

WESTERN GREAT LAKES REGION

OWL SURVEY

2013 Report



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2013 WESTERN GREAT LAKES REGION OWL SURVEY

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 ninth 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 2013, the majority of surveys were conducted between April 1 and April 15; however, the survey window was extended until the last week in April due to inclement weather (snow, wind, cold). 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.

The number of routes assigned in 2013 was 214, with 128 in Minnesota and 86 in Wisconsin. Of the assigned routes, 105 and 79 routes were surveyed in Minnesota and Wisconsin, respectively. The number of participants that signed up to conduct an owl survey was 184, with 160 volunteers (87%) returning completed survey sheets.

In total, 367 owls of seven species were recorded on 104 routes, with no owls recorded on 80 routes. 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 209 individual owls comprising six species were recorded. The mean number of owls/route was 1.99 compared to 2.48 in 2012. In Wisconsin, a total of 158 individual owls comprising six species were recorded. The mean number of owls/route was 2.00 compared to 2.05 in 2012.

Recommendations and future perspectives for the Western Great Lakes Region Owl Survey include: 1) centralize storage of all data collected to date into the newly-created Midwest Avian Data Center, 2) develop an on-line route selection and data entry system in Minnesota, 3) work with regional partners to finish analyses of detectability and other variables influencing owl calling activity, 4) conduct additional analyses of owl habitat associations and power to detect population trends, and 5) evaluate current survey methods and objectives to determine if

modifications are needed to better inform resource managers, enhance volunteer experiences, and monitor owl populations. For example, preliminary analyses suggest adding one or more survey replicates on an equal or even lesser number of routes may increase the survey's ability to detect population change.

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 can be a viable 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 2013, the HRBO and WBCI, in collaboration with the NRRI, MN-DNR, and WI-DNR, coordinated the ninth 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 2013 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 2013 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, with data for each owl recorded at one-minute intervals, 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) ≤ 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 (≤ 25 km/hr) and little or no precipitation.

SURVEY TIMING

Minnesota and Wisconsin. The owl survey period generally goes from April 1 to April 15, but the survey was extended to April 28 because of extreme inclement weather (snow, wind, cold) in 2013. 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. Likely due to convenience, most but not all observers conducted surveys in the first half of the night between 8pm and midnight.

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 2013. 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 randomized Breeding Bird Survey (BBS) routes. 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, Wilson's 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 2013, 184 volunteers signed up to conduct owl surveys in Minnesota and Wisconsin, with 160 participants (87%) surveying at least one route. In total, 214 survey routes were assigned to volunteers, with 128 in Minnesota and 86 in Wisconsin. In Minnesota, 89 volunteer teams returned data sheets for 105 routes. Seventy-four volunteer teams surveyed 1 route, 14 volunteer teams surveyed 2 routes, and one team surveyed 3 routes. In Wisconsin, 65 volunteer teams returned data sheets for 79 routes. Forty-six volunteer teams surveyed 1 route, six volunteer teams surveyed 2 routes, two volunteer teams surveyed 3 routes, and one volunteer team surveyed 4 routes.

SURVEY TIMING AND WEATHER

Minnesota. The date most surveys were completed in 2013 was 16 April (Table 1). The mean start and end temperatures for all routes was 34.4 °F and 31.3 °F, respectively. The mode

average wind speed code, based on the Beaufort scale, for all routes was 0 (<1 mph). The mode average sky code for all routes was 0 (0 – 25% cloud cover).

Wisconsin. The date most surveys were completed in 2013 was 16 April (Table 1). The mean start and end temperatures for all routes was 38.4 °F and 36.1 °F, respectively. The mode average wind speed code, based on the Beaufort scale, for all routes was 1 (1 – 3 mph). The mode average sky code for all routes was 0 (0 – 25% cloud cover).

Table 1. *The mean or mode survey dates from 2005 – 2013 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	
2010		8 April			9 April	
2011		8 April ¹			6 April ¹	
2012		11 April ¹			11 April ¹	
2013		16 April ¹			16 April ¹	

¹ = Mode average survey date.

