WINTER WREN
REPRODUCTIVE HABITAT

HABITAT SUITABILITY INDEX MODEL
VERSION 5

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Dan Gould, 2-53111 Range Road 220, Ardrossan, Alberta. T8E 2C6.
Dan Farr, Foothills Model Forest, Box 6330, Hinton, Alberta. T7V 1X6.
Barbara Beck, Department of Renewable Resources, University of Alberta, Edmonton, Alberta. T6G 2H1.
James Beck, Department of Renewable Resources, University of Alberta, Edmonton, Alberta. T6G 2H1.
Richard Bonar[1]**,** Weldwood of Canada, Hinton Division, 760 Switzer Drive, Hinton, Alberta. T7V 1V7.

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 winter wren (*Troglodytes troglodytes*) 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 winter wren 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 winter wren is small (10-11 cm), round, and dark reddish-brown with a stubby tail, dark brown barring on the belly, and a light line over the eye (Salt and Salt 1976). Winter wrens have a habitat of bobbing (Godfrey1986) and are usually located near the forest floor searching for food (Salt and Salt 1976). The winter wren is a summer migrant to the FMF but occasionally winters in southern Alberta. Winter wrens breed throughout the boreal and mountain forests and are typically found in well developed, older, coniferous stands and areas with dense woody undergrowth (Peterson 1961). In Alberta, the status of the winter wren is unknown but evidence suggests that the eastern populations may be declining (Wildlife Management Branch 1996). The winter wren has a patchy distribution in coniferous stands throughout the FMF (Farr 1995).

3. FOOD

Adult winter wrens forage for insects and other invertebrates in dense undergrowth, including root tangles, dead fall and slash piles (Godfrey 1986). The microhabitat of the winter wren is an important determinant of the type and quantity of arthropod food available. Among the four taxa most commonly fed to nestlings, Araneae and adult Coleoptera appear to be preferred over Lepidoptera larvae and adult Diptera.

4. COVER

The preferred habitat of the winter wren is usually mature stands of mixed coniferous and deciduous trees (Peterson 1961, Salt and Salt 1976, Holroyd and Van Tighem 1983, Armstrong 1990), although pure coniferous stands will also be used. Branches on or near the ground and roots extending above the ground provide cover and singing posts, while large logs and stumps provide feeding sites for wrens (Titterington et al. 1979, Miller and Miller 1980).

In hardwood forests of the Adirondack Mountains in north-eastern New York State, winter wren abundance decreased after clearcut logging but increased back to pre-harvest levels within 10 years (Webb et al. 1977). In Jasper and Banff National Parks, highest densities of winter wrens were in Engelmann spruce (*Picea engelmannii*)-subalpine fir (*Abies lasiocarpa*) forests with tall bilberry (*Vaccinium myrtilloides*) or false azalea (*Menziesii ferruginea*) understories;

[1] Contact Address

lodgepole pine (*Pinus contorta*) forests with Labrador tea understory (*Ledum groenlandicum*); or avalanche slopes dominated with subalpine fir and willow (Salix spp.) (Holroyd and Van Tighem 1983). In the FMF, winter wrens were significantly more often in old coniferous forests (> 180 yr; Farr 1995).

5. REPRODUCTION

Winter wrens breed in deciduous, mixed, and coniferous woodlands (Peck and James 1987). Nesting sites for winter wrens include upturned tree roots, crevices in a bank, beneath logs, old stumps, brush piles, or abandoned buildings (Salt and Salt 1976, Miller and Miller 1980, Peck and James 1987, Armstrong 1990, McGarigal and McComb 1992). Males are often polygamous (Godfrey 1986, Ehrlich 1988) and will build numerous dummy nests (Ehrlich 1988). The suitability of a habitat, primarily reflected in the availability of food, determines the "vigor" of the resident male. Proportional to the male's vigor is the size of territory, number of nests he will build, number of females he will have, and number of broods (1 or 2) raised in a season by each female (Armstrong 1955, 1956).

Nests are composed of mosses, twigs, and grasses and are lined with feathers and hair (Godfrey 1986, Peck and James 1987). Five to six mainly white eggs are produced and hatch in 14-17 days (Godfrey 1986). Females incubate the eggs and feed the young (Ehrlich 1988). The young fledge in 19 days (Ehrlich 1988). Two broods may be raised in a season (Ehrlich 1988).

6. HABITAT AREA

In garden woodland areas the largest breeding territories were 3 ha, the smallest was 0.3 ha (mean approximately 1 ha, Armstrong 1955). In mature forests of the Western Cascade Mountains in Oregon, a mean density of 0.6 pairs/ha was determined (Anthony et al. 1996). In the FMF, mean density in old-growth spruce forests was 0.1 pairs with the greatest density being 0.13 pairs/ha (Farr 1992).

7. HSI MODEL

7.1 MODEL APPLICABILITY

Species: Winter Wren (*Troglodytes troglodytes*).

