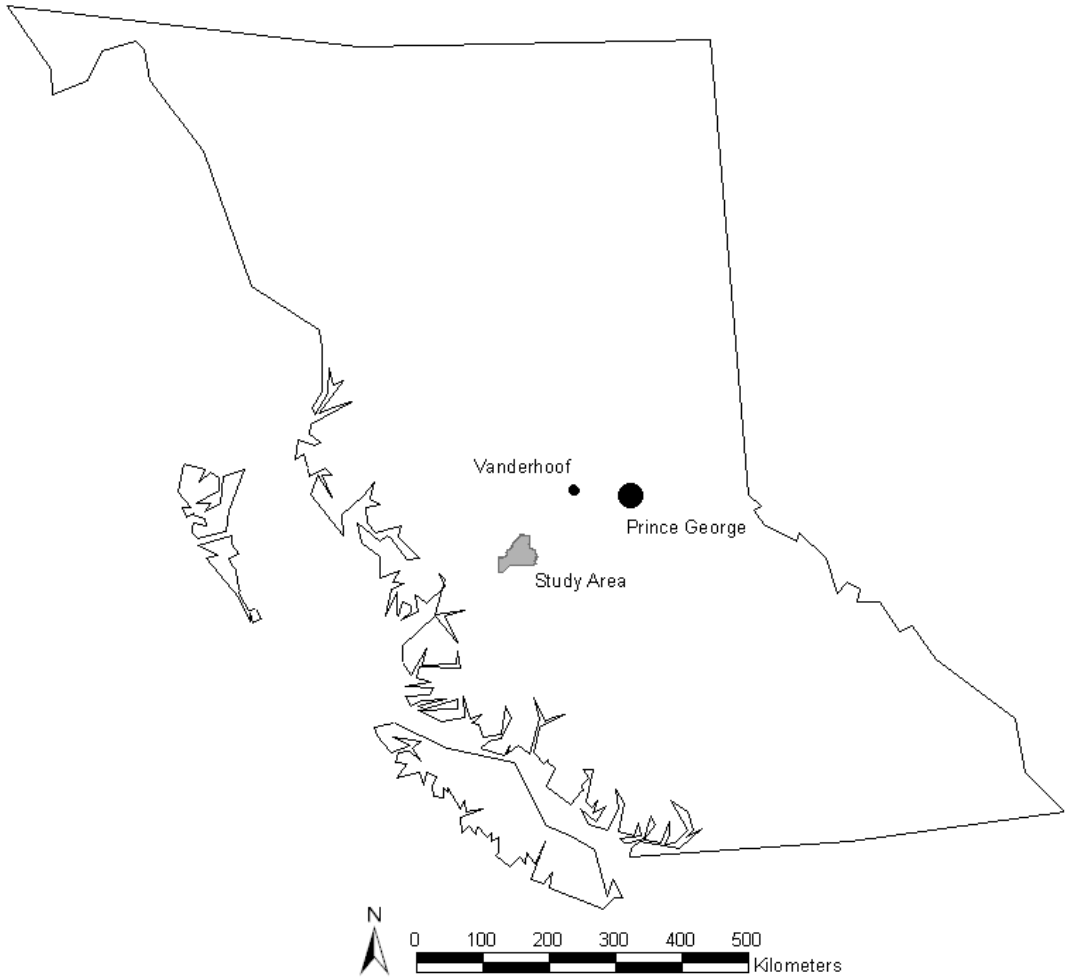

Figure 1. Generalized map showing the location of the study area in relation to nearby population centres and the province of British Columbia.

METHODS

Using the Digital Elevation Model (DEM), Biogeoclimatic Ecosystem Classification (BEC), and forest cover data from the original CHASE model run[1] a new PLWR capability map was produced following procedures documented in the *CHASE Model User's Guide* (Doucette *et al*., 2003). As this part of the project is assessing the landscape's capability for producing PLWR it was necessary to keep the 'Stand Age', 'Stocking', 'Stand Removal', and 'Habitat Value Reduction' nodes of the Netica PLWR model constant. The nodes for 'Aspect', 'Elevation', 'Ecological Unit', 'Biogeoclimatic Variant', and 'Stand Percent Pine' remained dynamic across the landscape (Figure 2). Because Predictive Ecosystem Mapping/Terrestrial Ecosystem Mapping (PEM/TEM) data was not to be used in this application of the model[2], it was necessary to force the model to ignore the PEM/TEM table while otherwise operating normally[3].

