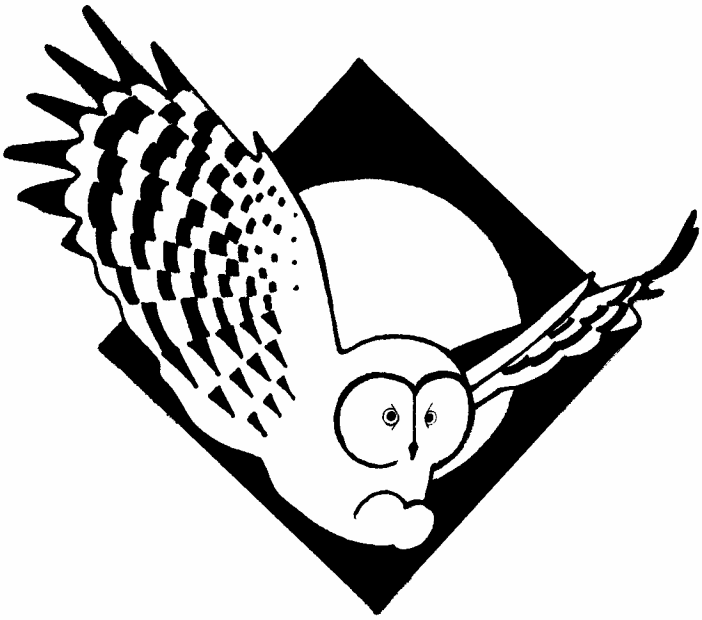
ONTARIO NOCTURNAL OWL SURVEY

2006 Final Report



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2006 ONTARIO NOCTURNAL OWL SURVEY

EXECUTIVE SUMMARY

Owls are considered good indicators of forest health because of their position at the top of the food chain and their dependence on relatively large tracts of forest. However, there is little known about the abundance and population status of most nocturnal owl populations in Canada. As a result of their unique biology, most owl species, in particular those breeding in boreal forests of Ontario, are not well monitored by existing bird monitoring programs such as the Breeding Bird Survey and Christmas Bird Count. For these reasons, the Ontario Nocturnal Owl Survey was initiated in 1995. The objectives of the survey are: (1) to monitor owl populations, (2) to determine habitat associations of owls in Ontario, and (3) to investigate the impacts of forest management practices on owls.

The Ontario Nocturnal Owl Survey is a roadside survey conducted by volunteers across central and northern Ontario. In 2006, 135 surveyors participated in the Ontario Nocturnal Owl Survey; 84 routes were surveyed in central Ontario and 69 in northern Ontario. In total, 776 owls of nine species (including 27 individuals of unknown species) were recorded on 136 routes. In central Ontario, a mean of 4.4 individuals was observed per survey route; in northern Ontario, a mean of 6.0 individuals was observed. The maximum number of owls recorded on a survey was 18 in central Ontario and 19 in northern Ontario. Mean number of Ruffed Grouse and Wilson's Snipe recorded on central and northern owl routes were similar to numbers recorded previously. Numbers of American Woodcock appear to have increased over time, particularly in central Ontario. In 2006, there were 3.6 woodcock/10 stops in central Ontario, compared to 2.2 birds/10 stops the year previous.

The Barred Owl population in central and northern Ontario has been quite stable from 1995-2006, which suggests that forest management activities in Ontario are not negatively affecting this species. Annual indices for Northern Saw-whet Owl and Boreal Owl, on the other hand, show high annual variation and are likely strongly influenced by small mammal abundance. For example, Northern Saw-whet Owl population indices in central Ontario are highly correlated with abundance of Red-backed Voles (BSC, OMNR unpub. data). The absence of long-term small mammal data from northern Ontario precludes comparisons with Boreal Owl numbers. However, the periodicity in Boreal Owl indices (roughly four year cycle) from a variety of sources suggests that Boreal Owls are similarly influenced by small mammal cycles.

Despite high annual variation and the periodicity that is typical of owl populations, the three Provincial Wildlife Population Monitoring Program representative owl species have shown no evidence of population declines. At present, there are no immediate indications that the survey is picking up region-wide negative signals that could be ascribed to land management practices.

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INTRODUCTION

Owls are considered good indicators of forest health because of their position at the top of the food chain, their dependence on relatively large tracts of forest, the dependence of some owl species on mature forest and, as a result, their assumed vulnerability to logging practices (Francis and Czerwinski 1995). Most owl species are wide-ranging, secretive, primarily nocturnal, and occur at relatively low densities (Shepherd 1992). Due to their secretive and nocturnal behaviour, most owl species, in particular those breeding in boreal forests of Ontario, are not well monitored by existing bird monitoring programs such as the Breeding Bird Survey and Christmas Bird Count. As a result, little is known about the abundance and population status of most nocturnal owl populations in Canada.

In 1995, The Ontario Nocturnal Owl Survey was initiated by Bird Studies Canada in partnership with the Ontario Ministry of Natural Resources' (MNR) Terrestrial Assessment Program (TAP; formerly Wildlife Assessment Program), in response to a need by MNR to assess population trends of representative wildlife species that may be affected by forest management practices on Crown Land in Ontario. In particular, Barred Owls, Boreal Owls and Northern Saw-whet Owls all depend on snags in mature or overmature forests for breeding and are recognized as representative owl species by Condition 30 (b) of the Provincial Wildlife Population Monitoring Program (Ministry of Natural Resources 2004).

Because owls are territorial, imitating or broadcasting owl vocalizations within an owl's territory may invoke a vocal response from many species. Consequently, broadcast surveys are one of the most effective methods of surveying for owls (Takats *et al*. 2001). Although response rate varies seasonally, among species, and with environmental conditions, this survey technique has been used to determine the distribution and population status of several North American owl species and, by recording distance and direction of owls, habitat associations can also be determined (Takats *et al*. 2001). For these reasons, the Ontario Nocturnal Owl Survey uses a roadside playback survey protocol based upon recommendations by Shepherd (1992) and following the design of similar surveys in Manitoba, Minnesota (Duncan and Duncan 1991, 1993) and in the Red Lake district of Ontario (Gilmore and MacDonald 1996).

This report summarizes the results of the survey to date (1995-2006), with emphasis on the 2006 survey season.

