

SMALL MAMMAL INVENTORY AND MONITORING PROGRAM, 2001,
VOYAGEURS NATIONAL PARK

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ABSTRACT

An inventory of the small mammals of Voyageurs National Park undertaken primarily in 1996 and 1997 was expanded in 2001. Targeted species included the smoky shrew (*Sorex fumeus*), heather vole (*Phenacomys ungava*), northern bog lemming (*Synaptomys borealis*), and weasels (*Mustela* spp.). Inventory lines were placed upon a consideration of most probable habitat, and new sites included some in remote areas of the Park that had not yet been trapped. There were 7,454 trap-nights. The woodchuck (*Marmota monax*) was added to the species known from the Park, documented by a photograph. The ermine (*Mustela erminea*) was added, documented by one specimen. The other targeted species were not secured.

Eleven of 12 monitoring lines established in previous years were undertaken. There was extensive disturbance of trap-lines by pine marten (*Martes americana*) and bear (*Ursus americanus*), and minor disturbance by otter (*Lontra canadensis*). Numbers of redback voles (*Clethrionomys gapperi*) and shorttail shrews (*Blarina brevicauda*) increased from numbers in 2000 but not significantly. There was a significant increase in the numbers of deer mice (*Peromyscus maniculatus*) ($P < 0.05$). Numbers of southern bog lemmings (*Synaptomys cooperi*) were not detectably different from numbers in 2000.

The southern bog lemming was abundant in areas searched for the heather vole, including dry granitic outcrops, as well as at sites searched for northern bog lemmings. The southern bog lemming appears to have an unusually broad ecological distribution in the Park, but it is not yet known if the commonness of this species in some of these habitats is usual or was ephemeral in 2001.

There was increased collecting at a site where the white-footed mouse (*Peromyscus leucopus*) was first discovered in the Park in 2000. However, no additional specimens were secured there or anywhere else in the Park.

Of the 27 species of native small mammals known or very probably existing in Voyageurs National Park, 21 (78%) have now been documented.

INTRODUCTION

A program to inventory the species and monitor the numbers of non-volant small mammals of Voyageurs National Park was begun in 1996. The work was expanded in 1997 and continued annually in 1998-2001. In 2001, greater attempts were made to secure specimens of species not previously documented but thought to be in the Park. Also in 2001, all of the previously established monitoring lines were replicated except one. The data are showing patterns of distributions of species and of abundances of numbers in the small mammal community across a wide geographic range east to west within the Park, both on the Kabetogama Peninsula and the mainland to the south.

There is currently a National Park Service goal of identifying 90% of the vertebrate and vascular plant species in each Park unit (NPS, 2000). This report updates the completeness of this goal for non-volant small mammals in Voyageurs National Park in the contexts of (1) a previous review (Jannett, 2000) of distribution maps of mammalian species known from, and mammal species with distributions proximate to, Voyageurs National Park, and (2) a 2002 synopsis of mammalian species by National Park Service staff. Comments are also included on the possible presences of larger species of mammals

MATERIALS AND METHODS

INVENTORY

Consensus was reached at the Greater Yellowstone Area Network Workshop on Inventorying and Monitoring (I&M) of the National Park Service (May, 2000), and to some extent at the mammal working group of the Great Lake Network I&M Workshop (April, 2000), that increasing the completeness of the small mammal species lists of the respective Park units could best be done by focused collecting of target species. Most of the documentation of small mammal species for Voyageurs National Park was done in a broad trapping program in 1996 and 1997. The remaining species are not likely to be secured in that fashion but rather by increasing the focused species-specific efforts on the mainland. This was done successfully for the northern flying squirrel (*Glaucomys sabrinus*) and Franklin's ground squirrel (*Spermophilus franklini*) in 2000 (Jannett, 2001). Two of the former and one of the latter species were secured in just 24 hours, and only six non-target specimens were taken in that effort.

The targeting approach was expanded in 2001. A decision was made by James Schaberl (NPS) not to target the two species of introduced peridomestic rodents, the house mouse (*Mus musculus*) and the Norway rat (*Rattus norvegicus*). The PI concurred, but one of the efforts could have secured the mouse. Also, Schaberl decided that, since a woodchuck (*Marmota monax*) had been seen by staff already in 2001, no trapping and no voucher specimen was necessary. Six species were targeted. Observations were made for other species and some additional trapping was made that could have revealed additional species.

Table 1 is a descriptive gazetteer of sites where inventory and monitoring were carried out in 2001. Table 2 is a summary of inventory efforts.

Trap types.

There were four types of traps and four baiting regimes for one type of trap.

1. Large non-folding aluminum Sherman live-trap. This is a commercially available trap. It was used for weasel sets.
2. Rat traps. This is a commercially available trap. It was used for weasel sets.
3. Pit-traps. Pit traps are thought to catch animals that are otherwise trap-shy (Kott, 1965; Call, 1986); animals accidentally fall into the pits. I used a specially constructed pit-trap for northern bog lemmings of the sort used by Christian (1993). It consists of a sheet metal funnel 30 cm tall, with a diameter of 14 cm at the top and a 1-2 cm diameter hole at the bottom. Figure 1 depicts appropriate and inappropriate sets of this trap. A board is put across the top of the trap to distribute weight applied to the trap with a stomp, driving the funnel into the moss or muck. It was set in wet locations so that it filled or partially filled with water from the bottom, and the water was more than two cm from the top rim so that a small mammal could not get out. Water is in the bottom of the pit trap for several reasons: 1) the animals succumb quickly; 2) the animals do not fight and eat each other in the trap; 3) the water precludes most carcass-feeding insects from destroying the specimens; 4) the water deters small carnivores from eating the specimens; 5) the water tends to preserve the specimens; and 6) the water weighs down the pit; without the weight, the pressure of the water in the bog would force the pit out of the peat and muck.
4. Museum Special traps. Museum Special traps are commercially available, are perhaps the most efficient type of break-back traps, and are commonly used to secure small mammals (Jones *et al.*, 1996). There were four baiting regimes.
 - 1) Peanut butter on the treadle and rolled oats on the front of the trap and in front of the trap on the ground. The traps were "seasoned," in that they had been used many times previously, and even without bait probably present a rich patina of scents to small mammals. Most had been used only in Voyageurs National Park, so few were impregnated with scents of small mammals not occurring there.
 - 2) Sardines on the treadle.
 - 3) Unbaited but seasoned traps baited with peanut butter and rolled oats in previous years.
 - 4) Unbaited, never previously baited traps. These were also relatively new traps that had only been used on Superior National Forest.

Success in trapping small mammals depends on several factors. Appropriateness of the bait is one. How the traps are set with respect to animal movements is another. Successful use of pit traps and unbaited traps depends largely on the latter.

Trap protocols.

Trap-lines had irregular intervals between trap-stations, and stations were chosen on the basis of where the traps would most likely be successful. There were usually two traps per station. In most lines, two types of traps or bait profiles were used in dyads so that, if specimens of the target species were obtained, the results might indicate the more efficacious trap regime for that species.

All traps were checked at approximately 24-hour intervals. One trap left out for approximately 24-hours equals one trap-night.

Targeted species.

Smoky Shrew (*Sorex fumeus*).

This species is commonly found in cool moist woods in proximity to water and rocks (Owen, 1984). It was sought at one site (01V4) on the north side of the Kabetogama Peninsula, a cool moist talus field below a granitic escarpment. Museum Special traps were set in four roughly parallel lines. At the beginning and ending stations in one of the longest lines, the respective compass readings taken from the base of the escarpment, looking perpendicular to the lines, were 290° and 320°. There was a heavy moss layer at the base of the escarpment, dense forbs further down-slope. Canopy was mixed black spruce (*Picea mariana*), paper birch (*Betula papyrifera*), big-toothed aspen (*Populus grandidentata*), and red maple (*Acer rubrum*). Traps were set in pairs; 100 were baited with peanut butter and rolled oats. In dyads, 50 were unbaited and 50 were baited with sardines. Calhoun (1963) reported that individuals of *Sorex* spp. tend to enter traps after the traps have been out for two days, and this is the case for this species on the Superior National Forest as shown in six-day trapping sessions (Jannett, unpublished). Therefore, traps were out for four days. There were 800 trap-nights. The site had probably received heavy rainfall within the preceding 24 hours.

This site had habitat appropriate for rock voles (*Microtus chrotorrhinus*) (Kirkland and Jannett, 1982).

Eastern Heather Vole (*Phenacomys ungava*).

