WESTERN GREAT LAKES REGION

OWL SURVEY

2010 Report

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Prepared for

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

December 2010

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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 sixth 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 2010, 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. 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 2010 was 204, with 118 in Minnesota and 86 in Wisconsin. Of the assigned routes, 99 and 76 routes were surveyed in Minnesota and Wisconsin, respectively. The number of participants that signed up to conduct an owl survey was 168, with 135 volunteers (80%) returning completed survey sheets.

In total, 313 owls of eight species were recorded on 108 routes, with no owls recorded on 67 routes (Table 2). The top three owl species combined for Minnesota and Wisconsin were Barred Owl, Northern Saw-whet Owl, and Great Horned Owl, respectively. In Minnesota, a total of 164 individual owls comprising seven species were recorded. The mean number of owls/route was 1.64 compared to 1.18 in 2009. In Wisconsin, a total of 149 individual owls comprising six species were recorded. The mean number of owls/route was 1.96 compared to 1.77 in 2009.

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 data entry system, 3) conduct analysis of owl habitat associations, detectability, climatic variables influencing owl calling activity, and power of the current survey to detect population trends, 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 2010, the HRBO and WBCI, in collaboration with the NRRI, MN-DNR, and WI-DNR, coordinated the sixth 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 2010 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 2010 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. 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 2010. 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 2010, 168 volunteers signed up to conduct owl surveys in Minnesota and Wisconsin, with 135 participants (80%) surveying at least one route. In total, 204 survey routes were assigned to volunteers, with 118 in Minnesota and 86 in Wisconsin. In Minnesota, 75 volunteer teams returned data sheets for 99 routes. Fifty-seven volunteer teams surveyed 1 route, fourteen volunteer teams surveyed 2 routes, two volunteer teams surveyed 3 routes, and two volunteer teams surveyed 4 routes. In Wisconsin, 60 volunteer teams returned data sheets for 76 routes in Wisconsin. Forty-eight volunteer teams surveyed 1 route, seven volunteer teams surveyed 2 routes, two volunteer teams surveyed 3 routes, and two volunteer teams surveyed 4 routes.

SURVEY TIMING AND WEATHER

Minnesota. The mean survey date for all routes was 8 April (Table 1). The mean start and end temperatures for all routes was 46.7 °F and 43.0 °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).

Wisconsin. The mean survey date for all routes was 9 April (Table 1). The mean start and end temperatures for all routes was 48.5 °F and 45.3 °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).

Table 1. ***The mean survey dates from 2005 – 2010 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	

OWL ABUNDANCE AND DISTRIBUTION

In total, 313 owls of eight species were recorded on 108 routes, with no owls being detected on 67 routes (Table 2). The top five owl species combined between Minnesota and Wisconsin were Barred Owl, Northern Saw-whet Owl, Great Horned Owl, Long-eared Owl, and Eastern Screech Owl, respectively (Figure 7). The overall mean number of individual owls detected per route was 1.78, compared to 1.43 in 2009. The overall mean number of Barred Owls detected per route increased by 21% compared to 2009 (0.53 to 0.67 owls/route). The overall mean number of Northern Saw-whet Owls detected per route increased by 55% compared to 2009 (0.22 to 0.50 owls/route). The overall mean number of Great Horned Owls detected per route decreased by 13% compared to 2009 (0.44 to 0.39 owls/route). The overall mean number of Long-eared Owls remained the same compared to 2009 (0.06 owls/route). Finally, the overall mean number of Eastern Screech Owls detected per route decreased by 29% compared to 2009 (0.07 to 0.05 owls/route).

Table 2. ***Total number of individual owls and the number of routes each species was detected in Minnesota and in Wisconsin, 2010.***

Owl Species	Minnesota		Wisconsin	
	Individuals	Routes	Individuals	Routes
Barred Owl	55	30	63	30
Northern Saw-whet Owl	53	24	34	14
Great Horned Owl	38	17	31	18
Long-eared Owl	7	5	3	3
Eastern Screech Owl	1	1	8	6
Short-eared Owl	0	0	2	2
Boreal Owl	2	2	0	0
Great Gray Owl	1	1	0	0
Unknown Owl	7	7	8	5
Total	164	57[1]	149	51[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 164 individual owls comprising seven species were recorded during all surveys (Table 3). The top three species detected in Minnesota were Barred Owl, N. Saw-whet Owl, and Great Horned Owl, respectively. The mean for Barred Owls was 0.56 owls/route, which was a 41% increase compared to the 2009 total (Figure 1). The mean for N. Saw-whet Owls was 0.53 owls/route, which was a 49% increase compared to 2009 total (Figure 2). The mean for Great Horned Owls was 0.38 owls/route and represents a 24% increase compared to 2009 (Figure 3). The number of individual owls detected during a survey ranged between 1 and 14, comprising between 1 and 3 species. The mean number of owls/route went up 29% compared to 2009 (1.18 to 1.66 owls/route). However, the 2010 overall mean of 1.64 owls/route remains 24% below the high in 2006 (2.17 owls/route), but this represents a 9% increase of the previous five-year average of 1.50 owls/route (Figure 6).

