PILEATED WOODPECKER
(Dryocopus pileatus)

Source: Salt and Salt (1976)

**Prepared for Millar Western Forest Products'
Biodiversity Assessment Project**

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Table of Contents

List of Figures

1.0 CONSERVATION AND THE EFFECT OF FOREST ACTIVITIES

1.1 Introduction

The Pileated Woodpecker (*Dryocopus pileatus*) is the largest woodpecker in North America, averaging 42 cm in length (Kilham 1983). Its upper surface is black or dark grey in colour and a white patch exists on the underside of its wings. Its red crest and the white line around its neck are obvious to observers.

The species is widely distributed throughout forested regions of North America from Great Slave Lake to Texas and Florida (Dance 1987, Figure 1). Its distribution limit to the north is likely related to the absence of trees of sufficient size for nesting (Bock and Lepthien 1975; Cadman *et al.* 1987). In Alberta, this woodpecker is observed year-round in the Boreal Forest, Foothills, and Rocky Mountain Natural Regions and its population is thought to be stable (Semenchuk 1992).

The Pileated Woodpecker has an important ecological role as a primary cavity excavator (Bonar 1995). The nest cavities that are excavated annually in large living or dead trees subsequently provide critical habitat for other wildlife species including the Boreal Owl, Screech Owl, Saw-whet Owl, Wood Duck, American Kestrel, Common Flicker, Northern Flying Squirrel, and American Marten (McClelland 1979; Millar 1994; Kirk and Naylor 1996). With at least 32 other species using the Pileated Woodpecker's excavated cavities, it provides more species with nest or roost holes than any other woodpecker in North America (Bonar pers. comm. 1999). Additionally, it is thought that the bird's role in controlling insect outbreaks in the forest is important (Kirk and Naylor 1996). The Pileated Woodpecker has been selected as an indicator, or management species, by almost all provincial natural resources agencies in Canada (Kirk and Naylor 1996).
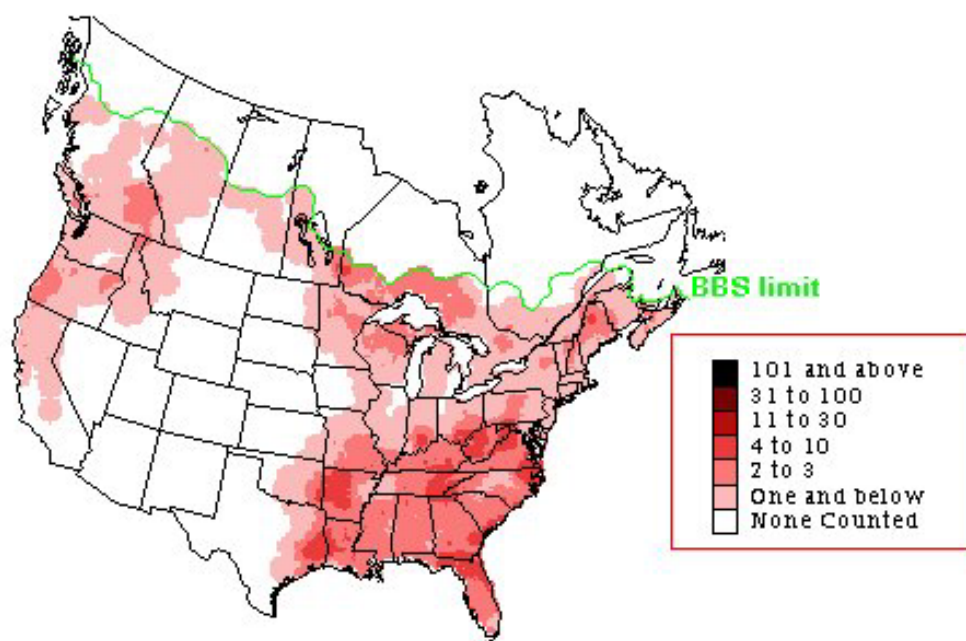
Figure 1. Breeding distribution of the Pileated Woodpecker in North America, BBS data (Gough *et al.* 1998).

1.2 Effects of Forest Management Activities

According to Bull (1975), critical components of Pileated Woodpecker habitat are large dead, damaged, or diseased trees in forest stands. Gauthier and Guillemette Consultants Inc. (1991) reported that logging activities negatively impact habitat suitability since security cover is removed and nesting and roosting opportunities are reduced (Kirk and Naylor 1996). Conner *et al.* (1975), Bull and Holthausen (1993), and Kirk and Naylor (1996) stated that uncut forests provide optimal foraging and nesting conditions. Conversely, Pileated Woodpeckers in some locations, including Alberta, have been known to feed and nest in clearcuts (Mellen *et al.* 1992; Bonar 1994; Kirk and Naylor 1996).

