



Juillet 2015

REPORT OF COCHRANE ECOLOGICAL INSTITUTE AREA STUDIE ABOUT HIS ABILITY TO WELCOME THE SPECIES “RANGIFER TARANDUS” (CARIBOU) FOR REHABILITATION IN ALBERTA.

Habitat and nutritional studies of the CEI plot according to the caribou needs.



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SALLE CLARA FOR COCHRANE ECOLOGICAL INSTITUTE

The following report is an analyze of the Cochrane Ecological Institute land with the purpose of knowing if it is favorable for the caribous (*Rangifer Tarandus*). Habitat and nutritive capacity are the two points discussed.

Indeed, the caribou is registered in the endangered species in the south Rockies country. The CEI, located at the foothills of this region, aims at reintroducing new individuals (to host five caribous, increase their number and bring them into the Rockies national park).

The method used for this survey doesn't try to be exhaustive but to underline the indispensable characteristics for the caribou evolution. Those will stay only few years on these plot.

The study has been done during June and July 2015, by a French student in protection and nature management (Sallé Clara), as part of an internship with the CEI. Therefore the report is published in French and English.

Data gathering: Strong Gavin, Sallé Clara Ecology students

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1. INTRODUCTION

The following section provides a contextualization, enabling a better comprehension of the study.

1.1. Cochrane Ecological Institute (CEI) presentation

The Cochrane Ecological Institute is a non-profit organization created in 1971. Its mandate is defined as follow :*"The Cochrane Ecological Institute- Cochrane Wildlife Reserve Society is devoted to the preservation of North America's biodiversity through the conservation and breeding of endangered indigenous species, environmental impact evaluation, ecosystem restoration through the reintroduction of extirpated flora and fauna, rescue and rehabilitation and release of injured and orphaned wildlife, public education and field research, and the monitoring of habitat and species through the development of non-intrusive survey methods."*¹

The 64 Hectare of the park are situated in south Alberta, in the valley between the Rockies and Calgary. For a long time now, the CEI has carried out reintroduction projects in this land, as the one concerning the swift fox (*vulpes velox*) in 1998, with biologists and qualified individuals.

This paper deals with one of this projects, the caribou's reintroduction. More especially my concern is the nutriment availability and the habitat, as it will be discussed later.

1.2. Caribou (*Rangifer Tarandus*) status

At the present time the caribou's distribution area stretches out on the boreal forest of north America, from Alaska to Quebec, including Greenland (as one can see on the map below, from A. Gunn, D. Russell and J. Eamer, *Northern caribou population trends in Canada, 2008.*). Five subspecies share the various ecosystems (boreal forest, tundra...) of this area. By the way, the



A. Gunn, D. Russell and J. Eamer, *Northern caribou population trends in Canada, 2008.*

¹ <http://www.ceinst.org/index.html>

caribou is a symbol for those countries as well as an indispensable part of the equilibrium of the environment.

Since few years the herd's number in North America dropped considerably. Canadian's population of woodland caribous is listed under Canada's Species at Risk Act (SARA) as *Endangered* (Atlantic-Gaspésie), *Threatened* (Southern Mountain and Boreal), and of *Special Concern* (Northern Mountain) since 2003², and since 2005 in Quebec. In this way Banff, Jasper, Revelstok mount and Glacier National Park have implemented a reintroduction program in the south of the Rockies Park. In fact, in this southern region of Canada there is only one herd, in danger.

The destruction of the caribou's habitats by human activities like forest or oil exploitation are the main causes of this ecological disturbance.

1.3. Report objectives

Considering the situation, the CEI wants to carry out a reintroduction program. The analysis of the 64 Ha of the property corresponding to the protected area required for the caribou³ will allow us to evaluate the capacity of this plot to host five caribous. This includes firstly a habitat analysis, and secondly a nutritive value analysis, which are the subjects of this study. The purpose of the project is to host the herd until it will be strong enough, and thereafter, to reintroduce it in the wild.

This report should be an argument for the CEI to properly conduce the reintroduction project, in the respect of the caribou and of the environment.

1.4. Realization

This analysis for the CEI has been realized in the context of a professional internship of environment protection and management, by a French student from Henri Queuille high school, with a Canadian student (Strong Gavin) collaboration, under the CEI management.

2. HABITAT ANALYSIS

The following chapter provides information about the analysis method of the habitat, the outcome of the CEI plot, and a discussion about this two points.

2.1. Caribou's habitat description

First of all, to analyze an area, one must identify the most important elements, which have an impact on the species evolution. Therefore the caribou needs are required.

In order to determine if the habitat is favorable or unfavorable for a delimited population of this species, I used the index of habitat quality (IHQ) worked out by Nature Quebec [Powell, 2006]. I combined data about needs and about habitat's characteristic with the aim of realizing a map of the favorable area for the species. Few IHQ have already been made for the woodland

² Park Canada report, species at risk, 2014.

³ according with the recommendations of the study: *Des critères d'aires protégées pour le Caribou*, Nature Quebec, 2007

caribou from Alberta and from Terre-Neuve Island [Higgelke and MacLeod, 2000; Côté et al., 2004].

The criteria for an IHQ equivalent to “favorable habitat” are:

- Non disturbed large areas (100 Km²/ individual)
- Ecological continuity (no deforestation, no exploitation, etc.)
- A wet land, spruce forest and water body majority
- 60% resinous tree

A place is considered as a favorable habitat for caribous if its surface is classified at 80% minimum with an IHQ “favorable habitat”.

However these criteria have been defined for protected area for caribou in all the Quebec. We have to take into account firstly the smallest scale of the CEI and the number of individual per Km², and secondly, but mostly, the fact that the caribou will spend only a few years on this land. Given this conditions of the reintroduction project, this criteria may be partly reconsidered.

