guidelines
for Nocturnal Owl Monitoring in North America

MARCH 2001

D. Lisa Takats • Charles M. Francis • Geoffrey L. Holroyd • James R. Duncan
Kurt M. Mazur • Richard J. Cannings • Wayne Harris • Denver Holt

For more information or to receive a printed copy, contact:

Lisa Takats
7th floor, O.S. Longman Building
6909-116 Street
Edmonton, AB
T6H 4P2

Phone: 780.427.1249
E-mail: lisa.takats@gov.ab.ca

Information on the North American Raptor Monitoring Strategy is available at:
http://www.im.nbs.gov/raptor/raptor.html

Copies of this document can be downloaded from: http://www.bsc-eoc.org

PUBLISHED BY:
Beaverhill Bird Observatory and Bird Studies Canada, March 2001

ISBN 0-9688736-0-X

PLEASE CITE AS:
D. Lisa Takats, D. L., C. M. Francis, G. L. Holroyd, J. R. Duncan, K. M. Mazur, R. J. Cannings, W. Harris, D. Holt. 2001. Guidelines for Nocturnal Owl Monitoring in North America. Beaverhill Bird Observatory and Bird Studies Canada, Edmonton, Alberta. 32 pp.

TABLE OF CONTENTS

GREAT GRAY OWL • GORDON COURT

Executive Summary iii

Acknowledgements iv

List of September 1999 Workshop Participants v

Introduction 1

Review of Existing Owl Surveys in Canada 3
- Manitoba 3
- Ontario 3
- Alberta 4
- Saskatchewan 4
- British Columbia 4
- Nova Scotia 5
- Montana 5

Guidelines for Survey Protocols 7
- Survey Objectives 7
- Survey Methods 7
- Route Selection 7
- Route Design 8
- Georeferencing 8
- Number and Timing of Surveys 8
- Silent Listening 9
- Playback (optional) 9
- Time of Night 10
- Environmental Conditions 11
- Owl Positions 11

Surveyor Training 12

Data Computerization 13

Data Analysis 15

Further Research Needs 16

Literature Cited 17

APPENDICES

Appendix I: Recommended Equipment 19
Appendix II: Scientific Names and Codes of North American Owls 21
Appendix III: Beaufort Scale Translations to Wind Speeds 22
Appendix IV: Noise Level Descriptions 22
Appendix V: Random Route Selection 23
Appendix VI: Sample Data Sheet 24

REMOVABLE DATA SHEET 25

LONG-EARED OWL • GORDON COURT

Information on distribution, abundance, and population trends of all North American bird species is required for developing sound conservation strategies, identifying species in need of particular conservation action, and evaluating the effectiveness of current management programs.

Most species of nocturnal owls are poorly monitored by existing multi-species surveys, such as the Breeding Bird Survey, Migration Monitoring, and Christmas Bird Counts. Several regions of Canada and the United States have established volunteer-based nocturnal roadside surveys for breeding owls. These appear to be an effective means of monitoring many species of owls, but there is considerable variation in the methods used.

In February 1997, participants in a workshop on nocturnal owl monitoring discussed the problems of current owl surveys (Holroyd and Takats 1997). In September 1999, representatives from the main volunteer surveys in Canada met in Winnipeg, Manitoba to develop a set of standards for owl monitoring that would allow data to be integrated across surveys, while recognizing geographic variation in target species and survey objectives. The outcome of that meeting was agreement on a set of standard components that should be incorporated into roadside surveys for breeding owls. These meetings, with subsequent discussions, have led to development of guidelines for survey protocols that we hope will be adopted by all organizations running nocturnal roadside surveys for owls.

These procedures are designed for broad scale monitoring of relative abundance, distribution, habitat use, and changes in these parameters over time. The key elements are as follows:

- routes should be selected using appropriate randomizations (if possible) to ensure that they are representative of the area being surveyed, within the constraints of a roadside survey.
- routes should consist of at least 10 stations, spaced at least 1.6 km apart, that can be surveyed in a single night.
- routes should be surveyed once per year at the time when the majority of species in the region are most active vocally.
- the starting position, and preferably all stations along a route should be georeferenced to allow linking of owl records to locations for habitat analysis.
- the protocol at each station should start with a 2-minute silent listening period.
- optionally, playback may be used at a station if particular species of owls are being targeted that may respond well to playback.
- the field data form should be designed so that the intervals in which each owl is detected (i.e. before or after playback of various species) are recorded.
- record the approximate direction and distance to the first location where each owl was detected.

ACNOWLEDGEMENTS

GREAT GRAY OWL • GORDON COURT

This document is a product of a National Nocturnal Owl Monitoring workshop held in Winnipeg on September 27-28, 1999.

Although not all participants are included as authors, they all provided valuable input, and the complete list of names and addresses of attendees is given on the following page. We greatly valued the interactions and input from everybody present at the workshop, including Bob Nero's unreleasable Great Gray Owl, Lady Grayl, who patiently sat through the workshop, reminding us constantly why we were there.

An earlier draft of this document was presented at the annual Raptor Research Conference in La Paz, Mexico in November 1999, where we received valuable feedback and input and added Denver Holt (Owl Research Institute), who conducts extensive owl surveys in Montana.

We would like to thank all of the individuals and agencies who have been supporting owl monitoring initiatives and this workshop in Canada, including: Steve Brechtel and Gordon Court (Alberta Environment-Fisheries and Wildlife Management Division); Alberta Sport, Recreation, Parks, and Wildlife Foundation; Beaverhill Bird Observatory; Canada Trust Friends of the Environment Fund; Canadian Wildlife Service (Environment Canada); Merlin Shoesmith, Brian Gillespie, and Carol Scott (Manitoba Conservation); Bird Studies Canada; Ontario Ministry of Natural Resources; James L. Baillie Memorial Fund; Saskatchewan Natural History Society; University of Manitoba Alumni Fund; Manitoba Conservation Data Centre; Boreal Wilderness Guides Ltd.; Partners in Flight Manitoba; Susann Myers (Parks Canada). We would particularly like to thank all of the volunteers who have helped by participating in the existing surveys.

LADY GRAYL
• GEOFF HOLROYD

The national meeting was hosted by Manitoba Conservation (Wildlife Branch). Comments on the document from Jeff Adamyk (Alberta Conservation Association), Jim and Barb Beck (Beck Consulting) Peter Blancher (Canadian Wildlife Service), Roger Brown, Gordon Court (Alberta Environment), Sue Cotterill (Alberta Environment), Ray Cromie, Tony Diamond, Loney Dickson (Canadian Wildlife Service), Erica Dunn (Canadian Wildlife Service), Bruce Falls, Hardy Pletz, Charles Priestley, Steve Sheffield (US Fish and Wildlife Service), and Dave Stepnisky were greatly appreciated. Thank you to Elson Olorenshaw (Treasurer, Beaverhill Bird Observatory), who took care of all the funding received for this project through Beaverhill Bird Observatory. Finally, a big thank you to all who donated photographs for the document.

LIST OF

SEPTEMBER 1999 WORKSHOP PARTICIPANTS

BARRED OWL • GORDON COURT

alberta

Lisa Takats, Beaverhill Bird Observatory
7th Floor O.S. Longman Building
6909-116 Street, Edmonton, AB T6H 4P2
PHONE: (780) 427-1249 / FAX: (780) 422-9685
E-MAIL: lisa.takats@gov.ab.ca

Geoff Holroyd, Environment Canada
Canadian Wildlife Service, Room 200
4999-98 Avenue, Edmonton, AB T6B 2X3
PHONE: (780) 951-8689 / FAX: (780) 495-2615
E-MAIL: geoffrey.holroyd@ec.gc.ca

manitoba

Jim Duncan, Manitoba Conservation
Box 24, 200 Saulteaux Crescent
Winnipeg, MB R3J 3W3
PHONE: (204) 945-7465 / FAX: (204) 945-3077
E-MAIL: jduncan@nr.gov.mb.ca

Kurt Mazur, Partners in Flight Manitoba
Box 24, 200 Saulteaux Crescent
Winnipeg, MB R3J 3W3
PHONE: (204) 945-6816 / FAX: (204) 945-3077
E-MAIL: kmazur@nr.gov.mb.ca

Bob Nero, Manitoba Conservation
Box 24, 200 Saulteaux Crescent
Winnipeg, MB R3J 3W3
PHONE: (204) 253-7115 *(h)* / FAX: (204) 945-3077

Heather Hinam, Dept. of Zoology
University of Manitoba
Winnipeg, MB R3T 2N2
PHONE: (204) 253-7115 *(h)*

ontario

Charles M. Francis, Bird Studies Canada
P.O. Box 160
Port Rowan, ON N0E 1M0
PHONE: (519) 586-3531 / FAX: (519) 586-3532
E-MAIL: cfrancis@bsc-eoc.org

