



2011 Small Mammal Survey Report

Prepared by:

Amy Wilson
Wildlife Technician

Technical Report Number 11-08
December 2011

1854 Treaty Authority
Resource Management Division
4428 Haines Road
Duluth, MN 55811
Phone: (218) 722-8907
www.1854treatyauthority.org

Introduction

The goal of the small mammal survey is to track trends in small mammal (mice, voles, shrews, etc.) populations within the forested and transition zones of northern Minnesota (Figure 1). These trends are important pieces of data that can contribute to the understanding of population fluctuations of a variety of game and nongame wildlife (terrestrial and avian). The small mammal survey was initially created to help explain trends in the pine marten (*Martes americana*) population. It started with some localized small mammal monitoring efforts by Minnesota Department of Natural Resources wildlife staff in Grand Marais and Ely in the mid 1980's. By 1998, nine routes were being completed in northeastern Minnesota by four cooperators. The 1854 Treaty Authority volunteered to coordinate the survey beginning in 2000. A standardized protocol was designed with the help of existing cooperators as well as Bill Berg (retired DNR Wildlife Research Biologist), Gerda Nordquist (DNR Animal Survey Coordinator), and Don Christian (Associate Dean of Biological Sciences at the University of Montana).

Currently, the small mammal survey consists of 43 routes and 17 cooperators (Figure 1). Project collaborators include the Agassiz National Wildlife Refuge, 1854 Treaty Authority, Fond du Lac Community College, Fond du Lac Resource Management Division, Glacial Ridge National Wildlife Refuge, Grand Portage Natural Resource Management Division, Itasca Community College, Leech Lake Department of Natural Resources, Mille Lacs Department of Natural Resources, Minnesota Department of Natural Resources, Red Lake Department of Natural Resources, Red Lake Wildlife Management Area, Roseau River Wildlife Management Area, Rydell National Wildlife Refuge, Superior National Forest, Thief Lake Wildlife Management Area, and Vermilion Community College.

Methods

Materials

Victor M150 mice traps were chosen for the survey, due to the cost factor and ease of replacement for survey participants. Number 15 bonded nylon twine and seven inch metal spikes were used to secure each trap.

Survey Procedures

Routes were to be completed between September 15 and October 20, if possible. Cooperators were asked to avoid three day forecasts that predicted heavy precipitation, which would create an increase in tripped traps. Establishment of each route was to be determined by each surveyor. Habitat types were not specified, but were to be representative of each cooperator's work area. Each surveyor was to record percent canopy closure, overhead cover species, diameter at breast height, height, and understory species, as well as chipmunk (*Tamias spp.*) and red squirrel (*Tamiasciurus hudsonicus*) sightings and vocalizations for each transect.

Each route consisted of three transects spaced one or more miles apart. Each transect included 10 stations with two traps per station baited with peanut butter. The first station was placed 100 feet in from the right-of-way and the next four stations were placed at 50-foot intervals. Stations six through 10 were placed in a parallel line 50 feet to either the

right or left of stations one through five. Each transect was flagged or recorded using a GPS unit so it could be found in future years. The trapline was checked for two consecutive mornings and then pulled on the last day. Species captured, trapnights, missing traps, and environmental information were recorded each day. Trapnights were recorded as follows: each empty, but triggered or broken trap or otherwise nonfunctional trap or any trap catching a non-target (frog, bird, etc.) species counted as ½ of a trapnight. Any missing trap counted as a zero trapnight. Non-triggered, functional traps and traps containing a small mammal were counted as one full trapnight.

Population Index

A population index was developed for each species captured, except for masked shrews (*Sorex cinereus*) and pygmy shrews (*Microsorex spp.*), which were grouped together since they are difficult to distinguish easily in the field. Each population index was calculated by taking the catch per unit effort (number of each species captured/total trapnights) X 100.

Habitat Types

Each transect was categorized as forested, grassland, brush or bog habitat, depending on percent canopy closure, overstory/understory species, and description. This was done to gain a more accurate individual species population index according to habitat types. For summary purposes, transects categorized as grassland, brush or bog habitat were combined into the grassland/brush category.

Results

Cooperators ran 25 of the 43 existing small mammal survey routes in 2011 (Figures 1 and 2). Nineteen of the 25 routes run in 2011 consisted of transects placed exclusively in forested habitat, while one route was located completely in grassland/brush habitat. The remaining five routes surveyed were comprised of transects from both habitat types (i.e. routes contained at least one transect in grassland/brush habitat and the rest were classified as forested habitat). Overall, 75 transects, 66 forested and 9 grassland/brush, were surveyed in 2011 (Table 1).

Small mammal survey routes were run between 26 September and 04 November 2011 (Table 1). The 2011 survey period had a mean maximum daily temperature of 64 °F (range 40 to 81 °F) and mean minimum daily temperature of 43 °F (range 19 to 59 °F).

In 2011 set-up took slightly longer than in previous years, with an average set-up time of just under 2 ½ hours versus just over 2 hours last year. During survey set-up, the mean number of chipmunks seen or heard decreased slightly from the previous year (0.27) to 0.24 chipmunks per route (Table 2), and for the fifth year in a row remained below the 11-year average (2001-2011) of 0.42 chipmunks per route per year. The mean number of red squirrels observed during route set-up fell only slightly from last year's all time high of 2.96 to 2.28 (Table 2), still well above the 11-year average of 1.86 red squirrels per route. Two Snowshoe Hares (*Lepus americanus*) were observed during 2011 set-up, as well as one Northern Flying Squirrel (*Glaucomys sabrinus*) that was trapped, but released alive.