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. Due to the high mobility of this species and thus the ability to use patchy resources, there is no minimum size constraint placed on this model application.

Model Output: The model will produce Habitat Units (HU) of reproductive habitat for each 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 (pairs of winter wrens per hectare). 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 local research, the current estimate of the maximum number of animals per ha is 0.13 in the most suitable habitat (Farr 1992).

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 model but 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 winter wren 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 winter wren habitat assumes the requisites of reproductive habitat (foraging and nesting cover) are limiting. The model determines an index value based on nesting cover and food availability at and near the nest site, based on structural elements within the area.

7.2.1 Habitat Variables and HSI Components

There are four variables in the winter wren HSI model. The first variable is the percent composition of spruce and fir in the tree canopy. Spruce and fir are preferred structurally since they produce low branches which provide nesting cover as well as protective cover while foraging. The second variable (S_2) is percentage of ground covered by coarse woody debris (CWD). Winter wrens use logs and stumps for nesting, foraging and singing perches. The third variable (S_3) is tree canopy closure, which ensures the model will only gives positive values in treed locations with protective cover (Table 1). Coniferous canopy tree height is the fourth variable (S_4) and is used to infer the developmental stage of the forest. In versions 1-3 of the model, age was used rather than height. However, age does not relate directly to cover and nesting as does height, and height is indicative of the developmental stage which may occur at different ages depending on the site's growth rates. Coniferous height is used rather than canopy height because in mixedwood forests, faster growing deciduous trees could grow to suitable heights without the coniferous development being suitable.

Table 1. Relationship between habitat variables and life requisites for the winter wren reproductive habitat HSI model.

HSI Component	Life Requisites	Habitat Variable	Habitat Variable Definition
S_1	Nesting and Foraging Cover	Spruce + Fir in Tree Canopy (%)	Percent composition of all spruce and fir species in the tree canopy.
S_2	Nesting and Foraging	CWD Cover	Percent of ground covered by coarse woody debris ≥ 7.6 cm.
S_3	Nesting and Foraging Cover	Tree Canopy Closure (%)	Percent of ground covered by a vertical projection of tree crown areas onto the ground. Includes all trees ≥ 8 cm dbh.
S_4	Nesting and Foraging Cover	Coniferous Canopy Height	Average top height of 100 coniferous trees/ha that have the largest dbh.

7.2.2 Graphical HSI Component Relationships

S_1 Suitability remains zero until there is at least 50% spruce and fir in the tree canopy. At 50% spruce and fir, suitability increases and becomes fully suitable at values > 70% (Figure 1a).

S_2 Percentage of ground covered by coarse woody debris (CWD) increases linearly once 5% ground cover is reached. Any value below 5% has zero suitability. At 10% CWD ground cover, the suitability = 1 (Figure 1b).

S_3 Tree canopy closure must be ≥ 30% and suitability increases linearly up to 1 at 50% canopy closure (Figure 1c).

S_4 Winter wrens are normally found in fully developed "old-growth" forests. In this model we predict these conditions according to coniferous tree heights. Trees that are 0-15 m high are deemed unsuitable. Suitability increases over the range of 15-24 m. and remains fully suitable at all heights greater than 24 m (Figure 1a).

7.3 MODEL ASSUMPTIONS

1. Food, cover, and reproductive habitat are provided by the same structural elements and all are equally limiting.
2. Winter wrens are not limited by water or mineral resources.
3. Spruce and fir forests with high structural diversity near the ground are preferred habitat
4. Winter wrens are not affected by human uses and are not dependent on the spatial arrangements of habitats. They are only affected by structural elements within a habitat area.
5. Coniferous tree height is indicative of mature forest attributes.

