Woodland Owl Surveys in Support of the Michigan Breeding Bird Atlas II: Distribution, Abundance, and Survey Effectiveness

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EXECUTIVE SUMMARY

The first Michigan Breeding Bird Atlas project occurred during 1983 – 1988 and had a goal of mapping the distribution of bird species that breed in Michigan (McPeek and Adams 1991). The Michigan Breeding Bird Atlas II (MBBA II) project was started in 2001 to help identify changes in bird populations and distributions. McPeek and Adams (1991) noted that early nesting and nocturnal species were underreported in the first Atlas. Because woodland owls are largely nocturnal, often utilize remote habitats, and breed in the late winter or early spring, they are typically underrepresented in large-scale breeding bird surveys. Consequently, information is lacking on the distribution, abundance, breeding phenology, and habitat use of woodland owls.

In 2003 the Michigan Natural Features Inventory proposed a three-year statewide survey of forest-nesting owls to increase the data available for the MBBA II. Eighteen (18) randomly selected North American Breeding Bird Survey (BBS) routes were surveyed in 2004 during three periods: mid January – mid February, mid February – mid March, and mid March – mid April. We situated point-count stations at approximately 1.6-km (1.0-mile) intervals along each route. Surveys occurred between 0.5 hr after sunset and 0.5 hr before sunrise. We avoided conducting surveys during heavy precipitation or high winds. At each point the time, temperature, moon visibility, cloud cover, precipitation level and type, wind speed, snow cover, and noise level was recorded. Each point count consisted of a two-min silent period, followed by a two-min broadcast period for each species, and ended with final two-min silent period. We broadcasted owl calls using an electronic game caller. At Lower Peninsula (LP) stations, calls of Northern Saw-whet Owl, Eastern Screech-Owl, Long-eared Owl, Barred Owl, and Great Horned Owl were played. Calls of Boreal Owl were played in place of Northern Saw-whet Owl and Great Gray Owl was added to the broadcast series for Upper Peninsula (UP) stations. The period of first response and estimated location was noted for each owl observation. We summarized the data recorded at survey stations by quarter-township (nine mi^2) MBBA II survey blocks. To look for possible trends in owl habitat use, we characterized the landscape-level habitat surrounding estimated owl locations and survey stations using an ArcView GIS and IFMAP land cover data. Similar land cover types were combined into nine categories: urban, tilled agricultural, herbaceous upland, deciduous forest, coniferous forest, mixed forest, nonforested wetland, water, and bare/sparsely vegetated. We estimated the proportion of each category present within circular buffers of four radii (500 m, 1000 m, 2000 m, and 5000 m) surrounding each point-count station and owl location.

We observed 456 owls, consisting of 35 Northern Saw-whet Owls, 157 Eastern Screech-Owls, five Long-eared Owls, 143 Barred Owls, and 116 Great Horned Owls. In the southern Lower Peninsula (SLP), we recorded nearly 2.5 times as many Eastern Screech-Owls as Great Horned Owls. The highest observation rates (birds/station) for both species occurred during the second period in the SLP. While Great Horned Owl was regularly observed throughout the State, we recorded more in the SLP than the northern Lower Peninsula (NLP) and UP combined. Barred Owl was the most common species in both the NLP and UP. In the NLP we observed Great Horned Owl at a slightly higher rate during the second period and Barred Owl more often during the third. Although we only recorded Northern Saw-whet Owl sporadically in the LP, we documented nearly as many in the UP as Great Horned Owl. Long-eared Owl was only observed in the UP and all five owls were recorded on one route. Observation rates in the UP were highest during the third survey for Northern Saw-whet and Barred Owl, while Great Horned Owl rates were similar in the second and third periods. We assigned breeding status for owls in 204 MBBA II survey blocks, with Eastern Screech-Owl, Barred Owl, and Great Horned Owl making up 25, 29, and 30% of the records, respectively.

Preliminary comparisons of the number of responses observed during equal length time periods occurring before and after broadcasts indicated that response to calls varied by species and survey. While Northern Saw-whet and Eastern Screech-Owl appeared to respond to broadcasts, the results for Barred Owl varied by survey and broadcasts appeared to reduce Great Horned Owl calling. Because we played broadcasts of all forest-nesting owls, it is unknown what affect this may have had on the responsiveness of each species.

It is difficult to evaluate the success of a given survey protocol without knowing if negative data (i.e. the species was not observed) was due to the species being absent or because the species was not detected. Likelihood-based modeling techniques were recently proposed that estimate the proportion of sites occupied and probability of detection for a species using the results of repeated surveys (MacKenzie et al. 2002, 2003). We used this method to estimate site occupancy rates and detection probabilities for Eastern Screech-Owl, Barred Owl, and Great Horned Owl and assess how they were influenced by landscape-level habitat and environmental factors. The observed proportion of sites occupied, estimated proportion of sites occupied, and estimated probability of detection varied among owl species and surveys. Our best-approximating models for the three species suggested that site occupancy rate was affected by landscape-level habitat. Estimated site occupancy for Eastern Screech-Owl increased with higher amounts of nonforested and urbanized area and lower proportions of forest. The Barred Owl model best-supported by our data indicated that site occupancy rate increased with as forest area increased among the sites. Estimated Great Horned Owl site occupancy increased as proportions of nonforested habitat increased among the sites; however, this may have resulted from regional differences in abundance and habitat. Wind and noise level were the most important environmental variables of those included to affect detection probabilities. The estimated probability of detecting Eastern Screech-Owl decreased as wind increased. Similarly, Barred and Great Horned Owl detection probabilities decreased as noise level increased. Our results indicate that substantially more survey effort would be needed to have a high level of confidence that these species are absent from a site when not detected.

Although we found differences in landscape-level habitat between owl locations and survey stations for the Eastern Screech-Owl and Barred Owl, the proportion of habitat surrounding Northern Saw-whet and Great Horned Owl positions were similar to survey stations for most categories. All four species had lower proportions of urban cover surrounding owl locations compared to survey stations; however, this was likely biased by having stations along roads, where urban development was more likely. We observed lower proportions of herbaceous upland and higher amounts of tilled agriculture, nonforested wetland, and deciduous forest in the 500-m buffer surrounding Eastern Screech-Owl positions when compared to survey stations. Barred Owl locations had significantly lower proportions of water and herbaceous upland and higher amounts of deciduous forest compared to survey stations at one or more buffer levels.

We believe additional owl surveys are needed to increase coverage of the State for Atlas purposes, refine survey protocols, further our understanding of owl breeding phenology and landscape habitat use, and provide additional opportunities to document rare owl species. Future studies should investigate if broadcast call techniques are effective for all owl species, what the optimal spacing of survey stations is for target species, the effective distance covered by broadcast calls, and the affect of wind speed and noise level on detectability. Research is also needed to improve our understanding of woodland owl habitat use, nest site selection, productivity, and the effects of forest fragmentation and management on breeding owls.

INTRODUCTION

The original Michigan Breeding Bird Atlas (Atlas) project spanned the years from 1983 to 1988, and the primary goal of the project was to map the distribution of each bird species that breeds in Michigan (McPeek and Adams 1991). Such surveys should be conducted at regular intervals (10 to 25 years) to identify range and population changes (McPeek and Adams 1991), which was the purpose for starting the Michigan Breeding Bird Atlas II (MBBA II) project in 2001. McPeek and Adams (1991) acknowledged that species that nest early in the season and are nocturnal were underreported in the first Atlas due to concentration of field work between late May and early July and in early morning hours. Because woodland owls are largely nocturnal, often utilize remote and inaccessible habitats, and breed in the late winter or early spring, they are typically underrepresented in most large-scale breeding bird surveys, such as state atlas projects and the North American Breeding Bird Survey (BBS). Subsequently, information is lacking on the distribution, abundance, breeding phenology, and habitat use of woodland owls. Scientists recognize the need to develop and use standardized protocols to monitor owl populations (Morrell et al. 1991, Takats et al. 2001).

In 2003 the Michigan Natural Features Inventory (MNFI) proposed to conduct systematic surveys for forest-nesting owls to provide improved data for the MBBA II. We expected that a three-year effort would be required to adequately survey the state for these species. Our objectives were to 1) provide improved data for the MBBA II project, 2) expand our knowledge of the distribution, abundance, breeding status, and phenology of forest-nesting owls in Michigan, 3) collect baseline data using an accepted protocol that would allow for long-term monitoring of trends, 4) evaluate the effectiveness of broadcast call surveys in locating breeding owls, and 5) gather information on the habitat use of forest-nesting owl species at the landscape level.

METHODS

Point Counts

Woodland owl surveys were conducted along 18 randomly selected BBS transects (Figure 1). MNFI staff conducted surveys on 15 of these routes and the Kalamazoo Nature Center (KNC) surveyed an additional three transects. Data from the KNC transects are also summarized in this report. Transects were surveyed once during each of three periods, mid January to mid February, mid February to mid March, and mid March to mid April, for a total of three surveys. Eight routes were surveyed in the southern Lower Peninsula (SLP), five in the northern Lower Peninsula (NLP), and five in the Upper Peninsula (UP) (Figure 1). Surveys were staggered so that SLP transects were done first, NLP second, and UP third, and starting dates were separated by approximately one week in each zone.

The owl survey methodology used in this project was based on the Guidelines for Nocturnal Owl Monitoring in North America (Takats et al. 2001). We located owl point-count stations at 1.6 km (1.0 mile) intervals along each transect. Since each BBS route has 50 point-count stations situated at approximately 0.8 km (0.5 mile) intervals, we generally surveyed every other station. Because woodland owls were the focus of this survey, stations that had no forest blocks within 0.8 km (0.5 mile) were excluded from the survey. When turns in the predefined routes placed a survey station closer than 1.6 km from the previous, we skipped that point and moved to the next station that was at least 1.6 km away. Each station was situated within approximately 0.4 km (0.25 mile) in any direction of the predefined point, which provided flexibility in finding locations that were safe and allowed the survey to be conducted without disturbing landowners. If a suitable station could not be located within 0.4 km of the

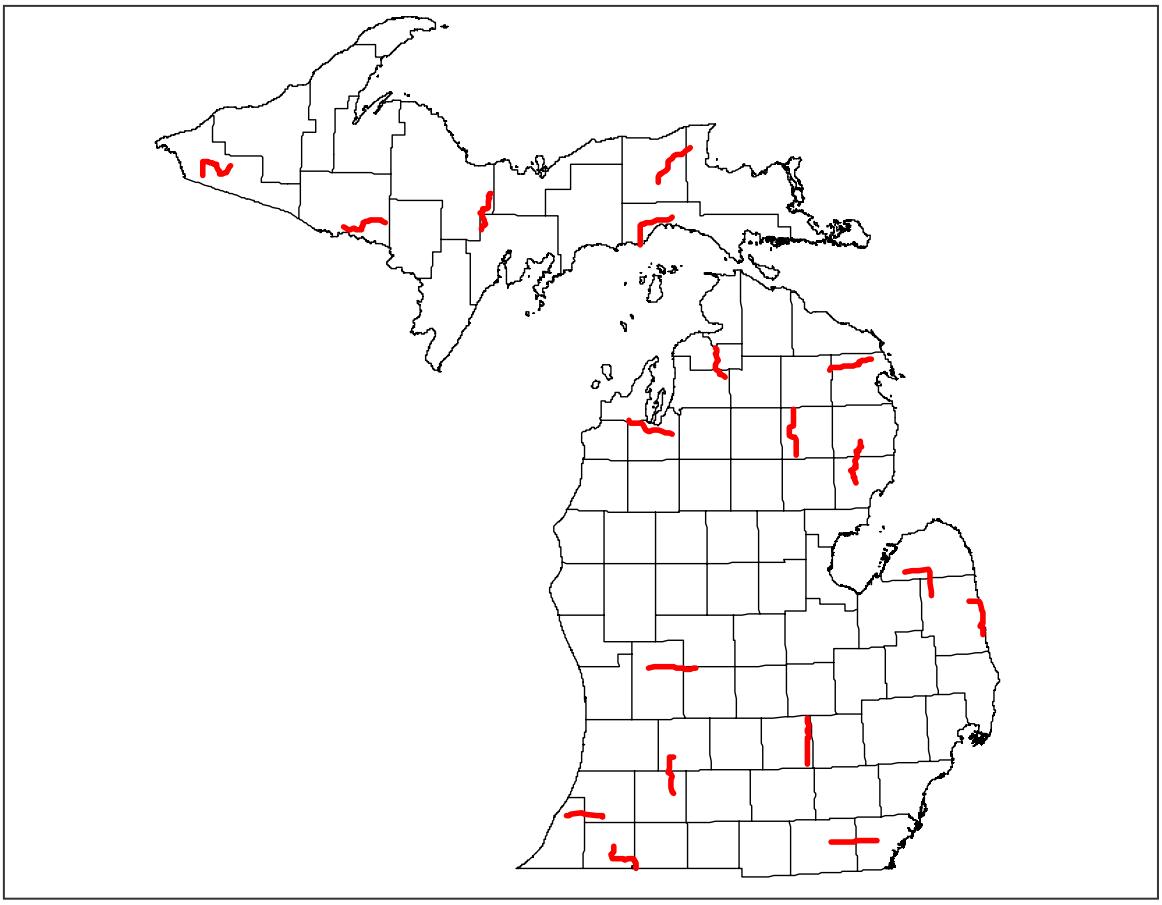

Figure 1. Locations of 2004 woodland owl survey routes conducted in Michigan.

original point, that station was skipped and observers moved on to the next point.

We conducted surveys between 0.5 hr after sunset and 0.5 hr before sunrise and varied starting times as much as practicable. We made an effort to survey each route during each of three portions of the night: first third (dusk to late evening), second third (late evening to early morning), and last third (early morning to dawn). Heavy precipitation and winds greater than or equal to 20 km/hr (13 mph, equivalent to Beaufort Scale 4) were avoided; however, if conditions deteriorated during the course of a survey, we completed the survey in an effort to evaluate the methodology in a variety of weather conditions. We noted the time of survey and collected data on temperature, moon visibility, cloud cover, precipitation level and type, wind speed, snow cover, and noise level at each station.

The point counts consisted of a two-minute silent period, followed by a two-minute broadcast period for each species, and ended with final two-minute silent period. We broadcasted owl calls recorded on a CD using an electronic game caller. A broadcast period for a species consisted of 20 s of calls followed by 20 s of silence, which was repeated three times for a total of two minutes. At Lower Peninsula stations calls of Northern Saw-whet Owl (*Aegolius acadicus*), Eastern Screech-Owl (*Megascops asio*), Long-eared Owl (*Asio otus*), Barred Owl (*Strix varia*), and Great Horned Owl (*Bubo virginianus*) were played for a total survey period of 14 minutes. Calls of Boreal Owl (*Aegolius funereus*), Eastern Screech-Owl, Long-eared Owl, Barred Owl,

Great Gray Owl (*Strix nebulosa*), and Great Horned Owl were broadcast at UP stations and the survey period totaled 16 minutes. Calls were played in order from smallest owl to largest. For each series of three calls, we rotated the caller 120° to ensure full coverage. We considered that an owl had responded to a broadcast when it vocalized or flew toward the survey station. For each owl response we recorded the species, sex (if discernable), survey period during which the response was first observed, and estimated location. Locations of owls were approximated by estimating the distance away from the observer and taking a compass bearing from the station point. Due to the difficulty of estimating distances of vocalizing owls at night, we recorded distance using six categories: 1) ≤ 100 m; 2) > 100 m and ≤ 250 m; 3) > 250 m and ≤ 500 m; 4) > 500 m and ≤ 750 m; 5) > 750 m and ≤ 1000 m; and 6) > 1000 m.

Nest Searches

We conducted targeted nest searches along several Lower Peninsula routes. A variety of techniques were used, including scanning forests from roadsides using binoculars and spotting scope and conducting ground surveys through suitable habitat. When searching forests, a stick was used to hit trees or snags with potential nesting cavities in an effort to flush incubating owls.

Atlas Breeding Status

Breeding status was determined by survey block according to methods set forth in the MBBA II Project Handbook (KNC 2004). MBBA II survey blocks are based on quarter-townships and consist of nine legal sections (KNC 2004). While data was collected from stations spaced at 1.6-km intervals along BBS routes, we summarized this information by MBBA II block. Owls vocalizing in response to broadcast calls were treated as singing males for the purposes of assigning breeding criteria codes. The "S" breeding code is assigned when a singing male is present at the same location on at least two dates at least seven days apart (KNC 2004). We used sections as boundaries in determining if observations were repeat occurrences, i.e. if we recorded an owl of the same species in the same section during two or more surveys separated by at least one week, we assigned the observation breeding code S and considered the species a probable breeder for that survey block.

Landscape-level Habitat

We used an ArcView Geographic Information System (GIS) to characterize the habitat around each survey station and owl observation. Owl locations were determined based on the estimated distance and compass bearing recorded in the field. For observations that occurred less than 100 m from the survey point, we used the GPS coordinates for the survey station as the center for habitat analysis. Because we used distance categories in the field, the midpoint of the assigned category was used to approximate the owl location for habitat analysis (e.g., for the 250 – 500 m category we used 375 m). Most observations placed in distance category six (> 1000 m) were estimated to occur between 1000 and 1500 m, so 1250 m was used to locate the analysis center. In cases when we had the same owl observed at more than one station, we used the intersection of our compass bearings to estimate the bird's location. The Michigan Department of Natural Resources (MDNR) Integrated Forest Monitoring Assessment and Prescription (IFMAP) land use coverage was used to describe landscape-level habitat. This coverage was derived from the classification of Landsat Thematic Mapper (TM) images dated between 1997 and 2001 and has a minimum mapping unit of 30 m^2. Imagery from three seasons, spring (leaf-off), summer, and fall (senescence), was used in the classification. We characterized the habitat around each owl observation and survey station using circular buffers of four radii: 500 m, 1000 m, 2000 m, and 5000 m. Similar land cover types were combined into the following nine landscape categories:

urban, tilled agricultural, herbaceous upland, deciduous forest, coniferous forest, mixed forest, nonforested wetland, water, and bare/sparsely vegetated. We provided descriptions of the IFMAP classes included in each category in Table A-1 (Appendix A).

Data Analysis

We noted several instances when apparently individual owls were recorded at more than one survey station. Repeat detections were observed for Northern Saw-whet Owl, Barred Owl, and Great Horned Owl at estimated overall rates of 8.3, 4.3, and 10.3% of the totals, respectively. We made two assumptions in estimating the number of repeat detections: 1) owl calls of the same species coming from the same approximate location (based field observations, compass bearings, and distance estimates) on two or more consecutive stations were made by the same owl (i.e. repeat detection), and 2) owl responses of the same species observed at different locations on two consecutive stations were from different birds. While repeat detections were noted in the field and removed during analysis, they occurred often enough to question whether each survey point could be considered independent. To reduce the likelihood of repeat observations and ensure that surveys were independent, we only analyzed data from a series of points along each route that were spaced at least 3.2 km (two miles) apart for these three species. Repeat detections of Eastern Screech-Owl were not observed in the field, so the approximate 1.6-km spacing of stations was assumed to be sufficient to consider the points as independent observations.

For all species except Great Horned Owl, which was observed commonly in all three regions, data analysis was focused on one or two of the regions surveyed. Because 25 of the 36 Northern Saw-whet Owl observations were recorded in the UP, we focused our analysis in that region. The majority of the UP Northern Saw-whet observations occurred during the third survey, which is the period when breeding birds were most likely to be observed. Conversely, most of the Northern Saw-whet Owls in the NLP and SLP were recorded during the first and second periods, which could indicate that these were wintering migrants. All but four of the 136 Eastern Screech-Owl records occurred in the SLP, so our analysis only used data from that region. Only records from the NLP and UP were used in our analysis of the Barred Owl data, since only six of the 140 occurrences were located in the SLP. Because only five Long-eared Owls were observed in total, we did not attempt further analysis for this species.

We used the Sign Test to determine if the number of owl observations recorded before and after conspecific broadcast was significantly different than what would be expected. Since we only considered the presence or absence of a species before and after broadcast, the binomial distribution was assumed. The Sign Test is a nonparametric paired-sample test developed from the concept of the binomial test, and is essentially a binomial test with p hypothesized to be 0.50 (Zar 1996). We only used data from stations where owls were present for this analysis, and examined the number of times an owl was observed before (+) or after (-) conspecific calls were played. Testing was conducted by survey period, since owl responsiveness may vary due to breeding phenology, and we only compared equal numbers of two-minute survey blocks (e.g. first silent period vs. Eastern Screech-Owl broadcast period).

