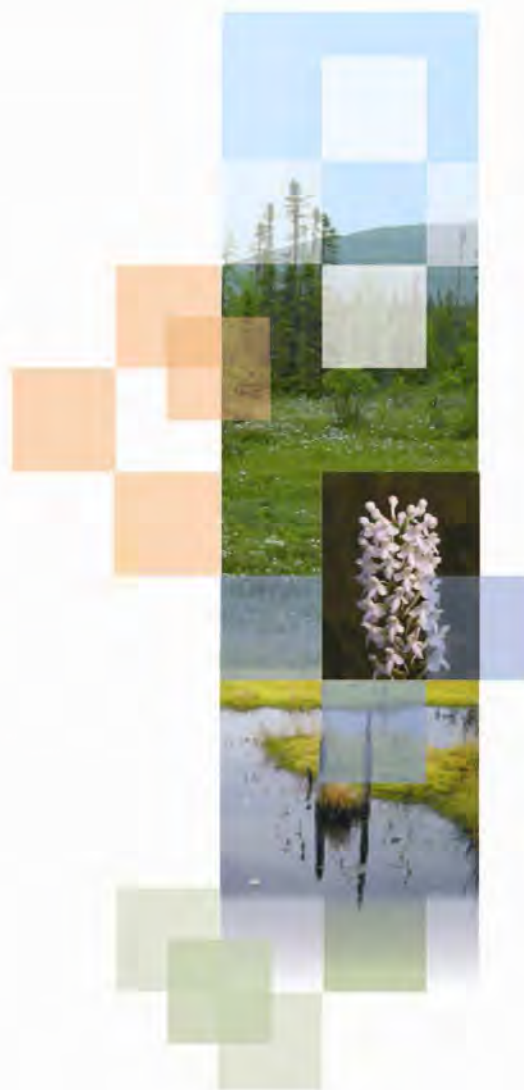




Protected areas
in Québec:

A Lifelong Heritage

Réserve écologique de la Tourbière-de-Shannon



PORTRAIT
OF TERRITORY

Québec 

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SUMMARY

The Réserve écologique de la Tourbière-de-Shannon is located on the territory of the municipality of Shannon in the Jacques-Cartier Regional County Municipality of the Capitale-Nationale administrative region. The 168.77 hectare territory aims at protecting most (66 %) of the Tourbière de Shannon ombrotrophic bog. The proposed name for the ecological reserve refers to the presence of a boggy ecosystem that covers approximately 250 hectares in Shannon. The ecological reserve is located within the Southern Laurentide natural province in the Basses-collines-du-lac-Saint-Joseph ecological district. The territory is within the Basswood-Sugar Maple forest bioclimatic domain. It is characterized by a sub-polar and continental climate, sub-humid annual precipitation and a long growing season.

Two floristic species liable to be designated as endangered or vulnerable have been observed so far in the Tourbière de Shannon: the Eastern Prairie Fringed-Orchid (*Platanthera blephariglottis* (Willd.) Lindl. var. *blephariglottis*) and the Southern Twayblade (*Listera australis* Lindl.). The Eastern Prairie Fringed-Orchid has been observed in great abundance in open and semi-open areas, particularly near groves of Larch and Black Spruce. There are probably in excess of 1000 individuals here, making this a population of excellent quality. As for the Southern Twayblade that grows in areas that are well protected by trees and shrubs, often on the south side of groves, more than 500 individuals in full blossom have been observed, which makes this the second largest population of the species in Québec.

The Tourbière de Shannon has not yet been subject to a detailed faunic inventory and no endangered faunic species are currently known to exist within the perimeter of the bog. However, many species of interest have been observed nearby.

The ecological reserve will make it possible to conserve a complete, representative sample of a bog developed on deltaic deposits in an excellent state of preservation

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1. Plan and description

1.1. Geographical location, boundaries and dimensions

The Réserve écologique de la Tourbière-de-Shannon is located on the territory of the Municipality of Shannon in the Jacques-Cartier Regional County Municipality of the Capitale-Nationale administrative region (03), approximately 30 km northwest of the city of Québec. Figure 1 shows the location and the boundaries of the ecological reserve.

The Tourbière de Shannon covers an area of approximately 250 hectares at an altitude of 180 metres, on the northern flanks of the Jacques-Cartier River valley. The size of the ecological reserve is 168.77 hectares, about 1.4% of the Jacques-Cartier RCM total boggy areas of nearly 11,600 hectares (Lachance, 2007). The map of the Réserve écologique de la Tourbière-de-Shannon, prepared by land surveyor Bertrand Bussièrès, is shown in Appendix 1.

1.2. Ecological overview

The territory of the ecological reserve lies within the Basses-collines-du-lac-Saint-Joseph ecological district in the Southern Laurentide natural province.

1.2.1. Representative elements

1.2.1.1 Climate

The territory of the Réserve écologique de la Tourbière-de-Shannon is located within the Basswood-Sugar Maple bioclimatic domain that is characterized by a sub-polar, sub-humid continental climate, with a long growing season that extends to between 170 and 180 days (Robitaille & Saucier, 1998). Average annual temperature varies from 2.5° C to 5° while average annual precipitation is on the order of 1000 to 1300 mm.

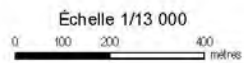
1.2.1.2 Formation and geology of the bog

At the height of the last ice age, approximately 20,000 years before our era, Québec was completely covered with ice except for some peaks and the Atlantic coast (Dyke & Prest, 1987).



Figure 1 : Réserve écologique de la Tourbière-de-Shannon
Localisation

 Réserve écologique



Métadonnées

Système de référence géodésique : NAD 83, ellipsoïde GRS80
 Projection cartographique : Mercator transverse modifiée (MTM), zone de 2°, Système de coordonnées planes du Québec (SCQP), fuseau 7

Sources

Données
 Orthophotographie noir et blanc à l'échelle de 1:40 000
 Cadastre
 Découpage du projet de réserve écologique

Organismes
 Ministère des Ressources naturelles et de la Faune
 Ministère du Développement durable, de l'Environnement et des Parcs

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Subsequently, the glacial front gradually retreated to the north, making southern Québec ice-free. The weight of all that ice on the continental plate had led to the continent sinking, and made it possible for the salt water of the Atlantic Ocean to flow into the St. Lawrence lowlands nearly 12,500 years ago (Prichonnet, 1977) and create the Champlain Sea, whose briny waters ran from what is now Ottawa to the city of Québec. When the sea retreated approximately 9,500 years ago the St. Lawrence River took on its current hydrologic state.

The Tourbière de Shannon sector, located at the border of the Laurentians and the Champlain Sea, was the site of the Jacques-Cartier river delta that extended over many tens of square kilometres (Grondin *et al.* 2003). The presence of this delta explains the dominant thick sandy glaciofluvial deposits in the area (Figure 2). The shallow and poorly drained troughs left by the Champlain Sea were environments that were particularly favourable to the establishment of boggy ecosystems. This explains why the sector is characterized today by a vast complex of wetlands in which organic deposits are common.

