

## **Ecological investigation of the Muskuuchii area**

Report submitted to the Grand Council of the Crees

By

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August 20<sup>th</sup>, 2002

### **Project situation**

Muskuuchii or Bear Mountain is an elevated landmark situated in the James Bay lowlands. Although long-term traditional use of this region has long been recognised, more recent development particularly in the mining and lumbering industries has led the Crees to consider what impact these non-traditional activities are having on the region. A cursory review of area's natural characteristics combined with the cultural importance suggest that Muskuuchii could fall in the category of an exceptional site to be protected from any further development that might compromise integrity.

Found just east of the Ontario/Quebec border and south of James Bay, the site straddles the lowlands in a south-east to north-west direction. Its appearance, a long and sinuous ridge, suggests that it may be remnants of a glacial esker. Other glacial deposits adjoin the esker and form a promontory that gives the site a unique feature not only in regards to its geophysical aspects, but also due to the variety of natural habitats present. Because of these features, the Muskuuchii site may retain a particular biogeographical character unique in this region as it funnels many natural organisms from the surrounding ecosystems in a north-south east-west pattern.

The biodiversity of the region, while not exceptional in numbers, may be significant in its representation. This is due to the confluence of many species of birds, reptiles, amphibians, and possibly insects and other invertebrates that are at their north-eastern most range. To confirm this further investigation is required; however the diversity of the plant kingdom also needs to be considered.

The flora of this region is not well known except for the many vascular plants which generally characterizes the boreal region. Many of the ecosystems present in the area might shelter plant species that are at their extreme range of distribution since Muskuuchii seems to reveal itself as a turntable for south, west and north vectors of influence. An investigation has therefore taken place in June and July 2002.

## Method

The area of Muskuuchii has been investigated in accordance to the different type of ecosystems present. Many types of forest, wetland and freshwater system were prospected to identify the most representative vegetative cover and their related fauna. Several contact zones between two ecosystems have also been examined.

The flora of the region was meticulously examined. A preliminary list of species had already been undertaken and a special attention was kept for rare taxa. The locations of rare plant species were recorded and marked GPS. (Since the exact location of such species might come under restricted information, it is proposed to screen out this information from unadvised persons.) Sampling of uncommon plant species was undertaken and two specimens were harvested unless their population was insufficient. Since flowering or fruiting bodies of plants are essential for positive identification, only these specimens were collected. One series of collected plant specimens will be forwarded to the Montreal Botanical garden and the other series will be submitted to the Cree Regional Authority.

The two field trips were planned according to the growing season. Since most plants bloom in spring or early summer, the first field trip took place in June (between the 23<sup>rd</sup> and 29<sup>th</sup>). The second trip was conducted in July (between the 22<sup>nd</sup> and 28<sup>th</sup> ) and several mid-summer plants were collected during time.

## Description of the area

- **The forests and other land ecosystems**

Most of the Muskuuchii area is covered by Black Spruce (*Picea mariana*) forests, a feature quite characteristic at this latitude and typical of the boreal forest. However this high plateau of moraine consists locally of deep sand deposits that have favoured the growth of Jack Pine (*Pinus banksiana*) stands; these forests dominate most of the eskers that run from the Abitibi plain towards the James Bay lowlands. The Jack Pine forests of Muskuuchii might represent the most north-western stands in the province. Some stands have survived several fires and seem to be more than 85 years old. Small isolated stands were estimated to be over 200 years old.

The Trembling Aspen (*Populus tremuloides*) and Paper Birch (*Betula papyrifera*) often form small pure stands on undulating terrain or they sometimes intermix with the conifers. At these sites the soil becomes loamier. The diversity of plants and animals is much higher than in the pure coniferous stands. Others secondary trees like the Balsam Fir (*Abies balsamea*) and White Spruce (*Picea glauca*) are also frequent. These well established mixed forests constitute the main pole of attraction for a large number of animals and are probably the best winter shelters in the whole area.

The peatland is not well established since most of the area is well drained. No fen or bog are present, except along small meandering creeks and aside small lakes. Many stands of Rough

Alders (*Alnus rugosa*) are well established towards the down slope area of the forests and in the depressions.

- **The fresh water ecosystems**

The designated area consisting of a rising plateau accentuates the drainage. Thus no important fresh water ecosystem is present except for a series of lakes along the western boundary. These lakes drain most of the plateau by means of numerous sources or by small creeks. On the opposite eastern slope, numerous depressions funnel the surface water but most appear as small intermittent creeks, the run off water being more conspicuous at the reach of the lowland where the Joncas river is located.

On the western side, the chain of lakes draw its origin from a glacial river running from south to north. Many glacial deposits are present. The riparian vegetation is highly diversified consisting in a succession of coniferous and deciduous stands of forest. The small river running through the lakes, locally named “Alder river” or “Rivière des aulnes”, and is highly attractive to the local fauna. Many animal tracks are visible along the riverbanks and the river’s bed favours numerous fish species and invertebrates. Since the river is located in a “V” shape valley on part of its course, it creates an exceptional microclimatic zone. In such areas, the high humidity level is maintained by the surrounding trees which shelters the valley from desiccating summer winds as well as blistering winter winds.

## **Biodiversity**

- **The flora**

The actual inventory of the Muskuuchii area shows a very high diversity level. More than 270 species of vascular plants have been identified within a few square kilometers. The plant diversity of Muskuuchii is among the highest in the boreal forest north of the 49<sup>th</sup> parallel. Many species also occur at their northernmost range, taxa from southern ecoregions being more common than from arctic ecoregions because of the topographic features and the prevailing dispersal vectors.

At least, 3 rare plants figure among the inventory, (namely *Solidago ptarmicoides*, *Mimulus glabratus* and *Erigeron lonchophyllus*). Later identification will probably extend the number of rare species to 5. Most of these rare species are vulnerable to invasive introduced plants and further lumbering could jeopardise their situation. A preliminary survey had forecast the presence of a few more rare species (see appendix 1 for the detailed list). A more intensive search during various seasons might complete the inventory.

The western valley where the chain of lakes extends gathers many species unique to the area. Furthermore, several species of orchids abound in this valley because of the constant humidity and the presence of a deep moss ground cover. It seems that most of the uncommon species of the Muskuuchii region are found preferably in old forest ecosystems where they have long been established. Only the more common Lady Slipper seems to have persisted after logging in the Jack Pine forests; in comparative logged area in the mature spruce

forests, no orchids or deep wood species of plant seems to have survived. There seems to be a clear correlation between undisturbed forests and the persistence of the more uncommon plants.

