BROWN CREEPER
REPRODUCTIVE HABITAT

HABITAT SUITABILITY INDEX MODEL
VERSION 3

Last Modified: 19 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 brown creeper (*Certhia americana*) applies to forests 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 brown creeper 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 brown creeper is a tree trunk foraging insectivore (gleaner). Its small size, striped brown back, and habit of clinging to tree bark makes this reclusive bird well camouflaged (Godfrey 1986). This year-round resident of the boreal forest is found in coniferous forests throughout the northern hemisphere (Godfrey 1986). In North America, brown creepers range as far north as Alaska and as far south as Nicaragua (Godfrey 1986).

In Alberta, brown creepers are found across central Alberta and as far north as Peace River district and throughout the Rockies (Salt and Salt 1976). Brown creepers are considered a sensitive species in Alberta because they are associated with habitats (old forests) that are or may be deteriorating (Wildlife Management Division 1996). In the FMF, brown creepers are considered uncommon during the spring and winter and common during the summer and fall (Foothills Forest Bird Checklist).

3. FOOD

Adults glean tree bark for insects and arachnids (Davis 1978, Armstrong 1990) by starting at the bottom of a tree and working upward in either a spiral fashion or directly up the trunk (Scott 1979, Franzreb 1985). Sometimes foraging along large branches occurs as well (Franzreb 1985). The brown creeper then flies to the base of the next tree and repeats the pattern (Raphael and White 1984, Armstrong 1990). In Louisiana, brown creepers foraging in coniferous forests spent 90% of their time low (< 9 m) and 8% of their time high (> 9 m) on tree trunks. In deciduous forests of the same state, this species spent 18% of their time foraging low and 80% foraging high (Grubb 1979).

In forests composed of Douglas fir, ponderosa pine, and southwestern white pine, brown creepers selected tall trees (> 27 m) for foraging (Franzreb 1985). This may be because old trees have more fissured bark (Franzreb 1985) and sustain more arthropods (Mariani and Manuwal 1990) than young trees. Live aspen was rarely used, but aspen snags were used as much as conifer snags for foraging (Franzreb 1985). On the western slope of the Sierra Nevada in incense cedar, sugar pine, ponderosa pine, white fir and Douglas fir forests, brown creepers were associated with a diverse tree structure (Adams and Morrison 1993), a tall dense canopy and a dense understory of young incense cedar during the winter (Morrison et al. 1986). Foraging habitat was in small diameter cedar and pines which was where high arthropod abundance occurred (Adams and Morrison 1993).

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4. COVER

Brown creepers occur primarily in mature and old growth coniferous forests (Holroyd and Van Tighem 1983, Armstrong 1990, Anthony et al. 1996). The brown creeper is associated with large snags that are used for foraging and nesting, however, for snags to be used, they need to be found near adequate cover (Mannan and Meslow 1984). In the Oregon Cascade Mountains, brown creepers were more abundant in old-growth stands during the summer compared with mature and young stands (Anthony et al. 1996). During the winter, densities were similar in mature and old growth forests, indicating that fidelity to old-growth is not as great during the winter (Anthony et al. 1996).

In Oregon, brown creepers occurred infrequently in managed stands (Mannan and Meslow 1984), and were more common along upslope transects than along streams, likely because upslope transects had more large conifer trees and snags than riparian transects (McGarigal and McComb 1992). In aspen mixedwood forests of Alberta, brown creepers were in old (120+ years) stands with trees ≥ 20 cm diameter at breast height (dbh at 1.3 m) and high sapling/shrub density during the breeding season (Schieck and Nietfeld 1995). Larger trees were present in old stands compared with young or mature stands. As well, there were more openings in the canopy from dying trees which produced dense shrubs and saplings in the understory. In conifer forests of FMF, brown creepers were significantly more abundant in old spruce-fir forest during the breeding season (Farr 1995). Canopy height ranged from 15-27 m, and percent tree canopy closure ranged from 51-70%. Most of the understory was characterized as open shrub/saplings with very little coverage above 1 m. Subalpine fir (seedlings and saplings) was the dominant understory species (D. R. Farr, Distribution and abundance patterns of birds in spruce forests near Hinton, Alberta, unpublished report, 1992).

