COSEWIC
Assessment and Update Status Report

on the

Van Brunt's Jacob's-ladder
Polemonium vanbruntiae

in Canada

THREATENED
2002

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE IN
CANADA

COSEPAC
COMITÉ SUR LA SITUATION DES
ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Previous report:

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Production note: COSEWIC would like to acknowledge André Sabourin for writing the status report on Van Brunt's Jacob's ladder *Polemonium vanbruntiae*, prepared under contract with Environment Canada. Van Brunt's Jacob's ladder *Polemonium vanbruntiae* was formerly listed as van Brunt's Jacob's-ladder *Polemonium vanbruntiae*

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Van Brunt's Jacob's-ladder — Rejean Roy.

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COSEWIC
Assessment Summary

Assessment Summary – November 2002

Common name
Van Brunt's Jacob's-ladder

Scientific name
Polemonium vanbruntiae

Status
Threatened

Reason for designation
Few extant populations occupying very small habitats at risk from agricultural impacts, logging and other development pressures, and recreational activities.

Occurrence
Quebec

Status history
Designated Threatened in April 1994. Status re-examined and confirmed in November 2002. Last assessment based on an update status report.

COSEWIC
Executive Summary

Van Brunt's Jacob's-ladder
Polemonium vanbruntiae

Information on the species

Van Brunt's Jacob's-ladder (*Polemonium vanbruntiae*) is an herbaceous perennial of the Polemoniaceae. The stems are upright, 40 to 140 cm tall. The leaves are composed of 7 to 21 ovate to oblong leaflets. The panicled flowers, which are blue-violet in colour, are 15 to 25 mm in diameter and have 5 petals and 5 sepals; the stamens are yellow and strongly exserted. The fruit is an ovoid capsule containing brownish-black seeds.

Distribution

Van Brunt's Jacob's-ladder is endemic to the central Appalachians. It is found from West Virginia to the southernmost part of Quebec and eastern Maine. In Canada, this species is only known to occur in the Eastern Townships and Bois-Francs regions of Quebec, at the bottom of the Nicolet and Stoke River valleys. There is also a historic record for New Brunswick.

Habitat

This plant is found in moist habitats such as riparian alder thickets, wet clearings, riparian herbaceous meadows and old fields with sufficient moisture. These are open or semi-open habitats, subject to flooding in the spring, with rich soils, often located near the bottom of slopes or near streams. This montane species occurs in rather cool microclimates.

Biology

The species reproduces by seed or by rhizomes (vegetatively). The flowers are pollinated by a wide variety of insects, mainly honey bees and bumblebees. Seed germination occurs only after a period of cold, dry conditions.

Population sizes and trends

Currently, there are only 8 known Canadian populations, all found in Quebec, for a total of approximately 20,000 plants. Although two new populations were discovered in

Quebec in 2001, two other populations are considered to have disappeared, and the species is declining both in its extent of occurrence and its area of occupancy.

Limiting factors and threats

Encroachment by the farming and logging industries represents the main limiting factor and threat to Van Brunt's Jacob's-ladder. These industries have caused the decline or extirpation of some populations. Road construction and other projects altering drainage can also be detrimental, if they cause prolonged flooding or drying-up of the habitat.

Special significance of the species

Van Brunt's Jacob's-ladder is the only species of genus *Polemonium* that is native to Canada east of Alberta. It is rare and sporadic over its entire range. It has primitive characteristics and may be a relict species. Its great beauty gives the species a horticultural potential for wetland gardens.

Existing protection or other status designations

This plant is not found on any Canadian protected public land. However, an important site has just been purchased by a private conservation agency, and negotiations are either under way or planned for the purchase of other sites by the same agency. The species has been designated threatened in both Canada and Quebec, where it falls under the provincial *Threatened or Vulnerable Species Act*.

Summary of the status report

Although *Polemonium vanbruntiae* is threatened in Canada and is generally on the decline, new populations have been discovered recently, and potential sites still need to be explored. Moreover, conservation measures have recently begun to take shape, and they should, at the very least, stabilize the status of this species.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.
** Formerly described as “Not In Any Category”, or “No Designation Required.”
*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list.

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Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

Update
COSEWIC Status Report

on the

Van Brunt's Jacob's-ladder
Polemonium vanbruntiae

in Canada

2002

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SPECIES INFORMATION

Name and classification

Scientific name:	*Polemonium vanbruntiae* Britton
Relevant synonyms:	*Polemonium van-bruntiae* Britton *Polemonium caeruleum* L. subsp. *vanbruntiae* (Britt.) Davidson
Name of the order:	Solanales
Name of the family:	Polemoniaceae
French common names:	polémoine de Van Brunt, polémonium de Van Brunt
English common names:	Van Brunt's Jacob's-ladder, Appalachian Jacob's-ladder, Eastern Jacob's-ladder

Comment on the taxonomy: Until just recently, the specific epithet van-bruntiae was used in the scientific name. The epithet vanbruntiae, which complies with the International Code of Botanical Nomenclature, was officially used by the Ministère de l'Environnement du Québec for the first time in 1998 (Couillard, 1998; Gouvernement du Québec, 1998), but it had already been used by American authors (Johnson and Murray, 1988; Thompson, 1991).

