Habitat Parameters and Small Mammal Associations of the Gaspe Shrew, *Sorex gaspensis*, in the Eastern Gaspé Peninsula, Québec

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The Gaspé Shrew (*Sorex gaspensis*) is one of the rarest of Canadian small mammals. Consequently, little is known about its habitat preferences. This paper documents habitat parameters and small mammal species associated with the capture of nine specimens in the Gaspé Peninsula, Québec. Small mammals were collected using both pitfall traps and Victor snap traps at 22 sites during August and September 2005. A total of 571 small mammals representing 12 species was captured during 5637 trap nights. *S. gaspensis* specimens were trapped at sites located on hilly, rocky habitats. Microhabitat was cool and moist in all cases. Slope was always over 15 degrees and altitude ranged from 29 to 240 meters. Estimated percent of moss ground cover exceeded 50% in seven of the nine capture sites. Six *S. gaspensis* were trapped near running water while the others were captured far from streams. Overall, ten species of small mammals were captured in the same sites of *S. gaspensis*. Smoky Shrew (*Sorex fumeus*) was by far the most strongly associated species.

Key Words: Gaspé Shrew, *Sorex gaspensis*, habitat, small mammals, Québec.

The Gaspé Shrew, *Sorex gaspensis*, has an eastern North American range distribution that encompasses the Appalachians of the Gaspé Peninsula of Québec and New Brunswick, and Cape Breton Island, Nova Scotia (COSEPAC 2006*). A first record of *S. gaspensis* at Forillon National Park of Canada (FNPC) in 2002 confirmed the species' distribution to the northern limit of the Appalachians (Pronovost et al. 2005*). It is one of the rarest and probably least studied of Canadian small mammals and consequently little is known about *S. gaspensis* habitat preferences. Populations appear to be restricted largely to hilly areas with steep slopes and varying amounts of rock outcrops and talus (Kirkland 1981; Scott 1988*; COSEPAC 2006*). *S. gaspensis* is associated with several other small mammals with boreal affinities, including other shrews. While they are currently recognized as distinct species, recent phylogenetic analyses suggest that Gaspé Shrew and Long-tailed Shrew (*Sorex dispar*) are conspecific (Rhymer et al. 2004). Both species have similar habitat requirements (COSEPAC 2006*).

This paper documents habitat parameters, and small mammals associated with the capture of nine specimens in the Gaspé Peninsula, Québec, in 2005. This region is a part of the range of *S. gaspensis* for which little information currently exists. Data presented here supports those reported by others.

Study Area and Trapping Sites

A total of 22 sites was sampled within Forillon National Park of Canada (245,5 km^2) and on territories managed by the GESPEG Micmac Nation (1.3–4.5 km^2), Gaspésie County, eastern Québec (48°55'N, 64°30'W, Appendix 1) (Figure 1), with the specific objective of capturing *S. gaspensis*. Hilly areas with moderate to steep slopes are present throughout the region although some flat lands occur locally. Elevation ranges from 0-50 m in flat areas to 500-600 m in hilly areas. The habitat of the study area was mainly mixed-forest associations, with deciduous stands in well-drained slopes and coniferous stands in poorly-drained areas, generally lower-slopes. The dominant tree and shrubs species include Balsam Fir (*Abies balsamea*), White Birch (*Betula papyrifera*), Yellow Birch (*Betula alleghaniensis*), White Spruce (*Picea glauca*), Sugar Maple (*Acer saccharum*), Mountain Maple (*Acer spicatum*), and Rough Alder (*Alnus rugosa*). Trapping site descriptions are given in Table 1.

Methods

Trapping was carried out between 15 and 27 August 2005 in the eight GESPEG sites and between 18 August and 24 September 2005 in the 14 FNPC sites. Sites were selected to represent different associations of habitat parameters. Habitat components including altitude, slope, substrate, forest type, forest age, presence/absence of running water, and presence/absence of disturbance were analysed using a geographic information system (ArcGIS), while dominant overstory species, dominant understory species, and ground cover (30 m radius) of mosses, litter, herbs, and ferns were estimated in the field.

