# BLACK BEAR
# SUMMER/FALL HABITAT

## HABITAT SUITABILITY INDEX MODEL
## VERSION 5

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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 black bear (*Ursus americanus*) 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 black bear habitat area and carrying capacity throughout an entire forest management cycle (200 years). The model was developed using literature review.

## 2. SPECIES DESCRIPTION AND DISTRIBUTION

Adult black bears are close to 1 m tall and up to 2 m in length (Banfield 1974). Males average 115-270 kg in mass and females average 92-140 kg (Banfield 1974). Their back and shoulders form almost a straight line, unlike grizzly bears, which have a humped shoulder. The most common colour is black, but various brown phases (cinnamon, blonde and brown) also occur. Black bears are present in all forested regions of Canada and occur in many habitats, especially those with a mosaic of forested and non-forested habitats. In Alberta, black bears are not at risk and their habitat is secure (Wildlife Management Division 1996). They are active both day and night (Banfield 1974).

## 3. FOOD

Black bears are opportunistic omnivores, and alter their food habits according to the availability of food throughout the various seasons. Although a wide variety of animal matter is consumed, the major food items are herbaceous material and fruit.

Although detailed studies on black bear food habits have not been undertaken in the foothills region, considerable work has been completed in other forested regions of North America. During the spring months following the denning period, bears select relatively open areas to feed, where new emergent vegetation is available. Grasses, sedges and horsetails are most commonly selected as these plants are among the first to appear in the spring (Hatler 1967, Norstrom 1974, Cole 1975, Lloyd and Fleck 1977, Nagy and Russell 1978, Ruff 1978). Overwintering berries, particularly bog cranberry, are also eaten (Chatalain 1950, Hatler 1967, 1972), in addition to carrion (Chatalain 1950, Spencer 1966, Norstrom 1974), insects (Chatalain 1950, Tisch 1961, Spencer 1966, Cole 1975, Ruff 1978) and herbs (Poelker and Hartwell 1973, Cole 1975, Ruff 1978).

As grasses, sedges and horsetails desiccate with the progression of summer, dietary preferences of black bears shift to berries, nuts, insects and a variety of herbs (Tisch 1961, Spencer 1966, Norstrom 1974, Nagy and Russel 1978,

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Ruff 1978). Berries are the preferred late summer/fall food, because of their high sugar content and digestibility, (Lindzey and Meslow 1977, Ruff 1978). Food abundance is the major determining factor of habitat use (Armstrup and Beechum 1976, Lindzey et al. 1976, Ruff 1978).

## 4. COVER

A mosaic of forest cover and clearings or early successional habitat represents the most suitable habitat for black bears (Irwin and Hammond 1985, Rogers and Allen 1987, Unsworth et al. 1989). As distance from cover to open area edge increases to 180 to 200 meters, use by black bears decreases (McCollum 1973).

Because black bears den during the winter, they do not have the thermal cover requirements of species active year round. Nevertheless, escape cover is required during a bear's active months (Herrero 1972) against potential predators such as other black bears, grizzly bears, and wolves (Banfield 1974, Gadd 1995). Black bears will use dense cover and/or trees to escape from predators, and commonly bed in dense shrub communities (Jonkel 1978).

## 5. REPRODUCTION

The oestrous period occurs from 20 June to 10 July and sexual activity occurs from mid-April to late August (Banfield 1974). The gestation period is approximately 220 days (Banfield 1974). Delayed implantation results in the embryo developing only in the last ten weeks of the gestation period (Banfield 1974). The cubs are born in mid January and early February in the winter den (Banfield 1974). Average litter size is 2.4 (1-5) cubs (Banfield 1974). The cubs are weaned at 5 months but den with the sow over the winter until the she mates the following spring or summer (Banfield 1974). Siblings may den together during the third winter (Banfield 1974). Females reach sexual maturity at 4-5 years and males reach maturity a year later (Banfield 1974). In the Berland area within the FMF, female black bears did not reproduce until age 7, and the average litter size was 2.3 young (Gunson 1989). Hibernation dens are typically in the shelter of a cave, rock crevice, hollow log, windthrow stump or in a mossy hollow under the branches of a spruce or fir tree (Banfield 1974).

## 6. HABITAT AREA

Male black bears have very large home ranges, and females have smaller, more defined home ranges (Gunson 1989). Home range areas are cited as 123 $km^2$ for the Cold Lake area (Young 1976), and 7.5 $km^2$ for the Fort McMurray area (Fuller and Keith 1980). Estimated density of black bears in the boreal foothills of Alberta is 10 bears/100 $km^2$ (Gunson 1989). A density estimate of 5.7 black bears/1000 $km^2$ was determined for the Berland area of the FMF, however, this is probably an underestimate because the study was primarily examining grizzly bears (Nagy et al. 1989).

Based on the estimated density of 0.1 bears/$km^2$, an area of 5000 $km^2$ of suitable habitat would be needed to support a genetic effective population of 500 individuals.

