# WESTERN GREAT LAKES REGION

# OWL SURVEY

## 2014 Report

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**Prepared for**

**Minnesota Dept. of Natural Resources – Nongame Region 2**
**Wisconsin Dept. of Natural Resources – Wildlife Management**

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Cover photo: Boreal Owl
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# 2014 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 tenth year of a collaborative effort between personnel from the Hawk Ridge Bird Observatory (HRBO), Natural Resources Research Institute (NRRI-UMN-Duluth), 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 2014, the majority of surveys were conducted between April 1 and April 15. 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 2014 was 194, with 109 in Minnesota and 85 in Wisconsin. Of the assigned routes, 81 and 69 routes were surveyed in Minnesota and Wisconsin, respectively. The number of participants that signed up to conduct an owl survey was 161, with 131 volunteers (81%) returning completed survey sheets.

In total, 313 owls of eight species were recorded on 105 routes, with no owls recorded on 45 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 174 individual owls comprising seven species were recorded. The mean number of owls/route was 2.15 compared to 1.99 in 2013. In Wisconsin, a total of 139 individual owls comprising five species were recorded. The mean number of owls/route was 2.01 compared to 2.00 in 2013.

Recommendations and future perspectives for the Western Great Lakes Region Owl Survey include: 1) centralize storage of all data collected to date into the 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 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 2014, the HRBO and WBCI, in collaboration with the NRRI, MN-DNR, and WI-DNR, coordinated the tenth 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 2014 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 2014 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) $\leq$ 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 was conducted between April 1 and 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. Likely due to convenience, most but not all observers conducted surveys in the first half of the night between 8 pm 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 2014, 161 volunteers signed up to conduct owl surveys in Minnesota and Wisconsin, with 131 participants (81%) surveying at least one route. In total, 194 survey routes were assigned to volunteers, with 91 in Minnesota and 85 in Wisconsin. In Minnesota, 74 volunteer teams returned data sheets for 81 routes. Sixty-seven volunteer teams surveyed 1 route and 7 volunteer teams surveyed 2 routes. In Wisconsin, 57 volunteer teams returned data sheets for 69 routes. Forty-nine volunteer teams surveyed 1 route, six volunteer teams surveyed 2 routes, and two volunteer teams surveyed 4 routes.

## SURVEY TIMING AND WEATHER

***Minnesota.*** The date most surveys were completed in 2014 was 15 April (Table 1). The mean start and end temperatures for all routes was 36.9 °F and 33.7 °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 2014 was 11 April (Table 1). The mean start and end temperatures for all routes was 41.0 °F and 37.8 °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).

**Table 1.** ***The mean or mode survey dates from 2005 – 2014 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] | |
| 2014 | | 15 April[1] | | | 11 April[1] | |

[1] = Mode average survey date.

## OWL ABUNDANCE AND DISTRIBUTION

In total, 313 owls of eight species were recorded on 105 routes, with no owls being detected on 45 routes (Table 2). The top five owl species combined between Minnesota and Wisconsin were Barred Owl, Great Horned Owl, Northern Saw-whet Owl, Long-eared Owl, and Eastern Screech Owl, respectively. The overall mean number of individual owls detected per route was 2.09 compared to 1.99 in 2013. The overall mean number of Barred Owls detected per route decreased by 3% compared to 2013 (0.91 to 0.88 owls/route). The overall mean number of Great Horned Owls detected per route decreased by 9% compared to 2013 (0.65 to 0.59 owls/route). The overall mean number of Northern Saw-whet Owls detected per route increased by 118% compared to 2013 (0.17 to 0.37 owls/route). The overall mean number of Eastern Screech Owls detected per route decreased by 22% compared to 2013 (0.09 to 0.07 owls/route). The overall mean number of Long-eared Owls increased by 250% compared to 2013 (0.02 to 0.07 owls/route).

**Table 2.** ***Total number of individual owls and the number of routes each species was detected in Minnesota and Wisconsin, 2014.***

| Owl Species | Minnesota | | Wisconsin | |
|---|---|---|---|---|
| | Individuals | Routes | Individuals | Routes |
| Barred Owl | 62 | 29 | 70 | 35 |
| Great Horned Owl | 47 | 26 | 42 | 23 |
| Northern Saw-whet Owl | 45 | 26 | 10 | 8 |
| Eastern Screech Owl | 0 | 0 | 10 | 8 |
| Long-eared Owl | 7 | 6 | 4 | 4 |
| Great Gray Owl | 3 | 3 | 0 | 0 |
| Boreal Owl | 1 | 1 | 0 | 0 |
| Northern Hawk Owl | 1 | 1 | 0 | 0 |
| Unknown Owl | 8 | 4 | 3 | 3 |
| Total | 174 | 57[1] | 139 | 48[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 174 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 0.77 owls/route (Table 3), which was a 3% increase compared to the 2013 total (Figure 5). The mean for Great Horned Owls was 0.58 owls/route (Table 3) and represents a 17% decrease compared to 2013 (Figure 6). The mean for N. Saw-whet Owls was 0.56 owls/route (Table 3), which

