University of Alberta

Barred Owl Habitat Use and Distribution in the Foothills Model Forest

by

Danielle Lisa Takats

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Science

in

Wildlife Ecology and Management

Department of Renewable Resources

Edmonton, Alberta

Spring, 1998

University of Alberta

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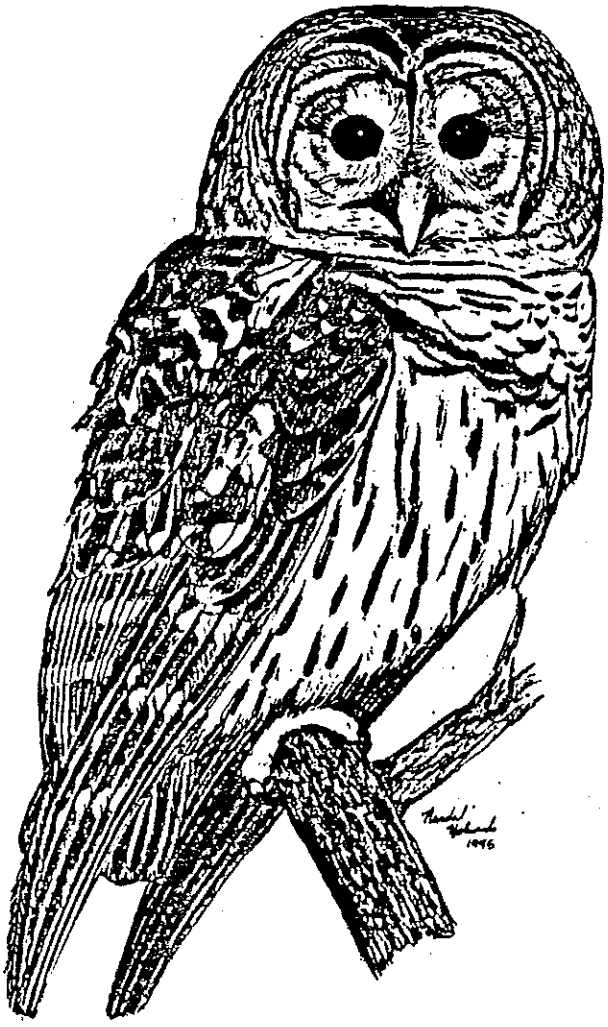

I'm afraid to speak or move

for fear that all this wonderful beauty

will just vanish like a broken silence.

words of Anne of Green Gables (L.M. Montgomery)

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled **Barred Owl Habitat Use and Distribution in the Foothills Model Forest** submitted by **Danielle Lisa Takats** in partial fulfillment of the requirements for the degree of Master of Science, in Wildlife Ecology and Management.

Geoffrey L. Holroyd (Co-Supervisor)

James A. Beck, Jr. (Co-Supervisor)

Peter Kershaw

Victor Lieffers

December 17 19 97

Dedicated To

My Father, Josef Takats,

My Mother, Margaret Rose Takats

and My Kindred Spirits.

Thank you for your love and support.

Abstract

A two-year ecological study (1995 through 1996) 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 investigate Barred Owl nesting, roosting, and foraging habitat use. Broadcast surveys were used to determine the presence and relative abundance of nocturnal owls. Data was collected in March, April, and May. 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 owl 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, low temperatures, and strong wind, fewer owls called spontaneously or responded to the playback calls. Owls responded significantly more during the two minute silent listening period beginning each 15 minute survey period than in subsequent listening periods after playback. Broadcast surveys, telemetry, and casual observations were used to record information on 42 territorial Barred Owls. Barred Owl density was determined to be 0.05 owls/km^2 and 0.04 owls/km^2 in 1995 and 1996 respectively. Six pairs of owls were investigated for nesting. They were found to nest in natural cavities of large diameter (mean dbh=74.0 cm) balsam poplar trees (*Populus balsamifera*). Barred Owls were found to use old mixedwood uneven-aged stands of white spruce (*Picea glauca*), trembling aspen (*Populus tremuloides*), and balsam poplar for nesting, roosting, and foraging. The Barred Owl is a generalist predator over its Foothills Model Forest range, and feeds on a variety of small mammal, bird, amphibian, and insect species. Some individuals were found to specialize on birds or microtines. They will opportunistically feed on certain species of prey when they are abundant. The Barred Owl can serve as a good indicator of old growth forests, particularly those associated with riparian areas. A draft habitat model, based on literature, was modified to include the importance of balsam poplar trees for nesting and the negative affects of openings associated with Great Horned Owl predation (*Bubo virginianus*) and anthropogenic disturbance.

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Chapter 1

Introduction

"The noisiest of the unseen witnesses around me were the owls, who pronounced their gloomy speeches with profound emphasis . . ."

-John Muir

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 and Spotted Owl are closely related to one another and are considered by some authors as a superspecies (American Ornithologists' Union 1983, Johnsgard 1988).

The Barred Owl was chosen for study because it has the potential to serve as an indicator of the presence of old growth forests in Alberta. Indicator species are measurable surrogates for environmental end points such as biodiversity. According to Noss (1990), an indicator should be sufficiently sensitive to provide an early warning of change.

Foresters usually consider old growth stands to be over-mature or decadent (Patton 1992). Older forests are usually targeted for harvesting because they contain large volumes of fiber, have insects and disease, and have slowed growth rates (low mean annual increment). The status of Canada's remaining old growth forests is of growing concern, because of the high rate of harvest (Ellis 1993).

There is no generally accepted definition of old growth forest (Hunter 1990). Old growth forests, as defined in this thesis, are characterized by 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). These forests can be very dense to relatively open depending on the dominant trees. The canopy in coniferous dominated stands will be more closed while in deciduous-dominated stands will be more open. Old growth forests include climax forests, but do not exclude sub-climax or even mid-seral forests (British Columbia Ministry of Forests 1992). Dominant trees are close to or older than their age of physiological maturity, therefore the old growth stage can be reached at different ages depending on the site, the ecosystem type, and the dominant tree species (Duchesne 1994).

1.2 The Foothills Model Forest

As a part of Canada's Green Plan, the federal government established a network of model forests, that would serve as a testing ground for new economically and ecologically sound approaches to forest management. A model forest is defined as a working scale forest that is managed for a sustainable supply of timber, but must also integrate other important values such as water quality, biological diversity, wildlife habitat, community stability, and recreational, cultural, and/or spiritual values (Forestry Canada 1993).

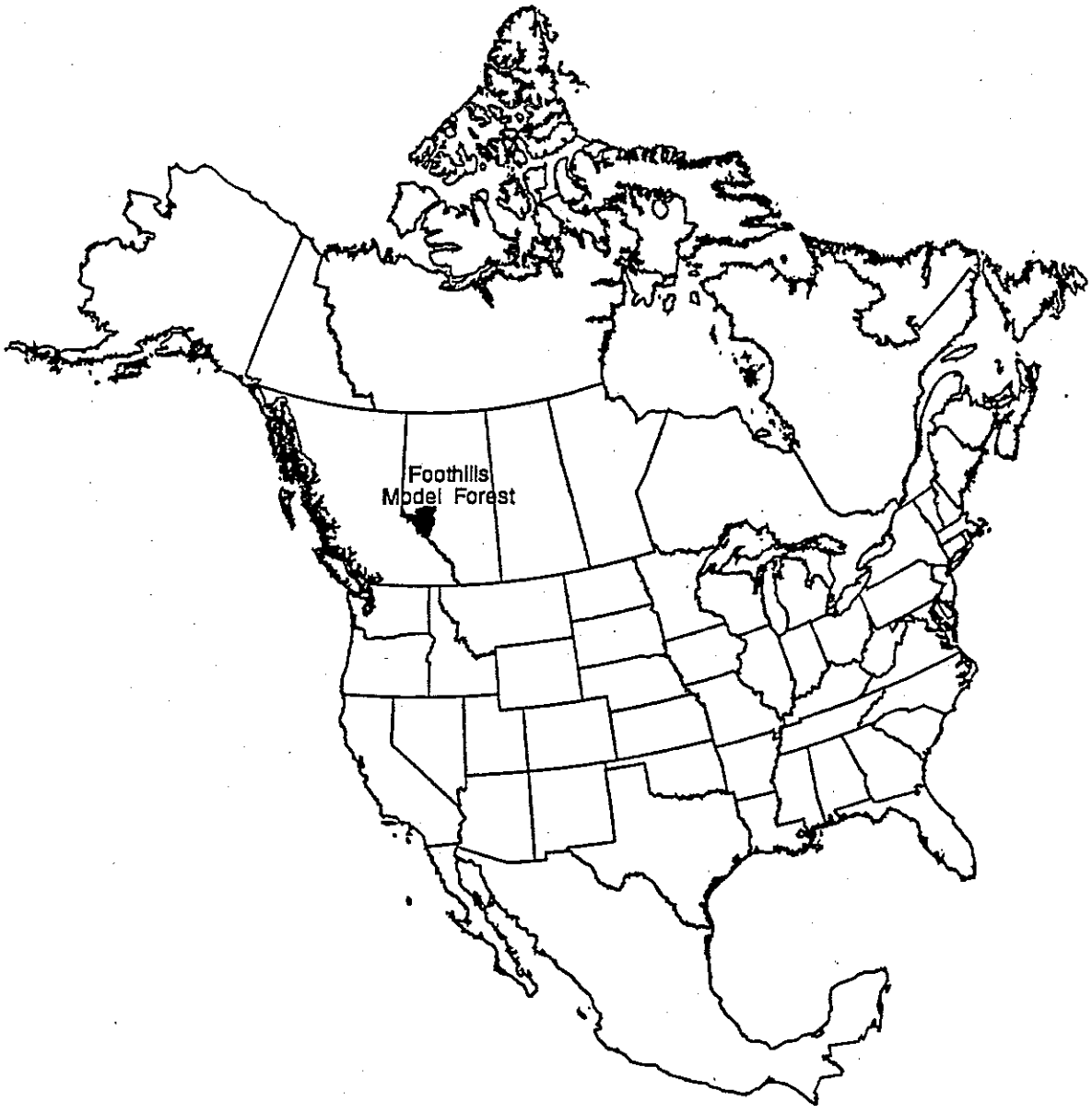

Figure 1-1: Map showing the location of the Foothills Model Forest in west-central Alberta.

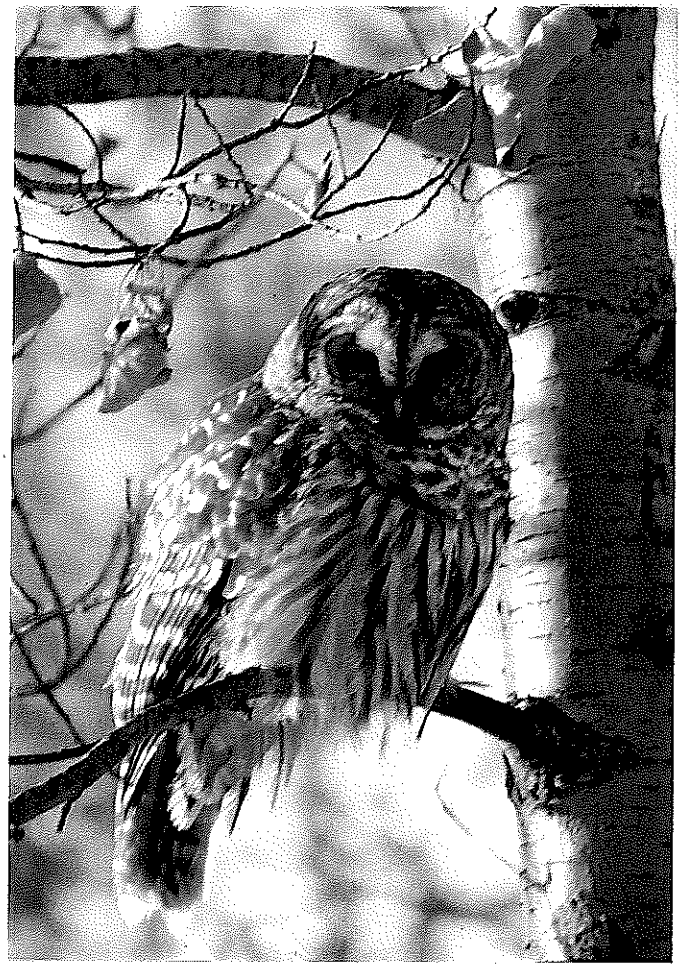

Figure 1-2: Photo of a Barred Owl showing the distinctive dark brown eyes and streaking on the chest. (photo by Stephen Glendinning)

Barred owl survival is dependent on the availability of food, areas for courtship and nesting, and sheltered 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). They have been found to have a close association with water (Bent 1938, Eckert 1974).

Average home range size of the Barred Owl varies from region to region. In Minnesota an average home range size of 229 ha (range 86 to 370 ha) was determined using radio telemetry (Nicholls and Warner 1972). Elody and Sloan (1985) reported that the average year round Barred Owl home range in Michigan was 282 ha, although during the summer months the home range averaged 118 ha. Hamer (1988) found that four pairs of owls in western Washington had a mean home range size of 905 ha. Bosakowski *et al.* (1987) reported a density of 0.07 pairs/km^2 in northern New Jersey, and Craighead and Craighead (1956) found the density of Barred Owls

in Michigan was 0.03 pairs/km^2. Barred Owl density and home range size 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, pers. comm.). Stands with large diameter trees that are mature enough to provide natural cavities are preferred (Allen 1987). Little or nothing is written on pair bonding in this species (Johnsgard 1988).

Murray (1976) reported an average clutch size of 2.4 eggs from across the Barred Owl's range but that there may be increases in the average clutch size with increasing latitude. Bent (1938) found that the race *varia* had an average clutch size was 2.36 (range 2-4). One five-egg clutch in the National Museum may be the work of two females (Johnsgard 1988). The reported incubation time is 28 to 32 days in the United States (Dunstan and Varchmin 1985). Apfelbaum and Seelbach determined that the average number of nestlings was 2.02 (based on 55 broods). The young fledge in four to five weeks (Bent 1938). Roost sites are usually in thickly foliated trees 5 m or more above the ground (Duncan 1994, Voous 1988). There is little information on the life history of Barred Owls in Alberta.

Barred Owls are considered opportunistic feeders, or food generalists, and are known to prey on small mammals, birds, amphibians, reptiles, fish, and insects. Small mammals are the primary component of the Barred Owls diet (Bent 1938, Errington 1932, Earhart and Johnson 1970, Marks *et al.* 1984). Neither diet studies nor studies on roost and forage habitat have ever been conducted on the Barred Owl in Alberta.

1.4 Habitat Suitability Index Models

The goal of wildlife habitat modelling is to develop models that can be used to assess habitat relationships and to predict their sensitivity to perturbations. Habitat suitability index (HSI) models synthesize 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). An assumption in HSI models is that there is a direct linear relationship between the HSI value and carrying capacity (USDA 1981). If this is true then, the models can further be used to predict current and future wildlife carrying

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Chapter 2

Broadcast Surveys in the Foothills Model Forest, Alberta: The Abundance of Owls and the Effects of Environmental Conditions on Call Rate

"A moonlit lake by wood canoe,
Where grebes would dance and loons would wail.
A Barred Owl's low *who cooks for you,*
A frosted mug, with draft drawn ale."

-J. Butler (Winter Reflections on a Year Gone By)

Holroyd and Van Tighem (1983) documented the status of owl species in the Jasper area (Table 2-1). Semenchuk (1992) describes the distributions of the Great Horned Owl and Northern Saw-whet Owl as widespread and common, the Northern Hawk-Owl, Great Gray Owl, Boreal Owl, Burrowing Owl, Northern Pygmy Owl, Short-eared and Long-eared Owls as fairly common but restricted to certain parts of the province, and the Barred Owl as the rarest owl in the province. The Snowy Owl is a winter visitor to the province.

Table 2-1: Status and distribution of owls in Jasper National Park (Holroyd and Van Tighem 1983).

