WESTERN GREAT LAKES REGION

OWL SURVEY

2009 Report

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EXECUTIVE SUMMARY

As top predators of the food chain, owls are considered good indicators of environmental health, making them important to monitor. However, there is a paucity of abundance and population status data available for most species of owls in the western Great Lakes region. Currently, few species of owls are adequately monitored using traditional avian survey methods, such as the Breeding Bird Survey (BBS) and Christmas Bird Counts (CBC). For these reasons, the Western Great Lakes Region Owl Survey was initiated in 2005. The objectives of this survey are to: 1) understand the distribution and abundance of owl species in the region, 2) determine trends in the relative abundance of owls in the region, 3) determine if trends are comparable in surrounding areas and analyze whether these trends could be scaled up or down on the landscape, and 4) determine if there are habitat associations of owl species in the region.

This was the fifth year of a collaborative effort between personnel from the Hawk Ridge Bird Observatory (HRBO), Natural Resources Research Institute (NRRI), MN-Dept. of Nat. Res. (MN-DNR), Wisconsin Bird Conservation Initiative (WBCI), and the WI-Dept. of Nat. Res. (WI-DNR) to monitor owl populations in the western Great Lakes region. Existing survey routes were used to conduct roadside surveys in Minnesota and Wisconsin. In 2009, surveys were conducted between April 1 and April 15; however, the period was extended until April 22 in northern Minnesota due to later phenology and road accessibility. All survey routes were randomly chosen and consisted of 10 survey points spaced ~1.6 km (1 mile) apart. There was a 5 minute passive listening period at each designated survey point along the route. This will provide data for testing detection probabilities using removal sampling, which should improve population estimates and provide a more effective evaluation of management decisions.

The number of routes assigned in 2009 was 218, with 128 in Minnesota and 90 in Wisconsin. Of the assigned routes, 112 and 85 routes were surveyed in Minnesota and Wisconsin, respectively. The number of participants that signed up to conduct an owl survey was 170, with 149 volunteers (88%) returning completed survey sheets.

In total, 282 owls of seven species were recorded on 105 routes, with no owls recorded on 92 routes (Table 2). The top three owl species combined for Minnesota and Wisconsin were Barred Owl, Great Horned Owl, and Northern Saw-whet Owl, respectively. In Minnesota, a total of 132 individual owls comprising seven species were recorded. The mean number of owls/route was 1.18 compared to 1.13 in 2008. In Wisconsin, a total of 150 individual owls comprising five species were recorded. The mean number of owls/route was 1.77 compared to 2.29 in 2008.

Recommendations and future perspectives for the Western Great Lakes Region owl survey include: 1) developing an on-line data entry system, 2) conduct analysis of owl habitat associations, owl distributions, and climatic variables influencing owl calling activity, 3) considering the importance of using and collecting small mammal data, and 4) assess the need to

use playback to increase detections for species of interest (i.e., Boreal Owl, Great Gray Owl, Long-eared Owl, Short-eared Owl).

INTRODUCTION

There is increasing concern about the distribution, population status, and habitat loss for both diurnal and nocturnal raptors (Newton 1979, Gutierrez *et al*. 1984, Wellicome 1997, Takats *et al*. 2001). Birds of prey occupy the top of the food chain and may be susceptible to environmental toxins and contaminants, making them important to monitor as indicators of environmental health (Johnson 1987, James *et al*. 1995, Duncan and Kearns 1997, Francis and Bradstreet 1997). Further understanding of the distribution, relative abundance, and density of wildlife populations would be valuable to make sound management decisions (Mosher and Fuller 1996).

Currently, there is a paucity of abundance and population status information available for most owl species in the western Great Lakes region. Due to their nocturnal behavior and time of breeding, owls often go undetected using traditional avian population monitoring methods (e.g. Breeding Bird Survey routes, Breeding Bird Atlases, Christmas Bird Counts, and migration monitoring). Breeding Bird Surveys and Breeding Bird Atlases are conducted in the morning, when few owls are vocal, and occur after the breeding season for most owl species in North America. Christmas Bird Counts are also done outside of the breeding season and may not detect resident owl species. Migration monitoring is presumably the best alternative method to monitor owl populations, but it may not be suitable to detect all owl species or determine reliable trends. Therefore, a large scale, long-term owl survey in the Western Great Lakes region would be beneficial to monitor owl populations.

In 2009, the HRBO and WBCI, in collaboration with the NRRI, MN-DNR, and WI-DNR, coordinated the fifth year of a volunteer-based roadside owl survey to monitor owl populations in the western Great Lakes region. Standardized methods developed by existing surveys in the United States and Canada were implemented to increase the statistical power to monitor owl population trends in North America (Takats *et al.* 2001, Hodgman and Gallo 2004, Monfils and Pearman 2004, Paulios 2005). The objectives of this survey are to: 1) understand the distribution and abundance of owl species in the region, 2) determine trends in the relative abundance of owls in the region, 3) determine if trends are comparable in surrounding areas and analyze whether these trends could be scaled up or down on the landscape, and 4) determine if there are habitat associations of owl species in the region.

This report summarizes the results of the 2009 Western Great Lakes Region Owl Survey conducted in Minnesota and Wisconsin, and briefly discusses a few recommendations and future perspectives.

METHODS

A standardized protocol, developed in 2005 from currently existing owl survey protocols, was used in 2009 to conduct a volunteer-based roadside survey in Minnesota and Wisconsin. The use

of standardized methods to monitor owl populations will provide comparable data throughout North America (Morrell et al. 1991, Takats et al. 2001).

CURRENT PROTOCOL

In both Minnesota and Wisconsin, each survey route consisted of 10 survey stations spaced ~1.6 km (1 mile) apart. A 5 minute "passive" listening period was done at each station, which will be used to test detection probabilities. Playbacks were not used given the logistical and standardization concerns with broadcast equipment.

At the start and finish of an owl survey route, the temperature, cloud cover, precipitation level and type, and snow cover and depth was recorded. At each survey station, the time, wind speed, and noise level was recorded. Volunteers were asked to record each owl detected on the data sheet, including direction (Azimuth bearing) and estimated distance [Categories = 1) $\leq$ 100 m, 2) > 100 m to 500 m, 3) >500 m to 1000 m, 4) >1000 to 1500 m, and 5) >1500 m]. Additionally, volunteers were asked to record the time interval when each owl detected was heard (e.g. in first minute, second minute, third minute, etc.). Volunteers were asked to conduct surveys on days with minimal wind ($\leq$ 25 km/hr) and little or no precipitation.

SURVEY TIMING

Minnesota and Wisconsin. The owl survey period went from April 1 to April 15; however, the survey period was extended to April 22 in northern Minnesota given temporal differences in the onset of spring compared to other regions of Minnesota and Wisconsin. Additionally, this was done because road conditions along many routes in northern Minnesota remain snow covered and impassible before April 15. Surveys started at least one half-hour after sunset and finished when the volunteer completed the route(s), typically taking 1.5 to 2 hours to complete.