2.0 HABITAT USE INFORMATION

2.1 Food Requirements

Although wood-boring insects, predominantly carpenter ants, comprise 75% of the Pileated Woodpecker's diet, it will also eat fruits, nuts, and sap (Beal 1911; Conner *et al.* 1975; Beckwith and Bull 1985; DeGraaf and Rudis 1992). An enormous amount of time is spent foraging for carpenter ants in dead wood (*i.e.,* snags and downed woody debris) or living trees with partial heartwood decay (Ehrlich *et al.* 1988; Swallow *et al.* 1988; Kirk and Naylor 1996). During summer, the bird is considered an omnivorous lower-canopy and ground forager (DeGraaf *et al.* 1985). In winter, it spends almost all of its time foraging for carpenter ants around the bases of trees (Bonar pers. comm. 1999).

While Pileated Woodpeckers will use most of the tree species within their range (Conner *et al.* 1994; Kirk and Naylor 1996) as foraging sites, preference is given to larger snags and logs (Bull and Meslow 1977; Conner 1979; McClelland 1979; Brawn *et al.* 1982; Bull and Holthausen 1993; Kirk and Naylor 1996). During winter, the birds may select trees with fairly sound wood, while during summer, the trees selected are likely to be in a more advanced stage of decay (Bonar pers. comm. 1999). Bonar (pers. comm. 1999) suggested that carpenter ant colonies are most commonly found in snags of at least 16 cm dbh. Additionally, his research suggests that stands become optimal when at least five large snags are present per ha.

2.2 Cover Requirements

Although the Pileated Woodpecker requires a large tract of habitat, it is not particular about the tree species composition of the stand (Bull 1987; Dance 1987; Renken and Wiggers 1989; Bonar 1995). With respect to cover requirements, research has not yielded unanimous results. Though Bull and Meslow (1977) and Naylor *et al.* (1997) have found that stands with significant canopy closure (> 60%)

best support Pileated Woodpecker populations, Bonar's (pers. comm. 1999) observations in Alberta are quite contrary, revealing that open stands appear to be preferred over dense stands.

Roost Sites

Additional cavities within a pair's home range are used as roost sites that provide protection from inclement weather and reduce the risk of predation by raptors (Bull *et al.* 1992; Bonar 1995; Kirk and Naylor 1996). Bull *et al.* (1992) found that each bird used an average of seven different roost sites in a three- to ten-month period. Bonar's data (pers. comm. 1999) lend support to this estimate as each bird in his study area used four to 13 trees per year. These cavities occur in any living or dead tree that has a hollow internal chamber (Kilham 1983; Bull *et al.* 1992; Bonar 1995). Bonar's (pers. comm. 1999) observations show that all old, inactive nests in his study area were subsequently used for roosting.

Hiding Cover

When disturbed by a predator, the Pileated Woodpecker will fly to a tree and move quickly around its trunk in an attempt to evade its pursuer. Bonar (pers. comm. 1999) suggested that only a few trees (> 5% canopy closure) need to be present for this behaviour to be successful. However, since the birds are large, we believe that it is also important that ample flying space is available for effective predator evasion.

2.3 Reproduction Requirements

As discussed above, the Pileated Woodpecker is a primary cavity nester (Bonar 1995) and each spring, a pair will search for a site in which to excavate a new hole (Conner *et al.* 1975). Once the cavity has been dug out, the female lays three to five eggs (Bull and Meslow 1988) which hatch approximately 18

days later (Ehrlich *et al.* 1988). Young are fed by the parents (Ehrlich *et al.* 1988) and remain in the nest hole for 24 to 28 days. First flight generally occurs after one month, but the young continue to be dependent on their parents for feeding until early fall (Bull and Meslow 1988). As autumn progresses, the fledglings may be split between the parents and each group may use its own distinct territory, increasing the total home range size of the family (Mellen *et al.* 1992).

While either living or dead trees can be used for nesting, there are several characteristics of the stand and of the individual tree that the Pileated Woodpecker will seek for the purpose. These are discussed below.

Tree Species Composition

Pileated Woodpeckers will nest in at least 42 different tree species within their range (Kirk and Naylor 1996) but local preferences exist by area (Bonar pers. comm. 1999). In Alberta, aspen is the preferred species for nesting though larch, white birch, jack pine, black cottonwood, balsam poplar, and white spruce will also be used (McClelland 1979; Bull 1987; Wedgewood 1988; Campbell *et al.* 1990; Millar 1994; Bonar 1995).

Tree Diameter and Height

Tree diameter is a physical characteristic important for nesting (Bull and Meslow 1977) since the trees must be large enough to support nest cavities that are 18 to 25 cm wide and ~ 60 cm deep. Some nest trees are as small as 26 cm dbh (Kirk and Naylor 1996). Studies in Alberta report that those greater than 44 cm dbh are optimal, but on average nests are created in trees of at least 35 cm dbh (Bonar pers. comm. 1999). In addition, since nests are generally constructed between 8 (Bonar pers. comm. 1999) and 15 m (Millar 1994) above the ground, trees should be of sufficient height to accommodate them.