The Tourbière de Shannon is mainly ombrotrophic (Buteau, 1989). This type of bog has a convex raised shape and is characterized by acid pH of between 3.5 and 4.6 and water and mineral intake that comes solely from precipitation (Gorham & Janssens, 1992). The sphagnum, through a process of cationic exchange, contributes heavily to the acidity of the environment (Clymo, 1964). The seasonal recovery profile of this type of bog is strictly a function of precipitation, except for the summertime when evapotranspiration is significant, and in winter, when the surface of the bog is frozen (Bastien, 2007). A lagg¹ exists on the periphery of the bog and acts as a junction with the surrounding mineral soil. The water intake, after having run through the adjacent mineral soil, flows towards the margin of the bog and enriches it with available minerals. The lagg is characterized by the simultaneous presence of minerotrophic, facultative or even ombrotrophic species.

The rocky substratum below the Tourbière de Shannon is principally composed of gneiss whose origin metamorphous and sedimentary rock.

¹ Lagg: the depressed and minerotrophic margin of a raised bog.

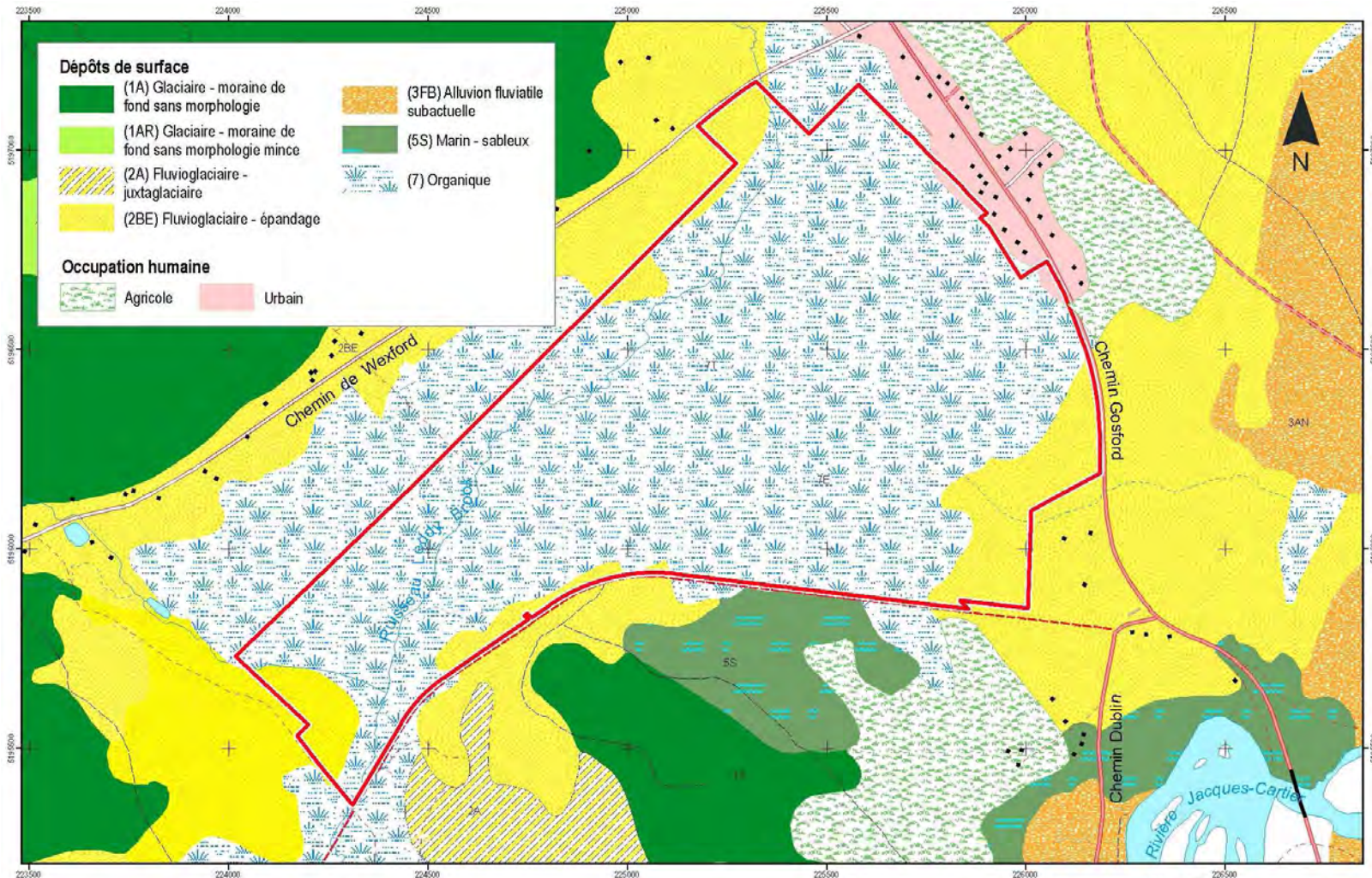
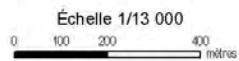


Figure 2 : Réserve écologique de la Tourbière-de-Shannon
 Les dépôts de surface

— Réserve écologique



Métadonnées

Système de référence géodésique

NAD 83, ellipsoïde GR83

Projection cartographique

Mercator transverse modifiée (MTM), zone de 7°, Système de coordonnées planes du Québec (SCQP), niveau 7

Sources

Données
 Base de données topographiques du Québec (BDTQ)
 à l'échelle de 1:20 000
 Cartes à colorantes, 3^e édition

Organismes

Ministère des Ressources naturelles et de la Faune

Découpage du projet de réserve écologique

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Québec

1.2.1.3 Peat deposits

The presence of organic deposits in excess of 30 cm. deep was established on the territory of the ecological reserve using a soil sampler driven into the ground at intervals of 25 metres (Lachance, 2007). More than 320 sampling points were tested in 2007. It appears that the marshy deposits occupy the major part of the Réserve écologique de la Tourbière-de-Shannon but do not cover the entire territory. The western portion of the territory is effectively covered by a set of sand dunes with vegetation dominated by spruce and whose formation took place at the end of the last ice age, a narrow Alder grove bordering Leddy Brook and a swamp lying on top of a boggy deposit of variable thickness, dominated by regrowth of spruce and fir (Figure 3).

The sand dunes present vegetation that from the air may be confused with that of a bog (Lachance, 2007). The vegetation structure is in fact characterized by the presence of spruce groves that are separated by open spaces dominated by lichens and moss (*Polytrichum* and *Dicranum* are particularly abundant). The soil sampler revealed however that boggy deposits were completely absent here. Sphagnum is also absent from this very dry environment. At the end of the last glacial period, the sector, that lay at the boundary between the Laurentians and the Champlain Sea, was in the Jacques-Cartier River delta, whose waves and currents during that epoch were responsible for the development of the sand dunes that can still be observed on the site.

The Alder grove, also dry when sampling was done, is dominated by Grey Alder (*Alnus incana* ssp. *rugosa*), while herbaceous plants colonize the clearings. Some sampling points showed organic deposits that rarely exceeded 15 centimetres in thickness. Except for these few sampled points, surface deposit is mainly sand (Lachance, 2007).

As the swamp stretches to the north of Leddy Brook, it becomes wetter (Lachance, 2007). The water table rises to the surface here, and sphagnum is relatively more abundant under a canopy of young spruce and fir. The thickness of organic deposits is quite variable and can go from more than 50 centimetres to less than 15 centimetres over short distances. The absence of continuous deposits in excess of 30 centimetres, the irregularity of the sphagnum carpet and the tree-dominated vegetation requires us to classify this environment as a swamp rather than a bog. It would, however, be more correct to consider this environment as a natural extension of the bog.

