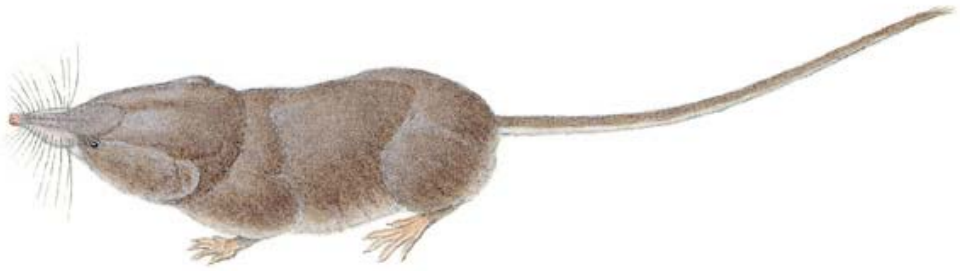
COSEWIC
Assessment and Update Status Report

on the

Gaspé Shrew
Sorex gaspensis

in Canada



NOT AT RISK
2006

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:

COSEWIC 2006. COSEWIC assessment and update status report on the Gaspé shrew *Sorex gaspensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 22 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Previous report

Scott, F.W. 1988. COSEWIC status report on the Gaspé shrew *Sorex gaspensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. 1-19 pp.

Production note:
This status report includes information on both Gaspé shrew (*sorex gaspensis*) and Long-tailed shrew (*sorex dispar*). However, only Gaspé shrew was assessed by COSEWIC.

COSEWIC would like to acknowledge David Anthony Kirk and Jennie L. Pearce for writing the update status report on the Gaspé shrew *Sorex gaspensis*, prepared under contract with Environment Canada, and overseen and edited by Mark Brigham, Co-chair (Terrestrial Mammals), COSEWIC Terrestrial Mammals Species Specialist Subcommittee.

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Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur la musaraigne de Gaspé (*Sorex gaspensis*) au Canada – Mise à jour.

Cover illustration:
Gaspé shrew — Painting by Nancy Halliday from Kays and Wilson's *Mammals of Nature America*, ©Princeton University Press (2002).

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COSEWIC
Assessment Summary

Assessment Summary – April 2006

Common name
Gaspé shrew

Scientific name
Sorex gaspensis

Status
Not at Risk

Reason for designation
It is highly likely that this shrew is more widespread and abundant than presently believed. Although the occurrence of presumed preferred habitat is restricted and isolated in the landscape, it is not at risk. The species appears to be widespread in talus habitats throughout its range. Recent information questions the taxonomic status of this shrew. Whereas it may well be a subspecies of *Sorex dispar*, when the original designation was made, it was considered a Canadian endemic species.

Occurrence
Quebec, New Brunswick, Nova Scotia

Status history
Designated Special Concern in April 1988. Status re-examined and designated Not at Risk in April 2006. Last assessment based on an update status report.

COSEWIC
Executive Summary

Gaspé Shrew
Sorex gaspensis

Species information

Part of the *Sorex* complex comprising 40-50 Holarctic species, the Gaspé Shrew *Sorex gaspensis* (French, la Musaraigne de Gaspé) and long-tailed or rock shrew *S. dispar* (French, la Musaraigne longicaude) are closely related, separated to date primarily by size. Both are small, slender and slate-grey in colour with long tails, although *S. dispar* is slightly larger than *S. gaspensis (S. dispar*: 3.1-8.3 g, total body length 103-136 mm, tail length 46-67 mm, condylobasal length 16.45-18.70 mm, length of molariform tooth row 3.75-4.30 mm; *S. gaspensis*: 2.2-4.3 g, total body length 95-127 mm, tail length 45-55 mm, condylobasal length 15.35-16.35 mm, length of molariform tooth row 3.40-3.65 mm). While they are currently recognized as distinct species, the taxonomic status of these species is equivocal. Genetic analyses by Judith Rhymer and colleagues suggest that *S. gaspensis* should be recognized as a subspecies of *S. dispar*, and preliminary results from more detailed ongoing genetic studies currently in progress by Don Stewart and colleagues confirm Rhymer *et al*.'s findings. Because of current uncertainties regarding the taxonomic status of the species we treat *S. dispar* and *S. gaspensis* together in this report.

Distribution

At present, *S. gaspensis* is the only shrew species unique to Canada, though this may change if it is accorded sub-specific status as *S. dispar gaspensis.* It has been recorded from five regions, one in the Gaspé Peninsula of Quebec, two in New Brunswick and two in northern Nova Scotia. To date, there are 133 records of the species (33 locations), 80 from the Maritime Provinces and 53 from Quebec. Of these, 16 have been captured since 1988. *S. dispar* also occurs in Canada, one end of a narrow belt of occurrence that stretches from North Carolina to Maine and the Adirondack Mountains of New York. There are 21 records of *S. dispar* from Canada (11 locations), from southeastern Quebec (n = 12 specimens), southeastern (2) and southcentral (1) New Brunswick, and mainland Nova Scotia (6). Of these, six have been recorded since 1988.

Habitat

S. gaspensis and *S. dispar* have similar habitat requirements, being restricted largely to steep slopes in mountainous regions that have differing amounts of rocky outcrops and talus. Both occur mainly on upper, mesic valley slopes that are east, north or west facing with ferns, mosses and other dense vegetation. Overstory trees include species associated with mesic sites, such as yellow birch *Betula alleghaniensis* and sugar maple *Acer saccharum*. Recent records of *S. gaspensis* from Quebec have been in mature mixed forests (four cases), a sugar maple forest with yellow birch, a mature coniferous forest and in one case a regenerating mixedwood. Sampling biased toward habitats that have been presumed to be preferred may make data on habitat preference unreliable.

Biology

Little is known of the biology of either species, reflecting their cryptic, inaccessible habitat and low capture frequencies. They are insectivorous, and are assumed to live for 14-17 months. Like other shrews they probably reach sexual maturity in the second summer after birth. Litter sizes range from 2-6, with the possibility of 1-2 litters per breeding female per year. Adults are believed to have fixed home range, although during the breeding season, males may wander widely in search of females. Young are probably weaned by 25 days of age, when they disperse in search of their own home range. Shrews are expected to be most vulnerable to predation and starvation during weaning and dispersal.

