AN ECOLOGICAL ASSESSMENT OF THE USE OF HYDRO UTILITY POLES FOR NESTING BY PILEATED WOODPECKERS IN SOUTHEASTERN MANITOBA

by

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in Partial Fulfillment of
the Requirements for the Degree,
Master of Natural Resources Management

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A practicum submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of Master of Natural Resources Management.

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ABSTRACT

An ecological assessment of the use of hydro utility poles for nesting by pileated woodpeckers in southeastern Manitoba was undertaken to identify habitat characteristics acting as discriminating factors in nest-site selection. Data on forest inventories, ground sampling, pole hardness, and pole preservative-type were analyzed using stepwise discriminant analysis to isolate important characteristics in pileated woodpecker nest-site selection. Pole hardness and preservative type are not factors in nest-site selection in utility poles. Food supply, age of surrounding forest stands, and distance to forest cover were associated with nest-site selection in utility poles.

Findings from this study and previous research were used to develop new and innovative management recommendations based on ecological parameters to control pileated woodpecker use of utility poles.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Woodpeckers use hydro utility poles throughout North America for nesting and feeding (Jorgennsen et al. 1957; Turcek 1960; Dennis 1963; and Rumsey 1968, 1970b, 1973). Manitoba Hydro has a 10 000-km network of wood pole transmission lines. Hundreds of hydro utility poles in Manitoba exhibit woodpecker nesting and feeding activity (Manitoba Hydro, unpubl. data). Woodpecker nesting and feeding in utility poles has probably occurred throughout Manitoba since the first installation of transmission lines in 1927 (W. Munro, Manitoba Hydro, pers. commun. 1990).

Woodpecker species present in Manitoba include the following:

1. Pileated woodpecker (*Dryocopus pileatus*)
2. Red-headed woodpecker (*Melanerpes erythrocephalus*)
3. Northern flicker (*Colaptes auratus*)
4. Yellow-bellied sapsucker (*Sphyrapicus varius*)
5. Hairy woodpecker (*Picoides villosus*)
6. Downy woodpecker (*Picoides pubescens*)
7. Three-toed woodpecker (*Picoides tridactylus*)
8. Black-backed woodpecker (*Picoides arcticus*)

Preliminary surveys by Manitoba Hydro and various published reports indicate that the pileated woodpecker is the primary species using utility poles for nesting and feeding sites (Jorgennsen et al. 1957; Dennis 1963; and Rumsey 1968, 1970b, 1973). Surveys, by the author, in Manitoba have identified numerous holes in hydro utility poles as pileated woodpecker nest cavities, based on the distinctive characteristics of the entrance hole which is triangular-shaped and approximately 8-11 cm in diameter as reported by Bent (1939).

Pileated woodpeckers excavate their nest cavities in utility poles at various heights above the ground. Poles containing nest cavities are subject to breakage from lateral loads imposed by windstorms; compressive strength is also affected and may be critical in areas where lines frequently ice over, but it is probable that most failures occur in bending (Rumsey and Woodson 1973). Nest cavities in utility poles capture precipitation and harbor decay organisms. This leads to accelerated wood rot and results in structural problems and premature pole replacement. The failure of a utility pole structure would result in the loss of thousands of dollar and the risks of interrupting power to hospitals and other facilities are great.

Pileated woodpeckers also forage in utility poles (Jorgennsen et al. 1957). They widen "checks" (cracks in the utility pole resulting from wood shrinkage during drying) to gain access to various invertebrate species (Jorgennsen et al. 1957, Rumsey 1968). Pileated woodpecker use of utility poles for feeding does not result in serious structural problems (Rumsey 1968). Use of hydro utility poles for nesting by pileated woodpeckers is of most concern to hydro utility companies because of the associated structural problems (Rumsey 1968, 1970a).

Habitat requirements of the pileated woodpecker was the focus of this study. Habitat requirements of the pileated woodpecker are not known for Manitoba and reasons for woodpecker use of utility poles for nesting are unclear. Thus, an understanding of the ecological characteristics important for pileated woodpecker nest site selection in utility poles is required. Documentation of habitat requirements will lead to ecologically based management decisions to aid in alleviating future use of utility poles by pileated woodpeckers.

1.2 ISSUE STATEMENT

Manitoba Hydro is dedicated to providing for the continuance of a supply of power adequate for the needs of the province, and to promote economy and efficiency in the generation, distribution, supply, and use of power (Manitoba Hydro Act 1961). Pileated woodpeckers damage hydro utility poles by excavating nest cavities which leads to premature pole replacement. Repair of utility poles with nest cavities and prevention of future woodpecker use is required to defer the costs of pole replacement and reduce the risk of interrupted power distribution.

Manitoba Hydro has an environmental credo which ensures that they play a leadership role in the protection and enhancement of the environment (Manitoba Hydro 1991a). Although the pileated woodpecker may be viewed as a "pest" species by Manitoba Hydro, their corporate decision-making now necessitates the use of sound environmental management practices. Therefore, repair and damage-prevention techniques must be implemented in an environmentally benign manner based on the ecological requirements of the pileated woodpecker.

1.3 PURPOSE AND OBJECTIVES OF STUDY

The primary purpose of this study was to conduct an ecological assessment of the use of hydro utility poles for nesting by pileated woodpeckers in southeastern Manitoba.

The objectives of this study were to:

1. review past studies describing pileated woodpecker habitat requirements;

2. identify ecological characteristics acting as discriminating factors in the selection of nesting sites by pileated woodpeckers in utility poles in southeastern Manitoba; and

3. recommend a long-term management plan to control the use of hydro utility poles by pileated woodpeckers that would be based on ecological parameters.

1.4 LIMITATIONS OF THIS STUDY

This is the first extensive ecological assessment of the use of hydro utility poles for nesting by pileated woodpeckers and the first ecological study of the pileated woodpecker in Canada. It was assumed the behavioral aspects of pileated woodpeckers in this study are similar to the species in other geographical locations.

CHAPTER 2

LITERATURE REVIEW

2.1 LIFE HISTORY OF THE PILEATED WOODPECKER

The pileated woodpecker is the largest woodpecker species in North America measuring approximately 42.5 cm in length from tip of bill to tip of the tail (Peterson 1947). Prior to extensive timber harvesting and settlement, the pileated woodpecker was common and generally distributed throughout North America (Roberts 1932). Habitat loss and a killing mania directed at large birds reduced the population (Roberts 1932). In the early 1900s an unfortunate confusion of the pileated woodpecker common name, "log-cock", with the game bird name, "woodcock", resulted in hunting efforts directed at the woodpecker (Roberts 1932). Decreasing numbers of woodpeckers warranted protection provided by the Federal Migratory Bird Convention Treaty Act established in 1917. Rumsey (1970b) reported some ornithologists consider the pileated woodpecker population to be increasing.

Pileated woodpeckers excavate nest cavities in either coniferous or deciduous dead, or less often, live trees. Excavation of nest cavities occurs in late March and early April and takes 3-6 weeks to complete (Bull 1988). Male pileated woodpeckers excavated more than females during nest construction (Hoyt 1957, Kilham 1979, Bull 1988). Clutch size of the pileated woodpecker is 3-4 white, ovate eggs averaging 33.2 by 25.2 mm in size (Bent 1939). The male and female incubate the eggs alternately during the day, and the male incubates at night (Bull 1988). Incubation of the eggs lasts approximately 18 days (Hoyt 1957). Both parents equally share feeding the young until nestlings fledge and leave the nest after 24-28 days (Kilham 1979, Bull 1988). Pileated woodpeckers may renest if the first nesting effort fails (Truslow 1966). Pileated woodpeckers often breed as 1-year-old birds (Bull 1988) and may survive 7-9 years in the wild (Hoyt 1952, Bull 1988).

Pileated woodpeckers roost at night in excavated cavities in trees or hollow trees (Bull 1990). Pileated woodpeckers occasionally roost in old nest cavities in dead trees but more often roost in hollow trees (Bull 1990). Hollow trees often provide a large cavity, 3.0-9.0 m deep, which does not require excavation (Bull 1990). Hoyt (1957) stated that pileated woodpeckers did not use old nest cavities during a 10-year study, however, McClelland (1979) reported that most roost cavities were probably old nesting cavities.

2.2 USE OF HYDRO UTILITY POLES FOR NESTING BY PILEATED WOODPECKERS

Pileated woodpeckers use hydro utility poles for nesting over considerable portions of the United States (Rumsey 1970b). Pileated woodpeckers are distributed throughout North America as illustrated by Godfrey (1986) in Figure 1. Pileated woodpeckers use considerable numbers of hydro utility poles for nesting sites in Manitoba. Approximately 10% of wooden utility poles in certain locales of the Province contain pileated woodpeckers nest cavities (Manitoba Hydro 1991b).

During treatment many utility poles develop internal burst checks characterized by a ring shake (separation between growth rings) usually 2.5-5 cm below the surface which extends approximately 15 cm concentrically (Rumsey 1970b). Rumsey (1970b) observed that internal voids in utility poles, detected by tapping the pole, are attractive to pileated woodpeckers in search of a suitable nest site. In search of a suitable nest site, pileated woodpeckers create several exploratory excavations (Hoyt 1957; Rumsey 1968, 1970b; and Bull 1988). Exploratory holes in utility poles go inward several centimeters but not downward (Rumsey 1968).

Pileated woodpeckers excavate nest cavities at heights of 4.5-21.0 m, usually in dead trees (Godfrey 1986). The

NORTH AMERICAN DISTRIBUTION OF THE PILEATED WOODPECKER (NATIONAL GEOGRAPHIC SOCIETY 1987).

entrance hole is approximately 8-11 cm in diameter and triangular in shape (Bent 1939). Nest cavities excavated in utility poles are 30-60 cm deep (Rumsey 1970b) and a thin shell of wood approximately 2.5 cm thick remains around the cavity (Rumsey 1968). Bent (1939) found similar depths of nest cavities in trees ranging from 25-60 cm.

Nest cavities and exploratory holes allow the entrance of precipitation and decay organisms accentuating risk of future structural problems in utility poles (Rumsey 1968, 1970b).

2.3 WOODPECKER DAMAGE IN MANITOBA

The functional life of utility poles is reduced by severe structural problems resulting from woodpecker nesting activities and damaged poles must eventually be replaced. Pole replacement costs for Manitoba Hydro in 1992 are approximately $9 000 each; poles are valued at approximately $2 500 each while labour, transportation and associated costs of pole replacement are approximately $6 500 per pole. Eight to 10 Manitoba Hydro utility poles must be replaced annually because of structural problems resulting from woodpecker activity. Severe costs would be incurred by Manitoba Hydro if a utility structure fell and interrupted power service. Interrupted service on an export line selling power would result in the loss of thousands of dollars and risks of cutting power to hospitals and other facilities are also great. The failure of one damaged utility structure may cause a chain reaction resulting in several poles being pulled down. The need to protect utility poles from woodpecker use is apparent, however, Manitoba Hydro has been unsuccessful in limited attempts to prevent woodpecker damage (W. Munro, Manitoba Hydro, pers. comm., 1992).

2.4 WOODPECKER DAMAGE PREVENTION TECHNIQUES

Pileated woodpecker nesting in utility poles is viewed as a costly problem by utility companies and research of management techniques to prevent woodpecker damage to utility poles is extensive. Several years of research were conducted at Pennsylvania State University and the results of the study were published by Jorgennsen et al. (1957). Turcek (1960) published a report on woodpecker damage to power and communication lines. The majority of research has been conducted in Pineville, Louisiana, by Rumsey at the Southern Forest Experiment Station. These include: Rumsey (1968, 1970ab); Rumsey and Biesterfeldt (1970); Rumsey (1973); and Rumsey and Woodson (1973).

Management techniques to control woodpecker damage to utility poles have been developed and tested by utility companies with varying degrees of success (Cunningham 1990).

These techniques include; 1) pole wrappings, 2) scaring devices, 3) lure poles, 4) various pole treatments, 5) chemical repellents, and 6) metal barriers.

2.4.1 POLE WRAPPINGS

Woodpeckers require a firm foothold when excavating nest cavities (Rumsey 1968, 1973) and pole wrappings do not allow woodpeckers to cling to the smooth surface. Wrappings cover existing nesting cavities and the birds soon leave the pole (Rumsey 1968).

A smooth, hard, plastic wrap prevented woodpecker damage to utility poles in central Louisiana over a two-year period as described by Rumsey (1973). The wrap, known as the Vaughn Bar-Bird Pole Shield is made of Eastman's Tenite, comes in 4.8-m lengths and is 26 cm or 35 cm in width. The polyethylene material is designed to be wrapped spirally from the top of a pole to 3 m above the ground (Rumsey 1973). Narrower strips are used on the smaller part of a pole, because the diameter of the pole must exceed the width of the strips to allow spiral winding. The wrap is tacked at each spiral and if attached properly the material will not allow woodpeckers to gain a firm foothold, but flanged overlaps permit aeration and moisture to escape (Rumsey 1973).

Stinging insects may construct nests in the flanged overlaps presenting a hazard to linemen. Ability of pole wraps to endure ultraviolet rays and other climatic aspects is also a concern. Resistance to elements such as moisture and ultraviolet rays of the Vaughn Bar-Bird black pole shield is estimated to be about 20 years (Rumsey 1973).

2.4.2 SCARING DEVICES

Success has been achieved in previous attempts to deter "pests", such as geese and white-tailed deer, through the use of predator decoys and bangers. Scaring devices were tested on woodpeckers in the southern United States. Imitation snakes and stuffed owls, predators of pileated woodpeckers and their eggs, proved unsuccessful in preventing use of hydro utility poles (Dennis 1963). Dennis (1963) stated that the pileated woodpecker and other woodpecker species were apparently not frightened by predator decoys and bangers. Rumsey (1968) stated that scaring devices failed because the birds quickly became accustomed to them.

2.4.3 LURE POLES

Hardness of wood is suspected of influencing the use of hydro poles for nesting by woodpeckers (Rumsey 1968). Soft wood is preferred by woodpeckers for excavating nest cavities (Rumsey 1970) and initial tests were conducted to deter woodpecker attack with extremely hard utility poles. Extremely hard tropical wood, tried in Louisiana, did not deter woodpecker use for nesting (Dennis 1963) and other tests attempting to direct woodpecker attack to soft lure or decoy poles also proved ineffective (Rumsey 1968).

Utility companies experimentally left damaged poles standing when replacement was necessary (Rumsey 1968). It was anticipated that previously damaged poles left standing would lure woodpeckers away from the utility poles in3 service (Rumsey 1968). Effectiveness of this practice has not been determined and damaged poles left standing are a safety hazard (Rumsey 1968).

Other tests consisted of attaching 2.1-m sections of creosoted eastern cottonwood to 28 utility poles at appropriate heights as described by Rumsey (1970b). Sections of soft wood were attached to utility poles to provide woodpeckers with favorable substrates for nest-cavity excavation. After 15 months, poles with lures attached had significantly less damage than controls. Instead of attracting woodpeckers the decoys seemed to function as scarecrows; only three decoys were excavated. Following tests were performed using lures of white pine that had been artificially hollowed out. White pine has better working properties for woodpeckers making it a more suitable lure or decoy. After 6 to 8 months, 15 of the 28 lures had large holes extending into the internal cavity, but damage to the poles with decoys was as extensive as those without decoys (Rumsey 1970b).

2.4.4 VARIOUS POLE TREATMENTS

Many tests have been performed involving the application of a variety of substances to hydro utility poles to repel woodpeckers. Trials were conducted to test if color repellency existed for woodpeckers as it does with certain seed-eating birds (Jorgennsen et al. 1957). Utility poles covered with white, red, green, yellow, and aluminum paint did not repel woodpeckers (Jorgennsen et al. 1957).

Coatings that become smooth and hard upon curing, making it difficult for woodpeckers to achieve a firm foothold, have also been tested. Brush-on applications of epoxies were tested as described by Rumsey (1970b). Epoxies exhibited the required smoothness but readily degraded with exposure to direct sunlight. Creosote, a common utility pole preservative, does not allow a good bond with coatings and often blisters through. Adhesion and curing were satisfactory only on utility poles treated by methods that left the surface free of oil (Rumsey 1968). A coating of gravel embedded in epoxy has protected fence posts (also susceptible to woodpecker damage) in Texas for 2 or 3 years, but difficulties exist in applying the coating.

2.4.5 CHEMICAL REPELLENTS

Taste in birds is similar to the four primary tastes in humans, but to what degree is uncertain (Portman 1961). Welty (1969) reported the sense of taste in birds is poorly developed and some ornithologists feel that birds have no sense of smell (Rumsey 1970b). Preliminary tests illustrated chemicals affecting taste and smell were unsuccessful in repelling woodpeckers (Rumsey 1970b). Woodpeckers appear to be able to excavate without the wood contacting the sensory organs (Rumsey 1970b). Chemicals that irritate the nerve endings in the feet are most likely to be effective (Rumsey 1968).

As reported by Jorgennsen et al. (1957) many tests were performed on the repellency of chemicals to a pileated woodpecker held in an aviary. Seventy-five chemical compounds and commercial repellent materials were tested by Jorgennsen et al. (1957). Only eight substances, listed in Table 1, repelled foraging activity of a pileated woodpecker under aviary conditions (Jorgennsen et al. (1957)

Dennis (1963) reported on a coal-tar derivative, called Kopper's Woodpecker Repellent, that apparently violated the sense of taste in woodpeckers. Early tests of Kopper's Woodpecker Repellent were promising but the product has not

Table 1. Chemical repellents of the pileated woodpecker successful in the aviary (Jorgennsen et al. 1957).

CHEMICAL	DONOR
Chromium Copper Arsenic (Greensalt)	Allied Chemical & Dye Corp.
Copper formate (Autoclaved)	National Cylinder Gas Co.
Rosin Amine D Pentachlorophenate	Hercules Powder Company
1,3 Dibutylthiourea	Sharples Chemical, Penn Salt Mfg. Co.
3-Nitro-4-Aminoanisole	Du Pont Chemical Company
4-Nitro-2-Aminotolulene	"
2-Naphthlmercapto Acidic Acid	"
MSG - 1.1 N,N,N′-Diodecyl-dithiooxamide	Mallinekrodt Chemical Works

been widely accepted by utility companies (Rumsey 1970b). ST-138 is a compound capable of repelling woodpeckers but has not been licensed by the Environmental Protection Agency for use on utility poles in the United States (F. Stubbs. The WPR Co., pers. comm., 1991).

The most recent woodpecker repellent was discovered by coincidence, as described by Cunningham (1990). J.H. Baxter & Co. in Oak Park, Illinois started to survey customers using the wood-pole preservatives, ammoniacal copper arsenate (ACA) and the new derivative ammoniacal copper zinc arsenate (ACZA), both more commonly known as Chemonite. Utility companies using Chemonite-treated poles reported minimal woodpecker use of the poles. Morgan (1989) also reported that woodpeckers were extremely reluctant to excavate nests in Chemonite-treated poles. Experts speculate that woodpeckers avoid Chemonite treated poles because of the ammoniacal odor (Cunningham 1990) and further research is planned to explain less woodpecker use of Chemonite treated utility poles.

Testing of potential chemical repellents is a time consuming and expensive process, and commercial use of the chemicals must be permitted by the Environmental Protection Agency.