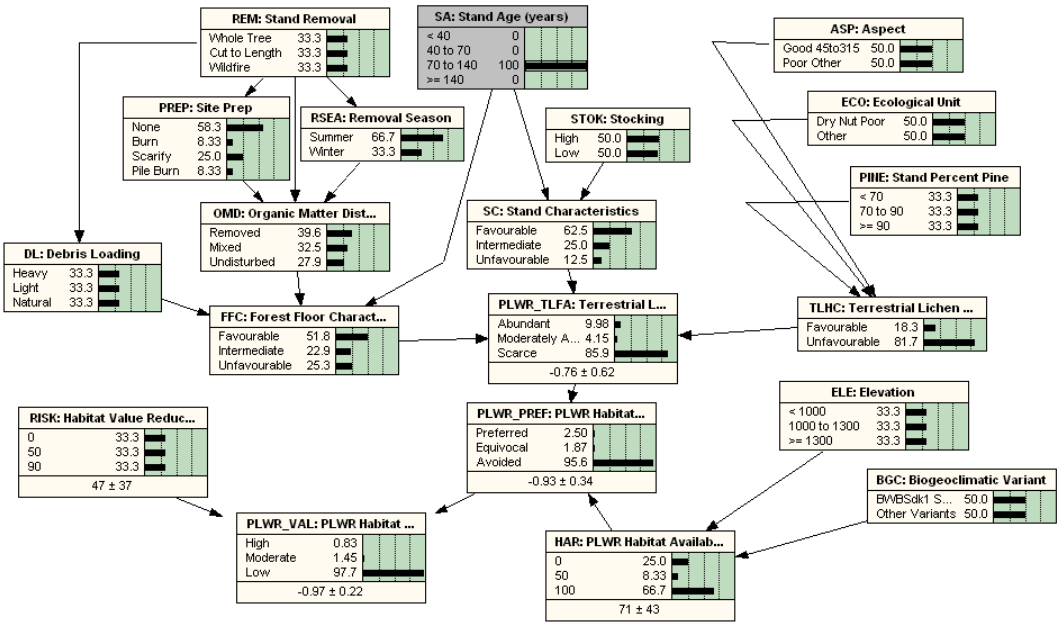

Figure 2. Netica PLWR Model Version 10b. This representation of the model shows node settings as they were used in this project. The model is a Bayesian Belief Network designed to assess the likely preference that caribou have for pine-lichen winter range in north-central British Columbia.

The 'Stand Age' node within the Netica PLWR model, as normal when constructing estimates of habitat "capability", was set to 100% for the '70 – 140 years' age group. Doing so introduces the assumption that all forest stands are at the optimal age for

[1] The original application of the CHASE model (11/12/02) was conducted by Forest Floor Contracting Ltd. with GIS support from Spatial Mapping Ltd. and forest cover analysis by Wildlife Infometrics Inc.
[2] This was a condition of the contractual arrangement.
[3] The major procedural difference was the creation of an ECP_TAG field in the 'rescap' table used in the Access database. This field was left empty so that it could act as a 'dummy' field for PEM/TEM data. The CHASE model has been designed such that it will use forest cover data when it encounters an empty ECP_TAG field.

containing PLWR; this is necessary for assessing capability rather than current suitability. This is accomplished through the use of a dummy field in the 'rescap' table in normal CHASE model operations. The method used in this project produces exactly the same result as the CHASE procedure and was chosen purely for convenience.

Once the PLWR capability map (Appendix A) had been created, it was possible to define TLH units (Appendix B) for the study area. As follows:

1) A 500m circular majority filter was applied to the PLWR capability map to create a layer which discards isolated PLWR cells and groups clusters of PLWR cells.
2) The filtered and unfiltered capability maps were converted to shapefile format and were assigned an Albers Equal-Area projection[2] before being transferred to ArcMap 8.2 for the remaining steps of the process.
3) UWR was identified by buffering the filtered PLWR capability map by a distance of 3000m.
4) An intersection of UWR and un-filtered PLWR capability was then performed to isolate which PLWR polygons fell within the newly identified UWR.
5) TLH units were finally created when the UWR-PLWR intersection was buffered by 200m. The resultant shapefile (called TLH_200.shp) is included in the ArcView 3.2 project file submitted with the deliverables for this project.

It should be noted that all data used in this project were displayed using an Albers Equal-Area conic projection in accordance with the standards defined at the outset of work.