Habitat affinities of this species are poorly understood, and understanding them is more difficult because of the possibility that the eastern heather vole, including the taxon in northern Minnesota, is a separate species (*Phenacomys ungava*) from a western heather vole (*Phenacomys intermedius*) (Jones *et al.*, 1997; George, 1999). A review of the literature indicated an association of heather voles, particularly the eastern heather vole, with water, rocks, and, not surprisingly, heather. The most significant report of habitat affinities because of numbers of eastern heather voles secured and the structure of the data set is perhaps that of Naylor *et al.* (1985) who reported a relatively large collection of voles taken in jack pine (*Pinus banksiana*) forests with dense *Vaccinium* (blueberry) in Ontario. Prior to the beginning of the inventory field work, I had secured seven of the nine specimens of this species from

Minnesota at a total of five sites (Jannett, 2001). Most of each of these five sites had some amount of jack pine and all had blueberry. In Voyageurs National Park, I therefore concentrated efforts for this species in areas with jack pine and/or blueberry.

Attempts were made to secure this species at three sites using Museum Special traps. In Minnesota, individuals of this species tend to enter the traps after they have been out for two days, and unbaited traps and those baited with peanut butter, oats, and apple chips take equal numbers of specimens (Jannett, 2002).

Site 01V5 was on the north side of the Kabetogama Peninsula at dry granitic outcrops interdigitating jack pine. Beneath the jack pine was scattered to dense *Vaccinium* sp(p), primarily or wholly *V. angustifolium*. Big-leafed aster (*Aster macrophyllus*) was abundant. There were isolated pockets of water, apparently perched. Traps were set on three consecutive days, so each was out for two, three or four days. Traps were set in meandering lines to encompass areas with good ground cover. Traps were set singly, or in pairs of baited (peanut butter and rolled oats), or in dyads of baited and unbaited. There were 1,119 trap-nights including 349 of unbaited trap-nights.

Site 01V6 was on the top and west side of the promontory south of the west arm of Sullivan's Bay. Trap lines meandered among the best ground cover generally within 50 m of the main trail to the weather station at the summit. There were two trap lines, and all traps were set in dyads of unbaited and baited (with peanut butter and rolled oats). The higher elevation line was beneath mixed red pine (*Pinus resinosa*) and jack pine and had patches of dense *Vaccinium* and interdigitating bedrock. There were 540 trap-nights August 6-9. The second line was downslope in more mixed canopy forest with paper birch and less *Vaccinium*. There were 360 trap-nights August 6-9. All traps were closed and left *in situ* on August 9 so that possibly trap-shy individuals would hopefully habituate to them. All traps except two were reopened unbaited on August 23 and left out for four more days, an additional 1,788 trap-nights.

Site 01V9. This site is on the south-east end of the Kabetogama Peninsula. The canopy is mixed with white pine (*Pinus strobus*) and white birch, and there is exposed bedrock, occasional shrubs, and patches of *Vaccinium*. Museum Specials were set in dyads of unbaited and baited with peanut butter and rolled oats. There were 504 trap-nights over six nights.

Northern Bog Lemming (*Synaptomys borealis*).

There is not a single substantial report of the ecology of the northern bog lemming. The most extensive search has perhaps been that undertaken in Montana, largely on National Forests over several years (Reichel and Beckstrom, 1993, 1994a, 1994b; Reichel, 1996; Reichel and Corn, 1997). It resulted in a total of 18 sites for the species in the state, probably "the most sites in any of the lower 48 states," and the conclusion that the best habitat predictor for potential northern bog lemming sites in Montana is the presence of large, thick moss mats, primarily *Sphagnum* (Reichel and Corn, 1997: iii.). There is some indication that the habitat affinities of the species are relatively broad near the southern border of the geographic range of the species (e.g., Clough and Albright, 1987; West, 1999). However, most of these communities included or could have included *Sphagnum*. Christian

(1993), had the mandate to find this species on the Chippewa National Forest (CNF). After reviewing the literature, he searched 50 sites and four habitat types, all with *Sphagnum*. He secured two specimens at one site of lowland closed canopy black spruce.

Prior to the beginning of the field work, I visited and walked the only site where Christian (1993) obtained northern bog lemmings on CNF. I also obtained a map of the location where Nordquist obtained the species on the Pine Island State Forest (Gerda Nordquist, personal communication) and walked that site. I had previously viewed, from the road, a site near the Canadian border where James Duncan supposedly has obtained northern bog lemmings (Duncan and Nordquist, personal communications).

The few habitat affinities reported for the northern bog lemming in Minnesota are relatively broad but all fall within communities characterized as having *Sphagnum*. There have been very few specimens secured, so the exact habitat needs or affiliations are not known. There may be some microhabitat need for the species that has not been identified. But since there is a clear association with *Sphagnum*, efforts to secure this species in Voyageurs National Park concentrated on sites that had substantial mats of *Sphagnum*.

There are so few published reports on the northern bog lemming that trappability cannot be assessed. Gordon Jarrell (personal communication) caught "about 30" in pit traps in Alaska in one night. Christian (1993) secured only two specimens on CNF, but both were taken in pit traps. Reichel and Beckstrom (1993) found northern bog lemmings difficult to secure in live traps and pit-traps; they secured most specimens in Museum Special traps. I assumed that the trappability of northern bog lemmings would be more like that of southern bog lemmings than any other species. Southern bog lemmings are not easily caught in live traps (Bole, 1939; Connor, 1959; Linzey, 1984). Alicia Linzey (personal communication) suggested using pit traps for them. On Superior National Forest in 2001 before the inventory in Voyageur National Park, I found that unbaited Museum Special traps secured more southern bog lemmings than baited traps. I therefore employed three types of trap sets to document northern bog lemmings in the Park: pit-traps, and Museum Special traps both unbaited and baited with peanut butter and rolled oats.

Site 01V7 has been a monitoring site since 1997. I added an inventory line in habitat different from that where monitoring lines M6 and M7 are established. This inventory line began about 26 m north and 20 m east of the end of the closest monitoring line (M7) in the same boggy area. The substrate at this site is a thick layer of *Sphagnum* moss with the water level generally 1/3 m below the surface. The line was set at the edge of the black spruce with alder [*Alnus* sp(p)], where there are intermittent open pools of water. Labrador tea (*Ledum groenlandicum*) is common and ground cover includes small cranberry (*Vaccinium oxycoccos*), creeping snowberry (*Gaultheria hispidula*), and wild lily of the valley (*Maianthemum canadense*). A meandering line was set along this edge where there were appropriate sites for correct placement of the pit-traps. Each of 48 pit-traps was paired with an unbaited Museum Special trap, and after one night another two dyads were set. On the third day the Museum Specials were closed and the pit traps were pulled out and laid across the respective flooded holes. Pit-traps were resunk and Museum Special traps reopened on August 26, by which time it was hoped that trap-shy animals would have habituated to the traps. They were left out again for four nights. There were totals of 298 pit-trap-nights and 298 Museum Special trap-nights.

Site 01V8 is an expansive bog on the east end of the Kabetogama Peninsula. Small mammals have been inventoried there since 1996, but an increased effort was made in 2001. A meandering trap-line was set within 20 m of the southern edge of the bog, out through a zone of shrubs dominated by Labrador tea and leatherleaf (*Chamaedaphne calyculata*), and into a zone of stunted black spruce. Each trap-station had three traps within a one-meter radius: a pit-trap, an unbaited Museum Special trap, and a Museum Special trap baited with peanut butter and rolled oats. There were 900 trap-nights.

Museum Special traps were set for northern bog lemmings at Site 01V14, south-west of Tom Cod Bay. There were two lines: one was in a lowland cedar (*Thuja occidentalis*) swamp (about 75% canopy closure) and the other in mixed lowland conifer with cedar, larch (*Larix laricina*), and black spruce. There were 520 trap-nights with unbaited traps. There were 16 trap-nights with unbaited traps that had been baited in previous years.

Ermine (*Mustela erminea*).

I set traps for this species at the margin of a partially flooded beaver meadow, along logs, and at culverts, in a manner that proved successful for me in Grand Teton National Park. I used large non-folding aluminum Sherman box traps. The traps were baited initially with salmon or beef; beginning on day two, parts of deer mice (*Peromyscus maniculatus*) were added. Also, the traps were scented with a solution of the anal secretions of a female *M. erminea* secured in Teton Co., Wyoming and stored in 70% ethanol.

Traps were set widely spaced at site 01V1 along NPS Road #1, most in the mixed canopy woods between the road and a flooded beaver pond to the west. Others were set on both sides of the road at entrances to culverts beneath the road, and at both sides of the road at the outflow of the beaver pond. There was a total of 98 trap-nights. All traps were pulled the day after an ermine was secured.

Traps were set (site 01V2) in mixed canopy woods and at a culvert at the junction of NPS Road #1 and the road at the north side of the west arm of Sullivan Bay. There was a total of 22 trap-nights, and all traps were pulled the day after an ermine was secured elsewhere.

Longtail Weasel (*Mustela frenata*).

Longtail weasels could be expected to investigate Sherman box traps scented with ermine as described above. In addition, there were five attempts to secure them with rat traps. These traps were each baited with beef or parts of deer mice tied to the treadle, and scented with ermine anal gland secretion solution. All of the traps were set on and perpendicular to small and large logs on the ground. Each trap was 10 to 40 cm off the ground and thus the catch of non-target species was very small.

