Québec Biodiversity Atlas

Threatened or Vulnerable Species

Québec

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Bernard Tardif, Gildo Lavoie and Yves Lachance

Abstract

Based on data held by the Centre de données sur le patrimoine naturel du Québec (CDPNQ), this atlas provides an overview of existing knowledge on Québec's threatened or vulnerable species, discusses related conservation efforts to date and identifies biodiversity conservation priorities (hot spots).

It also proposes a draft regional action framework designed to ensure that biodiversity elements are taken into account in conservation and land management initiatives, and seeks to illustrate an approach specifying where and how to intervene.

Ultimately, a similar analysis, targeting a larger segment of biodiversity, is envisaged.

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Cover photos:

1 *Asclepias tuberosa* var. *interior*: Gildo Lavoie

2 *Rangifer tarandus* pop. 2: Fred Klaus, MRNF

3 Grande-Plée-Bleue peatbog: Line Couillard

4 *Salix chlorolepis*: Frédéric Coursol

5 *Rana Palustris*: Jean Gaudet

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Preface

Some 17 years ago, the Québec government began to systematically and rigorously collect existing data on imperilled species. Some of the information gathered dates as far back as the discoveries of 19th- and 20th-century naturalists such as Léon Provancher and Frère Marie-Victorin, if not the first explorations of Pierre Boucher (1664), Michel Sarrazin (1704) and Pehr Kalm (1749).

Naturalists long concentrated on collecting, naming and describing species, paving the way for sciences with broader knowledge bases such as biogeography, ecology and, very recently, conservation biology.

A growing awareness of the role of biological diversity in the fate of our planet, and, consequently, mankind, has led societies to take a particular interest in threatened or vulnerable species. Information taken from scientific collections and contemporary surveys are, therefore, of critical importance. The Centre de données sur le patrimoine naturel du Québec, which tracks these species – along with species associations and ecosystems – uses these data to justify preventive action, intervention in cases of irreversible destruction and protection of this heritage of which we are sometimes the only stewards, given that certain elements are exclusive to our territory.

The Centre de données sur le patrimoine naturel du Québec has fulfilled its information and ecowatch duties most effectively since its creation in 1988. But it needs to be known and recognized. And, this impressive source of data must be processed from a spatial land management perspective in order for it to fully play its role. This first atlas on Québec's threatened or vulnerable species is eloquent testimony to this mandate. Containing a wealth of data and concepts, the atlas is practical, enlightening and methodical. It opens the door to more specific tools accessible to regional decision-makers and players. It reflects our current initiative of providing the regional offices of the government departments concerned and local and regional municipalities with recommendations designed to guide land developers, major public works contractors, regional forestry officers and many others with practices that are compatible with safeguarding this irreplaceable natural heritage.

Léopold Gaudreau

Director, Direction du développement durable, du patrimoine écologique et des parcs
Ministère du Développement durable, de l'Environnement et des Parcs

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We would like to thank all of those who commented a preliminary version of the atlas: Jacques Jutras[1], Josée Tardif[2] and Jacques Labrecque[3]. The latter two individuals also supervised numerous validations of animal and plant occurrences respectively. Special thanks to Line Couillard,[3] Léopold Gaudreau,[3] Isabelle Gauthier,[1] Vincent Gerardin[3] and Pierre Morisset for their expert input, which enabled us to substantially improve the final version. We extend our thanks to Vincent Gerardin for having initiated and oriented this project. Finally, we would like to thank Eric Kauffman[4] who, via cyberspace, most kindly generated the hexagonal polygons used to define hot spots.

[1] Ministère des Ressources naturelles et de la Faune

[2] Canadian Wildlife Service

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

[4] California Department of Fish and Game

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A conservation data centre (CDC) is:

A multidisciplinary team of specialists

A common methodology used throughout the Americas

A geographic information system for biodiversity conservation

Centre de données sur le patrimoine naturel du Québec

Introduction

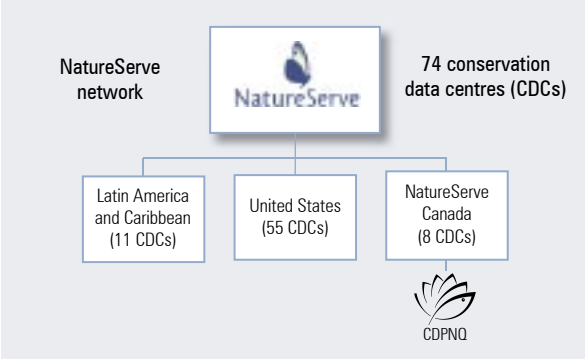
Québec is a recognized centre of endemism in northeastern North America (Fernald, 1918, 1924; Marie-Victorin, 1935; Morisset, 1971; Argus and McNeil, 1974; WWF and IUCN, 1994 - 1997). The distribution of its plant and animal species is relatively well-known but necessarily incomplete, given the territory's vast size and the fact that most of it is inaccessible. Paradoxically, apart from certain wildlife species that are harvested, species at risk are best characterized. This is the raison-d'être of the Centre de données sur le patrimoine naturel du Québec (CDPNQ), the main source of detailed data on all of Québec's threatened or vulnerable species.

The Centre de données sur le patrimoine naturel du Québec

An instrument of biodiversity measurement

Created in 1988, following the adoption of the *Act respecting threatened or vulnerable species*, the CDPNQ belongs to the NatureServe network (http://natureserve.org), which includes 74 conservation data centres (CDC) located throughout the Americas.

The CDCs' mission consists of documenting, analyzing and disseminating information on elements of biodiversity. Using a scientific approach and a common methodology based on data-sharing, the CDCs, which are composed of multidisciplinary teams of specialists, enable systematic, objective data processing and inter-jurisdictional analyses and comparisons.

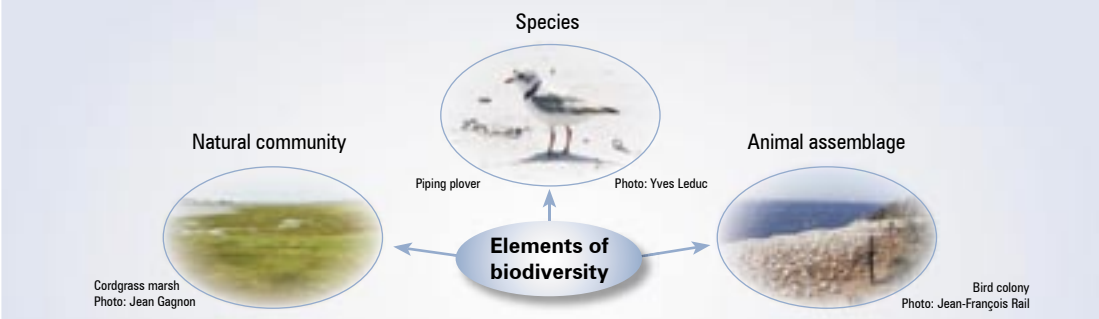


The CDPNQ and CDC network hold information such as nomenclature, conservation status, biological characterization and management of elements of biodiversity, along with data related to their geographic location obtained from various sources: specimens, inventories, specialized data banks for certain groups of species, observations by the public, scientific reports and publications, etc.

Québec's CDC—the CDPNQ—is managed jointly by the Ministère du Développement durable, de l'Environnement et des Parcs, which is responsible for plant species and natural communities, and the Ministère des Ressources naturelles et de la Faune, which is responsible for animal species. The regional offices of these two government departments help process the information requests forwarded to the CDPNQ.

Elements of biodiversity

Because biodiversity covers more than simply species, the methodology used by the NatureServe network characterizes it using three categories grouped together under the term "elements of biodiversity". They are: species, natural community and animal assemblage.



Assemblage of plants and animals that interact in space and time in a given ecological context. The natural communities approach partially compensates for the lack of sufficient species-related data. On land, it is primarily plant associations that are used as the fine-scale level for identifying natural communities.

Concentration of animal species using the same site for a phase of their life cycle (feeding, reproduction, migration, hibernating, etc.), e.g. bird colonies, bat or reptile hibernacula, concentrations of migrating shorebirds, multispecific spawning grounds, multispecific mussel habitats.

The Atlas

The CDCs' daily activities consist of updating data and taking action, on a case-by-case basis, to answer information requests and provide expert opinions related to the presence of elements of biodiversity in the territory. In addition to these essential tasks, it is important that the CDCs analyze their data to arrive at a global understanding and utilization thereof. This atlas is the result of such an analysis. It uses the information accumulated by the CDPNQ to present the very first overview of those elements of Québec's biodiversity whose survival is most at risk. Based on the methodological approach used in the CDCs, this analysis seeks to determine action priorities, both locally and for Québec as a whole. The atlas also outlines a draft intervention framework—and uses the example of the Outaouais administrative region—designed to take elements of biodiversity into account in conservation and land management activities. Ultimately, it seeks to illustrate an approach specifying "where" and "how" to take action.

Elements of biodiversity targeted

The elements of biodiv
groups which are currently sufficiently documented throughout Québec.

Québec's threatened or vulnerable species

The term "threatened or vulnerable species" groups together species designated or likely to be legally designated threatened or vulnerable. For a detailed definition of these terms and the criteria used to select species likely to be so designated, see Gouvernement du Québec (1992), Beaulieu (1992) and Labrecque and Lavoie (2002).

Species

In keeping with the *Act respecting threatened or vulnerable species*, the terms species is used in its broadest sense, including subspecies, varieties and populations.

Species likely to be designated

Any species on the list published in the *Gazette officielle du Québec*, in keeping with the *Act respecting threatened or vulnerable species*.

Designated species

Any species designated "threatened" or "vulnerable", in keeping with the *Act respecting threatened or vulnerable species*.

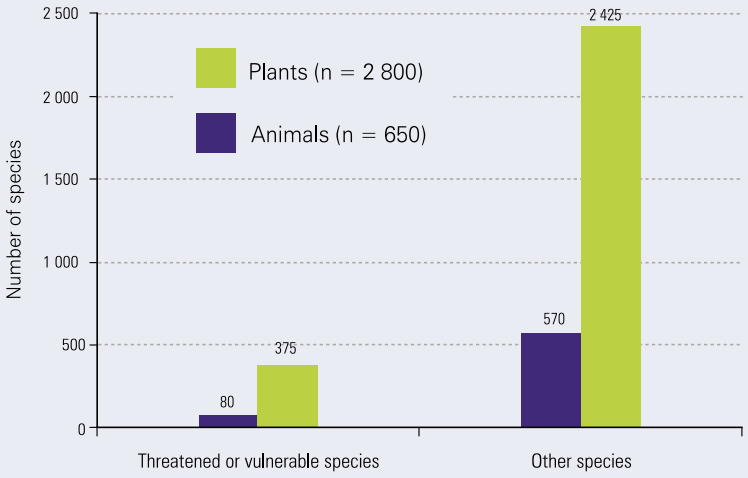
Threatened species

Any species whose extinction is apprehended.

Vulnerable species

Any species whose survival is at risk even though it is not likely to become extinct.

Number of vertebrate animal and vascular plant species in Québec



Québec's vegetation zones

Arctic zone

Photo: Jean Deshaye

Boreal zone

Photo: Jean-Pierre Saucier

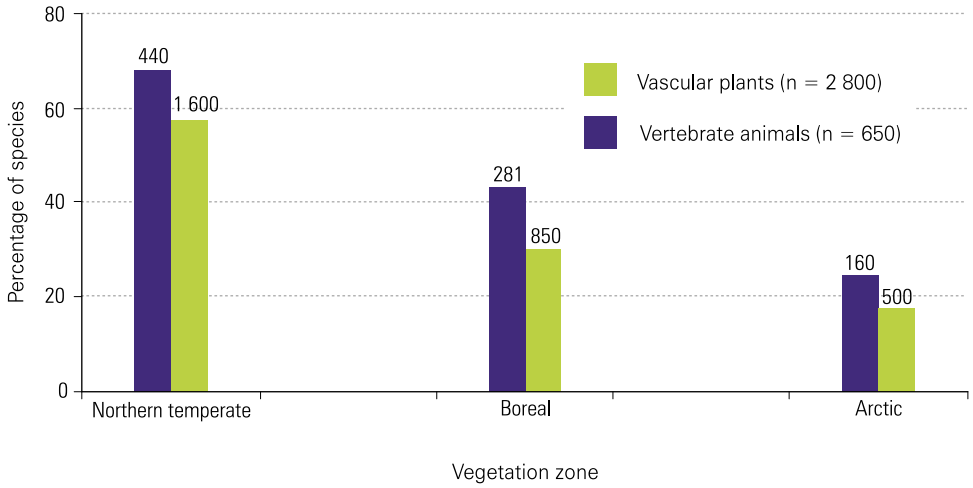
Northern temperate zone

Photo: Jean-Pierre Saucier

Biodiversity and Climate

Stretching over approximately 1.7 million square kilometres, Québec is a vast territory encompassing three climate zones: northern temperate, boreal and arctic. Climate is the most decisive factor in the distribution of Québec's biodiversity, which declines for the groups studied from the northern temperate to the arctic zone (see figure below). In southernmost Québec, the sugar maple-bitternut hickory domain is marked by a wealth of flora and fauna, notably because many thermophile species are in the northern limit of their range. With its extremely harsh climate, the arctic tundra, on the other hand, is home to barely 500 species of vascular plants and 160 species of vertebrate animals.

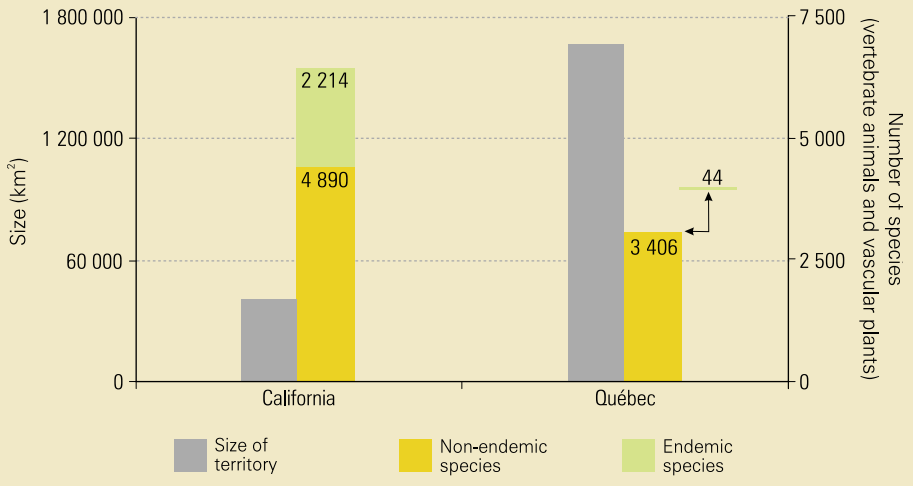
Species diversity in Québec's vegetation zones
(source: Redpath Museum, 1999)



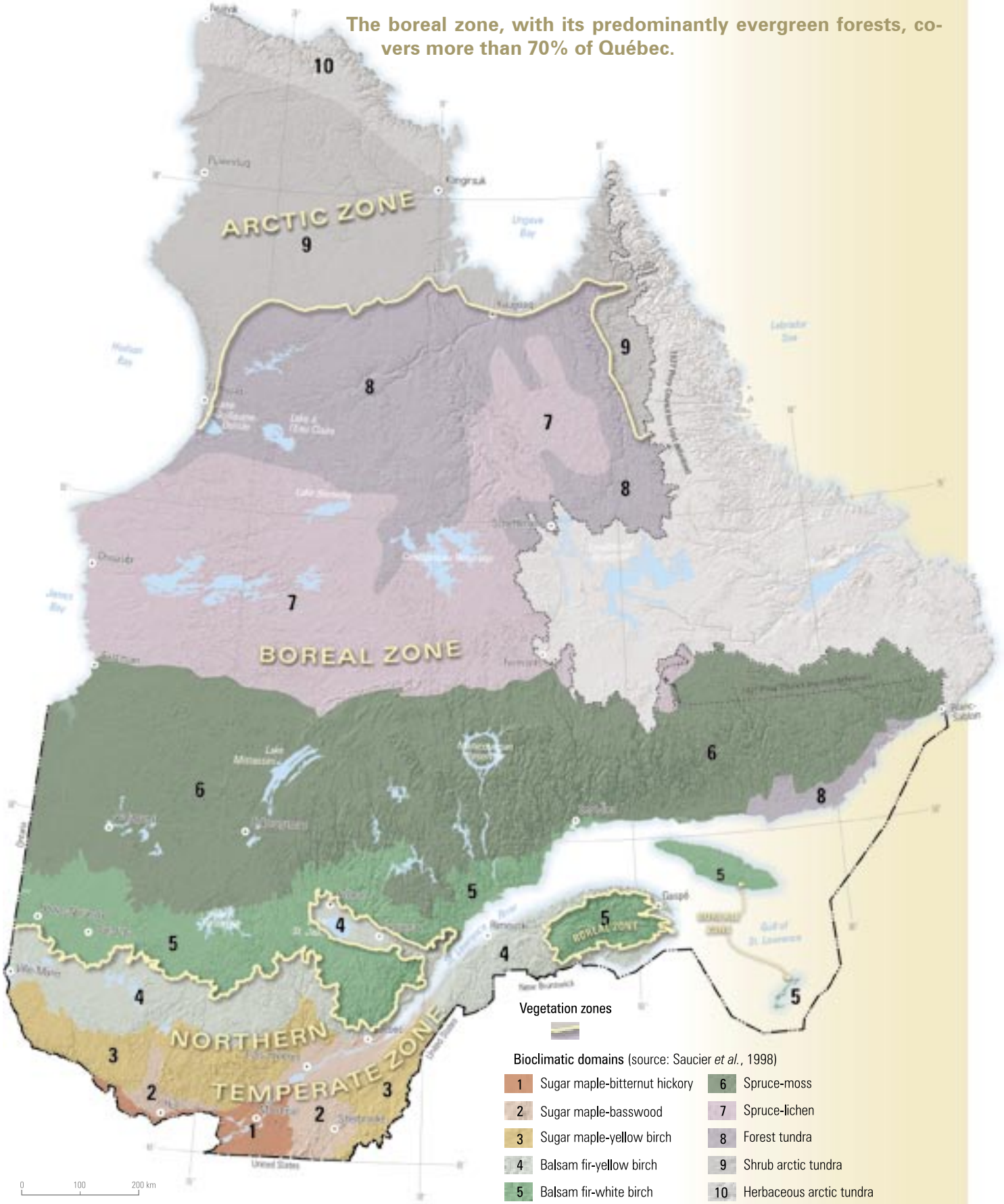
Although quite remarkable, species diversity in Québec cannot compare with the biodiversity of tropical or Mediterranean climes, given the less favourable living conditions. This lower diversity is also due, among other things, to the most recent period of glaciation during the Quaternary, when ice covered Québec's entire territory, eliminating all species present at the time. Only those confined to the southernmost portion of the glacier were able to withstand the climate conditions and recolonize Québec relatively recently, i.e. 10 000 years or less (Pielou, 1991).

Comparative biodiversity

California, where species displaced by glaciation took refuge, has twice as many taxons as Québec (vascular plants and vertebrate animals), despite the fact that it is four times smaller. Greater yet is the obvious difference in the two locations' respective numbers of endemic species.



The boreal zone, with its predominantly evergreen forests, covers more than 70% of Québec.



Vegetation zones and bioclimatic domains

Québec's geological provinces

Canadian Shield
(Hautes-Gorges-de-la-Rivière-Malbaie national park sector)

Photo: Gildo Lavoie

Appalachians
(Chic-Choc sector)

Photo: Frédéric Coursol

St. Lawrence Platform
(Montréal sector)

Photo: Paul Grant, © Le Québec en images, CCDMD

Biodiversity and Physical Environment

In addition to climate, other decisive factors in species distribution are geology, physiography and hydrography. They account for the habitat diversity and uniqueness associated with centres of biodiversity, often characterized by the presence of endemic species.

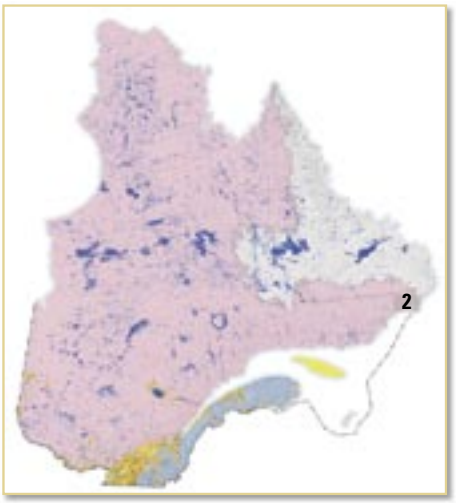
Plant species respond to the chemical nature of the substrate, bedrock and derivative soils—acidic or relatively alkaline—especially the presence of calcium carbonate. They also react to heavy metal content and the presence of magnesium, which only some tolerate. Vegetation composition influences habitat distribution and composition and, consequently, wildlife.

The Canadian Shield (90% of the territory), is dominated by acidic rocks (siliceous rocks, felsics, gneiss and paragneiss), which characterize most of boreal Québec. Carbonate rocks (calcareous rocks, dolomites and marbles) and certain clayey rocks that are rich in carbonates supporting calcicolous plants are found mainly in the Appalachians and the St. Lawrence Platform. The latter outcrops from the surface towards the east, in the Mingan Archipelago and Blanc-Sablon, areas renowned for their unique species. Certain mafic and ultramafic rocks, also called basic and ultrabasic due to their high base content, are also conducive to the presence of calcicole species given their high calcium content and presence in association with calcariferous intrusions. Although not extensively documented, this was shown in the basalts of the shores of Lake Superior (Bakowsky, 1998). Finally, among the ultramafic rocks, it is useful to distinguish peridotite and serpentinite, which are rich in magnesium and heavy metals and support a very specialized flora regardless of their location worldwide. These rocks are limited to a few small sectors of the Appalachians (Eastern Townships and Gaspé) and Northern Québec.

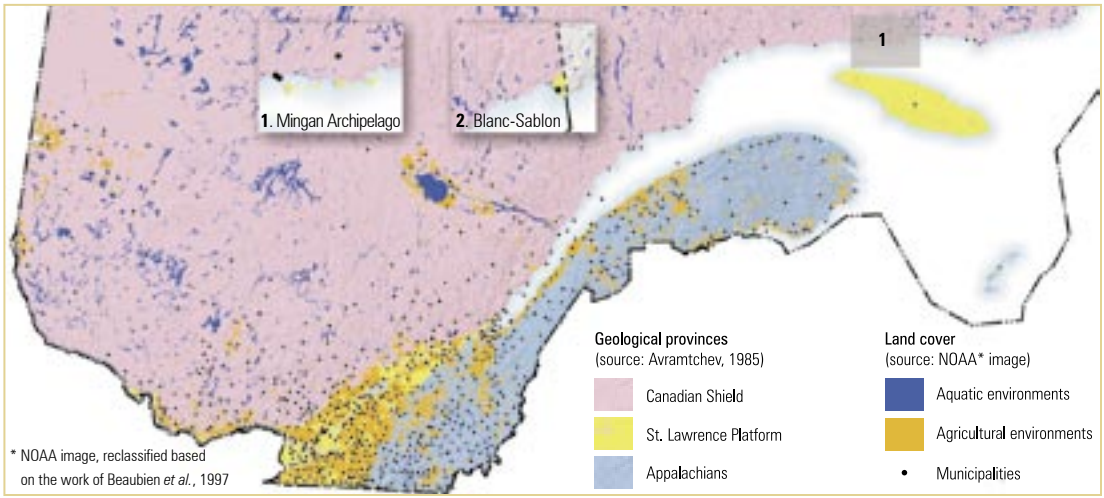
Hills and plateaus constitute Québec's dominant relief, modelled in the last glacial episode, which also significantly affected the distribution of unconsolidated deposits. Among the main highlands are the Chic-Chocs, McGerrigle and Notre Dame mountains (Appalachians), Mt. Lac des Cygnes and Mt. Tremblant (Laurentians), and, further north, the Otish, Groulx and Torngat mountains (the highest in Québec, 1622 m). Some of these peaks favour the presence of tundra at southern latitudes. Lowlands are located primarily along the St. Lawrence River and on northern shores.

Dotted with lakes and rivers, Québec is marked by the omnipresence of aquatic environments, wetlands and vast marine habitats. The majority of threatened or vulnerable species (69.7%) are present along the St. Lawrence River (52 animal species and 256 plant species are found in a 10-km strip along both shores), including a number of endemic plants associated with the freshwater estuary, characterized by the presences of tides twice daily.

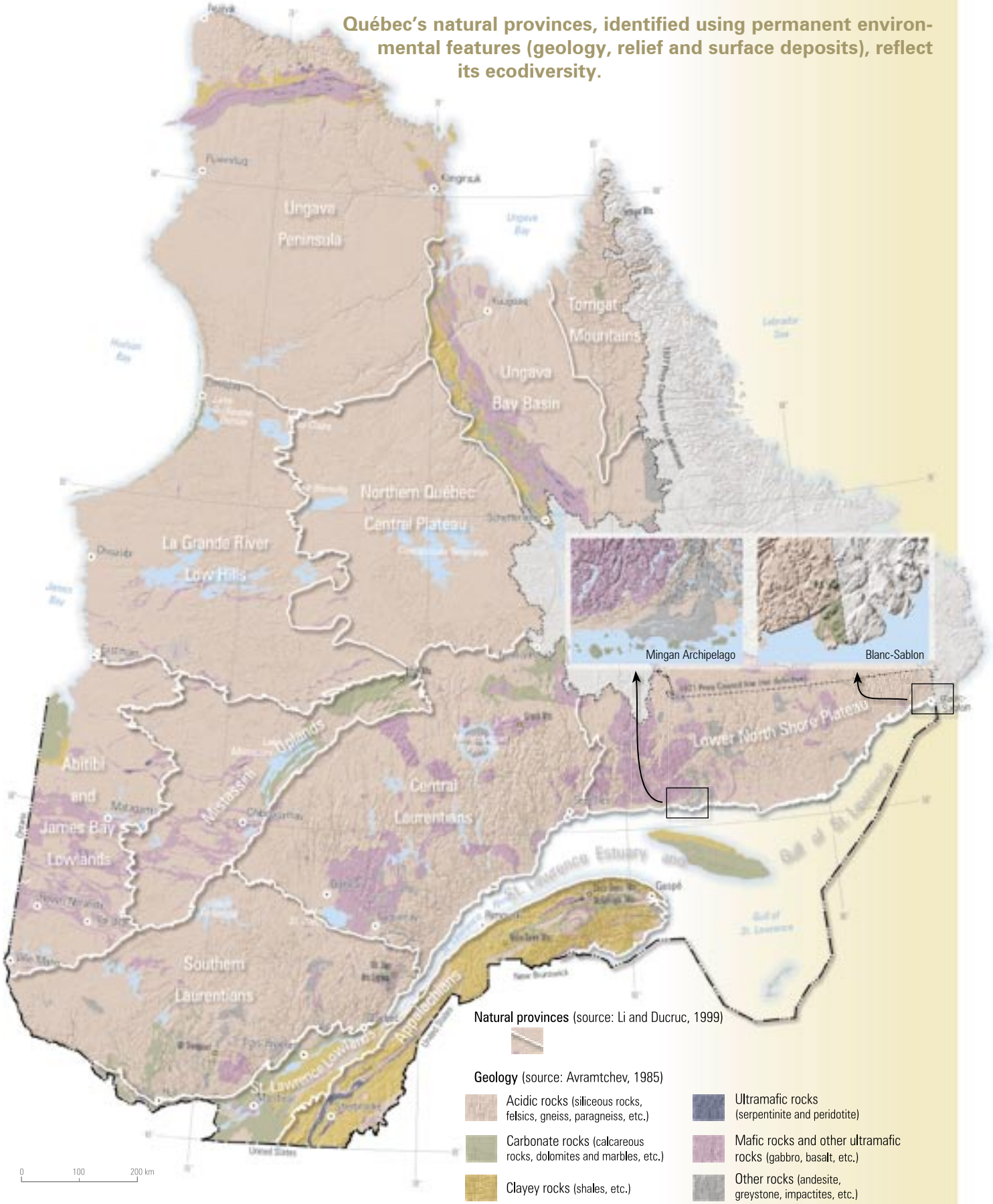
Québec is sparsely populated, except in the south, notably the St. Lawrence lowlands. Consequently, this is where pressure on habitats and biodiversity is concentrated, particularly since land holdings are primarily private contrary to most of the territory. Habitat loss is the main factor affecting threatened or vulnerable species.