Description

Herbaceous perennial emerging from a horizontal rhizome. Stems upright, 40-140 cm tall, glabrous, robust and single. Leaves alternate, compound, 2-50 cm long and 1.5-10 cm wide, glabrous; leaflets shortly petiolate, opposite or almost opposite, 1-3.5 cm apart, acuminate, entire; lower leaves with 15 to 21 ovate leaflets 15-60 mm long and 5-25 mm wide, upper leaves with 7 to 15 lance-oblong leaflets; inflorescence bracts glabrous or glandular-pubescent (Figure 1).

Inflorescence a rather narrow panicle, slightly glandular-pubescent. Flowers few, 2 to 8 per branch, scentless; pedicels densely glandular-pubescent, 2-15 mm long; calyx purple-green (at anthesis) to yellowish-green (at maturity), persistent; sepals 5, 8-17 mm long and 4-6 mm wide, pubescent with hairs up to 2 mm long, slightly glandular; corolla blue-violet and yellowish-green at the base, 15-25 mm in diameter, glabrous, tubular at the base; corolla lobes 5, 12-20 mm long and 7-10 mm wide; stamens 5, strongly exserted, 12-18 mm long, protruding 4-7 mm from corolla; anthers orange-yellow, 2-5 mm long; filaments white, villose at the base; style exserted, blue-violet, slightly longer than the stamens; stigma generally trilobate. Fruit an ovoid capsule, 5-7 mm long, 3-4 mm wide, generally 3-locular, sometimes 4- to 7-locular; seeds brownish-black, 1-10 per locule, slightly winged. 2n = 18, 36.

Figure 1. *Polemonium vanbruntiae* (drawing by Réjean Roy).

Polemonium vanbruntiae may be confused with *P. caeruleum* and *P. reptans*, two species introduced and cultivated in Canada, which occasionally escape near gardens and in disturbed habitats. The main differences between the three species are outlined below:

	P. caeruleum	***P. reptans***	***P. vanbruntiae***
1. Stamens and style	slightly exserted or level with the corolla.	inserted or level with the corolla.	strongly exserted.
2. Stems	20-90 cm tall, upright.	15-50 cm tall, spreading or prostrate.	40-140 cm tall, upright.
3. Lower leaf leaflets	19-29, lance-oblong, up to 10 mm wide.	11-17, lanceolate to ovate, up to 20 mm wide.	15-21, ovate, up to 25 mm wide.
4. Sepals	5-9 mm long.	5-8 mm long.	8-17 mm long.
5. Habitat	roadsides, waste ground.	rich woods.	moist open and semi-open habitats.

Readily available works providing the best descriptions include: Davidson (1950); Fernald (1950); Gleason and Cronquist (1991); Thompson (1991); Sabourin and Paquette (1992, 1994); Couillard (1998); Coursol (2001); Ministère de l'Environnement du Québec (2001); NatureServe (2001). Figure 1 illustration of *Polemonium vanbruntiae* was drawn by Réjean Roy.

DISTRIBUTION

Global range

Van Brunt's Jacob's-ladder is endemic to the central Appalachians, in eastern North America (Figure 2). Its range extends from West Virginia, in the south, to the southernmost portion of Quebec and eastern Maine, in the north. The species is sporadic over its entire range and is most frequent in New York State. Over the past ten years, there do not seem to have been discoveries indicating an extension of its range (Thompson, 1991; Sabourin and Paquette, 1992, 1994; NatureServe, 2001).

