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# THREE-TOED WOODPECKER

## YEAR-ROUND HABITAT

### HABITAT SUITABILITY INDEX MODEL

#### VERSION 6

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## 1. INTRODUCTION

Habitat Suitability Index (HSI) models predict the suitability of habitat for a species based on an assessment of habitat attributes such as habitat structure, habitat type and spatial arrangements between habitat features. This HSI model for the three-toed woodpecker (*Picoides tridactylus*) applies to habitats of the Foothills Model Forest (FMF) in west-central Alberta. The intended use is to predict habitat suitability at landscape scales and over long-time periods. The model was used to determine potential changes in three-toed woodpecker habitat area and carrying capacity throughout an entire forest management cycle (180 years) in the 1999 Weldwood Forest Management Plan. The model was primarily developed using literature review with reference to some local data (J. Watson, Habitat use by woodpeckers in the boreal forest region of Alberta. Foothills Model Forest Draft Annual Report, 1996).

## 2. SPECIES DESCRIPTION AND DISTRIBUTION

The three-toed woodpecker is medium sized (length 22 cm) with black and white colouration (Salt and Salt 1976). Three toes instead of four distinguish three-toed woodpeckers from all other local woodpecker species except the black-backed woodpecker (*Picoides arcticus*; Godfrey 1986). The back is barred white and black and males have a yellow patch on the crown (Salt and Salt 1976).

Three-toed woodpeckers occur across North America and Eurasia. They breed and winter in boreal forests across Canada (Salt and Salt 1976, Godfrey 1986). In Alberta three-toed woodpeckers breed in the northern half of the province and in the Rocky Mountains (Salt and Salt 1976) and are associated with coniferous forests (Salt and Salt 1976, Godfrey 1986). This woodpecker is not at risk in Alberta because populations are considered stable and habitat is considered secure (Wildlife Management Division 1996).

## 3. FOOD

Three-toed woodpeckers prey on bark beetle larvae and other wood boring insects (Bock and Bock 1974, Salt and Salt 1976). Foraging is primarily by scaling bark on dead or partially dead coniferous trees (Hogstad 1978, Short 1982, Bull et al. 1986). In spruce forests in Norway, three toed woodpeckers fed on dead conifers (mostly spruce). Trees used for foraging ranged in height from 2-20 m and diameter at breast height (dbh at 1.3 m) ranged from 5-15 cm, with most being > 15 cm dbh (Hogstad 1978).

## 4. COVER

Three-toed woodpeckers occur in mature and old coniferous stands and coniferous dominated mixedwood stands (Salt and Salt 1982, Bull et al. 1986, Godfrey 1986).

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## 5. REPRODUCTION

Three-toed males occasionally drum to attract mates but drumming is quiet compared to other woodpecker species (Salt and Salt 1976). Once a nest site is chosen, pairs excavate a nest hole as part of the courtship ritual (Thomas 1979), and the female produces 4 white eggs (Salt and Salt 1976). Both sexes incubate the eggs and provide parental care. Incubation lasts for 2 weeks (Godfrey 1986) and the male roosts nightly in the nest throughout incubation (Ehrlich 1988). Fledging occurs in 22-26 days (Ehrlich 1988). One brood is produced each year (Ehrlich 1988).

Three-toed woodpeckers nest in snags and partially-dead conifers, or occasionally deciduous trees (Godfrey 1986). Three-toed woodpeckers prefer fir (*Abies* spp.), spruce (*Picea* spp.), or pine (*Pinus* spp.) stands or muskegs with black spruce (*Picea mariana*; Salt and Salt 1976). Three cavities per year are excavated by each pair for nesting, roosting, and overwintering (Thomas 1979). In Oregon and Washington, cavities were excavated in living conifers and were in young (40-79 yr), mature (80-159 yr) and old (160+ yr) stands (Thomas et al. 1974). In Oregon, Thomas (1979) stated that a minimum tree dbh of 30 cm and height of 5 m was needed for nest trees. In the FMF, 30 three-toed woodpecker nests were examined (J. Watson, Habitat use by woodpeckers in the boreal forest region of Alberta. Foothills Model Forest Draft Annual Report, 1996). Seventy percent of nests were in dead snags or stubs, while 30% were in live trees. Nest tree species included aspen (*Populus tremuloides*; 47%), lodgepole pine (*Pinus contorta*; 20%), black spruce (17%), white spruce (*Picea glauca*; 7%), fir (7%), and larch (*Larix laricina*; 3%). Mean nest tree dbh and height were 25 cm (range 18-45) and 16 m (range 4-25), respectively. Mean dbh and height of the stand surrounding nest trees were 23 cm (range 10-57) and 20 m (range 6-31).

