
WARBLING VIREO

REPRODUCTIVE HABITAT

HABITAT SUITABILITY INDEX MODEL

VERSION 5

Last Modified: 21 October 1999

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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 warbling vireo (*Vireo gilvus*) 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 will be used to determine potential changes in warbling vireo habitat area and carrying capacity throughout an entire forest management cycle (200 years). The model was primarily developed using literature review.

2. SPECIES DESCRIPTION AND DISTRIBUTION

The warbling vireo is 12-15 cm long, with a grey head and back, a white breast and no wing bars (Godfrey 1986). The song is described as a continued musical warble rising in pitch at the end (Salt and Salt 1976, Godfrey 1986). Warbling vireos are commonly found in aspen (*Populus tremuloides*) and balsam poplar (*P. balsamifera*) stands (Godfrey 1986) throughout Canada and most of the United States (Salt and Salt 1976). Warbling vireos are the most common vireo in the Parkland and Foothills regions in Alberta (Salt and Salt 1976). This vireo winters in Central America from Mexico to Guatemala (Godfrey 1986). Warbling vireos are not at risk in Alberta and their habitat is considered secure (Wildlife Management Division 1996).

3. FOOD

Warbling vireos eat various species of insects including hairy caterpillars avoided by many other birds, spiders and some berries (Salt 1973, Ehrlich 1988). They feed primarily in tree tops (Ehrlich 1988).

4. COVER

Warbling vireos are associated with old deciduous forests (60 yr +) with open canopies and well developed shrub understories (Westworth et al 1984). They also occur in edge habitat where shrub/sapling and deciduous forest types meet (Salt and Salt 1976, T. Thormin personal communication).

5. REPRODUCTION

Nests are built by both sexes and are made of grass, strips of bark and cobwebs (Salt and Salt 1976). The nest is a basket-like cup with the rim usually suspended from a forked twig (Salt and Salt 1976, Godfrey 1986). Nests are often found at heights of up to 13 m (Salt and Salt 1976). Three to five eggs are laid, which hatch in 12-14 days (Godfrey 1986). Both sexes incubate the eggs (Godfrey 1986). Sixteen days later the young fledge (Ehrlich 1988).

6. HABITAT AREA

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Warbling vireo densities were 2.2 birds/ha in Colorado (Scott and Crouch 1987), 0.9-1.2 birds/ha in Arizona (Franzreb and Ohmart 1978), 0.26 pairs/ha near Medicine Lake in central Alberta (Westworth et al 1984) and 0.29 birds/ha in young (25-35 yr) forests in the Western Cascade Mountains in Oregon (Anthony et al. 1996). Mean densities of warbling vireos in young and mature mixedwoods in the FMF were 0.28 and 0.38 pairs/ha respectively with the maximum number of pairs per hectare being 0.44 (S. Rangen, Songbird abundance, distribution, and reproductive success in two age classes of mixedwood stands in the Foothills Model Forest, unpublished report, Foothills Model Forest, 1997).

7. HSI MODEL

7.1 MODEL APPLICABILITY

Species: Warbling Vireo (*Vireo gilvus*).

Habitat Evaluated: Nesting and Foraging Cover.

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

Seasonal Applicability: This model produces HSI values for critical reproductive habitat.

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 vegetation 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. Warbling vireos utilize habitats < 1 ha in size so no minimum habitat area has been specified.

Model Output: The model will produce Habitat Units (HU) of food, and nesting habitat for each habitat stand based on HSI value and stand area. HU are calculated by multiplying the HSI score with the area in hectares. The performance measure for the model is potential carrying capacity (breeding pairs of warbling vireos per ha). Model output must be correlated to estimates of carrying capacity to verify performance.

Carrying Capacity (Breeding Pairs per ha where HSI = 1.0): The current estimate of the maximum number of pairs per hectare of fully suitable habitat in the FMF is 0.44 (S. Rangen, Songbird abundance, distribution, and reproductive success in two age classes of mixedwood stands in the Foothills Model Forest, unpublished report, Foothills Model Forest, 1997).

Verification Level: The reliability of this model has not been evaluated against local data. The verification level is 5: model has been tested/revised using local data but the predictive performance of the revised model has 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 warbling vireo 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 warbling vireo reproductive habitat assumes the life requisites of food and nesting sites are limiting. The model determines an index value based on nesting cover and food availability at and near the nesting site, based on structural elements within the area and spatial relationships between nearby areas.

7.2.1 Habitat Variables and HSI Components

A. Nesting Cover

Warbling vireos nest in the upper canopy of deciduous trees. The structural elements which address this need were assumed to be deciduous canopy height, percent deciduous tree species in the tree canopy, and tree canopy closure. As deciduous trees get taller, the value of habitat for nesting is assumed to increase as is shown in HSI component S_1 . Deciduous composition is used to develop S_2 , since more deciduous trees in the tree canopy should provide more potential nest sites. However, composition only determines the relative tree ratio, not the number of available trees. Canopy closure, (S_3), ensures that trees will be dense enough to provide nest sites and protection from predation and inclement conditions (Table 1).

B. Foraging Cover

Warbling vireos feed in areas of shrubs or sapling-sized trees. S_4 is determined from % shrub and sapling canopy closure within the height range of 1.5-4 m. Foraging cover may be found in the same habitat as the nest or may be found in close proximity to the nest. Warbling vireos are known to utilize areas which have high coverage of sapling trees and shrubs such as regenerating blocks, if they are near a nesting location. It is assumed that there must be foraging habitat within 100 m of the potential nest stand before the nest stand is considered suitable habitat.

Table 1. Relationship between habitat variables and life requisites for the warbling vireo HSI model.