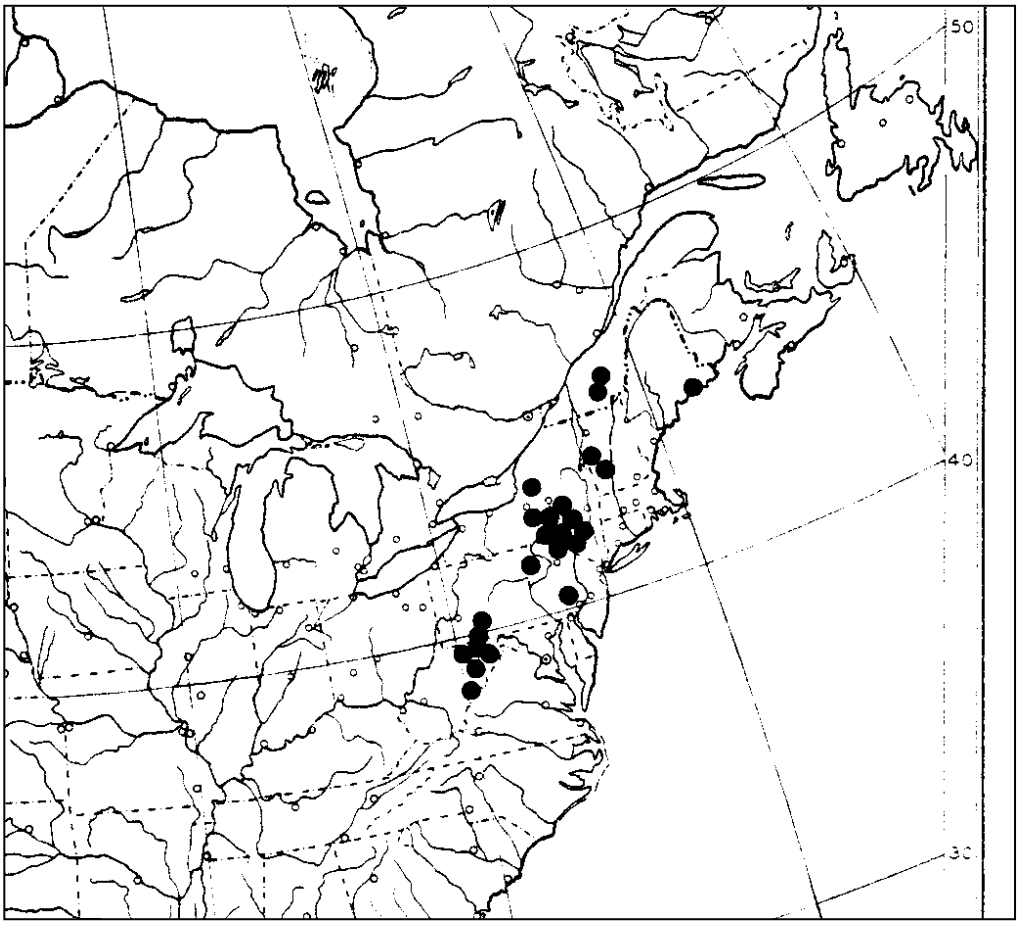

Figure 2. North American distribution of *Polemonium vanbruntiae* (one extirpated native historic population in New Brunswick is not mapped).

Canadian range

In Canada, *Polemonium vanbruntiae* is known to occur only in Quebec at the present time. A historic population (1885) was reported for southwestern New Brunswick at Trout Brook, Charlotte County (Sabourin and Paquette, 1992, 1994; Ministère de l'Environnement du Québec, 2001), but has not been seen since (Hinds, 1986; Blaney, pers. comm., 2001); another population reported for that same region, at Hoyt, Sunbury County, is considered by Hinds (1983) as possibly having been introduced.

In Quebec, the species has been observed in the Bois-Francs and Eastern Townships regions, at the southeastern tip of the province. The currently known populations are located in 3 regional county municipalities (RCM): Arthabaska, Asbestos and Le-Val-Saint-François.

Currently known locations

The Canadian locations of *Polemonium vanbruntiae* are listed below, with the exact number of populations within each of these locations. Eight extant locations are currently known, with a total of 12 populations. According to the Centre de données sur le patrimoine naturel du Québec, locations (occurrences) must be separated by a minimum distance of 1 kilometre.

RCM of Arthabaska

SAINTS-MARTYRS: 1 population; last seen on September 11, 2001, by Alain Meilleur.

DÉVELOPPEMENT-BOISVERT-EST: 3 populations; last seen on November 2, 2001, by Alain Gouge.

DÉVELOPPEMENT-BOISVERT-OUEST: 1 population; last seen on June 12, 2001, by André Sabourin and Alain Gouge.

Note: The two latter locations are separated by a distance of 1.5 km.

RCM of Asbestos

SAINT-ADRIEN: 1 population; last seen on July 12, 2001, by André Sabourin, Denis Paquette and Geoffrey Hall.

SAINT-CAMILLE: 2 populations; last seen on July 12, 2001, by André Sabourin and Denis Paquette.

HAM-SUD: 1 population; last seen on July 12, 2001, by André Sabourin, Denis Paquette and Geoffrey Hall.

RCM of Le-Val-Saint-François

STOKE RIVER: 2 populations; last seen on July 11, 2001, by André Sabourin and Denis Paquette.

MONT-CARRIER-SUD: 1 population; last seen on July 11, 2001, by André Sabourin and Denis Paquette.

In 2001, our fieldwork allowed us to discover two new locations in Quebec, those in Saint-Camille and in Ham-Sud. However, as these are located in the Nicolet-Centre River watershed, within the previously known range for the species, they do not represent true range extensions.

Extirpated locations

In Quebec, *Polemonium vanbruntiae* has not been seen since 1943 in the Arthabaska region, where it no longer appears to be present (Sabourin and Paquette, 1992, 1994). This region is located slightly northwest from the known extant range of the species.

Also, the species has not been seen since 1885 at Trout Lake, in southwestern New Brunswick (Hinds, 1986). However, the status of the species in this region is uncertain, due to a lack of significant research, and it is not clear whether the extant population in Hoyt (Hinds, 1983) is native or introduced. Further research would be needed in that part of the province, especially in the Magaguadovic, Oromocto, Digdeguash and St. Croix watersheds.

The extirpation of populations previously known from Arthabaska and Trout Lake represents a reduction of the global range of the species.

The fieldwork carried out in Quebec on July 4, 2000 (André Sabourin and Alain Gouge) and July 12, 2001 (André Sabourin and Denis Paquette) leads to believe that the Wotton location (Sabourin and Paquette, 1992, 1994) is now extirpated. However, as this population was located within the currently known range, its extirpation does not represent a true range reduction. Also, a small sub-population at Stoke River (ca. 100 plants) seems to be now extirpated. This site was bulldozed and drained in 2002, probably for a future agricultural field (Geoffrey Hall, pers. comm. 2002).