Thus we have to answer the following question: does the CEI meet the requirements of the caribou’s favorable habitat?

2.2. Method presentation

The following method I used for the study had been determined according to limiting factors. They will be discussed in the 2.4. part of this report. The method is composed of four parts: contextualization, global schematization, surface calculus and results analysis. They are detailed below.

The purpose is to create a map which underlines the various habitats (forest, wheat, etc.) and their superficies, in order to analyze the results.

The habitat mapping protocol was elaborated as followed: an air view georeferenced has been gridded with a one hectare scale. It was the first medium for the data harvesting and the mapping (annex A) beforehand any contextualization and analysis.

1° context: To establish a context card (annex E) help to identify the plants, the ecosystem but also to underline the potentially plot disturbance. By knowing the context, we can correctly interpret the data.

2° global schematization: From the air view we obtain a first sketch of the forest and non-forest areas. That must be completed by a full browse of the plot aiming at outlining the limits of these areas. Moreover the GPS permits localization by hectare (materialized on the air view) and to draw the habitats’ board. Those are named depending of the main vegetation which compose them (here: mixed, spruce (*pinus glauca*), aspen (*populus tremula*), grass land and wet land)⁴.

Then, all the GPS data are transferred on the computer to be mapped via the program *Map Source*.

⁴ Service canadien des forêts, *Field guide to ecosites of West-central Alberta*, 1995

From this point, all the data can be used to map the habitats polygons (annex B). Here I used the *Q.Gis* map program. Thanks to this latter, one can directly use the GPS coordinated with the Lambert 93 georeferencement.

3° surface calculus: The surface calculus is made thanks to *Q.Gis* program. (Map annex C)

4° results interpretation: The interpretation of the results is elaborated thanks to a spreadsheet allowing statistics, graphs, to answer the initial question: “Does the plot comply with the requirements of the caribou’s favorable habitat?” (See “characteristics of an optimal habitat”, part 2.1.)

The full browse in step 2° of the method is also the right time to notify the potentially disturbances, the exploitation area, etc.

2.3. Results

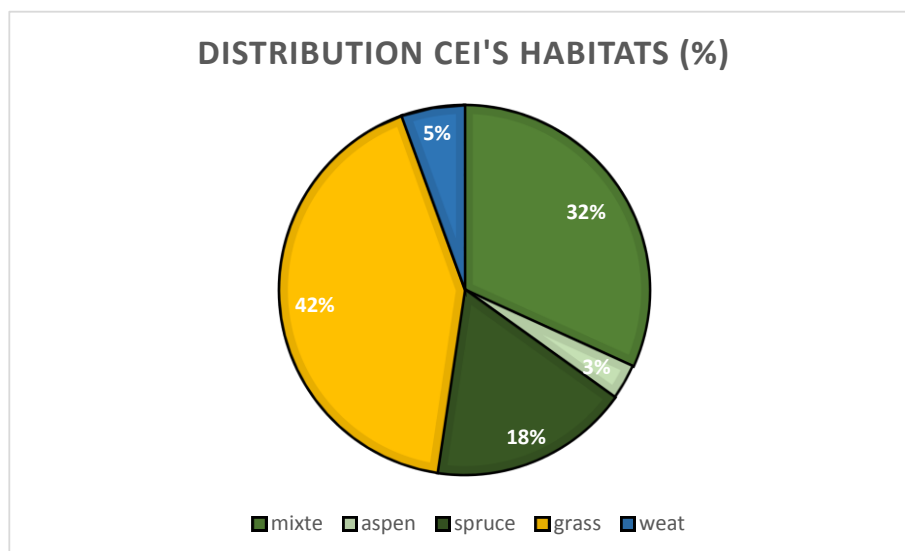
All the surveys data from the plot are classified. So we can conclude about quality of the habitat. The following part introduces this results.

All the data have been collected on 143 acres. These latter are composed of the following habitat: Spruce forest (*Picea Glauca*), Aspen forest (*populous tremula*), mixes forest (aspen and spruce), mesophilous land, wet land (flooded mainly all the year). The map (annex C) served to create the following table which summarizes the occurrence of each ecosystem.

Table 1 : surfaces of types of habitat.

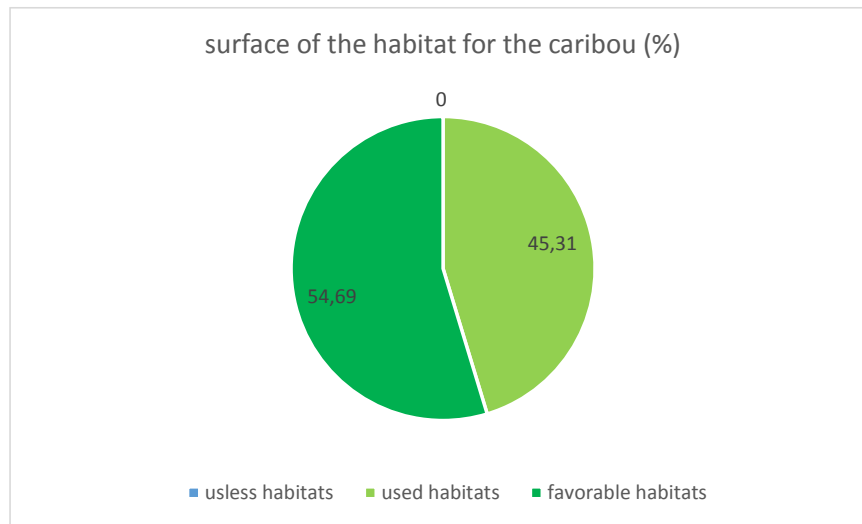
	surface (Ha.)												TOTAL	%	
mixte	0,14	1,17	0,2	0,3	2,4	1,14	1,9	0,18	0,16	0,31	9,1	1,33	18,33	31,7567568	
aspen	0,22	0,14	0,21	0,05	0,07	0,12	0,15	0,85					1,81	3,13582814	
spruce	1,53	1,2	0,49	1,08	2,85	0,32	0,29	2,1	0,22				10,08	17,4636175	
grass	18,2	1,85	4,3										24,35	42,1864172	
weat	0,04	0,05	0,15	1,74	0,24	0,8	0,13						3,15	5,45738046	
													TOTAL	57,72	100

The following graph summarizes the habitats analysis results on the 143 acres. Data are in % cover.