At Site 01V9, there was disturbance to an inventory line that seemed to be by weasel, and rat traps were set proximate to the line for two nights (10 trap-nights). At Site 01V10, there was similar disturbance to a monitoring line and scat the size of that of longtail weasel was

seen; rat traps were set proximate to this line (16 trap-nights). These traps were scented with the anal secretion of female ermine.

Three sites were chosen for securing a specimen of the longtail weasel based on habitat. At Site 01V15, traps were widely spaced along an old road, a path through mixed canopy woods, and as far as 20 m into the woods. At Site 01V16, traps were set along a trail between buildings at Whispering Pines (#53 and the "cold storage" garage). At Site 01V17, traps were set on and near an old pile of poles at the edge between a road-side meadow and mixed canopy woods. There was a total of 54 trap-nights. At each of these three sites, I alternated the traps receiving female ermine scent and that of male ermine anal scent (also from Teton Co., Wyoming).

Least Weasel (*Mustela nivalis*).

The habitat at Site 01V1, proximate to a grassy flooded beaver pond, was probably suitable for least weasels as well as for ermine. Least weasels also may have been attracted to the scent of ermine, but perhaps they were instead repelled by it.

Woodchuck (*Marmota monax*).

This species was noted when seen.

Eastern Gray Squirrel (*Sciurus carolinensis*).

I looked for this species at the Rainy Lake Visitor Center (five visits) and the Kabetogama Visitor Center (two visits).

House Mouse (*Mus musculus*).

Baited Museum Special traps were set in two buildings (#38 and #53) at Whispering Pines (Site 01V3). They were removed from one of the buildings when some of them disappeared there. There was a total of 111 trap-nights.

MONITORING

The monitoring regime consists of a line of 100 Museum Special traps, two per station, with 20' between contiguous stations. Each station is flagged according to a tape measure run out from the respective first station each year. The two traps at a station are placed at the best sign (feces, plant clippings, runways, holes) within 1 meter of the station flag. All lines except two are strictly linear; because of space limitations, one turns at an angle and one consists of two shorter segments.

There are 12 established monitoring lines. Five monitoring lines were done in 1996, all 12 in both 1997 and 1998, 11 in 1999, 2000, and 2001. Monitoring line 10 in an abandoned beaver pond was not trapped in 1999-2001 because it was completely flooded in 1999, still extensively flooded in 2000 and 2001.

Each monitoring line is left out for six days and checked daily at approximately 24-hr intervals. Missing traps are replaced, set-off traps are reopened. The condition of each trap and its catch are recorded daily.

If a monitoring line is heavily disturbed by bear (*Ursus americanus*), pine marten (*Martes americana*), otter (*Lontra canadensis*) or other carnivores, the traps are reset and replaced as needed. However, if there is a heavy disturbance for two days, the traps are taken up and not replaced. Indications of disturbance by pine marten are small tooth marks on trap treadles, traps missing, traps moved more than one meter, fresh marten scat, and traps with fresh blood, hair, and guts of small mammals on them. Otter scat was found at trap stations with sprung traps. Indications of disturbance by bear include treadles removed and chewed, and small mammals left in the respective traps. There was one exception to the protocol of pulling a monitoring line after two days of heavy disturbance. Monitoring line M8 was left out for five days because it was not clear that the traps were being disturbed by a repeat offending carnivore, and because companion line M9 was not heavily disturbed until the fifth night.

Table 1 also lists locations of monitoring sites. Table 3 lists dates of monitoring efforts and summarizes disturbances.

I compared the numbers of the three most common and important species in the series between 2000 and 2001: redback voles (*Clethrionomys gapperi*), deer mice (*Peromyscus maniculatus*), and shorttail shrews (*Blarina brevicauda*). I used a non-parametric test to avoid assumptions about sampling distributions that could not be met for other tests. For each of the three species, I used a two-tailed Wilcoxon matched-pairs signed-ranks test for the numbers in 2000 versus 2001. Data from only days one and two were used because there was disturbance by pine marten and bear on subsequent days in several samples. Only six monitoring lines could be included because two had been heavily disturbed in 2000 and three (M1, M2, M3) had been in 2001. I also used a one-tailed test for each comparison on the basis of there having been heavy disturbance at M8 on day two, and therefore there could have been even more specimens taken in traps but eaten by carnivores.

I also examined the numbers of southern bog lemmings (*Synaptomys cooperi*), because large numbers of this species were secured in inventory lines in habitat not thought to be typical for lemmings.

SPECIES DETERMINATIONS

External characters are not sufficient to differentiate the northern and southern bog lemmings. Specimens of lemmings were identified on the basis of the dental pattern of the lower molar teeth (Howell, 1927; Hazard, 1982). Most other specimens were identified in the hand on the basis of my experience with them on Superior National Forest and in the

Park. Species determinations of most of the masked shrew (*Sorex cinereus*) and pygmy shrew (*S. boyi*) remain to be verified on the basis of dentition. Cranial remnants of specimens have been identified. Other remnants of specimens chewed by other small mammals remain to be identified, but none seemed plausibly to be any of the target species.

Plant names herein follow Chadde (1998).

GPS

National Park Service staff recorded GPS locations for the beginning and end of monitoring lines mostly with a Trimble unit. GPS locations were also recorded for most of the new inventory sites, *i.e.*, those sites where trapping had not been carried out before 2001. No GPS recordings were made of inventory sites in previous years.

National Park Service staff maintain these records.

RESULTS

INVENTORY

There was a total of 7,454 trap-nights in inventory work, including 800 for smoky shrew (*Sorex fumeus*), 4,311 for heather vole (*Phenacomys ungava*), 2,032 for northern bog lemming (*Synaptomys borealis*), 200 for weasels (*Mustela* spp.), and 111 for house mouse (*Mus musculus*).

One ermine (*Mustela erminea*) was secured at site 01V1. There was a very small number of non-target species taken at sites 01V1 and 01V2 where traps were set for *Mustela* sp(p). There were only one water shrew (*Sorex palustris*) (saved as a specimen), one deer mouse (*Peromyscus maniculatus*) (used as bait), and one redback vole (*Clethrionomys gapperi*) (released).

A woodchuck (*Marmota monax*) was photographed by John Snyder, NPS (herein Figure 2). It was photographed June 17 at the beginning of Beaver Pond Overlook Trail off NPS Road #1, UTM Zone 15 (Easting 511400, Northing 5363098). A woodchuck sighting was also reported to me by Andy Nollman, NPS. He observed the animal in August at Whispering Pines in a rocky area along the foot path to the two most westerly cabins.

No specimen was secured of the smoky shrew (*Sorex fumeus*), eastern heather vole (*Phenacomys ungava*), northern Bog Lemming (*Synaptomys borealis*), longtail weasel (*Mustela frenata*), or least weasel (*Mustela nivalis*).

No eastern gray squirrel (*Sciurus carolinensis*) was observed.

No house mouse (*Mus musculus*) was taken. There were abundant deer mice (*Peromyscus maniculatus*) in both buildings at Whispering Pines.

Other Species, not Targeted

The southern bog lemming (*Synaptomys cooperi*) was taken at all seven sites outside of buildings where Museum Special traps were deployed in inventory lines. These sites included talus in mesic forest (01V4), dry granitic outcrops (01V5, 01V6, 01V9), and boggy areas (01V7, 01V8, 01V14). It was also taken in both monitoring lines (M11 and M12) at Site 01V10 in mature forest of primarily red pine.

No specimen of the wood mouse (*Peromyscus leucopus*) was taken in 2001. However, Lee Grim secured three specimens in a building on North Jack Fish Bay of Rainy Lake on three consecutive days in August, 2001.

No specimen of the shorttail shrew (*Blarina brevicauda*) having rare pelage color variation was secured. No pelage color variation was noted in any other species.

Both eastern chipmunks (*Tamias striatus*) and least chipmunks (*T. minimus*) were observed by the PI at Whispering Pines.

MONITORING

There was heavy disturbance to monitoring lines by both bear and marten (Table 3).

In the first two days in the six monitoring lines available to be included in test comparisons, numbers of redback voles (*Clethrionomys gapperi*) increased from 2000 to 2001 from an average of 27.5 to 35.0 individuals per site, but the increase was not significant at $\alpha=0.05$ ($T=5$, $N=6$). For shorttail shrews (*Blarina brevicauda*), numbers increased from an average of 2.2 to 2.7, but the increase was not significant ($T=1$, $N=4$). Deer mice (*Peromyscus maniculatus*) increased from an average of 10.2 to 16.7 per two-day period. This increase was not significant in the two-sided test, but was ($P<0.05$) ($T=2$, $N=6$) in the one-sided test.

In 2001, the overall ratio of redback voles to shorttail shrews was 20.8 : 1 in the two-day period analyzed above, and 11.8 : 1 overall for all monitoring sites over all days, including days with heavy disturbance.