Decay

Trees with intermediate heartrot provide the hard, dry external walls and easy-to-hollow centre required for excavation (Conner *et al.* 1975; Bonar pers. comm. 1999). It appears that the Pileated Woodpecker is able to detect trees with these characteristics (Conner *et al.* 1975).

Canopy Closure

Though Bull and Holthausen (1993) suggested that stands with canopy closure greater than 60% best provide cover for nesting habitat, Bonar (pers. comm. 1999) stated that Pileated Woodpeckers in Alberta tend to nest in relatively open stands, selecting edge habitat near an opening or even the centre of a clearcut as a nest site. Since Bull and Holthausen's research was carried out in the western United States and Bonar's was completed in Alberta, it was decided that Bonar's locally-collected data would be used to create the HSM.

Nest Tree Density

Because a new cavity is excavated every year, a continual supply of suitable nest sites is needed (Bull 1975). Pileated Woodpecker populations of maximum size can be supported by a density of 0.3 (Bull and Meslow 1977; Thomas *et al.* 1979) to 0.6 (Evans and Conner 1979) snags of suitable condition per ha. Bonar (pers. comm. 1999) suggested that optimal nesting sites will include at least 30 suitable trees per ha. This habitat element may be limiting in some areas (Bull and Meslow 1977).

2.4 Habitat Area Requirements

As a non-migratory species, the Pileated Woodpecker occupies the same home range for successive years, actively defending the territory from the threat of intruders (Kilham 1983; Bonar 1995). The size of the home range varies with the amount of suitable habitat available. Published territory size estimates include 42 ha (Robbins *et al.* 1989), 53 to 163 ha (Renken and Wiggers 1989), 250 ha (Millar 1994), and 364 ha (Bull and Holthausen 1993). Work by Bonar (pers. comm. 1999) has shown that territories in Alberta are much larger than these measured ranges. In fact, the average home range of a pair is > 2,000 ha with some pairs defending almost 4,000 ha of land. Following this research, we have decided to use a home range size of 2,000 ha for Pileated Woodpecker HSM development.

2.5 Landscape Configuration Requirements

Robbins *et al.* (1989) suggested that the bird is most reliably found in contiguous forests of at least 3,000 ha in size. DeGraaf *et al.* (1985) stated that the species rarely feeds in edge habitat and prefers forest interior. However, pairs have been observed both nesting and feeding in highly fragmented forests (Bonar 1995) and agricultural landscapes (Dance 1987) in Alberta. Millar (1994), Kirk and Naylor (1996), and Bonar (pers. comm., 1999) stated that the size and interspersion of forest cover types will not affect the presence of Pileated Woodpeckers. It has been recommended, however, that 25 (Bull and Holthausen 1993) to 40% (Millar 1994) of the territory should support suitable nesting habitat.

2.6 Sensitivity to Human Disturbance

The Pileated Woodpecker is not thought to be sensitive to human activity in Alberta. The birds will nest as close as 3 m to houses, busy campgrounds, and roads (Bonar pers. comm. 1999).

3.0 MODEL

3.1 Envirogram

Four elements have been identified as potentially critical components of Pileated Woodpecker habitat: the ability to find winter food, to find shelter from the elements in roost sites, to avoid predators, and to acquire suitable nest sites. The forest attributes that influence the birds' success in achieving these endeavours are shown in the envirogram below (Figure 2).

During winter, the Pileated Woodpecker consumes almost exclusively wood-boring insects. These are also an important food resource in summer and are most abundant in dead, diseased, or damaged trees. Shelter from inclement weather is provided by stands with available roost sites. Nesting habitat must also offer sufficient shelter. Additionally, it must have accessible nest trees of suitable species, dbh, height, and degree of decay in which the birds can excavate large cavities.

3.2 Application Boundaries

Season: This model produces SI values for use year-round.

Habitat Area: Home range size used for home range smoothing is 2,000 ha.

Model Output: The model assigns a SI value for foraging, cover, and nesting habitat suitability to each 25 m pixel of forested habitat.

3.3 Model Description

The HSM structure for Pileated Woodpecker habitat follows the envirogram (Figure 3). As food resources, shelter from predators, and nesting habitat are all required components of year-round habitat, there will be no compensation allowed between them.

The SI_{food} consists only of the variable indicating the density of dead, damaged, or diseased trees of sufficient size that are likely to support abundant insect populations.