5. REPRODUCTION

Brown creepers typically nest where bark has pulled away from the trunks of snags or dying trees (Bradbury 1919, Salt and Salt 1976, Davis 1978, Raphael and White 1984, Peck and James 1987, Armstrong 1990). Nests are made of twigs, bark pieces, grasses, mosses, hair, spider webs, plant fibres, plant down, leaves, and root hairs (Bradbury 1919, Salt and Salt 1976, Peck and James 1987). The female lays 5-6 white eggs (Ehrlich 1988). The male provides food for the female during incubation which lasts 14-17 days (Ehrlich 1988). Both parents feed the chicks and fledging occurs in 13-16 days (Ehrlich 1988). It is not known how many broods are raised a season (Ehrlich 1988).

In British Columbia, 4 of 11 nests were located in tree cavities and 7 were built behind loose bark (Kelleher 1963). There are no nest records of brown creepers in Banff or Jasper National Parks (Holroyd and Van Tighem 1983). In the FMF, two nesting pairs have been reported in mature spruce/fir forests. Both nests consisted of shredded bark, twigs, and *Usnea* spp. and were located behind loose bark on white spruce snags. One nest was located 1 m up a 5 m snag and contained 4 young. The second nest was 10 m high on a 20 m tree, with an unrecorded number of young (D. R. Farr, Ph.D., University of Alberta, Edmonton, Alberta, personal communication)

6. HABITAT AREA

Little is known about the habitat area used by brown creepers. In Michigan, territory size ranged from 2.3-6.4 ha (Davis 1978). Birds with small territories engaged in more vocal defense than those with large territories (Davis 1978). In old-growth coniferous forest of north-eastern Oregon, a density of 0.47 pairs/ha was found (Mannan and Meslow 1984). In old-growth forest in the Western Cascade Mountains, a density of 0.60 brown creepers/ha was determined (Anthony et al. 1996). In California, a density of 0.24 pairs/ha was reported (Raphael and White 1984). In Arizona, brown creeper density was lower on timber harvested plots with or without snag retention, than in control plots (Scott 1979). It was possible the snags were too far apart to be useful to brown creepers (Scott 1979). In the FMF, the density of brown creepers in old (> 180 yr) spruce forests was 0.15 pairs/ha (D. R. Farr, Distribution and abundance patterns of birds in spruce forests near Hinton, Alberta, unpublished report, 1992). Population densities may be more dependent upon the quantity and quality of winter habitat than summer habitat (Raphael and White 1984). Winter habitat requirements of resident birds are a concern for future research (Farr 1995).

7. HSI MODEL

7.1 MODEL APPLICABILITY

Species: Brown Creeper (*Certhia americana*).

Habitat Evaluated: Critical reproductive habitat (foraging and nesting cover).

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

Seasonal Applicability: Mid-spring to mid-summer 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. It is unknown whether brown creepers require a large contiguous forest or whether patches of suitable habitat in a managed landscape are suitable, so no minimum habitat area is defined for this model.

Model Output: The model will produce Habitat Units (HU) of reproductive habitat for a large geographic area based on HSI values and stand area. Habitat units are calculated by multiplying the HSI score with the area in hectares. The performance measure for the model is potential carrying capacity (brown creeper breeding pairs per ha). These HU must be correlated to estimates of carrying capacity to verify the model's performance.

Carrying Capacity (Breeding Pairs per ha where HSI = 1.0): Based on D. R. Farr, the density in the FMF in old spruce forests is 0.15 pairs/ha.