The numbers of southern bog lemmings were small in monitoring lines and were insufficient for statistical analysis. However, there was no indication that numbers were higher than in 2000. Indeed, at M4 and M5, the only monitoring lines without disturbance both years and that each had one or more southern bog lemmings in the first two days of either 2000 or 2001 or both years, the numbers over those two days fell from three to two (M4) and from seven to one (M5). Over the length of the entire respective monitoring sessions, the total numbers of lemmings fell from five to three (M4) and from 10 to 1 (M5). There was a total of only seven lemmings in monitoring lines M6 and M7 at the mainland boggy site (01V7), and only three other lemmings among all other monitoring lines across all days.

SPECIMENS

A total of 2,823 specimens was secured and saved. Another 27 small mammals were saved for baiting for weasels or were released.

Table 4 is a summary of the specimens collected and saved by species. Table 5 is a cross-tabulation of specimens by species and sites. Appendix A lists all specimens on the basis of specimen lists made in the field.

The Science Museum of Minnesota is the designated deposit institution for specimens secured in 2001. As yet, there is no room for them in the Biology Department there. An accession number has not been assigned.

DISCUSSION

INVENTORY

A Review of the Current Inventory Status

Table 6 lists species of non-volant small mammals present and possibly present in Voyageurs National Park, and follows the species designations in Jones *et al.* (1997). The table is an update of Table 4 in Jannett (2000), based on distribution maps in Hall (1981) and Hazard (1982), and a range extension of one additional species (Jannett and Oehlenschläger, 1994). It lists species with geographic ranges encompassing the Park and those with ranges that approach the Park.

The species of mammals present and possibly present in Voyageurs National Park include some that are problematic, and some that may not occur in the Park but that might in the near future due to increased human habitation on the Park's periphery, climate change, and vicariance.

Table 6 lists 29 species, of which two are introduced, usually peridomestics, specifically, the Norway rat (*Rattus norvegicus*) and the house mouse (*Mus musculus*). Of the 27 native species, 21 or 78% have now been documented in the present study. Six native and the two introduced species remain to be documented.

The longtail weasel (*Mustela frenata*) surely exists in the Park. Bruce Barrett, NPS (personal communication) suggested to me that it is the most common of the weasels taken by fur-bearer trappers in the vicinity of the Park. This species should be obtainable by targeted trapping as was the ermine in 2001. If populations of redback voles (*Clethrionomys gapperi*) crash by August, 2002, longtail weasels will be more readily trappable than in any recent year because the weasel population is probably high following two consecutive years of very abundant voles as prey, and the individual weasels will perhaps be more prone to enter traps without abundant prey available elsewhere.

Least weasels (*Mustela nivalis*) are probably present in the Park but were not likely to be caught because of the abundance of small mammal prey in 2001. As with longtail weasels,

they may be relatively easy to secure in 2002 because they should be relatively abundant after two consecutive years of abundant redback voles, and more trap-prone because of low prey numbers.

The northern bog lemming (*Synaptomys borealis*) and eastern heather vole (*Phenacomys ungava*) are also probably present in the Park. The extreme abundance of redback voles and the apparent abundance of southern bog lemmings in habitats targeted for both northern bog lemmings and heather voles may have hindered the trappability of the target species either by competitive exclusion or behavioral interference at trap stations. 2001 was probably not an opportune year for targeting these species given the numbers of the more common species.

Both the heather vole (*Phenacomys ungava*) and the smoky shrew (*Sorex fumeus*) are documented to the east of the Park on Superior National Forest, and both are associated with rock voles (*Microtus chrotorrhinus*) (Jannett, 1990 and unpublished). The most profitable next place to target collecting for these species in the Park would be those sites in the southeastern part of the Park where rock voles have already been secured in this inventory. However, since both of these species are more likely to enter traps that have been out for several days, trap-lines for them should be left out longer than the few days that lines were successfully set for rock voles in 1996 and 1997.

The eastern gray squirrel (*Sciurus carolinensis*) could be documented by sightings, most probably around habitation. NPS staff Mike Broschart, Lee Grim, and Jim Schaberl (personal communications) have seen this species in International Falls.

Two species of squirrels, the fox squirrel (*Sciurus niger*) and the thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*) could eventually be added to the list of possible species in the Park, as discussed below.

A Review of the List of Mammalian Species of Voyageurs National Park from the Great Lakes Network Office

A list of species and other taxa was forwarded to me by Bill Route of the Great Lakes Network Office. My review is broken down into three parts: (I.) comments on the non-volant small mammals; (II.) comments on species other than the non-volant small mammals; and (III.) comments on current nomenclature. Comments within each section are numerically coded with respect to the entries in the National Park Service list (Appendix B).

(I.) Non-volant small mammals.

1. The entry for the pygmy shrew (*Sorex hoyi*) should be changed to "Pres" based on specimens secured in the inventory and monitoring programs.
2. The entry for the white-footed mouse (*Peromyscus leucopus*) should be changed to "Pres" based on a specimen secured in 2000.

3. The entry for the Norway rat (*Rattus norvegicus*) should be changed to "Prob" based on range. However, I believe that the presence of the rat in the Park would be limited to buildings and be intermittent, even seasonal, probably without a viable population.
4. The entry for the eastern gray squirrel (*Sciurus carolinensis*) should be changed to "Prob" based on the occurrence of the species in International Falls. There will soon be pockets of squirrels within the Park near human dwellings.
5. The entry for the fox squirrel (*Sciurus niger*) could be changed to "Unco" based on the range of the species, habitat changes due to human activities, and climate change. The apparently recent range extension of the white-footed mouse was substantial. If this mouse could expand its range that much, so could the fox squirrel. Conversely, I do not believe that the chances for this squirrel being present are as good as those of the gray squirrel.
6. The smoky shrew (*Sorex fumeus*) should be added to the list as "Prob". It has become increasingly more common in Cook County, Minnesota and has been secured at an increasing number of sites there in recent years (Jannett, unpublished).
7. The house mouse (*Mus musculus*) should be changed to "Prob" based on range. However, I believe that the presence of the mouse in the Park would be limited to buildings and be intermittent, even seasonal, probably without a viable population. I know of no specimens to document it as "Pres" as now listed.
8. The least weasel (*Mustela nivalis*) should be changed from "Unco" to "Prob" based on its range and Lee Grim (NPS) (personal communication) having seen one on the outskirts of International Falls. Specimens of this species are harder to secure than those of other weasels.
9. The heather vole (*Phenacomys intermedius*) should be changed from "Unco" to "Fals" based on the taxonomic and apparently biological distinctiveness of the western heather vole (*Phenacomys intermedius*) and the eastern heather vole (*P. ungava*). *Phenacomys intermedius* (s.s.) is not in the Great Lakes Region.
10. The eastern heather vole (*Phenacomys ungava*) should be added to the list as "Prob" based on the finding of additional localities for the species, including a range extension, in Lake Co., Minnesota (Jannett, 2001).
11. The northern bog lemming (*Synaptomys borealis*) should similarly be changed from "Unco" to "Prob" based on the proximity of an unpublished range extension of the species (Christian, 1993).

(II.) Mammalian species other than non-volant small mammals.

12. The dog (*Canis familiaris*) could be listed as "Pres" because of individuals brought into the Park. While there may be no feral dogs in the Park, neighborhood and visiting dogs may be significant with respect to other aspects of their biology, e.g., as carriers of parvo virus. Here, the purpose of the list would presumable affect why the species is added or not added.

13. The cat (*Felis catus*) could also be listed as "Pres" for similar reasons as per the dog.
14. The gray fox (*Urocyon cinereoargenteus*) could be listed as "Unco" based on known range and specimen records for Minnesota (Hazard, 1982). I listed it as possibly present in the Park (Jannett, 2000). *SEE ALSO KURTZ 2001.*
15. The Virginia opossum (*Didelphis virginiana*) could be listed as "Unco" based on the known range of the species and its propensity to expand its range northward intermittently. But I do not foresee it establishing itself soon.
16. I suggest that the mountain lion (*Puma concolor*) be listed as "Unco" based on the range of the species, its secretive nature, and numerous apparently valid reports of individuals in Cook Co., Minnesota to Bill Peterson of the Minnesota Department of Natural Resources in the 1990's (Peterson, personal communication). I think this species is more likely to occur in the Park than the lynx (*Lynx canadensis*). I am not suggesting that the lion has a minimum viable population within the Park, but rather that the Park may occasionally be within the home range of an individual, or occasionally be traversed by one.
17. I suggest that the wolverine (*Gulo gulo*) be listed as "Unco" based on suspicions of individuals of this species occurring in remote areas of northeastern Minnesota (Burrell Draper, personal communication), and the refusal of the Minnesota Department of Natural Resources in the 1980's to allow me to commission someone to secure one for documentation. As with the lion, I am not suggesting that the wolverine has a minimum viable population within the Park, but that the Park may occasionally be within the home range of an individual, or occasionally be traversed by one. NOT SURE
I AGREE
18. The badger (*Taxidea taxus*) is listed as "Unco" but I would list it as "Prob". I listed it as possibly present species (Jannett, 2000). Since then, I saw one at its den in July, 2001 on Superior National Forest about 13 miles south of Blind Ash Bay in the Park.
19. The northern myotis (*Myotis septentrionalis*) is listed as "Unco" but I believe it is surely in the Park based on my having secured specimens of this species in Cook Co., Minnesota.
20. Keen's myotis (*Myotis keenii*) has been "split" and this taxon (s.s.) is no longer recognized in the Great Lakes Region.
21. The cottontail rabbit (*Sylvilagus floridanus*) is listed as "Unco" but I would list it as "Prob". I listed it as possibly present (Jannett, 2000). This is another species that will extend its range northward with climate change and/or with human habitation and/or agricultural activities.
22. The listing of the thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*) could be changed from "Unco" to "Prob" for the reasons of existing range, climate change, and land use change.