Species	Status and Distribution
Great Horned Owl (*Bubo virginianus*)	Uncommon year round resident.
Snowy Owl (*Nyctea scandiaca*)	Very rare visitor or migrant.
Northern Hawk-Owl (*Surnia ulula*)	Very rare resident.
Northern Pygmy Owl (*Glaucidium gnoma*)	Uncommon resident.
Burrowing Owl (*Speotyto cunicularia*)	Not recorded.
Barred Owl (*Strix varia*)	Rare resident.
Great Gray Owl (*Strix nebulosa*)	Very rare resident.
Long-eared Owl (*Asio otus*)	Not recorded.
Short-eared Owl (*Asio flammeus*)	Very rare visitor.
Boreal Owl (*Aegolius funereus*)	Rare resident.
Northern Saw-whet Owl (*Aegolius acadicus*)	Uncommon resident in spring/summer.

This paper describes the species and abundance of owls in the Foothills Model Forest, and evaluates some of the environmental conditions (i.e. moon phase, cloud cover, wind, precipitation, time of night, time of year, species of owl call used) that affect call rates in owls. The results were used to suggest some standard methods for conducting broadcast surveys.

2.1 Methods

2.1.1 Study Area

The Foothills Model Forest (FMF) is located in west-central Alberta, Canada, surrounding the town of Hinton, and includes the Weldwood of Canada Forest Management Area, William A. Switzer Provincial Park, the Cache-Percotte Forest, and Jasper National Park. Broadcast surveys were restricted to within 80 km of the town of Hinton, as it was not feasible to survey the entire

transect (Anderson *et al.* 1979). The roadways that were used for surveys had variable widths (range of 15 to 75 meters).

Stearns (1947) and Smith (1978) recorded Barred Owl calling up to 0.8 km away and Bondrup-Nielsen (1978) found that Boreal Owls could be heard up to 1.5 km. Equally spaced broadcast stations were set along all of the transects at 1.6 km intervals, to reduce the chances of recording the same owls calling at different stations, but to ensure that few owls were missed. Roads had to be 4x4 truck accessible in winter and could not be major log hauling routes for reasons of safety for the researcher and improved detectability of owls.

2.1.3 Broadcast Surveys

Owl calls are a major courtship signal. 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. It was determined that only one survey per month for three months was needed after reviewing the 1995 data and finding that only two additional owls were recorded with the fourth survey.

A Sony Mega Bass Sports ghetto blaster was used at half volume. This volume was chosen because it could not be heard at a distance of more than 600 meters (by the human ear). The blaster was slowly rotated continuously 360° during each 20 second broadcast, to ensure the sound traveled in all directions.

All stops began with a two minute listening period and ended with a five minute listening period. On the first 10 transects only Barred Owl taped calls were played. Tapes were made from a random combination of different Barred Owl call types: pair duetting, single female calling, single male calling (Voices of the New World Owls by Hardy, Coffee, and Reynard; Peterson Guide to Western Bird Songs; Peterson Guide Eastern/Central Birding By Ear; and the Alberta Owl Prowl by Beck and Beck). The two minute silent listening period was followed by a series of six 20 second Barred Owls broadcasts with one minute silent listening periods after each broadcast. The total survey time was 15 minutes for each station (2 minutes + 6 x 20 seconds + 6 x 1 minute + 5 minutes). If a call was heard but could not be identified in the 15 minutes, up to 10 additional minutes of listening was added (no more than this amount of time was added to ensure that a transect could be completed within the four hour night time interval).

was performed on the variables: time of year, moon phase, moon visible, night time interval, cloud cover, and temperature, to test environmental effects on owl call rates. To test for interaction between moon phase and cloud cover, a logistic regression with a covariate was performed. Call rates were compared for precipitation and wind events, but no statistics were performed on the data because of low sample size. A comparison was made of the number of owls responding at different broadcast intervals, and the types of behavioral responses.

2.2 RESULTS

2.2.1 Calls

A total of 893 stops were completed during March, April, and May, 1995 and 1996. Six species of owls were recorded on the transect surveys (Table 2-3): Barred Owls, Boreal Owls, Great Gray Owls, Great Horned Owls, Northern Saw-whet Owls and Northern Pygmy Owls. A total of 300 calls from owls was recorded on the transect surveys, a rate of 0.34 calls per stop. Some owls responded on more than one survey, therefore, the total number of calls was more than the total number of territorial owls that was present (Figure 2-2).

The Boreal Owl was the most abundant owl recorded on these transects (128 calls), while the Northern Pygmy Owls and Great Gray Owls were the least abundant owls recorded (4 calls and 8 calls respectively). The Boreal Owl had a much lower call rate in the second year. Declines in call rates were also found for the Barred Owl and Northern Saw-whet Owl. Barred Owls, Boreal Owls, and Great Horned Owls had the highest territorial call rates (Figure 2-2). Great Grey Owls and Northern Pygmy Owls had very low call rates, however more were recorded from casual observations (Table2-4).

Calls and sounds from non-owl species were recorded at 16 stations and include: Wolves (*Canis lupus*), Coyotes (*Canis latrans*), Wood Frogs (*Rana sylvatica*), Boreal Chorus Frogs (*Pseudacris triseriata*), Northern Goshawk (*Accipiter gentilis*), Common Snipe (*Gallinago gallinago*), Common Nighthawks (*Chordeiles minor*), Gray Jay (*Perisoreus canadensis*), Common Loon (*Gavia immer*), and various unidentified species of waterfowl. Three other species of owls were recorded in the FMF, but not during broadcast surveys: Snowy Owl, Northern Hawk-Owl, and Short-eared Owl.

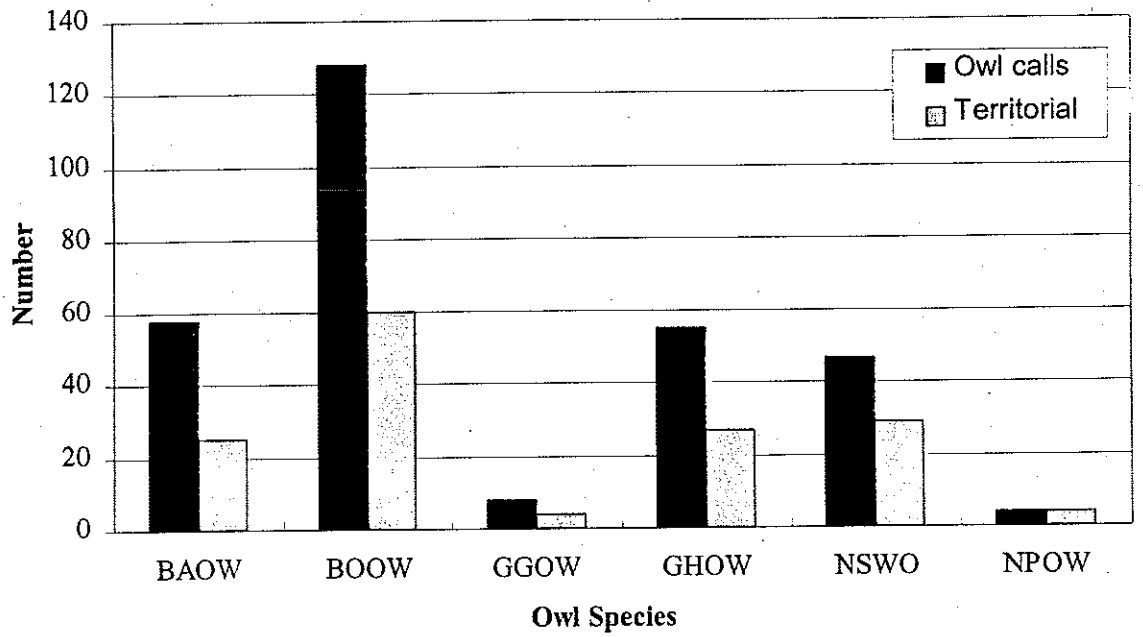

Figure 2-2: Graph showing total numbers of calls and total number of territorial owls recorded.

During 1996, I recorded 87 calls on the first ten transects (0.29 call rate), and 34 on the nine new transects (0.22 call rate). Call rate did not significantly increase (Logistic regression, Sig.=0.156) when the Great Gray and Boreal Owl calls were played in addition to the Barred Owl call, on the new transects. Seven test surveys were conducted in areas with three known Boreal Owls, to determine if they responded to Barred Owl broadcasts. When the Barred Owl call was played, three Boreal Owls that were calling spontaneously continued calling in all seven cases. Two Boreal Owls responded to the Barred Owl taped calls however, when a Boreal Owl call was played, the two Boreal Owls stopped calling on four different occasions. The Great Gray Owl call elicited responses from Great Gray Owls and Boreal Owls.

2.2.2 Environmental Conditions

Results from all transects were combined to test the effects of certain environmental conditions on owl call rates (call rate = number of owls that called/station). Overall, time of year did significantly affect the number of owl calls recorded (Logistic regression, Sig.=0.0246): 83 in March (28 percent), 118 in April (39 percent), and 99 in May (33 percent) (Table 2-5). April had the highest call rate in 1996 (0.43 calls/stop), but the lowest call rate in 1995 (0.16 calls/stop). Each species of owl had different peak calling months. Barred Owls hooted less in

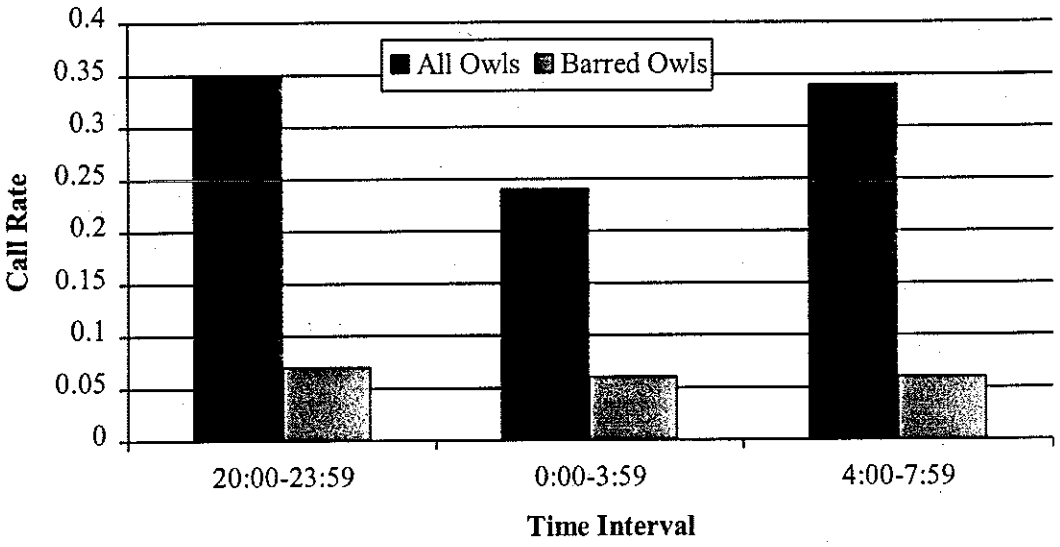

Figure 2-3: Overall call rate of all owls and Barred Owls at the different time intervals.

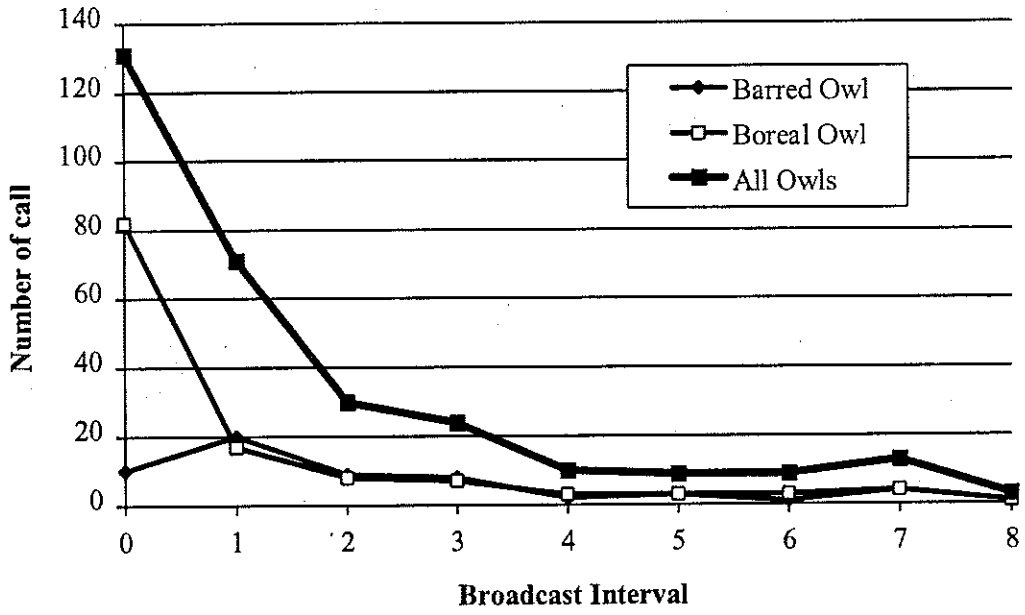

Figure 2-4: Number of new owls responding at different broadcast intervals (0=2 minute silent period, 1=after first broadcast, 2=after second broadcast, etc., 7=five minute listening, 8=10 minute listening).

Owl broadcast surveys were conducted at temperatures ranging from -30 °C to +10 °C (Figure 2-7). Owls called at temperatures as low as -28 °C. The call rate increased with temperature, and was highest between -10 °C and +10 °C. The highest jumps in call rate occurred between –20 °C and –10 °C. Owl call rate dropped as wind speed increased (Figure 2-8). No owls were heard calling when winds exceeded Beaufort scale of 3 (over 19 km/hr).

Although most transects were not run during precipitation events, there were stops where precipitation was recorded. No owls were recorded calling during heavy precipitation events (Figure 2-9). Light snow had little effect on owl call rate, however moderate rain and snow did significantly decrease call rate. No owls were recorded calling during heavy precipitation events.

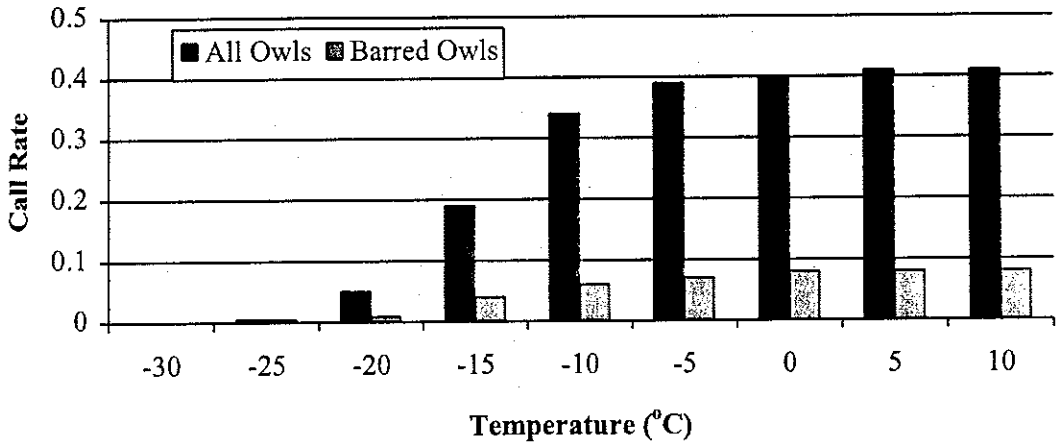

Figure 2-7: Call rates of all owls and Barred Owls as temperature increases (5 °C intervals).

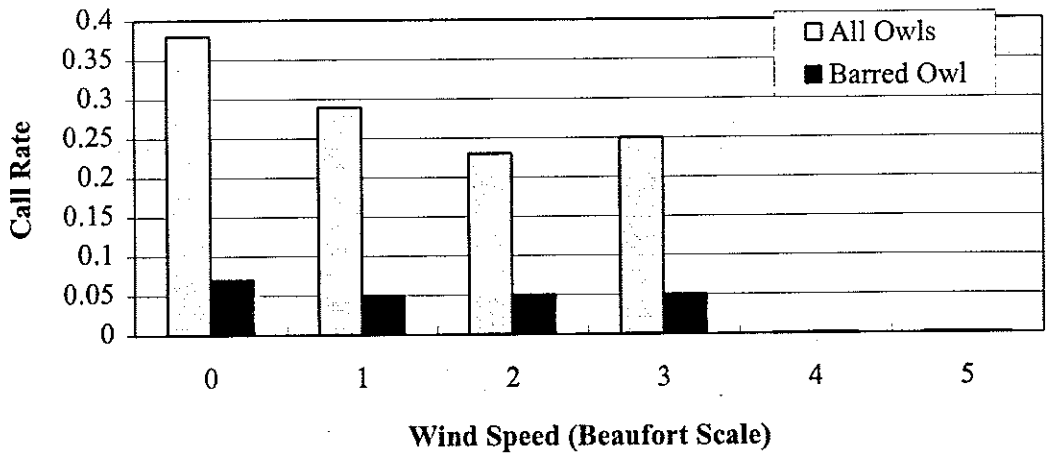

Figure 2-8: Overall call rate of all owls and Barred Owls at different Beaufort Scales.