METHODS

DATA COLLECTION

Since 1995, the Ontario Nocturnal Owl Survey has enlisted volunteers to conduct standardized roadside surveys in forested areas in central and northern Ontario using call playback. Routes were situated along snow-ploughed secondary roads, with pre-determined stations from which surveys were conducted. Most survey teams consisted of two volunteers – the surveyor was responsible for identifying all owls, while an assistant played the broadcast tape and recorded all observations on the data forms provided.

At each survey station, survey teams recorded when each owl was detected (i.e., during first passive listening period, after first call broadcast, etc.; see Survey Protocols below) and whether each owl was heard, seen, or both. Newly calling owls were discriminated from owls that called previously (duplicates), and the direction and distance of each owl from the stop site was estimated. In 2001, surveyors also began recording the number of Ruffed Grouse, Wilson's Snipe and American Woodcock observed, because all three species are crepuscular and, consequently, often present at the first few stations of a survey route.

In addition to species data, surveyors recorded the traffic count, background noise level, odometer reading, time at each stop, and any additional comments they felt were pertinent. Over the past five years, significant time has also been invested in obtaining geographic coordinates for owl routes; in 2006 surveyors who had not submitted geographic coordinates were encouraged to georeference their stops by using a GPS unit or by marking the stops on a topographic map.

SURVEY TIMING

Volunteers were asked to survey their route on a single evening during the month of April, at least one half hour after sunset, and on clear calm nights with winds less than force 3 on the Beaufort scale, no precipitation and temperatures warmer than -15° C. We encouraged volunteers to survey within the first two weeks of the month in order to avoid potential problems with noise from frogs and/or spring runoff and melt water. This also gave volunteers two additional weeks to complete their survey if they encountered poor weather and/or road conditions during the recommended time period.

Development of Survey Timing. April was chosen as the best time of year to conduct nocturnal owl surveys on the basis of preliminary research we completed that tested how the number of survey visits affected the statistical power to detect species trends. To do so, volunteers surveyed their route during two survey windows (March 13–18; April 3-16) from 1995-1998 in central Ontario and in 1995, 1997 and 1998 in northern Ontario, and during three survey windows (March 5-15; April 2-12 April; April 22-May 2) in 1999 in central Ontario and in 1996 and 1999 in northern Ontario. Results of this study suggested that a reduction to one survey window resulted in some loss of survey power. However, Francis and Whittam (2000) suggested that the loss of power would be compensated for by increased volunteer participation and longer-term commitment by volunteers with only one survey window. Thus, April was recommended for the survey, since owls were usually detected more often in April than March (with the exception of Great Horned Owl), and because the weather is generally warmer and therefore more amenable to volunteers at that time.

SURVEY PROTOCOLS

Central Ontario

The central Ontario Nocturnal Owl Survey (south of the 47th parallel on the Canadian Shield; Figure 1) targeted the Northern Saw-whet Owl and Barred Owl. In central Ontario, survey routes consisted of 10 stops spaced 2.0 km apart for a total route length of 18 km. At each stop,

volunteers played a 12-minute broadcast tape. The tape began with two-minutes of passive listening, divided into one-minute periods by double-beeps. This was followed by 20 seconds of Boreal Owl calls, one-minute of passive listening, 20 seconds of Barred Owl calls, two minutes of passive listening, and three more 20 second periods of Barred Owl calls with a passive listening period between each.

Central Ontario Protocol Development. The central Ontario broadcast methodology changed several times since the survey began in 1995. In 1995, the broadcast protocol consisted of one minute of passive listening, followed by 20 seconds of Boreal Owl calls, one minute of passive listening, 20 seconds of Barred Owl calls, two minutes of passive listening, 20 seconds of Barred Owl calls and eight minutes of passive listening, for a total of 13 minutes. Northern Saw-whet Owl calls were not broadcast at that time.

From 1996-1998, we tested whether broadcasting Northern Saw-whet Owl calls in place of Boreal Owl calls in the broadcast protocol affected owl response rate. We also tested the effect of broadcast duration on owl response rate by adding a third Barred Owl vocalization to the broadcast tape. Results from those studies suggested that Northern Saw-whet Owls responded equally well to conspecific calls as to Boreal Owl calls, and that Barred Owls responded more slowly to call playback than did the other owl species (see also McGarigal and Fraser 1985). Thus, in 1999, Boreal Owl was kept as the first species on the broadcast tape to remain consistent with the northern Ontario survey protocol, and an additional Barred Owl playback was added to the broadcast tape. An additional minute of passive listening period was also added to the beginning of the broadcast tape to meet national owl monitoring standards and to remain consistent with the northern Ontario protocol. In 2000, the additional Barred Owl call was removed from the protocol because the benefits of retaining volunteers by reducing the time required at each stop from 14 minutes to 12 minutes outweighed the benefits of increased response rate.

Northern Ontario

The northern Ontario Nocturnal Owl survey (north of the 47th parallel; Figure 1) targeted the Great Gray Owl and Boreal Owl. In northern Ontario, stops were placed 1.6 km apart, with a minimum of ten stops per route (total route length 14.4 km) and a maximum of 20 stops per route (total route length 30.4 km). At each stop, volunteers played the broadcast tape, which was 4 min. 40 sec. long. The tape began with two minutes of passive listening, divided into one-minute periods by double-beeps. This was followed by twenty seconds of Boreal Owl calls, one minute of passive listening, 20 seconds of Great Gray Owl calls and a final passive listening period.

Northern Ontario Protocol Development. The northern Ontario broadcast protocol also changed since the survey began. From 1995-1998 the protocol consisted of one minute of passive listening, 20 seconds of Boreal Owl calls, one minute of passive listening, 20 seconds of Great Gray Owl calls and a final passive listening period, for a total of 3 min. 40 sec. In 1999, an additional minute of passive listening was added to the beginning of the survey to meet national owl monitoring standards, and the broadcast protocol has not changed since.

The set-up of survey routes also evolved since 1995. Originally, each route consisted of 25 stops spaced 0.8 km apart, for a total distance of 19.2 km. In 1996, the number of stops per route was reduced to 20, although some routes were shorter because of inadequate road lengths. The distance between stops was also increased to 1.6 km (total route length 30.4 km) in order to reduce the potential for duplicate counts of individuals. In 2000, the minimum number of stops per route was reduced to 10 (for a total of 14.4 km); the maximum number of stops per route remained at 20.