Barred Owls were detected in 16 counties within Minnesota including: Aitkin, Beltrami, Blue Earth, Carlton, Cass, Cook, Crow Wing, Fillmore, Isanti, Itasca, Lake, Pine, Scott, St. Louis, Todd, and Wright. Northern Saw-whet Owls were detected in 10 counties within Minnesota including: Aitkin, Beltrami, Cass, Cook, Itasca, Lake, Polk, Roseau, St. Louis, and Todd. Great

Horned Owls were detected in 13 counties within Minnesota including: Aitkin, Becker, Big Stone, Fillmore, Isanti, Lincoln, Morrison, Polk, Rock, Roseau, Sherburne, St. Louis, and Todd.

Long-eared Owls were detected in three counties of the Minnesota including: Beltrami, Roseau, and St. Louis (Figure 4). Boreal Owls were detected in two counties of Minnesota including: Cook and Itasca. Eastern Screech Owl was detected in only one county (Stevens) in Minnesota (Figure 5). Great Gray Owl was also detected in only one county (Cook) in Minnesota.

Wisconsin. A total of 149 individual owls comprising six species were recorded during all surveys (Table 2). The top three species detected in Wisconsin were Barred Owl, Northern Saw-whet Owl, and Great Horned Owl, respectively. The mean for Barred Owls was 0.83 owls/route (Table 3), which was a 5% increase compared to 2009 (Figure 1). The overall mean for N. Saw-whet Owls was 0.45 owls/route (Table 3), representing a 62% increase compared to 2009 (Figure 2). The overall mean for Great Horned Owls was 0.41 owls/route (Table 3), which was a 37% decrease compared to 2009 (Figure 3). The number of individual owls detected ranged from 1 to 9, comprising between 1 and 4 species. The overall mean number of owls/route increased by 10% compared to 2009 (1.77 to 1.96 owls/route), but this represents a 12% increase compared to the previous five-year average of 1.72 owls/route (Figure 6).

Barred Owls were detected in 24 counties throughout Wisconsin including: Adams, Ashland, Barron, Bayfield, Chippewa, Columbia, Dunn, Fond du Lac, Iron, La Crosse, Langlade, Lincoln, Marinette, Marquette, Polk, Portage, Price, Rock, Sauk, Sheboygan, Taylor, Vilas, Waupaca, and Wood. Northern Saw-whet Owls were detected in 12 counties in Wisconsin including: Ashland, Bayfield, Chippewa, Crawford, Door, Douglas, Forest, Jackson, Lincoln, Marinette, Oneida, and Vilas. Great Horned Owls were detected in 16 counties throughout Wisconsin including: Barron, Brown, Chippewa, Columbia, Crawford, Dodge, Douglas, Dunn, Fond du Lac, Lincoln, Manitowoc, Marinette, Rock, Sauk, Vilas, and Waupaca.

Eastern Screech Owls were detected in 5 counties throughout Wisconsin including: Columbia, Crawford, Fond du Lac, Sauk, and Waupaca (Figure 5). Long-eared Owls were detected in 2 counties in Wisconsin including: Forest and Waupaca (Figure 4). Short-eared Owls were detected in 2 counties in Wisconsin including: Lafayette and Waukesha.