Grassland/Brush Habitat

Nine (12%) transects were categorized as grassland/brush habitat in 2011 (Table 1). No chipmunks were heard/sighted along these transects, but one red squirrel was heard/sighted in route 50 (transect 3) during route set-up. Overall, 19 total individuals, representing four

species, were captured (Table 3). Unlike previous years, where they represented a relatively small percent of total catch, short-tailed shrews (*Blarina brevicauda*) were the dominate catch at 32%. Red-backed vole (*Clethrionomys gapperi*) and white-footed deer mouse (*Peromyscus spp.*) came in a close second, representing 26% each of the total captures. The final species represented was meadow vole (*Microtus pennsylvanicus*, 16%). The total small mammal population index for grassland/brush habitat decreased from 6.48 in 2010 to 5.51 in 2011. 2011 individual population indices reflected increasing population trends for the two most common small mammal species found in this habitat: short-tailed shrew and white-footed mouse, where short-tailed shrew numbers were second highest ever since 2005 (7 captures) (Table 3, Figure 3). Meanwhile, the red backed vole population index decreased to levels seen in 2009, from 2.65 in 2010 to 1.45 in 2011. Also, the meadow vole population index decreased to near record low dropping from 2.06 in 2010 to .87 in 2011. These indices were calculated by taking the total number of a species captured in Grassland-Brush and dividing by the number of trapnights (344.5 for Grassland-Brush) then multiplying by 100. Other less common species, like masked, pygmy, and arctic shrews, were not sampled at all in 2011 (Table 3, Figure 3).

Forested Habitat

Sixty-six (88%) transects were categorized as forested habitat in 2011 (Table 1), and a total of 56 red squirrels and six chipmunks were seen or heard along these transects during route set-up (Table 2). Overall, 287 total individuals, representing seven species, were captured (Table 4). Red-backed voles (53%) and white-footed mice (36%) dominated the catch. Other species captured included short-tailed shrew (5%), meadow vole (2%), masked/pygmy shrew (2%), chipmunk spp. (<1%) and northern flying squirrel (*Glaucomys sabrinus*, <1%). The total small mammal population index for forested habitat decreased significantly from 20.22 in 2010 to 13.43 in 2011, this change was largely due to decreases in its three most common inhabitants, red-backed voles, white-footed mice, and meadow voles. (Table 4, Figure 4). Unlike in the grassland/brush habitat, the short-tailed shrew population index in forested habitat declined slightly from 0.74 in 2010 to 0.70 in 2011. Also, the masked/pygmy shrew index was at its highest level, of 0.33 in 2011, since 2003 when it was 0.37. These indices were calculated by taking the total number of a species captured in Forested and dividing by the number of trapnights (2136.5 for Forested) then multiplying by 100. Northern flying squirrel and chipmunk indices were very similar between 2010 and 2011.

Predator-Prey Relationships

Figure 5 compares the total small mammal population indices for forested transects with the percent of juvenile pine marten harvested during the 2001-2010 state trapping seasons (Erb 2011). The 2011 pine marten harvest info was not available at the time this report was written. Red-backed vole population indices were also plotted, since this species is believed to be the primary food source of pine marten. In 2004 and 2007, substantial declines occurred in the juvenile pine marten harvest. During these years, reduced numbers of small mammals, and in particular red-backed voles, were also observed along forested survey transects. From 2007 to 2009, the total small mammal population index for forested habitat decreased. This steady decline was largely due to a reduction in white-footed mice in 2008 and a nearly 40% decline in the red-backed vole population in 2009. Despite a negative trend in small mammal abundance, MN DNR harvest data show an increasing marten population over the same time period. In 2010, small mammal numbers, notably red-backed voles and white-footed mice increased considerably. Conversely, the percent of juvenile pine martens harvested in 2010 dropped from 55% in 2009 to 47% in 2010. This drop may

be due to a latent effect of the low small mammal population numbers in 2009. 2011 showed a significant decrease in red-backed vole and white-footed mice populations. Based on this decline, decreases in the juvenile pine marten harvest might also be expected in 2011.

Figure 6 compares the total small mammal population indices for forested transects with the ratio of juvenile to adult female pine martens harvested during the 2001-2010 state trapping seasons (Erb 2011). 2011 pine marten harvest info was not available at the time this report was written. Like the percent of juvenile pine marten harvested, the ratio of juvenile to adult female pine martens trapped (i.e. reproductive success) also dropped sharply (>80%) in 2007, followed by increasing productivity in 2008 and 2009. Despite the considerable increase in the small mammal numbers, especially red-backed voles, observed in forested habitat in 2010, pine marten numbers decreased from 4.9 in 2009 to 4.1 in 2010. Considering the decline in small mammal numbers seen in 2011, a continued decline in pine marten recruitment rates would also be expected.

Figure 7 compares the total small mammal population indices for forested transects with the mean number of owls detected per route in the Laurentian Forest Province during the 2005-2010 spring surveys (Grosshuesch 2005-2010). 2011 owl survey data was not available at the time this report was written. Similar to their small mammal prey, northern saw-whet (*Aegolius acadicus*) and long-eared (*Asio otus*) owl numbers peaked in 2006, followed by decreasing population trends in 2007 and 2008. Due to the substantial irruption of great gray owls (*Strix nebulosa*) during winter 2004-2005, great gray detections were higher than expected in 2005 (Grosshuesch 2005). However, similar to the other two owl species, great gray detections steadily declined in 2007 and 2008. The relationship between long-eared and great gray owls and their small mammal prey base becomes less clear in 2009 and 2010 when an inverse relationship was observed between small mammal abundance and detections of these two owl species. Northern saw-whet numbers, on the other hand, appear to mimic small mammal population trends more closely as most recently seen in 2010 when owl detections nearly doubled. This species may be more sensitive to the cyclical availability of its small mammal prey at the local scale than its nomadic cousins (Grosshuesch 2008).

