

BARRED OWL  
HABITAT USE AND DISTRIBUTION  
IN THE FOOTHILLS MODEL FOREST

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## **TECHNICAL REVIEW**

The author of this report is a student enrolled in Graduate Studies at the University of Alberta, under the direction of a graduate supervisory committee. This report has not been subjected to the peer review process. The author is working on a thesis dissertation and related peer-reviewed publications, which should be used as project references when completed.

## Abstract

A two-year ecological study was conducted on the Barred Owl (*Strix varia*) in the Foothills Model Forest (FMF) located in west-central Alberta. The Barred Owl was chosen for study because it is considered an indicator of old growth forest. Little information exists on the Barred Owl in Alberta. The purpose of this study was to collect information on the distribution and abundance of Barred Owls in the FMF, and to investigate Barred Owl nesting, roosting, and foraging (prey use) habitat use. Broadcast surveys, telemetry, and casual observations were used to record information on forty territorial Barred Owls. Barred Owl density was determined to be 0.05 owls/km<sup>2</sup> and 0.04 owls/km<sup>2</sup> in 1995 and 1996 respectively. Six pairs of owls were investigated for nesting. They were found to nest in natural cavities of large diameter Balsam Poplar trees (*Populus balsamifera*). Barred Owls were found to use old mixedwood stands of White Spruce (*Picea glauca*), Trembling Aspen (*Populus tremuloides*), and Balsam Poplar for nesting, roosting, and foraging. Prey taken by the owls included small mammals, birds, frogs, and insects. Other owl species recorded include: Boreal Owls (*Aegolius funereus*), Great Gray Owls (*Strix nebulosa*), Great Horned Owls (*Bubo virginianus*), Northern Saw-whet Owls (*Aegolius acadicus*), Northern Pygmy Owls (*Glaucidium gnoma*), two Northern Hawk-Owls (*Surnia alula*), a Short-eared Owl (*Asio flammeus*), and a Snowy Owl (*Nyctea scandiaca*).

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## Table of Contents

	Page
Introduction .....	1
The Issue .....	1
Barred Owl Ecology .....	1
Objectives .....	3
Methods .....	3
Study Area .....	3
Distribution and Abundance .....	5
Habitat Use .....	6
Prey Determination .....	7
Habitat Suitability Index Model .....	8
Results .....	8
Distribution and Abundance .....	8
Habitat Use .....	14
General .....	14
Nest Sites .....	16
Roost Sites .....	20
Prey .....	21
Discussion .....	24
Research Recommendations .....	25
Literature Cited .....	26
Appendices .....	31
Appendix A-Roost/nest/forage tree information recorded on each vegetation survey ....	31
Appendix B-Tree/Log characteristics recorded on each vegetation survey.....	32
Appendix C-Stand characteristics associated with Barred Owls locations from broadcasts.	33
Appendix D-List of all territorial Barred Owl locations recorded during the project .....	34
Appendix E-Bird species recorded on point counts run in 1996 .....	35
Appendix F- Habitat Suitability Index Model for the Barred Owl .....	37



## List of Tables

	Page
1. Distribution of tree species among subregions in west-central Alberta .....	3
2. Number of owl calls recorded during each month .....	8
3. Number of territorial owls recorded on ten transects run March through May, 1995 and 1996. .	9
4. Number of territorial owls recorded March through May 1996 on new transects .....	10
5. Total numbers of six species of owls recorded 1995 and 1996 from all methods of observation .	12
6. Stick nest search results. ....	13
7. Locations and dates of species caught in drop-lid traps. ....	16
8. Characteristics of Barred Owl nests. ....	18
9. Nest stand description of density and tree height .....	19
10. Prey taken by Barred Owls in the Foothills Model Forest .....	22
11. Snow track survey results showing relative abundance of each species in each habitat .....	23

## List of Figures

1. Photo of a Barred Owl showing the distinctive dark brown eyes and streaking on the chest .....	2
2. Map showing the location of the Foothills Model Forest .....	4
3. Plot layout for vegetation surveys. ....	7
4. Number of owls detected on broadcast surveys, and number of territorial owls .....	8
5. Comparison of call rates between the three time intervals during the night .....	10
6. Map showing the distribution of 41 territorial Barred Owls in the Foothills Model Forest .....	11
7. Stand density associated with owls recorded on the broadcast surveys .....	15
8. Stand height associated with owls calling on the transect surveys .....	15
9. Home range of the radiotagged Solomon Creek female Barred Owl .....	17
10. Home range of the Blackcat male Barred Owl. ....	17
11. Photo of the female Solomon Creek Barred Owl flying into the nest cavity .....	18
12. Diameter of Miette 3 nest tree compared to the diameters available in the nest stand .....	19
13. Mean diameter of trees in Barred Owl nest stands .....	19
14. Diameters of roost trees chosen by Barred Owls in the FMF .....	20
15. Mean diameter of trees in the roost stands. ....	20
16. Stand density associated with roost sites .....	21
17. Stand tree heights associated with roost sites of Barred Owls. ....	21

## INTRODUCTION

### The Issue

As forestry activities in Alberta have grown, new issues of sustainability and biodiversity have become increasingly important to forest managers. Clearcutting practices have the ability to dramatically alter the forests by opening up the canopy and creating edge. Understanding how forest-dwelling species depend on the forests, is a big step towards understanding and managing our forests in a sustainable way. Alberta Environmental Protection (1996) recently listed the Barred Owl (*Strix varia*) as a Yellow B species, meaning it warrants management attention in order to ensure it does not end up in trouble. It is a species that is associated with habitats or habitat elements that are, or may be, deteriorating.

It is not unusual for forest-dwelling wildlife species to exhibit specific affinities and adaptations for old or undisturbed forest environments (Marcot 1995). The Spotted Owl (*Strix occidentalis*) has been at the center of a debate over forest management in the Pacific Northwest for at least a decade (Thomas *et al.* 1993, USDA 1992, USDI 1990). Spotted Owls preferentially select old growth forests for all their life requisites (Forsman *et al.* 1984, Guitierrez *et al.* 1984, Carey *et al.* 1990), and are scarce in second-growth forests (Carey *et al.* 1992). The Barred Owl was chosen for study because it has the potential to serve as an indicator of old growth forests in Alberta. The Barred Owl and Spotted Owl are closely related to one another (Johnsgard 1988) and are considered by some authors to represent a superspecies (American Ornithologists' Union 1983).

Foresters usually consider old growth stands to be over-mature or decadent (Patton 1992). Older forests are targeted for harvesting because they contain large volumes of fiber, have insects and disease, and have slowed growth rates. Farr (1992) noted that forests managed primarily for fiber production undergo regional changes in vegetation patterns, particularly in the age class distribution of forest stands. The status of Canada's remaining old growth forests is of growing concern (Ellis 1993). Older forests are characterized by relatively large diameter trees (>35 cm dbh in Alberta), multilayered canopies, trees of a wide range of sizes and ages, and the presence of standing and downed dead woody material (Heinrichs 1983, Beck pers. comm.). These forests can be very dense to open depending on the species composition.

The Barred Owl was outlined for study by the Foothills Model Forest (FMF). The FMF is one of ten model forests that were established across Canada in 1992. The mission of the FMF is "to develop and recommend an approach to sustainability and integrated resource management through research and technology by means of collaborative partnerships." The partners are: Alberta Department of Environmental Protection, Weldwood of Canada, Alberta Environmental Training Center, and Jasper National Park. The purpose and rationale of this study was to determine what key habitat features are important to the Barred Owl in the Foothills Model Forest and provide this information to forest managers to ensure healthy populations are maintained.

### Barred Owl Ecology

Ecologies of most owl species, particularly forest-dwellers, are still relatively unknown. There is little information existing on the Barred Owl in western Canada except for British Columbia (Boxall and Stepney 1982). This species is widely distributed throughout North America, ranging from the east coast to western Canadian provinces (American Ornithologists' Union 1983). It is found from the southern tip of Florida to southeastern Alaska. The first Saskatchewan nest was not found until 1961 (Houston 1961). Mazur found 40 pairs of territorial Barred Owls during call surveys in the Prince Albert Model Forest, Saskatchewan (James *et al.* 1995). The status of the Barred Owl is largely unknown in Alberta (Boxall and Stepney 1982). The first nest record for Alberta was in 1966 in Edmonton (Jones 1966) and Semenchuk (1992) reports only eight breeding records during the five year provincial bird atlas. They are

found to be concentrated in the boreal forest region north of Edmonton, in the foothills/montane forests west of Calgary, and in Jasper National Park. There have been recent sightings in the Wabasca region and nesting confirmed near La Crete in northern Alberta (Takats 1995).

The Barred Owl is a medium sized owl with dark brown eyes and a distinctive streaked pattern on the body. Horizontal dark brown streaks occur on the throat, separated by vertical streaks on the lower breast and flanks (Johnsgard 1988). The tail, back, wings, and head are greyish-brown and barred heavily with white and/or buff. (Figure 1 and front cover). Their call is 'Who cooks for you, who cooks for you all'.



Figure 1: Photo of a Barred Owl showing the distinctive dark brown eyes and streaking on the chest.  
(photo by Stephen Glendinning).

Barred Owl survival is dependent on the availability of food, areas for courtship and nesting, and shelter and perches for roosting (Nicholls and Warner 1972, Elody and Sloan 1985). The Barred Owl shows a strong association with mature and old growth forest types across its North American range (McGarigal and Fraser 1985). An interior forest species, the Barred Owl requires larger blocks of mature dense woodland (Alberta Department of Environmental Protection 1996). They have been found to have a close association with water (Bent 1938, Semenchuk 1992). Average home ranges vary from region to region. In Minnesota an average home range size of 229 ha was determined using radio telemetry (Nicholls and Warner 1972). Barred Owl densities in Alberta are unknown.

Owls do not build their own nests. Hollows in trees, old hawk and raven stick nests, and broken off trees (stubs) have been used by the Barred Owl (Bent 1938, Court, pers. comm., Mazur 1997). Stands with large diameter trees that are mature enough to provide natural cavities are preferred (Allen 1987). An average clutch of two or three eggs is laid (Bent 1961). The incubation time is unknown for Alberta, but is reported in the United States as 28 to 32 days. The young fledge in four to five weeks. Another variable that is important to look at is the prey of the Barred Owl (O'Neil *et al.* 1988). Barred Owls are considered opportunistic feeders, and are known to prey on small mammals, birds, amphibians, reptiles, fish, and insects (Bent 1938). Small mammals are the primary component of the Barred Owls diet (Errington 1932, Earhart and Johnson 1970, Marks *et al.* 1984).

A draft habitat suitability index model was written for the Barred Owl (Olsen *et al.* 1996) based on literature. The goal of wildlife habitat modelling is to develop models that can be used to assess wildlife habitat relationships and to predict their sensitivity to perturbations. Habitat suitability index models arrange habitat use information into a framework appropriate for field application and are scaled to produce an index value between 0 (unsuitable habitat) and 1 (optimal habitat) (Allen 1987, Van Horn and Weins 1991). These models need to be validated and, if necessary, modified to perform adequately in the geographic area being studied (O'Neil 1988).

## OBJECTIVES

1. To determine the distribution and abundance of the Barred Owl in the Foothills Model Forest.
2. To determine the habitat (nesting, roosting, and foraging) associated with the Barred Owls' presence.
3. To determine the prey available to, and the prey selected by, the Barred Owl.
4. To validate, and if necessary, modify the Draft Habitat Suitability Index Model for the Barred Owl (Olsen *et al.* 1996).
5. To determine what other species of owls occur in the Foothills Model Forest.

## METHODS

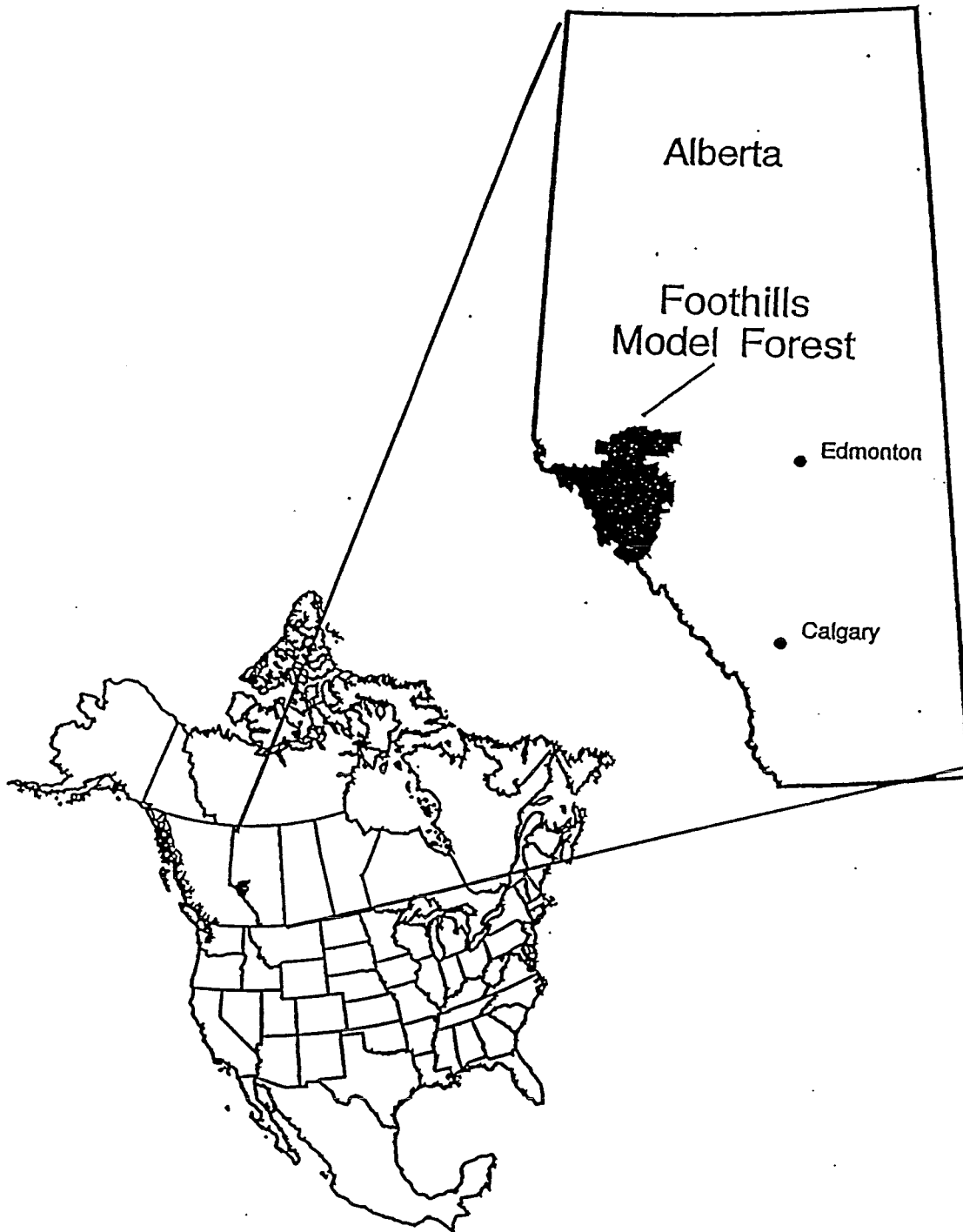
### Study Area

The Foothills Model Forest FMF is located in west-central Alberta (Figure 2) and includes the Weldwood of Canada Forest Management Area, William A. Switzer Provincial Park, the Cache Percotte Forest, and Jasper National Park. The FMF total area is 2.3 million hectares and covers portions of the Foothills and Rocky Mountain Natural Regions. The Foothills Natural Region is divided into Lower and Upper Foothills Subregions. The Rocky Mountain Region is divided into three Subregions: the Montane, Subalpine, and Alpine (Beckingham *et al.* 1996). Surveys were restricted to accessible areas in the Upper Foothills, Lower Foothills, Montane, and Subalpine Subregions. Table 1 shows the distribution of tree species among the subregions. The FMF is dominated by Lodgepole Pine in the foothills and Engelmann spruce in the mountains.

Table 1: Distribution of tree species among subregions in west-central Alberta (Strong and Leggat 1981).