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 forested landscapes using generalized species-habitat relationships and stand-level vegetation inventory. Its purpose is to predict relative changes in brown creeper 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 brown creeper reproductive habitat assumes that life requisites of food and nesting sites are limiting and are found in the same habitat. Mature to old-growth spruce forests with moderate to high tree canopy closure is the best habitat. Snags were not included in the model as it was assumed snags would exist in mature or old growth forests.

7.2.1 Habitat Variables and HSI Components

Brown creepers prefer to nest and forage in spruce-fir forests (rarely pine) where development has resulted in large diameter, tall trees with cavities and bark conditions suitable for nest locations and foraging. The first variable, S_1, mean conifer canopy height, ensures adequate forest development (Table 1). Height is used rather than age, since different forests achieve mature height at different ages depending on site growth factors. The inclusion of height also ensures that trees will be large and the stand structurally diverse. These forests are necessary for nesting as they are likely to have dead and dying trees with their bark peeling back for nesting sites. Brown creepers also nest in large snags which are found in these developed forests.

Brown creeper preference for spruce and fir is incorporated into the second variable (S_2). Spruce and fir bark is highly fissured which provides habitat for insects on which the creeper forages.

The third variable (tree canopy closure, S_3) ensures adequate nesting habitat for brown creepers will be present. Brown creepers were found most often in moderate or high tree canopy closure (D. R. Farr, Distribution and

abundance patterns of birds in spruce forests near Hinton, Alberta, unpublished report, 1992), because in old conifer forests many gaps from fallen or dying trees are scattered throughout the old dense canopy.

The last variable is percent pine in the tree canopy (S_4). Pine forests are occasionally used for nesting and foraging but the bark is less fissured and less protected. In the equation, the value of S_4 is only 2% as good as the value of spruce or fir.

Table 1. Relationship of habitat variables to life requisites for the brown creeper HSI model.

HSI Component	Life Requisite	Habitat Variable	Habitat Variable Definition
S_1	Breeding and Foraging Cover	Conifer Stand Height (m)	Average top height of 100 coniferous trees/ha that have the largest diameter at breast height (dbh at 1.3 m).
S_2	Breeding and Foraging Cover	Spruce and Fir in Tree Canopy (%)	Percent composition of black spruce + white spruce + subalpine fir + balsam fir in the tree canopy.
S_3	Breeding and Foraging Cover	Tree Canopy Closure (%)	Percent of ground covered by a vertical projection of tree crown areas onto the ground. Includes trees ≥ 8cm dbh.
S_4	Breeding and Foraging Cover	Pine in Tree Canopy (%)	Percent composition of pine in the tree canopy.

7.2.2 Graphical HSI Component Relationships

S_1 At heights less than 15 m it is assumed the stand has not developed to a mature structural state ($S_1 = 0$) and at 20 m the stand height is optimal ($S_1 = 1$; Figure 1a).

S_2 Forests which have less than 50% spruce and fir in the tree canopy are inadequate for the brown creeper. Between 50 and 70% suitability increases from 0-1. All habitats with ≥ 70% spruce and fir in the tree canopy are considered optimal (Figure 1b).

S_3 Tree canopy closure is considered optimal at 70% and suitability increases linearly from 50-70%. Anything below 50% is not suitable (Figure 1c)**.**

S_4 Stands that have at least 50% pine in the tree canopy begin to have some suitability for brown creepers. At 70% pine, suitability becomes 1 (Figure 1d)

7.3 MODEL ASSUMPTIONS

1. Brown creepers are not limited by water or mineral resources.
2. Brown creepers forage and nest equally in spruce and fir species but pine is 2% as useful as spruce or fir. Other conifers and deciduous trees are not utilized.
3. Brown creepers are not affected by human disturbance or other forest uses (roads, campsites, etc.)
4. Snags are not explicitly required for nesting or foraging, however, they will be found in mature and old conifer forests.
5. Tree height is indicative of mature forest development characteristics that are useful for brown creepers.