2.3 Discussion

The most often overlooked avian species in censusing are the nocturnal owls (Johnson *et al.* 1981). A variety of techniques have been used to determine owl distribution and abundance. Researchers hope to produce density, or at least, relative abundance results (Skirvin 1981). Transect surveys, conducted during the night, were effective in determining distribution and relative abundance of four species of owls in the FMF: Barred, Boreal, Great Horned, and Northern Saw-whet Owls. This survey method has also been used in Manitoba (Duncan and Duncan 1993) and Ontario (Francis and Bradstreet 1997) to determine distribution and abundance of owls, in particular Barred, Boreal, and Northern Saw-whet Owls. Carpenter (1987) and Palmer (1987) also found that playback is an effective method for studying various species of owls.

Broadcast surveys were not effective for determining the abundance of Great Gray Owls (Table 2-2, 2-3 and Figure 2-2). Winter (1986) found that Great Gray Owls in the Sierra Nevadas, California readily responded to taped calls at almost any time and Brenton and Pittaway (1971) observed that Great Grays are visible primarily in early morning and late afternoon during the winter and early spring. Most of the Great Gray Owls recorded during this project were seen foraging during daylight hours along openings, and did not respond well to playback (Table 2-4). Under ideal conditions the calls of Great Grays can be heard 800 meters, although they often carry only about 500 meters (Mikkola 1983). The call stations were set 1.6 km apart, which may have contributed to a lower number of certain owl species being detected. As well, the owls may have moved further into the forest for nesting.

Broadcasts were also not effective for determining the abundance of Northern Pygmy Owls (Table 2-2 and Figure 2-2), and were heard calling during the day in many instances (Table 2-4). König (1968) found that the Eurasian Pygmy Owl called at dawn, dusk, and during the day, but rarely after dark. The Pygmy Owl has a smaller home range, is relatively secretive, and may not be found near roads, therefore it may not have been detected due to the spacing of the call stations.

McGarigal and Fraser (1985) had sampling periods that were 32 minutes long. They found that response rate of Barred Owls increased rapidly during the first 15 minutes and then leveled off. Francis and Bradstreet (1997) found that 56-65% of Boreal Owls were detected in the first

conditions can inhibit calling, but as the breeding season progresses the birds can be affected less by weather (Armstrong 1963). The change in call rate due to weather can also contribute to the monthly variation in call rates. Temperatures would be colder in March than in April and May. Extremely low winter temperatures were found to inhibit the calling of Eastern Screech Owls in Wisconsin (Carpenter 1987), and Boreal Owls had reduced calling rate with colder temperatures (Bondrup-Nielsen 1978). Overall, this study found that call rate was highest at temperatures above –15°C (Figure 2-7 and 2-8), and therefore, surveys should not be run at temperatures below this temperature. Call rate remained relatively constant above this temperature, and therefore standardization of the data was unnecessary.

Environmental conditions directly affect owl vocalization rates in a number of ways. Owls do not respond well during heavy precipitation and high wind. Palmer (1987) found that the two factors that most affected Boreal and Saw-whet Owl calls were wind and precipitation. The single-most important weather variable influencing response to call playback was wind (Siminski 1976, Forsman 1983). Wind can directly affect the researcher's ability to hear owls calling and the owls' ability to hear the broadcast. As well, the wind may affect the ability of owls to fly or to detect prey (Smith 1987), therefore owl would not be actively moving around their territories to defend them. Robbins (1981b) also noted that, in poor environmental conditions, the total species observed might be near normal, but the number of individuals was reduced.

Cloud cover did not significantly influence either Boreal or Saw-whet owl calling activity during a study in Colorado (Palmer 1987). Mikkola (1983) found that Eagle Owls (*Bubo bubo*) called more on cloudless nights, whereas Hansen (1952) found the same trend with Tawny Owls (*Strix aluco*). The same results were found in the FMF. Cloud cover however affects whether the moon is visible or not, and in turn significantly affects call rate.

Moon phase can directly affect owl call rates (Armstrong 1963). O'Connor (1987) found that Boreal Owls were easier to detect during moonlit nights when they approached silently and did not vocalize. Northern Saw-whet Owls and Boreal Owls were heard calling more during a full moon phase than at any other time during a study in Colorado (Palmer 1987). The results of broadcast surveys in the FMF also showed that more owls called during the full moon phase (Table 2-6). The call rate follows an almost linear decline as moon phase decreases.

8. Surveys should not be run during temperatures below –15 °C and with winds higher than 3 on the Beaufort Scale.

9. Broadcast surveys can be used to survey Barred, Boreal, Great Horned, and Northern Saw-whet Owls, but other methods (e.g. daytime surveys) need to be used to survey other species that do not respond well to broadcasts.

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Chapter 3

Barred Owl Distribution, Density, and Habitat Use in the Foothills Model Forest

"An old growth forest!
Precious
Sophisticated
Complex
Uniquely irreplaceable."

-J. Butler, from "Execution of an Old Growth Forest" (1994)

1984, Elody and Sloan 1985, McGarigal and Fraser 1984, Bosakowski *et al.* 1987, Dunbar *et al.* 1991), and in Ontario, prefer tall hardwood forests that are vertically complex (Van Ael 1995). Oeming (1955) found Barred Owls were common in remote areas of undisturbed mature and old growth forest in Alberta. They avoid extensive clearings, open fields, and marshes (Nicholls and Warner 1972, Fuller 1979, Bosakowski *et al.* 1987), and can be preyed on by Great Horned Owls (*Bubo virginianus*) (Fuller *et al.* 1974, Laidig and Dobkin 1995, Court pers. comm.).

Barred Owls in the United States have been reported to nest in interior portions of expansive, mature woodland (Allen 1987). The typical Barred Owl nest is in a cavity in a large living or dead tree or in the top of a broken snag (Apfelbaum and Seelbach 1983), and a few nests have been reported in stick nests (Eckert 1974, Apfelbaum and Seelbach 1983).

The first nest reported in Saskatchewan was in a black poplar stub (balsam poplar), 6 m above ground in a cavity created by a partially broken off branch (Houston 1961). Price (1940) stated that Barred Owl nests were very hard to find and that he never found this species using an open nest, although he had tried for years to find one. In Alberta, two nests have been reported by Jones (1966) and Jones (1987), the first in a cavity 10 m up in a dead balsam poplar and another in a balsam poplar stump, 8 m above ground. Cavity use has also been recorded in Ontario (Allin 1944).

Little specific information exists on roosting and foraging habitat. Johnsgard (1988) describes Barred Owl habitat as densely foliaged (deciduous and coniferous) for daytime roosting. Foraging habitat is described as mature forests with large trees that provide clear unobstructed flight paths for hunting (Duncan 1994). Prey are more exposed where the understory vegetation is sparse (Elody 1983, Devereux and Mosher 1984). Fuller *et al.* (1974) found that Barred Owls used hunting perches 5-6 m in height.

3.1 Objectives

Johnson (1980) looked at habitat associations at three levels: the physical geographic range, the home range level, and the habitat components in that home range. These three levels are covered in this thesis chapter. The objectives were to:

1) Determine the distribution and abundance of the Barred Owl in the Foothills Model Forest.
2) Determine the general habitat associated with the Barred Owls' presence and its home range.
3) Determine specific habitat components associated with nesting, roosting, and foraging.

3.2.3 General Habitat Use

Locations of owls that responded on transect surveys were plotted on Weldwood of Canada, Forestry GIS (Geographic Information System) vegetation maps based on distance and direction of all calls from the observer at a known location. The stand data associated with these locations was taken off of the AVI maps (Alberta Vegetation Inventory, Appendix E) and was ground truthed to ensure accuracy. Proudfoot *et al.* (1997) found no significant difference between the habitat associated with radiotagged owl locations and locations of owls responding to broadcasts. This method of determining general habitat use was used for Spotted Owls in Olympic National Park (Mills *et al.* 1993).

3.2.4 Specific Habitat Use

Telemetry

Nesting, roosting, and foraging sites were difficult to determine because of the Barred Owl's secretive nature. As well, continuous data on movements of owls are difficult to follow (Nicholls and Warner 1972). For these reasons, radio telemetry was used to help track owl movements. Live capture efforts were run from May through August, 1995, and from March through August, 1996.

A variety of methods were used to trap raptors (Meng 1971, Kenward *et al.* 1983, Bull 1987, Fuller and Mosher 1987, Bub 1991, Redpath and Wyllie 1994). Barred Owls were trapped with two mist nets suspended between poles and set in a V-shape on the territory of a Barred Owl (Nicholls and Fuller 1987, Bloom 1987). Nets were set in small openings where perches were available (Bub 1991), and where trees were dense to make it difficult to see the mist net. Ground vegetation was cleared from the area before nets were unfurled to ensure they did not get tangled and to prevent any injury to birds caught in the net. 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, two types of traps were employed, as owls no longer responded well to taped calls (Kenward *et al.* 1983, Redpath and Wyllie 1994). The first design, the drop-lid (Figure 3-1a), was divided into two sections, the lower section holding the bait and the upper section holding the raptor (Bloom 1987). The raptor entered the top section causing a trigger to

Radio transmitters were affixed using a backpack harness style to Barred Owls that were successfully captured (Figure 3-2). Loops of Teflon passed from the corners of the transmitter and were crossed over the breast (Nichols and Warner 1968, Dunstan 1972, Kenward 1985). The area where the Teflon crossed on the breast was sewn together to prevent the straps from sliding up and down the breast. Although tail mount transmitters are preferable to backpacks (Dunstan 1973, Fuller and Tester 1973, Kenward 1978), they were not used because they would be shed in the fall, and telemetry in winter would not be possible. Transmitters had a battery life of 18 months, to ensure winter data could be collected, and to facilitate finding nests in two spring seasons.

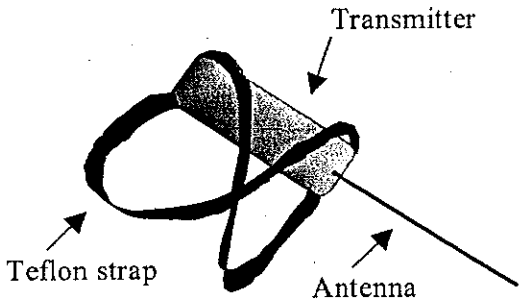


Figure 3-2: Sketch of backpack Transmitter with Teflon straps.

Using hand-held three element Yagi antennas (Amlaner 1980), researchers triangulated on radiotagged birds. Ideally successive bearings should be 60° apart (Springer 1979), but because this is extremely difficult to accomplish in this area with few roads, 20° was the minimum angle of separation chosen. Only one receiver package was available at most times, therefore bearings were not taken simultaneously. The maximum amount of time allowed to elapse between the three bearings was 10 minutes. Three or four bearings were plotted on orthophotos (Guetterman *et al.* 1991) and the center of the polygon was considered the location of the owl. The maximum size of an acceptable triangulation polygon was 2.5 ha. To check on the accuracy of triangulations, and to attempt to locate nest, roost, and forage sites, researchers walked in on radiotagged birds after a triangulation was taken (Guetterman *et al.* 1991).

Locations were taken randomly throughout the 18 months in an attempt to cover all times of the day and seasons. All locations that followed these criteria were used to determine the home range size of the Barred Owl. Call sites from transect surveys and casual observations in the field were also plotted on maps to help determine home ranges and general habitat use.

The nest/roost/forage tree was considered the center of the survey. Appendix 3-1 shows the specific information recorded on the center trees. Each plot had information recorded on trees in a 0.04 ha area, shrubs in a 0.004 ha area, and herbs in four 1 m^2 areas (average) (Figure 3-3). Tree characteristics that were recorded are listed in Appendix 3-2. 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). The percent cover of each category was determined and the depth of the litter and moss was measured.

Logs were measured in the 0.04 ha plots (Appendix 3-2). The overall site characteristics of 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 can be best estimated by means of a spherical densiometer (Bessie 1995). A convex spherical densiometer was used at the five-meter mark in four cardinal directions at each plot. Three nests located on the Weldwood FMA were plotted on aerial photos, and stands were AVI typed by Weldwood staff.

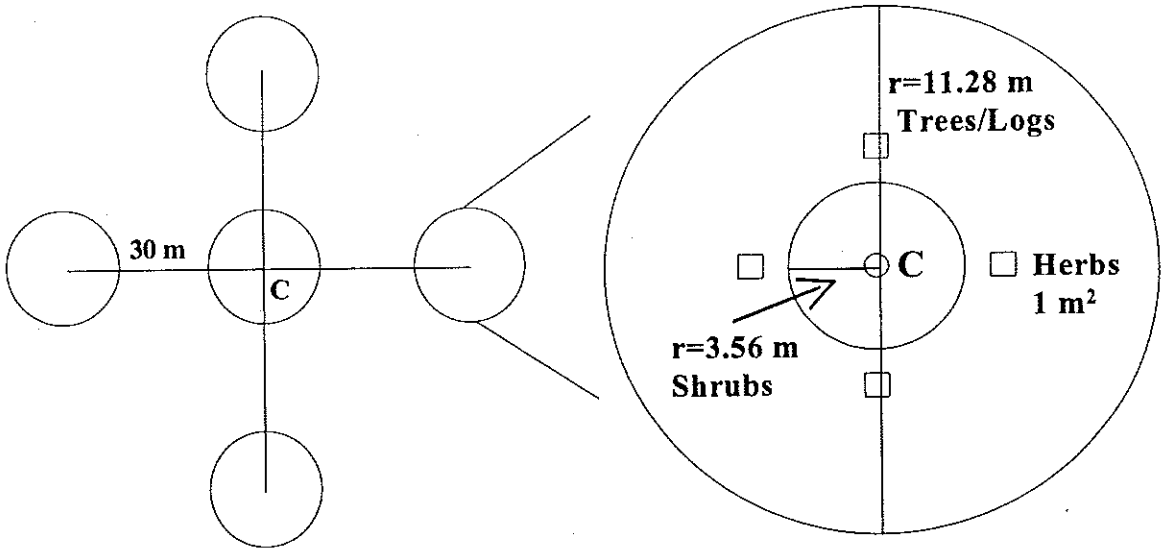


Figure 3-3: Plot layout for the vegetation surveys. Center plot with plots set in four cardinal directions. Each plot surveyed in trees in 0.04 ha, shrubs in 0.004 ha, and herbs in four 1 m^2 areas. C = nest/roost/forage tree.

Table 3-1: The number of territorial owls responding on ten transects run March through May, 1995 and 1996.

*Owl Species→	BAOW		BOOW		GGOW		GHOW		NSWO		NPOW	
Transect↓	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 3-2: The number of territorial owls recorded March through May, 1996 on new transects.