Species	Scientific Name	Lower Foothills	Upper Foothills	Montane	Subalpine
Lodgepole Pine	<i>Pinus contorta</i>	D	D	D	D
White Spruce	<i>Picea glauca</i>	C	C	C	R
Engelmann spruce	<i>Picea engelmannii</i>	X	R	X	C-D
Black spruce	<i>Picea mariana</i>	C	C	O	R
Balsam fir	<i>Abies balsamea</i>	O	O	X	X
Subalpine fir	<i>Abies lasiocarpa</i>	X	X	R	C
Douglas fir	<i>Pseudotsuga menziesii</i>	X	X	C	R
Trembling Aspen	<i>Populus tremuloides</i>	C	O	C	O
Balsam Poplar	<i>Populus balsamifera</i>	O-C	O	O	O
White birch	<i>Betula papyrifera</i>	O	O	X	X
Tamarack	<i>Larix laricina</i>	O	O	O	X

D=dominant, C=common, O=occasional, R=rare, X=not present



**Figure 2: Map showing the location of the Foothills Model Forest.**

## Distribution and Abundance

Raptors are difficult to study in the field because they occur at low densities, tend to have large home ranges, often inhabit remote areas, and are generally secretive (Pendleton *et al.* 1987). Owls are also nocturnal to diurnal and can nest in inconspicuous cavities (McGarigal and Fraser 1985). For this reason, a variety of methods were used to locate owls.

Birds aggressively establish, maintain, and protect their spatial relationships (Gill 1990). Owls vocalize to communicate with their mates, to delineate territory, and to signal its occupancy (Nichols and Fuller 1987). Imitating or broadcasting a tape recording of owl vocalizations can elicit vocal responses or approach (Fuller and Mosher 1981). Broadcast surveys were conducted during the breeding season (March through May, 1995 and 1996) because response rate during the non-breeding season is significantly lower (Bosakowski 1987).

Ten 16 km transects were randomly laid along roads within 80 km of Hinton (before Jasper joined the Model Forest) (Eberhardt and Thomas 1991). One hundred townships were selected and were numbered. Township and section numbers were drawn randomly. If a road was present, the transect was started from that point. A random direction was chosen for layout. Transects were used to ensure that a range of habitat were sampled for presence/absence (Van Horne 1983). The transects were separated by at least 5 km and were spaced far enough apart so that no sighting could be recorded on more than one transect (Anderson *et al.* 1979). Ten equally spaced broadcast stations (1.6 km) were set along these transects. Roads had to be 4x4 accessible in winter and could not have major hauling on them (safety for researcher and detectability of owls).

The transects were visited randomly in three time slots, 20:00 to 23:59, 0:00 to 3:59, and 4:00 to 7:59. After arriving at a broadcast station, a two minute silent period was followed by a series of six 20 second Barred Owl broadcasts. This was followed by five more minutes of silent listening. Counts were not conducted in inclement weather (wind >15km/hr or heavy precipitation). Wind velocity, precipitation, and temperature affect winter raptor counts (Fuller and Mosher 1987). Transects were visited four times in 1995 and three times in 1996.

In 1996, nine new transects were set out non-randomly, to cover more area and to include Jasper National Park in the sample. Three different owl calls were used on the new transects: Barred Owl, Boreal Owl (*Aegolius funereus*), and Great Gray Owl (*Strix nebulosa*). Calls were played in this sequence for 20 second intervals twice over. Environmental conditions recorded on each point included: start time, temperature, wind speed (Beaufort scale), precipitation, cloud cover, moon phase, moon visible, and snow depth. Researchers recorded all species of owls that responded and recorded information on: time of response, broadcast interval, owl species, direction, distance, response type. Response types include: singing and not approaching, singing and approaching, silently approaching and singing, and silently approaching with no vocalization (Beck and Beck, 1988).

Barred Owls and Great Gray Owls have been shown to use stick nests (Bent 1961). Stick nest searches were conducted in cooperation with a Northern Goshawk (*Accipiter gentilis*) study (Schaffer 1996). The first search method was an aerial survey by helicopter (Ethier 1995). Observers searched for stick nests as the pilot flew over a variety of habitats. The second method involved intensive ground searches during February and March, 1996 (before leaf-out), and when possible throughout the field season. Transect searches were conducted: in 1 km<sup>2</sup> areas, in 1 km radii around three known Northern Goshawk nest sites, and in areas where goshawks, owls, and other stick nests had been sighted. Northern Goshawks are known to build multiple nests in close proximity (within 0.8 km in Alaska) to each other and will alternate between them (McGowan 1975, Reynolds *et al.* 1982, Duncan and Kirk 1994).

Owls were recorded from casual sightings by myself, other researchers in the area, and the general public. All sightings were verified where possible. Owls forage along openings, will call spontaneously, and will fly in silently to check on intruders in their territories. Many owl locations were being reported as this project began. This information was collected for distribution maps, and for total number of owls recorded (if sightings were believed to be the same owl, they were not recorded twice). Other raptor sightings were recorded on or near Barred Owl territories, as these would be potential competitors for food, territories, and nest sites, and could also be potential predators on the Barred Owl.

### Habitat Use

It is difficult to determine Barred Owl nesting, roosting, and foraging sites. As well, it is difficult to obtain continuous data on movements of owls (Nicholls and Warner 1972). For this reason, radio telemetry was attempted to help track movements. Live capture efforts were run from May through August, 1995, and from March through August, 1996. A variety of methods have been used to trap raptors (Meng 1976, Kenward *et al.* 1983, Bull 1987). The technique most widely used to trap Barred Owls is mist netting. Two nets were suspended between poles and set in a V-shape on the territory of a Barred Owl (Nicholls and Fuller 1987, Bloom 1987). A mechanized Barred Owl decoy accompanied by taped calls was used to attract the Barred Owls to the mist nets (Court, pers. comm., Jacobs 1996).

In June, 1995 and 1996, drop-lid traps were employed, as owls no longer responded well to taped calls (Kenward *et al.* 1983, Redpath and Wyllie 1994). Traps were baited with pigeons or mice, and were checked every eight hours. Traps were closed during inclement weather. In 1996, a Bal Chatri trap was constructed. The Bal Chatri (Berger and Mueller 1959) is a wire cage with monofilament nooses tied to the top and/or sides with a lure animal inside (Bloom 1987). This trap was used in June and July, 1996.

Barred Owl nesting, roosting and foraging habitat was determined by four methods:

1. Locations of owls that responded on transect surveys were plotted on GIS vegetation maps based on the distance and direction information. The stand data associated with these locations was taken off the maps (also ground truthed to ensure accuracy). Proudfoot (1997) found no significant difference between radiotagged owl locations and locations associated with owls responding to broadcasts.
2. Researchers triangulated on radiotagged birds and walked in on them.
3. Audio triangulation and walking in on owls that were calling spontaneously.
4. Casual observations in the field.

Locations were classified as nesting, roosting, or foraging. If nesting was suspected all possible nest trees were tapped to flush the female. Trees with cavities were climbed to investigate possible nesting.

Vegetation surveys were conducted at known Barred Owl nest, roost, and forage sites. These surveys were modeled on Timoney (1993) and Bibby and Burgess (1992) nested plot methods. Each nest survey and 7 roost surveys had a center plot and four plots set in cardinal directions 30 m away (Figure 3). The rest of the roost and forage surveys had only one center survey.

The nest/roost/forage tree was considered the center of the survey. Appendix A shows the specific information recorded on these center trees. Each plot recorded information on trees in a 0.04 ha area, shrubs in a 0.004 ha area, and herbs in four one 1 m<sup>2</sup> areas (averaged). Tree characteristics that were recorded are listed in Appendix B. Shrub species were placed in three separate height classes: < 1 m, 1-2.5 m, and >2.5 m. The percent cover of each species was recorded and the total shrub cover was determined. Each herb species was recorded for percent cover. The average height and total percent cover

for herbs, grasses, and sedges/rushes was recorded. Ground cover was divided into the following categories: litter, mineral, moss, lichens/fungus, downed wood, and other (eg. water, tree). The percent cover of each category was determined (total had to equal 100) and the depth of the litter and moss was measured.

Logs were measured in the 0.04 ha plots (Appendix B). The overall site characteristics of the nest/roost/forage sites that were described include: site geographical position (macro and meso scales), surface shape, soil drainage, flood hazard, slope, aspect, canopy and subcanopy tree species, their heights and crown bases. Canopy closure was measured using a spherical convex densiometer at the five meter mark in four cardinal directions at each plot. Three nests were plotted on aerial photos and stands were AVI typed by Weldwood staff.

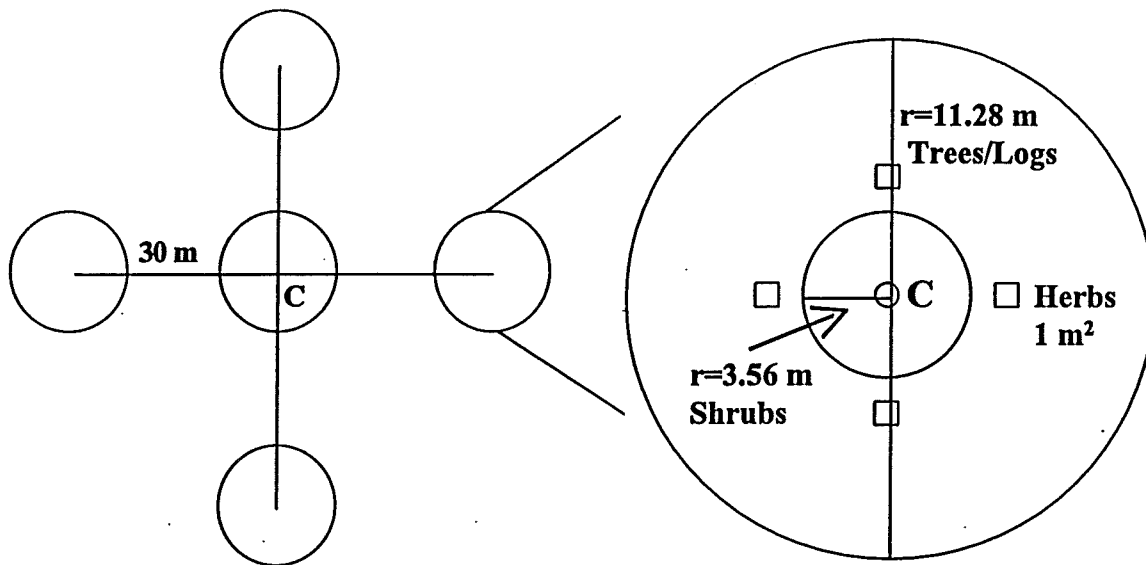


Figure 3: Plot layout for the vegetation surveys. Center plot with four plots set in cardinal directions. Each plot had surveys conducted in 0.04 (trees), 0.004 ha (shrubs), and four 1 m<sup>2</sup> (herbs) areas.

### Prey Determination

Nest observations, pellets, and prey remains are important in determining what different prey raptors are consuming (Holroyd, pers. comm.). Searches were made for pellets and prey remains under roost sites and around nests. Other methods included observing owls forage and watching prey transfers at nests. Barred Owl feathers were collected, when found, and were provided for isotope analysis (Duxbury 1996).

All potential prey species (birds/mammals/amphibians) in owl territories were recorded over the first field season, in Barred Owl territories. In 1996 relative abundance of these prey species was determined in a range of habitats. Transects were laid through 24 habitat types ensuring that most habitats used by the Northern Goshawk and Barred Owl for foraging were covered (determined from walking in on radiotagged birds during the winter). Chaining was used to flag transects in randomly chosen locations on or near Barred Owl or Northern Goshawk territories. Transects ranged in length depending on accessibility, but were usually two kilometers.

Snow track counts were conducted from February through March, 1996. Track counts were completed 12 to 96 hours after a snowfall. We recorded all tracks that crossed the transect, species of animal and amount of use. The habitat associated with each track was also recorded. Grouse surveys were run in April and May, 1996. All drumming grouse were counted during these surveys.



Songbird surveys were run from May through July along the transects using point counts set every 250 m (Reynolds *et al.* 1980). At each station, an observer stood for five minutes and recorded all species seen or heard within 50 m, and outside 50 m but within 125 m. Species seen flying over and en route between stations were recorded separately. We did not do surveys during inclement weather (precipitation, wind) and were started at sunrise. Red squirrels were recorded during all the surveys.

### Habitat Suitability Index Model

The habitat model is a separate document, and will have a copy attached as Appendix E.

## RESULTS

### Distribution and Abundance

A total of 893 stations were completed during March, April, and May, 1995 and 1996. Six species of owls were recorded on the transect surveys (Tables 2, 3 and 4): Barred Owls (*Strix varia*) (BAOW), Boreal Owls (*Aegolius funereus*) (BOOW), Great Gray Owls (*Strix nebulosa*) (GGOW), Great Horned Owls (*Bubo virginianus*) (GHOW), Northern Saw-whet Owls (*Aegolius acadicus*) (NSWO) and Northern Pygmy Owls (*Glaucidium gnoma*) (NPOW). Gregg Lake and Blackcat Ranch transects had the most Barred Owls recorded. A total of 300 owls were heard calling on the transects, a 0.34 response rate.

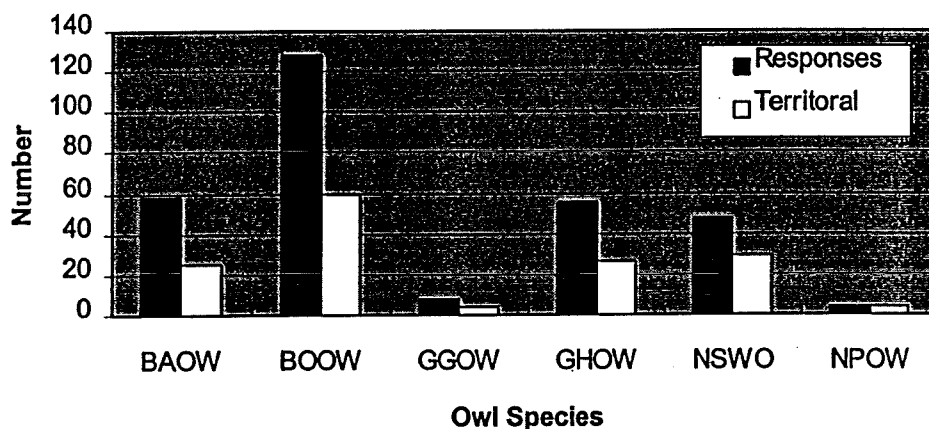


Figure 4: Number of owls detected on broadcast surveys, and number of territorial owls.

Table 2: Number of owl calls recorded during each month, 1995 and 1996.

Species	March		April		May	
	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	

Table 3: Number of territorial owls responding on ten transects run March through May, 1995 and 1996.

Owl Species→ Transect↓	BAOW		BOOW		GGOW		GHOW		NSWO		NPOW	
	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996
Gregg Lake	3	3	5	1	0	0	2	2	2	0	0	0
Cold Creek	2	1	12	3	0	1	1	1	0	0	0	0
TriCreeks	2	1	3	0	0	0	3	2	1	2	1	0
Fish Creek	0	0	9	2	0	0	1	2	2	0	0	0
Pedley	1	1	2	0	1	1	2	2	3	1	0	0
WildHay North	2	1	3	1	0	0	1	1	3	1	0	0
Medicine Lodge	1	0	9	7	1	1	2	6	1	4	0	0
Blackcat Ranch	3	4	3	0	0	0	2	1	1	2	0	0
Prest Creek	1	0	3	1	0	0	2	3	2	1	1	0
Lynx Creek	2	2	6	2	0	0	1	2	6	2	0	0
Total	17	13	55	17	2	3	17	22	21	13	2	0

Table 4: Number of territorial owls recorded March through May, 1996 on new transects.

Owl Species→ Transects↓	BAOW		BOOW		GGOW		GHOW		NSWO		NPOW	
	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996
Cache Percotte	1		1		1		0		0		0	
Paul's Road	0		2		0		0		1		0	
Beaver	0		1		0		0		0		0	
Mercoal	0		0		0		3		0		0	
Q-Road	0		0		0		0		0		0	
Pyramid/HW93 A	2		4		0		1		0		0	
Snaring	0		1		0		0		1		0	
HW 93	0		1		0		0		1		1	
Maligne Road	0		3		0		0		0		1	
TOTAL	3		13		1		4		3		2	

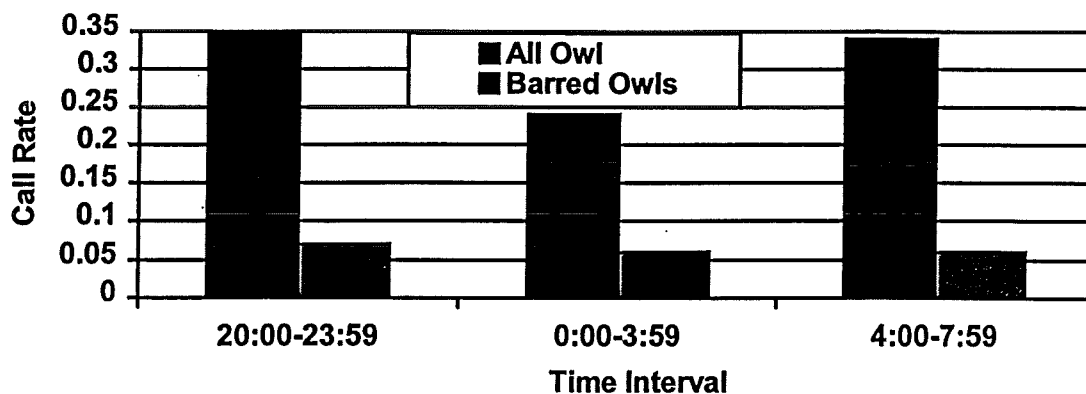


Figure 5: Comparison of call rates between the three time intervals during the night.