Based on known range and biology of the eastern pipistrelle (*Pipistrellus subflavus*), I do not believe that this species is in the Park. However, in addition to *Myotis septentrionalis*, I and an assistant have collected specimens of *Lasionycteris noctivagans*, *Myotis lucifugus*, *Eptesicus fuscus*,

and one or both species of *Lasiurus* (*borealis* and *cinereus*) in Cook Co., Minnesota; I suspect that all of these forest bats are in the Park.

(III.) Current nomenclature.

In reviewing the list for inclusiveness and status, I found it helpful to make notes regarding duplications and nomenclature. Perhaps there could be a column for older species designations to simplify the review of documentation from each Park. Comments on nomenclature follow Jones *et al.* (1997) in an effort to make things simple and able to be cross-referenced.

The list should be arranged so that all species in a family are proximate.

Bison bison is recognized as *Bos bison*.

There are two entries for *Rangifer tarandus*.

Felis concolor is recognized as *Puma concolor*, and the latter appears elsewhere.

Felis rufus is recognized as *Lynx rufus* and the latter appears elsewhere.

Lynx lynx is recognized as *L. canadensis*, and the latter appears elsewhere.

Lutra canadensis is recognized as *Lontra canadensis*, and the latter appears elsewhere.

Didelphis marsupialis is recognized as *D. virginiana* and the latter appears elsewhere.

Microsorex hoyi is recognized as *Sorex hoyi*, and the latter appears elsewhere.

The entry "*pennsylvanicus*" is presumably for *Microtus pennsylvanicus* and that appears elsewhere.

Pitymys pinetorum is recognized as *Microtus pinetorum*, and the latter appears elsewhere.

Eutamias minimus is recognized as *Tamias minimus* and the latter appears elsewhere.

There are two entries for *Glaucomys sabrinus*.

MONITORING

Overall, several species had been very abundant in 1997 compared to 1996 in Voyageurs National Park, especially redback voles (*Clethrionomys gapperi*), deer mice (*Peromyscus maniculatus*), and shorttail shrews (*Blarina brevicauda*). There were fewer numbers of individuals in the first two of these species in 1998. In 1999, redback voles and deer mice were at about the same levels as in 1998, but shorttail shrews were nearly twice as abundant as in 1998. In 2000, numbers of deer mice had not changed significantly, but shorttail shrew numbers plummeted while those of redback voles increased dramatically. In 2001, shorttail

shrew numbers were still low, redback voles were still abundant, and deer mice were substantially more abundant.

In 2000, the spectacular increase in numbers of redback voles and decrease in numbers of shorttail shrews strikingly mirrored the changes in numbers of those species in Cook County, Minnesota (Jannett, unpublished). The same pattern of high redback vole numbers and low shorttail shrew numbers in the Park was seen in Cook Co. in 2001.

The continued high numbers of redback voles and low numbers of shorttail shrews secured in 2001 was additional support for the long-standing hypothesis that shorttail shrews predate heavily upon vole populations (Merriam, 1886; Eadie, 1944; Lomolino, 1984). Relatively high populations of shorttail shrews may have kept vole and deer mouse populations relatively stable at moderate levels of numbers in 1998 and 1999. The ratio of redback voles to shorttail shrews in the first two days of monitoring lines not disturbed had been low (2.2 : 1) in 1998, was even lower (1.5 : 1) in 1999, but was extremely disparate (41.4 : 1) in 2000, and still disparate (20.8 : 1) in 2001. The overall ratio for all monitoring sites and days also showed this trend, 2.1 : 1 in 1998, 1.9 : 1 in 1999, 13.5 : 1 in 2000, and 11.8 : 1 in 2001.

OTHER FINDINGS

Southern bog lemmings (*Synaptomys cooperi*) were widespread and occurred at very dry sites where they may not be expected on the basis of the literature (e.g., Connor, 1959). There was no indication that the abundance of southern bog lemmings in such habitat was associated with a cyclic population high of the species in the Park as seen in other species of lemmings (Krebs and Myers, 1974). It would be significant to know if, in future years, they are also found on such a diversity of sites in the Park, and, if so, whether the wide distribution is associated with a short-term increase in numbers or a long-term change in distribution. There was some indication that numbers of southern bog lemmings were relatively high in Superior National Park in 2001 (Jannett, in preparation).

No specimen of the white-footed mouse (*Peromyscus leucopus*) was secured in the Park, despite increased trapping at Site 01V7 where one was taken in 2000. The finding in the Park then represented a significant range extension for the species (Jannett, *et al.* in preparation), especially since the species is a major reservoir for the spirochete responsible for Lyme disease (Anderson *et al.*, 1983; Bosler *et al.*, 1983; Anderson and Magnarelli, 1993). The monitoring lines can be expected to document the proliferation and geographic spread of wood mice within the Park.

No specimen of the shorttail shrew (*Blarina brevicauda*) having rare pelage color variation was secured. One such specimen was obtained in 1996, numerous in 1997, none in 1998-2001. No pelage color variation was noted in any other species.

No specimen of the rock vole (*Microtus chrotorrhinus*) was secured in 2001. Several sites searched for smoky shrews and heather voles were appropriate for this species. The initial finding of rock voles in Brown's Bay of the southeastern part of the Park remains the westernmost limit of the species in the United States.

GPS

GPS data have been recorded for all monitoring lines. Park staff and the PI still need to secure the rest of the GPS data for the many inventory sites worked in 1996-2000 and a few sites trapped for the first time in 2001.

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Figure 1. Placement of pit-traps. a) appropriate sets; b) inappropriate sets.