Geological provinces and land cover



Québec's natural provinces, identified using permanent environmental features (geology, relief and surface deposits), reflect its ecodiversity.



Geology, relief and natural provinces

Data Available: Species

Conservation status ranks are assigned according to three scales

The NatureServe methodology assigns each element of biodiversity a conservation status rank. Determined according to three scales: G (global: entire range), N (national: country) or S (subnational: province or state), this rank defines each element's relative conservation priority ranking and is used in analyses to establish action priorities. The basic priority rankings, which vary from 1 to 5, are assigned to species based essentially on total number of occurrences, population size and area of occupancy. Only the rankings 1 to 3 indicate a degree of risk (1 = critically imperilled; 2 = imperilled; 3 = vulnerable to extirpation or extinction; 4 = apparently secure; 5 = demonstrably widespread, abundant and secure).

An element ranked "G5 N2 S1", such as *Apalone spinifera* or *Pinus rigida*, means that it is "demonstrably widespread, abundant and secure" throughout its range (G5), "imperilled" in the target country (N2) and "critically imperilled" in the province or state in question (S1).

Conservation status ranks at the subnational (S)[1] level according to total number of occurrences and population size[2] (*The Nature Conservancy, 1988*)

Number of occurrences	Number of individuals			
	< 1 000	1 000 - 3 000	3 000 - 10 000	> 10 000
1 - 5	S1	S1	S1	S1
6 - 20	S1 (S2)[3]	S2 (S1)	S2 (S1)	S2 (S1, S3)
21 - 100	S2 (S1)	S2 (S1, S3)	S3 (S2)	S3 (S2, S4)
> 100	S2 (S1)	S2 (S1, S3)	S3 (S2, S4)	S4 (S3, S5)

[1] An identical chart can be applied to the global (G) and national (N) rankings.

[2] Main criteria used for species.

[3] The ranks in parentheses show possible disparities based on other criteria such as trends, number of protected element occurrences, etc.

These number rankings can be nuanced or replaced by other ranks. The following are used in the atlas: H: historical presence (possibly extinct or extirpated); Q: Questionable taxonomy (applies to G rank only, e.g. G1Q); T: infraspecific taxon or isolated population (e.g. G5T1); X: element presumed extinct (GX) or extirpated (SX). To facilitate analyses, complex ranking combinations are expressed by rounding according to the basic rank (1 to 5).

Extirpation and extinction

The extirpation of occurrences is a precursor to species extinction. It results from habitat destruction, the inevitable expression of the growth of human populations and their activities (Ehrlich, 1988). A species is extinct when its last occurrence disappears.

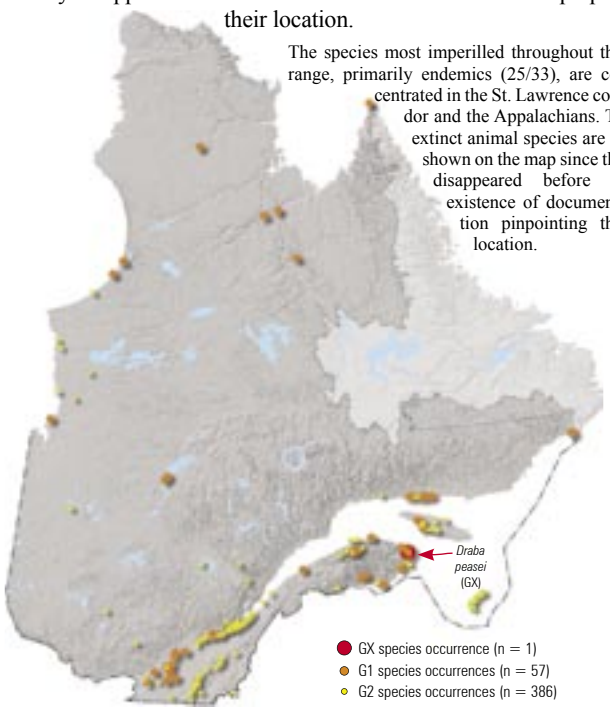
In Québec, 9 species are considered extirpated, 4 of which are extinct (†) (i.e. planet-wide). They are *Draba peasei* (†), a plant endemic to Québec, *Blephilia hirsuta* var. *hirsuta*, and 7 animal species, principally birds decimated by hunting at the turn of the 20th century: *Numenius borealis*, *Cygnus buccinator*, *Camptorhynchus labradorius* (†), *Pinguinus impennis* (†), *Ectopistes migratorius* (†), *Morone saxatilis* and *Cervus elaphus*. The extirpated and extinct animal species are not shown on the maps since they disappeared before the existence of documentation pinpointing their location.

Apalone spinifera

Photo: Jean-François Desrochers

Pinus rigida

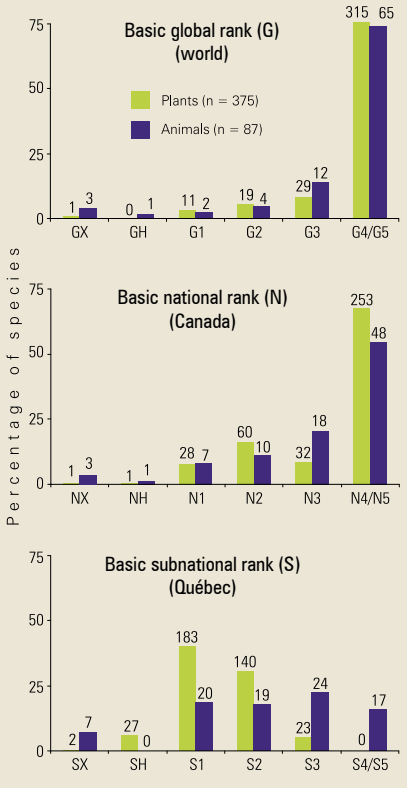
Photo: Norman Dignard



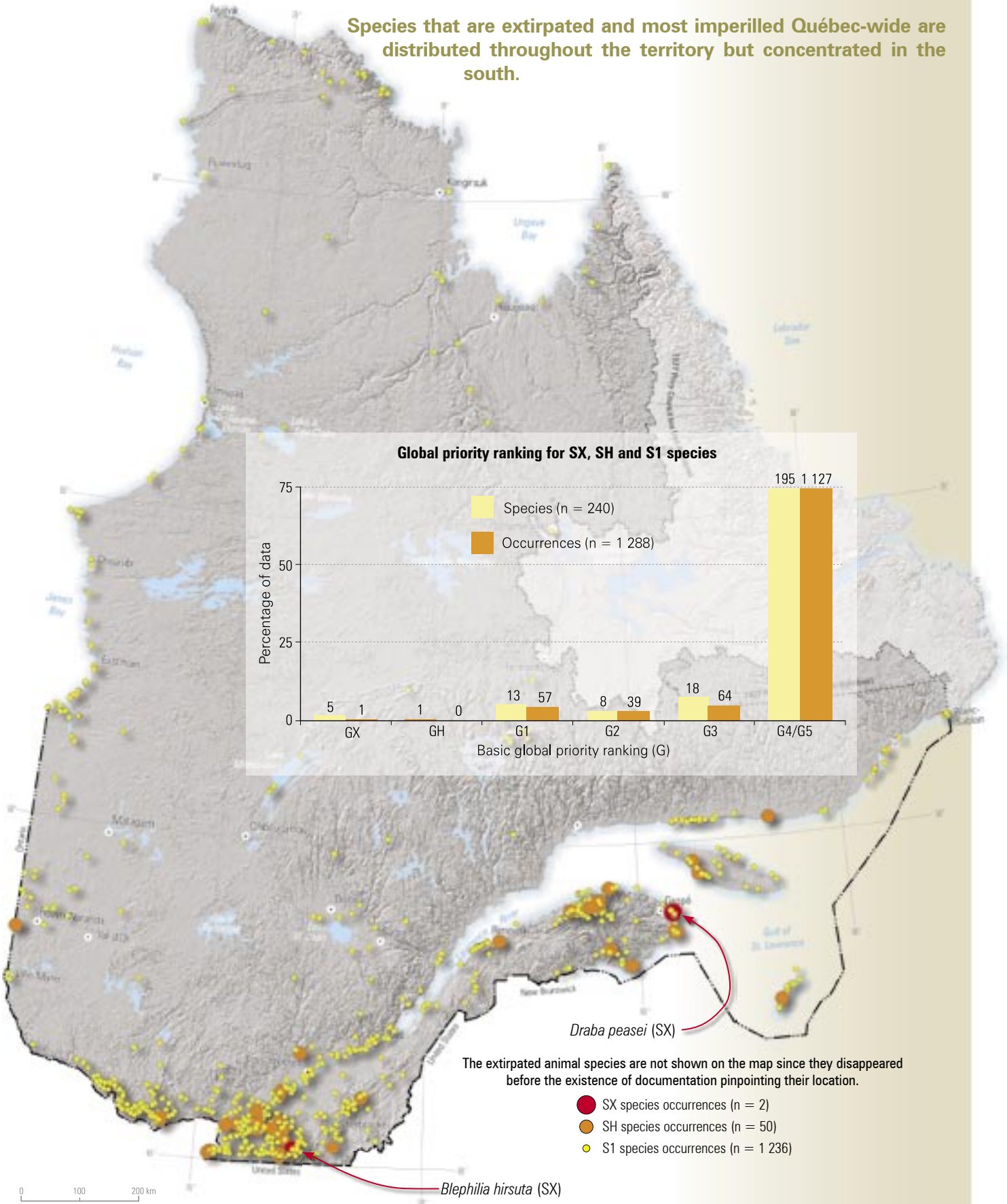
The species most imperilled throughout their range, primarily endemics (25/33), are concentrated in the St. Lawrence corridor and the Appalachians. The extinct animal species are not shown on the map since they disappeared before the existence of documentation pinpointing their location.

Species that are extinct and most imperilled on a global scale (GX, G1 and G2)

Global, national and subnational priority rankings for Québec's threatened, vulnerable, extirpated and extinct species



Species that are extirpated and most imperilled Québec-wide are distributed throughout the territory but concentrated in the south.



Species that are extirpated and most imperilled on a subnational scale (SX, SH and S1)

Occurrence ranking

Example using *Gentianopsis nesophila* – p09

Photo: Francis Boudreau

An occurrence of *Gentianopsis nesophila* –p09 ranked "excellent estimated viability" (A): more than 2000 stems occupying a large area in a habitat not subject to degradation or disturbance by human activity.

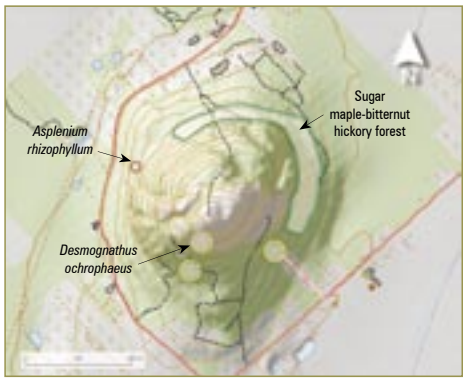
Photo: Francis Boudreau

An occurrence of *Gentianopsis nesophila* –p09 ranked "poor estimated viability" (D): fewer than 20 stems occupying a small area in a heavily disturbed habitat (roadside).

Photo: Francis Boudreau

Data Available: Element Occurrences

Element occurrence is the concept that is central to the NatureServe methodology. It refers to an area (point, line or map polygon) in which an element of biodiversity (species, natural community, animal assemblage) is, or was, present.

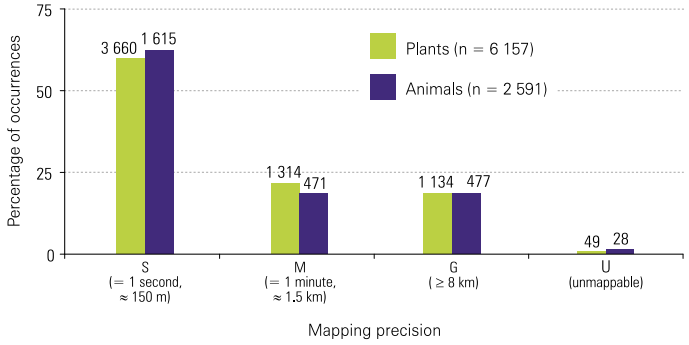


Depending on the element occurrence, this area may correspond to a single map polygon or to a group of nearby polygons. The criteria used to determine what constitutes an element occurrence, assess its quality and attribute a ranking (see below), vary according to the element considered. Not all elements are documented in this manner. Only species at risk are tracked but all natural communities are considered. For common communities, however, only element occurrences with a high conservation value (ranks A and B) are considered.

To date, 8748 occurrences of threatened or vulnerable species, representing 442 species, have been documented in Québec. All of these data were used for the overviews presented in this atlas. However, the occurrences used in most analyses, 5496 (62.8%), exclude those whose location is imprecise (G or U), as well as occurrences that are historical (H), introduced (I) or extirpated (X).

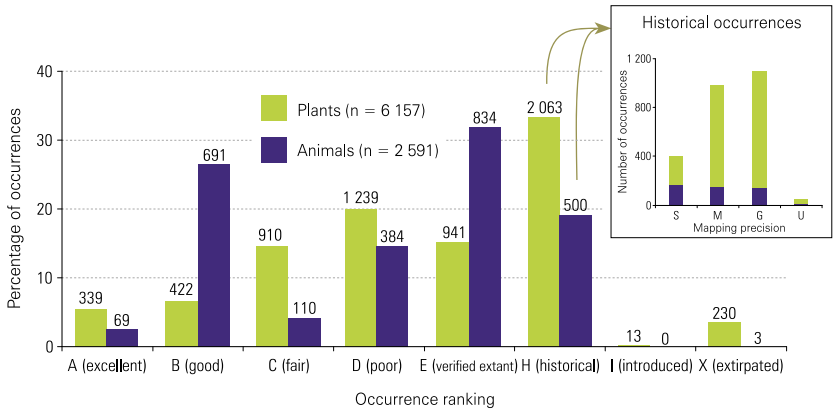
Mapping precision

Each occurrence is mapped to varying degrees of precision, depending on the source of documentation. Most locations (n = 7060; 80.7%) are accurate to less than one minute in the geographic coordinate system.

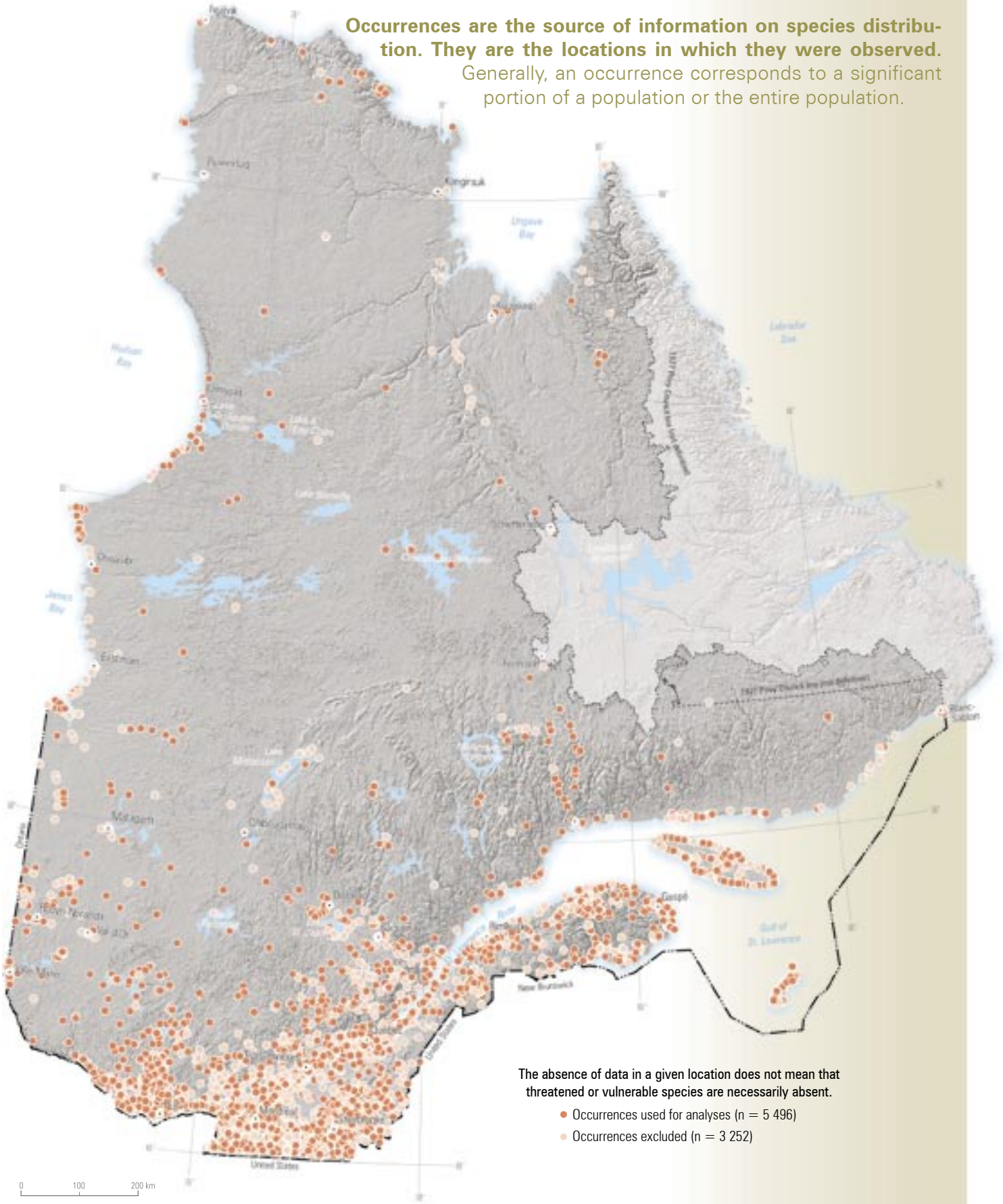


Occurrence ranking

Each occurrence is given a ranking indicating its viability and, consequently, its conservation value. These ranks are determined independently for each element (or group of elements), based on a number of variables. The main ones for species are: number of individuals, density or area occupied, habitat quality and landscape context. To date, ranks (A to D) have been assigned to only about half of all threatened or vulnerable species occurrences. Very few have a high conservation value (ranks A and B). Less than one-third (29.1%) are ranked A, B or C, meaning that populations are viable in their current state. The viability of D-rank populations, corresponding to 18.6% of available data, depends on eventual conservation measures. Most of the other occurrences (29.3%) are ranked H, meaning that the last time they were observed dates from more than 25 years ago or that the species has possibly disappeared due to changes in its habitat. Historical occurrences, whose presence must be confirmed in the field, are equally divided among those whose location is accurate (S, M) and inaccurate (G, U). Many of the observations by naturalists in the last century fall into this category. Finally, due to insufficient documentation, 20.3% of occurrences are termed extant (rank E), but their viability remains to be assessed.



Occurrences are the source of information on species distribution. They are the locations in which they were observed. Generally, an occurrence corresponds to a significant portion of a population or the entire population.



Distribution of occurrences of threatened or vulnerable species

Species distribution

Peripheral (northern): *Dendroica cerulea*

Peripheral species are located on the periphery of their range, in a given territory.

Disjunct: *Athyrium alpestre* subsp. *americanum*

Disjunct species are characterized by populations that are geographically isolated from the principal area occupied.

Sporadic: *Cypripedium arietinum*

Sporadic species have a very vast geographic distribution, but are dispersed in the territory considered.

Endemic (Northeastern America): *Moxostoma hubbsi*

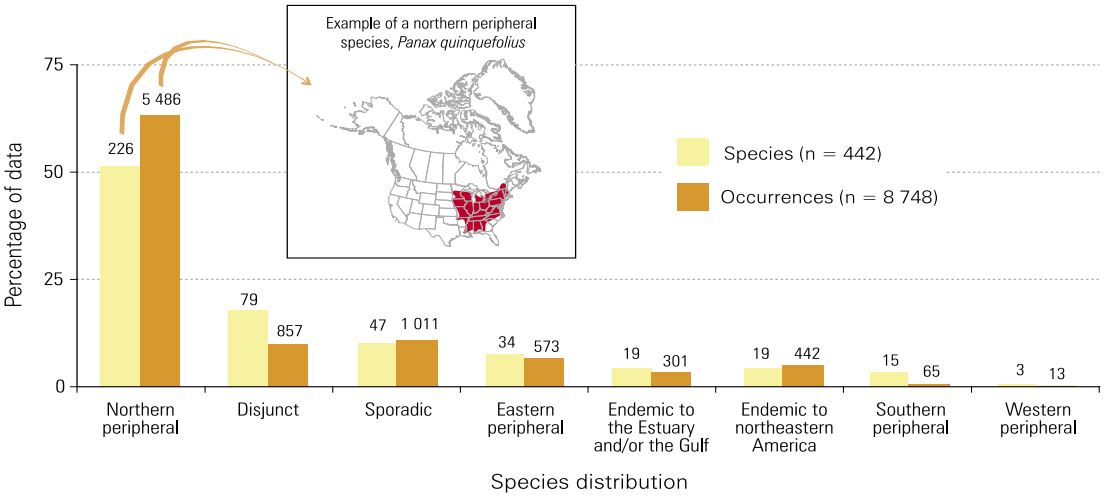
Endemic species are confined to a clearly defined territory, i.e. North America, the Appalachians or a mountain top. For threatened or vulnerable species, the term applies to cases of restricted endemism.

Species Distribution: Underlying Factors

The distribution of most of Québec's threatened or vulnerable species depends on two main factors: range type and, for plants, affinity for calcareous or serpentine substrates.

Range type

More than half of Québec's threatened or vulnerable species are northern peripheral species. Accounting for two-thirds (62.7%) of all known occurrences, they are confined to the territory's southern extremity.

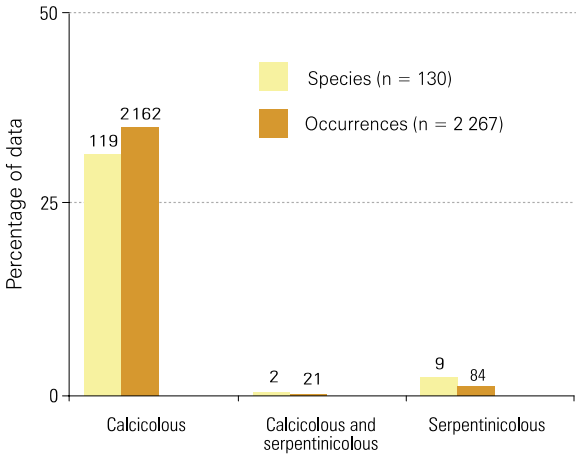


It is in Québec's most temperate fringe, the sugar maple-bitternut hickory domain (see p. 11), that many southern species reach the northern limit of their American range. They are rare and imperilled due to the fact that they are confined to relatively small area, significantly affected by development (Lavoie *et al.*, 2001).

Species affinity and geology

The specific distribution of occurrences for plant species is also due in large part to the nature of the bedrock, especially the influence of calcareous substrates (primarily carbonate rocks), which affect the distribution of calcicolous species. In many locations, these species have difficulty tolerating competition from other plants, notably forest species, and, as a result, are found only in permanently open calcareous habitats such as cliffs, slopes formed from fallen rocky debris and river flats (Tardif and Deshaye, 2000). Calcareous substrates also encourage southern species to move northward into temperate Québec, specifically those at the northern limit of their range. Finally, many species are restricted to serpentine outcroppings, located mainly along the Appalachian chain (see p. 13).

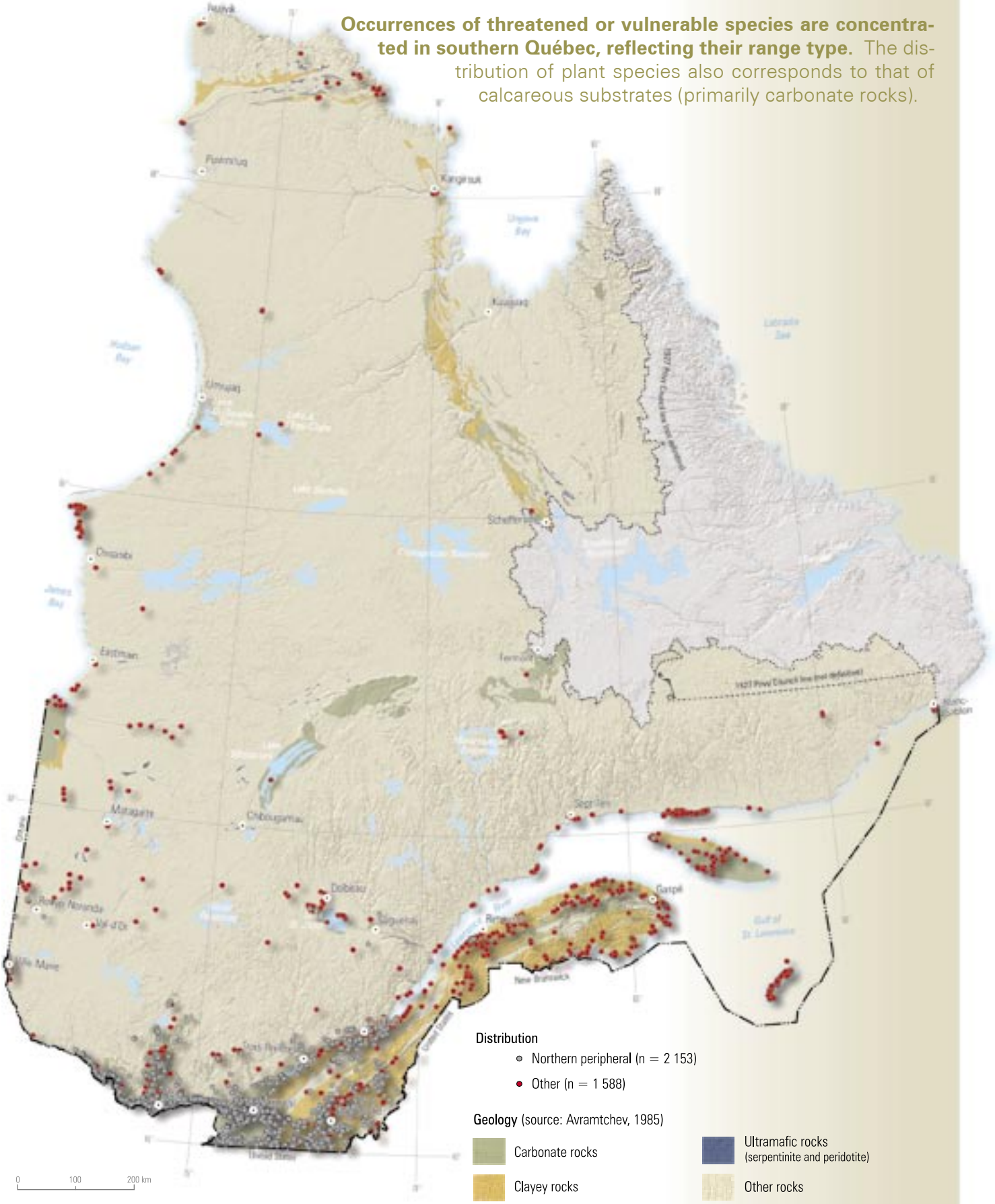
Plants' affinity for calcareous or serpentine substrates



As shown on the map opposite, there is a close connection between the distribution of carbonate, clayey and ultramafic rocks (serpentinite and peridotite) and that of the threatened or vulnerable plant species not confined to southern Québec.

Clearly, we have not yet discovered all occurrences. However, based on the above, for most of the territory, the potential for presence applies only to species that are not northern peripheral. For plant species, new occurrences should be sought almost exclusively in areas with calcareous or serpentine substrates.

Occurrences of threatened or vulnerable species are concentrated in southern Québec, reflecting their range type. The distribution of plant species also corresponds to that of calcareous substrates (primarily carbonate rocks).