2.4.6 METAL BARRIERS

The most widespread and effective technique for preventing woodpecker attack is 5 x 5 cm hardware cloth wrapped around most of the pole (Rumsey 1968; R. L. Rumsey, Dept. Agric. McNeese State Univ., pers. comm. 1991). Wire wrappings usually give relatively permanent protection, however, pileated woodpeckers occasionally tear through the hardware cloth and excavate nest cavities (Rumsey 1968). Existing holes should be filled to deter woodpeckers from tearing the wire mesh to gain access to cavities (R. Rumsey, Dept. Agric. McNeese State Univ., pers. comm. 1991). Manitoba Hydro uses a nest cavity filling substance, called "Vultafoam", which provides structural support to damaged utility poles (Munro and Wong 1991, Manitoba Hydro, unpubl. rep.) and will deter woodpeckers from tearing through the wire mesh (R. Rumsey, Dept. Agric. McNeese State Univ., pers. comm. 1991). Linemen would rather climb poles covered with wire mesh than poles wrapped in plastic (R. Rumsey, Dept. Agric. McNeese State Univ., pers. comm. 1991).

Costs increase greatly if the wire mesh is installed on poles already in use. Cost of installing wire mesh and filling holes in utility poles already in use are approximately $ 500.00 (Manitoba Hydro 1992). Costs are reduced by installation of the mesh before the pole is put in service. Wire wrappings have some disadvantages in addition to cost; a major problem is the conductivity of the wire mesh causing arcing and disruption of service (Rumsey 1968). Conductivity problems may be alleviated by grounding the wire mesh (W. Munro, Manitoba Hydro, pers. comm., 1992).

2.4.7 DAMAGE PREVENTION IN MANITOBA

Efforts by Manitoba Hydro to implement management techniques to control woodpecker damage have been minimal. Preliminary tests using a plastic pole wrapping proved unsuccessful. Pileated woodpeckers excavated nest cavities in sections of the pole not wrapped. Manitoba Hydro is now directing efforts toward understanding the ecology of the pileated woodpecker and its use of hydro utility poles for nesting.

2.5 HYPOTHESES FOR WOODPECKER USE OF UTILITY POLES

Many hypotheses have been developed over the years that address why woodpeckers use utility poles for nesting sites, as described by Rumsey (1968): 1) vibration of wires and transformers may create an acoustical attraction; 2) preservatives in utility poles may kill mites and other ectoparasites that reduce vigor of nestling woodpeckers; 3) a shortage of suitable nest sites in adjacent trees may exist; and 4) woodpeckers may be attracted to poles because of their strategic location for defending territories.

Rumsey (1968), and Rumsey and Biesterfeldt (1970) stated that utility poles' strategic location for defending territories is the most likely explanation. A territory is "any defended area" as defined by Noble (1939). Pileated woodpeckers are territorial (Bent 1939, Kilham 1959, Rumsey 1968, Kilham 1973), and they defend a large type A (Nice 1941) territory. Type A territories are defended against members of its own species and other birds for mating, nesting and feeding grounds for young (Nice 1941). Pileated woodpeckers advertise their presence by calling and drumming and defend their territory by chasing away intruders (Kilham 1959, Kilham 1979).

Rumsey (1968) stated that disturbances within a territory, such as the installation of a utility line, cause new conflicts between resident birds. Utility poles function as good points for spotting intruders and advertising the presence of resident birds (Rumsey 1968). Rumsey (1968) further speculated that utility poles used for guarding a territory are test probed for nest sites, and if suitable spots are located, nest cavities will be excavated.

Jorgennsen et al. (1957) stated that suitable pileated woodpecker foraging habitat surrounding the transmission line will bring the bird to the area in search of food. Probing for food will occur in the immediate vicinity of the transmission line and the resonance of utility poles is thought to resemble a dead tree thus leading the woodpeckers to explore for food and nesting sites (Townsend 1925).

An important function of nests is to aid in preventing predation of the eggs and young (Faaborg 1988). Strength of the nest tree, especially around the nest entrance, may be of great importance in preventing predators (such as Black bears (_Ursus americanus_) and raccoons (_Procyon lotor_)) from chewing their way into a nest cavity (Kilham 1968, 1971). Black bear predation on woodpecker nests has also been noted by DeWeese and Pillmore (1972). Strength of nest trees is also important to reduce the probability of the tree breaking at the nest site and pileated woodpeckers are strong excavators capable of constructing cavities in sound conifer wood (Bull 1987). Utility poles provide sturdy nest sites that may reduce predation of eggs and young and the probability the pole will break at the nest site.

Pileated woodpecker nest-site selection in utility poles is likely because of a combination of the above proposed hypotheses.

2.6 PILEATED WOODPECKER HABITAT REQUIREMENTS

2.6.1 NESTING REQUIREMENTS

Early reports on nesting habitat requirements of the pileated woodpecker were published by Townsend (1925), Roberts (1932), and Bent (1939). Many studies followed because of concern for the survival of this species; some of these studies include: Hoyt (1957), Conner et al. (1975), Bull and Meslow (1977), McClelland (1979), Conner (1980), Mannan (1984), Bull et al. (1986), Bull (1987), Mellen (1987), Renken and Wiggers (1991), and Mellen et al. (1992).

Although pileated woodpeckers use immature forest habitat (Mellen 1987, Mellen et al. 1992), they more frequently use older, mature, dense-canopied forest areas (Conner et al. 1975, McClelland 1979, Conner 1980, Mannan 1984, Bull et al. 1986, Bull 1987, Mellen 1987, Renken and Wiggers 1991, Mellen et al. 1992). Mellen et al. (1992) stated that forest habitat classes older than 40 years and deciduous riparian areas in western Oregon provide habitat for foraging and other diurnal activities of pileated woodpeckers, but not for nesting or roosting. To accommodate a pileated woodpecker nest cavity 22.5 cm wide and 55 cm deep at a minimum height of 7.0 m, a tree at least 37-50 cm in dbh is required (Bull and Meslow 1977). Douglas-fir (Pseudotsuga menziesii) stands in western Oregon younger than 70 years did not provide snags and trees large enough to accommodate pileated woodpecker cavities because dbh of trees averaged less than 50 cm according to yield tables (Mellen et al. 1992). Bull et al. (1986) determined that pileated woodpeckers selected the largest trees available for nesting sites.

Summer home ranges established using radio-tagged birds averaged 478 ha with a range of 267-1056 ha in southcentral Oregon (Mellen et al. 1992). Bull and Meslow (1977) estimated breeding territories of 130-240 ha in northeastern Oregon. McClelland (1979) stated that pileated woodpecker pairs fed throughout areas ranging from approximately 200-400 ha in the Northern Rocky Mountains. Winter home ranges of 70 ha in Georgia were estimated by Kilham (1976), and spring and summer territories of 53-160 ha in Missouri were established using radio-telemetry techniques (Renken and Wiggers 1991). Renken and Wiggers (1991) stated that pileated woodpecker territory size decreased as log and stump volume (food supply) within their territories increased.

Bull and Meslow (1977) stated that feeding habitat is not as critical as nesting habitat for pileated woodpeckers. The potential of an area as suitable nesting habitat for pileated woodpeckers is highly dependent on the presence of nesting trees (snags) (Conner and Adkisson 1976). Researchers have estimated the density of snags required to support populations of pileated woodpeckers. Bull and Meslow (1977) stated that optimum pileated woodpecker forest habitat in Oregon should contain dead standing trees (snags) greater than 51 cm dbh at a density of 0.35 snags/ha. Their estimate assumes: 1) a density of two pairs of pileated woodpeckers per 2.59 km^2; 2) a need for 3 snags per year per pair (1 for nesting and 2 for roosting); and 3) a need for a reserve of 15 snags for each snag used because not all snags are acceptable (Bull and Meslow 1977). Evans and Conner (1979) stated that optimum pileated woodpecker forest habitat in the northeastern United States contains snags 45-65 cm dbh and 12-21 m tall at densities of 0.6 snags/ha. Evans and Conner (1979) based their estimate of 0.6 snags/ha on: 1) a territory size of 71 ha; 2) a need for 4 snags/year/pair (1 for nesting, 2 for roosting, and 1 for fledged young); and 3) a need for a reserve of 10 snags for each snag used to account for unusable snags, replacements, feeding habitat needs, and a snag supply for secondary users.

2.6.2 FOOD REQUIREMENTS

The pileated woodpecker feeds upon insects that infest standing and fallen timber (woodborers and carpenter ants) and supplements its diet with wild berries and acorns (Beal 1911, Bent 1939, Hoyt 1957, Jackman 1975, Beckwith and Bull 1985). The diet of the pileated woodpecker consists mostly of carpenter ants (Camponotus spp.) (Hoyt 1957, Beckwith and

Bull 1985). Foraging activities of pileated woodpeckers are classified as: excavation--digging into the tree or log in search of insects; scaling--prying off layers of bark to retrieve insects in the superficial bark; and gleaning--pecking and retrieving insects from exterior bark (Bull 1990).

Food supply is an important factor in the selection and use of habitat for pileated woodpeckers (Renken and Wiggers 1991). Bull et al. (1986) quantified foraging habitat of the pileated woodpecker in comparison to randomly selected available habitat. Dead and downed material, such as logs and windfall, used as feeding sites differed significantly from the available dead and downed material in diameter, length, and tree species. Pileated woodpeckers used Douglas-fir and western larch (Larix occidentalis) logs of large diameter (>25 cm) and long length (>15 m) more than would be accounted for by random selection. Seventy-eight percent of dead and downed material used for foraging had less than 25 percent of the bark, branches and needles remaining.

Amount of bark and branches remaining and the dbh of dead trees used for feeding were significantly different from available trees (Bull et al. 1986). Dead trees greater than 50 cm dbh with approximately 75 percent of their bark but with less than 75 percent of their branches were characteristic of 75 percent of pileated woodpecker feeding sites in dead trees. An average of 12 percent of the needles remained on dead trees used as feeding sites. Sanders (1970) found that carpenter ants nest only in logs, stumps and dead standing trees greater than 30 cm in diameter and in live trees greater than 20 cm dbh. Ants used larger diameter material because the smaller diameter material lacks permanence, decays quicker, and forces the ants to move more often (Bull et al. 1986, Swift et al. 1984). Bull et al. (1986) suggested that pileated woodpeckers selected woody material greater than 25 cm in diameter because ants were more abundant there. In addition, larger diameter dead wood generally contains higher densities of woodborers because of improved moisture retention (Bull et al. 1986).

Bull et al. (1986) reported live trees used as feeding sites were significantly different from available live trees in dbh and height. Large trees were preferred; 46 percent of trees used for feeding were greater than 50 cm dbh, and 77 percent of the trees were taller than 15 m (Bull et al. 1986).

Water may be a habitat requirement of the pileated woodpecker (Conner et al. 1975, Hoyt 1957). However, pileated woodpeckers have rarely been observed drinking water in the wild which may indicate they get adequate water from food sources or they drink from crevices in trees (Hoyt 1957). Kilham (1959) noted pileated woodpeckers flying down to a water source and drinking before entering their roost holes for the night. Most nests located by Hoyt (1957) had a supply of water nearby, however, the presence of a nearby water supply may be coincidental. Conner and Adkisson (1976) stated that pileated woodpeckers selected nest trees in mesic areas relatively close to streams. Conner et al. (1975) stated that pileated woodpeckers may select nest sights mainly in mesic environments because these areas produce large trees acceptable for nest sites.

2.6.3 HABITAT REQUIREMENTS ALONG A TRANSMISSION LINE

Most research on pileated woodpecker habitat requirements has been isolated from disturbances such as transmission lines. Studies such as those conducted by Conner et al. (1975), McClelland (1979), Conner (1980), Mannan (1984), Bull et al. (1986), Bull (1987), Mellen (1987), Renken and Wiggers (1991), and Mellen et al. (1992) were centered in natural nesting habitat. Jorgennsen et al. (1957) studied the habitat alongside a transmission line used by pileated woodpeckers and found less nesting in utility poles along sections of transmission line that extended through mature timber stands. Jorgennsen et al. (1957) assumed that mature stands of hardwood with mixed conifers is the preferred pileated woodpecker habitat decreasing the of use of utility poles for nesting.

CHAPTER 3

METHODOLOGY

3.1 STUDY AREA

The study focused on the use of utility poles for nesting by pileated woodpeckers on the R50M 230 000 volt transmission line in southeastern Manitoba. The R50M line was chosen because it was relatively accessible and exhibited considerable pileated woodpecker use. The study area was approximately 120 km long extending from Provincial Trunk Highway 12 southeast to the Canada-U.S. border (Fig. 2). The R50M transmission line in the study area consists of 441 Western Red Cedar (*Thuja plicata*) double pole structures 22.9 m high extending through various vegetation types. Three major forest types were identified in the study area: aspen-parkland, mixed wood, and coniferous forest.

3.2 NESTING HABITAT ANALYSIS OF PILEATED WOODPECKERS

Pileated woodpeckers were chosen as the focus species of this study because it is the species that most often excavates nest cavities in utility poles in southeastern Manitoba as determined by the author. Nesting

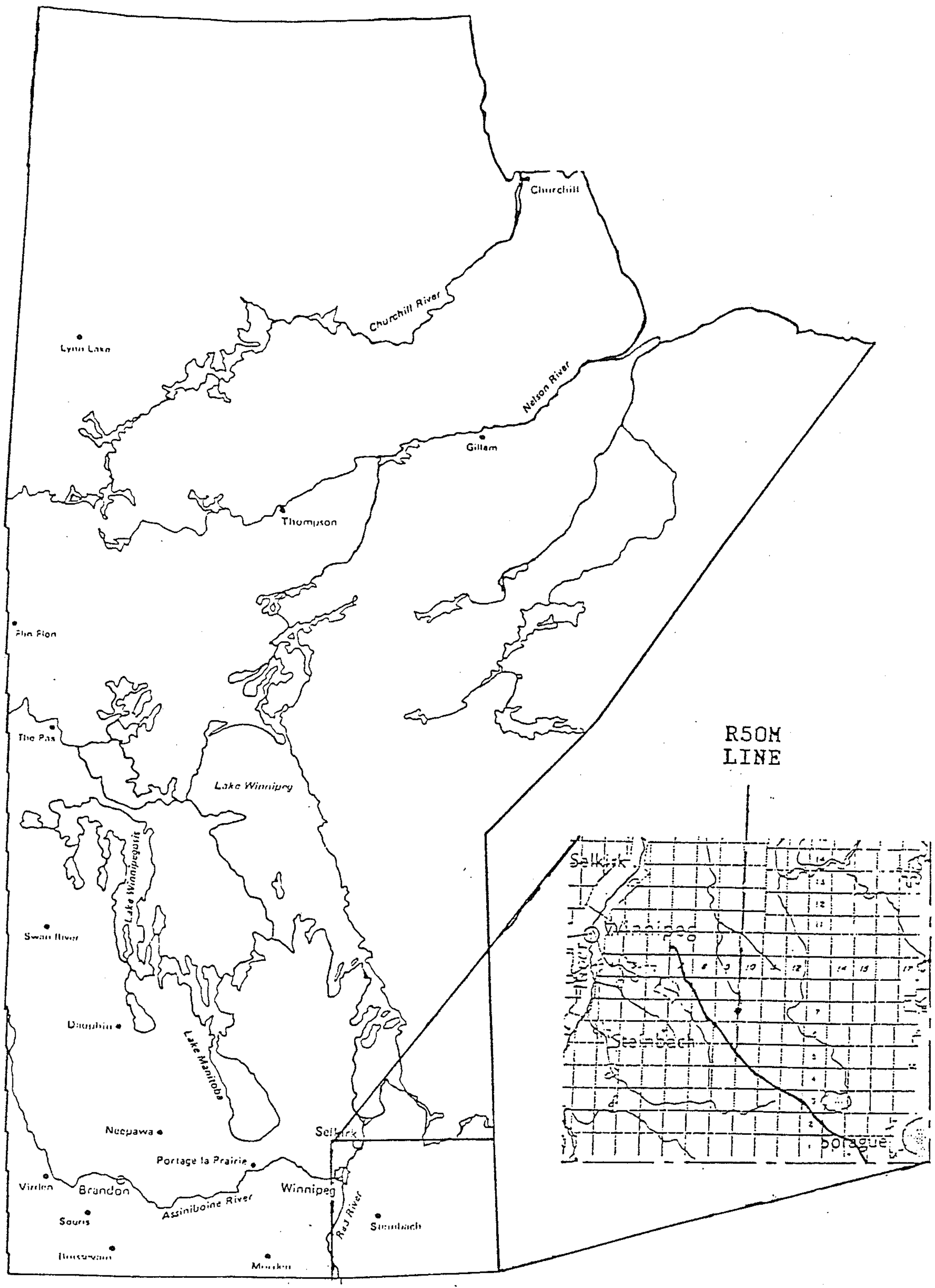

FIGURE 2. STUDY AREA IN SOUTHEASTERN MANITOBA

habitat characteristics of the pileated woodpecker measured in previous studies were also measured in this study to determine their importance in nest site selection in utility poles in the study area.

Data available from Manitoba Hydro depicted distinct woodpecker nesting and non-nesting sections (2 km or more in length) along the transmission line in the study area. The study area was searched in the winter to confirm pileated woodpecker nesting sections. Identification of pileated woodpecker nest cavities in utility poles was based on the entrance hole which is approximately 8 to 11 cm in diameter with a triangular outline (Bent 1939). Upon construction of the nest entrance as described above, approximately 50 percent of nests are excavated to completion (E. L. Bull, Dept. Agric., For. Serv., pers. comm. 1991). Areas along the transmission line (approximately 2 km in length) in the study area with four or more apparent nests in utility poles were considered nesting sections. A nesting section in this study was considered part of the territory of one pair of pileated woodpeckers using the utility poles for an extended period of time.

3.2.1 PILEATED WOODPECKER FORAGING

Observations of pileated woodpecker foraging were used to determine feeding range, food sources and food type during the nesting period. Foraging was defined as the activities of individual parent woodpeckers during food gathering. Feeding range was defined as the area used by pileated woodpecker parents during the nesting period. Food-source was defined as the substrate from which food was acquired. Food-type was the product obtained from the food source.

The study area was extensively searched in April and May of 1991 to identify utility poles recently excavated for nesting. Recent excavation was evident from fresh wood chips at the base of utility poles. Active nest sites were located by observing parents feeding young in the nest. Foraging was observed at all active nest sites in the study area while parents were feeding nestlings (approximately June 3 to July 3 of 1991).

Foraging behaviour was observed with the aid of field assistants equipped with 2-way radios and positioned in locations around the nesting pole. Field assistants were outfitted with camouflage clothing and trained in wildlife stalking techniques to afford successful foraging observations. Foraging observation periods occurred within 6 hours of sunrise (approximately 0600 to 1200 hours) to include the majority of feeding activity, in accord with Bull et al. (1986). Sampling bias may have resulted if the foraging activities of one individual parent woodpecker were used for extended periods of time; therefore, individual woodpeckers were observed for a maximum of 15 consecutive minutes to avoid sampling bias (Williams 1975).

Feeding activities of parent woodpeckers were recorded during foraging observations. A new foraging observation was recorded each time a woodpecker moved between trees or more than 1 m on the same tree.

Food-source was recorded for each foraging observation. Food-source was classified as: tree species; standing dead trees; live trees; stumps (< 1.5 m in height); and dead and downed material. Food-source was further classified as: broken top; percent of bark and branches remaining; diameter; and length. Food-source data were gathered through foraging observations and previous pileated woodpecker foraging activity. Previous pileated woodpecker foraging activity was identified from large excavations (10 cm up to 2 m in length), which is much larger than other woodpecker species (Bull 1990). Foraging observations and past foraging activity aided in determining pileated woodpecker food sources and food-type was identified, where possible, by sampling the food-source.

3.2.2 FEEDING RANGE DURING NESTING PERIOD

Observation of foraging enabled the establishment of feeding range of pileated woodpeckers during the nesting period. Observers recorded distance and direction of each foraging observation from the nest pole. Several techniques for estimating home ranges are available, however, the number of foraging observations was inadequate for use with available home range estimation techniques. Maximum distances flown by parent woodpeckers and information from the literature were used to estimate feeding range size. Shape of pileated woodpecker feeding ranges was found to be slightly oval, however, square sample areas would be sufficient for habitat sampling (E. L. Bull, Dept. Agric., For. Serv., pers. comm. 1991).