Graphic 1: available habitat according to dominant vegetation

If we refer to the caribou's HAQ criteria (part 2.1.), we obtain the following graph:



Graphic 2: *surface of available habitat according with Nature Quebec criteria*

Mainly, the habitats on the CEI area are considered as “favorable habitats” for the caribou as shown above (graph 2). The rest of the plot is used by the caribou in proportion of his availability. This means that he’s not going to avoid those areas but to take advantage of them to compensate potential needs.

We can notice a lack of unfavorable habitat. It’s an important factor of choice for the caribou, which is looking for an unfractured space to move on.

The CEI doesn’t fit with the Nature Quebec’s 80% of “favorable habitat” criteria. However one can not ignore the result of 100% of “used habitat” available in the CEI area (see graph.2). Moreover we have to keep in mind the reduced number of individual on the plot and the short time of living of the caribou there. Likewise, the established HAQ criteria of 60% of coniferous forest, could be re-balanced in relation with the pressure of the herd on his environment, regarding the conditions of the reintroduction project. The area of available forest from 18 % becomes of 50% with the mixed forests. Nevertheless, in the ecological succession, spruce are going to colonize all the forest plot and also a part of the land (but moderate by the buffalo and other animals’ grazing). That does mean that the conifer cover acreage increases. This evolution is already noticeable when we look at the mixed forest which are the transition between an aspen forest and a spruce forest as well as the edge where a lot of little spruce are growing.

With regard to the natural water, they are on the map but are not considered in the habitat result. They fill 2, 96 acres. They are indispensable for the caribou. So it’s an asset for the CEI.

For all the area there isn’t any disturbance, no exploitation; only few place over-grazed by the buffalos, mainly around the water. Moreover, according to the map, we notice an ecological continuum, without anthropization, and a forestry ecological corridor. This comes from the fact that the only human intervention is for the fence maintenance.

2.4. Method and results discussing

The purpose of these part was the CEI's plot analysis to identify the different habitats and to compare them with the caribou's needs. The method that I used and explained previously was made depending on various constraints and because of this, it has limits which have to be kept in mind.

The major difficulty in the habitat analysis is to determine the boundary of that habitat. Indeed, the various environments are not delimited by a clear line. They evolve all the time, following a specific ecological succession. This one is steady. This difficulty is most important in the forest area. So we used a vegetal dominance criteria. The problem with it is its subjectivity. In this case the air view is a really good tool to limit the habitats.

This involves less precision in the mapping and thus approximate acreage. However the margin of error is only in meters thanks to the GPS.

It's the same for the grass land. Indeed the ecological succession induced that trees and shrubs colonize the land, in edge and on the ungrazed place. So we choose to named forestry habitat when high woody covered more than 0.12 acres. This choice is arbitrary.

About the land, we named only two types: wet and mesophilic. But the identification of the land habitats is really difficult between different habitats or a same habitat but with different development stage. This could be subjective. Nevertheless for the caribou the land identification is not so important.

Lastly, the difficulty of access in some forestry plots made the itinerary almost homogenous. So the air view helped a lot.

All this fact have an influence on the surface calculation, but the fact that there isn't unfavorable place for the caribou is still true.

With regard to the pond we didn't include them into the surface calculation. This chose is only subjective and come from a will to study more the earth habitats (also because of our knowledge). But they are also very important for the caribou. That's why I mentioned them in the results part. Thus, an analysis of the water could be planned for the caribou's reintroduction.

3. NUTRIENT AVAIBILITY ANALYSIS

The following part is about the nutrient avaibility analysis method, the results on the CEI plot, as well as a discussing of both. The study is, in a first part about the plant, and in a second part focused on the lichens.

3.1. Vegetation

The following data are about the quantity and the diversity of the CEI's vegetation according to the caribou's needs.

3.1.1. Caribou's requirements

First of all we need to know the Rangifer Tarandus's feeding regime. Hereafter, a list of the main caribou's diet⁵.

Young buds, catkins, leaves, and/or sprouts of water sedge, water horsetail (*E. fluviatile*), mountain cranberry (*oxycoccus*), sheathed cottonsedge (*Eriophorum*

⁵ Information given by Clio Smeeton.

vaginatum), bog Labrador tea, northern Labrador tea (*Ledum decumbens*), bog birch, and leatherleaf (*Chamaedaphne calyculata*) arctic dryad, saxifrage (*Saxifraga spp.*), bog rosemary (*Andromeda spp.*), black crowberry (*Empetrum nigrum*), sheep-laurel (*Kalmia angustifolia*), bog-laurel (*K. polifolia*), spruce (*picea spp.*), sedges (*Cyperaceae*), blueberries (*Vaccinium spp.*), birches (*Betula spp.*), grasses, and mosses, caribou lightly browsed mountain maple (*Acer spicatum*), American mountain-ash (*Sorbus americana*), grouse whortleberry (*Vaccinium scoparium*), willows (*Salix spp.*), red-osier dogwood (*Cornus sericea*), and downy arrowwood (*Viburnum rafinesquianum*), fir (*abies spp.*), , and pine (*pinus spp.*), Oregon boxwood (*Paxistima myrsinites*). *Boletus spp.*, *Coprinus spp.*, *Lycoperdon spp.*, and *Morchella spp.*, fly agaric mushroom (*Amanita muscaria*).