OWL ABUNDANCE AND DISTRIBUTION

In total, 367 owls of seven species were recorded on 104 routes, with no owls being detected on 80 routes (Table 2). The top six owl species, given that two species tied for fifth place, combined between Minnesota and Wisconsin were Barred Owl, Great Horned Owl, Northern Saw-whet Owl, Eastern Screech Owl, Long-eared Owl, and Great Gray Owl, respectively. The overall mean number of individual owls detected per route was 1.99 compared to 2.24 in 2012. The overall mean number of Barred Owls detected per route decreased by 13% compared to 2012 (1.05 to 0.91 owls/route). The overall mean number of Great Horned Owls detected per route increased by 27% compared to 2012 (0.51 to 0.65 owls/route). The overall mean number of Northern Saw-whet Owls detected per route decreased by 59% compared to 2011 (0.41 to 0.17 owls/route). The overall mean number of Eastern Screech Owls detected per route decreased by 18% compared to 2012 (0.11 to 0.09 owls/route). The overall mean number of

Long-eared Owls decreased by 66% compared to 2012 (0.06 to 0.02 owls/route). Finally, the overall mean number of Great Gray Owls detected per route increased by 100% compared to 2012 (0.01 to 0.02 owls/route).

Table 2. Total number of individual owls and the number of routes each species was detected in Minnesota and Wisconsin, 2013.

Owl Species	Minnesota		Wisconsin	
	Individuals	Routes	Individuals	Routes
Barred Owl	79	29	88	32
Great Horned Owl	73	31	47	33
Northern Saw-whet Owl	23	18	8	6
Eastern Screech Owl	3	2	8	6
Long-eared Owl	2	2	1	1
Short-eared Owl	0	0	1	1
Great Gray Owl	3	3	0	0
Unknown Owl	26	12	5	4
Total	209	63 ¹	158	41 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 209 individual owls comprising six 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 0.75 owls/route (Table 3), which was a 27% decrease compared to the 2012 total (Figure 5). The mean for Great Horned Owls was 0.70 owls/route (Table 3) and represents a 25% increase compared to 2012 (Figure 6). The mean for N. Saw-whet Owls was 0.22 owls/route (Table 3), which was a 65% decrease compared to 2012 total (Figure 7). The number of individual owls detected during a survey ranged between 1 and 12, comprising between 1 and 3 species. The 2013 overall mean of 1.99 owls/route was a decrease of 20% compared to 2012. However, the 2013 overall mean of 1.99 owls/route represents a 16% increase compared to the overall average of 1.72 owls/route, and the fourth highest mean overall total in the past nine years (Figure 10).

Barred Owls were detected in 17 counties (Figure 1), Great Horned Owls in 22 counties (Figure 2), and Northern Saw-whet Owls in 12 counties (Figure 3). Eastern Screech Owls were detected in two counties including: Hubbard and Pine (Figure 4). Great Gray Owls were detected in three counties including: Cook, Koochiching, and Lake (Figure 4). Long-eared Owls were detected in two counties including: Pine and St. Louis (Figure 4).

Wisconsin. A total of 158 individual owls comprising six species were recorded during all surveys (Table 2). The top four species, given there was a tie for third place, detected in Wisconsin were Barred Owl, Great Horned Owl, Northern Saw-whet Owl, and Eastern Screech Owl, respectively. The mean for Barred Owls was 1.11 owls/route (Table 3), which was a 5% increase compared to 2012 (Figure 5). The mean for Great Horned Owls was 0.47 owls/route (Table 3), representing a 26% increase compared to 2012 (Figure 6). The mean for N. Saw-whet Owls was 0.10 owls/route (Table 3), which was a 55% decrease compared to 2012 (Figure 7). The mean for Eastern Screech Owl was 0.10 owls/route (Table 3), which was a 47% decrease compared to 2012 (Figure 4). The number of individual owls/route detected ranged from 1 to 9, comprising between 1 and 3 species. The overall mean number of owls/route decreased by 2% compared to 2012 (2.05 to 2.00 owls/route) (Figure 10).

Barred Owls were detected in 29 counties (Figure 1), Great Horned Owls in 25 counties (Figure 2), and Northern Saw-whet Owls in five counties (Figure 3). Eastern Screech Owls were detected in six counties including: Buffalo, Columbia, Crawford, Dunn, Fond du Lac, Jefferson, and Shawano (Figure 4). Long-eared Owls were only detected in Lafayette County (Figure 4). Short-eared Owls were only detected in Columbia County (Figure 4).

Table 3. The number of owls observed and mean number of owls/route for Minnesota and Wisconsin, 2013.

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. ^d	Mean
Minnesota	April 1 – 28	105	79	0.75	73	0.70	23	0.22	3	0.03	2	0.02
Wisconsin	April 1 – 28	79	88	1.11	47	0.59	8	0.10	8	0.10	1	0.01
Overall	April 1 – 28	184	167	0.91	120	0.65	31	0.17	11	0.09	3	0.02

^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 owls observed and mean number of owls/route for Minnesota and Wisconsin, 2013.*

		Short-eared Owl			Great Gray Owl		Total	
		# Routes ^a	# Obs. ^b	Mean ^c	# Obs.	Mean	# Obs. ^d	Mean
Minnesota	April 1 – 28	105	0	0.0	3	0.03	209	1.99
Wisconsin	April 1 – 28	79	1	0.01	0	0.0	158	2.00
Overall	April 1 – 28	184	1	0.01	3	0.02	367	1.99

^dTotal # observed includes 26 and 5 unknown owl individuals in MN and WI, respectively.