Threatened or vulnerable plant species and geology

Thirteen threatened or vulnerable species are not documented at the CDPNQ

In most cases, they are marine mammals.

Balaenoptera musculus

Photo: MRNF

Delphinapterus leucas

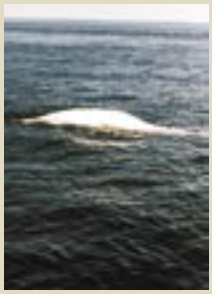


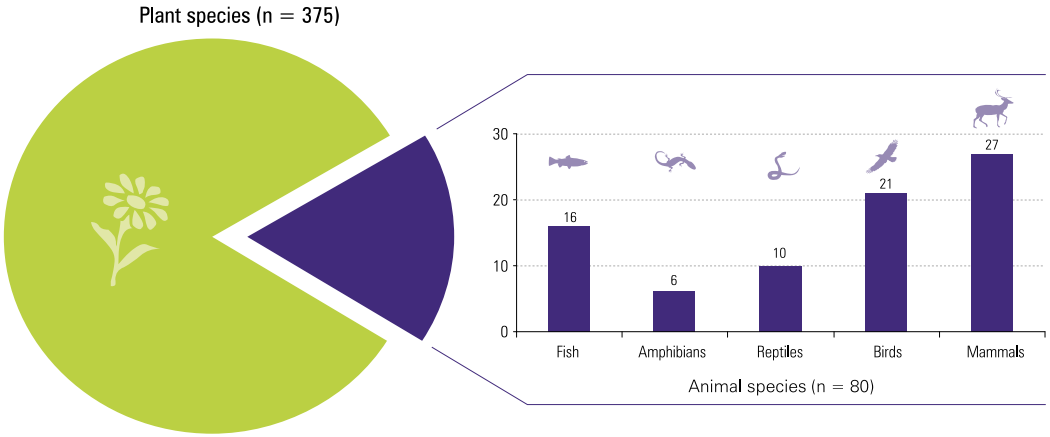
Photo: Modified image, Christine Blais, © Le Québec en images, CCDMD

Megaptera novaeangliae

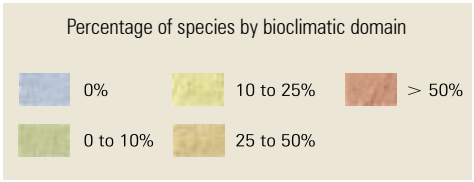
Photo: Modified image, Jacques Larivée, © Le Québec en images, CCDMD

Species by Bioclimatic Domain

Of Québec's 455 threatened or vulnerable species, 80 are vertebrate animals and 375, vascular plants.

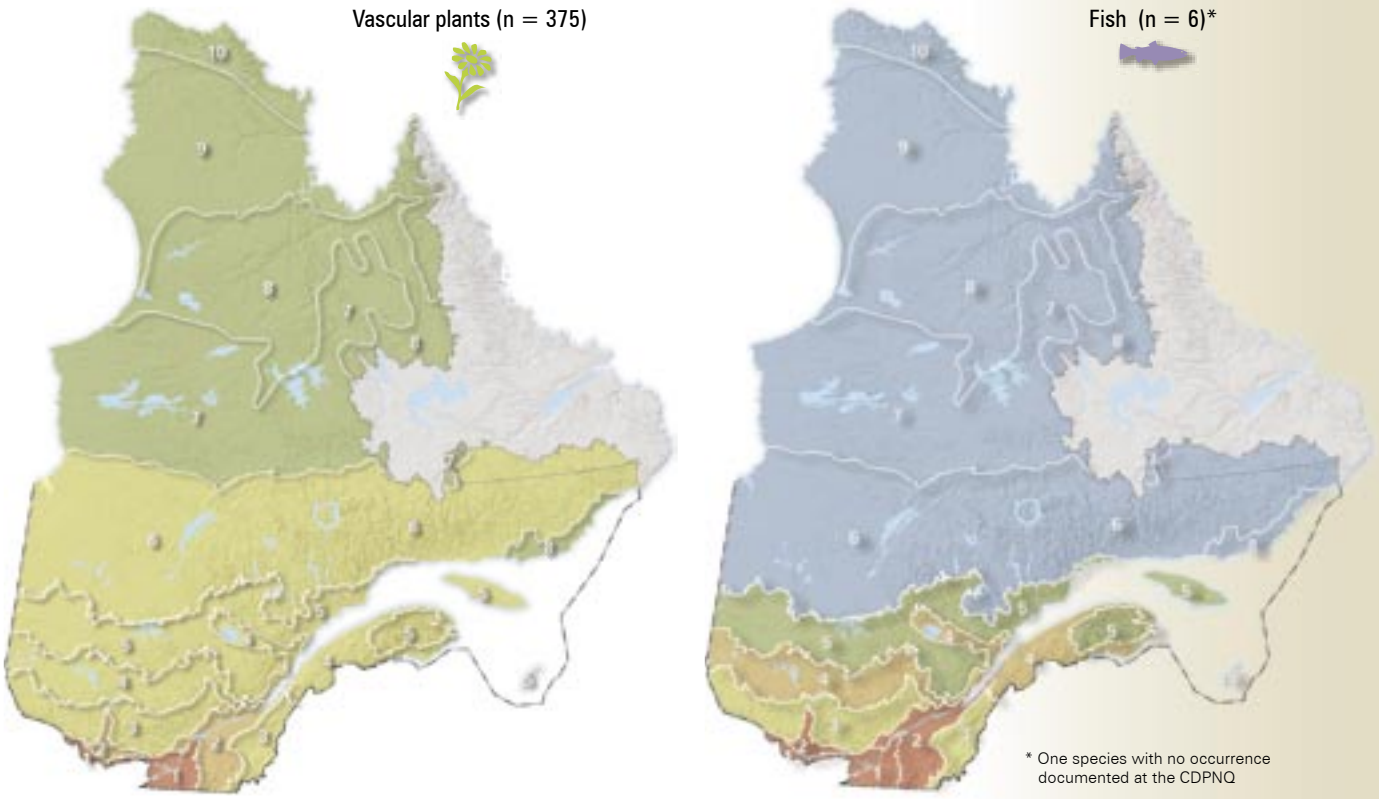


Moving northward, the diversity of threatened or vulnerable species decreases, as for plants and animals in general. It is higher in the northern temperate zone, specifically the sugar maple-bitternut hickory domain.

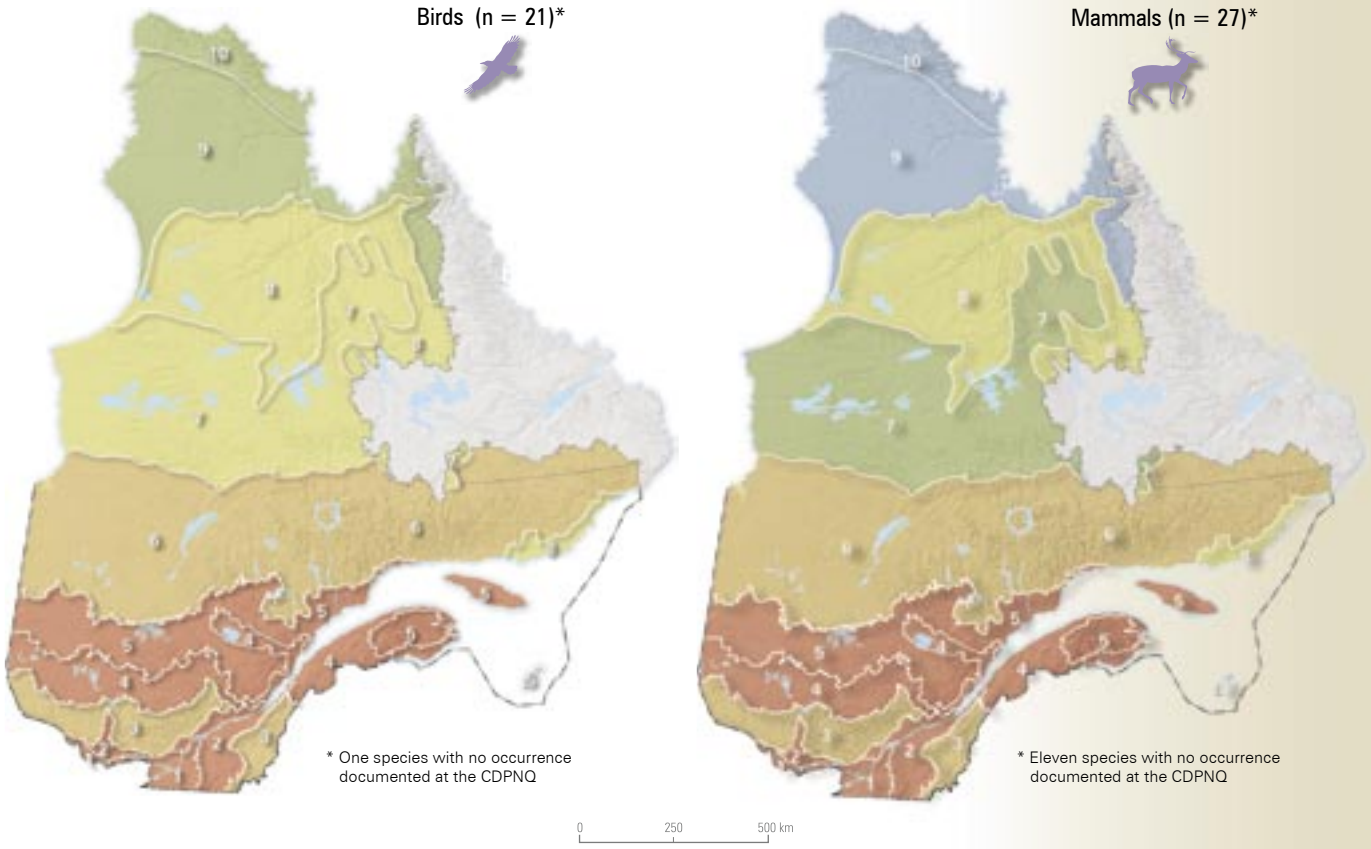


Bioclimatic domains
(Source: Saucier *et al.*, 1998)

1 : Sugar maple-bitternut hickory
2 : Sugar maple-basswood
3 : Sugar maple-yellow birch
4 : Balsam fir-yellow birch
5 : Balsam fir-white birch
6 : Spruce-moss
7 : Spruce-lichen
8 : Forest tundra
9 : Shrub arctic tundra
10 : Herbaceous arctic tundra



Fish and amphibians are found predominantly in southern Québec, while birds and mammals are well represented in the boreal zone (balsam fir and spruce domains).



Threatened or vulnerable species by bioclimatic domain
(calculations using total occurrences)

Many of Québec's threatened or vulnerable species are declining

Ixobrychus exilis

Photo: Yves Leduc

Phegopteris hexagonoptera

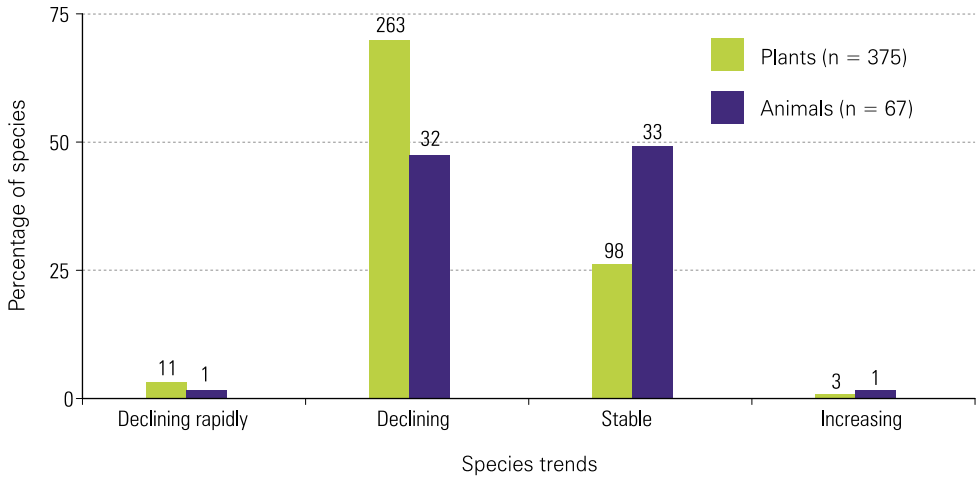
Photo: Jacques Labrecque

Sterna caspia

Photo: Chantal L'Heureux

Species Trends

More than 2/3 of Québec's threatened or vulnerable species (69.5%) are declining. This trend is stronger among plant species (73.1%) than animal species (49.3%). To objectively evaluate species trends, the CDPNQ analyzes EO ranks. In the absence of data enabling variations in population size and habitat integrity to be gauged over time (rank change from A to D for a given species), the proportion of historical (H) and extirpated (X) occurrences is a reliable indicator. Generally, declining species are those for which more than 50% of occurrences are historical (H) or extirpated (X). In cases where the available data precludes application of this rule, especially for species with only one occurrence (n = 42), the trend is evaluated subjectively.



The Loggerhead shrike is declining in Québec

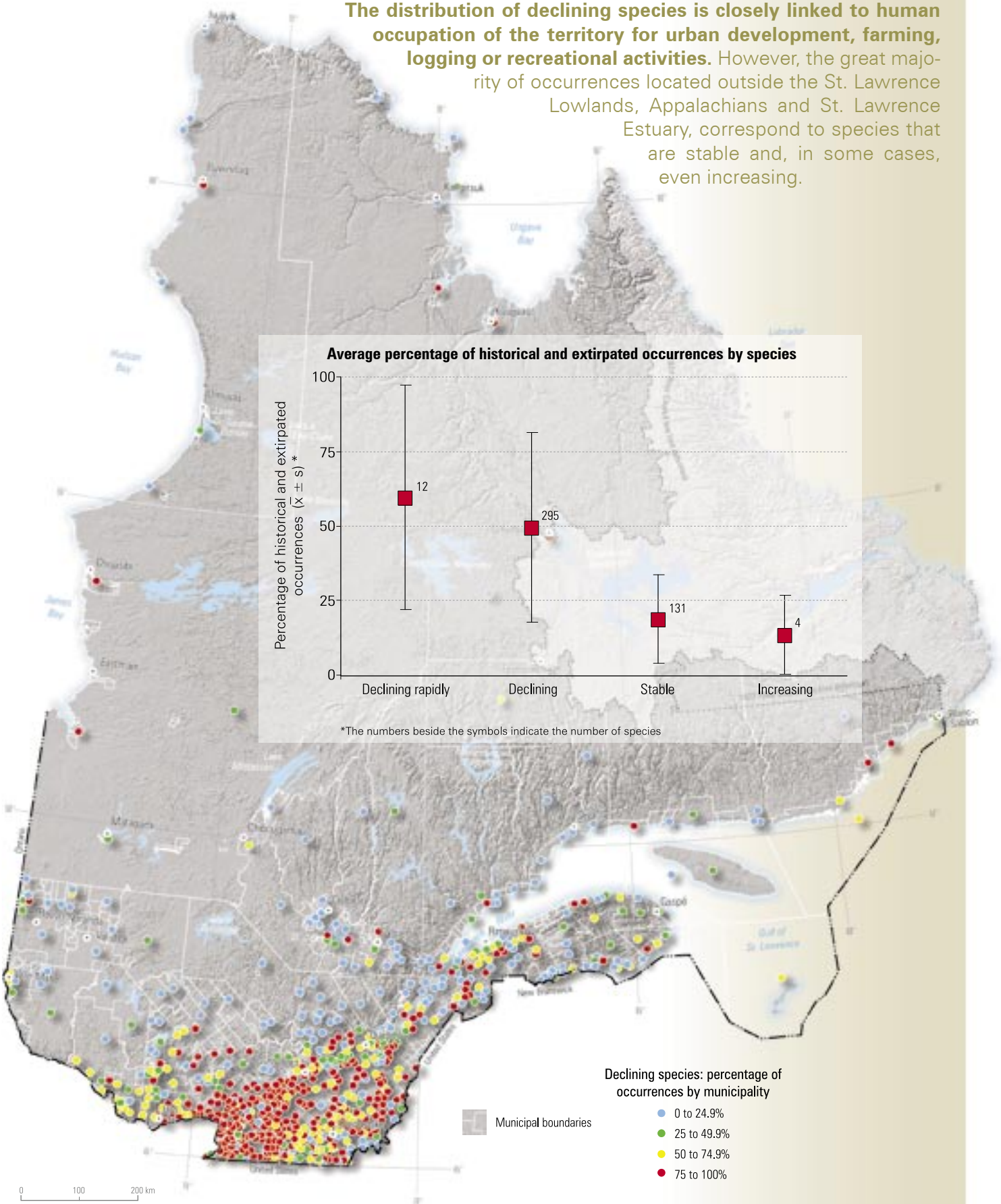
This species' decline is due to changes in agricultural landscapes: disappearance of pastures, increase in average cropland size, omnipresence of corn crops, elimination of windbreaks along farmlands and regeneration of farmlands bordering on forests (Robert *et al.*, 1995).

Photo: Chris Grooms

Element occurrence ranking

- Historical (H: occurrences monitored recently without success)
- Historical (H: species not observed since 1980)
- Extirpated (X: habitat destroyed)

The distribution of declining species is closely linked to human occupation of the territory for urban development, farming, logging or recreational activities. However, the great majority of occurrences located outside the St. Lawrence Lowlands, Appalachians and St. Lawrence Estuary, correspond to species that are stable and, in some cases, even increasing.



Declining threatened or vulnerable species

Ecological reserves are gems in protected areas

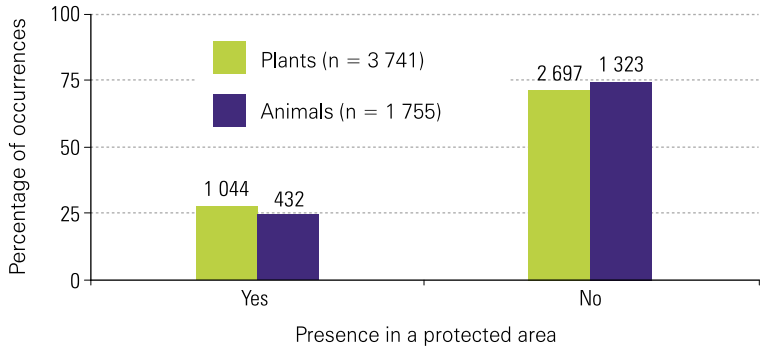
Photo: Réal Carpentier

The Fernald ecological reserve located in the Chic-Choc Mountains is home to at least ten threatened or vulnerable species, mainly plants growing on denudated crests, exposed rocky walls and subalpine meadows: *Arnica griscomii* subsp. *griscomii*, *Packera cymbalaria*, *Arnica lanceolata*, *Cirsium muticum* var. *monticolum*, *Dryopteris filix-mas*, *Festuca altaica* –p11, *Gnaphalium norvegicum* –p11, *Poa laxa* var. *fernaldiana*, *Rangifer tarandus* pop. 2 and *Saxifraga gaspensis*.

Occurrences in the Protected Area Network

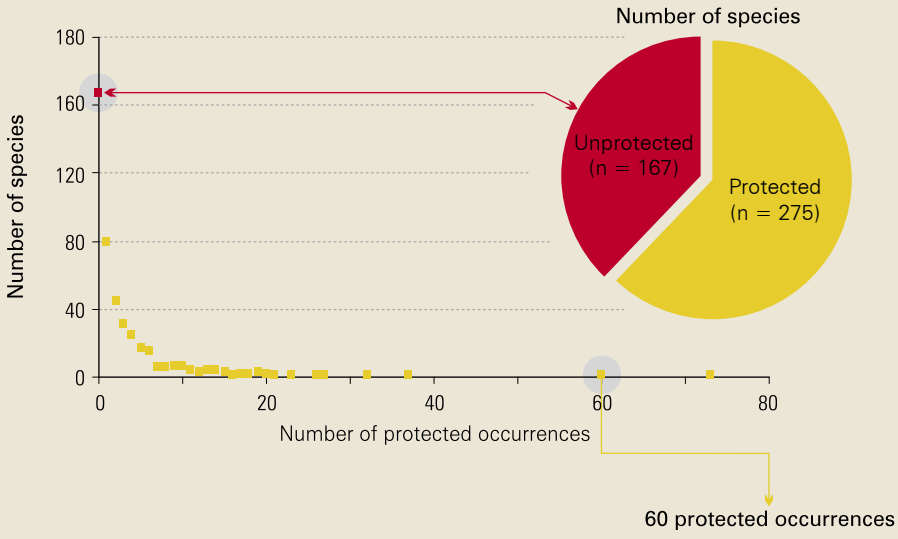
More than one-quarter of threatened or vulnerable species occurrences are found in protected areas (n = 1 476; 26.9%). The proportion of occurrences in protected and unprotected areas is comparable for plant and animal species. A species' presence in a protected area does not, in itself, guarantee persistence or the application of specific management objectives. To date, only a number of protected areas have been created for threatened or vulnerable species.

Protected and unprotected occurrences



Protected and unprotected occurrences and species

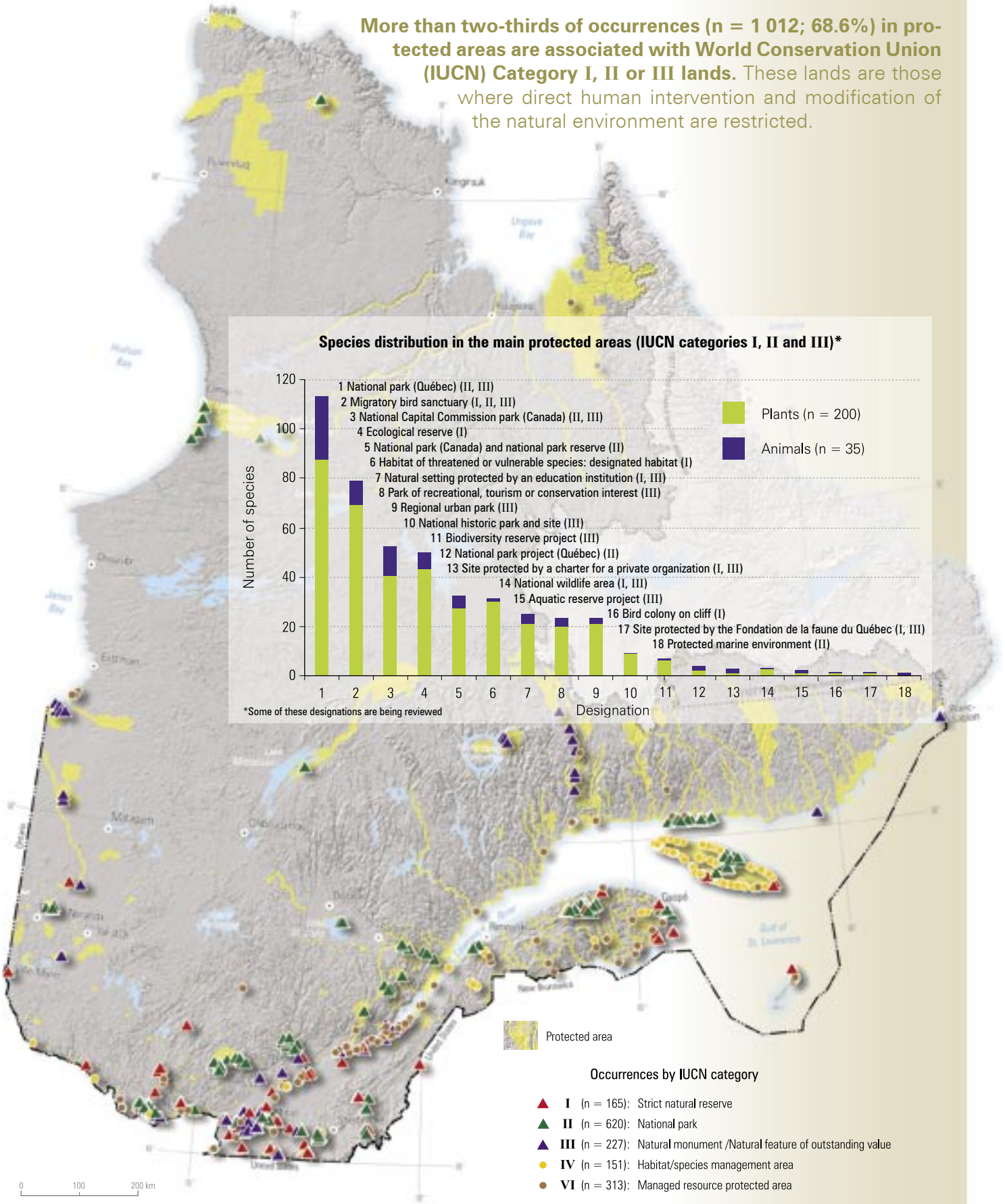
Almost 2/3 of Québec's threatened or vulnerable species (n = 275; 62.2%) have occurrences in the protected area network.



In the network, most species are represented by one occurrence or a small number of occurrences. Only a few have a large number. This is true for the Pickerel frog, for which close to half of all known occurrences (60/135) are in protected areas.

Rana palustris Photo: Jean Gaudet

More than two-thirds of occurrences (n = 1 012; 68.6%) in protected areas are associated with World Conservation Union (IUCN) Category I, II or III lands. These lands are those where direct human intervention and modification of the natural environment are restricted.



Threatened or vulnerable species in the protected area network

Certain territories located outside the protected area network show outstanding species diversity

Photo: Denis Paquette

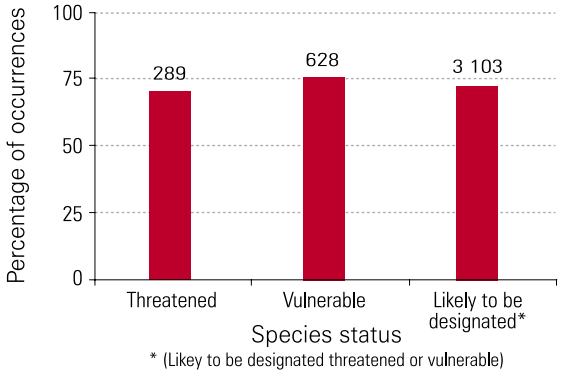
Cascades Island is a private territory whose 30 hectares shelter some 34 threatened or vulnerable species.

This high species diversity is due to the presence of a rare habitat type, the alvar, a calcareous platform characterized by an absence or thin layer of unconsolidated deposits. This limits the growth of the vegetation cover and favours the presence of specialized species, acclimatized to exposure, the environment's alkalinity and conditions of extreme drought and heat in summer.

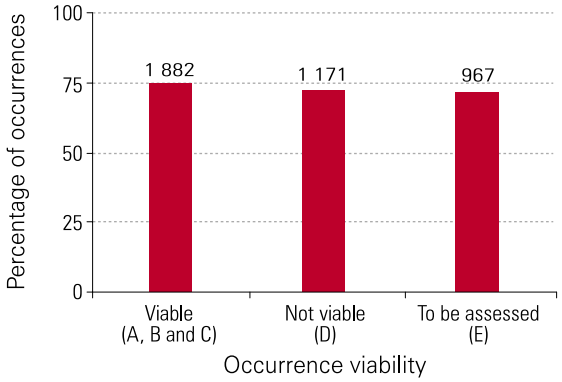
Occurrences Outside the Protected Area Network

The great majority of occurrences of threatened or vulnerable species are located outside the protected area network (n = 4 020; 73.1%), namely:

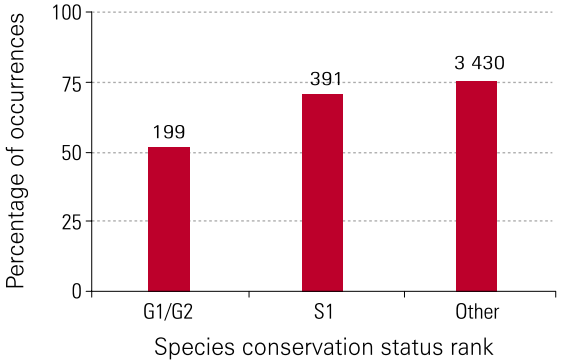
1 Three-quarters of all occurrences, regardless of species status.