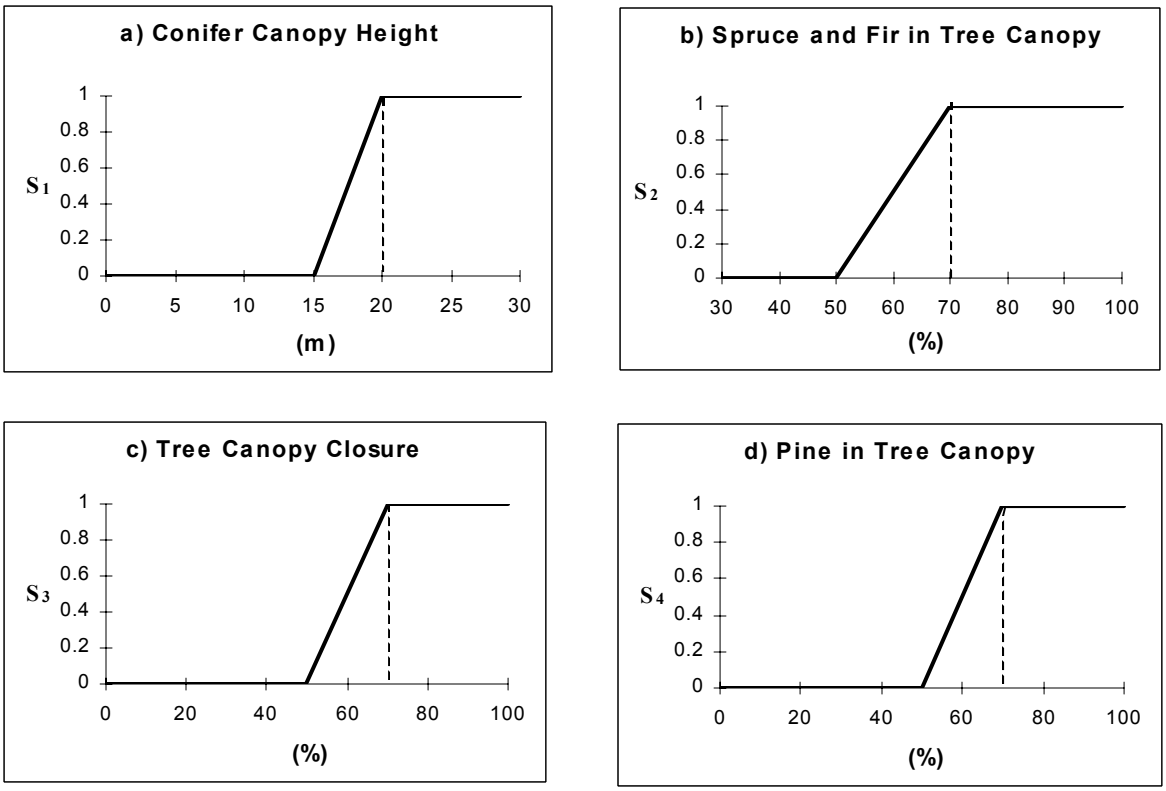

Figure 1. Graphical relationships between habitat variables and HSI components in the brown creeper model.

7.4 EQUATION

Brown creepers are associated with moderate to dense tree canopy closure, in a mature/old spruce/fir forest for foraging and nesting. The equation assumes pine is 2% as good as spruce or fir.

$$HSI = S_1 \times S_3 \times [\max = 1 (S_2 + 0.02 \times S_4)]$$

8. SOURCE OF OTHER MODELS

No other HSI models for the brown creeper 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 (1995) was developed by Tara Banks and Dan Farr as part of a special study course on habitat modelling at the University of Alberta.
- Version 2 (1996) was edited and reformatted by Wayne Bessie.
- Version 3 (1999) was revised by Karen Graham, Rick Bonar, Barb Beck and Jim Beck to incorporate information from recent literature.

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