This alimentation can be compared to the one of most of the hoofed mammals. Therefore there are all kind of grass, large leave plants, coniferous, trees (aspen ...), sedge, mushrooms, mosses and lichens.

The paper *Nature Quebec* summarize as follows the caribou's needs:

During spring and summer the caribou's alimentation is varied, with mainly young trees leaves, grasses and earth lichen. This last one rise up when the quantity of fresh leaves reduce. Whereas in winter lichen represents 50% to 75% of his alimentation (Bergerud, 1974; St-Pierre et al., 2003). Consequently of the using of each habitat (reproduction, food, migration, etc.), caribous change seasonally their habitat (Rettie et Messier, 2000; Gustine et al., 2006b).⁶

One individual can eat during summer, an average of three kilos of vegetation.⁷

The diversity of the vegetation brings a better appetite, so a better nutrition quality.

So we need to know the CEI's plants and there abundance to conclude about their nutritional quality, while taking into account the diversity factor.

3.1.2. Method presentation

The following method done on the plot have been created according to some limiting factors. This will be discussed in the 3.1.4. part of the report. It has been done mainly with the habitat analysis method.

The previous map of habitat is used as a help for the plants' quadrat, as well as all the data already collected (main vegetation, habitat identification, etc.).

In order to know the plants on the plot and there abundance (cover %) we proceed by quadrat, based on the habitats' polygons.

For each habitat's polygon (annex C) quadrats of 1 square meter are made. For each one we survey the plants, their % of cover and their number. Quadrats are geo-localized with the GPS and the maps (annex C).

⁶ « Méthodologie d'identification de secteurs favorables à la conservation du Caribou forestier, réalisée dans le cadre du projet « Critères et propositions d'aires protégées pour le Caribou forestier », *Nature Québec*, 2007.

⁷ Beverly and Qamanirjuaq Caribou Management Board, *Environment Canada* (Canadian Wildlife Service—Yukon).

The location of the quadrats is random and their number in a polygon is set with the method of “increase data string”. That does mean that as far as you still find new plants in the next quadrat you increase the frequency of survey. As soon as the plants’ number is steady we consider that the survey is enough in this polygon.

Then all the data survey are gathered on a spreadsheet software (Excel), by habitat and by polygon, with the aim of comparing them.

3.1.3. Results

All the data collected according to the previous method have been classified. Now we can conclude on the nutritive value of the CEI field. This part presents the results.

The field work allowed to make a list of the CEI’s plants wich can be eaten by the caribous during the summer time: Wild Vetchling (*Lathyrus pratensis*), Creamy vetchling (*Lathyrus ochroleucus*), prickly rose (*Rosa acicularis*), wild raspberry (*Rubus*), gold moss (*Polytrichum commune*), norway sedges (*Carex norvegica*), northern bedstraw (*Galium boreale*), yarrow (*Achillea millefolium*), wild strawberry (*Fragaria vesca*), clover (*Trifolium repens*), dwarf bluberry (*Vaccinium L.*), wild bluberry (*Vaccinium angustifolium*), 5 grass species (*Poaceae*), spruce (*Picea glauca*), aspen (*Populus tremula*).

The following table classified the datas according to the five habitats.

	total species	total species edible by the caribou	% cover of edible species of the quadra by habitat	habitat surface(Ha.)	average % cover edible species for the all area of the habitat
grass land	17	10	77,60%	24,35	18,8956
mixte	17	13	55,60%	18,33	10,19148
spruce	13	10	63,80%	10,08	6,43104
aspen	11	8	75,90%	1,81	1,37379
weat	5	4	96,40%	3,15	3,0366
total	27	20		57,72	69%

On the 25 species noted on the plot (wood and non-wood), 20 are part of the caribou alimentation during summer. It’s all at once deciduous tree, conifers, large leave plants, sedges, moss, grasses. So we can conclude that the place offers a diversified alimentation for the caribou.

Regarding to the abundance, 69% of the park surface is covered by eatable plants for the caribou. This result doesn’t take into account trees and lichens. If we compare this data to some others studies like from “ Méthodologie d’identification de secteurs favorables à la conservation du Caribou forestier, réalisée dans le cadre du projet « Critères et propositions d’aires protégées pour le Caribou forestier », Nature Québec, 2007 », so we can assert that this quantity will be enough for only a few caribous on the land.

Moreover, we can add the woody vegetation on the CEI’s field, composed mainly by aspen and spruce. We can observe few *Pinus nigra*. The following table shows the density of the two main species according to the habitat.

	average density per m ²	average density per habitat	% of all the forest area
grass land	0,025	6087,5	3%
mixte	0,5	91650	39%
spruce	1,25	126000	53%
aspen	0,75	13575	6%
weat	0	0	0%
total	0,505	237312,5	100%

We can underline a spruce dominance, more than 50% of the CEI's trees. That the advantage of the park for the caribou. Indeed, coniferous are the most favorable caribou environment for its nutritive value. Moreover we're going to see in the next part that the coniferous forest is the best for the lichens growth.

The nutritive review of the CEI's wood and non-wood vegetation is shared in two parts. First, 69% of the total surface of the field are covered with edible plants, which is enough for them. The plants diversity is an asset. Secondly the forest field represents 53% of the total surface. The density is really important (1, 25 per m²) for the coniferous. The nutritive and quantitative value is enough for the caribou during summertime.

3.1.4. Method and results discussing

The aim of this part was to analyze the CEI's plot to conclude on the nutritive and quantitative value of the vegetation, according to the caribou needs. The used method was described in the 3.1.2. parts. It was done according to some constraints, consequently it has limits. This have few aftereffects on the results. Yet I'm going to show those limits.