2 Three-quarters of all occurrences, regardless of viability.



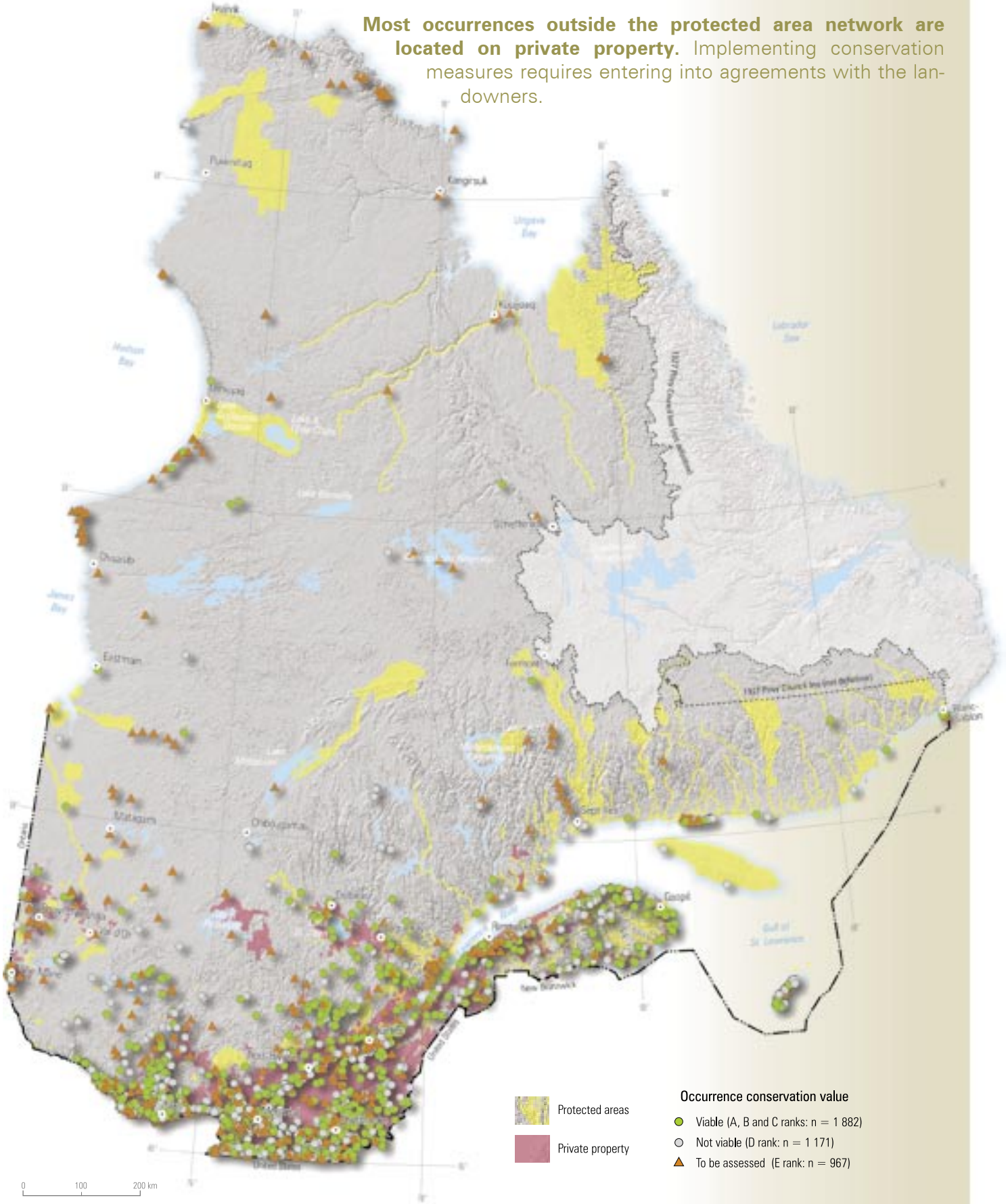
3 The majority of occurrences of the most imperilled species (G1/G2 and S1). However, nearly half of G1/G2 species occurrences are associated with the protected area network.



Occurrences outside the protected area network and land ownership

Two-thirds of occurrences outside the protected area network (n = 2690; 66.5%) are on private property.

Most occurrences outside the protected area network are located on private property. Implementing conservation measures requires entering into agreements with the landowners.



Threatened or vulnerable species located outside the protected area network

Conservation measures target certain occurrences

Polemonium vanbruntiae

Photo: Léopold Gaudreau

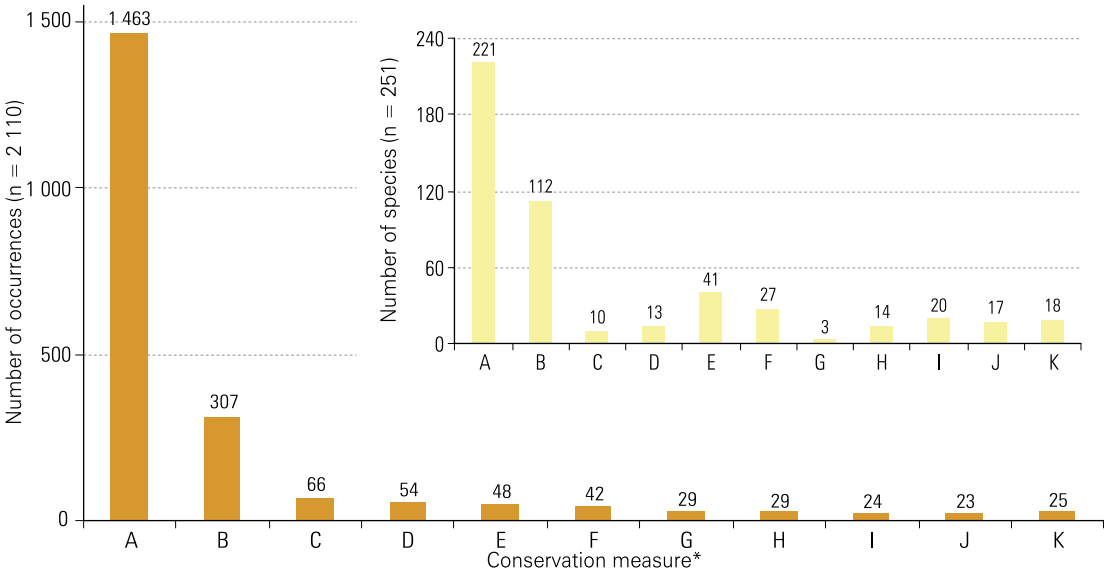
Numerous conservation measures have been implemented to protect *Polemonium vanbruntiae*. In Stoke, in 2003, 1.49 hectares were acquired by the Société de conservation des milieux humides du Québec to protect an occurrence of this species under the Ministère du Développement durable, de l'Environnement et des Parcs' national program for the acquisition of a private network of protected areas.

Other Conservation Measures

In addition to the protected area network, other measures are implemented to promote the conservation of threatened or vulnerable species occurrences. To date, only data related to measures targeting plant species have been compiled. These measures have been implemented by various government (Ministère du Développement durable, de l'Environnement et des Parcs, Ministère des Ressources naturelles et de la Faune, Canadian Wildlife Service) or private organizations and have affected one or more occurrences involving 251 threatened or vunerable species.

Above all, these conservation measures concern awareness (n = 1463; 69.4%), particularly directed at private landowners. Their repercussion on actual species protection is difficult to evaluate, apart from measures with a permanent effect (E, I and J).

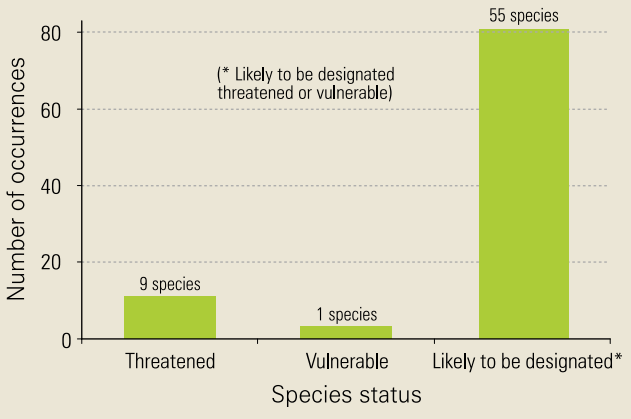
Types of conservation measures (protection and management)



*A : Awareness
B : Sylvicultural prescription
C : Surveillance
D : Population monitoring
E : NGO acquisition
F : Exclusion from staking for mining purposes
G : Species restoration
H : Declaration of intention
I : Government acquisition
J : Donation
K : Other measure

Threatened or vulnerables species targeted by long-term measures (E, I, J)

Measures with a permanent effect complement legal protection, particularly in cases of site acquisition, the prerequisite for creating a protected area.



To date, the measures implemented have affected mainly central southern Québec municipalities: Montréal, Laval, Bristol, Rougemont, etc. However, there are others, such as Havre-Saint-Pierre and the Magdalen Islands, where particular efforts have been made given the importance of the species found there.

Threatened or vulnerable species outside the protected area network targeted by conservation measures

Irreplaceable Occurrences

Certain occurrences are irreplaceable since they constitute the sole mention of a species. Most are found in southern Québec. There are 29, for the same number of species—all plants. Two of them are in the same location (No. 20: Summit of Mt. Albert; map on p. 31).

Some threatened or vulnerable species are known in only one location in Québec

Polystichum scopulinum
(Mt. Albert; Gaspésie National Park)

Photo: Fleurbec, Sylvain Lamoureux

Hordeum brachyantherum
(Blanc-Sablon River banks; Basse-Côte-Nord)

Photo: Francis Boudreau

Ranunculus sulphureus
(Nouveau-Québec)

Photo: Canada's Polar Life

Threatened or vulnerable species with only one occurrence in Québec*

Historical occurrences, whose presence must be confirmed in the field, are shown in green.

Outside protected area network

Conservation measures necessary

- *Helianthemum canadense* (8) **
- *Hordeum brachyantherum* (28)
- *Houstonia longifolia* (17)
- *Monarda punctata* var. *villicaulis* (11)
- *Myosotis verna* (12)
- *Oenothera pilosella* subsp. *pilosella* (14)
- *Oxytropis viscida* (22)
- *Solidago simplex* subsp. *simplex* var. *simplex* (24)

Inventory necessary
("viability to be assessed" and "historical" occurrences)

- *Carex glacialis* -p09 (19)
- *Poa hartzii* (3)
- *Puccinellia angustata* (4)
- *Carex mesochorea* (16)
- *Carex richardsonii* (6)
- *Chamaesyce polygonifolia* (26)
- *Puccinellia deschampsioides* (1)
- *Ranunculus sulphureus* (2)
- *Scirpus ancistrochaetus* (18)
- *Sparganium glomeratum* (27)
- *Thalictrum revolutum* (23)

In the protected area network

Conservation measures potentially necessary

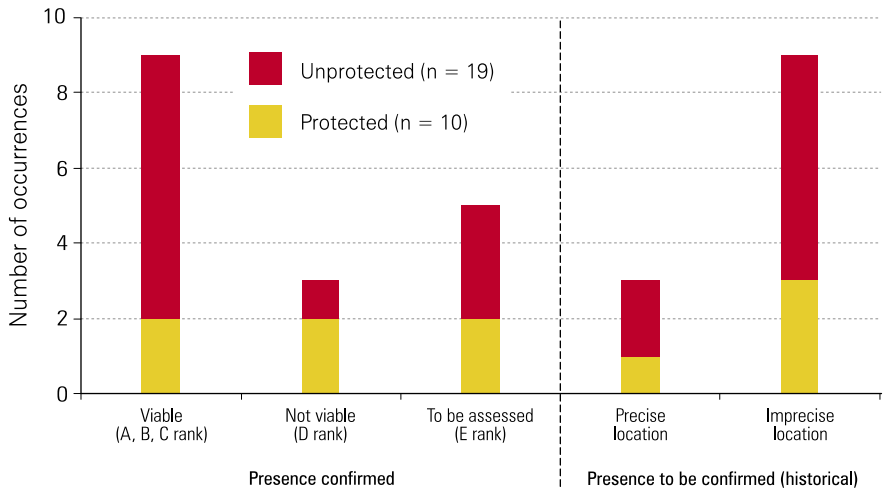
- *Carex oligocarpa* (9)
- *Packera obovata* (15)
- *Polystichum scopulinum* (20)
- *Salix chlorolepis* (20)

Inventory necessary
("viability to be assessed" and "historical" occurrences)

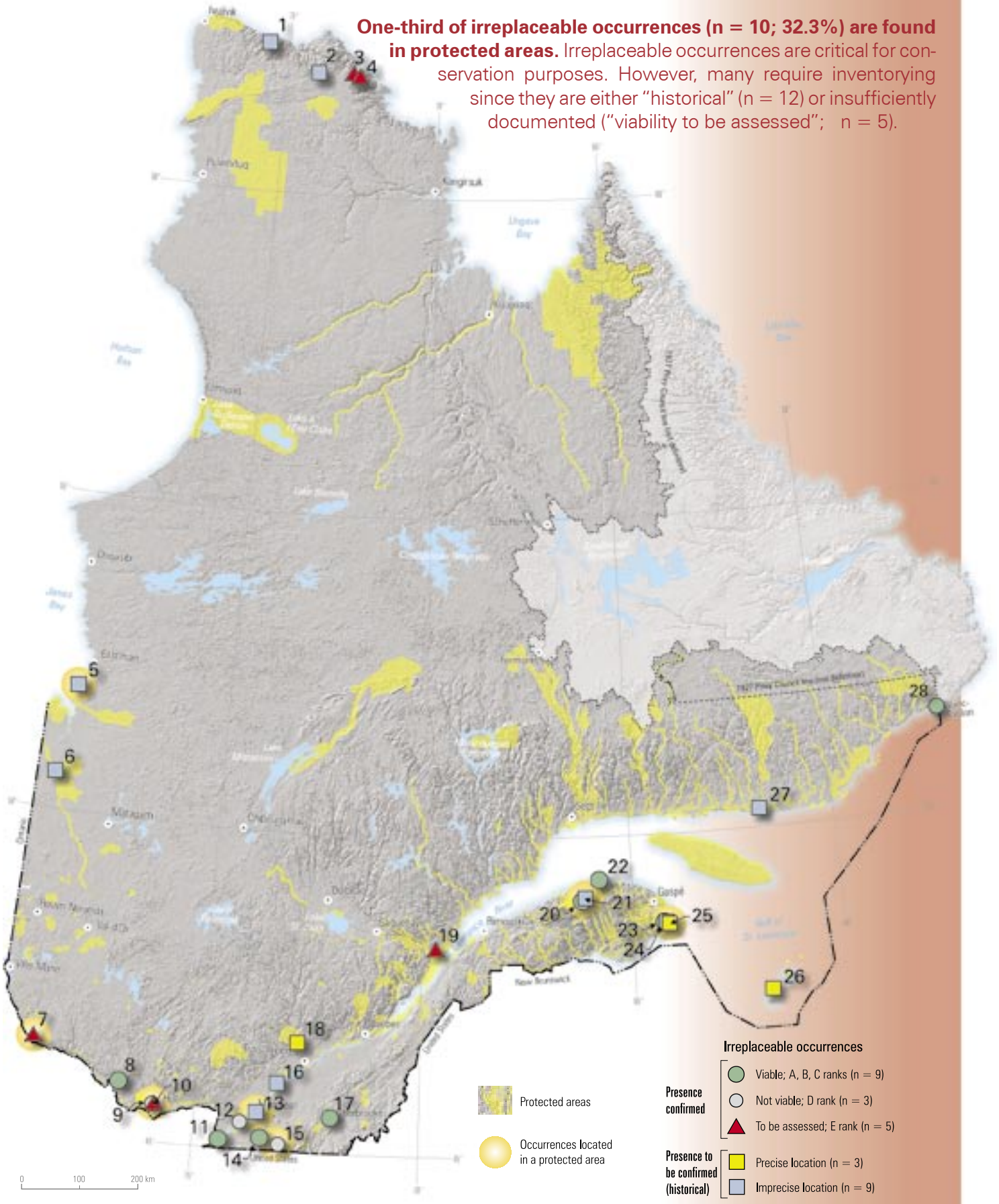
- *Arabis divaricarpa* var. *dacotica* (7)
- *Melica smithii* (10)
- *Achillea sibirica* (21)
- *Antennaria leuchippii* (5)
- *Corallorhiza striata* var. *vreelandii* (25)
- *Ranunculus rhomboideus* (13)

* Excluding extirpated occurrences
** The numbers refer to the map opposite

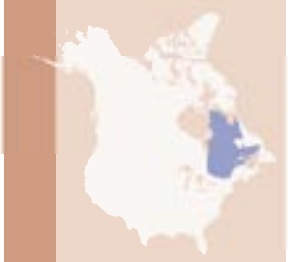
Irreplaceable occurrences: accuracy of location, viability and protection status



One-third of irreplaceable occurrences (n = 10; 32.3%) are found in protected areas. Irreplaceable occurrences are critical for conservation purposes. However, many require inventorying since they are either "historical" (n = 12) or insufficiently documented ("viability to be assessed"; n = 5).



Irreplaceable occurrences of threatened or vulnerable species



Areas rich in threatened or vulnerable species

Lake Champlain
(Missisquoi Bay)

Photo: Francis Boudreau

The Lake Champlain area, which is home to a wide variety of natural communities, has the highest number of threatened or vulnerable species (n=76).

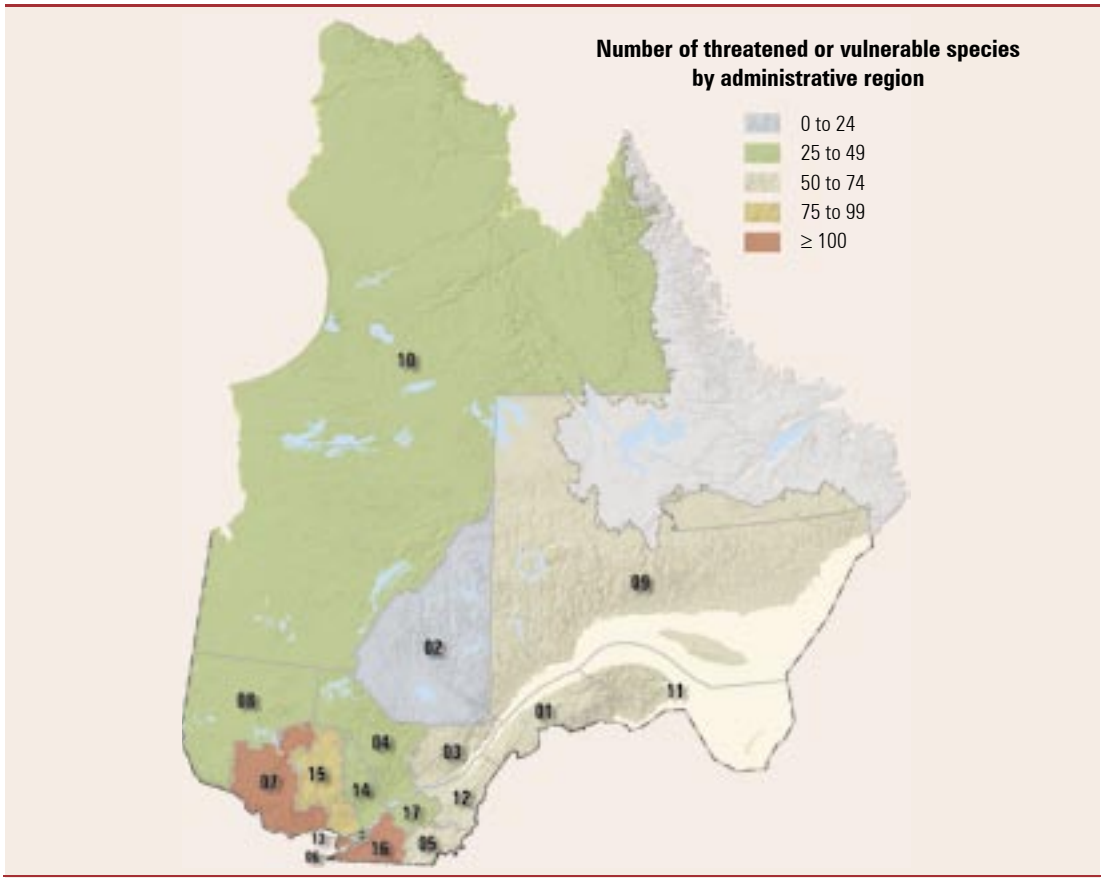
Shores of Lake Champlain
(Missisquoi Bay)

Photo: Gildo Lavoie

Richness Hot Spots

The following plates present an approach for determining threatened or vulnerable species hot spots. These hot spots are areas whose biodiversity has a higher index value than elsewhere, for richness (pp. 32 to 33), rarity (pp. 34 to 39) or biodiversity (pp. 40 to 41). Their identification facilitates research and makes it easier to define the specific locations with the greatest conservation value. This approach does not replace the individual-element approach, for which specific goals can be set.

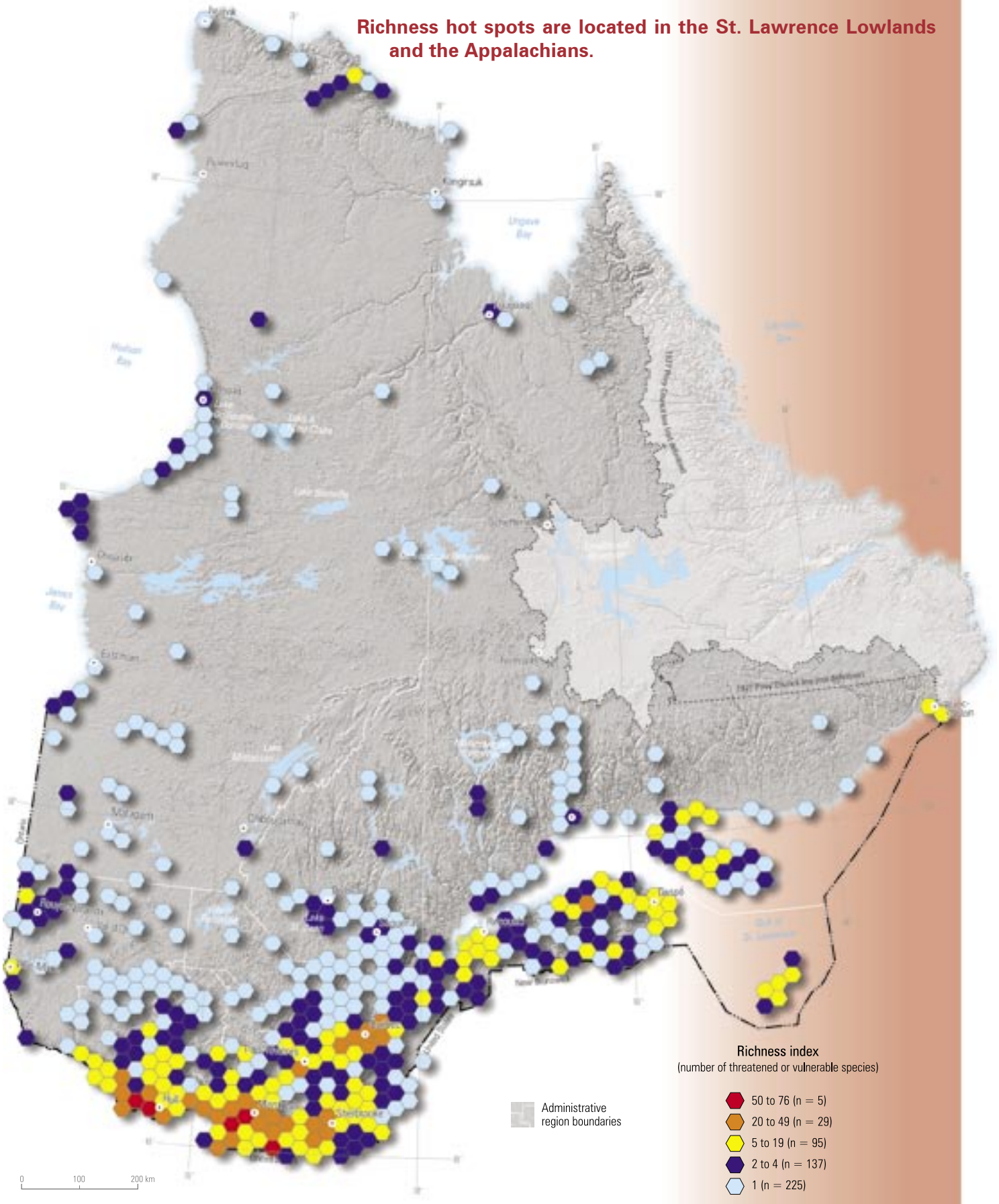
Recording the number of species is, no doubt, the easiest and most common way of defining the sectors that are most important for conservation. Among Québec's administrative regions, for instance, Montérégie and Outaouais are richest in threatened or vulnerable species.



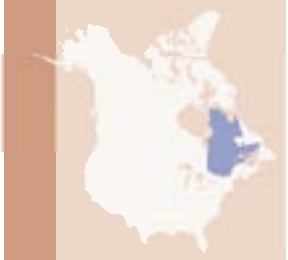
Administrative region		Number of species		Administrative region		Number of species	
		Total	Per 100 km²			Total	Per 100 km²
01	Bas-Saint-Laurent	57	0.20	10	Nord-du-Québec	45	0.01
02	Saguenay – Lac-Saint-Jean	18	0.02	11	Gaspésie – Îles-de-la-Madeleine	72	0.09
03	Capitale-Nationale	59	0.28	12	Chaudière-Appalaches	50	0.31
04	Mauricie	34	0.09	13	Laval	30	11.22
05	Estrie	67	0.64	14	Lanaudière	41	0.30
06	Montréal	48	7.67	15	Laurentides	94	0.42
07	Outaouais	143	0.42	16	Montérégie	171	1.44
08	Abitibi-Témiscamingue	37	0.06	17	Centre-du-Québec	41	0.57
09	Côte-Nord	58	0.02				

Because this approach does not take the surface areas compared into account, the calculations for the richness and other hot spots presented in the following plates used a method employed in the US and described by Spence and White (1992) and White *et al*. (1992). It portrays the data in a set of 2 712 hexagonal polygons, each measuring 648.5 km², covering Québec, 602 of which contain at least one threatened or vulnerable species. Consequently, using equal surface areas, the locations richest in species numbers—the richness hot spots—can be highlighted.

Richness hot spots are located in the St. Lawrence Lowlands and the Appalachians.



Distribution of richness in threatened or vulnerable species



Areas sheltering a large number of very rare species

Eardley Escarpment

Photo: Francis Boudreau

Together the Eardley Escarpment and Lake Des Chats sectors, in the Outaouais, shelter more than 100 threatened or vulnerable species, 35 of which are known in 5 locations or fewer in Québec.

Lake Des Chats (broadening of the Ottawa River)

Photo: Daniel Gagnon

Rarity Hot Spots

In addition to considering the number of species, the rarity index reflects their frequency, throughout the target area, i.e. the number of polygons in which a species is present.