Table 3. ***The number of observed and mean number of owls/route for Minnesota and Wisconsin, 2010.***

Region	Date	# Routes[a]	Barred Owl		N. Saw-whet Owl		Great Horned Owl		Long-eared Owl		E. Screech Owl	
			# Obs.[b]	Mean[c]	# Obs.	Mean	# Obs.	Mean	# Obs.	Mean	# Obs.	Mean
Minnesota	April 1 – 15	99	55	0.56	53	0.53	38	0.38	7	0.07	1	0.01
Wisconsin	April 1 – 15	76	63	0.83	34	0.45	31	0.41	3	0.04	8	0.11
Overall	April 1 – 15	175	118	0.67	87	0.50	69	0.39	10	0.06	9	0.05

[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, 2010.***

Region	Date	# Routes	Short-eared Owl		Boreal Owl		Great Gray Owl		Total	
			# Obs.	Mean	# Obs.	Mean	# Obs.	Mean	# Obs.[d]	Mean
Minnesota	April 1 – 15	99	0	0.0	2	0.02	1	0.01	154	1.64
Wisconsin	April 1 – 15	76	2	0.03	0	0.0	0	0.0	149	1.96
Overall	April 1 – 15	175	2	0.01	2	0.01	0	0.01	303	1.78

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

ADDITIONAL SPECIES

Volunteers recorded a total of 22 additional species while conducting an owl survey. Sixteen species were detected in Minnesota, with the top five being American Woodcock, Wilson's Snipe, Ruffed Grouse, Canada Goose, and American Robin (Table 4). Fourteen species were detected in Wisconsin, with the top five being Wilson's Snipe, American Woodcock, Canada Goose, Sandhill Crane, and Ruffed Grouse (Table 4).

Table 4. ***Top five additional species detected during owl surveys in Minnesota and Wisconsin, 2010.***

Minnesota		Wisconsin	
Species	**Total**	**Species**	**Total**
American Woodcock	66	Wilson's Snipe	26
Wilson's Snipe	52	American Woodcock	25
Ruffed Grouse	51	Canada Goose	15
Canada Goose	40+	Sandhill Crane	10
American Robin	18	Ruffed Grouse	8

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

DISCUSSION

VOLUNTEER PARTICIPATION

The number of volunteers that signed up to conduct a survey remained relatively stable compared to 2009. However, there was a slight decrease in the number of assigned routes completed from 93% in 2009 to 80% in 2010. This may be in part due to the weather conditions encountered during the spring survey season. In any case, the number of returned data sheets remains relatively high compared to other owl surveys in North America. The large percentage of assigned routes being completed in both states was likely due to persistent efforts from coordinators to express the importance of returning data sheets, regardless of whether or not owls were detected. However, if not for the 135 volunteers willing to conduct nighttime roadside surveys, it would be impossible to collect data on nearly 180 owl survey routes in the region! Because the volunteer base in the region continues to remain interested in owls, it's 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 2010, 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. Possibly the same owl was detected during each survey, which would inflate numbers.

Regardless, 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, which is best achieved with 10+ years of survey data. Fortunately, there is a solid volunteer base interested in collecting survey data, and after another four years of data we should be able to start assessing population trends.

In 2010, the trend observed for Northern Saw-whet Owls in Minnesota and Wisconsin showed a substantial increase compared to 2009. This is the first notable increase detected for N. Saw-whet Owls since 2006. After the 2006 high, a precipitous decline was observed followed by low, stable trends until 2009. For this species it is likely that trends are impacted by the abundance of mammalian prey. Regional fluctuations observed over time reveal the importance of collecting data over a wide geographical area, which in turn may provide insight into the effects influencing trends (e.g. do local or regional environmental or biological conditions influence detections, or 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 power analysis done in 2005 for 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 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 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. 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 third year of nocturnal bird surveys in 2010 and Michigan plans to begin owl 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 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. Coordinator of the newly-formed Midwest Coordinated Bird Monitoring Partnership (http://midwestbirdmonitoring.ning.com/).

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 three 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.

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) In 2011, we plan to upload all data into the newly-formly Midwest Avian Data Center, which will centralize and permanently archive all data in the Avian Knowledge Network. The data center may also provide a platform for online data entry system by volunteers.

3) 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.

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

5) 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.

6) We also plan to conduct a power analysis that will determine if the current survey design, protocol, and effort are capable of detecting significant population changes and meeting monitoring goals.

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

8) 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.

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, 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 Debbie Waters, of HRBO, for helping with website logistics in MN, and Jill Rosenberg (WI-DNR) for website 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: Mean # Barred Owls/route for Minnesota and Wisconsin, 2005 - 2010.