The SI_{cover} consists of canopy closure and free-to-manouevre flying space. There is no compensation allowed between these variables since they both are thought to contribute to predator evasion success.
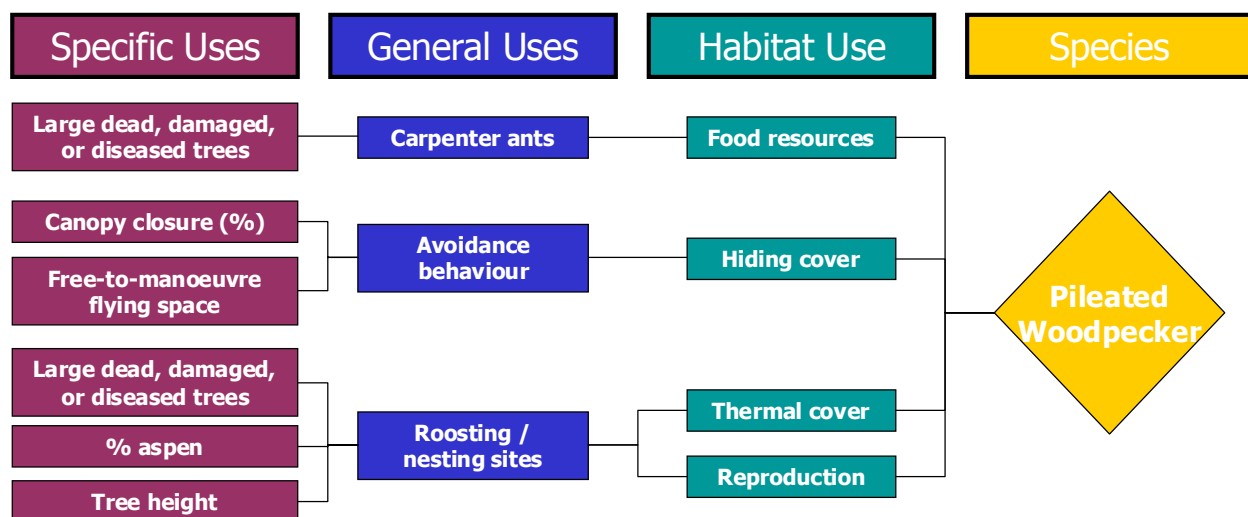

Figure 2. Envirogram of the Pileated Woodpecker based on available habitat information for HSM development.

Variable Description	Variables	Suitability Index Equation

Density of dead, damaged, or diseased trees weighted by diameter — S_{f1} — $SI_{food} = S_{f1}$

Canopy closure (%) — S_{c1}

Free-to-manoeuvre flying space — S_{c2} — $SI_{cover} = (S_{c1} * S_{c2})^{1/2}$

Density of dead, damaged, or diseased trees weighted by diameter — S_{n1}

% aspen — S_{n2} — $SI_{nesting\ and\ roosting} = (S_{n1} * S_{n2} * S_{n3})^{1/3}$
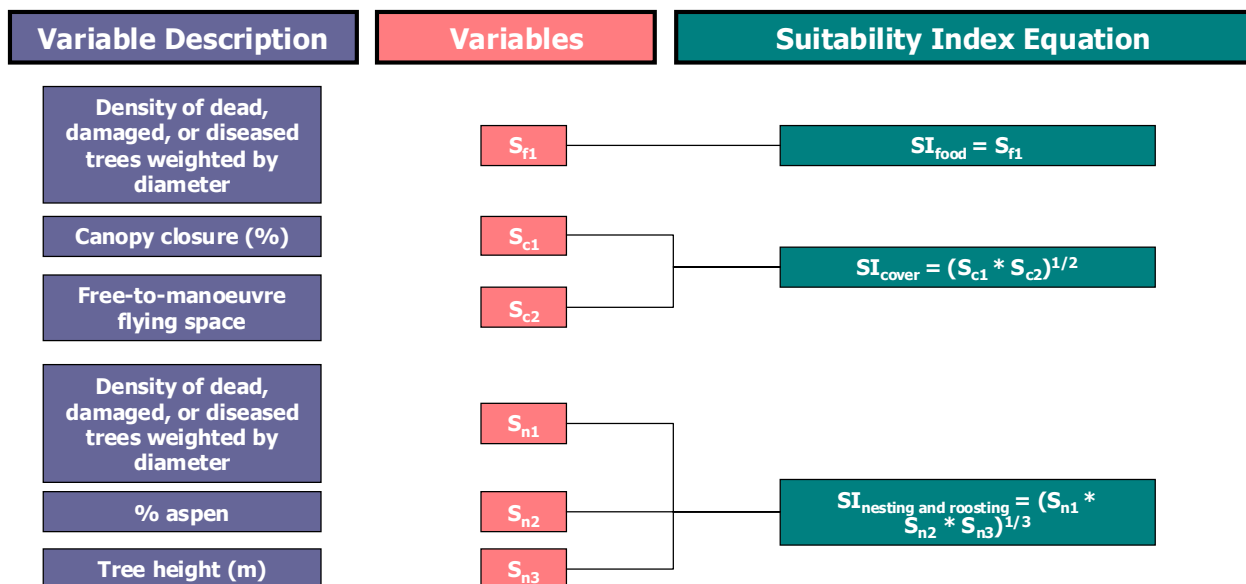
Tree height (m) — S_{n3}

Figure 3. HSM structure for the Pileated Woodpecker within Millar Western's FMA area.