1.2.1.4 Archaeology

According to the Québec archaeological site computer database, no protected archaeological site exists within the territory of the Réserve écologique de la Tourbière-de-Shannon. This is factual: no archaeological inventory has ever taken place on this site, making it unknown territory since the inventory of Québec archaeological sites only represents archaeological potential that is currently known.

1.2.1.5 Flora

The territory of the Réserve écologique de la Tourbière-de-Shannon includes wide expanses of open bog (Figure 3), characterized by a continuous floor of sphagnum colonized by Heath (mainly *Kalmia polifolia*, *Kalmia angustifolia*, *Chamaedaphne calyculata* and *Rhododendron groenlandicum*), with strong intermittent presence of Sedge (principally *Carex oligosperma*, *Eriophorum virginicum*, *Eriophorum vaginatum* and *Eriophorum angustifolium*). The Tourbière de Shannon also presents numerous peat forest populations, scattered muskeg groves dominated by Black Spruce (*Picea mariana*) or Larch (*Larix laricina*) in open areas. This is characteristic vegetation of bogs (Lachance, 2007).

With the aim of refining our understanding of plant associations and groupings and the principal taxa (vascular or invascular) present within the boundaries that have been suggested for the Réserve écologique de la Tourbière-de-Shannon, a more exhaustive field inventory was made during the summer of 2007 (Bastien, 2007). Subsequent to this inventory, the subdivision boundaries of the ministère des Ressources naturelles et de la Faune eco-forest map have been maintained and some clarification made as to the nature and delineation of forest populations and peaty plant communities. Identification of forest polygons, as well as delineation of peaty plant communities are illustrated in Figure 3, while the list of vascular and invascular plant species observed on the territory of the ecological reserve is presented in Appendix 2.

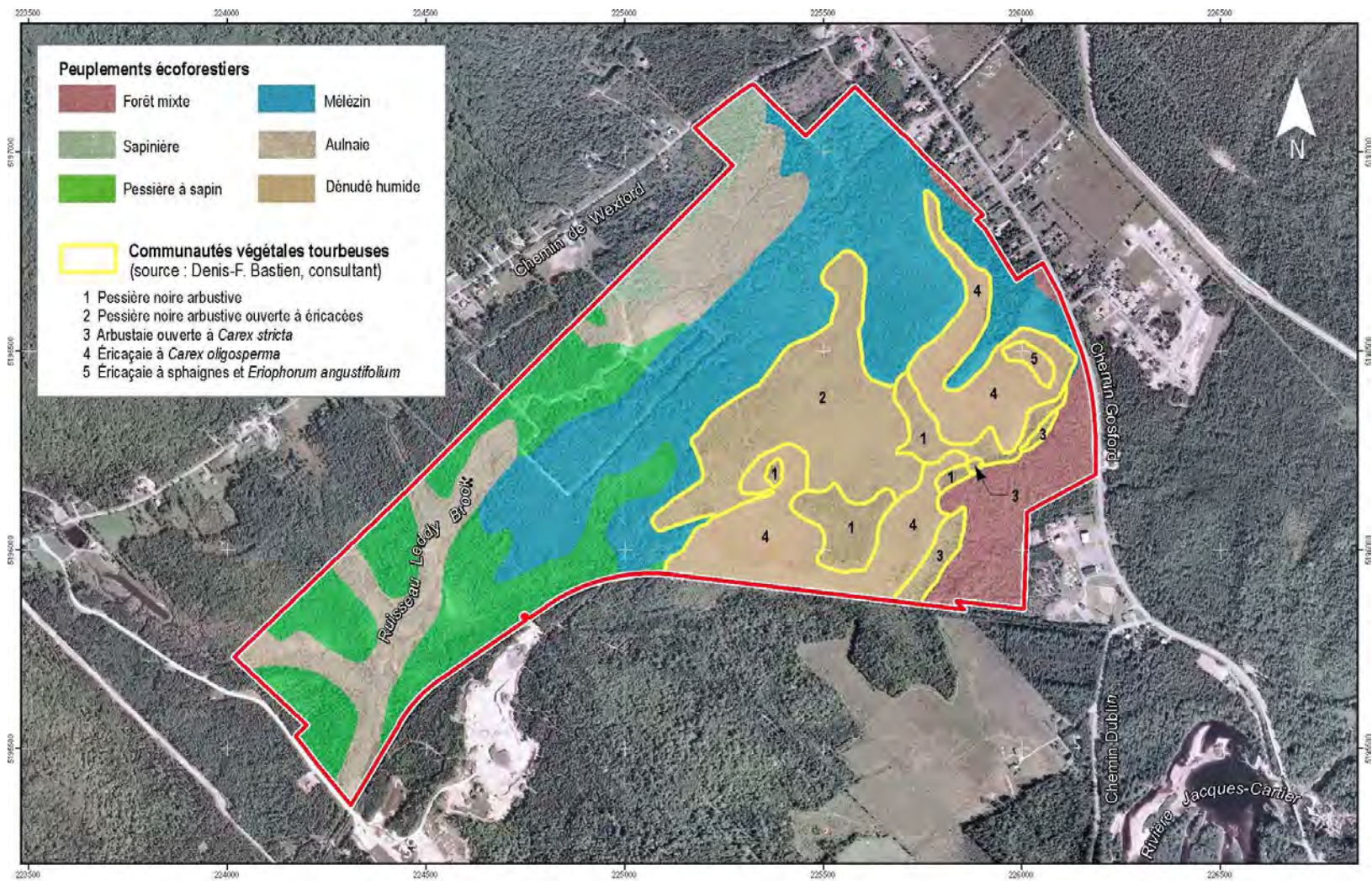
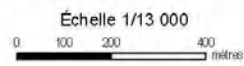


Figure 3 : Réserve écologique de la Tourbière-de-Shannon
Polygones écoforestiers et communautés végétales tourbeuses

— Réserve écologique



Métadonnées

Système de référence géologique: NAD 83, ellipsoïde GR80
Projection cartographique: Mercator transverse modifiée (MTM), zone de 2^e, Système de coordonnées planes du Québec (SQCP), bande 7

Sources

Données
Base de données topographiques du Québec (BDTQ) à l'échelle de 1:20 000
Cartes scolaires, 2^e édition

Déroulage du projet de réserve écologique

Organisme

Ministère des Ressources naturelles et de la Faune

Ministère du Développement durable, de l'Environnement et des Parcs

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1.2.1.6 Plant communities associated with forest polygons

Mixed forest: mixed forest, dominated by Balsam Fir (*Abies balsamea*) and Red Maple (*Acer rubrum*), is found on well-drained glaciofluvial soil and forms an arborescent structure more than 15 metres in height, possibly finding its origins in a forest fire due to the presence of Pine and charcoal in the forest bed (humus).

Balsam Fir stand: This forest colony dominated by Balsam Fir grows on moderately to imperfectly well-drained glaciofluvial deposits. The shrub and herbaceous strata of this forest are in the main composed of *Cornus canadensis*, *Oxalis acetosella* ssp. *montana* and *Dryopteris intermedia*.



Fir stand: This young forest, possibly the result of previous cutting, is to be found partly on poorly drained mineral soil and partly on thin or thick organic soil, depending on location. This forest stand is mainly home to Black Spruce (*Picea mariana*) and Red Spruce (*Picea rubens*) as well as, to a lesser degree, Balsam Fir. The understorey shrub and herbaceous species are sparse while moss cover is discontinuous.