Both pitfall traps (ice-cream containers; 0.5 L) and standard Victor snap traps were used at each of the 22 sites (Table 1). Pitfalls were partially filled with water and Victor traps were baited with peanut butter

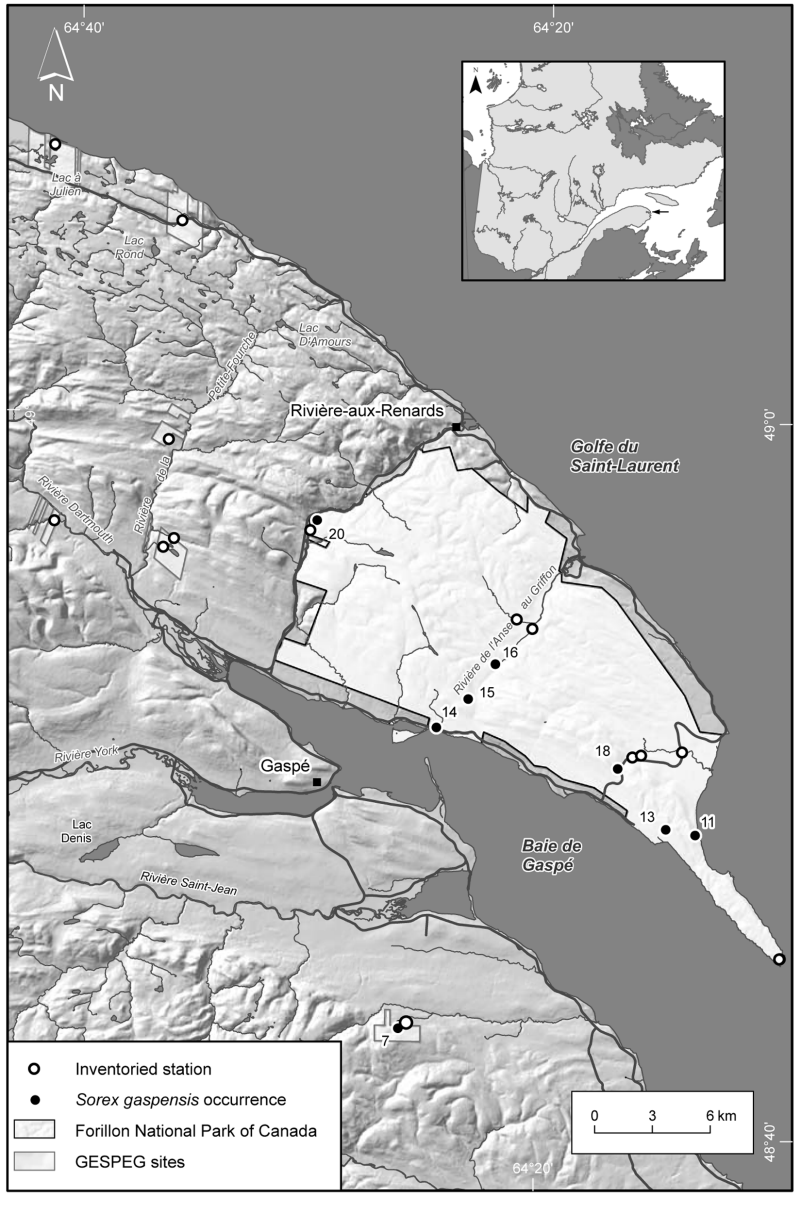

FIGURE 1. Geographic distribution of eight *Sorex gaspensis* occurrence stations in the eastern Gaspé Peninsula, Québec.

alone or a mixture of peanut butter and rolled oats. Traps were operated for at least ten consecutive days (Kirkland and Sheppard 1994), and were checked every day. As *S. gaspensis* was listed as a species of Special Concern in Appendix 3 of the Species at Risk Act in 2005, all traps at a site were closed when a specimen of this species was captured to prevent further mortality in this species. Specimens were bagged, frozen, and then identified according to Lupien (2000*, 2002*).

Results

All together 571 small mammals representing 12 species were captured in 5637 trap nights during the study (Table 2). With 247 individuals collected (43% of total), the Smoky Shrew (*Sorex fumeus*) was by far the most common small mammal species at all sites.