Many owls were calling spontaneously before any broadcasts were played (43%). Barred Owls, however, had a higher number of calls recorded after the first broadcast. Most owls responded by calling but not approaching the researcher. Few owls were detected approaching silently and not calling. Owl call rates varied significantly (Logistic regression,  $P=0.0064$ ) between time intervals (Figure 5).

The density of owls was calculated by dividing the number of owls recorded on the surveys by the total area covered (10 transects x 16 km length x 2 km width = 320 km<sup>2</sup>). Barred Owl density was determined to be 0.05 owls/km<sup>2</sup> or 0.025 pairs/km<sup>2</sup>. Density was not calculated for the Great Gray Owl, the Northern Saw-whet Owl, or the Northern Pygmy Owl because they did not respond well to broadcast surveys. The Northern Pygmy Owl is a daytime caller and the Northern Saw-whet Owls did not start calling regularly until May. Even when the Great Gray and Boreal Owl broadcasts were played, there was no increase in the number of Great Grays and/or Boreal Owls recorded (Takats and Holroyd 1997).

The Barred Owl was found to have a density of 0.05 and 0.04 owls/km<sup>2</sup>, in 1995 and 1996 respectively. This density is much higher than what was expected. The Boreal Owl had a very high density in 1995 (0.17 owls/km<sup>2</sup>), but dropped dramatically in 1996. Northern Saw-whet Owl numbers also dropped in 1996. Barred Owl and Great Horned Owl densities changed slightly from year to year, Barred Owls dropped and Great Horned Owls increased.

Many owls were recorded by casual observations (Table 5). Great Gray Owls were visible on a number of occasions foraging along roads and cutlines during the winter and early spring. Eleven individuals were recorded each year by casual observation. Three new species of owls were reported in the second year: a Short-eared Owl (*Asio flammeus*) (SEOW), a Snowy Owl (*Nyctea scandiaca*) (SNOW), and two Northern Hawk-Owls (*Surnia alula*) (NHOW). These species do not respond to broadcast surveys, and therefore would not have responded during the broadcast surveys. The Snowy and Short-eared Owls are unusual records from the area. The Northern Hawk-Owl is a species that was expected. One nesting record on the FMF is known from the past.

Forty-two territorial Barred Owls were recorded during the two years of this project (Appendix D). Of these, we found seven pairs. The other 28 Barred Owls may have had mates that did not respond to broadcasts. The distribution of Barred Owls recorded during this project is shown on Figure 6. The Barred Owl has a clumped distribution in the FMF.

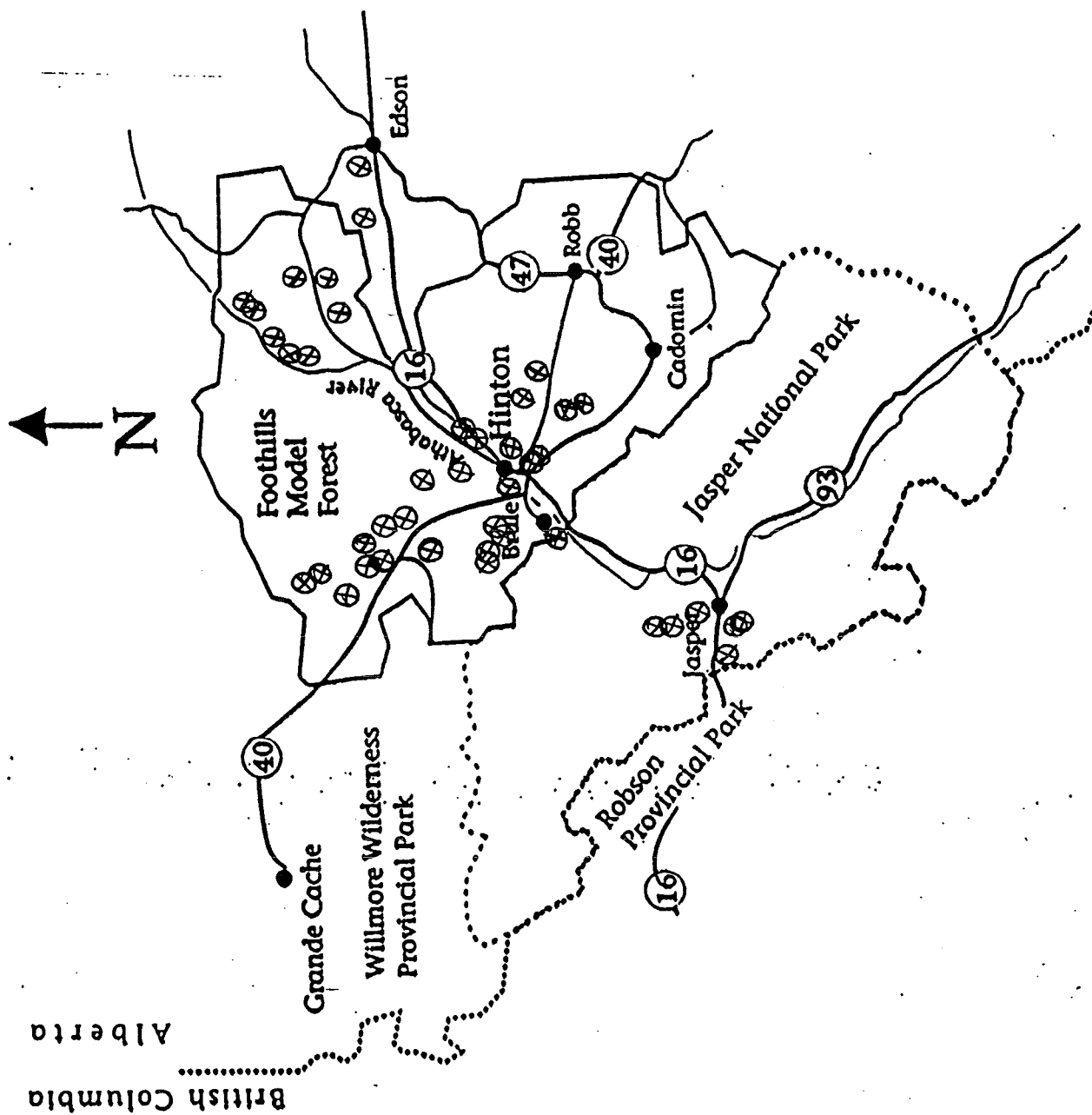


Figure 6: Map showing the distribution of forty-two territorial Barred Owls in the Foothills Model Forest.

Table 5: Total numbers of six species of owls recorded in 1995 and 1996 from all methods of observation.

Owl Species→ Observation↓	BAOW		BOOW		GGOW		GHOW		NSOW		NPOW	
	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996
First 10 transects	17	13	55	17	2	3	17	22	21	13	2	0
New transects	-	3	-	13	-	1	-	4	-	3	-	2
Casual observations	13	11	6	2	11	11	13	4	21	5	5	5
<b>Total</b>	<b>30</b>	<b>27</b>	<b>61</b>	<b>32</b>	<b>13</b>	<b>15</b>	<b>30</b>	<b>30</b>	<b>42</b>	<b>21</b>	<b>7</b>	<b>7</b>

On April 17, 1994, (before leaf flush) at 11:00, four researchers and a pilot conducted an aerial survey and searched for stick nests. The helicopter flew at 60 mph at a height of 200 feet above ground. Twelve parallel transects were run east-west along the Athabasca River east of Hinton (total area covered 34 km<sup>2</sup>). We observed one Canada Goose (*Branta canadensis*), one Common Raven (*Corvus corax*), and two adult Red-tailed Hawks (*Buteo jamaicensis*). We then traveled to Fish Creek, Peppers Lake, over to Athabasca Tower to Solomon Creek near Blackcat Ranch. No stick nest were located. The helicopter was even flown over an area containing a known stick nest, and the stick nest could not be located. Total flight time was 90 minutes. Our lack of success indicates that stick nests in this area are not very visible during aerial surveys and that there seems to be a low density of nests.

Ground stick nest searches were conducted in the summer of 1995 and from February through May, 1996, (before leaf flush). A total of 34 stick nests were located and investigated (Table 6a). The total area surveyed was 2900 ha. The goshawk study surveyed areas apart from apart from this, and found an additional 25 stick nests, but no owl nests were located (Table 6b). None of the fifty-nine stick nests were used by Barred Owls. Some of the stick nests were located on Barred Owl territories, but the owls did not use them for nesting.

Five raptor species were found using the stick nests: Northern Goshawks, Red-tailed Hawks, Osprey (*Pandion haliaetus*), Great Horned Owls, and Great Gray Owls. The Great Horned Owl nest at R.C. Fliers had two young that fledged successfully. The pair could not be located in 1996, therefore no nest was found. Old Fort Point (1995) and Jasper Park Lodge (1996) each had Great Horned Owl nests with two young. Two young successfully fledged from Old Fort Point, while only one fledged from the Jasper Park Lodge nest. These two nests could have been occupied by the same pair of owls. Obed had two different Great Gray Owl nests, one in 1995 and one in 1996. The 1995 nest was depredated, possibly from a mammalian predator. Great Gray Owl nests were also recorded at Emerson Gaswell and Edson. Neither of these were reoccupied in 1996. One non-raptor species, Common Ravens, were found using stick nests.

Other species of raptors recorded on or near Barred Owl territories included Northern Goshawk, Cooper's Hawk (*Accipiter cooperii*), Sharp-shinned Hawk (*Accipiter striatus*), Red-tailed Hawk, Golden Eagle (*Aquila chrysaetos*), Bald Eagle (*Haliaeetus leucocephalus*), Osprey, Merlin (*Falco columbarius*) and American Kestrel (*Falco sparverius*). Species found nesting on Barred Owl territories include the Northern Goshawk and the Red-tailed Hawk. The Blackcat Northern Goshawk nest was occupied in 1995. Two Barred Owl pairs had territories nearby. When the Goshawk did not nest in 1996, the southern pair of Barred Owls, increased their home range to include the nesting area.

Table 6: Stick nest search results: (a) area searched, number of stick nests found, tree species, and evidence of use (shared study) (b) Northern Goshawk stick nest data (Schaffer pers. comm.).

Location	Total Area Searched (ha)	Number of Stick Nests	Tree Species	Nest Occupant (Year)
<b>(a) Shared Study</b>				
Blackcat nest	315	3	1 Aw	NOGO (1995)
			2 Aw	2 CORA (1996)
Paul's Road nest	315	4	1 Aw	NOGO (1994)
			1 Aw	NOGO (1996)
			1 Aw, 1 Pl	unoccupied
Grizzly nest	315	2	1 Aw	NOGO (1995)
			1 Aw	RTHA (1996)
R.C. Fliers	100	4	1 Aw	GHOW (1995)
			1 Aw	CORA
			2 Aw	unoccupied
Athabasca Ranch	100	6	2 Aw	2 CORA (1996)
			3 Aw, 1 Pl	unoccupied
Blackcat Ranch	70	1	1 Aw	unoccupied
Solomon Creek	410	0	--	----
WildHay Ridge	350	1	1 Pl	unoccupied
Gregg Lake	300	2	1 Aw	CORA (1996)
			1 Pb	NOGO (1996)
Cold Creek (1 km <sup>2</sup> )	100	0	--	----
Cold Creek	40	1	1 Pl	unoccupied
Seabolt Creek Road	50	1	1 Aw	unoccupied
A16	85	0	--	----
Obed	100	3	1 Aw	GGOW (1995)
				RTHA (1996)
			1 Aw	GGOW (1996)
			1 Aw	unoccupied
Robb Road (km 23)	50	1	1 Aw	unoccupied
Emerson Gaswell	50	1	1 Aw	GGOW (1995)
Lynx	100	0	--	----
Pyramid Lake	100	1	1 Pl	OSPR (1996)
Jasper Park Lodge	20	1	1 Fd	CORA (1995)
				GHOW (1996)
Old Fort Point	20	1	1 Sw	GHOW (1995)
Edson	50	1	1 Aw	GGOW (1995)
<b>Total</b>	<b>2900</b>	<b>34</b>	<b>26 Aw, 5 Pl, 1 Sw, 1 Fd, 1 Pb</b>	

Table 6: Stick nest search results (Con't.).

Location	Total Area Searched (ha)	Number of Stick Nests	Tree Species	Nest Occupant (Year)
<u>(b) NOGO study</u>				
A road km 46.5		3	1 Aw 2 Aw	RTHA unoccupied
Marlboro		3	1 Aw 2 Aw	NOGO (1996) unoccupied
Medicine Lodge Road (nth block)		1	1 Aw	unoccupied
Medicine Lodge		1	1 Aw	RTHA
Gregg River Burn		2	2 Pl	2 CORA (1996)
South Jarvis Creek		4	4 Aw	unoccupied
D58		1	1 Aw	unoccupied
Lambert Creek		2	2 Aw	2 CORA (1996)
Round Lake (Obad)		2	2 Aw	2 CORA
East Cache/Graveyard		1	1 Aw	unoccupied
South of HW16/Hinton sign		2	2 Aw	unoccupied
HW 16 Right-of-way		1	1 Aw	unoccupied
A20		1	1 Sw	unoccupied
Peppers Lake Road		1	1 Aw	1 CORA (1996)
Total		25	2 Pl, 1 Sw 22 Aw	
<hr/>				
Grand Total		59	7 Pl, 2 Sw, 1 Fd 48 Aw, 1 Pb	

Aw=Trembling Aspen, Pb=Balsam Poplar, Sw=White Spruce, Pl=Lodgepole Pine, Fd=Douglas Fir  
RTHA=Red-tailed Hawk, CORA=Common Raven, NOGO=Northern Goshawk, GGOW=Great Gray Owl  
GHOW=Great Horned Owl, OSPR=Osprey

### Habitat Use

#### General Habitat Use

Habitats associated with each Barred Owl response from transect surveys are shown in Appendix C. Seventeen territorial Barred Owls were recorded in the first year on the transects. Thirteen (old transects) plus three (new transects) territorial Barred Owls were recorded in the second year. Some owls responded more than once during the surveys. If they responded from a new stand the new stand was recorded.

All locations had greater than 50% (B density) canopy closure (Figure 7). Thirty-seven on the locations were found in C density stands. Trees were above 18 m in height, but in most cases above 21 m (Figure 8). All of the stands had a White Spruce component, and were predominantly mixedwood containing Trembling Aspen and Balsam Poplar. Black spruce and Lodgepole Pine occurred in only nine of the forty-five stands.

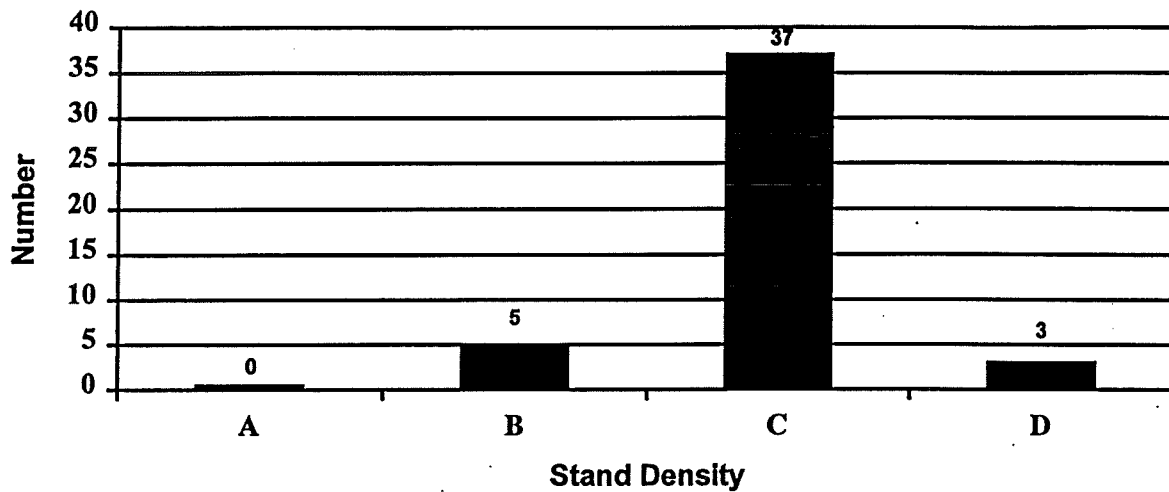


Figure 7: Stand density associated with owls recorded on the broadcast surveys. Density codes: A is 5-30%, B is 31-50 %, C is 51-70%, and D is 71-100% canopy closure.