Larch stand: This type of forest stand is habitually found at the margin of the open bog, on poorly drained organic soil. It is similar to the Spruce stand except that here, Tamarack (*Larix laricina*) replaces Black Spruce as the dominant arborescent cover (Bastien, 2007).



Alder grove: Alder groves can be seen especially along the shores of Leddy Brook that crosses the territory of the Réserve écologique de la Tourbière-de-Shannon, in places where poorly drained glaciofluvial or organic deposits may even be subject to intermittent flooding. A typical Alder grove is characterized by uniform tree cover dominated by Grey Alder (*Alnus incana* subsp. *rugosa*), with clearings colonized by herbaceous plants including *Calamagrostis canadensis*.



Aquatic or wetland plants, especially *Sparganium angustifolium*, *Onoclea sensibilis* and *Osmunda* spp., may be observed in the more humid troughs or on the watercourse itself (Bastien, 2007).



1.2.1.7 Plant communities associated with the open boggy sector

Black Spruce muskeg thickets :

Black Spruce muskeg thickets are characterized by poorly drained, high or low density coverage dominated by Black Spruce, with the water table visible here and there in the deepest troughs. The closed canopy results in notable impoverishment of other plant strata. The herbaceous stratum is dominated by *Carex stricta*, while *Pleurozium schreberii* is the most abundant species of moss.



Open heath black spruce stands :

Heath bogs are habitually located in the central portions of ombrotrophic bogs at the highest point, given their typically convex shape. They are characterized by hillocks (drier areas) and by troughs (wetter areas). Black spruce is common here in shrub form but in lower density than in Black Spruce muskeg thickets. Heath is represented in the main by *Rhododendron groenlandicum* and *Chamaedapne calyculata*, while *Eriophorum vaginatum* var. *spissum* dominates the herbaceous stratum. The moss stratum is essentially comprised of *Sphagnum capillifolium* and *S. fuscum*, to which *S. magellanicum* and *S. angustifolium* may be added for the hillocks and *S. fallax* in the wetter troughs.



Open *Carex stricta* thicket :

The *Carex stricta* thicket represents the lagg of this bog. Water from the adjacent mineral soil flows towards the bog margin and enriches it with available minerals. This shrub stand is characterized by the presence of minerotrophic species, especially *Nemopanthus mucronatus* and *Viburnum nudum* var. *cassinoides* in the shrub stratum and *Carex stricta* in the herbaceous stratum. Facultative and even ombrotrophic species may also be present.



Colonies of *Plantanthera blephariglottis* var. *blephariglottis* and *Listera australis* have been observed in this portion of the Réserve écologique de la Tourbière-de-Shannon.

Carex oligosperma Heath stand :

This Heath stand forms a transition plain between the drier sectors (Heath bogs and Black Spruce Stands) and the lagg at the bog margin. Many species of heath can be observed here, notably *Chamaedapne calyculata* and *Andromeda glaucophylla*, while *Carex oligosperma* dominates the herbaceous stratum. Black Spruce and Shrubby Larch are sparsely mixed in the Heath stand. The principal species of sphagnum observed in this plant community are *Sphagnum capillifolium* on the hillocks



and *S. fallax* in the wetter troughs. Colonies of *Plantanthera blephariglottis* var. *blephariglottis* and *Listera australis* are also present.

Sphagnum and *Eriophorum angustifolium*

Heath:

This wet plain is colonized by Heath, particularly *Chamaedapne calyculata* and *Kalmia polifolia*, with heavy sphagnum coverage, in the main represented by *Sphagnum papillosum* and *S. capillifolium*. The herbaceous stratum is dominated by *Eriophorum angustifolium* and *Carex oligosperma*. *Scheuchzeria palustris*, a species typically found in very wet, ombrotrophic or weakly minerotrophic microhabitats is also present here. The presence of *Sphagnum papillosum* suggests a weak minerotrophic habitat (Garneau, 2001).



1.2.1.8 Faunic species

Currently, we possess little information concerning the faunic resources that have been observed within the limits of the Réserve écologique de la Tourbière-de-Shannon. The Direction de l'aménagement de la faune de la Capitale-Nationale et de Chaudière-Appalaches has advised us that the Ministère des Ressources naturelles et de la Faune has no information about the faunic habitats of the area.

The Corporation du bassin de la Jacques-Cartier (CBJC) did, however, make a 2007 characterization of the aquatic habitats of Leddy Brook that crosses the Réserve écologique de la Tourbière-de-Shannon, and river bed flow patterns and particle size distribution were assessed in homogenous segments. Leddy Brook has a strong flow rate and the ligneous debris observed on its banks indicates heavy flooding (CBJC, 2007). This stream flows principally through natural environments that have been mostly or completely untouched by man. Beaver is ubiquitous here and a multitude of dams have changed the course of Leddy Brook by flooding large areas (Photo 1). The dams stop water runoff and at the same time lead to the formation of a wet environment that extends over more than one kilometre with certain portions dividing into multiple deep and flooded branches and arms (Photos 2–4). The presence of a dike has also created a small lake by the embankments from where a beaver hut can be seen (Photo 5). The upstream part of Leddy Brook, located in the northern sector of the ecological reserve, has a flow that is clearly lower than the downstream portion. This section of the brook includes shallow pools where numerous fish have been observed (Photo 6).

Electric fishing performed at two stations on Leddy Brook on a total area of 210 m² revealed the presence of Brook Trout (*Salvelinus fontinalis*), Creek Chub (*Semotilus atromaculatus*), White Sucker (*Catostomus commersoni*), Lake Chub (*Couesius plumbeus*) and various species of Dace. The habitats observed in the sampled stations have been deemed very favourable to Brook Trout, which is the most abundant species (CBJC, 2007).

Finally, residents who live in proximity to this sector have observed Black Bear, White-tailed Deer and Moose on the Chemin Gosford that abuts the border of the ecological reserve.

It is worthwhile noting that faunic inventories were made on the territory of the Valcartier Garrison (known as the Valcartier Military Base) located near the Réserve écologique de la Tourbière-de-Shannon (Envirotel, 2006). These inventories sought to document the composition, distribution and relative abundance of faunic species in this neighbouring territory of more than 220 km² and to validate the presence of threatened or vulnerable faunic species, including species that could be designated as such in Québec. In all, 9 species of Anurans (frogs and toads), 6 species of Salamanders, 1 Turtle species, 3 species of snakes, 137 species of forest birds, 8 species of owls, 12 species of hawks, 6 species of great wildlife, 14 species of micromammals and 6 species of bats were observed. It is presumable that the faunic species observed in the sectors adjacent to the ecological reserve are likely to be also found within the reserve, assuming that the preferred habitats of these species are present. Appendix 3 describes the

faunic species that were observed on the Valcartier Garrison territory between 2004 and 2006, in areas located near the Réserve écologique de la Tourbière-de-Shannon.



