

**Ontario Species at Risk Evaluation Report**  
**for**  
**Gypsy Cuckoo Bumble Bee (*Bombus bohemicus*)**

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Committee on the Status of Species at Risk in Ontario (COSSARO)

Assessed by COSSARO as ENDANGERED

December 2014

**Final**

## Psithyre bohémien (*Bombus bohemicus*)

Le psithyre bohémien (*Bombus bohemicus*) est l'une des six espèces de psithyres (sous-genre *Psithyrus*) présentes en Amérique du Nord. Les deux sexes sont de taille moyenne (longueur : 12–18 mm) et présentent un patron de coloration similaire, avec l'extrémité de l'abdomen blanche. En Amérique du Nord, le psithyre bohémien est un parasite social obligatoire de diverses espèces de bourdons du sous-genre *Bombus*, dont le bourdon à tache rousse (*B. affinis*) (désigné en voie de disparition par le COSEPAC), le bourdon terricole (*B. Terricola*) en Ontario. Les femelles n'ont pas de corbicule (« corbeille à pollen ») en raison de leur évolution biologique de parasite.

Le psithyre bohémien est aussi présent un peu partout en Europe et dans certaines parties du nord et du centre de l'Asie (COSEPAC, 2014). Au Canada, il est observé dans toutes les provinces et tous les territoires, à l'exception du Nunavut. On le trouvait auparavant dans la quasi-totalité du territoire ontarien, dans différents types d'habitat. La répartition de l'espèce serait vraisemblablement déterminée en premier lieu par la répartition et l'abondance de ses hôtes. Malgré de grands efforts de recherche déployés de 2001 à 2014 (n > 6 000 psithyres), on n'a observé qu'un seul individu en Ontario (parc provincial The Pinery, 2008). Pour cette espèce, la plus grande menace est le déclin de ses deux hôtes, possiblement dû à la dissémination de pathogènes par des populations de bourdons utilisées pour la pollinisation. D'autres menaces, comme l'utilisation de pesticides et la perte d'habitat, toucheront l'espèce à l'échelle locale.

L'évaluation de l'espèce la classe dans la catégorie « en voie de disparition » selon le critère A2abce. Même si cette espèce occupait dans le passé une des plus vastes aires de répartition de toutes les espèces de bourdons, son déclin était supérieur à 50 % en 10 ans. Cette forte baisse a été observée au cours des grands efforts de recherche déployés récemment dans le sud de l'Ontario et déduite des résultats obtenus par d'autres compétences. Le dernier relevé de cette espèce en Ontario (et au Canada) remonte à 2008, au parc provincial The Pinery.

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## Executive summary

The Gypsy Cuckoo Bumble Bee (*Bombus bohemicus*) is one of six cuckoo bumble bees (subgenus *Psithyrus*) occurring in North America. Both sexes are medium-sized (12 – 18 mm length), with a white-tipped abdomen and similar colour pattern. The Gypsy Cuckoo Bumble Bee is a nest parasite of bumble bees of the subgenus *Bombus* in North America. Host species are the Rusty-patched Bumble Bee (*B. affinis*) (assessed Endangered by COSEWIC) and the Yellow-banded Bumble Bee (*B. terricola*) in Ontario. Females lack corbiculae ('pollen baskets') due to their parasitic life history.

The Gypsy Cuckoo Bumble Bee also occurs throughout most of Europe and parts of north and central Asia (COSEWIC 2014). In Canada, the Gypsy Cuckoo Bumble Bee has been recorded in every province and territory except Nunavut. Historically it occurred throughout most of Ontario in various habitat types. The species distribution is likely determined primarily by the distribution and abundance of its hosts. Despite high search effort 2001-2014 (n>6000 bumble bees) only one individual has been observed in Ontario (Pinery Provincial Park 2008). The primary threat to this species is the decline of its two hosts, possibly due to pathogen spillover from managed bumble bees. Other threats such as pesticide use and habitat loss may affect the species locally.

This species is assessed as Endangered using criterion A2abce. Despite having one of the largest historic ranges of all bumble bee species, declines in this species have exceeded 50% in 10 years. This has been observed with high recent search effort in southern Ontario and inferred from findings in other jurisdictions. The last record in Ontario (and in Canada) for this species was in 2008 at Pinery Provincial Park.