Discussion

While the small mammal population numbers in grassland, brush or bog habitats during 2010 were encouraging, 2011 numbers were a mixed bag. Red backed vole numbers were down by almost half of what they were last year and were closer on par with the 2009 numbers. Also, meadow vole population numbers were the second lowest ever, falling 58% from 2010. Conversely, white-footed mice numbers were up slightly from 2010 and short-tail shrew numbers nearly tripled from 2010, the highest index of that species since 2005. Small mammal diversity still remained low (4 species). As small mammal populations fluctuate in grassland/brush habitat, the probability of detecting less common species, such as masked, pygmy, and arctic (*Sorex arcticus*) shrews, may increase.

During 2010, substantial increases in small mammal abundance occurred along forested transects, but 2011 brought mostly declines in population numbers. Small mammal population indices for forested habitat are most heavily influenced by the population dynamics of two species, the red-backed vole and white-footed mouse. Both species displayed considerable decline from last year, but numbers were still higher than the relatively low numbers of 2009. A declining small mammal population is detrimental to predators, particularly those believed to be heavily influenced by microtine population

cycles, such as pine martens and northern saw-whet owls.

Fluctuations in small mammal abundance in forested areas seem to correlate reasonably well with pine marten productivity from 2001 to 2007. For example, total small mammal, red-backed vole, and pine marten indices simultaneously peaked around 2001 and 2006, and then dropped sharply in 2004 and 2007. While differences in the magnitude of these changes may be a function of the harvest data used (e.g. trapping effort, aging techniques), the paralleling trends between predator and prey suggest a positive correlation whereby prey availability affects the success of the predator population to breed and raise young. An interesting anomaly to this pattern occurred in 2008 and 2009, when pine marten productivity increased while abundance of its primary prey, the red-backed vole steadily declined. It is unclear why this asynchronism occurred, but is noteworthy to mention that the least number of forest transects were surveyed during these same years (i.e. 2008 and 2009). Reductions in small mammal trapping effort could deflate population indices and affect our ability to accurately track small mammal population trends. Despite the relatively large population of red-backed voles detected in 2010, the pine marten population declined during this time period. With the decreased small mammal population in 2011, the pine marten population will most likely continue to decline.

An organized spring owl monitoring survey began in the Laurentian Forest Province of northern Minnesota in 2005 and has since expanded to other parts of the state (Grosshuesch 2005-2009). This data set provides us with another opportunity to begin to investigate predator-prey relationships between owls and small mammals. From 2006 to 2008, steady declines of northern saw-whet, long-eared, and great gray owls paralleled trends in small mammal abundance, suggesting that these owl species may be heavily influenced by the cyclic dynamics of their small mammal prey. While 2009 and 2010 results revealed a decent correlation between small mammal and northern saw-whet population trends, they failed to show a clear relationship between small mammal abundance and the other two owl species. These results highlight the need for longer data sets for both owls and small mammals to determine how sensitive these owl species are to local and regional fluctuations in small mammal abundance. Unfortunately, owl data was not available for 2011 at the time this report was written.

Recommendations & Future Directions

2011 marked the 11th year of data collection for the small mammal survey. Since this coordinated effort to survey small mammals began in 2001, an average of 29 routes have been completed each year by project collaborators. Except for a few years, survey participation has gradually declined, and the past few years, survey participation has hovered around 25 survey routes completed (or 58% of the available routes). Renewed effort needs to be put into encouraging past participants to resume small mammal monitoring activities along established routes, while also recruiting new agency staff, individuals, or groups (e.g., students, raptor conservation groups) to create new survey routes, particularly in bog, grassland, and brush habitats where the least effort currently lies. Likewise, it would be advantageous to conduct a power analysis to determine the minimum number of transects needed to adequately sample small mammals in each habitat type in order to provide a robust data set that will best accomplish survey objectives in the long term. As the small mammal data set expands in future years, more thorough time series analyses can be performed to further elucidate relationships among small mammal species and with their predators, particularly pine martens and owls.

Acknowledgements

I would like to thank the following cooperators and individuals for their assistance with the small mammal survey in 2011: Agassiz National Wildlife Refuge, Fond du Lac Reservation Resource Management Division, Grand Portage Reservation Natural Resource Management Division, Mille Lacs Reservation Natural Resource Management Division, Leech Lake Reservation Natural Resource Management Division, Itasca Community College, Marshall County Central High School Ecology Class, Minnesota Department of Natural Resources, Red Lake Reservation Department of Natural Resources, Red Lake Wildlife Management Area, Roseau River Wildlife Management Area, Superior National Forest, Thief Lake Wildlife Management Area, and Vermilion Community College, as well as John Erb from the Minnesota Department of Natural Resources for pine marten harvest data and 1854 Treaty Authority staff, particularly Andrew Edwards and Nick Bogyo for their assistance with survey work.

Literature Cited

Erb, J. 2011. Registered Furbearer Population Modeling: 2011 Report. Minnesota Department of Natural Resources. 16 pp.

Grosshuesch, D.A. and R.S. Brady. 2010. Western Great Lakes Region Owl Survey: 2010 Report, Annual report, Minnesota and Wisconsin Departments of Natural Resources. 20 pp.

Grosshuesch, D.A. and R.S. Brady. 2009. Western Great Lakes Region Owl Survey: 2009 Report, Annual report, Minnesota and Wisconsin Departments of Natural Resources. 31 pp.

Grosshuesch, D.A. 2008. Western Great Lakes Region Owl Monitoring Survey: 2008 Final Report, Annual report, Minnesota and Wisconsin Departments of Natural Resources. 25 pp.

Grosshuesch, D.A. 2007. Western Great Lakes Region Owl Monitoring Survey: 2007 Final Report, Annual report, Minnesota and Wisconsin Departments of Natural Resources. 26 pp.

Grosshuesch, D.A. 2006. Western Great Lakes Region Owl Monitoring Survey: 2006 Final Report, Annual report, Minnesota and Wisconsin Departments of Natural Resources. 23 pp.

Grosshuesch, D.A. 2005. Western Great Lakes Region Owl Monitoring Survey: 2005 Final Report, Annual report, Minnesota and Wisconsin Departments of Natural Resources. 19 pp.

