Owl Broadcast Surveys in the Foothills Model Forest, Alberta, Canada

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Abstract.—Broadcast surveys are used to determine the presence and relative abundance of nocturnal owls, but there has been little effort to standardize such surveys. This paper examines broadcast survey data collected in 1995 and 1996 in the Foothills Model Forest, Alberta, Canada. Three hundred calls from six species of owls were recorded at 893 stops for a call rate of 0.34 calls per stop. Moon phase significantly affected the rate of owls calls. Owl call rate was significantly lower in the middle of the night (midnight to 3:59) compared to the early night (20:00 to 23:59) and early morning (4:00 to 7:59). During precipitation and strong wind, fewer owls called spontaneously or responded to the playback calls. Call rate of owls also declined with temperature. Owls called significantly more frequently during the 2 minute listening period beginning each 15 minute survey period than in subsequent listening periods after playback. Four behavioral responses to playback were recorded: calling and approaching, silently approaching and calling, silently approaching and not calling, and calling but not approaching.

To effectively manage wildlife, knowledge of distribution, relative abundance and, if possible, density of the wildlife population is important (Mosher and Fuller 1996). In the past few decades raptors have become important in research and conservation (Newton 1979). Raptors are difficult to study in the field because they occur at low densities in most areas, tend to have large home ranges, are extremely mobile, often inhabit remote inaccessible areas, and can be secretive (Craighead and Craighead 1969, Pendleton *et al.* 1987). Owls are even more difficult to study than other raptors because of their nocturnal habits and their propensity to nest in inconspicuous places (McGarigal and Fraser 1985). Pendleton *et al.* (1987) describe a number of techniques for surveying owls: road surveys, foot surveys, aerial surveys, boat surveys, and broadcast surveys.

Broadcast surveys are one of the most widely used techniques to locate and census owls (Fuller and Mosher 1981, Johnson *et al.* 1981, Smith 1987). Owls vocalize to communicate with their mates, to delineate territory, and to signal its occupancy (Nicholls and Fuller 1987). They aggressively establish, maintain, and protect their spatial relationships (Gill 1990). Imitating or broadcasting tape recordings of owl vocalizations can invoke vocal responses and many species of owls approach the broadcast source (Fuller and Mosher 1981). Broadcasts can also be utilized to help locate nesting pairs (Devereux and Mosher 1984). This survey technique is usually used in forested areas where owls are difficult to detect. Call rates vary among owl species but can be as high as 82.4 percent as seen in the Barred Owl (*Strix varia*) (Bosa-kowski 1987). Wind velocity, precipitation, and temperature can directly affect owl call counts (Fuller and Mosher 1987).

This paper describes the species and abundance of owls in the Foothills Model Forest (FMF), and evaluates some of the environmental conditions that affect call rates in owls. The results were used to suggest some standard methods for running broadcast surveys.

METHODS

Study Area

The FMF is located in west-central Alberta, Canada, surrounding the town of Hinton, and

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includes the Weldwood of Canada Forest Management Area, William A. Switzer Provincial Park, the Cache-Percotte Forest, and Jasper National Park (fig. 1). Lodgepole pine (*Pinus contorta*) dominates the landscape throughout the Foothills Natural Region of the FMF. Engelmann spruce (*Picea engelmanii*), and Douglas fir (*Pseudotsuga menziesii*) dominate the Montane Ecoregion. Trembling aspen (*Populus tremuloides*), balsam poplar *(Populus balsamifera*), white spruce (*Picea glauca*), black spruce (*Picea mariana*), and balsam fir (*Abies balsamea*) are common to occasional in both ecoregions. The forest age ranges from young to old and occur in continuous to fragmented stands. The total area of the FMF is 2.3 million hectares.

Transects

Ten transects (16 km long) were randomly located along roads within 80 km of Hinton in 1995 (Eberhardt and Thomas 1991). In 1996, nine additional transects were set non-randomly (variable lengths), to cover more area and to include Jasper National Park. These transects ensured that a range of habitats were sampled (Van Horne 1983) and large areas were covered efficiently (Fuller and Mosher 1987). Transects were separated by at least 5 km and were spaced far enough apart so that calls could not be heard on more than one transect (Anderson *et al.* 1979). Equally spaced broadcast stations were set along these transects at 1.6 km intervals. Roads had to be accessible in winter and could not have major log hauling on them (safety of the researcher and detectability of owls).