ROUTE SELECTION

Minnesota. Owl surveys were conducted along currently existing randomized routes. The MN-DNR Frog/Toad survey routes were used as the base to conduct owl surveys. There are ~138 Frog/Toad survey routes randomly located in a variety of habitat types throughout Minnesota. The start point for the owl survey route corresponded with the start point of the Frog/Toad route.

Additionally, the 31 routes first identified in the Laurentian Forest Province of Minnesota in 2006 were again used in 2009. These routes were randomly selected implementing the same protocol used to identify the initial Frog/Toad survey routes. There are currently 82 survey routes in the Laurentian Forest Province of Minnesota and 87 routes throughout the remainder of southern and western Minnesota.

Wisconsin. Owl surveys were conducted along currently existing randomized routes. Breeding Bird Survey (BBS) routes were used as the base to conduct owl surveys. There are 92 active BBS routes located in a variety of habitat types throughout the state. The start point for the owl survey route corresponded with the start points of the BBS route.

DATA COLLECTION/ANALYSIS AND DATABASE STRUCTURE

Data collection/analysis. Volunteers were asked to record all owls detected, seen or heard, at each designated station along the route, keeping track of the direction and estimated distance for each owl. Additionally, participants were asked to document the time interval for each owl detected during the 5 minute listening period (e.g. first minute, second minute, third minute, etc.). The number of owls for each route was determined by eliminating any birds a participant detected from a previous station. Volunteers were requested to record other nocturnal species, such as American Woodcock, Common Snipe, and Ruffed Grouse, detected on survey routes.

Database structure. Data collected by volunteers were computerized into a Microsoft Excel database. The data were separated into three database files which included: 1) general survey data (including overall weather data), 2) station survey data (including station weather and additional species data), and 3) owl data.

RESULTS

VOLUNTEER PARTICIPATION

In 2009, 170 volunteers signed up to conduct owl surveys in Minnesota and Wisconsin, with 149 participants (88%) surveying at least one route. In total, 218 survey routes were assigned to volunteers, with 128 in Minnesota and 90 in Wisconsin. In Minnesota, 80 volunteer teams returned data sheets for 112 routes. Fifty-six volunteer teams surveyed 1 route, eighteen volunteer teams surveyed 2 routes, four volunteer teams surveyed 3 routes, and two volunteer teams surveyed 4 routes. In Wisconsin, 69 volunteer teams returned data sheets for 85 routes in Wisconsin. Fifty-nine volunteer teams surveyed 1 route, seven volunteer teams surveyed 2 routes, one volunteer team surveyed 3 routes, and two volunteer team surveyed 4 routes.

SURVEY TIMING AND WEATHER

Minnesota. The mean survey date for all routes was 10 April (Table 1). The mean start and end temperatures for all routes was 39.6 °F and 36.3 °F, respectively. The mean wind speed code, based on the Beaufort scale, for all routes was 1 (1 – 3 mph). The mean sky code for all routes was 1 (26 – 50% cloud cover).

Wisconsin. The mean survey date for all routes was 9 April (Table 1). The mean start and end temperatures for all routes was 40.5 °F and 36.0 °F, respectively. The mean wind speed code,

based on the Beaufort scale, for all routes was 1 (1 – 3 mph). The mean sky code for all routes was 1 (26 – 50% cloud cover).

Table 1. ***The mean survey dates from 2005 – 2009 for Minnesota and Wisconsin. The number of survey periods was reduced from three to one period in 2008.***

	Minnesota			Wisconsin		
Year	**1**	**2**	**3**	**1**	**2**	**3**
2005	17 March	4 April	19 April	—	4 April	20 April
2006	16 March	1 April	18 April	17 March	31 March	18 April
2007	14 March	1 April	17 April	14 March	30 March	18 April
2008		10 April			11 April	
2009		10 April			9 April	

OWL ABUNDANCE AND DISTRIBUTION

In total, 282 owls of seven species were recorded on 105 routes, with no owls being detected on 92 routes (Table 2). The top five owl species combined between Minnesota and Wisconsin were Barred Owl, Great Horned Owl, Northern Saw-whet Owl, Eastern Screech Owl, and Long-eared Owl, respectively (Figure 7). The overall mean number of individual owls detected per route was 1.43, compared to 1.68 in 2008. The overall mean number of Barred Owls detected per route decreased by 22% compared to 2008 (0.68 to 0.53 owls/route). The overall mean number of Great Horned Owls detected per route decreased by 20% compared to 2008 (0.55 to 0.44 owls/route). The overall mean number of Northern Saw-whet Owls detected per route remained the same compared to 2008 (0.22 owls/route). The overall mean number of Eastern Screech Owls detected per route increased by 14% compared to 2008 (0.06 to 0.07 owls/route). Finally, the overall mean number of Long-eared Owls increased by 17% compared to 2008 (0.05 to 0.06 owls/route).

Table 2. ***Total number of individual owls and the number of routes each species was detected in Minnesota and in Wisconsin, 2009.***

Owl Species	Minnesota		Wisconsin	
	Individuals	Routes	Individuals	Routes
Barred Owl	37	18	67	34
Great Horned Owl	32	18	55	30
Northern Saw-whet Owl	30	16	14	10
Eastern Screech Owl	3	3	10	4
Long-eared Owl	9	5	3	3
Short-eared Owl	4	2	0	0
Great Gray Owl	2	2	0	0
Unknown Owl	15	11	1	1
Total	132	49[1]	150	56[2]

[1] = total number of routes with at least one owl detected in Minnesota.
[2] = total number of routes with at least one owl detected in Wisconsin.

Minnesota. A total of 132 individual owls comprising seven species were recorded during all surveys (Table 3). The top three species detected in Minnesota were Barred Owl, Great Horned Owl, and N. Saw-whet Owl, respectively. The mean for Barred Owls was 0.33 owls/route, which was a 21% decrease compared to the 2008 total (Figure 8). The mean for Great Horned Owls was 0.29 owls/route and represents a 41% increase compared to 2008 (Figure 8). The mean for N. Saw-whet Owls was 0.27 owls/route, which was similar to the 2008 total (Figure 8). The number of individual owls detected during a survey ranged between 1 and 9, comprising between 1 and 3 species. The mean number of owls/route went up 4% compared to 2008 (1.13 to 1.18 owls/route). However, the 2009 mean of 1.18 owls/route remains 46% below the high in 2006 (2.17 owls/route), but was only 8% below the five-year average of 1.28 owls/route (Figure 11).

Barred Owls were detected in 13 counties within Minnesota including: Houston, Winona, Red Lake, Clearwater, Aitkin, Todd, Cass, Itasca, Beltrami, Roseau, St. Louis, Lake, and Cook (Figure 1). Great Horned Owls were detected in 15 counties within Minnesota including: Houston, Anoka, Big Stone, Red Lake, Blue Earth, Sibley, Scott, McLeod, Isanti, Polk,

Clearwater, Pine, Aitkin, Itasca, and St. Louis (Figure 2). Northern Saw-whet Owls were detected in 8 counties within Minnesota including: Houston, Wright, Carlton, Cass, Beltrami, Roseau, St. Louis, and Cook (Figure 3).