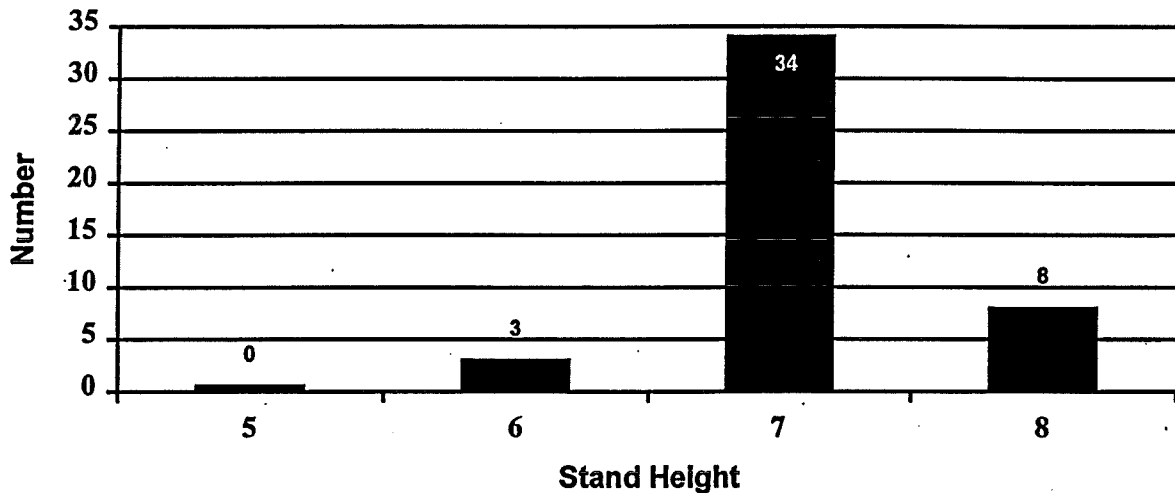


Figure 8: Stand tree heights associated with owls calling on the transect surveys. Height codes: 5 is 15.1 to 18.0 m, 6 is 18.1 to 21 m, 7 is 21.1 to 24 m, and 8 is 24.1 to 27 m.

Drop-lid trapping was an unsuccessful method for catching Barred Owls. Drop-lid traps were run for 6300 hours from June through August, 1995 in four areas: Fish Creek, Wild Hay Ridge, Lynx Creek, and Blackcat Ranch. In 1996, the traps were run for 1700 hours from June through July in the Blackcat area only. Species caught in the drop-lid traps (Table 7) during the two seasons included five raptor species: Northern Goshawk, Cooper's Hawk, Sharp-shinned Hawk, Red-tailed Hawk, and Broad-winged Hawk (*Buteo platypterus*), and two non-raptor species: Gray Jay (*Perisoreus canadensis*) and Red Fox (*Vulpes vulpes*). Most raptors were caught during June (early breeding season) and August (migration), in areas where the traps were visible. However, having traps in visible locations made them susceptible to vandalism, and three traps were damaged beyond repair.



Table 7: Locations and dates of species caught in drop-lid traps.

Species	Location	Date
Northern Goshawk	Wild Hay Ridge	June 29, 1995
Cooper's Hawk	Wild Hay Ridge	July 19, 1995
Cooper's Hawk	Blackcat Ranch	August 3, 1995
Gray Jay	Blackcat Ranch	August 4, 1995
Sharp-shinned Hawk	Blackcat Ranch	August 14, 1995
Red-tailed Hawk	Blackcat Ranch	August 16, 1995
Northern Goshawk	Blackcat Ranch	August 18, 1995
Red Fox	Blackcat Ranch	June 5, 1996
Cooper's Hawk	Blackcat Ranch	June 6, 1996
Broad-winged Hawk	Blackcat Ranch	June 6, 1996

The Bal Chatri was also not successful in trapping Barred Owls. The trap was used during five different trap nights. On two occasions a male Barred Owl flew down on the trap but was not caught. It was observed that the owl did not have its talons opened when the trap was struck. The owl hit the trap six times on one of the trap nights. A Northern Goshawk was captured in 1996 using this method (Schaffer, pers. comm.).

The mist nests were used to capture one female Barred Owl. The owl was caught on June 28, 1995 at 0:30 near Solomon Creek. A radiotag was affixed to the owl and radiolocations were taken from the capture date through October 21, 1996. The 18-month battery lasted until November, 1996. Over one hundred triangulations were taken and these locations were plotted to estimate the home range size of the Solomon Creek female owl (Figure 8). Home range was determined to be 150 ha in summer 1995, 170 ha in winter 1995/1996, and 185 ha in summer 1996. Home range was also determined for a male Barred Owl that had many calling and sighting records: 240 ha in summer 1995 and 155 ha in summer 1996 (Figure 9).

### Nests

By walking in on the radiotagged owl, we found five foraging locations, seventeen roost sites, and a nest (Figure 11 and Table 8). Five other nests were located by investigating all possible trees containing cavities (in areas with pairs of owls), by observing young owls, or from reports by birders in Jasper. All Barred Owl nests were found in natural cavities of live Balsam Poplar trees. These trees had a wound on the tree where it could rot and create a natural cavity. Trees chosen by the Barred Owls had large diameters to accommodate their body size. Trembling Aspen trees with woodpecker cavities are not large enough for the Barred Owl, though Boreal and Northern Saw-whet Owls used them readily. The average diameter of tree used by Barred Owls for nesting was 74.0 cm (n=6). Barred Owls were selecting the largest trees in the stand (Figure 12). The stands chosen for nesting by the Barred Owls were near water, but this is probably due to the Balsam Poplar trees being found near the water. Wet areas are usually bypassed by fire, and therefore have older and larger trees.

Mean diameter of the canopy/subcanopy trees in nest stands ranged from 21.8 to 35.3 cm (Figure 13). Nest stands had dense canopies (Table 9). According to a densiometer the stand densities were C to D, whereas AVI from air photos determined densities to be B density with A, B, and C understories. Of all the stick nests found during the two years, none were used by Barred Owls. Barred Owls seem to be choosing specific trees for nesting in the FMF. There is still a possibility that the owls may use stubs of trees, but this has not been documented in the Foothills Model Forest.

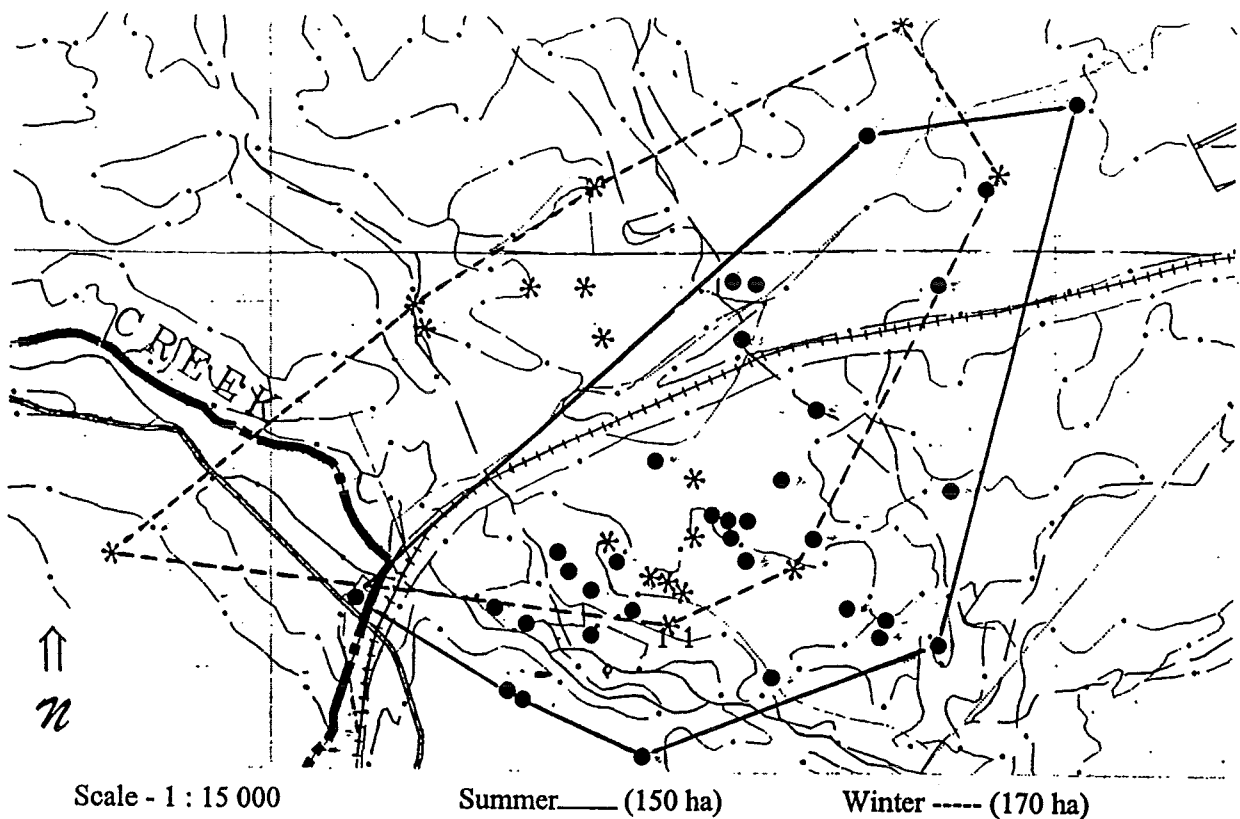


Figure 9: Home range of the radiotagged Solomon Creek female Barred Owl. Summer 1995 is shown with dots and solid line, winter 1995/1996 is shown with stars and dotted line.

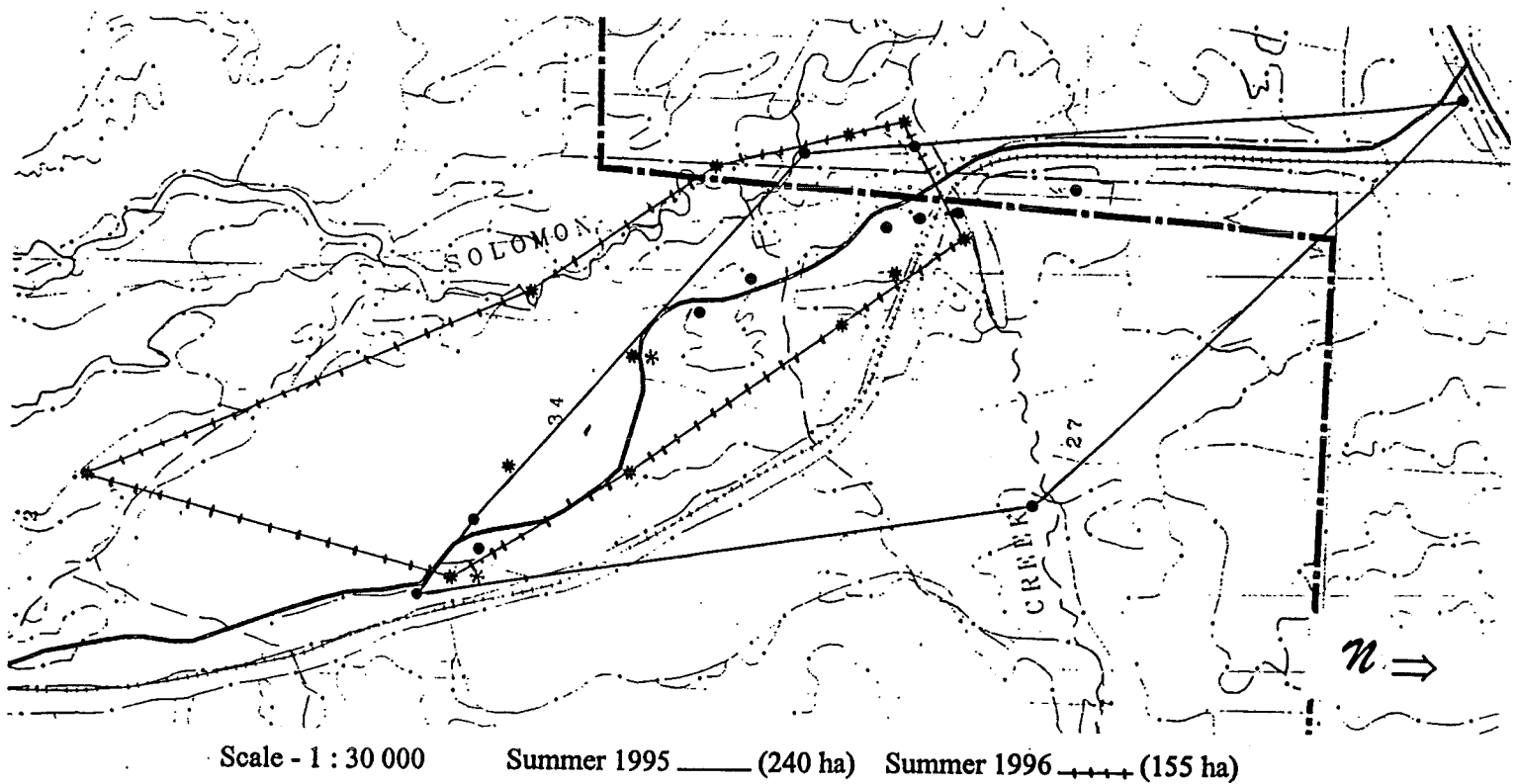


Figure 10: Home range of the Blackcat male Barred Owl. Summer 1995 shown with dots and solid line, summer 1996 shown with stars and slashed solid line.

(photo by Stephen Glendinning).



Figure 11: Photo of the female Solomon Creek Barred Owl flying into the nest cavity.

Table 8: Characteristics of Barred Owl nests (Pb=Balsam Poplar).

Nest	TREE				NEST	
	Species	DBH (cm)	Height (m)	Crown Base (m)	Type	Height (m)
Blackcat Ranch	Pb	61.8	19.0	11.2	cavity	10.4
Lynx Creek	Pb	74.5	26.4	15.0	cavity	15.3
Solomon Creek	Pb	69.1	23.4	19.2	cavity	16.8
Miette 1	Pb	71.1	27.3	17.1	cavity	17.0
Miette 2	Pb	82.7	28.9	17.3	cavity	17.3
Miette 3	Pb	85.0	27.0	11.7	cavity	16.8
Mean	-	74.0	25.3	15.3	-	15.6
S.D.	-	8.7	3.6	3.2	-	2.6

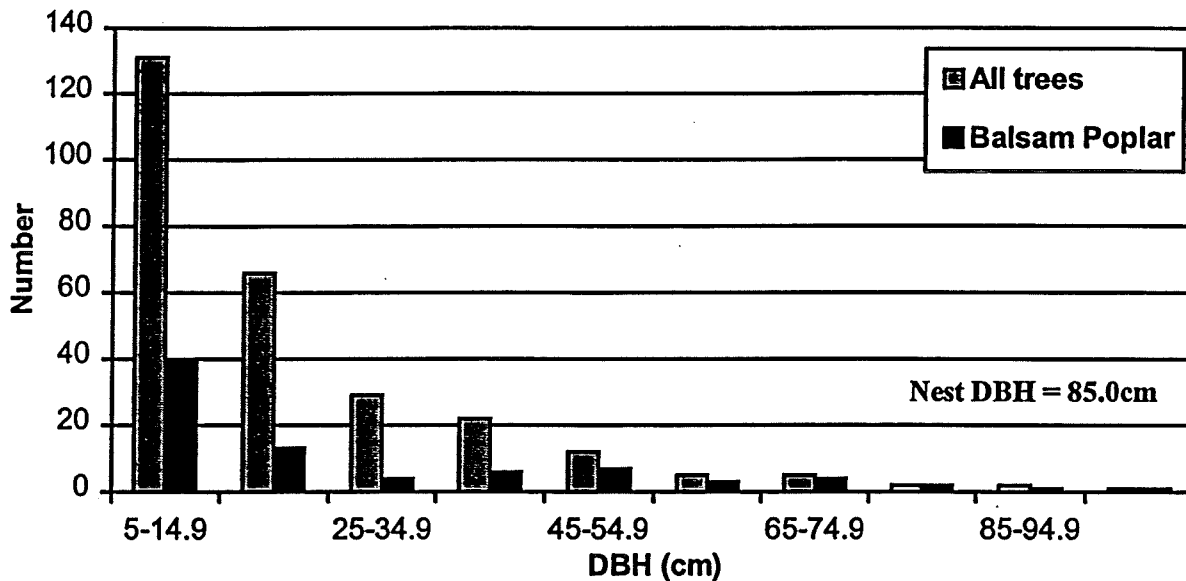


Figure 12: Diameter of Miette 3 nest tree compared to diameters available in the stand.