A few species are common throughout the area but are less common elsewhere in the province are the Tall Lungwort, the Hairy Honeysuckle, the Banks Honeysuckle and the Wood Anemone.



The sky-blue Lungwort (169)



The Banks Honeysuckle (167)

Other species like the Mistassini Primrose and Kalm's Lobelia which were found along the Alder River usually show an affinity for calcareous soils; the presence of lime, highly probable in the chain of lakes, might explain the presence of such plants.

- **The fauna**

Muskuuchii was not specifically explored for its fauna, but occasional observations made during the botanical investigations tend to show that the animal diversity follows the same trend as the floral diversity.

**Birds:** Among the birds species, the Canada Crane was observed several times. One observation is related to an adult specimen and could signify the possibility of a breeding area near by.

The Grey Owl has been heard at night but further investigation could indicate its breeding habitat that is perhaps among the old forest stands.

A Bluebird was spotted in the border of an old forest in a dead tree and it was presumed to be nesting.

Another 36 species of birds were noted but nesting is confirmed for the Belted Kingfisher, the Common Loon, the White-throated Sparrow, the Barn Swallow, the Tree Swallow, the Slate-colour Junco, and the Greater Yellowleg.



A single egg in a Common Loon's nest (218)



White-throated Sparrow (210)



A luring Sharp-tailed Grouse (355)



A Spotted Sandpiper (335)

**Reptiles and amphibians:** Among amphibians, Wood frogs were frequently observed in the Spruce forests. The American Toad was seen in open areas. It is presumed that the Boreal Chorus Frog might be present in a few ponds along the chain of lakes; however confirmation of the presence of this rare Quebec species is required and spring inventories is advised. The old forests are also very favourable habitats for Newts and Salamanders.

The common Garter Snake (*Thamnophis sirtalis sirtalis*) was seen and one specimen captured in open areas of the spruce forest. This capture confirms that the subspecies *sirtalis* is present in James Bay and extends its former range from the Ontario border.



Garter Snake near the Jeremy Camp, (239)



The Wood Frog, frequent in Muskuuchii (333)

**Mammals:** As previously cited, many mammal tracks were observed throughout the Muskuuchii area and more specifically in the chain of lakes. Bear, moose, beaver and muskrat were among the most abundant. Furthermore the tracks of otters and racoons were presumably seen along the Alder River but specific identification is needed.



Bear mark on a Jack Pine (296)



Beaver at work on Alder River (245)

Caribou tracks were seen several times along the east side of Muskuuchii on roads along open woodland and around the partially logged Jack Pine forest. A visit in a bog situated on the west side also confirms their presence towards the Harricana River.

Small rodents were seen several times in logged areas and along small streams. Two master students have gathered data showing that at least 10 species are present in the Muskuuchii area. Species are as following;

Blarina brevicauda	Northern Short-tailed Shrew	Grande musaraigne
Clethrionomys gapperi	Southern Red-backed Vole	Campagnol à dos roux de Gapper
Microtus chrotorrhinus *	Rock Vole	Campagnol des rochers
Microtus pennsylvanicus	Meadow Vole	Campagnol des champs
Napaeozapus insignis	Woodland Jumping Mouse	Souris sauteuse des bois
Peromyscus leucopus	Deer Mouse	Souris sylvestre
Phenacomys intermedius	Heather Vole	Phénacomys d'Ungava
Sorex arcticus	Black-backed Shrew	Musaraigne arctique
Sorex cinereus	Masked Shrew	Musaraigne cendrée
Sorex hoyi	Pygmy Shrew	Musaraigne pygmée
* unconfirmed		

Finally there is a high probability to find the Least Chipmunk (*Eutamias minimus*); it is present in Abitibi and the occurrence of Wild Cherry (*Prunus sp.*) in Muskuuchii, an important source of food, might be favour its presence locally.

### Impacts of logging in the Muskuuchii area

- Eventhough the deforested areas convey an image of good management techniques, the new growth is entangled with exotic plant species that compromise the natural evolution of forest ecosystems. This does not jeopardise the emerging new forest but it irrevocably modifies the natural sequence of plant colonisation. The significance of a new type of plant succession is normal but it contrasts deeply with the climax forest of our natural heritage. In the event that the Muskuuchii area is recognised for the importance of its forests, no further deforestation should occur within an acceptable buffer zone in order to maintain its natural aspect.



A dense cover of Timothy (344)



The spreading Fringed Bindweed (343)

- A high plateau rising more than 100 meters over the James Bay Lowlands characterizes the topographical features of the Muskuuchii area. This situation makes the forest more vulnerable to prevailing winds. Deforested areas already show evidence of tree fall and winter blister. Many tall White Spruces and Balsam Firs have already collapsed on the border of open areas and numerous Paper Birches have suffered from cold winter wind exposure.



Forest regeneration in an exposed area (324)



A plunging view toward the Alder River (202)