was a 150% increase compared to 2013 total (Figure 7). The number of individual owls detected during a survey ranged between 1 and 9, comprising between 1 and 4 species. The 2014 overall mean of 2.15 owls/route was an increase of 8% compared to 2013. The 2014 overall mean of 2.15 owls/route represents a 20% increase compared to the overall average of 1.79 owls/route, and the third highest mean overall total in the past ten years (Figure 10).

Barred Owls were detected in 15 counties (Figure 1), Great Horned Owls in 19 counties (Figure 2), and Northern Saw-whet Owls in 13 counties (Figure 3). Long-eared Owls were detected in five counties including: Beltrami, Carlton, Houston, Lake and St. Louis (Figure 4). Great Gray Owls were detected in two counties including: Beltrami and St. Louis (Figure 4). One Boreal Owl was detected in Lake County, and one Northern Hawk Owl was detected in St. Louis County (Figure 4).

***Wisconsin.*** A total of 139 individual owls comprising five 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 1.01 owls/route (Table 3), which was a 9% decrease compared to 2013 (Figure 5). The mean for Great Horned Owls was 0.61 owls/route (Table 3), representing a 30% increase compared to 2013 (Figure 6). The mean for N. Saw-whet Owls was 0.14 owls/route (Table 3), which was a 40% increase compared to 2013 (Figure 7). The mean for Eastern Screech Owl was 0.14 owls/route (Table 3), which was a 40% increase compared to 2013 (Figure 4). The number of individual owls/route detected ranged from 1 to 11, comprising between 1 and 4 species. The overall mean number of owls/route increased by 1% compared to 2013 (2.00 to 2.01 owls/route) (Figure 10).

Barred Owls were detected in 30 counties (Figure 1), Great Horned Owls in 20 counties (Figure 2), and Northern Saw-whet Owls in six counties (Figure 3). Eastern Screech Owls were detected in eight counties including: Barron, Crawford, Grant, Juneau, Manitowac, Sauk, Sheboygan, and Waushara (Figure 4). Long-eared Owls were detected in four counties including: Barron, Jefferson, Price, and Sheboygan (Figure 4).

**Table 3.** ***The number of owls observed and mean number of owls/route for Minnesota and Wisconsin, 2014.***

| | | | Barred Owl | | Great Horned Owl | | N. Saw-whet Owl | | Long-eared Owl | | E. Screech Owl | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Region | Date | # Routes[a] | # Obs.[b] | Mean[c] | # Obs. | Mean | # Obs. | Mean | # Obs. | Mean | # Obs.[d] | Mean |
| **Minnesota** | April 1 – 15 | 81 | 62 | 0.77 | 47 | 0.58 | 45 | 0.56 | 7 | 0.09 | 0 | 0.00 |
| **Wisconsin** | April 1 – 15 | 69 | 70 | 1.01 | 42 | 0.61 | 10 | 0.14 | 4 | 0.06 | 10 | 0.14 |
| **Overall** | April 1 – 15 | 150 | 132 | 0.88 | 89 | 0.59 | 55 | 0.37 | 11 | 0.07 | 10 | 0.07 |

[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, 2014.***

| Region | Date | # Routes[a] | Great Gray Owl | | Boreal Owl | | Northern Hawk Owl | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | # Obs. | Mean | # Obs. | Mean | # Obs. | Mean | # Obs.[d] | Mean |
| **Minnesota** | April 1 – 15 | 81 | 3 | 0.04 | 1 | 0.01 | 1 | 0.01 | 174 | 2.15 |
| **Wisconsin** | April 1 – 15 | 69 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 139 | 2.01 |
| **Overall** | April 1 – 15 | 150 | 3 | 0.02 | 1 | 0.01 | 1 | 0.01 | 313 | 2.09 |

[d]Total # observed includes 8 and 3 unknown individual owls 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, American Woodcock, Sandhill Crane, and Wilson's Snipe (Table 4). In addition, hundreds of spring peepers and smaller numbers of wood and chorus frogs were detected on Wisconsin surveys.