The $SI_{nesting\ and\ roosting}$ includes forest features that affect the birds' ability to successfully excavate nest holes that may subsequently be used as roost sites. These characteristics also influence the natural development of hollow trees that Pileated Woodpeckers may also use for roosting. Stand attributes that pertain to suitability as nesting or roosting sites are density of dead, damaged, or diseased trees weighted by diameter, % aspen, and tree height. As all of the variables are required components of nesting and roosting habitat, they are non-compensatory.

3.4 Habitat Variable SIs

Food

Optimal foraging habitat is provided by stands with at least five dead, damaged, or diseased trees > 16 cm dbh per ha (S_{f1}). As seen in Figure 4, habitat suitability increases linearly with density of foraging trees, peaking at five suitable trees per ha.

Cover

Evasion cover can be provided by very open stands (S_{c1}). Figure 5 shows that habitat suitability increases linearly with canopy closure to the optimal condition at 5% closure. A relatively clear understorey will best supply the flying space thought to be required for efficient predator evasion (Figure 6).

Nesting and Roosting Sites

The variables involved with the provision of nesting and roosting habitat are density of dead, damaged, or diseased trees weighted by diameter (S_{n1}), % aspen (S_{n2}), and tree height (S_{n3}). It is shown in Figure 7 that suitability increases linearly with a greater number of suitable trees, achieving the maximum at 30 trees per ha. As aspen trees are preferred, stands containing at least 50% aspen are desirable. However, since the Pileated Woodpecker will readily use trees of other species as nesting and roosting sites in the absence of aspen trees, stands that do not contain aspen receive a suitability rating of 0.5 (Figure 8). Tree height must be greater than 8 m, but preferably will approach 16 m (Figure 9).
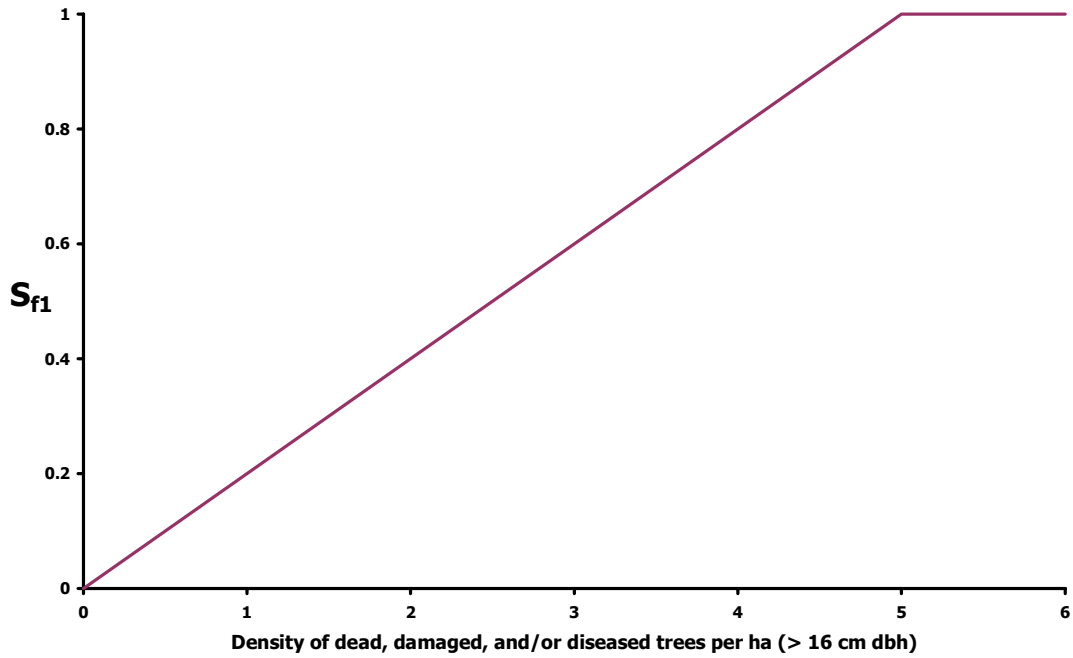
Figure 4. Pileated Woodpecker foraging habitat suitability in relation to the density of dead, damaged, or diseased trees > 16 cm dbh per ha within Millar Western's FMA area.
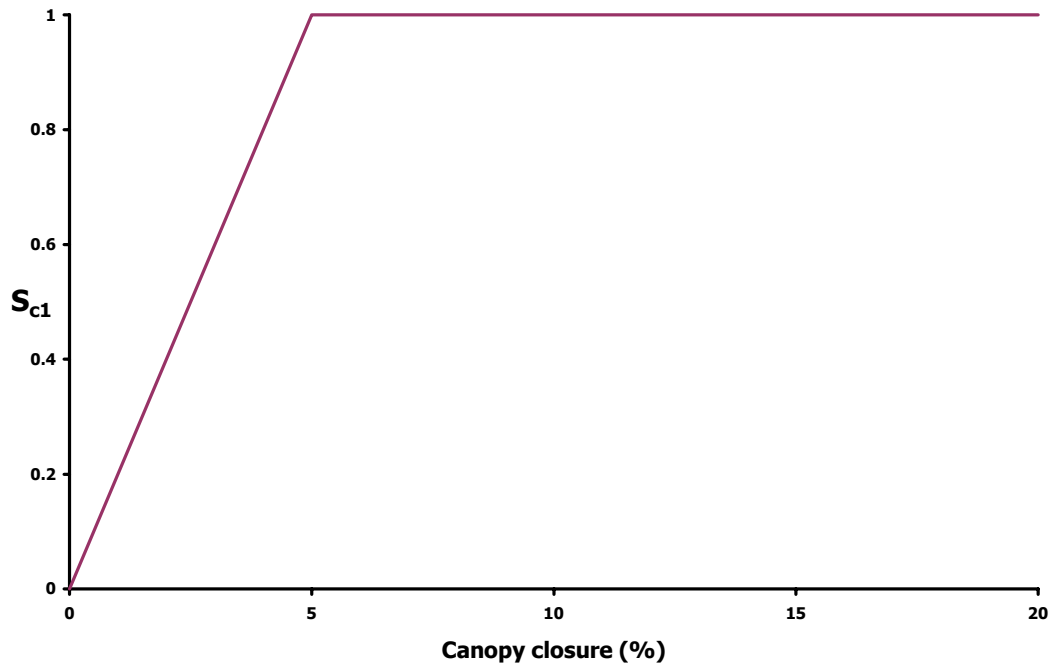