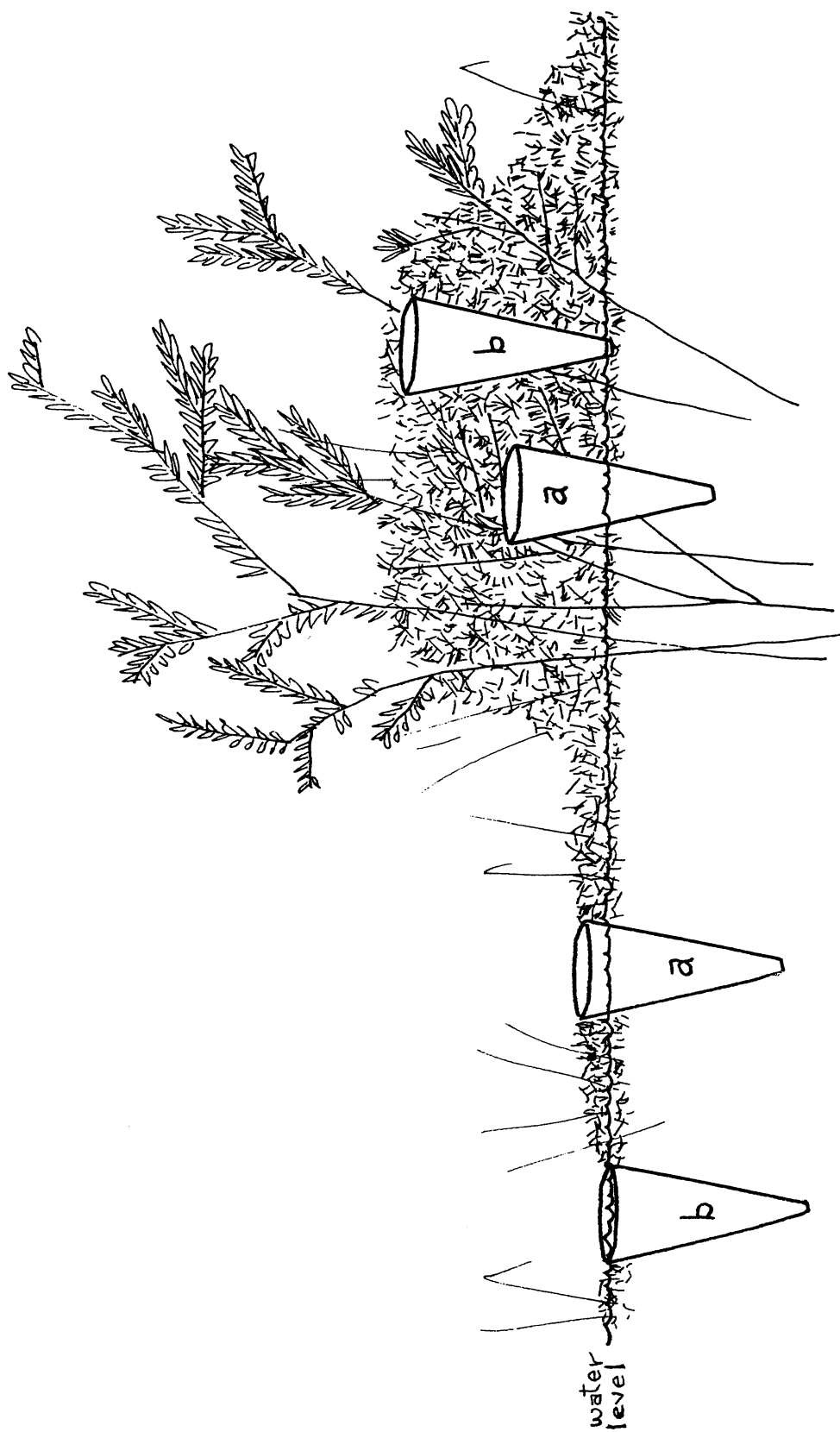


Figure 2. Woodchuck (*Marmota monax*). Photograph by John Snyder.



Table 1. Descriptive gazetteer of 2001 sites.

Site Code	Locality
01V1	MN, VNP, St. Louis Co., along NPS Road#1, 1.8 mi. S. of side road to Whispering Pines, W. side of NPS Road#1, in trees between road and beaver pond, and at culverts on E. side of NPS Road #1. (Site 01V1)
01V2	MN, VNP, St. Louis Co., SE. quadrant and culvert at junction of NPS Road#1 and road on N. side of W. arm of Sullivan Bay. (Site 01V2)
01V3	MN, VNP, St. Louis Co., Whispering Pines buildings (#38 and #53). (Site 01V3)
01V4	MN, VNP, St. Louis Co., N. side of Kabetogama Peninsula, talus below granitic escarpment about 100 m SE. of Windmill Rock View Campsite R56. (Site 01V4)
01V5	MN, VNP, St. Louis Co., N. side of Kabetogama Peninsula, granitic summit area S. and above Windmill Rock View Campsite R56. (Site 01V5)
01V6	MN, VNP, St. Louis Co., E. of NPS Road#1, top and W. side of promontory with signal tower and weather station. (Site 01V6)
01V7	MN, VNP, St. Louis Co., bog NW. of Ash River State campground, S. of Sullivan Bay. (Site 01V7) (=00V6) (=99V6) (=98V8) (=97V7) (=96V7) (monitoring lines M6 & M7) (There was also an inventory trap-line here in 2001.)
01V8	MN, VNP, St. Louis Co., Kabetogama Peninsula, bog 1 mi. WNW. of Kettle Falls dam. (Site 01V8) (=00V1) (=99V4) (=98V4) (=97V8) (=96V6)
01V9	MN, VNP, St. Louis Co., Kabetogama Peninsula, south face of spit of land between waters N. of Squirrel Island and bog 1 mi. WNW. of Kettle Falls dam. (Site 01V9)
01V10	MN, VNP, St. Louis Co., N. shore of Mica Bay. (Site 01V10) (=00V2) (=99V1) (=98V5) (=97V12) (monitoring lines M11 & M12) (There was also an inventory trap-line here in 2001.)
01V11	MN, VNP, St. Louis and Koochiching Counties, Kabetogama Peninsula, NE. side of stream along Gold Portage. (Site 01V11) (=00V3) (=99V3) (=98V6) (=97V9) (=96V10) (monitoring lines M8 & M9)
01V12	MN, VNP, St. Louis Co., Kabetogama Peninsula, bog 1/2 mi. W. of Lost Lake. (Site 01V12) (=00V5) (=99V5) (=98V3) (=97V5) (=96V5) (monitoring lines M4 & M5)
01V13	MN, VNP, St. Louis Co., N. of and E. of entrance to Blind Ash Bay, S. of Kabetogama Lake. (Site 01V13) (=00V4) (=99V7) (=98V7) (=97V4) (=96V4) (monitoring lines M1, M2 & M3.)

- 01V14 MN, VNP, Koochiching Co., W. of Tom Cod Bay, in SW. corner of Park segment encompassing the Bay, on the E. side of the N-S boundary of the Park in conifer swamp just below the 350 contour line. (Site 01V14)
- 01V15 MN, VNP, St. Louis Co., E. of NPS Road#1, along road and path up to promontory with signal tower and weather station. (Site 01V15)
- 01V16 MN, VNP, St. Louis Co., Whispering Pines, trail between cabin #53 and "cold storage" garage to the S. (Site 01V16)
- 01V17 MN, VNP, St. Louis Co., NPS Road#1, 0.15 mi. N. of Ash River Rd., W. side, large pile of poles. (Site 01V17)
-

Table 2. Targeted inventory efforts in 2001.

Site Code	Target Species	Dates	Days	Trap Type*	Trap-Nights **
1	<i>Mustela</i> spp.	July 30-August 9, August 12-15	13	LSLT	98
2	<i>Mustela</i> spp.	July 30-August 9, August 12-15	13	LSLT	22
3	<i>Mus musculus</i>	July 31-August 9, August 13-31	27	MSb	111
4	<i>Sorex fumeus</i>	August 1-5	4	MS2b+MSu	800
5	<i>Phenacomys intermedius</i>	August 1-5	4	MSb+MSu	1,119
6	<i>Phenacomys intermedius</i>	August 6-9, 23-29	9	MSb+MSu	2,688
7	<i>Synaptomys borealis</i>	August 7-9, 26-30	6	Pit+MSu	596
8	<i>Synaptomys borealis</i>	August 13-19	6	Pit+MSb+MSu	900
9	<i>Phenacomys intermedius</i>	August 13-19	6	MSb+MSu	504
9	<i>Mustela frenata</i>	August 17-19	2	RT	10
10	<i>Mustela frenata</i>	August 17-19	2	RT	16
14	<i>Synaptomys borealis</i>	August 27-30	3	MSu+MSpb	536
15	<i>Mustela frenata</i>	August 28-31	3	RT	42
16	<i>Mustela frenata</i>	August 29-31	2	RT	4
17	<i>Mustela frenata</i>	August 29-31	2	RT	8

* LSLT = large Sherman live-trap

MSb = Museum Special trap, baited with peanut butter and rolled oats

MS2b = Museum Special trap, some baited with peanut butter and rolled oats, some baited with sardines

MSu = Museum Special trap, unbaited and never previously baited

Pit = pit-trap

RT = rat trap

MSpb = Museum Special trap baited in previous year(s), not this session

** Trap-night = one trap set for approximately 24 hours

Table 3. Monitoring dates and extent of disturbances.

Monitoring Line Code	Dates	Days	Days with <50% sprung traps	Days with <50% sprung traps + no substantial disturbance(s)	Carnivore(s) disturbing traps
1	August 21-23	2	2	0	marten
2	"	2	1	0	marten
3	"	2	1	0	marten
4	August 20-26	6	6	6	
5	"	6	6	6	
6	August 24-30	6	5	5	bear
7	"	6	5	5	bear
8	August 15-20	5	1	1	bear?
9	"	5	5	4	bear
11	August 13-19	6	6	3	bear
12	"	6	5	3	marten + bear

Table 4. Tabulation of specimens by species.

Species	Common name	Specimens
<i>Blarina brevicauda</i>	Shorttail shrew	76
<i>Clethrionomys gapperi</i>	Redback vole	1242
<i>Condylura cristata</i>	Star-nosed mole	1
<i>Microtus pennsylvanicus</i>	Meadow vole	278
<i>Mustela erminea</i>	Ermine	1
<i>Peromyscus maniculatus</i>	Deer mouse	494
<i>Sorex arcticus</i>	Arctic shrew	4
<i>Sorex cinereus</i>	Masked shrew	522
<i>Sorex hoyi</i>	Pygmy shrew	5
<i>Sorex palustris</i>	Water shrew	4
<i>Synaptomys cooperi</i>	Southern bog lemming	135
<i>Tamias minimus</i>	Least chipmunk	5
<i>Tamias striatus</i>	Eastern chipmunk	11
<i>Tamiasciurus hudsonicus</i>	Red squirrel	1
Unknown, partial specimen		4
<i>Zapus hudsonius</i>	Meadow jumping mouse	36

Table 5. VNP 2001 specimens by site.