Table 1. Summary of total trapnights, routes completed, transects, and route dates for 2001-2011.

Year	Total trapnights	Total routes completed	Total transects	Grassland/Brushland	Forested	Dates routes were run
2001	3653	38	114	15	99	9/17/2001-10/24/2001
2002	3698.5	33	99	18.5	80.5	9/16/2002-10/27/2002
2003	3412	31	93	12	81	9/16/2003-10/18/2003
2004	3263	30	90	13	77	9/15/2004-10/27/2004
2005	3004.5	27	81	15	66	9/19/2005-10/19/2005
2006	3438.5	32	96	13	83	9/19/2006-10/27/2006
2007	3104	28	84	12	72	9/8/2007-10/17/2007
2008	2577	24	72	9	63	9/12/2008-10/31/2008
2009	2801	25	75	10	65	9/2/2009-10/20/2009
2010	2911.5	26	78	9	69	9/14/2010-10/20/2010
2011	2781	25	75	9	66	9/26/2011- 11/04/2011

Table 2. Total and mean numbers for chipmunks and red squirrels heard or sighted during route set-up, 2001-2011.

Year	Total Chipmunks	Total Red Squirrels	Mean # Chipmunks	Mean # Red Squirrels
2001	31	41	0.82	1.08
2002	16	57	0.48	1.73
2003	6	50	0.19	1.61
2004	16	29	0.53	0.97
2005	26	44	0.96	1.63
2006	14	62	0.44	1.94
2007	5	44	0.18	1.57
2008	4	56	0.17	2.33
2009	8	58	0.32	2.32
2010	7	77	0.27	2.96
2011	6	57	0.24	2.28

Table 3. Small mammal index and numbers captured (N) in the grassland/brush/bog transects, 2001-2011.

Year	2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		
	N	Index	N	Index	N	Index	N	Index	N	Index	N	Index	N	Index	N	Index	N	Index	N	Index	N	Index	
Species Captured																							
Meadow vole (<i>Microtus pennsylvanicus</i>)	23	3.95	5	0.69	18	3.91	36	7.68	51	9.18	24	5.65	5	1.07	23	7.02	5	1.31	7	2.06	3	0.87	
White-footed mice (<i>Peromyscus spp.</i>)	13	2.23	5	0.69	20	4.34	0	0	9	1.52	9	2.12	7	1.5	9	2.75	2	0.53	4	1.18	5	1.45	
Short-tailed shrew (<i>Blarina brevicauda</i>)	3	0.52	1	0.14	5	1.09	1	0.21	7	1.26	7	1.65	2	0.43	4	1.22	3	0.79	2	0.59	6	1.74	
Red-backed vole (<i>Clethrionomys gapperi</i>)	5	0.86	6	0.83	14	3.04	6	1.28	32	5.76	6	1.41	12	2.57	26	7.94	5	1.31	9	2.65	5	1.45	
Masked/Pygmy shrew (<i>Sorex cinereus/Microsorex</i>)	9	1.55	0	0	9	1.95	1	0.21	4	0.72	2	0.47	0	0	3	0.92	1	0.26	0	0	0	0	
Arctic shrew (<i>Sorex arcticus</i>)	1	0.17	0	0	2	0.43	3	0.64	2	0.36	1	0.24	0	0	12	3.66	0	0	0	0	0	0	
Meadow jumping mouse (<i>Zapus hudsonius</i>)	0	0	1	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Prairie vole (<i>Microtus ochrogaster</i>)	1	0.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Water shrew (<i>Sorex palustris</i>)	8	1.37	1	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total number	63	10.82	19	2.63	68	14.76	47	10.02	105	18.8	49	11.54	26	5.57	77	23.51	16	4.2	22	6.48	19	5.51	
Total number of species	8		6		6		5		6		6		4		6		5		4		4		

Table 4. Small mammal index and numbers captured (N) in the forested transects, 2001-2011.

Species Captured	N 2001	Index 2001	N 2002	Index 2002	N 2003	Index 2003	N 2004	Index 2004	N 2005	Index 2005	N 2006	Index 2006	N 2007	Index 2007	N 2008	Index 2008	N 2009	Index 2009	N 2010	Index 2010	N 2011	Index 2011	
Red-backed vole (<i>Clethrionomys gapperi</i>)	507	13.88	386	12.97	319	10.81	128	4.73	286	11.67	350	11.61	202	7.66	174	7.74	117	4.83	278	10.81	153	7.16	
White-footed mice (<i>Peromyscus spp.</i>)	379	10.38	185	6.21	275	9.31	194	7.17	179	7.31	280	9.29	259	9.82	115	5.11	105	4.34	193	7.5	104	4.87	
Meadow vole (<i>Microtus pennsylvanicus</i>)	10	0.27	13	0.44	10	0.34	4	0.15	13	0.53	28	0.93	2	0.08	20	0.89	17	0.7	22	0.86	5	0.23	
Short-tailed shrew (<i>Blarina Brevicauda</i>)	43	1.18	15	0.5	16	0.54	8	0.3	23	0.94	15	0.5	24	0.91	17	0.76	25	1.03	19	0.74	15	0.70	
Masked/Pygmy shrew (<i>Sorex cinereus/Microsorex</i>)	24	0.66	3	0.1	11	0.37	2	0.07	4	0.16	15	0.5	3	0.11	5	0.22	5	0.21	6	0.23	7	0.33	
Chipmunk <i>spp.</i>	11	0.3	8	0.27	8	0.27	6	0.22	1	0.04	4	0.13	0	0	0	0	4	0.17	1	0.04	2	0.05	
Northern flying squirrel (<i>Glaucomys sabrinus</i>)	0	0	0	0	0	0	0	0	0	0	1	0.03	0	0	0	0	1	0.04	1	0.04	1	0.09	
House mouse (<i>Mus musculus</i>)	2	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern bog lemming (<i>Synaptomys cooperi</i>)	5	0.12	2	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern flying squirrel (<i>Glaucomys volans</i>)	3	0.08	1	0.03	0	0	1	0.04	0	0	0	0	1	0.04	8	0.36	0	0	0	0	0	0	0
Arctic shrew (<i>Sorex arcticus</i>)	1	0.03	0	0	0	0	0	0	7	0.29	0	0	0	0	12	0.53	0	0	0	0	0	0	0
Meadow jumping mouse (<i>Zapus hudsonius</i>)	0	0	2	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water shrew (<i>Sorex palustris</i>)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.04	0	0	0	0	0	0	0
Total number	985	26.95	615	20.66	639	21.64	343	12.68	513	20.94	693	22.99	491	18.62	352	15.65	274	11.32	520	20.22	287	13.43	
Total number of species	10		9		6		7		7		7		6		8		7		7		7		