*Owl Species→ Transects↓	BAOW	BOOW	GGOW	GHOW	NSWO	NPOW
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**

* BAOW – Barred Owl, BOOW – Boreal Owl, GGOW – Great Gray Owl, GHOW – Great Horned Owl, NSWO – Northern Saw-whet Owl, NPOW – Northern Pygmy Owl

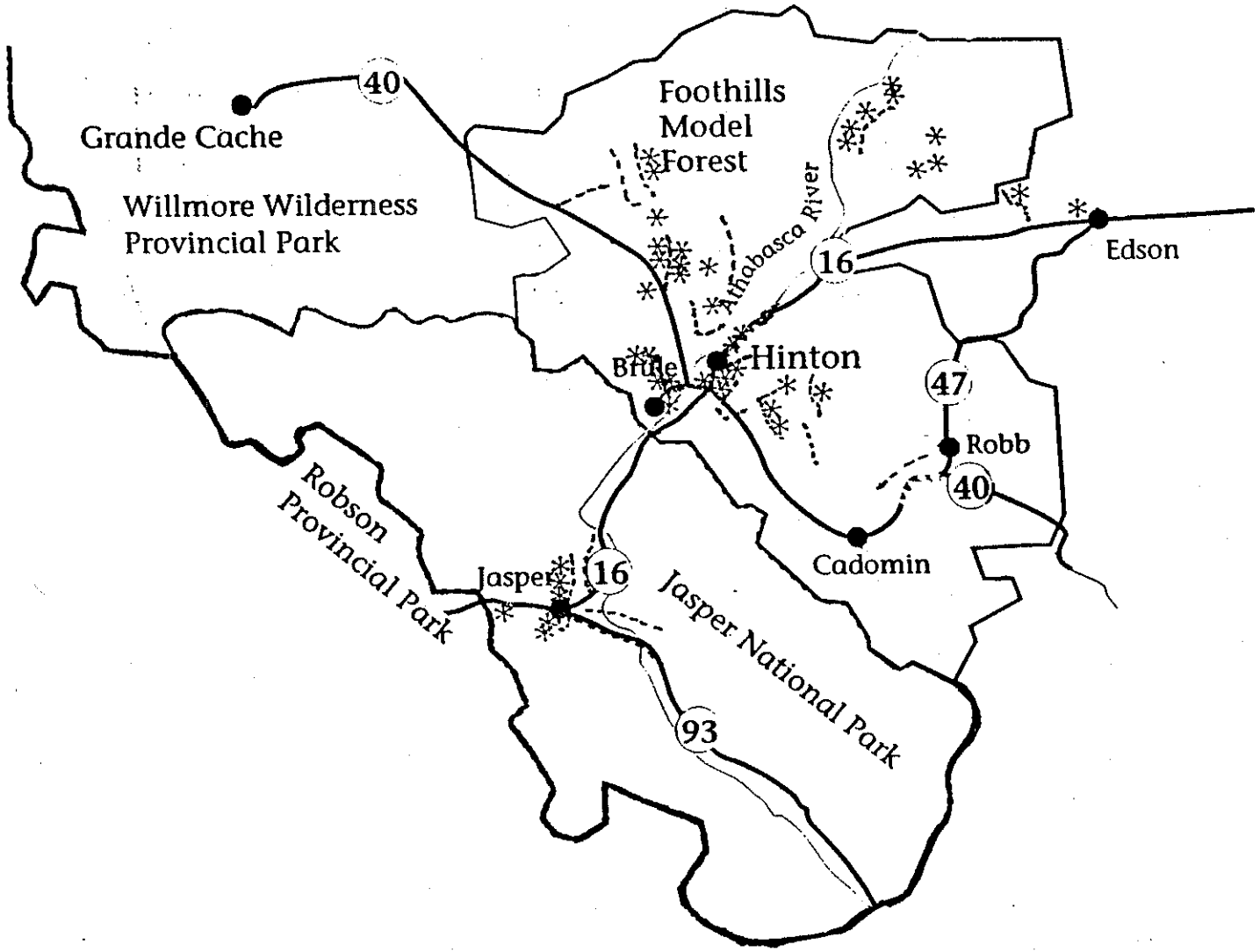


Figure 3-4: The distribution of forty-two territorial Barred Owls (based on broadcast surveys and casual observations). Dashed Lines indicate the transects where the 19 broadcast survey transects were located.

3.3.3 Specific Habitat Use

Stick Nest Searches

On 17 April 1994, (before leaf flush) at 11:00h, four researchers and a pilot conducted an aerial survey north and west of the town of Hinton and searched for stick nests. The helicopter flew at 95 km/hr at an average height of about 65 meters above the ground. Twelve parallel transects were run east-west along the Athabasca River east of Hinton (total area covered 34 km^2). We then traveled to Fish Creek, Peppers Lake, and over the Athabasca Tower lookout towards Solomon Creek near Blackcat Ranch. No stick nests were located during the search effort. The helicopter was flown over an area containing a known stick nest, and the stick nest could not be located. Total flight time was just over 90 minutes. We observed one Canada Goose (*Branta canadensis*), one Common Raven (*Corvus corax*), and two adult Red-tailed Hawks.

Ground stick nest searches were conducted in the summer of 1995 and from February through May 1996, (before leaf flush). A total of 36 stick nests were located and investigated (Table 3-4a) in a total area of 2900 ha. The goshawk study surveyed additional areas, and found another 25 stick nests, but no owl nests were located (Table 3-4b). None of the 61 stick nests were used by Barred Owls, although four of the nests were located in Barred Owl territories. Over 80% of the stick nests were found in trembling aspen trees. Most of the stick nests were in deciduous trees (83.6%).

Stick nests were used by Common Ravens and five raptor species: Northern Goshawks, Red-tailed Hawks, Osprey, 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. The same pair of owls could have occupied these two nests. The Obed area had two different Great Gray Owl nests in 1995 and 1996. The 1995 nest was depredated, possibly by a mammalian predator. Great Gray Owl nests were also recorded at Emerson Gaswell and Edson in 1995. Neither of these nests was reoccupied in 1996.

Table 3-4: Stick nest search results (Con't.).

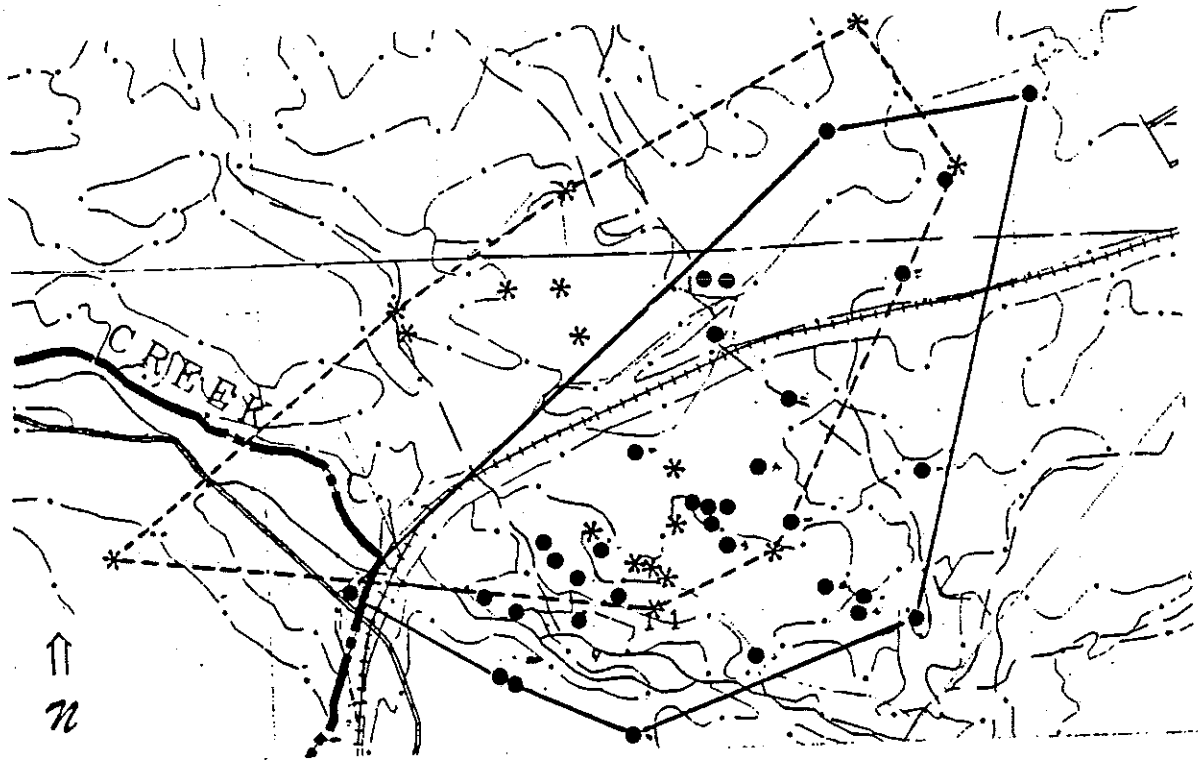
Location	Total Area Searched (ha)	Number of Stick Nests	Tree Species	Nest Occupant (Year)
(b) NOGO Study				
A road km 46.5		1	Aw	RTHA
		2	Aw	unoccupied
Marlboro		3	Aw	NOGO (1996)
		2	Aw	unoccupied
Medicine Lodge (nth block)		1	Aw	unoccupied
Medicine Lodge		1	Aw	RTHA
Gregg River Burn		2	2 Pl	2 CORA (1996)
South Jarvis Creek		4	4 Aw	unoccupied
D58		1	Aw	unoccupied
Lambert Creek		2	2 Aw	2 CORA (1996)
Round Lake (Obed)		2	2 Aw	2 CORA
East Cache/Graveyard		1	Aw	unoccupied
South of HW16/Hinton sign		2	2 Aw	unoccupied
HW 16 Right-of-way		1	Aw	unoccupied
A20		1	Sw	unoccupied
Peppers Lake Road		1	Aw	CORA (1996)
Total		**25**	**2 Pl, 1 Sw 22 Aw**	
Grand Total		**61**	**7 Pl, 2 Sw, 1 Fd 50 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

The Blackcat Northern Goshawk nest was occupied in 1995. Two Barred Owl pairs had territories nearby, one pair to the north, and the other to the south. The Goshawk did not occupy the nest in 1996, and the pair of Barred Owls located south of it increased their home range to include the stick nest area.

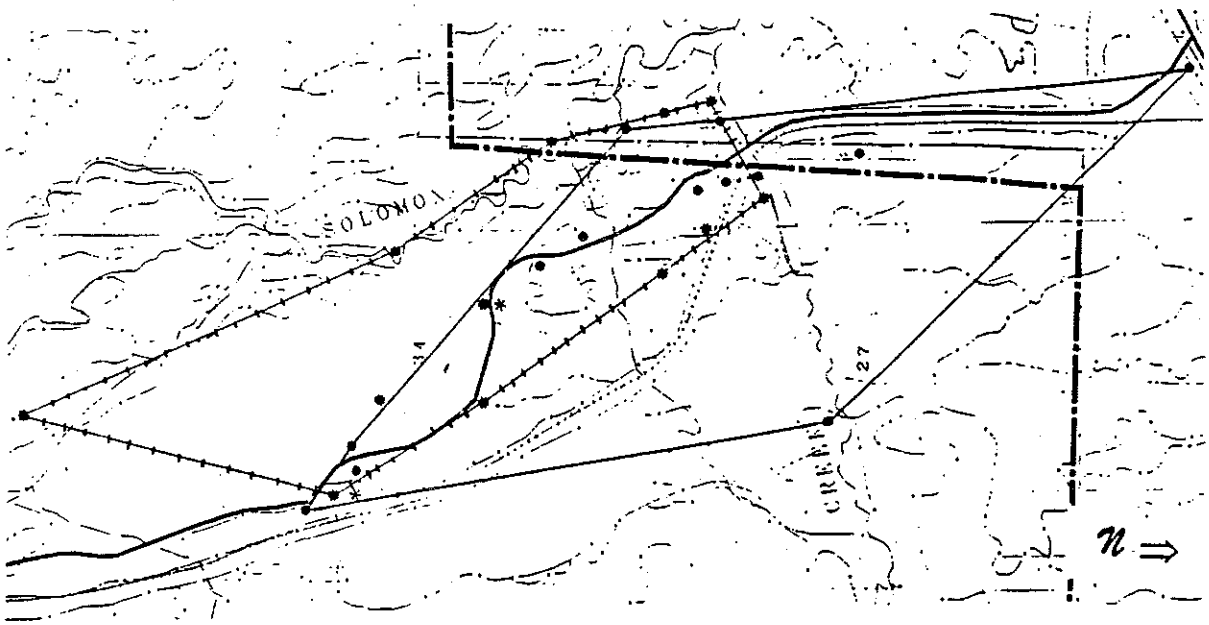
Telemetry

Drop-lid and drop-door trapping were unsuccessful methods for catching Barred Owls. The traps were used 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 used for 1700 hours from June through July in the Blackcat area only. Species caught in the drop-lid traps (Table 3-5) during the two seasons included five raptor species: Northern Goshawk, Cooper's Hawk,



Scale - 1 : 15 000 Summer— (150 ha) Winter ----- (170 ha)

Figure 3-7: 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.



Scale - 1 : 30 000 Summer 1995 — (240 ha) Summer 1996 — (155 ha)

Figure 3-8: 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.

Figure 3-9: Photo of the Solomon Creek female Barred Owl flying into the nest cavity (top photo by Stephen Glendinning) and close up of nest cavity (bottom photo by author).

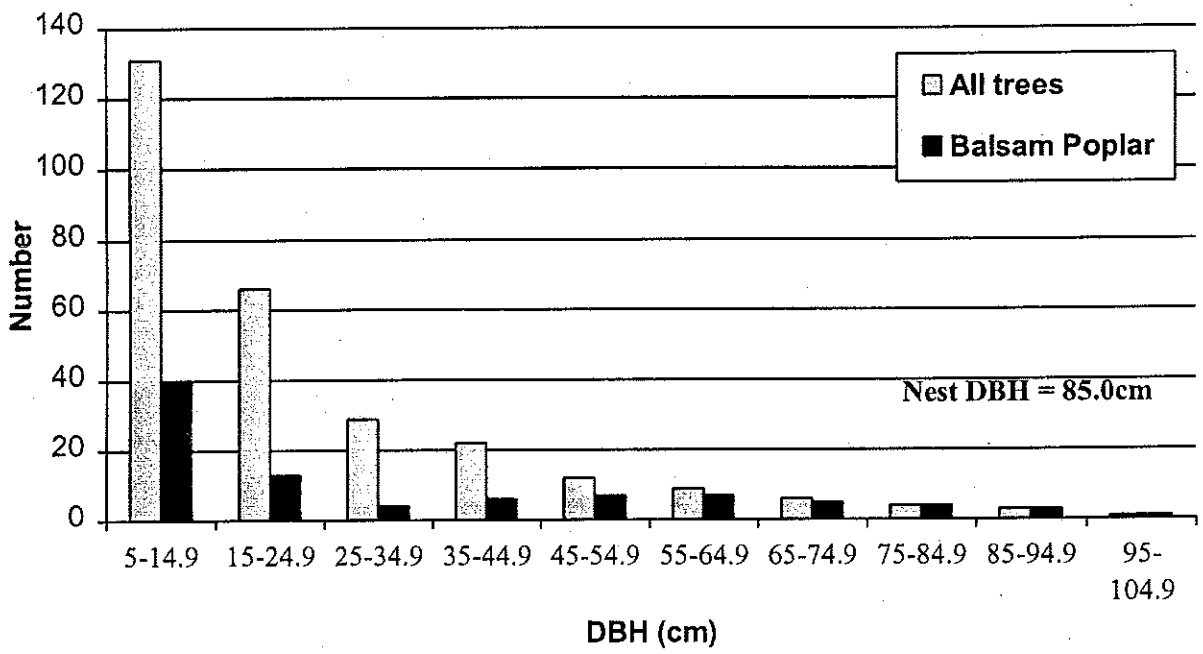


Figure 3-10a: Diameter of Miette 3 nest tree compared to diameters available in the stand.

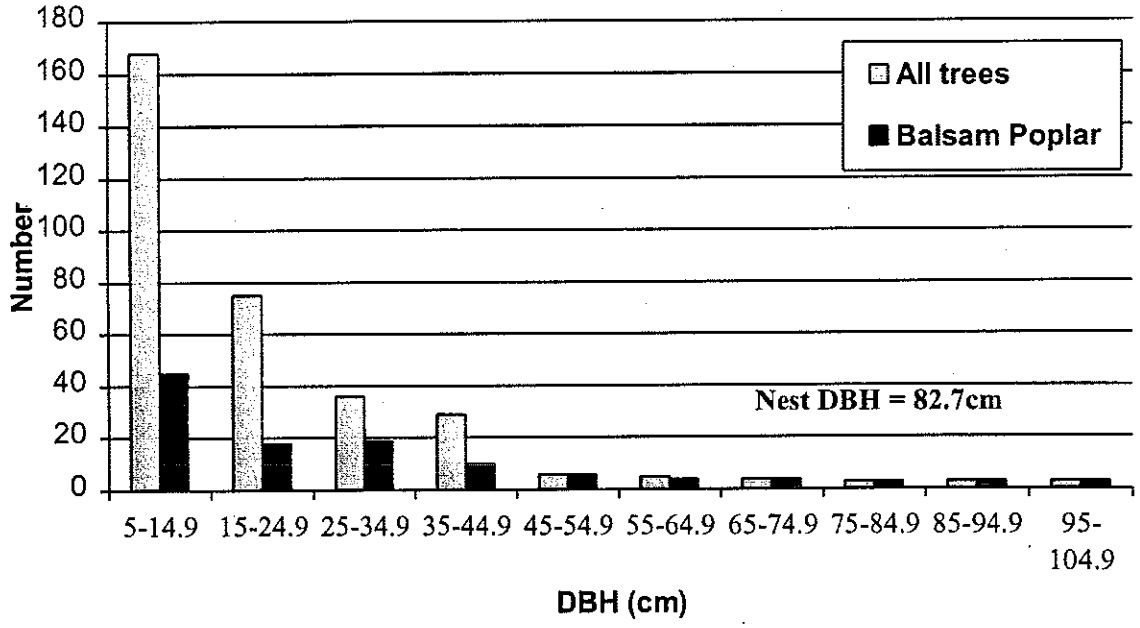


Figure 3-10b: Diameter of Miette2 nest tree compared to diameters available in the stand.