Doug Gilmore, Ontario Ministry of Natural Resources
Box 5003
Red Lake, ON P0V 2M0
PHONE: (807) 727-1336 / FAX: (807) 727-2861
E-MAIL: doug.gilmore@mnr.gov.on.ca

Neil Dawson, Ontario Ministry of Natural Resources
RR#1, 25th Side Road
Thunder Bay, ON P7C 4T9
PHONE: (807) 939-3120
E-MAIL: neil.dawson@mnr.gov.on.ca

saskatchewan

Wayne Harris, Saskatchewan Environment & Resource Management
350 Cheadle St. W
Swift Current, SK S9H 4G3
PHONE: (306) 778-8218 / FAX: (306) 778 8212
E-MAIL: wayne.harris.erm@govmail.gov.sk.ca

british columbia

Dick Cannings, Bird Studies Canada
1330 Debeck Road, S.11, C.96, RR#1
Naramata, BC V0H 1N0
PHONE: (250) 496-4049
E-MAIL: dickcannings@home.com

montana

U.S. Representative from November 1999 Raptor Research Conference

Denver Holt, Owl Research Institute, Inc.
P.O. Box 39
Charlo, MT 59824
PHONE: (406) 644-3412
E-MAIL: owl@montana.com

notes

GREAT HORNED OWL • GORDON COURT

INTRODUCTION

Information on distribution, abundance, and population trends of all North American bird species is required for developing sound conservation strategies, so that species in need of particular conservation action can be identified, and the effectiveness of current management programs can be evaluated.

In the past few decades there has been increasing concern over the status of both diurnal and nocturnal raptors (Newton 1979). Birds of prey are high on the food chain, making them vulnerable to many environmental factors, such as toxins (e.g., DDT, Carbofuran) as well as habitat loss (Fyfe *et al*. 1976, Gutierrez *et al*. 1984, Noble *et al*. 1993, Wellicome 1997, Whelan 1996). As such, they may be valuable indicators of environmental health (Oliphant 1994) and many species of raptors have been chosen as indicator species in various regions (Allen 1987, Bosakowski 1994, Gutierrez and Carey 1984, James *et al*. 1995, Johnson 1987, Duncan and Kearns 1997).

Relatively little is known about the abundance and population trends of most species of nocturnal owls in North America. Most owls are not adequately monitored by the existing multi-species continent-wide surveys in North America (Downes *et al*. 1999). The Breeding Bird Survey takes place outside of the breeding season for most owls, and at a time of day (early to mid-morning) when most owls are relatively silent. Christmas Bird Counts are also conducted at a time of year when most owls are relatively quiet, and the effort expended searching for owls is not standardized. Moreover, many owls may shift their home ranges in winter, so Christmas counts do not necessarily provide information on breeding distribution and abundance. Migration Monitoring may have the potential to monitor populations of some of the more common migratory species, such as Northern Saw-whet Owls (Dunn 1999) (see Appendix 1 [page 19] for scientific names), but the precision and reliability of trend estimates has not yet been demonstrated. Furthermore, it does not provide information on breeding distributions of owls, and is not useful for most species, as they do not migrate.

Broadcast surveys are one of the most widely used techniques to locate and survey owls (Bondrup-Nielsen 1978, Johnson *et al*. 1981, Smith 1987, Mosher *et al*. 1990). Owls vocalize to communicate with their mates and delineate territory (Johnsgard 1988). Imitating or broadcasting tape recordings of owl vocalizations can invoke vocal responses from many species of owls (Mosher and Fuller 1996). This survey technique has been used to document the range and status of several owl species in North America (Duncan and Duncan 1997), and can also be used to determine habitat associations (Laidig and Dobkin 1995, Lehmkuhl and Raphael 1993, Mazur *et al*. 1997, Proudfoot *et al*. 1997, Duncan and Kearns 1997, Takats 1998a). Unfortunately, despite their value for detecting owls, broadcast surveys have some limitations as a national monitoring tool. Playback calls will necessarily vary among regions depending upon the target species. Furthermore, variation in the type of call (call note, duetting, song), quality of the recording, sequence of calls, species included in playback, effect of timing on response, and nature of the broadcast equipment may all affect numbers of owls detected.

In Canada, volunteer owl surveys have been established in Manitoba (Duncan and Duncan 1991), Ontario (Francis and Whittam 2000, Lepage *et al*. 1999), Alberta (Takats 1998b), Saskatchewan (Harris, pers. comm.), and Prince Edward Island (Susann Myers, pers. comm.). Although there are some similarities in the protocols that have been adopted, there are also a number of differences. If these surveys, as well as any new surveys that may be developed, could adopt a standard protocol, then the data from different regions can be integrated to provide national or continental trend and relative abundance information.

A Nocturnal Owl Monitoring Workshop was held in February 1997 to discuss the development of a strategy to determine the status and assess trends of nocturnal owls in Canada and the USA (Holroyd and Takats 1997). In September 1999, representatives from the major volunteer owl surveys in Canada met to develop guidelines for standardizing owl monitoring surveys that could be used throughout Canada. Eventually, we hope that these guidelines will be integrated into the North American Raptor Monitoring Strategy (http://www.im.nbs.gov/raptor/raptor.html). The goal of this document is to present these guidelines for owl monitoring protocols for North America. We hope they will be adopted by all of the existing surveys in Canada and elsewhere in North America, and also by any new surveys that might be established.

These guidelines require a number of common elements, but provide some flexibility to support regional needs. They are intended primarily for large-scale, extensive surveys, particularly those involving volunteer surveyors. Volunteers are particularly suitable for owl surveys, because most areas have relatively few species of owls and volunteers can be trained relatively easily to differentiate common species. Inclusion of volunteers also helps increase public awareness of owls and related conservation issues.

These procedures could also be used by organizations such as consulting companies or agencies with objectives such as assessing relatively large regions for owl populations. They are less suitable for small-scale monitoring, which would generally require alternative, more intensive procedures.

In this document, we first review the main existing owl surveys in Canada and Montana. We then define the objectives of surveys based on the proposed standard protocol, each aspect of the protocol, and some considerations for data computerization and analysis.

LISA TAKATS

NORTHERN SAW-WHET OWL • GORDON COURT

REVIEW OF EXISTING OWL SURVEYS IN CANADA AND MONTANA, USA

Manitoba, Ontario, Alberta, British Columbia, Saskatchewan and Montana all have had some relatively standardized owl monitoring programs running for various numbers of years. Note that a number of these surveys were modified in 2000, to fit within the guidelines presented in this document. Here we describe their protocols prior to those changes.

Manitoba

In 1991, Jim and Patsy Duncan in cooperation with Manitoba Conservation initiated the first extensive, systematic volunteer owl survey in Canada. Initially consisting of 21 routes in southeastern Manitoba and adjacent Minnesota, the survey grew to 77 routes by 1998 and covered a larger area (Duncan and Duncan 1998). This survey's goals were: 1) to estimate relative abundance and distribution of each owl species; 2) to estimate species-specific habitat associations; 3) to estimate year to year population fluctuations; and 4) to provide an opportunity for volunteers to contribute to the understanding of owl ecology. This owl survey has been run every year from 1991 to 1999. Although all species were recorded, the only playback calls used were of Boreal and Great Gray Owls. Surveys were conducted between 30 min. after sunset and 30 min. before sunrise, using a standard protocol (Table 1).

Ten species of owls have been detected on these surveys: Barn Owl, Barred Owl, Boreal Owl, Eastern Screech-owl, Great Gray Owl, Great Horned Owl, Long-eared Owl, Northern Hawk Owl, Northern Saw-whet Owl, and Short-eared Owl. By 1999, over 400 volunteers had participated in this survey (Duncan, pers. comm.).

Ontario

The Ontario Nocturnal Owl Pilot Study was started in 1995 in response to the Ministry of Natural Resources need for information on owl populations in central and northern Ontario forested regions to assess the impact of current forest management regimes (Francis and Whittam 2000, Lepage *et al.* 1999). Bird Studies Canada (formerly Long Point Bird Observatory) coordinates this survey, which presently has over 100 volunteers This is a roadside survey, with different protocols in northern and central Ontario (Table 1).

In northern Ontario, playback of Boreal Owl (to stimulate responses from Boreal and Northern Saw-whet Owls) and Great Gray Owl has been used with a protocol similar to the Manitoba surveys, except that 20 stops are spaced 1.6 km. In central Ontario, playback of Boreal and Barred Owls is used, with only 10 stops, but a much longer playback and listening period, because Barred Owls tend to respond slowly to playback. Nine species of owls have been detected: Barred Owl, Boreal Owl, Eastern Screech-owl, Great Gray Owl, Great Horned Owl, Long-eared Owl, Northern Hawk Owl, Northern Saw-whet Owl, and Short-eared Owl.

Alberta

In 1988, Jim and Barb Beck organized the first volunteer owl surveys in the Alberta. Between February 20 and March 22, 78 participants in 31 parties heard and observed 528 owls of 7 species in the Edmonton region. The survey was relatively unstructured (effort was not standardized) and gave primarily distributional data (Beck and Beck 1988). The Alberta Owl Prowl ran for one year, and collected owl distributional information across the province (Beck and Beck, pers. comm.).