## 6. HABITAT AREA

Maximum densities of 0.03 pairs/ha occurred in Washington and Oregon (Thomas et al. 1979). In a synopsis, breeding densities of 0.023 pairs/ha (1 pair per 43 ha) was determined (Short 1982). There is no density information for three-toed woodpeckers in the FMF. Until specific information is collected, a population density of 0.03 pairs/ha is assumed in optimal habitat. Based on this figure, a genetic effective population of 500 individuals would require 109 km<sup>2</sup> of suitable habitat.

## 7. HSI MODEL

### 7.1 MODEL APPLICABILITY

**Species:** Three-toed Woodpecker (*Picoides tridactylus*).

**Habitat Evaluated:** Food, Cover, and Nesting Habitat.

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

**Seasonal Applicability:** This model produces HSI values for year-round range.

**Cover types:** This model applies to all forest and non-forest habitat areas of the Lower and Upper Foothills, Montane and Subalpine Natural Subregions (Beckingham et al. 1996) since suitability is determined from structural characteristics within stands rather than classified forest stands directly. The model should also be broadly applicable to other habitat areas dominated by forest cover similar to that in this region, including pure deciduous, mixedwood and pure coniferous forest types, as well as wetland and riparian forests, meadows, shrublands, and areas regenerating after forest harvesting.

**Minimum Habitat Area:** Minimum habitat area is defined as the minimum amount of contiguous habitat to which the model will be applied. No minimum habitat area is required as it is assumed that three-toed woodpeckers can use small patches of forest interspersed throughout a managed landscape.

**Model Output:** The model produces Habitat Units (HU) of breeding habitat for each stand or type based on HSI value and stand area. The performance measure for the model is potential carrying capacity (breeding pairs per ha). Model output (HU) should be correlated to estimates of carrying capacity to verify model performance.

**Carrying Capacity (Breeding Pairs per ha where HSI = 1.0):** Based on suggested breeding territory size of 30 ha/pair (Thomas et al. 1979), the maximum number of breeding pairs per optimal ha is 0.03.

**Verification Level:** The reliability of this model has not been evaluated against local data. The verification level is 4: local data was used to develop the model but the model predictions have not been tested.

**Application:** This HSI model is designed to assess habitat suitability for relatively large forest landscapes using generalized species-habitat relationships and stand-level vegetation inventory. Its purpose is to predict relative changes in three-toed woodpecker habitat supply at the landscape level over long time periods (200 years), for integration with forest management planning. The model is not designed to provide accurate prediction of suitability or use at the stand level. Approximate population size can be calculated by assuming linear habitat-population relationships, but the model is not designed to provide accurate population density estimates. Any attempt to use the model in a different geographic area or for other than the intended purpose should be accompanied by model testing procedures, verification analysis, and other modifications to meet specific objectives.

## 7.2 MODEL DESCRIPTION

The HSI model for three-toed woodpecker year-round habitat assumes the life requisites of food, cover, and nesting are limiting. It is assumed that foraging habitat requirements are met by the same parameters that provide essential nesting and cover needs.

### 7.2.1 Habitat Variables and HSI Components

#### A. Foraging Habitat

Three-toed woodpeckers primarily acquire food (bark beetle and other wood-boring insect larvae) by scaling bark off dead or partially dead conifers. Forest characteristics which complement this feeding behaviour include large trees, represented by stand dbh, used to predict HSI component  $S_1$ , and coniferous canopy tree height, which defines  $S_2$ . The number of snags within the forest stand determines the food resource since snags provide bark beetle larvae and other arthropods. Snag density per hectare is used to define  $S_3$  (Table 1).