Population sizes and trends

Virtually nothing is known about population sizes and trends of the two species (or subspecies), and apart from some new occurrences our knowledge about their ecology does not appear to have changed since the 1988 COSEWIC status report on *S. gaspensis*. It is highly likely that both species are more widespread and abundant than presently believed, although the occurrence of presumed preferred habitat is restricted and isolated in the landscape. The lack of systematic inventory and monitoring for these species in known or potential habitat makes it impossible to provide any evaluation of possible population changes.

Limiting factors and threats

Potential threats to these species are limited since their habitat is unsuitable for anthropogenic uses such as forestry, agriculture or mining. Populations are widespread, and although single populations may be lost from an intense fire event, both species appear to be widespread in talus habitats throughout the region.

Special significance of the species

S. gaspensis is significant because presently it is believed to be the only North American *Sorex* species unique to Canada. Like some other species' populations in Atlantic Canada, its small, isolated and disjunct population may be a relict of geography and glacial history.

Existing protection

S. gaspensis has been designated as a species of Special Concern in April 1988, by COSEWIC and is on Schedule 3 of the federal Species at Risk Act (SARA 2002). Within the provinces, neither species is protected by provincial endangered species legislation.

COSEWIC HISTORY

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. On June 5th 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2006)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* 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. Definition of the (DD) category revised in 2006.

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

Update
COSEWIC Status Report

on the

Gaspé shrew
Sorex gaspensis

in Canada

2006

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SPECIES INFORMATION

Name and classification

Sorex gaspensis and *S. dispar* belong to the order Insectivora and the family Soricidae (subfamily Soricinae, tribe Soricini). The genus *Sorex* contains 40-50 species and occurs throughout the Holarctic. The Gaspé shrew *S. gaspensis* Anthony and Goodwin (French, la Musaraigne de Gaspé) belongs in the subgenus *Otisorex*. *S. gaspensis* and the long-tailed or rock shrew *S. dispar* Batchelder (French, la Musaraigne longicaude) are allospecies comprising the *S. dispar* group. Two subspecies of *S. dispar* are currently recognized, *S. d. dispar* Batchelder and *S. d. blitchi* Schwartz. *S. gaspensis* is monotypic (Kirkland and Van Deusen 1979).

To date *S. dispar* and *S. gaspensis* have been recognized as different species primarily because of differences in body size. There is a south to north cline of decreasing size in *S. dispar*, with the southern Appalachian subspecies *S. d. blitchi* being the largest (Kirkland and Van Deusen 1979). Extrapolating this cline to Quebec, Kirkland and Van Deusen (1979) predicted that if *S. gaspensis* belonged to the *dispar* cline, then *S*. *gaspensis* should be larger than it is. In fact *S. gaspensis* is slightly smaller than *S. dispar*. This discontinuity in body size, and the observed disjunction in the range of the two species, has supported the view that *S. gaspensis* is a distinct species (Kirkland and Van Deusen 1979). Their conclusions were confirmed by French and Kirkland (1983) and Scott and van Zyll de Jong (1989).

However, similarity in skull shape between *S. dispar* and *S. gaspensis* challenge the notion that the two are distinct species. Furthermore, a hypothesized steeper cline at the northern edge of the range coinciding with a harsher climate also is suggestive of one species. Small numbers of specimens for analyses from the northern edge of the cline (Scott and van Zyll de Jong 1989; Rhymer *et al*. 2004) leave the question open.

The following paragraph summarizes recent genetic work and was written by Don Stewart (pers. comm.). ‘’Two studies of mitochondrial DNA variation have now been conducted on the *S. dispar*/*S. gaspensis* species complex. Recently, Rhymer *et al*. (2004) used partial mitochondrial control region sequence (284 bp). Don Stewart, Fred Scott and Stephen Petersen (in preparation) used partial mitochondrial cytochrome b sequence (309 bp) amplified from DNA extracted from small (~1x5 mm) pieces of dried skin samples. In addition to having analyzed different mitochondrial genes, the two studies differ in the geographic areas sampled. Rhymer *et al*. (2004) examined 35 specimens from northwestern Maine, southern Quebec, and Quebec's Gaspé Peninsula. Stewart *et al*. (in prep) examined specimens of *S. dispar* from Tennessee, North Carolina, New York, and Atlantic Canada and specimens of *S. gaspensis* from New Brunswick and Cape Breton Island, Nova Scotia. Rhymer *et al*. (2004) found little polymorphism and no differentiation between the two species. Stewart *et al*. (in prep) found two clades present among the sample of 18 individuals. One clade consisted of *S. dispar* specimens from Tennessee, North Carolina, and New York State. The other clade consisted primarily of *S. gaspensis* specimens but also

included three *S. dispar* specimens from Nova Scotia. There was very little sequence variation in each of these two clades. The average sequence divergence between the two clades was also quite small (~1%), which may be consistent with conspecific status, as suggested by Rhymer *et al*. (2004).

The amount of divergence noted for this region of cyt b (309 bp) is less than that observed between several other closely related species of shrews (i.e., 3.2% divergence between *S. palustris* and *S. bendirii,* 5.7% between *S. cinereus* and *S. haydeni*, and 3.9% between *S. hoyi* and *S. thompsoni,* two putative pygmy shrew species). At present, the taxonomic status of *S. dispar* and *S. gaspensis* must be viewed as uncertain. Although Rhymer's work clearly indicated that the two species were indistinguishable, the geographic range of specimens examined was very small (northwestern Maine and the Gaspé region of Quebec). The current work of Stewart *et al*. (in prep), which includes specimens from the southern portion of the range (Tennessee, North Carolina) and the northeastern portion of the range (mainland Nova Scotia and Cape Breton), suggests that there may be some taxonomically significant divisions within this complex. However, given the amount of cytochrome b sequence divergence, it could be argued that the two clades represent different subspecies rather than different species.

Taken together, the two studies suggest that the geographic boundaries of these two putative species or subspecies (i.e., *S. dispar* and *S. gaspensis* or *S. dispar dispar* and *S. dispar gaspensis*) will likely have to be re-drawn. It certainly appears unlikely that *S. gaspensis* (or *S. dispar gaspensis*) will continue to be recognized as a Canadian endemic taxon. Further work on this species complex needs to be done focusing on (1) broader sampling of the range of *S. dispar* in New England, particularly in areas where the two mitochondrial DNA lineages identified by Stewart *et al*. (in prep) are likely to come into contact (i.e., Vermont, New Hampshire, southern Maine); (2) sequencing of additional mitochondrial DNA gene regions (e.g., the complete cytochrome b gene); and (3) the addition of nuclear DNA markers (e.g., microsatellites)''.