RESULTS

The analysis described in the previous section produced a number of map layers describing various 'preferred' PLWR landscapes. In addition to the PLWR capability map and TLH units, the process used in this project resulted in the creation of UWR units and filtered PLWR capability shapefiles. These shapefiles all contain different interpretations of PLWR which are necessary in the definition of TLH units. Summary statistics for these interpretations of PLWR are included in Table 1.

Table 1. Summary statistics for PLWR by shapefile name.

	PLWR_cap	PLWR_Maj	UWR	TLH_200
# of units	982	89	4	38
Total area	17967ha	17355ha	120967ha	43624ha
Mean area	18ha	195ha	30242ha	1148ha
Standard deviation	89ha	524ha	48855ha	3525ha
Layer Description	Preferred PLWR units from the PLWR capability map	PLWR_cap after a 500m circular majority filter application	3000m buffer of the PLWR_Maj shapefile	Final TLH units made from a UWR/PLWR_cap intersection

It is clear from the table that the process used to define TLH units shrinks the number lichen habitat units from a high of 982 to a more manageable 38. Since the TLH units

are created through a buffering process, the overall area to be managed increases by more than 200%. Also of interest is the size distribution of these units. The extremely large values of standard deviation (and by extension, large variance values) with respect to the means illustrate that a normal distribution of unit size does not exist. A plot of TLH unit frequency by area would more closely resemble an inverse relationship than a normal one.

It is interesting to note that in the case of the TLH units that the four largest units account for nearly 92% of the total TLH area. This illustrates that the overwhelming majority of the TLH area can be managed with only a few units. Also of note is that the TLH units occur almost exclusively in the SBPS zone. This distribution corresponds well with the findings of Cichowski and Banner (1993); in particular, note the almost direct correspondence between TLH units identified here and the "Caribou High" (4/H) zone identified in Figure 4 of Cichowski and Banner.

DISCUSSION

Aspect Grid

During the course of this project it became clear that there were significant differences between the PLWR identified for the study area in the previous run of the CHASE model and the PLWR that was being identified by this project. The differences merited investigation to ensure that errors were not being made in current work.

An investigation into the causes of this found that the source of the differences was a grid called '*aspctrcl*'. This is a reclassed slope aspect grid derived from a DEM that is used as an input in the 'combine_active_grids.ave' script used when making the PLWR capability map. It was discovered that the two classes of aspect in this grid were reverses of each other as can be seen in Table 2.

Table 2. Class reversal between November 2002 *aspctrcl* grid and October 2003 *aspctrcl* grid.

Cell Class	November 2002 (cells)	October 2003 (cells)
1	40504	148867
2	148674	40539
Total Cell Count	189178	189406

The minor differences between the overall cell counts of the two grids reflects the fact that the October 2003 grids contain 228 more cells than in the November grid (this difference will be discussed at the end of this section).

Further examination of the two aspect grids yielded the finding that November 2002 *aspctrcl* grid had been incorrectly classified. This bears the result that the November 2002 PLWR capability map is also flawed as a consequence of its being created with an unsuitable *aspctrcl* grid.

This was checked extensively to ensure that an erroneous conclusion had not been drawn. To confirm that the reversed aspect grids were the sole cause of this problem, the current *aspctrcl* grid was reversed and a PLWR capability map was created using this grid. When compared with the flawed PLWR capability grid, the reversed version of the new PLWR capability grid proved to be a nearly perfect match.

PLWR Capability Changes

The PLWR capability map produced by this project displays some significant differences from the November 2002 map that go beyond those that can be attributed to the flawed *aspctrcl* grid.

Most notably, one can see that there is no longer any PLWR outside of the SBPS zone. This is because the current model uses biogeoclimatic zone information as a surrogate for snowfall data. This rules out some land area purely on the basis of biogeoclimatic subzones. It should be noted however that UWR and TLH units still extend into zones outside of the SBPS as they are simply buffers of PLWR.

Some of the differences in PLWR capability may also be attributed to the fact that PEM/TEM data was used in the November 2002 run but was not used in the current run.

Area and Positioning

As mentioned earlier, the grids used in the work on this project, though derived from the same DEM as those used in the November 2002, contain 228 more cells than their older counterparts. Because a 100m cell size was used by this project, this corresponds to 228ha of extra area in the current grids.

These extra cells were found to be spread fairly evenly about the perimeter of the study area rather than being clumped in any way. It is not definitively clear why these extra cells have appeared, though the fact that they are spread about the perimeter would suggest that the differences may be a result of different algorithms being used to convert shapefiles to grids and vice versa between the two runs. Since it is not known how this was performed in the November 2002 run, it is impossible to know for certain if this is the case.