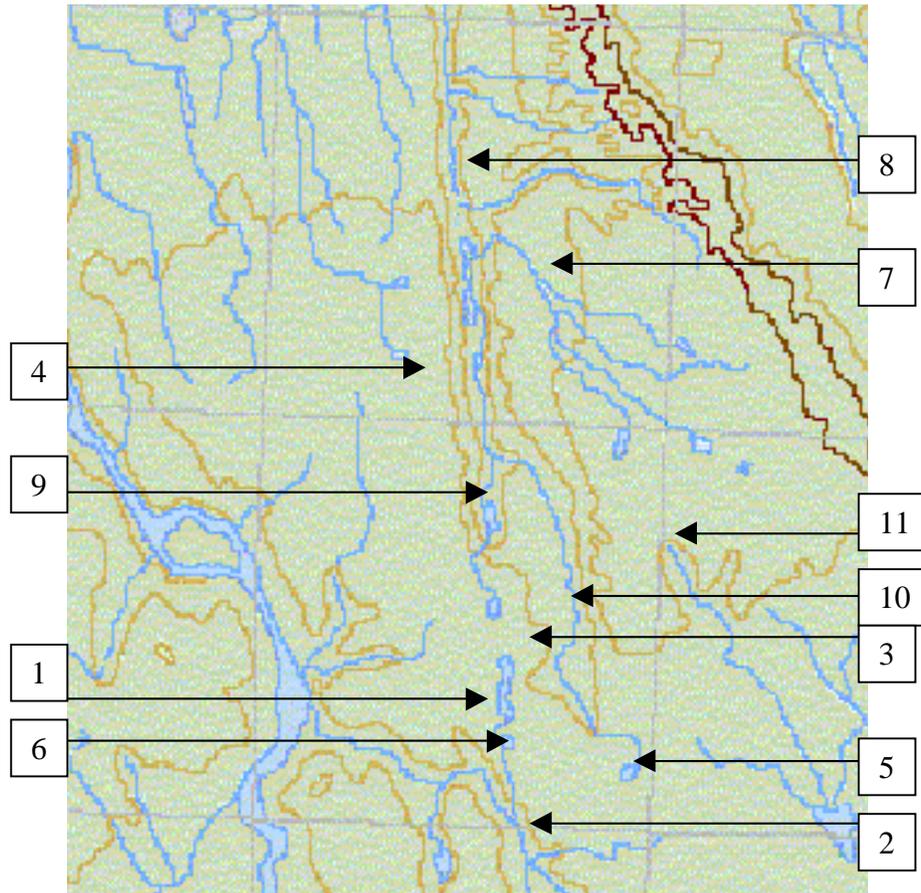
- A more inconspicuous effect might also influence the western valley that has been depleted from its lateral protecting forest band as in the case of the chain of lakes and the flowing Alder River. In this specific case, the undergrowth will be more vulnerable to temperature variations. The wind's chilling factor has a definite grasp on the riverbanks and lake basins and subsequent plant generations can be compromised by shortened growing periods.
- The interpenetrating roads and the logged areas constitute a major obstacle to migrating mammals on the Muskuuchii plateau. Many former migration routes are now disabled and east to west movements are impaired.

### **Plant inventory stations**

#### **List of stations:**

- 1: Chemin des conquérants
- 2: Samson River
- 3: Birch forest
- 4: String Bog
- 5: Lac Jérémie (camp 50°06'157"/ 78°46'273")
- 6: Lac Rond 50°08'763"/ 78°48'998")
- 7: Ruisseau du coteau
- 8: Alder River
- 9: Spring lake
- 10: Meander

11: Sand deposit ( 50°07'706"/ 78°45'151")



**Station 1:**

- Location; “chemin des conquérants “, along a winter road near a lake and an adjacent lumbered area.
- Date: June 26<sup>th</sup> 2002
- Type of inventory; linear transect of 100 meters long by 4 meters wide
- Vegetation type: Black spruce and Balsam fir forest
- 

This type of forest is characteristic of loamy soils. These fine deposits have evolved towards the minor depressions of most of the area covered by the moraine. Many furrows oriented in the east to west axis have probably been carved by the long-term surface erosion long before the pioneer implant of the vegetation. Fine grain material has since been colonized by mesic and hydric species. The Alder River and its chain of lakes constitute such an example.

Tree strata:	<i>Abies balsamea</i>	<i>Picea mariana</i>
High shrub strata:	<i>Amelanchier humilis</i>	<i>Alnus rugosa</i>
	<i>Prunus virginiana</i>	<i>Rhamnus alnifolius</i>
	<i>Salix sp.</i>	<i>Viburnum edule</i>

Low shrub strata:	<i>Cornus stolonifera</i>	<i>Kalmia angustifolia</i>
	<i>Ledum groenlandicum</i>	<i>Lonicera hirsuta</i>
	<i>Lonicera involucrata</i>	<i>Lonicera villosa</i>
	<i>Ribes americanum</i>	<i>Ribes lacustre</i>
	<i>Rosa acicularis</i>	<i>Rubus idaeus</i>
	<i>Vaccinium myrtilloides</i>	
Herbaceous strata:	<i>Anemone quinquefolia</i>	<i>Caltha palustris</i>
	<i>Cardamine pensylvanica</i>	<i>Carex lagulinosa</i>
	<i>Cirsium muticum</i>	<i>Clintonia borealis</i>
	<i>Coptis groenlandicum</i>	<i>Corallorhiza trifida</i>
	<i>Cornus canadensis</i>	<i>Epilobium angustifolium</i>
	<i>Fragaria virginiana</i>	<i>Equisetum sylvaticum</i>
	<i>Galium</i> sp.	<i>Geum rivale</i>
	<i>Goodyera repens</i>	<i>Listera cordata</i>
	<i>Huperzia lucidula</i>	<i>Lysimachia terrestris</i>
	<i>Mentha canadensis</i>	<i>Mertensia paniculata</i>
	<i>Mianthemum canadense</i>	<i>Mitella nuda</i>
	<i>Petasites palmatus</i>	<i>Pyrola secunda</i>
	<i>Schizachne purpurescens</i>	<i>Senecio aureus</i>
	<i>Smilacina stellata</i>	<i>Smilacina trifolia</i>
	<i>Symphyotrichum puniceum</i>	<i>Taraxacum officinale</i>
	<i>Thalictrum pubescens</i>	
Ground strata:	<i>Gaultheria hispidula</i>	<i>Linnaea borealis</i>
	Musci	

### Station 2: Samson River

- Location; Samson River, near the intersection with the road, mostly upstream.
- Date; June 26<sup>th</sup> 2002
- Type of inventory; at random along the banks of the river and on the rocky islands.
- Vegetation type; Riparian and forest fringe
- 

The riverbed is naturally excavated in the moraine, which lies transversely on each side. The slope is strong on the average although the declivity reaches between 3 to 10 meters. The river's current is accentuated for a stretch of nearly 150 meters on account of rock outcrops dominating this specific segment. The metamorphic rock is essentially composed of quartz, mica, calcite and feldspar and resembles a pegmatite rather than granite.

The water's colour is depth red or brown as most of its upper drainage basin occupies a large muskeg area.

A coniferous forest composed of Black and White Spruces, Tamaracks, Balsam Firs and occasional Paper Birches borders the river. Alders and willows occupy the undergrowth. However, along the outcrops of the banks and on the small rocky isles more herbaceous vegetation appears. This particular vegetation is submitted to constant humidity from the

adjacent rapids. It is completely submerged during the spring swelling and is also exposed to the icing effect. Thus many of the plant species are annuals or perennials.