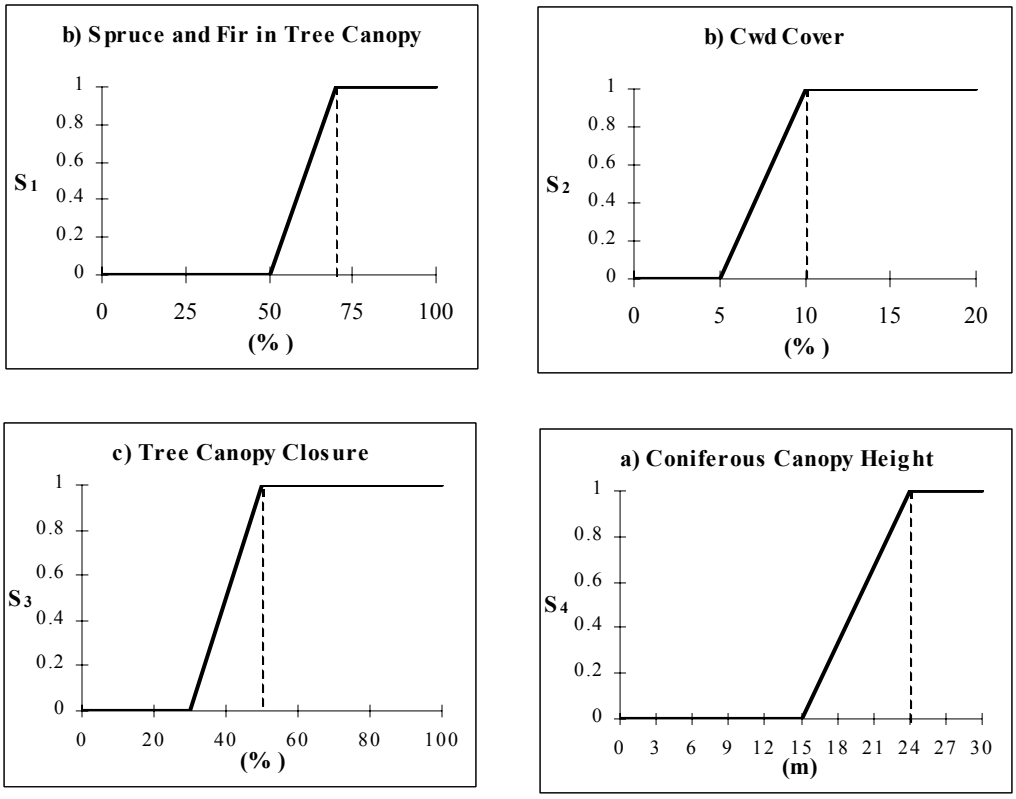

Figure 1. Graphical relationships between habitat variables and HSI components in the winter wren model

7.4 EQUATION

All 4 variables are considered equal and non-compensatory. This means low values of one variable can not be compensated by high values of the others in determining the quality of an area as reproductive habitat for winter wrens.

$$HSI = S_1 \times S_2 \times S_3 \times S_4$$

8. SOURCES OF OTHER MODELS

No other HSI models were found for the winter wren.

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 Dan Gould for a special topics course in habitat modelling at the University of Alberta. Dan Farr also contributed to this version.
- 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

Armstrong, E. A. 1955. The wren. Collins, London.

Armstrong, E. A. 1956. Territory in the wren *Troglodytes troglodytes*. Ibis 98:430-437.

Armstrong, R. H. 1990. Guide to the birds of Alaska. Alaska Northwest Books.

Anthony, R. G., G. A. Green, E. D. Forsman and S. K. Nelson. 1996. Avian abundance in riparian zones of three forest types in the Cascade Mountains, Oregon. Wilson Bulletin 108:280-291.

Beckingham, J. D., I. G. W. Corns and J. H. Archibald. 1996. Field guide to ecosites of west-central Alberta. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta, Special Report 9.

Degraff, R. M. and A. L. Shigo. 1985. Managing cavity trees for wildlife in the northeast. U.S. Department of Agriculture, Forest Service, General Technical Report NE-101.

Ehrlich, P. R., D. S. Dobkin and D. Wheye. 1988. The birders handbook: a field guide to the natural history of North American birds. Simon and Schuster, New York, New York.

Farr, D. R. 1992. Distribution and abundance patterns of birds in spruce forests near Hinton, Alberta. Unpublished report. Canadian Wildlife Service, Conservation and Protection, Edmonton, Alberta.

Farr, D. R. 1995. Forest birds and ecosystem conservation in the rocky mountain foothills of Alberta. Thesis, University of Alberta, Edmonton, Alberta.

Holroyd, G. L. and K. J. Van Tighem. 1983. Ecological (Biophysical) land classification of Banff and Jasper National Parks. Vol. III: the wildlife inventory. Environment Canada, Canadian Wildlife Service, Edmonton, Alberta.

McGarigal, K. and W. C. McComb. 1992. Streamside versus upslope breeding bird communities in the central region Coast Range. Journal of Wildlife Management 56:10-23.

Miller, E. and Miller, D. R. 1980. Snag use by birds. Pages 337-356 *in* R. M. Degraff and N. G. Tilghman, editors. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA Forest Service, General Technical Report INT-86.

Peck, G. K. and R. D. James. 1987. Breeding birds of Ontario: nidiology and distribution. Volume 2: passerines. Royal Ontario Museum, Toronto, Ontario.

Peterson, R. T. 1961. A field guide to western birds. Houghton Mifflin, Boston, Massachusetts.

Salt, W. R., and J. R. Salt. 1976. Birds of Alberta. Hurtig Publishing, Edmonton, Alberta.

Titterington, R. W., H. S. Crawford, and B. N. Burgason. 1979. Songbird responses to commercial clearcutting in Maine spruce-fir forests. Journal of Wildlife Management 43:602-609.

Webb, W. L., D. F. Behrend and B. Saisorn. 1977. Effect of logging on songbird populations in a northern hardwood forest. Wildlife Monographs 55:1-34.

Wildlife Management Division. 1996. The status of Alberta wildlife. Alberta Environmental Protection, Natural Resources Service, Wildlife Management Division.