3.2.3 NESTING HABITAT CHARACTERISTICS

Habitat characteristics of nesting and non-nesting sections in the study area were measured after the nesting period. Sample areas were at the median of nesting and non-nesting sections. Sample areas were 225 ha (1.5 x 1.5 km) as estimated by the size of feeding range identified from foraging observations and past studies. Habitat characteristics in sample areas were measured using ground sampling techniques and forest inventory maps available from the Forestry Branch of the Manitoba Department of Natural Resources.

Nesting habitat characteristics measured in nesting and non-nesting sample areas include:

1. food sources;
2. distance to clearing;
3. distance to water;
4. distance to cover;
5. covertype;
6. site class;
7. cutting class; and
8. crown closure class.

Food sources recorded include standing dead trees, stumps and dead and downed material. Food sources were sampled randomly along pre-determined transects in all nesting and non-nesting sample areas. Standing dead trees and stumps were quantified using the line-strip method (Wooden and Lindsey 1954, Lindsey 1955, Barbour et al. 1980). Line strips 10 m wide and 375-m long were sampled perpendicularly to the transmission line. The line-intercept method (Bauer 1943) was used to sample dead and downed material with 375 m long line intercepts and was coordinated with the line-strip method.

To identify acceptable pileated woodpecker food sources; species, percentage of remaining bark and branches, broken top, length, diameter, and foraging activity were recorded for food sources sampled along line strips and line intercepts. Species was determined if a sufficient amount of bark remained on food sources. Percentage of remaining bark and branches (in quartiles) was an ocular estimation using a transparent grid. Broken top of dead standing trees was recorded and the length of food sources was measured with either a tape measurer or inclinometer. Diameter of dead standing trees and stumps greater than 1.5 m in height was measured at breast height and diameter of dead and downed material and stumps less than 1.5 m in height was measured at the median. Pileated woodpecker foraging activity was identified from large excavations (10 cm up to 2 m in length) which is much larger than other woodpecker species (Bull 1990). A raw data set of the above food source characteristics was created from the ground sampling techniques.

Previous studies found that diameter and percentage of bark and branches remaining appeared to be limiting factors for acceptance as a food source (Bull 1986). Acceptable pileated woodpecker food sources were determined from the raw data set based on diameter and percentage of bark and branches remaining. Percentage of bark and branches remaining on food sources with foraging activity ranged from 0 to 100 percent and was not a limiting factor for acceptance as a food source. The minimum diameter of a food source with foraging activity in the study area was 3.8 cm.

Observations of 1 376 dead and downed materials, stumps and dead standing trees from the raw data exceeded 3.8 cm in diameter and were considered acceptable food sources.

Total quantity of acceptable food sources was determined from the raw data for each nesting and non-nesting 225-ha sample area. Total quantity of acceptable nest trees, in accord with the literature, was determined from the raw data for each nesting and non-nesting sample area. Other variables derived from the raw data set for each nesting and non-nesting sample area include: 1. relative percentages of food-source types (percentage of dead and downed material, percentage of stumps, and percentage of dead standing trees); 2. mean diameter of food-source types; 3. mean percentage of bark and branches remaining on food-source types; and 4. mean diameter and mean percentage of remaining bark and branches on food sources with confirmed foraging activity. The above variables were included in a data set, after this referred to as the ground sampling habitat data set.

Distances to clearing, water and cover were measured from utility pole structures at the midpoint of each nesting and non-nesting section and included in the ground sampling habitat data set. A clearing was defined as an area lacking a tree layer more than 10 m in height, excluding the right-of-way. Water was defined as any permanent source of water observed at the beginning and end of the nesting period.

Cover was defined as stands of trees more than 10 m in height.

Covertype, cutting class, site class and crown closure class of sample areas was determined using the Manitoba Department of Natural Resources (MDNR), Forestry Branch Geographic Information System (GIS). Maps of nesting and non-nesting sections were generated by the Forestry Branch for 9 sample areas (Appendix G). The remaining 10 sample areas were not in the GIS and were analyzed manually using forest inventory maps available from the Forestry Branch.

Species composition of the tree stand, as outlined by the MDNR (1986), is based on the comparison of the tree count (basal area) for each species to the total tree count (basal area) of the stand, expressed as a percentage. The abundance of each species present is rounded off to the nearest 0.10 percent. Four broad cover-type categories (see Appendix A) are recognized based on the percentage of softwoods within a stand; Softwood (S), Softwood-Hardwood (M), Hardwood- Softwood (N), and Hardwood (H). The proportion of area occupied by each cover-type in nesting and non-nesting sample areas was determined and included in a data set, after this referred to as the GIS data set.

Site class is an indication of the potential for growth of the stand and is determined from age and average height in meters of forest stands. Site class ranges on a scale from 1 to 3, where 1 is a site with the best potential for growth of the major tree species while 3 is a site with least potential for productive growth. The proportion of area occupied by each site class in nesting and non-nesting sample areas was determined and included in the GIS data set.

Approximate maturity of forest stands was estimated from the cutting class of forest stands (see Appendix B). Cutting class is based on the size, vigor, state of development and maturity of a stand for harvesting purposes. Cutting class ranges on a scale from 0 to 5. Class 0 is forest land not restocked following fire, cutting, windfall or other major disturbances. Class 5 is overmature stands which should be given priority in cutting. The proportion of area occupied by each cutting class in nesting and non-nesting sample areas was determined and included in the GIS data set.

Crown closure class was recorded for the surrounding habitat (see Appendix C). Crown closure is based on the density of the crown for each stand and is estimated from aerial photographs by an experienced photo interpreter. Crown closure varies on a scale from 0 to 4, with 0 representing crown closure densities of 0 to 20 percent and 4 representing crown closure densities of 71 percent or greater. The proportion of area occupied by each crown closure class in nesting and non-nesting sample areas was determined and included in the GIS data set.

3.2.4 STATISTICAL ANALYSIS OF NESTING HABITAT CHARACTERISTICS

Simple plots of nesting and non-nesting variables from the GIS and ground sampling data sets were constructed. Plotting the variables revealed how habitat characteristics related to nesting and non-nesting by pileated woodpeckers in utility poles; however, simple plots did not identify the order of importance habitat characteristics have for nesting selection. A stepwise discriminant analysis was performed to determine the order of importance of habitat characteristics in pileated woodpecker nest site selection.

The stepwise discriminant analysis is a multivariate technique that aided in distinguishing between different items (Conner and Adkisson 1976). Items distinguished in this study were habitat characteristics of nesting and non-nesting sections along the transmission line. Habitat characteristics that emerged from the stepwise discriminant analysis were considered good discriminators. Analysis allowed classification as nesting habitat or habitat not suitable for nesting in the study area. Ecological characteristics acting as discriminating factors in the selection of nest sites by pileated woodpeckers in utility poles were identified with the aid of this stepwise discriminant analysis.

A stepwise discriminant analysis was initially performed on the ground sampling habitat variables and important characteristics were merged with the GIS data set for further analysis. Characteristics selected from the merged GIS and ground sampling data set by stepwise discriminant analysis were considered the most important for nest-site selection.

3.3 UTILITY POLE HARDNESS AND PRESERVATIVE TYPE

All poles in nesting and non-nesting sample areas were tested for hardness and the presence of decay using a wood testing instrument, called a "Pilodyn". The pilodyn injected a spring loaded steel striker pin into the wood. Penetration, measured in mm, of the striker pin depended on density of wood. Preliminary hardness testing on cedar utility poles revealed a range between 20 to 40 mm in penetration (W. Munro, Manitoba Hydro, pers. comm. 1990). Hardness measurements were taken equidistant from each other in four directions around each pole. The mean value of the four hardness measurements was included in the ground sampling habitat data set. Low values of penetration indicated high density of wood. Wood chips were collected from spring nest excavations for analysis by Manitoba Hydro to determine the presence of decay.

Preservative type was recorded for all poles in nesting and non-nesting sample areas. Utility poles in the study area were treated with two types of wood preservative; Ammoniacal Copper Arsenate (ACA or Chemonite) and Pentachlorophenol (Penta). A stepwise discriminant analysis was performed to determine if pole hardness and preservative type are important factors for nest-site selection in utility poles.

3.4 NEST CAVITY HEIGHT AND DIRECTION

Height and compass direction of 47 nesting cavities in utility poles in the study area were recorded. Cavity heights were measured with an inclinometer, direction of nest cavities were measured with a compass.

3.5 SECONDARY INHABITANTS

McClelland (1979) recorded 17 bird and mammal species using abandoned pileated woodpecker nest cavities. Secondary use of pileated woodpecker nesting cavities in utility poles was recorded during summer observations in the present study. It was important to know secondary inhabitants of pileated woodpecker nest cavities in utility poles for future management decisions to control woodpecker use of utility poles.

CHAPTER 4

RESULTS

4.1 HABITAT ANALYSIS OF THE PILEATED WOODPECKER

4.1.1 ACTIVE NESTING SECTIONS

Pileated woodpecker nesting cavities were observed in 25 or 5.7 percent of utility pole structures in the study area. Winter observations identified 9 nesting and 10 non-nesting sections within the study area. One recently excavated cavity was found in the spring in a utility pole but this cavity was not used as a nest site. Parent pileated woodpeckers were observed feeding young in utility poles in 2 of the 9 nesting sections.

An active nest was found in nesting section 183N (pole-182) approximately 2 km north of the Trans Canada Highway. GIS habitat characteristics of the 225-ha sample area for nesting section 183N are listed in Table 2. Nesting section 183N was mostly immature trembling aspen (*Populus tremuloides*) with some surrounding mature stands of trembling aspen.

A second active nest was found in nesting section 464N (pole-466) approximately 3 km northeast of Vassar, Manitoba.

TABLE 2. HABITAT CHARACTERISTICS IN NESTING SECTIONS

GIS HABITAT CHARACTERISTICS (% of 225 ha area)	NESTING SECTION 183N	464N
FORESTED	61.6	86.4
NON-FORESTED	38.4	13.6
COVERTYPE 1	0	27.8
COVERTYPE 2	0	0
COVERTYPE 3	0	21.9
COVERTYPE 4	100.0	36.7
SITE CLASS 1	100.0	67.6
SITE CLASS 2	0	28.0
SITE CLASS 3	0	0
CUTTING CLASS 1	30.9	4.0
CUTTING CLASS 2	10.3	4.3
CUTTING CLASS 3	20.4	55.9
CUTTING CLASS 4	0	22.1
CUTTING CLASS 5	0	0
CROWN CLOSURE 1	0	0
CROWN CLOSURE 2	12.5	18.7
CROWN CLOSURE 3	24.2	8.6
CROWN CLOSURE 4	24.9	59.0

The GIS habitat characteristics of the 225-ha sample area for nesting section 464N are listed in Table 2. Nesting section 464N is largely mature trembling aspen stands with some black spruce (Picea mariana), jack pine (Pinus banksiana) and tamarack (Larix laricina).

4.1.2 FORAGING OBSERVATIONS DURING THE NESTING PERIOD

Observations of pileated woodpecker foraging began early in the nesting period June 3, and concluded on July 3, the last day nestlings were observed in the nest. Parents were observed feeding young during the nesting period beginning at sunrise and ending at dusk at both nest sites. Late in the nesting stage, nestlings often had their heads out the nest entrance, which facilitated counting them. Each active nest contained three or more nestlings. Parents and nestlings had left the nesting section and it was assumed fledglings successfully left the nests approximately July 4-6.

Only one extended observation of foraging by the male pileated woodpecker from nesting section 183N was possible. In this instance the bird excavated for approximately 5 min. in two stumps and a log 820 m from the nest site. Foraging observations of pileated woodpeckers during the nesting period were mostly unsuccessful.

Maintaining visual contact with the pileated woodpecker was difficult because of dense forest cover and only brief sightings of the bird were possible. In most sightings, the pileated woodpecker was startled and retreated into the forest cover immediately. For all recorded sightings the birds retreated from a food source and were considered to have been foraging prior to disturbance. Eleven pileated woodpecker sightings were recorded, 45 to 840 m from the nest site, in the study area.

4.1.3 FEEDING RANGE DURING THE NESTING PERIOD

Feeding range was not determined by a technique for estimation of home range because of the limited number of pileated woodpecker foraging observations. Parent woodpeckers were observed foraging approximately 840 meters from the nesting pole that was determined to be the maximum foraging distance for both active nesting sections. The maximum foraging distance was considered the radius (r= 840 m) for determining feeding range area. Relevant literature and the maximum foraging distance ($3.1416 \times r^2$=area) was used to estimate a feeding range of 225 ha (1.5 x 1.5 km) for pileated woodpeckers in the study area.

4.1.4 FOOD SOURCES AND FOOD-TYPE

Habitat sampling allowed identification of food sources and food types. Food sources used by pileated woodpeckers in the study area included: logs, stumps, dead standing trees, live trees, fence posts and utility poles. Pileated woodpeckers often foraged in tall stumps with small diameters and the minimum diameter of food sources was 3.8 cm. Figure 3 shows the total quantity of food sources plotted against mean diameter of food sources illustrating a wide range of foraging diameters.

Food-type was determined to be mostly ants, although the species were not identified. Excavations in food sources revealed ant galleries suggesting the pileated woodpecker searched for them. Some scaling of coniferous trees was also evident in the study area, indicating the birds searched for woodboring insects.

4.2 STATISTICAL ANALYSIS OF NESTING HABITAT CHARACTERISTICS

Habitat characteristics of the nesting and non-nesting sections were sampled as outlined in Chapter 3. Data sets of the ground sampling (Table 3) and GIS habitat characteristics (Table 4) were created for analysis.

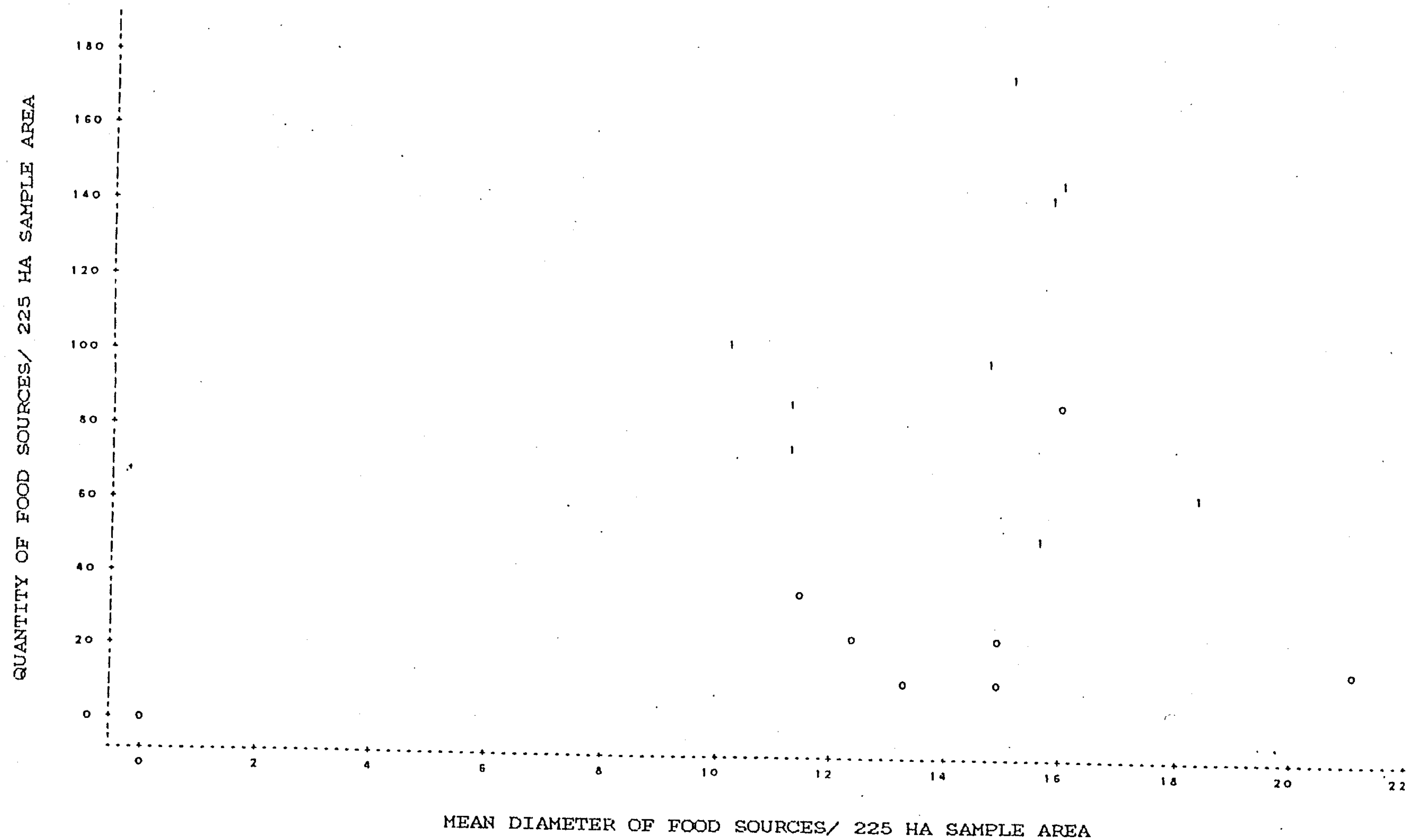

FIGURE 3. Quantity of Food Sources Plotted Against Mean Diameter of Food Sources in Sample Areas. (1= nesting sample area, 0= non-nesting sample area)

TABLE 3. Ground Sampling Habitat Characteristics.