Upstream view of Samson River (290)



The turbulent brownish water of a rapid (277)

The following species are among such plants that require a constant level of humidity to survive. They were found on the rock surface along fissures or on pads of mosses:

*Castilleja septentrionalis*

*Geum rivale*

*Pinguicula vulgaris*

*Plantathera hyperborea*

*Ranunculus reptans*

*Solidago ptarmicoides*

*Erigeron hyssopifolius*

*Mentha canadensis*

*Primula mistassinica*

*Prunella vulgaris*

*Sisyrinchium angustifolium*

*Tofieldia glutinosa*



*Solidago ptarmicoides*, a rare species (363)



The Mistassini Primrose (281)

### Station 3: Birch forest

- Location; main gravel road on the west side.
- Date; June 27<sup>th</sup> 2002
- Type of inventory; quadrat of 100 square meters in area
- Vegetation type; Paper Birch forest

On part of the area covered by the undulated moraine, the higher proportion of silt in the soil favours the presence of deciduous trees by creating a mesic condition. Some stands in the area originate from old fires. Most of the deciduous forests of the Muskuuchii area are concentrated along both the east and west fringes of the moraine and along the valley of the Alder River. The actual percentage of these forests is about 5% but a more accurate mapping should be done to evaluate their importance.



Birches on the moraine plateau (444)



Mountain Maple in the undergrowth (309)

### Station 4: Peat bog

- Location; on the west side of Alder River on a raised plateau near a lumber road.
- Date; June 25<sup>th</sup> 2002
- Type of inventory; at random around the small water ponds and along the edges.
- Vegetation type; ombrotrophic peatland

This is probably classified as a raised bog because this area remains on high ground compared to the adjacent Alder River. There is no apparent flow of the contained waters. Nevertheless the overall drainage is oriented to the N-N-W toward an affluent of the Harricana River. Sphagnum mosses largely dominated the ground cover. There are a few oval shaped water ponds scattered in the middle area.



A raised bog (197)



A view towards the North (190)

The visit to the bog did not reveal any exceptional species of plant but it is presumed that the aquatic vegetation was still underdeveloped and the high water level made the search impracticable. Furthermore the late season species were too immature for proper identification. It is highly probable to find several species of Bladderwort but less probable of finding rare orchids species. This type of ecosystem remains uncharacteristic of the Muskuuchii area but is very common on most of the lowlands surrounding it.

Along the edges of the woodland, many caribou tracks were observed.



A submerged Cow Lily (200)



A flowering Pitcher Plant (191)

### **Station 5: Jeremy Lake**

- Location; about a 100 yards south of “Camp Jérémie”.
- Date; July 23rd 2002
- Type of inventory; random walk on the periphery of the lake.
- Vegetation type; minerotrophic peatland

This area was visited mostly for its ease of access. It consists of a circular lake surrounded by a muskeg type of Spruce forest. The perimeter is quite flat and the dominating vegetative cover is composed of several species of sedges on a mat of mosses. The lake depression seemingly sits on a sand deposit, which is more apparent on the east side. The major basin shows a rather slimy bottom occupied mostly by decomposing vegetation and algae. The lake was occupied by a couple of loons with their juvenile.

Two plants were found no where else on the Muskuuchii site; one orchid (*Platanthera lacera*) and a Juniper (*Juniperus communis*)

### Station 6: Round lake

- Location; about 400 meters west of the intersecting road entry in Muskuuchii, following a trail that leads to the “Chemin des conquérants”.
- Date; July 25<sup>th</sup> 2002
- Type of inventory; linear transect along the trail starting at the beaver dam and ending 80 meters to the north.
- Vegetation type; mature Spruce forest

The small round lake is surrounded by a tall Spruce forest dominated by Black Spruce (*Picea mariana*), though the White Spruce (*Picea glauca*) is also present along the neighbouring effluents. An old beaver dam obstructs the main effluent of the lake and it drains southward to the Samson River. A few species of observed plants such as the Kalm’s Lobelia (*Lobelia kalmii*) may indicate the presence of lime in the lake sediments. Many aquatic plant species are present but little collecting was done.

From the beaver dam to the north, the trail follows a dark forest sitting on a deep mat of mosses. This particular area revealed a large abundance of orchids such as Heart-leaved Twayblades, Ragged Orchis and Creeping Rattlesnake Plantain.

Bear and moose tracks were observed along the trail and fur bearing small mammals seemed to be present around the beaver dam.



Trail along Round lake (434)



One-flowered Wintergreen (430)

### Station 7: Small creek

- Location; crossing of the main gravel road, along the bank of the river and on an adjacent ridge side.
- Date; July 27<sup>th</sup> 2002

- Type of inventory; random walk from the creek's bed to the opened forest.
- Vegetation type; Alder community and Black Spruce forest.

At this point the forestry road intercepts a creek that drains a large part of the central area of Muskuuchii. The creek's bed is scattered with large blocks and the alders have evolved to cast shadow over its running water. Thus the dense vegetation marks a sharp contrast with the neighbouring forest that consists mostly of Black Spruces on the down slopes and Jack Pines on the upper ridges.



Relief of the central Muskuuchii (382)



Small natural landslide along a valley (375)

Some exposed ridges of the open forest that have undergone slight landslides are favourable to open area plants such as the Canadian Antennaria and the Spurred Gentian. This type of habitat can shelter rare plants.

The creek was also interesting for aquatic and riparian species.



The Hair-like Water-crowfoot (369)



The colonising Spurred Gentian (372)

### Station 8: Alder River

- Location; main stream of the river on the west side near a lumbered area.
- Date; July 27<sup>th</sup> 2002
- Type of inventory; linear transect of about 100 meters in length
- Vegetation type; riparian along a valley of various conifers.

The Alder River is such locally named not so much for the presence of alders along this part of its course moreover for its polarizing effect on wild game. The surveyed area is adjacent to a logged Jack Pine forest that rise 25 meters from the river bed. A “V” shaped valley shelters a very particular type of vegetation since it funnels most species from the entire Muskuuchii area and carries a quality of water compatible with many taxa of plants. The riverbed varies from boulders to very fine sand according to the hydrodynamic of the watercourse. Fine particulate sediments enrich the banks as each spring overflow fertilizes the soil.



A plunging view of the valley (383)



The luxurious riparian vegetation (390)

The quality of this river ecosystem can be exemplified not only by the numerous plant species along its shores but also by the occupation level of the fauna. A quick inventory as revealed the presence of uncommon plant species (the positive identification of *Thalictrum dasycarpum* is not yet confirmed). More intensive search will shed a better knowledge of the whole valley considering it extends to the limit of the Muskuuchii promontory.