ROUTE SELECTION

Ideally, routes surveyed by volunteers would have been selected randomly from all suitable secondary roads that were ploughed in winter and had little traffic. Initially, this was considered too difficult to implement, because inadequate information was available on road suitability to permit us to do this centrally, and because matching volunteers with pre-selected routes was considered too difficult. Instead, we relied upon volunteers to select routes, with coordination by BSC to avoid overlap among surveyors. Some central Ontario routes were chosen to coincide with pre-selected Red-shouldered Hawk survey routes (Badzinski 2001), while regional OMNR offices selected other routes.

Once a route was established, we encouraged volunteers to continue to survey the same route over time. However, some routes were abandoned because they were no longer accessible (i.e., no longer ploughed in winter) or because the original volunteers could no longer participate. New volunteers were encouraged to adopt abandoned routes where possible, but new routes were established if necessary.

ROUTE RANDOMIZATION

In order to conform to National Owl Survey Guidelines (Takats *et al.* 2001), a route randomization strategy was implemented in 2002. To do so, areas with insufficient coverage were first identified. This was accomplished by dividing the province into blocks (one block = 1:250,000 topographic map), and subdividing those blocks into left and right, such that each sub-block measured 1° latitude x 1° longitude (Figure 1). Sub-blocks that were less than 1/3 covered by land or less than 1/3 within political boundaries of Ontario were excluded from the randomization process.

The starting point of each Nocturnal Owl Survey route was then overlaid on the sub-block grid. If a sub-block was more than 50% covered by land, minimum route coverage was set at two routes per sub-block. If a sub-block was 33-50% covered by land, minimum route coverage was set at one route per sub-block. We found that most sub-blocks greatly exceeded the minimum coverage level, and we therefore examined route distribution on a finer scale by dividing each sub-block into 16 cells, each cell representing 1:50,000 on a topographic map (Figure 1). At this scale, maximum coverage was set at one route per cell.

There were 34 sub-blocks in northern Ontario with insufficient route coverage (none in central Ontario), ten of which had road access (Table 1). New routes were chosen in those 10 sub-blocks by randomly selecting a cell within each sub-block and randomly selecting a starting

point within that cell. If a cell without road access was chosen, another cell was chosen until an appropriate cell was found. In some cases, there was only one cell in the sub-block with road access.

To facilitate setting up new routes for volunteers, a database was constructed with a list of blocks with insufficient coverage and a list of cells without an owl route. When volunteers contacted BSC to request an owl route, the nearest cell to their home with accessible roads was chosen, and a random starting point was selected within the cell. If all nearby cells had maximum coverage, the volunteer was placed on a waiting list. Despite attempts to assign volunteers to the new random routes, few have been assigned due to their remote locations.

DATA MANAGEMENT

In 2002, the Ontario Nocturnal Owl Survey database was converted from Paradox to Microsoft Access. The database is comprised of 8 main tables:

1. Surveys (date, start/end time, weather conditions)
2. Stations (station specific information: time, odometer reading, traffic/noise counts, any notable remarks)
3. Owl data (species, time interval recorded, distance, direction)
4. Route (route information: route name, status, region, current surveyor information)
5. Coordinates (geographic stop coordinates and written stop descriptions)
6. Equipment test (results of volunteer conducted equipment test)
7. Confidence (confidence levels for distance and direction estimates)
8. Additional species (# of Ruffed Grouse, Wilson's Snipe, American Woodcock at each station)

The main parent table in the database is Surveys, which is linked to three tables that contain survey specific information: Stations, Route, and Equipment Test. The Stations table is further linked to Owl Data and Additional Species, and Route is further linked to Coordinates and Confidence. Referential integrity is enforced in the database to ensure that all relationships between related tables are valid. This means that all records in the primary table must also be found in the related table.

The Access database includes complete information on the owls recorded at each stop, including which time interval each individual was seen and/or heard calling. This allows us to assess the impact of potential changes in survey protocol, and provides a basis for using data from years with slightly different protocols (by restricting analyses to birds detected during comparable parts of the protocol).

DATA ANALYSIS

The total number of owls on a route was determined by adding all owls that were newly detected at each station. To estimate population changes among years, data from the second survey window were used if data were collected prior to 2000. If a route was not surveyed during that window, data from the first survey window were used. The second survey window was

preferred for analyses because the mean survey date of that window corresponded most closely to the mean survey date of the first and only survey window for routes surveyed since 2000.

Annual Population Indices

We calculated annual indices using Poisson regression with a log-link model, treating year and route identifier as class variables (Proc Genmod; SAS 2001). This approach was based on methods developed for analysis of Breeding Bird Survey (BBS) data (Link and Sauer 1997, 1998). To compare among years, only owls detected during standardized parts of the protocol and/or adjusted counts for variation in protocol (i.e., differing amounts of playback in central and northern Ontario) were used. As a result, some counts were not integer values, but this did not appear to cause problems for the SAS program. The issue of over-dispersion, which greatly complicates the analysis but has been found to be important for some BBS data, was not considered. Most likely, variances were slightly underestimated, which may have over-estimated the statistical significance of changes. For each species, only routes on which the species was detected at least once during the survey period were included. Routes on which a species has never been detected do not provide information on trends for that species. We tested annual variation in counts by comparing models with and without year effects using a likelihood ratio test. If significant differences were found, contrasts were used to determine which pairs of years differed significantly ($P < 0.05$).

RESULTS

VOLUNTEER PARTICIPATION

In 2006, 135 surveyors participated in the Ontario Nocturnal Owl Survey. Approximately 250 routes were assigned to survey teams, of which data were returned for 159 routes. Eighty-four routes were surveyed in central Ontario and 69 in northern Ontario. One hundred and sixteen volunteers surveyed one route each, 15 surveyed two routes each, three surveyed three routes each and one pair of surveyors completed four routes. Data from 153 routes of the 2006 survey were included in trend analyses; six routes were excluded because they did not meet data standards.

Of the 159 routes surveyed (Figure 1), four (two in central Ontario, two in northern Ontario) were surveyed in all 12 years. In 2006, three randomly selected routes were assigned to volunteers, and two were completed. To date, approximately 80% of active owl routes in Ontario have geographic coordinates for each station.