HSI Component	Life Requisites	Habitat Variable	Habitat Variable Definition
S_1	Nesting Cover	Deciduous Canopy Height (m)	Average top height of 100 deciduous trees/ha that have the largest diameter at breast height (dbh at 1.3m).
S_2	Nesting Cover	Deciduous in Tree Canopy (%)	Percent composition of all aspen, balsam poplar, and birch species in the stand.
S_3	Nesting Cover	Tree Canopy Closure (%)	Percent of ground covered by a vertical projection of tree crown areas onto the ground. Includes trees ≥ 8 cm dbh.
S_4	Foraging Cover	Shrub and Sapling Cover (%)	Percent of ground covered by a vertical projection of tall shrub and sapling crown areas onto the ground. Includes shrub + sapling cover for layer heights ≥ 1.5 m and ≤ 4.0 m.

7.2.2 Graphical HSI Component Relationships

A. Nesting Cover

- S_1 Up to 10 m tall, deciduous trees are unusable for warbling vireo nesting. Trees 10 m tall begin to have some nesting value and suitability increases linearly until 15 m. All deciduous tree canopies ≥ 15 m are assumed to provide optimal habitat (Figure 1a).
- S_2 Deciduous trees are needed for nesting but only when there are none in an area will the habitat be considered fully unsuitable. Suitability increases linearly between 0-30%, and stands with $> 30\%$ deciduous are assumed optimal (Figure 1b).
- S_3 Like the last component, canopy closure is too low only when there is none, then between 0 and 50% the suitability increases to optimal. At all values $\geq 50\%$ $S_3 = 1$ (Figure 1c).

B. Foraging Cover

- S_4 Foraging is optimal in areas where shrub and sapling canopy closures at 1.5-4 m height is $\geq 50\%$. (Figure 1d). Suitability decreases linearly to 0 if there is no sapling or shrub closure.

7.3 MODEL ASSUMPTIONS

1. Warbling vireos will find adequate thermal and security cover in habitats that provide critical reproductive habitat.
2. Shrub or tree species have the same value in providing foraging cover.
3. Water and minerals are not limiting.

4. Warbling vireos are not affected by settlements, roads, or industrial activity.

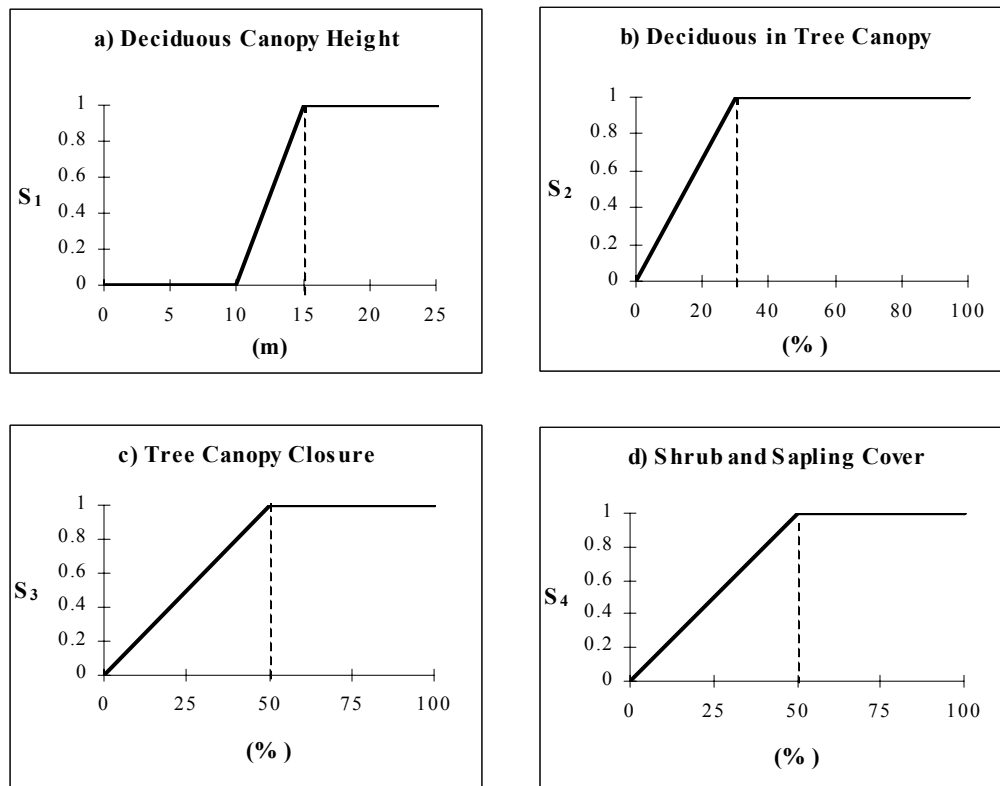


Figure 1. Graphical relationships between habitat variables and HSI components in the warbling vireo model.

7.4 EQUATIONS

A. Nesting Cover

Nesting cover is determined by the product of the first three components. This equation assumes that all three variables are equally important and non-compensatory. A low value of one variable cannot be compensated by a high value in another variable.

$$\text{HS-nesting} = S_1 \times S_2 \times S_3$$

B. Foraging Cover

The foraging cover HSI works by assessing the food at the nesting habitat and in adjacent habitats.

$$\text{HSI-foraging} = S_4$$

C. Overall HSI

The nesting habitat will only be suitable if there is at least 0.5 HU of suitable foraging habitat within 100 m of the potential nest stand.

8 SOURCES OF OTHER MODELS

No other HSI models for the warbling vireo 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 Tara Banks 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.

9. LITERATURE CITED

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