**Table 4.** ***Top five additional species detected during owl surveys in Minnesota and Wisconsin, 2014.***

| Minnesota | | Wisconsin | |
|---|---|---|---|
| **Species** | **Total** | **Species** | **Total** |
| Canada Goose | 125+ | Canada Goose | 237 |
| American Woodcock | 80 | American Woodcock | 172 |
| Wilson's Snipe | 18 | Sandhill Crane | 77 |
| Ruffed Grouse | 17 | Killdeer | 41 |
| Killdeer | 16 | Ruffed Grouse | 25 |

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

# DISCUSSION

Results of the 2014 Western Great Lakes Region Owl Survey were similar to previous years in many regards, as detections of Barred and Great Horned Owls, as well as all owls combined, were near recent averages. Eastern Screech Owl detections remained low, while Long-eared Owls rebounded a bit after a poor showing in the cold, snowy spring of 2013. Perhaps most notable was a significant spike in numbers of N. Saw-whet Owls found in Minnesota, particularly northern Saint Louis County, a spike only modestly mirrored in Wisconsin. Saint Louis

County also hosted several Long-eared Owls, Great Gray Owls, a N. Hawk Owl, and a Boreal Owl was also detected in nearby Lake County. The influx of these boreal species may have likely indicated an outbreak of rodent prey in this area, or perhaps a function of the late spring arrival in this region leading to a delay in breeding phenology.

Ten years of survey data moves us closer to being able to conduct trend analyses. One of the survey's primary goals has always been to provide information on population trends for the region's owl species. Because other surveys, such as the federal Breeding Bird Survey, do not assess nocturnal bird populations this survey is especially meant to serve as an early warning system for significant population declines and/or range shifts. Initial results from unadjusted counts (e.g. Figures 6 – 11) suggest relatively stable or even slightly increasing populations of most species. However, highly variable calling behavior of owl species leads to some uncertainty in relatively short-term trend data, so confidence in these patterns will grow as the survey continues in the years ahead.

Unfortunately, detections for uncommon species are too low to allow for reasonable trend assessments. These include Great Gray, Boreal, N. Hawk, Long-eared, and Short-eared Owls. However, occurrence information for these species is highly desired among conservationists across both states. As such we anticipate some survey adjustments in the near-future that would aim to increase detections of these species. These may include increasing routes in areas of known distribution, stratifying a subset of routes by preferred habitat type, and/or modifying current protocol to use conspecific playback. These strategies could also be successfully used for E. Screech and N. Saw-whet Owls. Additional resources will be needed to design and implement such efforts toward less common, hard-to-detect species.

While Minnesota and Wisconsin have collaborated and advanced standardized owl monitoring in the western Great Lakes for a decade now, present and future activities are taking shape under a broader partnership known as the Midwest Nocturnal Bird Monitoring Working Group, spearheaded by USFWS biologist Katie Koch, who coordinates the Midwest Coordinated Bird Monitoring Partnership. Michigan has conducted similar statewide owl surveys since 2011 and Illinois since 2008. Ohio is planning to join the mix in 2015. These regional partners will greatly improve our ability to monitor trends at broad scales, and provide a much-needed laboratory for the germination of research ideas, protocol adjustments, data management systems, analysis tools, and best management practices for owls and nightjars.

A recent analysis of multi-state owl data by working group partners indicates that our power to detect population trends would be significantly improved by the addition of one or more replicate surveys within a season. Therefore, we anticipate expanding the current survey design in 2015 by asking volunteers to conduct two replicate surveys of their routes, the first in early April as usual and a second some time later. This will allow for further estimates of detectability and occupancy, and thus improve the efficacy of our monitoring program.

Anticipated activities for this working group in 2015-2016 are listed below. A high priority for the near future is getting all nocturnal bird survey data from the region into the Midwest Avian Data Center (MWADC). This will serve as a central repository for data sets, make the data easily available to interested users, provide automated visualizations and analysis, and possibly allow for online data entry directly by volunteers.

1. Objectives
    i. Continue trend monitoring on an annual basis for owls and nightjars with an emphasis on the nightjar survey approach; and
    ii. Run surveys two times/year and possibly incorporate using playback for owls.
2. Products
    i. Upload nocturnal bird data into MWADC (and develop online data management application);

ii. Produce two manuscripts and a Joint Venture technical report on standardized survey protocols and evaluation of nightjar and owl data to date;
iii. Incorporate best management practices (BMP's), managing for other species at the same time;
iv. Conduct human dimensions surveys; and
v. Outreach (tell our story, deliver our data)
    i. Public Citizens
    ii. Land managers
    iii. Administrators
    iv. Policy makers
    v. Partners
    vi. Universities

Last but not least, 2015 will also mark the start of the Wisconsin's second Breeding Bird Atlas project (WBBA II). The first was conducted from 1995-2000. WBBA II will no doubt provide a wealth of new information on owl distribution and nesting behavior across the state, including population changes from the first atlas. The Western Great Lakes Owl Survey will contribute hundreds of observations, while atlasers will be encouraged to conduct additional nocturnal counts, including playback for select species, within their designated blocks. Given their priority conservation status in the state, additional surveys specifically for Long-eared and Short-eared Owls may also be designed and implemented at some point in the life of the five-year project.