Figure 1. Small mammal survey route locations for 2011.

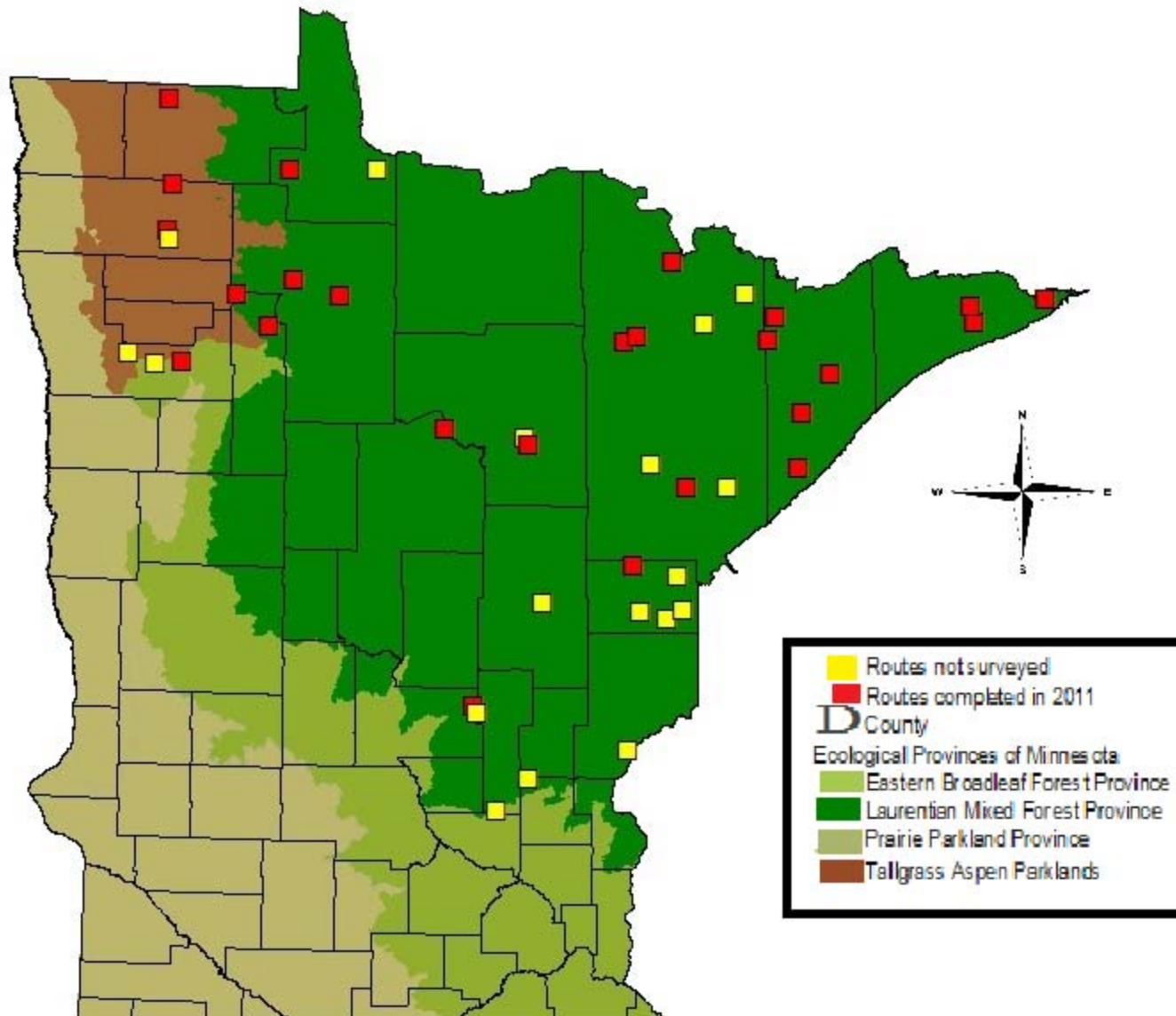
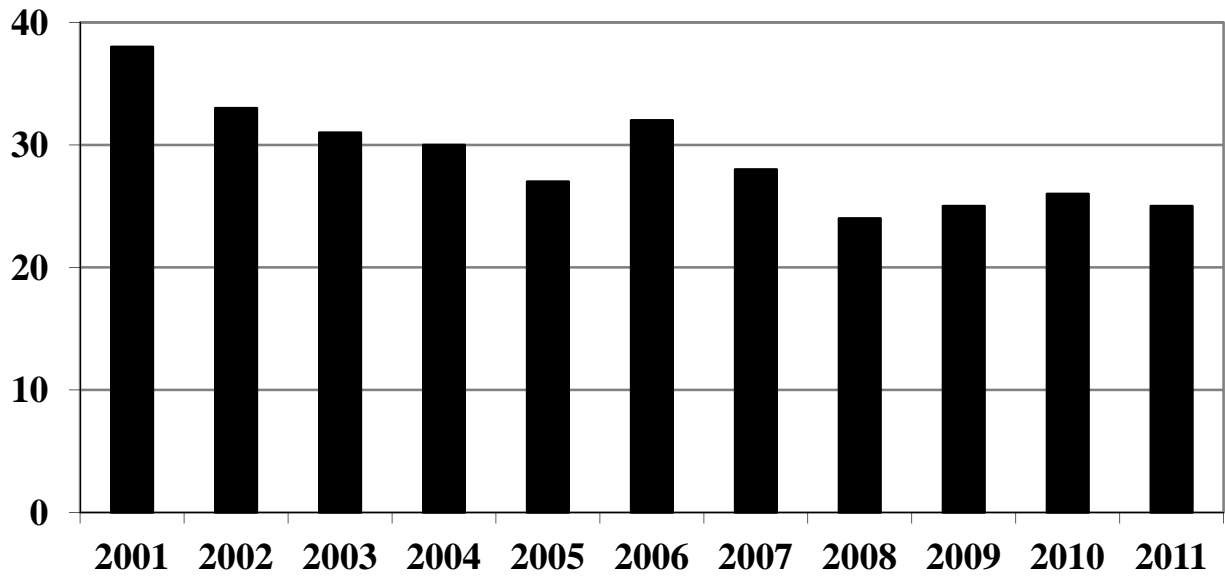