# 1. Background information

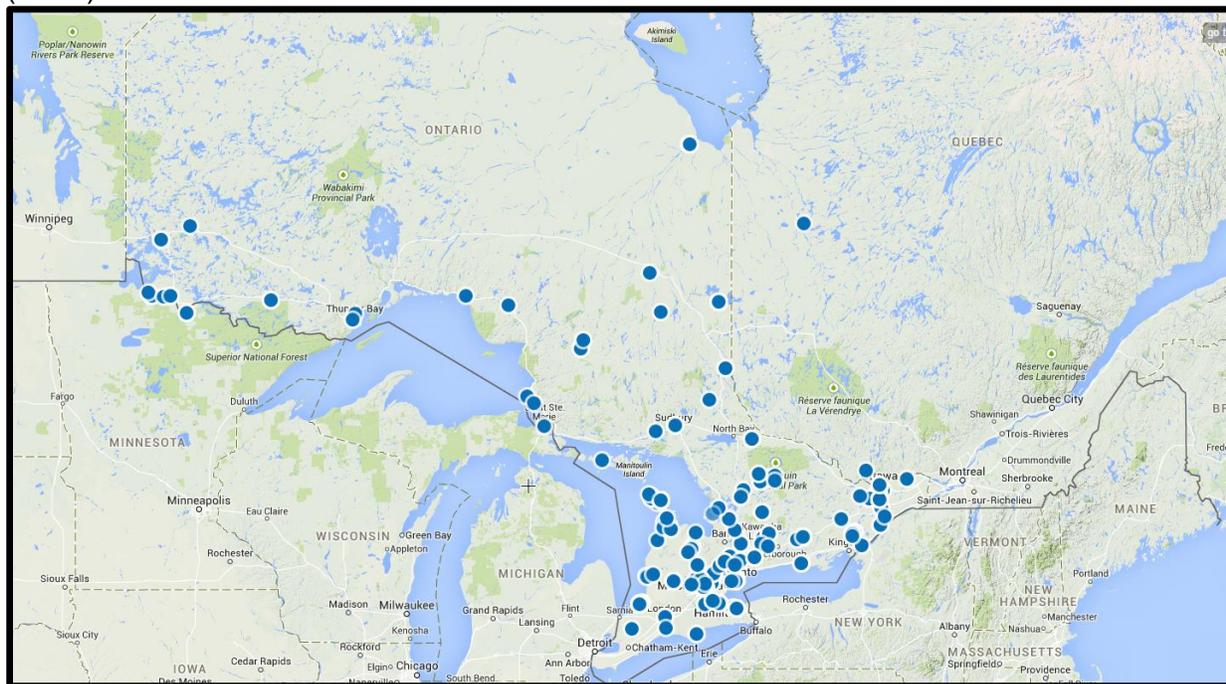
## 1.1. Current designations

- GRANK: GH (NatureServe, accessed 24/11/2014, under *Bombus ashtoni*)
- NRANK Canada: NH
- COSEWIC: Endangered (May 2014)
- SARA: No schedule, No Status
- ESA 2007: N/A
- SRANK: SU (under *Psithyrus ashtoni*)

## 1.2. Distribution in Ontario

In Ontario, the Gypsy Cuckoo Bumble Bee has been found throughout most of the province. The northern portion of Ontario lacks survey effort, thus its northern range boundary is not known (See Figure 3, COSEWIC 2014). However, the only recent Canadian (and Ontario) record for Gypsy Cuckoo Bumble Bee is from Pinery Provincial Park (2008). In Ontario, one of its hosts, the Yellow-banded Bumble Bee (*B. terricola*), ranges across the Mixedwood Plains and Boreal Shield ecozones of southern Ontario, and is also occasionally found in the Hudson Bay Lowlands around James Bay. The Yellow-banded Bumble Bee host species remains present and continues to be collected in southern Ontario, although reduced in abundance (S. Colla pers. comm. 2014). Its other host in Ontario, the Rusty-patched Bumble Bee (*B. affinis*), has experienced severe declines, and was last recorded in 2009 from Pinery Provincial Park (COSEWIC 2010). The Rusty-patched Bumble Bee's historic range is restricted to southern Ontario. No data on *Bombus bohemicus* occurrences were available from MNRF thus an EO map is unavailable; an approximate map showing the historic range of this species is found in Figure 1.