## ACKNOWLEDGMENTS

Thanks to the Minnesota Dept. of Natural Resources for funding this project, and the Wisconsin Bird Conservation Initiative for taking over volunteer coordination in Wisconsin and providing on-line training/certification. Thanks to Jerry Niemi, of NRRI-UMN-Duluth, for providing logistical support. Thanks to Ron Regal, of the Univ. of MN-Duluth, for helping with database formatting and statistical analysis. Thanks to Rich Baker, of the MN-DNR, for providing information and maps for MFTCS routes throughout Minnesota. Thanks to Janelle Long, of HRBO, for helping with website logistics in MN, and Jill Rosenberg (WI-DNR) for website and online data entry development in Wisconsin. Finally, special thanks to Julie O'Connor, of HRBO, for helping with logistics and volunteer recruitment and coordination in Minnesota.

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 2014.**

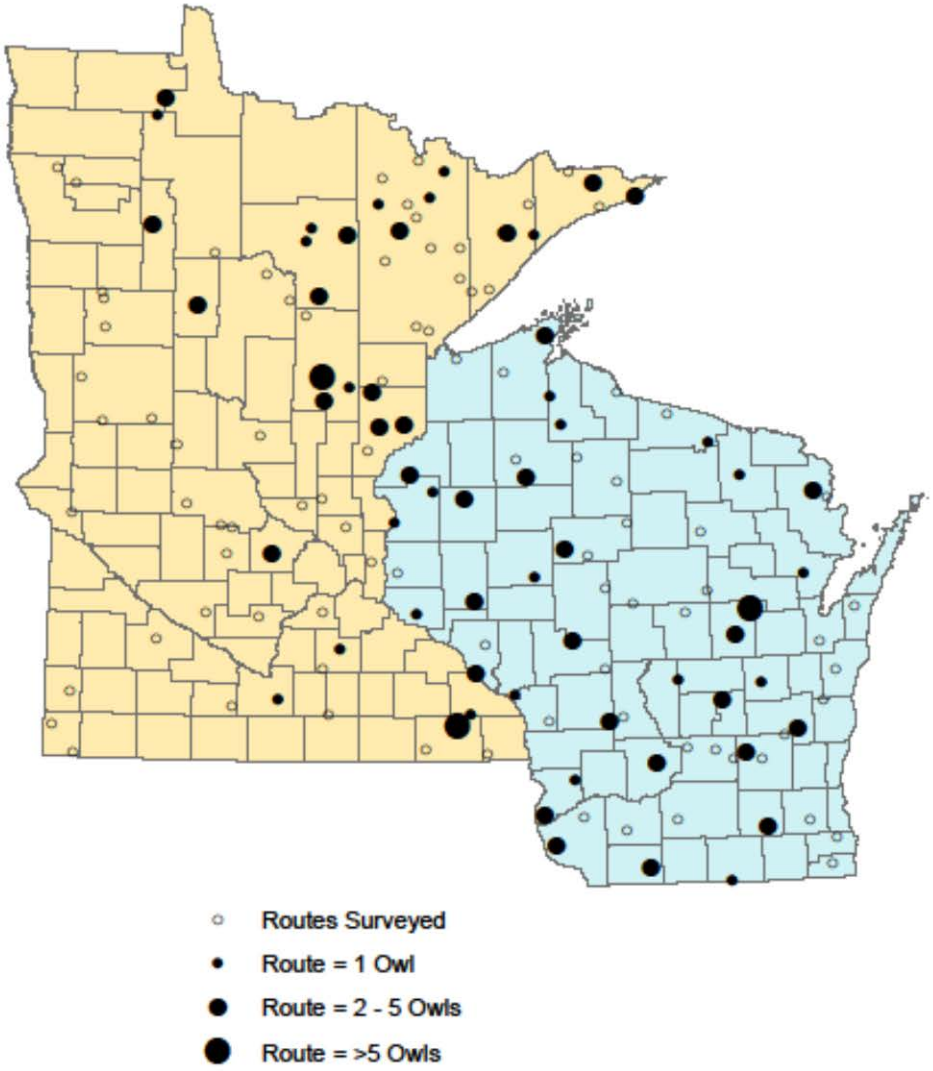