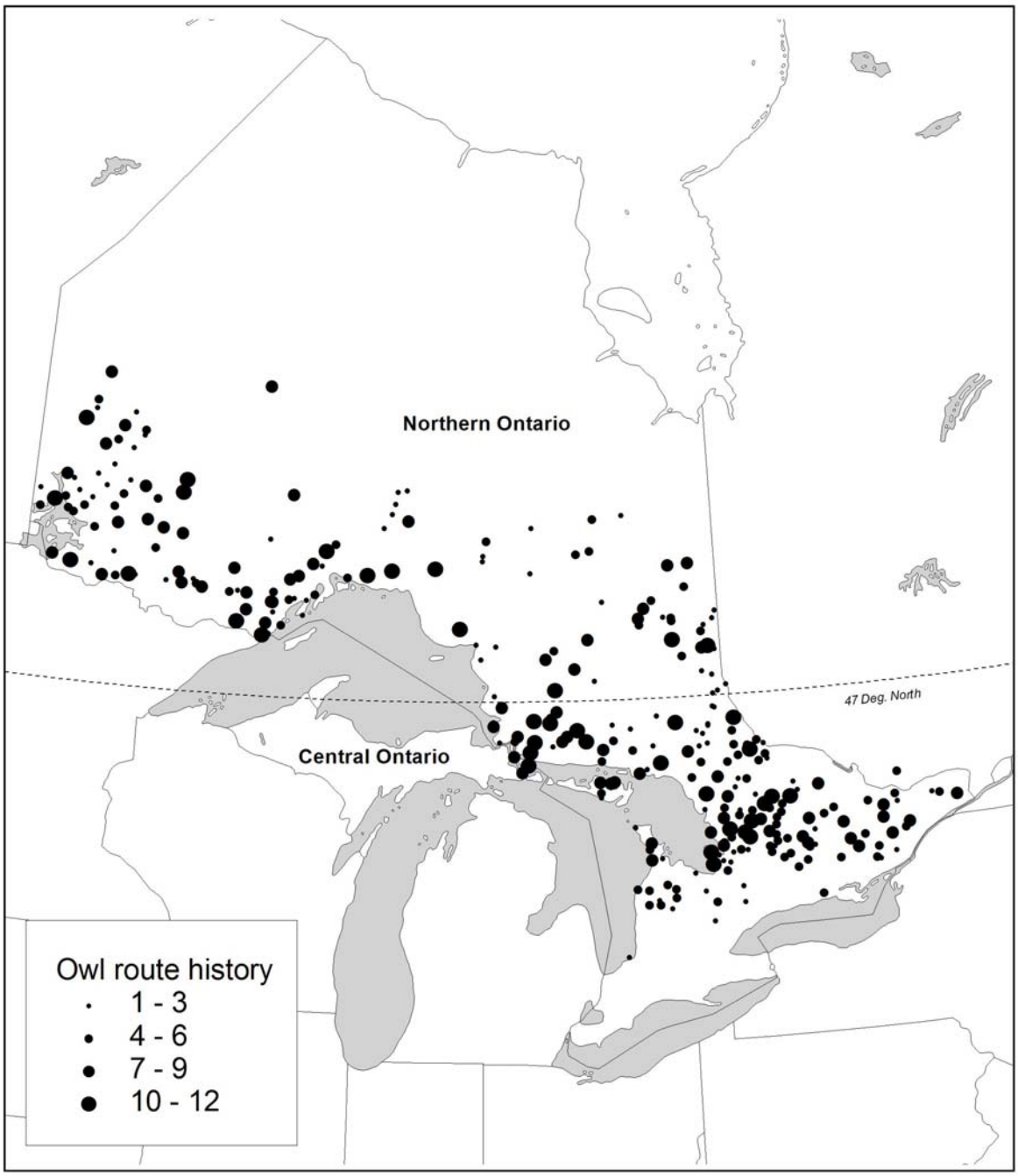

Figure 1 - Map of Ontario showing boundaries of the study area, location of the routes, and the number of times that each route was run from 1995-2006. Increasing circle size indicates routes that were run in a greater number of years. Routes north of the 47th parallel use northern Ontario protocol, and all routes south of the 47th parallel use central Ontario protocol.

SURVEY TIMING

During 2006 owl surveys, temperatures ranged from –3 °C to 17 °C in central Ontario and from –6 °C to 22 °C in northern Ontario. All routes but one was surveyed during the month of April. This route was surveyed 5 May. Mean survey date in 2006 was 13 April in central Ontario and 17 April in northern Ontario, which is similar to the mean date recorded since 2000 (Table 1).

Table 1 – Mean survey dates from 1995-2006 in central and northern Ontario for each survey window. Starting in 2000, a single survey window protocol was implemented.

	Central Ontario			Northern Ontario		
Year	**1**	**2**	**3**	**1**	**2**	**3**
1995	14 March	12 April	—	16 March	14 April	—
1996	12 March	10 April	—	14 March	11 April	30 April
1997	15 March	08 April	—	12 March	12 April	—
1998	13 March	12 April	—	13 March	09 April	—
1999	12 March	09 April	28 April	11 March	09 April	28 April
2000	—	18 April		—	17 April	
2001	—	17 April		—	17 April	
2002	—	15 April		—	18 April	
2003	—	18 April		—	18 April	
2004	—	15 April		—	18 April	
2005	—	15 April		—	18 April	
2006	—	13 April		—	17 April	

OWL DISTRIBUTION AND ABUNDANCE

In total, 776 owls of nine species (including 27 individuals of unknown species) were recorded on 136 routes; 17 routes did not record any owls (Figures 2, 3; Table 2). Routes with owls had one to 19 individuals with one to five species. In central Ontario, owls were encountered on 71 of the 84 routes, with a total of 369 individuals (including 14 individuals of unknown species). In northern Ontario, owls were encountered on 65 of the 69 routes, with a total of 407 individuals (including 13 individuals of unknown species). In central Ontario, a mean of 4.4 individuals was observed per survey route; in northern Ontario, a mean of 6.0 individuals was observed. The maximum number of owls recorded on a survey was 18 in central Ontario and 19 in northern Ontario.