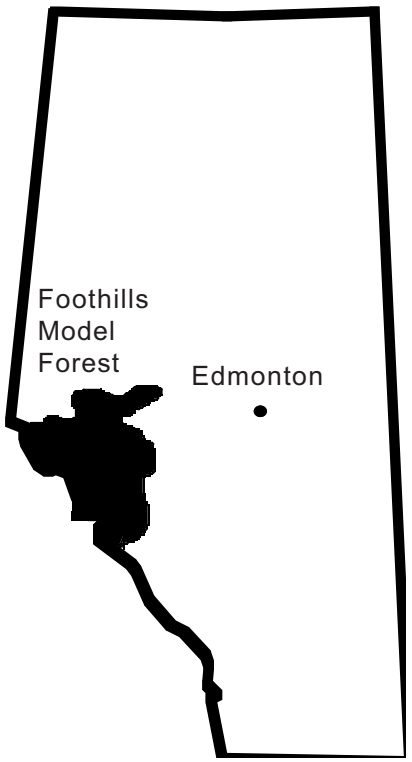

Figure 1.—*Map showing the location of the Foothills Model Forest in Alberta, Canada.*

Broadcast Surveys

Broadcast surveys were conducted during the owls' breeding season (March through May, 1995 and 1996) because call rate during the breeding season is significantly higher than in the non-breeding season (Bosakowski 1987). Transects were completed four times in 1995 and three times in 1996. We looked at the 1995 data and determined that only one survey per month was needed. Only two additional owls were recorded with the fourth survey. A Sony Mega Bass Sports cassette player was used at half volume. This volume was chosen because it could not be heard at a distance of more than 600 m (by the human ear). The cassette player was slowly and continuously rotated 360° during each broadcast, to ensure the sound traveled in all directions. All stops began with a 2 minute listening period and ended with a 5 minute listening period. On the first 10 transects only Barred Owl taped calls were played (fig. 2). The 2 minute silent listening period was followed by a series of six 20-second barred owls broadcasts with 1 minute

Stephen Glendinning

Figure 2.—*Photo of a Barred Owl (*Strix varia*) Foothills Model Forest, Alberta.*

Table 1.—*Beaufort scale wind speed translations.*

Beaufort number	Wind speed in miles/hr	Indicators of wind speed
0	Less than 1	Smoke rises vertically
1	1 to 3	Wind direction shown by smoke drift
2	4 to 7	Wind felt on face, leaves rustle
3	8 to 12	Leaves, small twigs in motion
4	13 to 18	Raises dust and loose paper; small branches move
5	19 to 24	Small trees sway; crested waves on inland waters

silent listening periods after each broadcast. The total survey time was 15 minutes for each station. If a call could not be identified in the 15 minutes, an additional 10 minutes of listening was added. On the second set of transects broadcasts of three different owl calls, were played in sequence, twice each: Barred Owl, Boreal Owl (*Aegolius funereus*), and Great Gray Owl (*Strix nebulosa*).

The sequence of conducting transects were determined randomly during three time periods, 20:00 to 23:59, 0:00 to 3:59, and 4:00 to 7:59. Counts were not usually conducted in inclement weather (heavy precipitation or strong wind), although if inclement weather started during the latter part of a survey route, the route was completed. Environmental conditions recorded at each stop included: time, start time, temperature (˚C), wind speed (Beaufort scale, used in Breeding Bird Surveys, see table 1), precipitation (type and intensity), cloud cover (percent), moon phase (based on the calendar-new moon and eight quarters), moon visible or not at each station, and snow thickness (centimeters). All owl calls were recorded as follows: time of call, broadcast interval (eight intervals), owl species, direction and distance from the observer, and behavior type. Behavior types included: singing and not approaching, singing and approaching, silently approaching and singing, and silently approaching with no vocalization (Beck and Beck, 1988). A sample field data sheet is included (Appendix A).