The random quadrat method was choose because of the surface area. Indeed the global path would be too long and tedious, as for transects. However, this method can't take into account localized or uncommon plants. As an example: *Pinus nigra* isn't on any survey while it is on the area. The same with the *Salix spp.* and *E. fluviatil.*

A second factor that could influence the result is a knowledge lacke about the Canadian plants. But this one is minimal.

Regarding to the "humans" factor, we can't leave the subjectivity. Indeed for the estimation or the method decisions, the subjectivity can disturb the data analysis. Nevertheless, a good utilization of the materiel can minimize the errors.

At last, the lake of knowledge about the exact caribou's needs, compared with what I'm able to do on the field gives only a idea of what can really be the result.

3.2. Lichens

The previous part shows a nutritive analyze of the area for the summertime. Indeed, all this green plants are inexistent during winter. So lichens become the main caribou's alimentation during this period, as bark. Thus they are indispensable to survive.

But lichens are really different compared to spermaphytes and pteridophytes. So we need a specific method to analyze them.

3.2.1. Caribou's requirements

First of all we need to know the caribou's diet with regard to the lichens. Following a non-exhaustive list of edible lichens:

Reindeer lichens (*Cladonia spp.*), cup lichens (*C. amaurocraea* and *C. uncialis*), cetraria lichen (*Flavocetraria nivalis*), felt lichen (*Peltigera spp.*), and snow lichens (*Stereocaulon spp.*) cup lichens, witch's hair lichen and horsehair lichens.

The trees and terrestrial lichens are both eatable by the Rangifer tarandus species.

« Un caribou adulte en consomme environ 3 kg (poids sec) par jour (Bellefeuille, 2001 , e. g. Desmeules et Heyland, 1969b ; Crête et al, 1990b). Nous distinguons deux types de lichens, soit les lichens épiphytiques et les lichens terrestres. Les lichens terrestres des genres Cladina, Cladonia, Cetraria, Parmelia sont les plus consommés dans notre aire d'étude. Parmi les lichens arboricoles fruticoles les plus recherchés mentionnons les genres Alectoria, Bryoria, Usnea et Evernia (Bellefeuille, 2001, e.g. Edwards et Ritcey, 1960 ; Desmeules et Heyland, 1969a ; Stevenson, 1990 ; Schaefer et Pruitt, 1991 ; Rheault et al. 2003 ; Boudreault et al. 2002 ; sous presse). »⁸

- A caribou eats 3 Kg of lichen per day-

3.2.2. Method presentation

The following method aims at identifying the different lichen species of the CEI's plot. The method will be discussed in the next part.

The methodology of lichen analyze is composed by two steps. First for the wood lichen, secondly for the earthly lichen.

The estimation is done by habitat (annex C). It is applicated in one polygon and after data are extended to all the habitat surface.

In one polygon we choose ten trees alive at random. At least 30cm diameter spruces and 20cm diameter aspens (to have mature trees).

On each tree four (North, South, Est, West) 10cm² square are put on the trunk, from 1m of the ground. If there are branches in the square we written down them in the 1m². For each square of lichen species and % covered are written down. Thus we have the lichen diversity by habitat and their dominance in relation to one other.

Then the method is applicated in the other forest habitat.

For the earthly lichen:

For a habitat polygon, we write down the surface (square cm) of the lichen "spots" situated along a 100m x 1m transect (placed randomly). Then we can make an estimation for all the same habitat.

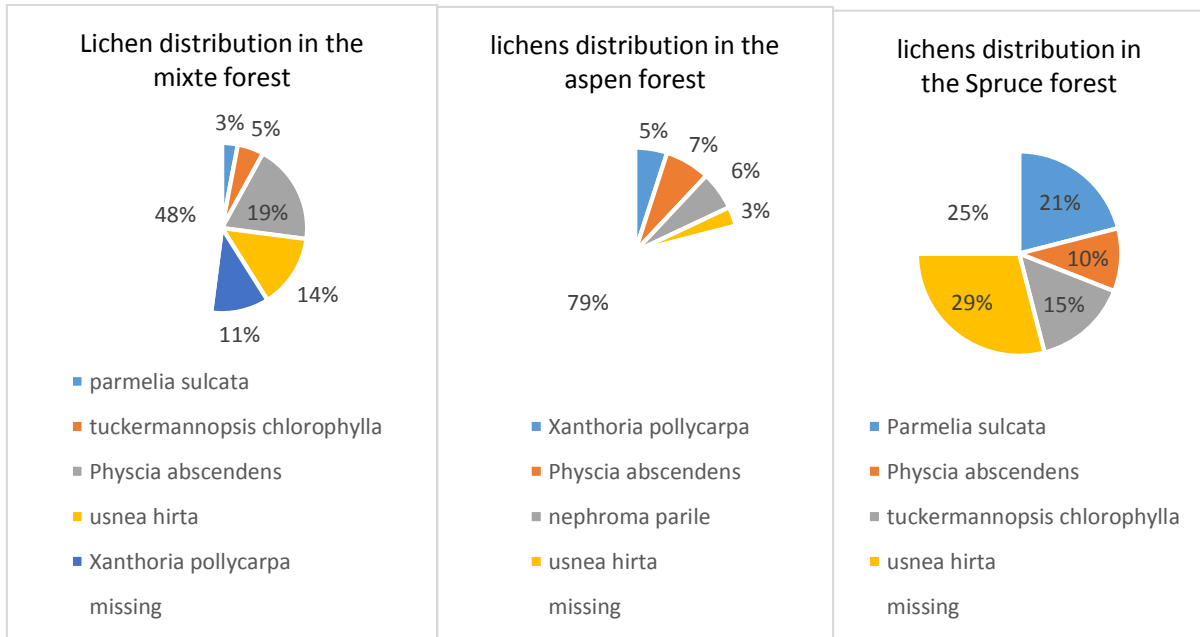
The same method is used for the grass land.