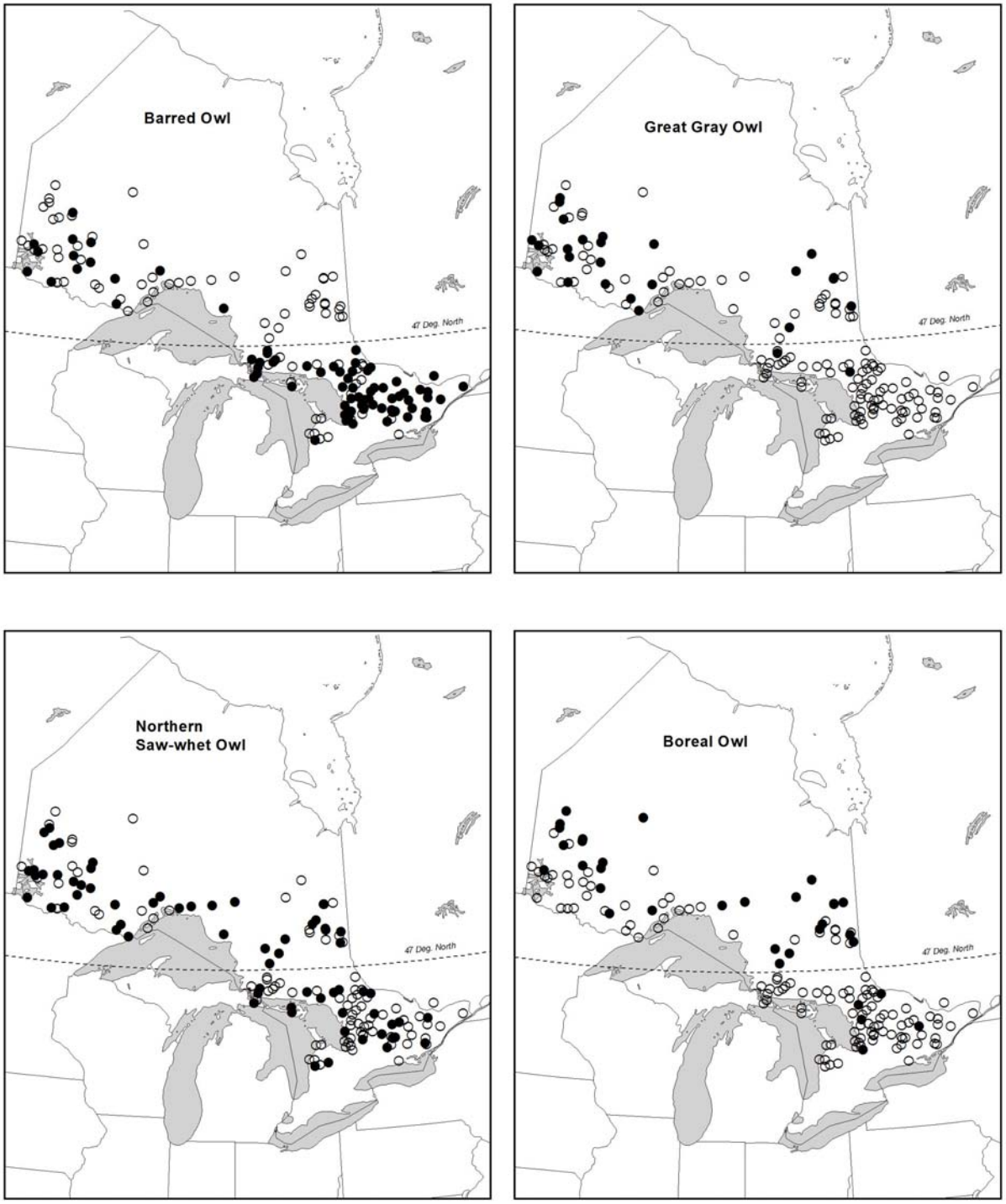

Figure 2 - Distribution of routes where owls of the four target species (Barred Owl, Great Gray Owl, Northern Saw-whet Owl, Boreal Owl) were reported in 2006 (●), and routes without owls detected (○).