To evaluate the success of a given survey protocol, it is important to know if negative data (i.e. the species was not observed) was due to the species being absent or because the species was not detected. We used a likelihood-based modeling approach to evaluate the effectiveness of our survey protocol by providing estimates of site occupancy rates and detection probabilities given environmental conditions and landscape-level habitat. MacKenzie et al. (2002) proposed this model as a method to

estimate site occupancy rates when detection probabilities are less than one. The major assumptions of this model are that occupancy rate remains constant throughout the survey, species are never falsely detected at a site when absent and may or may not be detected when present, and detection of the species at a site is independent of detecting the species at all other sites (MacKenzie et al. 2002). We expected that detection probabilities might vary among surveys for some species given different breeding phenologies. Because of the limited observations of Northern Saw-whet and Long-eared Owls, we were unable to model their site occupancy rates and detection probabilities.

To reduce the number of parameters to be included in our candidate models and increase the interpretability of the results, we conducted a principal components analysis (PCA) on five landscape categories developed from IFMAP data for each of the three owl species using JMP-IN 5.1 software (Sall et al. 2005). We used the urban, deciduous forest, coniferous forest, and mixed forest variables described above and a fifth category, nonforested, which was a combination of the tilled agricultural, herbaceous upland, nonforested wetland, water, and bare/sparsely vegetated categories in the PCA. The first three principal components (PC1, PC2, and PC3) for each species were used in developing our candidate models. These three variables explained 82.9, 77.8, and 81.0% of the variation in landscape-level habitat among the sites for Eastern Screech-Owl, Barred Owl, and Great Horned Owl, respectively. We used the program PRESENCE (www.proteus.co.nz, MacKenzie et al. 2003) to produce our models and estimate occupancy rates and detection probabilities. Akaike's Information Criterion (AIC) was used to select the best approximating model from our candidate sets (Burnham and Anderson 2002). Field observations indicated that five environmental variables, time of night, temperature, wind speed, moon visibility, and noise level, might be important in affecting owl activity and detection, so we included these parameters in our candidate models. Previous research has indicated that these factors can affect the detection and activity of some owl species (Gehlbach 1995, Morrell et al. 1991).

A three-step hierarchical approach was used to develop the set of candidate models for each owl species. We began by comparing two models that included the parameters ψ (probability that the species is present) and p (probability that the species will be detected), but no site-specific or environmental covariates. The first model assumed that p was constant across surveys whereas the second model assumed that p varied among surveys. If AIC values indicated that the data provided more support for the model with detection probabilities that varied among surveys, we included that parameter in all subsequent models. The second step in model development was to add landscape-level habitat variables, which we believed may be important in determining the probability that a species was present at a site. This was accomplished by specifying seven models with all possible combinations of our three habitat variables (PC1, PC2, and PC3). The model with the greatest support from our data was then used in forming all subsequent candidate models. The final step in our process was to add one sampling variable (time, wind, temperature, moon visibility, and noise level) to the model resulting from step two individually to form five models. This hierarchical process resulted in a set of 14 candidate models for each species.

If detection probability is known, the minimum number of visits needed to be certain that a species is absent at a given level of confidence can be calculated using the following equation (Reed 1996):

$$N = \frac{\ln(\alpha \text{ level})}{\ln(1-p)},$$

where N is the minimum number of visits and p is the probability of detection. We

used an α-level of 0.05 to provide estimates of the minimum number of visits to be 95% certain that the species is absent.

Proportions of the nine landscape-level habitats surrounding our survey stations and estimated owl locations were compared using the Wilcoxon Signed-Rank Test. We made paired comparisons for each buffer radius (500, 1000, 2000, and 5000 m) at stations with owl observations for each species using JMP-IN 5.1. An α-level of 0.05 was used for all comparisons.

RESULTS

Nest Searches

Owl nest searches were conducted along eight survey routes in the Lower Peninsula. Searches occurred on both public and private land, with permission obtained from eight landowners. While we found seven potential stick nests, only one appeared to be active and no adults were seen or responded to broadcast calls. We were not able to confirm owl nesting at any of the sites searched.

Atlas Breeding Status

A total of 456 owls, consisting of 35 Northern Saw-whet Owls, 157 Eastern Screech-Owls, five Long-eared Owls, 143 Barred Owls, and 116 Great Horned Owls was observed during surveys conducted at 1054 points along 18 BBS routes (Table 1). In the SLP nearly 2.5 times as many Eastern Screech-Owls were observed than Great Horned Owls. Overall owl observation rate (birds/stations surveyed) in the SLP was greatest during the second survey period (mid February – mid March), with the highest rates for both Eastern Screech-Owl and Great Horned Owl occurring during this period (Table 1). While Great Horned Owl was regularly observed throughout the State, we recorded more in the SLP than the NLP and UP combined. We observed Barred Owl most often in both the NLP and UP. In the NLP Great Horned Owl was recorded at a slightly higher rate during the second period and Barred Owl during the third. Although we only recorded Northern Saw-whet Owl sporadically in the Lower Peninsula, we observed nearly as many in the UP as Great Horned Owl (Table 1). We only observed Long-eared Owl in the UP and all were recorded along one route. Observation rates in the UP were highest during the third survey for Northern Saw-whet Owl and Barred Owl, while Great Horned Owl rates were similar between the second and third surveys.

We determined breeding status for five owl species on 204 MBBA II survey blocks (Table 2). The highest number of possible Northern Saw-whet Owl breeding records was recorded in the UP, while we only documented the species sporadically in the rest of the State (Figure 2). Eastern Screech-Owl was observed on the greatest number of survey blocks and had the highest number of probable breeding records in the SLP (Figure 3). Our only Long-eared Owl records were recorded on three blocks in the UP (Figure 4). We observed Barred Owl on the greatest number of blocks in both the NLP and UP (Table 2), with few observations occurring in the SLP (Figure 5). Great Horned Owl was the second-most recorded species in the SLP and was observed on the greatest number of blocks overall (Figure 6). Table B-1 (Appendix B) lists the owl breeding data by survey block.

Because the third survey occurred during the early spring, we observed breeding activity of several incidental species. Fourteen (14) other bird species were recorded during owl surveys. American Woodcock (*Scolopax minor*) was the most commonly observed incidental species, being recorded on 39 survey blocks. We recorded Ruffed Grouse (*Bonasa umbellus*) on seven and Canada Goose (*Branta candensis*) on six survey blocks, while the remaining 11 species were only observed occasionally (Table 3). Incidental species data is summarized by survey block in Table B-2 (Appendix B).

Table 1. Summary of owl observations by region and survey period recorded during surveys conducted in Michigan in 2004.

Region[a]	Survey Period	No. Points	No. Saw-whet Owl[b]		East. Screech-Owl[c]		Long-eared Owl		Great Horned Owl		Barred Owl		Total	
			No. Obs.[d]	Mean[e]	No. Obs.	Mean	No. Obs.	Mean	No. Obs.	Mean	No. Obs.	Mean	No. Obs.	Mean
SLP	1	108	---	---	40	0.37	---	---	13	0.12	1	0.01	54	0.50
	2	150	4	0.03	77	0.51	---	---	33	0.22	2	0.01	116	0.77
	3	147	1	0.01	36	0.24	---	---	16	0.11	3	0.02	56	0.38
	Subtotal	405	5	0.01	153	0.38	---	---	62	0.15	6	0.01	226	0.56
NLP	1	101	1	0.01	1	0.01	---	---	6	0.06	5	0.05	13	0.13
	2	101	4	0.04	2	0.02	---	---	12	0.12	24	0.24	42	0.42
	3	105	---	---	1	0.01	---	---	7	0.07	34	0.32	42	0.40
	Subtotal	307	5	0.02	4	0.01	---	---	25	0.08	63	0.21	97	0.32
UP	1	114	1	0.01	---	---	---	---	5	0.04	9	0.08	15	0.13
	2	114	3	0.03	---	---	---	---	13	0.11	21	0.18	37	0.32
	3	114	21	0.18	---	---	5	0.04	11	0.10	44	0.39	81	0.71
	Subtotal	342	25	0.07	---	---	5	0.01	29	0.08	74	0.21	133	0.39
Overall	1	323	2	0.01	41	0.13	---	---	24	0.07	15	0.05	82	0.25
	2	365	11	0.03	79	0.22	---	---	58	0.16	47	0.13	195	0.53
	3	366	22	0.06	37	0.10	5	0.01	34	0.09	81	0.22	179	0.49
	Total	1054	35	0.03	157	0.15	5	<0.01	116	0.11	143	0.14	456	0.43

[a] SLP = Southern Lower Peninsula, NLP = Northern Lower Peninsula, and UP = Upper Peninsula.
[b] Northern Saw-Whet Owl.
[c] Eastern Screech-Owl.
[d] Number of owls observed.
[e] Average number of owls per point surveyed.

Table 2. Number of blocks with owl observations by region and breeding status (according to MBBA II criteria) from surveys conducted in Michigan in 2004.

	SLP[a]		NLP		UP		
Species	**Possible**	**Probable**	**Possible**	**Probable**	**Possible**	**Probable**	**Total**
Northern Saw-whet Owl	5	1	5	---	18	---	29
Eastern Screech-Owl	21	28	2	1	---	---	52
Long-eared Owl	---	---	---	---	2	1	3
Barred Owl	3	2	13	10	19	12	59
Great Horned Owl	20	11	13	3	7	7	61
Total	49	42	33	14	46	20	204

[a] SLP = Southern Lower Peninsula, NLP = Northern Lower Peninsula, and UP = Upper Peninsula.

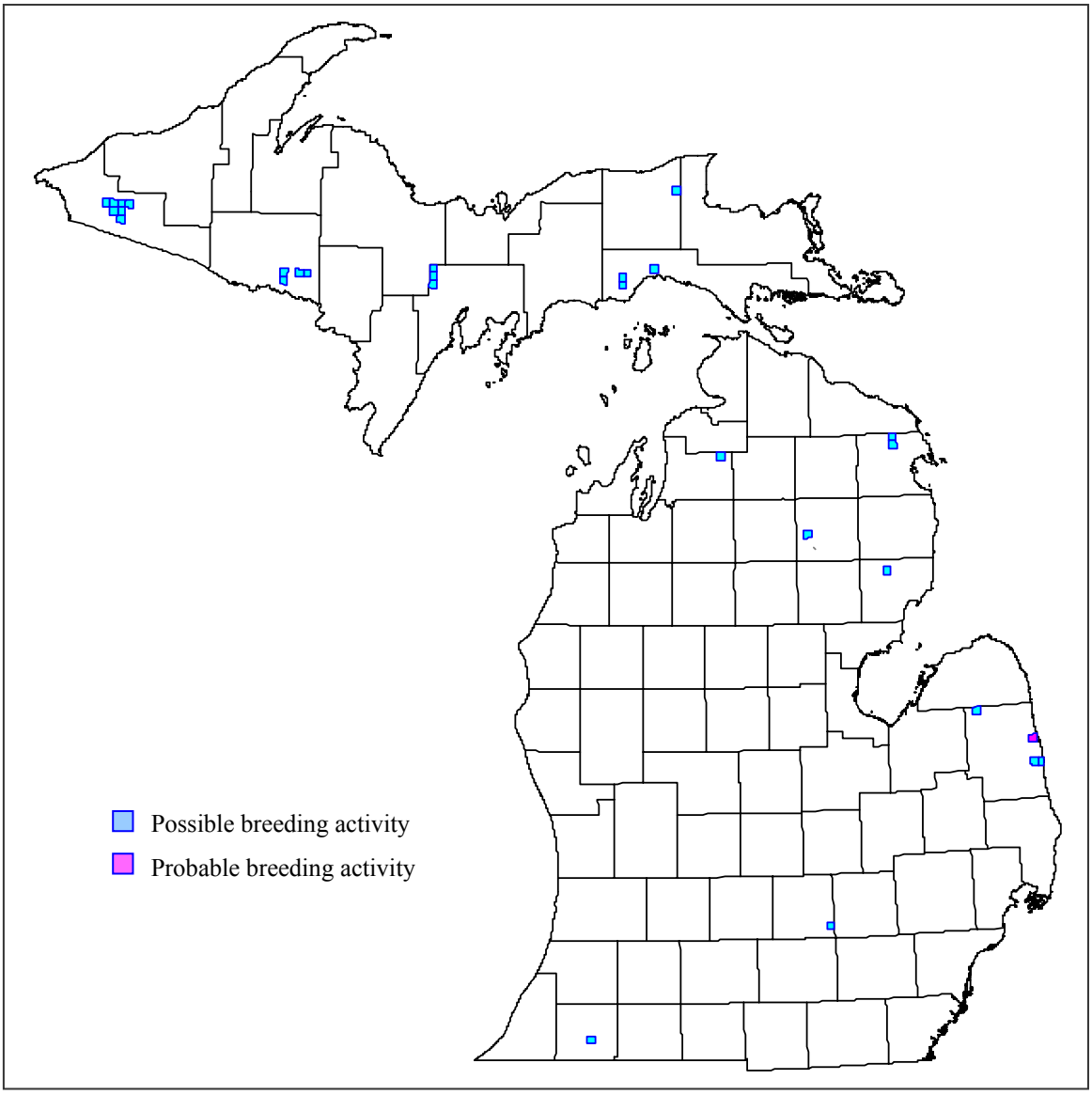

Figure 2. Observed breeding status for Northern Saw-whet Owl by MBBA II survey block as determined from surveys conducted in Michigan during 2004.

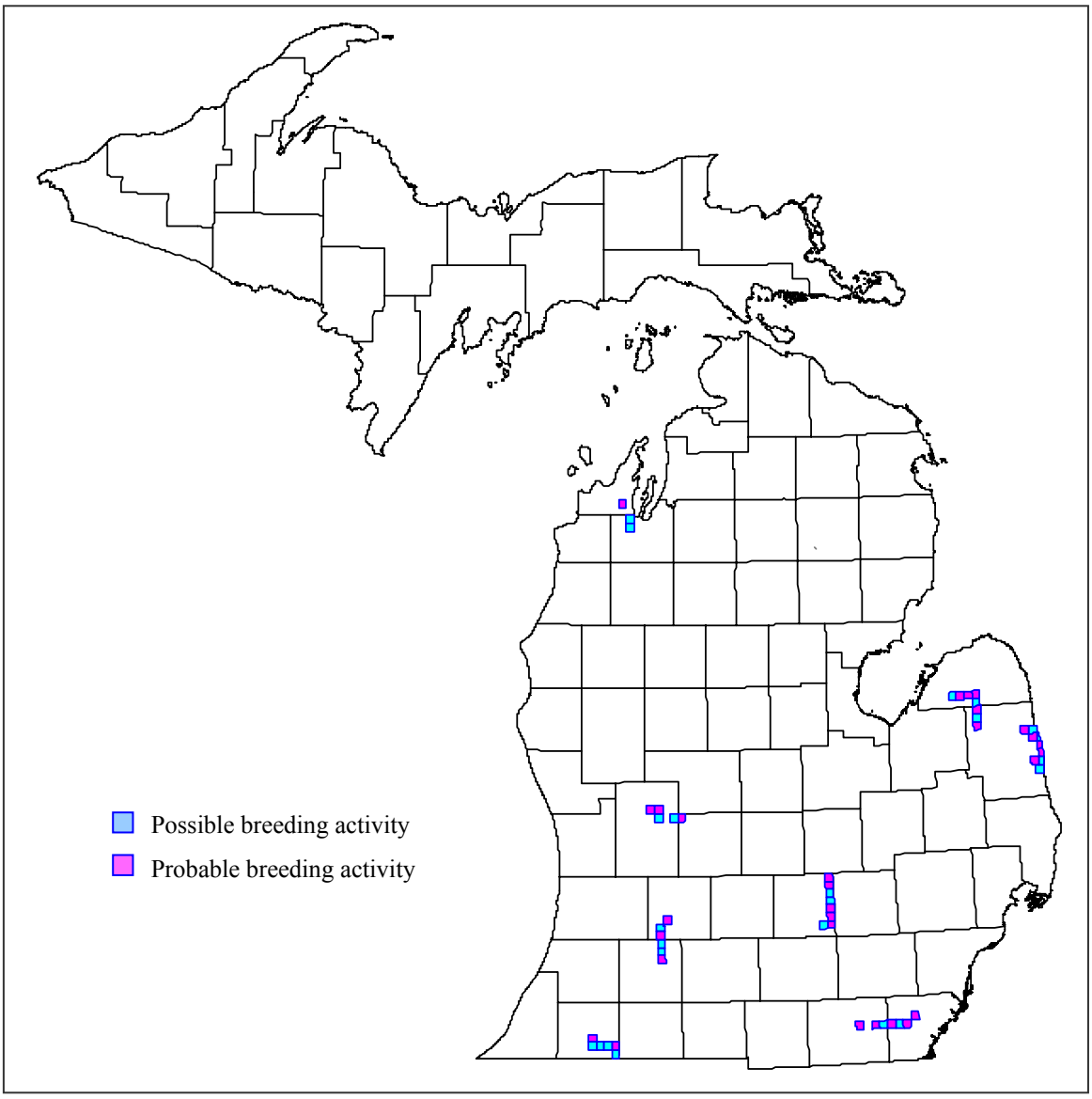

Figure 3. Observed breeding status for Eastern Screech-Owl by MBBA II survey block as determined from surveys conducted in Michigan during 2004.

Figure 4. Observed breeding status for Long-eared Owl by MBBA II survey block as determined from surveys conducted in Michigan during 2004.

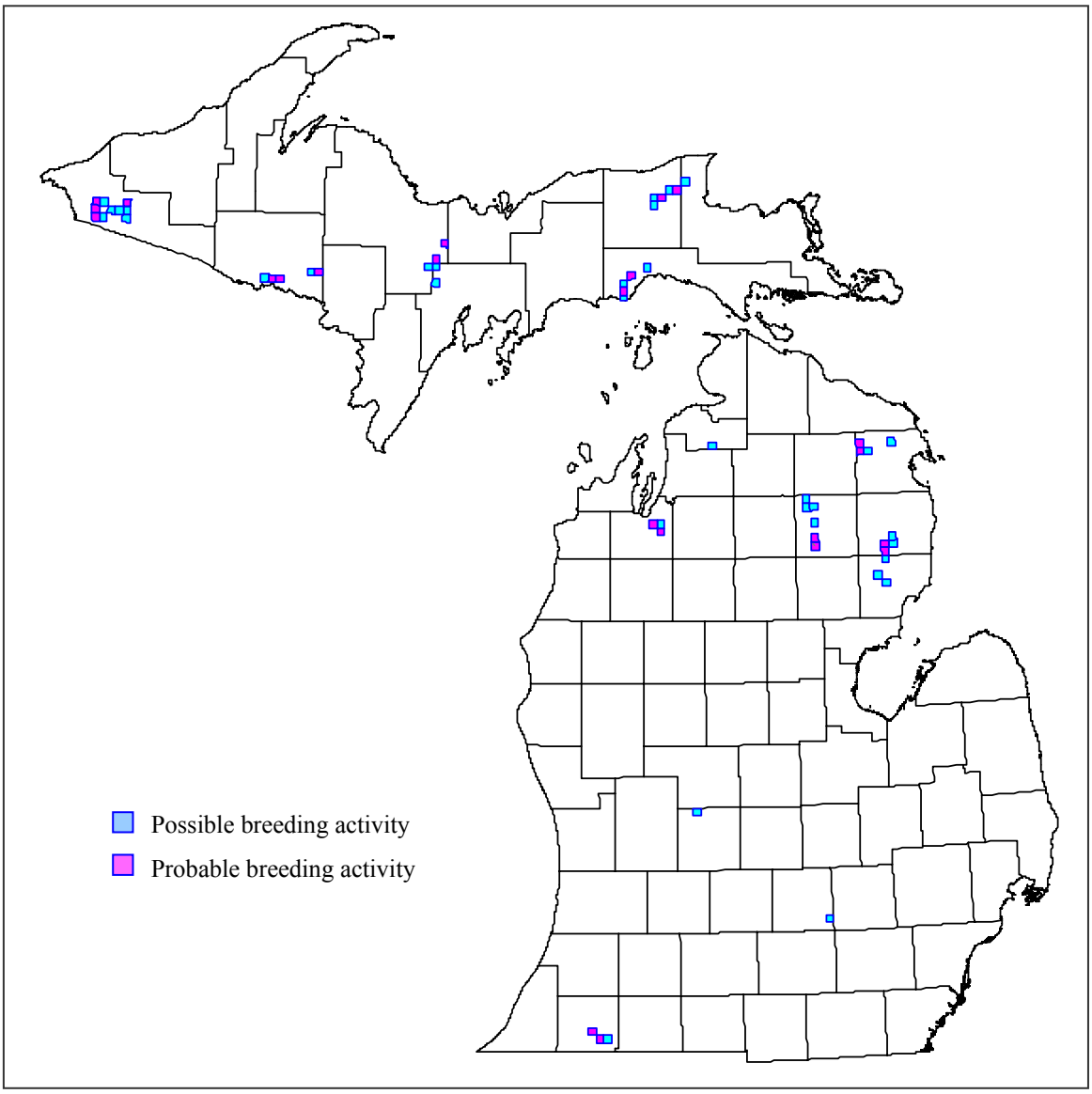

Figure 5. Observed breeding status for Barred Owl by MBBA II survey block as determined from surveys conducted in Michigan during 2004.