All data was entered into Microsoft Excel, and then imported into an SPSS (Statistical Package for the Social Sciences) for Windows (1996). Logistic regression was performed on the variables moon phase, moon visible, and night time interval, cloud cover, and temperature, to test their effects on owl call rates. A logistic regression with a covariate was performed to test for interaction between moon phase and cloud cover. Call rates were compared for precipitation and wind events. A comparison was made of the number of owls responding at different broadcast intervals, and the types of behavioral responses.

RESULTS

Calls

A total of 893 stop-counts were completed during March, April, and May, 1995 and 1996. Six species of owls were recorded on the transect surveys (table 2): Barred Owl, Boreal Owl, Great Gray Owl, Great Horned Owl (*Bubo virginianus*), Northern Saw-whet Owl (*Aegolius acadicus*) and Northern Pygmy Owl (*Glaucidium gnoma*). A total of 300 calls from owls were recorded on the transect surveys, a 0.34 call rate. The Boreal Owl was the most abundant owl recorded on transects. Some transects had very few owls recorded on them, possibly due to poor habitat along the transect. The locations of calling owls were recorded on maps to determine the total number of territorial owls (fig. 4).

During 1996, we recorded 87 calls on the first 10 transects (0.29 call rate), and 34 on the nine other ones (0.22 call rate), therefore using the Great Gray Owl and Boreal Owl in addition to the Barred Owl call did not increase over all call rate. Test surveys were conducted in an area with Boreal Owls, to determine if they responded to Barred Owl calls. When a Barred Owl call was played, Boreal Owls responded; when a Boreal Owl call was played, the Boreal Owls stopped calling in some instances (unpubl. data).

Results from all transects were combined to test the effect of environmental conditions on owl call rates. Time of year affected the number of owl calls detected, but this varied by species. The number of calls we recorded were:

Table 2.—*Broadcast survey results, Foothills Model Forest, Alberta, Canada, showing the total number of calls from all species of owls.*

Owl species[1]→	BAOW		BOOW		GGOW		GHOW		NSOW		NPOW	
TRANSECT↓	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996
Gregg Lake	8	8	7	1	0	1	4	5	2	0	0	0
Cold Creek	4	1	25	4	0	2	2	1	0	1	0	0
TriCreeks	2	1	6	0	0	0	4	4	5	2	1	0
Fish Creek	0	0	16	4	0	0	1	3	2	0	0	0
Pedley Road	1	1	3	0	1	1	3	2	4	1	0	0
WildHay Road	4	2	3	1	0	0	1	0	3	1	0	0
Medicine Lodge	1	0	15	9	1	0	2	8	0	6	0	0
Blackcat Ranch	10	6	4	0	0	0	2	0	1	3	0	0
Prest Creek	2	0	4	1	0	0	4	0	3	2	1	0
Lynx Creek	1	2	7	3	0	0	2	0	7	0	0	0
Semi-total	**33**	**21**	**90**	**23**	**2**	**4**	**25**	**23**	**27**	**16**	**2**	**0**
Paul's Road	-	0	-	4	-	0	-	0	-	1	-	0
Beaver	-	0	-	1	-	0	-	0	-	0	-	0
Mercoal	-	0	-	0	-	0	-	6	-	0	-	0
Cache Percotte	-	1	-	1	-	2	-	0	-	0	-	0
Q-road	-	0	-	0	-	0	-	1	-	0	-	0
Snaring	-	0	-	1	-	0	-	0	-	1	-	0
HW 93A/Pyramid	-	3	-	4	-	0	-	0	-	1	-	0
HW 93	-	0	-	1	-	0	-	0	-	1	-	1
Maligne	-	0	-	3	-	0	-	0	-	0	-	1
Semi-total	**-**	**4**	**-**	**15**	**-**	**2**	**-**	**7**	**-**	**4**	**-**	**2**
TOTAL	**33**	**25**	**90**	**38**	**2**	**6**	**25**	**30**	**27**	**20**	**2**	**2**
TOTAL (1995&1996)	**58**		**128**		**8**		**55**		**47**		**4**	

[1]BAOW - Barred Owl (*Strix varia*), BOOW - Boreal Owl (*Aegolius funereus*), GGOW - Great Gray Owl (*Strix nebulosa*), GHOW - Great Horned Owl (*Bubo virginianus*), NSWO - Northern Saw-whet Owl (*Aegolius acadicus*), NPOW - Northern Pygmy Owl (*Glaucidium gnoma*).