Standardized owl monitoring was initiated as part of a Barred Owl study conducted in the Foothills Model Forest (FMF) 1995-1996 (Takats 1998a), and as part of a forest fragmentation study on the Alberta Pacific Forest Management Area near Calling Lake (Court, pers. comm.). The objectives of the FMF study were to determine the distribution and habitat use of the Barred Owl in the region. Standardized surveys were used to collect distributional information, not only on Barred Owls, but on other species as well (Table 1). Surveys have continued along the 10 routes that were set up in the first year of this project. Seven species have been recorded to date: Barred Owl, Boreal Owl, Great Gray Owl, Great Horned Owl, Northern Hawk Owl, Northern Pygmy Owl, and Northern Saw-whet Owl.

Primarily as a result of the work in the FMF, a volunteer nocturnal owl monitoring program was initiated in 1998 (Table 1). This project is being coordinated through Beaverhill Bird Observatory with support from Alberta Environment (Takats 1998b). The species of particular concern in the province are Barred Owl, Boreal Owl, Burrowing Owl, Great Gray Owl, Northern Pygmy Owl, and Short-eared Owl. Surveys are conducted anytime between 30 min. after sunset and 30 min. before sunrise. Boreal, Great Gray, and Barred Owl taped calls are played in the north, the foothills, and the mountains, and Northern Saw-whet, Long-eared, and Great Horned Owl are played in the southern prairie/aspen regions. Ten species of owls have been identified including: Barred Owl, Boreal Owl, Great Gray Owl, Great Horned Owl, Long-eared Owl, Northern Hawk Owl, Northern Pygmy Owl, Northern Saw-whet Owl, Short-eared Owl, and Snowy Owl.

NORTHERN SAW-WHET OWL • GORDON COURT

Saskatchewan

In Saskatchewan, non-standardized surveys were conducted along 31 different road routes from 1974 through 1991 (Harris, pers. comm.). Most routes were repeated at irregular intervals. These routes had variable distance between stops, were variable in length, and used a variety of human imitation owl calls instead of standardized tape playbacks.

From 1992 –1994 a volunteer survey program similar to that of Manitoba was carried out (Table 1). Although emphasis was on boreal forest owls, routes were also completed in the aspen parkland, grassland (riparian corridors) and Cypress Hills regions. These surveys were initiated 30 min. after sunset and also recorded amphibians. Since that time, no coordinated effort has been made, although some volunteers continue to conduct their routes.

British Columbia

In the Okanagan area of British Columbia, non-standardized surveys for Western

Screech-owls, Flammulated Owls, Northern Saw-whet Owls and Northern Pygmy Owls have been conducted (Cannings, pers. comm.). These surveys were conducted in late February and March for the Screech and Saw-whet Owls, and May-June for the Flammulated and Pygmy Owls. One minute of silent listening was followed by approximately one minute of vocal imitations, followed by one minute of silent listening; all repeated three times for a total of approximately five minutes spent at each stop.

BARRED OWL • GORDON COURT

Nova Scotia

A volunteer owl survey was initiated on Cape Breton Island, Nova Scotia in spring 2000. The objective was to develop an annual survey to collect information on population densities and fluctuations, distribution, and habitat preferences of nocturnal owls (Myers, pers. comm.). Surveys were conducted from mid-March through mid-May. Surveys were initiated _ hour after sunset and started with 2 min. of silent listening followed by taped calls of Boreal and Barred Owls, followed by a final 2 min. of silent listening (Table 1). Routes consisted of 10 stops spaced at 1.6 km intervals. Four species of owls were detected including: Barred, Great Horned, Northern Saw-whet, and Long-eared Owls.

Montana

The Owl Research Institute in Montana (ORI) has been conducting standardized nocturnal owl surveys for over 10 years (Holt, pers. comm.). Species of regional concern include Boreal, Flammulated and Great Gray Owls.

The survey does 3 min. silent listening at stations set at 1/4 mile (400 m) intervals along roads in the western half of the state. These surveys are conducted along roads and by snow machines in higher elevations. The work is conducted from mid-May to mid-June for Flammulated Owls and from mid-February to mid-April for all other forest species.

Owls that have been recorded on these silent listening surveys include: Eastern and Western Screech Owl, Flammulated Owl, Barred Owl, Boreal Owl, Great Gray Owl, Great Horned Owl, Long-eared Owl, Northern Pygmy Owl, and Northern Saw-whet Owl. The first nest records and status reports in Montana for Barn, Boreal and Flammulated Owls are a product of the surveys. Additionally, relative habitat associations for western Montana owls have been identified.

GREAT GRAY OWL • GORDON COURT

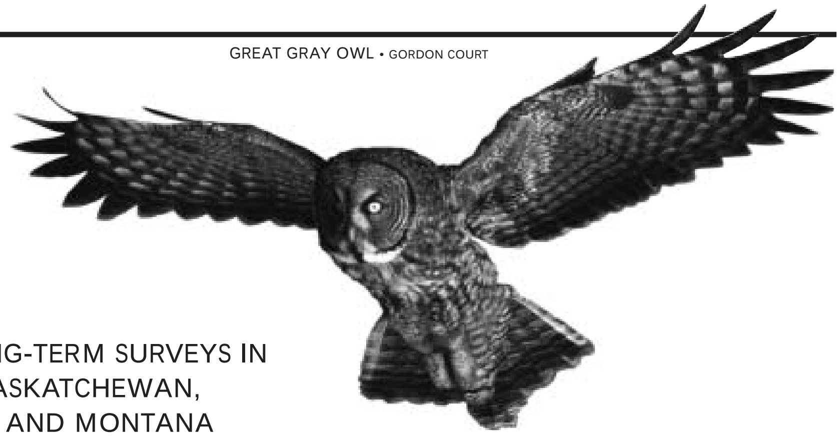


table 1

PROTOCOL INFORMATION FOR LONG-TERM SURVEYS IN MANITOBA, ONTARIO, ALBERTA, SASKATCHEWAN, BRITISH COLUMBIA, NOVA SCOTIA, AND MONTANA

Region	Stations per route	Station spacing/ time at station	Surveys per year/ timing	Broadcast protocol (minutes) & playback species*
Manitoba	20 or more	0.8 km 3:40 min	1 visit - late March/early April	1:00 listening 0:20 BOOW / 1:00 listening 0:20 GGOW / 1:00 listening
Ontario - north	20 stations	1.6 km 3:40 min (4:40 min in 1999)	2 visits (3 in 1999) - early-mid March - early-mid April - late April/early May	2:00 listening (2:00 in 1999) 0:20 BOOW / 1:00 listening 0:20 GGOW / 1:00 listening
Ontario - central	10 stations	2.0 km 13:00 min (14:00 min in 1999)	2 visits (3 in 1999) - early-mid March - early-mid April - late April/early May	1:00 listening (2:00 in 1999) 0:20 BOOW / 1:00 listening 0:20 BARR / 2:00 listening (x2) 0:20 BARR / 1:40 listening (x3)
Alberta Foothills	10 stations	1.6 km 15:00 min	3 visits (4 in 1995) - March 20 to May 5	2:00 listening 0:20 BARR / 1:00 listening (x6) 5:00 silent listening
Alberta	10 stations	1.6 km 8:00 min (9:00 in 1999)	2 visits - March 20 to April 10 - April 11 to May 2	2:00 listening 0:20 BOOW/NSWO / 1:00 listening 0:20 GGOW/LEOW / 1:00 listening 0:20 BARR/GHOW / 3:00 listening
Saskatchewan	non-standard	1.0 km or more 5:00 min	April 1 to 10 April 30 to May 8	1:00 listening BOOW/GGOW/BARR imitations or other species in different habitats
British Columbia	non-standard	variable	All species: Late February to March Flammulated/Pygmy Owl: May to June	1:00 listening 1:00 Vocal imitation 1:00 listening (repeated over 5 minutes)
Nova Scotia	10 stations	1.6 km 8:00 min	1 visit - March 17 to May 7	2:00 listening 0:20 BOOW / 1:00 listening 0:20 BARR / 2:00 listening 0:20 BARR / 2:00 listening
Montana	Standard routes, different lengths	0.25 mile (400 m) 3:00 min	All owl species: February 15 to April 15 Flammulated Owl: May 15 to June 15	3:00 listening

*OWLS: BOOW - Boreal / BARR - Barred / GGOW - Great Gray / NSWO - Northern Saw-whet
GHOW - Great Horned / LEOW - Long-eared

LONG-EARED OWL • LISA TAKATS

Survey Objectives

These guidelines were developed to achieve the following objectives:

1/ Obtaining information on distribution of owls.

2/ Estimating relative abundance of owls within regions and across North America.

3/ Estimating trends in populations of nocturnal owls at scales ranging from regional (ie. ecoregion, province, state) to continental.