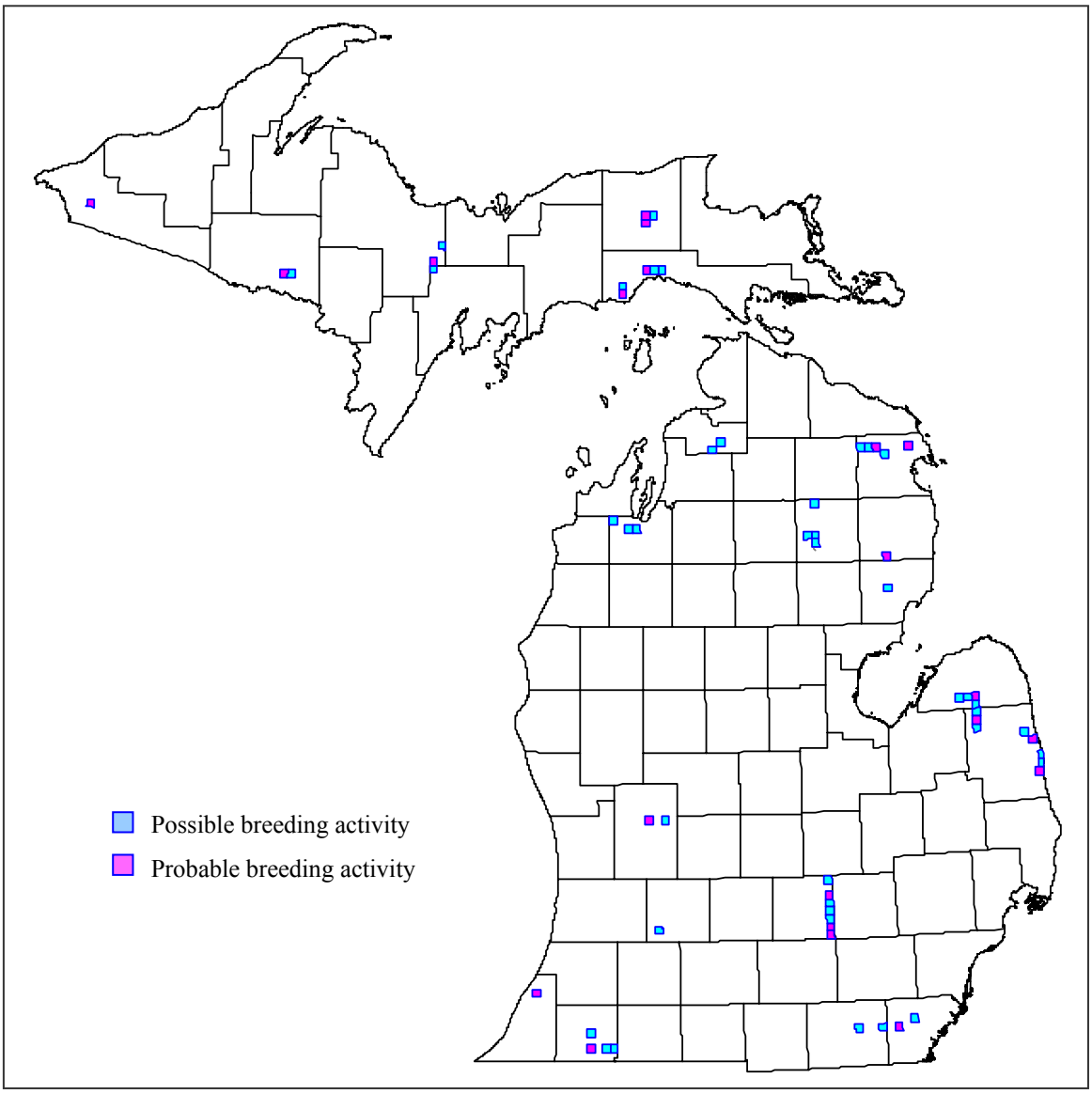

Figure 6. Observed breeding status for Great Horned Owl by MBBA II survey block as determined from surveys conducted in Michigan during 2004.

Table 3. Number of blocks with incidental species observations by region and breeding status (according to MBBA II criteria) from owl surveys conducted in Michigan in 2004.

	SLP		NLP		UP		
Species	**Possible**	**Probable**	**Possible**	**Probable**	**Possible**	**Probable**	**Total**
Canada Goose	3	---	---	---	2	1	6
Mallard	1	--	---	---	2	---	3
Ring-necked Pheasant	3	---	---	---	---	---	3
Ruffed Grouse	1	---	2	---	4	---	7
Wild Turkey	---	---	---	---	1	---	1
Sandhill Crane	---	---	---	---	4	---	4
Killdeer	3	---	---	---	---	---	3
American Woodcock	15	1	16	---	7	---	39
Common Snipe	1	---	---	---	---	---	1
Mourning Dove	2	---	---	---	---	---	2
Horned Lark	1	---	---	---	---	---	1
American Robin	2	---	---	---	---	---	2
Northern Cardinal	1	---	---	---	---	---	1
Song Sparrow	2	---	---	---	---	---	2
Total	35	1	18	---	20	1	75

We documented estimated repeat detections (i.e. the same owl species observed at the same approximate location at more than one station) for Northern Saw-whet Owl, Barred Owl, and Great Horned Owl. All of the Northern Saw-whet Owl repeat detections occurred in the UP, which represented 12.0% of the total. We estimated the mean distance of Northern Saw-whet Owl repeat observations at 1.5 km (n = 3, range 0.8 – 2.0 km). An estimated 4.8 and 4.1% of the Barred Owls recorded in the NLP and UP, respectively, were heard at more than one point. The mean distance of Barred Owl repeat observations was 1.5 km (n = 8, range 0.7 – 2.2 km). Repeat observations appeared to be most common for Great Horned Owl, which we estimated to occur in 10.3% of the 105 observations. While an estimated 6.5 and 8.0% of the Great Horned Owls had repeat detections in the SLP and NLP, respectively, 20.7% of our UP observations were recorded at more than one station. Great Horned Owl repeat detections occurred at an average distance of 1.8 km (n = 15, range 1.2 – 2.9 km).

Principal Components Analysis

Our PCA of the landscape surrounding survey stations indicated that the first three principal components explained the majority of the variation among sites for each species. The eigenvectors, eigenvalue, percent of variation explained, and cumulative percent of variation explained are provided for each principal component (PC) in Table C-1 (Appendix C). The PCA of SLP sites used in Eastern Screech-Owl analyses showed an inverse relationship between the three forest types and nonforested habitat for PC1, which explained the majority of the variation. Eigenvectors for PC2 indicate that as coniferous and mixed forest increased, proportions of urban cover decreased. PC3 represented an inverse relationship of deciduous forest versus urban cover and coniferous forest. PCA of the NLP and UP sites used in Barred Owl analyses indicated an inverse relationship between forest and nonforested cover for PC1. Eigenvectors for PC2 primarily showed that coniferous forest decreased as deciduous forest increased at Barred Owl sites. PC3 represented an inverse relationship of deciduous forest versus urban and mixed forest cover. The PCA of the landscape surrounding sites used in Great Horned Owl analyses indicated an inverse relationship between nonforested cover and coniferous and mixed forest for PC1, which explained 44.3% of the variation among

sites. For PC2, eigenvectors indicate that as deciduous forest increased, coniferous forest decreased. PC3 primarily represented an inverse relationship of urban cover and deciduous forest for Great Horned Owl survey sites.

Survey Efficacy

Our preliminary testing of equal length survey blocks before and after broadcasts indicated that response to calls varied by species and survey period. During the third survey, the number of Northern Saw-whet Owl responses was higher after the Boreal Owl broadcast than before ($p=0.002$). We consistently observed Eastern Screech-Owls more often after conspecific calls were broadcast than before during each survey period ($p \leq 0.013$). The result was the same whether we compared two-min (first silent vs. Eastern Screech-Owl period) or four-min (first silent + Northern Saw-whet periods vs. Eastern Screech-Owl + Long-eared Owl periods) blocks of the survey. There was no difference in the number of Barred Owl responses when we compared the first silent and Barred Owl broadcast periods. When we compared Barred Owl responses between four-min blocks (first silent + Northern Saw-whet or Boreal Owl periods vs. Barred Owl + Great Gray or Great Horned Owl periods), more responses were observed after broadcast than before during the second survey ($p=0.017$) but not during the first or third periods. Significantly fewer Great Horned Owl responses were observed after conspecific broadcast than before during all survey periods when we compared the first silent period with the Great Horned Owl broadcast period ($p \leq 0.031$). When we compared four-min blocks (first silent + Northern Saw-whet Owl or Boreal Owl periods vs. Great Horned Owl + final silent periods), the number of responses was similar before and after broadcast during the first and third periods but significantly lower after broadcast than before during the second survey ($p=0.016$).

The observed proportion of sites occupied (naïve estimate), estimated proportion of sites occupied (ψ), and estimated probability of detection (p) varied among owl species and surveys (Table 4). The best supported models for each species included the environmental variables wind or noise (Table 4).

Our best-approximating model for Eastern Screech-Owl included the covariates PC1, PC2, survey effects, and wind. Estimated site occupancy was approximately 30% higher than the observed proportion of sites where Eastern Screech-Owl was present. Detection probability varied among surveys, with the highest probability occurring during the second survey. Assuming a mean detection probability of 0.43, we estimated a minimum of five (rounded to the nearest whole number) visits would be required to achieve 95% certainty that Eastern Screech-Owl is not present at a site. The estimated proportion of sites occupied was negatively related to PC1 and positively related to PC2, which indicates that site occupancy increased with increasing levels of nonforested and urban/suburban cover and decreasing proportions of forest near the sites.

The Barred Owl model best supported by our data included PC1, survey effects, and noise level as covariates (Table 4). Our observed proportion of sites with Barred Owl observations was 28% lower than the model-estimated site occupancy rate. Estimated probability of detection varied by survey and was highest during the third period. Based on the average detection probability (0.37), we estimate that seven surveys would be needed to have 95% confidence that Barred Owl is not present at a survey station. The estimated proportion of sites occupied by Barred Owl was negatively related to the PC1 habitat variable, suggesting that site occupancy rate increased with increasing proportions of forest surrounding the sites.

Table 4. Summary of the model selection criteria and parameter estimates for three woodland owl species. Estimates of detection probability (p) are provided for the predefined (lacking site-specific and environmental covariates) and best-approximating models. ΔAIC is the difference between the model with the lowest AIC and the given model, w is the Akaike weight, ψ is the estimated proportion of sites occupied, and SE is the standard error of ψ.

Model	ΔAIC	w	K	$\hat{\psi}$ (SE)	$\hat{p}$
Eastern Screech-Owl (naïve $\hat{\psi}$ = 0.57)					
ψ(PC1,PC2)p(survey,wind)	0	0.867	6	0.74 (0.065)	0.41, 0.58, 0.30
ψ(PC1,PC2)p(survey,noise)	3.84	0.127	6	0.78 (0.070)	---
ψ(PC1,PC2)p(survey,temp)	11.38	0.003	6	0.73 (0.065)	---
ψ(PC2)p(survey)	11.66	0.003	4	0.73 (0.069)	---
ψ(PC1,PC2)p(survey,time)	14.71	0.001	6	0.71 (0.060)	---
ψ(PC1,PC2)p(survey)	18.98	0.000	5	0.71 (0.063)	---
ψ(PC1,PC2,PC3)p(survey)	19.95	0.000	7	0.70 (0.060)	---
ψ(PC1,PC2)p(survey,moon)	20.64	0.000	7	0.71 (0.066)	---
ψ(PC1)p(survey)	21.44	0.000	5	0.72 (0.068)	---
ψ(PC2,PC3)p(survey)	22.55	0.000	6	0.73 (0.068)	---
ψ(PC1,PC3)p(survey)	22.80	0.000	6	0.72 (0.065)	---
ψ(·)p(survey)	25.71	0.000	4	0.71 (0.065)	0.40, 0.60, 0.32
ψ(PC3)p(survey)	26.58	0.000	5	0.72 (0.065)	---
ψ(·)p(·)	38.07	0.000	2	0.74 (0.069)	0.42
Barred Owl (naïve $\hat{\psi}$ = 0.32)					
ψ(PC1)p(survey,noise)	0	0.602	6	0.41 (0.071)	0.15, 0.34, 0.62
ψ(PC1)p(survey)	4.14	0.076	5	0.38 (0.064)	---
ψ(PC1, PC2)p(survey)	4.26	0.072	6	0.39 (0.066)	---
ψ(PC1)p(survey,time)	4.74	0.062	6	0.39 (0.064)	---
ψ(PC1)p(survey,wind)	4.56	0.056	6	0.38 (0.062)	---
ψ(PC1)p(survey,moon)	5.09	0.047	6	0.38 (0.063)	---
ψ(PC1,PC3)p(survey)	6.13	0.028	6	0.38 (0.064)	---
ψ(PC1,PC2,PC3)p(survey)	6.25	0.028	7	0.39 (0.067)	---
ψ(PC1)p(survey,temp)	6.13	0.026	6	0.38 (0.064)	---
ψ(·)p(·)	29.21	0.001	2	0.43 (0.079)	0.38
ψ(·)p(survey)	12.42	0.001	4	0.38 (0.065)	0.18, 0.38, 0.71
ψ(PC2)p(survey)	12.48	0.000	5	0.38 (0.064)	---
ψ(PC3)p(survey)	14.39	0.000	5	0.38 (0.065)	---
ψ(PC2,PC3)p(survey)	14.44	0.000	6	0.38 (0.064)	---
Great Horned Owl (naïve $\hat{\psi}$ = 0.25)					
ψ(PC1)p(noise)	0	0.680	4	0.70 (0.081)	0.14
ψ(PC1)p(wind)	1.59	0.306	4	0.64 (0.107)	---
ψ(PC1)p(temp)	7.83	0.014	4	0.70 (0.079)	---
ψ(PC1)p(time)	16.72	0.000	4	0.70 (0.108)	---
ψ(PC1)p(·)	17.96	0.000	3	0.70 (0.109)	---
ψ(PC1)p(moon)	18.85	0.000	4	0.69 (0.108)	---
ψ(PC1,PC2)p(·)	18.91	0.000	4	0.67 (0.117)	---
ψ(PC2)p(·)	19.72	0.000	3	0.82 (0.116)	---
ψ(PC1,PC3)p(·)	19.89	0.000	4	0.82 (0.125)	---
ψ(PC1,PC2,PC3)p(·)	20.47	0.000	5	0.65 (0.117)	---
ψ(PC2,PC3)p(·)	21.66	0.000	4	0.73 (0.115)	---
ψ(·)p(·)	24.47	0.000	2	0.92 (0.400)	0.10
ψ(PC3)p(·)	26.05	0.000	3	0.84 (0.275)	---
ψ(·)p(survey)	26.16	0.000	4	0.89 (0.322)	0.09, 0.14, 0.09

Our best-approximating Great Horned Owl model included the covariates PC1 and noise level. Model-estimated site occupancy rate was nearly three times as high as the observed proportion of sites with Great Horned Owl detections. Detection probability was low and constant among survey periods. Given the low detection probability, we estimate it would take a minimum of 20 visits to a site to have 95% certainty that Great Horned Owl is absent. Great Horned Owl site occupancy was negatively related to the habitat variable PC1, indicating higher occupancy rates with increasing proportions of nonforested habitat at the sites.

Landscape-level Habitat

While we found differences in landscape-level habitat between owl locations and survey stations for the Eastern Screech-Owl and Barred Owl, the proportion of habitat surrounding Northern Saw-whet and Great Horned Owl positions were similar to survey stations for most categories (Table 5). The landscape surrounding the locations of all four species had lower proportions of urban area compared to survey stations for one or more of the buffer sizes. We observed lower proportions of herbaceous upland and higher amounts of tilled agriculture, nonforested wetland, and deciduous forest in the 500-m buffer surrounding Eastern Screech-Owl positions when compared to survey stations. Barred Owl locations had significantly lower proportions of water and herbaceous upland compared to survey stations at one or more buffer levels. We found higher proportions of deciduous forest at three of four buffer levels surrounding Barred Owl positions when compared to survey stations.

DISCUSSION

Atlas Data

While the 2004 owl survey succeeded in finding 456 owls in 204 MBBA II survey blocks, it required substantial resources, including over 1,500 man-hours of survey time. This highlights the need for long-term focused owl surveys in order to gather the information needed to adequately monitor these species. While population data is needed for all owl species, it is especially important for species such as the State-threatened Long-eared Owl, which we only observed on three survey blocks. Continued surveys would provide for increased coverage of the State for Atlas purposes, refinement of survey protocols, a better understanding of breeding phenology and landscape habitat use, and additional opportunities to document rare owl species, such as the nesting Great Gray Owl found in 2004 (Baetsen 2004).

Nest Searches

We found that nest searching was not an effective means of confirming owl breeding during this project, and the level of effort required to adequately search for owl nests was beyond the scope of this study. During future surveys we recommend putting additional effort into broadcast surveys rather than searching for nests.

Survey Efficacy

A number of studies have shown increased rates of calling in response to broadcast conspecific calls for several owl species (Fuller and Mosher 1981, Gerhardt 1991, Morrell et al. 1991, Hardy and Morrison 2000, Proudfoot et al. 2002). While we observed similar results for the Northern Saw-whet Owl and Eastern Screech-Owl, Barred and Great Horned Owl response patterns were inconsistent. Unlike previous research, we observed fewer Great Horned Owl responses after conspecific broadcast compared to before in most of our comparisons. However, our study was not specifically designed to test broadcast effectiveness, and it is unknown what affect the playing of calls from several species prior to the Great Horned Owl broadcast had

Table 5. Comparison of mean proportions and standard errors of landscape habitat categories between survey stations and estimated owl locations recorded during surveys conducted in Michigan in 2004. Bold-faced type indicates significant difference at $\alpha \leq 0.0.5$.