Eastern Screech Owls were detected in three counties of Minnesota including: Houston, Watonwan, and Todd (Figure 4). Great Gray Owls were detected in two counties of Minnesota including: Clearwater and St. Louis (Figure 4). Long-eared Owls were detected in five counties of the Minnesota including: Houston, Aitkin, Lake of the Woods, Roseau, and St. Louis (Figure 5). Short-eared Owls were detected in two counties of Minnesota including: Aitkin and Beltrami (Figure 5).

Wisconsin. A total of 150 individual owls comprising 5 species were recorded during all surveys (Table 2). The top three species detected in Wisconsin were Barred Owl, Great Horned Owl, and N. Saw-whet Owl, respectively. The mean for Barred Owls was 0.79 owls/route (Table 3), which was a 18% decrease compared to 2008 (Figure 6). The overall mean for Great Horned Owls was 0.65 owls/route (Table 3), which represents a 32% decrease compared to 2008 (Figure 7). The overall mean for N. Saw-whet Owls was 0.17 owls/route (Table 3), which represents a 21% increase compared to 2008 (Figure 8). The number of individual owls detected ranged from 1 to 9, comprising between 1 and 3 species. The mean number of owls/route decreased 23% compared to 2008 (2.29 to 1.77 owls/route), but was 3% higher than the five-year average of 1.72 owls/route (Figure 11).

Barred Owls were detected in 29 counties throughout Wisconsin including: Adams, Ashland, Barron, Bayfield, Chippewa, Columbia, Crawford, Door, Dunn, Fond du Lac, Forest, Grant, Jackson, Juneau, La Crosse, Lafayette, Langlade, Marathon, Marinette, Marquette, Oneida, Polk, Rock, Sawyer, Sheboygan, Taylor, Vilas, Waupaca, and Waushara (Figure 1). Great Horned Owls were detected in 25 counties throughout Wisconsin including: Bayfield, Buffalo, Clark, Columbia, Crawford, Dodge, Door, Dunn, Fond du Lac, Forest, Grant, Jackson, Kewaunee, Manitowoc, Marquette, Oneida, Polk, Portage, Sauk, Sawyer, Sheboygan, St. Croix, Taylor, Vernon, and Waupaca (Figure 2). Northern Saw-whet Owls were detected in 10 counties in Wisconsin including: Bayfield, Crawford, Jackson, Lincoln, Marinette, Oneida, Shawano, Vilas, Waushara, and Wood (Figure 3).

Eastern Screech Owls were detected in three counties throughout Wisconsin including: Crawford, Fond du Lac, and Sauk (Figure 4). Long-eared Owls were detected in three counties in Wisconsin including: Burnett, Jefferson, and Oneida (Figure 5). Short-eared Owl was the only species not detected in 2009 that had been detected previously (2008 only).

Table 3. ***The number of observed and mean number of owls/route for Minnesota and Wisconsin, 2009.***

Region	Date	# Routes[a]	Barred Owl		Great Horned Owl		N. Saw-whet Owl		E. Screech Owl		Long-eared Owl	
			# Obs.[b]	Mean[c]	# Obs.	Mean	# Obs.	Mean	# Obs.	Mean	# Obs.	Mean
Minnesota	April 1 – 22	112	37	0.33	32	0.29	30	0.27	3	0.03	9	0.08
Wisconsin	April 1 – 15	85	67	0.79	55	0.65	14	0.17	10	0.12	3	0.04
Overall	April 1 – 22	197	104	0.53	87	0.44	44	0.22	13	0.07	12	0.06

[a] Number of routes surveyed between survey date.
[b] Number of owls detected.
[c] Average number of owls detected per route surveyed.

Table 3 (continued). ***The number of observed and mean number of owls/route for Minnesota and Wisconsin, 2009.***

Region	Date	# Routes	Short-eared Owl		Great Gray Owl		Total	
			# Obs.	Mean	# Obs.	Mean	# Obs.[d]	Mean
Minnesota	April 1 – 22	112	4	0.04	2	0.02	132	1.18
Wisconsin	April 1 – 15	85	—	—	—	—	150	1.77
Overall	April 1 – 22	197	4	0.02	2	0.01	282	1.43

[d]Total # observed includes 15 and unknown owl species in MN and WI, respectively.

ADDITIONAL SPECIES

Volunteers recorded a total of 23 additional species while conducting an owl survey. Eighteen species were detected in Minnesota, with the top five being Canada Goose, American Woodcock, Wilson's Snipe, Ruffed Grouse, and Killdeer (Table 4). Sixteen species were detected in Wisconsin, with the top five being American Woodcock, Canada Goose, Ruffed Grouse, Wilson's Snipe, and Killdeer (Table 4).

Table 4. ***Top five additional species detected during owl surveys in Minnesota and Wisconsin, 2008.***

Minnesota		Wisconsin	
Species	**Total**	**Species**	**Total**
Canada Goose	161+	American Woodcock	66
American Woodcock	105	Canada Goose	46+
Wilson's Snipe	71	Ruffed Grouse	32
Ruffed Grouse	66	Wilson's Snipe	23
Killdeer	56	Killdeer	22

$^{+}$ = not quantified (estimated total).

FIVE-YEAR ROUTE SUMMARIES

Minnesota. In Minnesota, 138 routes were surveyed at least once during the first five years of the owl survey (Table 5). Nineteen (14%) were surveyed every year and 78 (57%) were surveyed in three or more years. The average number of owls detected per route was 5.9 but 34 routes featured no owl detections and 31 routes had 10 or more owl detections (Table 5). A Roseau County route totaled 69 owls over the first five years of the survey, which more than doubled the second highest route total of 26 owls. There were five routes (Aitkin, Beltrami, Koochiching, and St. Louis County) with five or more owl species over the first five years of the survey.

Wisconsin. Of the 92 routes in Wisconsin, 25 (27%) were surveyed all five years of the owl survey's history, while 76 routes (83%) were surveyed three or more years (Table 6). Only two routes were surveyed one year or less. On average, the total number of owls detected per route was 9.3, although results varied greatly among routes (Table 6). Seven routes had no owl detections and observers on 29 routes detected 10 or more owls. The highest total for a single route was 74 owl detections in Waupaca County, which doubled the second-highest route total (37; Table 6). Only two routes (Portage and Dunn County) detected five or more owl species over the first five years of the survey.

DISCUSSION

VOLUNTEER PARTICIPATION

The number of volunteers that signed up to conduct a survey increased each year from 105 in 2005 to 170 in 2009. This is in part due to an increase in the number of routes available in northern Minnesota in 2006, as well as expanding the survey area throughout Minnesota in 2007. In 2009, 93% of assigned routes were completed compared to 75% in 2008, 76% in 2007, and 85% in 2006. In 2009, the regional breakdown between Minnesota and Wisconsin was 88% and 94% of assigned routes completed, respectively. This represents an impressive 27 % increase in Minnesota and a 3% increase in Wisconsin of assigned routes completed compared to 2008. The large percentage of assigned routes being completed in both states is likely due to persistent efforts from coordinators to express the importance of returning data sheets. However, if not for the 170 volunteers willing to conduct nighttime roadside surveys, it would be nearly impossible to collect data on over 200 owl survey routes in the region! Because the volunteer base in the region continues to remain interested in owls, it is likely the Western Great Lakes Region Owl Survey will continue for many years to come.