4/ Determining habitat associations of owls.

Survey Methods

The basic survey method being proposed is to listen for calling owls along a predetermined route consisting of a minimum number of evenly spaced stations (Bibby *et al*. 1992). In most cases, the routes will be along secondary roads, with relatively little traffic, although off-road routes could be developed in some areas. This basic sampling method is used by the Breeding Bird Survey, and lends itself to large-scale surveys where the intention is to obtain data that can be analysed at a regional or larger scale. It is less suitable for intensive sampling of small areas. As well, it has the drawback that results may only be extrapolated to habitats along roads, where population trends may or may not be the same as those away from roads.

Route Selection

Routes need to be selected so that they are representative of the region being surveyed, in order to make valid statistical inferences about owl populations in the region.

- The only way to ensure that routes are representative is to select routes randomly from within the survey area using some sort of stratified sampling scheme.
- Although some routes could be selected away from roads, for access by snowmobile or horse or even possibly on foot (though few routes could safely be done on foot at night), most routes will necessarily be along roads. Suitable roads must be accessible in late winter/early spring, should not have excessive traffic or heavy logging trucks (for safety reasons and so that owls can be heard) and should go through potentially suitable habitat.
- Each route should be separated by at least 5 km from any other route, to minimize the risk that the same owls will be heard on more than one route (Anderson *et al*. 1979).
- The objective of random route selection is to ensure that all suitable roads are equally likely to be selected. One possible approach to selecting random routes is outlined in Appendix V (on page 23).
- Unfortunately, there are a number of difficulties in selecting random routes. For example, information on which roads are suitable, especially with respect to winter accessibility and habitat, may not be available centrally. Also, volunteers may not always be willing to survey selected random routes. Furthermore, even if roads are selected randomly, habitats or owl populations near roads may differ from those away from roads.
- In many cases if may not be possible to select routes in a fully random fashion. Provided that routes are selected without prior knowledge of the distribution of owls, we believe that data from such surveys are still valuable, especially in the absence of

any alternative information. Nevertheless, the greater the element of randomization, the greater the statistical credibility of the survey.

- Existing programs, with non-random routes, should continue to run existing routes, because there is considerable value to maintaining continuity, but should try to adopt a suitable randomization procedure for selecting new routes. In analyses, random and existing routes should be treated separately, and if average densities or trends prove to differ on the two types of routes, it may be appropriate to phase out the non-random routes and replace them with random routes (e.g., by attrition, through replacing non-random routes with random routes when volunteers drop out and new ones join).
- If any off-road routes are developed, they should be clearly identified as such, as they may require separate analysis, due at least in part to differences in selection procedures.
- In reporting on the results of the survey, it is important to clarify the area that has been sampled, and the procedures used to select routes, as this needs to be taken account in the analysis (e.g. for developing weighting factors for routes) as well as in the interpretation of results.
- Because routes without owls do not contribute to trend analysis (and are unlikely to interest volunteers) and routes without owls for two years in a row, could be discontinued, but efforts should be made to run them again every five years or so, in case owls have returned to the route (this procedure has been used by the Mourning Dove call survey in the United States).
- Selected routes should usually be ground-checked during the day, prior to starting the survey, to ensure that they are, in fact, safe and usable, and go through suitable habitat.

Route Design

Each route should have 10 stations, distributed along the route at equal intervals of 1.6 km.

- If the listening/playback protocol is short [see below], and the length of suitable road is adequate, then it is recommended that another route be run (continued from the first route, or in another area).
- The spacing of 1.6 km is intended to reduce the chances of detecting the same owl at multiple stations, while not requiring surveyors to spend too much time driving between stations. Depending upon the topography, some of the louder owls, such as Barred Owl, can be heard at distances of 2 km or more (Takats 1998a, Mazur pers. comm., Duncan pers. comm.), but other owls cannot be heard as far or as clearly. In practice, we have found that most small owls are not heard at neighbouring stations along the route, if stations are spaced at 1.6 km.

Georeferencing

The location of the starting point of the route, and of each station along the route, should be recorded as precisely as possible, either using a GPS (Global Positioning System) or through reading the coordinates from an accurate and detailed map.

- Accurate locations help ensure that the same route and stations can be relocated in the future
- In conjunction with GIS habitat maps, accurate locations allow analysis of broad scale habitat associations of owl locations, through plotting precise owl locations on the maps.
- Knowledge of station locations is required, in combination with accurate habitat maps to enable post-hoc stratification, to ensure that routes are appropriately weighted relative to the amount of each habitat in the region.

Number and Timing of Surveys

Each route should be surveyed once per year at the time of year when vocal activity of the majority of species is greatest. The survey window should be relatively broad (e.g., 4 weeks) to maximize the number of surveys that can be conducted, and to include any annual variation in phenology.

- A single survey per year would encourage more surveyors to participate by reducing the amount of time spent surveying. Highly motivated volunteers could be encouraged to survey multiple routes per year thus allowing for a higher number of routes to be surveyed.
- Surveying a route two (or more) times per year would provide information on annual variation in the peak time of owl calling, and would more accurately monitor owl species with peak calling at different times of the year. However, for this general survey, we do not believe these advantages justify the 2-fold (or more) increase in the survey effort required. For a more intensive survey or limited areas, more than one repeat survey may be preferred.
- The optimal timing for surveys is likely to vary among regions. In Canada this may range from mid-February through May depending upon the location. Also, there is some variation in peak calling among species (for example, in Ontario and Alberta, peak calling of Great Horned Owls is earlier than for Barred Owls). In most areas the calling period for each species is broad enough that there are time periods when all species are potentially calling. If possible, survey timing should be selected to minimize the number of migrating owls recorded. The survey window should be clearly defined by the survey coordinators.
- Each route should be surveyed close to the same date every subsequent year.

Silent Listening

All protocols should start with a two-minute silent listening period at each survey stop.

- This will allow data to be compared across the continent, regardless of what playback protocols (if any) may be adopted. Two minutes appears to be adequate for most spontaneously calling owls to be detected, at least during the period of peak calling activity. In Alberta, relatively few additional owls were detected during a third minute of listening (Takats, pers. comm.). In Ontario, more than 70% of 5 species of owls that were detected over a 5 minute period (included playback) were detected in the first two minutes (Francis pers. comm.).
- A relatively short silent listening period allows for the possibility of incorporating playback, if desired, or for increasing the numbers of stations to be surveyed, both of which are likely to be more efficient than a protracted silent listening period.

Playback (optional)

It is well known that broadcasting recordings of owl vocalizations can increase calling rates or invoke approach from many species (Fuller and Mosher 1981, McGarigal and Fraser 1985, Duncan and Duncan 1991, Lepage and Francis 1998, Mazur pers. comm., Takats pers. comm.), although this has not been the case in all studies.

- Regionally specific playback protocols, or additional silent listening periods could be added, provided that owls heard during these periods are recorded separately from those heard during the first two minutes, and the playback protocol is standardized at each station.

BROADCASTING • GORDON COURT

- Playback protocols, however, cannot be standardized across the continent, because of variation in target species and the differences and changes in recording quality, broadcast species, or broadcast equipment which could affect response rates and hence lead to long-term bias in trend estimates.
- Carrying and working with playback units on a cold winter night can be a significant hassle. Playback can also potentially be disruptive to owls (may increase risk of predation, disrupt foraging and courtship, and/or draw females off nests). In addition, playing calls can pull owls off their territories giving inaccurate information on their habitat use (Holroyd and Takats 1997).
- The benefits of broadcasts vary considerably among species, and need to be balanced against the problems. For example, in Ontario, a 12-minute period of alternating broadcasts and silent listening increased 3- to 6-fold the number of Barred Owls detected relative to the initial 2-minute silent listening period (Francis, unpublished). But for Northern Saw-whet and Boreal Owls, the relative increase in calling rates was much lower (because most of them were calling spontaneously); for Great Gray Owls there was no noticeable effect of playback on calling rates.
- We recommend against the use of imitated calls (voice or whistling), as they cannot be standardized, either across observers or over time.
- Playback recordings, if used, should be as clear and loud as possible without distortion. Digital technology is recommended (CD-ROM, solid state, or digital tape) as the sound quality can be better controlled and is less likely to deteriorate over time. If cassette tapes are used, they should be replaced periodically to avoid deterioration of the tape. The audio equipment should be of sufficient quality that it will not distort the sound at loud volumes. We suggest the volume be such that the recording can be heard at 400m, but not at 800m (to minimize bias at the next survey station due to owls hearing the recording from the previous station). If possible, the volume should be measured at a standard distance (e.g., 1m from the speakers) using a decibel meter.
- If playback is used, a recording should be used that includes all of the playback sequences and the silent listening periods. A soft ‘beep’ or other sound can be used to indicate the start of the first silent listening period, and another beep to indicate the end of the final listening period. This will ensure that the time is fully standardized at each station, and reduce the need for participants to keep checking their watches. If a cassette tape is used, the tape length should match the recording length, and the same recording put on both sides, so the tape can be flipped instead of rewound.