ADDITIONAL SPECIES

Volunteers recorded a variety of additional non-target birds and wildlife while conducting owl surveys. Between Minnesota and Wisconsin, the most abundant species among these were Canada Goose, Tundra Swan, American Woodcock, and Sandhill Crane (Table 4).

Table 4. *Top three additional species detected during owl surveys in Minnesota and Wisconsin, 2013.*

Minnesota		Wisconsin	
Species	Total	Species	Total
Canada Goose	234+	Tundra Swan	278+
Sandhill Crane	29+	Canada Goose	226+
American Woodcock	17+	American Woodcock	61+

+ = total number is based undefined totals from some datasheets.

DISCUSSION

The 2013 Western Great Lakes Region Owl Survey could be described in two words – cold and snowy! Because of the unfavorable survey weather, the survey window was extended to the end of April instead of our usual April 15th deadline. Despite the weather, though, the number of owls detected did not severely drop compared to previous years. The overall mean number of owls per route for both states (1.99) ranked third in the nine year WGLROS history. Both states saw a decline compared to 2012; however, Minnesota saw a 20% decrease in detections versus a 2% decline across the border in Wisconsin. Minnesota's decrease largely resulted from 65% and 27% decreases in N. Saw-whet and Barred Owls, respectively. Meanwhile, Wisconsin saw a 55% decrease in N. Saw-whet Owls with a slight increase in Barred Owls. The disparity between the states in Barred Owls likely led to the larger overall decrease in Minnesota. Interestingly, both states observed a $\geq 25\%$ increase in Great Horned Owls, possibly related to a phenological shift in nesting due to the late spring (i.e. delayed nesting yielded above-average calling activity during the survey period). Although Long-eared Owls make a minimal contribution in overall numbers of owls detected, in both states there was a 75% decline compared to the previous year. Like N. Saw-whet Owls, Long-eared Owls tend to be migratory and the late spring may have influenced detections for both species. Moreover, a harsh winter and late spring likely took a further toll on populations wintering in or arriving early to the region.

Explaining causes for such annual patterns requires caution as a variety of factors can influence the number of owl detections in a given year. For example, it's possible the owl population truly increased or decreased in number, which may be related to a decrease in available habitat, more abundant prey populations, or other variables. However, another possibility is not a change in numbers but a change in detectability, i.e. the likelihood that an owl calls and we are able to hear it. Calling activity may be affected by time of year, time of night, various weather conditions, and a host of other factors, many of which remain poorly understood. Hearing owls may be affected by observer ability, wind, and other external noise sources, such as frogs, traffic, etc.

The Western Great Lakes Region Owl Survey is designed to account for changes in detectability by controlling for some of these variables and quantifying others for use as covariates in analyses. For example, one can calculate probabilities of detections using data from the five 1-minute listening intervals. These detection probabilities are then incorporated into population indices to provide more accurate assessments of relative abundance and population trends (Pollock et al. 2002). Ultimately, the goal of the survey is to detect long-term changes in population trends, which is best achieved with 10+ years of survey data. Fortunately, with hundreds of volunteers annually, there is a solid base of citizen scientists interested in collecting survey data, and after another few years of data we should be able to start assessing population trends while accounting for these detectability issues.

Partners in the Western Great Lakes Region Owl Survey also received a grant to conduct detailed analyses of all years' data prior to the 2015 field season. This analysis is ongoing and has included preliminary calculations of detection probabilities and an assessment of variables affecting detectability (e.g. time of year, count duration, number of survey replicates, etc.). Additionally, a power analysis will be done to determine the level of survey effort required to

detect trends, and a revised evaluation of population indices and trends. Also, we hope to expand our habitat analyses to investigate associations of owls and help to address management questions for some species. Results of all analyses will be used to adjust survey design to adequately meet survey objectives and engage land managers in hopes of providing them the information they need to better manage and conserve owls. Currently we are considering modifying the 2015 protocol so that surveys are conducted during at least two windows (e.g. once in late March/early April and once in early/mid-April), as well as possibly reducing the number of routes surveyed. This is based on preliminary results from our partners that have begun data analysis.