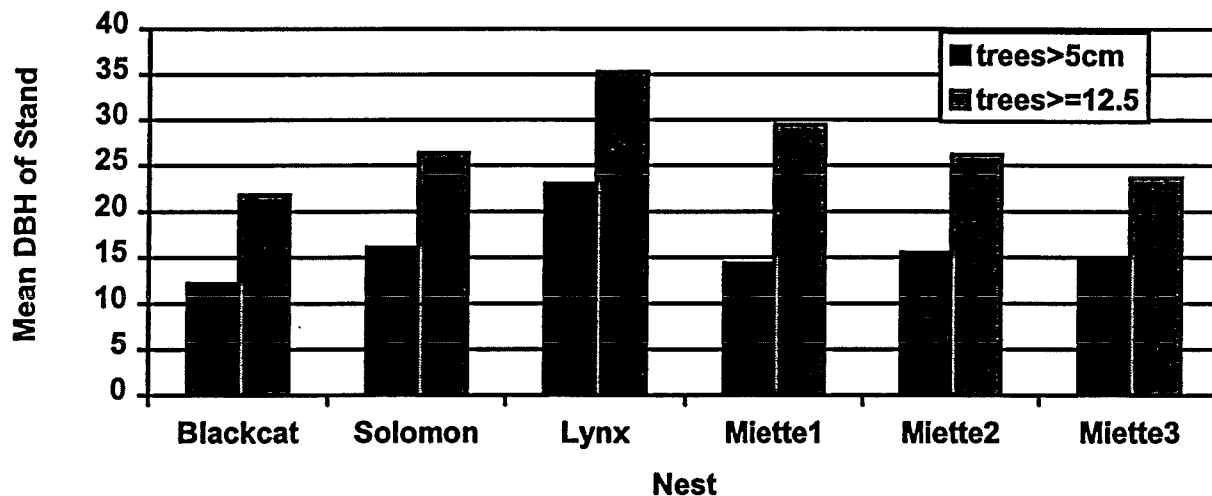


Figure 13: Mean diameter of all trees and just canopy trees in Barred Owl nest stands.

Table 9: Stand description density and tree height measured with a spherical densiometer and clinometer versus aerial photos interpretation AVI typed by Weldwood (overstory/understory). Density: A=6-30%, B=31-50%, C=51-70%, D=71-100%. Height in meters.

Nest	Densiometer	Weldwood Air Photo (AVI)
Blackcat	C25	B26 / C11
Solomon	C24	B26 / B10
Lynx	C27	B28 / A8
Miette 1	C29	n/a
Miette 2	C27	n/a
Miette 3	C24	n/a

## Roost Sites

Twenty-five roost sites were located. Three species of trees were used for roosting: Trembling Aspen (n=11), Balsam Poplar (n=8), and White Spruce (n=6). The average diameter of tree used was 35.7 cm and ranged from 17.0 to 69.7 cm (Figure 14). The roost trees were found in a variety of stand types, but had very little to no Lodgepole Pine present in them. The average diameters of the stands ranged from 12.6 to 31.7 cm (trees > 5 m), or 19.2 to 41.8 cm (trees > 12.5 cm) (Figure 15). Stand characteristics were similar to the nest stands, C and D density stands with tall canopies (Average=24.4 m) were chosen (Figures 16 and 17). All stands contained trees greater than 35 cm DBH, a characteristic of older forests.

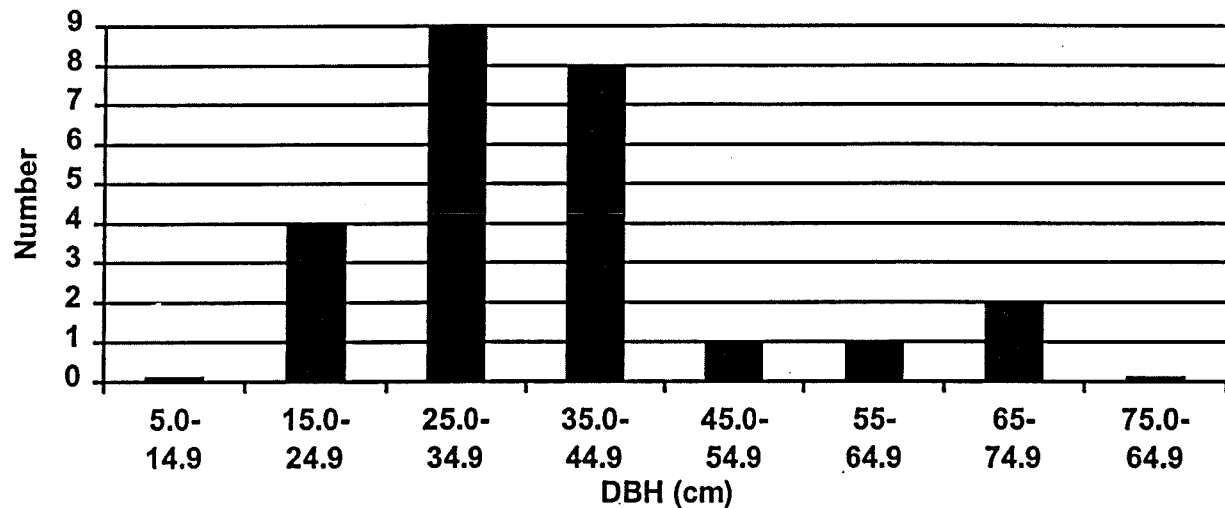


Figure 14: Diameters of the roost trees chosen by Barred Owls in the FMF (mean=35.7 cm).

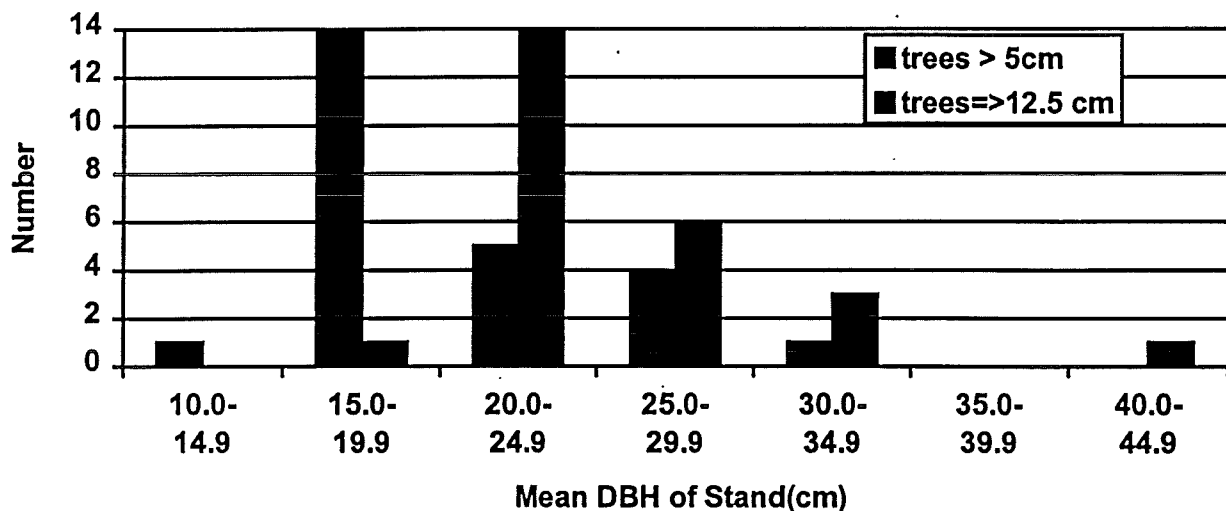


Figure 15: Mean diameter of trees in the roost stands, when all trees > 5 cm are measured, and when all trees > 12.5 cm are measured.

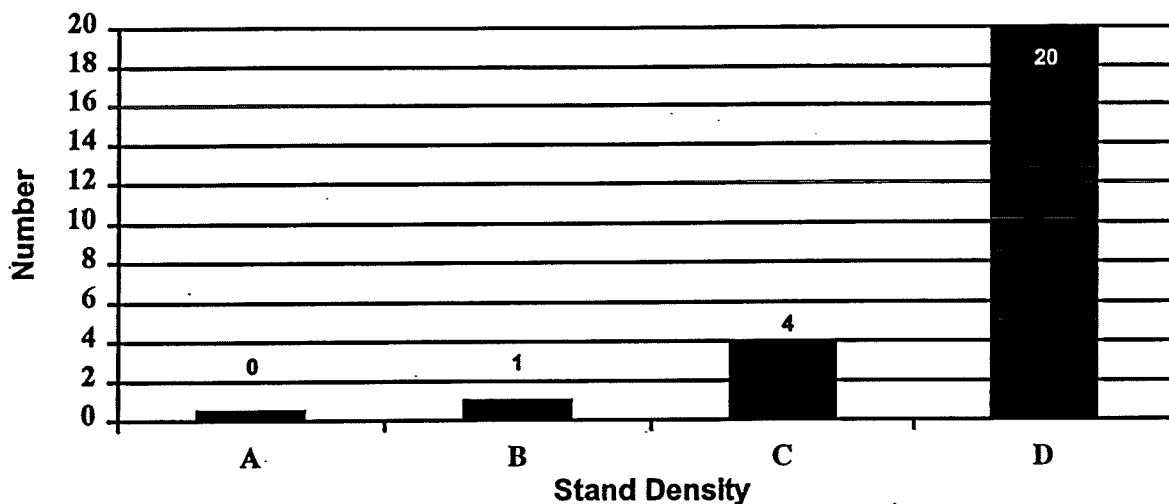


Figure 16: Stand density associated with roost sites. Density codes: A is 5-30%, B is 31-50 %, C is 51-70%, and D is 71-100% canopy closure.

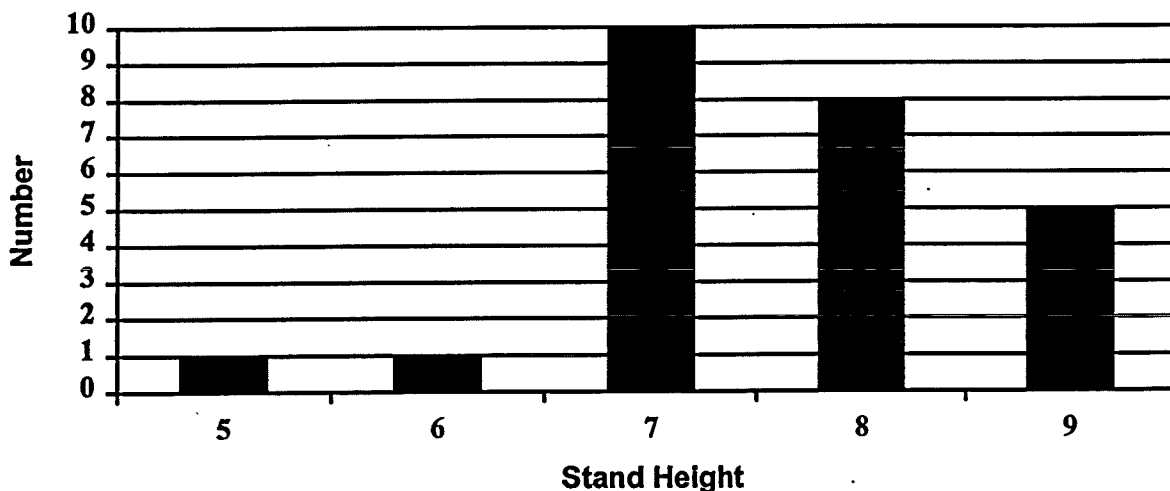


Figure 17: Stand tree heights associated with roost sites of Barred Owls. Height codes: 5 is 15.1 to 18.0 m, 6 is 18.1 to 21 m, 7 is 21.1 to 24 m, and 8 is 24.1 to 27 m.

### Prey

In the first year, no prey remains or pellets were found. The Barred Owls did not use specific trees for roosting, so it was difficult to find any sign of prey use. During the winter/spring four foraging observations were made on the radiotagged female Barred Owl (Takats 1996). One more was made in September, 1996. This resulted in five prey selections being determined: two Microtines, one Red Squirrel (*Tamiasciurus hudsonicus*), one Red-backed Vole (*Clethrionomys gapperi*), and one Ruffed Grouse (*Bonasa umbellus*). Five prey transfers were observed, one at the Miette nest and the others at the

Solomon Creek nest. These included three Microtines, one Deer Mouse (*Peromyscus maniculatus*), and one Ruffed Grouse.

All other prey were determined through pellet and prey remains analysis. Thirty-eight pellets and seven prey remains were collected and analyzed. Other species identified in the Barred Owls diet are: Long-tailed Voles (*Microtus longicaudus*), Meadow Voles (*Microtus pennsylvanicus*), Shrews (*Sorex spp.*), Bushy-tailed Woodrat (*Neotoma cinerea*), Red Squirrels, Northern Flying Squirrels (*Glaucomys sabrinus*), Weasel (*Mustella spp.*), Northern Flickers (*Colaptes auratus*), Gray Jay (*Perisoreus canadensis*), Varied Thrushes (*Ixoreus naevius*), American Robin (*Turdus migratorius*), Dark-eyed Junco (*Junco hyemalis*), White-throated Sparrow (*Zonotrichia albicollis*), Common Yellowthroat (*Geothlytis trichis*), Wood Frogs (*Rana sylvatica*), and Beetle elytra (Coleoptera) (Table 10).

Table 10: Prey taken by Barred Owls in the Foothills Model Forest.

<b>Birds</b>	<b>Number</b>	<b>Mammals</b>	<b>Number</b>
Ruffed Grouse	5	Shrew spp.	3
Northern Flicker	2	Deer Mouse	5
Gray Jay	1	Southern Red-backed Vole	8
Varied Thrush	6	Meadow Vole	6
American Robin	1	Long-tailed Vole	8
Common Yellowthroat	1	Microtine	6
White-throated Sparrow	1	Bushy-tailed Woodrat	1
Dark-eyed Junco	1	Red Squirrel	5
Unknown Birds	5	Northern Flying Squirrel	4
<b>Invertebrates</b>		Weasel spp.	1
Beetle	5	<b>Amphibians</b>	
Snail	1	Wood Frogs	16

The Barred Owls diet consisted of: 47 small mammals (51.1%), 23 birds (25.0%), 16 amphibians (17.4%), 6 invertebrates (6.5%). Over half of the diet is made up of small mammals. Microtines make up over 36% of the diet.

A total of seventeen different species were recorded during the snow track surveys (Table 11). Only ten of these species could be potential prey for the Barred Owl, and therefore are the only ones analyzed for abundance in different habitats. The Red Squirrel, Ruffed Grouse, and Snowshoe Hare were the most abundant species recorded on the snow track counts. Microtines were recorded few times. The Ruffed Grouse was found associated with deciduous stands, whereas the Red Squirrel was associated with conifer stands. The Snowshoe Hare had the highest abundance in Black Spruce stands. Species not used by Barred Owls as prey, but were recorded on the transects include: Fisher (*Martes pennanti*), Marten (*Martes americana*), Coyote (*Canis latrans*), Wolf (*Canis lupus*), Moose (*Alces alces*) and Deer (*Odocoileus sp.*).

Sixty-three species of birds and Red Squirrels were recorded on the point counts (Appendix E). The most abundant species included Black-capped Chickadees, Ravens, Gray Jays, Swainson's Thrushes, Least Flycatchers, Myrtle Warblers, Orange-crowned Warblers, Ovenbirds, Ruby-crowned Kinglets, White-throated Sparrows, Chipping Sparrows, and Red Squirrels.