Time of Night

Surveys should be conducted between a half hour after sunset and midnight. An attempt should be made to conduct the survey at the same time of night each year.

- Owl call rates can change significantly during the night (Palmer 1987, Takats and Holroyd 1997). Call rates of at least some species tend to be lowest in the middle of the night (midnight to 04:00) and resume again early in the morning (Takats 1998a). However, few volunteers are prepared to

GORDON COURT

complete a survey before dawn. As such, we recommend surveying routes in the evening.

Environmental Conditions

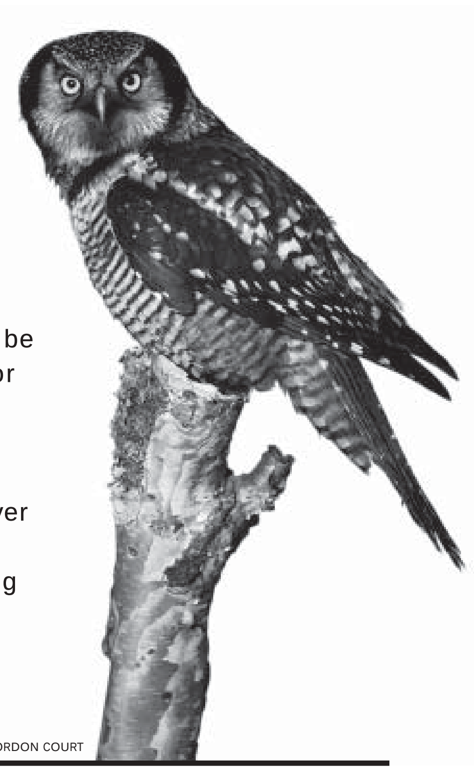
Environmental conditions such as wind velocity, precipitation, and temperature can affect owl calling propensity and the ability of surveyors to detect owls (Fuller and Mosher 1987, Takats 1998a). Song carries farther during certain meteorological conditions. For example, audibility can be high when a low altitude inversion is present, since the sound waves are reflected downwards, but audibility can be low in unstable or windy conditions (Elkins 1983). Extremely cold or stormy weather also poses a safety risk for surveyors.

- Surveys should only be conducted under favourable conditions: wind speeds <20 km per hour (Beaufort 3 or less; Appendix III [page 22]) and no precipitation (including rain and/or snow). Temperatures should be close to the average for the season and efforts should be made to avoid extremely cold temperatures for reasons of volunteer safety and because of evidence that owls may be less vocal in very cold weather (Takats 1998a).
- If conditions deteriorate over the course of an evening, surveyors must use their judgement whether the route should be completed, or run again on another evening. Generally, light snow or drizzle starting in the middle of a survey would not prevent completion of the survey.
- Some researchers have found moon phase to have a significant correlation with owl call rates (Takats 1998a), however other studies have found no clear relationship. Therefore, to avoid limiting the window of available survey dates (and forcing changes in the dates from year to year) it is best not to restrict surveys to certain phases of the moon. Moon phase may be useful as a covariate, but does not need to be recorded as it is easily calculated from the date in a calendar or almanac.
- Cloud cover has not been found to have a large effect on call rate (Takats 1998a), but as it could, for example, interact with moon phase, we suggest that surveyors record it (as percentage of sky that is covered by cloud).
- Data on weather conditions should be recorded at the beginning and end of each survey, and preferably at every station, so that weather variables can be used as covariates to reduce variance in count indices, or so that data from selected stations can be excluded from certain types of analyses if conditions exceeded the thresholds.

Owl Positions

Surveyors should be asked to estimate the approximate direction and distance to the first position where they detect each owl. When possible they should also plot estimated locations on maps provided (useful for checking the estimates). Actual distances can be estimated (possibly indicating an uncertainty ±50 m, ±100 m) or distances can be grouped into categories (i.e. 0-100 m, 100-300 m, 300+ m). Distance/direction information can be helpful for several purposes.

- The location may help to determine whether the same owls are being detected at different stations along the route.
- More precise habitat modeling can be conducted, provided that the stations themselves are georeferenced.
- Distance information can be used to adjust for some of the variation in detection rates, especially observer variation, using distance sampling methods.



NORTHERN HAWK OWL • GORDON COURT

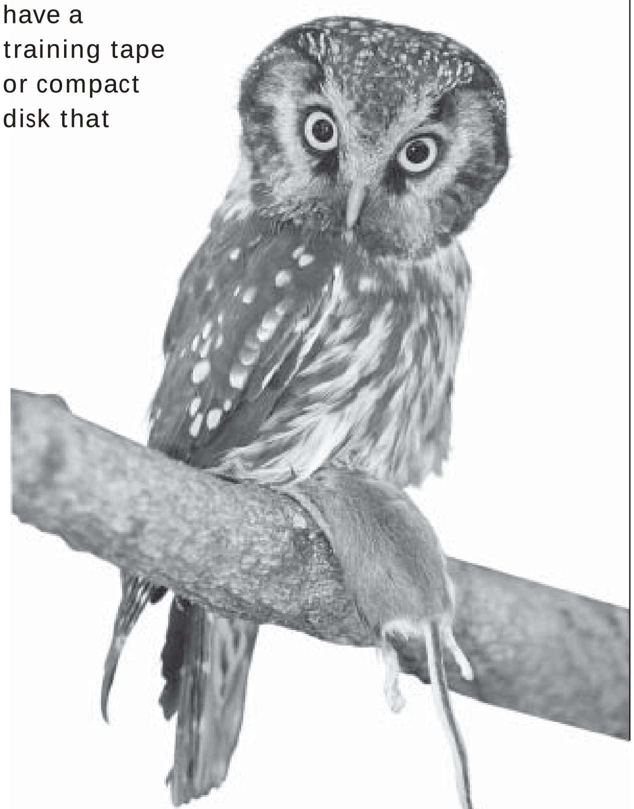
GREAT GRAY OWL • GORDON COURT

SURVEYOR TRAINING

Owl surveys lend themselves to being run by volunteers, because relatively little experience is required. The volunteers should be able to meet two basic requirements: ability to identify a small suite of owl species, and ability to keep track of where they are.

Volunteers may vary in ability to hear the owls; however it is important that they are able to identify what they are hearing (Sauer *et al*. 1994)

Surveyors must be able to identify, by vocalizations, all species of owls that regularly occur in their area. Although many people may be familiar with the most common vocalizations of each species, owls may give variants on their calls, and some species such as Long-eared Owls have a wide variety of vocalizations. As a result, participants should have a training tape or compact disk that includes the vocalizations of all of the owl species likely to be encountered, preferably with some narrative or accompanying text that highlights the major distinguishing features. Similar sounds that might be encountered at the same time of year and that could be confused with an owl (for example, the winnowing of snipe could be confused with the call of a Boreal Owl) could be included.



BOREAL OWL • GORDON COURT

Surveyors must be able to determine where they are on a map, so that they can report accurately the location of their route. Staking out the stops during the daytime prior to conducting the survey is recommended, and is useful to ensure that the route goes through suitable habitat and is safe. The volunteer must also have a good enough sense of direction to determine the direction of any calling owls, either from a map, from the stars, or from a compass.

BARRED OWL • GORDON COURT

Data from the survey are only useful if they are efficiently stored and subsequently analyzed. To analyze trends at a national or continental level, all data must be computerized in a compatible format, so that they can be combined for analysis.

We recommend that all data should be computerized in a relational data base format. In the future, it may be possible to develop a common database program that can be used for all surveys, but in the meantime, if a database is developed with the following structure, it should be relatively easy to share data and convert them into a common format for analysis.

The main tables would be as follows:

1/ **ROUTE table** *(information on each route that does not change with time)*

- route identifier *(number)*
- route name
- nearest town and other location information
- coordinates of first station *(preferable in Lat/Long, although if UTM is used then it is important to indicate datum and grid zone)*; if coordinates are available for all stations on the route, these should be put in a separate table

2/ **SURVEY table** *(information specific to each time the route is surveyed)*

- route number *(link to previous table)*
- surveyor ID number *(this should link to a Surveyor table that includes name and address information for each surveyor or assistant)*
- surveyor's assistant ID number
- date of survey
- start and finish time of survey
- weather information at start and end of survey, if not recorded at individual stations *(temperature, cloud cover, precipitation)*
- broadcast equipment information *(if used)* – make and model of equipment

3/ **STATIONS table** *(conditions at each station that was surveyed)*

- route number & survey date *(link to previous table)*
- odometer reading *(not needed if coordinates available for each station)*
- start time at station
- wind conditions *(Beaufort scale)* at station *(see Appendix III on page 22)*
- codes for background noise *(vehicles, running water, machinery, frogs)*
- comments *(optionally computerized to include other species recorded, habitat notes, etc.)*

4/ **OWLS table** *(one record for each individual owl detected)*

- route number, survey date, station *(link to previous table)*
- owl species – four letter code *(see Appendix II on page 21)*
- owl number (if more than one of a species at that station)
- intervals when the owl was detected *(if there are multiple intervals because of*

additional silent listening period or broadcasts)

- estimated distance to owl *(metres or yards)*
- direction to owl *(in degrees, if necessary converted from N, NW, W, SW, S, SE, E, NE)*
- comments *(optional, i.e. indication of same owl from previous station, etc.)*

Obviously, the field data sheets must be designed to ensure that the appropriate data are collected. A sample data sheet is provided in Appendix VI (page 24), but variations on that theme may be required depending upon the protocol adopted (e.g., with or without playback). Even if coordinates are determined by GPS, a detailed map of the stops should be prepared, so that the coordinates can be checked, and so that this will be available if a new volunteer surveys the route in the future. Preparation of this map should be part of the route selection procedure.