The following part introduces the results for the CEI's area.

3.2.3 Results

⁸ N. Bergeron, *Utilisation des habitats par la caribou forestier (Rangifer Tarandus caribou) à l'échelle des domaines saisonniers dans le nord du Québec, Mémoire présenté comme exigence partielle de maîtrise en biologie*, Université du Québec à Montréal, décembre 2012.

The following graphs show the lichen %cover per habitat. This one is an average calculated on ten trees. Those data can't give a specific estimation for the all area. Nevertheless graphs give a global vision on the lichen diversity and their repartition.



For the forestry habitat we notice that the species *Usnea Hirta* is always here. So it is adapted to different timber species, both coniferous and deciduous tree. The “missing” part is the % cover where there is no lichen. This help to show the average lichen abundance per tree. Still for the forestry habitat it was the spruce area which housed the main quantity of lichen. Indeed in those area trees are completely covered from top to bottom and also branches with lichen. Hair lichen predominates.

Aspen forest are less favorable to host lichen. Few species are noticeable but in lowest number.

If we are looking for diversity, the mixed forest is the best one. This is due to the attendance of both tree species, spruce and aspen.

Results don't take in account lichen on the dead branches on the ground. However their quantity is important, so good for the caribou alimentation.

Regarding to the grass land, it's difficult to extend data from the 100m² transect to all the area. Indeed, the lichen repartition is too irregular. It depend on trampled, grazed places. But survey clearly shows that the species *Peltigera* is mainstream. The other species are *Cladonia* and *Flavocetraria*.

When we compare all those data with the caribou's needs (part 3.2.1.), all the ground lichen species belong to the caribou diet. Grass land will be good for this hoofed mammal in winter time. Indeed they can scrape the snow to find plants, roots, lichens and bryophytes. In all the CEI's habitat the species *Usnea* (fructitose lichen, long thalle; also named hair lichen) will be the main provenance of the caribou alimentation, as the species *Parmelia* (leave lichen). The other species are leave lichen (thalle: spray lobe) that can also be a part of the wintry caribou alimentation.

So we enumerate on the CEI's plot three terrestrial lichen species and six arboreal, of which two are the main alimentation of the caribou (because most common in all the Canada).

Thus lichen species are diversified and good for the specie *Rangifer tarandus*.

After it could be interesting to evaluate the lichen quantity according to the species needs.

We have to underline the fact that lichens are fragile species, sensitive to pollution and others perturbations. Moreover its growth is extremely slow, not more than 1mm per year. Consequently at the fact that caribous will be in the park they may not migrate. Yet this practice will disturb the lichen regeneration from year to year. We should find a solution to protect CEI's lichen, with an importation of food during winter for example.

3.2.4. Method and results discussing

The aim of the previous part was to analyze the lichen diversity in the CEI's area because of its importance in the caribou wintry alimentation. The used method described at the beginning was thought according to few constraints, consequently there are few limits and impacts on the results. The following part shows those limits.

First of all the method is based on a random sampling. This always involves that you can miss a very particular species. But the main default is that you only survey lichens from 1m from the ground on the trunk, whereas lichens are differently spread on trees. It is a rough estimation. The assets of the method is the survey on the four faces of the trunk (N, S, E, W).

Then the method don't help to know the dry density of lichen in the area (average 3Kg/day), yet important to know the nutritional capacity of the plot to host caribous. With more time, more specific field survey would be done. Indeed, we know an average number of tree per habitat, an average %cover of lichen per ten tree. But here we only conclude on the % of each lichen according to each other.

At last the lichen identification is complicated for a non-specialist people. So I just identify the lichen family and not the specific species. However this don't have an important impact on the results for the caribou because they have a diversified alimentation concerning lichen. If they eat one species of lichen they eat all the lichens from the same family.

4. REVIEW

After having analyzed step-by-step the nutritional capacity of the CEI's area both for woody and non-timber vegetation or lichen, we can, now, make a review to answer the starting question: Does the CEI's park answer to the caribous' needs, both in terms of habitat and in terms of alimentation?

In a first part we saw that the CEI doesn't completely answer to the caribous' habitat needs. The patchwork field (spruce forest, aspen forest, mixt forest, grass land, wet land) can partly host the animals. The natural pond is an asset for the caribou. But the absence of human activities have to be kept to let the spruce become mature.

The sharing of the park with the buffalo and other hoofed mammals can only be favorable for the herd growth.

In a second part the vegetation analyze allowed to conclude on the nutritional sufficiency of the area in terms of quality and quantity. The vegetation diversity and abundance is enough per habitat (about twenty species), and spruce are mostly everywhere.

At last, the lichen survey shows that nine species are on the CEI's plot, main caribou alimentation in winter. The diversity will be good for the species appetite. But we didn't

analyze the quantity of lichen, so it's difficult to make a review on the quantitative capacity of the area to feed caribous in winter.

Limits of the study were underlined in the end of each part. So we have to keep a critical eye on the report.

This one doesn't give any information on the mushrooms, which are also a part of the caribou diet. But with the data on the field, we can have an idea of what kind of fungi we can find, and if they are good for the caribou or not.

To pursue the study a water quality analyze can be done, and can eventually improve it, aiming in improving the caribou well-being.

To conclude we can say that the CEI has the capacity to host few individual from the *Rangifer tarandus* species. However they have to keep the great quality of the park, no human activities; but also find solution to protect it, which we did with the lichens which are sensible species.