Extent of occurrence

The occurrence of *Polemonium vanbruntiae* in Canada extends over 644 square kilometres (46 x 14 km), essentially in Quebec. The long-term historic trend associated with this extent of occurrence seems to be one of decline, given the presumed extirpation of the populations in Arthabaska, Quebec, and Trout Lake, New Brunswick.

The actual area of occupancy is much smaller and covers approximately 5.1 ha, in Quebec. The area covered by each location is as follows:

Saints-Martyrs	0.45 ha (150 x 30 m)
Développement-Boisvert-Est	1.5 ha (200 x 30 m; 200 x 30 m; 100 x 30 m)
Développement-Boisvert-Ouest	0.9 ha (300 x 30 m)
Saint-Adrien	1 m^2 (1 x 1 m)
Saint-Camille	1.01 ha (100 x 100 m; 10 x 10 m)
Ham-Sud	0.15 ha (50 x 30 m)
Stoke River	1.1 ha (200 x 50; 50 x 30 m = extirpated in 2002)
Mont-Carrier-Sud	0.02 ha (20 x 10 m)

The current trend associated with the area of occupancy is on the decline. There has been a growth in the area of occupancy, mainly due to the locations discovered in 2001 at Saint-Camille and Ham-Sud (>1 ha), which more than compensate for the loss of the Wotton location, which was very small (<10 m^2) according to Sabourin and Paquette (1992, 1994), and the loss of a sub-population at Stoke River (0,15 ha) in 2002. Moreover, in 2001, new subpopulations were found at Développement-Boisvert-Ouest, which tripled the area of occupancy known in 1992 (0.3 ha, or 150 x 20 m); at Développement-Boisvert-Est, a third population was identified, the smallest, central one.

However, although there is a current increase in locations, these new sites presumably represent populations that already existed but were not known. With recent losses of sites or part of sites there has been a slight decline in the overall area of occupancy of the species in Quebec. Declines in occupancy likely are also primarily of historic occurrence following the arrival of the farming and logging industries in the area.

Moreover, no other recent discovery (in the last 10 years) was mentioned by the relevant resource persons, both in Quebec (Couillard, pers. comm., 2001) and in New Brunswick (Blaney, pers. comm., 2001).

HABITAT

Habitat requirements

In Quebec, our personal observations indicate that *Polemonium vanbruntiae* is found in moist habitats that are open to semi-open, rarely shady. This species occupies areas subject to seasonal flooding such as marshy alder or willow stands, riparian meadows associated with rivers or streams, wet clearings, and basins or depressions with herbaceous vegetation. The species occasionally escapes from these stable natural environments into successional environments such as waste grounds and old fields with sufficient moisture, or logging road ditches.

These moist habitats are often located near the foot of slopes, in seepage areas, or near rivers. The species tolerates spring or seasonal flooding, but does not tolerate flooding that is permanent or lasts during the whole growing season.

In Quebec, open or semi-open alder stands appear to be the species' original native habitat. This habitat is relatively specialized. In the United States, *Polemonium vanbruntiae* is considered a facultative wetland species (FACW), with a 67 to 99% likelihood of occupying moist habitats when it is found in a natural environment (Rhoads and Klein, 1993; Magee and Ahles, 1999). Our personal observations tend to indicate that this is also the case in Quebec, where the species comes very close to being an obligate wetland plant.

In Quebec, Van Brunt's Jacob's-ladder is found in environments where the terrain is flat or slightly sloping, even though the species is associated with the Appalachians, a mountainous region. This type of terrain promotes the accumulation of sediments and alluvial deposits that enrich the soils. The foot of slopes and other sites with some sort of seepage or water flow favour the formation of the rich, deep and humid soils that Van Brunt's Jacob's-ladder prefers. This substrate generally contains few or no stones.

The Quebec regions where Van Brunt's Jacob's-ladder occurs have a cool climate, and the species is found at moderately high elevations, between 205 and 355 metres. Further south, *Polemonium vanbruntiae* also prefers cool montane climates, and it is found at elevations above 1,200 metres in West Virginia (NatureServe, 2001).

Van Brunt's Jacob's-ladder rarely grows on unstable substrates. The only habitats where it grows that may correspond to such environments are forest road ditches; in fact, we saw the plant growing in ditches only at the two Développement-Boisvert locations.

Plant species most frequently associated with *Polemonium vanbruntiae* and occurring at almost all Quebec locations include: *Alnus incana* subsp. *rugosa*, *Calamagrostis canadensis*, *Clematis virginiana*, *Carex* spp., *Doellingeria umbellata*, *Eupatorium maculatum*, *Salix* spp., *Spiraea latifolia*, and *Thalictrum pubescens*.