Figure 1. Historic range of *Bombus bohemicus* in Ontario (n=352). Map created by COSSARO using <http://geocat.kew.org> and a subset of the data used in COSEWIC (2014).



### 1.3. Distribution and status outside Ontario

Gypsy Cuckoo Bumble Bee is a holarctic species. In North America, it ranges throughout most of Canada (except Nunavut) and parts of the northern United States (US) (i.e., Alaska, Connecticut, Indiana, Massachusetts, Minnesota, North Dakota, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Virginia, West Virginia, Wisconsin) (Figure 3). In the Old World, the species occurs throughout most of Europe (except Iceland and extreme southwestern Europe) and across Asia (COSEWIC 2014). It is still common in the Old World, likely due to the success of its main European host, *Bombus terrestris*.

There have been numerous studies suggesting this species has declined dramatically throughout its range including in Manitoba, Quebec and adjacent US states (please see COSEWIC 2014, pp. 16-19 for further details of each study).

### 1.4. Ontario conservation responsibility

Less than 5% of the global range of this species is in Ontario, given the species' widespread holarctic distribution.

### 1.5. Direct threats

The Gypsy Cuckoo Bumble Bee has one of the largest ranges of all bumble bee species in Canada, and is a habitat generalist. It is unlikely that specific habitat trends

have caused its decline at such large scales, though habitat loss due to urbanization or intensive agriculture may threaten this species in the southern parts of its range (COSEWIC 2014).

The use of neonicotinoid pesticides has been implicated in bee declines across the developed world (Whitehorn et al. 2012), primarily because these are harmful to bees even in very low concentrations (Marletto et al. 2003). The flight time for females is May-August and males June-October (COSEWIC 2014), thus this species may be locally susceptible to pesticide contact through the entire growing period.

The most likely threat to Gypsy Cuckoo Bumble Bee is the decline of two of its host species, the Rusty-patched Bumble Bee and the Yellow-banded Bumble Bee. These host species are thought to have declined due to the spread of a protozoan parasite (*Nosema* sp.) from commercially managed bumble bee colonies (Cameron et al. 2011). However, this is still uncertain.

## **1.6. Specialized life history or habitat use characteristics**

The Gypsy Cuckoo Bumble Bee is a social parasite, and does not have the eusocial colony cycle typical of other bumble bees, and therefore does not produce workers. This species is entirely dependent on the presence of suitable host colonies. Mated females emerge in the spring and look for potential host nests. The female kills or subdues the host queen and lays eggs that the host colony workers tend. In the late summer and autumn, females and males emerge from the host nest and leave to mate with conspecifics. Mated females then select an overwintering site. In Ontario, this species is an obligate parasite of two species which are known or thought to be in decline. The Rusty-patched Bumble Bee is listed as Endangered and the Yellow-banded Bumble Bee will be assessed by COSEWIC shortly.

Bumble bees also become increasingly susceptible to extinction when population sizes are small. This genetic phenomenon has been referred to as the “diploid male extinction vortex” (Zayed and Packer 2005). Sex in bees is determined by genotype at a single “sex locus”: hemizygotes (haploids) are males, heterozygotes are female and homozygotes are diploid males. Diploid males are usually sterile or unviable. As population sizes decline, the number of sex alleles in the population decreases, and the frequency of (sterile) male diploids increases. This means that if bee populations are reduced to only a few reproductive individuals, local extirpation is likely even if environmental conditions remain stable.

## **2. Eligibility for Ontario status assessment**

### **2.1. Eligibility conditions**

#### **2.1.1. Taxonomic distinctness**

Yes. *Bombus bohemicus* was described by Seidl in 1837, and has been considered a valid species in the Old World since that time. In North America, Cresson (1864)

described *Apathus ashtoni*, *Psithyrus ashtoni* and, until recently, *Bombus ashtoni* (Cresson) (Ashton's Cuckoo Bumble Bee) has been the scientific name used for this taxon. More recently, using morphological and additional genetic data, the North American *B. ashtoni* has been synonymized under *B. bohemicus*, a name which is now applied to this Holarctic species (Williams et al. 2014).