Figure 5. Pileated Woodpecker cover habitat suitability in relation to canopy closure within Millar Western's FMA area.
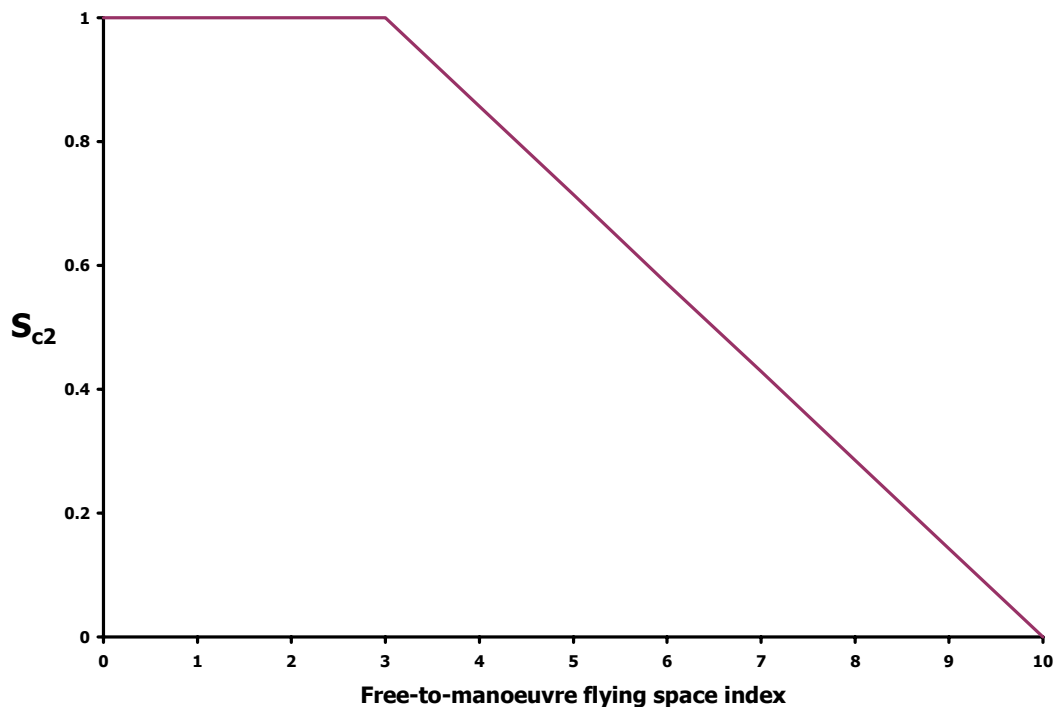
Figure 6. Pileated Woodpecker cover habitat suitability in relation to free-to-manoeuvre flying space within Millar Western's FMA area.
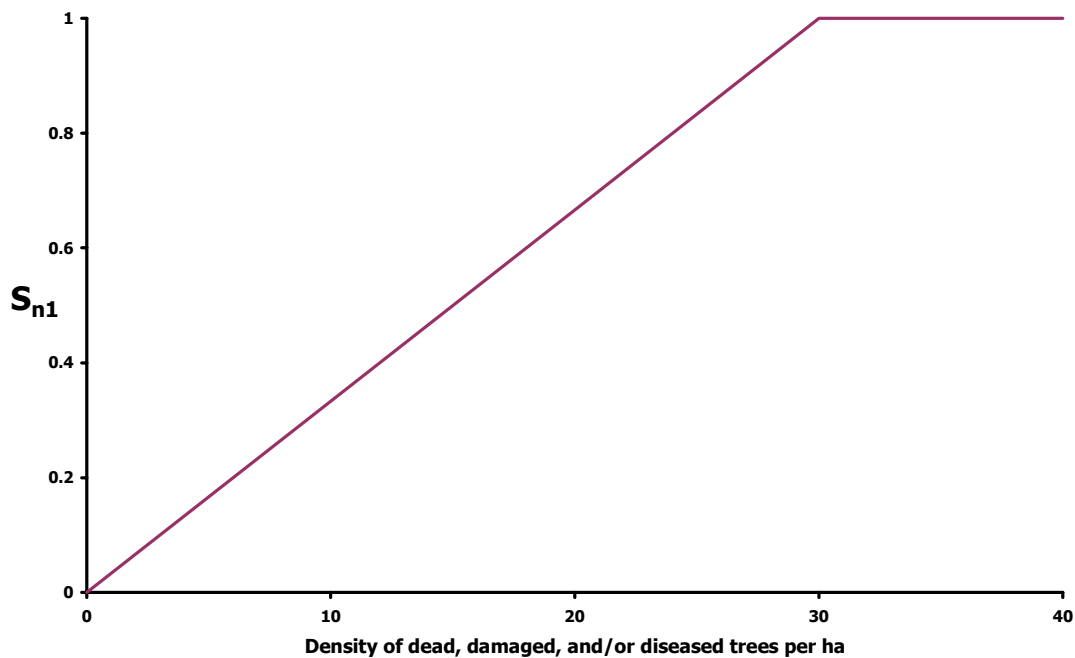