The upper valleys of Nicolet River and its main branches and the Stoke River Valley are critical areas for the survival of *Polemonium vanbruntiae* in Quebec and in Canada. Although these valleys are already fragmented, the species still occurs in areas that are large enough to support it; however, the farming and logging industries will need to limit their expansion around Jacob's-ladder sites. It should be noted that these industries are stable or expanding in the Nicolet-Centre and Stoke River Valleys, whereas agriculture is declining in the upper Nicolet River Valley.

Trends

The former extent of the current locations is unknown. The extirpation of the Wotton population, between 1991 and 2000, may be due to the establishment of a Christmas tree plantation. Over the last 10 years, other populations have declined in

terms of their number of plants, but not in terms of their area of occupancy. This is the case at Saints-Martyrs, where logging took place, and in the northern part of the Stoke River site, where a field was partially ploughed and mowed.

The Stoke River population is the most threatened of all, but both this location and the Mont-Carrier-Sud location are threatened by agriculture, which could expand and cause the extirpation of both populations.

Potential habitats seem to exist in the neighbouring valleys. The most favourable valleys are those of the Nicolet-Sud-Ouest and Watopéka Rivers, located within the extent of occurrence, and those of the Bécancour, Bulstrode and Saint-François Rivers, located outside the current extent of occurrence.

At the present time, no site is officially protected by a public authority in Quebec.

Protection/ownership

Currently, all Quebec locations of *Polemonium vanbruntiae* are located on private land.

The northern part of the Développement-Boisvert-Est location was purchased in September 2001 by the Société de conservation des milieux humides du Québec (SCMHQ), a private conservation agency. This purchase was specifically aimed at protecting *Polemonium vanbruntiae*. The Saints-Martyrs location also benefits from a conservation agreement (Alain Gouge, pers. comm., 2001); this is also the case for the southern and central parts of the Développement-Boisvert-Est location. The former is the most important location, both in terms of number of plants and of occupied surface area, and the Saint-Martyrs occurrence is average in this respect, so that a large proportion of the species' habitat is already protected, or will likely be in the near future.

Moreover, negotiations are underway or planned for the protection of additional sites (Ms. Line Couillard, Ministère de l'Environnement du Quebec, pers. comm., 2001).

BIOLOGY

General

The two most important factors relating to the conservation status of this species are reproductive characteristics and climate conditions. Apparently, Van Brunt's Jacob's-ladder seeds can only germinate after a period of cold, dry conditions. However, the plant can also reproduce vegetatively.

Reproduction

Polemonium vanbruntiae can reproduce vegetatively or sexually. Asexual or vegetative reproduction takes place through the branched rhizomes of this perennial

plant. In Vermont, E. Thompson (1991) observed that occasionally hundreds of stems can connect in the ground to form a clone covering tens of square feet. This would tend to reduce the number of genetically distinct plants in Quebec populations, where clones also seem to occur.

Sexual reproduction takes place by way of cross-pollination and mainly with the help of insects. Wherry (1935) and Thompson (1991) report that pollination is carried out by honey bees (*Apis mellifera*) and bumblebees (*Bombus* sp.). Our observations in 1991 and 1992 (Sabourin and Paquette, 1992, 1994) indicate that several other insects, such as butterflies, and even a bird, the ruby-throated hummingbird (*Archilochus colubris)* visit the flowers of *Polemonium vanbruntiae*. This suggests that the species can produce a large quantity of nectar. According to NatureServe (2001), the species is self-sterile.

A very important factor that must be considered is seed germination. In the course of various experiments, Brumback (1989) found that the seeds could not germinate under cold, wet conditions, but would readily germinate after being kept under cold, dry conditions (between September 1986 and April 1987). However, this author does not provide details on how long the seeds were kept before germination and under which temperature, humidity and light conditions they were maintained. Also, the experiences with this species at the Montréal Botanical garden demonstrated a low germination rate of 0 to 15% (A. Meilleur, pers. comm. 2002).

Survival

Little information is available on this subject. The field observations suggest some predation by white-tailed deer (*Odocoilus virginianus*), which may occasionally browse a few stems, but this does not appear to be an important factor in the plant's Canadian distribution.

Physiology

Polemonium vanbruntiae reaches its northern limit in Quebec, at about 46° latitude north, at Saints-Martyrs-Canadiens. As the elevation of this site is also the highest in Quebec for the species, almost 65 metres higher than the second highest site, it is possible that the species occurs even further north.

The species seems to have a good ability to adapt to changes in its environment, since it has been found in logging road ditches and agricultural old fields. However, there must be sufficient moisture throughout the growing season, without prolonged flooding or drought. Interestingly, in alder thickets, the species is often found on the mounds forming at the base of alders. According to NatureServe (2001), the plant seems to have a rather wide ecological tolerance, but it has a rather narrow pH range, and open areas with circumneutral springs would represent its ideal habitat. According to Wherry (1935), the pH ranges from circumneutral to slightly acidic.

Van Brunt's Jacob's-ladder is a perennial plant that prefers deep rich soils. In Quebec, it flowers for about 5 weeks, approximately from June 20 to July 25, with some year to year variation. The first fruit ripen around mid-August at the latest.

Movements/dispersal

Seed dispersal occurs most readily in winter, when the stems extend above the snow cover, and the seeds can be carried by the wind over the icy crust or the snowy surface; occasionally, the stems can break and roll away with the wind. The distance covered in this fashion may reach several hundred metres.