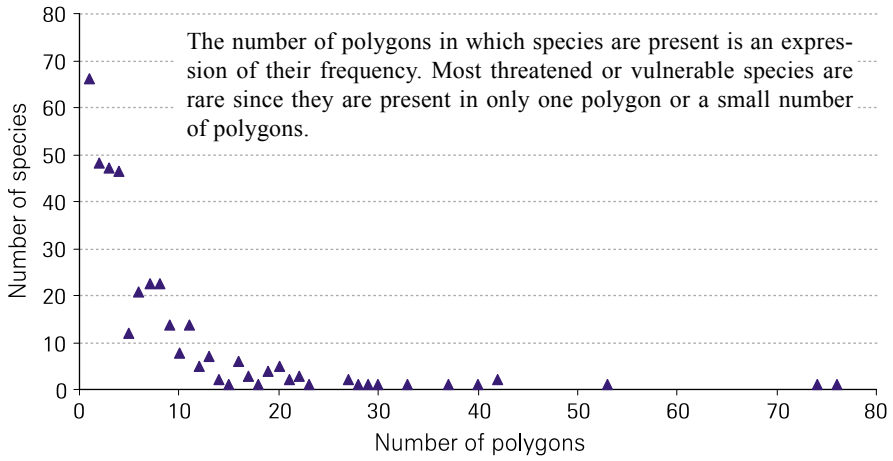
Calculating the rarity index

The *rarity-weighted richness index* (RWRI; Williams *et al*., 1997; Csuti *et al*., 1997; Parisi, 2003), referred to here as the rarity index, is presented below. It was used by NatureServe in an analysis designed to locate biodiversity hot spots in the United States (Chaplin *et al.*, 2000) and is calculated as follows:

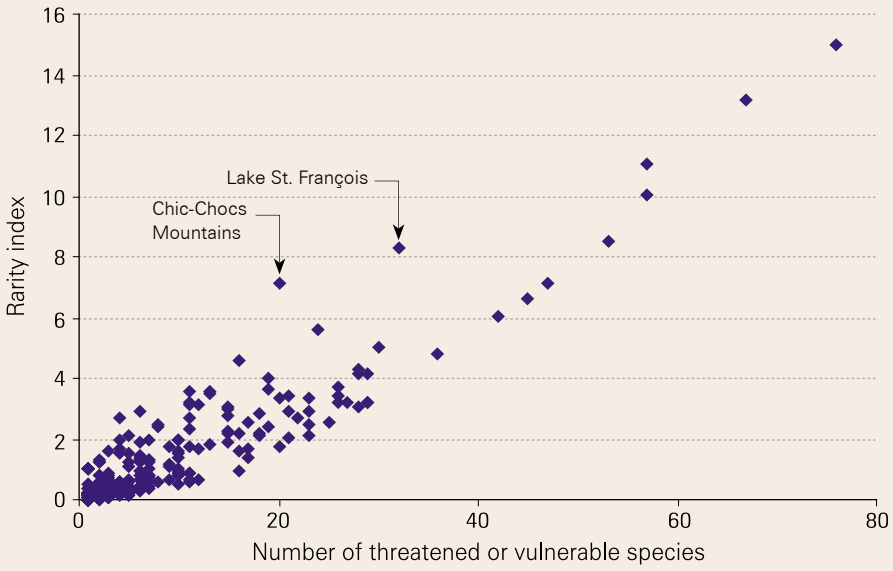
$$RWRI = \sum_{i=1}^{n} \frac{1}{h_i}$$

1. Attribute a value to each species corresponding to the opposite of the number of polygons in which it is found: for a species present in only one polygon, the value is 1.0; for a species present in 20 polygons, it is 0.05.
2. Total the values in each polygon.

$\mathbf{h_i}$ = number of hexagons (polygons) occupied by the species **n** = number of species in the hexagon (polygon) considered



The number of polygons in which species are present is an expression of their frequency. Most threatened or vulnerable species are rare since they are present in only one polygon or a small number of polygons.



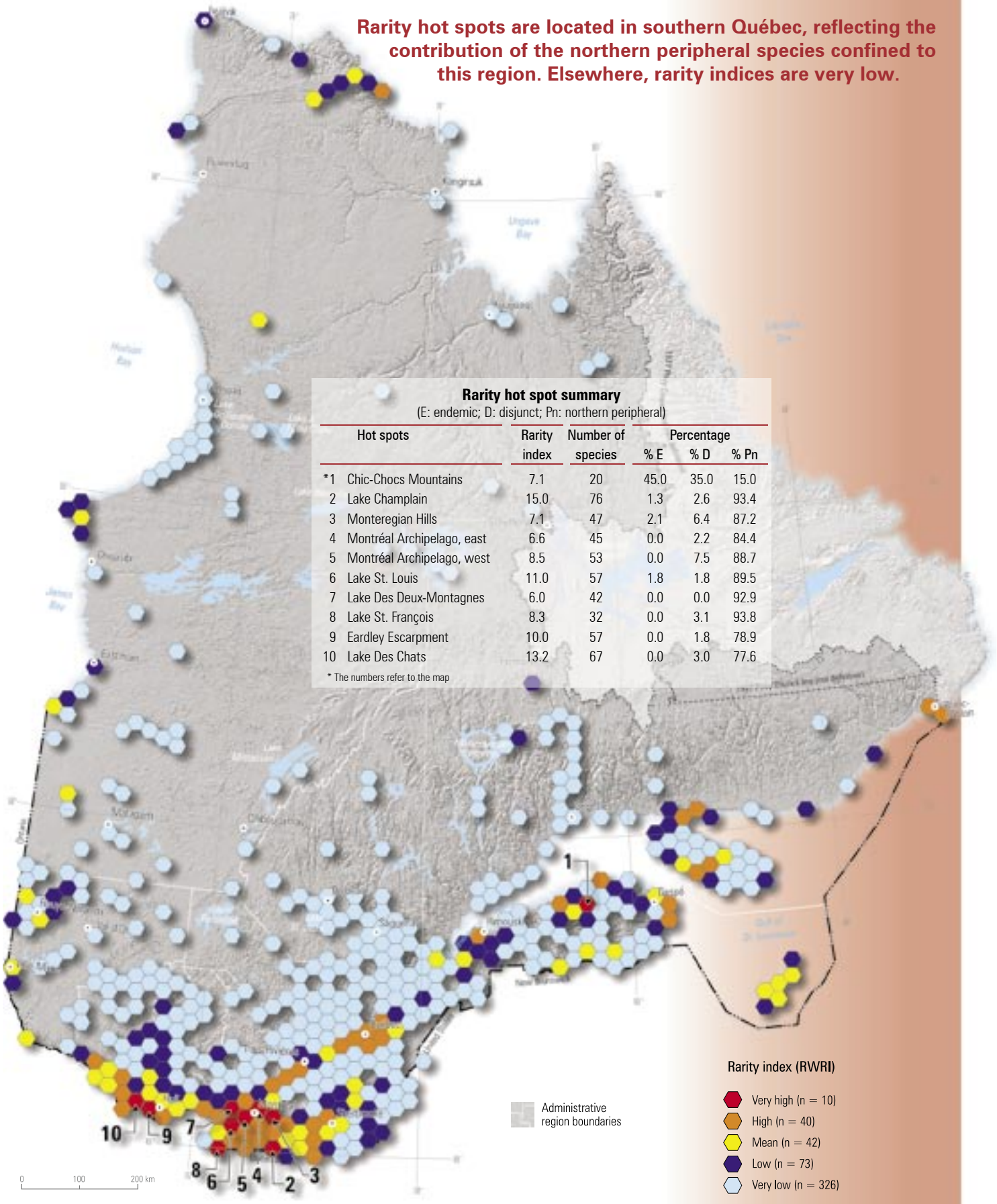
The polygons with the highest number of threatened or vulnerable species generally have the highest rarity indices ($r_s = 0.95$; $p < 0.01$; $n = 491$). However, there are significant exceptions, notably the Chic-Chocs Mountains and Lake St. François sectors, given the very great rarity of the species present.

Rarity hot spots are located in southern Québec, reflecting the contribution of the northern peripheral species confined to this region. Elsewhere, rarity indices are very low.

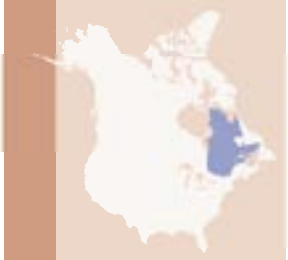
Rarity hot spot summary
(E: endemic; D: disjunct; Pn: northern peripheral)

Hot spots		Rarity index	Number of species	Percentage % E	% D	% Pn
*1	Chic-Chocs Mountains	7.1	20	45.0	35.0	15.0
2	Lake Champlain	15.0	76	1.3	2.6	93.4
3	Monteregian Hills	7.1	47	2.1	6.4	87.2
4	Montréal Archipelago, east	6.6	45	0.0	2.2	84.4
5	Montréal Archipelago, west	8.5	53	0.0	7.5	88.7
6	Lake St. Louis	11.0	57	1.8	1.8	89.5
7	Lake Des Deux-Montagnes	6.0	42	0.0	0.0	92.9
8	Lake St. François	8.3	32	0.0	3.1	93.8
9	Eardley Escarpment	10.0	57	0.0	1.8	78.9
10	Lake Des Chats	13.2	67	0.0	3.0	77.6

* The numbers refer to the map



Distribution of rarity associated with threatened or vulnerable species



The rarest species on a global scale among those found in Québec

Moxostoma hubbsi

Photo: Louis Bernatchez

Salix chlorolepis

Photo: Frédéric Coursol

Saxifraga gaspensis

Photo: Jacques Labrecque

Global Rarity Hot Spots

The Rarest Species (*sensu stricto*)

Of Québec's threatened or vulnerable species, 13 (*sensu stricto*) are represented by only 20 or fewer occurrences worldwide. These species, which are rare globally (G1 or G2 global conservation status) are, for the most part, endemic. Calculating the rarity index (RWRI) using only these species shows Québec conservation hot spots of global interest.

G1-G2 species (*sensu stricto*)

Name	Global rank *	Basic global rank **	Number of occurrences	Distribution
Animal				
Moxostoma hubbsi	G1	G1	4	Endemic to northeastern America
Plant				
Adiantum viridimontanum	G2	G2	28	Endemic to northeastern America
Bidens eatonii	G2	G2	38	Disjunct
Bidens heterodoxus	G2	G2	11	Endemic to northeastern America
Draba pycnosperma	G2	G2	9	Endemic to Gulf
Hieracium robinsonii	G2G3	G2	6	Sporadic
Minuartia marcescens	G2	G2	2	Endemic to northeastern America
Salix chlorolepis	G1	G1	1	Endemic to Gulf
Saxifraga gaspensis	G2	G2	2	Endemic to northeastern America
Symphyotrichum anticostense	G2	G2	9	Endemic to Gulf
Symphyotrichum laurentianum	G2	G2	12	Endemic to Gulf
Taraxacum latilobum	G2Q	G2	8	Endemic to northeastern America
Taraxacum laurentianum	G1Q	G1	4	Endemic to Gulf

* See p. 14 for code meanings ** Value used for analyses

Québec has very few locations of interest for G1-G2 species. The Chic-Chocs Mountains sector stands out since it shelters three G1-G2 species that are among the rarest found in Québec: *Minuartia marcescens*, *Salix chlorolepis* and *Saxifraga gaspensis*. Two other sectors also stand out, albeit less so: the Mingan Archipelago with *Taraxacum latilobum* and *Taraxacum laurentianum*, and the Magdalen Islands with 2 species that are exclusive to this part of Québec: *Bidens heterodoxus* and *Symphyotrichum laurentianum*.

North American biodiversity hot spots

Based on a methodology identical to the one used in this atlas (RWRI index, G1-G2 species, hexagons measuring 648.5 km^2) Chaplin *et al*. (2000) defined the 6 most important biodiversity hot spots in the United States.

1. San Francisco Bay area

2. Death Valley Region

3. Coastal and interior Southern California

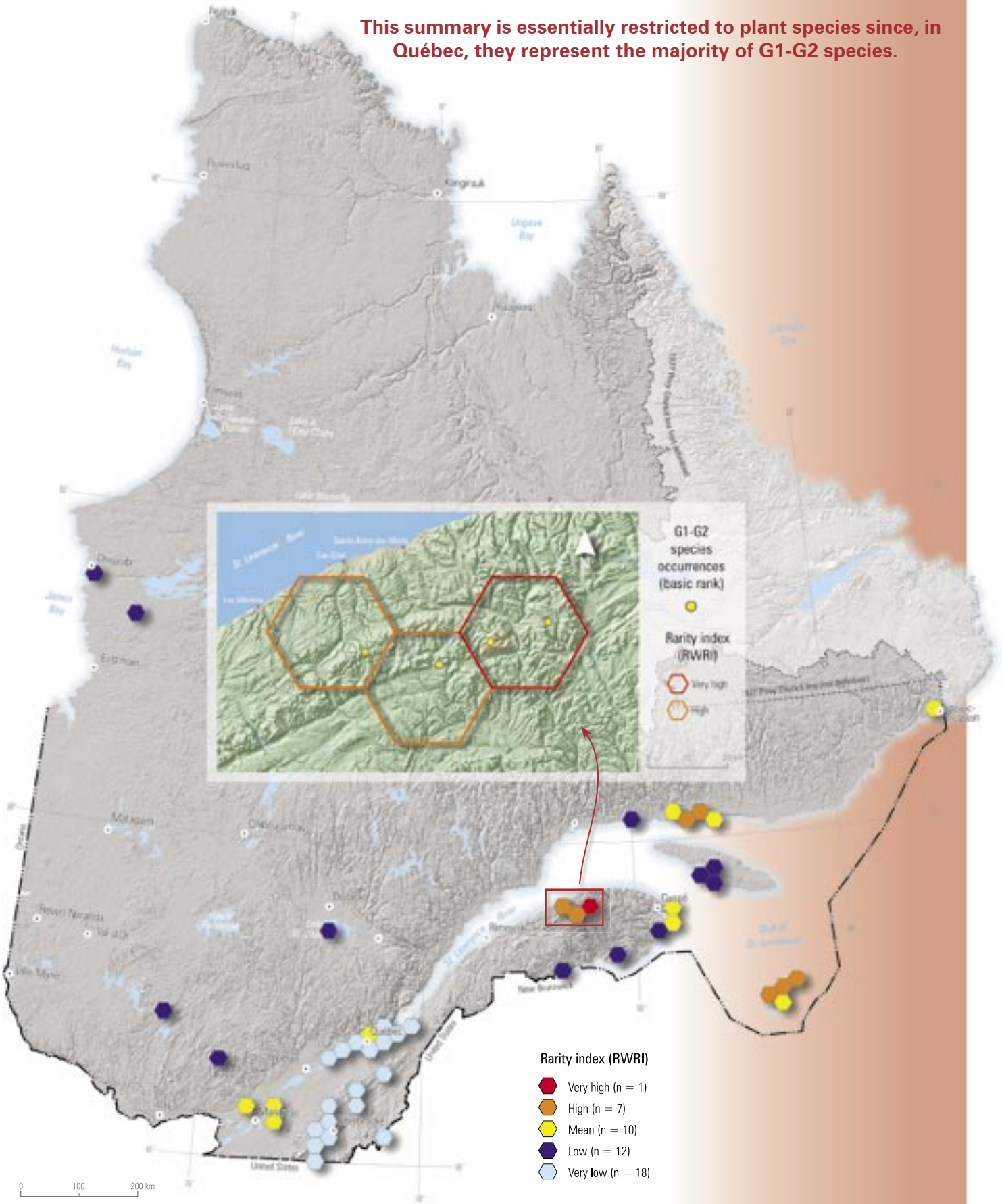
4. Southern Appalachians

5. Florida Panhandle

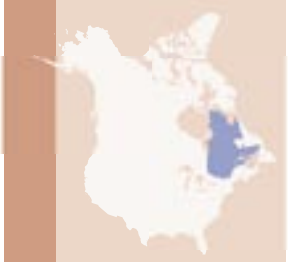
6. Hawaii (not illustrated)

For the threshold selected by these authors (RWRI $\geq 2.25 \times 10^{-3}$ / km^2), the Chic-Chocs Mountains sector, with its index of 3.08×10^{-3} / km^2, is another major North American hot spot.

This summary is essentially restricted to plant species since, in Québec, they represent the majority of G1-G2 species.



Distribution of rarity on a global scale:
G1-G2 species (*sensu stricto*)



Recent age taxa endemic to Québec

Two plants restricted to the St. Lawrence Estuary (freshwater portion): *Cicuta maculata* var. *victorinii*

Photo: Francis Boudreau

Gentianopsis procera subsp. *macounii* var. *victorinii*

Photo: Gildo Lavoie

A Golden rod associated with serpentine, in Gaspésie: *Solidago simplex* subsp. *simplex* var. *chlorolepis*

Photo: Fleurbec, Sylvain Lamoureux

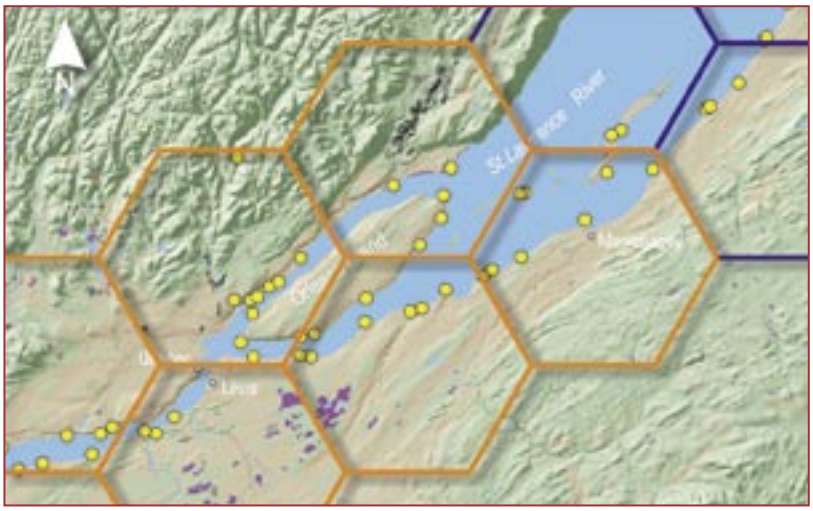
Global Rarity Hot Spots

The Rarest Species (*sensu stricto*) and Infraspecific Taxa

The taxa endemic to Québec are recent age biological entities (Labrecque and Lavoie, 2002). Only slightly differentiated, they are generally considered subspecies or varieties. This explains the presence of numerous infraspecific taxa among Québec's threatened or vulnerable "species". The global rarity hot spot picture presented in the preceding plate changes considerably if we add these taxa. The following three areas stand out:

1. St. Lawrence Estuary (freshwater portion)

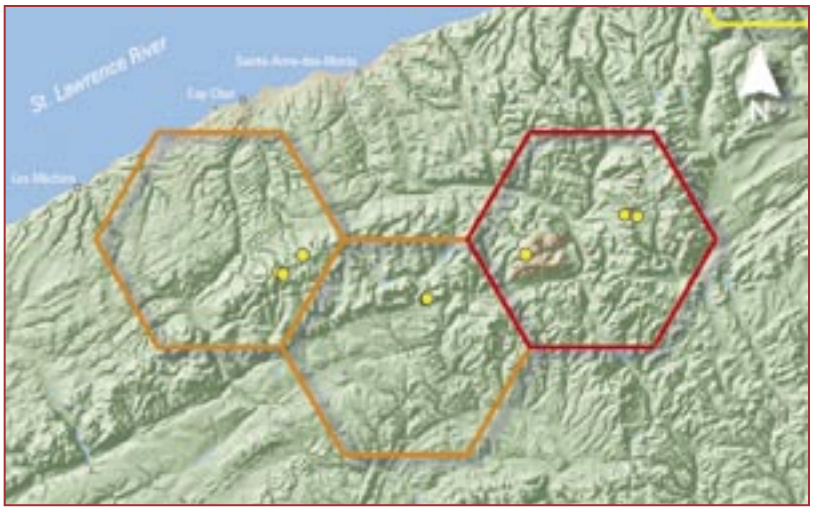
G1-G2 species occurrences (basic rank)



2. Chic-Chocs Mountains

Rarity index (RWRI)

- Very high
- High
- Mean

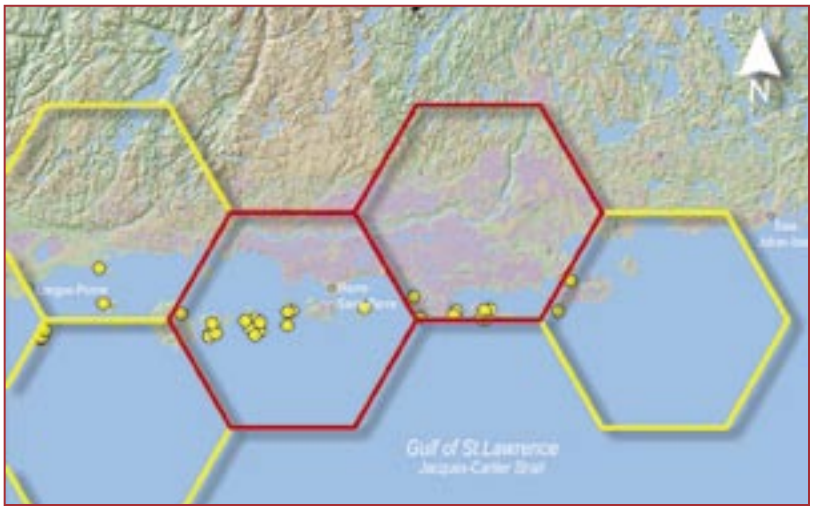


3. Mingan Archipelago

Land use

- Woodlands
- Open habitats
- Wetlands

0 10 20 km

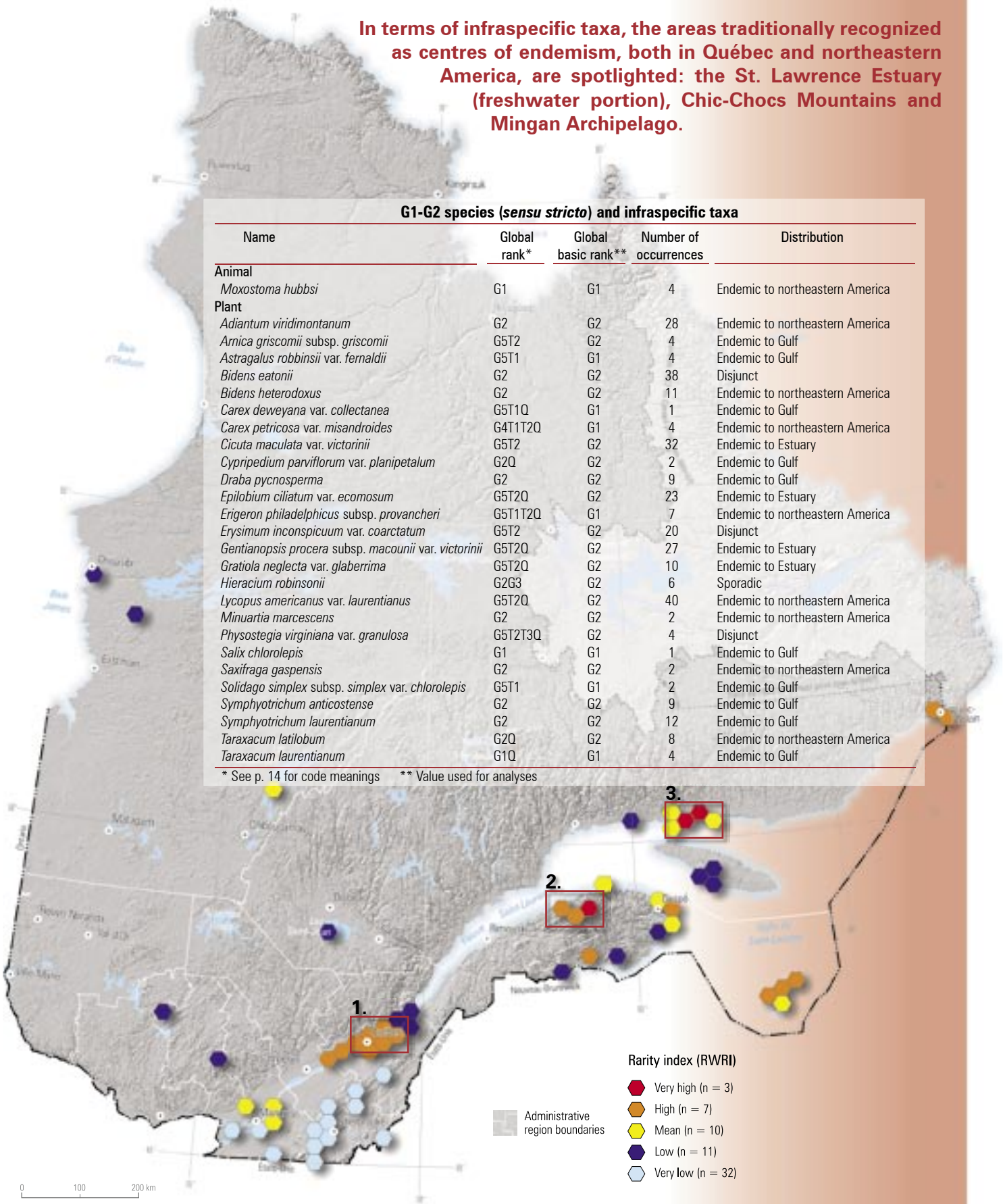


In terms of infraspecific taxa, the areas traditionally recognized as centres of endemism, both in Québec and northeastern America, are spotlighted: the St. Lawrence Estuary (freshwater portion), Chic-Chocs Mountains and Mingan Archipelago.

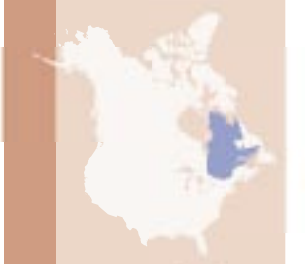
G1-G2 species (*sensu stricto*) and infraspecific taxa

Name	Global rank*	Global basic rank**	Number of occurrences	Distribution
Animal				
Moxostoma hubbsi	G1	G1	4	Endemic to northeastern America
Plant				
Adiantum viridimontanum	G2	G2	28	Endemic to northeastern America
Arnica griscomii subsp. *griscomii*	G5T2	G2	4	Endemic to Gulf
Astragalus robbinsii var. *fernaldii*	G5T1	G1	4	Endemic to Gulf
Bidens eatonii	G2	G2	38	Disjunct
Bidens heterodoxus	G2	G2	11	Endemic to northeastern America
Carex deweyana var. *collectanea*	G5T1Q	G1	1	Endemic to Gulf
Carex petricosa var. *misandroides*	G4T1T2Q	G1	4	Endemic to northeastern America
Cicuta maculata var. *victorinii*	G5T2	G2	32	Endemic to Estuary
Cypripedium parviflorum var. *planipetalum*	G2Q	G2	2	Endemic to Gulf
Draba pycnosperma	G2	G2	9	Endemic to Gulf
Epilobium ciliatum var. *ecomosum*	G5T2Q	G2	23	Endemic to Estuary
Erigeron philadelphicus subsp. *provancheri*	G5T1T2Q	G1	7	Endemic to northeastern America
Erysimum inconspicuum var. *coarctatum*	G5T2	G2	20	Disjunct
Gentianopsis procera subsp. *macounii* var. *victorinii*	G5T2Q	G2	27	Endemic to Estuary
Gratiola neglecta var. *glaberrima*	G5T2Q	G2	10	Endemic to Estuary
Hieracium robinsonii	G2G3	G2	6	Sporadic
Lycopus americanus var. *laurentianus*	G5T2Q	G2	40	Endemic to northeastern America
Minuartia marcescens	G2	G2	2	Endemic to northeastern America
Physostegia virginiana var. *granulosa*	G5T2T3Q	G2	4	Disjunct
Salix chlorolepis	G1	G1	1	Endemic to Gulf
Saxifraga gaspensis	G2	G2	2	Endemic to northeastern America
Solidago simplex subsp. *simplex* var. *chlorolepis*	G5T1	G1	2	Endemic to Gulf
Symphyotrichum anticostense	G2	G2	9	Endemic to Gulf
Symphyotrichum laurentianum	G2	G2	12	Endemic to Gulf
Taraxacum latilobum	G2Q	G2	8	Endemic to northeastern America
Taraxacum laurentianum	G1Q	G1	4	Endemic to Gulf

* See p. 14 for code meanings ** Value used for analyses



Distribution of rarity on a global scale:
G1-G2 species (*sensu stricto*) and infraspecific taxa



Areas showing little diversification are of prime importance for biodiversity conservation

The Blanc-Sablon region is one of the most critical from the viewpoint of the conservation of Québec's threatened or vulnerable species, although it ranks rather low in terms of species richness (see p. 32).