OWL SURVEYS

The overall mean number of owls detected has oscillated between 2005 and 2009, with a high of 1.84 owls/route in 2006 to a low of 1.43 owls/route in 2009. The potential bias in this comparison was that all owls recorded between 1 April and 22 April for 2005 – 2007 were included. Some routes were sampled twice during this time frame, and therefore, each time the route was surveyed it was considered an independent survey. It could be possible that the same owl was detected during each survey, which would inflate numbers.

Regardless of this potential bias, the overall trend observed in both states may reflect changes in owl populations, and/or it may reflect changes in owl detections based on a number of variables (e.g. environmental influences on calling activity, annual temporal differences in calling activity). Ultimately, the goal of the survey is to detect long-term changes in population trends. Fortunately, there is a solid volunteer base interested in collecting survey data, and after another five years of data we should be able to start assessing population trends.

Despite the importance of evaluating overall population trends, regional long-term trends will also be useful for state-level management considerations. For example, the trend observed for Great Horned Owls between Minnesota and Wisconsin in 2009 was not consistent. There was a precipitous decline in the Great Horned Owls detected in Wisconsin, while there was an increase in Minnesota. The regional annual fluctuations observed over time reveal the importance of collecting data over a wide geographical area by providing greater insight into the spatial effects influencing trends (e.g. do local or regional environmental conditions influence detections, are there local or regional management effects on populations).

The data collected to date will be used to conduct a revised power analysis to determine the number of routes needed to detect reliable population trends. The initial power analysis done in northern Minnesota was based on the limited data available from previous owl surveys in Minnesota. Because the results of those surveys do not necessarily reflect results obtained here, it would be valuable to redo the power analysis to obtain a more reliable estimate. Also, an analysis of the habitat associations for owls will be done to address management questions, as well as reviewing our current strategy of using a completely randomized route selection design. It may be possible to incorporate a stratified random design to select routes, which may increase the survey's power to detect trends. The stratification would be done by selecting "blocks" of habitat owls may be associated with and then identifying random routes within that block.

Data gather to date shows the statistical power using current survey methods remains low for uncommon or hard-to-detect species such as Eastern Screech Owl, Long-eared Owl, Short-eared Owl, Great Gray Owl, and Boreal Owl. We plan to assess this in at least two ways:

1. We are planning to pilot the use of playback/broadcast for these species. The current survey protocol would remain unchanged, but the addition of playback after completing a survey or along designated survey routes should increase detections of these species and provide more accurate information about their distribution and abundance.

2. Populations of these species may be monitored on a regional level (Western Great Lakes) if other states joined MN and WI in conducting standardized owl surveys. Fortunately, this effort is gaining momentum as Illinois recently completed a second year of nocturnal bird surveys in 2009 and Michigan plans to begin nightbird surveys within the next few years. With standardized methods in place, these data can be synthesized for efficient large-scale analyses, including these less common, hard-to-detect species. All of this work is united through a recently-formed Midwest Nightbird Working Group, spearheaded by USFWS biologist Katie Koch, who is leading a dedicated Coordinated Bird Monitoring effort in the Midwest.

Also, the development of a nightjar (Common Nighthawk, Whip-poor-wills) survey in Wisconsin, where surveys are conducted from late May to early July, allows surveyors to also record owls. This data could be used to supplement results and interpretation of the spring owl survey, which will provide increased confidence in our conclusions.

Finally, with two years of data using five 1-minute listening intervals, we are interested in estimating detection probabilities for owls. Because it cannot be assumed that detections are temporally or spatially constant, it would be valuable to incorporate detection probabilities into developing population indices (Pollock et al. 2002). This information will not only be used to obtain more accurate abundance estimates (i.e., increasing power), but also to modify current survey design if necessary.

FIVE-YEAR ROUTE SUMMARIES

The five-year route summaries provided in Tables 5 and 6 are the first to be included in this annual report. These tables are meant to:

1. Summarize owl survey effort and detections to date,
2. Provide feedback and perspective to volunteers on relative abundance and diversity of owls on their routes and others in the states,
3. Allow for modification of the survey design as necessary (e.g. routes that were surveyed frequently but detected few or no owls may be moved or not surveyed annually), and
4. Serve as an important first step to landscape-level analyses of owl habitat associations, which may ultimately inform land management decisions and allow for stratification of new survey routes (thus improving our ability to detect trends in populations).

The survey effort across both Minnesota and Wisconsin was remarkable, with volunteers across both states surveying 150 routes in at least three years of the survey. Variability in owl detections among all routes was high, though this is somewhat expected given the randomization inherent to the route selection procedure and relatively sparse distributions of most owl species. Nonetheless, volunteers detected owls in one or more years on most routes with appreciable survey effort. In Minnesota, 33 routes had no owl detections but only seven routes were surveyed in three or more years. Likewise, in Wisconsin, only three of the seven routes with no owl detections were surveyed at least three years. The future of the ten regularly-surveyed routes without owl detections and those routes with only one owl detection will be assessed prior to the 2010 owl survey.

RECOMMENDATIONS AND FUTURE GOALS

1) We would like to increase the number of participants conducting surveys in southern and western Minnesota. To achieve this we will contact and recruit volunteers well in advance of the looming survey period.

2) We would like to add routes in Wisconsin to provide more opportunities for volunteers and increase the statistical power to monitor population trends.

3) We continue to work with staff from Bird Studies Canada about the possibility of integrating an on-line data entry system for volunteers. This will reduce the number of mailings, and it will make data access easier for volunteers.

4) We would like to begin an analysis to better understand habitat associations of owls, as well as climatic influences on calling activity in the Western Great Lakes region.

5) As future data continues to be collected, a trend analysis will be done to determine changes in owl populations.

6) We would like to do an analysis of the 1 minute owl calling time intervals for determining detection probabilities. This data will provide more accurate owl abundance estimates for the trend analysis.

7) Pilot the use of playback for species of interest.

8) Lastly, it would be extremely valuable to collect data on small mammal populations. Currently, limited small mammal data is available, but it may prove valuable to include such information when interpreting trend abundance and distribution data. In the future, it may be possible to work collaboratively with other resource organizations collecting such data.

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Most importantly, we would like to thank the volunteers that made this project possible! Participants deserve special thanks for generously donating their time and money driving many miles to conduct owl surveys. The amount of energy and enthusiasm volunteers expressed is greatly appreciated, and it will surely help with the continuation of this survey! Thanks again for your dedication in providing valuable information about owls in the western Great Lakes region.

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Table 5: Summary of survey effort and owls detected for 138 owl survey routes in Minnesota, 2005 – 2009.