A Meadow-rue yet to be identified (393)



The Hairy Honeysuckle (397)

### Station 9: Spring lake

- Location; on the north side of the lake about 100 meters east of the emissary.
- Date; June 27<sup>th</sup> and July 25<sup>th</sup> 2002
- Type of inventory; at random along the shore and around the spring.
- Vegetation type; littoral and hydrophytic

The spring consists in the reappearance of a subterranean water table at the surface. The very finely particulate sand overlays an impermeable layer in the forested area close to the shore and the cold spring water creates a very particular habitat for the flora. Such springs occur all along the valley of the Alder River but this particular one has created an unstable ground substrate similar to quick sand. This situation meets the requirements for rare plant species. This is the third known site for the Smooth Monkey-flower ( *Mimulus glabratus*) in the province, but in our particular case, the plant has colonized the shore and appears in a dwarf form that differs from the other two known sites.



Cold spring habitat (423)



The Smooth Monkey-flower (413)

Other plants related to the spring in the forest were the Marsh Marygold and a few types of orchids as well as a few specimens of Stinging Nettle. Mosses form a deep and moist substrate enabling the presence of only a very selective variety of plants. The underlying mineral soil remains very unstable.



A Stinging Nettle (416)



A colony of Marygold (149)

### Station 10: Meander

- Location; 300 meters south of a secondary road along a meander.
- Date; June 26<sup>th</sup> 2002
- Type of inventory; at random along the meander
- Vegetation type; Alder community

On the plain within the moraine of Muskuuchii, the poorly drained forest area is accompanied by the slow drainage pattern of creeks gradually joining together toward the main stream of Alder River. The creeks are interrupted by several beaver dams that favour the expansion of Alder communities at the expense of the adjoining Black Spruce forest. The contact zone between the former ecosystems has revealed the presence of several interesting plant species among which the uncommon Northern Valerian (*Valeriana dioica*) and the more northern Stemless Arctic Bramble (*Rubus acaulis*).



The Stemless Arctic Bramble (243)



The larger Blue-flag (155)

### Station 11: Sand road

- Location; main gravel road in a lumbered zone.
- Date; July 25<sup>th</sup> 2002
- Type of inventory; random observation site
- Vegetation type; pioneer

A medium size colony of a Fleabane species has been sighted along the gravel road in a sandy substrate of an exposed lumbered area. It is probable that the species is related to *Erigeron lonchophyllus*. This rare occurrence has to be confirmed. (441)



## Recommendations

- Overall, since Muskuuchii remains unappreciated for its biogeographical features, a complete survey based on a refined mapping system such as used by the Ministry of environment should be considered. This study would be most helpful in determining more precisely the vulnerability of the area to any anthropic disturbance.
- The territorial limit of Muskuuchii must be established not only by considering the physiographical aspect but rather by including the range of its influence in the whole area such as circumscribed by the Harricana, Samson and Joncas rivers.
- Old growth forests should be identified more precisely. Beyond the location of these forests, the knowledge of their corresponding structural communities could be essential in understanding the past three centuries and the projected patterns of evolution in the boreal forest.
- Since the watershed is an important feature of the regional ecosystems, the water quality should be analysed. Similar areas around Amos have revealed a high quality standard. If such is the case in Muskuuchii, a more adequate planning of the road system is required.
- Any further inventory of the biotic components of Muskuuchii should be planned in accordance with their seasonal occurrence. On account of the difficulty to survey the entire area within a short time limit, it is recommended to stage field studies during several years and to focus representative ecosystems rather than those close to access roads.

## Conclusion

Muskuuchii must be considered as an exceptional site in the same manner as any other site that demonstrates evidence of high diversity.

The biodiversity found relates more specifically to the valley located along the Alder River but it also includes the numerous sites surrounding the area. Perhaps the plant kingdom has revealed much interest considering its high specific value and the few rare species present but the virginity of the old forest ecosystem has undoubtedly a special value. Logging and forest fires will eventually rarefy old forests. Should areas like Muskuuchii become scarce, we will raise the issue of our present management techniques and our interest in safeguarding our heritage.

The actual problem is connected to our lack of knowledge on the exact nature and importance of that heritage. Our perpetual quest for new resources, renewable or not, more often overrides the principles of sustainable development. In all equity, it is necessary to weigh Muskuuchii not only on its present day value but moreover on the basis of long-term forecasting. How many sites such as Muskuuchii occupy the boreal forest? This is a question that cannot be answered without further ecological and anthropological study.

The legacy of former generations is measured not only by how they used the land but also by how they valued it for future use. If the fate of Muskuuchii must be decided only on account of its present day value, it implies ignoring the base of that heritage. This report may support the ecological importance of the site but it does not link it with former human occupancy. But shall we consider that in the north words like human and ecology were traditionally linked.

**Appendix 1          Rare and endangered vascular plants probable in the  
Muskuuchii area**

<b>Scientific name</b>	<b>natural region *</b>	<b>occurrence probability</b>
<i>Amerorchis americana</i>	F	medium
<i>Antennaria isolepis</i>	incomplete data	low
<i>Antennaria leuchippi</i>	F coastal	low
<i>Antennaria rosea</i>	H coastal	low
<i>Arabis arenicola</i> var. <i>pubescens</i>	incomplete data	low
<i>Arethusa bulbosa</i>	F	high
<i>Arnica chamissonis</i> ssp. <i>foliosa</i>	F coastal	low
<i>Artemisia tilesii</i> subsp. <i>elatior</i>	F coastal	low
<i>Astragalus australis</i>	F south	low
<i>Botrychium spathulatum</i>	F coastal	medium
<i>Calamagrostis stricta</i> ssp. <i>inexpansa</i>	incomplete data	low
<i>Calypso bulbosa</i> var. <i>americana</i>	F calcarous	low
<i>Canadanthus modestus</i>	F	medium
<i>Carex heleonastes</i>	incomplete data	low
<i>Carex marina</i>	incomplete data	low
<i>Carex petricosa</i> var. <i>misandroides</i>	G calcarous	low
<i>Carex prairea</i>	F coastal fen	low
<i>Carex richardsonii</i>	F sand bank or rock	medium
<i>Carex sartwelli</i>	F coastal	low
<i>Ceanothus herbaceus</i>	F south	low
<i>Cicuta maculata</i> var. <i>angustifolia</i>	incomplete data	
<i>Cicuta virosa</i>	incomplete data	
<i>Corallorhiza striata</i> var. <i>striata</i>	F south fen	medium
<i>Corydalis aurea</i> subsp. <i>aurea</i>	F calcarous	low
<i>Cypripedium arietinum</i>	F south	low
<i>Cypripedium passerinum</i>	F coastal calcarous	low
<i>Drosera linearis</i>	F calcarous	high
<i>Elaeagnus commutata</i>	F calcarous	medium
<b><i>Erigeron lonchophyllus</i></b>	F coastal	medium
<i>Gentianopsis macounii</i>	F coastal	medium
<i>Geum perincisum</i> var. <i>perincisum</i>	incomplete data	
<i>Gnaphalium norvegicum</i>	G	low
<i>Gratiola aurea</i>	F littoral sand bank	high
<i>Gymnocarpium jessoense</i> subsp. <i>parvulum</i>	F south	medium
<i>Hedysarum boreale</i> subsp. <i>mackenzii</i>	H	low
<i>Hieracium robinsonii</i>	F rock	high
<i>Hudsonia tomentosa</i>	F sand	medium
<i>Juncus ensifolius</i>	F littoral	medium
<i>Juncus longistylis</i>	F littoral	medium