BOREAL OWL • GORDON COURT

DATA ANALYSIS

To monitor owl populations, data must be analysed regularly, and the results made available to the public, to managers, and especially to participants to encourage them to participate in the survey. Regular correspondence at least twice a year is desirable to maintain their interest.

Data from the surveys described here are similar to those of the Breeding Bird Survey, and similar analysis methods may be appropriate, though some modifications may be required in the future. A wide variety of methods have been developed for analysis of BBS data (James *et al*. 1996, Link and Sauer 1994, 1998), but there is still some disagreement as to which methods are best (James *et al*. 1996, Link and Sauer 1994a, Link and Sauer 1994b, Thomas 1996). There are two main methods currently being used by the coordinators of the BBS. One involves route regression using estimating equations (Link and Sauer 1994), which assumes that trends may differ among routes, and calculates a weighted mean of the trends within routes. The selection of weighting factors is strongly dependent upon the sampling scheme used to select routes. An alternate approach involves a generalized linear model assuming over-dispersed Poisson residuals and a log-link function (Link and Sauer 1998). This approach assumes that trends are similar within a broader region, and allows more robust modelling of non-linear population changes (e.g., year to year fluctuations). A simplified version of this latter approach has been used for analysis of population trends in Ontario (Lepage and Francis 1998, Francis and Whittam 2000), but it is not yet known whether this is the most appropriate analysis method.

Finally, we recommend that relevant data be made publicly available, preferably over the Internet. This will encourage volunteers by allowing them to see their results immediately, and will encourage further research into analysis methods, thus ensuring that maximum use is made of the data for conservation purposes. The data are collected largely by volunteers, and therefore should be viewed as publicly available data. However, care should be taken to protect sensitive information, such as precise nesting locations of rare species.

FURTHER RESEARCH NEEDS

GREAT HORNED OWL • GORDON COURT

The methods recommended in this report are based upon the best information available to us during compilation of this report. We believe they provide a sound basis for developing owl monitoring protocols that will provide comparable data across North America.

Nevertheless, our knowledge of owls and owl behaviour, as well as monitoring techniques, is far from complete, and it is quite likely that as further research is done it will be possible to develop new and better methods for monitoring owls in the future.

Some areas where further research would be useful are as follows:

- Route selection: developing improved methods to select routes and/or analyse data to reduce bias due to non-random selection (including roadside biases), while remaining practical for surveyors.
- Observer effects: finding ways to reduce or correct for variation among observers, possibly through estimating the proportions of birds being detected.
- Playback: evaluating whether additional playback or silent listening periods might improve counts, especially for species or geographic areas that have not yet been well studied.
- Survey methods: research optimal methods for documenting specific owl species or owl species distribution, especially in geographic areas not yet studied.

LONG-EARED OWL
• GORDON COURT

LITERATURE CITED

NORTHERN SAW-WHET OWL • LISA TAKATS

Allen, A.W. 1987. Habitat suitability index models: barred owl. USDI, Fish and Wildlife Service Biological Report 82. 17 pp.

Anderson, D.R., J.L. Laake, B.R. Crain, and K.P. Burnham. 1979. Guidelines for line transect sampling of biological populations. Journal of Wildlife Management 43(1): 70-78.

Beck, J. and B. Beck. 1988. The first ever greater Edmonton owl prowl. Edmonton Naturalist 16(3): 6-20.

Bibby, C.J, N.D. Burgess, and D.A. Hill. 1992. Bird census techniques. Academic Press Inc., San Diego, CA. 257 pp.

Bondrup-Nielsen, S. 1978. Vocalizations, nesting and habitat preferences of the boreal owl (*Aegolius funereus*) in North America. MSc. Thesis, University of Toronto, Ontario. 158 pp.

Bosakowski, T. 1994. Landsat reveals negative effect of forest fragmentation on barred owl distribution. Records of New Jersey Birds 20: 66-70.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. P. Laake. 1993. Distance sampling: estimating abundance of biological populations. Chapman and Hall, London, U.K.

Downes, C., E.H. Dunn, and C.M. Francis. 1999. Canadian landbird monitoring strategy: Monitoring needs and priorities into the new millennium. Partners in Flight – Canada, Ottawa. 34 pp.

Duncan, P.A. and J.R. Duncan. 1991. Nocturnal audio/playback owl survey of southeastern Manitoba and adjacent Minnesota, 1991 progress report. Manitoba Department of Natural Resources, Winnipeg, Manitoba. 8 pp.

Duncan, J.R. and P.A. Duncan. 1997. Increase in distribution records of owl species in Manitoba based on a volunteer nocturnal surveys using boreal owl (*Aegolius funereus*) and great gray owl (*Strix nebulosa*) playback. In Biology and Conservation Owls of the Northern Hemisphere by J.R. Duncan, D.H.Johnson, and T.H. Nicholls (eds.). USDA Forest Service General Technical Report NC-190. Pp. 519-524.

Duncan, J.R. and P.A. Duncan. 1998. Manitoba's nocturnal owl survey: 1998 progress report. Manitoba Conservation, Winnipeg, Manitoba. 8 pp.

Duncan, J.R. and A.E. Kearns. 1997. Habitat association with barred owl (*Strix varia*) locations in southeastern Manitoba: a review of a habitat model. In Biology and Conservation Owls of the Northern Hemisphere by J.R. Duncan, D.H.Johnson, and T.H. Nicholls (eds.). USDA Forest Service General Technical Report NC-190. Pp. 138-147.

Dunn, E.H. 1999. Recommendations for banding of nocturnally migrating owls for the purpose of monitoring populations change. Draft for Canadian Wildlife Service, Hull, Quebec.

Elkins, N. 1983. Weather and bird behaviour. T and AD Poyser, Carlton, UK. 239 pp.

Francis, C.M., and B. Whittam. 2000. Ontario nocturnal owl survey 1999 pilot study final report. unpublished report by Bird Studies Canada for the Wildlife Assessment Program, Ontario Ministry of Natural Resources. 34 pp.

Fuller, M.R. and J.A. Mosher. 1981. Methods of detecting and counting raptors: a review. In: Estimating Numbers of Terrestrial Birds by C.J. Ralph and J.M. Scott (eds.). Studies in Avian Biology 6. Pp. 235-246.

Fuller, M.R. and J.A. Mosher. 1987. Raptor survey techniques. In: Raptor Research Management Techniques Manual by B.A. Giron Pendleton, B.A. Millsap, K.W. Cline, and D.M. Bird (eds.). National Wildlife Federation, Washington, D.C. Pp. 37-65.

Fyfe, R.W., S. Temple, and T.J. Cade. 1976. The 1975 North American peregrine falcon survey. Canadian Field-Naturalist 90: 228-273.

Gutierrez, R.J., D.M. Solis, and C. Sisco. 1984. Habitat ecology of the spotted owl in northwestern California: implications of management. Proceedings of the Society of American Foresters 1983. Pp. 368-373.

Gutierrez, R.J. and A.B. Carey. 1984. Ecology and management of the spotted owl in the Pacific Northwest. USDA, Forest Service, General Technical Report PNW-185.

Holroyd, G.L. and L. Takats. 1997. Report on the Nocturnal Raptor Monitoring Workshop. In: Biology and Conservations of Owls of the Northern Hemisphere by J.R. Duncan, D.H.Johnson, and T.H. Nicholls (eds.). USDA Forest Service General Technical Report NC-190. Pp. 609-611.

James, P.C., K.M. Mazur, and S.D. Frith. 1995. The barred owl as an indicator of old forest and its role in long-term forestry planning. Annual Report, Saskatchewan Environment and Resource Management. 27 pp.

James, F. C., C. E. McCulloch, and D. A. Wiedenfeld. 1996. New approaches to the analysis of population trends in land birds. Ecology 77:13-27.

Johnson, B.T., B.T. Brown, L.T. Haight, and J.M. Simpson. 1981. Playback recordings as a special avian censusing technique. In: Estimating Number of Terrestrial Birds by C.J. Ralph and J.M. Scott, eds. Studies in Avian Biology 6: 68-75.