Photo 1. Active beaver dam on Leddy Brook



Photo 2. View of Leddy Brook and some of its riparian wetlands



Photo 3. View of Leddy Brook and some of its riparian wetlands



Photo 4. View of Leddy Brook and some of its riparian wetlands



Photo 5. Artificial lake created by a dam built on Leddy Brook, next to which is a beaver hut (insert)

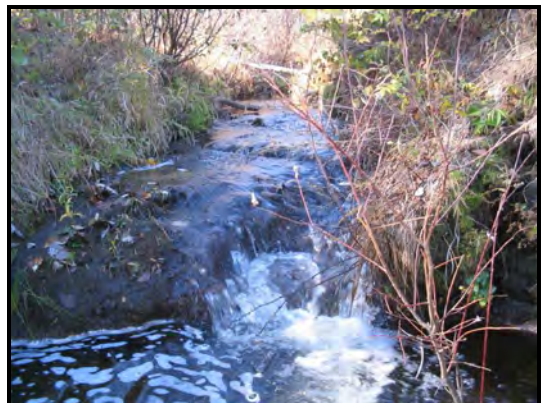


Photo 6. Pool observed in the portion of Leddy Brook located at the northern extremity of the ecological reserve

1.2.2. Outstanding elements

1.2.2.1 Flora

As of now, two floristic species likely to be designated as endangered or vulnerable have been observed within the boundaries of the Tourbière de Shannon: the Eastern Prairie Fringed-Orchid (*Platanthera blephariglottis* (Willd.) Lindl. var. *blephariglottis*) and the Southern Twayblade (*Listera australis* Lindl.). The Eastern Prairie Fringed-Orchid is an orchid that generally colonizes bog swamps but that can also be found in fens, which are richer in nutrients due to the fact that they are fed by oblique internal mineral drainage waters. Currently, the Centre de données sur le patrimoine naturel du Québec (CDPNQ) lists 80 occurrences of this species in Québec. However, many of these occurrences are historical, and the most recent observation in Southern Québec goes back more than 20 years, while others are endangered by peat harvesting. The Eastern Prairie Fringed-Orchid can be found at the northern limits of its distribution range in Québec.

In the Tourbière de Shannon, the Eastern Prairie Fringed-Orchid has been observed to be ubiquitous in the open or semi-open zones dominated by *Kalmia polifolia*, *Andromeda glaucophylla*, *Rhododendron groenlandicum* and *Eriophorum virginicum*. The species seems, however, to avoid the dampest areas where, for example, *Scheuchzeria palustris* is found. In this bog, the Eastern Prairie Fringed-Orchid is quite well distributed throughout its habitat, even if density of individuals is higher in the sectors located near groves of Larch and Black Spruce. Individuals probably number in excess of 1,000, making this in fact a population of excellent quality (Labrecque, 1997).

As for the Southern Twayblade, the CDPNQ claims that about 20 occurrences are currently known in Québec. In the Tourbière de Shannon, this species is much better distributed than the Eastern Prairie Fringed-Orchid and seems more demanding as to the characteristics of its habitat. For example, it is only found in places that are well protected by trees or shrubs, often on the southern side of groves: this phenomenon has already been documented (Greenwood, 1962). More than 500 individuals in bloom were observed during a June 2007 visit, making it the second largest population of this species in Québec (Jacques Labrecque, 2007 harvest notebook).

1.2.2.2 Fauna

The Centre de données sur le patrimoine naturel du Québec (CDPNQ) mentions no faunic species that is endangered, vulnerable or likely to be designated as such on the territory of the Réserve écologique de la Tourbière-de-Shannon or within a 2.5 km perimeter of the reserve. However, information available from the CDPNQ only reflects current knowledge. As well, parts of existing data may not have been incorporated into the system as yet, present lacunae with respect to geographical precision or require updating and additional documenting.

It is however interesting to note that a number of endangered faunic species have been observed in areas of the Valcartier Garrison located in proximity to the ecological reserve. These are the Pickerel Frog and the Dusky Salamander, two species of amphibians liable to be designated as endangered or vulnerable in

Québec, the Red-shouldered Hawk, a bird species that has been designated as fragile in Canada and the Bald Eagle, a bird species that has been designated as vulnerable in Québec (Envirotel, 2006). Many fragile species of mammals have also been observed in this territory, including the Grey Wolf—considered vulnerable in Canada, the Smoky Shrew, Rock Vole and Southern Bog Lemming, three species of micromammals liable to be designated as endangered or vulnerable in Québec and finally, the Silver-haired Bat, Hoary Bat and the Eastern Pipistrelle, three bat species liable to be designated as endangered or vulnerable in Québec (Appendix 3).

1.3. Land occupation and use

The Réserve écologique de la Tourbière-de-Shannon will become the second ecological reserve in the Jacques-Cartier RCM, the first being the Réserve écologique de Tantaré that is located 15 kilometres to the north. Apart from these two ecological reserves, the Jacques-Cartier RCM also includes an exceptional forest ecosystem (the Forêt ancienne de Duchesnay), a site that is protected by a private organization and acknowledged as a natural reserve (Réserve naturelle des Marais-du-Nord) as well as nearly one-third of the Parc national de la Jacques-Cartier.

The ombrotrophic Tourbière de Shannon is in an excellent state of conservation (Labrecque, 1997). The only disturbances observed during the inventory of 1997 were some traces of all-terrain vehicle use. It seems then that the populations of Eastern Prairie Fringed-Orchid (*Platanthera blephariglottis* (Willd.) Lindl. var. *blephariglottis*) and Southern Twayblade (*Listera australis* Lindl.) are not endangered in the short term. However, the boggy habitats are vulnerable to changes in drainage and to sustained hiker and ATV activity. Considering the fact that this bog abuts the urban territory of the municipality of Shannon and is located approximately 30 km northwest of the city of Québec, it will be vital to ensure that bog visits remain minimal.

Conserving the Tourbière de Shannon is definitely pertinent, from both the ecological and hydrologic perspectives. This is first of all a bog that is representative of bogs that developed on deltaic deposits. Its many habitats (open bog, forest populations on peat, watercourses, wetlands) are home to diverse flora and fauna that are characteristic of boggy ecosystems. The presence of two species liable to be designated as endangered or vulnerable underscores the rarity of some elements of the floral inhabitants. The Tourbière de Shannon also plays a crucial hydrologic role, contributing to the stabilization of outflow from Leddy Brook by absorbing precipitation and releasing the water slowly during dry periods. The Tourbière de Shannon thus helps to prevent washout in soils that border the stream and, consequently, the erosion of its banks.

2. Activity plan

Activities taking place within the Réserve écologique de la Tourbière-de-Shannon are subject to the provisions of the Natural Heritage Conservation Act (R.S.Q., c. C-61.01) and include scientific studies and educational activities. The conservation plan does not plan any prohibitions other than activities that are already prohibited in the ecological reserve by the act, nor does it authorize or add any constraints to activities already authorized by the act.

2.1 Scientific research

Scientific research in the reserve must be authorized in writing by the Minister of Sustainable Development, Environment and Parks or its designated representative. Applications for research project authorization should include the name of the ecological reserve, person responsible for the application, project name, duration, objectives and justification for choice of territory, methodology and instrumentation, a description of any foreseeable impacts, siting of work and schedule of planned current year activities. As a general rule, applications for authorization of scientific research are handled by the Direction du patrimoine écologique et des parcs.

Scientific activities may focus on a number of research areas, including ecology, paleo-ecology (study of environmental conditions at various epochs), hydrology and the impact of climate warming on peaty ecosystems.