Nutrition and interspecific interactions

Polemonium vanbruntiae does not live as a symbiont or parasite with other species. However, companion plants provide, as they decompose, the organic matter needed to form the rich and deep soils preferred by Van Brunt's Jacob's-ladder. Of course, material deposited by rivers and streams or through seepage and run-off is also important in this respect.

Apart from the white-tailed deer, the plant may also be eaten by insects, but this type of negative interaction does not appear to be significant.

Behaviour/adaptability

Van Brunt's Jacob's-ladder can tolerate a certain level of habitat modification, but it does not tolerate major changes, such as permanent flooding or soil drying-up. For instance, the population at Saint-Adrien almost disappeared (1 plant observed in 2001) after a nearby road was widened, as this altered the drainage and resulted in prolonged flooding.

At Stoke River, one of the two sites (the one to the north) was mowed and partly ploughed during the late 1990s, and several Jacob's-ladder plants disappeared. A similar change happened at Saints-Martyrs, because of logging and drainage work.

Transplantation has already been carried out successfully. There are at least 18 living specimens at the Montreal Botanical Garden. At the Garden, a team recently undertook cultivation and germination work on plants having a vulnerable or endangered status in Quebec, and *Polemonium vanbruntiae* is at the top of their list (A. Meilleur, pers. comm. 2002).

POPULATION SIZES AND TRENDS

The number of mature individuals of *Polemonium vanbruntiae* currently known in Canada is estimated at approximately 20,000, all in Quebec. In 2001, two new populations and two new subpopulations were discovered in Quebec, but this does not

mean that the species is actually colonizing new sites, since these sites had never been explored. The density of populations varies from 1 to 20 individuals per square metre, based on our personal observations; the stricter density calculations made in 2001 can explain estimated population differences with the 1992 report, especially at Développement-Boisvert-Est. Accepting that the new populations recently discovered were always present but simply missed in previous surveys, there has been a slight decline in the overall population size due to recent losses of populations and declines at three.

Declines in the extent of occurrence and area of occupancy are primarily of historic occurrence. Recent discoveries are essentially of populations that were previously not documented. On the positive side, agriculture has been declining in certain regions, such as the upper Nicolet River Valley, and some wet fields have been abandoned only to be invaded by Van Brunt's Jacob's-ladder.

Certain locations may undergo cyclical changes in the number of plants, especially those that have a lot of plants growing on abandoned farm land. These locations will likely face progressive invasion by trees, unless farming activities are resumed. This is the case at the Développement-Boisvert-Est, Saint-Camille and Stoke River locations, where about three quarters of the plants are found.

The species has probably always been rare in Canada, given the scarcity of its specialized habitats within its narrow Canadian range. If such a conspicuous plant had occurred in other regions, it would not have gone unnoticed. Data for calculating the overall decline in populations are inadequate. However, the number of plants has definitely declined over the past ten years at the Saints-Martyrs and Stoke River locations. This decline can roughly be estimated as a loss of 500 to 1,000 plants, but these figures are very approximate and are not based on systematic field surveys. It is possible that this decline is continuing, but efforts to acquire sites or negotiate conservation agreements with owners could slow down or even halt the decline.

The total Canadian population of *Polemonium vanbruntiae* is made up of a few small populations and a few large ones, but these are located in 4 distinct watersheds, those of the Nicolet, Nicolet-Nord-Est, Nicolet-Centre, and Stoke Rivers.

The estimated size and quality rating of the currently known Canadian locations (all in Quebec) are given below. Quality rating criteria are given in Table 1.

Locations	Number of mature plants	Quality rating
Saints-Martyrs	900	C
Développement-Boisvert-Est	13,000	A
Développement-Boisvert-Ouest	330	C
Saint-Adrien	1	D
Saint-Camille	2,000	C
Ham-Sud	300	C
Stoke River	3,000	C
Mont-Carrier-Sud	70	D

Table 1. Criteria* used to rate the quality of the occurrences (locations) of *Polemonium vanbruntiae.*

Rating	
A	population of over 10,000 individuals in a habitat that is little or not disturbed by human activities and that is stable over the long term.
B	population of 1,000 to 10,000 individuals in a habitat that is little or not disturbed by human activities and that is stable over the long term.
C	population of 100 or more, and fewer than 1,000 individuals, in a habitat that may or may not be disturbed by human activities, or population of more than 1,000 individuals in a habitat highly disturbed by human activities (agriculture, logging) and not stable over the long term.
D	population of fewer than 100 individuals, in a habitat that may or may not be disturbed by human activities, or population of fewer than 1,000 individuals in a habitat highly disturbed by human activities (agriculture, logging) and not stable over the long term.

*Proposed by the author and adapted from the methodology used by the United States organization. The Nature Conservancy. The quality rating of each extant occurrence is based on the size and status of the populations (surface area occupied, density, number of fertile and vegetative individuals) and on the surrounding context (habitat integrity, and quality of the surrounding landscape from the standpoint of its impact on viability of the occurrence). Rating D presumably represents the viability threshold for the species.