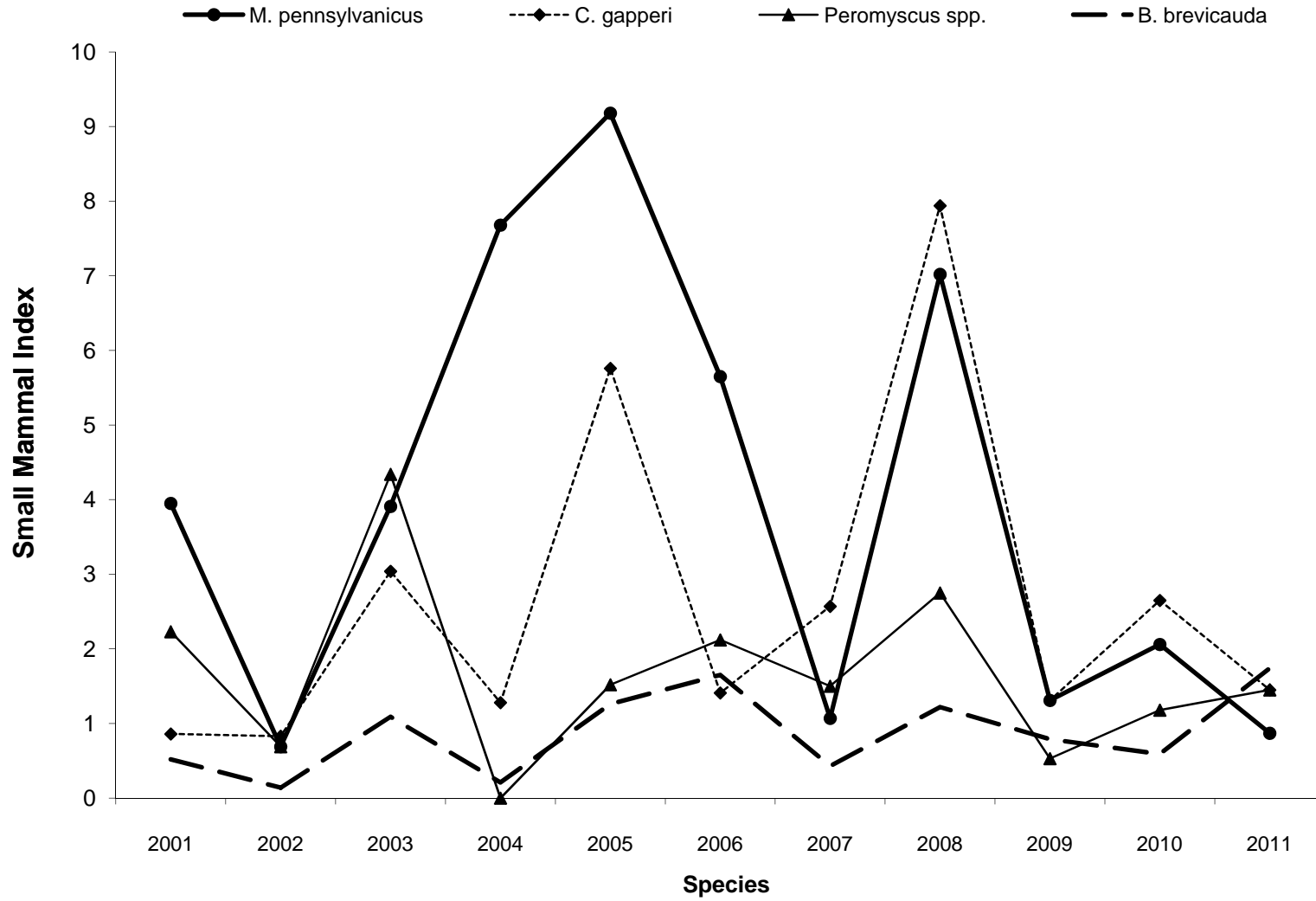


Figure 2. Number of small mammal survey routes completed, 2001-2011.