Habitat	Buffer	Northern Saw-whet Owl				Eastern Screech-Owl				Barred Owl				Great Horned Owl			
		Stations		Owl Locations		Stations		Owl Locations		Stations		Owl Locations		Stations		Owl Locations	
Category[a]	Radius (m)	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
UR	500	**0.065**	**0.017**	**0.035**	**0.009**	**0.053**	**0.003**	**0.047**	**0.003**	**0.038**	**0.003**	**0.021**	**0.003**	**0.059**	**0.008**	**0.035**	**0.006**
	1000	0.044	0.010	0.040	0.010	**0.046**	**0.003**	**0.043**	**0.003**	0.026	0.003	0.019	0.002	**0.044**	**0.006**	**0.037**	**0.005**
	2000	0.026	0.004	0.025	0.004	**0.044**	**0.002**	**0.043**	**0.002**	0.020	0.003	0.019	0.002	0.039	0.006	0.040	0.006
	5000	0.023	0.004	0.023	0.004	0.046	0.002	0.046	0.002	0.017	0.002	0.017	0.002	0.039	0.006	0.038	0.006
AG	500	0.016	0.014	0.001	0.001	0.278	0.018	0.276	0.018	0.006	0.004	0.009	0.005	0.161	0.032	0.169	0.035
	1000	0.013	0.011	0.007	0.005	0.287	0.016	0.295	0.016	0.006	0.004	0.007	0.003	0.149	0.028	0.168	0.031
	2000	0.009	0.008	0.009	0.008	**0.304**	**0.016**	**0.309**	**0.016**	0.004	0.001	0.004	0.001	0.161	0.027	0.165	0.028
	5000	0.005	0.003	0.006	0.003	0.301	0.014	0.302	0.014	0.004	0.001	0.004	0.001	0.161	0.026	0.160	0.026
HU	500	0.074	0.025	0.055	0.019	**0.394**	**0.014**	**0.365**	**0.013**	0.130	0.024	0.096	0.019	0.337	0.032	0.284	0.030
	1000	0.061	0.017	0.070	0.021	0.390	0.011	0.382	0.011	**0.109**	**0.019**	**0.093**	**0.016**	0.310	0.026	0.284	0.027
	2000	0.072	0.020	0.074	0.019	0.383	0.011	0.384	0.010	**0.097**	**0.014**	**0.093**	**0.014**	0.291	0.024	0.279	0.025
	5000	0.075	0.017	0.075	0.017	0.389	0.010	0.388	0.009	0.096	0.012	0.095	0.012	0.293	0.024	0.294	0.023
WT	500	0.069	0.023	0.066	0.024	**0.052**	**0.004**	**0.059**	**0.005**	0.107	0.021	0.080	0.014	0.084	0.019	0.098	0.021
	1000	0.073	0.024	0.063	0.021	0.053	0.003	0.054	0.003	0.097	0.016	0.085	0.013	0.095	0.017	0.093	0.018
	2000	0.071	0.016	0.067	0.017	0.051	0.003	0.050	0.003	0.095	0.013	0.096	0.013	0.101	0.016	0.094	0.014
	5000	0.076	0.012	0.075	0.012	0.050	0.002	0.050	0.002	0.094	0.010	0.094	0.010	0.097	0.014	0.096	0.013
WA	500	0.005	0.003	0.013	0.012	0.006	0.002	0.006	0.002	**0.003**	**0.002**	**0.000**	**0.000**	0.004	0.002	0.025	0.015
	1000	0.007	0.004	0.006	0.004	0.005	0.001	0.005	0.001	0.003	0.002	0.004	0.002	0.008	0.003	0.028	0.013
	2000	0.010	0.005	0.010	0.005	0.011	0.002	0.011	0.002	0.012	0.004	0.010	0.003	0.014	0.004	0.023	0.009
	5000	0.011	0.003	0.011	0.004	0.015	0.002	0.014	0.002	0.023	0.004	0.023	0.004	0.016	0.003	0.015	0.003
BA	500	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001
	1000	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001
	2000	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001
	5000	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.002	<0.001	0.002	<0.001	0.002	<0.001	0.001	<0.001
DF	500	0.432	0.051	0.519	0.063	**0.175**	**0.010**	**0.203**	**0.011**	**0.438**	**0.038**	**0.485**	**0.036**	0.205	0.026	0.237	0.026
	1000	0.454	0.037	0.496	0.045	0.180	0.008	0.182	0.009	**0.448**	**0.033**	**0.474**	**0.033**	0.238	0.023	0.228	0.023
	2000	0.475	0.038	0.496	0.033	0.169	0.007	0.167	0.007	**0.433**	**0.027**	**0.448**	**0.028**	0.230	0.021	0.224	0.021
	5000	0.463	0.033	0.463	0.030	0.163	0.006	0.163	0.006	0.397	0.020	0.398	0.020	0.218	0.017	0.218	0.016
CF	500	0.203	0.034	0.169	0.037	0.028	0.004	0.028	0.004	0.183	0.029	0.204	0.029	0.117	0.025	0.112	0.020
	1000	0.223	0.033	0.186	0.027	0.026	0.003	0.025	0.003	0.219	0.027	0.229	0.027	0.118	0.023	0.127	0.024
	2000	0.214	0.028	0.198	0.021	0.025	0.003	0.025	0.003	0.249	0.026	0.246	0.025	0.130	0.024	0.139	0.026
	5000	0.232	0.027	0.230	0.024	0.023	0.002	0.024	0.002	0.280	0.022	0.280	0.021	**0.142**	**0.024**	**0.143**	**0.024**

Table 6. Continued.

Habitat	Buffer	Northern Saw-whet Owl				Eastern Screech-Owl				Barred Owl				Great Horned Owl			
		Stations		Owl Locations		Stations		Owl Locations		Stations		Owl Locations		Stations		Owl Locations	
Category[a]	Radius (m)	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
MF	500	0.137	0.031	0.141	0.032	0.014	0.001	0.015	0.001	0.094	0.011	0.104	0.012	0.034	0.007	0.038	0.007
	1000	0.124	0.023	0.131	0.025	0.013	0.001	0.013	0.001	0.091	0.010	0.089	0.009	0.036	0.007	0.034	0.006
	2000	0.121	0.017	0.120	0.017	0.012	0.001	0.012	0.001	0.086	0.008	0.084	0.008	0.033	0.006	0.034	0.006
	5000	0.115	0.012	0.116	0.012	0.011	0.001	0.011	0.001	0.088	0.007	0.088	0.007	0.033	0.005	0.034	0.006

[a] Habitat categories: UR = urban, AG = tilled agricultural, HU = herbaceous upland, DF = deciduous forest, CF = coniferous forest, MF = mixed forest, WT = nonforested wetland, WA = water, and BA = bare/sparsely vegetated.

on that species' responsiveness. Barred Owl was only observed more often after broadcast compared to before in one of the six comparisons we made. McGarigal and Fraser (1985) observed a 62.5% Barred Owl response rate to broadcast conspecific calls; however, the authors did not include a prebroadcast period to determine if calls increased owl detections. Barred Owl was the only species observed at a higher rate after conspecific broadcasts were played during surveys conducted in Alberta (Takats and Holroyd 1997). More data are needed before clear conclusions can be made about the effectiveness of broadcast call techniques for owl surveys in Michigan.

Our preliminary results indicate that, depending on the goal of future surveys, substantially more survey effort would be required to determine if forest-nesting owls are present at a given site. For example, we estimated that five surveys would be needed for Eastern Screech-Owl and seven surveys for Barred Owl to achieve 95% confidence that these species are absent from a given site. However, methodologies such as ours that employ three to four surveys would likely be able to reach an 80% confidence level for these species. Given the low detection probability and high estimated site occupancy for Great Horned Owl, our survey protocol did not appear to adequately survey this species. Additional work will be needed to determine the effects that home range size, survey timing, and geographic region have on Great Horned Owl detectability. Barred Owl detection probability doubled during each subsequent survey, most likely due to increased breeding activity. Since Barred Owls tend to nest later than other species, such as Eastern Screech-Owl and Great Horned Owl, it is not surprising that detectability was highest during the last survey. Courtship usually begins in late winter and vocalizations increase in intensity until egg-laying, which spans early March to early May (Ebbers 1991). We found that the second survey period was best overall for detecting Eastern Screech-Owls; however, more work is needed to determine if this is a consistent result.

The environmental variables wind and noise were important in the best-approximating models for the three species we examined. These variables were interrelated in that moderate to strong winds often increased the overall noise level through the movement of trees and leaves. The most common causes of elevated noise levels were automobile traffic and wind. Both of these variables could influence the detection of owls in three ways: 1) restricting the ability of observers to hear calling owls; 2) limiting the number of owls that can hear broadcasts and thus reducing the effective survey area; and 3) potentially changing the behavior of the owls such that calling is reduced or impeded. In the case of the Northern Saw-whet Owl, moderate winds may actually increase rate of singing while high winds have a negative affect (Johnsgard 2002). Morrell et al. (1991) observed reduced Great Horned Owl responses with increasing wind speed, and never heard any owls when the wind speed exceeded 19 km/h. Wind has also been found to affect the detection of Mottled Owl (*Ciccaba virgata*), Elf Owl (*Micrathene whitneyi*), and Western Screech-Owl (*Megascops kennicottii*) (Hardy and Morrison 2000, Gerhardt 1991).

We recommend future surveys experiment with different levels of survey intensity, such as more surveys at a sub-sample of sites. Adding survey periods that occur earlier (e.g. mid December to mid January) or later (e.g. mid April to mid May) than were used in 2004 may improve the detection of Great Horned Owl, Long-eared Owl, and Northern Saw-whet Owl. Additional research is needed to determine if broadcast call surveys are effective for all owl species, what the optimal spacing of survey stations is for each target species, the effective distance covered by broadcast calls, and the impact of environmental variables on responsiveness and detectability. Future data collection and analysis should also explore at what wind

speed and noise level detections significantly decline.

Landscape-level Habitat

Preliminary comparisons of the surrounding landscape between our survey stations and estimated owl locations revealed some general trends for Eastern Screech-Owl and Barred Owl, but not for Northern Saw-whet or Great Horned Owls. All four species showed lower amounts of urban cover compared to survey stations; however, this is likely biased by having our stations located along roads where urban development is more likely to occur. Higher amounts of tilled agriculture and nonforested wetland surrounding Eastern Screech-Owl locations could indicate use of these habitats and/or edges for foraging. Our best-approximating model for the Eastern Screech-Owl similarly indicated increasing estimated site occupancy with increasing proportions of nonforested habitat and decreasing amounts of forest among the survey sites. This species prefers forests interspersed with open habitats such as fields, marshes, and scrub (Carpenter 1991). We often observed Eastern Screech-Owls near farm buildings during our surveys. Carpenter (1991) noted that barns and abandoned buildings are regularly used for foraging and roosting. These farmsteads also typically had large deciduous trees that may provide cavities suitable for roosting and nesting. Higher proportions of deciduous forest near Screech-Owl locations would be expected given the species' preference for tree-dominated landscapes (Gehlbach 1995) and the prevalence of the forest type in the SLP. We observed lower amounts of herbaceous upland and higher proportions of deciduous forest surrounding Barred Owl observations compared to survey stations, which may be due to the species preference for large, unfragmented forests (Mazur and James 2000). The best supported model for Barred Owl showed a similar trend with an increasing estimated proportion of sites occupied with increasing proportions of forest at the sites. The model best supported by our data indicated that Great Horned Owl had higher estimated site occupancy rates with increasing proportions of nonforested cover among the sites. While this result may have been biased by analyzing data from all regions together, it is consistent with the ability of this species to adapt and thrive in fragmented landscapes. Great Horned Owls utilize a variety of forest types, and their home ranges typically include some open habitats of fields, wetlands, pastures, or croplands (Houston et al. 1998).

Our preliminary data suggests that owl presence is associated with landscape-level habitat. For example, Eastern Screech-Owl and Great Horned Owl presence appeared to be related to decreasing proportions of forest. However, more study is needed to determine the upper and lower thresholds of preferred habitats required to support forest-nesting owl species. Further comparisons of habitat surrounding owl locations should be made with systematically or randomly selected areas at both local and larger landscape scales in order to remove the bias of road sampling. Additional surveys may allow the development of habitat models that could be used to predict the occurrence of each species. Research is also needed to improve our understanding of woodland owl habitat use, nest site selection, and productivity in Michigan. Investigations that explore the effects of forest fragmentation and management on breeding owls would provide valuable information to wildlife managers and conservationists.

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LITERATURE CITED

Baetsen, R. 2004. Michigan's first documented nest of the Great Gray Owl. Unpublished report submitted to the Michigan Department of Natural Resources.

Burnham, K.P., and D.R. Anderson. 2002. Model selection and multimodel inference: a practical information-theoretic approach, second edition. Springer-Verlag, New York, NY. 488 pp.

Carpenter, T.W. 1991. Eastern Screech-Owl (*Otus asio*) species account. Pages 238-239 *in* The Atlas of Breeding Birds of Michigan (R. Brewer et al., eds.). Michigan State University Press, East Lansing, MI. 594 pp.

Ebbers, B.C. 1991. Barred Owl (*Strix varia*) species account. Pages 242-243 *in* The Atlas of Breeding Birds of Michigan (R. Brewer et al., eds.). Michigan State University Press, East Lansing, MI. 594 pp.

Fuller, M.R., and J.A. Mosher. 1981. Methods of detecting and counting raptors: a review. Studies in Avian Biology 6:235-246.

Gehlbach, F.R. 1995. Eastern Screech-Owl (*Otus asio*). *In* The Birds of North America, No. 165 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

Gerhardt, R.P. 1991. Response of Mottled Owls to broadcast of conspecific call. Journal of Field Ornithology 62(2):239-244.

Hardy, P.C., and M.L. Morrison. 2000. Factors affecting the detection of Elf Owls and Western Screech Owls. Wildlife Society Bulletin 28(2):333-342.

Houston, C.S., D.G. Smith, and C. Rohner. 1998. Great Horned Owl (*Bubo virginianus*). In The Birds of North America, No. 372 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Johnsgard, P.A. 2002. North American owls: biology and natural history, second edition. Smithsonian Institution Press, Washington, D.C. 298 pp.

Kalamazoo Nature Center. 2004. Michigan breeding bird atlas II handbook. 65 pp.

MacKenzie, D.I., J.D. Nichols, G.B. Lachman, S. Droege, J.A. Royle, and C.A. Langtimm. 2002. Estimating site occupancy rates when detection probabilities are less than one. Ecology 83(8):2248-2255.

_____, _____, J.E. Hines, M.G. Knutson, and A.B. Franklin. 2003. Estimating site occupancy, colonization, and local extinction when a species is detected imperfectly. Ecology 84(8):2200-2207.

McGarigal, K., and J.D. Fraser. 1985. Barred owl responses to recorded vocalizations. Condor 87:552-553.

Mazur, K.M., and P.C. James. 2000. Barred Owl (*Strix varia*). *In* The Birds of North America, No. 508 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

McPeek, G.A. and R.J. Adams, Jr. 1991. The atlas survey. Pages 1-10 *in* The Atlas of Breeding Birds of Michigan (R. Brewer et al., eds.). Michigan State

University Press, East Lansing, MI. 594 pp.

Morrell, T.M., R.H. Yahner, and W.L. Harkness. 1991. Factors affecting detection of Great Horned Owls by using broadcast vocalizations. Wildlife Society Bulletin 19(4):481-488.

Proudfoot, G.A., S.L. Beasom, F. Chavez-Ramirez, and J.L. Mays. 2002. Response distance of Ferruginous Pygmy-Owls to broadcast conspecific calls. Journal of Raptor Research 36(3):170-175.

Reed, J.M. 1996. Using statistical probability to increase confidence of inferring species extinction. Conservation Biology 10(4):1283-1285.

Sall, J., L. Creighton, and A. Lehman. 2005. JMP start statistics: a guide to statistics and data analysis using JMP and JMP IN software. Brooks/Cole – Thomson Learning, Belmont, CA. 560 pp.

Takats, D.L., C.M. Francis, G.L. Holroyd, J.R. Duncan, K.M. Mazur, R.J. Cannings, W. Harris, and D. Holt. 2001. Guidelines for nocturnal owl monitoring in North America. Beaverhill Bird Observatory and Bird Studies Canada, Edmonton, Alberta. 32 pp.

_____, and G.L. Holroyd. 1997. Owl broadcast surveys in the Foothills Model Forest, Alberta, Canada. In Biology and Conservation of Owls of the Northern Hemisphere (J.R. Duncan et al., eds.). USDA Forest Service General Technical Report NC-190.

Zar, J.H. 1996. Biostatistical analysis, third edition. Prentice Hall, Upper Saddle River, NJ. 662 pp. + appendices.

APPENDIX A

GIS Landscape Category Descriptions

Table A-1. Landscape categories and IFMAP classes used in land cover analysis of point-count stations and estimated owl locations from woodland owl surveys conducted in Michigan in 2004.

Landscape Categories and Associated IFMAP Class Names and Grid Values ()	Class Descriptions
Urban (UR)	
Low Intensity Urban (Residential) (1)	Land area >10% and <25% manmade structures, including paved and gravel roads and parking lots.
High Intensity Urban (2)	Land area >25% solid impervious cover made from man-made materials, other than airports, roads, or parking lots.
Airports (3)	Impervious land within airport grounds, including runways.
Roads / Pavement (4)	Roads or parking lots.
Tilled Agricultural (AG)	
Non-vegetated agriculture (5)	Land area tilled for crop production with <25% currently vegetated.
Row Crops (6)	Vegetation is annual crops planted in rows (e.g. corn, soybeans).
Herbaceous Upland (HU)	
Forage Crops (7)	Vegetation used for fodder production (e.g. alfalfa, hay). Also includes land used for pasture, or non-tilled herbaceous agriculture.
Herbaceous Openland (10)	<25% of land area is covered by woody cover.
Low Density Trees (12)	The combination of woody shrubs and trees is >25% of the land area and >25% of the woody cover is trees. None mapped in SLP.
Parks, Golf Courses (13)	Upland open land maintained for recreational purposes.
Deciduous Forest (DF)	
Northern Hardwoods (14)	Combination of maples, beech, basswood, white ash, cherry, and yellow birch >60% of the canopy.
Oak Type (15)	Proportion of oaks >60% of the canopy.
Aspen Type (16)	Proportion of aspen >40% of the canopy.
Other Upland Deciduous (17)	Proportion of any other single species >60% of the canopy.
Mixed Upland Deciduous (18)	Proportion of deciduous trees >60% of the canopy.
Lowland Deciduous Forest (24)	Proportion of deciduous trees >60% of the canopy.
Coniferous Forest (CF)	
Pines (19)	Proportion of pines >60% of the canopy.
Other Conifers (20)	Proportion of non-pine upland conifers >60% of the canopy.
Mixed Upland Conifers (21)	Proportion of coniferous trees >60% of the canopy. None mapped in SLP.
Lowland Coniferous Forest (25)	Proportion of coniferous trees >60% of the canopy.

Table A-1. Continued.

Mixed Forest (MF)	
Upland Mixed Forest (22)	Mixed forest not falling into any other category. Proportion of conifers:deciduous ranges between 40%:60% to 60%:40%.
Lowland Mixed Forest (26)	Mixed forest not falling into any other category. Proportion of conifers:deciduous ranges between 40%:60% to 60%:40%.
Nonforested Wetland (WT)	
Floating Aquatic (27)	Proportion of floating aquatic vegetation >60% of non-water cover.
Lowland Shrub (28)	Proportion of lowland shrub >60% of non-water cover.
Emergent Wetland (29)	Proportion of emergent wetland >60% of non water cover.
Mixed Non-forest Wetland (30)	Non-forested wetlands not falling into any other category.
Water (WA)	
Water (23)	Proportion of open water >75% of the land area.
Bare/Sparsely Vegetated (BA)	
Sand, Soil (31)	Land cover is formed primarily of sand or bare soil.
Exposed rock (32)	Land cover is formed of solid rock. None mapped in SLP.
Other Bare\Sparsely Vegetated (35)	None.

APPENDIX B

Michigan Breeding Bird Atlas Data by Survey Block

Table B-1. Owl observation data by MBBA II survey block from surveys conducted in Michigan in 2004.