SPECIES	SITE					
Frequency Row Pct Col Pct	VNP01	VNP03	VNP04	VNP05	VNP06	Total
Blarina brevicauda	0 0.00 0.00	1 1.32 50.00	0 0.00 0.00	0 0.00 0.00	2 2.63 0.67	76
Clethrionomys gapperi	0 0.00 0.00	1 0.08 50.00	43 3.45 33.33	115 9.23 49.15	172 13.80 57.72	1246
Condylura cristata	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1
Microtus pennsylvanicus	0 0.00 0.00	0 0.00 0.00	22 7.91 17.05	13 4.68 5.56	1 0.36 0.34	278
Mustela erminea	1 100.00 50.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1
Peromyscus maniculatus	0 0.00 0.00	0 0.00 0.00	45 9.11 34.88	44 8.91 18.80	44 8.91 14.77	494
Remnant, unknown species	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4
Sorex arcticus	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4

Table 5. VNP 2001 specimens by site, continued.

SPECIES	SITE					
Frequency						
Row Pct						
Col Pct	VNP01	VNP03	VNP04	VNP05	VNP06	Total
Sorex cinereus	0	0	11	33	37	522
	0.00	0.00	2.11	6.32	7.09	
	0.00	0.00	8.53	14.10	12.42	
Sorex hoyi	0	0	0	0	0	5
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Sorex palustris	1	0	0	0	0	4
	25.00	0.00	0.00	0.00	0.00	
	50.00	0.00	0.00	0.00	0.00	
Synaptomys cooperi	0	0	1	23	42	135
	0.00	0.00	0.74	17.04	31.11	
	0.00	0.00	0.78	9.83	14.09	
Tamias minimus	0	0	1	3	0	5
	0.00	0.00	20.00	60.00	0.00	
	0.00	0.00	0.78	1.28	0.00	
Tamias striatus	0	0	3	1	0	11
	0.00	0.00	27.27	9.09	0.00	
	0.00	0.00	2.33	0.43	0.00	
Tamiasciurus hudsonicus	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Zapus hudsonius	0	0	3	2	0	36
	0.00	0.00	8.33	5.56	0.00	
	0.00	0.00	2.33	0.85	0.00	

Table 5. VNP 2001 specimens by site, continued.

SPECIES	SITE					
Frequency						
Row Pct						
Col Pct	VNP07	VNP08	VNP09	VNP10	VNP11	Total
Blarina	17	0	3	9	43	76
brevicauda	22.37	0.00	3.95	11.84	56.58	
	3.41	0.00	2.33	2.00	10.80	
Clethrionomys	265	17	58	224	139	1246
gapperi	21.27	1.36	4.65	17.98	11.16	
	53.21	13.39	44.96	49.78	34.92	
Condylura	0	0	0	0	0	1
cristata	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Microtus	15	32	0	15	2	278
pennsylvanicus	5.40	11.51	0.00	5.40	0.72	
	3.01	25.20	0.00	3.33	0.50	
Mustela erminea	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Peromyscus	58	2	45	92	121	494
maniculatus	11.74	0.40	9.11	18.62	24.49	
	11.65	1.57	34.88	20.44	30.40	
Remnant, unknown	0	0	0	0	3	4
species	0.00	0.00	0.00	0.00	75.00	
	0.00	0.00	0.00	0.00	0.75	
Sorex arcticus	3	0	0	0	0	4
	75.00	0.00	0.00	0.00	0.00	
	0.60	0.00	0.00	0.00	0.00	

Table 5. VNP 2001 specimens by site, continued.

SPECIES	SITE					
Frequency						
Row Pct						
Col Pct	VNP07	VNP08	VNP09	VNP10	VNP11	Total
Sorex cinereus	113	54	15	106	72	522
	21.65	10.34	2.87	20.31	13.79	
	22.69	42.52	11.63	23.56	18.09	
Sorex hoyi	1	0	0	1	1	5
	20.00	0.00	0.00	20.00	20.00	
	0.20	0.00	0.00	0.22	0.25	
Sorex palustris	0	0	0	0	0	4
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Synaptomys cooperi	22	20	7	3	0	135
	16.30	14.81	5.19	2.22	0.00	
	4.42	15.75	5.43	0.67	0.00	
Tamias minimus	0	0	0	0	0	5
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Tamias striatus	0	0	0	0	6	11
	0.00	0.00	0.00	0.00	54.55	
	0.00	0.00	0.00	0.00	1.51	
Tamiasciurus hudsonicus	0	0	0	0	1	1
	0.00	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	0.00	0.25	
Zapus hudsonius	4	2	1	0	10	36
	11.11	5.56	2.78	0.00	27.78	
	0.80	1.57	0.78	0.00	2.51	

Table 5. VNP 2001 specimens by site, continued.

SPECIES	SITE					
Frequency Row Pct Col Pct	VNP12	VNP13	VNP14	VNP15	VNP16	Total
Blarina brevicauda	0 0.00 0.00	1 1.32 0.43	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	76
Clethrionomys gapperi	42 3.37 17.14	150 12.04 63.83	18 1.44 26.09	2 0.16 33.33	0 0.00 0.00	1246
Condylura cristata	1 100.00 0.41	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1
Microtus pennsylvanicus	114 41.01 46.53	29 10.43 12.34	35 12.59 50.72	0 0.00 0.00	0 0.00 0.00	278
Mustela erminea	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1
Peromyscus maniculatus	6 1.21 2.45	32 6.48 13.62	0 0.00 0.00	4 0.81 66.67	1 0.20 100.00	494
Remnant, unknown species	0 0.00 0.00	1 25.00 0.43	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4
Sorex arcticus	1 25.00 0.41	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4

Table 5. VNP 2001 specimens by site, continued.

SPECIES	SITE					
Frequency						
Row Pct						
Col Pct	VNP12	VNP13	VNP14	VNP15	VNP16	Total
Sorex cinereus	64	15	2	0	0	522
	12.26	2.87	0.38	0.00	0.00	
	26.12	6.38	2.90	0.00	0.00	
Sorex hoyi	2	0	0	0	0	5
	40.00	0.00	0.00	0.00	0.00	
	0.82	0.00	0.00	0.00	0.00	
Sorex palustris	2	0	1	0	0	4
	50.00	0.00	25.00	0.00	0.00	
	0.82	0.00	1.45	0.00	0.00	
Synaptomys cooperi	4	0	13	0	0	135
	2.96	0.00	9.63	0.00	0.00	
	1.63	0.00	18.84	0.00	0.00	
Tamias minimus	0	1	0	0	0	5
	0.00	20.00	0.00	0.00	0.00	
	0.00	0.43	0.00	0.00	0.00	
Tamias striatus	0	1	0	0	0	11
	0.00	9.09	0.00	0.00	0.00	
	0.00	0.43	0.00	0.00	0.00	
Tamiasciurus hudsonicus	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Zapus hudsonius	9	5	0	0	0	36
	25.00	13.89	0.00	0.00	0.00	
	3.67	2.13	0.00	0.00	0.00	
Total						2823

Table 6. Species of non-volant small mammals present and possibly present in Voyageurs National Park.

Species	Documented
<i>Sorex arcticus</i> , arctic shrew	X
<i>S. cinereus</i> , masked shrew	X
<i>S. fumeus</i> , smoky shrew	
<i>S. hoyi</i> , pygmy shrew	X
<i>S. palustris</i> , water shrew	X
<i>Blarina brevicauda</i> , shorttail shrew	X
<i>Condylura cristata</i> , star-nosed mole	X
<i>Tamias minimus</i> , least chipmunk	X
<i>T. striatus</i> , eastern chipmunk	X
<i>Marmota monax</i> , woodchuck	X
<i>Spermophilus franklinii</i> , Franklin's ground squirrel	X
<i>Sciurus carolinensis</i> , eastern gray squirrel	
<i>Tamiasciurus hudsonicus</i> , red squirrel	X
<i>Glaucomys sabrinus</i> , northern flying squirrel	X
<i>Peromyscus leucopus</i> , wood mouse	X
<i>P. maniculatus</i> , deer mouse	X
<i>Clethrionomys gapperi</i> , southern redback vole	X
<i>Phenacomys ungava</i> (formerly <i>intermedius</i>), eastern heather vole	
<i>Microtus chrotorrhinus</i> , rock vole	X
<i>M. pennsylvanicus</i> , meadow vole	X
<i>Synaptomys borealis</i> , northern bog lemming	
<i>S. cooperi</i> , southern bog lemming	X
<i>Rattus norvegicus</i> , Norway rat	
<i>Mus musculus</i> , house mouse	
<i>Napaeozapus insignis</i> , woodland jumping mouse	X
<i>Zapus hudsonius</i> , meadow jumping mouse	X
<i>Mustela erminea</i> , ermine	X
<i>M. frenata</i> , longtail weasel	
<i>M. nivalis</i> , least weasel	

Appendix B. Great Lakes Network Species List.