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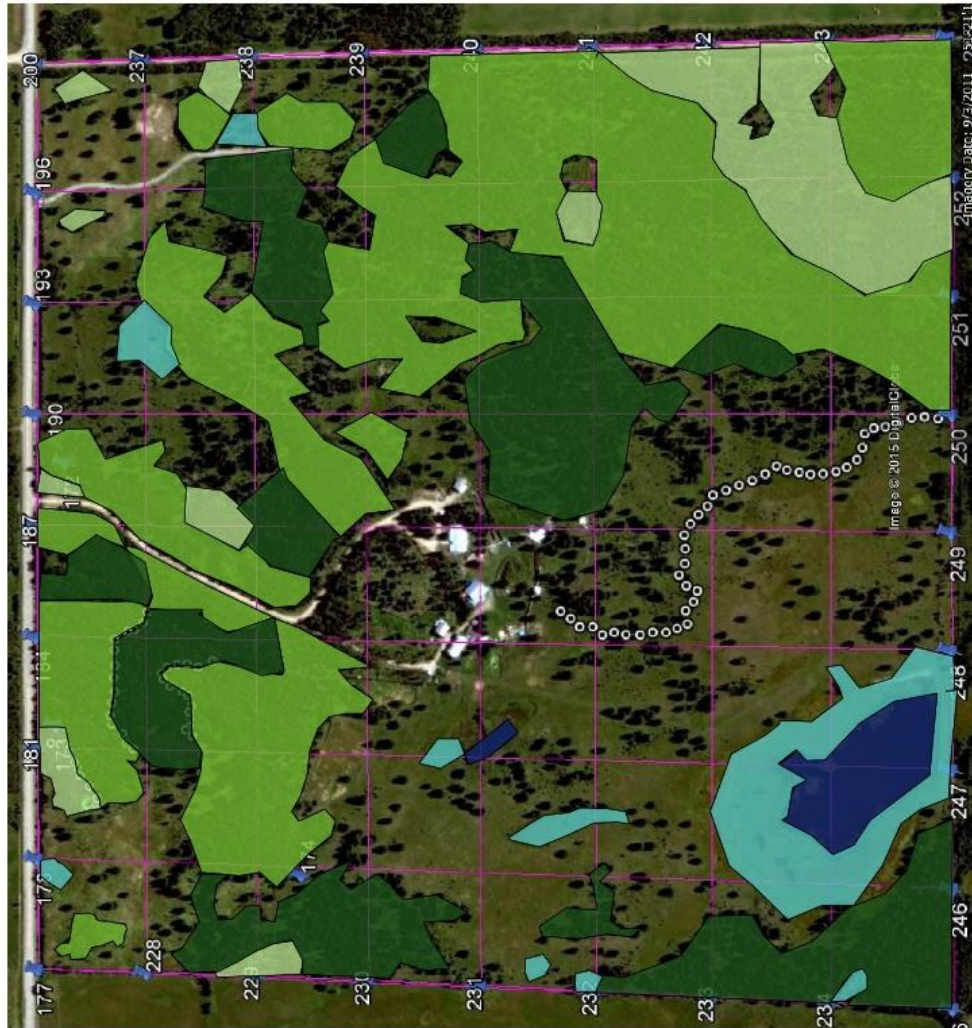
ANNEX