Morphological description

Both *S. dispar* and *S. gaspensis* are small, slender and slate-grey in colour throughout the year (usually on both dorsal and ventral surfaces). The tail is long, well furred and not distinctly bicoloured (Kirkland 1981). *S. gaspensis* weighs approximately 3 g (range 2.2-4.3 g) and measures 95-127 mm in total body length, with a tail length of 45-55 mm. *S. dispar* is larger in all respects (3.1-8.3 g, total length 103-136 mm, tail length 46-67 mm). Morphologically, skulls of the two species can be separated based on condylobasal length and the length of the molariform tooth row. In *S. gaspensis* the condylobasal length is < 16.4 mm (range 15.35-16.35 mm) and the molariform tooth row is < 3.7 mm (range 3.40-3.65 mm), and in *S. dispar* these features are larger (condylobasal length 16.45-18.70 mm, molariform tooth row 3.75-4.30 mm, Kirkland and Van Deusen 1979, Table 1).

Table 1. Mean and standard deviation of measurements for adult *Sorex dispar* and *S. gaspensis*. Measurements for *S. gaspensis* are from Kirkland and van Deusen (1979). The first four measurements for *S. dispar* were calculated from specimens taken in Canada (Woolaver *et al* 1998, McAlpine *et al*. 2004, Kirkland and Schmidt 1982, Scott and van Zyll de Jong 1989, Scott 1987). The following two measurements for *S. dispar* were taken from Kirkland and van Deusen (1979), and refer to *S. dispar* captured in New England, as these measurements were not available for Canadian specimens. All means were significantly different at p < 0.01.

Measurements	*Sorex dispar*	*Sorex gaspensis*	t-test
Total length	120.26 ± 4.24 (n=5)	105 ± 8.78 (n=21)	3.74
Tail length	57.68 ± 1.85 (n=5)	49.72 ± 2.65 (n=23)	6.34
Hind foot length	13.08 ± 0.78 (n=5)	11.98 ± 0.57 (n=23)	3.67
Mass	4.08 ± 0.37 (n=5)	2.89 ± 0.63 (n=9)	3.83
Condylobasal length	17.12 ± 0.33 (n=33)	15.88 ± 0.37 (n=18)	12.29
Length of molariform tooth row	3.92 ± 0.12 (n=49)	3.56 ± 0.07 (n=18)	3.74

Externally, their dorsal pelage, slender build, unusually long snout and long tail serve to separate *S. dispar* and *S. gaspensis* from other sympatric soricids. The smoky shrew *(S. fumeus)* is chunky and robust, with an incrassate (swollen in mid-length) tail not found in *S. dispar* or *S. gaspensis.* As well, tail length of the smoky shrew generally averages 60-70% of head-body length, whereas in both *S. dispar* and *S. gaspensis* it is usually larger, averaging 80-90% of head-body length (Kirkland 1981). Both *S. dispar* and *S. gaspensis* can be distinguished from other North American *Sorex* based on the position of the posterior border of the intraorbital foramen (posterior to the plane between M1 and M2) and the rostra (which are longer than other *Otisorex*; see Fig. 1).

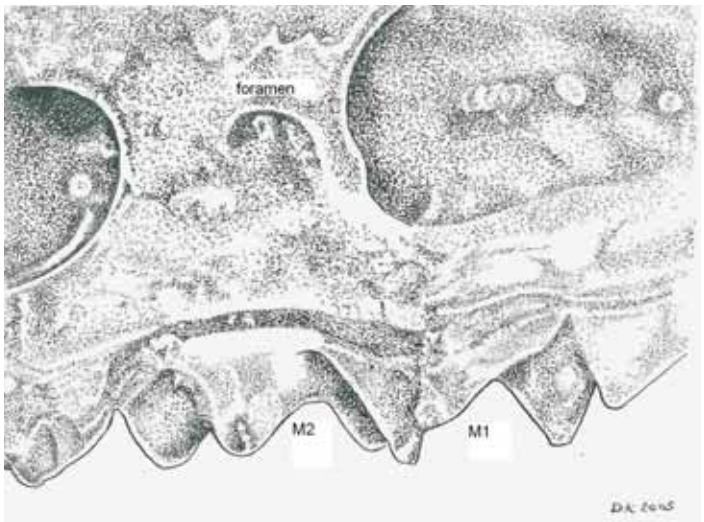

Figure 1. Distinguishing features of skull in *S. gaspensis* (similar to *S. dispar*) compared to other *Otisorex*, specifically the position of the intraorbital foramen in relation to M1 and M2, and the rostra (from photograph in Lupien 2001).

DISTRIBUTION

S. gaspensis is currently considered to be the only North American shrew having its entire range within Canada. *S. gaspensis* are recorded from five regions: one in the Gaspé Peninsula, two in New Brunswick and two in northern Nova Scotia (Figure 2). There are 80 records from the Maritime Provinces and 53 from Quebec, totalling 133 to date (33 locations to 2004). Since the status report of Scott (1988), four additional historical records have been located and 15 new records reported.