Nine individuals of *S. gaspensis* were captured at a total of eight sites. Two of these specimens were collected at the same site during the same day. Hence, a mean of 626 trapping nights was necessary for each

TABLE 1. Description of the 22 *Sorex gaspensis* trapping sites within territories managed by the GESPEG Micmac nation and Forillon National Park of Canada (FNPC).

Site	Altitude (m)	Number of trapping days	Number of pitfall traps	Number of Victor traps	Forest type	Stand age	Proximity to water (<15 m)	Slope (°)
GESPEG1	121	12	10	20	Mixed	10	Yes	15-30
GESPEG2	152	12	10	20	Mixed	70	Yes	15-30
GESPEG3	80	11	10	20	Mixed	70	Yes	8-15
GESPEG4	95	11	5	10	Mixed	50	Yes	15-30
GESPEG5	111	11	10	20	Coniferous	70	Yes	15-30
GESPEG6	230	10	10	20	Deciduous	50	Yes	15-30
GESPEG7	242	10	11	18	Deciduous	50	Yes	15-30
GESPEG8	50	10	10	20	Coniferous	70	Yes	15-30
FNPC9	64	10	10	20	Mixed	50	Yes	15-30
FNPC10	10	10	10	20	Coniferous	Ua[1]	Yes	0-3
FNPC11	87	4	10	20	Coniferous	50	No	>40
FNPC12	88	10	10	20	Mixed	30	No	>40
FNPC13	129	9	10	20	Mixed	70, 30	Yes	30-40
FNPC14	31	6	10	20	Mixed	70	Yes	15-30
FNPC15	183	2	10	20	Mixed	90	Yes	15-30
FNPC16	89	10	11	18	Mixed	70	Yes	15-30
FNPC17[2]	60	11	11	18	Mixed, deciduous	50, Ua[1]	Yes, no	15-30, 30-40
FNPC18	160	7	11	18	Mixed	70, 30	Yes	15-30
FNPC19	130	10	10	20	Mixed	50	Yes	8-15
FNPC20	155	2	10	20	Deciduous	Regeneration	No	>40
FNPC21	16	10	10	10	Deciduous	50	Yes	3-8
FNPC22	25	10	10	10	Fallow land	Regeneration	Yes	3-8

[1] Uneven-aged first growth forest.
[2] This site is subdivided into two parts.

S. gaspensis specimen trapped. Other species captured in the same sites as *S. gaspensis* were Smoky Shrew (86 specimens), Red-backed Vole (24), *Clethrionomys gapperi,* Masked Shrew, *Sorex cinereus* (17), Woodland Jumping Mouse (10), *Peromyscus* sp. (5), Short-tailed Shrew, *Blarina brevicauda* (2), Water Shrew, *Sorex palustris* (2), Meadow Vole, *Microtus pennsylvanicus* (1), and Southern Bog Lemming, *Synaptomys cooperi* (1).

Occurrence sites of *S. gaspensis* were all located on hilly, rocky habitats (Table 3). Slope was always over 15 degrees, and all occurrence sites included varying amounts of blocks, boulders and rock outcrops. In all cases, the microhabitat at the capture site was cool and moist. Estimated percent of moss ground cover exceeded 50% in seven of the nine capture sites. Relative abundance of herbs was always low. No specimen was captured on level ground and in soil composed of mainly sand and clay (three trapping sites).

All other habitat components varied to some degree from one occurrence site to another. The altitudinal range was from 29 to 240 meters (Table 3). Six of the nine *S. gaspensis* were trapped close to running water while three specimens were captured a considerable distance from the nearest streams (up to 232 m). *S. gaspensis* occurred in all three forest types (deciduous, coniferous and mixed forests), in different stand ages, and in stands with varying degree of habitat disturbance, such as stands defoliated by insects. Dominant overstory species included Balsam Fir, *Acer* sp. *Betula* sp. and *Picea* sp. Estimated percent of litter covered ground ranged from 0 to 75. Importance of ferns varied greatly.