83 in March (28 percent), 118 in April (39 percent), and 99 in May (33 percent) (table 3).

Owl call rates varied significantly (Logistic regression, p = 0.0064) between time intervals (fig. 5). Intervals 1 and 3 had higher call rates than Interval 2. Barred Owls, however, had equal call rates in the three time intervals. More owls called in the 2 minute silent period before the first broadcast than in any subsequent 2 minute period (43.7 percent). By the end of the fourth broadcast, most of the calls had occurred (88.7 percent) (fig. 6). Only 10 of the 58 Barred Owls that called were recorded in the first 2 minutes. Owls responded to the broadcasts in a variety of ways (fig. 7). Most of the owls (79 percent) called from a distance, but did not approach the researcher. On 19 percent of the occasions, owls called and then

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Figure 3.—*Photo of a Great Gray Owl (*Strix nebulosa*), an owl that apparently did not respond well to broadcasts, Foothills Model Forest, Alberta, Canada.*

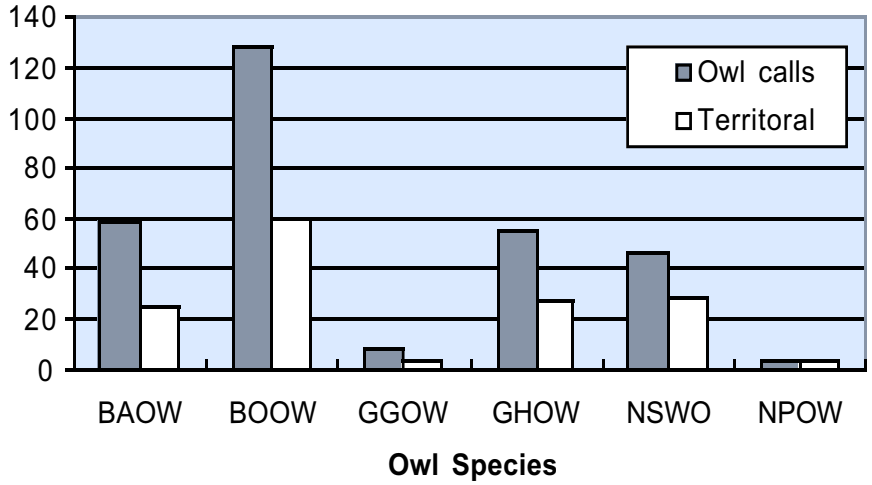

Figure 4.—*Graph showing total number of calls and total number of territorial owls recorded, Foothills Model Forest, Alberta, Canada. Abbreviations are:* BAOW - Barred Owl (*Strix varia*), BOOW - Boreal Owl (*Aegolius funereus*), GGOW - Great Gray Owl (*Strix nebulosa*), GHOW - Great Horned Owl (*Bubo virginianus*), NSWO - Northern Saw-whet Owl (*Aegolius acadicus*), NPOW - Northern Pygmy Owl (*Glaucidium gnoma*).

Table 3.—*Number of owl calls recorded during each month, Foothills Model Forest, Alberta, Canada, 1995 and 1996*

	March		April		May	
Species[1]	**1995**	**1996**	**1995**	**1996**	**1995**	**1996**
Barred Owl	6	7	11	12	16	6
Boreal Owl	39	7	30	18	22	12
Great Gray Owl	0	1	0	4	2	1
Great Horned Owl	9	6	8	18	8	6
Northern Saw-whet Owl	5	2	5	12	17	6
Northern Pygmy Owl	1	0	0	0	1	2
Total	60	23	54	64	66	33
Month Totals	83		118		99	

[1] Barred Owl (*Strix varia*), Boreal Owl (*Aegolius funereus*), Great Gray Owl (*Strix nebulosa*), Great Horned Owl (*Bubo virginianus*), Northern Saw-whet Owl (*Aegolius acadicus*), Northern Pygmy Owl (*Glaucidium gnoma*).