With respect to the ecology of bogs, the acquisition of knowledge about certain biological components would be desirable, particularly knowledge concerning birds, amphibians and insects. The fact is, no faunic inventory has yet been taken on the territory of the ecological reserve. For example, we do not completely know which types of birds inhabit the territory, nor the main orders of insects and other forms of life that are present in the bog, nor their ecological roles for that matter. Accordingly, it would be of interest to study the various types of plant-related microorganisms, especially mycorrhizes, which are particularly important to Heath and plants of the Orchid family. Studies of different microhabitats (hillocks, flatlands and troughs) could also be made in relation to a number of parameters such as 1) the diversity and abundance of observed plant species; 2) the hydrologic characteristics (humidity levels of the plant cover, depth of the water table, annual and daily fluctuations of the water table); 3) the process of formation and breakdown of the bog and 4) physicochemical characteristics (pH, conductivity, temperature, nutrient cycles).

The populations of the Eastern Prairie Fringed-Orchid and the Southern Twayblade, two floristic species likely to be designated as endangered or vulnerable in Québec, should also be periodically followed to ensure that they remain in a healthy state of conservation.

Paleo-ecological research could include analysis of peat core and macroremains as well as carbon-14 sample dating that would make it possible to understand the bog's age and history of formation.

Studies on the hydrology of this bog could measure the impact of various disturbances (drainage channels, ATV use) on the water table, vegetation and environmental resiliency of the area. For example, a rewetting project could take place by blocking current drainage channels and following the evolution of vegetation within permanent quadrats along the sampling transects perpendicular to these channels. As part of the studies on bog restoration, it is also important to compare sites that have been restored with natural sites by measuring, for example, microorganism cycles and hydrologic characteristics to determine whether or not restoration methods are functioning properly. The Tourbière de Shannon could thus serve as a natural site for reference purposes.

Finally, in the context of global climate warming, many scientists and climate models predict a lowering of the water table during the next century. As much of bogs are humid environments where the water table is found close to the surface, any such lowering would have a significant impact on vegetation (reforestation, for example) as well as on the carbon cycle in the bogs. In fact, the bog aerobic decomposition at ground level (acrotelm) would thicken, potentially resulting in significant emissions of carbon dioxide (CO₂) into the atmosphere. It is thus of relevance to follow the plant communities of various bogs to measure the effects of eventual changes to these ecosystems that have until now been considered to be carbon sinks and not sources of emissions.

2.2. Educational activities

The Minister of Sustainable Development, Environment and Parks must approve all nature awareness, interpretation and observation activities in the ecological reserve, as defined by a protocol agreement among all parties involved in the project. Subsequent educational program follow-up is handled by the Minister of Sustainable Development, Environment and Park's regional office that is closest to the ecological reserve. It is important to note that the implementation of an educational program on the territory of an ecological reserve requires both the involvement of the municipality and that the project be handled by a not-for-profit organization.

In the perspective of the implementation of an educational program, it is important to highlight the fact that these large bogs represent the only natural environments in southern Québec that have not been changed by human activity. The biological diversity and ecological roles played by these ecosystems represent interesting themes to develop, as is a regionally-contextualized history of the formation of this area.

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APPENDIX 1

PLAN ACCOMPANYING
THE TECHNICAL DESCRIPTION OF THE
LA RÉSERVE ÉCOLOGIQUE DE
LA TOURBIÈRE-DE-SHANNON

Municipality : SHANNON
Regional county municipality : LA JACQUES-CARTIER
Administrative region : CAPITALE-NATIONALE
Registration division : PORTNEUF
Cadastre : PAROISSE DE SAINTE-CATHERINE

Scale 1:5 000
100 0 100 200 300 400

LEGEND

Boundary of the ecological reserve

Prepared at Québec on March 12, 2009

By : BERTRAND BUSSIÈRE
Land Surveyor

Minute : 1455 Field sheet 47-395
Direction du patrimoine écologique et des parcs
file : 5141-03-03-3.25

The original of this document is kept in the office
of Bertrand Bussière, Land Surveyor

Date :By :L.S.



Area of ecological reserve
168,77 hectares (1,69 km²)

NOTES

Measures in the map expressed in the International System of Units (SI).

The directions indicated on this document are bearings based on the SCOPQ system (zone 7) NAD 83.

APPENDIX 2

Appendix 2. Vascular and invascular plant species observed in the Réserve écologique de la Tourbière-de-Shannon (Bastien, 2007)

Category	Latin name	French name	English name
Arborescent Stratum	<i>Abies balsamea</i>	Sapin baumier	Balsam Fir
	<i>Acer rubrum</i>	Érable rouge	Red Maple
	<i>Betula papyrifera</i>	Bouleau à papier	Paper Birch
	<i>Betula populifolia</i>	Bouleau gris	Grey Birch
	<i>Larix laricina</i>	Mélèze laricin	Tamarack
	<i>Picea glauca</i>	Épinette blanche	White Spruce
	<i>Picea mariana</i>	Épinette noire	Black Spruce
	<i>Picea rubens</i>	Épinette rouge	Red Spruce
	<i>Pinus strobus</i>	Pin blanc	Eastern White Pine
	Shrub Stratum	<i>Acer pensylvanicum</i>	Érable de Pennsylvanie
<i>Alnus incana ssp. rugosa</i>		Aulne rugueux	Grey Alder
<i>Amelanchier sp.</i>		Amélanchier sp.	Saskatoon
<i>Andromeda glaucophylla</i>		Andromède glauque	Bog Rosemary
<i>Aronia melanocarpa</i>		Aronie à fruits noirs	Black Chokecherry
<i>Betula glandulosa</i>		Bouleau glanduleux	Scrub Birch
<i>Chamaedapne calyculata</i>		Cassandre caliculé	Leatherleaf
<i>Gaultheria hispidula</i>		Petit thé	Wintergreen
<i>Kalmia angustifolia</i>		Kalmia à feuilles étroites	Sheep-laurel
<i>Kalmia polifolia</i>		Kalmia à feuilles d'andromède	Bog-laurel
<i>Linnaea borealis</i>		Linnée à longues fleurs	Twinflower
<i>Nemopanthus mucronatus</i>		Némopanthe mucroné	Mountain Holly
<i>Rhododendron groenlandicum</i>		Thé du Labrador	Labrador Tea
<i>Rubus idaeus ssp. strigosus</i>		Framboisier sauvage	Flowering Raspberry
<i>Sorbus americana</i>		Sorbier d'Amérique	American Mountain Ash
<i>Spiraea alba var. latifolia</i>		Spirée à larges feuilles	Broad-leaved Meadowsweet
<i>Taxus canadensis</i>		If du Canada	Canada Yew
<i>Vaccinium angustifolium</i>		Bleuet à feuilles étroites	Narrow-leaved Blueberry
<i>Vaccinium corymbosum</i>		Bleuet en corymbe	Highbush Blueberry
<i>Vaccinium myrtilloides</i>		Bleuet fausse-myrtille	Velvet Leaf Blueberry
<i>Vaccinium oxycoccos</i>	Canneberge commune	Small Cranberry	
<i>Viburnum nudum var. cassinoïdes</i>	Viorne cassinoïde	With-rod	
Herbaceous Stratum	<i>Aralia nudicaulis</i>	Aralie à tige nue	Wild Sarsaparilla

Appendix 2. Vascular and invascular plant species observed in the Réserve écologique de la Tourbière-de-Shannon (Bastien, 2007)