Route #	County	# yrs. surveyed	# yrs. owls detected	Total # owls	# owls detected by species					
					GHOW	BDOW	NSWO	LEOW	EASO	Other
50104	Polk	3	0	0						
50106	Lake of the Woods	4	4	12	0	0	5	5	0	2
50113	Polk	1	0	0						
50115	Beltrami	2	2	10	5	2	3	0	0	0
50116	Aitkin	3	2	5	0	0	3	1	0	1
50117	St. Louis	3	2	1	0	0	1	0	0	0
50118	Lake	5	5	14	1	4	9	0	0	0
50122	Cass	3	2	7	2	2	3	0	0	0
50123	Aitkin	5	5	14	3	11	0	0	0	0
50124	Pine	5	3	10	4	3	3	0	0	0
50126	Stevens	1	1	1	1	0	0	0	0	0
50128	Stearns	2	1	1	1	0	0	0	0	0
50129	Sherburne	4	3	7	5	0	2	0	0	0
50131	Lincoln	2	1	2	1	0	0	0	1	0
50132	Chippewa	2	1	1	1	0	0	0	0	0
50133	McLeod	2	1	1	1	0	0	0	0	0
50134	Rice	2	2	4	4	0	0	0	0	0
50140	Blue Earth	2	2	2	1	1	0	0	0	0
50141	Freeborn	2	0	0						
50204	Roseau	1	1	1	0	0	1	0	0	0
50208	St. Louis	5	4	20	4	2	9	1	0	4
50210	Cook	3	2	4	0	3	1	0	0	0
50214	Clearwater	1	1	9	1	5	0	0	0	3
50215	Cass	4	2	5	1	3	0	0	0	1
50216	Itasca	3	3	6	3	0	2	0	0	1
50217	St. Louis	5	3	8	3	0	0	0	0	5
50218	St. Louis	4	1	1	0	1	0	0	0	0
50219	Cook	3	0	0						
50222	Todd	2	2	7	1	3	2	0	1	0
50223	Crow Wing	4	4	12	3	7	0	0	0	2
50224	St. Louis	3	2	4	0	0	1	0	0	3
50226	Big Stone	1	1	8	8	0	0	0	0	0
50227	Chippewa	1	1	1	0	0	0	0	0	1
50228	Meeker	3	0	0						
50229	Isanti	2	1	6	0	6	0	0	0	0
50231	Redwood	1	0	0						
50232	Brown	1	0	0						
50233	Renville	1	0	0						
50234	Rice	1	0	0						
50235	Goodhue	2	0	0						
50239	Jackson	2	0	0						
50241	Steele	2	0	0						
50242	Houston	3	3	6	3	3	0	0	0	0
50305	Roseau	1	0	0						
50306	Lake of the Woods	3	2	12	0	1	4	6	0	1
50307	Koochiching	4	3	15	1	6	3	3	0	2

Route #	County	# yrs. surveyed	# yrs. owls detected	Total # owls	# owls detected by species					
					GHOW	BDOW	NSWO	LEOW	EASO	Other
50314	Red Lake	3	2	4	2	1	1	0	0	0
50315	Cass	5	3	6	0	4	2	0	0	0
50316	Itasca	3	2	4	1	1	2	0	0	0
50317	St. Louis	5	2	8	2	0	6	0	0	0
50322	Cass	1	0	0						
50323	Aitkin	5	4	10	1	5	1	0	0	3
50324	St. Louis	5	5	6	0	1	4	0	0	1
50326	Stearns	1	1	1	1	0	0	0	0	0
50327	Stearns	1	0	0						
50328	Stearns	2	0	0						
50330	Pine	2	0	0						
50333	Renville	1	0	0						
50334	Blue Earth	2	1	1	1	0	0	0	0	0
50335	Wabasha	3	2	3	0	2	0	0	1	0
50337	Rock	3	1	2	2	0	0	0	0	0
50339	Watonwan	2	1	1	0	0	0	0	1	0
50340	Steele	2	0	0						
50341	Olmstead	3	0	0						
50342	Winona	3	3	8	0	7	0	0	1	0
50404	Marshall	1	0	0						
50405	Roseau	5	5	69	6	10	43	10	0	0
50407	Koochiching	2	2	4	0	0	3	0	0	1
50408	St. Louis	5	4	12	0	1	9	0	0	2
50411	Cook	5	3	19	0	9	8	0	0	2
50414	Polk	1	1	1	1	0	0	0	0	0
50415	Itasca	5	5	22	1	4	14	1	0	2
50416	Itasca	1	1	3	0	0	1	2	0	0
50417	St. Louis	4	3	11	2	4	5	0	0	0
50418	Lake	4	3	5	0	0	4	1	0	0
50419	Cook	3	3	11	0	6	5	0	0	0
50422	Morrison	2	1	2	0	0	0	0	0	2
50423	Aitkin	5	2	8	0	0	1	0	0	7
50424	Carlton	3	2	2	0	0	1	0	0	1
50426	Big Stone	1	1	1	1	0	0	0	0	0
50427	Todd	3	3	13	9	3	0	0	1	0
50428	Stearns	2	1	1	0	0	0	0	0	1
50429	Hennepin	3	1	1	1	0	0	0	0	0
50430	Washington	3	0	0						
50433	Sibley	2	2	5	3	0	0	0	0	2
50434	Rice	3	0	0						
50435	Goodhue	2	0	0						
50439	Martin	2	0	0						
50441	Fillmore	3	1	1	0	0	0	0	1	0
50442	Houston	2	2	6	1	0	1	1	3	0
50505	Beltrami	5	3	5	1	0	2	0	0	2
50506	Koochiching	1	1	14	1	12	1	0	0	0
50508	St. Louis	4	2	6	0	0	5	0	0	1
50513	Pennington	3	1	7	7	0	0	0	0	0
50514	Polk	4	2	5	5	0	0	0	0	0
50515	Beltrami	4	0	0						
50516	St. Louis	5	4	23	2	13	5	0	0	3

Route #	County	# yrs. surveyed	# yrs. owls detected	Total # owls	# owls detected by species					
					GHOW	BDOW	NSWO	LEOW	EASO	Other
50517	St. Louis	5	5	12	2	3	7	0	0	0
50518	Lake	4	4	26	0	7	16	0	0	3
50521	Becker	1	0	0						
50522	Cass	3	2	4	0	1	3	0	0	0
50523	Aitkin	5	5	16	3	5	1	6	1	0
50524	Pine	5	4	6	0	2	2	0	0	2
50527	Kandiyohi	1	0	0						
50528	Wright	3	2	3	1	0	1	0	0	1
50529	Anoka	2	2	7	5	1	0	0	1	0
50531	Yellow Medicine	3	1	1	0	0	0	0	0	1
50532	Redwood	2	0	0						
50533	Redwood	1	0	0						
50534	Scott	3	3	5	3	2	0	0	0	0
50615	Hubbard	2	1	7	2	2	2	1	0	0
50616	Beltrami	3	1	2	0	2	0	0	0	0
50617	St. Louis	2	0	0						
50618	St. Louis	4	3	11	2	0	8	0	0	1
50622	Crow Wing	2	2	10	7	3	0	0	0	0
50623	Aitkin	3	3	10	0	10	0	0	0	0
50624	Pine	4	2	15	4	8	2	1	0	0
50715	Beltrami	4	2	20	2	3	1	1	0	13
50716	Cass	3	3	10	0	7	3	0	0	0
50717	St. Louis	4	4	13	2	1	7	2	0	1
50718	Lake	4	2	7	3	0	4	0	0	0
50722	Cass	1	1	3	2	0	0	0	0	1
50723	Morrison	1	0	0						
50724	St. Louis	4	2	7	4	1	2	0	0	0
50732	Murray	1	0	0						
50815	Hubbard	4	2	8	2	4	2	0	0	0
50816	Itasca	4	3	5	0	2	2	0	0	1
50817	St. Louis	4	4	21	0	2	15	2	1	1
50818	Lake	4	3	9	0	1	7	0	0	1
50822	Cass	4	3	7	2	5	0	0	0	0
50823	Aitkin	4	2	4	0	4	0	0	0	0
50824	Pine	2	2	2	2	0	0	0	0	0
50838	Nobles	1	0	0						
50915	Cass	3	1	1	1	0	0	0	0	0
50916	Itasca	2	2	7	0	1	5	0	0	1
50917	St. Louis	2	2	7	0	4	3	0	0	0
50923	Aitkin	4	4	17	1	13	0	0	0	3
50929	Isanti	3	1	3	3	0	0	0	0	0

Table 6: Summary of survey effort and owls detected for 92 owl survey routes in Wisconsin, 2005 – 2009.