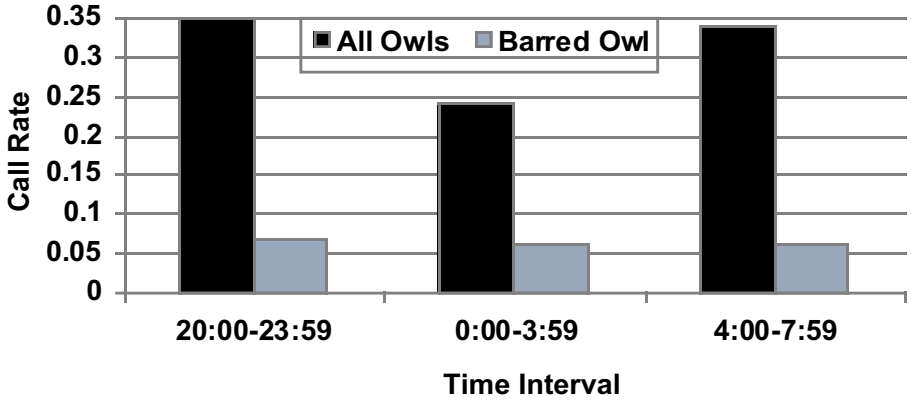

Figure 5.—*Call rate of all owls and Barred Owls (*Strix varia*) at the different time intervals, Foothills Model Forest, Alberta, Canada.*

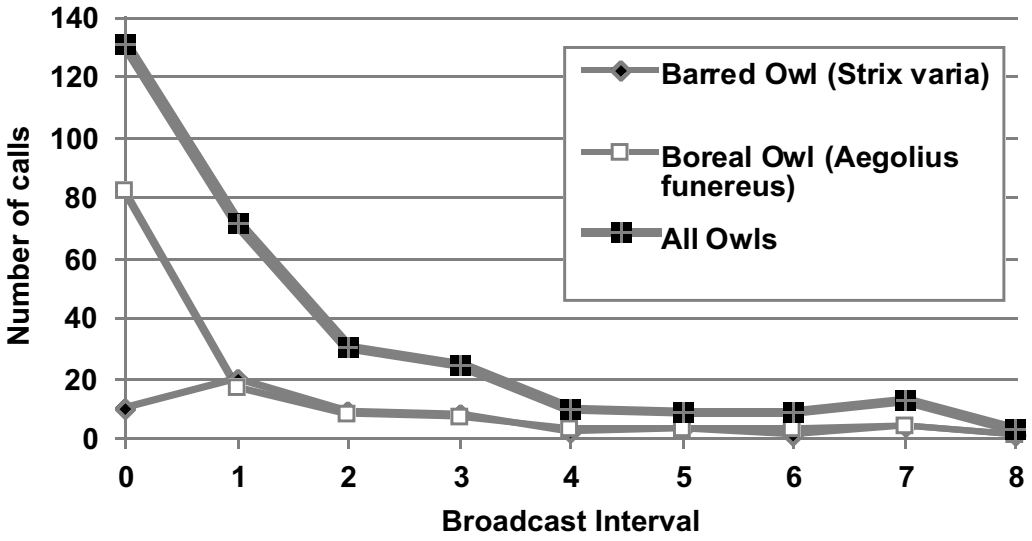

Figure 6.—*Number of owls responding at different broadcast intervals (0 = 2 minute silent period, 1 = after first broadcast, 2 = after second broadcast, etc., 7 = 5 minute listening, 8 = 10 minute listening), Foothills Model Forest, Alberta, Canada.*