Johnson, D.H. 1987. Barred owls and nest boxes: results of a five-year study in Minnesota. In: Biology and Conservation of Northern Forest Owls by R.W. Nero, R.J. Clark, R.J. Knapton, and R. H. Hamre (eds.). USDA Forest Service Technical Report RM-142. Pp. 129-134.

Johnsgard, P.A. 1988. North American owls, biology and natural history. Smithsonian Institution, Washington, D.C. 295 pp.

Laidig, K.J. and D.S. Dobkin. 1995. Spatial overlap and habitat associations of barred owls and great horned owls in southern New Jersey. Journal Raptor Research 29: 151-157.

Lehmkuhl, J.F. and M.G. Raphael. 1993. Habitat pattern around northern spotted owl locations on the Olympic Peninsula, Washington. Journal of Wildlife Management 57: 302-315.

Lepage, D., C.M. Francis, and V. Deschamps. 1999. Ontario nocturnal owl survey 1998 pilot study final report. Report by Bird Studies Canada for Ontario Ministry of Natural Resources Wildlife Assessment Program. WAP-99-01. 21 pp.

Link, W.A., and J.R. Sauer. 1994a. Estimating equations estimates of trends. Bird Populations 2:23-32.

Link, W.A., and J.R. Sauer. 1994b. «New approaches to the analysis of population trends in land birds»: a comment on statistical methods. Ecology 78:2632-2634.

Link, W.A., and J.R. Sauer. 1998. Estimating population change from count data: application to the North American Breeding Bird Survey. Ecological Applications 8:258–268.

Mazur, K.M. 1997. Spatial habitat selection by barred owls (*Strix varia*) in the boreal forest of Saskatchewan, Canada. MSc. Thesis, University of Regina, Regina, Saskatchewan. 85 pp.

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

Mosher, J.A. and M.R. Fuller. 1996. Surveying woodland hawks with broadcasts of great horned owl vocalizations. Wildlife Society Bulletin 24: 531-536.

Mosher, J.A., M.R. Fuller, and M. Kopeny. 1990. Surveying woodland raptors by broadcast of conspecific vocalzations. Journal of Field Ornithology 61: 453-461.

Newton, I. 1979. Population ecology of raptors. Buteo Books, Vermillion, South Dakota. Pp. 13-17.

Nichols, J. D., J. E. Hines, J. R. Sauer, F. W. Fallon, J. E. Fallon, and P. J. Heglund. 2000. A double-observer approach for estimating detection probability and abundance from point counts. Auk 117: 393-408.

Noble, D.G., J.E. Elliott, and J.L. Shutt. 1993. Environmental contaminants in Canadian raptors. Technical Report Series No. 91. Canadian Wildlife Service, Environment Canada, Ottawa, ON.

Oliphant, L. 1994. A report on results of national and regional ornithological surveys in Canada. Bird Trends 4:1.

Palmer, D.A. 1987. Annual, seasonal, and nightly variation in calling activity of boreal and northern saw-whet owls. In Biology and Conservation of Northern Forest Owls by R. W. Nero, R.J. Clark, R.J. Knapton, and R.H. Hamre (eds.). USDA Forest Service Technical Report RM-142. Pp. 162-168.

Pendleton, B.A. Giron, B.A. Millsap, K.W. Cline, and D.M. Bird (eds.). 1987. Raptor management techniques manual. National Wildlife Federation, Washington, DC. 420 pp.

Proudfoot, G.A., J.L. Mays, S.L. Beasom, and R. Bingham. 1997. Effectiveness of broadcast surveys in determining habitat use of ferruginous pygmy-owls (*Glaucidium brasilianum*) in southern Texas. In: Biology and Conservation of Owls of the Northern Hemisphere by J.R. Duncan, D.H.Johnson, and T.H. Nicholls (eds.). USDA Forest Service General Technical Report NC-190. P. 338.

Sauer, J. R., B. G. Peterjohn, and W. A. Link. 1994. Observer differences in the North American Breeding Bird Survey. Auk 111:50-62.

Smith D.G. 1987. Owl census techniques. In: Raptor Research Management Techniques Manual by B.A. Giron Pendleton, B.A. Millsap, K.W. Cline, and D.M. Bird (eds.). National Wildlife Federation, Washington, D.C.

Takats, D.L. 1998a. Barred owl habitat use and distribution in the Foothills Model Forest. MSc. Thesis, Department of Renewable Resources, University of Alberta, Edmonton, Alberta. 139 pp.

Takats, D.L. 1998b. Volunteer nocturnal owl surveys in Alberta, annual report. Beaverhill Bird Observatory, Edmonton, Alberta. 9 pp.

Takats, D.L. and G.L. Holroyd. 1997. Owl broadcast surveys in the Foothills Model Forest. In: Biology and Conservations of Owls of the Northern Hemisphere by J.R. Duncan, D.H.Johnson, and T.H. Nicholls (eds.). USDA Forest Service General Technical Report NC-190. Pp. 421-431.

Thomas, L. 1996. Monitoring long-term population change: why are there so many analysis methods? Ecology 77: 49-58.

Wellicome, T. 1997. Status of the burrowing owl (*Speotyto cunucularia hypugaea*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 11. 21 pp.

Whelan, P. 1996. Swainson's hawk still in trouble. Raptor Watch 10(2): 1. Hawk Watch International.

The following is a list of equipment that volunteer surveyors are likely to need to conduct the nocturnal owl survey. Individual survey protocols should include a similar list.

Equipment provided by the coordinating group:

Instruction Booklet

This should detail why the survey is being conducted and describe the details of the protocol.

Training Tape/CD

The tape should include the calls of all species of owls the surveyor is likely to encounter, and even others that may not be expected. As well, it should include calls of other species of animals the surveyor is likely to hear (frogs and toads, snipe, woodcock, ruffed grouse). This can help the surveyor differentiate between similar sounding species, but can also be used to collect information on other species of interest.

Playback Tape/CD

(if the protocol involves broadcasts of owl calls). Recording should be digital, if possible, and should include the silent listening periods as well. If a tape is used, the same recording should be on both sides of the tape, so it does not need to be rewound.

Data Forms

Data sheets should be simple and easy to use, but also readily computerized (see sample in Appendix).

Route Map

Volunteers should be provided with a suitable scale map showing the route location, on which they should mark the exact location of each station. They can also mark where they estimate each owl they hear on a copy of the map. The map should be included with the data forms when submitted.

Tax Relief Form *(optional)*

When a non-profit group with charitable status is running the surveys, it may be possible to provide volunteer surveyors with a tax receipt for their out-of-pocket expenses while running the route. This could be useful incentive to encourage more to participants. In Canada, in-kind donations cannot be receipted, so it is necessary for the volunteer to submit an expense claim with a record of their food, mileage, and other expenses to the organization. The organization then reimburses the expenses, which the volunteer then donates back to the organization to receive a tax receipt (in practice, the organization will usually want to receive the return donation (post-dated if necessary) before issuing the reimbursement cheque).

Volunteer Form

Many volunteer programs can be run under the auspices of an organization that can cover individuals for General Liability, Accidental Death and Dismemberment. There are significant risks associated with travelling, and standing at the side of, remote roads at night in late winter (e.g. winter storms, vehicle breakdowns, etc.). Because there is always the possibility of an injury some coverage for volunteers is encouraged.

APPENDIX I: RECOMMENDED EQUIPMENT. . .CONTINUED

Equipment provided by the surveyor:

Warm clothes	Volunteers need to be reminded to bring extra warm clothes, even on a warm night, especially in case of changes in weather, storms, or vehicle breakdown. Also, standing outside, without moving, listening for owls can get quite cold. Several layers of warm clothes are advisable, including a weather-proof jacket, wool or fleece clothes, mittens/gloves, a hat, a warm coat and boots.
Playback Unit	(if playback is part of protocol). Any tape or CD player should meet protocol specifications in terms of broadcast volume, but should not be too heavy to handle easily. It can run on batteries or on a cord that plugs into the car cigarette lighter (cord should be long enough to reach outside the vehicle). Volunteers using batteries should bring extras. A towel can be placed underneath the unit to avoid scratching the vehicle.
Flashlight	A safety item, in case of car trouble and also useful in case any thing is dropped outside the vehicle. A strong flashlight can be used to observe an owl that has flown in, in response to playback, though we do not recommend repeatedly scanning for owls, as this could scare them.
Thermometer	A small thermometer to record the temperature during the survey.
Compass	To determine directions to calling owls, especially if the stars are obscured by clouds, or the road is curving, or it is otherwise difficult to determine orientation.
Watch/Clock	A watch or clock with a second hand to time the listening period, if a broadcast recording is not used. An illuminated digital stopwatch would be ideal, as it must also be easy to see in the dark.
Pen/Pencil	Pencils are more reliable than pens in very cold temperatures, but must be dark enough to ensure legible writing on the form. If using a pen, ensure it is waterproof, in case the data sheets get wet (snow/water).
Reliable Vehicle/ Safety Supplies	Volunteers should be reminded that the best safety precaution is a reliable vehicle that has been regularly maintained. A spare tire, with tools for changing tires, jumper cables, and road flares should always be carried. Standard safety items for the survey (or any other time during winter travel) include a candle, an empty can and matches (for heat and light), a flashlight, a blanket or warm sleeping bag, a first aid kit, a thermos of hot drinks, and some snacks. Volunteers should be encouraged to survey with somebody else, and to report their travel plans to somebody else.