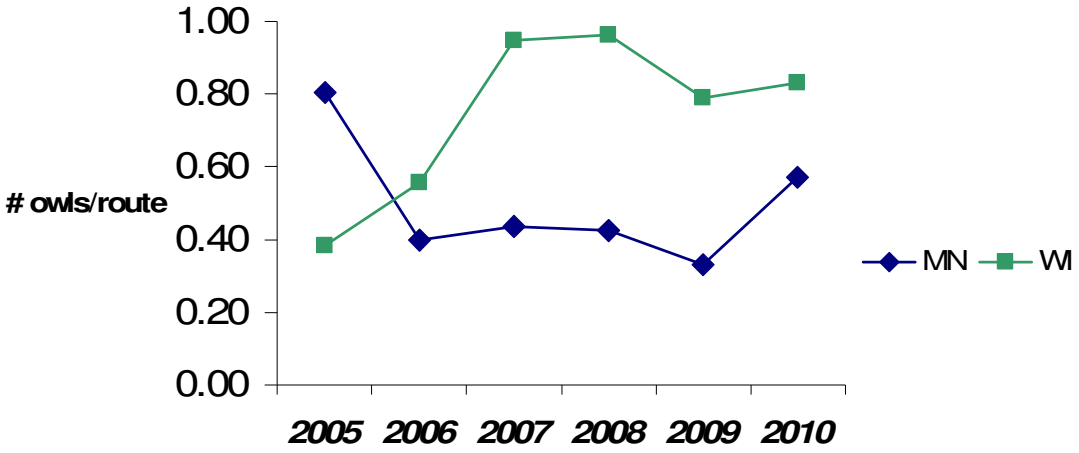

Figure 2: Mean # N. Saw-whet Owls/route for Minnesota and Wisconsin, 2005 - 2010.

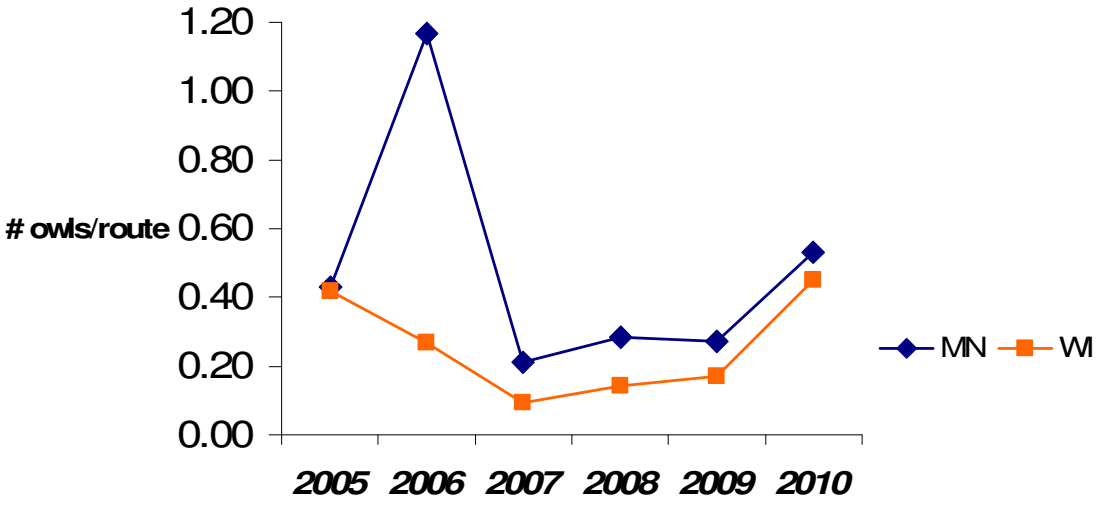

Figure 3: Mean # Great Horned Owls/route for Minnesota and Wisconsin, 2005 - 2010.

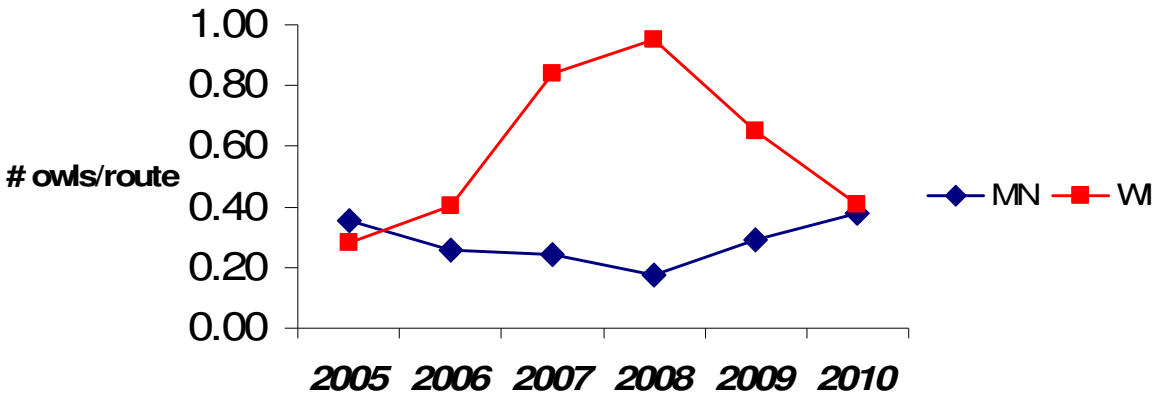

Figure 4: Mean # Long-eared Owls/route for Minnesota and Wisconsin, 2005 - 2010.