Data gathered 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 considering the idea 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. For example, the Monitoring of Owls and Nightjars in Illinois (<http://www.inhs.illinois.edu/research/MOON/>) has significantly increased detections of E. Screech-Owls through the use of conspecific playback.
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 sixth year of nocturnal bird surveys and Michigan began surveys in 2011. 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 an active Midwest Nocturnal Bird Monitoring Working Group, spearheaded by USFWS biologist Katie Koch, who is coordinator of the Midwest Coordinated Bird Monitoring Partnership (<http://midwestbirdmonitoring.ning.com/>).

RECOMMENDATIONS AND FUTURE GOALS

1. We will continue to work with our partners to complete the analyses of detection probability, power, climatic influences on calling activity, and possibly habitat associations prior to the 2015 field season. Results may lead to adjusted protocols in order to best meet the survey's monitoring goals. These goals are also being revised as needed by the Midwest Nocturnal Bird Monitoring Group based on discussions initiated at an August 2012 regional coordinated bird monitoring conference in Milwaukee.

2. In 2014, we plan to upload all data into the Midwest Avian Data Center, which will centralize and permanently archive all data in the Avian Knowledge Network.
3. Minnesota plans to develop a web-based route selection and data entry system in 2015. Volunteers will be able to select open routes and enter their own data via the same website in which they view protocols, print datasheets, etc. – similar to what Wisconsin successfully initiated over the past few years.
4. 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.
5. As future data continues to be collected, a trend analysis will be done to determine changes in owl populations.
6. Lastly, it would be 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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Figure 1: Distribution and abundance of Barred Owls for MN and WI in 2013.

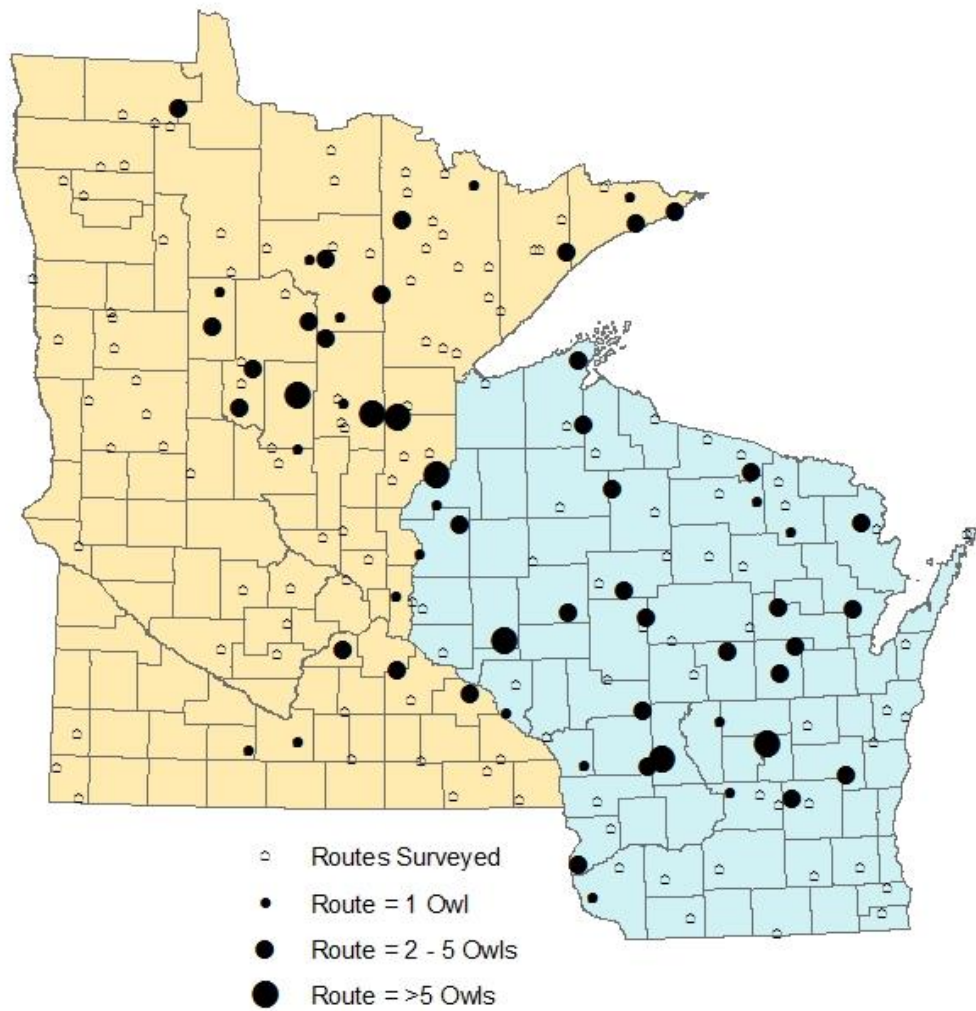


Figure 2: Distribution and abundance of Great Horned Owls for MN and WI in 2013.