Small Mammal Indices for Grassland/Brush/Bog Transects 2001-2011



Small Mammal Indices for Forested Transects, 2001-2011

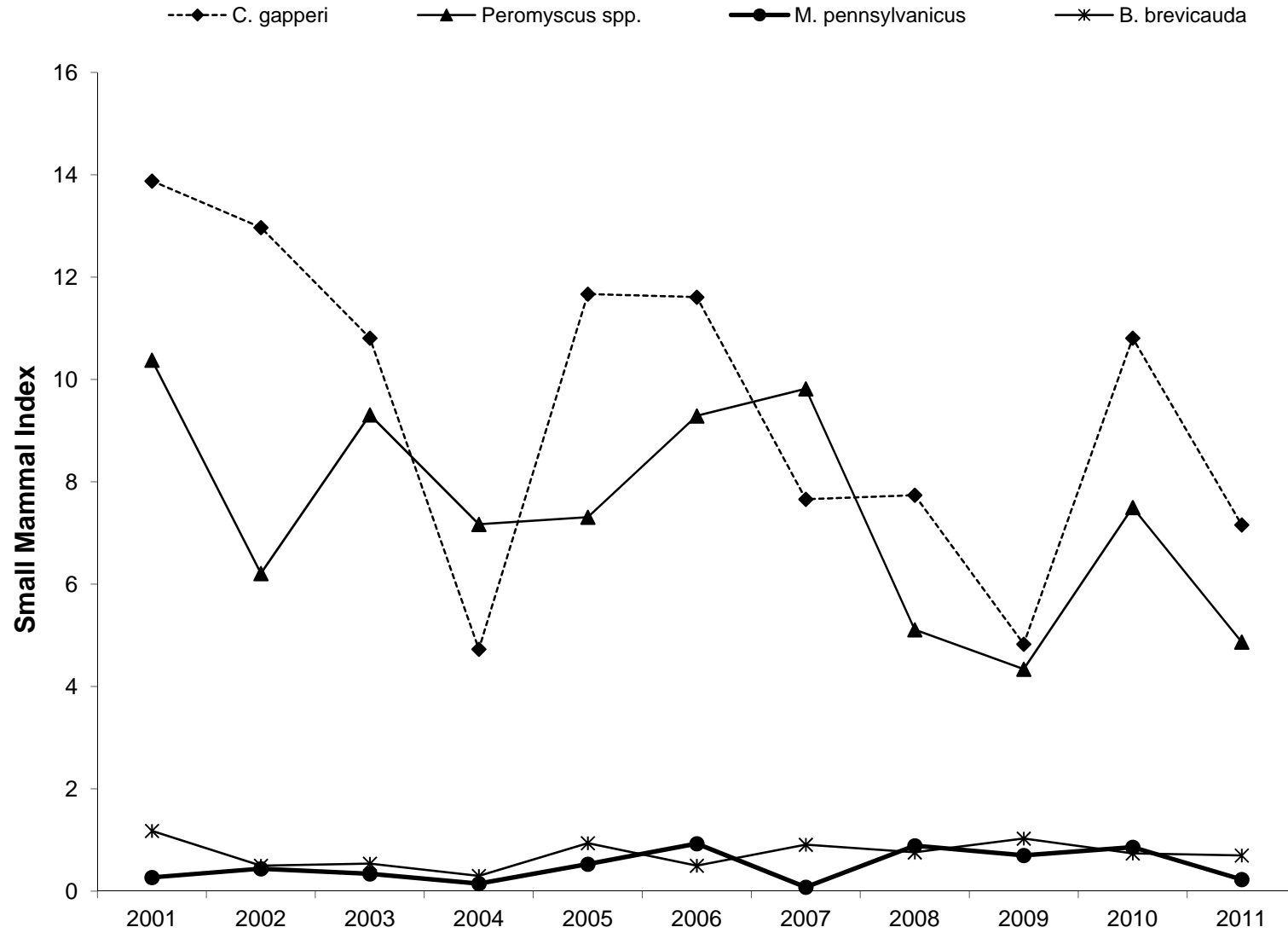


Figure 5. Total Small Mammal Index for Forested Transects and Percent Juvenile Pine Marten Trapped, 2001-2011