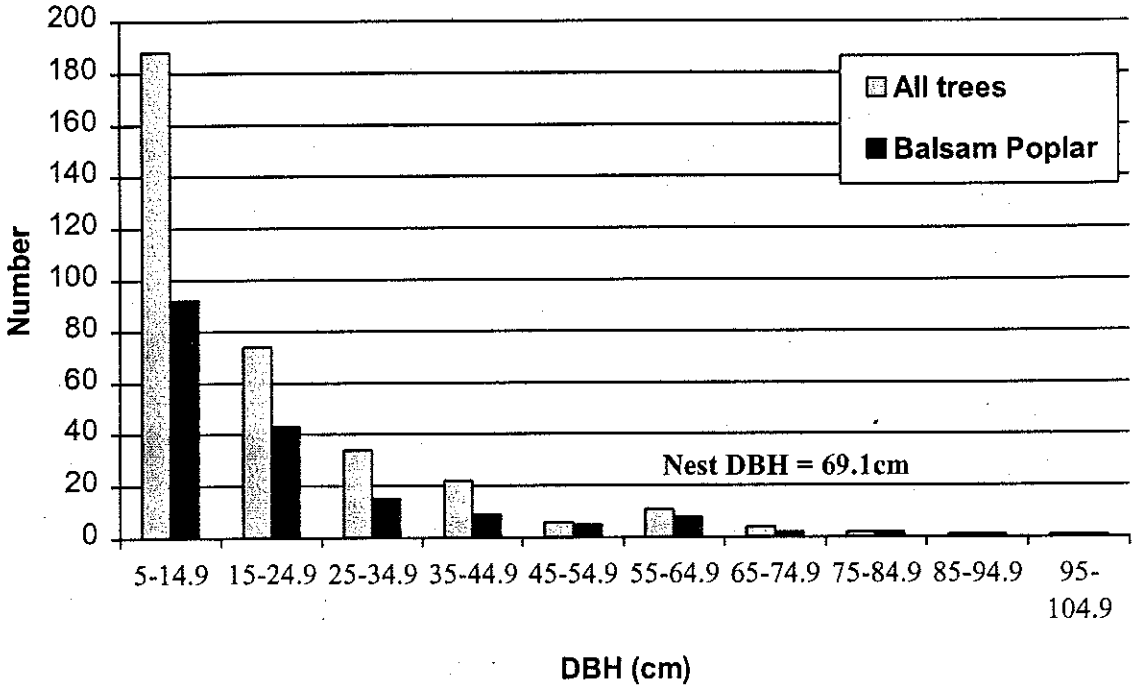


Figure 3-10e: Diameter of Solomon nest tree compared to diameters available in the stand.

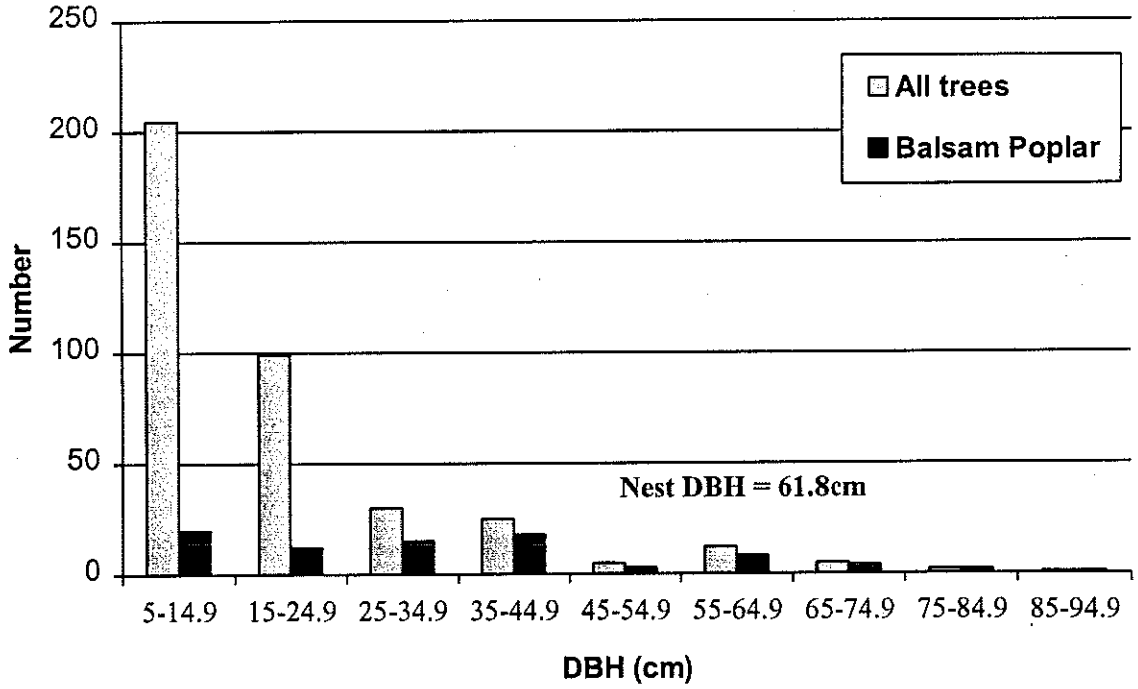


Figure 3-10f: Diameter of Blackcat nest tree compared to diameters available in the stand.

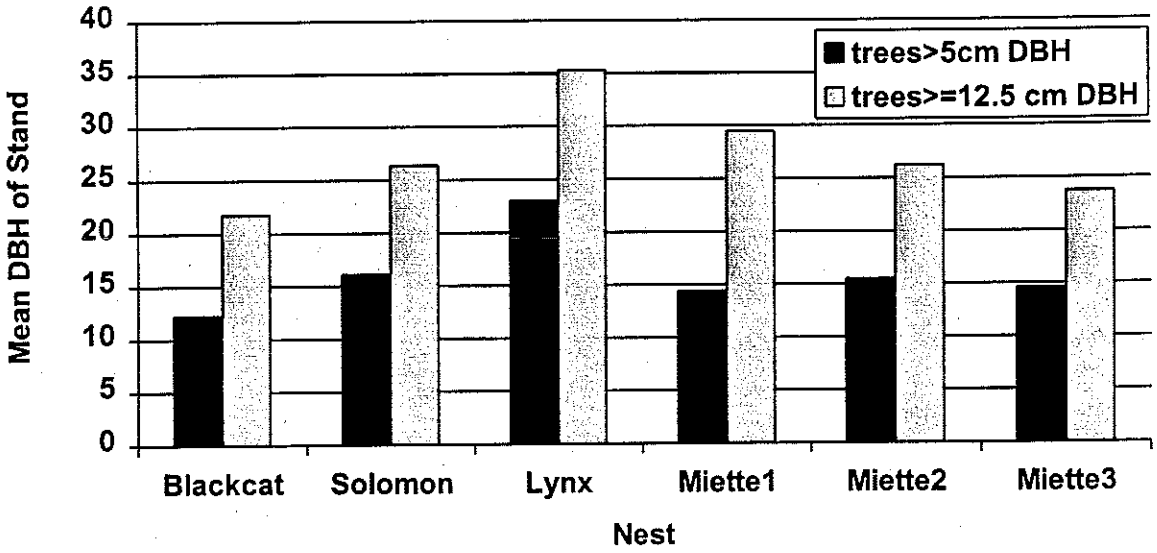


Figure 3-11: Comparison of the mean diameter of trees >5 cm dbh and the mean diameter of canopy trees >12.5 cm dbh in Barred Owl nest stands.

Table 3-9: Stand description density and tree height measured with a spherical densiometer and clinometer versus aerial photos interpretation AVI typed by Weldwood (overstory/ understory).

Nest	%Cover of Species	Density	Tree Height (m)	Weldwood Air Photo *(AVI)
Blackcat	80Sw10Pb10Aw	80.2	25.2	B26 / C11
Solomon	70Sw20Pb10Aw	66.6	25.8	B26 / B10
Lynx	70Sw20Aw10Pb	70.5	27.4	B28 / A8
Miette 1	50Sw30Pb20Aw	78.0	29.1	n/a
Miette 2	60Sw20Pb20Aw	67.5	27.3	n/a
Miette 3	50Sw30Aw20Pb	79.4	24.8	n/a

*Density: A=6-30%, B=31-50%, C=51-70%, D=71-100%. Height in meters.

Roost Sites

Twenty-five roost sites were located, 17 sites were from the radiotagged owl and 8 were from the other owls. 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 these trees was 35.7 cm and ranged from 17.0 to 69.7 cm (Figure 3-12). The roost trees were found in a variety of stand types: mixedwood, pure trembling aspen, pure balsam poplar, and pure white spruce. The stands had very little or no lodgepole pine in them.

Table 3-11: Average of roost plot and surrounding stand diameters and significance values.

Roost	Roost Plot Average Tree Diameter	Roost Stand Average Tree Diameter	*P
Solomon 1	21.325	22.714	0.096
Solomon 2	23.821	22.910	0.164
Solomon 3	24.432	24.019	0.574
Solomon 4	20.143	20.566	0.598
Solomon 5	17.138	17.276	0.271
Solomon 6	18.522	17.914	0.078
Blackcat 1	12.615	12.982	0.327

*none of the P values are significant

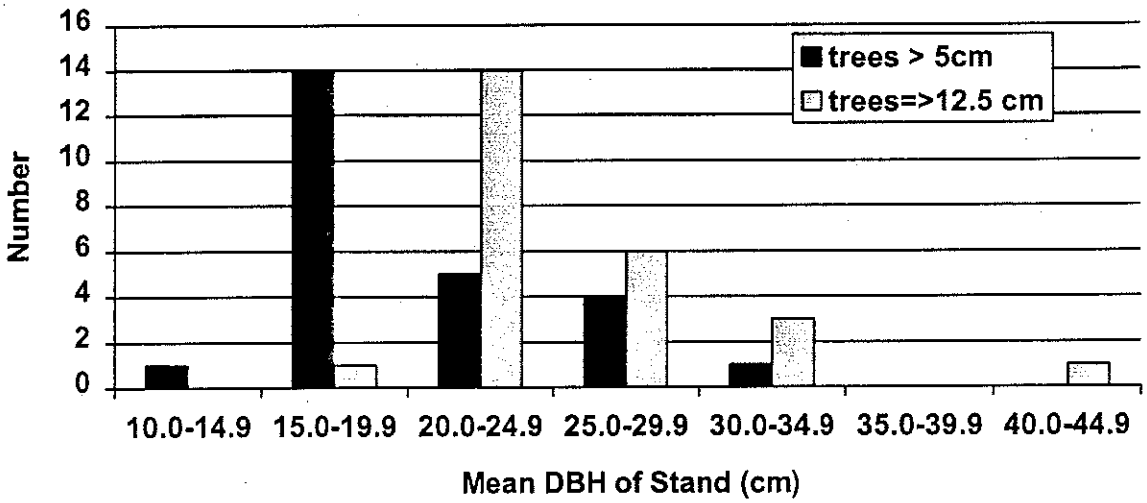


Figure 3-13: Mean diameter of trees in the roost stands, when all trees > 5 cm dbh are measured, and when all trees > 12.5 cm dbh are measured.

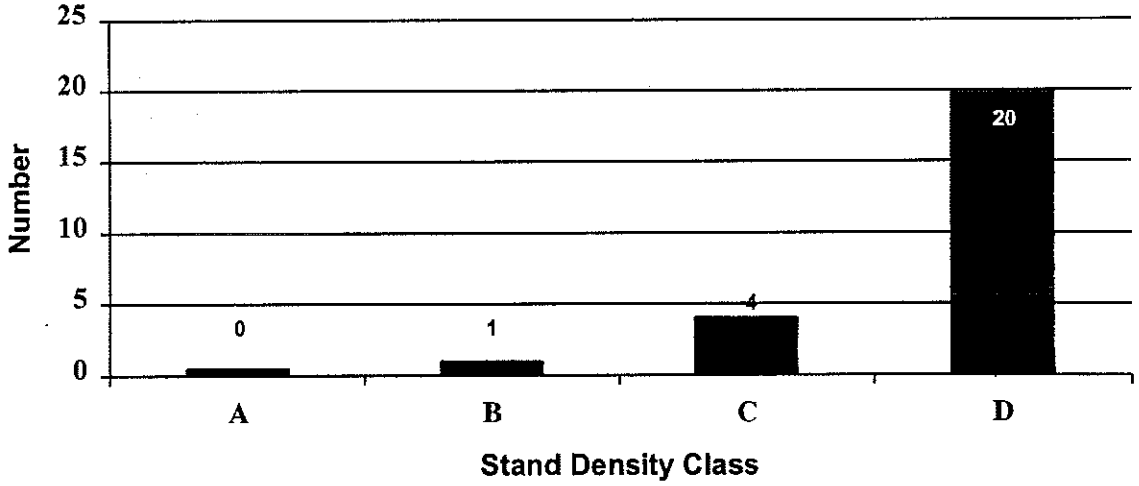


Figure 3-14: Stand density associated with roost sites. Density codes: A is 5-30%, B is 31-50% C is 51-70%, and D is 71-100% canopy closure.

Forage Sites

Eleven forage sites were located during this project. Eight were from the radiotagged female Barred Owl at Solomon Creek (four in 1995 (Takats 1996) and four in 1996). Three foraging attempts, one each, by the male Solomon Creek Barred Owl, the Blackcat male, and the Wild Hay female were observed. Eight live trees (seven trembling aspen, one balsam poplar), one white spruce stub, one trembling aspen snag, and one man-made post were used as forage perches. Mean diameter and height of the hunting structures were 27.5 cm and 18.3 m respectively. Mean perch height was 5.2 m, and mean distance of the perch site from trunk was 10.0 cm. The owls did not choose specific exposures to forage from.

The canopy cover of the forage stands was lower than for the roost and nest stands, averaging 61.5 percent canopy closure (range 22.9-89.7 percent). The average tree diameters of the forage stands were not significantly different from the center forage plots (Tables 3-10 and 3-11), in the three of the sites. The foraging plot had a slightly lower average tree diameter than the surrounding stand. Foraging areas were not located in the same stand as nest trees, but were found near the roost sites on four occasions. Average total shrub cover was significantly lower under the forage trees than the surrounding stand (T-test, P=0.02). The average total herb cover was also significantly lower (T-test, P=0.04).

Table 3-12: Example of test for skewness and kurtosis on the first Solomon female Barred Owl foraging observation average tree diameters.

	Mean	S.D.	Kurtosis	S.E. Kurtosis	Skewness	S.E. Skewness
Forage Plot	21.114	12.049	2.479	0.717	1.513	0.365
Forage Stand	22.594	12.486	2.539	0.428	1.428	0.216
Log Forage	1.265	0.226	-0.380	0.717	0.274	0.365
Log Stand	1.280	0.265	-0.428	0.428	-0.248	0.216

Table 3-13: Average tree diameters of forage plot and surrounding stand and significance values of three sites (* none of the P values are significant).

Forage Site	Forage Plot Average Tree Diameter	Forage Stand Average Tree Diameter	*P
Solomon 1	21.114	22.594	0.086
Solomon 2	19.625	20.452	0.097
Wild Hay 1	19.212	20.734	0.126

Telemetry

Live trapping of Barred Owls was not successful. 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 cautious individuals. Drop-lid trapping is not recommended for capturing Barred Owls, however, this method is useful for capturing other species of raptors.