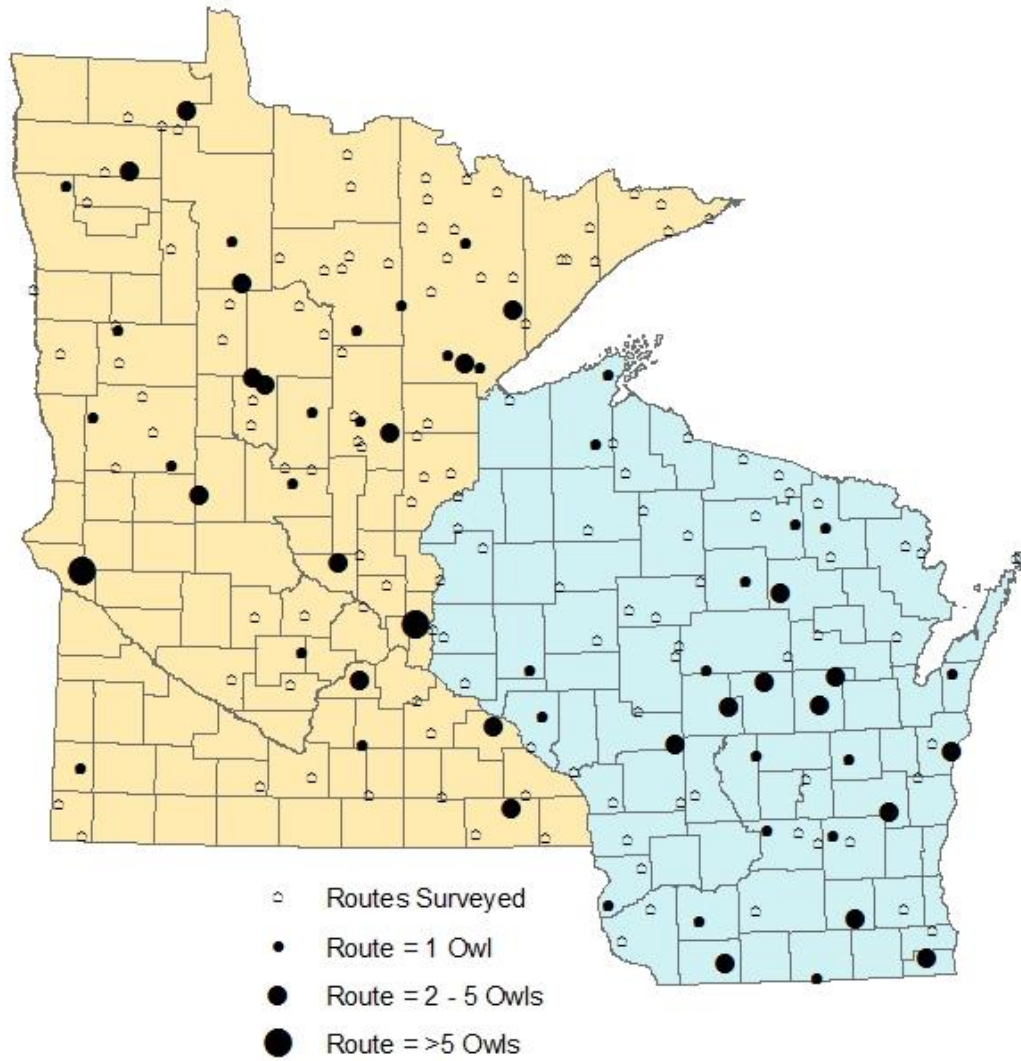


Figure 3: Distribution and abundance of N. Saw-whet Owls for MN and WI in 2013.