Photo: Gildo Lavoie

Photo: Francis Boudreau

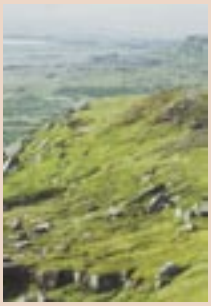


Photo: Francis Boudreau

Biodiversity Hot Spots

Using rarity hot spots to define areas of conservation value is justified when the rarest species (G1-G2) are considered. In this case, all occurrences are deemed important from a conservation standpoint, regardless of their quality (see pp. 34 to 37). However, this is not true when all of Québec's threatened or vulnerable species are considered. In this case, the value of occurrences must be considered. This is possible using the biodiversity index, a qualitative index designed for outstanding elements of biodiversity.

Criteria for using species to assign a biodiversity index to an area*
(adapted from *The Nature Conservancy*, 1994 and 1996)

B1 : (B1.01) Single occurrence worldwide of a G1 species
(B1.02) Single occurrence in Québec of a G1 species
(B1.03) Single occurrence in Québec of a G2 species
(B1.04) Single occurrence in Québec of a G3 species
(B1.05) Presence of "excellent" occurrence(s) of G1 species
(B1.06) 4 or more "excellent-to-good" occurrences of G2 species
(B1.07) Single occurrence in Québec of an S1 species
(B1.08) 4 or more "excellent" occurrences of S1 species

B2 : (B2.01) Presence of "other-than-excellent" occurrence(s) of G1 species
(B2.02) 1-3 "excellent-to-good" occurrence(s) of G2 species
(B2.03) Presence of "excellent" occurrence(s) of G3 species
(B2.04) 1-3 "excellent" occurrence(s) of S1 species
(B2.05) 4 or more "fair" occurrences of G2 species
(B2.06) 4 or more "good" occurrences of G3 species
(B2.07) 4 or more "good" occurrences of S1 species
(B2.08) 10 or more "excellent-to-good" occurrences of S2 species

B3 : (B3.01) 1-3 "fair" occurrence(s) of G2 species
(B3.02) 1-3 "good" occurrence(s) of G3 species
(B3.03) 1-3 "good" occurrence(s) of S1 species
(B3.04) 4-9 "excellent" occurrences of S2 species
(B3.05) 1-3 "excellent" occurrences of S2 species
(B3.06) 4-9 "good" occurrences of S2 species
(B3.07) 4 or more "fair" occurrences of G3 species
(B3.08) 4 or more "fair" occurrences of S1 species
(B3.09) 4 or more "excellent" occurrences of S3 species
(B3.10) 10 or more "poor, historical or extant" occurrences
(B3.11) 1-3 "good" occurrence(s) of S2 species

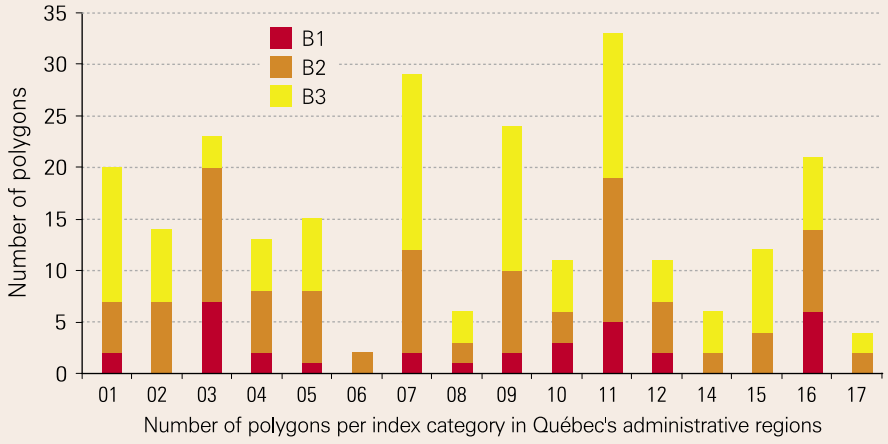
B4 : (B4.01) 1-3 "fair" occurrence(s) of G3 species
(B4.02) 1-3 "fair" occurrence(s) of S1 species
(B4.03) 1-3 "excellent" occurrences of S3 species
(B4.04) 4 or more "good" occurrences of S3 species
(B4.05) 4 or more "fair" occurrences of S2 species
(B4.06) 1-3 "good" occurrence(s) of S3 species
(B4.07) 4 or more "poor, historical or extant" occurrences

B5 : (B5.01) 1-3 "fair" occurrences of S2 species
(B5.02) 4 or more "fair" occurrences of S3 species
(B5.03) 1-3 "fair" occurrences of S3 species
(B5.04) 1-3 "poor, historical or extant" occurrences

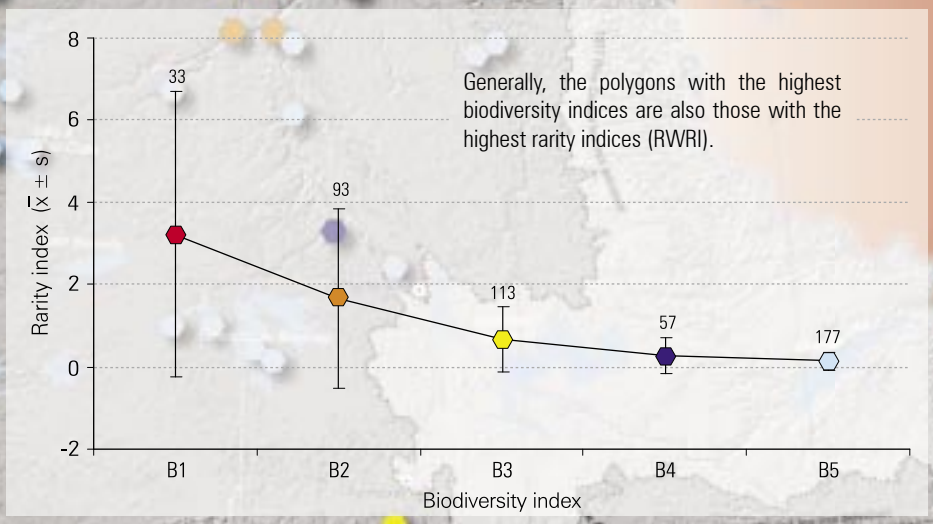
* Other criteria that have not been presented take other elements of biodiversity (natural communities and animal assemblages) into account.

The biodiversity index is an attribute producing a value (B1, B2, B3, B4 or B5) once a predefined criterion is met. It stresses the rarest elements and the quality of their occurrences; the number of elements represented comes second. Precedence is also given to those elements most at risk globally and, consequently, to endemic taxa. All G1 and single species occurrences (irreplaceable), whose mapping is sufficiently precise, are considered. Although "viability to be assessed" (E) and historical (H) occurrences are considered, their weight in terms of the conservation status of a given area are minimal. Each index category has an internal hierarchy (e.g. B1.01, B1.02, etc.).

The polygons of great value for the conservation of threatened or vulnerable species (B1, B2 and B3) are concentrated in six administrative regions: Bas-Saint-Laurent (01), Capitale-Nationale (03), Outaouais (07), Côte-Nord (09), Gaspésie–Îles-de-la-Madeleine (11) and Montérégie (16).



Threatened or vulnerable species biodiversity hot spots (B1, B2 and B3) are found in various parts of Québec but are concentrated along the St. Lawrence River, in the St. Lawrence Plain and in the Appalachians.



Distribution of biodiversity associated with threatened or vulnerable species

Threatened or vulnerable species occurrences to be protected

Rangifer tarandus pop. 2

Photo: Frédéric Coursol

The isolated caribou population of Gaspésie National Park is the same subspecies as that of Northern Québec. It frequents the highest summits of the McGerrigle and Chic-Chocs Mountains and the mature coniferous forest bordering the park. Today, it constitutes the last vestige of the populations formerly occupying the Maritimes and New England (Boileau, 1996; Desrosiers and Faubert, 1999).

Helianthemum canadense

Photo: Denis Paquette

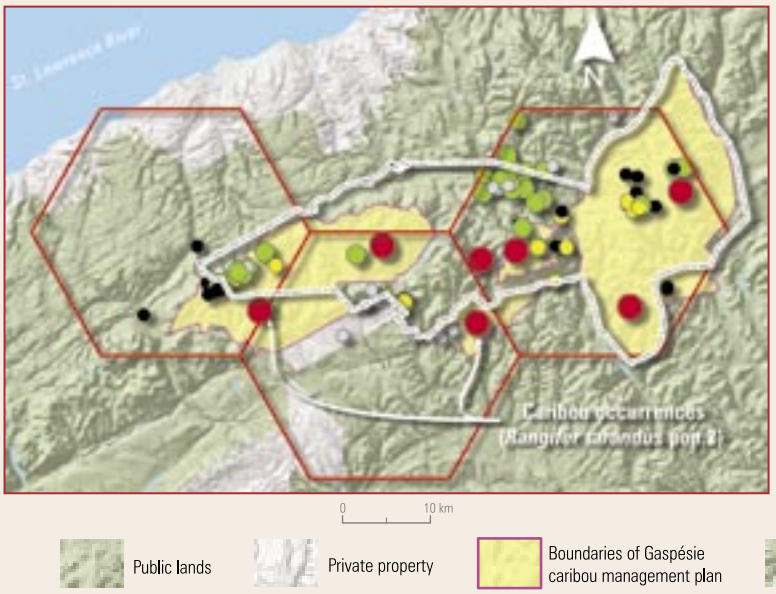
Known in Québec only in the Grand Calumet Island sector since 1942, notably through specimen collection by Frère Marie-Victorin, the species continues to grow there.

Defining Conservation Sites Based on Biodiversity Hot Spots

The CDPNQ uses the biodiversity hot spots to define conservation sites. Areas with the biodiversity indices B1, B2 and B3 are the most important for threatened or vulnerable species conservation. Conservation sites can be defined within these hot spots, based on the location of the elements found there.

Example 1: Chic-Chocs Mountains sector

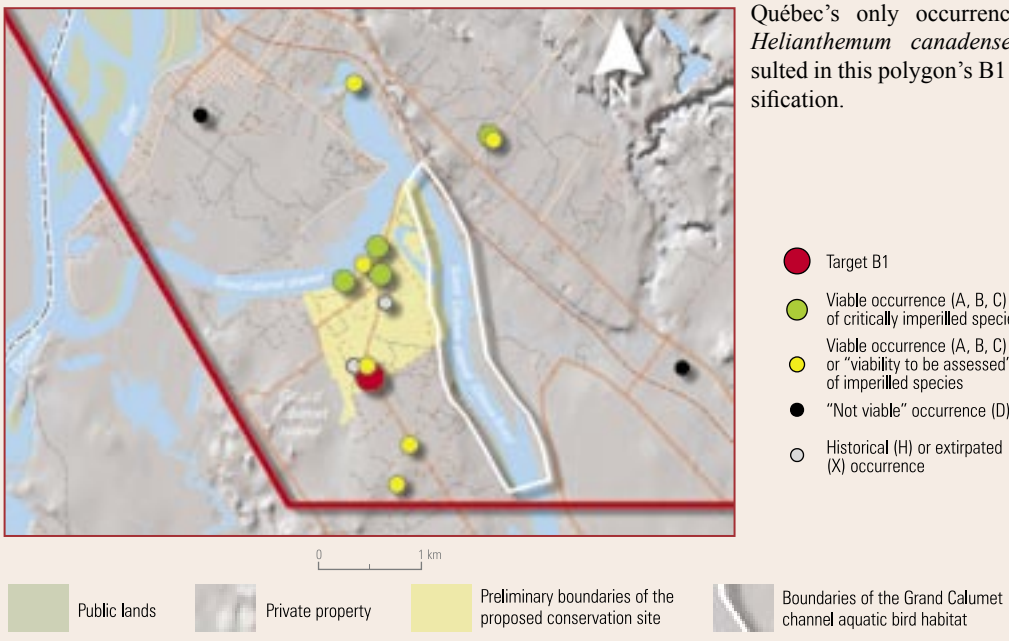
The threatened or vulnerable species of the Chic-Chocs Mountains, many of which are endemic, already enjoy considerable protection in Gaspésie National Park. However, the park does not contain all of the occurrences that are most important from a conservation viewpoint. Including them would mean expanding the protected area to the boundaries of the Gaspésie caribou management plan.



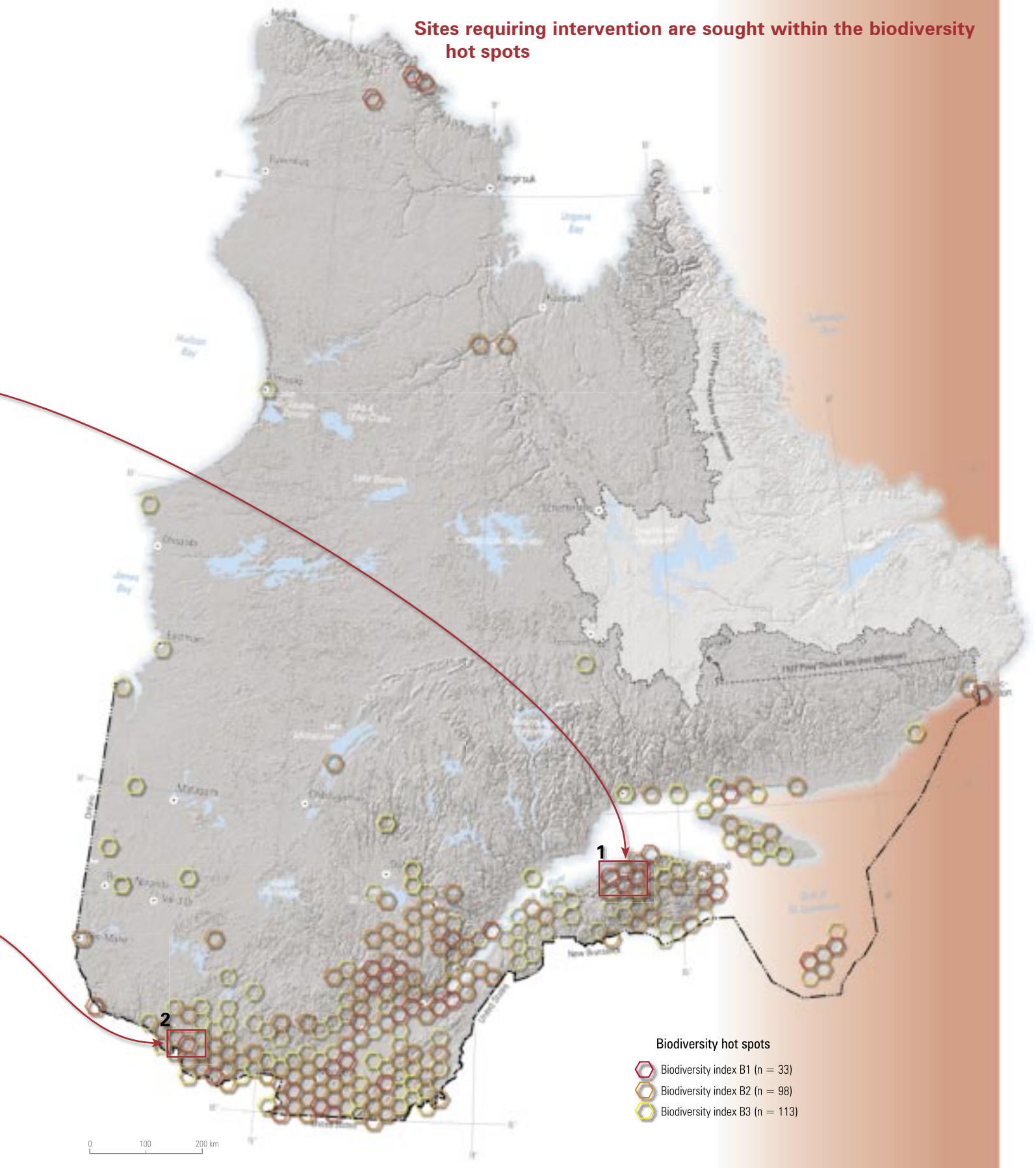
Example 2: Northern tip of Grand Calumet Island sector

This sector of the Outaouais region, located at the northern tip of Grand Calumet Island, is a jackpine forest on sand bordered by an aquatic bird habitat. Protection of an area of approximately 400 ha would safeguard 10 threatened or vulnerable species.

Québec's only occurrence of *Helianthemum canadense* resulted in this polygon's B1 classification.



Sites requiring intervention are sought within the biodiversity hot spots



Threatened or vulnerable species biodiversity hot spots

Regional pictures

Various regional divisions can be used to characterize threatened or vulnerable species.

Administrative regions

Natural provinces

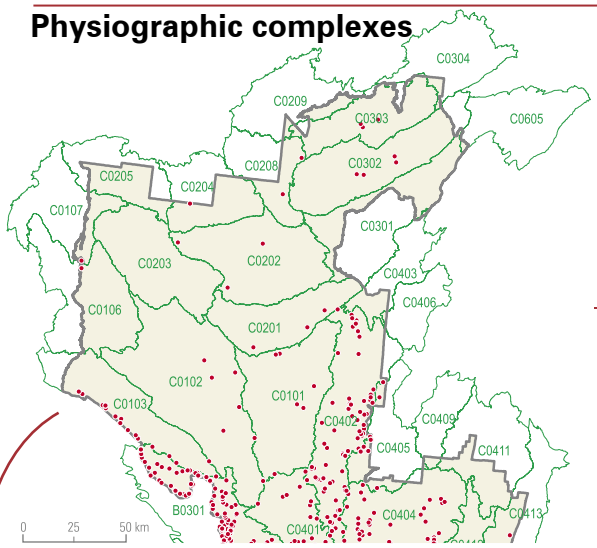
Bioclimatic domains

Selection and Description of a Regional Unit

Data analysis can be performed on a regional scale by dividing the territory up according to either ecological or administrative criteria. The following example applies to Québec's administrative region 07, the Outaouais.

For analysis purposes, the region was divided into 6 species intervention zones. These zones are based on large ecological units (physiographic complexes) and municipal land use, and reflect species distribution.

Physiographic complexes



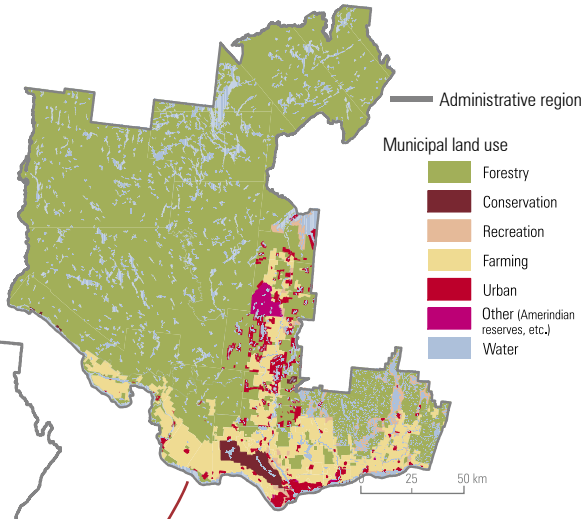
Physiographic complexes (Li and Ducruc, 1999) were used as an integrator of the area's overall ecological conditions, notably type of relief, altitude and predominant type of deposit.

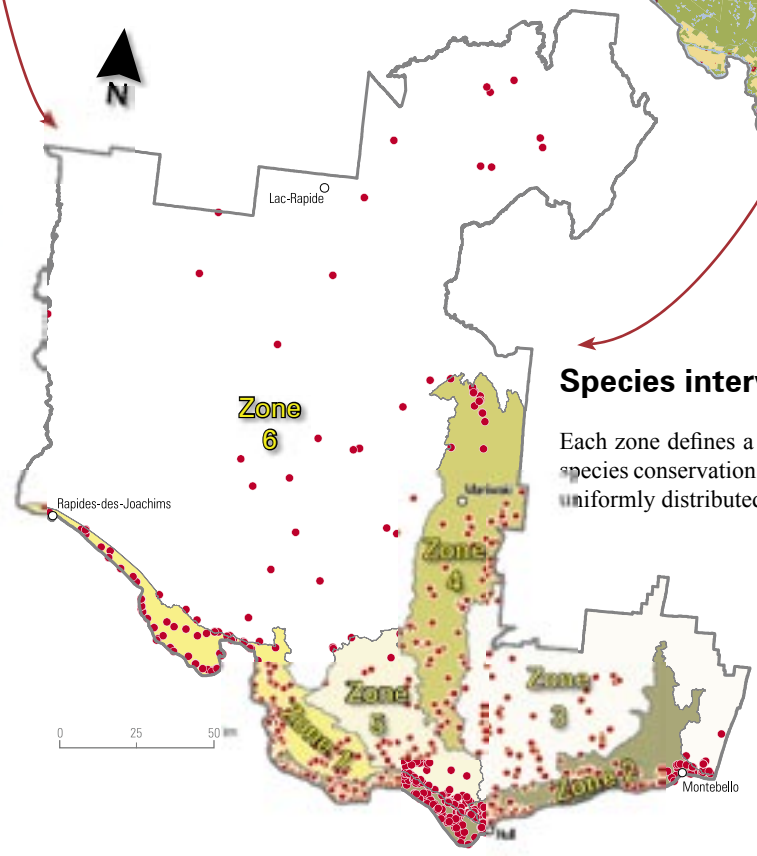
- Threatened or vulnerable species occurrences (n = 1 108)
- Physiographic complexe
- Administrative region

Each code designates a distinct physiographic complexe (e.g. B0301 = Plain of the Grand Calumet and Allumettes islands).

Municipal land use

Municipal land use, obtained from the L'ATINO group (2004), corresponds to that established by the Outaouais regional county municipality (RCM).





Species intervention zones

Each zone defines a homogeneous threatened or vulnerable species conservation intervention sector. Occurrences are not uniformly distributed: zones 1 and 2 contain the majority.

- Threatened or vulnerable species occurrences (n = 1108)

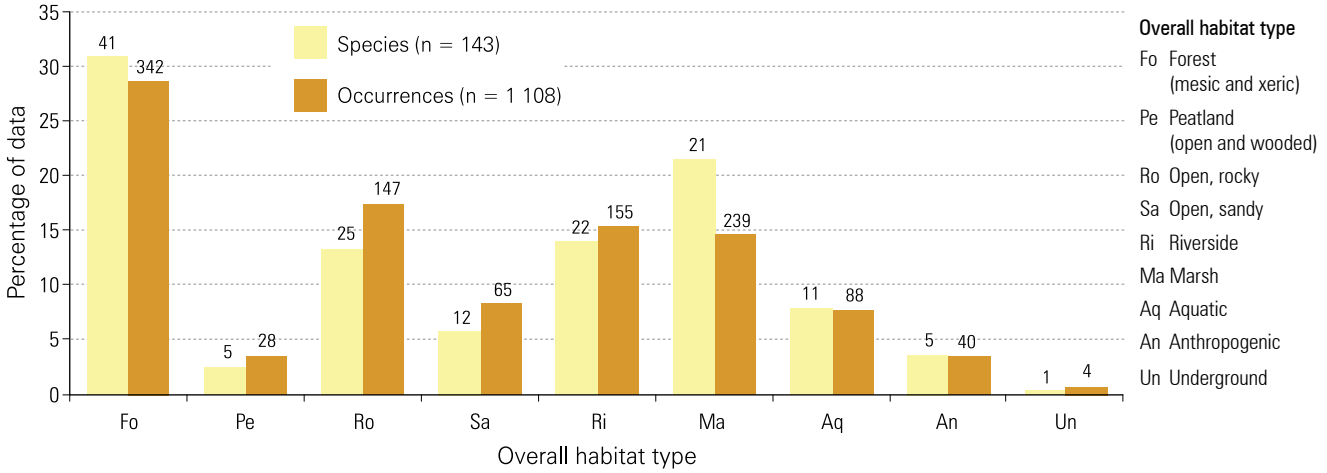
NOTE: For reasons of vegetation composition, the physiographic unit C0103 (Lake Esker Low Hills) was divided between zones 1 and 6.

Species and zone characterization by habitat

Analysis of species distribution according to affinity for a general habitat type shows a concentration of certain species in specific zones, reflecting the predominance of certain habitats in these zones.

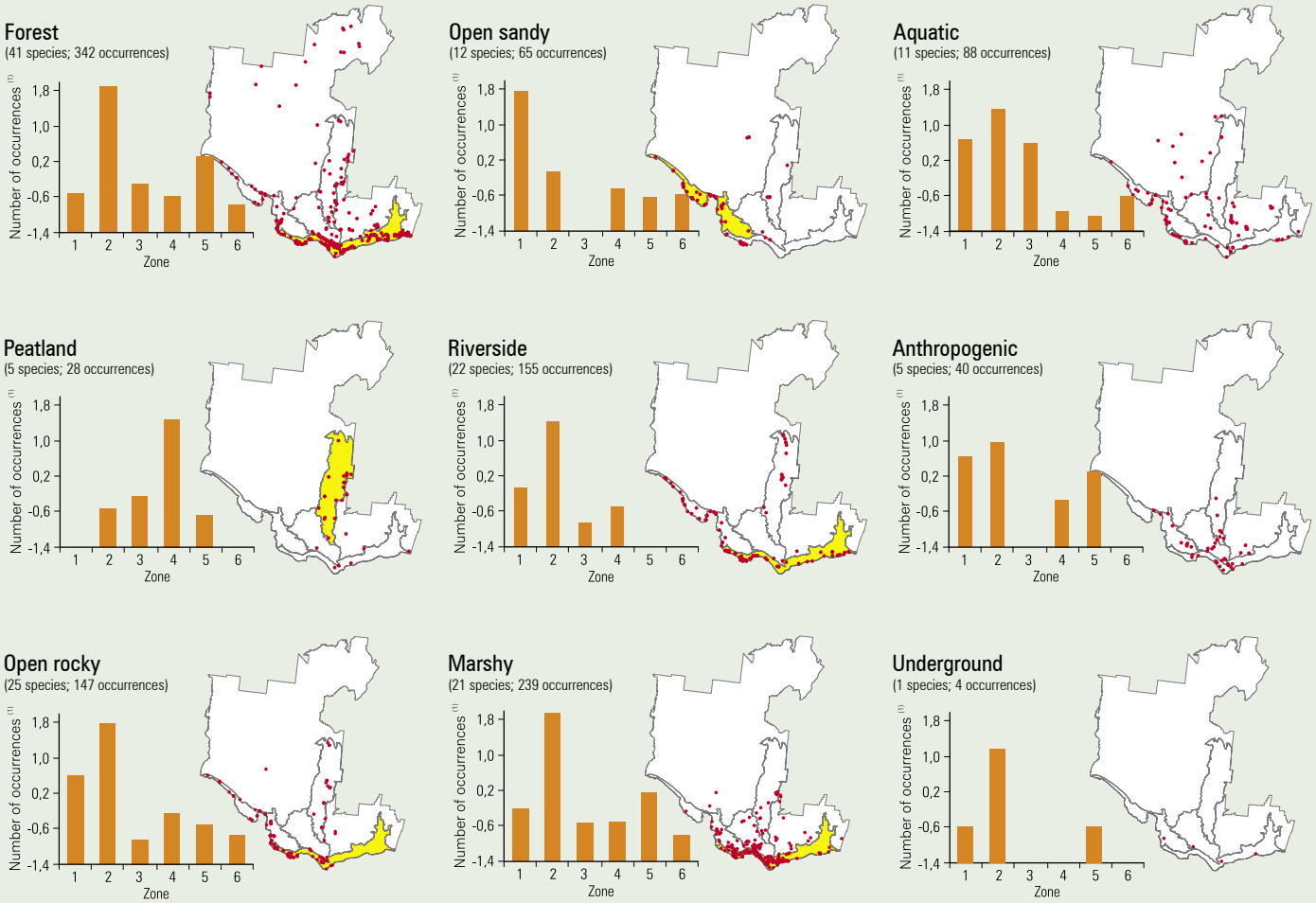
Threatened or vulnerable species classification by general habitat type in the Outaouais

Each species was associated with a preferential category from among the 9 habitat categories used.



Species found in forest, open rocky, riverside and marshy habitats are predominant in zone 2, while species found in peatland habitats are concentrated in zone 4 and species found in open sandy habitats dominate zone 1.

Species distribution in the zones by preferential habitat



(1) The values presented have been standardized to enable comparison between species based on preferential habitat.

Analyses on a regional scale should permit better planning of intervention for conservation and land management purposes

Analyses for Intervention Purposes

A regional overview allows action targeting regional species to be oriented and makes it easier to take these species into account in planning regional intervention measures.