#### B. Cover

Cover is determined from coniferous composition and tree canopy closure. As tree canopy closure or coniferous percentage becomes greater, the model produces higher suitability values. Conifers provide better cover than deciduous trees because their branches are denser and they remain in leaf throughout the winter. Closed canopies protect against weather and predation. The two components are  $S_4$  and  $S_5$  (respectively).

#### C. Nesting

Nesting is determined by combining stand dbh ( $S_1$ ) and snag density ( $S_3$ ) to ensure that trees will be large enough for nest cavities.

**Table 1.** Relationship between habitat variables and life requisites for the three-toed woodpecker HSI model.

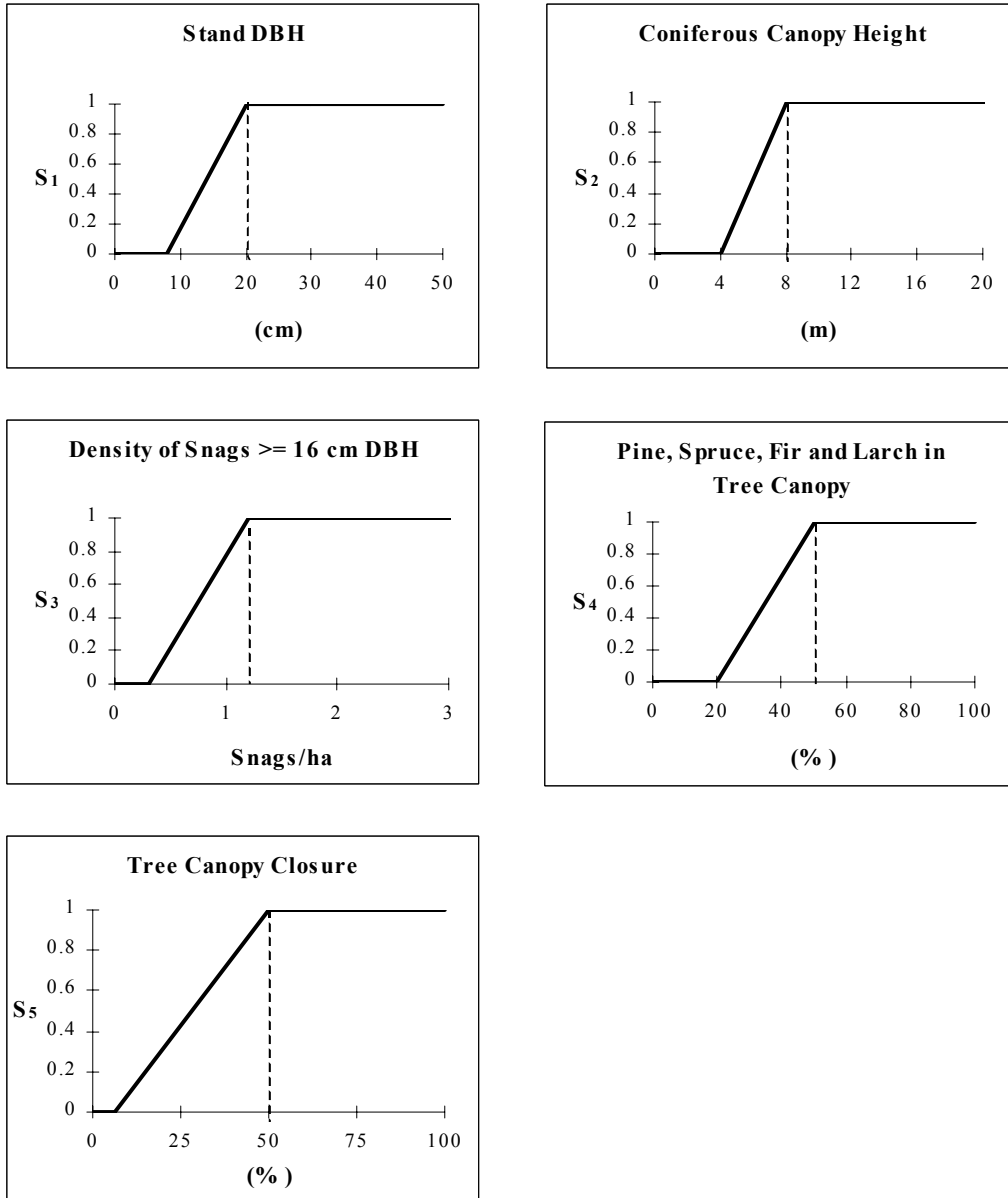
HSI Component	Life Requisites	Habitat Variables	Habitat Variable Definition
$S_1$	Food, Nesting	Stand dbh (cm)	Average dbh of canopy trees measured at 1.3 m in height .
$S_2$	Food, Cover	Coniferous Canopy Height (m)	Average top height of 100 coniferous trees/ha that have the largest dbh.
$S_3$	Food, Nesting	Snag Density (stems/ha)	Total density of standing dead trees or stubs $\geq 16$ cm dbh per hectare.
$S_4$	Food, Nesting, Cover	Pine, Spruce, Fir and Larch in Tree Canopy (%)	Percent composition of pine, spruce, fir and larch species in the tree canopy.
$S_5$	Cover	Tree Canopy Closure (%)	Percent of ground covered by a vertical projection of tree crown areas onto the ground. Includes trees $\geq 8$ cm dbh.