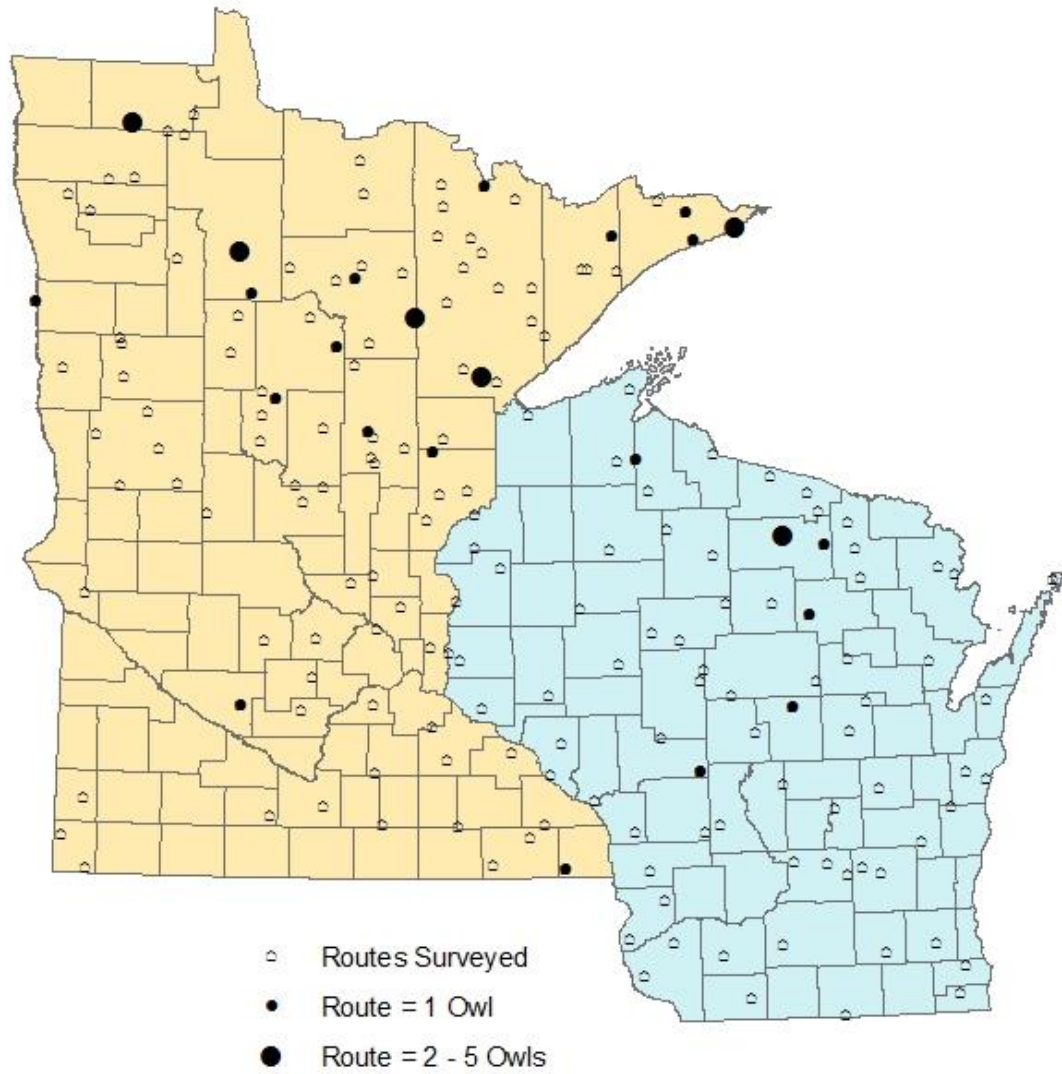


Figure 4: Distribution and abundance of Eastern Screech Owls, Long-eared Owls, Great Gray Owls, and Short-eared Owls for MN and WI in 2013.