Lactuca tatarica var. pulchella	F coastal	low
Lathyrus ochroleucus	F south	low
Listera borealis	F calcarous	high
Lycopus asper	F coastal	low
Malaxis paludosa	incomplete data	
<b>Mimulus glabratus</b>	F cold spring	medium
Neobeckia aquatica	F south	low
Nymphaea leibergii	F	high
Oxytropis viscida	incomplete data	
Pedicularis parviflora	incomplete data	
Polygala senega	F	medium
Polygonella articulata	F sand bank	medium
Potentilla multifida	incomplete data	
Potentilla pulchella	incomplete data	
Ribes hudsonianum	incomplete data	
Salix arbusculoides	G rock	low
Salix maccaliana	F coastal	medium
Salix pseudomonticola	F	high
<b>Solidago ptarmicoides</b>	F	high
Thalictrum confine	incomplete data	
Thalictrum dasycarpum var. dasycarpum	F coastal	low
Torreyochloa pallida var. pallida	F south	medium
Trichophorum clintonii	F rocky shore	high
Utricularia geminiscapa	F south	medium
Utricularia resupinata	F south	medium
Vicia americana	F south	low
Viola sagittata var. ovata	F south	low

\*: F; Abitibi and James Bay lowlands, G; Mistassini highlands, H; La Grande river low hills

( translated from “ Les provinces naturelles du Québec “ )

Highlighted characters correspond to species present in Muskuuchii

## Appendix 2

## Vascular plant list of the Mushuuchii area

Scientific name	English name	French name	Station											
			1	2	3	4	5	6	7	8	9	10		
<i>Abies balsamea</i>	Balsam Fir	Sapin baumier	x	x	x									
<i>Acer spicatum</i>	Mountain Maple	Érable à épis	x		x									
<i>Achillea millefolium</i>	Common Yarrow	Achillée millefeuille		x	x									
<i>Actaea rubra</i>	Red Baneberry	Actée rouge			x									
<i>Agrostis scabra</i>	Scabrous Agrostis	Agrostis scabre												
<i>Agrostis stolonifera</i>	Red Top	Agrostis stolonifère												
<i>Alnus crispa</i>	Green Alder	Aulne crispé												
<i>Alnus incana</i> (Syn. <i>A. rugosa</i> )	Rough Alder	Aulne rugueux	x	x		x								
<i>Amelanchier alnifolia</i> ( <i>humilis</i> )	Low Shadbush	Amélanchier bas	x				x							
<i>Amelanchier bartramiana</i>	Bartram's Shadbush	Amélanchier de Bartram												
<i>Amelanchier laevis</i>	Glabrous Shadbush	Amélanchier glabre												
<i>Amelanchier spicata</i> ( <i>stolonifera</i> )	Stoloniferous Shadbush	Amélanchier stolonifère			x									
<i>Anaphalis margaritacea</i>	Life-everlasting	Immortelle												
<i>Andromeda glaucophylla</i>	Rosemary	Andromède glauque				x	x							
<i>Anemone quinquefolia</i> var. <i>interior</i>	Wood Anemone	Anémone à cinq folioles	x	x				x		x				
<i>Anemone virginiana</i> var. <i>riparia</i>	River-bank Anemone	Anémone des rivages									x			
<i>Antennaria howellii</i>	Canadian Antennaria	Antennaire du Canada		x						x				
<i>Apocynum androsaemifolium</i>	Spreading bogbane	Apocyn à feuilles d'Androsème		x										
<i>Aralia hispida</i>	Bristly Sarsaparilla	Aralie hispide												
<i>Aralia nudicaulis</i>	Wild Sarsaparilla	Salsepareille	x	x	x								x	
<i>Arctostaphylos uva-ursi</i>	Bear-berry	Arctostaphyle raisin-d'ours											x	
<i>Athyrium filix-femina</i> s. <i>angustum</i>	Female Fern	Athyrium fougère-femelle			x									
<i>Barbarea vulgaris</i>	Winter Cress	Barbarée vulgaire												
<i>Betula glandulosa</i>	Glandular Birch	Bouleau glanduleux				x								
<i>Betula papyrifera</i>	White Birch	Bouleau blanc	x	x	x									
<i>Botrychium virginianum</i>	Virginia Grape-Fern	Botryche de Virginie	x	x										x
<i>Caltha palustris</i>	Marsh Marygold	Populage des marais	x	x									x	
<i>Cardamine pensylvanica</i>	Pennsylvania Bittercress	Cardamine de Pennsylvanie	x	x										
<i>Carex aenea</i>	Copper Sedge	Carex cuivré												
<i>Carex aquatilis</i>	Aquatic Sedge	Carex aquatique		x			x							
<i>Carex arctata</i>	Compressed Sedge	Carex comprimé												
<i>Carex atratiformis</i>	Black Sedge	Carex atratiforme		x										
<i>Carex aurea</i>	Golden Sedge	Carex doré												
<i>Carex backii</i>	Back's Sedge	Carex de Bock												
<i>Carex brunnescens</i>	Brownish Sedge	Carex brunâtre												
<i>Carex buxbaumii</i>	Buxbaum's Sedge	Carex de Buxbaum		x										
<i>Carex canescens</i>	Silvery Sedge	Carex blanchâtre												
<i>Carex capillaris</i>	Hair-like Sedge	Carex capillaire		x										
<i>Carex castanea</i>	Chesnut Sedge	Carex châtain		x										
<i>Carex crinita</i>	Fringed Sedge	Carex crépu												
<i>Carex flava</i>	Yellow Sedge	Carex jaune		x										
<i>Carex houghtonii</i>	Houghton's Sedge	Carex de Houghton												
<i>Carex lacustris</i>	Lake Sedge	Carex lacustre		x			x							