Characteristics of the Outaouais intervention zones

Zones	1	2	3	4	5	6
Threatened or vulnerable species (n)						
Occurrences	217	**490**	90	120	146	45
Species	64	**107**	35	34	50	17
Habitats (number of associated occurrences)						
Forest	36	**133**	44	33	70	26
Peatland	0	3	5	**18**	2	0
Open rocky	40	**71**	2	18	11	5
Open sandy	**43**	12	0	5	2	3
Riverside	36	**101**	1	17	0	0
Marshy	30	**130**	15	16	46	2
Aquatic	21	27	20	6	5	9
Anthropogenic	10	11	3	7	9	0
Underground	1	2	0	0	1	0
Land cover (NOAA*; % of surface area)						
Forest	66,1	33,7	**93,4**	**91,6**	**93,6**	**96,5**
Farming	27	**46,6**	4,3	5,1	6,4	0,2
Other	6,6	13,9	2,3	3,2	0,1	3,2
Municipal land use (L'ATINO, 2004; % of surface area)						
Forest	27,8	6,7	62,2	41,9	49,2	**91**
Farming	**61,2**	**60,2**	18,9	29,8	22,7	0,2
Urban	1,6	11,6	3,5	13,5	1,5	0,4
Conservation	0,6	**0,8**	0,4	0	21,8	0
Other	8,9	20,6	15	14,8	4,8	8,4

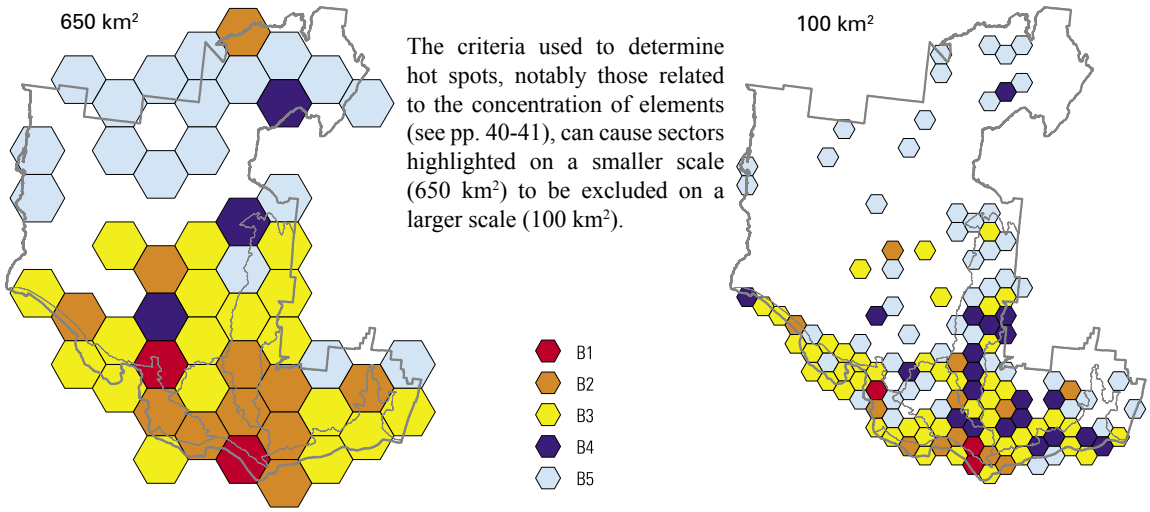
* NOAA image, reclassified based on the work of Beaubien *et al.*, 1997

Examples of interpretation

- Zone 2 alone has close to half of the Outaouais' threatened or vulnerable species occurrences (44.2%).
- Species found in forest, open rocky, riverside and marshy habitats are more common in zone 2.
- Forest species are concentrated in a farming zone (zone 2) due to the presence of maple stands used primarily for maple syrup production.
- Only 0.8% of the surface area of zone 2 is devoted to protection.
- Species found in open sandy habitats are virtually confined to zone 1.
- Species found in peatland habitats are more common in zone 4.
- Although zone 6 is larger, it is of less conservation value for threatened or vulnerable species given its less attractive ecological and climate characteristics.

Based on a knowledge of species distribution patterns, such a synthesis can be interpreted in conjunction with the distribution of areas of conservation value (hot spots). The latter must be defined at the level at which decision - making occurs, for instance, a 100 km² grid cell in the case of the Outaouais intervention zones.

Biodiversity indices for the Outaouais' threatened or vulnerable species, calculated on scales of 650 km² and 100 km²



The criteria used to determine hot spots, notably those related to the concentration of elements (see pp. 40-41), can cause sectors highlighted on a smaller scale (650 km²) to be excluded on a larger scale (100 km²).

When and how to intervene

The information derived from the knowledge of threatened or vulnerable species can be used according to various intervention categories to define action priorities and optimize results.

Through the creation or expansion of protected areas

(fictitious example)

Protecting sectors of great value requires precise boundaries and characterization on a small scale.

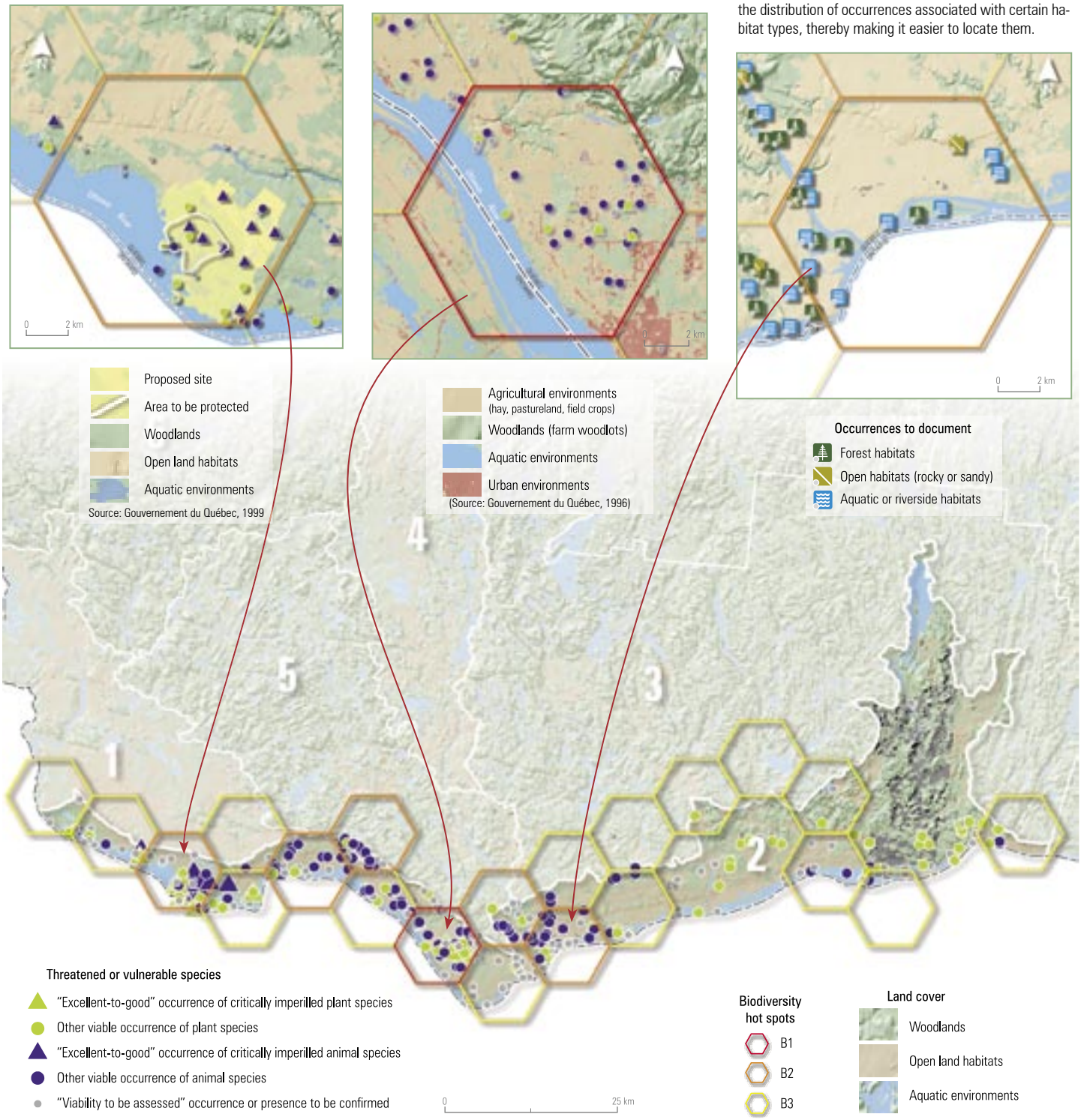
Through land management proposals

Studying the distribution of occurrences may generate land management proposals that take the presence of threatened or vulnerable species into account.

Through validation measures

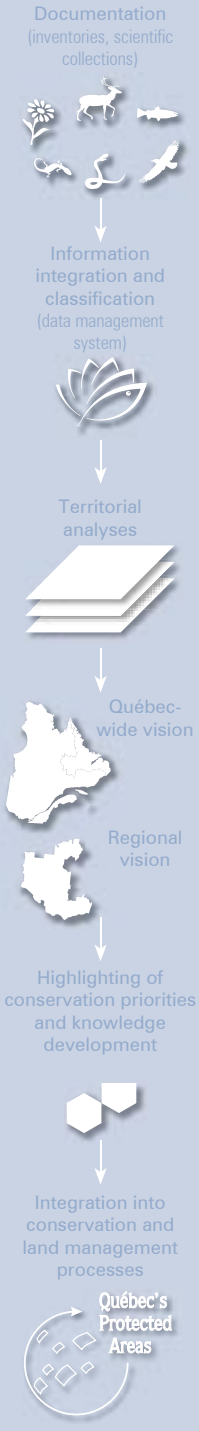
(Sector in which occurrences to be documented are concentrated)

Planning field campaigns to valid or complete the information available can benefit from a regional intervention framework. The latter makes it possible to take land use pressure and other characteristics into account, including the distribution of occurrences associated with certain habitat types, thereby making it easier to locate them.



Intervention zone 2

Where and how to intervene to protect elements of biodiversity



Conclusion

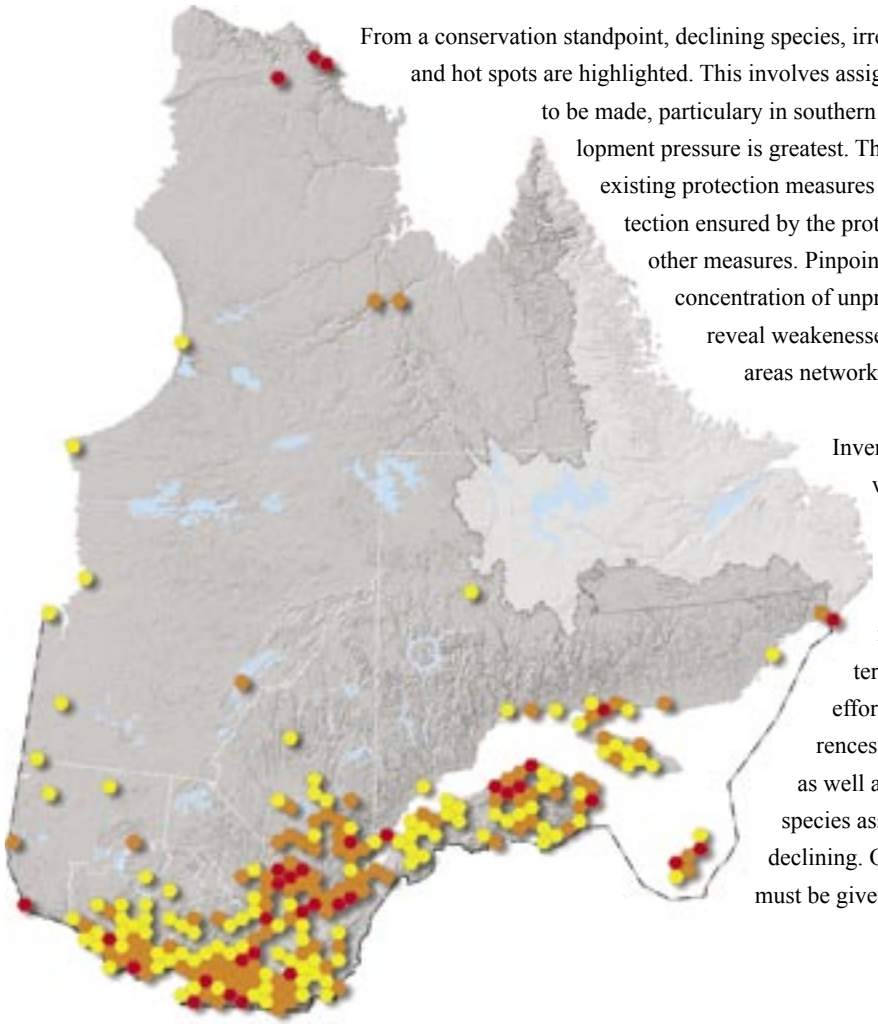
This atlas constitutes the first rigorous exercise in analyzing all data on Québec's threatened or vulnerable species. It illustrates a means of using the information gathered at the CDPNQ over the past 17 years and presents a structured approach to taking it into consideration. The atlas clearly highlights the importance of systematically collecting and recording information on elements of biodiversity.

This exercise shows that existing knowledge on threatened or vulnerable species is sufficient to take positive action, despite the validation and characterization efforts still required. The method presented allows this to be achieved effectively—by considering Québec as a whole or based on a specific regional framework, by administrative region, for instance. Defining those areas where conservation efforts should be concentrated makes it possible to take all of the species in a given location into account in the process of classifying land units, in other words, pinpointing where intervention is most important and optimal. The sectors-of-intervention approach on a regional scale entails a better understanding and use of information on threatened or vulnerable species in planning intervention for conservation and land use management purposes.

Think globally

Québec-wide, knowledge put into perspective generally applies to planning land protection and inventory efforts.

From a conservation standpoint, declining species, irreplaceable occurrences and hot spots are highlighted. This involves assigning priorities to efforts to be made, particulary in southern Québec, where development pressure is greatest. These actions must take existing protection measures into account: real protection ensured by the protected areas network and other measures. Pinpointing sectors with a high concentration of unprotected occurrences may reveal weakenesses in the current protected areas network.

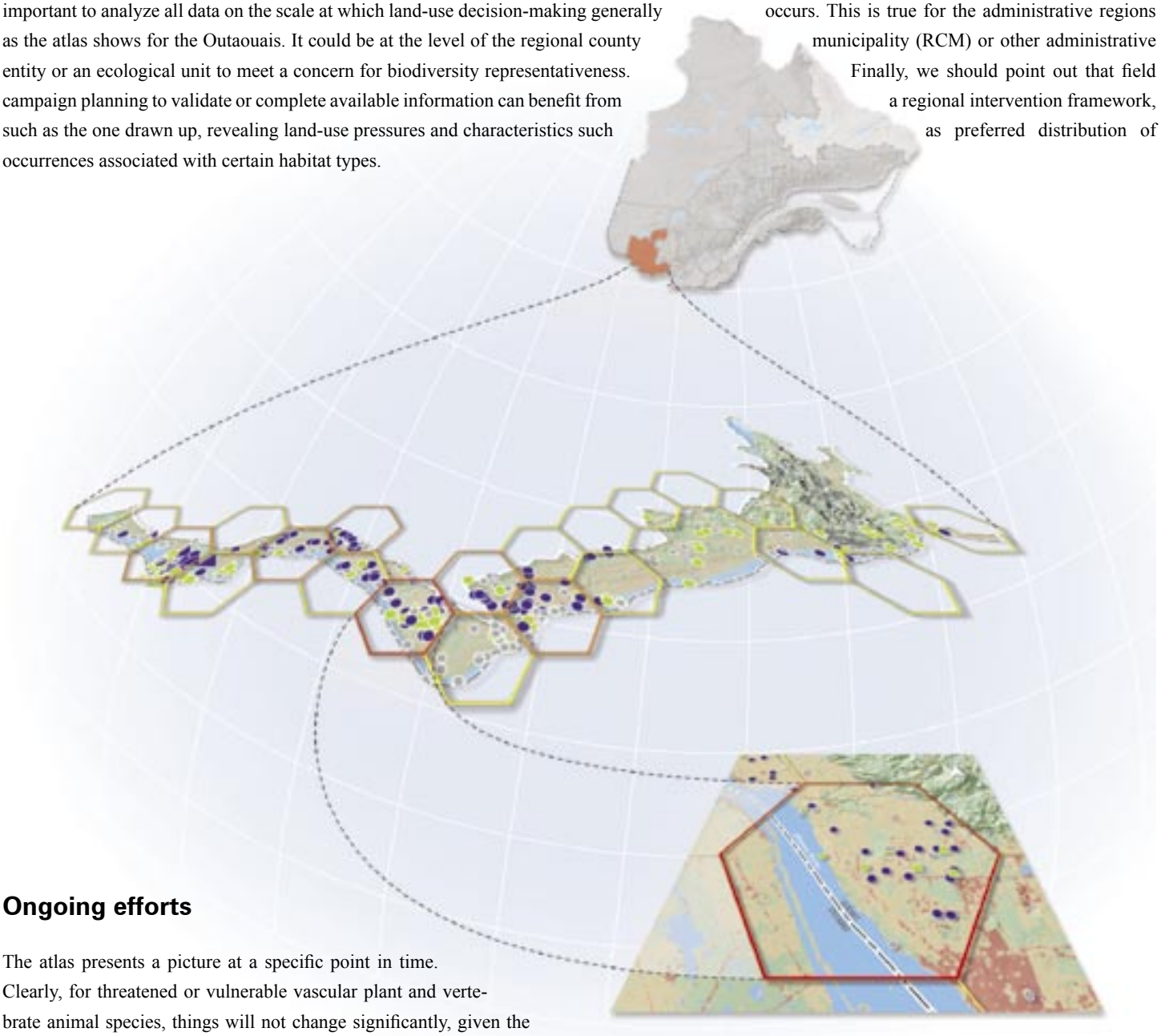


Conservation priorities

Inventorying requirements were also identified throughout Québec by locating historical occurrences and occurrences requiring further characterization. To be realistic, efforts must first target occurrences that are irreplaceables, as well as those associated with species assigned high priority or declining. Once again, precedence must be given to southern Québec.

Act locally

Over and above the need to protect important sectors, whose definition and accurate characterization requires examination on a more detailed scale—regional if not local, the question of considering threatened or vulnerable species in various intervention measures warrants particular attention. It is done on a daily basis and is a crucial, recurring task which the CDPNQ and its departmental regional representatives already fulfil through the follow-up performed on information requests and the case-by-case expert opinions issued. However, from a land management planning viewpoint, it is important to analyze all data on the scale at which land-use decision-making generally occurs. This is true for the administrative regions as the atlas shows for the Outaouais. It could be at the level of the regional county municipality (RCM) or other administrative entity or an ecological unit to meet a concern for biodiversity representativeness. Finally, we should point out that field campaign planning to validate or complete available information can benefit from a regional intervention framework, such as the one drawn up, revealing land-use pressures and characteristics such as preferred distribution of occurrences associated with certain habitat types.



Ongoing efforts

The atlas presents a picture at a specific point in time. Clearly, for threatened or vulnerable vascular plant and vertebrate animal species, things will not change significantly, given the substantial amount of data already validated. However, a broader analysis encompassing the other elements of biodiversity (other groups of species, natural communities, animal assemblages), could modify and considerably enhance analyses. This would definitely be desirable in the medium term. In the near future, it would be useful to hone the regional picture begun here and to repeat the exercise for the other regions, making information accessible in a user-friendly manner and adding guidelines for using it properly. In order to sustain protection proposals, it would be necessary to more closely characterize sites with the greatest biodiversity value. Further, it would be useful to characterize the potential for the presence of threatened or vulnerable species by habitat in order to better orient efforts to increase the existing body of knowledge.

List of Threatened, Vulnerable, Extinct and Extirpated Species in Québec

PLANTS

Scientific name *	Common name	Number of occurrences **	Status ***
Acer nigrum	Black Maple	88	likely to be designated
Achillea sibirica	Siberian Yarrow	1	likely to be designated
Adiantum aleuticum	Aleutian Maidenhair-fern	20	likely to be designated
Adiantum viridimontanum	Green Mountain Maidenhair-fern	30	likely to be designated
Adlumia fungosa	Climbing Fumitory	29	likely to be designated
Agastache nepetoides	Yellow Giant-hyssop	15	likely to be designated
Agoseris aurantiaca	Orange-flowered False-dandelion	4	likely to be designated
Agrimonia pubescens	Soft Groovebur	4	likely to be designated
Alchemilla filicaulis subsp. *filicaulis* -p09		7	likely to be designated
Alchemilla glomerulans	Clustered Lady's-mantle	7	likely to be designated
Allium canadense	Meadow Onion	23	likely to be designated
Allium tricoccum	Small White Leek	341	vulnerable
Alnus serrulata	Brook-side Alder	8	likely to be designated
Amelanchier sanguinea var. *grandiflora*		21	likely to be designated
Amerorchis rotundifolia	Round-leaved Orchis	40	likely to be designated
Antennaria howellii subsp. *gaspensis*		26	likely to be designated
Antennaria leuchippii		1	likely to be designated
Antennaria rosea	Rosy Pussy-toes	5	likely to be designated
Aplectrum hyemale	Puttyroot	6	threatened
Arabis boivinii		8	likely to be designated
Arabis canadensis	Sicklepod	2	likely to be designated
Arabis divaricarpa var. *dacotica*		1	likely to be designated
Arabis holboellii var. *retrofracta*	A Holboell Rock-cress	14	likely to be designated
Arabis holboellii var. *secunda*		9	likely to be designated
Arabis laevigata	Smooth Rock-cress	13	likely to be designated
Arctous rubra -p09	Red Manzanita	4	likely to be designated
Arethusa bulbosa	Swamp-pink	61	likely to be designated
Arisaema dracontium	Green Dragon	29	threatened
Arnica chamissonis subsp. *foliosa*		4	likely to be designated
Arnica griscomii subsp. *griscomii*		5	threatened
Arnica lanceolata	Arnica	54	likely to be designated
Arnica lonchophylla subsp. *lonchophylla*		31	likely to be designated
Artemisia tilesii subsp. *elatior*		3	likely to be designated
Asclepias exaltata	Poke Milkweed	4	likely to be designated
Asclepias tuberosa var. *interior*	Butterflyweed	2	likely to be designated
Aspidotis densa	A Pod-fern	6	likely to be designated
Asplenium platyneuron	Ebony Spleenwort	14	likely to be designated
Asplenium rhizophyllum	Walking-fern Spleenwort	61	likely to be designated
Asplenium ruta-muraria	Wall-rue Spleenwort	3	likely to be designated
Astragalus americanus	American Milk-vetch	12	likely to be designated
Astragalus australis		8	likely to be designated
Astragalus robbinsii var. *fernaldii*		4	threatened
Athyrium alpestre subsp. *americanum*	American Alpine Lady Fern	6	threatened
Bartonia virginica	Yellow Screwstem	19	likely to be designated
Bidens discoideus	Swamp Beggar-ticks	28	likely to be designated
Bidens eatonii	Eaton's Beggar-ticks	42	likely to be designated
Bidens heterodoxus	Connecticut Beggar-ticks	11	likely to be designated
Blephilia hirsuta var. *hirsuta*		1	extirpated/likely to be designated
Botrychium campestre	Prairie Dunewort	1	likely to be designated
Botrychium lineare		2	likely to be designated
Botrychium mormo		3	likely to be designated
Botrychium oneidense	Blunt-lobe Grape-fern	8	likely to be designated
Botrychium pallidum	Pale Moonwort	4	likely to be designated
Botrychium rugulosum	Rugulose Grape-fern	7	likely to be designated
Botrychium spathulatum	Spoon-leaf Moonwort	2	likely to be designated
Braya glabella var. *glabella*		5	likely to be designated

PLANTS			
Scientific name *	**Common name**	**Number of occurrences****	**Status *****
Bromus kalmii	Wild Chess	20	likely to be designated
Bromus pubescens	Hairy Wood Brome Grass	4	likely to be designated
Calamagrostis purpurascens	Purple Reedgrass	18	likely to be designated
Calypso bulbosa var. *americana*		62	likely to be designated
Canadanthus modestus	Great Northern Aster	5	likely to be designated
Cardamine bulbosa	Bulbous Bitter-cress	23	likely to be designated
Cardamine concatenata	Cutleaf Toothwort	66	likely to be designated
Carex annectens var. *xanthocarpa*		6	likely to be designated
Carex appalachica	Appalachian Sedge	32	likely to be designated
Carex argyrantha	Hay Sedge	12	likely to be designated
Carex atherodes	Awned Sedge	3	likely to be designated
Carex atlantica subsp. *capillacea*	Howe Sedge	3	likely to be designated
Carex backii	Rocky Mountain Sedge	42	likely to be designated
Carex baileyi	Bailey's Sedge	10	likely to be designated
Carex cephalophora	Oval-leaved Sedge	28	likely to be designated
Carex cumulata	Clustered Sedge	8	likely to be designated
Carex deweyana var. *collectanea*		4	likely to be designated
Carex digitalis	Slender Wood Sedge	2	likely to be designated
Carex folliculata	Long Sedge	33	likely to be designated
Carex formosa	Handsome Sedge	10	likely to be designated
Carex glacialis -p09	Alpine Sedge	1	likely to be designated
Carex hirsutella	Hirsute Sedge	11	likely to be designated
Carex hirtifolia	Pubescent Sedge	50	likely to be designated
Carex hitchcockiana	Hitchcock's Sedge	47	likely to be designated
Carex hostiana	Host Sedge	24	likely to be designated
Carex lapponica		4	likely to be designated
Carex laxiculmis	Spreading Sedge	4	likely to be designated
Carex lupuliformis	False Hop Sedge	11	threatened
Carex macloviana -p11	Falkland Island Sedge	4	likely to be designated
Carex mesochorea	Midland Sedge	1	likely to be designated
Carex molesta	Troublesome Sedge	5	likely to be designated
Carex muehlenbergii	Muhlenberg's Sedge	8	likely to be designated
Carex oligocarpa	Eastern Few-fruit Sedge	1	likely to be designated
Carex petricosa var. *misandroides*		13	likely to be designated
Carex platyphylla	Broad-leaved Sedge	43	likely to be designated
Carex prairea	Prairie Sedge	12	likely to be designated
Carex richardsonii	Richardson's Sedge	1	likely to be designated
Carex sartwellii	Sartwell's Sedge	8	likely to be designated
Carex siccata	Dry-spike Sedge	4	likely to be designated
Carex sparganioides	Bur-reed Sedge	41	likely to be designated
Carex swanii	Swan Sedge	19	likely to be designated
Carex sychnocephala	Many-headed Sedge	8	likely to be designated
Carex trichocarpa	Hairy-fruit Sedge	3	likely to be designated
Castilleja raupii	Raup Indian-paintbrush	21	likely to be designated
Ceanothus americanus	New Jersey Tea	33	likely to be designated
Ceanothus herbaceus	Prairie Redroot	20	likely to be designated
Celtis occidentalis	Common Hackberry	107	likely to be designated
Cerastium cerastioides -p01, p11	Starwort Chickweed	3	likely to be designated
Cerastium nutans var. *nutans*		11	likely to be designated
Ceratophyllum echinatum	Prickly Hornwort	29	likely to be designated
Chamaesyce polygonifolia	Seaside Spurge	1	likely to be designated
Chenopodium foggii	Fogg's Goosefoot	2	likely to be designated
Chimaphila maculata	Spotted Wintergreen	1	likely to be designated
Cicuta maculata var. *victorinii*		38	threatened
Cirsium muticum var. *monticolum*		7	likely to be designated
Cirsium scariosum	Drummond Thistle	9	threatened
Claytonia virginica	Narrow-leaved Spring Beauty	31	likely to be designated
Conopholis americana	Squaw-root	24	likely to be designated