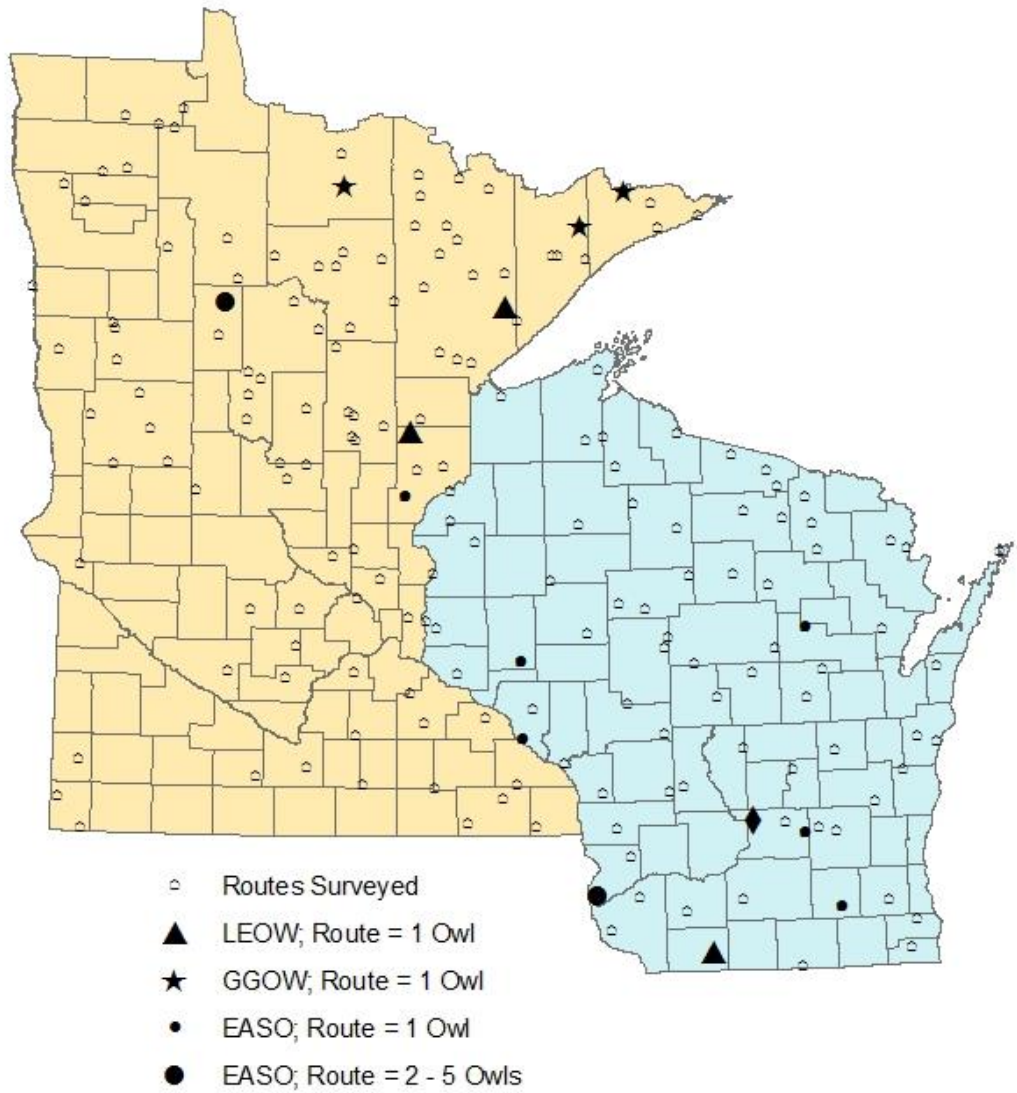


Figure 5: Mean # Barred owls/route for Minnesota and Wisconsin, 2005 - 2013.

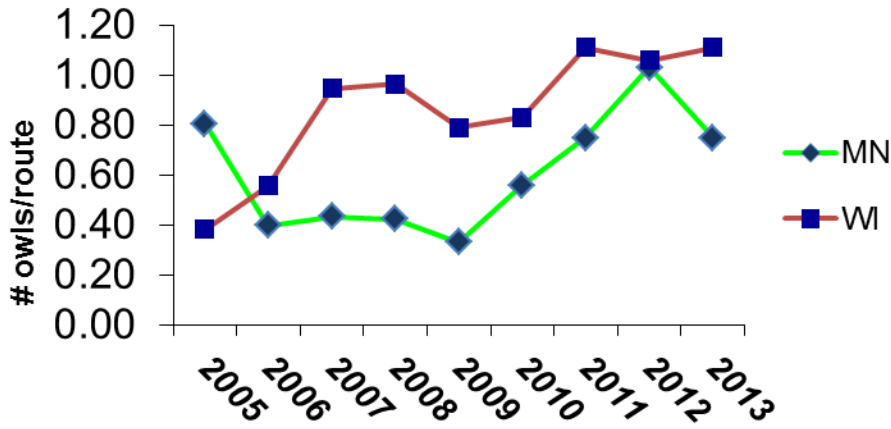


Figure 6: Mean # Great Horned owls/route for Minnesota and Wisconsin, 2005 - 2013.

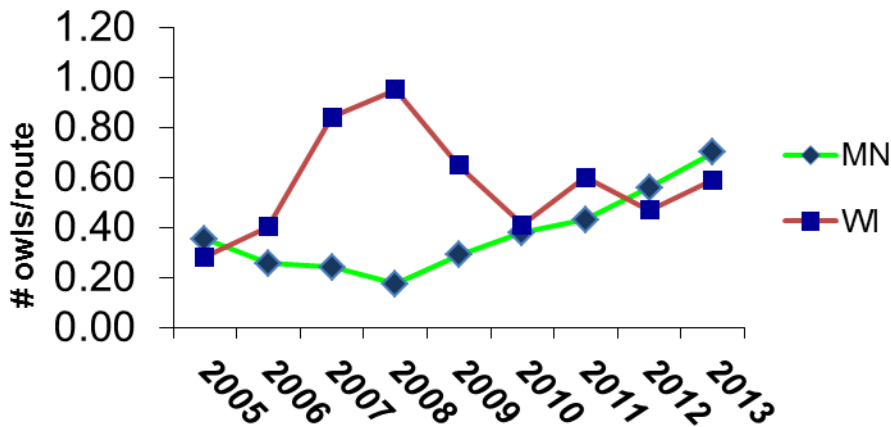


Figure 7: Mean # N. Saw-whet owls/route for Minnesota and Wisconsin, 2005 - 2013.