Discussion

This study emphasises the importance of large, rocky substrate and moist areas as key habitat components for *S. gaspensis*. Rock formations, which include blocks, boulders and rock outcrops, occurred in all capture sites. The incidence of moss cover at capture sites reflects the cool microclimate, created either by the rock formation, canopy influence, exposure (e.g., north facing slope), topographic characteristics of the site (e.g., narrow canyon), or the proximity to water, in the form of surface or subsurface streams. These results correspond closely to information presented for *S. gaspensis* from other localities (Anthony and Goodwin 1924; Goodwin 1929; Peterson and Symansky 1963; Roscoe and Majka 1976; French and Kirkland 1983; Scott 1988*), and for *S. dispar* (Kirkland et al. 1979; Scott and van Zyll de Jong 1989; Woolaver et al. 1998; Ford and Rodrigue 2001; McAlpine et al. 2004; Shafer and Stewart 2006).

Scott (1988*) questioned the importance of running water as a habitat requirement for *S. gaspensis*. He concluded that proximity to water is probably not of

TABLE 2. Summary of captures of small mammals at 8 sites within territories managed by the GESPEG Micmac Nation and 14 sites in Forillon National Park, Québec.

	GESPEG								Forillon National Park														
Species/Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	TOTALS
Sorex cinereus	1	5	1		1			1		11	8	1	2	1	4		2	2	1		8	7	56
Sorex fumeus	8	8	26		5	10	7	9	12	3	4	9	15	18	9	22	22	6	26	5	13	10	247
Sorex palustris		4		1	2		1							1			2		5		1		17
Blarina brevicauda		2	3										2				1						8
Sorex gaspensis							1				1		1	1	1	1		1		2			9
Sorex hoyi										1							1						2
Microtus chrotorrhinus				1																			1
Clethrionomys gapperi	9	7	7	1	10		3	3	7	3	5	3	3	5		1	2	7	8				84
Synaptomys cooperi											1												1
Microtus pennsylvancus			1				1			1													3
Napaeozapus insignis	10	7	12	1	8		4	21	7			3	4			1	4		16	2	1	2	103
Peromyscus sp	6		1		1		1	2	7			7	1	1			6			1	5	1	40
TOTALS	34	33	51	4	27	10	18	36	33	19	19	23	28	27	14	25	40	16	56	10	28	20	571
SAMPLING EFFORT (TN)	360	360	330	275	330	300	280	300	300	300	120	300	270	180	60	290	319	203	300	60	200	200	5637

TN = trap nights

critical importance to this species. Our results concur with this hypothesis as three of the nine specimens were captured more than 200 m from the nearest stream.

Throughout its range, *S. gaspensis* has generally been associated with steep slopes in hilly or highland areas (Scott 1988*; COSEPAC 2006*), similar to *S. dispar* (Woolaver et al. 1998; McAlpine et al. 2004; Shafer and Stewart 2006). In this study, specimens were captured on steep (30-40°) and abrupt slopes (>40°), but most of the capture sites were on moderate slopes (15-30°). This suggest that slopes over 15 degrees may provide minimal structural features (e.g. rock formation) associated with suitable habitat for this species.

There is no evidence in this study to suggest that *S. gaspensis* is restricted by altitude or structural component of the vegetation. Previous trapping studies yielded specimens at elevations ranging from 46 m (*in* Scott 1988*) to 610 m (Anthony and Goodwin 1924). *S. gaspensis* has been recorded in coniferous, deciduous and mixed forests and with many dominant overstory species (review in Scott 1988* and COSEPAC 2006*). Although this shrew is often associated with mature stands (Anthony and Goodwin 1924; Peterson and Symansky 1963; Scott 1988*), regenerating forest is also reported as a stand age class used by *S. gaspensis* (COSEPAC 2006*). Similarly, Woolaver et al. (1998) reviewed habitat characteristics for *S. dispar* in the United States and Canada and observed that forest type varies widely between localities.

In our study area, *S. gaspensis* is part of a diverse small mammal community with ten other species captured (nine from this study; one specimen of Pygmy Shrew, *Sorex hoyi*, was also captured in 2002, Pronovost et al. 2005*). Literature, reviewed by Scott (1988*), also reports that *S. gaspensis* has been recorded in association with several species of small mammals, including some species of shrews. *Sorex fumeus* was by far the most strongly associated species in our study area and was observed in each occurrence site of *S. gaspensis* in 2002 (Pronovost et al. 2005*) and 2005 (this study).