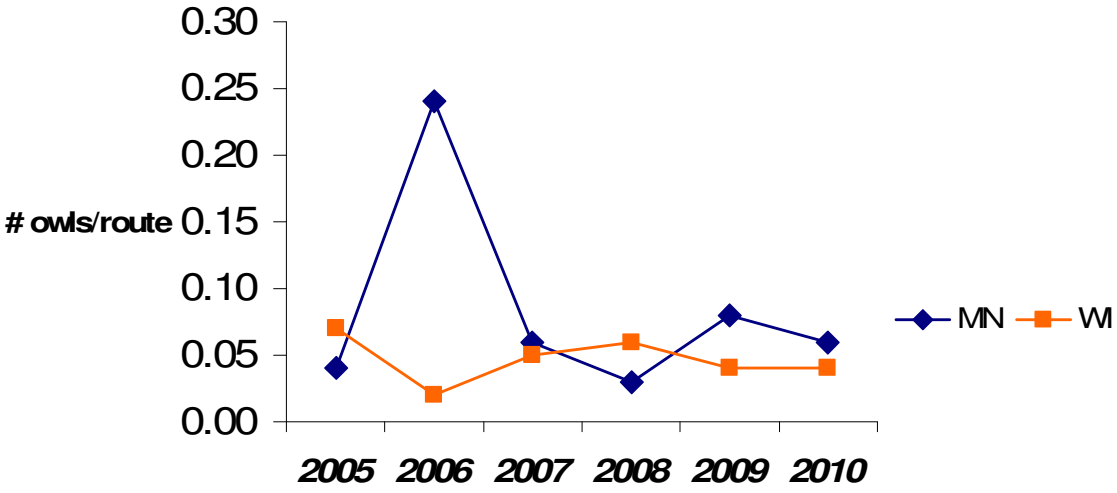

Figure 5: Mean # E. Screech Owls/route for Minnesota and Wisconsin, 2005 - 2010.

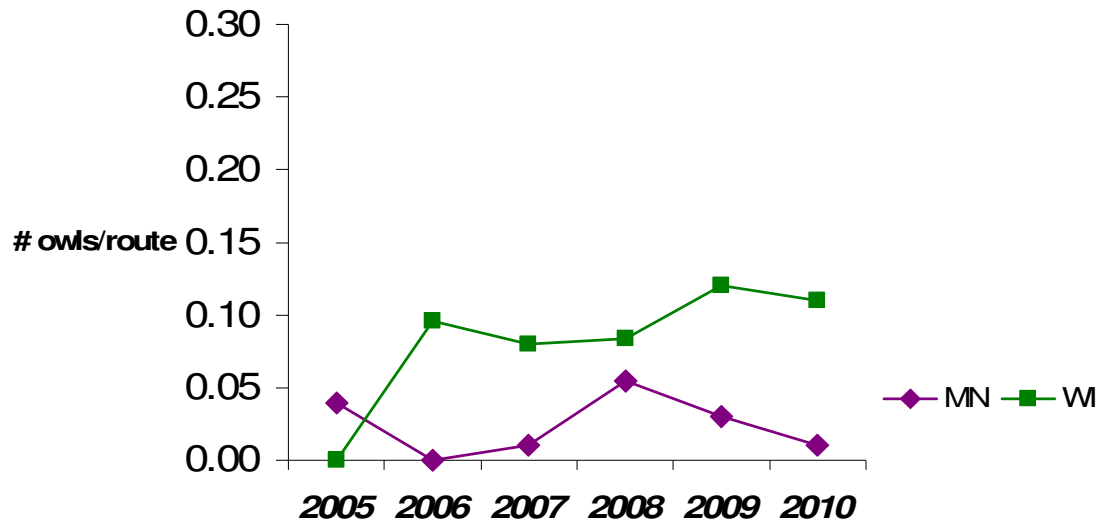

Figure 6: Overall mean # owls/route for Minnesota and Wisconsin, 2005 - 2010.