### **2.1.2. Designatable units**

N/A

### **2.1.3. Native status**

Yes, this species is considered native with records dating back to 1883.

### **2.1.4. Occurrence**

There are numerous records of this species occurring in Ontario.

## **2.2. Eligibility results**

The Gypsy Cuckoo Bumble Bee (*Bombus bohemicus*) is eligible for status assessment in Ontario.

## **3. Ontario status assessment**

### **3.1. Application of endangered/threatened status in Ontario**

#### **3.1.1. Criterion A – Decline in total number of mature individuals**

Endangered, A2(abce). There are observed and inferred declines of greater than 50% in the total number of mature individuals over the last 10 years.

Despite high search effort in recent years in Ontario (2001 – 2014, n>6000 specimens), only one specimen of Gypsy Cuckoo Bumble Bee has been recorded (Pinery P.P. 2008). This is the same site where the last known Canadian population of its host, the Rusty-patched Bumble Bee, was last observed (2009). Pinery Provincial Park has been extensively surveyed from 2008 – 2011 with no new specimens of Gypsy Cuckoo Bumble Bee collected.

Historical abundances of the Gypsy Cuckoo Bumble Bee throughout its range and in Ontario have been estimated using relative abundances among all co-occurring bumble bee species (i.e. #GCBB/total BBs). Relative abundances of the species throughout its historical US and CAN range was found to be between 1-2% at different intervals between the late 19<sup>th</sup> century to 1990 (see Table 1, page 21, COSEWIC 2014). Thus, based on historical relative abundances, one would conservatively expect 1% of >6000 collections (i.e., 60 individuals) to have been collected from 2001-2014. Actual survey results (representing increased survey effort) therefore represent a decline far greater

than 50% (2001-2014), and possibly even exceeding 90% in southern Ontario, in just over a decade.

Similarly, from 1971-1973, a study of the bumble bee community over three years in Guelph and surrounding area indicated *B. bohemicus* represented 1% of total bumble bees (Macfarlane 1974). A 3-year resurvey of the same sites from 2004-2006 failed to detect the species (Colla & Packer 2008). It should be noted that most survey effort has focused on southern Ontario. Some sites in central and northern Ontario (e.g., Mississagi Provincial Park June 13 – 16, 2011) have been surveyed in recent years with no specimens recorded (COSEWIC 2014).

A considerable decline has also been observed in the index of area of occupancy and extent of occurrence of this species, although these cannot be accurately quantified.

The continuous introduction of parasitic taxa (i.e., pathogens from managed bee colonies) may be an indirect cause of decline and degradation of suitable habitat due to its effects on hosts, although this has not been confirmed as a direct cause.

### **3.1.2. Criterion B – Small distribution range and decline or fluctuation**

Not applicable. Present distribution unknown due to recent rapid declines, and EO is not known (B1). IAO cannot be calculated with accuracy (B2)

### **3.1.3. Criterion C – Small and declining number of mature individuals**

Not applicable. Population sizes are unknown.

### **3.1.4. Criterion D – Very small or restricted total population**

Not applicable. Population sizes are unknown.

### **3.1.5. Criterion E – Quantitative analysis**

Not applicable, none performed.

## **3.2. Application of Special Concern in Ontario**

Not applicable, endangered criterion met.

## **3.3. Status category modifiers**

### **3.3.1. Ontario's conservation responsibility**

Not applicable.

### **3.3.2. Rescue effect**

Rescue effect is considered very unlikely. The low abundance of Gypsy Cuckoo Bumble

Bee and the possible declines of its host species make recolonization by rescue effect throughout its historical range in southern Canada unlikely. In the past decade, there have been few confirmed records from the US, all from Alaska (Williams *et al.* 2014).

### **3.4. Other status categories**

#### **3.4.1. Data deficient**

Not applicable.

#### **3.4.2. Extinct or extirpated**

Not applicable.

#### **3.4.3. Not at risk**

Not applicable.