The radiotagged Barred Owl increased its home range slightly from summer 1995 to winter 1995/96. Increases in home range allow for an increased area for foraging, when prey populations are less available. The home range also shifted into white spruce dominated habitat to take advantage of better thermal cover, which is required to shelter the owls from microclimate extremes (Demarchi and Bunnell 1993). The Blackcat male increased its home range, from 1995 to 1996, when the Northern Goshawk did not nest in the same location again. The Barred Owl and Northern Goshawk are known to be competitors (Eifrig 1907).

Habitat Use

By using stick nest searches and casual observations, 61 nests were located, however none were used by Barred Owls. There is one record of a Barred Owl using a stick nest in Alberta (G. Court, pers. comm.), and two in Saskatchewan (Mazur, pers. comm.). In the United States, there are also other records of Barred Owls using stick nests (Apfelbaum and Seelbach 1983). Our lack of success in finding stick nests during the aerial surveys indicates that stick nests in this area were not very visible from above.

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 stands of these species. Clearcuts and younger forests were also surveyed. A variety of topographic areas were surveyed including river valleys, lakes, streams, lower foothills, upper foothills, and montane ecoregions. The Barred Owls were found in mature and old growth mixedwood stands of white spruce, balsam poplar and trembling aspen (Appendix 3-3).

2. The effect fragmentation and disturbance on Barred Owls needs to be studied. Barred Owls may be affected by forest fragmentation because suitable nest, roost and forage habitats are opened up. Riparian areas are difficult to regenerate after clearcutting practices. Patch cuts are recommended to ensure that the forest is not fragmented to the stage where Barred Owls will no longer nest, and this will increase the speed at which the forest regenerates. Forestry practices must ensure that continuous stands of old mixedwood forest remain on the landscape.

3. Radiotelemetry is an excellent way to get detailed information about the habitat use (nesting, roosting and foraging) by Barred Owls. Other trapping techniques should be used to capture Barred Owls.

4. The difference in stand characterization between the photo interpreted AVI and the in field data collection, demonstrates the need to do ground truthing. As well, way data is collected should be compatible with forest harvest inventories, to ensure the data can be directly used in forest management.

5. The number of Barred Owls and other owls found during this project demonstrates the fact that the ecology of owls is still a relatively unknown. Broadcast surveys are a good way to get general owl habitat use, distribution, and relative abundance information of owls.

6. More information needs to be compiled on the owls in the Foothills Model Forest. These are long-lived species require long-term monitoring to understand the natural population fluctuations, so that anthropogenic caused declines can be seen. Baseline data needs to be collected to ensure that declines can be detected. Little is known about the reproductive success, productivity, percent of the populations breeding, and density.

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Appendix 3-2: Tree/Log characteristics recorded on vegetation surveys (0.04 ha area).

Tree species	Aw	Trembling Aspen (*Populus tremuloides*)
	Pb	Balsam Poplar (*Populus balsamifera*)
	Sw	White Spruce (*Picea glauca*)
	Sb	Black Spruce (*Picea mariana*)
	Pl	Lodgepole Pine (*Pinus contorta*)
	Fb	Balsam Fir (*Abies balsamea*)
	Fd	Douglas fir (*Pseudotsuga menziesii*)
	Lt	Tamarack, larch (*Larix laricina*)
Type	t	tree
	n	snag (above 1.4 m)
	m	stump (<= 1.4 m)
	c	cut stump
	s	stub
Distance from center	in meters	
DBH	diameter at breast height (cm), all trees 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
	1	insects
	2	falling/breakage
	3	animal
	4	other
	5	fungus
	6	cracking
	7	fire
	8	competition
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 > 1.4 m in height but < 5 cm DBH	
Log length	total length (m) all logs with base DBH > 5 cm in 0.04 ha plot	
Tip Diameter	diameter at the tip (cm)	
Base Diameter	diameter at the base (cm)	
Condition	1	fresh/green
	2	Hard, branches absent
	3	Soft, bark breaks with effort
	4	Rotten/punky, bark breaks easily
	5	Log becoming part of ground

Appendix 3-4: List of all territorial Barred Owl locations, sex of the owl, whether it is paired, and breeding evidence.

No.	Location	Sex	Paired	Breeding Evidence
1	Solomon Creek	F	Y	Nest (1996)
2	Solomon Creek	M	Y	Nest (1996)
3	Blackcat Ranch	F	Y	Nest (1996)
4	Blackcat Ranch	M	Y	Nest (1996)
5	WildHay Ridge	F	Y	No
6	WildHay Ridge	M	Y	No
7	Gregg Lake	F	Y	No
8	Gregg Lake	M	Y	No
9	Jarvis Creek	M	N	No
10	Jarvis Lake	U	U	No
11	Miette	F	Y	Nest (1994,95,96)
12	Miette	M	Y	Nest (1994,95,96)
13	Lynx Creek	F	Y	Nest (1995)
14	Lynx Creek	M	Y	Nest (1995)
15	Cold Creek	M	N	No
16	Cold Creek	F	N	No
17	Pedley 1	M	U	Unknown
18	Pedley 2	U	U	Unknown
19	Karen Owl	F	N	No
20	TriCreeks	M	U	Unknown
21	Gregg River	F	U	Unknown
22	Prest Creek	M	N	No
23	Marke Owl	U	U	Unknown
24	Emerson Lake	F	U	Unknown
25	Brian Owl	U	U	Unknown
26	Sheila Owl	U	U	Unknown
27	Lynx/Emerson	M	U	Unknown
28	Lynx Point 5	U	U	Unknown
29	Medicine Lodge	U	U	Unknown
30	Cache Percotte	M	N	No
31	WildHay North A	M	N	No
32	WildHay North B	U	U	Unknown
33	Camp Owl	M	N	Unknown
34	Patricia Lake	M	N	Unknown
35	Cottonwood	U	N	Unknown
36	Mina Lake	M	N	No
37	Kinky Lake	U	U	Unknown
38	Willow Creek	U	U	Unknown
39	Kirby Owl	U	U	Unknown
40	Jody Owl	U	U	Unknown
41	Polecat	U	U	Unknown
42	Carl Owl	U	U	Unknown

*M-male, F-female

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

Chapter 4

Barred Owl Prey Use in the Foothills Model Forest

Literature Review

There are a variety of opinions as to the feeding ecology of the Barred Owl. According to Errington (1932) considered the Barred Owl a generalist species, which takes a wide variety of prey. He also noted that their food choice was further determined by what was within their power to kill. The diet of the Barred Owl is comprised of small mammals, birds, reptiles, amphibians, fish, and insects showing they are clearly an opportunistic feeder (Karalus and Eckert 1974, Bent 1938, Johnsgard 1988).

Barred Owls appear to be specializing on small mammals in many cases (Table 4-1). Wilson (1938) found that *Microtus* comprised about 83 % of the Barred Owls' diet in Michigan. Errington and McDonald (1937) found that Barred Owls turned to small mammals in winter. Marks *et al.* (1984) discovered that *Microtus* dominated the diet of Montana Barred Owls. Devereux and Mosher (1984) recorded mammals, birds, and arthropods (crayfish, insects) in the diet of Barred Owls in the Central Appalachians, but found that mammals dominated the diet.

The Barred Owl supplements its diet with birds, fish, amphibians, and insects (Table 4-1). Marks *et al.* (1984) found some unusually large items including a Sharp-shinned Hawk (*Accipiter striatus*), and a Ring-necked Pheasant (*Phasianus colchicus*). Jackson and White (1995) located a road-killed Barred Owl with a freshly killed Loggerhead Shrike (*Lanius ludovicianus*) in its talons. The Shrike had a grasshopper in its bill. They also observed an owl hunting for grasshoppers on a roadside. Devine *et al.* (1985) also found Barred Owls hunting insects (noctuid moths) in Florida. Smith *et al.* (1983) observed Barred Owls fishing and Sweeny (1959) watched one plunge feet first into one meter of water, then flapped its wings to make its way to shore.

Although there is an abundance of literature on Barred Owl diet in the United States, there is very little literature on diet in Alberta, or Canada (Table 4-1). The only diet information existing for Alberta are of single sightings (Jones 1956, Takats 1996).

Objectives

The purpose of this study was to determine the diet and feeding ecology of the Barred Owl in the Foothills Model Forest, Alberta. The objectives were to determine 1) the prey of the Barred Owl, 2) the species and relative abundance of possible prey in a range of habitats, and 3) what prey was available to the Barred Owl.

4.2 Methods

Study Area

The Foothills Model Forest (FMF) is located in west-central Alberta and encompasses the Weldwood of Canada Forest Management Area, William A. Switzer Provincial Park, the Cache Percotte Forest, and Jasper National Park (2.3 million hectares). The study efforts were restricted to an area within a radius of 80 km from the town of Hinton, where pairs of Barred Owls had been located by broadcast surveys. Lodgepole pine (*Pinus contorta*) dominates the landscape in the foothills, while white spruce (*Picea glauca*), black spruce (*Picea mariana*), and trembling aspen (*Populus tremuloides*) are common at lower elevations, and balsam poplar (*Populus balsamifera*) and balsam fir (*Abies balsamea*) are uncommon. In the mountains Douglas fir (*Pseudotsuga menziesii*) is common and lodgepole pine are dominant (Strong and Leggat 1981).

Prey Use

Pellets and prey remains can be found under favorite roost trees (Blakemore 1940) or near nests (K. Mazur, pers. comm.). Searches were made for pellets and prey remains under and around roost and nest sites (within a 300 m radius). The pellets were picked apart and all skulls, jawbones, feathers, insect parts, and fur were identified. Unidentifiable parts were given to Wayne Roberts (Zoology museum, University of Alberta) and John Acorn (host of "The Nature Nut", Great North Productions, Edmonton) for identification. Other methods included observing owls forage and watching prey transfers at nests. Barred Owl feathers were collected and provided for stable isotope analysis (Duxbury, in prep.). This last method will not be discussed in this thesis.

Prey Surveys

A list of all potential prey species (birds/mammals/amphibians) was compiled over the first field season, in and near Barred Owl territories. To determine the relative abundance of these prey species, grouse drumming and bird point counts were conducted in 1996 in a range of habitats. Transects were randomly laid through 24 habitats (Appendix 4-2) ensuring that most habitat types found in Barred Owl territories were covered. Transects were chosen on or near Barred Owl territories and were measured using a 50 m chain. The transects varied in length, but were usually two kilometers.

Track counts were conducted in snow from February through April 1996. We recorded all tracks that crossed the transect, including species of animal that made the track and the amount of use. The counts were completed 12 to 96 hours after a snowfall so that tracks would be

Five prey transfers were observed during the project (Table 4-2). One microtine was brought in to the Miette nest and at the Solomon Creek nest one deer mouse, one Ruffed Grouse, and two unknown microtines were brought in. All the observations were made in April, May and June, 1996. The diet items were 75.0 percent mammals, 12.5 percent birds, and 12.5 percent amphibians. Microtines made up 31.3 percent of all prey items found by these two methods.

Table 4-2: Prey identified by direct observation of foraging or prey transfers.

Species	Forage	Prey Transfer	Total	% of Diet Items
Mammals				
Unidentified Shrew	1		1	
Deer Mouse	1	1	2	
Red-backed Vole	2		2	
Unidentified Microtine	2	3	5	
Red Squirrel	1		1	
Unidentified Bat	1		1	
Total Mammals	**8**	**4**	**12**	**75.0**
Birds				
Ruffed Grouse	1	1	2	**12.5**
Amphibian				
Wood Frog	2		2	**12.5**
Total	**11**	**5**	**16**	**100.0**

All other prey items were determined through pellet and prey remains analysis. In the first summer, no prey remains or pellets were found. The Barred Owls did not use specific trees for roosting and no nests were located, so it was difficult to find any signs of prey use. Most of the pellets (91.0%) and all but one of the prey remains were found 30-200 m away from active nests, in 1996. The remaining pellets were found in the winter above the snow under roost trees.

Seventy-eight pellets and eleven prey remains were collected and analyzed and were found to contain 155 prey items of a variety of mammals, birds, amphibians, and insects (Table 4-3). Wood Frogs were identified using jawbones found in pellets. Most of the wood frogs were adults based on the size of the jaws. Birds were identified by feathers and small mammals were determined using skulls, jaws, teeth and leg bones. The elytra of the beetles were used to identify them to species. The Barred Owls' diet consisted of 71 small mammals (45.8%), 39 birds (25.2%), 38 amphibians (24.5%), and 7 invertebrates (4.5%). Almost all the prey remains were birds (90.9%) while most of diet items in the pellets were small mammals (48.6%).

Almost half of the diet was made up of small mammals, and microtines were 30.3% (n=47) of the diet. The three vole species were made up 20.6 percent of the diet items. Some interesting and abundant diet items include the wood frog (n=38) and the three species of Thrush (n=14), in particular the Varied Thrush (n=10). Each pellet contained 1.8 prey items on average.

When the prey items (pellets, prey remains, foraging observations) are divided by individual Barred Owl, some birds appear to have unique feeding habits (Table 4-4). The Solomon Creek female Barred Owl was the only one found to be eating beetles. Amphibians were only found in the pellets of the Solomon Creek male and female and the Miette female Barred Owls. The Wild Hay female Barred Owl was taking more birds (70.6 %) than mammals (29.4 %). Both the Blackcat Ranch male and the Miette female had a high proportion of small mammals in their diets.

Table 4-4: *Prey items (%) of individual Barred Owls (sample size in brackets)

Location	Mammals	Birds	Amphibians	Invertebrates	Total
Solomon Creek Female	41.3 (45)	20.2 (22)	32.1 (35)	6.4 (7)	100 (109)
Solomon Creek Male	50.0 (4)	12.5 (1)	37.5 (3)		100 (8)
Miette Female	77.8 (21)	14.8 (4)	7.4 (2)		100 (29)
Blackcat Male	80.0 (4)	20.0 (1)			100 (5)
Wild Hay Female	29.4 (5)	70.6 (12)			100 (17)

*Does not include prey transfers.

Snow Track Surveys

A total of seventeen species were recorded during snow track surveys (Table 4-5). Only ten of these species could serve as potential prey for the Barred Owl, and therefore are the only ones analyzed for abundance in different habitats. The species analyzed are: Ruffed Grouse, shrew sp., deer mouse, jumping mouse, vole sp., red squirrel, snowshoe hare, least weasel (*Mustela nivalis)*, long-tailed weasel (*Mustela frenata)*, and ermine (*Mustela erminea)*. The red squirrel, Ruffed Grouse, and snowshoe hare were the most abundant species recorded on the snow track counts. Species that were not used by Barred Owls as prey, but were recorded on the snow transects include: fisher (*Martes pennanti*), marten (*Martes americana*), coyote (*Canis latrans*), wolf (*Canis lupus*), moose (*Alces alces*) and deer (*Odocoileus sp.*).

Ruffed Grouse were most abundant in old growth balsam poplar/white spruce mixedwood,

Table 4-5: Con't.

	[1]HABITAT TYPE										
Species	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Birds											
Ruffed Grouse	0	1.9	0	0	2.1	0	2.0	1.7	0	0	0
Mammals											
Shrew	0	0	0	0	0	0.2	0	0	0	0	0
Deer Mouse	0.5	0.2	0	0	0	0	0	0	0	0	0
Jumping Mouse	0	0.2	0	0	0	0	0	0	0	0	0
Vole	0	0.1	0	0	0	0	0	0	0	0	0
Red Squirrel	4.3	5.8	4.2	6.7	1.1	0.8	0	3.1	1.2	1.2	4.0
Snowshoe Hare	0	5.7	0.2	26.7	0	3.3	0	1.7	0	0	6.0
Least Weasel	0	0	0	0	0	0	0	0	0	0	0
Long-tailed Weasel	0	0	0	0	0	0	0	0	0	0	0
Ermine	0	0.2	0.5	0	0	0	0	0	0	0	0

[1]Habitats: Aw-trembling aspen, Pb-balsam poplar, Sw-white spruce, Pl-lodgepole pine, Fb-balsam fir, Sb-black spruce.
14=PlAw, >25 m; 15=Sb, 10-15 m; 16=SbPl, 1-20 m; 17=PlFb, 20-25 m; 18=SbAw, 15-20 m; 19=SwSb, 15-20 m; 20=AwPl, regenerating clearcut, 0.5-3 m; 21=Sw, sparse 10 m; 22=Pl, 6-8 m regenerating clearcut; 23=Sw, dense 10 m; 24=cutlines

mature black spruce, and younger forests containing white spruce. They were also found to be fairly abundant in regenerating clearcuts (trembling aspen/lodgepole pine) and in mature white spruce forests. The red squirrel was closely associated with conifer stands and was never found in pure deciduous forests (habitat types 3 and 11). The snowshoe hare had the highest abundance in balsam poplar/trembling aspen mixedwood, mature and old growth white spruce, mature lodgepole pine/balsam fir mixedwood, and mature black spruce stands. The hares were not found to be using clearcuts.