<i>Carex laguninosa</i>	Villose Sedge	<i>Carex laineux</i>	x										
<i>Carex magellanica</i> sp. <i>crispus</i> ?													
<i>Carex pauciflora</i>	Pauciflorous Sedge	<i>Carex pauciflore</i>											
<i>Carex stipata</i>	Stipitate Sedge	<i>Carex stipité</i>											
<i>Carex tonsa</i> var. <i>rugosperma</i>	Rough-fruited Sedge	<i>Carex</i> à fruit rugueux		x									
<i>Carex utricularia</i>	(see <i>C. aquatilis</i> )												
<i>Cassandra calyculata</i>	Leather-leaf	Cassandre calyculée		x		x							x
<i>Castilleja septentrionalis</i>	Northern Painted-cup	Castilléjie septentrionale		x									
<i>Cirsium muticum</i>	Canada Thistle	Chardon des champs	x	x									
<i>Clintonia borealis</i>	Yellow Clintonia	Clintonie boréale	x	x	x			x					
<i>Coptis trifolia</i> ssp. <i>groenlandica</i>	Goldthread	Coptide trifolié	x	x	x	x		x					x
<i>Corallorhiza maculata</i>	Large Coralroot	Corallorhize maculée											
<i>Corallorhiza trifida</i>	Early Coralroot	Corallorhize trifide	x					x					
<i>Cornus canadensis</i>	Bunchberry	Cornouiller quatre-temps	x		x			x					x
<i>Cornus sericea</i> (stolonifera)	Red-osier Dogwood	Cornouiller stolonifère	x	x									
<i>Corydalis sempervirens</i>	Pale Corydalis	Corydale toujours verte											
<i>Crataegus chrysoarpa</i>	Jack's Hawthorne	Aubépine de Jack		x									
<i>Cypripedium acaule</i>	Steamless Lady's-slipper	Cypripède acaule				x							
<i>Danthonia spicata</i>	Common Wild Oat-grass	Danthonie à épi											
<i>Diervilla lonicera</i>	Bush Honey-suckle	Dièreville chèvrefeuille		x	x								
<i>Doellingeria umbellata</i>	Umbellate Aster	Aster à ombelles		x									
<i>Drosera intermedia</i>	Intermediate Sundew	Rosolis intermédiaire						x					
<i>Drosera rotundifolia</i>	Round-leaved Sundew	Rosolis à feuilles rondes						x					
<i>Dryopteris carthusiana</i>	Spinulose Shield-Fern	Dryoptéride spinuleuse	x		x								
<i>Dryopteris cristata</i>	Crested Shield-Fern	Dryoptéride accrétée			x			x					
<i>Epigaea repens</i>	Mayflower	Épigée rampante									x		
<i>Epilobium angustifolium</i>	Fireweed	Épilobe à feuilles étroites	x	x	x			x					
<i>Epilobium ciliatum</i> var. <i>glandulosum</i>	Glandula Willow-herb	Épilobe glanduleux		x				x					
<i>Epilobium palustre</i>	Swamp Willow-herb	Épilobe palustre						x					x
<i>Equisetum arvense</i>	Field Horsetail	Prêle des champs		x									
<i>Equisetum fluviatile</i>	River Horsetail	Prêle fluviatile											x
<i>Equisetum litorale</i>	Shore Horsetail	Prêle littorale		x									x
<i>Equisetum palustre</i>	Marsh Horsetail	Prêle des marais		x									
<i>Equisetum pratense</i>	Meadow Horsetail	Prêle des prés											
<i>Equisetum scirpoides</i>	Sedge-like Horsetail	Prêle faux-scirpe											
<i>Equisetum sylvaticum</i>	Wood Horsetail	Prêle des bois	x	x	x								x
<i>Equisetum variegatum</i>	Variiegated Horsetail	Prêle panachée											
<i>Erigeron hyssopifolius</i>	Érigéron à feuilles d'Hysope	Hyssop-leaved Fleabane		x									
<i>Erigeron lonchophyllus</i>													
<i>Eriophorum vaginatum</i>	Dense Cotton-grass	Linaigrette dense						x					
<i>Eriophorum viridicarinatum</i>	Green Cotton-grass	Linaigrette verte											
<i>Eupatorium maculatum</i>	Joe-Pye Weed	Eupatoire maculée											
<i>Festuca rubra</i>	Red Fescue-grass	Fétuque rouge											
<i>Fragaria virginiana</i>	Virginia Strawberry	Fraisier de Virginie	x	x									
<i>Galium palustre</i>	Marsh Bedstraw	Gaïlet palustre											
<i>Galium triflorum</i>	Sweet-scented Bedstraw	Gaïlet à trois fleurs				x							
<i>Gaultheria hispida</i>	Snowberry	Gaulthérie hispide	x	x	x								
<i>Gentiana linearis</i>	Narrow-leaved Gentian	Gentiane à feuilles linéaires		x									