Category	Latin name	French name	English name
Herbaceous Stratum (cont'd)	<i>Arisaema triphyllum</i>	Arisème petit-prêcheur	Jack-in-the-pulpit
	<i>Athyrium filix-femina</i>	Athyrie fougère-femelle	Lady Fern
	<i>Bidens cernuus</i>	Bident penché	Nodding Beggarticks
	<i>Calamagrostis canadensis</i>	Calamagrostide du Canada	Bluejoint
	<i>Carex crinita</i>	Carex crépu	Fringed Sedge
	<i>Carex lurida</i>	Carex luisant	Shining Sedge
	<i>Carex oligosperma</i>	Carex oligosperme	Few-seeded Sedge
	<i>Carex pauciflora</i>	Carex pauciflore	Pauciflorous Sedge
	<i>Carex magellanica ssp. irrigua</i>	Carex chétif	Stunted Sedge
	<i>Carex sp.</i>	Carex sp.	Sedge
	<i>Carex stricta</i>	Carex raide	Stiff Sedge
	<i>Carex trisperma</i>	Carex trisperme	Three-fruited Sedge
	<i>Clintonia borealis</i>	Clintonie boréale	Yellow Clintonia
	<i>Coptis trifolia</i>	Savoyane	Gold-thread
	<i>Cornus canadensis</i>	Quatre-temps	Bunchberry
	<i>Cypripedium acaule</i>	Cypripède acaule	Stemless Lady's-slipper
	<i>Dalibarda repens</i>	Dalibarde rampante	False Violet
	<i>Drosera rotundifolia</i>	Droséra à feuilles rondes	Round-leaved Sundew
	<i>Dryopteris intermedia</i>	Dryoptère intermédiaire	Intermediate Woodfern
	<i>Eleocharis acicularis</i>	Éléocharide aciculaire	Needle Spike-rush
	<i>Epilobium ciliatum ssp. glandulosum</i>	Épilobe glanduleux	Glandular Willow-herb
	<i>Eriophorum angustifolium</i>	Linaigrette à feuilles étroites	Narrow-leaved Cotton-grass
	<i>Eriophorum vaginatum var. spissum</i>	Linaigrette à large gaine	Tussock Cottongrass
	<i>Eupatorium maculatum</i>	Eupatoire maculée	Joe-pye weed
	<i>Galium sp.</i>	Gaillet sp.	Goosegrass
	<i>Geocaulon lividum</i>	Comandre livide	Northern Comandra
	<i>Glyceria canadensis</i>	Glycérie du Canada	Canada Manna-Grass
	<i>Glyceria melicaria</i>	Glycérie mélicaire	Melica Manna-Grass
	<i>Glyceria striata</i>	Glycérie striée	Fowl Manna-Grass
	<i>Gymnocarpium dryopteris</i>	Gymnocarpe du chêne	Oak Gymnocarpous
	<i>Hypericum ellipticum</i>	Millepertuis elliptique	Elliptic St. John's-wort
	<i>Impatiens capensis</i>	Impatiente du Cap	Lady's Earrings
	<i>Juncus effusus</i>	Jonc épars	Soft Rush

Appendix 2. Vascular and invascular plant species observed in the Réserve écologique de la Tourbière-de-Shannon (Bastien, 2007)

Category	Latin name	French name	English name
Herbaceous Stratum (cont'd)	<i>Listera australis</i>	Southern Twayblade	Southern Twayblade
	<i>Lycopodium clavatum</i>	Lycopode claviforme	Common club-moss
	<i>Lycopodium obscurum</i>	Lycopode obscur	
	<i>Lycopus uniflorus</i>	Lycope à a fleur	
	<i>Lysimachia terrestris</i>	Lysimaque terrestre	Swamp-candles
	<i>Maianthemum canadense</i>	Maïanthème du Canada	Wild lily-of-the-valley
	<i>Maianthemum trifolium</i>	Smilacine trifoliée	Three-leaved Solomon's seal
	<i>Monotropa uniflora</i>	Monotrope uniflore	Indian-pipe
	<i>Oenothera sp.</i>	Onagre sp.	(Evening-Primrose)
	<i>Onoclea sensibilis</i>	Onoclée sensible	Sensitive Fern
	<i>Osmunda cinnamomea</i>	Osmonde cannelle	Cinnamon Fern
	<i>Osmunda claytoniana</i>	Osmonde de Clayton	Interrupted Fern
	<i>Osmunda regalis</i>	Osmonde royale	Royal Fern
	<i>Oxalis acetosella ssp. montana</i>	Oxalide de montagne	Common Wood Sorrel
	<i>Panicum sp.</i>	Panic sp.	Common Millet
	<i>Persicaria sagittata</i>	Renouée sagittée	Arrow-leaved smartweed
	<i>Phalaris arundinacea</i>	Alpiste roseau	Reed phalaris
	<i>Phegopteris connectilis</i>	Phégoptère du hêtre	
	<i>Platanthera blephariglottis var. blephariglottis</i>	Platanthère blanchâtre de l'Est	Eastern Prairie Fringed-Orchid
	<i>Potentilla norvegica</i>	Potentille de Montpellier	Rough cinquefoil
	<i>Pteridium aquilinum</i>	Fougère-aigle de l'Est	Eastern Brackenfern
	<i>Rhynchospora alba</i>	Rhynchospore blanc	Beaked Rush
	<i>Rubus pubescens</i>	Ronce pubescente	Hairy raspberry
	<i>Sarracenia purpurea</i>	Sarracénie pourpre	Pitcher Plant
	<i>Scheuchzeria palustris</i>	Scheuchzérie des marais	Scheuchzeria
	<i>Scirpus atrocinctus</i>	Scirpe à ceinture noire	Black-girded Wool-grass
	<i>Scirpus sp.</i>	Scirpe sp.	Club-Rush
	<i>Scutellaria lateriflora</i>	Scutellaire latériflore	Mad-dog Skullcap
	<i>Solidago rugosa</i>	Verge d'or rugueuse	Rough Goldenrod
	<i>Sparganium angustifolium</i>	Rubaniar à feuilles étroites	Narrowleaf bur-reed
	<i>Thalictrum pubescens</i>	Pigamon pubescent	King-of-the-meadow

Appendix 2. Vascular and invascular plant species observed in the Réserve écologique de la Tourbière-de-Shannon (Bastien, 2007)

Category	Latin name	French name	English name
	<i>Triadenum fraseri</i>	Millepertuis de Fraser	Fraser St. John's-Wort
	<i>Trientalis borealis</i>	Trientale boréale	Starflower
	<i>Trilium undulatum</i>	Trille ondulé	Painted Trillium
	<i>Vicia cracca</i>	Vesce jargeau	Tufted Vetch
	<i>Viola sp.</i>	Violette sp.	Violet
Invascular Plants	<i>Bazzania trilobata</i>	n.d.	Grey Liverwort
	<i>Cladonia sp.</i>	Cladonie sp.	Cup Moss
	<i>Dicranum fuscescens</i>	n.d.	Dicranum Moss
	<i>Dicranum polysetum</i>	n.d.	Rugose Fork-moss
	<i>Dicranum undulatum</i>	n.d.	Wavy dicranum
	<i>Hylocomium splendens</i>	n.d.	Stair-Step Moss
	<i>Pleurozium schreberii</i>	n.d.	Schreber's moss
	<i>Polytrichum juniperinum</i>	n.d.	Juniper Moss
	<i>Polytrichum strictum</i>	n.d.	Stiff Moss
	<i>Ptilium crista-castrensis</i>	n.d.	Plume moss
	<i>Sphagnum angustifolium</i>	Sphaigne angustifoliée	Narrow-leaved Sphagnum
	<i>Sphagnum capillifolium</i>	n.d.	Acute-leaved Peat Moss
	<i>Sphagnum cuspidatum</i>	Sphaigne cuspidée	Cuspidate Sphagnum
	<i>Sphagnum fallax</i>	n.d.	Flat-topped Bog-moss.
	<i>Sphagnum fuscum</i>	n.d.	Rusty Peat Moss
	<i>Sphagnum girgensohnii</i>	Sphaigne de Girgensohn	Girgensohn sphagnum
	<i>Sphagnum magellanicum</i>	n.d.	Magellan's Sphagnum
	<i>Sphagnum papillosum</i>	n.d.	Papillose Sphagnum
	<i>Sphagnum quinquefarium</i>	Sphaigne quinquéfariée	Quinquefarious Sphagnum
	<i>Sphagnum russowii</i>	n.d.	Russow's Sphagnum
	<i>Sphagnum spp.</i>	Sphaigne	Sphagnum