**Figure 2: Distribution and abundance of Great Horned Owls for MN and WI in 2014.**

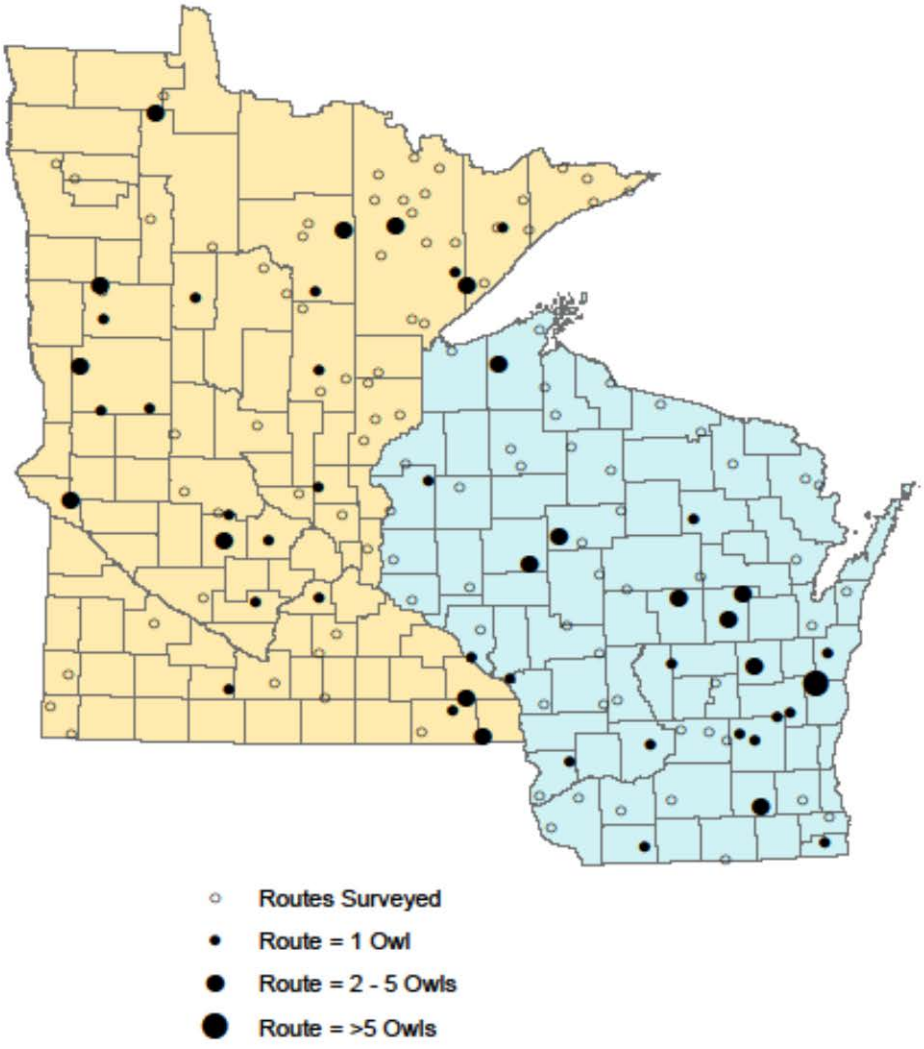


**Figure 3: Distribution and abundance of Northern Saw-whet Owls for MN and WI in 2014.**

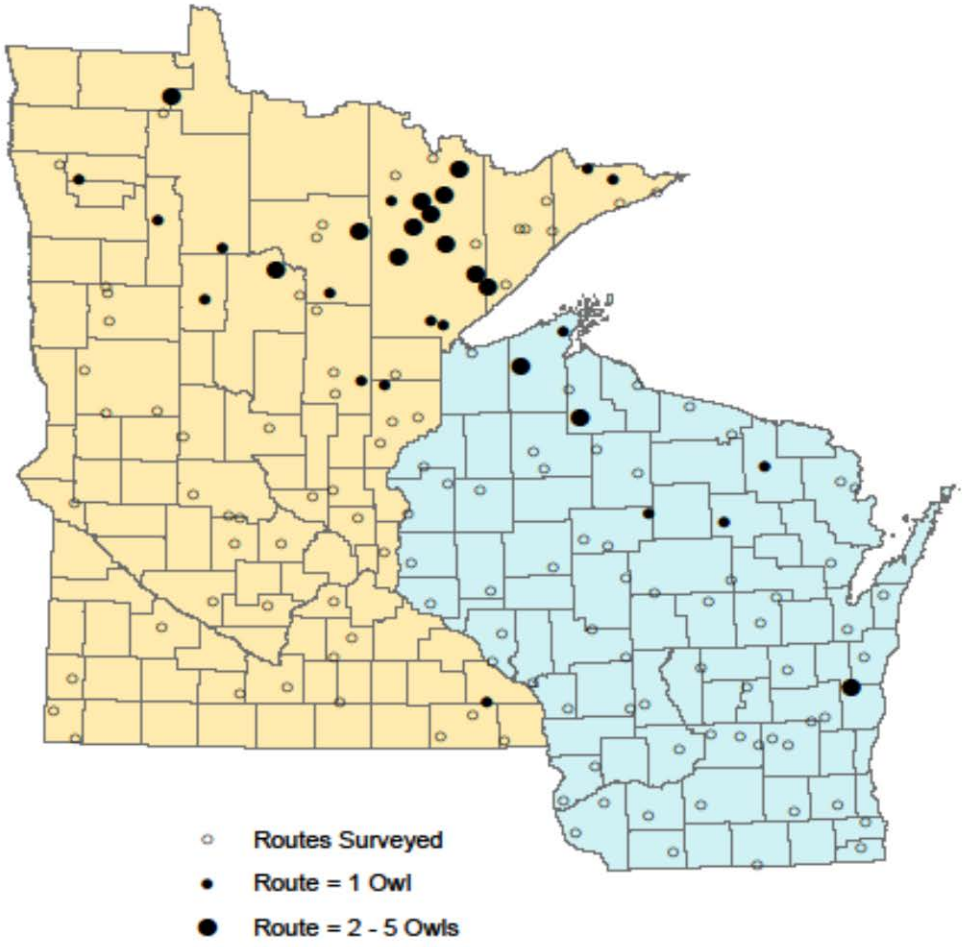
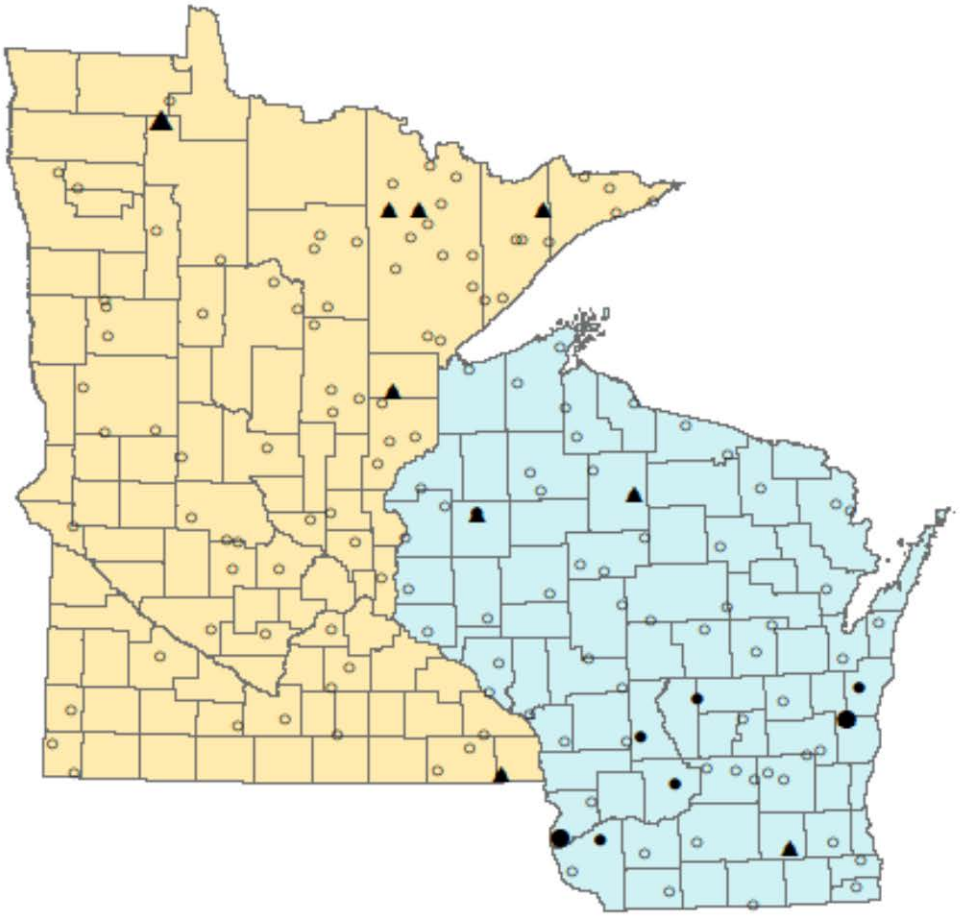


**Figure 4: Distribution and abundance of Long-eared and Eastern Screech Owls for MN and WI in 2014.**



- Routes Surveyed
- LEOW; Route = 1 Owl
- LEOW; Route = 2 - 5 Owls
- EASO; Route = 1 Owl
- EASO; Route = 2 - 5 Owls