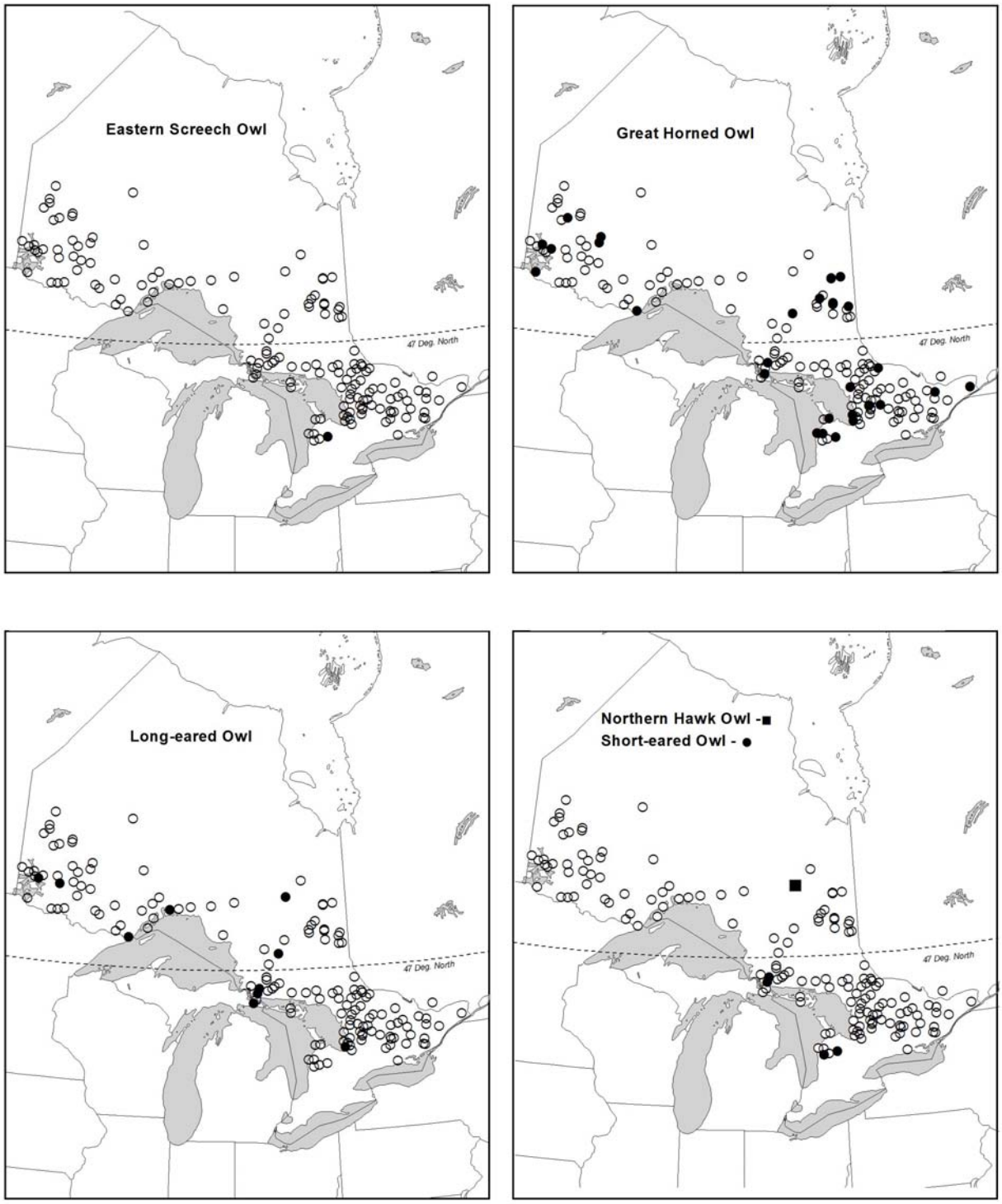

Figure 3 - Distribution of routes where owls of the non-target species (Eastern Screech Owl, Great Horned Owl, Long-eared Owl, Short-eared Owl, Northern Hawk Owl) were reported in 2006 (●,■), and routes without owls detected (○).

Table 2 – Number of individuals of each owl species, Ruffed Grouse, Wilson's Snipe, and American Woodcock and number of routes on which each species was detected during the 2006 Ontario Nocturnal Owl Survey in central and northern Ontario.

	Central Ontario		Northern Ontario	
Owl Species	**Individuals**	**Routes**	**Individuals**	**Routes**
Boreal Owl	9	5	122	30
Northern Saw-whet Owl	66	26	131	41
Barred Owl	249	62	43	14
Great Gray Owl	2	2	45	23
Great Horned Owl	19	14	44	15
Long-eared Owl	5	4	6	6
Eastern Screech Owl	1	1		
Northern Hawk-Owl			3	1
Short-eared Owl	4	4		
Unknown Owl	14	9	13	9
Additional species				
Ruffed Grouse	41	27	33	18
Wilson's Snipe	39	24	55	26
American Woodcock	302	105	137	50

ADDITIONAL SPECIES

In 2006, a total of 74 Ruffed Grouse, 94 Wilson's Snipe and 439 American Woodcock was recorded on owl surveys (Table 2). Numbers of Ruffed Grouse and Wilson's Snipe recorded on central and northern owl routes have been relatively stable from 2001-2006. Numbers of American Woodcock seem to be increasing, particularly in central Ontario. In 2006, there were 3.6 woodcock/10 stops in central Ontario, compared to 2.2 birds/10 stops the year previous.

Table 3 – Mean number of Ruffed Grouse, Wilson's Snipe, and American Woodcock recorded per 10 stops on nocturnal owl surveys in central and northern Ontario from 2001-2006.

	Ruffed Grouse		Wilson's Snipe		American Woodcock	
Year	**Central**	**North**	**Central**	**North**	**Central**	**North**
2001	0.2	0.4	0.4	0.3	1.8	0.8
2002	0.2	0.5	0.4	0.3	1.3	0.7
2003	0.2	0.4	0.6	0.3	1.6	0.6
2004	0.2	0.3	0.5	0.4	1.6	1.3
2005	0.3	0.4	0.5	0.9	2.2	1.5
2006	0.5	0.3	0.5	0.4	3.6	1.1

Table 4 – Owl species monitored by the Ministry of Natural Resources' Provincial Wildlife Population Monitoring Program, and the habitat features from which they are expected to benefit.

Species	Habitat Type/Feature		
	Snags	Mature/ Overmature	Large Areas
Barred Owl	Y	Y	Y
Northern Saw-Whet Owl	Y	Y	
Boreal Owl	Y	Y	

OWL POPULATION CHANGES

Central Ontario

Barred Owl. The Barred Owl is one of three owl species monitored by the MNR's Provincial Wildlife Population Monitoring Program because of its dependence on snags and large tracts of mature to overmature forest stands (Table 4). In central Ontario, where they were most effectively monitored, the Barred Owl population has shown little change. The only significant year-to-following year contrast in Barred Owl population indices was an increase in population size from 2002 to 2003.

Northern Saw-whet Owl. Northern Saw-whet Owls are monitored by TAP in accordance with the Provincial Wildlife Population Monitoring Program because of their dependence on snags and mature to overmature forest stands (Table 4). Population indices for this species showed high annual variation in central Ontario ($P < 0.0001$; Figure 4). From 1995 to 1996, saw-whets showed a large, significant decline ($P < 0.01$), followed by a gradual non-significant decline through to 1998. Population indices showed a large increase in 1999, and subsequently declined significantly in 2000 to the lowest level recorded since 1995 ($P < 0.01$). Following that decline, N. Saw-whet Owls showed a one-year cyclic pattern from 2000-2004, although years with higher population estimates (2001, 2003) did not reach the levels recorded in 1995 and 1999. During this cyclic pattern, saw-whets experienced population lows in 2000, 2002 and 2004. In 2005, numbers of saw-whets recorded did not change significantly from 2004 estimates, but there was a significant increase in 2006.