## **4. Summary of Ontario status**

Gypsy Cuckoo Bumble bee (*Bombus bohemicus*) is classified as Endangered in Ontario.

This large and distinctive bee is a nest parasite of other declining bumble bees. It had an extensive range in Canada and has been recorded from all provinces and territories except Nunavut. Although not known to be abundant (1-2% of sampled bumble bees historically), there has been a large observed decline in relative abundance in the past 20-30 years in areas of Canada where the species was once common. Despite significant search effort in Ontario from 2001-2014, only one individual has been detected (Pinery Provincial Park in 2008), even at sites where one of its hosts (the Yellow-banded Bumble Bee) remains extant. Primary threats in Ontario include decline of hosts (Rusty-patched Bumble Bee and the Yellow-banded Bumble Bee), pesticide use (particularly neonicotinoids) and the escape of pathogens from infected bumble bees managed for crop pollination. This species meets criteria A2abce for Endangered.

## **5. Information sources**

Cameron, S.A., J.D. Lozier, J.P. Strange, J.B. Koch, N. Cordes, L.F. Solter and T.L. Griswold. 2011. Patterns of widespread decline in North American bumble bees. *Proceedings of the National Academy of Sciences USA* 108(2):662-667.

Colla, S.R. and L. Packer. 2008. Evidence for decline in eastern North American Bumble Bees (Hymenoptera: Apidae), with special focus on *Bombus affinis* Cresson. *Biodiversity and Conservation* 17:1379-1391.

[COSEWIC](#). 2014. COSEWIC assessment and status report on the Gypsy Cuckoo Bumble *Bombus bohemicus* in Canada. Committee on the Status of Endangered

Wildlife in Canada. Ottawa. ix + 56 pp.

[Evans, E., R. Thorp, S. Jepson and S. Hoffman-Black](#). 2008. Status Review of three formerly common species of bumble bees in the subgenus *Bombus*. The Xerces Society. 63 pp.

Macfarlane, R. 1974. Ecology of Bombinae (Hymenoptera: Apidae) of Southern Ontario, with emphasis on their natural enemies and relationships with flowers. PhD, University of Guelph, Guelph, Ontario.

Marletto, F., A. Patetta, and A. Manino. 2003. Laboratory assessment of pesticide toxicity to Bumble Bees. *Bulletin of Insectology* 56:155-158.

Whitehorn, P., S. O'Connor, F.L. Wackers and D. Goulson. 2012. Neonicotinoid pesticide reduces bumble bee colony growth and queen production. *Science* 336:351-352.

Williams, P.H., R.W. Thorp, L.L. Richardson, and S.R. Colla. 2014. *The Bumble Bees of North America: an identification guide*. Princeton University Press. NY, USA. 208 pp.

Zayed, A. and L. Packer. 2005. Complementary sex determination substantially increases extinction proneness of haplodiploid populations. *Proceedings of the National Academy of Sciences* 102:10742-10746.

## Appendix 1: Technical summary for Ontario

Species: Gypsy Cuckoo Bumble Bee

### Demographic information

Demographic attributes	Value
Generation time.	1 year
Is there an observed, inferred, or projected continuing decline in number of mature individuals?	Yes, observed and inferred decline > 50% based on lack of collected specimens over the past ten years; and despite widespread bumble bee surveys
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations.	Unknown
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over the last 10 years or 3 generations.	Unknown
Projected or suspected percent reduction or increase in total number of mature individuals over the next 10 years or 3 generations.	Unknown
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over any 10 years, or 3 generations, over a time period including both the past and the future.	Observed, inferred and suspected decline >50% in 10-year period based on lack of records of Gypsy Cuckoo Bumble Bee and decline in host species.
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. No b. Yes, partially c. No
Are there extreme fluctuations in number of mature individuals?	No

### Extent and occupancy information in Ontario

Extent and occupancy attributes	Value
Estimated extent of occurrence.	Unknown
Index of area of occupancy (IAO).	Unknown
Is the total population severely fragmented? (i.e. is >50% of its total area of occupancy in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?)	Unknown. Perhaps; recent collections are disjunct based on lack of specimens in areas where hosts are still present.
Number of locations ( <i>as defined by COSEWIC</i> ).	Unknown