Kingdom / Group: Animalia / Mammal

PARK STATUS

Order/Family	Latin Name	GRPO	VOYA	ISRO	APIS	PIRO	SACN	MISS	SLBE	INDU	Reference number
Artiodactyla - Bovidae	Bison bison		✓				Unco			Hist	
Artiodactyla - Cervidae	Alces alces	Pres	Pres✓	Pres		Pres	Pres				
Artiodactyla - Cervidae	Cervus elaphus	Hist	Hist✓								
Artiodactyla - Cervidae	Odocoileus virginianus	Pres	Pres✓		Pres	Pres	Pres	Pres	Pres		
Artiodactyla - Cervidae	Rangifer tarandus	Hist	✓	Hist							
Artiodactyla - Cervidae	Rangifer tarandus caribou		Hist✓								
Carnivora - Canidae	Canis familiaris		PRES		Unkn						12.
Carnivora - Canidae	Canis latrans	Pres	Pres✓	Hist	Pres	Pres	Pres	Pres	Pres	Pres	
Carnivora - Canidae	Canis lupus	Pres	Pres✓	Pres		Pres	Pres			Hist	
Carnivora - Canidae	Canis rufus		✓							Hist	
Carnivora - Canidae	Urocyon cinereoargenteus	Unco	UNCO			Prob	Pres	Pres	Prob	Pres	14.
Carnivora - Canidae	Vulpes vulpes	Unco	Pres✓	Pres	Pres	Pres	Pres	Pres	Pres	Pres	
Carnivora - Felidae	Felis catus		PRES								13.
Carnivora - Felidae	Felis concolor	Unco	✓			Hist	Unco	Unco	Pres	Hist	
Carnivora - Felidae	Felis tigris		✓		Unkn	Fals				Unco	
Carnivora - Felidae	Lynx canadensis	Hist	Prob✓	Prob		Prob	Prob	Pres		Hist	
Carnivora - Felidae	Lynx lynx		✓				Unco				
Carnivora - Felidae	Lynx rufus	Pres	Prob✓			Pres	Pres	Pres	Prob		
Carnivora - Felidae	Puma concolor		Fals UNCO								16.
Carnivora - Mephitidae	Mephitis mephitis	Pres	Pres✓	Unco	Unco	Pres	Pres	Pres	Pres	Pres	
Carnivora - Mephitidae	Spilogale putorius		✓					Hist			
Carnivora - Mustelidae	Gulo gulo	Hist	Hist UNCO			Hist			Hist		17.
Carnivora - Mustelidae	Lontra canadensis		Pres✓				Pres	Pres			
Carnivora - Mustelidae	Lutra canadensis	Pres	✓	Pres	Pres	Pres			Pres	Unco	
Carnivora - Mustelidae	Martes americana	Pres	Pres✓	Unco	Unkn	Pres	Pres	Unco	Prob		
Carnivora - Mustelidae	Martes pennanti	Pres	Pres✓		Unkn	Pres	Pres	Unco		Hist	
Carnivora - Mustelidae	Mustela erminea	Pres	Pres✓	Pres	Unkn	Pres	Unco		Pres		
Carnivora - Mustelidae	Mustela frenata	Unco	Prob✓	Unco	Unkn	Pres	Pres	Pres	Pres	Pres	
Carnivora - Mustelidae	Mustela nivalis	Unco	Unco PROB				Prob	Prob	Pres	Pres	8.
Carnivora - Mustelidae	Mustela vison	Pres	Pres✓	Pres	Pres	Pres	Pres	Pres	Pres	Pres	
Carnivora - Mustelidae	Taxidea taxus		Unco PROB			Prob	Pres	Pres	Prob	Prob	18.
Carnivora - Procyonidae	Procyon lotor		Pres✓		Unco	Pres	Pres	Pres	Pres	Pres	
Carnivora - Ursidae	Ursus americanus	Pres	Pres✓		Pres	Pres	Pres	Pres	Pres	Hist	
Vespertilionidae	Eptesicus fuscus		Prob✓	Pres	Pres	Prob	Pres	Pres	Pres	Pres	
Vespertilionidae	Lasionycteris noctivagans	Unco	Prob✓	Prob	Pres	Prob	Unco	Pres	Pres	Pres	

"PRES" CONFIRMED
BY ROUTE 2001

★

★

"PRES"
CONFIRMED 2001
BY ROUTE

Vespertilionidae	Lasurus borealis	Unco	Prob ✓	Pres	Pres	Prob	Unco	Pres	Pres	Pres	Pres	Pres	
Vespertilionidae	Lasurus cinereus	Pres	Prob ✓	Prob	Unkn	Prob	Unco	Pres	Pres	Pres	Pres	Prob	
Vespertilionidae	Myotis keenii = SEPTEN.	Unco	Prob FALS	Pres			Prob	Pres	Pres	Pres	Pres	Prob	20.
Vespertilionidae	Myotis lucifugus	Pres	Pres ✓	Pres		Pres	Pres	Pres	Pres	Pres	Pres	Pres	
Vespertilionidae	Myotis septentrionalis		Unco (PROB)	Prob		Prob				Prob			19.
Vespertilionidae	Myotis sodalis		✓									Prob	
Vespertilionidae	Nycticeius humeralis		✓									Hist	
Vespertilionidae	Pipistrellus subflavus		✓			Prob	Pres	Pres	Pres	Pres	Pres	Unco	
Didelphidae	Didelphis marsupialis		✓							Fals			
Didelphidae	Didelphis virginiana		UNCO				Pres	Pres	Pres	Pres	Pres	Pres	15.
Insectivora - Soricidae	Blarina brevicauda	Pres	Pres ✓			Pres	Pres	Pres	Pres	Pres	Pres	Pres	
Insectivora - Soricidae	Cryptotis parva		✓				Unco	Unco	Unco			Prob	
Insectivora - Soricidae	Microsorex hoyi		✓				Unco	Unco	Unco				
Insectivora - Soricidae	Sorex arcticus	Unco	Pres ✓			Pres	Prob	Unco	Unco				
Insectivora - Soricidae	Sorex cinereus	Pres	Pres ✓		Unkn	Pres	Pres	Pres	Pres	Pres	Pres	Pres	
Insectivora - Soricidae	Sorex hoyi		PRES			Pres				Prob	Unco	Unco	1.
Insectivora - Soricidae	Sorex palustris	Unco	Pres ✓			Prob	Prob	Unco	Unco	Prob	Prob		
Insectivora - Soricidae	Sorex fumeus		PROB		Unkn								6. add species
Insectivora - Soricidae	Condylura cristata	Unco	Pres ✓			Prob	Pres	Pres	Pres	Pres	Pres	Pres	
Insectivora - Talpidae	Scalopus aquaticus		✓				Unco	Unco	Unco	Pres	Pres	Pres	
Lagomorpha - Leporidae	Lepus americanus	Pres	Pres ✓	Pres	Pres	Pres	Pres	Pres	Pres	Pres	Pres	Pres	
Lagomorpha - Leporidae	Lepus townsendii		✓				Unco	Unco	Unco	Pres	Pres		
Lagomorpha - Leporidae	Oryctolagus cuniculus		✓							Pres			
Lagomorpha - Leporidae	Sylvilagus floridanus		Unco PROB				Pres	Pres	Pres	Pres	Pres	Pres	21.
Rodentia - Castoridae	Castor canadensis	Pres	Pres ✓	Pres	Pres	Pres	Pres	Pres	Pres	Pres	Pres	Pres	
Rodentia - Dipodidae	Napaeozapus insignis	Unco	Pres ✓			Pres	Pres	Unco	Unco	Pres	Pres	Pres	
Rodentia - Dipodidae	Zapus hudsonius	Pres	Pres ✓		Unkn	Pres	Pres	Pres	Hist	Pres	Pres	Pres	
Rodentia - Erethizontidae	Erethizon dorsatum	Pres	Pres ✓		Unkn	Pres	Pres	Pres	Pres	Pres	Pres	Hist	
Rodentia - Geomyidae	Geomys bursarius		✓				Pres	Pres	Pres				
Rodentia - Heteromyidae	Perognathus flavescens		✓				Unco	Unco	Unco	Pres			
Rodentia - Muridae	Clethrionomys gapperi	Pres	Pres ✓	Unco	Pres	Pres	Pres	Pres	Unco	Pres			
Rodentia - Muridae	Microtus chrotorrhinus		Pres ✓				Unco	Unco	Unco	Hist		Pres	
Rodentia - Muridae	Microtus ochrogaster		✓				Unco	Unco	Unco	Hist		Pres	
Rodentia - Muridae	Microtus pennsylvanicus		Pres ✓		Pres	Pres	Pres	Pres	Pres	Pres	Pres	Pres	
Rodentia - Muridae	pennsylvanicus		✓		Unco								
Rodentia - Muridae	Microtus pinetorum	Fals	✓							Pres	Prob	Pres	
Rodentia - Muridae	Mus musculus		Pres PROB			Prob	Pres	Pres	Pres	Pres	Pres	Pres	7.