A. air view georeferenced have been gridded with a one hectare scaled



B. Polygon habitats' map

CEI HABITATS - MAIN COMPOSITION



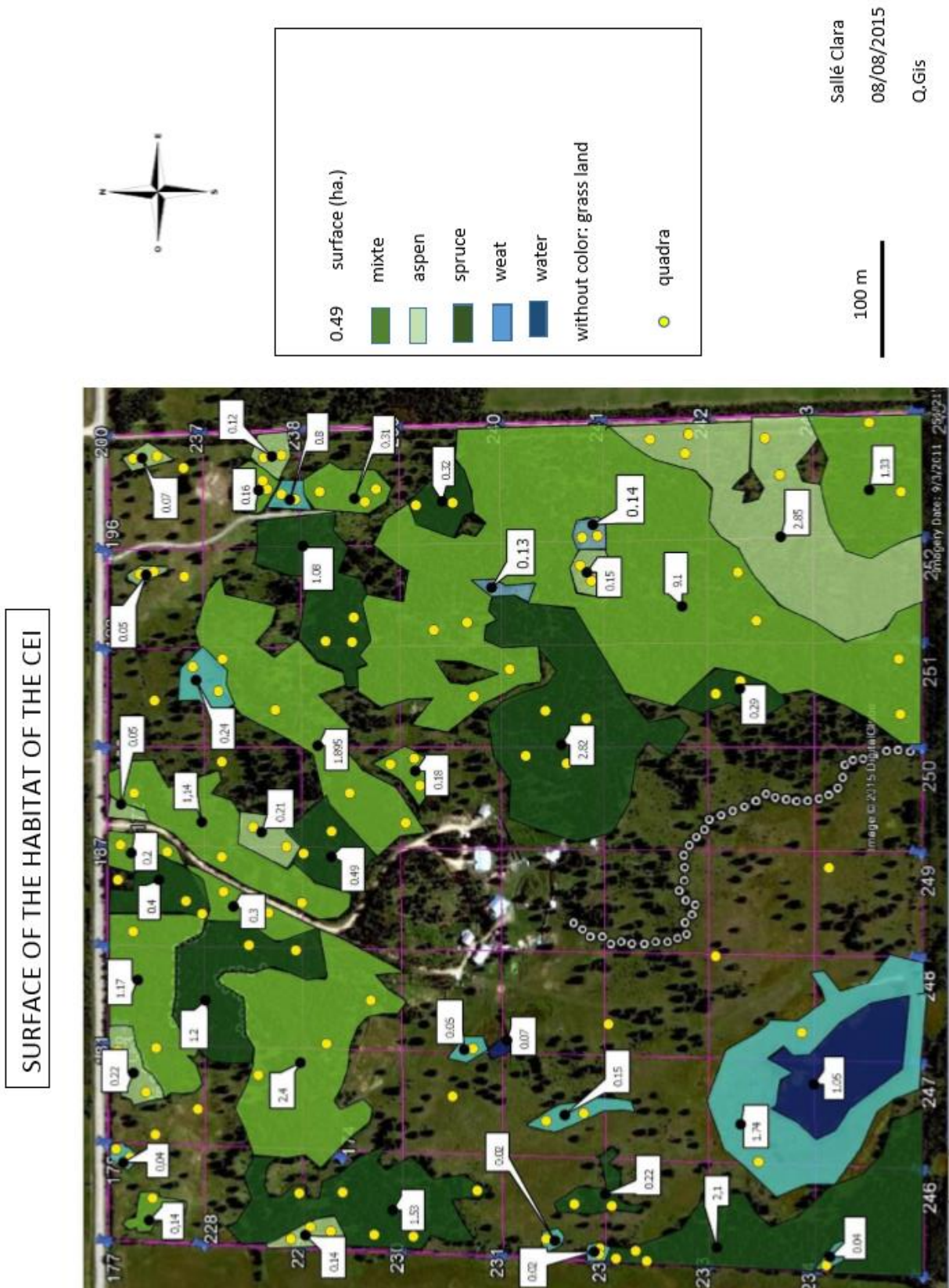
carte esral

- aquatic
- aspen forest
- mixte forest
- spruce forest
- weat land

the land without color is grass land. There are different types of grass land (with a lot of shrubs, with spruce/aspen growth, dry,...)

07/06/2015

C. Area surface and quadrat's map



D.

**Tableau 1 –
Classes d'habitat utilisées pour classifier l'aire de répartition québécoise du Caribou forestier et classification de ces habitats selon qu'ils soient favorables, non favorables ou non sélectionnés par les caribous**

Source	Classes d'habitat ^a	Type d'habitat pour le caribou
1 ^b	Absence de données	
1	Ombre	
1	Nuages	Sélection non répertoriée
1	Neige/glace	
1	Affleurement rocheux/débris	
1	Eau	Eau
1	Plantes invasculaires (bryophytes, lichens)	
1	Milieux humides arborés	Favorables :
1	Milieux humides arbustifs	habitats sur-utilisés par le
1	Milieux humides herbacés	caribou par rapport à sa
1	Résineux denses	disponibilité dans l'aire
1	Résineux ouverts	d'étude
1	Résineux épars	
1	Arbustes - hauts	
1	Arbustes - bas	Non sélectionnés :
1	Herbacé	Habitats utilisés
1	Feuillus denses	proportionnellement à sa
1	Feuillus ouverts	disponibilité au sein de
1	Feuillus épars	l'aire d'étude
1	Mélangés denses	
1	Mélangés ouverts	
1	Mélangés épars	
1	Surface dénudée	Non favorables :
2 ^c	Secteurs évités	habitats sous-utilisés par le
3 ^d	Feu	caribou par rapport à sa
3	Chablis total	disponibilité dans l'aire
3	Coupe	d'étude

^a Voir en annexe pour la description des classes d'habitat / ^b Couche d'occupation du sol du MRN / ^c BNDT de Géomatique Canada / ^d Tesselles de SIFORT

E. Context

Historique :	<p>En 1988 du haut du terrain (coté route) on pouvait voir le lac, cela veut dire qu'il n'y avait pas la forêt. Mais c'est simplement le fait de ne pas exploiter le terrain qui a permis aux conifères de se développer dans un cycle naturel. La forêt n'est donc pas très vieille.</p> <p>Ont gagné les <u>Emerald Award</u> en 1996. Pris qui récompense les initiatives environnementales prises par des organisations ou des individus dans un but non lucratif dans la région de l'Alberta.</p> <p><i>« Albertans are passionate about balancing the development of this province's rich resources with environmental stewardship. The Emerald Awards recognize and reward the excellent environmental initiatives undertaken each year by large and small corporations, individuals, not-for-profit associations, community groups and governments. »</i></p>		
Climat :	Climat tempéré froid, les températures varient entre -15°C et 30°C. Les précipitations sont en moyenne de 480 mm par an.		
Situation topographique :	Dans la vallée Bow River, au contrefort des Rocheuses. La région est donc légèrement vallonnée, homogène.		
Altitude :	1186 m		
Géologie :	Sol majoritairement sableux.		
Activité sur la parcelle :	Région agricole (principalement élevage bovin) et exploitation de pétrole.	La parcelle du CEI est utilisée uniquement pour la réintroduction et le pâturage de quelques bisons. Pas d'exploitation forestière (uniquement quelques conifères pour Noël). Pas d'apport. Pas de chasse ni activité agricole.	La parcelle n'est pas « nettoyée », le bois mort est donc laissé sur place.
Accès :	Le CEI est facilement accessible par la route, à l'intérieur de la parcelle il n'y a pas de chemin.		
Autre :	L'ensemble du terrain est entouré d'une double clôture.	2 plans d'eau naturels.	

F. CEI's plants pictures



Creamy vetchling, Lathyrus ochroleucus



Meadowrue, Thalictrum

Pretty shootingstar, Dodecatheon pulchellum



Pussytoes, Antennaria

Yarrow, achillea millfolium

Heart leaves alexanders, zizia aptera



wild strawberry, Fragaria vesca



Shrubby cinquefoil, Dasiphora fruticosa



G. CEI's lichen pictures



Usnea hirta



peltigera



tuckermannopsis chlorophylla



physcia abscondens



xantoria pollycarpa

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