LIMITING FACTORS AND THREATS

Personal observations indicate that the factors that most limit or threaten *Polemonium vanbruntiae* in Quebec are agriculture and logging.

Agricultural impact is due to mowing, ploughing, drainage and Christmas tree growing, especially in wet and/or riparian meadows. Impacts associated with agriculture have been noted in the Stoke River and Wotton locations, and the Saint-Camille and Mont-Carrier-Sud locations may also be at risk in the near future, because agriculture is already practised nearby.

Logging, through felling and drainage work, has already caused partial elimination of the Saints-Martyrs location. This may happen elsewhere, but actual and future conservation agreements and land purchases could halt this trend.

Road infrastructure work is another threat when the drainage is altered, as has happened at Saint-Adrien. However, only one other population is located near a road, the one in the southern part of the Stoke River location. No dam projects are planned within the extent of occurrence of Van Brunt's Jacob's-ladder.

Over the medium term, the construction of cottages or homes could threaten a portion of the Développement-Boisvert-Ouest location. Off-road vehicle trails can also damage Jacob's-ladder populations, as we have already seen in the northern part of the Développement-Boisvert-Est location.

SPECIAL SIGNIFICANCE OF THE SPECIES

- *Polemonium vanbruntiae* is endemic to the central Appalachians and is found in Canada and the United States.
- The species does not have an important ecological role, except perhaps for the survival of the flower-feeding insects in those locations where the plant exists.
- *Polemonium* is not a monotypic genus, but only one of its species, *P. vanbruntiae,* is native to Canada east of Alberta (Scoggan, 1979).
- The species is not at risk at the global scale, but it is rare (G3) and sporadic (Lavoie, 1992; Argus and Pryer, 1990; NatureServe, 2001).
- The species is protected in Canada, where it was designated as threatened in Canada, in 1994 (COSEWIC, 2000), and threatened in Quebec, in 1998 (Ministère de l'Environnement, 2001; Coursol, 2001). It has been on Canada's list of rare plants since 1990 (Argus and Pryer, 1990). There are no related forms that are threatened.
- The Canadian populations may contain genetic diversity important for the species' survival, since they represent the species' northernmost locations.
- Van Brunt's Jacob's-ladder is of scientific interest because of its primitive nature; according to Grant (1959), *Polemonium* is the most primitive genus within tribe Polemoniae.
- The plant is of public interest due to its great beauty as well as its horticultural potential in wetland gardens. According to Klimas and Cunningham (1981), North American Indians used to wash their hair with a leaf decoction from this plant. Cox (1985) mentions the astringent and sudorific medicinal properties of two related species, *P. caeruleum* and *P. reptans*, which are recommended for diarrhoea, stings, bites, and lung ailments.
- There is no negative public opinion against this species.
- *Polemonium vanbruntiae* may be confused with two cultivated plants, *P. caeruleum* and *P. reptans*, which occasionally escape cultivation but grow in slightly drier environments.

EXISTING PROTECTION OR OTHER STATUS

- *Polemonium vanbruntiae* is designated as threatened in Canada and will thus be protected under the federal *Species at Risk Act*. In Quebec, pursuant to the provincial *Threatened or Vulnerable Species Act* (R.S.Q., c. E-12.01), the species may not be harvested, destroyed or possessed outside of its natural environment, and stiff fines can be imposed (Couillard, 1998).
- At the international level, the species is not listed or designated in the IUCN Red Book, nor under the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES), nor under the United States *Endangered Species Act*.
- No international agreements have been signed with respect to Van Brunt's Jacob's-ladder.

- The most recent status ranks for the species (Nature Serve, 2001) are as follows:
  Global status: G3
  National status:
    United States of America: N3
    Canada: N1
  Subnational status:
    United States of America: Maine (S1), Maryland (S2), New Jersey (SX), New York (S3), Pennsylvania (S1), Vermont (S2), West Virginia (S2); the species has been designated as threatened in Vermont (Thompson,1989) and endangered in Maine (Magee and Ahles, 1999)
    Canada: New Brunswick (SH), Quebec (S1)
- The species was designated as threatened in Canada, in 1994, by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2000), and as threatened in Quebec, in 1998, by the Government of Quebec (gouvernement du Québec, 1998).
- In Canada and in Quebec, there are no protected public areas where the species is found. The Société de conservation des milieux humides du Québec (SCMHQ), a private agency, recently purchased the northern part of the Développement-Boisvert-Est location, which is home to Quebec's largest *Polemonium vanbruntiae* population (Alain Gouge, *verbatim*, October 16, 2001).

SUMMARY OF THE STATUS REPORT

Declines in the extent of occurrence and the area of occupancy of *Polemonium vanbruntiae* are mainly of historic occurrence. Some localized recent declines at some sites have been documented. In total there are about 20,000 plants in Canada at eight locations in Quebec. Current and potential threats are mainly from logging and farming-related activities. These threats will probably continue to exist over the short, medium and long term, unless mitigative measures are taken.

Two new populations and two new subpopulations were discovered in 2001 in Quebec. It is clear that there is still a potential for future discoveries in Quebec, in watersheds where the species is known to occur and also adjacent watersheds, even though such searches often prove fruitless and must be carried out in difficult habitats. There is also a potential in southwestern New Brunswick.