Table 11: Snow track survey results showing relative abundance of each species detected in each habitat.  
(X=none, L=low, M=medium, H=high)

Species	Scientific Name	1Habitat												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Blue														
Ruffed Grouse	<i>Bonasa umbellus</i>	L	M	X	L	L	X	L	L	X	X			
Yellow														
Shrew	<i>Sorex sp.</i>	X	X	X	X	X	X	X						
Deer mouse	<i>Peromyscus maniculatus</i>	X	L	L	X	X	L	L	M	X	X	X	X	X
Jumping mouse	<i>Zapus sp.</i>	L	X	X	X	L	X	X	X	X	X	X	X	X
Vole		L	X	X	X	L	L	M	L	X	X	X	X	X
Red Squirrel	<i>Tamiasciurus hudsonicus</i>	H	L	X	L	H	L	H	H	L	L	X	M	H
Snowshoe Hare	<i>Lepus americanus</i>	L	L	L	L	H	X	H	M	X	X	M	X	L
Least Weasel	<i>Mustela nivalis</i>	X	X	X	X	X	X	X	X	X	X	X	L	X
Long-tailed Weasel	<i>Mustela frenata</i>	X	X	X	X	X	X	X	X	X	X	X	L	L
Ermine	<i>Mustella erminea</i>	X	X	X	L	L	X	L	X	L	X	X	X	X
1Habitat														
Species	Scientific Name	14	15	16	17	18	19	20	21	22	23	24		
Blue														
Ruffed Grouse	<i>Bonasa umbellus</i>	X	L	X	X	L	X	M	L	X	X	X		
Yellow														
Shrew	<i>Sorex sp.</i>	X	L	X	X	X	X	X	X	X	X	X		
Deer mouse	<i>Peromyscus maniculatus</i>	M	M	X	X	X	X	X	X	X	X	X		
Jumping mouse	<i>Zapus sp.</i>	X	M	X	X	X	X	X	X	X	X	X		
Vole	<i>Clethrionomys /Microtus</i>	X	L	X	X	X	X	X	X	X	X	X		
Red Squirrel	<i>Tamiasciurus hudsonicus</i>	L	M	M	L	L	L	X	L	L	L	L		
Snowshoe Hare	<i>Lepus americanus</i>	X	H	L	L	X	M	X	L	X	X	L		
Least Weasel	<i>Mustela nivalis</i>	X	X	X	X	X	X	X	X	X	X	X		
Long-tailed Weasel	<i>Mustela frenata</i>	X	X	X	X	X	X	X	X	X	X	X		
Ermine	<i>Mustella erminea</i>	X	L	L	X	X	X	X	X	X	X	X		

Habitats: 1=AwSw, 25 m; 2=PbSw, 25 m; 3=Pb, 25 m; 4=Aw, 23 m; 5=SwPl, 25 m; 6=SwFb, 20 m; 7=Sw, 18 m; 8=Sw, 25 m; 9=Sw/Aw, clearcut; 10=AwSw, 18 m; 11=PbAw, 25 m; 12=Pl, 25 m; 13=Pl, 18 m; 14=PlAw, 25 m; 15=Sb, 13 m; 16=SbPl, 18 m; 17=PlFb, 20 m; 18=SbAw, 18 m; 19=SwSb, 18 m; 20=AwPl, clearcut; 21=Sw, 10 m; 22=Pl, 7 m regen.; 23=Sw, 10 m; 24=cutlines



## Discussion

### Distribution and Abundance

The Barred Owls in the Foothills Model Forest show a clumped distribution (Figure 6). The habitat in the FMF is not uniform, and this shows that they are selecting for specific habitat types. Barred Owl densities are different throughout their range across North America. The density of 0.025 pairs/km<sup>2</sup> determined by this study falls close to the range of 0.03 to 1.0 pairs/km reported from across its breeding range (Craighead and Craighead 1969, Bosakowski *et al.* 1987, Stewart and Robbins 1958). The Barred Owl is not the most abundant owl in the FMF.

The Boreal Owl appears to have the highest abundance (Figure 4). A density of 0.17 owls/km<sup>2</sup> is high compared to a study in Manitoba where densities were estimated to be 0.061, 0.034 and 0.069 owls/km in 1991, 1992, and 1993 (Duncan and Duncan 1993).

### Habitat Use

The Barred Owls are selecting mixedwood stands of White Spruce, Balsam Poplar and Trembling Aspen (Appendix C). A range of habitats were surveyed during the broadcast transects, including Lodgepole Pine, White Spruce, Black Spruce, Aspen, Balsam Poplar, Douglas Fir, Engelmann Spruce, and mixedwood of these species as well as clearcuts. A variety of topographic areas were also surveyed including river valleys, lakes, streams, lower foothills, upper foothills, and montane ecoregions. Barred Owls were found in specific habitat types. Stands were old, had greater than 50 % canopy closure and had tree heights above 18 m. These habitats were in lower elevations, where large Balsam Poplar trees were present, little fragmentation had occurred, and White Spruce was present to provide cover.

Nests were in large diameter Balsam Poplar trees. Barred Owls used Aspen, White Spruce, and Balsam Poplar for roosting. Roost and nest stands were mixedwood (White Spruce and Aspen). This habitat selection is similar to habitat chosen by Barred Owls in Saskatchewan and northeastern Alberta. Barred Owls demonstrated a preference for mature mixedwood (James *et al.* 1995, K. Mazur, pers. comm., G. Court, pers. comm.).

Live trapping of Barred Owls had little success. Fuller and Christenson (1976) discuss a variety of techniques for capturing raptors. A variety of techniques need to be employed to be able to capture individuals. Barred Owls are difficult to capture because they are wary of humans. They are also subject to predation by other owls and hawks and will seldom fly into open areas. Mist netting was successful in capturing one owl. This technique will work for some individuals, but other methods need to be used to trap more wary individuals.

### Prey

The Barred Owls in the FMF are taking a wide variety of prey, and therefore appear to be a generalist feeder. A major portion of their diet consisted of small mammals and birds. According to the literature Barred Owls are prey generalists (Bent 1938). The Barred Owls appeared to be opportunistic in their foraging behavior on some occasions, taking food that was most available at certain times. In early May, a winter snowstorm dumped 78 cm of snow in two days. The Varied Thrush had already returned to the FMF. The birds had a difficult time with the snow and were seen in the open. The Barred Owls targeted this food source for only one week. The Wood Frogs were a similar case, being found in the pellets during three weeks in June. Snow track surveys were successful in determining relative abundance for Ruffed Grouse, Snowshoe Hares, and Red Squirrels. It was not successful for Microtine surveys. Microtines are subnivean animals, spending the majority of the winter under the snow pack. Therefore this survey technique is limited to certain species of animals.

## Research Recommendations

Management of forests must include wildlife concerns. The Barred Owl can serve as an indicator of older mixedwood forests and needs to be managed, if it is not to end up like the Spotted Owl. There is a lot of potential for future owl work in the Foothills Model Forest.

1. Barred Owls are long-lived species that rely on older forests for nesting, roosting, and foraging, and require healthy prey populations in order to survive. Long-term owl monitoring programs need to be set up to ensure baseline data is collected on distribution, abundance, and important areas, to ensure populations are maintained. Longer lived species can have natural population fluctuations that cannot be determined based on two years. By understanding the dynamics of the owl populations in the FMF they can be managed sustainably for the long-term.
2. Broadcast surveys are a good way to get information on the presence of owls and general habitat use information. A workshop was conducted on the use of broadcast surveys, at a conference on northern forest owls in Winnipeg. Use of playback increases response rate for some owls species. These surveys can be run by volunteers and/or researchers with little time spent. Using a standardized method is important to ensure results are comparable. Long Point Observatory has tested the feasibility of volunteer roadside surveys to monitor owls and found it to be successful (Francis and Bradstreet 1997).
3. Understanding the prey populations is also important. Habitat models do not include information on prey. Small mammal surveys need to be conducted in Barred Owl territories.
4. Radiotelemetry is a good way to get detailed information about the owls. Although this study was unsuccessful in trapping, there are other methods that may be used for trapping Barred Owls successfully.
5. Raptors are excellent indicators of ecosystem health (eg. Peregrine Falcon, Bald Eagle, Burrowing Owl, Spotted Owl). They are high on the food chain and can be affected by poor habitat management. Raptor surveys need to be continued to ensure the Foothills Model Forest continues to support healthy populations. Banding of all species of raptors caught will ensure a database is started.
6. More information needs to be collected on owls. Little is known about the reproductive success, productivity, percent of the population breeding, and density. I recommend setting up a 10 km<sup>2</sup> area for study. It is important to collect detailed information on the number owls, species, number nesting, number of young, and number fledging. Similar studies have been conducted in Finland (P. Saurola, pers. comm.).
7. Barred Owls used large diameter Balsam Poplar trees for nesting. Balsam Poplar is associated with wetter sites. Forestry has a difficult time regenerating these stands. Leaving these areas standing provides good Barred Owl habitat. Barred Owls require older forests for its life requisites. Forestry must ensure that enough old mixedwood forest remains to ensure healthy populations of Barred Owls are maintained.
8. Barred Owls are directly affected by forest fragmentation. Nest sites are lost and suitable roost and forage habitats are lost. As well, Great Horned Owl populations can move into fragmented areas and will prey upon Barred Owls (B. Olsen pers. comm.) and Great Gray Owls. Nest sites need to be protected with 100 m buffers. Disturbance should be minimized during the nesting season (March through July).

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**Appendix A: Roost/Forage/Nest tree information recorded on all vegetation surveys.**

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Observer	Who observed the owl at its nest/roost.forage tree
Date	The date the owl was observed
Time	The time the owl was observed
Temperature	The temperature when the owl was observed
Cloud Cover	The cloud cover (%) when the owl was observed
Wind	The wind (Beaufort scale) when the owl was observed
Precipitation	Any precipitation (snow/rain) when the owl was observed
Moon	Moon phase (if at night) when the owl was observed
Veg. survey by	Person(s) name
Date	Date veg. survey done
Location	Location name and sex of owl
Plot	1, 2, 3, etc. (if more than one roost/nest/forage site is found/individual)
Tree species	see Appendix B
Tree Type	"
DBH	"
Basal Area	calculated as $A=\pi r^2$ (diameter/2)
Lean	"
Condition	"
Damage	"
Cavities	number
Tree height	in meters using clinometer
Crown Base	in meters using clinometer
Crown Width	average of longest canopy branch and one perpendicular to it (meters)
Perch/Roost/Nest Height	in meters using clinometer
Direction/Exposure	in degrees
Distance from trunk	in centimeters
Crown Density	0-0, 1-low, 2-medium, 3-high, 4-very high
Nest type	1-stick, 2-cavity, 3-other
Nest materials	description
Nest size	depth, width, surface area
Flight corridor	Presence of a 2 meter opening that is 5 meters in length
Distance to clearing	Natural and/or artificial (in meters)
Sketch	Drawing of tree from side view, location in stand

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**Appendix B: Tree/Log characteristics recorded on vegetation surveys (0.04 ha area).**

Tree species	Aw	Trembling Aspen ( <i>Populus tremuloides</i> )	
	Pb	Balsam Poplar ( <i>Populus balsamifera</i> )	
	Sw	White Spruce ( <i>Picea glauca</i> )	
	Sb	Black Spruce ( <i>Picea mariana</i> )	
	Pl	Lodgepole Pine ( <i>Pinus contorta</i> )	
	Fb	Balsam Fir ( <i>Abies balsamea</i> )	
	Fd	Douglas fir ( <i>Pseudotsuga menziesii</i> )	
	Lt	Tamarack, larch ( <i>Larix laricina</i> )	
Type	t	tree	c cut stump
	n	snag (above 1.4 m)	s stub
	m	stump ( $\leq 1.4$ m)	
Distance from center	in meters		
DBH	diameter at breast height (cm), all trees down to 5 cm are measured		
% Lean	lean of tree, 100 % flat on ground, 0% straight		
Tree Condition	0	healthy	
	1	leaf/needle loss	
	2	dieback	
Sang/Stub/Stump Condition	1	Fresh/recently dead - leaves may still be attached	
	2	Hard, dead a short time - fine branches present	
	3	Hard, dead a few years - fine branches absent, bark crumbling	
	4	Hard, dead many years - branches few to none, stem softening	
	5	Soft - no branches, stem decomposing, bark mostly absent	
	6	Decomposed - no branches, stem punky/rotten, bark absent	
Damage	0	none	5 fungus
	1	insects	6 cracking
	2	falling/breakage	7 fire
	3	animal	8 competition
	4	other	
Animal Cavities	number, exposure, height		
Seedlings	number of live and dead trees less than 1.4 m in height		
Saplings	number of live and dead trees greater than 1.4 m in height but $< 5$ cm		
DBH			
Log length	total length (meters) of all logs with base DBH $> 5$ cm in the 0.04 ha plot		
Tip Diameter	diameter at the tip (cm)		
Base Diameter	diameter at the base (cm)		
Condition	1	fresh/green	4 Rotten/punky, bark breaks easily
	2	Hard, branches absent	5 Log becoming part of ground
	3	Soft, bark breaks off with effort	

**Appendix C: Stand characteristics associated with Barred Owl locations from broadcast surveys.**

No.	Owl Location	Date	Sex	Paired	Density	Height	% Tree Species
1	Solomon Creek	April 7, 1995	F	Y	C	8	80Pb10Aw10Sw
2	Solomon Creek	April 7, 1995	M	Y	B	8	60Pb20Aw20Sw
3	Solomon Creek	May 4, 1995	F	Y	B	7	70Pb20Aw10Sw
4	Solomon Creek	May 4, 1995	M	Y	C	7	70Aw20Aw10Pb
5	Solomon Creek	May 10, 1995	M	Y	D	7	80Sw20Aw
6	Solomon Creek	May 16, 1995	F	Y	C	7	70Sw30Aw
7	Solomon Creek	March 4, 1996	M	Y	C	7	60Sw20Pb20Aw
8	Solomon Creek	March 4, 1996	F	Y	C	7	60Sw20Pb20Aw
9	Blackcat Ranch	May 4, 1995	F	Y	D	7	80Sw20Pb
10	Blackcat Ranch	May 10, 1995	F	Y	D	7	80Sw20Pb
11	Blackcat Ranch	May 16, 1995	F	Y	C	7	80Sw20Pb
12	Blackcat Ranch	March 4, 1996	M	Y	C	7	70Sw30Aw
13	Blackcat Ranch	March 4, 1996	F	Y	C	7	80Sw20Pb
14	WildHay Ridge	March 26, 1995	F	Y	C	7	70Sw30Aw
15	WildHay Ridge	April 7, 1995	F	Y	C	7	60Aw40Sw
16	WildHay Ridge	April 7, 1995	M	Y	C	8	100Sw
17	WildHay Ridge	April 2, 1996	F	Y	C	7	60Aw30Sw10Pl
18	WildHay Ridge	April 2, 1996	M	Y	C	7	60Aw30Sw10Pl
19	Gregg Lake	March 17, 1995	M	N	C	7	60Aw30Sw10Sb
20	Gregg Lake	March 26, 1995	M	N	C	7	100Sw
21	Gregg Lake	April 7, 1995	M	N	C	7	100Sw
22	Gregg Lake	April 2, 1996	M	N	C	7	80Sw20Aw
23	Cold Creek	March 17, 1995	M	N	C	7	60Aw40Sw
24	Cold Creek	April 7, 1995	M	N	B	7	60Aw40Sw
25	Cold Creek	April 7, 1995	F	N	C	7	70Aw30Sw
26	Cold Creek	May 4, 1996	U	N	C	7	70Aw30Sw
27	Lynx Creek Pt. 5	May 13, 1995	U	U	C	7	70Sw30Aw
28	Lynx Creek	May 24, 1995	F	Y	C	8	60Sw40Pb
29	Lynx Creek Pt. 8	March 5, 1996	U	U	C	7	70Sw20Pl10Aw
30	Lynx Creek Pt. 5	April 20, 1996	U	U	C	6	70Sw2Pl10Aw
31	Medicine Lodge	April 11, 1995	U	U	C	7	60Sw20Pl20Aw
32	Prest Creek	April 10, 1995	U	N	C	7	80Sw20Aw
33	Prest Creek	May 3, 1995	M	N	C	7	80Sw20Aw
34	Gregg River	May 9, 1995	F	N	C	8	90Sw10Pb
35	Gregg River	April 25, 1996	F	N	C	8	90Sw10Pb
36	TriCreeks	March 18, 1995	M	U	C	8	90Sw10Aw
37	Cache Percotte	May 13, 1996	M	U	C	7	60Sw30Aw10Pl
38	Pedley	April 28, 1995	U	U	C	7	90Sw10Aw
39	Pedley	March 20, 1996	U	U	C	6	100Sw
40	WildHay North A	May 16, 1995	M	N	B	7	40Aw40Sw10Pb
41	WildHay North A	April 14, 1996	M	N	C	7	40Aw40Sw10Pb
42	WildHay North A	April 26, 1996	M	N	B	7	60Sw30Aw10Pb
43	WildHay North B	May 16, 1995	U	U	C	7	50Sw40Aw10Pl
44	Patricia Lake	April 22, 1996	M	N	C	6	90Pb10Pl
45	Miette	April 22, 1996	F	Y	C	8	60Sw30Aw10Pb

Density - B=31-50, C=51-70 D=71-100%; Height - 6=18.1-21 m, 7=21.1-24 m, 8=24.1-27 m;

Species - Aw=Trembling Aspen, Pb=Balsam Poplar, Sw=White Spruce, Sb=black spruce, Pl=Lodgepole Pine.