APPENDIX 3

Appendix 3. Faunic species observed on the territory of the Valcartier Garrison from 2004 to 2006, in sectors close to the Réserve écologique de la Tourbière-de-Shannon (Envirotel, 2006)

Category	Latin name	French name	English name
Amphibians	<i>Ambystoma laterale</i>	Salamandre à points bleus	Blue-spotted Salamander
	<i>Ambystoma maculatum</i>	Salamandre maculée	Yellow Spotted Salamander
	<i>Bufo americanus</i>	Crapaud d'Amérique	American Toad
	<i>Desmognathus fuscus</i>	Salamandre sombre du Nord	Dusky Salamander
	<i>Euricea bislineata</i>	Salamandre à two lignes	Two-lined Salamander
	<i>Hyla versicolor</i>	Rainette versicolore	Eastern Frey Treefrog
	<i>Notophthalmus viridescens</i>	Triton vert	Eastern Newt
	<i>Plethodon cinereus</i>	Salamandre cendrée	Eastern Redback Salamander
	<i>Pseudacris crucifer</i>	Rainette crucifère	Spring Peeper
	<i>Rana catesbeiana</i>	Ouaouaron	Bullfrog
	<i>Rana clamitans</i>	Grenouille verte	Green Frog
	<i>Rana palustris</i>	Grenouille des marais	Pickerel Frog
	<i>Rana pipiens</i>	Grenouille léopard	Leopard Frog
	<i>Rana septentrionalis</i>	Grenouille du Nord	North Frog
	<i>Rana sylvatica</i>	Grenouille des bois	Wood Frog
Reptiles	<i>Chrysemys picta</i>	Tortue peinte	Painted Turtle
	<i>Opheodrys vernalis</i>	Couleuvre verte	Smooth Green Snake
	<i>Storeria occipitomaculata</i>	Couleuvre à ventre rouge	Red-bellied Snake
	<i>Thamnophis sirtalis</i>	Couleuvre rayée	Common Garter Snake
Owls	<i>Aegolius acadicus</i>	Petite nyctale	Northern Saw-whet Owl
	<i>Aegolius funereus</i>	Nyctale de Tengmalm	Boreal Owl
	<i>Asio flammeus</i>	Hibou des marais	Short-eared Owl
	<i>Asio otus</i>	Hibou moyen-duc	Long-eared Owl
	<i>Bubo scandiacus</i>	Harfang des neiges	Snowy Owl
	<i>Bubo virginianus</i>	Grand-duc d'Amérique	Great Horned Owl
	<i>Strix nebulosa</i>	Chouette lapone	Great Gray Owl
	<i>Strix varia</i>	Chouette rayée	Barred Owl
Hawks	<i>Accipiter cooperii</i>	Épervier de Cooper	Cooper's Hawk
	<i>Accipiter gentilis</i>	Autour des palombes	Northern Goshawk
	<i>Accipiter striatus</i>	Épervier brun	Sharp-shinned Hawk
	<i>Buteo jamaicensis</i>	Buse à queue rousse	Red-tailed Hawk
	<i>Buteo lineatus</i>	Buse à épaulettes	Red-shouldered Hawk
	<i>Buteo platypterus</i>	Petite buse	Broad-winged Hawk
	<i>Cathartes aura</i>	Urubu à tête rouge	Turkey Vulture
	<i>Circus cyaneus</i>	Busard Saint-Martin	Northern Harrier
	<i>Falco columbarius</i>	Faucon émerillon	Merlin
	<i>Falco sparverius</i>	Crécerelle d'Amérique	American Kestrel
	<i>Haliaeetus leucocephalus</i>	Pygargue à tête blanche	Bald Eagle
	<i>Pandion haliaetus</i>	Balbusard pêcheur	Osprey
Mammals	<i>Alces alces</i>	Orignal	Moose
	<i>Canis lupus</i>	Loup	Grey Wolf
	<i>Castor canadensis</i>	Castor	Canadian Beaver

Appendix 3. Faunic species observed on the territory of the Valcartier Garrison from 2004 to 2006, in sectors close to the Réserve écologique de la Tourbière-de-Shannon (Envirotel, 2006)

Category	Latin name	French name	English name	
Mammals (continued)	<i>Erethizon dorsatum</i>	Porc-épic d'Amérique	American Porcupine	
	<i>Odocoileus virginianus</i>	White-tail deer	White-tail Deer	
	<i>Vulpes vulpes</i>	Renard roux	Red Fox	
Micromammals	<i>Blarina brevicaud</i>	Grande musaraigne	Northern Short-tailed Shrew	
	<i>Clethrionomys gapperi</i>	Campagnol à dos roux de	Northern Red-backed Vole	
	<i>Microtus chrotorrhinus</i>	Campagnol des rochers	Rock Vole	
	<i>Microtus pennsylvanicus</i>	Campagnol des champs	Meadow vole	
	<i>Mus musculus</i>	Souris commune	House Mouse	
	<i>Napaeozapus insignis</i>	Souris sauteuse des bois	Woodland Jumping Mouse	
	<i>Peromyscus sp.</i>	Souris du genre <i>Peromyscus</i>	Mouse	
	<i>Ratus norvegicus</i>	Rat surmulot	Norway Rat	
	<i>Sorex cinereus</i>	Musaraigne cendrée	Cinereous Shrew	
	<i>Sorex fumeus</i>	Musaraigne fuligineuse	Smoky Shrew	
	<i>Sorex palustris</i>	Musaraigne palustre	American Water Shrew	
	<i>Synaptomys cooperi</i>	Campagnol-lemming de	Southern Bog Lemming	
	<i>Zapus hudsonius</i>	Souris sauteuse des champs	Meadow Jumping Mouse	
	Bats	<i>Myotis lucifugus</i>	Petite chauve-souris brune	Little Brown Bat
		<i>Eptesicus fuscus</i>	Grande chauve-souris brune	Big Brown Bat
<i>Myotis septentrionalis</i>		Chauve-souris nordique	Northern Long-eared Bat	
<i>Pipistrellus subflavus</i>		Pipistrelle de l'Est	Eastern Pipistrelle	
<i>Lasionycteris noctivagans</i>		Chauve-souris argentée	Silver-haired Bat	
<i>Lasiurus cinereus</i>		Chauve-souris cendrée	Hoary Bat	