It is also worthy to note that between the DEM grid used in the November 2002 run and the PLWR capability shapefile produced at that time there is an offset which places the PLWR map approximately 8.5m to the south of the DEM grid. The cause of this is unknown. The resulting grids and shapefiles produced by this project do not suffer from this problem.

MANAGEMENT IMPLICATIONS

The PLWR capability map and resulting TLH units identified by this project clearly occupy the greater portion of the SBPS zone in the study area. In fact, the TLH units occupy much more area in this zone than identified in the November 2002 results. This agrees with the findings of Cichowski and Banner (1993) as they referred to the region

covered by large TLH units in the western reaches of the study area as "the core of the caribou winter range". The other large cluster of TLH units, located in the southeastern portion of the study area, provides further agreement. Cichowski and Banner (1993) referred to this region as "the only block of good quality caribou winter habitat in the southeastern part of the winter range". Areas not identified as TLH units by this project also agree well with the findings of Cichowski and Banner (1993). This corroboration validates the use of the results of this project in management of the Tweedsmuir-Entiako caribou herd. Nevertheless, further corroboration of the predictions based on field data is still recommended since CHASE operates on data inputs that are modeled interpretations (e.g. DEM, PEM/TEM, forest cover). Such corroboration can be efficiently conducted through a simple reconnaissance of the identified polygons (McNay and Sulyma In Prep.)[4]

[4] McNay, R. S. and R. Sulyma. In Prep. Aerial Reconnaissance of Modeled Terrestrial Lichen Habitat Units in the Scott, Wolverine, and Chase Caribou Herds of North-Central British Columbia. Wildlife Infometrics Inc Report No. 94, Mackenzie, British Columbia.