As *S. fumeus* is larger than *S. gaspensis*, the former is probably dominant in interspecific interactions. We propose that vertical segregation (*sensu* Churchfield 1990) may explain the persistence of *S. gaspensis* in the presence of high densities of *S. fumeus* by forming the basis of differential habitat use. This pattern of shrew coexistence has been observed in some shrew communities, with one species being primarily subterranean while the others live mostly on the ground surface (Churchfield 1990; Feldhamer et al. 1993). In our study area, we hypothesize that *S. gaspensis* is most active underground while *S. fumeus* is most active on the surface. This could explain why *S. gaspensis* was rarely captured compared to *S. fumeus*. Morphological differences between these two species could also explain this apparent coexistence (Kirkland and

TABLE 3. Habitat characteristics at the *Sorex gaspensis* capture sites.

Habitat characteristic	Capture site								
	GESPEG 7	FNPC 18	FNPC 15	FNPC 20	FNPC 20	FNPC 14	FNPC 11	FNPC 16	FNPC 13
Altitude (m)	240	156	181	151	147	29	75	91	121
Slope (°)	15-30	15-30	15-30	>40	>40	15-30	>40	15-30	30-40
Distance to nearest water (m)	1	0	5	227	232	2	228	12	2
Forest type	Deciduous	Mixed	Mixed	Deciduous	Deciduous	Mixed	Coniferous	Mixed	Mixed
Stand age (years)	50	70, 30	90	Regeneration	Regeneration	70	50	Ua[1]	70, 30
Dominant overstory species[2]	Be,Ab	Pi,Be	Pi,Ab,Be	Be,Ac	Be,Ac	Ac,Be,Ab	Pi,Ab,Th	Pi,Ab,Ac	Pi,Ab,Be
Disturbance[3]		LID	LID	SID	SID	LID			
Dominant substrate classes[4]	PC,BB,RO	PC, BB	CS,PC,BB	BB	BB	PC,BB,RO	PC,BB	PC,BB,RO	PC,RO
Litter (% coverage)	50	25	10	75	50	20	0	25	30
Moss (% coverage)	50	50	10	25	50	80	100	75	70
Relative abundance of ferns[5]	2	1	2	3	1	2	0	Na	Na
Relative abundance of herbs[5]	1	1	1	1	1	1	1	Na	Na

[1] Uneven-aged first growth forest.
[2] Ab: *Abies balsamea*; Ac: *Acer* sp.; Be: *Betula* sp.; Pi: *Picea* sp.; Th: *Thuja occidentalis*.
[3] LID: light insect defoliation; SID: severe insect defoliation.
[4] CS: clay and sand; PC: pebbles and cobbles; BB: blocks and boulders; RO: rock outcrops.
[5] 0: none; 1: trace to 5% coverage; 2: 6 to 50%; 3: >50%; na: no data available.

Van Deusen 1979). *Sorex gaspensis* is more slender and has a narrowed rostrum than *S. fumeus*, allowing the former to exploit resources in the narrower crevices of rock formations which are not accessible to the more robust *S. fumeus* (Kirkland and Van Deusen 1979).

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APPENDIX 1. Locality data (NAD 83 coordinates) of the 22 *Sorex gaspensis* trapping sites within territories managed by the GESPEG Micmac Nation and Forillon National Park of Canada (FNPC).

Site	UTM north	UTM east
GESPEG1	5422234	383214
GESPEG2	5421781	382659
GESPEG3	5438652	383653
GESPEG4	5442586	377073
GESPEG5	5427348	382948
GESPEG6	5397021	394904
GESPEG7	5396893	394790
GESPEG8	5423152	377028
FNPC 9	5410839	407102
FNPC10	5411190	409697
FNPC11	5406875	410179
FNPC12	5400440	414538
FNPC13	5407193	408622
FNPC14	5412365	396743
FNPC15	5413928	398511
FNPC16	5415628	400002
FNPC17[1]	5410855	406973
FNPC18	5410289	406213
FNPC19	5422541	390239
FNPC20	5423145	390612
FNPC21	5417349	401615
FNPC22	5417907	401156

[1] This site is composed of two parts.