Species[a]	Owl Observation ID	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
BDOW	BDOW 053-2-01	1	02/19/2004	DC, CP	X	01N	02E	10	1	Y	Stockbridge	Ingham
BDOW	BDOW 039-3-01	1	04/08/2004	JB, BS	X	07S	13W	32	3	Y	Porter	Cass
BDOW	BDOW 039-2b-01/02	2	03/08/2004	JB	P	07S	14W	8	2	Y	Calvin	Cass
BDOW	BDOW 039-3-02/03	2	04/08/2004	JB, BS	P	07S	14W	26	4	Y	Calvin	Cass
BDOW	BDOW 034-1-01	1	01/20/2004	MM, PP	#	08N	07W	6	2	Y	Orleans	Ionia
BDOW	BDOW 034-2-01	1	02/19/2004	DC, CP	#	08N	07W	6	2	Y	Orleans	Ionia
BDOW	BDOW 061-3-03	1	03/31/2004	MM, DC	X	23N	06E	9	2	Y	Plainfield	Iosco
BDOW	BDOW 061-3-04	1	03/31/2004	MM, DC	X	23N	06E	9	2	Y	Plainfield	Iosco
BDOW	BDOW 061-3-02b	1	03/31/2004	MM, DC	X	23N	06E	16	2	Y	Plainfield	Iosco
BDOW	BDOW 061-3-01	1	03/31/2004	MM, DC	X	23N	06E	35	4	N	Plainfield	Iosco
BDOW	BDOW 061-3-02	1	03/31/2004	MM, DC	X	23N	06E	35	4	N	Plainfield	Iosco
BDOW	BDOW 061-3-05/06	2	03/31/2004	MM, DC	P	24N	06E	1	1	N	Oscoda	Iosco
BDOW	BDOW 061-2-01/02	2	02/25/2004	MM, CP	P	24N	06E	14	1	N	Oscoda	Iosco
BDOW	BDOW 047-3-06/07	2	04/01/2004	MM, DC	P	25N	02E	6	2	Y	Big Creek	Oscoda
BDOW	BDOW 047-1-01	1	02/01/2004	MM, CP	X	25N	02E	7	2	Y	Big Creek	Oscoda
BDOW	BDOW 047-2-05/06	2	02/28/2004	MM, CP	P	25N	02E	7	2	Y	Big Creek	Oscoda
BDOW	BDOW 047-2-07	1	02/28/2004	MM, CP	X	25N	02E	17	2	Y	Big Creek	Oscoda
BDOW	BDOW 047-3-08	1	04/01/2004	MM, DC	P	25N	02E	17	2	Y	Big Creek	Oscoda
BDOW	BDOW 061-1-02	1	01/31/2004	MM, CP	X	25N	06E	12	1	N	Curtis	Alcona
BDOW	BDOW 061-2-06	1	02/26/2004	MM, CP	X	25N	06E	12	1	N	Curtis	Alcona
BDOW	BDOW 061-3-09/10	2	04/01/2004	MM, DC	P	25N	06E	12	1	N	Curtis	Alcona
BDOW	BDOW 061-1-01	1	01/31/2004	MM, CP	X	25N	06E	24	4	Y	Curtis	Alcona
BDOW	BDOW 061-2-05	1	02/26/2004	MM, CP	X	25N	06E	24	4	Y	Curtis	Alcona
BDOW	BDOW 061-3-07	1	04/01/2004	MM, DC	P	25N	06E	24	4	Y	Curtis	Alcona
BDOW	BDOW 061-3-08	1	04/01/2004	MM, DC	P	25N	06E	24	4	Y	Curtis	Alcona
BDOW	BDOW 061-2-04	1	02/26/2004	MM, CP	X	25N	06E	25	4	Y	Curtis	Alcona
BDOW	BDOW 061-2-03	1	02/25/2004	MM, CP	X	25N	06E	35	4	Y	Curtis	Alcona
BDOW	BDOW 061-3-11	1	04/01/2004	MM, DC	X	25N	07E	6	2	Y	Mikado	Alcona
BDOW	BDOW 061-2-07	1	02/26/2004	MM, CP	X	25N	07E	7	2	Y	Mikado	Alcona
BDOW	BDOW 061-2-08	1	02/26/2004	MM, CP	X	25N	07E	7	2	Y	Mikado	Alcona
BDOW	BDOW 047-3-02	1	04/01/2004	MM, DC	X	26N	02E	18	2	N	Big Creek	Oscoda
BDOW	BDOW 047-3-03	1	04/01/2004	MM, DC	X	26N	02E	29	3	Y	Big Creek	Oscoda
BDOW	BDOW 047-3-04/05	2	04/01/2004	MM, DC	P	26N	02E	32	3	Y	Big Creek	Oscoda
BDOW	BDOW 061-1-03	1	01/31/2004	MM, CP	X	26N	07E	30	3	Y	Millen	Alcona
BDOW	BDOW 061-3-12	1	04/01/2004	MM, DC	X	26N	07E	31	3	Y	Millen	Alcona

Table B-1. Continued.

Species[a]	Owl Observation ID	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
BDOW	BDOW 130-3-04/05	2	04/02/2004	MM, DC	P	26N	09W	4	2	Y	Union	Grand Traverse
BDOW	BDOW 047-2-04	1	02/28/2004	MM, CP	X	27N	02E	19	3	Y	Elmer	Oscoda
BDOW	BDOW 130-3-03	1	04/02/2004	MM, DC	X	27N	09W	33	3	Y	Whitewater	Grand Traverse
BDOW	BDOW 130-2-02	1	03/04/2004	MM, CP	X	27N	10W	25	4	N	East Bay	Grand Traverse
BDOW	BDOW 130-2-01	1	03/04/2004	MM, CP	X	27N	10W	26	4	N	East Bay	Grand Traverse
BDOW	BDOW 130-3-01	1	04/02/2004	MM, DC	X	27N	10W	26	4	N	East Bay	Grand Traverse
BDOW	BDOW 130-3-02	1	04/02/2004	MM, DC	X	27N	10W	36	4	N	East Bay	Grand Traverse
BDOW	BDOW 047-2-01	1	02/27/2004	MM, CP	X	28N	01E	12	1	Y	Greenwood	Oscoda
BDOW	BDOW 047-2-03	1	02/27/2004	MM, CP	X	28N	01E	25	4	N	Greenwood	Oscoda
BDOW	BDOW 047-2-02	1	02/27/2004	MM, CP	X	28N	02E	19	3	N	Elmer	Oscoda
BDOW	BDOW 047-3-01	1	03/31/2004	MM, DC	X	28N	02E	30	3	N	Elmer	Oscoda
BDOW	BDOW 059-2-02	1	02/26/2004	MM, CP	X	31N	05E	3	1	Y	Wellington	Alpena
BDOW	BDOW 059-1-01	1	02/03/2004	MM, CP	X	31N	05E	4	2	Y	Wellington	Alpena
BDOW	BDOW 059-2-04/05	2	02/26/2004	MM, CP	P	31N	05E	5	2	Y	Wellington	Alpena
BDOW	BDOW 059-3-05/06	2	04/07/2004	MM, CP	P	31N	05E	6	2	Y	Wellington	Alpena
BDOW	BDOW 059-2-03	1	02/26/2004	MM, CP	X	32N	05E	33	3	N	Wellington	Alpena
BDOW	BDOW 059-3-03/04	2	04/07/2004	MM, CP	P	32N	05E	33	3	N	Wellington	Alpena
BDOW	BDOW 043-3-03	1	04/06/2004	MM, CP	X	32N	06W	36	4	N	Wilson	Charlevoix
BDOW	BDOW 059-2-01	1	02/26/2004	MM, CP	#	32N	07E	21	3	N	Maple Ridge	Alpena
BDOW	BDOW 059-3-01	1	04/06/2004	MM, CP	X	32N	07E	30	3	N	Maple Ridge	Alpena
BDOW	BDOW 059-3-02	1	04/06/2004	MM, CP	X	32N	07E	30	3	N	Maple Ridge	Alpena
BDOW	BDOW 043-2-01/02	2	03/04/2004	MM, CP	P	33N	05W	18	2	Y	Melrose	Charlevoix
BDOW	BDOW 043-3-01/02	2	04/05/2004	MM, CP	P	33N	05W	18	2	Y	Melrose	Charlevoix
BDOW	BDOW 025-2-05	1	03/09/2004	MM, CP	X	41N	11W	8	2	N	Newton	Mackinac
BDOW	BDOW 025-3-01	1	04/08/2004	MM, CP	X	42N	11W	4	2	N	Newton	Mackinac
BDOW	BDOW 025-2-03	1	03/09/2004	MM, CP	X	42N	11W	20	3	N	Newton	Mackinac
BDOW	BDOW 025-2-04	1	03/09/2004	MM, CP	X	42N	11W	28	3	N	Newton	Mackinac
BDOW	BDOW 025-3-02	1	04/08/2004	MM, CP	X	42N	11W	28	3	N	Newton	Mackinac
BDOW	BDOW 025-1-03	1	02/11/2004	MM, CP	X	42N	11W	33	3	N	Newton	Mackinac
BDOW	BDOW 025-3-03	1	04/08/2004	MM, CP	X	42N	11W	33	3	N	Newton	Mackinac
BDOW	BDOW 009-2-03	1	03/12/2004	MM, CP	X	42N	23W	7	2	N	Maple Ridge	Delta
BDOW	BDOW 007-2-03/04	2	03/11/2004	MM, CP	P	42N	33W	8	2	N	Mastodon	Iron
BDOW	BDOW 007-3-04	1	04/14/2004	MM, MS	X	42N	33W	16	2	N	Mastodon	Iron
BDOW	BDOW 007-2-02	1	03/11/2004	MM, CP	X	42N	33W	17	2	N	Mastodon	Iron
BDOW	BDOW 007-2-05	1	03/11/2004	MM, CP	X	42N	34W	3	1	Y	Stambaugh	Iron

Table B-1. Continued.

Species[a]	Owl Observation ID	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
BDOW	BDOW 007-3-08	1	04/14/2004	MM, MS	X	42N	34W	4	2	N	Stambaugh	Iron
BDOW	BDOW 007-3-06/07	2	04/14/2004	MM, MS	P	42N	34W	10	1	Y	Stambaugh	Iron
BDOW	BDOW 007-3-05	1	04/14/2004	MM, MS	X	42N	34W	14	1	Y	Stambaugh	Iron
BDOW	BDOW 025-2-01	1	03/08/2004	MM, CP	X	43N	10W	11	1	N	Garfield	Mackinac
BDOW	BDOW 025-1-02	1	02/10/2004	MM, CP	X	43N	11W	23	4	N	Newton	Mackinac
BDOW	BDOW 025-1-01	1	02/10/2004	MM, CP	X	43N	11W	24	4	N	Newton	Mackinac
BDOW	BDOW 025-2-02	1	03/09/2004	MM, CP	X	43N	11W	24	4	N	Newton	Mackinac
BDOW	BDOW 009-3-07	1	04/16/2004	MM, MS	X	43N	23W	5	2	Y	Maple Ridge	Delta
BDOW	BDOW 009-3-08	1	04/16/2004	MM, MS	X	43N	23W	7	2	Y	Maple Ridge	Delta
BDOW	BDOW 009-3-06	1	04/16/2004	MM, MS	X	43N	24W	1	1	N	Turin	Marquette
BDOW	BDOW 007-1-01	1	02/12/2004	MM, CP	X	43N	31W	19	3	N	Mansfield	Iron
BDOW	BDOW 007-3-02/03	2	04/13/2004	MM, MS	P	43N	31W	22	4	N	Mansfield	Iron
BDOW	BDOW 007-3-01	1	04/13/2004	MM, MS	X	43N	31W	27	4	N	Mansfield	Iron
BDOW	BDOW 007-2-01	1	03/10/2004	MM, CP	X	43N	31W	28	3	N	Mansfield	Iron
BDOW	BDOW 009-3-03	1	04/16/2004	MM, MS	X	44N	23W	21	3	Y	Turin	Marquette
BDOW	BDOW 009-3-04/05	2	04/16/2004	MM, MS	P	44N	23W	28	3	Y	Turin	Marquette
BDOW	BDOW 009-1-01	1	02/13/2004	MM, CP	X	45N	23W	22	4	N	Skandia	Marquette
BDOW	BDOW 009-2-01	1	03/12/2004	MM, CP	P	45N	23W	27	4	N	Skandia	Marquette
BDOW	BDOW 009-2-02	1	03/12/2004	MM, CP	P	45N	23W	27	4	N	Skandia	Marquette
BDOW	BDOW 009-3-01	1	04/15/2004	MM, MS	X	45N	23W	34	4	N	Skandia	Marquette
BDOW	BDOW 009-1-02	1	02/13/2004	MM, CP	X	45N	23W	35	4	N	Skandia	Marquette
BDOW	BDOW 009-3-02	1	04/15/2004	MM, MS	X	45N	23W	35	4	N	Skandia	Marquette
BDOW	BDOW 003-3-01	1	04/14/2004	MM, MS	X	46N	43W	4	2	N	Marenisco	Gogebic
BDOW	BDOW 003-3-03	1	04/14/2004	MM, MS	X	46N	43W	17	2	N	Marenisco	Gogebic
BDOW	BDOW 003-3-02	1	04/14/2004	MM, MS	X	46N	43W	18	2	N	Marenisco	Gogebic
BDOW	BDOW 003-3-04	1	04/14/2004	MM, MS	X	46N	43W	19	3	N	Marenisco	Gogebic
BDOW	BDOW 003-3-06	1	04/15/2004	MM, MS	X	46N	44W	4	2	N	Marenisco	Gogebic
BDOW	BDOW 003-3-05	1	04/14/2004	MM, MS	X	46N	44W	13	1	N	Marenisco	Gogebic
BDOW	BDOW 003-3-12	1	04/15/2004	MM, MS	X	46N	45W	5	2	N	Bessemer	Gogebic
BDOW	BDOW 003-3-13	1	04/15/2004	MM, MS	X	46N	45W	5	2	N	Bessemer	Gogebic
BDOW	BDOW 003-3-15	1	04/15/2004	MM, MS	X	46N	45W	8	2	N	Bessemer	Gogebic
BDOW	BDOW 003-2-01	1	03/10/2004	MM, CP	X	46N	45W	9	2	N	Bessemer	Gogebic
BDOW	BDOW 003-3-14	1	04/15/2004	MM, MS	X	46N	45W	9	2	N	Bessemer	Gogebic
BDOW	BDOW 003-3-16	1	04/15/2004	MM, MS	X	46N	45W	16	2	N	Bessemer	Gogebic
BDOW	BDOW 003-2-02	1	03/10/2004	MM, CP	X	46N	45W	21	3	Y	Bessemer	Gogebic

Table B-1. Continued.

Species[a]	Owl Observation ID	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
BDOW	BDOW 003-3-17	1	04/15/2004	MM, MS	X	46N	45W	21	3	Y	Bessemer	Gogebic
BDOW	BDOW 003-3-18	1	04/15/2004	MM, MS	X	46N	45W	22	4	N	Bessemer	Gogebic
BDOW	BDOW 024-1-02	1	02/10/2004	MM, CP	X	47N	09W	17	2	Y	McMillan	Luce
BDOW	BDOW 003-1-01	1	02/12/2004	MM. CP	X	47N	43W	33	3	N	Marenisco	Gogebic
BDOW	BDOW 003-3-07	1	04/15/2004	MM, MS	X	47N	45W	22	4	N	Bessemer	Gogebic
BDOW	BDOW 003-3-09	1	04/15/2004	MM, MS	X	47N	45W	28	3	N	Bessemer	Gogebic
BDOW	BDOW 003-3-08	1	04/15/2004	MM, MS	X	47N	45W	29	3	N	Bessemer	Gogebic
BDOW	BDOW 003-3-10/11	2	04/15/2004	MM, MS	P	47N	45W	32	3	N	Bessemer	Gogebic
BDOW	BDOW 024-1-01	1	02/10/2004	MM, CP	X	48N	08W	1	1	Y	McMillan	Luce
BDOW	BDOW 024-2-01	1	03/08/2004	MM, CP	X	48N	08W	1	1	Y	McMillan	Luce
BDOW	BDOW 024-3-02	1	04/08/2004	MM, CP	#	48N	08W	1	1	Y	McMillan	Luce
BDOW	BDOW 024-2-02	1	03/08/2004	MM, CP	X	48N	08W	2	1	Y	McMillan	Luce
BDOW	BDOW 024-3-05	1	04/08/2004	MM, CP	X	48N	08W	8	2	N	McMillan	Luce
BDOW	BDOW 024-3-03	1	04/08/2004	MM, CP	P	48N	08W	11	1	Y	McMillan	Luce
BDOW	BDOW 024-3-04	1	04/08/2004	MM, CP	P	48N	08W	11	1	Y	McMillan	Luce
BDOW	BDOW 024-2-04	1	03/08/2004	MM, CP	X	48N	09W	23	4	N	McMillan	Luce
BDOW	BDOW 024-2-03	1	03/08/2004	MM, CP	X	48N	09W	24	4	N	McMillan	Luce
BDOW	BDOW 024-3-06	1	04/09/2004	MM, CP	X	48N	09W	24	4	N	McMillan	Luce
BDOW	BDOW 024-2-05	1	03/08/2004	MM, CP	X	48N	09W	33	3	N	McMillan	Luce
BDOW	BDOW 024-2-06	1	03/08/2004	MM, CP	X	48N	09W	34	4	N	McMillan	Luce
BDOW	BDOW 024-3-07	1	04/09/2004	MM, CP	X	48N	09W	34	4	N	McMillan	Luce
BDOW	BDOW 024-3-01	1	04/08/2004	MM, CP	X	49N	07W	31	3	N	Whitefish	Chippewa
EASO	EASO 053-3-07	1	03/20/2004	MM, CP	P	01N	02E	3	1	Y	Stockbridge	Ingham
EASO	EASO 053-2-08	1	02/19/2004	DC, CP	X	01N	02E	15	1	Y	Stockbridge	Ingham
EASO	EASO 053-1-03	1	01/22/2004	MM, PP	X	01N	02E	22	4	Y	Stockbridge	Ingham
EASO	EASO 053-2-09	1	02/19/2004	DC, CP	X	01N	02E	27	4	Y	Stockbridge	Ingham
EASO	EASO 053-2-10	1	02/19/2004	DC, CP	X	01N	02E	27	4	Y	Stockbridge	Ingham
EASO	EASO 035-3-02	1	04/14/2004	JB, BN	X	01N	10W	2	1	Y	Prairieville	Barry
EASO	EASO 035-3-03	1	04/15/2004	JB, BN	X	01N	10W	24	4	Y	Prairieville	Barry
EASO	EASO 035-2-01	1	03/10/2004	JB, BN	X	01N	10W	26	4	Y	Prairieville	Barry
EASO	EASO 035-3-04	1	04/15/2004	JB, BN	X	01N	10W	26	4	Y	Prairieville	Barry
EASO	EASO 035-2-03	1	03/11/2004	JB, BN	X	01S	10W	14	1	Y	Richland	Kalamazoo
EASO	EASO 035-3-05	1	04/15/2004	JB, BN	X	01S	10W	25	4	Y	Richland	Kalamazoo
EASO	EASO 053-3-05	1	03/20/2004	MM, CP	P	02N	02E	3	1	Y	White Oak	Ingham
EASO	EASO 053-2-06	1	02/19/2004	DC, CP	X	02N	02E	22	4	Y	White Oak	Ingham

Table B-1. Continued.