**Appendix D: List of all territorial Barred Owl locations recorded during the project.**

<b>No.</b>	<b>Location</b>	<b>*Sex</b>	<b>**Paired</b>
1	Solomon	F	Y
2	Solomon	M	Y
3	Blackcat	F	Y
4	Blackcat	M	Y
5	WildHay	F	Y
6	WildHay	M	Y
7	Gregg Lake	F	Y
8	Gregg Lake	M	Y
9	Jarvis Creek	M	N
10	Jarvis Lake	U	U
11	Miette	F	Y
12	Miette	M	Y
13	Lynx Creek	F	Y
14	Lynx Creek	M	Y
15	Cold Creek	M	N
16	Cold Creek	F	N
17	Pedley 1	M	U
18	Pedley 2	U	U
19	Karen's Owl	F	N
20	TriCreeks	M	U
21	Gregg River	F	U
22	Prest Creek	M	N
23	Marke's Owl	U	U
24	Emerson Lake	F	U
25	Brian's Owl	U	U
26	Sheila's Owl	U	U
27	Lynx/Emerson	M	U
28	Lynx (pt. 5)	U	U
29	Medicine Lodge	U	U
30	Cache Percotte	M	N
31	WildHay Nth A	M	N
32	WildHay Nth B	U	U
33	Camp Owl	M	N
34	Patricia Lake	M	N
35	Cottonwood	U	N
36	Mina Owl	M	U
37	Kinky Lake	U	U
38	Willow Creek	U	U
39	Kirby's Owl	U	U
40	Jody's Owl	U	U
41	Polecat	U	U
42	Carl's Owl	U	U

\*M-male, F-female

\*\*Y=yes, N=no, U-unknown

**Appendix E: List of birds recorded during point counts in 1996.**

Number	Species	Scientific Name	CODE
1	Creeper, brown	<i>Certhia americana</i>	BRCR
2	Crow, American	<i>Corvus brachyrhynchos</i>	AMCR
3	Chickadee, black-capped	<i>Parus atricapillus</i>	BCCH
4	Chickadee, boreal	<i>Parus hudsonicus</i>	BOCH
5	Finch, purple	<i>Carpodacus purpureus</i>	PUFI
6	Flicker, Northern	<i>Colaptes auratus</i>	NOFL/COFL
7	Flycatcher, alder	<i>Empidonax alnorum</i>	ALFL
8	Flycatcher, least	<i>Empidonax minimus</i>	LEFL
9	Grosbeak, rose-breasted	<i>Pheucticus ludovicianus</i>	RBGR
10	Grouse, ruffed	<i>Bonassa umbellus</i>	RUGR
11	Grouse, spruce	<i>Dendragapus canadensis</i>	SPGR
12	Hawk, Cooper's	<i>Accipiter cooperii</i>	COHA
13	Hawk, red-tailed	<i>Buteo jamaicensis</i>	RTHA
14	Jay, Gray	<i>Perisoreus canadensis</i>	GRJA
15	Junco, dark-eyed	<i>Junco hyemalis</i>	DEJU
16	Kinglet spp.	<i>Regulus spp.</i>	Kinglet
17	Kinglet, golden-crowned	<i>Regulus satrapa</i>	GCKI
18	Kinglet, ruby-crowned	<i>Regulus calendula</i>	RCKI
19	Loon, common	<i>Gavia immer</i>	COLO
20	Mallard	<i>Anas platyrhynchos</i>	MALL
21	Nuthatch, red-breasted	<i>Sitta canadensis</i>	RBNU
22	Ovenbird	<i>Seiurus aurocapillus</i>	OVEN
23	Owl, Barred	<i>Strix varia</i>	BAOW
24	Raven, common	<i>Corvus corax</i>	CORA
25	Redstart, American	<i>Setophaga ruticilla</i>	AMRE/REDS
26	Robin, American	<i>Turdus migratorius</i>	AMRO
27	Sapsucker, yellow-bellied	<i>Sphyrapicus varius</i>	YBSA
28	Siskin, pine	<i>Carduelis pinus</i>	PISI
29	Snipe, common	<i>Gallinago gallinago</i>	COSN
30	Solitaire, Townsend's	<i>Myadestes townsendii</i>	TOSO
31	Sparrow, chipping	<i>Spizella passerina</i>	CHSP
32	Sparrow, clay-colored	<i>Spizella pallida</i>	CCSP
33	Sparrow, Lincoln's	<i>Melospiza lincolnii</i>	LISP
34	Sparrow, white-crowned	<i>Zonotrichia leucophrys</i>	WCSP
35	Sparrow, White-throated	<i>Zonotrichia albicollis</i>	WTSP
36	Squirrel, red	<i>Tamiasciurus hudsonicus</i>	RESQ
37	Swallow, barn	<i>Hirundo rustica</i>	BASW

Appendix E continued

38	Tanager, western	<i>Piranga ludoviciana</i>	WETA
39	Thrush, hermit	<i>Catharus guttatus</i>	HETH
40	Thrush, Swainson's	<i>Catharus ustulatus</i>	SWTH
41	Thrush, varied	<i>Ixoreus naevius</i>	VATH
42	Warbler, bay-breasted	<i>Dendroica castanea</i>	BBWA
43	Warbler, black-throated green	<i>Dendroica virens</i>	BTGW
44	Warbler, Myrtle	<i>Dendroica coronata</i>	MYWAYRWA
45	Warbler, orange-crowned	<i>Vermivora celata</i>	OCWA
46	Warbler, Tennessee	<i>Vermivora peregrina</i>	TEWA
47	Warbler, yellow	<i>Dendroica petechia</i>	YEWA
48	Woodpecker spp.	Picidae	PICO
49	Woodpecker, pileated	<i>Dryocopus pileatus</i>	PIWO
50	Woodpecker, three-toed	<i>Picoides tridactylus</i>	TTWO
51	Wren, winter	<i>Troglodytes troglodytes</i>	WIWR
52	Vireo, red-eyed	<i>Vireo olivaceus</i>	REVI
53	Vireo, solitary	<i>Vireo solitarius</i>	SOVI
54	Vireo, warbling	<i>Vireo gilvus</i>	WAVI
55	White-winged Crossbill	<i>Loxia leucoptera</i>	WWCR
56	Western wood-peewee	<i>Contopus sordidulus</i>	WWPE
57	Killdeer	<i>Charadrius vociferus</i>	KILL
58	Bufflehead	<i>Bucephala albeola</i>	BUFF
59	Brown-headed cowbird	<i>Quiscalus quiscula</i>	BHCO
60	Waterthrush, northern	<i>Seiurus noveboracensis</i>	NOWA
61	Woodpecker, hairy	<i>Picoides villosus</i>	HAWO
62	Waxwing, Bohemian	<i>Bombycilla garrulus</i>	BOWA
63	Chickadee, mountain	<i>Parus gambeli</i>	MOCH

## Appendix F - Habitat Suitability Index Model for the Barred Owl

This section has been copied in a similar format to the draft habitat model for the Barred Owl (Olsen *et al.* 1996), and has been modified based on data collected on a Barred Owl study conducted by Lisa Takats. New graphs, of data collected during the project, have been created. Suggestions of changes are made at the end of this document.

### 2.1 MODEL APPLICABILITY

**Geographic area:** This model is applicable to the Foothills Model Forest in west-central Alberta.

**Season:** This model has been developed to evaluate reproductive habitat quality (nesting and roosting habitat) for the Barred Owl throughout the year.

**Cover types:** This model applies to all stands of the Boreal Foothills, Boreal Uplands, Montane and Subalpine ecoregions (Strong and Leggat 1981).

**Minimum Habitat Area:** Minimum habitat area is defined as the minimum amount of contiguous habitat required before an area can be occupied by a species (Allen 1987). Manitoba Forestry/Wildlife Management (1994) estimated 500 ha, based on unpublished data from Saskatchewan and northwestern Ontario. Based on home range data collected from nesting pairs in the Foothills Model Forest, the minimum habitat area occupied by a pair is 300 ha.

**Model Output:** The model will produce habitat units (HU) of reproductive habitat for each stand or forest type based on HSI value and polygon area. The performance measure for the model is potential carrying capacity (number of breeding pairs per ha). Model output (HU) must be correlated to estimates of carrying capacity.

**Carrying Capacity (Breeding Pairs per ha where HSI = 1.0):** Based on Elody (1983) from Michigan, the maximum number of Barred Owl pairs per perfect hectare was estimated to be 0.004 pairs/ha (based on 0.36 pairs km<sup>-2</sup>). The density of Barred Owls in the Foothills Model Forest was determined to be 0.05 owls km<sup>-2</sup>. This is low because of the amount of unsuitable habitat in the FMF. The maximum number of Barred Owls per perfect hectare was determined by the average breeding season home range size for a pair (300 ha) which translates to 0.003 pairs/ha.

**Verification Level:** The draft model was developed as part of a special study course on Habitat Modelling at the University of Alberta based on data from literature and local observation (pers. obs.). The model is evaluated below using information collected over two field seasons to evaluate habitat use.

**Disclaimer:** This model is designed to assess habitat suitability at the landscape scale for a large geographic area (>1 million ha) using general species relationships with stand-level inventory. Its purpose is to predict changes in the supply of habitat and potential carrying capacity at the landscape level over long time periods (100 - 300 y), for integration with forest management planning. It is not intended for application at the stand level, and it is not intended to provide population density estimates. Any attempt to use the model in a different geographic area or for other than the intended purpose should be accompanied by model testing procedures, verification analysis, and other modifications to meet specific objectives.

### 2.2 MODEL DESCRIPTION

This model is based on the assumption that reproductive habitat, which includes nesting and roosting, is the most limiting characteristic of year-round Barred Owl distribution. It is assumed that in a forested area adequate foraging sites will be available. Stands of mature trees with large diameters for nesting sites and suitable canopy closure are essential reproductive habitat components for the Barred Owl. According to

the Barred Owls prefer mature stands with little or no understory vegetation to facilitate hunting. This model assumes that the presence of large diameter trees increases the potential for suitable nesting sites and is therefore more representative of high quality reproductive habitat than the density of understory vegetation. Availability and distribution of water is not assumed to be a limiting component of Barred Owl habitat in Alberta and has not been addressed in this model.

This model will produce index values that are proportional to the forest stands ability to provide suitable reproductive habitat for the Barred Owl. An HSI value of 1.0 is assumed to represent the highest quality reproductive habitat. A forest stand with an HSI value of 0.0 is assumed to represent unsuitable reproductive habitat for the Barred Owl.

### **2.2.1 Habitat Variables and HSI Components**

The relationship of habitat variables to nest tree and nesting cover HSI components which are required to allow year-round distribution of the Barred Owl are given in Table 1. Each variable used to predict the HSI components are then defined.

#### **2.2.1.a Nest Tree**

This model evaluates potential nesting habitat for Barred Owls based on the characteristics of trees which must be present in order to build a nest or utilize an existing cavity. Barred Owl nests in the FMF were found exclusively in Balsam Poplar (*Populus balsamifera*) trees with high DBH (> 60 cm). The main habitat variable used to characterize this attribute is the number of Balsam Poplar trees > 60 cm which is used to determine HSI components S<sub>2</sub>. There is still the potential that the Barred Owl will use deciduous tree stubs or cavities in large Aspen trees, therefore nest trees greater than 35 cm in diameter is component S<sub>5</sub>. Because the nesting habitat with smaller deciduous trees is not as good as that with the large Balsam Poplar (> 60 cm DBH) trees, component S<sub>5</sub> is multiplied by 0.5. Stick nests may also be used, but are not selected for.

#### **2.2.1.b Nesting Cover**

Owls prefer to nest in mature or old growth forest stands where forest development has resulted in tall canopy trees with large diameters, numerous dead or dying trees with cavities and tree tops suitable for nest construction, especially since these forests have had more time to withstand climatically related damage or insect and fungal infections (Spurr and Barnes 1980).

The area around Barred Owl nests are associated with certain cover characteristics which determine suitability of the habitat for year round use. These variables are mean tree DBH, tree canopy closure, and spruce + fir composition in the canopy. The tree DBH component (S<sub>1</sub>) ensures that the stand has developed to a mature state, and that trees are large enough to provide sufficient cover, the tree canopy closure component (S<sub>3</sub>) ensures that the stand has enough shelter in the overhead horizontal plane, and percent White Spruce and/or fir component (S<sub>4</sub>) ensures that there are a sufficient numbers of conifer branches in the vertical plane for shelter and concealment.

#### **2.2.1c Spatial Components of Nesting Habitat**

Barred Owls are adversely affected by human disturbance, defined as roads and trails with motorized access (including railroads), camps, industrial activity, and human settlements. The distance to human disturbance areas is used to predict HSI component S<sub>6</sub>. Barred Owls also typically avoid clearings or other open areas as well as the mature forest edge within the first few hundred metres, so this distance is used to predict HSI component S<sub>7</sub>.

**Table 1.** Relationship of habitat variables to life requisites for the Barred Owl year-round range HSI model. Life requisites are either nesting or cover since food is not assumed to be limiting. Each variable is defined<sup>1</sup> and units are given.

HSI Component	Predictive Variable	Habitat Requisite	Definition
S <sub>1</sub>	Mean DBH of Stand (cm)	Cover	Mean diameter of all dominant and codominant canopy trees at 1.4 m height ( $\geq 12.5$ cm DBH)
S <sub>2</sub>	Balsam Poplar Trees $\geq 60$ cm dbh/ha	Nesting	Number of Balsam Poplar trees with a minimum diameter of 60 cm at 1.4 m height.
S <sub>3</sub>	% Canopy Closure	Cover	Projected horizontal coverage of canopy trees in relation to the total stand area.
S <sub>4</sub>	% White Spruce and/or Fir	Cover	Sum of the percent composition of all spruce and fir trees as determined from proportion of total tree volumes.
S <sub>5</sub>	Deciduous Trees $\geq 35$ cm dbh/ha	Nesting	Number of deciduous trees with a minimum diameter of 35 cm at 1.4 m height.
S <sub>6</sub>	Distance From Human Disturbance (m)	Cover	Human disturbance is defined as roads and trails with motor vehicle access, train tracks, industrial sites, active well sites, and settlement areas.
S <sub>7</sub>	Distance From Opening (m)	Cover	Openings are defined as all areas with less than 'A' class crown closure ( $< 6\%$ ). This also includes regenerating clearcuts which do not yet have canopy tree development

### 2.2.2 Graphical HSI Component Relationships

- S<sub>1</sub> The state of the forest development is thought to be optimum for Barred Owls at 25 cm or higher. Thus, S<sub>1</sub> is 0 unless the trees are larger than 15 cm in diameter and becomes 1 when the trees are  $> 25$  cm in diameter (Figure 2a).
- S<sub>2</sub> The main nesting is thought to occur in stands with 10 or more trees of the appropriate size. This may allow more choice in nesting site locations. Stands with no Balsam Poplar trees over 60 cm receive a 0 value for component S<sub>2</sub>, but this increases linearly to the value 1 at 5 or more large Balsam Poplar trees (Figure 2b).
- S<sub>3</sub> Optimum cover occurs in the higher density tree stands (C - D crown closures). Tree canopy closure must be more than 30 percent to have a positive value of S<sub>3</sub> and S<sub>3</sub> equals 1 when canopy closure is  $> 50\%$  (Figure 2c). When canopy closure becomes too high ( $> 80\%$ ) the value declines to 0 at 90%.
- S<sub>4</sub> Optimal vertical coverage by conifer branches occurs at 25 % or more spruce and fir trees. The spruce and fir component has a value of 0 unless there is at least 5 percent spruce and fir in the stand and becomes 1 when spruce and fir comprise at least 25 percent of the canopy (Figure 2d).

<sup>1</sup> Non-spatial variable definitions based on Bessie, W.C. 1995. The development of habitat structure yield curves for use in wildlife habitat supply analyses in the Foothills Model Forest, Unpublished Draft Report.



- S5 This component has a value of 0, until 10 deciduous trees  $\geq 35$  cm dbh are found, to allow for the possibility of Barred Owls nesting in Aspen trees or smaller Balsam Poplar trees. The component then increases to 1.0 at 25 trees (Figure 2e).
- S6 Only habitat more than 100 m from human disturbance has the potential to be perfect nesting habitat, as defined in component S<sub>6</sub> (Figure 2f).
- S7 To account for open area effects, the spatial variable S<sub>8</sub> was set so that it was equal to 0 within any open area (an area with less than 6 % tree canopy closure) and was set so that the value increased to the value 1 over the range 0 to 100 m metres from the forest edge (Figure 2g).

### 2.3 MODEL ASSUMPTIONS

1. The availability of reproductive habitat is the most limiting factor in year-round Barred Owl distribution. If the nesting and roosting habitat is available in a forested area adequate foraging habitat will be available. Water is not assumed to be limiting.
2. Reproductive habitat quality increases as forest stands develop structurally to have larger trees, more dying or dead trees, and more likelihood of trees with broken tops or large branches for nest locations.
3. Mean DBH is indicative of stand age and maturity and is therefore representative of potential nesting habitat quality.
4. Balsam Poplar (*Populus balsamifera*) are most likely to contain suitable nesting sites for the Barred Owl because they are prone to break up and disease as they mature. The density of large Balsam Poplar trees  $\geq 60$  cm DBH in a particular stand is representative of reproductive habitat quality. Barred Owls may nest in stick nests built by other raptor, in stubs, or in Aspen cavities therefore deciduous trees  $\geq s$ . Most stick nests located in the FMF are found in deciduous trees, therefore conifers are not considered important for nest tree choice.
5. Barred Owl reproductive habitat quality is dependent on the roosting requirements of that species. The percent spruce and fir in the overstory and the canopy closure of the stand are the most significant factors that determine roosting habitat. Barred Owls prefer C and D density stands where the overstory canopy cover is  $\geq 50\%$ .
6. Snags are not used for nesting in this model, but could potentially be used.