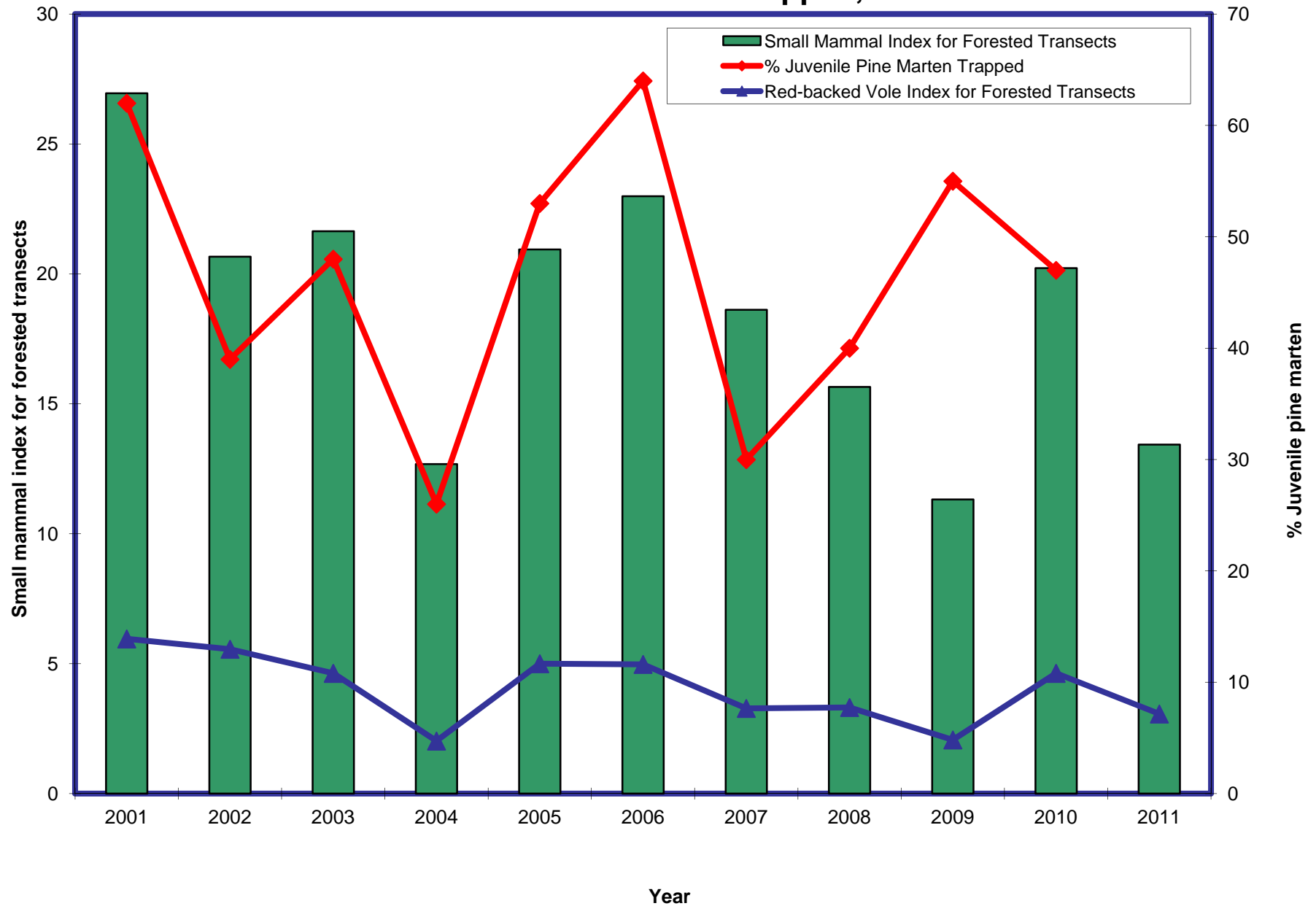


Figure 6. Total Small Mammal Index for Forested Transects and Juvenile to Mother Pine Marten Ratio Trapped, 2001-2011

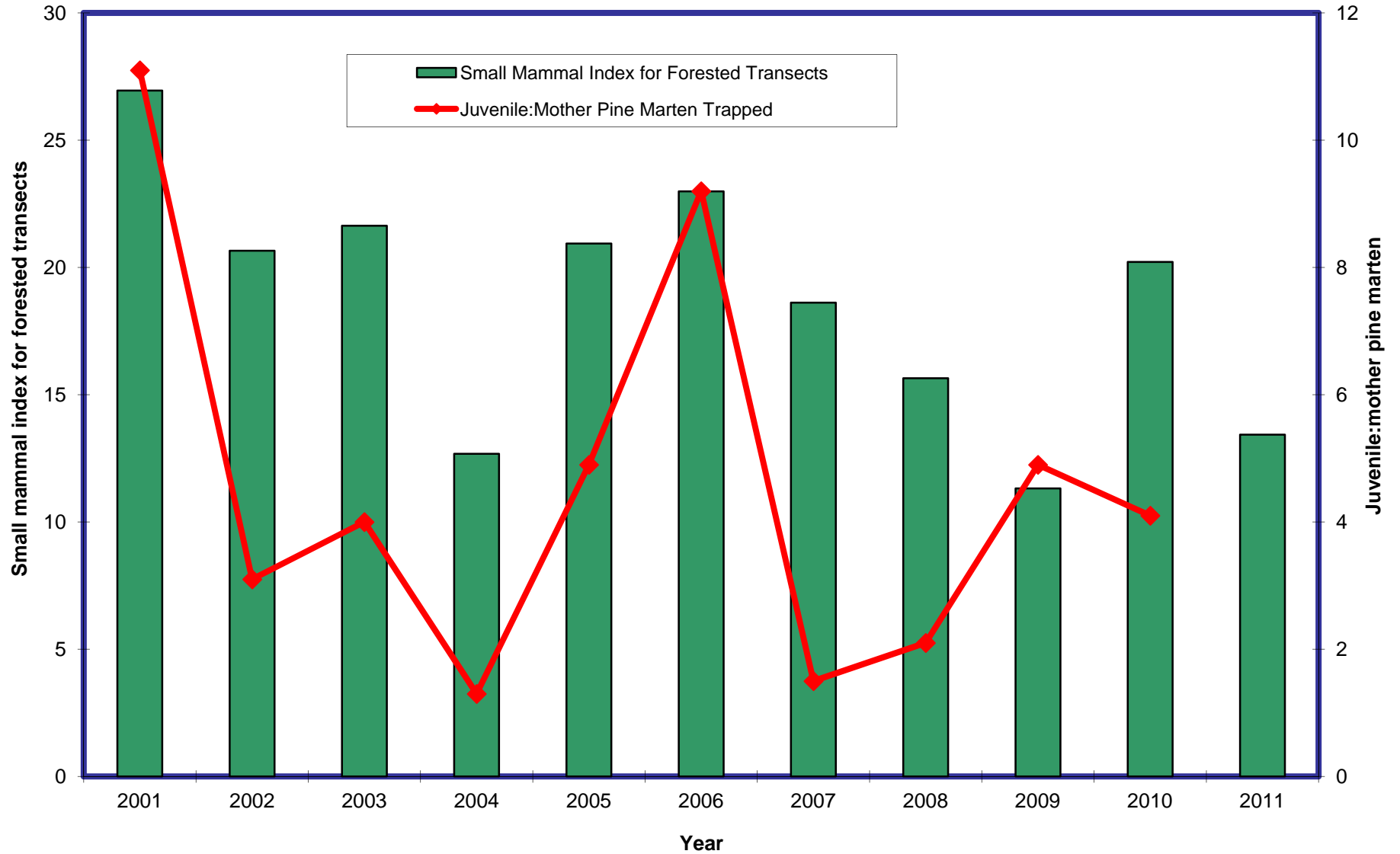


Figure 7. Small Mammal Indices for Forested Transects and Mean Number of Owls/Route for the Laurentian Forest Province, 2005-2011