OBS	SITE	NEST	TOTQ	TOTS	A	B	C	MDIAA	MDIAB	MDIAC	MBA	MBB	MBC	FORA	FORB	FORC	MDIFOR	BFOR	DWA	DCO	DOP	MHARD	PENTA	ACA
1	535	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	174	240	0	21.2	33.3	66.7
2	512	1	174	11	61.8	16.0	22.2	11.1	16.9	24.9	38.5	50.0	86.2	33.3	40.0	26.7	15.1	51.0	0	2	190	20.2	50.0	50.0
3	489	0	22	0	40.9	31.8	27.3	11.2	12.8	13.5	55.6	46.4	70.8	60.0	20.0	20.0	12.3	56.8	140	20	110	18.7	35.7	64.3
4	464	1	142	5	43.6	30.0	26.4	12.8	16.3	20.1	32.7	56.5	87.8	48.8	29.3	22.0	15.8	54.5	0	20	600	16.9	16.7	83.3
5	411	0	37	1	50.0	11.1	38.9	5.4	10.7	19.0	94.4	68.8	93.3	0.0	0.0	0.0	11.5	91.2	150	20	45	23.0	28.6	71.4
6	348	1	50	1	26.0	50.0	26.0	17.3	13.5	18.0	59.6	65.0	95.8	20.0	53.3	26.7	15.6	71.0	0	20	132	21.6	57.1	42.9
7	324	0	13	0	76.9	15.4	7.7	12.3	13.3	23.9	35.0	50.0	0.0	0.0	0.0	0.0	13.3	34.6	600	20	550	19.5	100.0	0.0
8	293	1	62	5	41.9	27.4	30.6	14.9	17.4	23.8	52.9	83.8	77.6	28.6	33.3	38.1	18.3	69.0	0	20	85	17.4	66.7	33.3
9	275	0	13	0	23.1	15.4	61.5	8.9	12.1	17.8	50.0	62.5	78.1	0.0	25.0	75.0	14.9	69.2	0	20	185	21.7	71.4	28.6
10	258	1	89	2	55.9	11.8	32.3	9.4	12.9	13.8	50.0	75.0	86.7	47.8	28.3	23.9	11.2	64.8	0	20	290	17.2	38.5	61.5
11	233	0	15	1	33.3	33.3	33.3	17.9	21.1	24.3	60.0	55.0	100.0	25.0	50.0	25.0	21.1	71.7	50	145	0	17.9	28.6	71.4
12	208	1	100	1	68.0	16.0	16.0	13.0	17.0	19.7	32.4	70.3	93.8	64.5	19.4	16.1	14.7	48.3	190	20	550	22.3	40.0	60.0
13	196	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	300	260	0	18.8	28.6	71.4
14	183	1	76	3	68.4	15.8	15.8	8.6	15.6	18.5	18.3	41.7	68.8	42.1	31.6	26.3	11.3	30.0	280	20	125	19.1	46.7	53.3
15	170	0	22	0	50.0	9.1	40.9	13.2	19.4	17.8	54.5	75.0	97.2	50.0	25.0	25.0	14.9	70.7	10	180	0	23.0	100.0	0.0
16	156	1	103	0	61.3	19.0	19.7	8.5	12.0	14.0	42.2	73.1	88.4	45.5	31.8	22.7	10.2	57.0	250	20	280	21.7	100.0	0.0
17	145	0	88	1	25.9	21.2	52.9	12.6	15.8	17.7	76.1	90.3	90.6	0.0	16.7	83.3	16.0	86.8	440	20	280	23.4	100.0	0.0
18	130	1	146	3	31.5	28.8	39.7	14.2	15.6	17.7	37.5	42.9	81.5	20.8	39.6	39.6	16.0	56.5	115	88	0	23.3	83.3	16.7
19	118	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35	215	0	23.8	100.0	0.0

Index

OBS= observation
SITE= Section #

NEST= 1=nest site
0=non-nest site
TOTQ= Quantity of Food Sources
TOTS= Quantity of Nest Snags
A= % logs of food sources
B= % stumps of food sources
C= % dead standing trees
MDIAA= mean diam. of logs (cm)
MDIAB= mean diam. of stumps (cm)
MDIAC= " " of dead trees (cm)
MBA= mean % bark remaining - logs
MBB= mean % bark " - stumps
MBC= " " " " - dead trees

FORA= % Foraging on logs
FORB= % Foraging on stumps
FORC= % " on dead trees
MDIFOR= mean diam. food(cm)
BFOR= % bark on food
DWA= distance to water (m)
DCO= distance to cover (m)
DOP= distance to open (m)
MHARD= mean hardness (mm)
PENTA= % poles with PENTA
ACA= % pole with ACA

TABLE 4. GIS Habitat Characteristics.

OBS	SITE	NEST	FOR	NFOR	C1	C2	C3	C4	S1	S2	S3	CC1	CC2	CC3	CC4	CC5	CR1	CR2	CR3	CR4	TOTQ	TOTS	C
1	118	0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0	.
2	130	1	27.3	72.7	0.0	0.0	0.0	27.3	27.3	0.0	0	1.7	6.7	18.3	1.3	0.0	0	3.1	9.3	14.9	146	3	39.7
3	145	0	80.7	19.3	0.0	0.0	0.0	80.7	80.7	0.0	0	3.9	35.8	1.4	39.7	0.0	0	3.1	9.9	67.6	88	1	52.9
4	156	1	64.6	35.4	0.0	0.0	0.0	64.6	64.6	0.0	0	0.0	11.6	47.5	5.5	0.0	0	1.7	4.7	58.2	103	0	19.7
5	170	0	42.8	57.2	0.0	0.0	0.0	42.8	42.8	0.0	0	3.9	12.0	27.0	0.0	0.0	0	3.2	17.1	22.5	22	0	40.9
6	183	1	61.6	38.4	0.0	0.0	0.0	61.6	61.6	0.0	0	30.9	10.3	20.4	0.0	0.0	0	12.5	24.2	24.9	76	3	15.8
7	196	0	13.9	86.1	0.0	0.0	0.0	13.9	9.0	4.9	0	0.4	0.5	4.2	8.8	0.0	0	3.0	4.2	6.7	0	0	.
8	208	1	60.1	39.9	0.0	0.0	0.0	60.1	60.1	0.0	0	0.0	10.9	49.2	0.0	0.0	0	0.0	0.0	60.1	100	1	16.0
9	233	0	26.7	73.2	0.0	0.0	5.7	21.0	26.7	0.0	0	0.0	8.8	1.3	16.6	0.0	0	0.0	4.4	22.3	15	1	33.3
10	258	1	71.7	28.3	0.0	0.0	1.0	70.7	62.9	8.8	0	0.0	3.1	57.6	11.0	0.0	0	1.8	0.5	69.4	89	2	32.3
11	275	0	69.9	30.1	100.0	0.0	0.0	0.0	1.9	67.9	0	4.7	22.5	16.9	25.8	0.0	0	0.0	13.3	56.6	13	0	61.5
12	293	1	71.8	28.2	18.8	0.6	21.0	31.3	59.9	11.9	0	4.9	6.2	32.2	28.5	0.0	0	8.7	19.4	43.7	62	5	30.6
13	324	0	93.5	6.5	93.5	0.0	0.0	0.0	0.0	93.5	0	0.0	0.7	1.7	68.4	22.6	0	9.1	53.8	30.7	13	0	7.7
14	348	1	87.4	12.6	43.5	17.8	9.2	16.9	39.9	47.5	0	2.2	19.3	65.9	0.0	0.0	0	0.0	21.7	65.6	50	1	26.0
15	411	0	57.2	42.8	49.8	0.0	3.5	3.9	42.4	14.8	0	0.0	0.0	53.3	3.9	0.0	0	5.7	5.2	46.3	37	1	38.9
16	464	1	86.4	13.6	27.8	0.0	21.9	36.7	58.4	28.0	0	4.0	4.3	55.9	22.1	0.0	0	18.7	8.6	59.0	142	5	26.4
17	489	0	44.0	56.0	8.4	0.0	0.0	35.9	36.4	7.6	0	0.8	4.4	33.7	5.1	0.0	0	1.7	14.4	27.9	22	0	27.3
18	512	1	41.4	58.6	12.3	6.4	14.9	5.8	41.4	0.0	0	1.6	8.4	31.4	0.0	0.0	0	0.0	12.3	29.1	174	11	22.2
19	535	0	12.7	67.3	0.5	0.0	0.0	12.2	12.7	0.0	0	0.0	4.3	7.9	0.5	0.0	0	2.8	3.6	6.4	0	0	.

Index

OBS=OBSERVATION
SITE= SECTION #
NEST= 1= NEST
0= NON-NEST

FOR= FORESTED

NFOR= NON-FORESTED

C1= COVERTYPE 1
C2= COVERTYPE 2
C3= COVERTYPE 3
C4= COVERTYPE 4

S1= SITE CLASS 1
S2= SITE CLASS 2
S3= SITE CLASS 3

CC1= CUTTING CLASS 1
CC2= CUTTING CLASS 2
CC3= CUTTING CLASS 3
CC4= CUTTING CLASS 4
CC5= CUTTING CLASS 5

CR1= CROWN CLOSURE 1
CR2= CROWN CLOSURE 2
CR3= CROWN CLOSURE 3
CR4= CROWN CLOSURE 4

TOTQ= QUANTITY FOOD SOURCES
TOTS= QUANTITY OF NEST SNAGS
C= % DEAD STANDING TREES

4.2.1 SIMPLE PLOTS

Simple plots of the habitat characteristics revealed a variety of relationships with nest-site selection. Total quantity of food sources in sample areas showed a relationship with nest site selection (Fig. 4). Nesting sections had a higher quantity of acceptable pileated woodpecker food sources opposed to non-nesting sections with lower numbers of food sources. Cutting class 3 (cc3) exhibited a relationship with nest-site selection (Fig 5). Nesting sections contained a higher proportion of cc3 stands in the sample area. Site class 1 exhibited a relationship with nest site selection (Fig. 6) as a higher proportion of the sample area was site class 1 in nesting sections. Distance to cover showed some relationship with nest site selection (Fig. 7) as distance to forest cover was lowest in nesting sections. Order of importance of the above habitat characteristics for nest site selection was not revealed through analysis of simple plots.

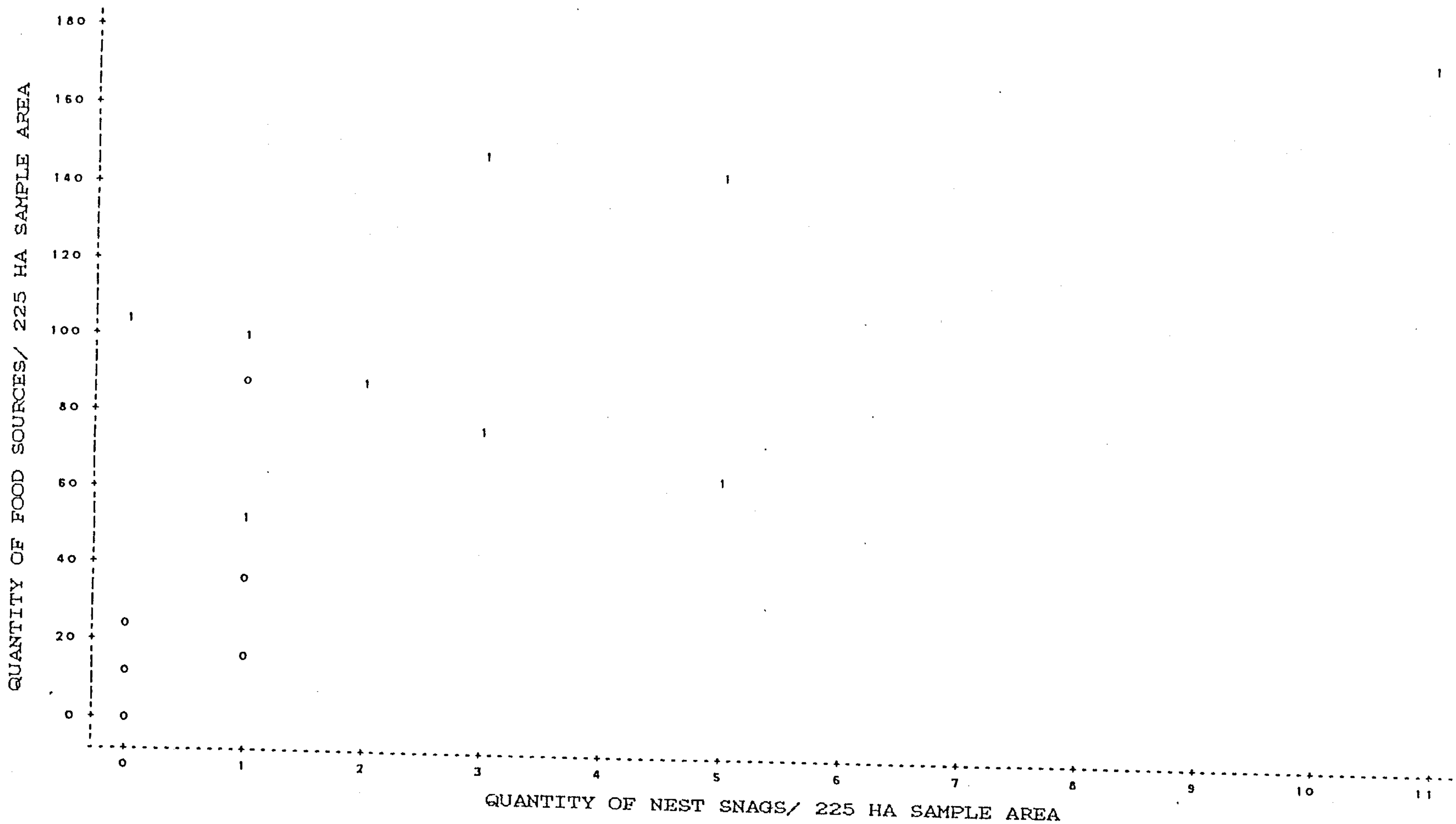

FIGURE 4. Quantity of Food Sources Plotted Against Quantity of Nest Snags.
(1= nesting sample area, 0= non-nesting sample area)

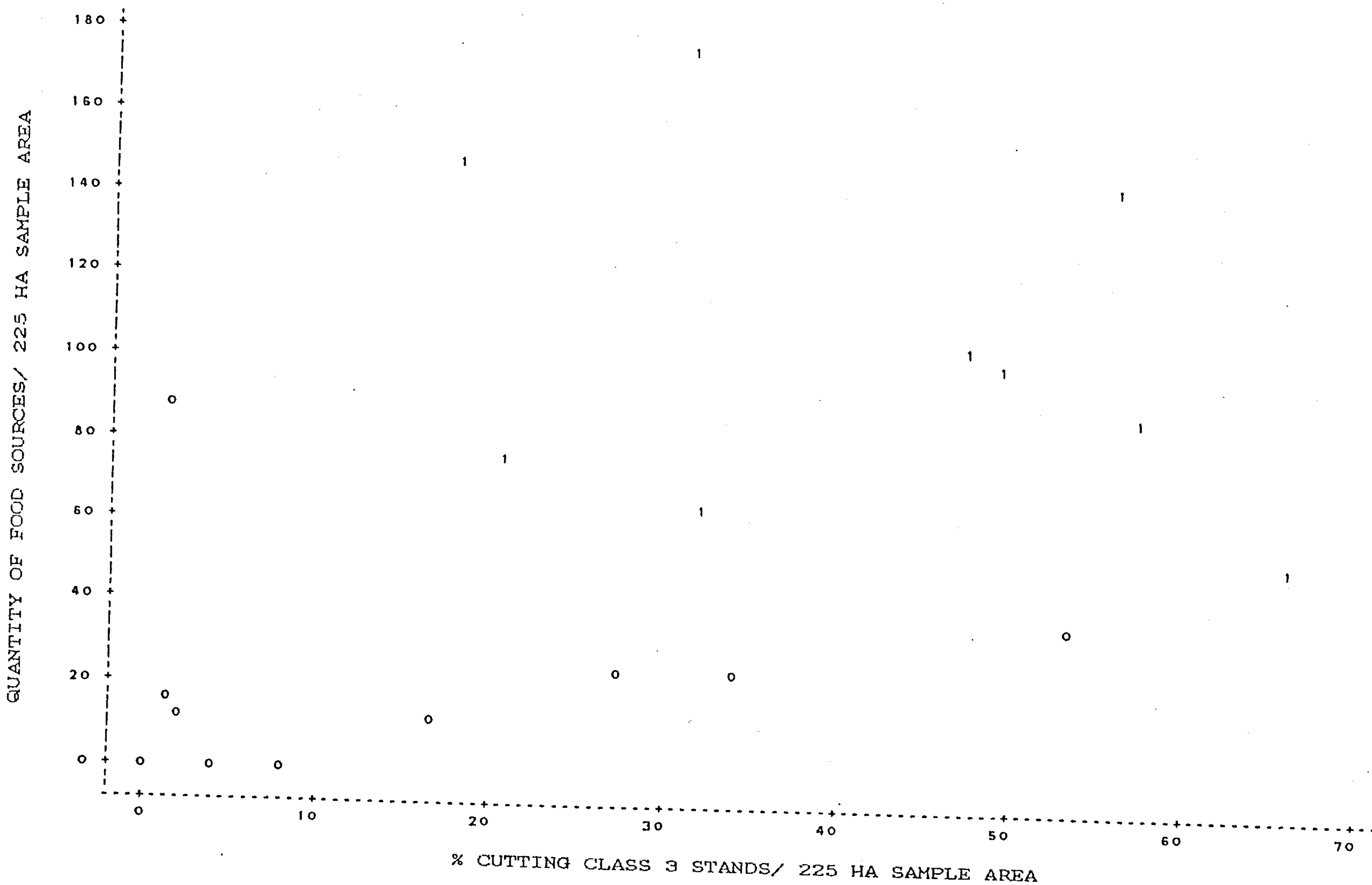

FIGURE 5. Quantity of Food Sources Plotted Against Cutting Class 3 Forest Stands.
(1= nesting sample area, 0= non-nesting sample area)

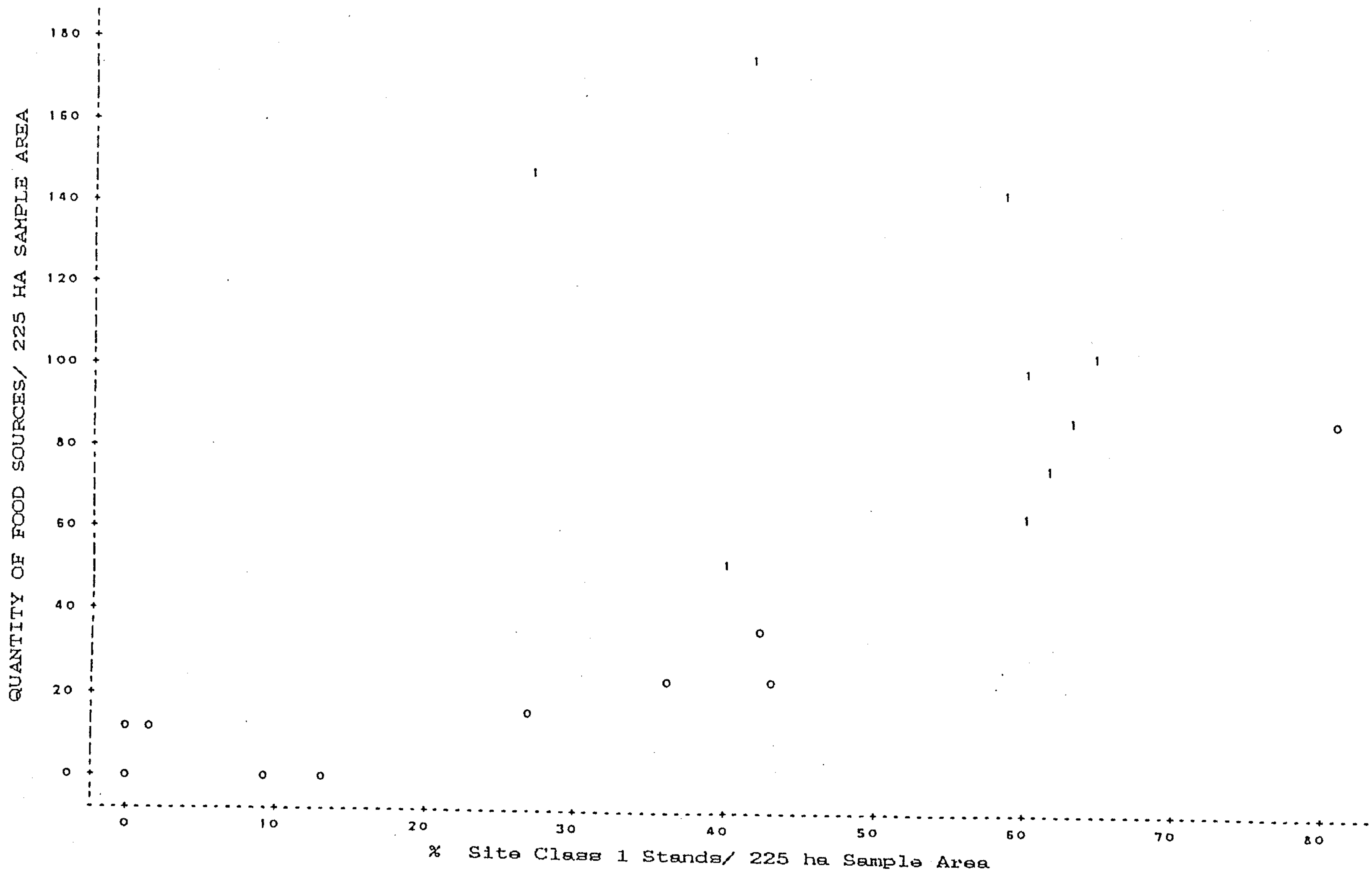

FIGURE 6. Quantity of Food Sources Plotted Against Site Class 1 Forest Stands.
(1= nesting sample area, 0= non-nesting sample area)