Species[a]	Owl Observation ID	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
EASO	EASO 053-3-06	1	03/20/2004	MM, CP	P	02N	02E	27	4	Y	White Oak	Ingham
EASO	EASO 053-2-07	1	02/19/2004	DC, CP	X	02N	02E	34	4	Y	White Oak	Ingham
EASO	EASO 035-2-02	1	03/10/2004	JB, BN	X	02N	09W	31	3	Y	Hope	Barry
EASO	EASO 035-3-01	1	04/14/2004	JB, BN	X	02N	09W	31	3	Y	Hope	Barry
EASO	EASO 035-2-04	1	03/11/2004	JB, BN	X	02S	10W	1	1	Y	Comstock	Kalamazoo
EASO	EASO 035-3-06	1	04/15/2004	JB, BN	X	02S	10W	1	1	Y	Comstock	Kalamazoo
EASO	EASO 053-2-04	1	02/18/2004	DC, CP	X	03N	02E	11	1	Y	Leroy	Ingham
EASO	EASO 053-2-05	1	02/18/2004	DC, CP	X	03N	02E	26	4	Y	Leroy	Ingham
EASO	EASO 053-2-01	1	02/18/2004	DC, CP	X	04N	02E	11	1	Y	Locke	Ingham
EASO	EASO 053-2-02	1	02/18/2004	DC, CP	X	04N	02E	14	1	Y	Locke	Ingham
EASO	EASO 053-3-01	1	03/19/2004	MM, CP	X	04N	02E	14	1	Y	Locke	Ingham
EASO	EASO 053-3-02	1	03/19/2004	MM, CP	X	04N	02E	14	1	Y	Locke	Ingham
EASO	EASO 053-1-01	1	01/19/2004	MM, PP	X	04N	02E	35	4	Y	Locke	Ingham
EASO	EASO 053-1-02	1	01/19/2004	MM, PP	X	04N	02E	35	4	Y	Locke	Ingham
EASO	EASO 053-2-03	1	02/18/2004	DC, CP	X	04N	02E	35	4	Y	Locke	Ingham
EASO	EASO 053-3-03/04	2	03/20/2004	MM, CP	P	04N	02E	35	4	Y	Locke	Ingham
EASO	EASO 057-2-01	1	02/17/2004	MM, DC	P	06S	04E	31	3	Y	Raisin	Lenawee
EASO	EASO 057-2-02	1	02/17/2004	MM, DC	P	06S	04E	31	3	Y	Raisin	Lenawee
EASO	EASO 057-3-01	1	03/18/2004	MM, CP	X	06S	04E	31	3	Y	Raisin	Lenawee
EASO	EASO 057-1-01	1	01/24/2004	MM, DC	X	06S	04E	32	3	Y	Raisin	Lenawee
EASO	EASO 057-1-04	1	01/24/2004	MM, DC	X	06S	05E	25	4	Y	Deerfield	Lenawee
EASO	EASO 057-1-03	1	01/24/2004	MM, DC	X	06S	05E	29	3	Y	Ridgeway	Lenawee
EASO	EASO 057-2-03	1	02/17/2004	MM, DC	X	06S	05E	29	3	Y	Ridgeway	Lenawee
EASO	EASO 057-1-02	1	01/24/2004	MM, DC	X	06S	05E	32	3	Y	Ridgeway	Lenawee
EASO	EASO 057-3-02	1	03/18/2004	MM, CP	P	06S	05E	32	3	Y	Ridgeway	Lenawee
EASO	EASO 057-3-03	1	03/18/2004	MM, CP	P	06S	05E	32	3	Y	Ridgeway	Lenawee
EASO	EASO 057-2-04	1	02/17/2004	MM, DC	X	06S	05E	33	3	Y	Ridgeway	Lenawee
EASO	EASO 057-3-04	1	03/18/2004	MM, CP	X	06S	05E	34	4	Y	Deerfield	Lenawee
EASO	EASO 057-2-05	1	02/17/2004	MM, DC	X	06S	05E	35	4	Y	Deerfield	Lenawee
EASO	EASO 057-1-09	1	01/25/2004	MM, DC	X	06S	06E	23	4	Y	Dundee	Monroe
EASO	EASO 057-1-10	1	01/25/2004	MM, DC	X	06S	06E	23	4	Y	Dundee	Monroe
EASO	EASO 057-2-07	1	02/17/2004	MM, DC	X	06S	06E	23	4	Y	Dundee	Monroe
EASO	EASO 057-2-08	1	02/17/2004	MM, DC	X	06S	06E	23	4	Y	Dundee	Monroe
EASO	EASO 057-1-08	1	01/25/2004	MM, DC	X	06S	06E	27	4	Y	Dundee	Monroe
EASO	EASO 057-1-07	1	01/25/2004	MM, DC	X	06S	06E	28	3	Y	Dundee	Monroe

Table B-1. Continued.

Species[a]	Owl Observation ID	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
EASO	EASO 057-2-06	1	02/17/2004	MM, DC	X	06S	06E	28	3	Y	Dundee	Monroe
EASO	EASO 057-1-05	1	01/25/2004	MM, DC	X	06S	06E	29	3	Y	Dundee	Monroe
EASO	EASO 057-1-06	1	01/25/2004	MM, DC	X	06S	06E	29	3	Y	Dundee	Monroe
EASO	EASO 057-1-13	1	01/25/2004	MM, DC	X	06S	07E	27	0	N	Raisinville	Monroe
EASO	EASO 057-3-08	1	03/18/2004	MM, CP	X	06S	07E	27	0	N	Raisinville	Monroe
EASO	EASO 057-1-12	1	01/25/2004	MM, DC	X	06S	07E	28	3	Y	Dundee	Monroe
EASO	EASO 057-2-10	1	02/18/2004	MM, DC	P	06S	07E	28	3	Y	Dundee	Monroe
EASO	EASO 057-2-11	1	02/18/2004	MM, DC	P	06S	07E	28	3	Y	Dundee	Monroe
EASO	EASO 057-3-07	1	03/18/2004	MM, CP	X	06S	07E	28	3	Y	Dundee	Monroe
EASO	EASO 057-3-05	1	03/18/2004	MM, CP	X	06S	07E	29	3	Y	Dundee	Monroe
EASO	EASO 057-1-11	1	01/25/2004	MM, DC	X	06S	07E	31	3	Y	Dundee	Monroe
EASO	EASO 057-2-09	1	02/18/2004	MM, DC	X	06S	07E	32	3	Y	Dundee	Monroe
EASO	EASO 057-3-06	1	03/18/2004	MM, CP	X	06S	07E	32	3	Y	Dundee	Monroe
EASO	EASO 039-2b-05	1	03/09/2004	JB	X	07S	13W	25	4	Y	Porter	Cass
EASO	EASO 039-2a-02	1	02/19/2004	JB	X	07S	13W	26	4	Y	Porter	Cass
EASO	EASO 039-3-02	1	04/08/2004	JB, BS	X	07S	13W	26	4	Y	Porter	Cass
EASO	EASO 039-2a-03	1	02/19/2004	JB	X	07S	13W	27	4	Y	Porter	Cass
EASO	EASO 039-2b-03	1	03/09/2004	JB	X	07S	13W	27	4	Y	Porter	Cass
EASO	EASO 039-2b-04	1	03/09/2004	JB	X	07S	13W	27	4	Y	Porter	Cass
EASO	EASO 039-3-03	1	04/08/2004	JB, BS	X	07S	13W	27	4	Y	Porter	Cass
EASO	EASO 039-2a-04	1	02/19/2004	JB	X	07S	13W	32	3	Y	Porter	Cass
EASO	EASO 039-2a-01	1	02/17/2004	JB	X	07S	13W	36	4	Y	Porter	Cass
EASO	EASO 039-2b-01	1	03/09/2004	JB	X	07S	13W	36	4	Y	Porter	Cass
EASO	EASO 039-2b-02	1	03/09/2004	JB	X	07S	13W	36	4	Y	Porter	Cass
EASO	EASO 039-2b-06	1	03/09/2004	JB	X	07S	13W	36	4	Y	Porter	Cass
EASO	EASO 039-2a-08	1	02/19/2004	JB	X	07S	14W	5	2	Y	Calvin	Cass
EASO	EASO 039-2a-06	1	02/19/2004	JB	X	07S	14W	8	2	Y	Calvin	Cass
EASO	EASO 039-2a-07	1	02/19/2004	JB	X	07S	14W	8	2	Y	Calvin	Cass
EASO	EASO 039-3-05	1	04/08/2004	JB, BS	X	07S	14W	8	2	Y	Calvin	Cass
EASO	EASO 039-2a-05	1	02/19/2004	JB	X	07S	14W	18	2	Y	Calvin	Cass
EASO	EASO 039-2b-07	1	03/09/2004	JB	X	07S	14W	26	4	Y	Calvin	Cass
EASO	EASO 039-3-04	1	04/08/2004	JB, BS	X	07S	14W	28	3	Y	Calvin	Cass
EASO	EASO 034-2-01	1	02/19/2004	DC, CP	X	08N	08W	6	2	Y	Otisco	Ionia
EASO	EASO 034-3-01/02	2	03/25/2004	YL, CP	P	08N	08W	6	2	Y	Otisco	Ionia
EASO	EASO 034-1-02	1	01/21/2004	MM, PP	X	08N	08W	7	2	Y	Otisco	Ionia

Table B-1. Continued.

Species[a]	Owl Observation ID	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
EASO	EASO 034-1-01	1	01/21/2004	MM, PP	X	08N	08W	8	2	Y	Otisco	Ionia
EASO	EASO 034-3-03	1	03/25/2004	YL, CP	X	08N	09W	2	1	Y	Grattan	Kent
EASO	EASO 034-1-05	1	01/21/2004	MM, PP	X	08N	10W	1	1	Y	Cannon	Kent
EASO	EASO 039-3-01	1	04/08/2004	JB, BS	X	08S	13W	1	1	Y	Porter	Cass
EASO	EASO 034-1-06	1	01/21/2004	MM, PP	X	09N	10W	32	3	Y	Courtland	Kent
EASO	EASO 034-3-04	1	03/25/2004	YL, CP	X	09N	10W	32	3	Y	Courtland	Kent
EASO	EASO 034-1-03/04	2	01/21/2004	MM, PP	P	09N	10W	36	4	Y	Courtland	Kent
EASO	EASO 034-2-02	1	02/19/2004	DC, CP	X	09N	10W	36	4	Y	Courtland	Kent
EASO	EASO 070-2-20	1	02/23/2004	MM, DC	X	10N	16E	2	1	Y	Lexington	Sanilac
EASO	EASO 070-2-13	1	02/23/2004	MM, DC	X	11N	16E	2	1	Y	Sanilac	Sanilac
EASO	EASO 070-2-12	1	02/23/2004	MM, DC	X	11N	16E	3	1	Y	Sanilac	Sanilac
EASO	EASO 070-2-14/15	2	02/23/2004	MM, DC	P	11N	16E	10	1	Y	Sanilac	Sanilac
EASO	EASO 070-3-03	1	03/26/2004	CP, JF	X	11N	16E	10	1	Y	Sanilac	Sanilac
EASO	EASO 070-2-16	1	02/23/2004	MM, DC	X	11N	16E	14	1	Y	Sanilac	Sanilac
EASO	EASO 070-2-17	1	02/23/2004	MM, DC	X	11N	16E	23	4	Y	Sanilac	Sanilac
EASO	EASO 070-2-18/19	1	02/23/2004	MM, DC	P	11N	16E	33	3	Y	Sanilac	Sanilac
EASO	EASO 070-2-21	1	02/23/2004	MM, DC	X	11N	16E	34	4	Y	Sanilac	Sanilac
EASO	EASO 070-1-02	1	01/25/2004	MM, YL	X	12N	16E	3	1	Y	Forester	Sanilac
EASO	EASO 070-2-06	1	02/22/2004	MM, DC	X	12N	16E	4	2	Y	Forester	Sanilac
EASO	EASO 070-2-07	1	02/22/2004	MM, DC	X	12N	16E	5	2	Y	Forester	Sanilac
EASO	EASO 070-3-01	1	03/25/2004	CP, JF	X	12N	16E	5	2	Y	Forester	Sanilac
EASO	EASO 070-2-05	1	02/22/2004	MM, DC	X	12N	16E	6	2	Y	Forester	Sanilac
EASO	EASO 070-1-03	1	01/25/2004	MM, YL	X	12N	16E	10	1	Y	Forester	Sanilac
EASO	EASO 070-2-08	1	02/22/2004	MM, DC	X	12N	16E	15	1	Y	Forester	Sanilac
EASO	EASO 070-2-09	1	02/22/2004	MM, DC	X	12N	16E	15	1	Y	Forester	Sanilac
EASO	EASO 070-1-04	1	01/25/2004	MM, YL	X	12N	16E	35	4	Y	Sanilac	Sanilac
EASO	EASO 070-2-10/11	1	02/23/2004	MM, DC	P	12N	16E	35	4	Y	Sanilac	Sanilac
EASO	EASO 070-3-02	1	03/25/2004	CP, JF	X	12N	16E	35	4	Y	Sanilac	Sanilac
EASO	EASO 064-2-21	1	02/25/2004	MM, DC	X	13N	12E	2	1	Y	Evergreen	Sanilac
EASO	EASO 064-3-04	1	03/30/2004	MM, DC	X	13N	12E	2	1	Y	Evergreen	Sanilac
EASO	EASO 064-2-22	1	02/25/2004	MM, DC	X	13N	12E	12	1	Y	Evergreen	Sanilac
EASO	EASO 070-2-01	1	02/22/2004	MM, DC	X	13N	15E	35	4	Y	Marion	Sanilac
EASO	EASO 070-1-01	1	01/25/2004	MM, YL	X	13N	15E	36	4	Y	Marion	Sanilac
EASO	EASO 070-2-02	1	02/22/2004	MM, DC	X	13N	15E	36	4	Y	Marion	Sanilac
EASO	EASO 070-2-04	1	02/22/2004	MM, DC	X	13N	15E	36	4	Y	Marion	Sanilac

Table B-1. Continued.

Species[a]	Owl Observation ID	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
EASO	EASO 070-2-03	1	02/22/2004	MM, DC	X	13N	16E	31	3	Y	Forester	Sanilac
EASO	EASO 064-1-11	1	01/30/2004	MM, CP	X	14N	12E	1	1	Y	Greenleaf	Sanilac
EASO	EASO 064-1-10	1	01/30/2004	MM, CP	X	14N	12E	2	1	Y	Greenleaf	Sanilac
EASO	EASO 064-2-17	1	02/25/2004	MM, DC	X	14N	12E	11	1	Y	Greenleaf	Sanilac
EASO	EASO 064-3-03	1	03/30/2004	MM, DC	X	14N	12E	11	1	Y	Greenleaf	Sanilac
EASO	EASO 064-2-18	1	02/25/2004	MM, DC	X	14N	12E	14	1	Y	Greenleaf	Sanilac
EASO	EASO 064-1-12	1	01/30/2004	MM, CP	X	14N	12E	23	4	Y	Greenleaf	Sanilac
EASO	EASO 064-1-13	1	01/30/2004	MM, CP	X	14N	12E	23	4	Y	Greenleaf	Sanilac
EASO	EASO 064-1-14	1	01/30/2004	MM, CP	X	14N	12E	25	4	Y	Greenleaf	Sanilac
EASO	EASO 064-2-19	1	02/25/2004	MM, DC	X	14N	12E	26	4	Y	Greenleaf	Sanilac
EASO	EASO 064-2-20	1	02/25/2004	MM, DC	X	14N	12E	36	4	Y	Greenleaf	Sanilac
EASO	EASO 064-2-02	1	02/24/2004	MM, DC	X	15N	11E	8	2	Y	Grant	Huron
EASO	EASO 064-2-03	1	02/24/2004	MM, DC	X	15N	11E	9	2	Y	Grant	Huron
EASO	EASO 064-1-02	1	01/29/2004	MM, CP	X	15N	11E	14	1	Y	Grant	Huron
EASO	EASO 064-2-05	1	02/25/2004	MM, DC	X	15N	11E	14	1	Y	Grant	Huron
EASO	EASO 064-1-01	1	01/29/2004	MM, CP	X	15N	11E	15	1	Y	Grant	Huron
EASO	EASO 064-2-04	1	02/25/2004	MM, DC	X	15N	11E	15	1	Y	Grant	Huron
EASO	EASO 064-3-01	1	03/29/2004	MM, DC	X	15N	11E	15	1	Y	Grant	Huron
EASO	EASO 064-2-01	1	02/24/2004	MM, DC	X	15N	11E	17	2	Y	Grant	Huron
EASO	EASO 064-2-06	1	02/25/2004	MM, DC	X	15N	12E	7	2	Y	Sheridan	Huron
EASO	EASO 064-1-03/04	2	01/29/2004	MM, CP	P	15N	12E	8	2	Y	Sheridan	Huron
EASO	EASO 064-2-07	1	02/25/2004	MM, DC	X	15N	12E	8	2	Y	Sheridan	Huron
EASO	EASO 064-3-02	1	03/29/2004	MM, DC	X	15N	12E	8	2	Y	Sheridan	Huron
EASO	EASO 064-2-08	1	02/25/2004	MM, DC	X	15N	12E	9	2	Y	Sheridan	Huron
EASO	EASO 064-2-09/10	2	02/25/2004	MM, DC	P	15N	12E	9	2	Y	Sheridan	Huron
EASO	EASO 064-1-05	1	01/29/2004	MM, CP	X	15N	12E	10	1	Y	Sheridan	Huron
EASO	EASO 064-1-06	1	01/29/2004	MM, CP	X	15N	12E	10	1	Y	Sheridan	Huron
EASO	EASO 064-2-12	1	02/25/2004	MM, DC	X	15N	12E	10	1	Y	Sheridan	Huron
EASO	EASO 064-2-11	1	02/25/2004	MM, DC	X	15N	12E	11	1	Y	Sheridan	Huron
EASO	EASO 064-2-14	1	02/25/2004	MM, DC	X	15N	12E	11	1	Y	Sheridan	Huron
EASO	EASO 064-1-08	1	01/29/2004	MM, CP	X	15N	12E	13	1	Y	Sheridan	Huron
EASO	EASO 064-2-13	1	02/25/2004	MM, DC	X	15N	12E	13	1	Y	Sheridan	Huron
EASO	EASO 064-2-15	1	02/25/2004	MM, DC	X	15N	12E	14	1	Y	Sheridan	Huron
EASO	EASO 064-1-07	1	01/29/2004	MM, CP	X	15N	12E	23	4	Y	Sheridan	Huron
EASO	EASO 064-2-16	1	02/25/2004	MM, DC	X	15N	12E	25	4	Y	Sheridan	Huron

Table B-1. Continued.

Species[a]	Owl Observation ID	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
EASO	EASO 064-1-09	1	01/29/2004	MM, CP	X	15N	12E	35	4	Y	Sheridan	Huron
EASO	EASO 130-3-1	1	04/01/2004	MM, DC	X	27N	11W	8	2	Y	Garfield	Grand Traverse
EASO	EASO 130-2-2	1	03/04/2004	MM, CP	X	27N	11W	29	3	N	Garfield	Grand Traverse
EASO	EASO 130-1-1	1	02/04/2004	MM, CP	X	27N	12W	11	1	N	Long Lake	Grand Traverse
EASO	EASO 130-2-1	1	03/04/2004	MM, CP	X	27N	12W	11	1	N	Long Lake	Grand Traverse
GHOW	GHOW 053-2-01	1	02/19/2004	DC, CP	X	01N	02E	3	1	Y	Stockbridge	Ingham
GHOW	GHOW 053-3-04	1	03/20/2004	MM, CP	X	01N	02E	3	1	Y	Stockbridge	Ingham
GHOW	GHOW 053-3-05/06	2	03/20/2004	MM, CP	P	01N	02E	15	1	Y	Stockbridge	Ingham
GHOW	GHOW 053-2-03	1	02/19/2004	DC, CP	P	01N	02E	22	4	Y	Stockbridge	Ingham
GHOW	GHOW 053-2-02	1	02/19/2004	DC, CP	P	01N	02E	27	4	Y	Stockbridge	Ingham
GHOW	GHOW 053-2-04	1	02/19/2004	DC, CP	X	01N	02E	27	4	Y	Stockbridge	Ingham
GHOW	GHOW 053-2-05	1	02/19/2004	DC, CP	X	01N	02E	27	4	Y	Stockbridge	Ingham
GHOW	GHOW 035-3-01	1	04/15/2004	JB, BN	X	01N	10W	1	1	Y	Prairieville	Barry
GHOW	GHOW 053-1-03	1	01/19/2004	MM, PP	X	02N	02E	15	1	Y	White Oak	Ingham
GHOW	GHOW 053-3-03	1	03/20/2004	MM, CP	X	02N	02E	34	4	Y	White Oak	Ingham
GHOW	GHOW 053-3-01/02	2	03/20/2004	MM, CP	P	03N	02E	3	1	Y	Leroy	Ingham
GHOW	GHOW 053-1-02	1	01/19/2004	MM, PP	X	03N	02E	26	4	Y	Leroy	Ingham
GHOW	GHOW 053-1-01	1	01/19/2004	MM, PP	X	04N	02E	14	1	Y	Locke	Ingham
GHOW	GHOW 020-2-01/02	2	03/08/2004	BN	P	04S	18W	13	1	Y	Benton	Berrien
GHOW	GHOW 020-3-01/02	2	04/09/2004	BN	P	04S	18W	13	1	Y	Benton	Berrien
GHOW	GHOW 057-3-01	1	03/18/2004	MM, CP	X	06S	04E	32	3	Y	Raisin	Lenawee
GHOW	GHOW 057-1-01	1	01/24/2004	MM, DC	X	06S	05E	36	4	Y	Deerfield	Lenawee
GHOW	GHOW 057-1-03/04	2	01/25/2004	MM, DC	P	06S	06E	23	4	Y	Dundee	Monroe
GHOW	GHOW 057-1-02	1	01/25/2004	MM, DC	X	06S	06E	26	4	Y	Dundee	Monroe
GHOW	GHOW 057-2-01	1	02/17/2004	MM, DC	X	06S	06E	26	4	Y	Dundee	Monroe
GHOW	GHOW 057-3-02	1	03/18/2004	MM, CP	X	06S	07E	27	0	N	Raisinville	Monroe
GHOW	GHOW 039-2b-05	1	03/08/2004	JB	X	06S	14W	28	3	Y	Penn	Cass
GHOW	GHOW 039-2b-01	1	03/08/2004	JB	X	07S	13W	22	4	Y	Porter	Cass
GHOW	GHOW 039-2b-02	1	03/09/2004	JB	X	07S	13W	25	4	Y	Porter	Cass
GHOW	GHOW 039-2b-03	1	03/09/2004	JB	X	07S	13W	30	3	Y	Porter	Cass
GHOW	GHOW 039-2b-04	1	03/09/2004	JB	X	07S	13W	32	3	Y	Porter	Cass
GHOW	GHOW 039-2a-01/02	2	02/19/2004	JB	P	07S	14W	28	3	Y	Calvin	Cass
GHOW	GHOW 039-3-01	1	04/08/2004	JB, BS	X	07S	14W	29	3	Y	Calvin	Cass
GHOW	GHOW 034-1-01	1	01/21/2004	MM, PP	X	08N	09W	6	2	Y	Grattan	Kent
GHOW	GHOW 034-1-02	1	01/21/2004	MM, PP	P	08N	10W	4	2	Y	Cannon	Kent

Table B-1. Continued.