Route #	County	# yrs. surveyed	# yrs. owls detected	Total # owls	# owls detected by species					
					GHOW	BDOW	NSWO	LEOW	EASO	Other
91001	Douglas	4	3	13		10	3			
91002	Bayfield	4	2	7	5		2			
91003	Washburn	1	0	0						
91004	Bayfield	4	3	6	2	2	2			
91005	Bayfield	4	3	12	1	3	8			
91006	Ashland	5	1	3		1	2			
91007	Iron	3	2	2		1	1			
91008	Vilas	5	5	19	1	13	5			
91009	St. Croix	3	2	9	9					
91010	Polk	4	2	2	2					
91011	Burnett	4	3	18	8	10				
91012	Polk	3	3	32	14	16		2		
91013	Barron	4	3	8	1	7				
91014	Chippewa	5	4	8	4	3		1		
91015	Sawyer	3	3	4	1		1	1		1
91016	Sawyer	3	0	0						
91017	Taylor	5	3	4	1	2	1			
91019	Price	2	0	0						
91020	Taylor	4	3	9	4	1	2	1		1
91021	Lincoln	3	3	3			3			
91022	Lincoln	5	3	7	5		2			
91023	Oneida	4	2	8	1	5	2			
91024	Oneida	5	3	14		6	8			
91025	Forest	4	3	15		11	4			
91026	Forest	3	3	12	1	10	1			
91027	Langlade	3	3	21		20				1
91028	Marinette	5	3	14	2	7	5			
91029	Marinette	5	5	12	1	9	2			
91030	Door	4	4	13	6	3	2			2
91031	Pierce	2	2	6	1	2	2			1
91032	Buffalo	3	3	8	6	1				1
91033	Buffalo	3	2	4	1	2		1		
91034	Trempealeau	4	1	2	2					
91035	Chippewa	5	5	13	1	9	1		2	
91036	Clark	2	0	0						
91037	Jackson	2	2	4	2			2		
91038	Jackson	3	3	9	1	6	2			
91039	Marathon	4	2	4	4					
91040	Wood	5	3	6	1	3	1	1		
91041	Portage	5	5	6	1	2	1	1		1
91042	Marathon	5	2	4		3	1			
91043	Waushara	4	3	9	3	4	1		1	
91044	Waupaca	5	5	37	23	12	1	1		
91045	Oconto	2	1	1		1				

Route #	County	# yrs. surveyed	# yrs. owls detected	Total # owls	# owls detected by species					
					GHOW	BDOW	NSWO	LEOW	EASO	Other
91046	Winnebago	4	1	1		1				
91047	Waupaca	5	5	74	43	28	1	2		
91048	Manitowoc	4	3	5	5					
91049	Kewaunee	4	3	6	6					
91050	La Crosse	3	2	3	1	2				
91051	Vernon	2	2	2	2					
91052	Crawford	3	2	6	2	2	1		1	
91053	Juneau	5	4	24	10	14				
91054	Monroe	2	1	2	2					
91055	Sauk	5	5	29	11	15			3	
91056	Columbia	3	1	3	1	2				
91057	Marquette	2	2	11	3	6	2			
91058	Columbia	4	3	4	3				1	
91059	Dodge	3	2	10	10					
91060	Dodge	2	1	2	2					
91061	Dodge	3	3	33	24	6			3	
91062	Fond du Lac	5	3	11	6	3			2	
91063	Ozaukee	3	0	0						
91064	Grant	3	2	6	2	3			1	
91065	Lafayette	5	2	4	3					1
91066	Lafayette	5	5	23	12	8		1	2	
91068	Jefferson	3	3	5	1	3		1		
91069	Kenosha	4	1	1	1					
91070	Racine	0	0	0						
91118	Taylor	3	2	5		4	1			
91167	Dane	5	2	2	1			1		
91301	Douglas	4	1	2		1	1			
91302	Ashland	4	2	8		2	6			
91303	Vilas	5	5	30		15	14	1		
91304	Burnett	5	5	12	3	5	3	1		
91305	Sawyer	2	1	2	2					
91306	Sawyer	4	1	1		1				
91307	Oneida	3	3	6		3	2	1		
91308	Forest	2	1	3		1	2			
91309	St. Croix	4	3	5	4			1		
91310	Dunn	5	5	35	15	13	1	2	3	1
91311	Clark	2	2	4	2	2				
91312	Adams	5	4	6	3	1		1	1	
91313	Shawano	2	1	1			1			
91314	Manitowoc	5	2	4	4					
91315	Crawford	4	4	14	4	1	2		7	
91316	Grant	3	1	2		1		1		
91317	Columbia	4	3	16	8	8				
91318	Sheboygan	4	4	23	11	7			5	
91319	Iowa	2	1	6	4		1		1	
91320	Rock	4	4	10	7	2		1		
91321	Waukesha	4	0	0						
91322	Brown	3	2	7	7					

Figure 1: Barred Owl locations in 2009.

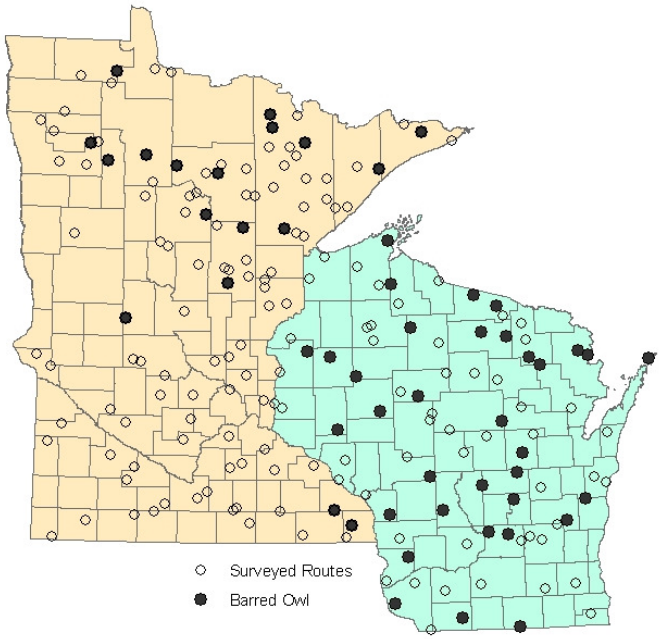

Figure 2: Great Horned Owl locations in 2009.