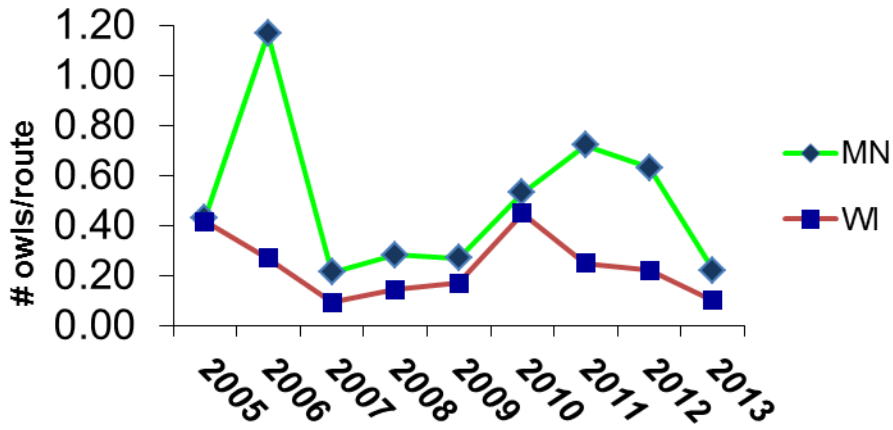


Figure 8: Mean # Eastern Screech owls/route for Minnesota and Wisconsin, 2005 - 2013.

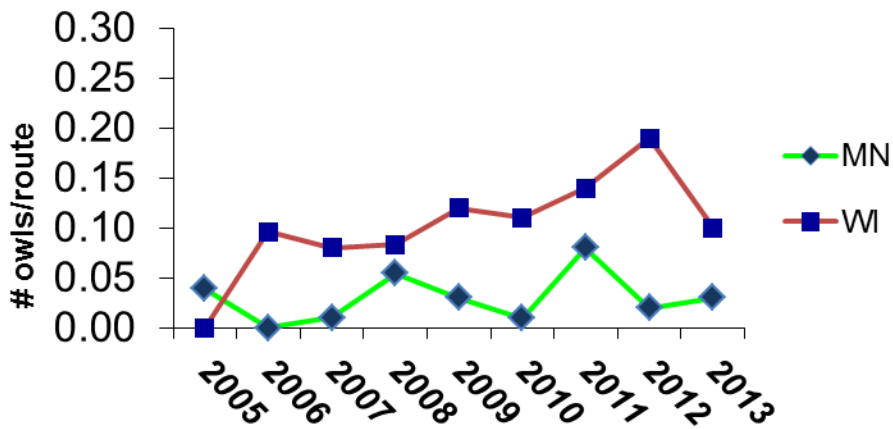


Figure 9: Mean # Long-eared owls/route for Minnesota and Wisconsin, 2005 - 2013.

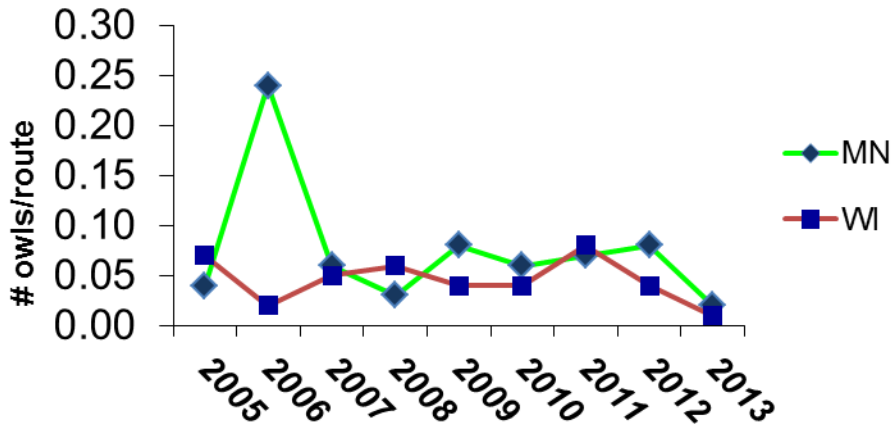


Figure 10: Overall mean # owls/route for Minnesota and Wisconsin, 2005 - 2013.