Species[a]	Owl Observation ID	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
GHOW	GHOW 034-1-03	1	01/21/2004	MM, PP	P	08N	10W	4	2	Y	Cannon	Kent
GHOW	GHOW 070-2-07	1	02/23/2004	MM, DC	X	10N	16E	2	1	Y	Lexington	Sanilac
GHOW	GHOW 070-2-09	1	02/23/2004	MM, DC	X	10N	16E	2	1	Y	Lexington	Sanilac
GHOW	GHOW 070-2-10	1	02/23/2004	MM, DC	X	10N	16E	2	1	Y	Lexington	Sanilac
GHOW	GHOW 070-2-11	1	02/23/2004	MM, DC	X	10N	16E	2	1	Y	Lexington	Sanilac
GHOW	GHOW 070-2-12	1	02/23/2004	MM, DC	X	10N	16E	2	1	Y	Lexington	Sanilac
GHOW	GHOW 070-2-08	1	02/23/2004	MM, DC	X	10N	16E	3	1	Y	Lexington	Sanilac
GHOW	GHOW 070-2-13	1	02/23/2004	MM, DC	X	10N	16E	12	1	Y	Lexington	Sanilac
GHOW	GHOW 070-2-05	1	02/23/2004	MM, DC	X	11N	16E	15	1	Y	Sanilac	Sanilac
GHOW	GHOW 070-2-06	1	02/23/2004	MM, DC	X	11N	16E	35	4	Y	Sanilac	Sanilac
GHOW	GHOW 070-2-04	1	02/22/2004	MM, DC	P	12N	16E	4	2	Y	Forester	Sanilac
GHOW	GHOW 070-3-01	1	03/25/2004	CP, JF	X	12N	16E	4	2	Y	Forester	Sanilac
GHOW	GHOW 070-2-03	1	02/22/2004	MM, DC	P	12N	16E	5	2	Y	Forester	Sanilac
GHOW	GHOW 070-2-02	1	02/22/2004	MM, DC	X	12N	16E	6	2	Y	Forester	Sanilac
GHOW	GHOW 064-1-03	1	01/30/2004	MM, CP	X	13N	12E	1	1	Y	Evergreen	Sanilac
GHOW	GHOW 064-3-03	1	03/30/2004	MM, DC	X	13N	12E	2	1	Y	Evergreen	Sanilac
GHOW	GHOW 070-2-01	1	02/22/2004	MM, DC	X	13N	15E	36	4	Y	Marion	Sanilac
GHOW	GHOW 064-2-07	1	02/25/2004	MM, DC	X	14N	12E	1	1	Y	Greenleaf	Sanilac
GHOW	GHOW 064-1-01	1	01/30/2004	MM, CP	X	14N	12E	24	4	Y	Greenleaf	Sanilac
GHOW	GHOW 064-2-09	1	02/25/2004	MM, DC	X	14N	12E	25	4	Y	Greenleaf	Sanilac
GHOW	GHOW 064-1-02	1	01/30/2004	MM, CP	X	14N	12E	36	4	Y	Greenleaf	Sanilac
GHOW	GHOW 064-2-08	1	02/25/2004	MM, DC	X	14N	12E	36	4	Y	Greenleaf	Sanilac
GHOW	GHOW 064-2-10	1	02/25/2004	MM, DC	X	14N	12E	36	4	Y	Greenleaf	Sanilac
GHOW	GHOW 064-3-02	1	03/29/2004	MM, DC	X	15N	11E	13	1	Y	Grant	Huron
GHOW	GHOW 064-3-01	1	03/29/2004	MM, DC	X	15N	11E	15	1	Y	Grant	Huron
GHOW	GHOW 064-2-01	1	02/25/2004	MM, DC	X	15N	12E	8	2	Y	Sheridan	Huron
GHOW	GHOW 064-2-03/04	2	02/25/2004	MM, DC	P	15N	12E	13	1	Y	Sheridan	Huron
GHOW	GHOW 064-2-02	1	02/25/2004	MM, DC	X	15N	12E	15	1	Y	Sheridan	Huron
GHOW	GHOW 064-2-06	1	02/25/2004	MM, DC	X	15N	12E	23	4	Y	Sheridan	Huron
GHOW	GHOW 064-2-05	1	02/25/2004	MM, DC	X	15N	12E	24	4	Y	Sheridan	Huron
GHOW	GHOW 061-3-01	1	03/31/2004	MM, DC	X	23N	06E	22	4	N	Plainfield	Iosco
GHOW	GHOW 061-1-01/02	2	01/31/2004	MM, CP	P	25N	06E	24	4	Y	Curtis	Alcona
GHOW	GHOW 061-2-01/02	2	02/26/2004	MM, CP	P	25N	06E	26	4	Y	Curtis	Alcona
GHOW	GHOW 047-1-01	1	01/31/2004	MM, CP	X	26N	01E	12	1	Y	Big Creek	Oscoda
GHOW	GHOW 047-3-02	1	04/01/2004	MM, DC	X	26N	02E	18	2	N	Big Creek	Oscoda

Table B-1. Continued.

Species[a]	Owl Observation ID	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
GHOW	GHOW 047-1-02	1	02/01/2004	MM, CP	X	26N	02E	29	3	Y	Big Creek	Oscoda
GHOW	GHOW 047-3-03	1	04/01/2004	MM, DC	X	26N	02E	30	3	Y	Big Creek	Oscoda
GHOW	GHOW 047-3-04	1	04/01/2004	MM, DC	X	26N	02E	31	3	Y	Big Creek	Oscoda
GHOW	GHOW 130-2-1	1	03/04/2004	MM, CP	X	27N	11W	21	3	N	Garfield	Grand Traverse
GHOW	GHOW 130-1-2	1	02/04/2004	MM, CP	X	27N	11W	27	4	Y	Garfield	Grand Traverse
GHOW	GHOW 130-1-1	1	02/04/2004	MM, CP	X	27N	12W	7	2	Y	Long Lake	Grand Traverse
GHOW	GHOW 047-3-01	1	03/31/2004	MM, DC	X	28N	02E	18	2	N	Elmer	Oscoda
GHOW	GHOW 059-2-03	1	02/26/2004	MM, CP	X	31N	06E	1	1	N	Long Rapids	Alpena
GHOW	GHOW 059-2-08	1	02/26/2004	MM, CP	X	32N	05E	31	3	N	Wellington	Alpena
GHOW	GHOW 059-2-06	1	02/26/2004	MM, CP	X	32N	05E	32	3	N	Wellington	Alpena
GHOW	GHOW 059-2-07	1	02/26/2004	MM, CP	X	32N	05E	33	3	N	Wellington	Alpena
GHOW	GHOW 059-2-05	1	02/26/2004	MM, CP	X	32N	05E	36	4	Y	Wellington	Alpena
GHOW	GHOW 043-2-01	1	03/04/2004	MM, CP	X	32N	05W	8	2	Y	Boyne Valley	Charlevoix
GHOW	GHOW 059-2-04	1	02/26/2004	MM, CP	X	32N	06E	32	3	Y	Long Rapids	Alpena
GHOW	GHOW 059-3-01	1	04/07/2004	MM, CP	X	32N	06E	32	3	Y	Long Rapids	Alpena
GHOW	GHOW 043-3-01	1	04/06/2004	MM, CP	X	32N	06W	25	4	N	Wilson	Charlevoix
GHOW	GHOW 059-2-01	1	02/26/2004	MM, CP	P	32N	08E	19	3	N	Alpena	Alpena
GHOW	GHOW 059-2-02	1	02/26/2004	MM, CP	P	32N	08E	19	3	N	Alpena	Alpena
GHOW	GHOW 025-2-07	1	03/09/2004	MM, CP	X	42N	11W	8	2	N	Newton	Mackinac
GHOW	GHOW 025-3-03	1	04/08/2004	MM, CP	X	42N	11W	16	2	N	Newton	Mackinac
GHOW	GHOW 025-2-08	1	03/09/2004	MM, CP	X	42N	11W	17	2	N	Newton	Mackinac
GHOW	GHOW 025-1-01/02	2	02/11/2004	MM, CP	P	42N	11W	21	3	N	Newton	Mackinac
GHOW	GHOW 025-2-01	1	03/08/2004	MM, CP	X	43N	09W	1	1	N	Garfield	Mackinac
GHOW	GHOW 025-2-03	1	03/08/2004	MM, CP	X	43N	09W	7	2	Y	Garfield	Mackinac
GHOW	GHOW 025-2-02	1	03/08/2004	MM, CP	X	43N	09W	11	1	N	Garfield	Mackinac
GHOW	GHOW 025-3-02	1	04/07/2004	MM, CP	P	43N	10W	1	1	N	Garfield	Mackinac
GHOW	GHOW 025-2-04	1	03/08/2004	MM, CP	P	43N	10W	12	1	N	Garfield	Mackinac
GHOW	GHOW 025-2-05	1	03/08/2004	MM, CP	P	43N	10W	12	1	N	Garfield	Mackinac
GHOW	GHOW 025-3-01	1	04/07/2004	MM, CP	P	43N	10W	12	1	N	Garfield	Mackinac
GHOW	GHOW 025-2-06	1	03/09/2004	MM, CP	X	43N	10W	15	1	N	Garfield	Mackinac
GHOW	GHOW 009-2-01	1	03/13/2004	MM, CP	X	43N	23W	6	2	Y	Maple Ridge	Delta
GHOW	GHOW 007-2-01	1	03/11/2004	MM, CP	X	43N	32W	28	3	N	Crystal Falls	Iron
GHOW	GHOW 007-2-02/03	2	03/11/2004	MM, CP	P	43N	33W	36	4	N	Crystal Falls	Iron
GHOW	GHOW 009-1-02/03	2	02/13/2004	MM, CP	P	44N	23W	20	3	Y	Turin	Marquette
GHOW	GHOW 009-1-01	1	02/13/2004	MM, CP	X	45N	23W	34	4	N	Skandia	Marquette

Table B-1. Continued.

Species[a]	Owl Observation ID	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
GHOW	GHOW 024-3-04	1	04/09/2004	MM, CP	P	46N	10W	2	1	N	McMillan	Luce
GHOW	GHOW 024-3-06	1	04/09/2004	MM, CP	X	46N	10W	13	1	N	McMillan	Luce
GHOW	GHOW 024-2-01	1	03/09/2004	MM, CP	X	46N	10W	14	1	N	McMillan	Luce
GHOW	GHOW 024-3-01	1	04/09/2004	MM, CP	X	47N	09W	21	3	N	McMillan	Luce
GHOW	GHOW 024-3-02	1	04/09/2004	MM, CP	X	47N	10W	35	4	N	McMillan	Luce
GHOW	GHOW 024-3-03	1	04/09/2004	MM, CP	P	47N	10W	35	4	N	McMillan	Luce
GHOW	GHOW 024-3-05	1	04/09/2004	MM, CP	X	47N	10W	36	4	N	McMillan	Luce
GHOW	GHOW 003-3-01/02	2	04/15/2004	MM, MS	P	47N	45W	21	3	N	Bessemer	Gogebic
LEOW	LEOW 025-3-01/02	2	04/08/2004	MM, CP	P	43N	10W	16	2	N	Garfield	Mackinac
LEOW	LEOW 025-3-03	1	04/08/2004	MM, CP	X	43N	10W	19	3	N	Garfield	Mackinac
LEOW	LEOW 025-3-05	1	04/08/2004	MM, CP	X	43N	11W	22	4	N	Newton	Mackinac
LEOW	LEOW 025-3-04	1	04/08/2004	MM, CP	X	43N	11W	24	4	N	Newton	Mackinac
NSWO	NSWO 053-2-01	1	02/19/2004	DC, CP	X	01N	02E	15	1	Y	Stockbridge	Ingham
NSWO	NSWO 039-2b-01	1	03/08/2004	JB	X	07S	14W	18	2	Y	Calvin	Cass
NSWO	NSWO 070-2-02	1	02/23/2004	MM, DC	#	11N	16E	33	3	Y	Sanilac	Sanilac
NSWO	NSWO 070-2-03	1	02/23/2004	MM, DC	#	11N	16E	34	4	Y	Sanilac	Sanilac
NSWO	NSWO 070-2-01	1	02/22/2004	MM, DC	X	12N	16E	4	2	Y	Forester	Sanilac
NSWO	NSWO 070-3-01	1	03/25/2004	CP, JF	X	12N	16E	4	2	Y	Forester	Sanilac
NSWO	NSWO 064-3-01	1	03/30/2004	MM, DC	X	14N	12E	14	1	Y	Greenleaf	Sanilac
NSWO	NSWO 061-2-01	1	02/25/2004	MM, CP	#	24N	06E	35	4	Y	Oscoda	Iosco
NSWO	NSWO 047-2-01	1	02/28/2004	MM, CP	X	26N	01E	3	1	Y	Big Creek	Oscoda
NSWO	NSWO 043-2-01	1	03/04/2004	MM, CP	X	31N	05W	8	2	N	Warner	Antrim
NSWO	NSWO 059-1-01	1	02/02/2004	MM, CP	X	32N	07E	17	2	Y	Maple Ridge	Alpena
NSWO	NSWO 059-2-01	1	02/26/2004	MM, CP	X	32N	07E	19	3	N	Maple Ridge	Alpena
NSWO	NSWO 025-3-03	1	04/08/2004	MM, CP	X	42N	11W	4	2	N	Newton	Mackinac
NSWO	NSWO 009-3-07	1	04/16/2004	MM, MS	X	42N	23W	5	2	N	Maple Ridge	Delta
NSWO	NSWO 007-2-01	1	03/11/2004	MM, CP	X	42N	33W	1	1	Y	Mastodon	Iron
NSWO	NSWO 007-3-04	1	04/14/2004	MM, MS	X	42N	33W	13	1	Y	Mastodon	Iron
NSWO	NSWO 025-3-01	1	04/07/2004	MM, CP	X	43N	09W	16	2	Y	Garfield	Mackinac
NSWO	NSWO 025-3-02	1	04/08/2004	MM, CP	X	43N	11W	33	3	N	Newton	Mackinac
NSWO	NSWO 009-3-01	1	04/16/2004	MM, MS	X	43N	23W	7	2	Y	Maple Ridge	Delta
NSWO	NSWO 009-3-03	1	04/16/2004	MM, MS	X	43N	23W	16	2	Y	Maple Ridge	Delta
NSWO	NSWO 009-3-02	1	04/16/2004	MM, MS	X	43N	23W	17	2	Y	Maple Ridge	Delta
NSWO	NSWO 009-3-04	1	04/16/2004	MM, MS	X	43N	23W	21	3	N	Maple Ridge	Delta
NSWO	NSWO 009-3-05	1	04/16/2004	MM, MS	X	43N	23W	32	3	N	Maple Ridge	Delta

Table B-1. Continued.

Species[a]	Owl Observation ID	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
NSWO	NSWO 009-3-06	1	04/16/2004	MM, MS	X	43N	23W	33	3	N	Maple Ridge	Delta
NSWO	NSWO 007-3-01	1	04/13/2004	MM, MS	X	43N	31W	20	3	N	Mansfield	Iron
NSWO	NSWO 007-3-02	1	04/13/2004	MM, MS	X	43N	32W	23	4	N	Crystal Falls	Iron
NSWO	NSWO 007-3-03	1	04/14/2004	MM, MS	X	43N	33W	36	4	N	Crystal Falls	Iron
NSWO	NSWO 003-1-01	1	02/12/2004	MM. CP	X	46N	43W	8	2	N	Marenisco	Gogebic
NSWO	NSWO 003-3-01	1	04/15/2004	MM, MS	X	46N	43W	19	3	N	Marenisco	Gogebic
NSWO	NSWO 003-3-04	1	04/15/2004	MM, MS	X	46N	44W	3	1	N	Marenisco	Gogebic
NSWO	NSWO 003-3-03	1	04/15/2004	MM, MS	X	46N	44W	11	1	N	Marenisco	Gogebic
NSWO	NSWO 003-3-02	1	04/15/2004	MM, MS	X	46N	44W	13	1	N	Marenisco	Gogebic
NSWO	NSWO 003-2-02	1	03/09/2004	MM, CP	X	47N	43W	28	3	N	Marenisco	Gogebic
NSWO	NSWO 003-2-01	1	03/09/2004	MM, CP	X	47N	43W	34	4	Y	Marenisco	Gogebic
NSWO	NSWO 003-3-06	1	04/15/2004	MM, MS	X	47N	44W	33	3	Y	Wakefield	Gogebic
NSWO	NSWO 003-3-05	1	04/15/2004	MM, MS	X	47N	44W	34	4	N	Wakefield	Gogebic
NSWO	NSWO 024-3-01	1	04/08/2004	MM, CP	X	48N	08W	11	1	Y	McMillan	Luce

[a] Species: BDOW = Barred Owl; EASO = Eastern Screech-Owl; GHOW = Great Horned Owl; LEOW = Long-eared Owl; and NSWO = Northern Saw-whet Owl.
[b] Observers: JB = John Brenneman; DC = David Cuthrell; JF = Jennifer Fettinger; YL = Yu Man Lee; MM = Michael Monfils; BN = Brian Nelson; PP = Peter Pearman; CP = Caleb Putnam; MS = Michael Sanders; and BS = Betsy Skare.
[c] Breeding criteria codes: # = species observed in suitable nesting habitat during its breeding season; X = singing male present in suitable nesting habitat during its breeding season; P = pair observed in suitable nesting habitat during breeding season.
[d] Priority survey block: Y = yes and N = no.

Table B-2. Incidental species observation data by MBBA II survey block from owl surveys conducted in Michigan in 2004.