### 2.4 EQUATIONS

The calculation of an HSI for the Barred Owl considers only the life requisite of reproductive habitat (nesting and roosting habitats). It is assumed to provide for adequate year round habitat. As stated previously, the main nest tree components (S<sub>1</sub> x S<sub>2</sub>) can be partially compensated for low values when there are deciduous trees over 35 cm DBH. The value of this compensation is reduced by weighting it at 0.5, and once a suitable density of deciduous trees over 35 cm DBH are present the trees smaller than that are not used. The remaining variables are all regarded to be equal in value, non-compensatory for each other and completely interactive such that if any one component yields a 0 value, the HSI also has a 0 value. For example, even if seemingly perfect habitat exists adjacent to a road or clearing, it will compute to HSI = 0.

$$HSI = \text{MAX}[S_1 \times S_2, 0.5 \times S_5 \times S_1] \times S_3 \times S_4 \times S_6 \times S_7$$

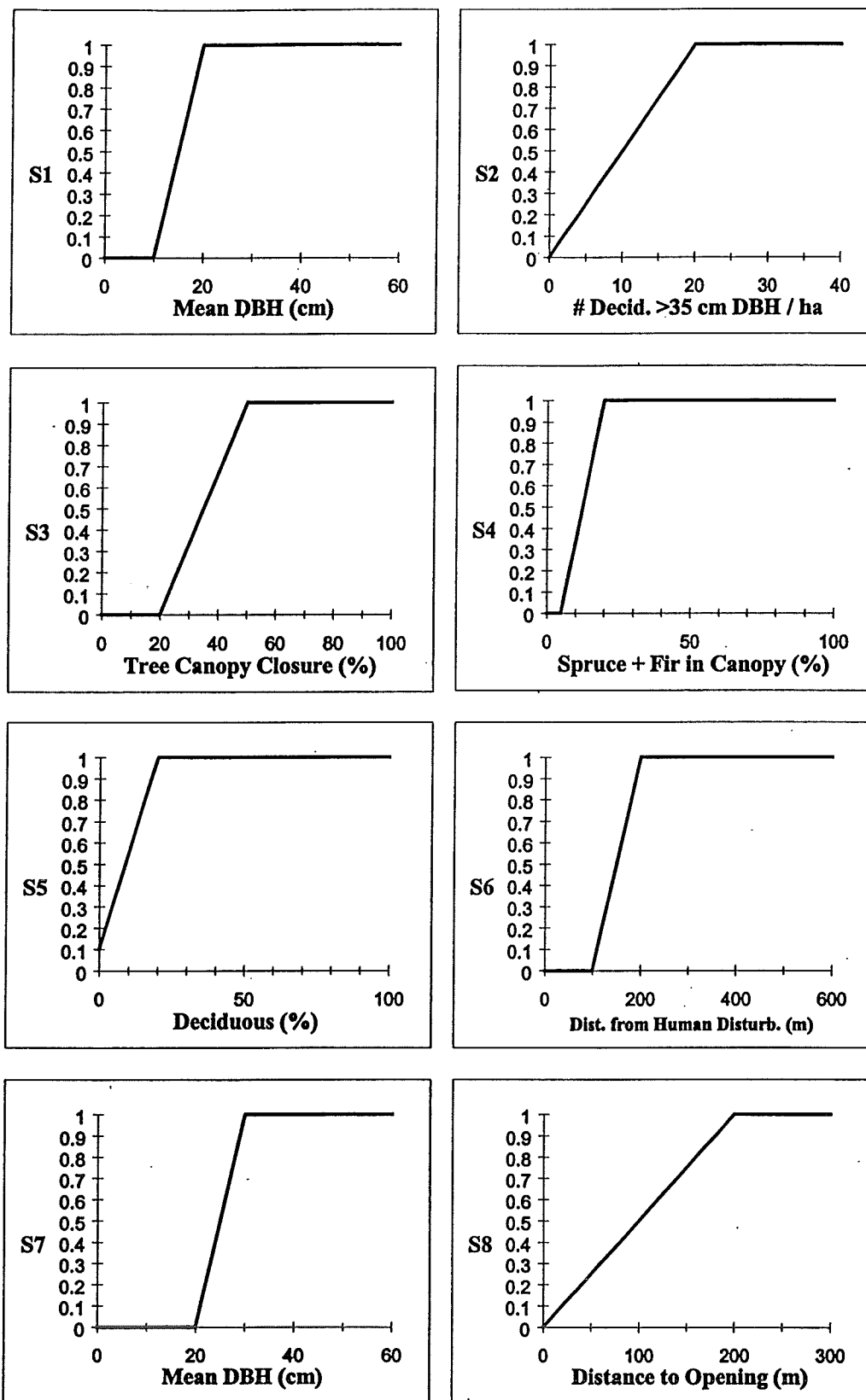


Figure 1. Relationships between habitat and spatial variables and components 1 through 8 (S1 - S8) of the draft Barred Owl Habitat Suitability Index,  $HIS = \text{MAX}[S1 \times S2, 0.3 \times S7 \times S5] \times S3 \times S4 \times S6 \times S8$

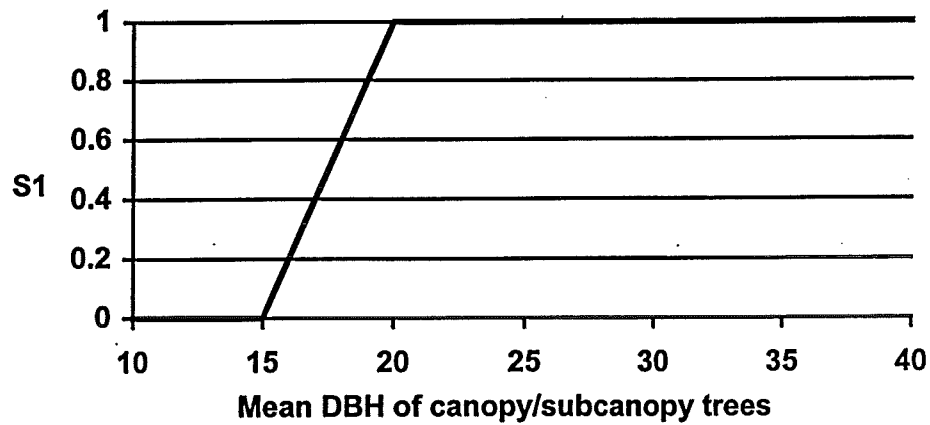


Figure 2(a): S1 variable of mean DBH of canopy/subcanopy trees in stand (trees  $\geq 12.5$  cm DBH).

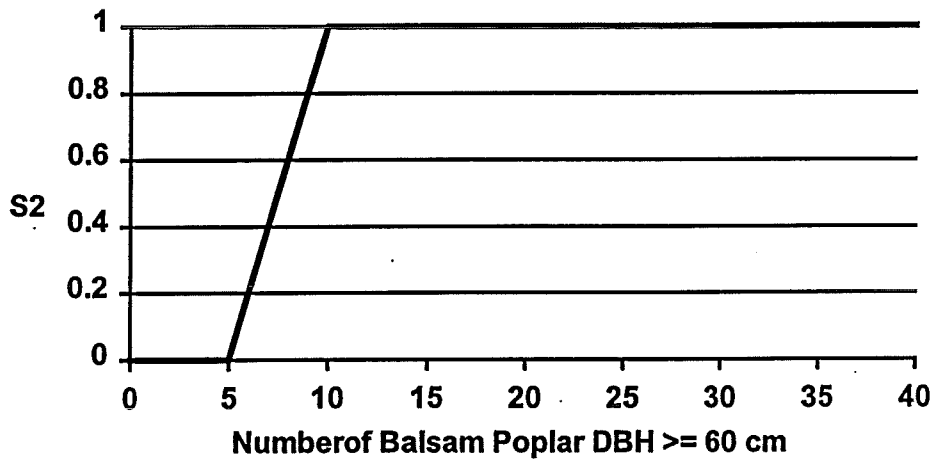


Figure 2(b): S2 variable - number of Balsam Poplar trees with DBH  $\geq 60$  cm.

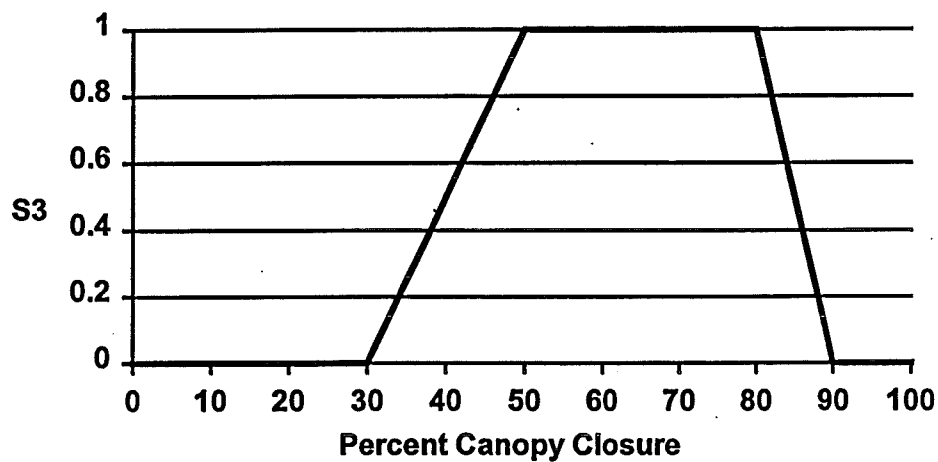


Figure 2(c): S3 variable - percent canopy closure of the stand.

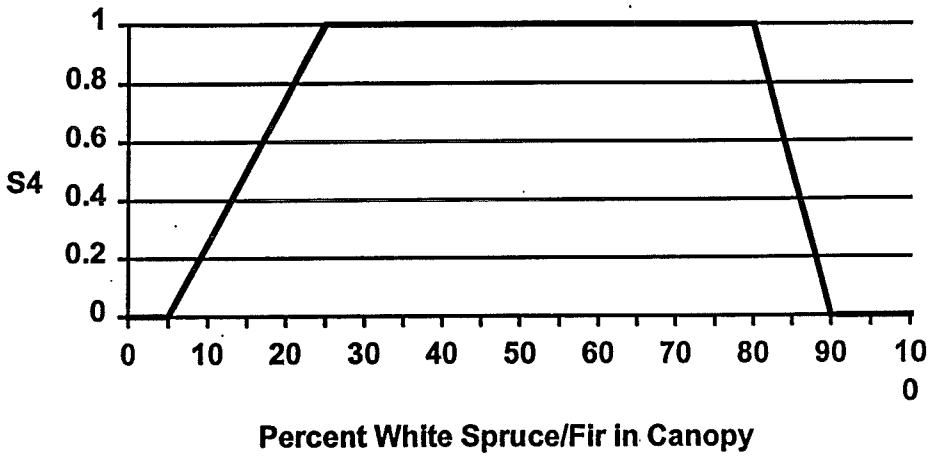


Figure 2(d): S4 variable - percent White Spruce and/or fir in the canopy.

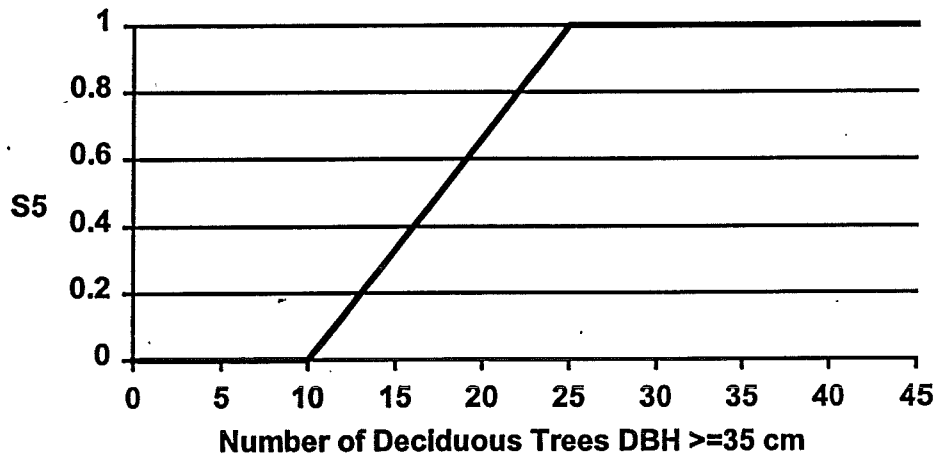


Figure 2(e): S5 variable - number of deciduous trees with diameter  $\geq 35$  cm.

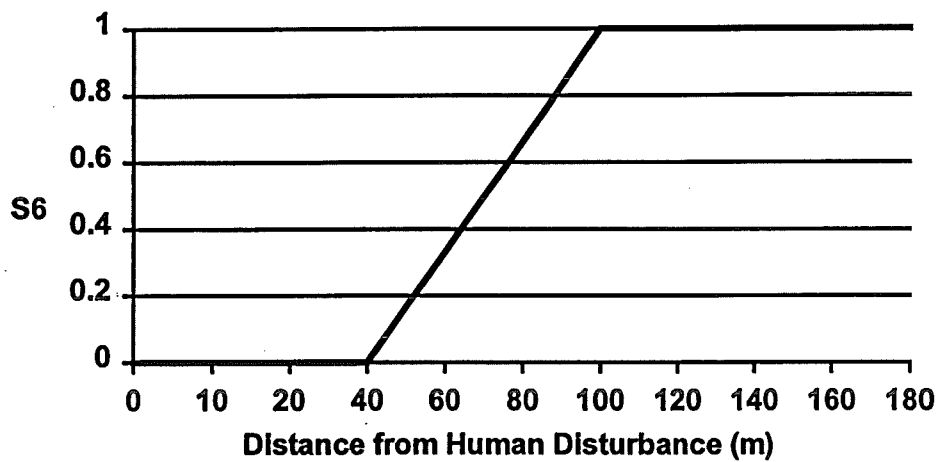


Figure 2(f): S6 variable - distance from human disturbance (m).

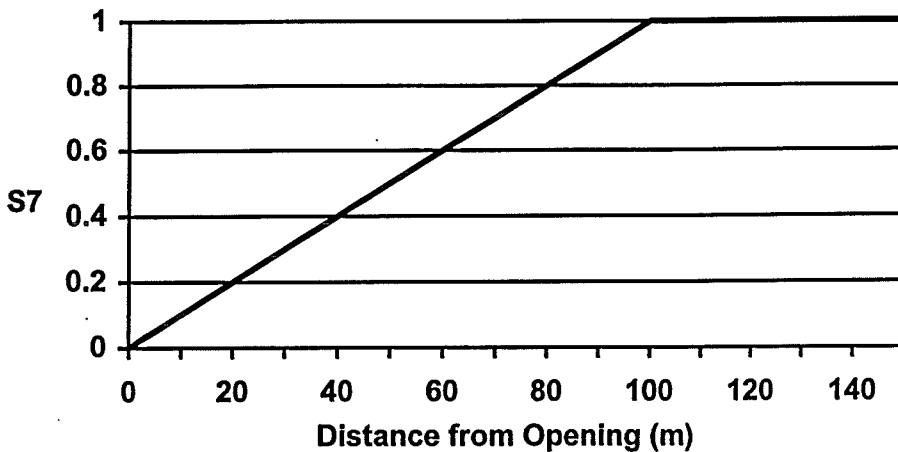


Figure 2(g): S7 variable - distance from opening (m).

### CHANGES

1. S1 remains unchanged.
2. S2 becomes Balsam Poplar trees  $\geq 60$  cm.
3. S3 has an HSI value of 0 until a canopy closure of above 30 is reached (B density).
4. The HSI value for S4 does not become 1 until 25 % spruce/fir is found in the canopy, and begins dropping in value after 80 % is reached. HSI is 0 at 90% spruce/fir in canopy..
5. S5 changes to number of deciduous trees  $\geq 35$  cm DBH. These trees may be used for nesting as well, but will be multiplied by 0.5 because they are not as good as a larger balsam poplar tree.
6. Distance from human disturbance has been reduced based on nests found near a highway. This pair of owls has been in the same area for year, and probably adapted over time to the increasing disturbance. For owls that have never been disturbed before, the effects of human disturbance may be drastic.
7. Distance from opening .

These recommendations for changes are based on only six nests, 25 roost sites, and general habitat information of 42 territorial owls. As more information is learned about Barred Owls, these may have to be modified again. Habitat models can be used as a single step to habitat management, but continued surveys need to be conducted to ensure that Barred Owls and other species are being maintained.