Species #	Common Name	Scientific Name	Code
365.0	Barn Owl	*Tyto alba*	BNOW
366.0	Long-eared Owl	*Asio otus*	LEOW
367.0	Short-eared Owl	*Asio flammeus*	SEOW
368.0	Barred Owl	*Strix varia*	BARR*
368.6	Spotted x Barred Owl Hybrid	*Strix occidentalis x Strix varia*	SBOH
369.0	Spotted Owl	*Strix occidentalis*	SPOW
370.0	Great Gray Owl	*Strix nebulosa*	GGOW
371.0	Boreal Owl	*Aegolius funereus*	BOOW
372.0	Northern Saw-whet Owl	*Aegolius acadicus*	NSWO
373.0	Eastern Screech-owl	*Otus asio*	EASO
373.1	Whiskered Screech-owl	*Otus trichopsis*	WHSO
373.2	Western Screech-owl	*Otus kennicottii*	WESO
374.0	Flammulated Owl	*Otus flammeolus*	FLOW
375.0	Great Horned Owl	*Bubo virginianus*	GHOW
376.0	Snowy Owl	*Nyctea scandiaca*	SNOW
377.0	Northern Hawk Owl	*Surnia ulula*	NHOW
378.0	Burrowing Owl	*Athene cunicularia*	BUOW
379.0	Northern Pygmy-owl	*Glaucidium gnoma*	NOPO
380.0	Ferruginous Pygmy-owl	*Glaucidium brasilianum*	FEPO
381.0	Elf Owl	*Micrathene whitneyi*	ELOW

* These are derived from the standard bird-banding codes, except for Barred Owl which should have the code BDOW (BAOW conflicts with Barn Owl). When hand-written BDOW could easily be confused with BOOW, so we recommend use of BARR instead.

APPENDIX III: BEAUFORT SCALE TRANSLATIONS TO WIND SPEEDS

Beaufort #	Wind Speed in km/hr (mph)	Indicators of Wind Speed
0	< 2 (< 1)	Smoke rises vertically
1	2 to 5 (1 to 3)	Wind direction shown by smoke drift
2	6 to 12 (4 to 7)	Wind felt on face, leaves rustle
3	13 to 19 (8 to 12)	Leaves, small twigs in constant motion
4	20 to 29 (13 to 18)	Raises dust/loose paper, small branches move
5	30 to 38 (19 to 24)	Small trees in leaf sway

APPENDIX IV: NOISE LEVEL DESCRIPTIONS

Noise Level	Description
1	Quiet
2	Some noise, but not distracting (dogs or coyotes barking/howling)
3	Significant noise that may have reduced owl detectability (ie. creek)
4	Constant noise (ie. heavy traffic, compressor station, roaring creek)

A variety of methods could be used for randomizing route selection, to ensure that routes are as representative as possible within the constraints of a roadside survey. One approach would be to use the same protocol as the Breeding Bird Survey (USGS). However, in regions where large sections of the landscape may not be suitable for owls (e.g., agricultural fields), it may be more efficient to modify this approach to consider only areas with suitable habitat. Here we outline one approach that may be able to achieve this, though we caution that it has not yet been widely used, and some modifications may be necessary for implementation in a particular region.

- The survey area should be divided into relatively large units, such as 1-degree blocks, or 100 x 100km UTM blocks. Within each block, a starting point should be selected randomly, by picking two random numbers (from a random number table, or using a computer/calculator) to represent coordinates within that block (UTM or latitude-longitude). Using a map showing potentially suitable roads and habitats within the area, move from the random starting point to the nearest point on a suitable road, within suitable habitat, and use that as the starting point of the route. Suitable roads must be accessible in late winter/early spring and should not have excessive traffic or heavy logging trucks (for safety reasons and so that owls can be heard). Select another random number to indicate the direction of travel on the road. If the road is not long enough in the selected direction, or reverts to unsuitable habitat, take turns onto other roads if necessary, or move the starting point backwards along the road until a route can be accommodated. Ideally, the whole route should remain within the sampling block, although allowing a limited portion of the route to extend into the next block (e.g. <25%) could be allowed. If the selected road is not suitable (e.g. too short even after working both ways) then the next nearest road to the sampling point should be selected. If there are no suitable roads within a reasonable distance of the randomly selected point (e.g. 10 km) then a new random point should be selected.
- If insufficient information is available to survey organizers on the distribution of suitable habitat or roads, then volunteers could assist with the route selection (e.g., survey organizers could provide the random starting point, and volunteers could select the route using the same set of rules). Survey organizers must work closely with the volunteers to ensure that they understand and follow the rules properly.
- Efforts should be made to ensure that routes are selected from as many blocks as possible, to cover as wide an area as possible with the survey.
- The definition of suitable habitat should be sufficiently broad to cover the range of habitats used by any of the target species in the region, and not restricted to the best habitat. This type of habitat-based sampling scheme must be accompanied by a habitat-monitoring program to ensure that changes in the extent of habitat (e.g., loss of habitat, or regrowth of new habitat) are detected.

D A T A S H E E T

Route Number: ____________ Route Name: ____________

Surveyor: ____________ Assistant(s): ____________

Date: ____ / ____ / ____
DAY MONTH YEAR

Do you wish to participate again next year? [ ] YES [ ] NO

Temperature: START ______ END ______ [ ] °C [ ] °F / Cloud Cover (%): START ______ % END ______ %

Precipitation: [ ] NONE [ ] LIGHT [ ] MEDIUM / [ ] SNOW [ ] RAIN

Snow Cover: [ ] NONE [ ] PATCHY [ ] CONTINUOUS / Max. Depth: ______ Min. Depth: ______ [ ] CM [ ] IN

STATION: 1 ODOMETER: ______ km/mile START TIME: ______ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2	
						3 4	
						Traffic Count	

STATION: 2 ODOMETER: ______ km/mile START TIME: ______ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2	
						3 4	
						Traffic Count	

STATION: 3 ODOMETER: ______ km/mile START TIME: ______ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2	
						3 4	
						Traffic Count	

STATION: 4 ODOMETER: ______ km/mile START TIME: ______ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2	
						3 4	
						Traffic Count	

OPTIONAL

Continued for 10 Stations per form.

D A T A S H E E T

Route Number: ____________ Route Name: ____________

Surveyor: ____________ Assistant(s): ____________

Date: ______ / ______ / ______ (DAY / MONTH / YEAR) Do you wish to participate again next year? [ ] YES [ ] NO

Temperature: START ______ END ______ [ ] °C [ ] °F / Cloud Cover (%): START ______% END ______%

Precipitation: [ ] NONE [ ] LIGHT [ ] MEDIUM / [ ] SNOW [ ] RAIN

Snow Cover: [ ] NONE [ ] PATCHY [ ] CONTINUOUS / Max. Depth: ______ Min. Depth: ______ [ ] CM [ ] IN

STATION: 1 ODOMETER: ______ km/mile START TIME: ______ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2	
						3 4	
						Traffic Count	

STATION: 2 ODOMETER: ______ km/mile START TIME: ______ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2	
						3 4	
						Traffic Count	

STATION: 3 ODOMETER: ______ km/mile START TIME: ______ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2	
						3 4	
						Traffic Count	

STATION: 4 ODOMETER: ______ km/mile START TIME: ______ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2	
						3 4	
						Traffic Count	

STATION: 5 ODOMETER: ___________ km/mile START TIME: ________________ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2 3 4	
						Traffic Count	

STATION: 6 ODOMETER: ___________ km/mile START TIME: ________________ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2 3 4	
						Traffic Count	

STATION: 7 ODOMETER: ___________ km/mile START TIME: ________________ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2 3 4	
						Traffic Count	

STATION: 8 ODOMETER: ___________ km/mile START TIME: ________________ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2 3 4	
						Traffic Count	

STATION: 9 ODOMETER: ___________ km/mile START TIME: ________________ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2 3 4	
						Traffic Count	

STATION: 10 ODOMETER: ___________ km/mile START TIME: ________________ WIND: 0 1 2 3 >3

Species	Owl Number	Distance/ Direction	During First Minute	During Second Minute	After Broadcast	Noise Level	Comments
						1 2 3 4	
						Traffic Count	

FRONT/BACK COVER PHOTOS:
GREAT HORNED OWLS • GORDON COURT

GUIDELINES FOR NOCTURNAL OWL MONITORING IN NORTH AMERICA

MARCH 2001