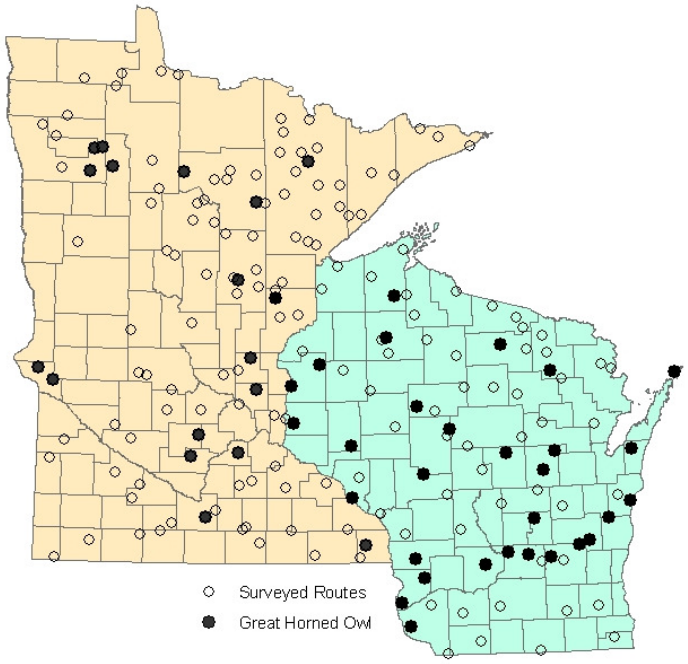

Figure 3: N. Saw-whet Owl locations in 2009.

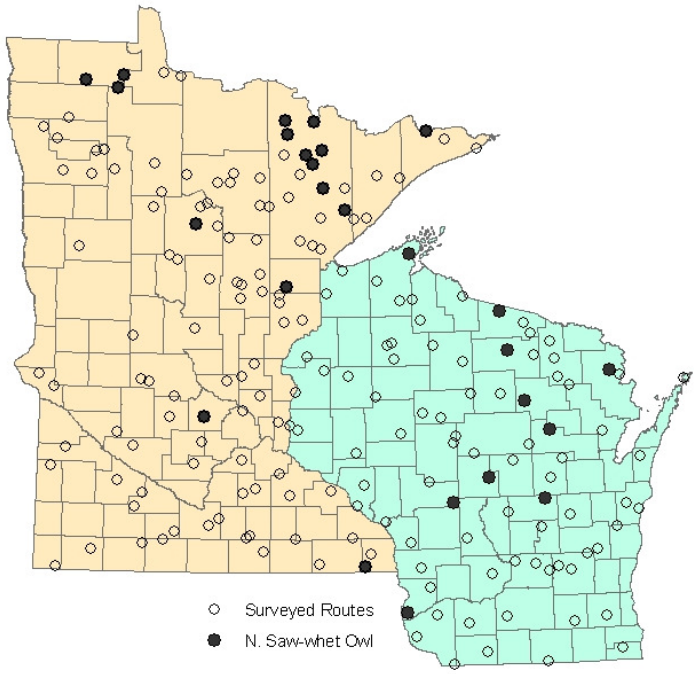

Figure 4: Eastern Screech Owl and Great Gray Owl locations in 2009.

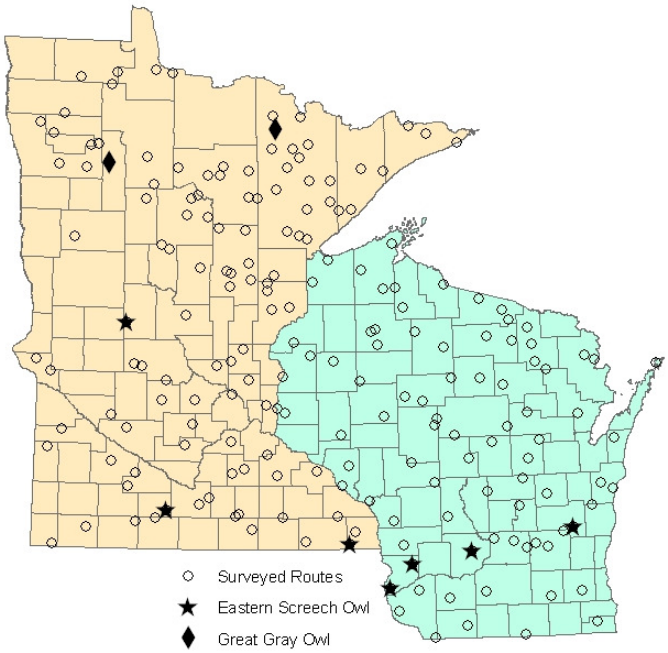

Figure 5: Long-eared Owl and Short-eared Owl locations in 2009.

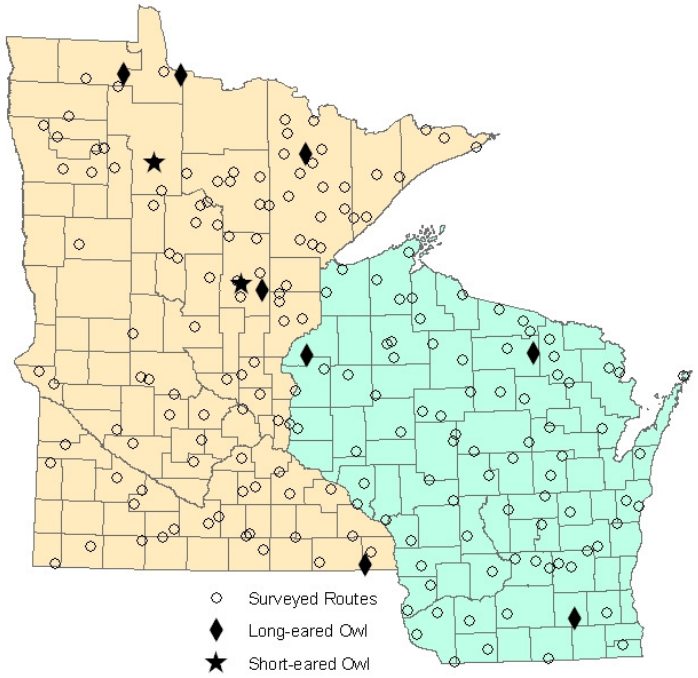

Figure 6: Mean # Barred Owls/route for Minnesota and Wisconsin, 2005 - 2009.