PLANTS			
Scientific name *	**Common name**	**Number of occurrences ****	**Status *****
Corallorhiza odontorhiza var. *pringlei*		2	threatened
Corallorhiza striata var. *striata*	A Striped Coral-root	23	likely to be designated
Corallorhiza striata var. *vreelandii*		1	likely to be designated
Corema conradii	Broom Crowberry	5	threatened
Corydalis aurea subsp. *aurea*	Golden Corydalis	19	likely to be designated
Corylus americana	American Hazelnut	5	likely to be designated
Crataegus brainerdii	Brainerd Hawthorn	3	likely to be designated
Crataegus crus-galli	Cockspur Hawthorn	3	likely to be designated
Crataegus dilatata	A Hawthorn	3	likely to be designated
Crataegus pruinosa var. *pruinosa*		1	likely to be designated
Crataegus suborbiculata	A Hawthorn	1	likely to be designated
Cyperus lupulinus subsp. *macilentus*		23	likely to be designated
Cyperus odoratus var. *engelmannii*	Engelmann's Umbrella-sedge	25	likely to be designated
Cypripedium arietinum	Ram's-head Lady's-slipper	38	vulnerable
Cypripedium parviflorum var. *planipetalum*	Flat-petal Lady's-slipper	11	likely to be designated
Cypripedium passerinum	Sparrow's-egg Lady's-slipper	7	threatened
Cypripedium reginae	Showy Lady's-slipper	85	likely to be designated
Deschampsia brevifolia	Short-Leaf Hair Grass	4	likely to be designated
Deschampsia cespitosa subsp. *alpina*	Alpine Hair Grass	2	likely to be designated
Deschampsia paramushirensis		5	likely to be designated
Desmodium nudiflorum	Bare-stemmed Tick-trefoil	30	likely to be designated
Desmodium paniculatum	Narrow-leaf Tick-trefoil	2	likely to be designated
Draba aurea -p01, p09	Golden Draba	8	likely to be designated
Draba corymbosa	Flat-top Whitlow-grass	4	likely to be designated
Draba crassifolia	Snowbed Whitlow-grass	13	likely to be designated
Draba nemorosa	Wood Whitlow-grass	6	likely to be designated
Draba peasei		1	extinct/likely to be designated
Draba pycnosperma	Dense Withlowgrass	13	likely to be designated
Drosera linearis	Slenderleaf Sundew	23	likely to be designated
Dryopteris clintoniana	Clinton Woodfern	77	likely to be designated
Dryopteris filix-mas	Male Fern	27	likely to be designated
Echinochloa walteri	Walter's Barnyard Grass	3	likely to be designated
Elaeagnus commutata	American Silverberry	25	likely to be designated
Eleocharis robbinsii	Robbins Spikerush	16	likely to be designated
Elymus riparius	River Wild Rye	41	likely to be designated
Elymus villosus	Hairy Wild Rye	4	likely to be designated
Epilobium arcticum		2	likely to be designated
Epilobium ciliatum var. *ecomosum*	Hairy Willow-herb	28	likely to be designated
Eragrostis hypnoides	Teal Love Grass	33	likely to be designated
Erigeron compositus	Dwarf Mountain Fleabane	10	likely to be designated
Erigeron hyssopifolius var. *villicaulis*		2	likely to be designated
Erigeron lonchophyllus	Short-Ray Fleabane	15	likely to be designated
Erigeron philadelphicus subsp. *provancheri*		7	likely to be designated
Eriocaulon parkeri	Parker's Pipewort	24	threatened
Erysimum inconspicuum var. *coarctatum*		21	likely to be designated
Eurybia divaricata	White Wood-aster	11	likely to be designated
Festuca altaica -p01, p11, p12	Rough Fescue	5	likely to be designated
Festuca baffinensis -p11	Baffin Fescue	3	likely to be designated
Festuca frederikseniae		6	likely to be designated
Festuca hyperborea	Boreal Fescue	6	likely to be designated
Fimbristylis autumnalis	Slender Fimbry	12	likely to be designated
Floerkea proserpinacoides	False Mermaid-weed	18	likely to be designated
Galearis spectabilis	Showy Orchis	68	likely to be designated
Galium circaezans	Wild Licorice	27	likely to be designated
Gaura biennis	Biennial Gaura	2	likely to be designated
Gaylussacia dumosa var. *bigeloviana*	Northern Dwarf Huckleberry	5	threatened
Gentiana clausa	Closed Gentian	6	likely to be designated
Gentiana nivalis	Snow Gentian	2	likely to be designated

PLANTS			
Scientific name *	**Common name**	**Number of occurrences ****	**Status *****
Gentianella propinqua subsp. *propinqua* -p09, p11		6	likely to be designated
Gentianopsis crinita	Fringed Gentian	10	likely to be designated
Gentianopsis nesophila -p09	Island Gentian	33	likely to be designated
Gentianopsis procera subsp. *macounii* var. *macounii*	Macoun's Gentian	6	threatened
Gentianopsis procera subsp. *macounii* var. *victorinii*	Victorin's Gentian	48	threatened
Geranium maculatum	Wild Crane's-bill	2	likely to be designated
Gnaphalium norvegicum -p01, p09, p11	Norwegian cudweed	11	likely to be designated
Goodyera pubescens	Downy Rattlesnake-plantain	40	likely to be designated
Gratiola aurea	Golden Hedge-hyssop	25	likely to be designated
Gratiola neglecta var. *glaberrima*		21	likely to be designated
Gymnocarpium jessoense subsp. *parvulum*		3	likely to be designated
Halenia deflexa subsp. *brentoniana*		15	likely to be designated
Hedeoma hispida		7	likely to be designated
Hedysarum boreale subsp. *mackenziei*		7	likely to be designated
Helianthemum canadense	Canada Frostweed	1	likely to be designated
Helianthus divaricatus	Woodland Sunflower	17	vulnerable
Hieracium robinsonii	Robinson's Hawkweed	16	likely to be designated
Hordeum brachyantherum	Meadow Barley	1	likely to be designated
Houstonia longifolia	Longleaf Bluet	1	likely to be designated
Hudsonia tomentosa	Sand-heather	60	likely to be designated
Hydrophyllum canadense	Blunt-leaf Waterleaf	2	likely to be designated
Hypericum kalmianum	Kalm's St. John's-wort	10	likely to be designated
Ionactis linariifolius	Flaxleaf Aster	17	likely to be designated
Iris virginica var. *shrevei*	Southern Blueflag	11	likely to be designated
Isoetes tuckermanii	Tuckerman's Quillwort	38	likely to be designated
Juncus acuminatus	Sharp-fruit Rush	2	likely to be designated
Juncus ensifolius	Three-stamened Rush	2	likely to be designated
Juncus greenei	Greene's Rush	8	likely to be designated
Juncus longistylis	Long-styled Rush	2	likely to be designated
Juniperus virginiana var. *virginiana*	Eastern Red-cedar	31	likely to be designated
Justicia americana	Common Water-willow	12	threatened
Lactuca hirsuta var. *sanguinea*	Hairy Wild Lettuce	9	likely to be designated
Lactuca tatarica var. *pulchella*	Blue Lettuce	6	likely to be designated
Lathyrus ochroleucus	Pale Vetchling Peavine	38	likely to be designated
Lathyrus venosus var. *intonsus*	Veiny Pea	1	likely to be designated
Lesquerella arctica	Artic Bladderpod	7	likely to be designated
Leucanthemum integrifolium	Entire-leaf Daisy	1	likely to be designated
Lindernia dubia var. *inundata*	False-pimpernel	36	likely to be designated
Lipocarpha micrantha	Dwarf Bulrush	1	likely to be designated
Listera australis	Southern Twayblade	21	likely to be designated
Listera borealis	Northern Twayblade	11	likely to be designated
Lycopus americanus var. *laurentianus*		44	likely to be designated
Lycopus asper	Rough Bugleweed	12	likely to be designated
Lycopus virginicus	Virginia Bugleweed	12	likely to be designated
Lysimachia hybrida	Lance-leaf Loosestrife	34	likely to be designated
Lysimachia quadrifolia	Whorled Loosestrife	6	likely to be designated
Melica smithii	Smith Melic Grass	1	likely to be designated
Mimulus glabratus var. *jamesii*		3	likely to be designated
Minuartia marcescens	Serpentine Stitchwort	2	threatened
Minuartia michauxii	Michaux's Stitchwort	11	likely to be designated
Moehringia macrophylla -p01, p05, p11, p12	Large-leaved Sandwort	16	likely to be designated
Monarda punctata var. *villicaulis*	Horsemint	1	likely to be designated
Muhlenbergia richardsonis	Soft-leaf Muhly	15	likely to be designated
Muhlenbergia sylvatica	Woodland Muhly	9	likely to be designated
Muhlenbergia tenuiflora var. *tenuiflora*		2	likely to be designated
Myosotis verna	Spring Forget-me-not	1	likely to be designated
Myriophyllum heterophyllum	Broadleaf Water-milfoil	10	likely to be designated
Myriophyllum humile	Low Water-milfoil	4	likely to be designated

PLANTS			
Scientific name *	**Common name**	**Number of occurrences ****	**Status *****
Najas guadalupensis subsp. *olivacea*	Southern Naiad	5	likely to be designated
Neobeckia aquatica	Lake-cress	17	likely to be designated
Neotorularia humilis		8	likely to be designated
Nymphaea leibergii	Dwarf Water-lily	21	likely to be designated
Oenothera pilosella subsp. *pilosella*		1	likely to be designated
Onosmodium bejariense var. *hispidissimum*	Hairy False Gromwell	1	likely to be designated
Oxytropis deflexa var. *foliolosa* -p11	Pendent-pod Crazyweed	2	likely to be designated
Oxytropis hudsonica		7	likely to be designated
Oxytropis viscida	Boreal Locoweed	1	likely to be designated
Packera cymbalaria	Dwarf Arctic Groundsel	4	threatened
Packera obovata	Roundleaf Groundsel	1	likely to be designated
Panax quinquefolius	American Ginseng	124	threatened
Panicum depauperatum var. *depauperatum*		1	likely to be designated
Panicum flexile	Wiry Witch Grass	13	likely to be designated
Panicum philadelphicum	Philadelphia Panic Grass	21	likely to be designated
Panicum virgatum	Old Switch Panic Grass	20	likely to be designated
Pedicularis sudetica subsp. *interioides*		12	likely to be designated
Pellaea atropurpurea	Purple-stem Cliff-brake	11	likely to be designated
Pellaea glabella subsp. *glabella*		5	likely to be designated
Peltandra virginica	Green Arrow-arum	5	likely to be designated
Phegopteris hexagonoptera	Broad Beech Fern	16	threatened
Physostegia virginiana var. *granulosa*		11	likely to be designated
Phytolacca americana	Common Pokeweed	13	likely to be designated
Pinus rigida	Pitch Pine	3	likely to be designated
Platanthera blephariglottis var. *blephariglottis*		76	likely to be designated
Platanthera flava var. *herbiola*	Pale Green Orchid	45	likely to be designated
Platanthera foetida	Alaskan Rein-orchid	4	likely to be designated
Platanthera macrophylla	Large Round-leaved Orchid	46	likely to be designated
Poa hartzii	Hartz Bluegrass	1	likely to be designated
Poa languida	Drooping Bluegrass	4	likely to be designated
Poa laxa subsp. *fernaldiana*	Wavy Bluegrass	7	likely to be designated
Poa secunda	Curly Bluegrass	5	likely to be designated
Podophyllum peltatum	May Apple	7	threatened
Podostemum ceratophyllum	Threadfoot	23	likely to be designated
Polanisia dodecandra subsp. *dodecandra*		7	likely to be designated
Polemonium vanbruntiae	Jacob's Ladder	12	threatened
Polygala polygama var. *obtusata*	Purple Milwort	9	likely to be designated
Polygala senega	Seneca Snakeroot	38	likely to be designated
Polygonella articulata	Eastern Jointweed	12	likely to be designated
Polygonum careyi	Carey's Smartweed	3	likely to be designated
Polygonum douglasii subsp. *douglasii*		18	vulnerable
Polygonum hydropiperoides var. *hydropiperoides*	Mild Water-pepper	40	likely to be designated
Polygonum punctatum var. *parvum*		32	likely to be designated
Polygonum robustius	Stout Smartweed	3	likely to be designated
Polystichum lonchitis	Northern Holly-fern	40	likely to be designated
Polystichum scopulinum	Mountain Holly-fern	1	threatened
Potamogeton illinoensis	Illinois Pondweed	26	likely to be designated
Potamogeton pusillus subsp. *gemmiparus*	Budding Pondweed	5	likely to be designated
Potamogeton vaseyi	Vasey's Pondweed	23	likely to be designated
Potentilla prostrata subsp. *chamissonis*		2	likely to be designated
Potentilla vahliana	Vahl's Cinquefoil	2	likely to be designated
Proserpinaca palustris	Marsh Mermaid-weed	17	likely to be designated
Pseudorchis straminea	Vanilla-scent Bogorchid	2	likely to be designated
Pterospora andromedea	Giant Pinedrops	25	likely to be designated
Puccinellia angustata		1	likely to be designated
Puccinellia deschampsioides	Polar Alkali Grass	1	likely to be designated
Pycnanthemum virginianum	Virginia Mountain-mint	36	likely to be designated
Quercus alba	White Oak	66	likely to be designated

PLANTS			
Scientific name *	**Common name**	**Number of occurrences ****	**Status *****
Quercus bicolor	Swamp White Oak	42	likely to be designated
Ranunculus allenii	Allen Buttercup	4	likely to be designated
Ranunculus flabellaris	Yellow Water-crowfoot	50	likely to be designated
Ranunculus rhomboideus	Prairie Buttercup	1	likely to be designated
Ranunculus sulphureus	Sulphur Butter-cup	1	likely to be designated
Rhus aromatica var. *aromatica*	Fragrant Sumac	20	vulnerable
Rhus glabra	Smooth Sumac	1	likely to be designated
Rhynchospora capillacea	Horned Beakrush	7	likely to be designated
Rhynchospora capitellata	Brownish Beakrush	15	likely to be designated
Ribes oxyacanthoides subsp. *oxyacanthoides*		4	likely to be designated
Rubus flagellaris	Northern Dewberry	23	likely to be designated
Sagina nodosa subsp. *nodosa*	Knotted Pearlwort	5	likely to be designated
Sagina saginoides -p01, p11	Arctic Pearlwort	4	likely to be designated
Sagittaria montevidensis subsp. *spongiosa*	Spongy Arrow-head	3	threatened
Salix arbusculoides	A Willow	4	likely to be designated
Salix chlorolepis	Green-scaled Willow	1	threatened
Salix maccalliana	Mccall's Willow	12	likely to be designated
Salix pseudomonticola	False Mountain Willow	2	likely to be designated
Samolus valerandi subsp. *parviflorus*	Water Pimpernel	4	likely to be designated
Sanicula canadensis var. *canadensis*		3	likely to be designated
Saururus cernuus	Lizard's Tail	12	likely to be designated
Saxifraga gaspensis		5	likely to be designated
Schoenoplectus heterochaetus	Slender Bulrush	24	likely to be designated
Schoenoplectus purshianus	Weakstalk Bulrush	3	likely to be designated
Schoenoplectus torreyi	Torrey's Bulrush	41	likely to be designated
Scirpus ancistrochaetus	Northeastern Bulrush	1	likely to be designated
Scirpus pendulus	Pendulous Bulrush	26	likely to be designated
Sedum villosum	Purple Stonecrop	9	likely to be designated
Selaginella eclipes	Hidden Spike-moss	24	likely to be designated
Solidago ptarmicoides	Prairie Goldenrod	34	likely to be designated
Solidago simplex subsp. *randii* var. *monticola*	Mountain Goldenrod	17	likely to be designated
Solidago simplex subsp. *randii* var. *racemosa*	Lake Ontario Goldenrod	19	likely to be designated
Solidago simplex subsp. *simplex* var. *chlorolepis*		2	threatened
Solidago simplex subsp. *simplex* var. *simplex*		1	likely to be designated
Sorghastrum nutans	Yellow Indiangrass	65	likely to be designated
Sparganium androcladum	Branching Bur-reed	24	likely to be designated
Sparganium glomeratum	Northern Bur-reed	1	likely to be designated
Spiranthes casei var. *casei*		8	likely to be designated
Spiranthes lucida	Shining Ladies'-tresses	25	likely to be designated
Sporobolus compositus var. *compositus*	Tall Dropseed	5	likely to be designated
Sporobolus cryptandrus	Sand Dropseed	12	likely to be designated
Sporobolus heterolepis	Northern Dropseed	11	likely to be designated
Sporobolus vaginiflorus var. *vaginiflorus*	Poverty Dropseed	6	likely to be designated
Staphylea trifolia	American Bladdernut	68	likely to be designated
Stellaria alsine	Trailing Stitchwort	5	likely to be designated
Strophostyles helvula	Trailing Wild Bean	23	likely to be designated
Symphyotrichum anticostense	Aster d'Anticosti	11	threatened
Symphyotrichum lanceolatum subsp. *lanceolatum* var. *interior*		2	likely to be designated
Symphyotrichum laurentianum	St. Lawrence Aster	15	threatened
Symphyotrichum novi-belgii var. *villicaule*		5	likely to be designated
Symphyotrichum pilosum var. *pringlei*		3	likely to be designated
Taenidia integerrima	Yellow Pimpernel	6	likely to be designated
Taraxacum latilobum	Broad-lobe Dandelion	11	likely to be designated
Taraxacum laurentianum	St. Lawrence Dandelion	8	likely to be designated
Thalictrum dasycarpum	Purple Meadowrue	4	likely to be designated
Thalictrum revolutum	Waxleaf Meadowrue	1	likely to be designated
Thelypteris simulata	Bog Fern	3	threatened
Tofieldia coccinea	Northern False-asphodel	2	likely to be designated

PLANTS

Scientific name *	Common name	Number of occurrences **	Status ***
Torreyochloa pallida var. *pallida*	Pale Manna Grass	7	likely to be designated
Toxicodendron vernix	Poison Sumac	11	likely to be designated
Triadenum virginicum	Marsh St. John's Wort	4	likely to be designated
Trichophorum clintonii	Clinton Bulrush	27	likely to be designated
Trichophorum pumilum	Rolland's Leafless-bulrush	15	likely to be designated
Trichostema brachiatum	False Pennyroyal	9	likely to be designated
Trichostema dichotomum	Forked Bluecurls	2	likely to be designated
Triglochin gaspensis	Gaspe Peninsula Arrow-grass	39	likely to be designated
Ulmus thomasii	Rock Elm	67	likely to be designated
Utricularia geminiscapa	Hidden-fruited Bladderwort	24	likely to be designated
Utricularia gibba	Humped Bladderwort	32	likely to be designated
Utricularia resupinata	Northeastern Bladderwort	24	likely to be designated
Valeriana uliginosa	Marsh Valerian	38	likely to be designated
Verbena simplex	Narrow-leaved Vervain	6	likely to be designated
Veronica anagallis-aquatica	Brook-pimpernell	12	likely to be designated
Viburnum recognitum	Northern Arrow-wood	7	likely to be designated
Vicia americana	American Purple Vetch	16	likely to be designated
Viola affinis	Leconte's Violet	33	likely to be designated
Viola rostrata	Long-spur Violet	15	likely to be designated
Viola sagittata var. *ovata*		4	likely to be designated
Viola sagittata var. *sagittata*		1	likely to be designated
Wolffia borealis	Dotted Watermeal	10	likely to be designated
Wolffia columbiana	Columbian Watermeal	24	likely to be designated
Woodsia obtusa subsp. *obtusa*		5	likely to be designated
Woodsia oregana subsp. *cathcartiana*	Oregon Woodsia (Tetraploid)	6	likely to be designated
Woodsia scopulina subsp. *laurentiana*		7	likely to be designated
Woodwardia virginica	Virginia Chainfern	43	likely to be designated
Zizania aquatica var. *aquatica*	Indian Wild Rice	26	likely to be designated
Zizania aquatica var. *brevis*		64	likely to be designated

ANIMALS

Scientific name	Common name	Number of occurrences **	Status ***
Acipenser fulvescens	Lake Sturgeon	17	likely to be designated
Acipenser oxyrinchus	Atlantic Sturgeon	3	likely to be designated
Alosa sapidissima	American Shad	19	vulnerable
Ammocrypta pellucida	Eastern Sand Darter	1	likely to be designated
Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow	8	likely to be designated
Ammodramus savannarum	Grasshopper Sparrow	16	likely to be designated
Apalone spinifera	Spiny Softshell	20	threatened
Aquila chrysaetos	Golden Eagle	61	likely to be designated
Asio flammeus	Short-eared Owl	20	likely to be designated
Balaenoptera musculus	Blue Whale		likely to be designated
Balaenoptera physalus	Fin Whale		likely to be designated
Bucephala islandica	Barrow's Goldeneye	2	likely to be designated
Camptorhynchus labradorius	Labrador Duck		not tracked/extinct
Catharus bicknelli	Bicknell's Thrush		likely to be designated
Cervus elaphus	Elk		not tracked/extirpated
Charadrius melodus	Piping Plover	43	threatened
Cistothorus platensis	Sedge Wren	27	likely to be designated
Clemmys guttata	Spotted Turtle	3	likely to be designated
Coregonus artedi pop. 1	Spring Cisco		likely to be designated
Coturnicops noveboracensis	Yellow Rail	13	likely to be designated
Cygnus buccinator	Trumpeter Swan		not tracked/extirpated
Delphinapterus leucas pop. 1	Beluga - Eastern Hudson Bay		likely to be designated

ANIMALS			
Scientific name	**Common name**	**Number of occurrences ****	**Status *****
Delphinapterus leucas pop. 2	Beluga - Ungava Bay		likely to be designated
Delphinapterus leucas pop. 3	Beluga - St. Lawrence Estuary Population		threatened
Dendroica cerulea	Cerulean Warbler	12	likely to be designated
Dermochelys coriacea	Leatherback	3	likely to be designated
Desmognathus fuscus	Dusky Salamander	151	likely to be designated
Desmognathus ochrophaeus	Allegheny Mountain Dusky Salamander	6	likely to be designated
Ectopistes migratorius	Passenger Pigeon		not tracked/extinct
Emydoidea blandingii	Blanding's Turtle	38	likely to be designated
Esox americanus vermiculatus	Grass Pickerel	4	likely to be designated
Etheostoma caeruleum	Rainbow Darter	1	likely to be designated
Eubalaena glacialis	Right Whale		likely to be designated
Falco peregrinus anatum	American Peregrine Falcon	44	vulnerable
Felis concolor couguar	Puma	3	likely to be designated
Glaucomys volans	Southern Flying Squirrel	10	likely to be designated
Glyptemys insculpta	Wood Turtle	192	likely to be designated
Graptemys geographica	Common Map Turtle	87	likely to be designated
Gulo gulo	Wolverine	16	threatened
Gyrinophilus porphyriticus	Spring Salamander	73	likely to be designated
Haliaeetus leucocephalus	Bald Eagle	156	vulnerable
Hemidactylium scutatum	Four-toed Salamander	21	likely to be designated
Histrionicus histrionicus	Harlequin Duck - Eastern Population	3	likely to be designated
Hybognathus hankinsoni	Brassy Minnow	7	likely to be designated
Ichthyomyzon fossor	Northern Brook Lamprey	4	likely to be designated
Ixobrychus exilis	Least Bittern	17	likely to be designated
Lampropeltis triangulum	Milk Snake	63	likely to be designated
Lanius ludovicianus	Loggerhead Shrike	70	threatened
Lasionyct eris noctivagans	Silver-haired Bat	11	likely to be designated
Lasiurus borealis	Eastern Red Bat	10	likely to be designated
Lasiurus cinereus	Hoary Bat	6	likely to be designated
Lynx canadensis	Canada Lynx		likely to be designated
Lynx rufus	Bobcat	39	likely to be designated
Megaptera novaeangliae	Humpback Whale		likely to be designated
Melanerpes erythrocephalus	Red-headed Woodpecker	26	likely to be designated
Microtus chrotorrhinus	Rock Vole	31	likely to be designated
Microtus pinetorum	Woodland Vole	4	likely to be designated
Morone saxatilis	Striped Bass		not tracked/extirpated
Moxostoma carinatum	River Redhorse	9	likely to be designated
Moxostoma hubbsi	Copper Redhorse	11	threatened
Mustela nivalis	Least Weasel	6	likely to be designated
Nerodia sipedon	Northern Water Snake	116	likely to be designated
Notropis bifrenatus	Bridle Shiner	18	likely to be designated
Noturus insignis	Margined Madtom	3	likely to be designated
Numenius borealis	Eskimo Curlew		not tracked/extirpated
Osmerus mordax pop. 1	Rainbow smelt - St. Lawrence southern estuary	8	likely to be designated
Percina copelandi	Channel Darter	68	likely to be designated
Phoca vitulina mellonae	Lacs de Loups Marins Harbor Seal		likely to be designated
Pinguinus impennis	Great Auk		not tracked/extinct
Pipistrellus subflavus	Eastern Pipistrelle	13	likely to be designated
Podiceps auritus	Horned Grebe	11	threatened
Podiceps grisegena	Red-necked Grebe	7	likely to be designated
Pseudacris triseriata	Western Chorus Frog	268	vulnerable
Rana palustris	Pickerel Frog	177	likely to be designated
Rangifer tarandus pop. 2	Caribou - Gaspe Peninsula	77	vulnerable
Rangifer tarandus pop. 3	Caribou - Abitibi Region		likely to be designated
Salvelinus alpinus oquassa	Landlocked Arctic Char	144	likely to be designated
Sorex fumeus	Smoky Shrew	101	likely to be designated
Sorex gaspensis	Gaspe Shrew	10	likely to be designated
Sorex hoyi	Pygmy Shrew	38	likely to be designated

ANIMALS			
Scientific name *	**Common name**	**Number of occurrences ****	**Status *****
Sterna caspia	Caspian Tern	6	likely to be designated
Sterna dougallii	Roseate Tern	5	likely to be designated
Sternotherus odoratus	Common Musk Turtle	2	likely to be designated
Storeria dekayi	Brown Snake	67	likely to be designated
Synaptomys cooperi	Southern Bog Lemming	57	likely to be designated
Ursus maritimus	Polar Bear		likely to be designated
Vermivora chrysoptera	Golden-winged Warbler	8	likely to be designated

* The symbol p (population) followed by a number corresponding to the administrative region of Québec (Gouvernement du Québec, 1998) and following the scientific name indicates a threatened or vulnerable species only in this portion of its Québec range: p01: Bas-Saint-Laurent; p05: Estrie; p09: Côte-Nord; p11: Gaspésie–Îles-de-la-Madeleine; p12: Chaudière–Appalaches.

** Including occurrences excluded from analysis.

*** Likely to be designated = likely to be designated threatened or vulnerable.

Note

The data used for the analyses in this atlas date from December 2004. Since that time, 6 animal species and 25 plant species were designated threatened or vulnerable.

The 6 animal species designated vulnerable are: *Aquila chrysaetos*, *Rangifer tarandus* (pop. 3), *Osmerus mordax*, *Percina copelandi*, *Glyptemys insculpta* and *Graptemys geographica*.

The following 14 plant species were designated threatened: *Asclepias tuberosa* var. *interior*, *Aspidotis densa*, *Asplenium ruta-muraria*, *Erigeron philadelphicus* subsp. *provancheri*, *Eurybia divaricata*, *Muhlenbergia tenuiflora* var. *tenuiflora*, *Onosmodium bejariense* var. *hispidissimum*, *Packera obovata*, *Pinus rigida*, *Pterospora andromedea*, *Saururus cernuus*, *Ulmus thomasii*, *Verbena simplex* and *Woodsia obtusa* subsp. *obtusa*.

The other 11 plant species were designated vulnerable: *Floerkea proserpinacoides*, *Valeriana uliginosa* and 9 common plants not tracked by the CDPNQ, targeted by restrictive regulations due to their sensitivity to commercial harvesting for horticultural or other purposes (*Adiantum pedatum*, *Asarum canadense*, *Cardamine diphylla*, *Cardamine maxima*, *Lilium canadense*, *Matteuccia struthiopteris*, *Sanguinaria canadensis*, *Trillium grandiflorum* and *Uvularia grandiflora*).

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