**Figure 5: Distribution and abundance of Great Grey, Boreal and Northern Hawk Owls for MN and WI in 2014.**

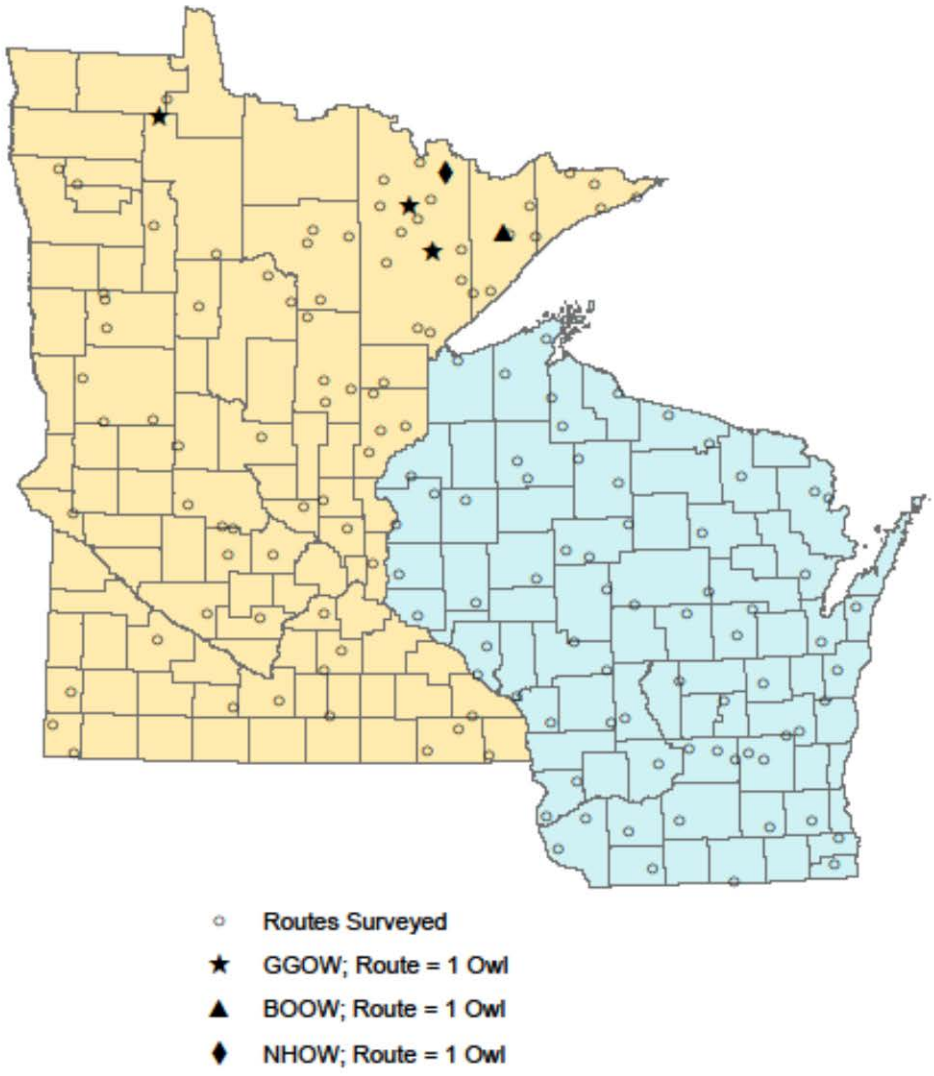


**Figure 6: Mean # Barred owls/route for Minnesota and Wisconsin, 2005 - 2014.**

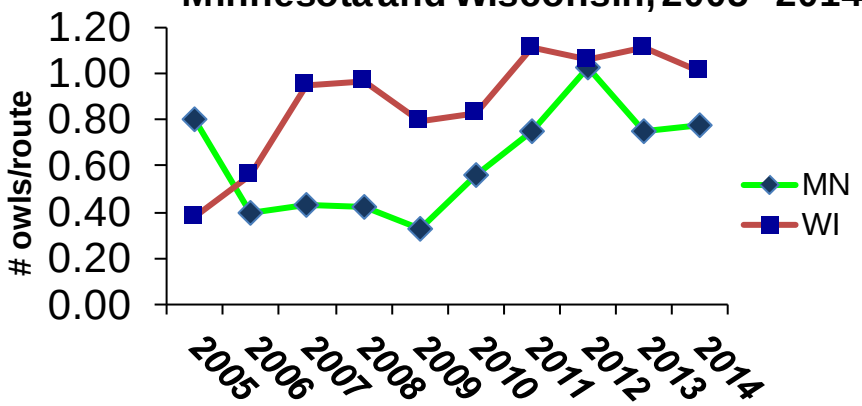



**Figure 7: Mean # Great Horned owls/route for Minnesota and Wisconsin, 2005 - 2014.**

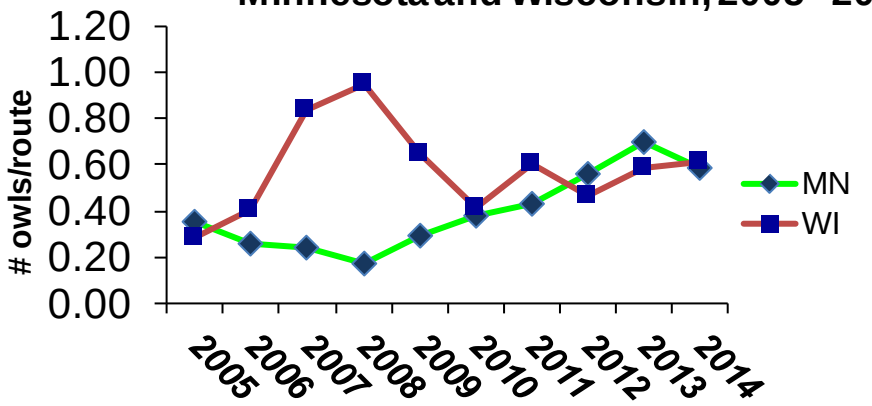