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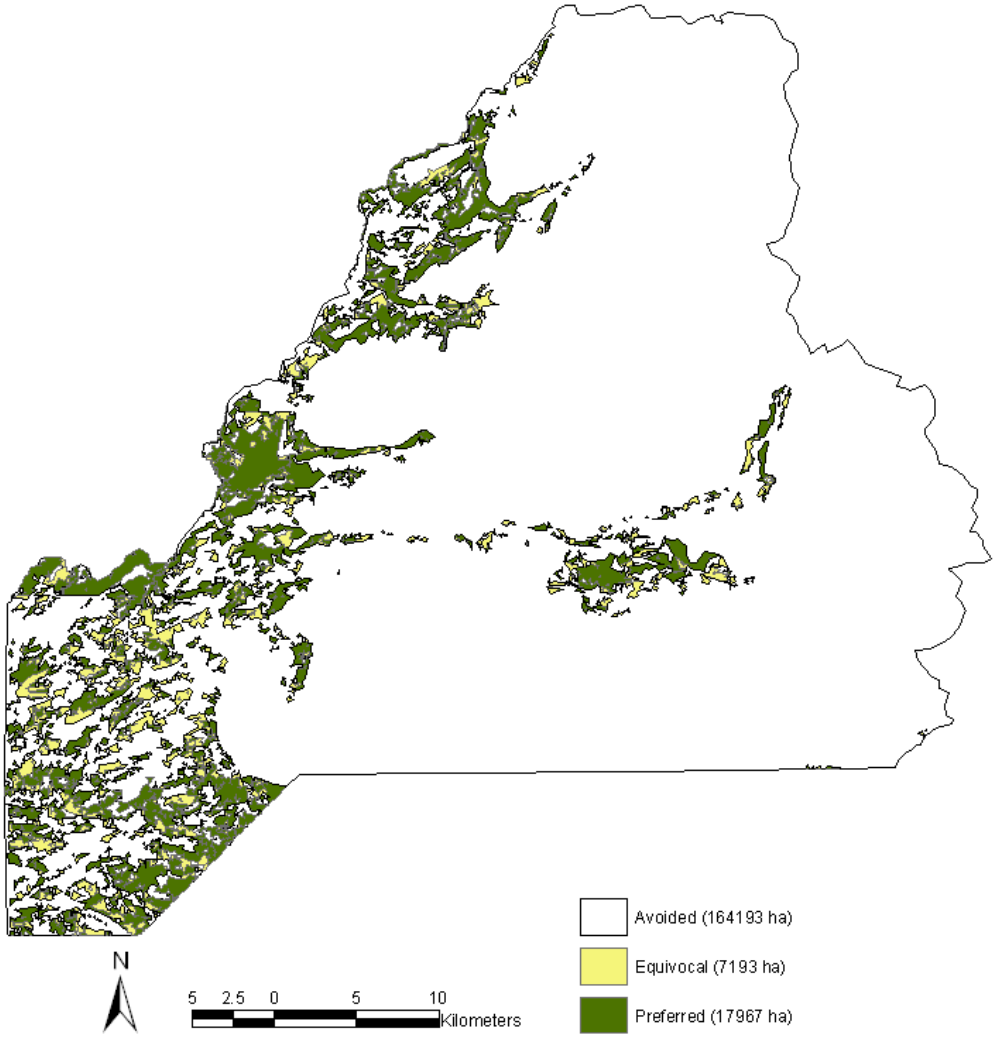
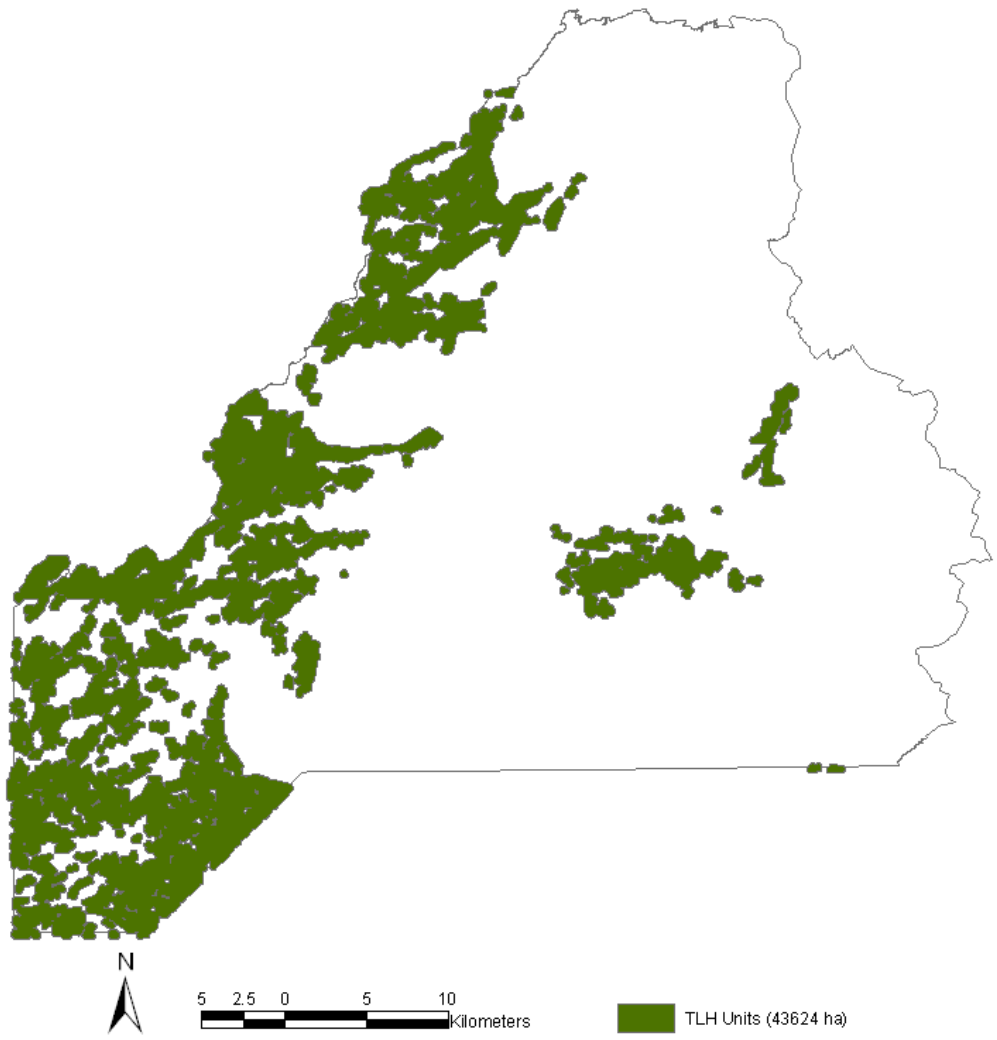
APPENDIX A. SPATIAL REPRESENTATION OG PLWR CAPABILITY



Modeled Distribution of PLWR in the Entiako study area.

APPENDIX B: SPATIAL REPRESENTATION OF THL UNITS



Modeled Distribution of TLH Units in the Entiako study area.