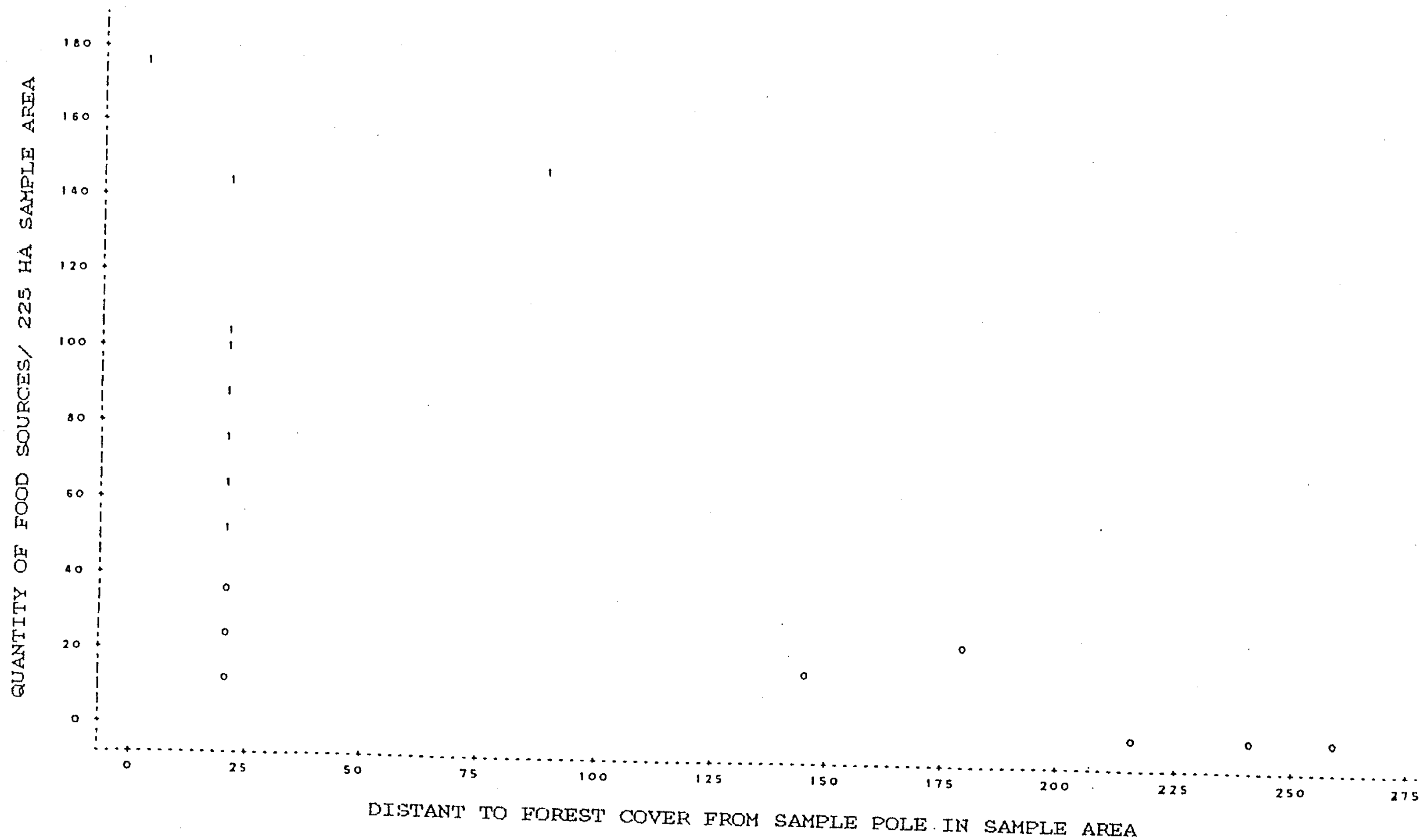

FIGURE 7. Quantity of Food Sources Plotted Against Distance to Forest Cover.
(1= nesting sample area, 0= non-nesting sample area)

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4.2.2 STEPWISE DISCRIMINANT ANALYSIS

Stepwise discriminant analysis selected habitat characteristics in their order of importance for nest-site selection (Appendix D). The most important habitat characteristic for nest-site selection was the quantity of food sources. The next most important characteristic was cutting class 3 stands followed by cutting class 1 stands. The least important of the discriminating factors were: the relative percentage of foraging in stumps; the relative percentage of dead standing trees; and distance to cover. Relative percentage of foraging in stumps was ignored because it measured the occurrence of foraging in both nesting and non-nesting sections. Selection of the relative percentage of dead standing trees was likely coincidental because of low quantities of food sources in non-nesting sections. The proportion of area occupied by cutting class 1 stands was very low in both nesting and non-nesting sections (see Table 4). Cutting class 1 stands were likely selected because of minor differences and only nesting section 183N had substantial cutting class 1 stands, which will be discussed further in Chapter 5.

4.3 INTENSITY OF USE OF UTILITY POLES

The intensity of use of utility poles by the resident pair of pileated woodpeckers in nesting sections was variable in the study area. Nesting section 183N contained 10 nest cavities in utility poles, which was the highest number of cavities for a nesting section in the study area. Remaining nesting sections in the study area contained only 4 or 5 nest cavities in utility poles.

4.4 UTILITY POLE HARDNESS AND PRESERVATIVE TYPE

Measurements of hardness and preservative type were made for 271 utility poles in the study area. Measurements were separated into 3 groups: nesting poles in nesting sections (NN); non-nesting poles in nesting sections (NNN); and non-nesting poles in non-nesting sections (NNNN). Analysis of pole hardness and preservative data indicated selection for preservative type. Proportion of nesting in poles with Chemonite preservative was lower than in poles with PENTA preservative (40 percent Chemonite: 60 percent PENTA). Selection against Chemonite poles appeared to exist, however, the proportions of PENTA and Chemonite poles were similar for all groups (Table 5). The mean hardness of utility poles selected for nesting was similar to those not selected for nesting (Table 5). Decay was not evident in

TABLE 5. UTILITY POLE HARDNESS AND PRESERVATIVE TYPES

POLE GROUP	PRESERVATIVE TYPE (%)		POLE HARDNESS	
	ACA	PENTA	MEAN	S.D.
NN (n=38)	40.0	60.0	20.6	3.9
NNN (n=96)	39.6	60.4	20.1	4.5
NNNN (n=137)	42.0	58.0	21.0	3.8

wood chips recovered from a recent nest excavation in a utility pole. Stepwise discriminant analysis selected neither pole hardness nor preservative type as a factor in nest-site selection (Appendix D).

4.5 NEST CAVITY HEIGHT AND DIRECTION IN UTILITY POLES

Height and compass direction of 47 nest cavities in utility poles within the study area were determined. Height of nest cavities in utility poles ranged from 4.3-16.8 m (mean height= 10.0 m, standard deviation= 3.4 m). Pileated woodpeckers excavated nest cavities in utility poles in all directions (southeast 29.8 percent, southwest 27.6 percent, northeast 21.3 percent, and northwest 21.3 percent).

4.7 ADDITIONAL OBSERVATIONS

4.7.1 SECONDARY INHABITANTS

Three pairs of American kestrels (Falco sparverius) were observed nesting in old pileated woodpecker cavities in utility poles and 2 pairs of northern flickers were observed in old pileated cavities. An unidentified flycatcher species and a flying squirrel (Glaucomys sabrinus) were also observed in old pileated nest cavities in utility poles.

4.7.2 PILEATED WOODPECKER OBSERVATIONS IN NON-ACTIVE NESTING SECTIONS

Pileated woodpeckers were observed in 4 nesting sections without active nesting in utility poles. Pileated woodpeckers were also observed near non-nesting section 233NN.

4.7.3 APPARENT ATTEMPTED BEAR PREDATION OF NEST POLES

Several utility poles in the study area were scarred with claw marks made by black bears (Ursus americanus). Several utility poles with nest cavities had been climbed by bears.

4.7.4 NATURAL PILEATED WOODPECKER NEST TREES IN MANITOBA

Five natural pileated woodpecker nest cavities were located in the study area, 4 in nesting sample areas and 1 in a non-nesting sample area. Natural nest trees were not climbed, however, nest entrances exhibited pileated woodpecker characteristics. Nest-tree characteristics measured in the study area and in pileated woodpecker nest record cards for Manitoba include: 1) nest height (N.H.); 2) species; 3) tree condition (live or dead); 4) diameter at breast height (dbh); 5) percent of bark and branches remaining (%bark); and 6) broken top (see Table 6).

The range of dbh for natural pileated woodpecker nest trees found in Manitoba was 31.2-43.0 cm (n= 12, mean= 37.3 cm, SD= 3.4 cm) and the range of nest height was 2.2-15.2 m (n= 18, mean= 7.5 m, SD= 3.3 m). The GIS habitat characteristics of forest stands with natural nest cavities in the study area were listed in Table 7.

Table 6. Natural Nest Tree Characteristics in Study Area.

Sample Area	N.H. (m)	dbh (cm)	species	tree condition	%bark	broken top (yes/no)
512N	7.6	39.5	B. poplar	dead	75.0	no
512N	8.9	33.1	B. poplar	dead	75.0	no
464N	7.2	36.1	B. poplar	dead	75.0	no
411NN	14.6	39.8	Birch	dead	100.0	no
208N	2.2	31.2	B. poplar	dead	100.0	yes
*B. Hill	8.0	41.0	Aspen	dead	N/A	no
*B. Hill	10.0	35.0	Aspen	dead	N/A	no
*B. Hill	8.7	43.0	B. poplar	dead	N/A	yes
*B. Hill	4.5	39.0	Aspen	live	N/A	yes
*B. Hill	5.5	37.0	Aspen	live	N/A	yes
*B. Hill	4.3	38.0	Aspen	dead	N/A	no
*B. Hill	7.6	35.0	Aspen	dead	N/A	no
*The Pas	6.7	N/A	N/A	N/A	N/A	N/A
*SW. MB.	5.2	N/A	Aspen	N/A	N/A	N/A
*Kleefeld	4.3	N/A	Aspen	N/A	N/A	N/A
*Pinawa	7.6	N/A	Aspen	N/A	N/A	N/A
*E. Brain	7.6	N/A	B. poplar	N/A	N/A	N/A
* "	15.2	N/A	Elm	dead	N/A	N/A

* Prairie Nest Records Scheme infromation available at the Manitoba Museum of Man and Nature.
B. Hill= Birds Hill Provincial Park.
E. Brain= East Braintree, Mb..
N/A= not available

B. Poplar= Balsam Poplar (*Populus balsamifera*).
Aspen= Trembling Aspen (*Populus tremuloides*).
Birch= White Birch (*Betula papyrifera*)

Table 7. GIS Habitat Characteristics of Forest Stands with Natural Nest Cavities.

Sample Area	Covertype	site class	cutting class	crown closure class
208N	4	1	4	4
464N	4	1	4	4
512N	3	1	3	4
512N	4	1	3	4

CHAPTER 5
DISCUSSION

5.1 PILEATED WOODPECKER NESTING HABITAT CHARACTERISTICS IN THE STUDY AREA

5.1.1 FEEDING RANGE DURING THE NESTING PERIOD

Maximum observed foraging distance provided the best information available for estimating feeding range (225 ha) of pileated woodpeckers during the nesting period in the study area. This estimate is similar to pileated woodpecker territory sizes estimated by other studies. Bull and Meslow (1977) estimated breeding territories of 130-240 ha in northeastern Oregon. Summer home ranges established using radio-tagged birds averaged 478 ha with a range of 267-1056 ha in southcentral Oregon (Mellen et al. 1992). McClelland (1979) stated that pileated woodpecker pairs fed throughout areas ranging from approximately 200-400 ha in the Northern Rocky Mountains. The feeding range estimate for this study was larger than winter home ranges of 70 ha in Georgia (Kilham 1976), and spring and summer 53-160 ha territories in Missouri established using radio-telemetry techniques (Renken and Wiggers 1991). The feeding range estimate for this study was likely adequate for habitat sampling needs, however, use of radio-telemetry techniques would provide a more accurate estimate of feeding range.

5.1.2 HABITAT CHARACTERISTICS IMPORTANT IN NEST-SITE SELECTION IN THE STUDY AREA

Stepwise discriminant analysis selected habitat characteristics important for nest-site selection in utility poles. Habitat characteristics selected by discriminant analysis may only reflect the small sample size. Other characteristics appeared important from analysis of simple plots, however, only habitat characteristics selected by stepwise discriminant analysis were further discussed.

Discriminant analysis selected distance to cover as an important factor in nest-site selection. Self-protection is provided by nesting near forest cover. Distance to cover in most nesting sections was approximately 20 m and non-nesting sections were often in agricultural areas resulting in large distances to cover (see Table 3). Distance to cover in non-nesting section 233NN was 145 m. Pileated woodpeckers were observed in non-nesting section 233NN, foraging was found in nearby aspen stands and nest cavity starts were found in two poles in section 233NN. It was possible nests were not excavated in non-nesting section 233NN because forest cover was not readily accessible and distance to cover should be considered in management decisions.

Stepwise discriminant analysis selected food supply and cutting class 3 stands as the most important habitat characteristics in nest-site selection. Nesting sections contained higher densities of food sources and higher proportions of area of cutting class 3 stands. Cutting class 3 stands contained residual stumps and logs providing food sources. Smith (1980) stated that there may be some relationship between food supply and habitat selection. Food supply was inversely correlated with pileated woodpecker territory size in Missouri (Renken and Wiggers 1991). Bull and Meslow (1977) and McClelland (1979) stated that food supply was important in habitat selection and territory size, and Hooper et al. (1982) could not eliminate the possibility that habitat quality influenced territory size. This study and previous studies found that food supply was important in habitat selection.

However, Bull and Meslow (1977) stated that feeding habitat is not as critical as nesting habitat for pileated woodpeckers. The potential of an area as suitable nesting habitat for pileated woodpeckers is highly dependent on the presence of nesting trees (snags) (Conner and Adkisson 1976).

5.1.3 NATURAL PILEATED WOODPECKER NEST TREES IN MANITOBA

Although pileated woodpeckers will use immature forest habitat (Mellen 1987 and Mellen et al. 1992), they more frequently use older, mature, dense-canopied forest areas (Conner et al. 1975, McClelland 1979, Conner 1980, Mannan 1984, Bull et al. 1986, Bull 1987, Mellen 1987, Renken and Wiggers 1991 and Mellen et al. 1992). Mellen et al. (1992) stated that forest habitat classes older than 40 years and deciduous riparian areas in western Oregon provide habitat for foraging and other diurnal activities of pileated woodpeckers, but not for nesting or roosting. Douglas-fir stands younger than 70 years did not provide snags and trees large enough to accommodate pileated woodpecker nest cavities because trees averaged less than 50 cm dbh (Mellen et al. 1992).

To accommodate a pileated woodpecker nest cavity 22.5 cm wide and 55 cm deep at a minimum height of 7.0 m, a tree at least 37-50 cm in dbh is required (Bull and Meslow 1977). Pileated woodpeckers in Manitoba appeared to construct nest cavities in trees that meet the minimum nest tree size requirements (37.0 cm dbh) and at the minimum nest cavity height (7.0 m) as suggested by Bull and Meslow (1977). However, pileated woodpecker nest cavities in Manitoba were found in trees less than 37.0 cm dbh and at heights greater than 7.0 m (Table 6). This indicates that some of the nest cavities may have been smaller than the dimensions suggested by Bull and Meslow (1977).

The majority of natural trees used by pileated woodpeckers for nesting in Manitoba are hardwoods, trembling aspen and balsam poplar (see Table 6), and hardwood stands covered a large portion of nesting sample areas as was illustrated by the GIS maps in Appendix G.

Two pileated woodpecker natural nest sites were observed in cutting class 3 hardwood stands and 2 nest sites were found in cutting class 4 hardwood stands in the study area. Cutting class 3 hardwood stands are 21-50 years old having an average dbh of 20.1 cm at 50 years for trembling aspen (see Appendix E). Cutting class 4 hardwood stands are 51-70 years old having an average dbh of 26.7 cm at 70 years for trembling aspen (see Appendix E). Average dbh of cutting class 3 and 4 hardwood stands in the study area were less than the minimum average dbh of 50 cm for stands as required for acceptable pileated woodpecker nesting habitat as suggested by Mellen et al. (1992), however, nesting was found in cutting class 3 and 4 hardwood stands in Manitoba. The reasons why nesting occurs in forest stands with an average dbh much lower than suggested by Mellen et al. (1992) were unclear. It was possible that pileated woodpeckers in Oregon nested in the largest trees available and this resulted in a much larger estimated average dbh required for nesting stands than was seen for Manitoba.

5.2 USE OF UTILITY POLES BY PILEATED WOODPECKERS IN THE STUDY AREA

Rumsey (1968) suggested that woodpecker use of utility poles may result because of a shortage of suitable nest sites in adjacent forest stands. A shortage of suitable natural nest sites would be difficult to determine, however, Bull et al. (1986) determined that pileated woodpeckers selected the largest trees available for nest sites. Cutting class 3 and 4 hardwood stands in the study area provided nest sites, however, utility poles were most often the largest "trees" available (approximately 48 cm dbh) and were used for nesting likely because of opportunistic nest-site selection by pileated woodpeckers.

Opportunistic nest-site selection by pileated woodpeckers may have resulted because of additional benefits derived from nesting in utility poles. These benefits might include: 1) improved territorial advertisement and defence; 2) reduced predation on young and eggs; and 3) reduced nest failure because of tree breakage.

Rumsey (1968) stated that the most likely reason for woodpecker use of utility poles is because of the strategic location provided for territorial defence. Utility poles in the present study area are often taller than the surrounding forest cover and provide excellent locations for the birds to advertise their presence. Parent pileated woodpeckers in the present study area were observed flying along the transmission line alighting on utility poles near the top and giving territorial calls in early spring (late March). Rumsey (1970b) also found that in late winter and early spring, utility poles are the scene of considerable activity for mating and the establishment of territorial rights. Parent pileated woodpeckers in the present study area were also observed using utility poles during the nesting period as calling sites.

Strength of nest trees, especially around the nest entrance, may be of great importance as a deterrent to prevent predators (bears and raccoons) from chewing their way into a nest cavity (Kilham 1968, 1971). Black bears often used utility poles in the study area as territorial markers by scarring the pole with their claws. Bears had appeared to climb utility poles with pileated woodpecker nest cavities, however, determining if damage to nest holes was because of attempted bear predation was difficult. Bull (1987) stated that excavating in sound wood also reduces the probability the tree will break at the nest site. Pileated woodpeckers may select utility poles for nest sites to reduce nest predation and nest failure because of tree breakage.

5.2.1 INTENSITY OF USE OF UTILITY POLES BY PILEATED WOODPECKERS IN THE STUDY AREA

Different levels of intensity of use of utility poles for nesting by pileated woodpeckers was found in this study and by Jorgennsen et al. (1957). The difference in intensity of use of utility poles by a pair of pileated woodpeckers in their territory may have resulted because of habitat differences. Nesting section 183N had 10 cavities in utility poles and the remaining nesting sections in the study area contained only 4 or 5 cavities in utility poles. High intensity use of utility poles was found in nesting section 183N which had a high proportion of cutting class 1 hardwood stands (see Fig. 8) with residual stumps and logs. Residual stumps and logs provided food sources, however, cutting class 1 hardwood stands do not provide nesting snags. The woodpecker pair in nesting section 183N may be heavily dependent upon utility poles for nest sites. A higher proportion of more mature forest stands, cutting class 3 and 4, was found in the remaining nesting sections and low intensity use of utility poles was found in all remaining nesting sections. Jorgennsen et al. (1957) and this study found less use of utility poles for nesting by pileated woodpeckers in areas of mature forest.

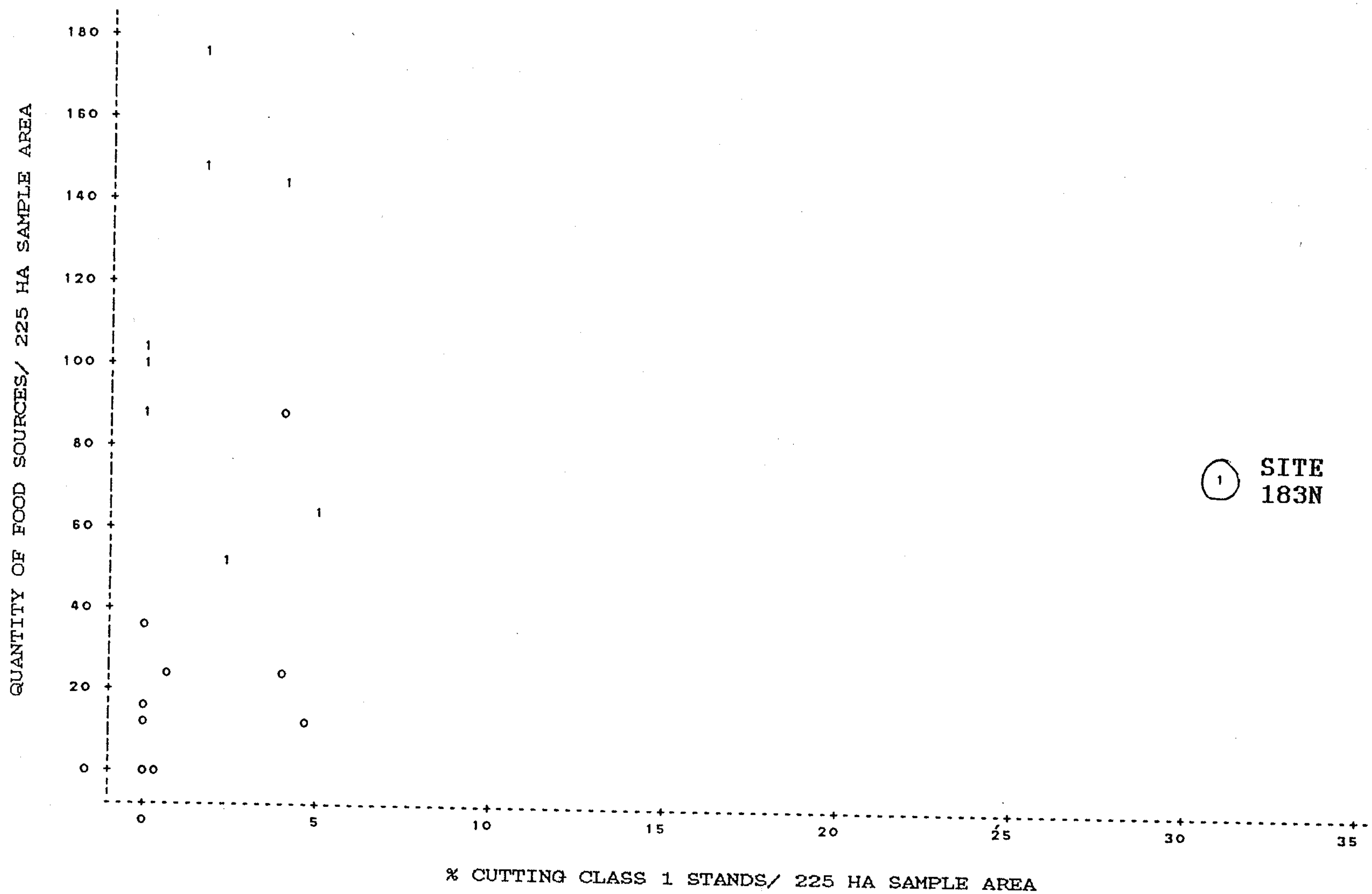

FIGURE 8. Quantity of Food Sources Plotted Against Cutting Class 1 Stands.
(1= nesting sample area, 0= non-nesting sample area)

5.3 UTILITY POLE HARDNESS AND PRESERVATIVE TYPE

Rumsey (1968) speculated that pole hardness was a factor in nest-site selection, however, this study revealed no relationship with pole hardness and nest-site selection. Bull (1987) found pileated woodpecker excavations in sound conifer wood as this study also found excavations in sound conifer utility poles.

Utility poles preserved with Chemonite previously were reported to repel woodpeckers, for what reasons remain unclear (Morgan 1989, Cunningham 1990). Stepwise discriminant analysis of the data in this study revealed no relationship between preservative type and nest-site selection in utility poles. Analysis of the raw data from this study showed selection against ACA utility poles because of the existing proportion of preservative types. The existing proportions of preservative types used for utility poles may explain the premature claims of Chemonite's ability to repel woodpeckers by Morgan (1989) and Cunningham (1990).

5.4 NEST CAVITY HEIGHT IN UTILITY POLES

Pileated woodpecker nest cavities were not excavated higher than 16.8 m in utility poles in the study area, however, it was not clear if this was because of size restrictions of the poles. Bull and Meslow (1977) stated that pileated woodpecker cavities are approximately 22.5 cm wide. Rumsey (1968) stated a thin shell of wood approximately 2.5 cm thick remains around the cavity. A minimum diameter of approximately 28.0 cm at the nest is required to accommodate the cavity in accord with Rumsey (1968) and Bull and Meslow (1977). Minimum diameter at the top of poles in the study area is 18.3 cm. Cavities may be excavated smaller than dimensions suggested by the literature and pole protection may be required at diameters less than 28.0 cm.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

6.1.1 NESTING HABITAT REQUIREMENTS ALONG A TRANSMISSION LINE

Hydro utility poles are used as nest sites by pileated woodpeckers in the study area. Utility pole hardness or preservative type do not influence nest-site selection but habitat characteristics along the transmission line are important.

Stepwise discriminant analysis selected food sources, cutting class 3 stands, and distance to forest cover as the most important habitat characteristics for nest-site selection in utility poles. Nesting sections contained higher quantities of food sources, higher proportions of cutting class 3 stands and shorter distances to forest cover.

6.1.2 USE OF UTILITY POLES FOR NESTING BY PILEATED WOODPECKERS

Utility poles are used for nesting because of opportunistic nest-site selection by pileated woodpeckers in the study area. Opportunistic nest-site selection in utility poles occurs likely because of the following reasons: 1) utility poles are most often the largest "trees" (approximately 48 cm dbh) available in the study area ; 2) utility poles provide strategic locations for territorial defence; and 3) utility poles provide sturdy nest sites reducing nest predation and the probability of the "tree" breaking at the nest site.

The intensity of use of utility poles in nesting sections indicates the woodpecker pairs' dependence upon the poles for nest sites that is likely governed by the availability of alternative nest sites in the surrounding habitat.

6.1.3 REPAIR AND PREVENTION OF WOODPECKER DAMAGE

Repair and prevention of woodpecker damage will defer the costs of pole replacement and reduce the risk of interrupted power service. The cost of pole replacement is, at a minimum, 10-fold the cost of woodpecker-damage repair and prevention techniques. In accord with other successful utility operations, wrapping utility poles with hardware cloth and filling existing cavities is the most effective technique to repair and prevent pileated woodpecker use of utility poles for nesting.

6.1.4 PERSPECTIVES ON THE PILEATED WOODPECKER

The use of hydro utility poles for nesting by pileated woodpeckers may broadly be considered in three main ways:

1. the pileated woodpecker may be considered as a "pest" and controlling their use of utility poles may be seen as simply an economic issue;
2. individual pileated woodpeckers may be valued in their own rights and their availability for observation in utility poles may be considered a desirable outcome in its own right (a naturalist perspective); and
3. the pileated woodpecker may be seen as a species that must be maintained within an ecological framework as a part of the integrity of the environment. In this ecological view, individuals prevented from nesting in poles need not necessarily damage the population as a whole. At least, there is no biological evidence that pileated woodpeckers cannot return to their natural nesting habitat (an ecological perspective).

The following recommendations take into account all three perspectives. Firstly, the use of hydro utility poles for nesting by pileated woodpeckers has to be controlled. Secondly however, control of use should be done without unduly harming nesting pileated woodpeckers. Thirdly, as long as the population of the pileated woodpecker is not harmed, preventing the use of utility poles for nesting is an ecologically-sensible option. The following recommendations are offered in accord with the above.

6.2 RECOMMENDATIONS

1. Manitoba Hydro should evaluate the future technologies developed for controlling woodpecker use of utility poles. Research presented at the annual International Conference on Avian Interactions with Utility Structures should be evaluated by Manitoba Hydro. Information on this conference is available from Ed Colson, Sr. Biologist, Pacific Gas & Electric Co., 3400 Crow Canyon Rd., San Ramon, CA 94583. 510/866-5826.

2. More research is required to better understand the natural habitat requirements of the pileated woodpecker in Manitoba.

3. Radio-telemetry techniques should be used if further research of pileated woodpecker territory size in Manitoba is necessary.

6.2.1 A MANAGEMENT STRATEGY FOR EXISTING TRANSMISSION LINES

Separate management strategies have been developed to control pileated woodpeckers use of utility poles for existing transmission lines and proposed transmission lines.

1. A Woodpecker Damage Inventory System recording all woodpecker damage along hydro utility lines throughout the province should be established and used to determine the number of cavities in nesting sections.

2. Intensity of use of utility poles in a nesting section should be determined by assessing the following: 1. the presence of pileated woodpeckers actively nesting in the area by direct observations; 2. the number of nest cavities in utility poles in the nesting area using the Woodpecker Damage Inventory System (less than 6 nest cavities is likely a low intensity use area); and 3. the surrounding habitat type, studying the nest-site selection factors determined in this study and the literature using Forest Inventory maps. These factors include;

    a). cutting class; and

    b). covertype.

Low intensity use nesting sections are surrounded by mature (cutting class 3 and 4), hardwood and hardwood-softwood forest stands (covertype 3 and 4) providing alternative nesting sites. Low intensity use sections will likely not have pileated woodpeckers actively nesting in utility poles.

High intensity use nesting sections are surrounded by less mature (cutting class 1 and 2) hardwood forest stands lacking the alternative nesting sites provided in cutting class 3 and 4 stands, however, some mature hardwood stands may be in close proximity to the nesting territory. High intensity use sections will likely have pileated woodpeckers actively nesting in utility poles.

3. Manitoba Hydro should attempt to determine the impact on pairs of pileated woodpeckers after repair and protection of utility poles in their nesting section. The following research is recommended:

a) All poles in the nesting section and acceptable buffer zone should be protected with hardware mesh and filling older cavities as previously stated. However, access to the most recently excavated nest cavities in utility poles should be provided by removing hardware mesh from the entrance to cavities (2 or 3 cavities should be available to meet the immediate requirements of the nesting pileated woodpeckers). The nesting section should be monitored for a minimum of 2 nesting seasons to determine if the woodpeckers continue to use cavities in the protected utility poles. It is anticipated that the woodpecker pair will find alternative natural nest sites in the surrounding habitat. However, if further use of cavities in utility poles occurs, provision of alternative nest sites should be considered.

b) A more direct assessment of the impact upon the birds may be accomplished by radio-tagging woodpecker pairs nesting in utility poles prior to complete protection of the poles. Radio-tags are now available that last approximately 15 months making it possible to follow a woodpecker pairs' movements to determine if they have a successful nesting attempt the following year.

If it is determined from the above research that the birds readily adapt to the protection of poles by nesting in the surrounding natural habitat, Manitoba Hydro will not have to provide alternative nesting sites.

4. All relatively old nest cavities (older cavities in a nesting section) should be filled with "Vultafoam". All damaged and undamaged utility poles in nesting sections (225-ha area) should be wrapped with hardware cloth (5x5cm), as suggested 9by Rumsey (pers comm. 1991), from 1 m above the ground to a height at which the pole diameter is 20.0 cm, approximately 18.0 m. Repair and protection of poles

should occur after the nesting season to minimize disturbance to birds (approximately July 15 or after use of the nesting cavity has ended). Because the literature determined an average9 home range of 478 ha (2.2 x 2.2 km), a buffer zone of protected poles outside the nesting section should be established based on: 1. the available pileated woodpecker habitat (mature hardwood forest stands) in and around the nesting section; 2. protection of poles more than 200 m from forest cover is likely not necessary; and 3. economical considerations.

5. Alternative pileated woodpecker nest sites should be provided upon protection of utility poles if suggested by the research in #3 above. Alternative nest sites will allow the birds to adapt to the protection of poles. Lure poles should be installed along the right-of-way. The number of alternative nest sites required by pileated woodpeckers in the study area is unclear, however, the literature suggests up to 20 alternative nest sites may be required in each high intensity use nesting section. Providing alternative nest sites by killing trees is not well understood for the study area and requires more research. Provision of alternative nesting sites for secondary inhabitants, such as American kestrel nest boxes (Appendix F), should be considered in nesting sections where secondary use has been noted.

6.2.2 A MANAGEMENT STRATEGY FOR PROPOSED UTILITY LINES

Potential pileated woodpecker use of utility poles should be identified prior to the installation of new transmission and distribution lines. Forest Inventory Data may be used to determine the potential risk of woodpecker use along a proposed right-of-way. Additional ground sampling and observations in the area will likely indicate the presence of pileated woodpeckers and available natural nest sites. Potential pileated woodpecker use may be assessed as follows;

High-Risk Area:

* mainly cutting class 1 and 2, covertype 3 and 4 forest stands with some more mature hardwoods in the area.
* minimal distance to forest cover.
* similar habitat as for high intensity use nesting sections on existing utility lines.

Medium-Risk Area:

* mainly cutting class 3 and 4, covertype 3 and 4 forest stands.
* minimal distance to forest cover.
* similar habitat as for low intensity use nesting sections on existing utility lines.

Low-Risk Area:

* lacks covertype 3 and 4 forest stands.
* large distances to forest cover (> 200 m).

Utility poles in high-risk areas should be protected with hardware cloth at the time of installation. Utility poles in medium-risk areas should be repaired if damage occurs and wrapped with hardware cloth in the future if necessary. Utility poles in low-risk areas do not require protection.

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APPENDIX A

MANITOBA FOREST INVENTORY COVER TYPE CLASSIFICATION

COVER TYPE 1 (SOFTWOOD)

* all stands where at least 76% of the total basal area consists of coniferous tree species.

COVER TYPE 2 (SOFTWOOD-HARDWOOD)

* all stands where the basal area of the coniferous species is between 51% and 75% of the total basal area.

COVER TYPE 3 (HARDWOOD-SOFTWOOD)

* all stands where the basal area of all coniferous species is between 26% and 50% of the total basal area.

COVER TYPE 4 (HARDWOOD)

* all stands where the basal area of all coniferous species is less than 25% of the total basal area.

APPENDIX B

MANITOBA FOREST INVENTORY CUTTING CLASS CLASSIFICATION

Class 0 - forest land not restocked following fire, cutting, windfall or other major disturbances (hence, potentially productive land). Some reproduction or scattered residual trees may be present.

Class 1 - stands which have an average height of less than 3 meters. They may have been restocked either naturally or artificially and have scattered residual trees.

Class 2 - advanced young growth of post size, with some merchantable volume. The average height of the stand must be over 3 meters.

Class 3 - immature stands with merchantable volume growing at or near their maximum rate, and should definitely not be cut. The average height of the stand should be over 10 meters and the average diameter should be over 9.0 at DBH.

Class 4 - mature stands which may be cut as they have reached rotation age.

Class 5 - overmature stands, which should be given priority in cutting.

AGE DISTRIBUTION BY CUTTING CLASSES

	CUTTING CLASS				
	1	2	3	4	5
HARDWOODS	1-10	11-20	21-50	51-70	71+

APPENDIX C

MANITOBA FOREST INVENTORY CROWN CLOSURE CLASSIFICATION

CLASS 0 - 0% to 20% crown density

CLASS 2 - 21% to 50% crown density

CLASS 3 - 51% to 70% crown density

CLASS 4 - 71% and greater crown density

APPENDIX D

STEPWISE DISCRIMINANT ANALYSIS OF NESTING HABITAT CHARACTERISTICS

PART A GROUND SAMPLING HABITAT VARIABLES

STEP	ENTERED VARIABLE	F-STATISTIC	Prob>F
1	Quantity of food sources	28.123	0.0001
2	Relative % of dead standing trees	6.403	0.0231
3	Relative % of foraging in stumps	3.141	0.0954
4	Distance to cover	2.722	0.1212

PART B COMBINED GROUND SAMPLING AND GIS HABITAT VARIABLES

STEP	ENTERED VARIABLE	F-STATISTIC	Prob>F
1	Quantity of food sources	16.929	0.0011
2	% Cutting Class 3 stands/225 ha	5.130	0.0412
3	% Cutting Class 1 stands/225 ha	3.473	0.0870

PART C UTILITY POLE HARDNESS AND PRESERVATIVE TYPE

NO DISCRIMINATING VARIABLES ENTERED

APPENDIX E

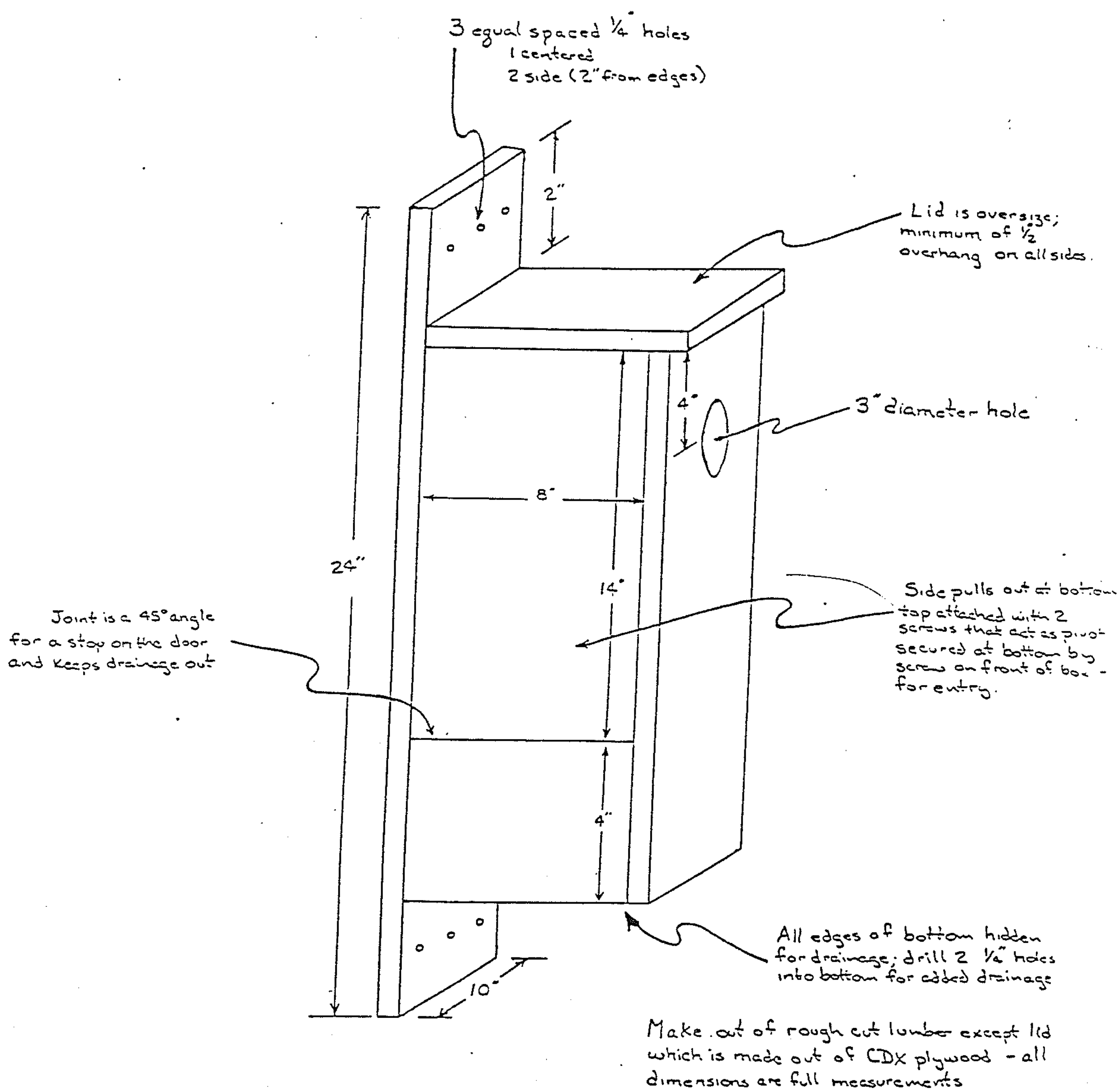
NORMAL YIELD TABLE FOR
SITE CLASS 1 ASPEN STANDS
(ONTARIO NORMAL YIELD TABLES)

Site-Class 1 ASPEN

Age in Years	Height Aver. m	Height From - To m	D.B.H. in cm	Number of Trees	Basal Area in m2	Gross Total Volume m3/ha: Main Stand Vol.	Main Stand C.A.I.	Main Stand M.A.I.	Suppressed Trees Vol.	Suppressed Trees Cumulative	Total Production	Volume m3/ha Gross Merch.	Volume m3/ha To 7cm D.O.B.	Age in Years
20	11.8	10.7–12.9	8.9	2525	15.7	87	–	4.4	5	5	92	29	62	20
25	14.2	12.9–15.5	10.7	2082	18.9	124	7.4	5.0	6	11	135	68	99	25
30	16.4	15.0–17.9	12.7	1725	21.7	164	8.0	5.5	8	19	183	112	141	30
35	18.5	16.9–20.1	14.5	1463	24.3	205	8.2	5.9	10	29	234	160	184	35
40	20.3	18.7–22.1	16.5	1255	26.8	245	8.0	6.1	11	40	285	203	225	40
45	22.0	20.3–23.8	18.3	1092	28.7	281	7.2	6.2	12	52	333	241	263	45
50	23.5	21.7–25.4	20.1	961	30.5	315	6.8	6.3	12	64	379	275	297	50
55	24.8	22.9–26.7	21.8	853	31.9	345	6.0	6.3	11	75	420	304	328	55
60	25.9	24.0–27.8	23.6	759	33.2	371	5.2	6.2	11	86	457	328	355	60
65	26.8	24.9–28.8	25.2	687	34.2	393	4.4	6.0	10	96	489	349	377	65
70	27.6	25.7–29.6	26.7	625	35.0	411	3.6	5.9	9	105	516	365	396	70
75	28.2	26.3–30.3	27.9	582	35.7	426	3.0	5.7	7	112	538	377	411	75
80	28.8	26.8–30.8	29.2	537	36.1	438	2.4	5.5	6	118	556	386	422	80
85	29.1	27.2–31.2	30.2	507	36.5	446	1.6	5.2	6	124	570	393	431	85
90	29.4	27.4–31.4	31.2	478	36.6	452	1.2	5.0	5	129	581	398	438	90
95	29.6	27.6–31.7	32.0	457	36.8	456	0.8	4.8	3	132	588	401	442	95
100	29.7	27.7–31.8	32.5	444	37.0	459	0.6	4.6	2	134	593	403	445	100

APPENDIX F

KESTREL NEST BOX PLAN



APPENDIX G

GIS HABITAT MAPS

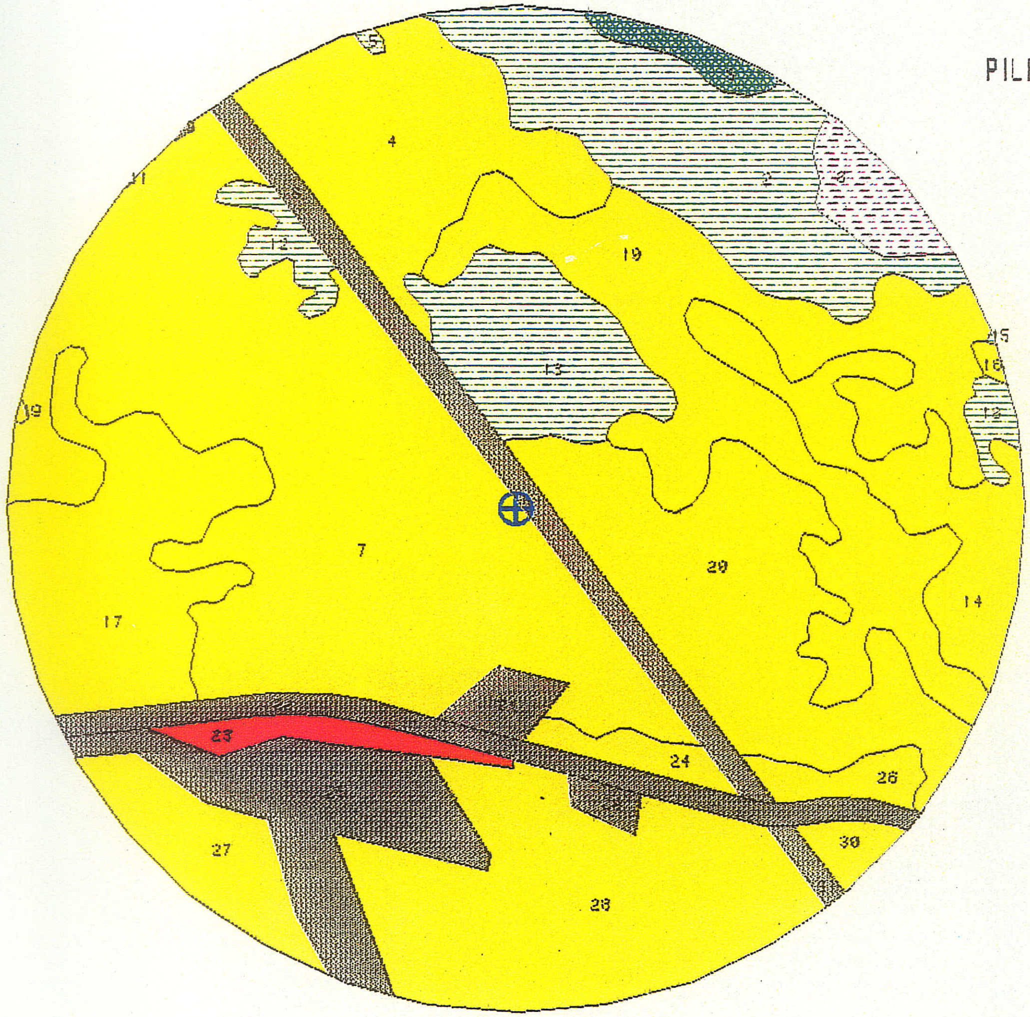
INDEX

N= NESTING SECTION

NN= NON-NESTING SECTION

(eg. sample area 258 N = nesting section)

see APPENDIX A for information on PRODUCTIVE FOREST.



LAND COVER WITHIN 225 ha OF PILEATED WOODPECKER RANGE SAMPLE AREA 258 N

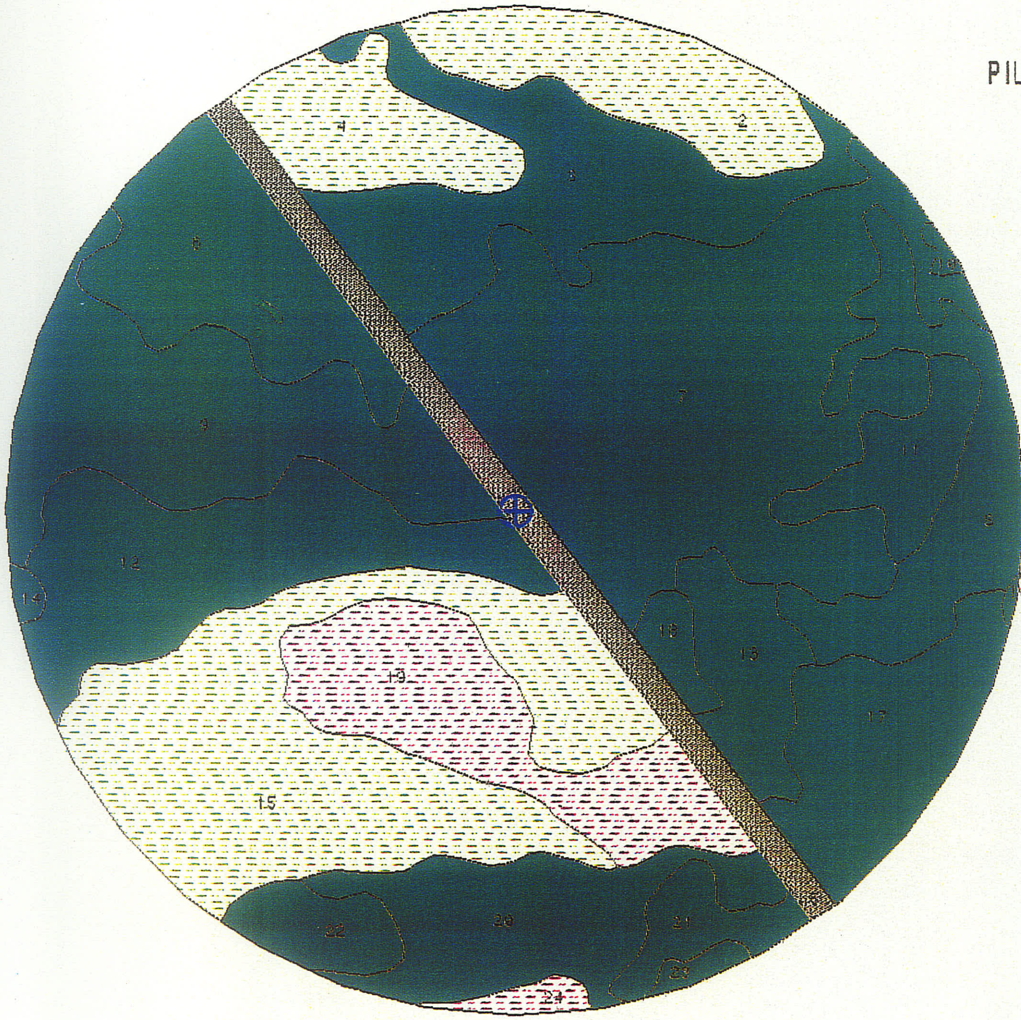
Easting: 691566
Northing: 5488489
UTM Zone 14

PRODUCTIVE FOREST
- Softwood
- Softwood-hardwood
- Hardwood-Softwood
- Hardwood

NON-PRODUCTIVE FOREST
- Treed muskeg
- Treed rock
- Willow-alder/scrub
- Protection forest

NON-FORESTED
- Barrens-bare rock
- Agriculture
- Meadow
- Marsh-muskeg
- Water
- Other

LAND COVER
WITHIN 225 ha OF
PILEATED WOODPECKER RANGE
SAMPLE AREA 275 NN

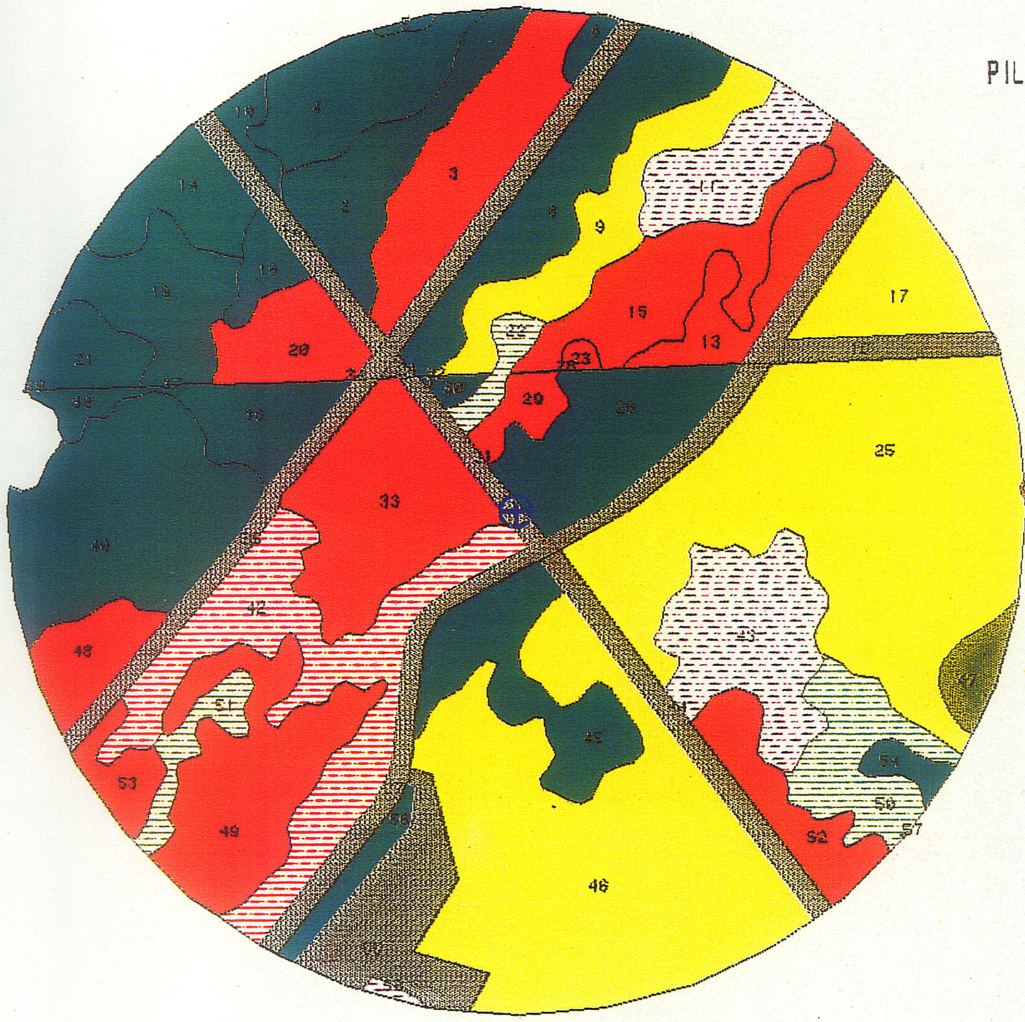


Easting: 695214
Northing: 5483683
UTM Zone 14

PRODUCTIVE FOREST
- Softwood
- Softwood-hardwood
- Hardwood-Softwood
- Hardwood

NON-PRODUCTIVE FOREST
- Treed muskeg
- Treed rock
- Willow-alder/scrub
- Protection forest

NON-FORESTED
- Barrens-bare rock
- Agriculture
- Meadow
- Marsh-muskeg
- Water
- Other



LAND COVER
WITHIN 225 ha OF
PILEATED WOODPECKER RANGE
SAMPLE AREA 293 N

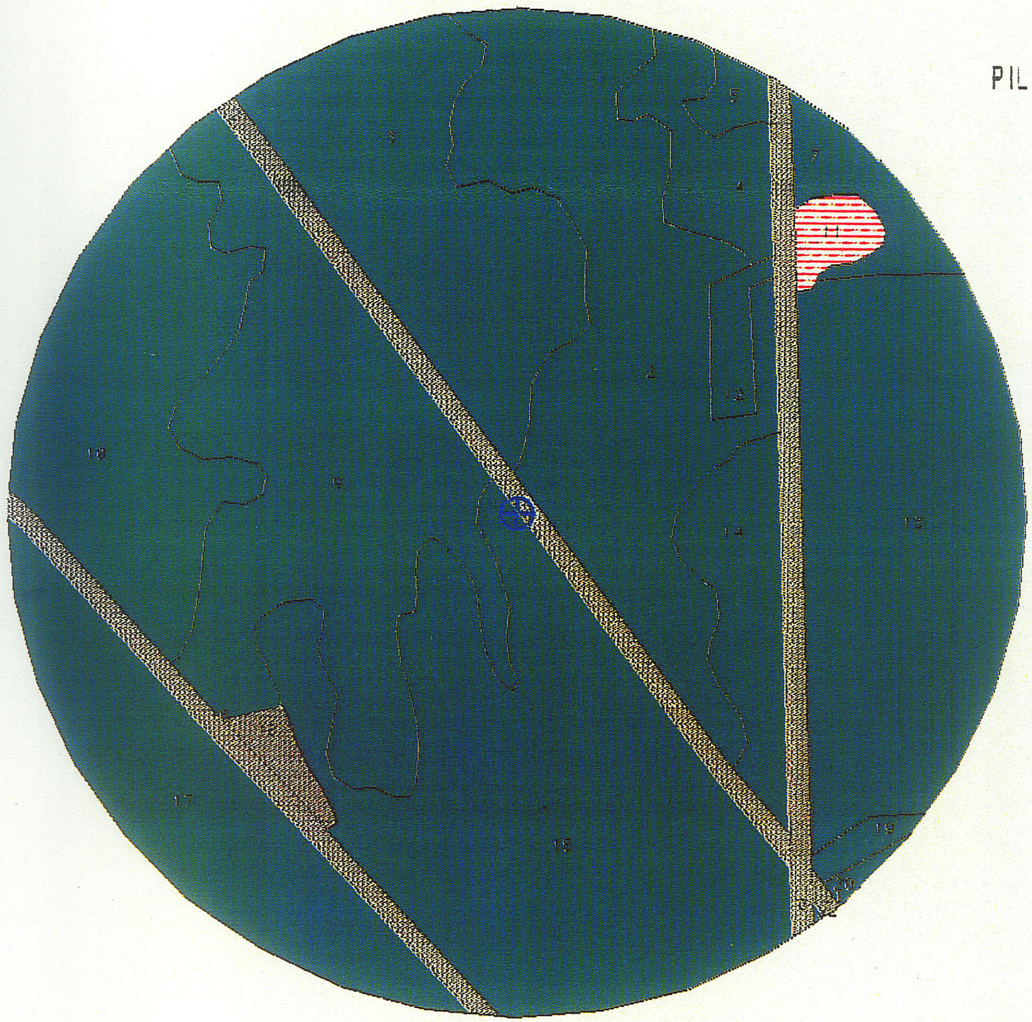
Easting: 698095
Northing: 5479913
UTM Zone 14

PRODUCTIVE FOREST
- Softwood
- Softwood-hardwood
- Hardwood-Softwood
- Hardwood

NON-PRODUCTIVE FOREST
- Treed muskeg
- Treed rock
- Willow-alder/scrub
- Protection forest

NON-FORESTED
- Barrens-bare rock
- Agriculture
- Meadow
- Marsh-muskeg
- Water
- Other

LAND COVER
WITHIN 225 ha OF
PILEATED WOODPECKER RANGE
SAMPLE AREA 324 NN



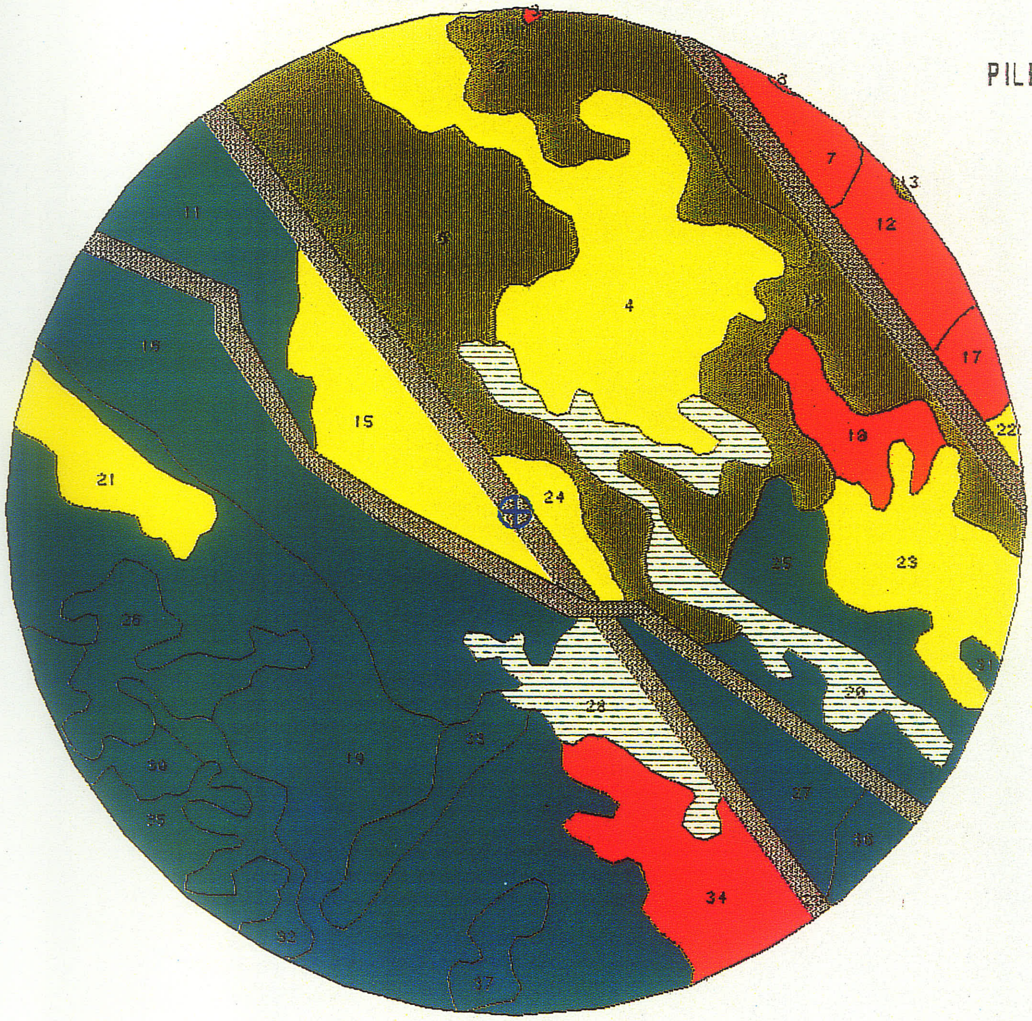
Easting: 703186
Northing: 5473121
UTM Zone 14

PRODUCTIVE FOREST
- Softwood
- Softwood-hardwood
- Hardwood-Softwood
- Hardwood

NON-PRODUCTIVE FOREST
- Treed muskeg
- Treed rock
- Willow-alder/scrub
- Protection forest

NON-FORESTED
- Barrens-bare rock
- Agriculture
- Meadow
- Marsh-muskeg
- Water
- Other

LAND COVER
WITHIN 225 ha OF
PILEATED WOODPECKER RANGE
SAMPLE AREA 348 N



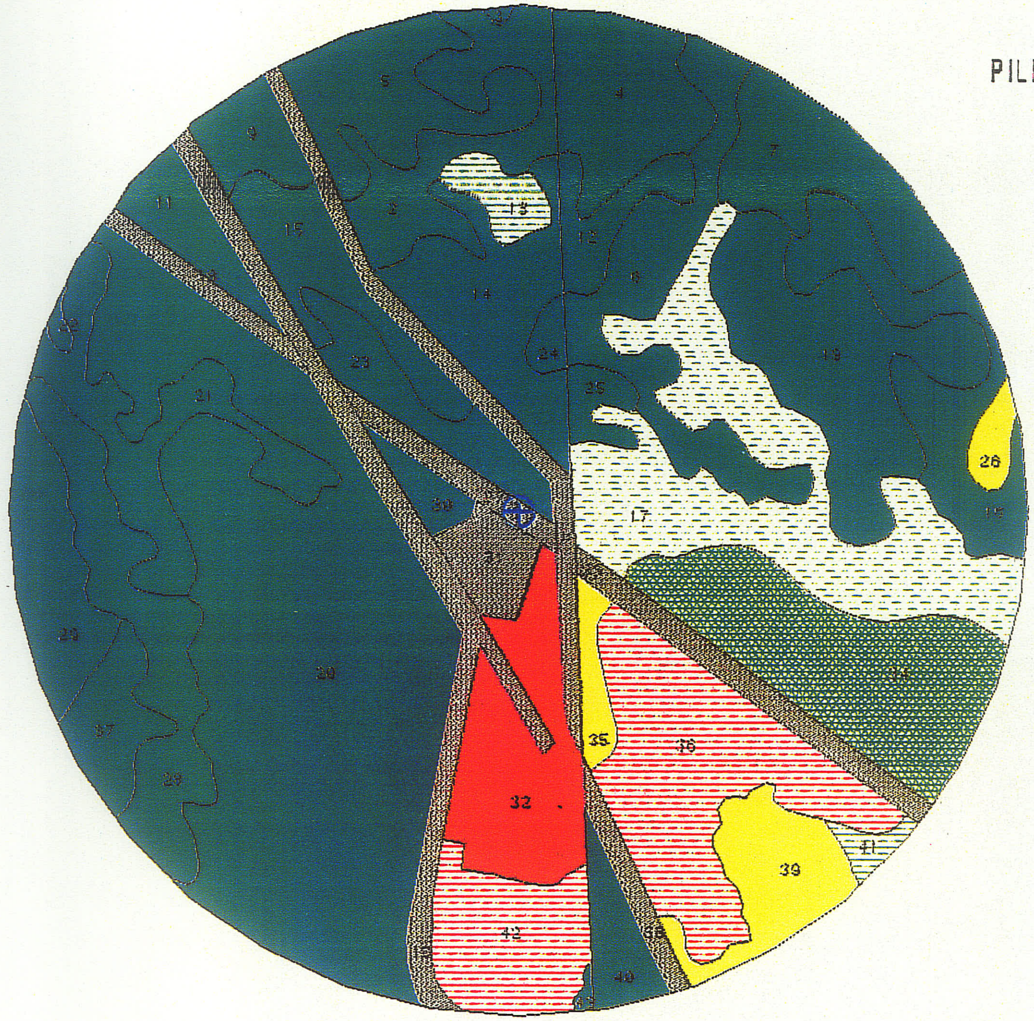
Easting: 707517
Northing: 5467407
UTM Zone 14

PRODUCTIVE FOREST
- Softwood
- Softwood-hardwood
- Hardwood-Softwood
- Hardwood

NON-PRODUCTIVE FOREST
- Treed muskeg
- Treed rock
- Willow-alder/scrub
- Protection forest

NON-FORESTED
- Barrens-bare rock
- Agriculture
- Meadow
- Marsh-muskeg
- Water
- Other

LAND COVER
WITHIN 225 ha OF
PILEATED WOODPECKER RANGE
SAMPLE AREA 411 NN

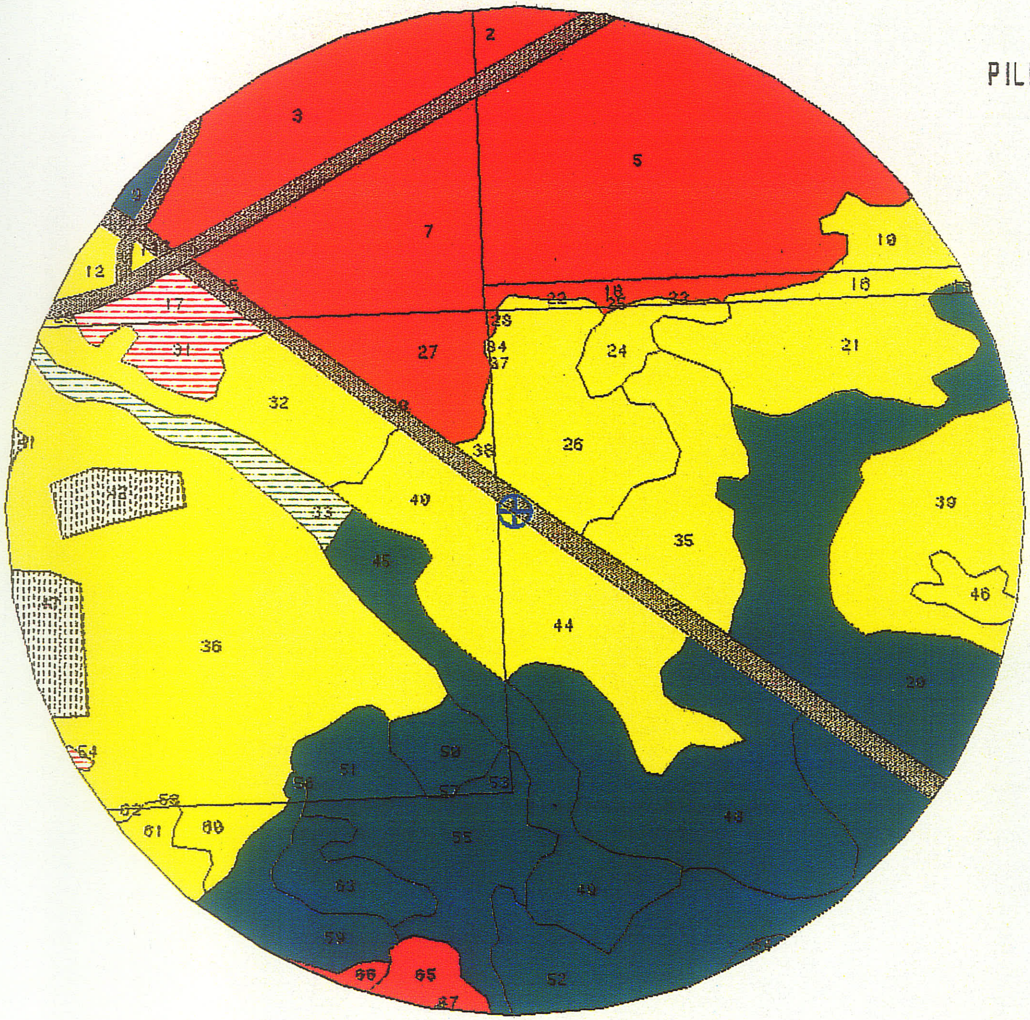


Easting: 720714
Northing: 5455240
UTM Zone 14

PRODUCTIVE FOREST
- Softwood
- Softwood-hardwood
- Hardwood-Softwood
- Hardwood

NON-PRODUCTIVE FOREST
- Treed muskeg
- Treed rock
- Willow-alder/scrub
- Protection forest

NON-FORESTED
- Barrens-bare rock
- Agriculture
- Meadow
- Marsh-muskeg
- Water
- Other



LAND COVER
WITHIN 225 ha OF
PILEATED WOODPECKER RANGE
SAMPLE AREA 464 N

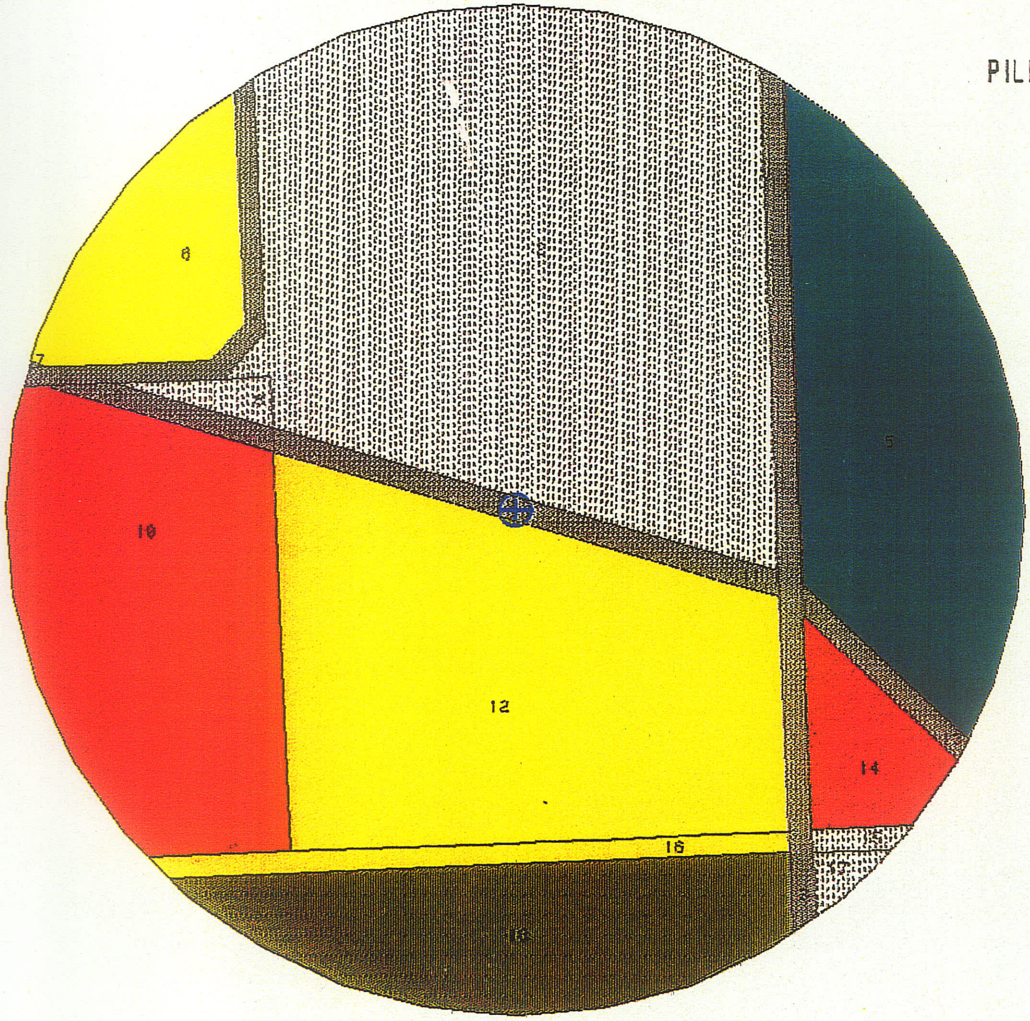
Easting: 732657
Northing: 5446642
UTM Zone 14

PRODUCTIVE FOREST
- Softwood
- Softwood-hardwood
- Hardwood-Softwood
- Hardwood

NON-PRODUCTIVE FOREST
- Treed muskeg
- Treed rock
- Willow-alder/scrub
- Protection forest

NON-FORESTED
- Barrens-bare rock
- Agriculture
- Meadow
- Marsh-muskeg
- Water
- Other

LAND COVER
WITHIN 225 ha OF
PILEATED WOODPECKER RANGE
SAMPLE AREA 512 N



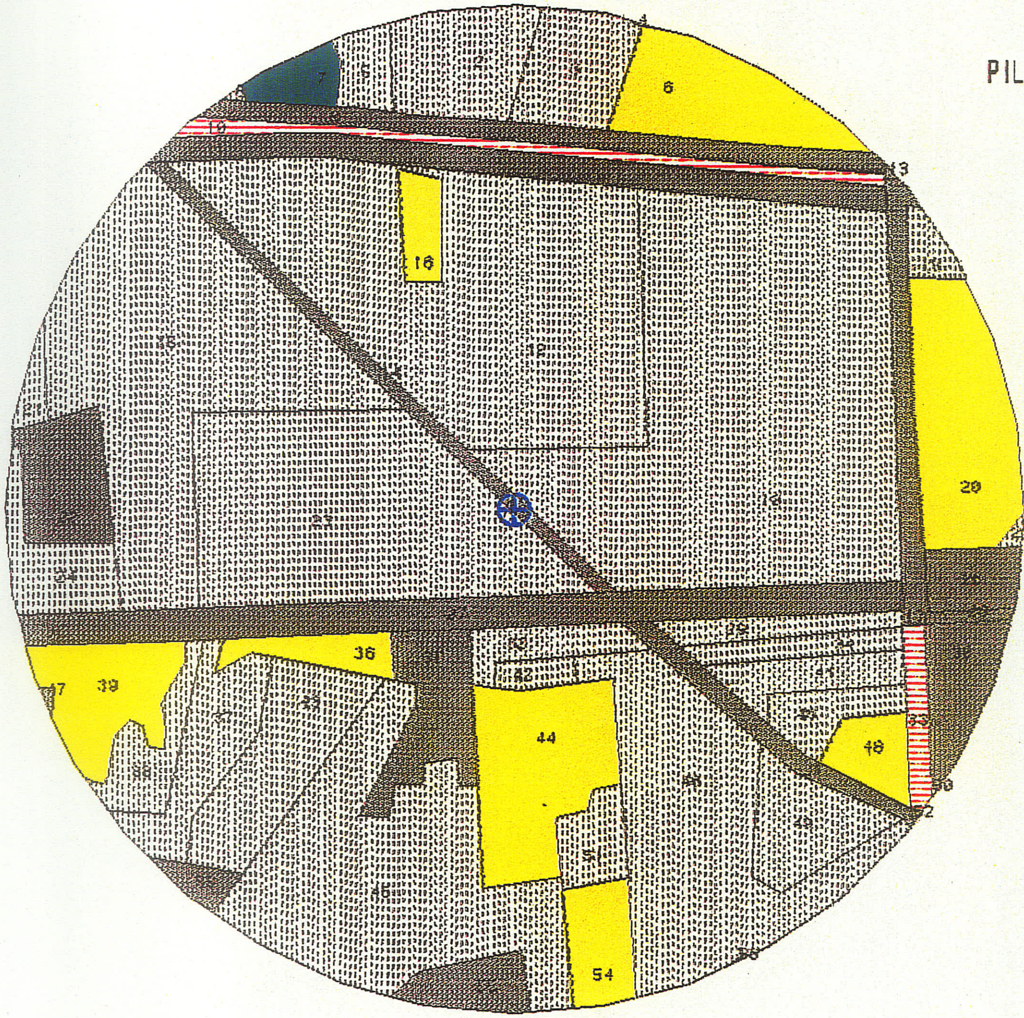
Easting: 744804
Northing: 5439871
UTM Zone 14

PRODUCTIVE FOREST
- Softwood
- Softwood-hardwood
- Hardwood-Softwood
- Hardwood

NON-PRODUCTIVE FOREST
- Treed muskeg
- Treed rock
- Willow-alder/scrub
- Protection forest

NON-FORESTED
- Barrens-bare rock
- Agriculture
- Meadow
- Marsh-muskeg
- Water
- Other

LAND COVER
WITHIN 225 ha OF
PILEATED WOODPECKER RANGE
SAMPLE AREA 535 NN



Easting: 749696
Northing: 5435602
UTM Zone 14

PRODUCTIVE FOREST
- Softwood
- Softwood-hardwood
- Hardwood-Softwood
- Hardwood

NON-PRODUCTIVE FOREST
- Treed muskeg
- Treed rock
- Willow-alder/scrub
- Protection forest

NON-FORESTED
- Barrens-bare rock
- Agriculture
- Meadow
- Marsh-muskeg
- Water
- Other