Grouse Drumming Counts

Ruffed Grouse surveys were conducted on eight of the fifteen transects due to time constraints. Grouse began drumming in early April and continued through to late May. Fifteen grouse were recorded on 55 stations. Grouse were heard drumming primarily in pure deciduous or deciduous dominated mixedwood stands that were above 20 m in height (Table 4-6). No grouse were heard in older pure coniferous stands.

Table 4-6: Locations and habitats associated with drumming Ruffed Grouse.

Habitat	Stand Height (m)	# of points	# of Ruffed Grouse
Trembling Aspen/White Spruce	>25	12	4
Balsam Poplar/White Spruce	>25	2	1
Balsam Poplar	>25	2	2
Trembling Aspen	>25	12	3
White Spruce/Lodgepole Pine	>25	1	0
White Spruce/Balsam Fir	20	1	0
White Spruce	15-20	2	0
White Spruce	>25	5	0
Trembling Aspen/White Spruce	15-20	7	1
Balsam Poplar/Trembling Aspen	>25	2	2
Lodgepole Pine	>25	1	0
Trembling Aspen/Lodgepole Pine	1-3	4	0
White Spruce (sparse)	10	3	1
Lodgepole Pine	7	1	0
White Spruce (dense)	10	1	1

Bird/Squirrel Point Counts

Sixty-three species of birds and Red Squirrels were recorded on the point counts (Appendix 4-4). The species of birds that had more than 15 records were: Black-capped Chickadees, Gray

Table 4-7: Point count results showing relative abundance of each species detected in each habitat (number observed/plot/visit).

	[1]HABITAT TYPE											
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Birds												
Ruffed Grouse	0.09	-	-	-	-	-	-	-	-	-	-	-
Northern Flicker	0.36	0.50	-	0.25	-	-	-	-	-	-	-	-
Least Flycatcher	0.63	1.00	-	0.75	-	-	0.14	0.17	-	-	-	1.00
Gray Jay	1.00	-	-	-	-	0.17	-	-	-	-	-	-
Black-capped Chickadee	0.45	-	-	0.25	-	-	-	-	-	0.33	-	-
American Robin	0.64	-	-	0.33	-	-	-	0.50	-	-	-	-
Swainson's Thrush	1.00	1.00	1.00	0.42	-	1.00	1.00	0.33	-	-	-	-
Varied Thrush	-	-	-	-	-	0.17	-	-	-	-	-	-
Golden-crowned Kinglet	0.63	-	0.50	0.08	0.67	1.00	0.29	1.17	-	0.33	-	0.33
Ruby-crowned Kinglet	1.00	1.00	-	0.42	0.67		0.86	1.00	-	1.33	1.50	-
Myrtle Warbler	0.81	1.00	1.50	0.75	1.67	2.00	0.71	0.83	-	1.00	1.00	0.33
Orange-crowned Warbler	0.27	1.50	1.50	0.42	0.17	-	-	-	-	0.33	-	0.33
Common Yellowthroat	0.11	0.11	-	-	-	-	-	-	-	-	-	-
Ovenbird	0.63	0.11	1.00	1.08	-	-	0.14	-	-	0.33	1.00	-
White-throated Sparrow	0.64	-	-	0.58	-	-	0.86	0.83	-	-	2.00	-
Chipping Sparrow	0.36	-	-	0.33	0.33	-	0.43	0.83	-	0.33	1.00	-
Dark-eyed Junco	1.00	-	-	0.33	0.33	-	0.43	0.17	1.00	-	-	-
Mammal												
Red Squirrel	1.09	1.00	-	0.33	0.33	1.00	0.29	1.33	-	0.67	-	-

[1]Habitat types: see bottom of Table 4-6.

4.4 Discussion

Prey Use

The Barred Owls in the FMF are taking a wide variety of prey, and therefore appear to be a generalist feeder over their foothills range. A major portion of their diet consisted of small mammals, birds, and amphibians. However, if the wood frog and Varied Thrush are eliminated from the totals, the Barred Owl is a specialist on microtines and sciurids (56.9% of diet items) and 68.1 % of the diet is mammals. According to the literature Barred Owls are prey generalists (Bent 1938), exploiting a wide range of resources (Krebs 1994). When each individual Barred Owl's diet is examined, we find some opportunistic feeding behavior on certain prey items, at certain times of the year, in certain locations.

The diet of the Barred Owls was found to be 75.0 % mammals when foraging and prey transfers were observed, whereas only 45.8 % of the diet items were mammals when pellets and prey remains were analyzed. All of the foraging attempts and the prey transfers were observed between late summer and early spring. The pellets and prey remains were collected throughout the year. The Barred Owls may be feeding on more birds during June, July and August when they are more available. The addition of Varied Thrushes and wood frogs to the diet also decreased the percentage of small mammals in the pellets and prey remains.

The Barred Owls appeared to be opportunistically feeding on two occasions, taking food that was most available at that time. In early May, a winter snowstorm produced 78 cm of snow in two days. The Varied Thrushes had already arrived in numbers from the south. This species is known to return early April to mid-May (Holroyd and Van Tighem 1983), but is not adapted to this colder weather. Many birds were seen in flocks along the open roads and cutlines, perched on the ground in places where snow had melted. The Barred Owls targeted this food source for one week.

When the Varied Thrush became less available to the Barred Owl and it returned to its usual habitat, wood frogs became more common in the pellets. Many predators will seek another prey species, when the one they have been specializing on becomes rare or unavailable. Prey switching occurs when one prey item becomes less available and another becomes more available (Begon *et al.* 1990). The Barred Owls appeared to be opportunistically feeding on wood frogs in May and early June when the adults were dispersing from breeding ponds Russell and Bauer

The highest abundance of snowshoe hares was recorded in pure deciduous forest. There was also a high abundance in pure coniferous forest. Snowshoe hares occur in a variety of different habitats (Wrigley 1969, Keith 1974, Wolff 1980, Litvaitis *et al.* 1985), however the amount of understory cover is the most important factor in the winter months, to provide thermal protection (Meslow and Keith 1968, Conroy *et al.* 1979, Litvaitis *et al.* 1985). There is little cover in a deciduous stand in the winter due to loss of leaves, and little shrub cover due to snow pack. A conifer forest would provide better thermal cover than a deciduous stand when air temperatures are colder.

The red squirrel was found to be associated with conifers. This species was never found in pure deciduous stands during the snow track surveys and was only recorded once during the point counts. The majority of its diet consists of seeds extracted from conifer cones, therefore spruce and/or pine are an essential part of their habitat (Pattie and Hoffman 1992). Although the red squirrel is primarily arboreal, the Barred Owl was able to catch one in a tree (Takats 1996).

The Northern Flicker was abundant in old deciduous and mixedwood forests with a high number of snags. Woodpeckers are dependent on older trees and snags for nesting, roosting, and foraging (Conner *et al.* 1975). Mannan *et al.* (1980) found the highest abundance of flickers in 200 year old stands in western Oregon, and Semenchuk (1992) reports this species uses a variety of habitats in Alberta. Northern Flickers spend much of their time foraging on the ground for ants, beetles and other invertebrates.

The Gray Jay chose predominantly coniferous stands and was only found in older forest. Conversely, Farr (1995) found that the Gray Jay had a higher abundance in younger forest. The Varied Thrush was also found in coniferous stands, which is similar to the findings of Farr (1995) and Semenchuk (1992). Quinlan *et al.* (1990) notes that there is little provincial research on the habitat associations of the Varied Thrush. This thrush is frequently seen foraging on the ground. The American Robin is also a ground feeder, and is in highest density in white spruce and trembling aspen forests. The points counts showed that the robins was more of a generalist and was found in lodgepole pine/balsam fir, black spruce, and white spruce/trembling aspen mixedwood.

The microtines were a very important part of the Barred Owls diet. No conclusions could be reached based on the snow track surveys. According to Holroyd and Van Tighem (1983) red-

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Appendix 4-1: Common and scientific names of Barred Owl prey items found in literature.

Common Name	Scientific Name
Small Mammals	
Short-tailed Shrew	*Blarina brevicauda*
Masked Shrew	*Sorex cinereus*
Starnose Mole	*Condylura cristata*
Chipmunk	*Tamias striatus*
Northern Pocket Gopher	*Thamomys talpoides*
Red Squirrel	*Tamiasciurus hudsonicus*
Northern Flying Squirrel	*Glaucomys sabrinus*
Southern Flying Squirrel	*Glaucomys volans*
Deer Mouse	*Peromyscus maniculatus*
White-footed Mouse	*Peromyscus leucopus*
Red-backed Vole	*Clethrionomys gapperi*
Meadow Vole	*Microtus pennsylvanicus*
Rat	*Rattus sp.*
Snowshoe Hare	*Lepus americanus*
Birds	
Ruffed Grouse	*Bonasa umbellus*
Northern Flicker	*Colaptes auratus*
Blue Jay	*Cyanocitta cristata*
Invertebrates	
Crayfish	*Cambarus sp.*

Appendix 4-3: Article on four foraging observation on a female Barred Owl.

Foraging Observations of a Barred Owl in the Foothills Model Forest

D. Lisa Takats

Throughout its range, the Barred Owl *(Strix varia)* is known to feed on a wide variety of prey including small mammals (especially rodents), birds, frogs, lizards, small snakes, salamanders, fish and insects (Johnsgard 1988). In most cases, prey have been determined through analysis of pellets and prey remains. The Barred Owl is thought to be a seminocturnal to nocturnal hunter. On four separate occasions, I observed a radio-tagged, female Barred Owl foraging near Brule, Alberta.

On two occasions, the owl flew to the ground from low perches in trembling aspen *(Populus tremuloides)* trees. The habitat was a mixedwood stand of aspen and spruce *(Picea glauca)*. The perch trees were on the side of a small hill, which minimized the distance the owl had to travel to the ground. The owl appeared to be foraging for small mammals, but was unsuccessful. These observations were made at 8:05 p.m. on August 2, 1995 and at 11:30 a.m. on October 1, 1995.

The third foraging observation was more interesting. The owl was found at 9:30 a.m. on December 30, 1995 roosting 5 m up in an aspen snag. The habitat was white spruce-dominated mixedwood. A red squirrel *(Tamiasciurus hudsonicus)* ran across an opening and drew the attention of the owl. She sat watching the squirrel for 10 minutes, but flew away a short time later when it went underground. I followed in hot pursuit. I could hear a squirrel barking loudly about 50 m away and walked in that direction. Just as I spotted the squirrel 5 m up in a spruce tree, the owl flew into the scene and right at the squirrel. The squirrel bolted up the tree out of reach of the owl. The owl flew up to another aspen tree, perched 7 m up and watched the squirrel.

The squirrel sat 5 m up in a spruce tree barking and rattling for over a half hour, then quieted down. Then the owl suddenly flew at the squirrel a second time, but missed her target, as the squirrel ran up the tree. The owl's wings were tangled in the dense branches, and it was a while before it was able to get its talons secured onto a branch. The owl flew to another perch and sat watching the squirrel intently. The squirrel was barking loudly, running from tree to tree, but did not leave the area.

The squirrel calmed down again about 20 minutes later. The owl immediately flew at the squirrel, once again missing, and once again getting tangled in the branches. Without stopping, the owl flew at the squirrel again and again missed. This time she really got caught up in the branches, and almost fell out of the tree.

Being too low for good flight, the owl proceeded to scale up the spruce tree's trunk until she reached a 6 m perch. She scratched her bill with a talon, looking down at me with an exasperated expression. "You can do it," I willed her. She scratched one more time, stretched one wing and preened it for a short time. Then she sat quietly, staring intently at the squirrel running up and down from tree to tree but never going to the ground. I believe the squirrel thought it was safer in the trees than on the ground. The squirrel finally stopped running and sat still in a spruce tree about five meters up. Another squirrel in an adjacent territory started barking. The barking must have distracted the first squirrel, because the owl flew at it and killed it with her talons. There was no struggle; the owl sat there for a short time, then flew off with her prize.

The fourth foraging observation was not nearly as exciting. On March 17, 1996, at 6:30 a.m., the owl was perched in a 30 cm diameter aspen tree, about 4 m off the ground. The habitat was mixedwood with balsam poplar, *(Populus balsamifera)*, white spruce and aspen. I looked over to see what the owl was looking at and observed a vole scurrying along the ground. In a split second, the owl grasped the prey and flew up to a perch. The vole disappeared in one swallow.

In my Masters thesis, I am studying the ecology of the Barred Owl in the Foothills Model Forest, Alberta. The Barred Owl has the potential to serve as an indicator of older age class forests. My objectives are to determine what key habitat features are important to the Barred Owl for nesting, roosting and foraging. I am also trying to determine what prey species are selected by the Barred Owl, through the analysis of pellets and prey remains. In the first field season, I did not find any pellets or prey remains. Observing foraging attempts is an alternate way of determining prey used by the Barred Owl, and it is much more interesting than picking through bones and feathers.

Acknowledgments:

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Appendix 4-4 (Con't.)

44	Thrush, Swainson's	*Catharus ustulatus*
45	Thrush, Varied	*Ixoreus naevius*
46	Vireo, Red-eyed	*Vireo olivaceus*
47	Vireo, Blue-headed***	*Vireo plumbeus*
48	Vireo, Warbling	*Vireo gilvus*
49	Warbler, Bay-breasted	*Dendroica castanea*
50	Warbler, Black-throated green	*Dendroica virens*
51	Warbler, Myrtle	*Dendroica coronata*
52	Warbler, Orange-crowned	*Vermivora celata*
53	Warbler, Tennessee	*Vermivora peregrina*
54	Warbler, Yellow	*Dendroica petechia*
55	Waterthrush, Northern	*Seiurus noveboracensis*
56	Waxwing, Bohemian	*Bombycilla garrulus*
57	Western Wood-peewee	*Contopus sordidulus*
58	White-winged Crossbill	*Loxia leucoptera*
59	Woodpecker spp.	Picidae
60	Woodpecker, Hairy	*Picoides villosus*
61	Woodpecker, Pileated	*Dryocopus pileatus*
62	Woodpecker, Three-toed	*Picoides tridactylus*
63	Wren, Winter	*Troglodytes troglodytes*

1997 AOU changes (American Ornithologists Union 1997)
* the genus for chickadee changed from *Parus* to *Poecile*
** the genus of the Spruce Grouse was formerly *Dendragapus*
*** the Plumbeus Vireo is formerly known as the Solitary Vireo, *Vireo solitarius*

5 Introduction

Habitat suitability index models (HSI) are useful tools that can help in forest management. The main objectives of HSI models are to understand the key environmental factors that affect the abundance of a species, and to use this information to predict the future of the species when changes in the environmental conditions occur (Lancia *et al.* 1982, Morrison *et al.* 1992). HSI modeling is one way of estimating the ability of forested lands to support specific species (Beck and Beck 1995). The planning and evaluation process called Habitat Evaluation Procedures (HEP), focuses on the quantification of the habitat requirements of certain wildlife species based on two primary variables: the HSI and the total area of available habitat (Schamberger *et al.* 1982, USDI 1981).

Three categories of life requisites, that could limit a species in a given habitat or range of habitats, are specified in HSI models: food, cover, and reproduction (Van Horne and Weins 1991). The HSI model for the Barred Owl (*Strix varia*) in the United States identifies the most critical component of Barred Owl habitat as the availability of trees for nesting (Allen 1987). The variables in this model are: number of trees ≥51 cm dbh/0.4 ha, mean diameter of overstory trees, and percent canopy cover of overstory trees.