Species[a]	Point ID Number	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
CAGO	070-05	several	03/25/2004	CP, JF	#	12N	15E	1	Y	1	Bridgehampton	Sanilac
AMWO	070-07	1	03/25/2004	CP, JF	X	13N	16E	32	Y	3	Forester	Sanilac
AMWO	070-21	2	03/25/2004	CP, JF	X	12N	16E	26	Y	4	Sanilac	Sanilac
SOSP	070-21	1	03/25/2004	CP, JF	X	12N	16E	26	Y	4	Sanilac	Sanilac
AMWO	070-28	1	03/25/2004	CP, JF	X	11N	16E	10	Y	1	Sanilac	Sanilac
AMWO	070-37	1	03/26/2004	CP, JF	X	11N	16E	27	Y	4	Sanilac	Sanilac
AMWO	070-40	5	03/26/2004	CP, JF	X	11N	16E	33	Y	3	Sanilac	Sanilac
AMWO	070-42	3	03/26/2004	CP, JF	X	11N	16E	34	Y	4	Sanilac	Sanilac
AMWO	070-44	1	03/26/2004	CP, JF	X	10N	16E	1	Y	1	Lexington	Sanilac
AMWO	070-46	5	03/26/2004	CP, JF	X	10N	16E	12	Y	1	Lexington	Sanilac
KILL	070-46	1	03/26/2004	CP, JF	X	10N	16E	12	Y	1	Lexington	Sanilac
AMRO	070-46	1	03/26/2004	CP, JF	X	10N	16E	12	Y	1	Lexington	Sanilac
RNPH	070-46	1	03/26/2004	CP, JF	X	10N	16E	12	Y	1	Lexington	Sanilac
AMWO	070-48	2	03/26/2004	CP, JF	X	10N	16E	13	Y	1	Lexington	Sanilac
KILL	070-48	1	03/26/2004	CP, JF	X	10N	16E	13	Y	1	Lexington	Sanilac
MODO	070-48	1	03/26/2004	CP, JF	X	10N	16E	13	Y	1	Lexington	Sanilac
RNPH	070-48	1	03/26/2004	CP, JF	X	10N	16E	13	Y	1	Lexington	Sanilac
AMRO	070-48	1	03/26/2004	CP, JF	X	10N	16E	13	Y	1	Lexington	Sanilac
KILL	070-50	1	03/26/2004	CP, JF	X	10N	16E	24	Y	4	Lexington	Sanilac
SOSP	070-50	1	03/26/2004	CP, JF	X	10N	16E	24	Y	4	Lexington	Sanilac
AMRO	070-50	1	03/26/2004	CP, JF	X	10N	16E	24	Y	4	Lexington	Sanilac
AMWO	070-50	2	03/26/2004	CP, JF	X	10N	16E	24	Y	4	Lexington	Sanilac
RNPH	070-50	1	03/26/2004	CP, JF	X	10N	16E	24	Y	4	Lexington	Sanilac
MODO	070-50	1	03/26/2004	CP, JF	X	10N	16E	24	Y	4	Lexington	Sanilac
AMWO	130-01	2	04/01/2004	MM, DC	X	28N	12W	31	Y	3	Solon	Leelanau
AMWO	130-06	2	04/01/2004	MM, DC	X	27N	12W	8	Y	2	Long Lake	Grand Traverse
AMWO	130-31	3	04/01/2004	MM, DC	X	27N	11W	27	Y	4	Garfield	Grand Traverse
AMWO	061-01	1	03/31/2004	MM, DC	X	23N	06E	35	N	4	Plainfield	Iosco
AMWO	061-09	1	03/31/2004	MM, DC	X	23N	06E	22	N	4	Plainfield	Iosco
AMWO	061-24	4	03/31/2004	MM, DC	X	24N	06E	23	Y	4	Oscoda	Iosco
AMWO	061-26	1	03/31/2004	MM, DC	X	24N	06E	14		1	Oscoda	Iosco
AMWO	061-28	2	03/31/2004	MM, DC	X	24N	06E	11		1	Oscoda	Iosco
AMWO	061-34	1	03/31/2004	MM, DC	X	25N	06E	25	Y	4	Curtis	Alcona
AMWO	061-38	1	04/01/2004	MM, DC	X	25N	06E	24	Y	4	Curtis	Alcona

Table B-2. Continued.

Species[a]	Point ID Number	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
RUGR	061-38	1	04/01/2004	MM, DC	X	25N	06E	24	Y	4	Curtis	Alcona
RUGR	003-05	1	04/14/2004	MM, MS	X	46N	43W	4	N	2	Marenisco	Gogebic
RUGR	003-45	1	04/15/2004	MM, MS	X	46N	45W	9	N	2	Bessemer	Gogebic
AMWO	003-49	1	04/15/2004	MM, MS	X	46N	45W	22	N	4	Bessemer	Gogebic
MALL	003-37	1	04/15/2004	MM, MS	#	47N	45W	22	N	4	Bessemer	Gogebic
AMWO	025-37	1	04/08/2004	MM, CP	X	42N	11W	4	N	2	Newton	Mackinac
AMWO	025-39	1	04/08/2004	MM, CP	X	42N	11W	9	N	2	Newton	Mackinac
AMWO	064-07	3	03/29/2004	MM, DC	X	15N	11E	17	Y	2	Grant	Huron
MALL	064-15	1	03/29/2004	MM, DC	A	15N	11E	13	Y	1	Grant	Huron
AMWO	064-21	1	03/29/2004	MM, DC	X	15N	12E	16	Y	2	Sheridan	Huron
RUGR	064-36	1	03/30/2004	MM, DC	X	14N	12E	12	Y	1	Greenleaf	Sanilac
AMWO	039-32	2	03/08/2004	JB	X	07S	14W	27	Y	4	Calvin	Cass
AMWO	039-29	1	03/08/2004	JB	X	07S	14W	26	Y	4	Calvin	Cass
AMWO	039-22	1	04/08/2004	JB, BS	X	07S	13W	32	Y	3	Porter	Cass
WISN	039-22	1	04/08/2004	JB, BS	X	07S	13W	32	Y	3	Porter	Cass
AMWO	039-40	1	04/08/2004	JB, BS	X	07S	14W	18	Y	2	Calvin	Cass
AMWO	039-42	1	04/08/2004	JB, BS	X	07S	14W	8	Y	2	Calvin	Cass
HOLA	039-49	UK	04/08/2004	JB, BS	X	06S	14W	29	Y	3	Penn	Cass
AMWO	034-03	1	03/25/2004	YL, CP	X	08N	08W	1	Y	1	Belding	Ionia
AMWO	034-05	1	03/25/2004	YL, CP	X	08N	08W	2	Y	1	Belding	Ionia
AMWO	034-20	1	03/25/2004	YL, CP	X	08N	09W	3	Y	1	Grattan	Kent
CAGO	034-20	UK	03/25/2004	YL, CP	X	08N	09W	3	Y	1	Grattan	Kent
CAGO	034-22	UK	03/25/2004	YL, CP	X	08N	09W	4	Y	2	Grattan	Kent
KILL	034-25	1	03/25/2004	YL, CP	X	08N	09W	5	Y	2	Grattan	Kent
AMWO	034-35	1	03/25/2004	YL, CP	X	09N	10W	33	Y	3	Courtland	Kent
AMWO	034-49	1	03/25/2004	YL, CP	X	09N	11W	32	Y	3	Algoma	Kent
NOCA	034-49	1	03/25/2004	YL, CP	X	09N	11W	32	Y	3	Algoma	Kent
CAGO	007-01	1	04/13/2004	MM, MS	X	43N	31W	26	N	4	Mansfield	Iron
MALL	007-04	1	04/13/2004	MM, MS	X	43N	31W	22	N	4	Mansfield	Iron
CAGO	007-28	1	04/14/2004	MM, MS	P	42N	33W	1	Y	1	Mastodon	Iron
RUGR	007-34	1	04/14/2004	MM, MS	X	42N	33W	16	N	2	Mastodon	Iron
WITU	007-47	1	04/14/2004	MM, MS	#	42N	34W	10	Y	1	Stambaugh	Iron
AMWO	059-01	1	04/06/2004	MM, CP	X	32N	08E	19		3	Alpena	Alpena
AMWO	059-39	1	04/07/2004	MM, CP	X	32N	05E	34	Y	4	Wellington	Alpena

Table B-2. Continued.

Species[a]	Point ID Number	No. Obs.	Date	Observer(s)[b]	Code[c]	Town	Range	Section	Block	Priority[d]	Twp. Name	County
AMWO	059-41	3	04/07/2004	MM, CP	X	32N	05E	32		3	Wellington	Alpena
AMWO	059-43	1	04/07/2004	MM, CP	X	31N	05E	6	Y	2	Wellington	Alpena
AMWO	059-46	1	04/07/2004	MM, CP	X	32N	04E	36	Y	4	Montmorency	Montmorency
AMWO	047-07	1	03/31/2004	MM, DC	X	28N	02E	30		3	Elmer	Oscoda
AMWO	047-09	2	03/31/2004	MM, DC	X	28N	01E	25		4	Greenwood	Oscoda
AMWO	047-25	1	04/01/2004	MM, DC	X	27N	01E	34	Y	4	Greenwood	Oscoda
RUGR	047-25	1	04/01/2004	MM, DC	X	27N	01E	34	Y	4	Greenwood	Oscoda
AMWO	047-28	1	04/01/2004	MM, DC	X	26N	01E	2	Y	1	Big Creek	Oscoda
AMWO	043-06	1	04/06/2004	MM, CP	X	33N	05W	30	Y	3	Melrose	Charlevoix
SHCR	024-30	2	04/09/2004	MM, CP	X	47N	09W	3	N	1	McMillan	Luce
SHCR	024-32	1	04/09/2004	MM, CP	X	47N	09W	9	Y	2	McMillan	Luce
AMWO	024-32	1	04/09/2004	MM, CP	X	47N	09W	9	Y	2	McMillan	Luce
AMWO	024-34	1	04/09/2004	MM, CP	X	47N	09W	16	Y	2	McMillan	Luce
AMWO	024-38	1	04/09/2004	MM, CP	X	47N	09W	19	N	3	McMillan	Luce
AMWO	024-40	1	04/09/2004	MM, CP	X	47N	09W	30	N	3	McMillan	Luce
SHCR	024-40	2	04/09/2004	MM, CP	X	47N	09W	30	N	3	McMillan	Luce
AMWO	024-42	3	04/09/2004	MM, CP	X	47N	10W	25	N	4	McMillan	Luce
SHCR	024-42	UK	04/09/2004	MM, CP	X	47N	10W	25	N	4	McMillan	Luce
AMWO	024-47	2	04/09/2004	MM, CP	X	46N	10W	11	N	1	McMillan	Luce
CAGO	024-47	UK	04/09/2004	MM, CP	X	46N	10W	11	N	1	McMillan	Luce
AMWO	024-49	2	04/09/2004	MM, CP	X	46N	10W	14	N	1	McMillan	Luce
RUGR	024-49	1	04/09/2004	MM, CP	X	46N	10W	14	N	1	McMillan	Luce
AMWO	009-01	2	04/15/2004	MM, MS	X	45N	23W	11	Y	1	Skandia	Marquette

[a] Species: AMWO = American Woodcock; CAGO = Canada Goose; HOLA = Horned Lark; KILL = Killdeer; MALL = Mallard; NOCA = Northern Cardinal; RNPH = Ring-necked Pheasant; RUGR = Ruffed Grouse; SHCR = Sandhill Crane; SOSP = Song Sparrow; WISN = Wilson's Snipe; and WITU = Wild Turkey.
[b] Observers: JB = John Brenneman; DC = David Cuthrell; JF = Jennifer Fettinger; YL = Yu Man Lee; MM = Michael Monfils; BN = Brian Nelson; PP = Peter Pearman; CP = Caleb Putnam; MS = Michael Sanders; and BS = Betsy Skare.
[c] Breeding criteria codes: # = species observed in suitable nesting habitat during its breeding season; X = singing male present in suitable nesting habitat during its breeding season; P = pair observed in suitable nesting habitat during breeding season.
[d] Priority survey block: Y = yes and N = no.

APPENDIX C

Summary Information for Principal Components Analysis

Table C-1. Eigenvectors for principal components (PC) one through five derived from principal components analysis of landscape-level habitat surrounding survey stations used during woodland owl surveys conducted in Michigan in 2004. The eigenvalue, percent of variation explained, and cumulative percent of variation explained are provided for each PC. Habitat variable names refer to the landscape habitat category (UR = urban, NF = nonforested, DF = deciduous forest, CF = coniferous forest, and MF = mixed forest) and buffer radii (500, 1000, 2000, and 5000 m).

Landscape Variable	PC1	PC2	PC3	PC4	PC5
Eastern Screech-Owl Survey Sites (stations in SLP with approximate 1.6 km separation)					
UR_0500	0.1334	-0.4085	0.2166	0.0149	-0.3241
UR_1000	0.1492	-0.3856	0.2586	0.1333	-0.2711
UR_2000	0.1640	-0.3888	0.2266	0.1523	0.0507
UR_5000	0.1535	-0.3565	0.1695	0.0830	0.4915
NF_0500	-0.2594	0.0591	0.1691	-0.3343	0.0355
NF_1000	-0.2777	0.0899	0.1427	-0.1435	0.1771
NF_2000	-0.2818	0.0674	0.1025	0.1599	0.1562
NF_5000	-0.2635	0.1190	0.0365	0.3365	-0.1981
DF_0500	0.1885	-0.0361	-0.3897	0.3332	0.1143
DF_1000	0.2160	-0.0604	-0.4145	0.0784	-0.0700
DF_2000	0.2199	-0.0245	-0.3641	-0.2445	-0.1447
DF_5000	0.2074	-0.0934	-0.2608	-0.4323	0.0373
CF_0500	0.2095	0.2925	0.0980	0.2550	-0.1504
CF_1000	0.2265	0.2695	0.1708	0.1332	-0.2107
CF_2000	0.2246	0.2407	0.2130	-0.1388	-0.3117
CF_5000	0.2275	0.1875	0.2418	-0.2467	-0.0663
MF_0500	0.2202	0.2300	0.0207	0.2719	0.3283
MF_1000	0.2539	0.1964	0.1188	0.1407	0.1826
MF_2000	0.2616	0.1286	0.1657	-0.0858	0.0962
MF_5000	0.2528	0.0497	0.1913	-0.2302	0.3491
Eigenvalue	11.0387	3.2447	2.2948	1.1904	0.5457
Percent	55.1937	16.2234	11.4739	5.9522	2.7286
Cum Percent	55.1937	71.4170	82.8909	88.8431	91.5717
Barred Owl Survey Sites (stations in NLP and UP with at least 3.2 km separation)					
UR_0500	0.1233	0.0534	0.2911	0.4282	-0.3370
UR_1000	0.1240	0.0660	0.3323	0.4468	-0.1790
UR_2000	0.1945	0.0701	0.3398	0.3236	0.1636
UR_5000	0.2216	0.0723	0.2790	0.1170	0.5115
NF_0500	0.3447	0.0503	-0.0108	-0.2348	-0.3471
NF_1000	0.3648	0.0273	-0.0170	-0.2359	-0.2025
NF_2000	0.3690	0.0102	0.0050	-0.1885	0.0890
NF_5000	0.3578	0.0017	-0.0286	-0.1071	0.3136
DF_0500	-0.1894	0.2921	-0.1800	0.1587	0.2905
DF_1000	-0.1896	0.3209	-0.1591	0.1398	0.1858
DF_2000	-0.1721	0.3440	-0.1424	0.0900	-0.0897
DF_5000	-0.1679	0.3274	-0.0657	0.0119	-0.3009
CF_0500	-0.1263	-0.3750	0.0289	0.0937	0.0553
CF_1000	-0.1269	-0.3825	0.0005	0.0899	0.0161
CF_2000	-0.1261	-0.3872	-0.0273	0.0961	-0.0010
CF_5000	-0.1405	-0.3455	-0.0729	0.1059	-0.0450
MF_0500	-0.1961	0.0426	0.3415	-0.2746	0.1978
MF_1000	-0.2170	0.0407	0.3557	-0.2872	0.0693
MF_2000	-0.2087	0.0554	0.3789	-0.2604	-0.0731
MF_5000	-0.2000	0.0517	0.3666	-0.1577	-0.1622
Eigenvalue	6.1945	5.6351	3.7357	1.9172	0.7030
Percent	30.9726	28.1757	18.6787	9.5862	3.5151
Cum Percent	30.9726	59.1483	77.8271	87.4133	90.9283

Table C-1. Continued.

Landscape Variable	PC1	PC2	PC3	PC4	PC5
Great Horned Owl Survey Sites (stations in SLP, NLP, and UP with at least 3.2 km separation)					
UR_500	-0.0638	0.1028	0.4639	-0.2062	-0.3157
UR_1000	-0.0774	0.1079	0.4810	-0.1714	-0.2048
UR_2000	-0.1193	0.1150	0.4736	-0.1328	0.1414
UR_5000	-0.1542	0.1081	0.3781	-0.0371	0.4444
NF_500	-0.3033	-0.0259	-0.0679	0.1906	-0.3128
NF_1000	-0.3150	-0.0418	-0.0745	0.1806	-0.1539
NF_2000	-0.3191	-0.0404	-0.0488	0.1526	0.0940
NF_5000	-0.3166	-0.0259	-0.0463	0.0913	0.2421
DF_500	0.1617	0.3439	-0.1507	-0.2071	0.3317
DF_1000	0.1666	0.3747	-0.1279	-0.1825	0.2075
DF_2000	0.1729	0.3758	-0.1315	-0.1251	-0.1418
DF_5000	0.1977	0.3257	-0.0745	-0.0291	-0.4021
CF_500	0.2009	-0.3534	0.0683	-0.1362	0.0991
CF_1000	0.2132	-0.3488	0.0534	-0.1543	0.0269
CF_2000	0.2217	-0.3390	0.0373	-0.1721	-0.0089
CF_5000	0.2429	-0.2707	0.0050	-0.1812	-0.0541
MF_500	0.2243	0.0451	0.1488	0.4265	0.2487
MF_1000	0.2442	0.0390	0.1555	0.4244	0.0939
MF_2000	0.2515	0.0481	0.1680	0.4005	-0.0656
MF_5000	0.2620	0.0395	0.1614	0.2975	-0.1688
Eigenvalue	8.8685	4.1507	3.1863	1.8814	0.5538
Percent	44.3424	20.7535	15.9317	9.4068	2.7692
Cum Percent	44.3424	65.0959	81.0276	90.4344	93.2036

APPENDIX D

Woodland Owl Survey Data Form

BBS Route Number:		Date:		Visit Number:		Time Period(s):	
Moon Phase:		County:		Surveyor(s):			

Station No.:	GPS Pt. Name:	Start Time:	Wind Speed: [ ]km/h [ ]mph [ ]Beaufort Index
Snow Cover: [ ]none [ ]patchy [ ]continuous / Approx. depth: [ ]cm [ ]in	Temp.: [ ]°F [ ]°C	Noise Level [ ]1 [ ]2 [ ]3 [ ]4	
Precip.: [ ]none [ ]light [ ]medium / [ ]snow [ ]rain	Cloud Cover (%):	Notes:	

SPECIES	2-MIN	BROADCAST PERIOD (shaded species UP only)							2-MIN	SEX	BEARING	ESTIMATED DISTANCE (km, circle one)
		N	B	E	L	B	G	G				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)
		S	O	A	E	D	G	H				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)
		W	O	S	O	O	O	O				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)
		O	W	O	W	W	W	W				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)

Comments:

Station No.:	GPS Pt. Name:	Start Time:	Wind Speed: [ ]km/h [ ]mph [ ]Beaufort Index
Snow Cover: [ ]none [ ]patchy [ ]continuous / Approx. depth: [ ]cm [ ]in	Temp.: [ ]°F [ ]°C	Noise Level [ ]1 [ ]2 [ ]3 [ ]4	
Precip.: [ ]none [ ]light [ ]medium / [ ]snow [ ]rain	Cloud Cover (%):	Notes:	

SPECIES	2-MIN	BROADCAST PERIOD (shaded species UP only)							2-MIN	SEX	BEARING	ESTIMATED DISTANCE (km, circle one)
		N	B	E	L	B	G	G				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)
		S	O	A	E	D	G	H				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)
		W	O	S	O	O	O	O				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)
		O	W	O	W	W	W	W				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)

Comments:

Station No.:	GPS Pt. Name:	Start Time:	Wind Speed: [ ]km/h [ ]mph [ ]Beaufort Index
Snow Cover: [ ]none [ ]patchy [ ]continuous / Approx. depth: [ ]cm [ ]in	Temp.: [ ]°F [ ]°C	Noise Level [ ]1 [ ]2 [ ]3 [ ]4	
Precip.: [ ]none [ ]light [ ]medium / [ ]snow [ ]rain	Cloud Cover (%):	Notes:	

SPECIES	2-MIN	BROADCAST PERIOD (shaded species UP only)							2-MIN	SEX	BEARING	ESTIMATED DISTANCE (km, circle one)
		N	B	E	L	B	G	G				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)
		S	O	A	E	D	G	H				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)
		W	O	S	O	O	O	O				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)
		O	W	O	W	W	W	W				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)

Comments:

Station No.:	GPS Pt. Name:	Start Time:	Wind Speed: [ ]km/h [ ]mph [ ]Beaufort Index
Snow Cover: [ ]none [ ]patchy [ ]continuous / Approx. depth: [ ]cm [ ]in	Temp.: [ ]°F [ ]°C	Noise Level [ ]1 [ ]2 [ ]3 [ ]4	
Precip.: [ ]none [ ]light [ ]medium / [ ]snow [ ]rain	Cloud Cover (%):	Notes:	

SPECIES	2-MIN	BROADCAST PERIOD (shaded species UP only)							2-MIN	SEX	BEARING	ESTIMATED DISTANCE (km, circle one)
		N	B	E	L	B	G	G				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)
		S	O	A	E	D	G	H				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)
		W	O	S	O	O	O	O				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)
		O	W	O	W	W	W	W				(<.1) (.1-.25) (.25-.5) (.5-.75) (.75-1) (>1)

Comments: