STATUS AND HABITAT REQUIREMENTS OF THE BOREAL OWL (*Aegolius funereus*) IN NORTHEAST MINNESOTA.

1990-1991
FINAL REPORT SUBMITTED TO:

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BY:

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ABSTRACT

Nocturnal, auditory surveys were conducted in 1990 and 1991 to locate singing male boreal owls (*Aegolius funereus*) in northeast Minnesota. Nineteen male boreal owls were located in 1990 during 324.4 miles of surveys. Thirty male boreal owls were located in 1991 during 720.2 miles of surveys. Six cavity trees were identified during the 1990 field season and 10 during 1991. Fourteen (88%) of the 16 cavity trees were upland, old-forest trembling aspen (*Populus tremuloides*). Three nest sites were documented in 1990, and 6 in 1991. Beginning in 1990, male boreal owls were trapped, banded, and outfitted with backpack-type radio transmitters to assist in the identification of diurnal and nocturnal habitats used by the species. Eighteen diurnal roost sites were located and qualitatively described in 1990. One hundred and twenty-four diurnal relocations and 201 nocturnal relocations were recorded in 1991. Roost trees were identified at 83 locations in 1991. Seventy-two (87%) of the roost trees occurred in lowland, black spruce (*Picea mariana*) stands. This report summarizes survey results for 1990 and 1991, and presents quantitative habitat data for cavity- and roost-sites used by the boreal owl in northeast Minnesota.

INTRODUCTION

The boreal owl (*Aegolius funereus*) is holarctic in distribution, with a breeding range in North America generally limited to the boreal forest zone of the United States and Canada. The species is cavity-dependent for nesting, and is found in habitats ranging from pure deciduous, to deciduous/conifer-mixed, to pure conifer stands (Johnsgard 1988). The first documented nesting of the boreal owl in the 48 contiguous United States occurred in Cook County, Minnesota, in 1978 (Eckert and Savaloja 1979). Since then, several additional nest records have been added in the state, and localized populations have been documented in the central Rocky Mountains (Johnsgard 1988). Janssen (1988) described the species as a rare nester but a regular winter visitant in Minnesota. Despite the breeding observations suggesting an endemic population, prior to 1987 little effort had been made to determine the status, distribution, and habitat requirements of the boreal owl in Minnesota.

Beginning in 1987, I established five survey routes in Lake and Cook Counties (Lane 1989) to conduct nocturnal, auditory surveys to locate singing male boreal owls. Methods of nocturnal censusing for boreal and other owl species are well documented (Bondrup-Nielsen 1984; Ryder et al. 1987; Smith 1987). The male boreal owl begins vocalizing at the onset of its breeding season (late winter to early spring), and employs its staccato song for both territorial defense and mate attraction (Bondrup-Nielsen 1984). The presence of a female boreal owl on an established territory is indicated by the males' prolonged staccato song (Bondrup-Nielsen 1984), uttered from its selected cavity entrance. Persistent singing by the male at the time of pairbond formation allows straightforward identification of the cavity location.

The use of radio telemetry allows identification of habitats used by the boreal owl for other circadian activities. Nicholls and Warner (1972); Forbes and Warner (1974); Palmer (1986); Nicholls and Fuller (1987); and Jacobsen and Sonerud (1987) have used radio telemetry with a variety of owls. Hayward et al. (1987) incorporated radio telemetry to identify habitats and home range movements of boreal owls in Idaho. A similar study was undertaken in Colorado (Ryder et al. 1987).

Habitats used by the boreal owl for its circadian activities in Minnesota were undocumented prior to 1990. In that year, I began a study of habitat use by the boreal owl using backpack-type radio transmitters for the purpose of identifying roost-sites, foraging habitat, and home range movements of the species in northeast Minnesota. This paper reports on the results of telemetry monitoring, as well as survey results for the years 1990 and 1991.

METHODS AND MATERIALS

The study was conducted in Lake and Cook Counties along five routes I established in 1987 (Fig 1). Nocturnal, auditory censuses were run along county, state, and federal roads maintained for access during winter months. Cross-country skis and mountain bikes were used to survey roads and trails closed by snow.

Surveys were conducted from 13 March 1990 to 11 April 1990, and from 24 February to 17 April 1991. Along each route, listening stations were established at 0.5 mile intervals. At each stop, investigators listened for three minutes for the vocalizations of male boreal owls as well as other owl species. Owls were identified according to species and their location estimated by a combination of compass bearing, triangulation from subsequent listening posts, and loudness estimates (faint, moderate, loud). Locations of singing male boreal owls were plotted on United States Geological Survey (USGS) 1:24000 maps. Surveys were initiated at least 0.5 hours after sunset and conducted until the route was finished or daylight occurred. Surveys were not conducted in winds exceeding 15 mph, or in moderate to heavy precipitation.

Locations of singing male boreal owls were monitored through mid-June in both 1990 and 1991 to determine the status of individual birds. When vocalizations of the male indicated the presence of a female on his territory (ie. prolonged staccato), investigators walked in to determine the location of the cavity tree.

In both 1990 and 1991, territorial male boreal owls were trapped using taped playback of the owl's staccato song, mist nets, and bal-chartris (Bull 1987). The owls were banded and outfitted with 6.0 gm (5.2 gm in 1991) backpack-type radio transmitters (Advanced Telemetry Systems (ATS), Isanti, MN.). Attachment of transmitters was accomplished using .25 in. elastic ribbon crimped with a small diameter of copper tubing over the keel of the bird.

Transmitter-equipped owls were relocated using an ATS scanning receiver and a hand held, 3-element Yagi antenna. Air searches were conducted in both 1990 and 1991 in an attempt to locate owls which had left the study area. Owl locations were determined by triangulation of compass bearings and recorded on USGS 1:24,000 maps, and aerial photographs. Locations were then transposed onto a Universal Transverse Mercator (UTM) grid system for home range analysis using the McPaal Home Range program.

Quantitative habitat measurements were collected at cavity sites using a modification of James and Shugart (1970) methods (Appendix 1). Roost sites were qualitatively described in 1990, and quantitatively described in 1991, using a shortened version of James and Shugart methods (Appendix 2).

1990 RESULTS

Each of the five survey routes was censused a minimum of two times between 13 March 1990, and 11 April 1990. Survey mileage totaled 324.4 miles, and involved 73.4 survey hours. Nineteen singing male boreal owls, three nest sites (female observed in cavity and/or male observed making food deliveries), and 6 cavity trees (male observed in cavity but no nesting activities observed) were located during the survey period. Survey results are reported in Table 1. One nest occurred in a trembling aspen (*Populus tremuloides*) cavity that had been occupied in both 1988 and 1989 by an unpaired male boreal owl. Three young were banded at this location on 14 May 1990. Another nest was found in a red pine (*Pinus resinosa*) cavity within an old-growth stand of red and white pine (*Pinus strobus*). This represented the first recorded non-aspen cavity tree used by boreal owls in the study area. The third nest was destroyed by a predator between 3 and 5 May 1990. The male of this pair had been outfitted with a transmitter on 21 April 1990, and left the study area shortly after the nest failed.

Three unpaired male boreal owls were also trapped, banded, and outfitted with 6 gram backpack-type radio transmitters prior to release. Eighteen diurnal relocations were obtained during the field season and qualitative site descriptions made. Fifteen roost sites occurred in lowland conifer, one in upland conifer, and two in upland-mixed habitats. All radio signals were lost from the study area by 5 May 1990. On 12 May 1990, an aerial search for the missing owls was conducted. Approximately 600 square miles were covered and no owls were relocated.

1991 RESULTS

Survey mileage totaled 720.2 miles, and involved 169.2 hours. Thirty singing, male boreal owls were located during the survey period. Survey results are reported in Table 2. Five nest sites were located as a result of censusing. An additional nest within our study area was reported by a cooperator (Steve Wilson, MN Department of Natural Resources; pers.comm.), and included in the years' results. A total of 10 cavity trees were identified in 1991. Included was the use of a wood duck (*Aix sponsa*) nest box attached to a black spruce (*Picea mariana*). No nesting attempt was documented at this location. Of the six nest sites, two fledged young, three were predated, and one was abandoned. Other than the nest box, all cavity trees were in old-forest, upland trembling aspen. A summary of quantitative cavity-site descriptions for both 1990 and 1991 appears in Table 3.

Four nesting male boreal owls were trapped and equipped with backpack transmitters. Monitoring of the 4 radio-equipped owls resulted in 124 diurnal and 201 nocturnal relocations. Quantitative roost site data was recorded at 83 locations and is summarized in Table 4. Of these locations, 72 of the 83 identified roost trees were in lowland black spruce.

One of the radio-tagged males left the study area within 72 hours of nest site predation. He was tracked approximately 3 miles north of his established home range on the evening of 5 May, remained there until 7 May, and was not relocated. An aerial search conducted on 9 May 1991, covering approximately 700 square miles, failed to find the missing owl. Transmitters on the three remaining owls were removed in mid-June, following completion of the field season.

Minimum Convex Polygon (MCP) estimates, derived from 1991 relocations, resulted in home ranges of 19.62 and 9.90 square kilometers (1962 and 990 hectares, respectively) for 2 nesting male boreal owls. Other home range data from 1991 is not available at present, due to software problems.

DISCUSSION

The regular occurrence of singing male boreal owls each year, the documentation of 14 nest sites (1988-1991), and the fledging of young at 5 of those sites strongly suggests that there is a resident, breeding population of boreal owls in the study area.

Study results support an association of boreal owl nesting activities with cavity excavations located in old-forest trembling aspen. Kingsley (1991) described aspen as the dominant hardwood in the area. Aspen in the 60+ year age class is a common substrate for cavity excavation, primarily by common flickers (*Colaptes auratus*) and pileated woodpeckers (*Dryocopus pileatus*) (Johnsgard 1988). The use of this age class of cavity trees by boreal owls is supported by quantitative site measurements in my study area (Table 3) as well as existing timber stand data.

An association of lowland conifer habitats with roosting activities is also supported by study results. Preliminary telemetry analysis and direct observations suggest that the lowland conifer-type habitat may also be utilized for foraging activities. Pellet and nest-site contents are being analyzed, and may further define foraging habitat of the owl.

Sonerud, (1985) suggested that nest site predation of Tengmalm's owl in Europe (*Aegolius funereus funereus*) is primarily caused by the pine marten (*Martes martes*). In my study area, no direct predation has been observed. However, egg shell fragments suggest that the marten (*Martes americana*) may play a role in nest site predation. In addition, teeth imprints found in an egg shell in 1991 suggest possible predation by the northern flying squirrel (*Glaucomys sabrinus*) (Donald Christian, University of Minnesota-Duluth; pers. comm).

Based upon telemetry results and trapping attempts at sites originally supporting unpaired male boreal owls, I suggest that a number of the boreal owls encountered in the study area are wintering birds, and represent a transient population in Minnesota. Of 8 owls outfitted with radio transmitters in 1990 and 1991, 5 were lost without reacquiring the radio signal, despite extensive air searches. This suggests transmitter failure or large scale movements by the owls. Trapping attempts in locations where unpaired, singing male owls were located during surveys have been mostly unsuccessful, again suggesting some movement of the birds following an unsuccessful mating season. Catling (1972) described the boreal owl as highly nomadic in eastern North America, and suggested that southern movements (ie. into Minnesota) of boreal owls in February and March are countered by return flights north in April and May. Janssen (1988) supports Catling by describing the boreal owl as a regular winter visitant in northern Minnesota.

In conclusion, study results strongly suggest there is a resident, breeding population, as well as a nonbreeding, wintering population of boreal owls in northeast Minnesota. Upland deciduous/conifer habitats, and in particular old-forest quaking aspens are typically used for nesting, and lowland conifer habitats are utilized by the species for roosting and foraging activities. As a result, landscape-scale management for both resident and wintering populations of boreal owls is indicated, including the maintenance of both upland and lowland habitat-types. Monotypic management (ie. 200 acre blocks of lowland conifers) is suggested by the Superior National Forest (1989) for boreal owl management, but neither its size nor habitat composition are supported by this study as adequate for the owl. Certainly, further studies of the boreal owl in northeast Minnesota are warranted, particularly those addressing habitat use, home range movements, population trends, and the affects of forest fragmentation on the species.

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SURVEY ROUTE LOCATIONS

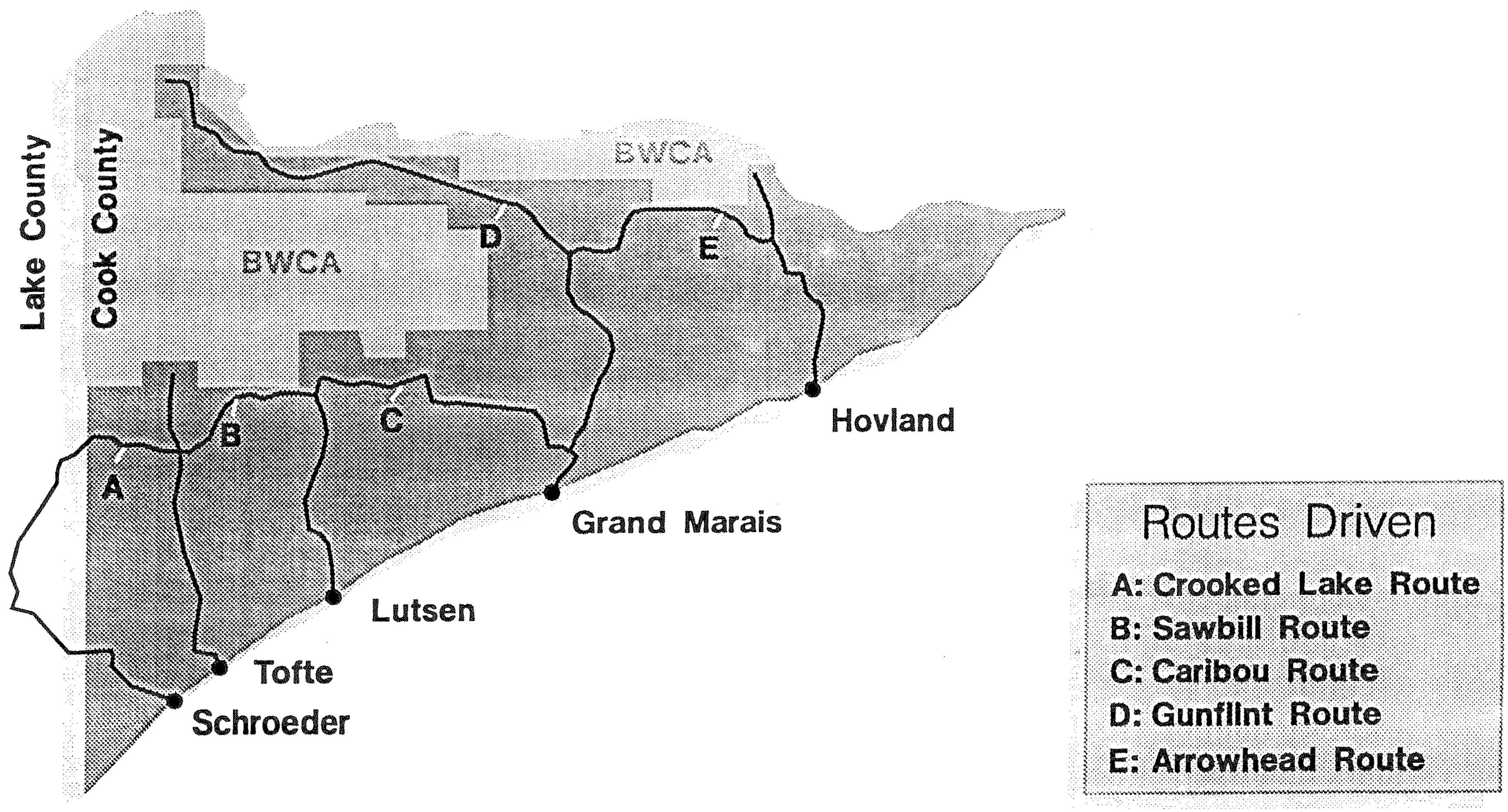

FIGURE 1

TABLE 1: 1990 OWL SURVEY RESULTS

ROUTE	DATE	MILES SURVEYED	HOURS SURVEYED	BOOW	NSWO	BAOW	GGOW	GHOW	LEOW
CROOKED	31390	0	0	0	0	0	0	0	0
CROOKED	31490	8.5	3	0	0	0	0	0	0
SAWBILL	31690	11.4	2.9	0	0	0	0	0	0
CROOKED	31890	19.1	6.5	0	0	0	0	0	0
SAWBILL	31990	35.9	9.2	5	1	2	0	0	0
CROOKED	32090	19.9	3.5	0	1	0	0	1	0
SAWBILL	32390	13.8	2	0	2	0	0	0	0
CROOKED	32590	13.7	2.9	1	0	0	0	0	0
GUNFLINT	32690	37.3	7.8	4	1	2	1	0	0
ARROWHEAD	32790	35.2	8.5	1	4	0	0	0	0
CROOKED	32990	20.9	4.3	2	3	2	0	0	0
SAWBILL	33090	24.2	4	2	0	0	0	0	0
CROOKED	40590	18	3.7	0	0	0	0	0	0
CARIBOU	40690	23.6	6.8	1	0	0	0	0	0
GUNFLINT	40790	29.1	5.8	3	0	2	1	0	0
ARROWHEAD	41190	13.8	2.5	0	1	0	0	0	0
TOTALS		324.4	73.4	19	13	8	2	1	0

BOOW: BOREAL OWL
NSWO: NORTHERN SAW-WHET OWL
BAOW: BARRED OWL
GGOW: GREAT GRAY OWL
GHOW: GREAT-HORNED OWL
LEOW: LONG-EARED OWL

TABLE 2: 1991 OWL SURVEY RESULTS

ROUTE	DATE	MILES SURVEYED	HOURS SURVEYED	BOOW	NSWO	BAOW	GGOW	GHOW	LEOW
CROOKED	22491	26	6.3	0	0	0	0	0	0
SAWBILL	22591	37.5	7.6	0	0	0	0	0	0
CARIBOU	22691	26.4	5.8	0	0	0	0	0	0
GUNFLINT	22791	20.6	4.2	0	0	0	0	0	0
ARROWHEAD	22891	37.3	9	1	0	0	0	0	0
CROOKED	30391	33.6	7.8	2	0	0	0	1	0
CARIBOU	30491	27.3	6.8	1	0	3	0	0	0
SAWBILL	30491	30	7.7	5	1	6	0	0	0
CROOKED	30991	33.9	8.7	2	0	0	0	0	0
GUNFLINT	31391	39	8	0	0	2	0	1	0
ARROWHEAD	31491	37.1	7.2	0	0	0	0	0	0
TREFORTY	31591	5.7	1.3	0	0	0	0	0	0
CARIBOU	31591	26.7	6.4	1	1	3	0	0	0
CROOKED	31691	25.4	7	3	0	0	0	0	0
SAWBILL	31791	36.5	7.6	0	2	6	0	2	1
CARIBOU	31891	13.5	4	0	1	1	0	0	1
ARROWHEAD	32491	33	8.4	0	1	3	0	1	0
SAWBILL	32591	29	5.1	2	1	3	0	1	0
CARIBOU	32891	6.5	1	0	0	0	0	0	0
CARIBOU	32991	26.5	6.6	2	0	0	0	0	0
SAWBILL	32991	29	7.5	1	0	0	0	0	0
CROOKED	33191	22	8.4	3	2	1	0	2	1
GUNFLINT	33191	38	7.5	3	4	3	0	1	0
ARROWHEAD	40291	8.5	1.7	1	0	0	0	0	0
ARROWHEAD	40391	14	4.5	1	1	0	0	0	0
CARIBOU	41591	8	1.6	0	2	0	0	0	0
CROOKED	41591	15.8	3.9	0	0	1	0	0	0
CROOKED	41791	33.4	7.6	2	4	2	0	0	0
TOTALS		720.2	169.2	30	20	34	0	9	3

BOOW: BOREAL OWL
NSWO: NORTHERN SAW-WHET OWL
BAOW: BARRED OWL
GGOW: GREAT GRAY OWL
GHOW: GREAT-HORNED OWL
LEOW: LONG-EARED OWL

TABLE 3: CAVITY TREE-SITE PARAMETERS 1990-1991

SITE	YEAR	NEST SITE?	CAVITY TREE SPP	DBH (CM)	TREE HEIGHT (M)	CAVITY HT (M)	BASAL AREA (DECIDUOUS)	BASAL AREA (CONIFEROUS)
TWO ISLAND	1990	N	ASPEN	30	13.7	5.5	20	0
CRESCENT LAKE	1990	N	ASPEN	46	20.7	9.1	100	0
SWANSON WEST	1990	N	ASPEN	33.3	25.9	12.2	140	0
RED PINE	1990	Y	RED PINE	55.9	33.8	18.6	0	110
FOUR-PEAT	1990	Y	ASPEN	35.6	25	8.5	150	0
GREENWOOD	1990	Y	ASPEN	45.7	23.2	6.1	60	0
GUST LAKE	1991	Y	ASPEN	44.2	22.6	10.7	80	40
THREE40	1991	Y	ASPEN	35.8	24.1	12.5	70	40
WYE LAKE	1991	Y	ASPEN	54.4	25.6	10.4	60	20
MISSIS CREEK	1991	Y	ASPEN	45	24.1	12.5	50	60
KAW-CLEAR	1991	N	ASPEN	41.1	24.1	13.1	60	0
CASCADE	1991	N	BLACK SPRUCE/NESTBOX	28.4	17.4	6.7	0	50
PLOUFF	1991	Y	ASPEN	46.2	27.7	13.4	50	90
KOSKI	1991	Y	ASPEN	49.3	20.7	10.4	10	30
HOG CREEK	1991	N	ASPEN	49.3	22.3	11.3	30	60
SQUASH LAKE	1991	N	ASPEN	31.8	18	7.6	130	10
			MINIMUM	28.5	13.7	5.5	0	0
			MAXIMUM	55.9	33.8	18.6	150	110
			AVERAGE	42.2	23.1	10.5	63	32

TABLE 4: 1991 ROOST SITE-HABITAT SUMMARY

	OWL:				
	PLOUFF	KOSKI	340	MISS CREEK	
NUMBER OF OBSERVED ROOST SITES:	29	26	20	8	
NUMBER OF ROOSTS IN:					AVERAGE DBH (cm):
BLACK SPRUCE:	28	21	15	8	17.5
BALSAM FIR:	1	4	2	0	15.1
WHITE SPRUCE:	0	0	2	0	30.1
WHITE CEDAR:	0	0	1	0	22.6
ALDER:	0	1	0	0	3
AVERAGE ROOST TREE HEIGHT(m):	11.9	10.3	12.2	11.5	
AVERAGE ROOST PERCH HT (m):	5.2	3.7	4.1	4.1	
AVERAGE d OF OWL TO BOLE(cm):	8.5	8.4	5.7	7	
AVERAGE ROOST SITE SLOPE (%):	1.6	4	2.4	0.4	
AVERAGE BASAL AREA (DECIDUOUS):	0.7	1.5	5	0	
AVERAGE BASAL AREA (CONIFEROUS):	159	125	136	124	

APPENDIX 1: BOREAL OWL CAVITY-SITE HABITAT PARAMETERS

METHODS

A .04 hectare circular plot is established using the cavity tree as plot-center. Four transect line are made from plot center, in each of the cardinal directions. Each of the four transects are 11.3 meters in length. Along each transect line, the following variables are measured:

HEIGHT of the cavity tree is estimated to the nearest meter, using a clinometer.

DIAMETER AT BREAST HEIGHT (dbh) of the cavity tree is measured to the nearest cm.

HEIGHT OF CAVITY is estimated to the nearest meter, using a clinometer.

DEGREE OF SLOPE is measured along the line of steepest slope within the plot.

CANOPY HEIGHT, to the nearest meter, of the top most foliage of five trees within the plot is measured using a clinometer.

SHRUB DENSITY is determined by recording the number of woody stems (< 3 cm, dbh) touched by outstretched arms while walking along each transect line.

EXPOSED SLOPE is recorded by shading the appropriate sectors on data sheets to show in which direction the cavity is exposed.

BASAL AREA (square footage at dbh) within the plot is measured using a 10-factor prism.

CANOPY AND GROUND COVER is estimated using an ocular tube along each transect line.

POINT-QUARTER, tree species, dbh, distance to, and height of the tree nearest plot-center (> 8 cm dbh) are measured in each quarter.

TREE SPECIES and dbh of all standing trees contributing to canopy foliage within the plot are recorded to the nearest cm.

UNDERSTORY TREES are counted and recorded without indicating species.

APPENDIX 2: BOREAL OWL ROOST SITE HABITAT PARAMETERS

METHODS

A .04 hectare circular plot is established using the roost tree as plot-center. Four transect lines are made from plot center, in each of the cardinal directions. Each of the four transects are 11.3 meters 9in length. Within the 22.6 meter plot, the following parameters are recorded:

HEIGHT of the roost tree is estimated to the nearest meter, using a clinometer.

DIAMETER AT BREAST HEIGHT (dbh) of the roost tree is measured to the nearest cm.

ROOST PERCH HEIGHT is estimated using a clinometer.

DISTANCE of the owl to the bole of the roost tree is visually estimated.

CANOPY heights of the five tallest trees within the 22.6 meter plot, are determined to the nearest meter, using a clinometer.

GROUND VEGETATION is described to type.

HEIGHT of the dominant ground vegetation is estimated.

DEGREE OF SLOPE is measured along the line of steepest slope within the plot.

BASAL AREA of the 22.6 meter plot is measured using a 10-factor prism.

POINT-QUARTER tree species, dbh, and distance to roost tree are measured in each quarter.

NUMBER OF TREES within the 22.6 meter plot will be estimated by counting the number of trees in a quarter plot, and multiplying by four.