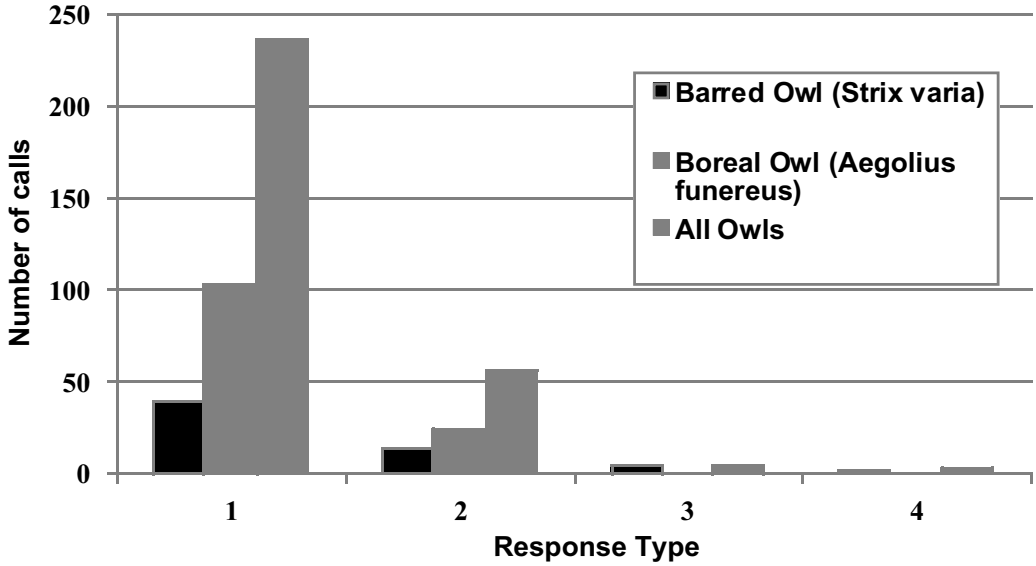

Figure 7.—*Owl responses to broadcast surveys (1 = sings, does not approach; 2 = sings, approaches; 3 = silently approached, sings; 4 = silently approaches, no vocalization), Foothills Model Forest, Alberta, Canada.*

approached. Few owls were detected approaching silently.

Calls and sounds were recorded from 16 other species including: wolves (*Canis lupus*), coyotes (*Canis latrans*), wood frogs (*Rana sylvatica*), boreal chorus frogs (*Pseudacris triseriata*), Common Snipe (*Gallinago gallinago*), Common Nighthawk (*Chordeiles minor*), Common Loon (*Gavia immer*), and various waterfowl species. Three other species of owls were recorded in the FMF, but not during broadcast surveys: Snowy Owl (*Nyctea scandiaca*), Northern Hawk Owl (*Surnia ulula*), and Short-eared Owl (*Asio flammeus*).

Environmental Conditions

The moon phase had a significant effect on owl call (Logistic regression, p = 0.0025). Call rates were highest during full moon phase and lowest during new moon phase. Cloud cover did not have a significant effect on call rate (Logistic regression, p = 0.5276). When moon phase and cloud cover were tested together as covariates, they significantly affected call rates (Logistic regression, p = 0.0249). Therefore, the number of calls increased significantly when the moon was visible.

Owl broadcast surveys were conducted at temperatures ranging from -30˚C to +10˚C (fig. 8). Owls responded at temperatures as low as -28˚C. The rate of calling increased with temperature, and was highest between -15˚C and +5˚C. Owl call rate dropped as wind speed increased (fig. 9). No owls were recorded when winds exceeded Beaufort scale 4 (over 13 miles/hr). Although most of the transects were not run during precipitation, there were stops where precipitation was recorded. No owls responded during heavy precipitation (fig. 10). Light snow had little effect on owl call rate, however moderate rain and snow did significantly decrease call rate. No owls were recorded during heavy precipitation events.

DISCUSSION

The survey methods described appear to be useful to estimate the distribution and relative abundance of owls. They may be less useful in determining the abundance of Great Gray Owls and Northern Pygmy Owls (figs. 3 and 4), which were also recorded during daytime (unpubl. data).

Environmental conditions directly affect owl calls in a number of ways. Owls called less frequently during heavy precipitation and high wind. Wind can directly affect the researcher's ability to hear owls calling and the owls' ability to hear the broadcast. McGarigal and Fraser (1985) suggest that stops for Barred Owls should last a minimum of 15 minutes. Most of the owl calls in this study were recorded within

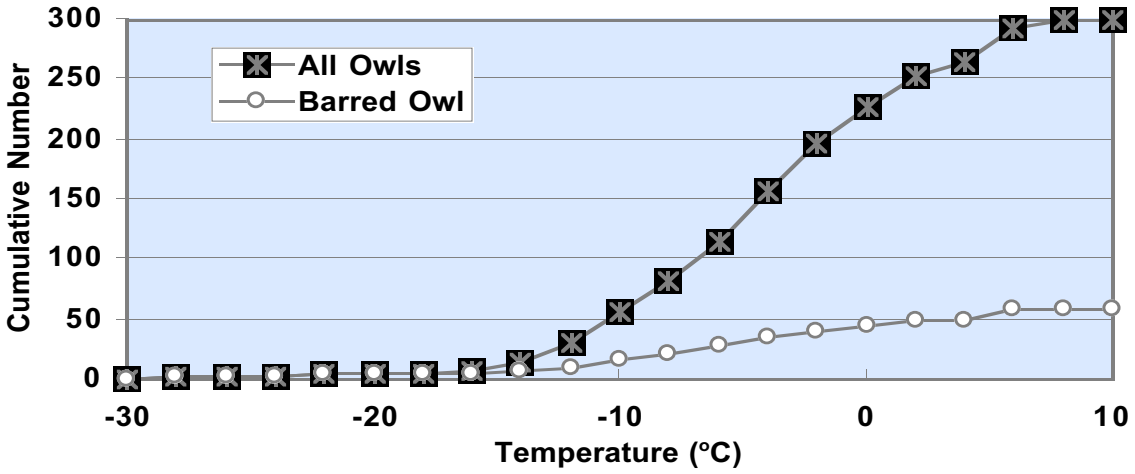

Figure 8.—*Cumulative number of owl calls and Barred Owl (*Strix varia*) calls at increasing temperatures, Foothills Model Forest. Alberta, Canada.*

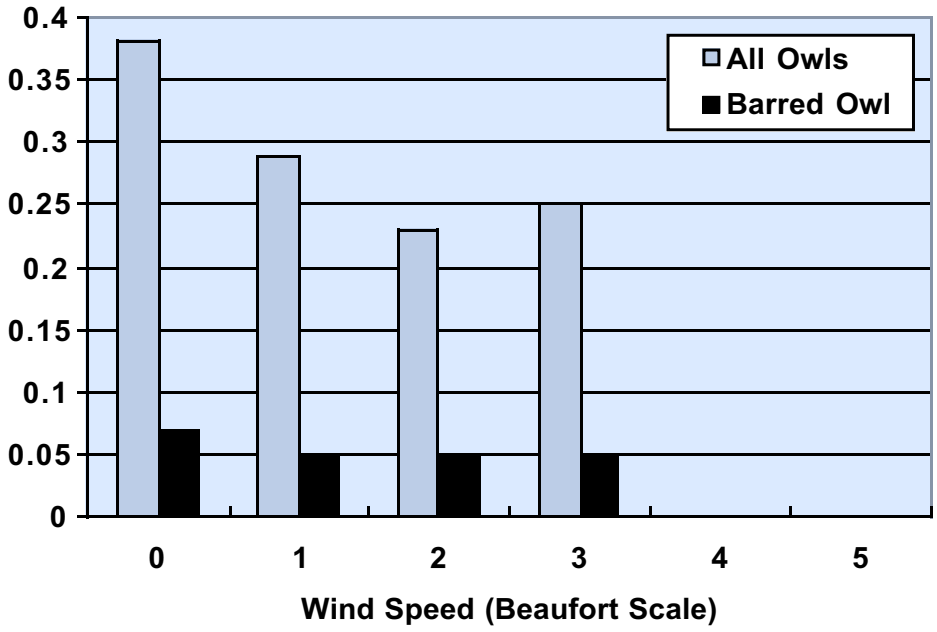

Figure 9.—*Call rate of all owls and Barred Owls (*Strix varia*) at different wind speeds, Foothills Model Forest, Alberta, Canada.*

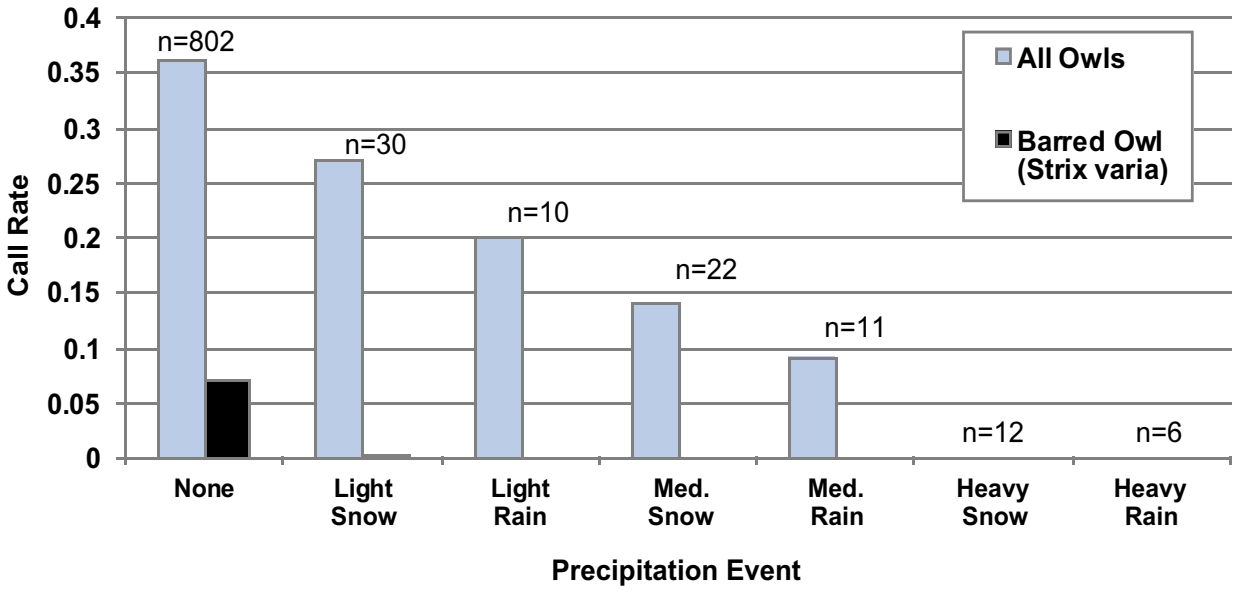

Figure 10.—*Call rates of owls in various amounts of precipitation, n = the number of stops surveyed, Foothills Model Forest, Alberta, Canada.*

7 minutes, suggesting that stops can be shorter. Many owls were calling spontaneously at stations. Only Barred Owls showed an increase in call rate after the first broadcast was played. Owls did not respond more when other species of owl calls were used during the surveys. Barred Owl vocalizations can elicit calls from most species of owls in the Foothills Model Forest Study Area, Alberta. Survey transects are an excellent way to survey large areas efficiently.

Suggestions for Standardized Surveys

1. A silent listening period of at least 2 minutes, before broadcasts, is recommended.

2. Run surveys before midnight and after 4:00 in the morning to get the highest call rates.

3. Repeat the survey routes more than once, because owl call activity is not constant between nights.

4. Information on the environmental conditions should be recorded at each stop. This information can be tested, to determine how environmental conditions affect call rates.

5. Broadcast surveys can be used to survey certain species of owls, but other methods need to be used to survey other species that do not respond well to broadcasts.

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APPENDIX A:

Sample data sheet used in the field for owl broadcast surveys in the Foothills Model Forest, Alberta, Canada.

Owling Transects Data Sheets

Date:_____ Observer(s):_____ Transect:_____

Owls Species	Interval	Response Type	Tree Species
BAOW-barred BOOW-boreal NSWO-saw-whet NPOW-pygmy GHOW-great-horned GGOW-great gray NHOW-hawk-owl LEOW-long-eared	0 first 2 minutes 1 after first broadcast 2 after second broadcast 3 after third broadcast 4 after fourth broadcast 5 after fifth broadcast 6 after sixth broadcast 7 five minute interval after 8 ten minute interval beyond	1 sings, does not approach 2 sings, approaches 3 silently approaches, sings 4 silently approaches, no vocalization	Aw aspen Pb balsam poplar Bw paper birch Sw white spruce Sb black spruce Pl lodgepole pine Lt tamarack Fa subalpine fir

Point: 1 Start Time:_____ Temp.:_____°C Wind:_____ Prec.:_____

Cloud cover:_____% Moon phase:_____ Snow depth: _____

Time	Interval	Owl Species	Direction	Distance	Response	Comments

Point: 2 Start Time:_____ Temp.:_____°C Wind:_____ Prec.:_____

Cloud cover:_____% Moon phase:_____ Snow depth: _____

Time	Interval	Owl Species	Direction	Distance	Response	Comments