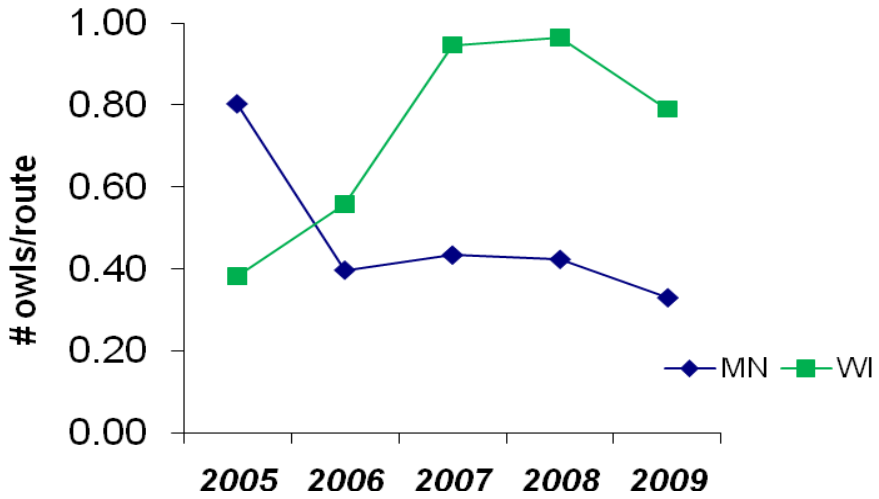

Figure 7: Mean # Great Horned Owls/route for Minnesota and Wisconsin, 2005 - 2009.

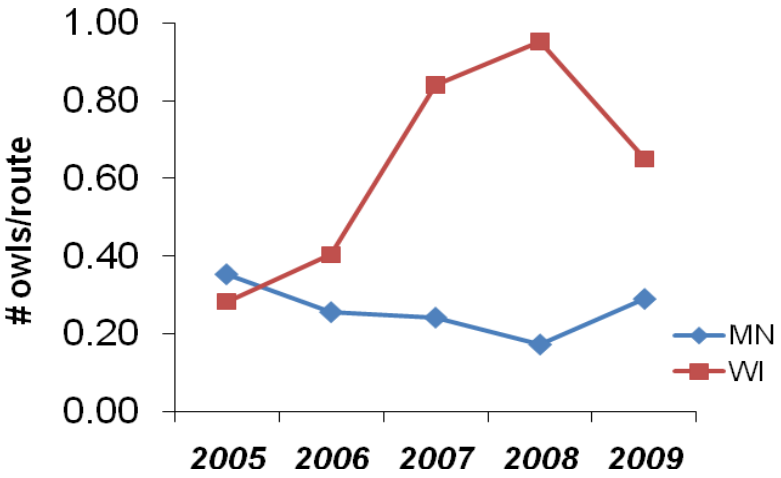

Figure 8: Mean # N. Saw-whet Owls/route for Minnesota and Wisconsin, 2005 - 2009.

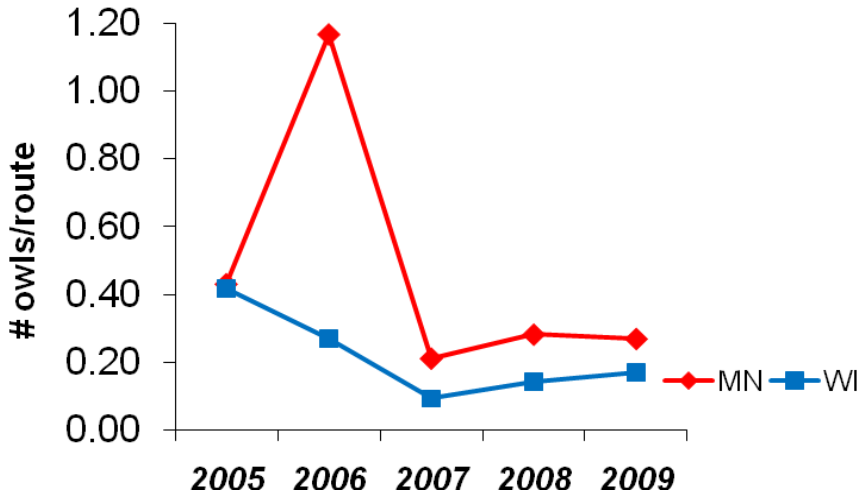

Figure 9: Mean # E. Screech Owls/route for Minnesota and Wisconsin, 2005 - 2009.

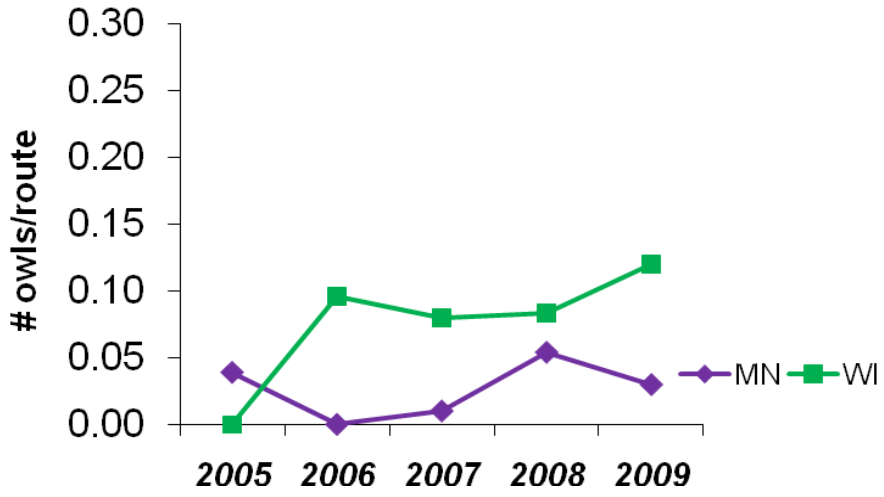

Figure 10: Mean # Long-eared Owls/route for Minnesota and Wisconsin, 2005 - 2009.

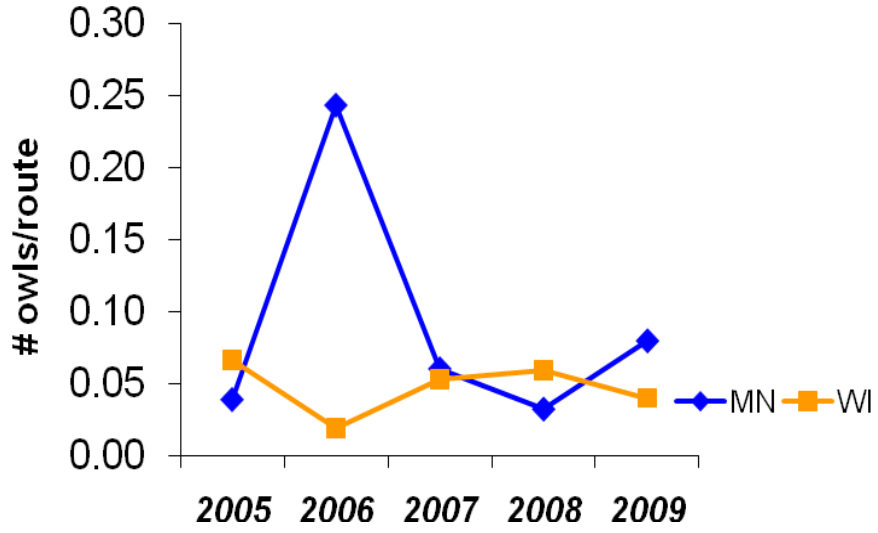

Figure 11: Overall mean # owls/route for Minnesota and Wisconsin, 2005 - 2009.