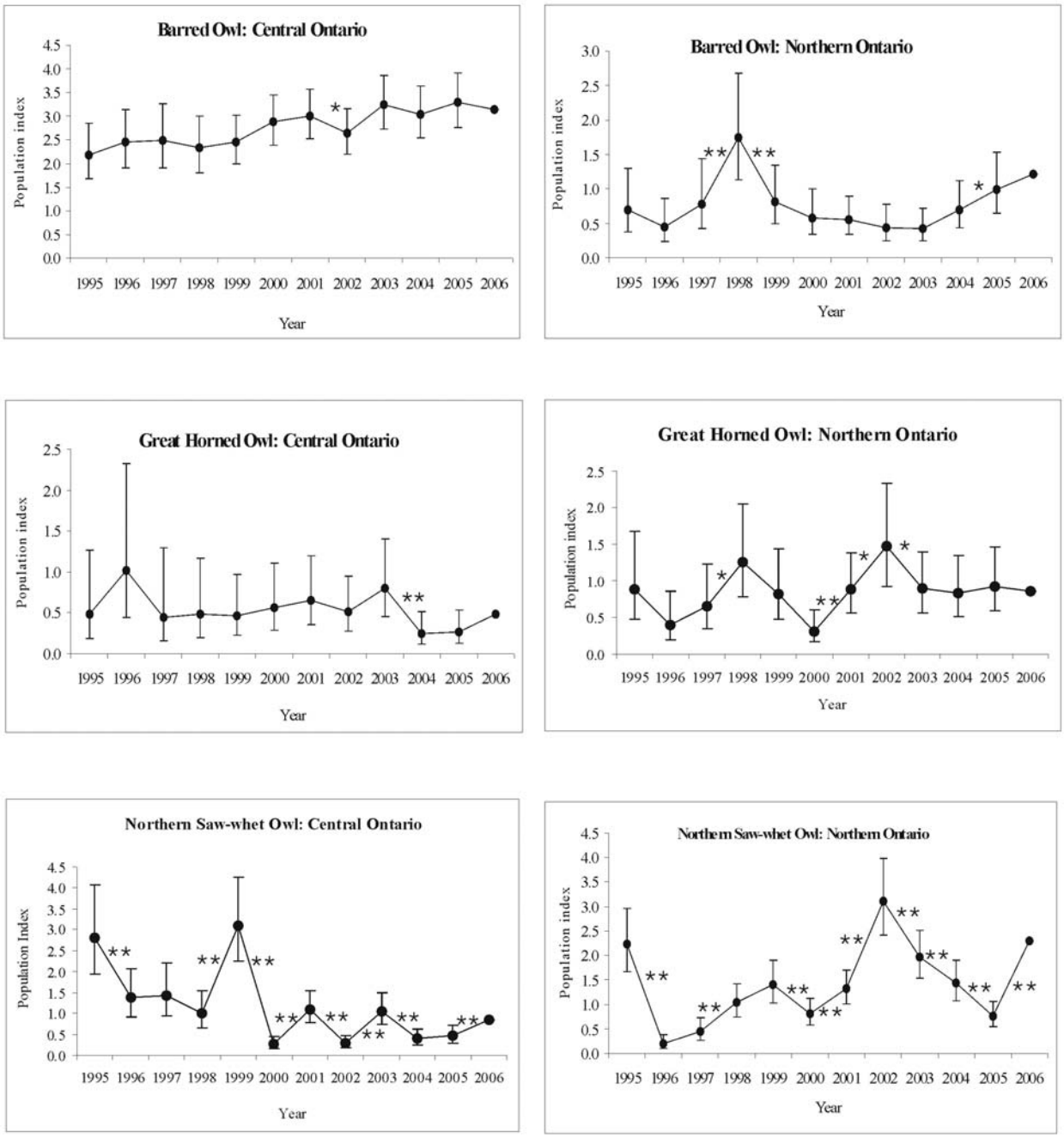

Figure 4 – Annual population indices (1995-2006) for Barred Owl, Northern Saw-whet Owl, and Great Horned Owl, the three owl species that are monitored in both central and northern Ontario. Data were collected by participants in the Ontario Nocturnal Owl Survey. Asterisks indicate significant differences between pairs of years: * P<0.05, ** P<0.01.

Great Horned Owl. Annual indices for Great Horned Owls in central Ontario showed significant annual variation (P = 0.01), although much of this variation can be attributed to a large (non-significant) increase in the population index in 1996 and a significant decline in 2003 (Figure 4). From 1997-2003, annual indices showed little change, but subsequently declined significantly in 2004 and have remained near that level in 2005 and 2006. The Ontario Nocturnal Owl Survey has low power to detect population changes in this species because of the low precision around population estimates (as displayed by the large error bars).

Northern Ontario

Barred Owl. In northern Ontario, Barred Owl population indices showed significant annual variation (P < 0.0001; Figure 4), although this appears to be due largely to a relatively high population index in 1998. The Barred Owl has not shown any significant change since 1999 but has been slowly (non-significantly) increasing over the last three years.

Northern Saw-whet Owl. In northern Ontario, saw-whet trends showed high annual variation (p < 0.0001), but the pattern was quite different compared to central Ontario (Figure 4). From 1995 to 1996, the northern Ontario saw-whet population experienced a large decline, similar to the central Ontario population. However, the northern Ontario population gradually increased until 1999, then declined significantly in 2000. The population then increased significantly in 2001 and 2002 to its highest level. From 2003-2005, Northern Saw-whet Owls declined in northern Ontario, then increased significantly in 2006.

Great Horned Owl. Great Horned Owls in northern Ontario experienced greater year-to-year variation than those in central Ontario (P < 0.001; Figure 4). From 1996-2002, this species seemed to follow a two-year cycle, with peaks in 1998 and 2002. The Great Horned Owl population index again declined significantly in 2003, but has remained relatively stable since that time. The Ontario Nocturnal Owl Survey has low power to detect population changes in this species, thus results should be interpreted with caution.

Boreal Owl. The Boreal Owl is the third owl species monitored by the Provincial Wildlife Population Monitoring Program because it depends on snags and mature to overmature forest stands for breeding (Table 4). In northern Ontario, Boreal Owl numbers differed significantly among years (P < 0.0001; Figure 5) and showed high annual variation. There was a large decline in population indices from 1995 to 1996, followed by a large increase in 1997. Following 1997, Boreal Owls experienced three years of decline, two of which were significant (1998, 2000; p < 0.01). Boreal Owls then showed a large and significant increase in 2001, followed by four years of population decline from 2002-2005. There was a significant increase in 2006.