**Figure 8: Mean # N. Saw-whet owls/route for Minnesota and Wisconsin, 2005 - 2014.**

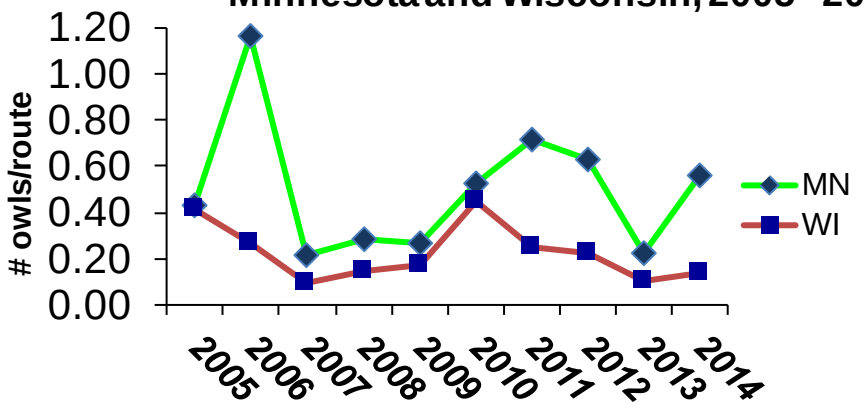



**Figure 9: Mean # Long-eared owls/route for Minnesota and Wisconsin, 2005 - 2014.**

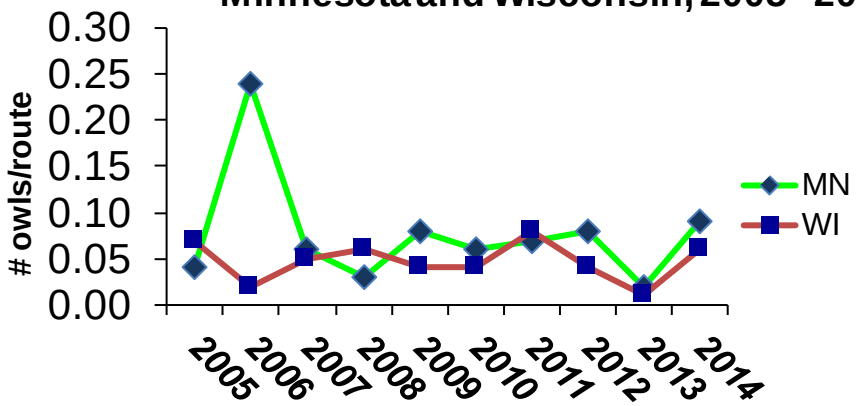


**Figure 10: Mean # Eastern Screech owls/route for Minnesota and Wisconsin, 2005 - 2014.**

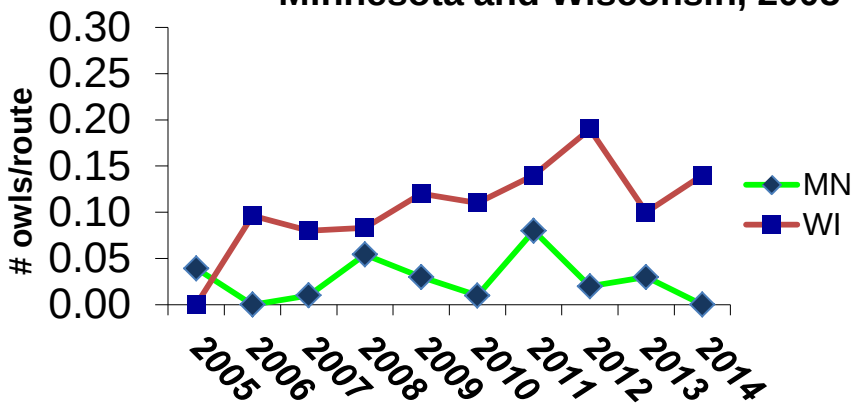



**Figure 11: Overall mean # owls/route for Minnesota and Wisconsin, 2005 - 2014.**