Figure 7. Pileated Woodpecker habitat suitability in relation to density of dead, damaged, or diseased trees per ha within Millar Western's FMA area. Weighting: > 40 cm dbh = 1, 25-40 cm dbh = 0.8, others = 0.
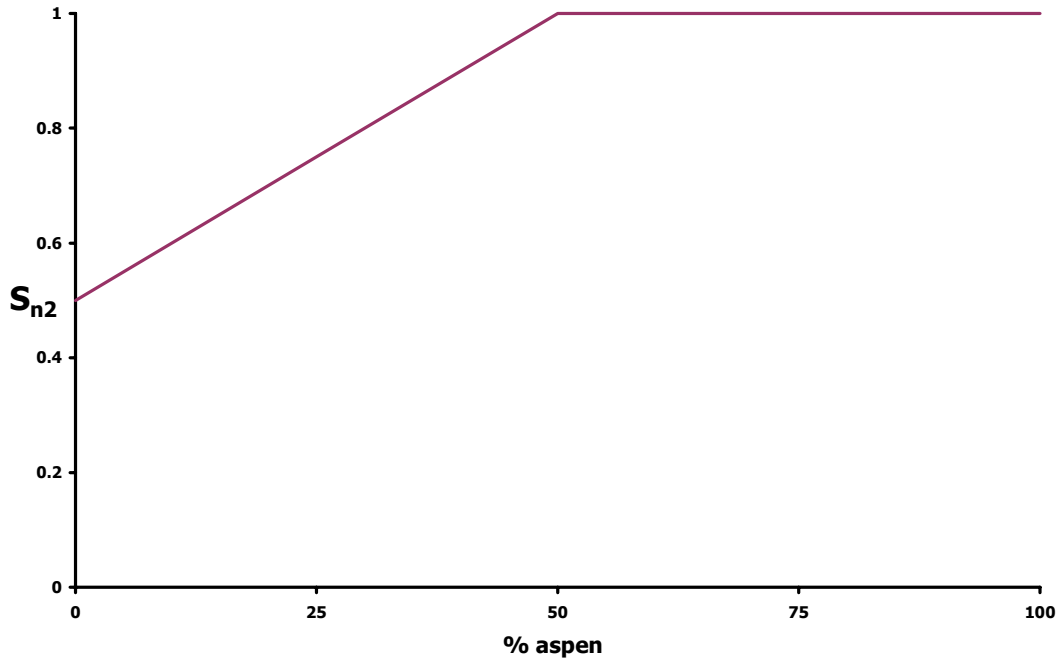
Figure 8. Pileated Woodpecker nesting and roosting habitat suitability in relation to tree species composition within Millar Western's FMA area.
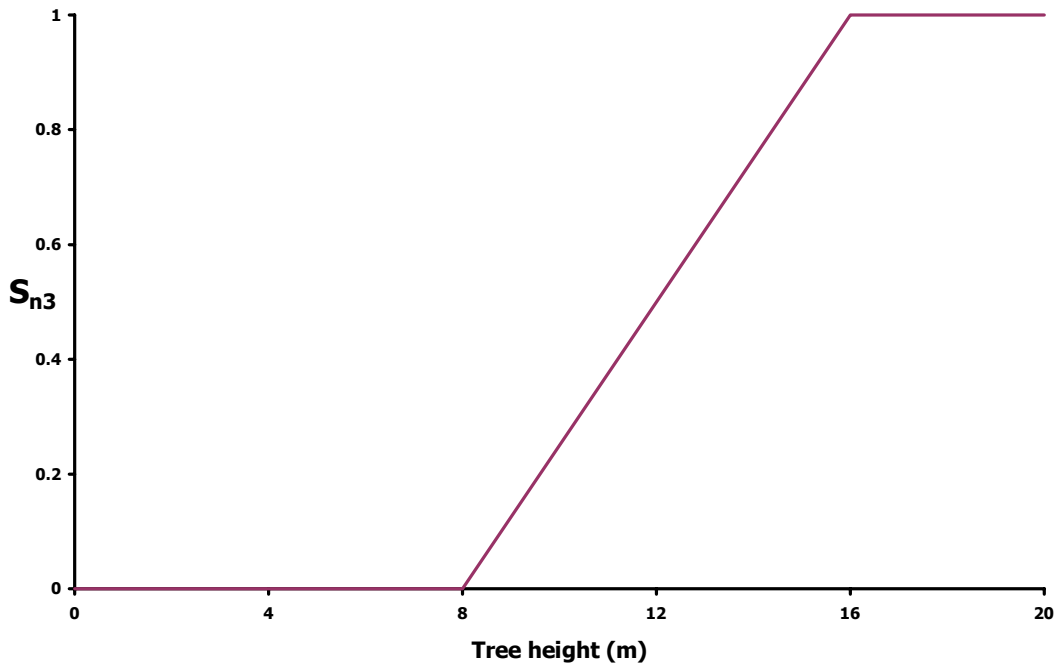