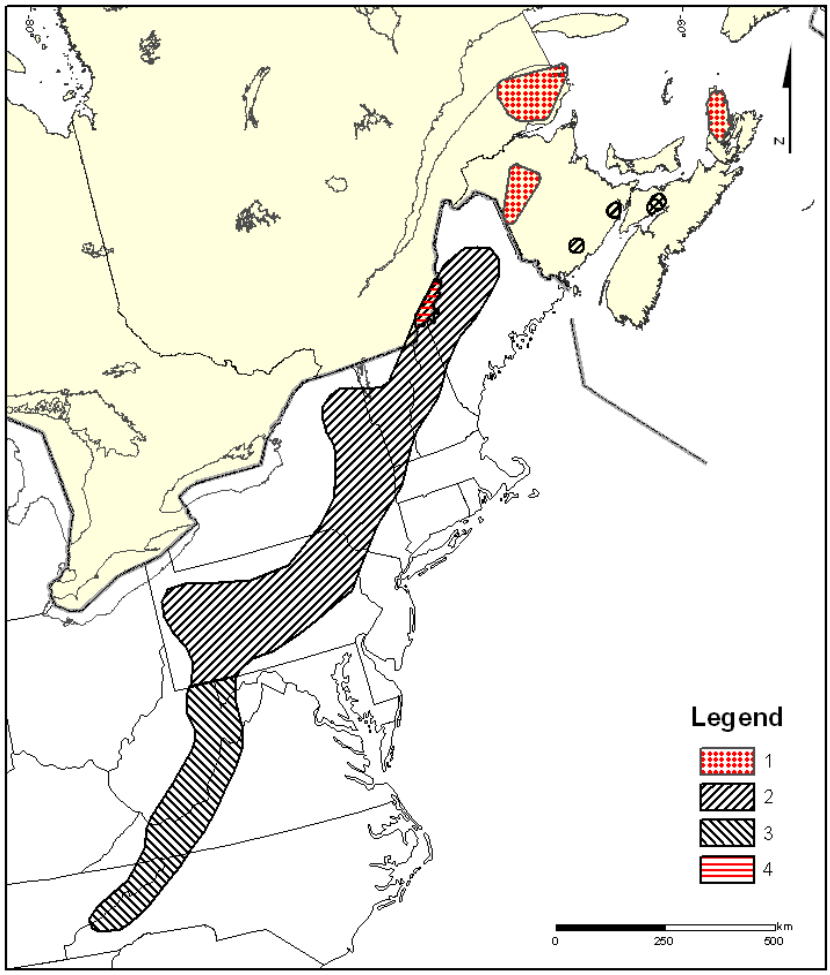

Figure 2. Geographic distribution of *S. dispar* subspecies *S. d. dispar*, *S. d. blitchi* and *S. gaspensis*. The map is modified from Rhymer *et al*. (2004). Key: 1 = *S. gaspensis*; 2 = northern U.S. *S. d. dispar*; 3 = southern U.S. *S. d. blitchi*; 4 = Overlap of *S. gaspensis* and *S. d. dispar.*

Recent surveys indicate less of a geographical gap in range between *S. dispar* and *S. gaspensis* (e.g., McAlpine *et al*. 2004). To date (2004), 20 specimens of *S. dispar* have been recorded in Canada (11 locations), 12 in southeastern Quebec, 2 from southeastern and one from southcentral New Brunswick, and 6 on mainland Nova Scotia (McAlpine *et al*. 2004). *S. dispar* is limited to the mountainous regions of northeastern North America (Figure 3).

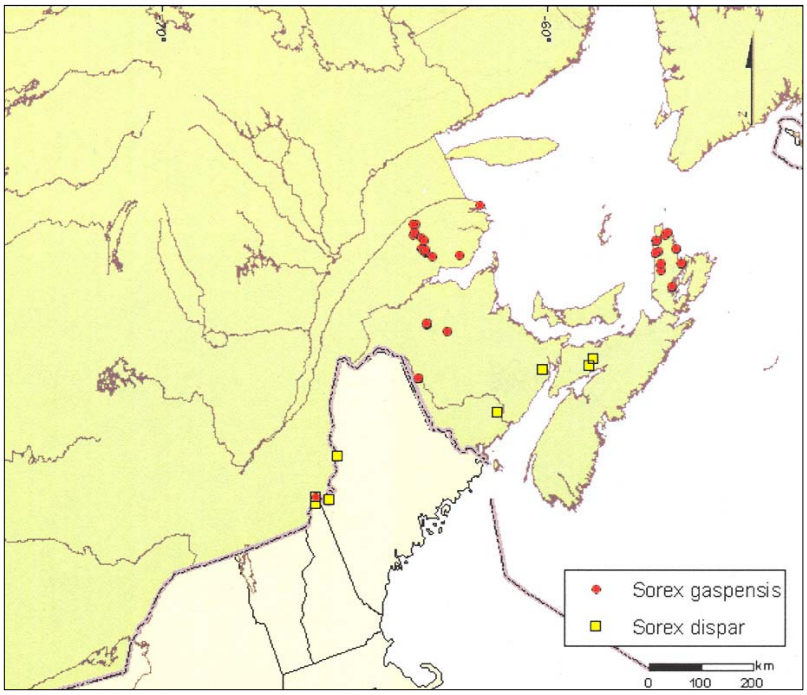

Figure 3. Locations within Canada from which *S. gaspensis* and *S. dispar* have been recorded.

Both species may be more widespread than is currently believed. Many areas of suitable habitat have not been surveyed for shrews. For example, apparently suitable habitat exists for both species in the Cobequid Mountains of Nova Scotia and the Nerepis Hills of New Brunswick (Woolaver *et al*. 1998; McAlpine *et al*. 2004). There is extensive granitic talus habitat in the highlands on the east side of Cape Breton Island between Tarbotvale and Cape Smokey (Scott 1988; F. Scott, pers. comm.).

Both species are hard to detect and intensive trapping is required. For example, in Nova Scotia, only one *S. dispar* was caught in 1,500 nights of trapping (Woolaver *et al*. 1998; M. Elderkin, pers. comm.) and approximately 1,000 trapping nights for each of four *S. dispar* trapped in the Smith Brook Valley (Scott and van Zyll de Jong 1989). Similarly, in Forillon National Park on the Gaspé Peninsula a single *S. gaspensis* was among 27 *Sorex* specimens trapped on 340 nights of trapping (S. Paradis, pers. comm.).

Extent of occurrence (EO) for *S. gaspensis* and *S. dispar* was calculated using the minimum convex polygon technique (C. Lougheed, Environment Canada, pers. comm.). Parts of polygons that fell in either the Atlantic Ocean (northern Nova Scotia locations) or in the northern United States (southern Quebec locations) were excluded from calculations. For any isolated observations, a 2-km radius buffer was drawn around each location. These calculations gave an extent of occurrence of 13,089 km^2 for *S. gaspensis* and 1,369 km^2 for *S. dispar*. If the two species are considered subspecies then the total extent of occurrence would be 14,385 km^2 (combined EO of *S. gaspensis* and *S. dispar*).

Table 2. Localities at which *S. gaspensis* has been collected and the present location of specimens in museum collections. Table updated from Scott 1988.