### 7.2.2 Graphical HSI Component Relationships

- S<sub>1</sub> Trees < 8 cm dbh are unsuitable for either food or nesting. Trees ≥ 20 cm dbh are considered optimum and between 8 cm dbh and 20 cm dbh, suitability increases linearly (Figure 1a).
- S<sub>2</sub> Tree heights ≥ 8 m are optimal. Tree heights < 4 m are unsuitable and suitability increases linearly from 4–8 m, (Figure 1b).
- S<sub>3</sub> Stands with numerous snags have more food and potential nest sites. Stands with ≥ 1.2 snags/ha are optimal (Figure 1c).
- S<sub>4</sub> Conifer-dominated stands (> 50% conifers) are preferred. However deciduous dominated mixedwoods (20-40% conifers) also provide habitat. Stands with < 20% conifers are unsuitable (Figure 1d).
- S<sub>5</sub> Tree canopy closure must be > 6% for a stand to have any value for three-toed woodpeckers. Suitability increases as canopy closure values increase from 6-50%. Stands with ≥ 50% canopy closure are optimal (Figure 1e).

### **7.3 MODEL ASSUMPTIONS**

1. Conifer dominated areas have coniferous snags directly proportional to the proportion of conifers in the tree canopy.
2. Food, cover, and nesting needs are all interrelated and must be found within the same area before the area is considered suitable habitat for three-toed woodpeckers.
3. Three-toed woodpeckers are unaffected by the proximity of human developments or roads.



**Figure 1.** Graphical relationships between habitat variables and HSI components in the three-toed woodpecker model.

#### 7.4 EQUATION

The HSI model combines all three needs (food, cover, nesting) into a single equation.  $S_4$  and  $S_5$  determine the cover suitability for three-toed woodpeckers in either coniferous or mixedwood forests with varying amounts of canopy closure. These two variables are considered compensatory in that having a high value in one can compensate a low value in the other. The other three variables ( $S_1$ ,  $S_2$  and  $S_3$ ) determine the quality of food and nesting within areas of suitable cover. These are multiplied directly to the cover component.

$$HSI = S_1 \times S_2 \times S_3 \times (S_4 \times S_5)^{1/2}$$

### 8. SOURCES OF OTHER MODELS

No other HSI models on three-toed woodpeckers were found.

## Model History

All of the HSI models for the Weldwood Forest Management Area have undergone several revisions, and they will be revised again as new information becomes available. Contact Rick Bonar for information about the most current version.

- Version 1 (1989) was developed by the Weldwood of Canada Integrated Resource Management Steering Committee (IRMSC).
- Version 2 (1994) was revised by Barb Beck and Melissa Todd.
- Version 3 (1995) was written by Ryan Zapisocki for a special topics course in habitat modelling at the University of Alberta.
- Version 4 (1996) was edited and reformatted by Wayne Bessie.
- Version 5 (1999) was revised by Karen Graham, Rick Bonar, Barb Beck, and Jim Beck to incorporate information from recent literature.
- Version 6 (2000) was edited by Rick Bonar but the model relationships were not changed from Version 5.

## 9. LITERATURE CITED

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