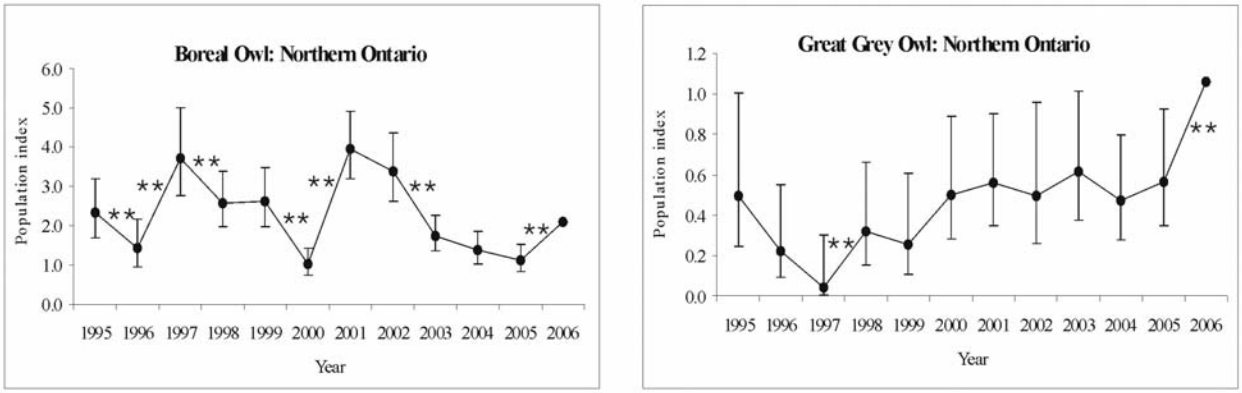

Figure 5 – Annual population indices (1995-2006) for Boreal Owl and Great Gray Owl, the two owl species that occur only in northern Ontario. Data were collected by participants in the Ontario Nocturnal Owl Survey. Asterisks indicate significant differences between pairs of years: * P<0.05, ** P<0.01.

Great Gray Owl. Great Gray Owl populations in northern Ontario varied significantly among years (P = 0.03; Figure 5). Population indices for this species declined (non-significantly) in 1996 and 1997, followed by a significant increase in 1998, a slight decline in 1999, and a non-significant increase in 2000. From 2000-2005 Great Gray Owl numbers were relatively stable, but there was a significant increase in 2006. As with the Great Horned Owl, low precision around the population estimates occurred because this species is detected on few routes, and rarely detected on the same route twice.

SUMMARY

Central Ontario

Provincial Wildlife Population Monitoring Program Representative Species. In central Ontario, two of MNR's Provincial Wildlife Population Monitoring Program's representative species, Barred Owl and Northern Saw-whet Owl, were detected frequently enough for analysis. The Barred Owl population in central Ontario has been quite stable from 1995-2006, which suggests that forest management activities in central Ontario are not negatively affecting this species.

Annual indices for Northern Saw-whet Owls, on the other hand, show high annual variation and appear to have declined over time. Preliminary analyses show that numbers of calling saw-whets closely track small mammal numbers (Badzinski 2005). Comparisons of owl population indices from central Ontario and small mammal abundance from Algonquin Park reveal a strong correlation, particularly with Red-backed Voles (BSC, OMNR unpub. data). For this reason, it is important to consider small mammal abundance when interpreting owl survey data.

Barred Owls feed on a wider variety of prey than do Northern Saw-whet Owls and are therefore better able to adapt to alternate prey sources when populations of preferred prey decline. This was likely a factor in the low annual variation observed in Barred Owl populations over time.

Correlations between small mammal and Barred Owl indices are typically weak (BSC, OMNR unpub. data). Additionally, Barred Owls are the most sedentary of the owls, and tend to remain on territory year round. They do not exhibit the nomadic movements that are typical of other owl species.

Other Species. Great Horned Owls were also detected frequently enough for analysis on central Ontario survey routes. This species remained relatively stable over the course of the survey, but declined significantly in 2004 and remained low in 2005, but increased non-significantly in 2006.

Northern Ontario

Provincial Wildlife Population Monitoring Program Representative Species. In northern Ontario, all three of the Provincial Wildlife Population Monitoring Program's representative owl species were detected frequently enough for analysis of annual indices. Like the central Ontario Barred Owl population, northern Barred Owls had low annual variation over the past 11 years, with the exception of a prominent peak in 1998, followed by an equally large decline the following year. Over the past three years, this species' population showed signs of a modest population increase, but overall, its population in the northern study area appears to have been relatively stable since 1995.

Unlike Barred Owl, Northern Saw-whet Owls and Boreal Owls both showed high annual variation in northern Ontario. Data from the owl survey, migration monitoring and from a Quebec checklist program suggest that Boreal Owls follow a four-year cycle. In fall 1996, 2000, and 2004, larger than average numbers of Boreal Owls were captured on fall migration at Observatoire d'Oiseaux du Tadoussac in Quebec and Whitefish Point Bird Observatory in Michigan (Crewe and Badzinski 2006). These southward movements corresponded with years of lower than average numbers of Boreal Owls on spring Nocturnal Owl Survey routes. Winter invasions of Boreal Owls into southern Québec during the period 1990-2000 were also found to occur on a four-year cycle, with invasions occurring in 1996 and 2000 (Cheveau *et al.* 2004). Numbers of Boreal Owls recorded by the Ontario Nocturnal Owl Survey peaked in 1997, 2001 and 2006, which also roughly follows a four-year cycle. According to Cheveau et al. (2004), Boreal Owls move south when small mammal populations in the north crash, because more southern populations of small mammals did not show the same periodicity as northern small mammal populations (for example, see Fryxell et al. 1998). The documented increase in number of Boreal Owls in 2006 suggests that small mammal populations in northern Ontario have at least partially recovered.

Northern Saw-whet Owls also increased significantly in northern Ontario in 2006. Saw-whets in northern Ontario do not follow the saw tooth pattern that is evident from the central Ontario population. Rather, this species appears to be following a similar trajectory as the Boreal Owl population. Boreal and saw-whet owl numbers are most likely linked to small mammal numbers but there are no long-term small mammal data available for northern Ontario.

Other Species. Great Horned Owl and Great Gray Owl were also detected frequently enough for analysis in northern Ontario. Great Horned Owl appeared to show some periodicity from 1996-

2002, but has remained relatively stable since then. Interestingly, Great Gray Owl numbers increased significantly in 2006 to an all-time high. In winter 2004/2005, there was a mass invasion of Great Gray Owls into southern Ontario, presumably due to a crash in small mammal numbers in the north. It appears that the population has now recovered from that low. Because of the low precision around population estimates for these two species, annual indices should be interpreted with caution.

Despite high annual variation and the periodicity that is typical of owl populations, the three Provincial Wildlife Population Monitoring Program representative owl species have shown no evidence of population declines. The degree to which population trends for Boreal and Northern Saw-whet Owls actually reflect the amount of snags and mature to overmature forest stands on the landscape is complicated by availability of prey populations, but long-term monitoring will help clarify this relationship. At present, there are no immediate indications that the survey is picking up region-wide negative signals that could be ascribed to land management practices.

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