Prov.	County	Location	#	Date	Museum	Sex	Pub
NS	Victoria	South Mountain, Cape Breton Highlands National Park	2	1974	NMC 46973-46974	U	1
NS	Inverness	Grand Anse Valley, Cape Breton Highlands National Park	1	1974	NMC 46975	1♀ 4U	1
NS	Inverness	Cheticamp River Valley, Cape Breton Highlands	4	1974	NMC 46976-46979	U	
NS	Victoria	Summit Kelly's Mountain, near Englishtown	1	1971	NSM 971.324.16	♂	
NS	Inverness	Lewis Brook	1	1981	NSM 981.301.5	♂	
NS	Inverness	Wreck Cove Brook	1	1981	NSM 981.302.1	♀	
NS	Inverness	Northeast Margaree	1	1979	NSM 979.305.1	S♂	
PQ	Gaspé-Ouest	At falls above chalet, Gaspesian Provincial Park, Quebec	2	1953	NMC 21950-21951	2A♂	
PQ	Gaspé-Ouest	Near Chutes, Gaspesian Provincial Park	3	1955	AMNH 173442-443, 173645	3♂	
PQ	Gaspé-Ouest	Mount Albert, Gaspesian Provincial Park [type locality]	2	1923	AMNH 64190[type], 64191	♂♀	
PQ	Gaspé-Ouest	10 miles W of Mt Albert, Gaspesian Provincial Park	1	1923	AMNH 64189	♂	
PQ	Bonaventure	Cascapédia Valley at Red Camp, 8 mi. inland	7	1927	AMNH 74511-13, 74515, 74517-18	1♂ 5♀	
PQ	Bonaventure	Cascapédia Valley at New Dureen, 12 mi. inland	1	1927	AMNH 74516	♀	
PQ	Bonaventure	Cascapédia Valley at Middle Camp, 20 mi. inland	1	1927	AMNH 74514	♂	
PQ	Matapedia/ Matane	Cascapédia Valley at Big Berry Mt, 35 mi. inland	1	1927	AMNH 74808	U	
PQ		R. Cascapédia, Berry Mt	1	1927	AMNH 74519	U	
PQ		R. Cascapédia, Red Camp	2	1927	AMNH 74520-74521	2♂	
PQ		R. Cascapédia, Middle Camp	1	1927	AMNH 74522	♂	
PQ		Rivière Cascapédia, Ruisseau Indian Falls	3	1995			**5**
PQ		Rivière Cascapédia, Ruisseau Morency	1	1995			**5**
PQ		Rivière Cascapédia, Ruisseau Charles	6	1995			
PQ		Rivière Cascapédia, Ruisseau Charles	1	1999			
PQ		Rivière Cascapédia, Ruisseau Dechêne	1	2000			
PQ		Petite Cascapédia	1	2001			

Prov.	County	Location	#	Date	Museum	Sex	Pub
PQ		Parc de la Gaspésie	1	1996			**5**
PQ		Mont Albert, Lac Ste-Anne	1	1961			
PQ		Mont Albert, Ruisseau des Quatre Lacs à la hauteur du petit lac Sainte-Anne	1	1961			
PQ		Rivière Bonaventure, Caverne de Saint-Elzéar-de-Bonaventure	13	1977			
PQ		Près du ruisseau Deloge à Notre Dame des Bois	1	1998			**5**
PQ		Forillon National Park	1	2002			**5**
NB	Carleton	Moose Mountain, near Bath	1	1980	USNM 553302	A♀	
NB	Northumberland	3.5 mi SW Mt Carleton, Mt Carleton Provincial Park	1	1961	RM R-125	A♂	**2**
NB	Restigouche	N slope of Sagamook Mtn, Mt Carleton Provincial Park	67	1980	NBM 1843-1846, SU 12018-12019, TWF 561, USNM 553242-553301	3A♂ 2A♀ 62S?	**3,4**

1missing AMNH 74510, cited in Scott 1988

Collection abbreviations: AMNH = American Museum of Natural History, New York City; NBM = New Brunswick Museum, Saint John; NMC = National Museum of Natural Sciences, Ottawa; NSM = Nova Scotia Museum, Halifax; RM = Redpath Museum, Montreal; SU = The Vertebrate Museum, Shippensburg University, Shippensburg PA; TWF = private collection of Thomas W. French; USNM = United States National Museum, Washington DC, ACAD = Wildlife Museum, Acadia University.

Author: 1. Roscoe and Majka (1976), 2 Peterson and Symansky (1963), 3. Whitaker and French (1982), 4 French and Kirkland (1983), 5 Rhymer *et al*. (2004).

We calculated area of occupancy (AO) using two types of grid, one 2 km^2 and the other 4 km^2 grid (C. Lougheed, pers. comm.). The 2-km^2 scale was a conservative estimate of AO while the 4 km^2 was less conservative. Using a 2-km^2 grid, the total AO for *S. gaspensis* was 128 km^2 and for *S. dispar* 36 km^2. The combined AO for both species was 164 km^2. Using the 4-km^2 grid, the AO for *S. gaspensis* was 480 km^2 and for *S. dispar*, 128 km^2. The combined AO for both species was 608 km^2. Given that the calculated AOs are very small, it is important to note that setting the grid to 4 km^2 may exclude apparently suitable adjacent habitat that has not been surveyed. We would expect that further surveys in suitable habitat would identify other populations (especially with a systematic sampling design); however, considerable survey effort will be necessary given the low detectability of this species.

No data are available on historical changes in number of populations or extent, but this may be assumed to be relatively stable due to the lack of significant anthropogenic disturbance to their habitat.

Table 3. Localities at which *S. dispar* has been collected in Canada and the present location of specimens in museum collections.

Prov	County	Location	#	Date	Museum	Sex	Pub
PQ		Armstrong, 10 mi SE near Lac du Portage and near Maine border	2	1955	AMNH 174347, 252529	2♂	**1**
PQ		South of Chartierville, a few yards north of New Hampshire border	3	1955	AMNH 252526-252528	2♂ 1♀	**1**
PQ			3	1955	AMNH 174344-174346	2♂ 1♀	
PQ		Parc du Mont Mégantic	2	1995			**6**
PQ		Parc du Mont Mégantic	1	1998			**6**
PQ		Gosford	1	1997			**6**
NB	Albert	Crowley Mountain, Nerepis Hills	1	2002	NBM 5970	A♂	**2**
NB	Albert	5.3 km N, 3.5 km W of Riverside-Albert	2	1978 1979	SU 8393 ??	2S♂	**3, 4**
NS	Cumberland	Folly Mountain	1	1984	NSM 984.301.1	A♀	**5**
NS	Cumberland	Smith Brook Valley	4	1986	NMC 52250-52251, NSM 10017, 10024	3S♂ A♂	**7**
NS	Colchester County	Copper Mine Brook	1	1996	ACAD 0400000195	1S♂	**8**

Authors: 1. Peterson (1966), 2 McAlpine *et al*. (2004), 3 Kirkland and Schmidt (1982), 4. Kirkland *et al*. (1979), 5 Scott (1987), 6 Rhymer *et al*. (2004), 7 Scott and van Zyll de Jong (1989), 8 Woolaver *et al* 1998.

HABITAT

Habitat requirements

Both *S. gaspensis* and *S. dispar* appear to be largely restricted in distribution to steep slopes in highland areas, with varying amounts of talus and rock outcrops, often near mountain streams. *S. gaspensis* appears to be most abundant in mature forest on well-developed talus formations and least in areas with little or no talus (Scott 1988). At Kelly's Mountain and South Mountain, these shrews were trapped along streams with a few boulders (Scott 1988). There may be some geographic differences in habitat use, with Gaspé Peninsula and New Brunswick populations occurring more often in non-talus substrates and coniferous forests, whereas in Cape Breton Island *S. gaspensis* distribution seems to be more closely linked to talus formations, hardwood forest and less associated with streams (Scott 1988).

Shrews appear to inhabit the talus to some depth, using the maze of passages among the rocks (Richmond and Grimm 1950). Specific types of rock formations seem to be preferred – those that form particular sizes and shapes of talus (e.g., granite; F. Scott, pers. comm.). While many occurrences are close to streams (*S. gaspensis* was originally collected in Quebec at the edge of small streams – Anthony and Goodwin 1924), these observations are probably biased, reflecting the trapping behaviour of mammalogists (Scott 1988).

In New Brunswick, *S. gaspensis* has been captured in spruce habitat with little undergrowth along a small stream (Peterson and Symansky 1963). Further sampling near this location revealed large numbers of *S. gaspensis* within 15 m of streams on the north-facing slope of Sagamook Mountain (Whitaker and French 1984). The forest was dominated by black spruce (*Picea mariana*), yellow birch, eastern white cedar (*Thuja occidentalis*) and balsam fir. The understory consisted mainly of maples (*Acer* species) and herbaceous species. Portions of the adjacent hillsides were covered with talus, which consisted of large boulders ranging from 0.4 to 1.3 m in diameter.

On Cape Breton Island, Nova Scotia, *S. gaspensis* has been recorded from seven habitats, two of which were described by Roscoe and Majka (1976): 1) a mixedwood stand composed of spruces (*Picea* spp), white birch (*Betula papyrifera*), and balsam fir (*Abies balsamifera*) with scattered maples (*Acer* spp); and 2) a mature hardwood stand of sugar maple (*Acer saccharum*) and yellow birch (*Betula alleghaniensis*).

The first stand was located beside a small stream on the north side of South Mountain, Cape Breton Highlands National Park (CBHNP), and had an abundant understory of speckled alder (*Alnus rugosa*), herbs, ferns and grasses. The second stand was located along a north-facing slope (Grande Anse Valley, CBHNP), with the ground composed of broken rock, with boulders ranging from 0.5-2 m across, and covered with moss and scattered wood fern (*Dryopteris spinulosa*). Habitat characteristics of five other stands are described by Scott (1988).

Recent records of *S. gaspensis* in Quebec come from mature mixed forest (3), mature coniferous forest (1) or regenerating mixed forest (1); the shrews were captured along small brooks, bordered by mixed forest, coniferous forest or shrubs. Rocky boulders with moss cover were also present in the area (J. Jutras, pers. comm.). A single *S. gaspensis* was also recently collected in Forillon National Park on the Gaspé Peninsula in similar stream habitat, with moss ground cover (S. Paradis, pers. comm.).

In Canada, like *S. gaspensis, S. dispar* has been recorded from rocky habitats near streams. In New Brunswick, McAlpine *et al*. (2004) found *S. dispar* on a 50-75 degree slope over mossy, granitic talus with a dominant overstory of red spruce (*Picea rubens*) and scattered yellow birch, with much coarse woody debris, and Kirkland and Schmidt (1982) in an open talus slide on a mixed coniferous/deciduous forest hillside. Another specimen was trapped on a rocky east-facing hillside in deciduous-coniferous forest dominated by yellow birch, with mountain maple (*Acer spicatum*) and balsam fir as subdominants. The understory consisted of mosses and ferns.

In Nova Scotia, Scott (1987) trapped *S. dispar* on an east-facing slope (40°) of Folly Mountain, in mature deciduous forest dominated by sugar maple, American beech (*Fagus grandifolia*) and yellow birch. There was about 35% talus and 5% rock outcrop. However, *S. dispar* does not appear to be restricted to natural talus, as Kirkland (1976) recorded them on terraced mine waste deposits in New York, and Scott and van Zyll de Jong (1989) caught one on the artificial talus created by a railroad crossing a steep valley.

Habitat trends

There is virtually no information about trends in habitat for either species. The talus slopes that appear to be preferred habitat of these species are apparently not threatened by anthropogenic influences (Scott 1988; F.W. Scott, pers. comm.). Generally, this habitat is not conducive to logging operations because slopes are too steep and unstable. Although both yellow birch and sugar maple are commonly used for firewood, as in the case of commercial forestry, talus slopes are unlikely to be harvested because of their inaccessibility. Talus slopes are also not conducive to mining, although some minable minerals do occur in granite.

Habitat protection/ownership

Protected areas in northern New Brunswick and the Gaspé Peninsula contain a disproportionate amount of montane habitats, so a high proportion of potentially suitable habitat for the species is government-owned. However, some areas are not under government protection and the habitat for some shrew populations in those areas may be threatened. These were listed by Scott (1988) as Moose Mountain, New Brunswick; a small mountain encroached by agricultural land, and all areas in Cape Breton Island outside the Cape Breton Highlands National Park.

BIOLOGY

Little is known about the biology or life history of either *S. gaspensis* or *S. dispar*. The following information is mainly based on information gleaned from the physical examination of captured specimens, or inferred from biological studies on other, similar shrew species.

Life cycle and reproduction

Both *S. gaspensis* and *S. dispar* are insectivorous, consuming mainly small invertebrates such as centipedes, spiders, beetles, flies and grasshoppers (Richmond and Grimm 1950). In Canada, the stomach contents of *S. dispar* contained spiders and centipedes (1 specimen, August, McAlpine *et al*. 2004) and *S. gaspensis* spiders, beetles, flies, Trichoptera and Lepidoptera (two specimens, Hamilton and Hamilton 1954, 64 specimens Whitaker and French 1984). Spiders are possibly the most important food items (Whitaker and French 1984).

Both species most likely live for 14-17 months, attaining sexual maturity in the second summer after birth. In *S. dispar* the reproductive season appears to extend from early spring to late summer (Kirkland 1981), and based on the sexual maturity of captured specimens is probably of similar length in *S. gaspensis* (French and Kirkland 1983; McAlpine *et al*. 2004). Courtship in shrews is generally rudimentary, with males pursuing females until contact is made. Females in oestrus will allow males to mount; otherwise the male's advances will be met with aggression. Females are probably in oestrus for a few hours every three weeks or so. Repeated copulation may be necessary to stimulate ovulation. The gestation period is probably 22-25 days. Embryo counts suggest litters range from 2-6 (Richmond and Grimm 1950; Kirkland and Van Deusen 1979; French and Kirkland 1983). Young are probably fully weaned by 22-25 days old. Two litters per breeding female may be possible if the first litter is conceived by early May.

We presume that both species are largely solitary. Female shrews generally have fixed home ranges where they remain for most of their life. However, males may wander widely during the breeding season, possibly abandoning their territories, in search of females in oestrus. Meetings between shrews may result in aggressive reactions such as postures and vocal signals, and often a fight. Although these interactions would rarely be fatal, a shrew prevented from feeding for a period of time may be at risk of starvation. Aggressive interactions are likely highest in mid-summer when juveniles are competing with adults for territories and nesting sites, and population density is high.

Predation

Owls, weasels, cats and short-tailed shrews have been observed catching and eating small shrews like *S. dispar* and *S. gaspensis*. Shrews are not usually depredated because of distasteful secretions located in their dermal glands.

Dispersing shrews are probably most vulnerable to predation, when they may be active on the ground surface rather than in subsurface tunnels and runways. To our knowledge, no information exists on the specific effects of predation on either *S. gaspensis* or *S. dispar*.

Physiology

High metabolic rates and voracious appetites are characteristic of shrews. Generally active both day and night, they require food every 2-3 hours to maintain their high metabolism. To maintain body temperature in winter, shrews increase their metabolic rates as well as reduce heat loss by undergoing a pre-winter moult, which produces a longer and thicker pelage. Use of subterranean space by both species should mitigate the effects of harsh winter weather, as the talus and snow layer have an important moderating influence on temperature. Possibly due to their elevated metabolism and activity levels, shrews usually have a high evaporative respiratory loss, resulting in relatively high water requirements (Churchfield 1990).

Dispersal/migration

In *Sorex* generally, young disperse from their natal areas as soon as they are weaned, and may wander widely in search of their own home range. Establishing themselves quickly within a home range is important for juvenile survival by ensuring access to food and nesting sites, and minimizing predation and aggressive interactions with conspecifics. The dispersal distances of *S. gaspensis* and *S. dispar* are unknown.

Interspecific interactions

Both *S. gaspensis* and *S. dispar* have been captured in association with other small mammal species, including red-backed vole (*Clethrionomys gapperi*), masked shrew (*Sorex cinereus*), water shrew (*S. palustris*), smokey shrew (*S. fumeus*), pygmy shrew (*Microsorex hoyi*), short-tailed shrew (*Blarina brevicauda*), deer mouse (*Peromyscus maniculatus)*, woodland jumping mouse (*Napaeozapus insignis*), meadow vole (*Microtus pennsylvanicus)* and rock vole (*Microtus chrotorrhinus*) (Roscoe and Majka 1976; Kirkland and Schmidt 1982; Whitaker and French 1984; Scott 1987; Scott and van Zyll de Jong 1989; McAlpine *et al*. 2004). The extent to which these species compete for habitat and food with *S. gaspensis* and *S. dispar* is unknown.

Shrews are host to a wide variety of external and internal parasites. Whitaker and French (1982) describe 18 ectoparasites found on 67 *S. gaspensis* individuals trapped at Mt. Carleton Provincial Park in New Brunswick, and Whitaker and French (1988) and O'Connor (1985) describe the ectoparasites found on *S. dispar* in New York and Tennessee. However, there is little evidence that parasite loads affect mortality in shrews (Churchfield 1990).

Adaptability

Nothing is known about the adaptability of either species.

POPULATION SIZES AND TRENDS

Search effort

Both *S. dispar* and *S. gaspensis* are best sampled using pitfall traps. A pitfall trap placed below the talus surface in places between rocks is generally most effective (Richmond and Grimm 1950). Often traps can be placed in the litter that accumulates in pockets between talus boulders (F. Scott, pers. comm.).

Sampling with pitfall traps could be biased towards males, at least in *S. dispar* with 14 of 17 specimens of known sex being male (Table 3). In *S. gaspensis* 12 females and 19 males of known sex have been captured. Given the assumed biology of this species, the capture of dispersing juveniles and wandering males is expected at a higher rate than the more sedentary females. The association with streams may be a function of streams being used as dispersal routes, rather than breeding habitat. Greater search effort within the crevices of talus slopes is required to identify female breeding habitat.

Recent records for *S. dispar* on the mainland of Nova Scotia (Woolaver *et al*. 1998) suggests that the species is more widely distributed and abundant than previously thought. The new site was predicted based on biophysical data from an occupied site and deploying a geographic information system (GIS) algorithm to predict potential areas. Other such potential sites occur throughout the Cobequid Hills in Cumberland and Colchester counties in Nova Scotia. However, no targeted searches have taken place to establish the presence/absence of the shrew in those areas (M. Elderkin, pers. comm.).

Appropriate, intensive sampling is needed to establish the population status of both *S. gaspensis* and *S. dispar* over their geographic ranges in Canada. Although talus slopes are not readily identifiable from landsat imagery, steep slopes (40^{o}) may be identified through topographical maps.

Abundance

The population density of both *S. gaspensis* and *S. dispar* is unknown. Although on Sagamook Mountain, Mount Carleton Provincial Park (New Brunswick), 67 individuals were captured in 1980, the samples from other locations are small in number.

Fluctuations and trends

No data exist on these population aspects.

Rescue effect

Populations of *S. gaspensis* are isolated and geographically separated. Given the potentially small home range of the species and limited movement patterns, dispersal between *S. gaspensis* populations is probably impossible.

LIMITING FACTORS AND THREATS

Because of the inaccessibility of the habitat used by *S. gaspensis* and *S. dispar*, few factors have been identified that could threaten populations. It is probable that many populations occur on government-owned (federal or provincial) lands and are thus afforded some level of protection. Commercial logging or tree cutting for firewood is difficult or impossible on steep (35-45^{o}) talus slopes. Roads are generally built in valley bottoms, and talus provides an unstable foundation for road building. Fire may potentially be a threat and stand-replacing fires could kill many shrews; however, little is known about whether fires above or below talus slopes affect shrews. Talus slopes at high elevations are not susceptible to winter or spring snowmelt flooding (Herman and Scott 1992; Herman and Scott 1994). The fact that shrew populations are small, isolated and disjunct may make *S. gaspensis* susceptible to stochastic events that extirpate populations; however, isolated populations of this species appear to have survived for many years.