Figure 9. Pileated Woodpecker habitat suitability in relation to tree height within Millar Western's' FMA area.

3.5 Computation

Our goal is to create HSMs that allow the user to identify the potential impacts of proposed forest management strategies on foraging, cover, and nesting and roosting habitats. Therefore, the outputs of the SI_{food}, SI_{cover}, and $SI_{nesting\ and\ roosting}$ calculations are considered individually to display trends in habitat availability.

Foraging Habitat Index

The suitability of each pixel as foraging habitat is assessed using the equation:

$$SI_{food} = S_{f1}$$

Cover Habitat Index

The suitability of each pixel as cover habitat is assessed using the SI_{cover} equation:

$$SI_{cover} = (S_{c1} * S_{c2})^{1/2}$$

Nesting and Roosting Index

To calculate the nesting and roosting index, the suitability rating of each pixel with respect to its density of dead, damaged, and diseased trees of suitable size, % aspen, and tree height is established. These variables are brought together in the following equation:

$$SI_{nesting\ \&\ roosting} = (S_{n1} * S_{n2} * S_{n3})^{1/3}$$

Home Range Smoothing

The suitability of the foraging and cover opportunities within the entire home range (~2,000 ha) is evaluated. A circular window of radius 2,525 m (2,003 ha) moves over the grid representing Millar Western's FMA area in such a way that centres are located 2,525 m (one full radius) apart. The SI_{food} and SI_{cover} values received by each pixel within the circle are averaged. These average values are applied to the centre pixel as its SI_{food} and SI_{cover} ratings.

As noted above, a home range will optimally contain at least 25% suitable nesting habitat (defined as $SI_{nesting\ and\ roosting}$). To take this into account, the best 25% of the $SI_{nesting\ and\ roosting}$ values received by the pixels within the circular window are averaged and applied as the $SI_{nesting\ and\ roosting}$ value of the centre pixel.

4.0 EXTERNAL REVISION

Rick Bonar of Weldwood of Canada, Hinton division, reviewed an early draft of the Pileated Woodpecker HSM and on April 27, 1999, supplied his comments. The following changes have been made to the original document on his advice:

1) The original document stated that the woodpecker excavates and scales bark in winter and that year-round, the birds prefer well-decayed wood. In Alberta, however, the woodpeckers feed almost exclusively on carpenter ants and forage around the bases of trees in winter. In addition, the degree of decay preferred changes with seasons. In summer, fairly decayed wood is preferred while during winter, sound wood is chosen.

2) Though many researchers suggest that the woodpeckers require significant canopy closure as shelter, Bonar has observed the birds nesting and feeding in all habitats. Open stands seem to be preferred over very dense stands.

3) We had decided to use a home range size of 1,000 ha for HSM development. Bonar suggested that in Alberta, the birds occupy an average territory size of 2,000 ha and sometimes use almost 4,000 ha.

4) Research in Ontario had shown that the birds may be sensitive to human activity but Bonar has observed them nesting very close to houses, campgrounds, and roads.

5) Bonar shared his data with us so that we could adjust the optimal density of feeding and nesting trees to reflect the condition in Alberta.

On June 23, 1999, Arlen Todd, wildlife biologist with the Natural Resources Service, Fisheries and Wildlife Management Division, in Whitecourt, Alberta reviewed the Pileated Woodpecker HSM. As he does not have extensive experience with this species, he did not recommend any specific alterations.

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