Ranunculus abortivus	Smooth-leaved Crowfoot	Renoncule abortive		x										
Ranunculus acris	Buttercup	Renoncule âcre												
Ranunculus aquatilis	Hair-like Water-Crowfoot	Renoncule capillaire		x					x					x
Ranunculus reptans	Creeping Spearwort	Renoncule rampante		x					x				x	
Ranunculus septentrionalis	Northern Crowfoot	Renoncule septentrionale											x	
Rhamnus alnifolius	Alder-leaved Buckthorn	Nerprun à feuilles d'aulne	x											
Rhinanthus minor	Northern Rattle	Rhinanthe boréal												
Ribes americanum	American Black Currant	Gadellier américain	x		x									
Ribes glandulosum	Fetid Currant	Gadellier glanduleux			x									
Ribes hirtellum	Hairy Gooseberry	Groseillier hérissé			x									
Ribes lacustre	Swamp Currant	Gadellier lacustre	x											
Ribes triste	American Redcurrant	Gadellier amer												
Rosa acicularis	Bristly Rose	Rosier aciculaire	x	x								x		
Rosa nitida	Shining Rose	Rosier brillant										x		x
Rubus acaulis	Stemless Arctic Bramble	Ronce acaule												x
Rubus chamaemorus	Cloudberry	Ronce petit-mûrier				x	x							x
Rubus idaeus	Raspberry	Framboisier commun	x	x	x				x					
Rubus pubescens	Dwarf red Blackberry	Ronce pubescente		x	x				x					x
Rumex occidentalis	Broad-leaved Dock	Rumex à feuilles obtuses											x	
Rynchospora alba	White Beak-rush	Rhynchospore blanc						x						
Salix bebbiana	Bebb's Willow	Saule de Bebb		x										
Salix discolor	Pussy Willow	Saule discoloré												
Salix lucida	Shining Willow	Saule brillant												
Salix myrtillofolia		Saule à feuilles de myrtille		x										
Salix pellita	Silky Willow	Saule satiné												
Salix petiolaris	Slender Willow	Saule pétiolé												
Salix planifolia	Flat-leaved Willow				x									
Salix pyrifolia	Balsam Willow	Saule à feuilles de poirier												
Salix serissima	Late willow	Saule très tardif												
Sambucus pubens	American Elder	Sureau blanc		x	x									
Sanicula marilandica	Black Sanicle	Sanicle du Maryland		x										
Sarracenia purpurea	Pitcher-plant	Sarracénie pourpre				x	x							
Scheuchzeria palustris	Scheuchzeria	Scheuzérie palustre						x						
Schizachne purpureascens v pubescens	Purple Schizachne	Schizachné pourpré	x	x	x									
Schoenoplectus torreyi	Torrey's Bulrush	Scirpe de Torrey												
Scirpus atrocinctus	Black-girted Woolgrass	Scirpe à ceinture noire												
Scirpus atrovirens	Blackish Bulrush	Scirpe noirâtre												
Scirpus cyperinus	Common Wool-grass	Scirpe souchet												
Scirpus hudsonianus	Hudsonian Club-rush	Scirpe hudsonien		x										
Scirpus microcarpus	Red-sheated bulrush	Scirpe à gaines rouges												
Scutellaria lateriflora	Side-Flowering Skulicap	Scutellaire latéiflore												
Silene cucubalus	Bladder Campion	Silène cucubale												
Sisyrinchium angustifolium	Narrow-leaved Blue-eyed Grass	Bermudienne à feuilles étroites		x								x		
Sium suave	Water parsnip	Berle douce							x					
Smilacina stellata	Star-flowered False Solomon's-seal	Smilacine étoilée	x	x										
Smilacina trifolia	Three-leaved False Solomon's-seal	Smilacine trifoliée	x	x	x									
Solidago flexicaulis	Zigzag-stemmed Goldenrod	Verge d'or zigzaguante												

<i>Solidago hispida</i>	Hairy Goldenrod	Verge d'or hispide		x														
<i>Solidago ptarmicoides</i>	Upland White Goldenrod	Verge d'or faux-ptarmica		x														
<i>Sorbus americana</i>	Mountain Ash	Sorbier d'Amérique		x														
<i>Sorbus decora</i>	Showy Mountain Ash	Sorbier des montagnes		x	x													
<i>Sparganium</i> sp.																		
<i>Spiraea latifolia</i>	Meadowsweet	Spirée à larges feuilles																
<i>Spiranthes romanzoffiana</i>	Romanzoff's Ladies'-tresses	Spiranthe de Romanzoff								x								
<i>Streptopus amplexifolius</i>	Twisted Stalk	Streptope amplexicaule																
<i>Streptopus lanceolatus</i> ( <i>S. roseus</i> )	Rosybells	Streptope rose								x								
<i>Symphyotrichum puniceum</i>	Red-stalked Aster	Aster ponceau	x															
<i>Taraxacum officinale</i>	Dandelion	Pissenlit commun	x															
<i>Thalictrum dasycarpum</i> ?	Hairy-carpelled Meadow-rue	Pigamon ...															x	
<i>Thalictrum pubescens</i>	Pubescent Meadow-rue	Pigamon pubescent	x	x													x	x
<i>Thelypteris palustris</i>	Marsh Shield-Fern	Thélyptéride palustre		x														
<i>Tofieldia glutinosa</i>	Glutinous False Asphodel	Tofieldie glutineuse		x														
<i>Trientalis borealis</i>	Star-Flower	Trientale boréale		x	x													
<i>Trifolium agrarium</i>	Hop-Clover	Trèfle agraire																
<i>Trifolium arvense</i>	Stone Clover	Trèfle des champs																
<i>Trifolium pratense</i>	Red Clover	Trèfle des prés																
<i>Trifolium repens</i>	White Clover	Trèfle rampant																
<i>Typha latifolia</i>	Brond-leaved Cat-tait	Quenouille à feuilles larges																
<i>Urtica dioica</i> ssp. <i>gracilis</i>	Stinging Nettle	Ortie élevée																x
<i>Vaccinium angustifolium</i>	Blue-berry	Airelle à feuilles étroites		x	x													
<i>Vaccinium cespitosum</i>	Dwarf Bilberry	Airelle gazonnante																
<i>Vaccinium myrtilloides</i>	Saur-top Blueberry	Airelle fausse-myrtille	x	x	x													
<i>Vaccinium oxycoccos</i>	Small Cranberry	Airelle canneberge																
<i>Vaccinium uliginosum</i>	Bog Bilberry	Airelle des marécages		x														
<i>Valleriana dioica</i> sp. <i>subarctica</i>	Northern Valerian	Valeriane (nordique)																x
<i>Viburnum edule</i>	Edible Cranberry-tree	Viorne comestible	x	x	x													
<i>Vicia cracca</i>	Cow Vetch	Vesce jargeau																
<i>Viola blanda</i> var. <i>incognita</i>	Sweet White Violet	Violette agréable																
<i>Viola pubescens</i> var. <i>leiocarpa</i>	Pensylvania Yellow Violet	Violette de Pensylvanie																
<i>Viola renifolia</i>	Kidney-leaved Violet	Violette réniforme								x								
<i>Viola rancloskeyi</i> var. <i>pallens</i>	Northern White Violet	Violette pâle																
<i>Viola selkirkii</i>	Selkirk's Violet	Violette de Selkirk																
<i>Viola sororia</i>	Woolly Blue Violet	Violette parente		x														