SPECIAL SIGNIFICANCE OF THE SPECIES

Currently *S. gaspensis* is the only North American *Sorex* species unique to Canada; together with *S. dispar* it is probably still the least known of all Canadian mammals.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

In Canada, *S. gaspensis* has been designated as a species of Special Concern by COSEWIC in April 1988. The species is currently on Schedule 3 of the Canadian Species at Risk Act (Statutes of Canada 2002). In Nova Scotia, New Brunswick and Quebec, neither *S. gaspensis* nor *S. dispar* is listed under provincial Endangered Species Acts. However, Quebec lists *S. gaspensis* as ”susceptible d'être désigné espèce menacée ou vulnérable”.

According to NatureServe, the global status of *S. gaspensis* is G3 (vulnerable to extirpation or extinction, assessed 1 November 1996). In New Brunswick, *S. gaspensis* is listed as S1 (extremely rare throughout its range in the province with typically five or fewer occurrences or very few remaining individuals) and in Nova Scotia as S2 (rare throughout its range in the province [6 to 20 occurrences or few remaining individuals] and may be vulnerable to extirpation due to rarity or other factors). It is listed as S1 in Quebec.

S. dispar is listed globally and within the United States, as G4 (apparently secure) by NatureServe (NatureServe 2004, assessed 1 November 1996). However in Canada, NatureServe lists this species as N1N2 (imperilled-critically imperilled, assessed 8 February 2000). Its provincial status has not been assessed in Quebec. However, in Nova Scotia and New Brunswick it has been ranked as S1, although this designation is uncertain in New Brunswick.

TECHNICAL SUMMARY

Sorex gaspensis
Gaspé shrew — la musaraigne de Gaspé
Range of Occurrence in Canada: Quebec, New Brunswick, Nova Scotia

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* **[explain source of information and calculation]**	13,089 km^2; calculated using minimum convex polygon (see text).
• *Specify trend in EO*	None known
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)* **[explain source of information and calculation]**	128 km^2 calculated using 2-km^2 grid; 480 km^2 calculated using 4-km^2 grid.
• *Specify trend in AO*	None known
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	33 (11)
• *Specify trend in #*	None
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	None known
Population Information	
• *Generation time (average age of parents in the population)*	Unknown
• *Number of mature individuals*	Unknown
• *Total population trend:*	Unknown
• *% decline over the last/next 10 years or 3 generations.*	
• *Are there extreme fluctuations in number of mature individuals?*	No
• *Is the total population severely fragmented?*	Yes
• *Specify trend in number of populations*	Not known
• *Are there extreme fluctuations in number of populations?*	Not known
• List populations with number of mature individuals in each: Not known	
Threats (actual or imminent threats to populations or habitats)	
None identified	
Rescue Effect (immigration from an outside source)	
• *Status of outside population(s)?* **USA: *S. gaspensis* does not occur in USA**	
• *Is immigration known or possible?*	No
• *Would immigrants be adapted to survive in Canada?*	Does not occur outside Canada
• *Is there sufficient habitat for immigrants in Canada?*	Yes, but habitat is naturally fragmented and isolated
• *Is rescue from outside populations likely?*	No
Quantitative Analysis [provide details on calculation, source(s) of data, models, etc]	[x% probability of extirpation in y years]
Current Status COSEWIC: Special Concern, April 1988 Not at Risk, April 2006	

Status and Reasons for Designation

Status: Not at Risk	**Alpha-numeric code**: Not applicable

Reasons for Designation:
It is highly likely that this shrew is more widespread and abundant than presently believed. Although the occurrence of presumed preferred habitat is restricted and isolated in the landscape, it is not at risk. The species appears to be widespread in talus habitats throughout its range. Recent information questions the taxonomic status of this shrew. Whereas it may well be a subspecies of *Sorex dispar*, when the original designation was made, it was considered a Canadian endemic species.

Applicability of Criteria

Criterion A: There is no direct evidence of a declining population trend, but there are no good data on population size. Likely widespread throughout its range in Canada. May not be a distinct species but a subspecies of *S. dispar*.

Criterion B: EO > 13,000 km^2; AO is at least 128 km^2. It is likely that species is more widespread and abundant than believed.

Criterion C: Total population size is unknown but there is no apparent threat to suitable habitat.

Criterion D: Total population size is unknown but the species is widespread.

Criterion E: Not available.

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BIOGRAPHICAL SUMMARIES OF REPORT WRITERS

Born in England, Dr. David Anthony Kirk immigrated to Canada in 1989 and since then has worked as a self-employed research ecologist. He has completed 12 previous COSEWIC status reports (6 full reports and 6 updates). Most of his current research focuses on monitoring biodiversity (including species at risk) at broad scales; he also works on the effects of farming and forestry on plants, invertebrates and birds. Outside Canada, his research ranges from studying the effects of introduced hares on vegetation and avifauna of islands in the Seychelles and conservation of maquis vegetation in North Africa, to resource partitioning among sympatric vultures in South America. He has published more than 25 scientific papers, in addition to numerous technical reports; his literature reviews are on subjects ranging from the impacts of genetically modified organisms on Canadian biodiversity, to evaluating the economic value of birds as predators of pests in farmland, the effects of Double-crested Cormorants *Phalacrocorax auritus* on Carolinian island vegetation, and ways to mitigate predation by mesopredators on turtle and other species at risk.

Dr. Jennie L. Pearce was born in Australia and immigrated to Canada in 1999. In both countries her research has focused on spatial modelling of the distribution and abundance of wildlife; her Ph.D. was on the endangered Helmeted Honeyeater *Lichenostomus melanops cassidix*. She is particularly interested in testing the accuracy of spatial models and how these can be used for solving landscape management concerns, such as conservation of endangered species, managing forests in an ecologically sustainable framework and allocating resource extraction industries over landscapes. She is also interested in the use of bioindicators for sustainable forest management, particularly for large and small mammals (including wolverine *Gulo gulo* and shrews), amphibians, carabid beetle and spider communities. She has published more than 25 scientific papers in this area, as well as participated in numerous workshops and conference proceedings.

COLLECTIONS EXAMINED

No collections were examined during preparation of this status report.