Moreover, the planned and current purchases and conservation agreements with site owners, by the Société de conservation des milieux humides du Quebec and by the Ministère de l'Environnement du Quebec, suggest that the downward trends will be halted and that the species' status will stabilize.

Further research is needed for a better understanding of the actual current status of this species, both in Quebec and in New Brunswick. This research should be part of a Canadian *Polemonium vanbruntiae* recovery plan and involve a partnership agreement between the COSEWIC, the Ministère de l'Environnement du Quebec, the New Brunswick Department of Natural Resources and Energy, the SCMHQ, the Montreal Botanical Garden, as well as other public and private agencies of Canada and the two provinces.

TECHNICAL SUMMARY

Polemonium vanbruntiae
Van Brunt's Jacob's-ladder — Polémoine de Van Brunt
Quebec

Information on the extent of occurrence and the area of occupancy	
• *extent of occurrence (EO) (km²)*	644 km²
• *specify the trend (on the decline, stable, growing, unknown)*	Decline
• *are there extreme fluctuations in the EO (order of magnitude > 1)?*	No
• *area of occupancy (AO) (km²)*	About 5 ha
• *specify the trend (on the decline, stable, growing, unknown)*	Slight decline
• *are there extreme fluctuations in the AO (order of magnitude > 1)?*	No
• *number of existing locations*	8 areas with 11 sub-populations
• *specify the trend (on the decline, stable, growing, unknown)*	Slight decline
• *are there extreme fluctuations in the number of locations (order of magnitude > 1)?*	No
• *habitat trend: specify the trend: on the decline, stable, growing, unknown of the area, extent or quality of the habitat*	Slight decline
Information on the population	
• *generation time (mean age of the parents in the population) (indicate the years, months, days, etc.)*	Primarily about 2 years to ample flowering for many species of this genus
• *number of mature specimens (able to reproduce) in the Canadian population (or specify a scale of plausible values)*	20,000 est.
• *total population trend: specify the trend: on the decline, stable, growing or unknown of mature specimens*	Slight decline
• *if the trend is on the decline, % of decline over the last/next 10 years or 3 generations, the one that is bigger (or specify that it involves a shorter period)*	About 4 to 7%
• *are there extreme fluctuations in the number of mature specimens (order of magnitude > 1)?*	No

• *is the total population seriously fragmented (most of the specimens are found in small populations, that are relatively isolated (geographically or otherwise) between which there are few exchanges, namely, ≤ 1 successful migration/year)?*	Yes
• *List each population and give the number of mature specimens in each population*	1- Saints-Martyrs: 900 2- Développement-Boisvert-Est:13,000 3- Développement-Boisvert-Ouest: 330 4- Saint-Adrien: 1 5- Saint-Camille: 2,000 6- Ham-Sud: 300 7- Stoke River: 3,000 8- Mont-Carrier-Sud: 70
• *Specify the trend in the number of populations (on the decline, stable, growing, unknown)*	Trend? New pops. found in sites previously not surveyed
• *Are there extreme fluctuations in the number of populations (order of magnitude > 1)?*	No
Threats (real or imminent for the populations or the habitats): Agriculture (mowing, drainage, ploughing, cultivation of Christmas trees); logging (felling, drainage); road infrastructures (prolonged flooding); residential development; off-road vehicle trails and use of such vehicles.	
Rescue effect (immigration from an outside source)	Unlikely due to disjunction from main range
• *Does the species exist elsewhere (in Canada or abroad)?*	In New Brunswick:? (potential) In the United States: yes
• *Status of the populations elsewhere?*	Maine: endangered (S1) New York: rare (S3) Vermont: threatened (S2)
• *Is immigration known or possible?*	Unlikely?
• *Would immigrants adapt to survive at this place?*	Yes
• *Does a sufficient habitat exist at this place for immigrants?*	Yes
Quantitative analysis	

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BIOGRAPHICAL SUMMARY OF THE CONTRACTOR

André Sabourin is a geographer by training, having obtained a Bachelor's Degree in Geography in 1972 from Université du Québec à Montréal. From 1973 to 1988, he practised botany as a hobby and became a self-taught biologist. In 1989, he obtained his first professional contract, from COSEWIC. In 1991, he published a *Guide des Crucifères sauvages de l'Est du Canada*. In 1991 and 1992, he did research on Van Brunt's Jacob's-ladder for COSEWIC, and he submitted his report in 1992. In 1997 and 2000, he returned to the field on behalf of the ministère de l'Environnement du Québec and the Société de conservation des milieux humides du Québec, to help with the conservation of this threatened species. He is the Canadian botanist with the most extensive knowledge on this plant and its habitat.

AUTHORITIES CONSULTED

Couillard, L. October 2001. Person in charge of threatened or vulnerable plants, Ministère de l'Environnement du Québec, Direction de la conservation et du patrimoine écologique, 675, boulevard René-Lévesque Est, 10^{e} étage, P.O. Box 21, Quebec City, Quebec G1R 5V7.

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COLLECTIONS CONSULTED

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