The draft HSI model for the Barred Owl in the Foothills Model Forest uses breeding habitat as the focus (Olsen *et al.* 1996). The variables measured in this draft model include: mean diameter (DBH) of stand (S1 and S7), number of deciduous trees greater than 35 cm DBH (S2), tree canopy closure (S3), the percent spruce and/or fir in the canopy (S4), percent deciduous forest (S5), distance from human disturbance (S6), and distance from opening (S8) (Figure 5-1, Table 5-1). The formula is: HSI = MAX [S1xS2, 0.3xS7xS5] x S3 x S4 x S6 x S8. The main nest tree components (S1 and S2) can be partially compensated (0.3) when the mean DBH of the trees is over 20 cm DBH (S5 and S7). This higher average diameter allows for the possibility that the Barred Owls may choose a cavity or a stick nest in a smaller tree.

This HSI model produces 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. The model produces a 0-1.0 index with the assumption that there is a direct linear relationship between the HSI value and carrying capacity (USDI 1981).

Table 5-1: Relationship of habitat variables to life requisites for Barred Owl year-round range. Life requisites are either nesting or cover since food is not assumed to be limiting (Olsen *et al.* 1996).

HSI Variable	Description Requisite	Life	Definition
S1	Mean DBH of Stand (cm)	Cover	Mean diameter of all dominant and codominant canopy trees at 1.4 m height (≥12.5 cm DBH).
S2	Deciduous Trees > 35 cm DBH/ha	Nesting	Number of balsam poplar trees with a minimum diameter of 35 cm at 1.4 m height.
S3	% Canopy Closure	Cover	Projected horizontal coverage of canopy trees in relation to the total stand area.
S4	% Spruce and/or Fir	Cover	Sum of the percent composition of all spruce and fir trees as determined from proportion of total tree volumes.
S5	% Deciduous	Nesting	Sum of the percent composition of aspen, balsam poplar, and paper birch trees as determined from proportion of total tree volumes
S6	Distance From Human Disturbance (m)	Nesting, Cover	Human disturbance is defined as roads and trails with motor vehicle access, train tracks, industrial sites, active well sites, and settlement areas.
S7	Mean DBH (cm)	Nesting/ Cover	Mean diameter of all dominant and codominant trees at 1.4 m height.
S8	Distance From Opening (m)	Cover	Openings are defined as all areas (≥1 ha) with 'A'class crown closure (< 6 %). This also includes regenerating clearcuts which do not yet have canopy tree development

The objectives of this chapter are:

1. To use information gathered on the habitat use of the Barred Owl in the Foothills Model Forest to test the draft habitat model.
2. To modify the variables and formula of the draft HSI model to fit the current data.
3. To make recommendations on future work needed to improve the model further.

owls' choice of stands. The average measure of each variable for the three nests was used to modify the graphs to better fit the data. Three other nests were used to verify the equation.

5.2 Results

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). Based on home range data collected from two nesting pairs in the FMF, the minimum habitat area occupied by a pair was 300 ha.

Carrying Capacity

The density of Barred Owls was determined to be 0.05 owls/km^2 (see Chapter 3), which translates to 0.0025 pairs/ha. This density covers the entire study area (calculated by number of owls that responded on broadcast surveys in a measured area, see Chapter 2 of this thesis) and therefore includes suitable and unsuitable habitats.

Test

The three test nests had similar measures for the variables included in the draft HSI model (Table 5-2). The mean stand DBH of the three nests ranged from 21.8 to 29.5 cm. The number of deciduous trees ≥ 35 cm DBH/ha and the tree canopy closures (measured by a densiometer) were quite high. The spruce/fir in the canopy was over 50 percent in all nest sites, and the deciduous component was always over 20 percent. The distance from human disturbance was less than 100 meters in one case. The distance to an opening ≥ 1 ha was 15, 20, and 40 meters.

Table 5-2: Measured variables (S1 to S7) for the three randomly chosen nests.

Nest	Mean DBH (cm)	# deciduous ≥ 35 cm DBH/ha	Tree Canopy Closure (%)	% Spruce/Fir in Canopy
1 (Blackcat)	21.8	40	80.2	80
2 (Miette 1)	29.5	30	78.0	50
3 (Miette 3)	23.7	25	79.4	50

Nest	% Deciduous in Canopy	Distance from Human Disturbance (m)	Distance to an Opening (m)
1	20	70	15
2	50	100	20
3	50	250	40

7. The size of opening in the draft model is 1 ha (the smallest polygon visible on a GIS map). This component is to ensure habitat is not suitable for the Great Horned Owl. Great Horned Owls require larger opening in the forest, and therefore this component has been changed to distance to openings (<6% canopy closure) greater than 5 ha (Figure 5-8).

Table 5-4: Modified relationship of habitat variables to life requisites for Barred Owl year-round range. Life requisites are either nesting or cover, as food is not considered limiting.

HSI Variable	Description Requisite	Life	Definition
S1	Mean DBH of Stand (cm)	Cover	Mean diameter of all dominant and codominant canopy trees 1.4 m height (≥12.5 cm DBH).
S2	Balsam Poplar Trees ≥ 60 cm dbh/ha	Nesting	Number of Balsam Poplar trees with a minimum diameter of 60 cm at 1.4 m height.
S3	% Canopy Closure	Cover	Projected horizontal coverage of canopy trees in relation to the total stand area.
S4	% White Spruce and/or Fir	Cover	Sum of the percent composition of all spruce and fir trees as determined from proportion of total tree numbers in canopy.
S5	Deciduous Trees ≥ 35 cm dbh/ha	Nesting	Number of deciduous trees with a minimum diameter of 35 cm at 1.4 m height.
S6	Distance From Human Disturbance (m)	Nesting, Cover	Human disturbance is defined as roads and trails with motor vehicle access, train tracks, industrial sites, active well sites, cutblocks, and settlement areas.
S7	Distance From Opening (m)	Cover	Openings are defined as all vegetated areas (≥5 ha) with 'A'class crown closure (< 6 %). This also includes regenerating clearcuts which do not yet have canopy tree development.

The new formula is:

$$\mathbf{HSI = MAX[S1xS2, 0.5xS5xS1]x\ S3\ x\ S4\ x\ S6\ x\ S7}$$

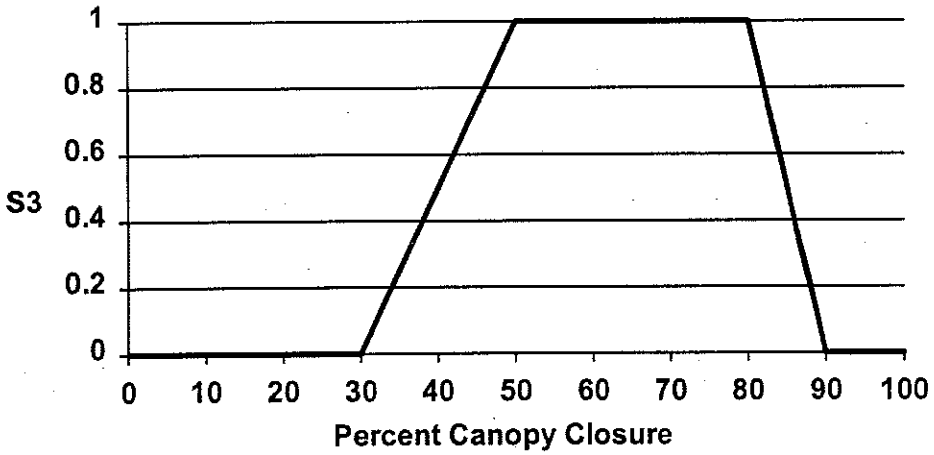

Figure 5-4: S3 variable - percent canopy closure of the stand.

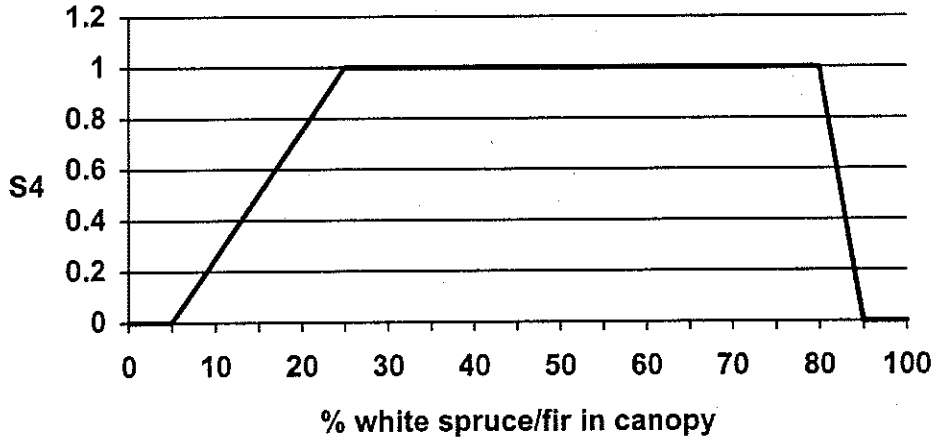

Figure 5-5: S4 variable - percent white spruce and/or fir in the canopy.

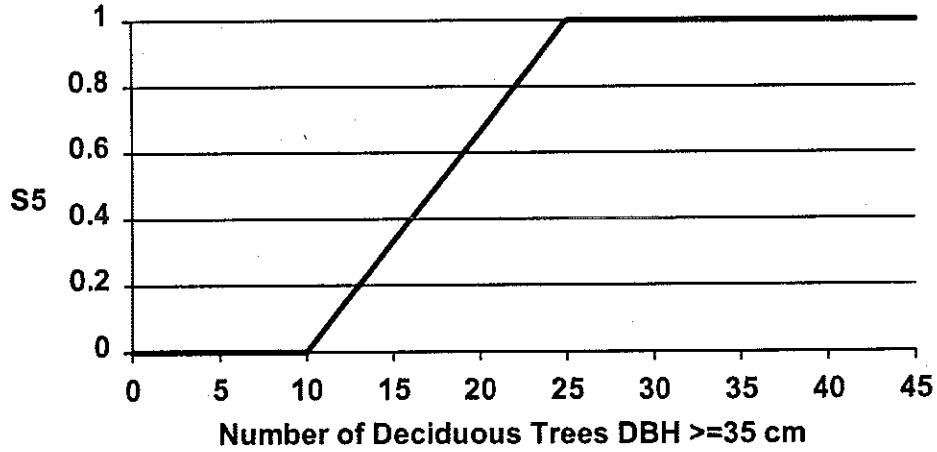

Figure 5-6: S5 variable - number of deciduous trees with diameter $\geq$ 35 cm.

Table 5-6: HSI values for the modified habitat model on three new nests and three previously tested nests.

Nest	S1	S2	S3	S4	S5	S6	S7	HSI
4	1.0	1.0	1.0	1.0	1.0	1.0	0.85	0.85
5	1.0	1.0	1.0	1.0	1.0	0.5	0.05	0.0025
6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1	1.0	1.0	0.98	1.0	1.0	0.5	0.5	0.245
2	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.5
3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

5.3 Discussion

5.3.1 Habitat Variables and HSI Components

The calculation of this HSI for the Barred Owl considers only the life requisite of reproductive habitat (nesting and roosting). The main nest tree components (S1 x S2) 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.

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 5-2. Each variable used to predict the HSI components are then defined.

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. Based on data collected on foraging habitat, forested habitats that contain cover for nesting and roosting are suitable for foraging. Stands of mature trees with large diameters for nesting sites and suitable canopy closure are essential reproductive habitat components for the Barred Owl. The Barred Owls use mature stands with little or no understory vegetation to facilitate hunting.

distance to human disturbance areas is SI component S6. Barred Owls also typically avoid clearings or other open areas as well as the mature forest edge within the first few hundred meters, so this distance is used to predict SI component S7 (Bosakowski *et al.* 1987). The distance to opening is a penalty for the creation of Great Horned Owl habitat. Great Horned Owls (*Bubo virginianus*) move into fragmented forests and will prey on the Barred Owl (Laidig and Dobkin 1995).

5.3.2 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 trees with broken tops or cavities 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 ≥ 60 cm DBH in a particular stand is representative of reproductive habitat quality. Barred Owls may nest in stick nests built by other raptors, in stubs, or in Aspen cavities therefore deciduous trees ≥ 35 cm. 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 ≥50% but not greater than 80%.
6. Snags are not used for nesting in this model, but could potentially be used.

5.4 Conclusion

The recommendations for changes are based on six nests and general habitat information of 42 territorial owls. As more information is learned about Barred Owls, these may have to be modified again. Future work should include:

-determining fledging success of Barred Owls.

-determining turnover rates.

-studying the affects of habitat fragmentation and human disturbance on Barred Owls.

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6.1 Overview

Human activities have dramatically disturbed the natural environment. With increases in population growth, there has been an increase in the exploitation of natural resources for human use (Morrison *et al.* 1992). This increased exploitation of resources results in a conflict with wildlife habitat, in many cases. This is true with the forest industry, an industry that has become a cornerstone of Alberta's economy. The Spotted Owl (*Strix occidentalis*), an old growth dependent raptor, is the most dramatic example of conflict between wildlife and the forest industry in North America.

As older forests are usually targetted first for harvest, the amount of old growth forest remaining becomes lower and increasingly fragmented. Older forests are said to be decadent, overmature, and unhealthy (insects and disease) by the forest industry. The words on a sign at a demonstration forest near Whitecourt, Alberta describes old growth forest as this:

> "Look around. You are surrounded by an 'old growth forest' – a white spruce forest which has escaped destruction by fire and is now in a state of decline due to old age and other natural forces. The white spruce trees are approximately 150 years old, long past the normal lifespan of healthy maturity. Look carefully and you can see evidence of the decline: trees blown over by the wind, interior fungus rot, extremely visible insect damage to bark, mosses growing on the branches, and balsam fir saplings beginning to take over the stand. Stands such as this, if left alone, usually succumb to natural decay or fire, and result in the loss of timber for lumber or pulp. A managed forest is harvested before the trees reach this state and subsequently reforested with seedlings, perpetuating the cycle of establishment, growth and harvest."

As well, clearcut harvesting practices select for even-aged, single species forests. Barred Owls in the Foothills Model Forest use old, uneven-aged, mixedwood forests.

Barred Owl populations are affected by the loss of habitat. Loss of nesting, roosting and foraging habitat occurs when a forest is clearcut, and the Great Horned Owls move in with increased fragmentation. There is direct conflict between these two owl species, with the Barred Owl losing out to the larger Great Horned Owl (Bent 1961, Johnson 1993, Laidig and Dobkin 1995, Court personal comm.). The lack of suitable habitat, plus the increased presence of Great Horned Owls were major factors in determining the absence of Barred Owls in Michigan (Craighead and Craighead 1969).

4. Radiotelemetry is a good way to get detailed information about the Barred Owl nesting, roosting and foraging. Although this study was unsuccessful in trapping, there is other methods that may be used for trapping Barred Owls successfully. The use of hand nets with a lure animal and the use of live decoy with mist nets have been used successfully in other studies (Court, Cromie, Olsen pers. comm.).

5. Raptors are excellent indicators of ecosystem health (Oliphant 1994). Raptor surveys need to be continued to better understand the distribution and abundance of raptors in the Foothills Model Forest. Daytime road surveys and banding of all species of raptors will ensure a database is started.

6. More ecological information needs to be collected on owls. To know how a species is affected by fragmentation it is important to measure breeding success and turnover (Redpath 1995). Little is known about the reproductive success, productivity, percent of the population breeding, and density. I recommend setting up a 10 km^2 area for study. It is important to collect detailed information on the number owls, species, number nesting, number of young, and number of young fledging in a known area. Similar studies have been conducted in Finland (P. Saurola, pers. comm.).

7. To maintain biodiversity and ecological function, clearcuts are not advisable in a boreal riparian ecosystem (Perry *et al.* 1989, Timoney and Peterson 1996). Barred Owls used large diameter balsam poplar trees for nesting. Balsam poplar is associated with wetter sites and forest companies have a difficult time regenerating these stands. Although, leaving these areas standing will provide some good Barred Owl habitat, forestry operations must ensure that enough old mixedwood uneven-aged forest remains to ensure healthy populations of Barred Owls are maintained.

8. Barred Owls are directly affected by forest fragmentation (Laidig and Dobkin 1995). 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 and Great Gray Owls. Nesting areas need to be protected with at least a 100 m buffer, and disturbance should be minimized during the nesting season (February through July).

9. Studies need to look at the effects of anthropogenic changes (fragmentation) and Great Horned Owls on Barred Owl productivity and survival.