<b>Extent and occupancy attributes</b>	<b>Value</b>
Number of NHIC Element Occurrences	No data available
Is there an observed, inferred, or projected continuing decline in extent of occurrence?	Unknown
Is there an observed, inferred, or projected continuing decline in index of area of occupancy?	Unknown
Is there an observed, inferred, or projected continuing decline in number of populations?	Yes
Is there an observed, inferred, or projected continuing decline in number of locations?	Unknown
Is there an observed, inferred, or projected continuing decline in [area, extent and/or quality] of habitat?	Unknown
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations?	No
Are there extreme fluctuations in extent of occurrence?	Unknown
Are there extreme fluctuations in index of area of occupancy?	Unknown

**Number of mature individuals in each sub-population or total population (if known)**

Unknown.

**Quantitative analysis (population viability analysis conducted)**

Probability of extinction in the wild has not been calculated.

**Rescue effect**

<b>Rescue effect attribute</b>	<b>Likelihood</b>
Is immigration of individuals and/or propagules between Ontario and outside populations known or possible?	No. Few recent records in the United States.
Would immigrants be adapted to survive in Ontario?	Yes
Is there sufficient suitable habitat for immigrants in Ontario?	Yes to habitat; but unknown if sufficient host abundance (inferred from decline of host species) in much of its range.
Is the species of conservation concern in bordering jurisdictions?	Not assessed
Is rescue from outside populations reliant upon continued intensive recovery efforts?	Probably

## Appendix 2: Adjoining jurisdiction status rank and decline

### Information regarding status rank and decline of Gypsy Cuckoo Bumble Bee

Jurisdictions	Subnational Rank	Population Trend	Sources
Ontario	SU	Unquantified decline, but >50% within the last 10 years. Last observed 2008 despite significant search effort.	COSEWIC 2014
Manitoba	SH	Unquantified decline. Last observed 1986.	COSEWIC 2014
Michigan	SH	See comments below.	NatureServe 2014
Minnesota	Not present	n/a	NatureServe 2014
Nunavut	Not present	n/a	NatureServe 2014
New York	SH	See comments below.	NatureServe 2014
Ohio	Not present	n/a	NatureServe 2014
Pennsylvania	SH	See comments below.	NatureServe 2014
Quebec	SH	Unquantified decline. Last observed 2008.	COSEWIC 2014

For all NatureServe (2014) citations, see listing under *Bombus ashtoni* (synonym). Although declines are not described by state, NatureServe (2014) states that no records have been reported anywhere in the lower 48 states since 2000 (Evans 2008). Note that the US National Status is considered “NU” on the following basis (NatureServe 2014; status assigned June 2010):

“For a nest parasite on subgenus *Bombus*, if the most recent record is as old as 2003 then the possibility that there are no more occurrences has to be considered, which generates a GH from Rank Calculator version 3.1. *Bombus* declines have not been well documented as far north as Alaska, so one could make a case for assuming the species probably is still extant, and thus assign GU. There really is no other rank that is appropriate for a recently widespread species that has probably declined by well over 99% in about a decade and has been undetectable anywhere since 2003.”

Evans, E., R. Thorp, S. Jepson and S. Hoffman-Black. 2008. Status Review of three formerly common species of bumble bees in the subgenus *Bombus*. The Xerces Society. 63 pp. Accessed at [http://www.xerces.org/wp-content/uploads/2008/12/xerces\\_2008\\_bombus\\_status\\_review.pdf](http://www.xerces.org/wp-content/uploads/2008/12/xerces_2008_bombus_status_review.pdf)

#### Acronyms:

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

COSSARO: Committee on the Status of Species at Risk in Ontario

ESA: Endangered Species Act

GRANK: global conservation status assessments  
IAO: index of area of occupancy  
MNR: Ministry of Natural Resources and Forestry  
NHIC: Natural Heritage Information Centre  
NNR: Unranked  
NRANK: National conservation status assessment  
NS: no source  
SARA: Species at Risk Act  
SH: possibly extirpated  
SRANK: subnational conservation status assessment  
SU: Unrankable

COSEPAC: Le Comité sur la situation des espèces en péril au Canada