## 7. HSI MODEL

### 7.1 MODEL APPLICABILITY

**Species:** Black bear (*Ursus americanus*)

**Habitat Evaluated:** Food and Cover Habitat

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

**Seasonal Applicability:** The critical summer-fall feeding season.

**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 required before an area will be occupied by a species (Allen 1987). In the case of the black bear, no minimum habitat area is given, as black bears are capable of using small patches of habitat interspersed throughout a managed landscape.

**Model Output:** This model will be used to calculate Habitat Units (HU) for each stand or forest type based on HSI values and habitat area. HU are calculated by multiplying the HSI score with the area of the stand. The performance measure for the model is potential carrying capacity (adult black bears per ha). Model output (HU) must be correlated to estimates of carrying capacity.

**Carrying Capacity (Adult black bears per ha where HSI = 1.0):** The estimate based on Gunson (1989) is 1 bear per 10 $km^2$, which is equivalent to 0.001 bears per ha.

**Verification Level:** The reliability of this model has not been evaluated against local data. The verification level is 1: model developed based on literature review and published models for the species.

**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 black bear 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 black bear summer/fall habitat assumes that foraging habitat and cover are limiting. Spring food and winter den sites are assumed not to be limiting. The black bear utilizes many different habitats and may feed in areas away from dense tree cover as long as cover is nearby when required.

### 7.2.1 Habitat Variables and HSI Components

A. Cover

High quality cover habitat for black bears include large trees with a dense tree canopy closure. Black bears will climb when escaping predators and trees with a diameter at breast height (dbh at 1.3 m) of 20 cm or greater ($S_1$) are adequate to support a black bear. Black bears also utilize dense tree canopy closure to hide from predators.

B. Foraging Habitat

Black bears are opportunistic feeders, and alter their diet according to the availability of food. Although a wide variety of animal matter is consumed, the major food items are herbaceous material and fruit. This food is usually associated with berry producing shrubs, so a shrub cover component ($S_3$) is important. Food habitat is only useful when it is within a safe distance (200 m) from cover so distance is used to define HSI component $S_4$ (Table 1).

C. Habitat Effectiveness

Effective habitat is determined by the distance the habitat is from human activity and from roads and trails. Roads and trails tend to affect bears only within a relatively short distance due to the noise and the injuries or deaths sustained on roads. The effect of human settlements and industrial land uses is much farther reaching due to constant harassment and displacement of bears away from these areas. The distance to nearest road or trail is used to define HSI component $S_5$. The distance to human land use defines HSI component $S_6$ (Table 1).

**Table 1.** Relationship of habitat variables to life requisites for the black bear HSI model.

| HSI Component | Life Requisite | Habitat Variable | Definition |
|---|---|---|---|
| $S_1$ | Cover | Stand dbh (cm) | Mean diameter of canopy trees in the stand at 1.3 m height. |
| $S_2$ | 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. |
| $S_3$ | Foraging | Shrub Cover (%) | Percent of ground area covered by a vertical projection of all shrubs onto the ground. |
| $S_4$ | Foraging | Distance from Cover (m) | Distance to the nearest forested stand that has ≥ 10 cm dbh and ≥ 10% canopy closure. |
| S5 | Habitat Effectiveness | Distance from Road (m) | Distance from the edge of the nearest road, railroad, or trail with horse or motorized access. |
| S6 | Habitat Effectiveness | Distance from Human Activity | Distance from industrial sites, active well sites, active logging, settlements, ranches, camps, or other area based land activities. |

### 7.2.2 Graphical HSI Component Relationships

$S_1$ Stands with mean tree dbh < 10 cm are rated as unsuitable ($S_1 = 0$). The suitability increases between 10 and 19 cm. All stands with mean dbh ≥ 20 cm are fully suitable (Figure 1a).

$S_2$ Stands with a tree canopy closure ≥ 70% provide optimum cover. Stands with < 10% tree canopy closure are unsuitable. Between 10 and 70%, $S_2$ increases linearly (Figure 1b).

$S_3$ Habitat with no shrub cover is unsuitable for foraging. The value rapidly increases between 0 and 10% shrub cover, where the optimum value is reached (Figure 1c).

$S_4$ Food habitat is only fully suitable when it is within 200 m of cover as defined in Table 1. Between 200 and 400 m, food habitat becomes less suitable and becomes completely unsuitable after 400 m (Figure 1d).

$S_5$ Cover and food habitat is only fully suitable when it is at least 250 m from a road (Figure 1e).

$S_6$ Cover is also less useful if it is < 5 km from regular human activity (Figure 1f).

## 7.3 MODEL ASSUMPTIONS

1. Late summer and fall is the critical season for black bears.
2. Food has no benefit when it is a long distance from cover, because of decreased survival and/or energy loss in these areas.
3. All shrubs have an equal food value. The mixture of berry-producing shrubs and non-berry-producing shrubs is constant across all forest types. Berry production by shrubs depends on cover, not shrub height or the number of stems.
4. Water and minerals are not a limited resource.

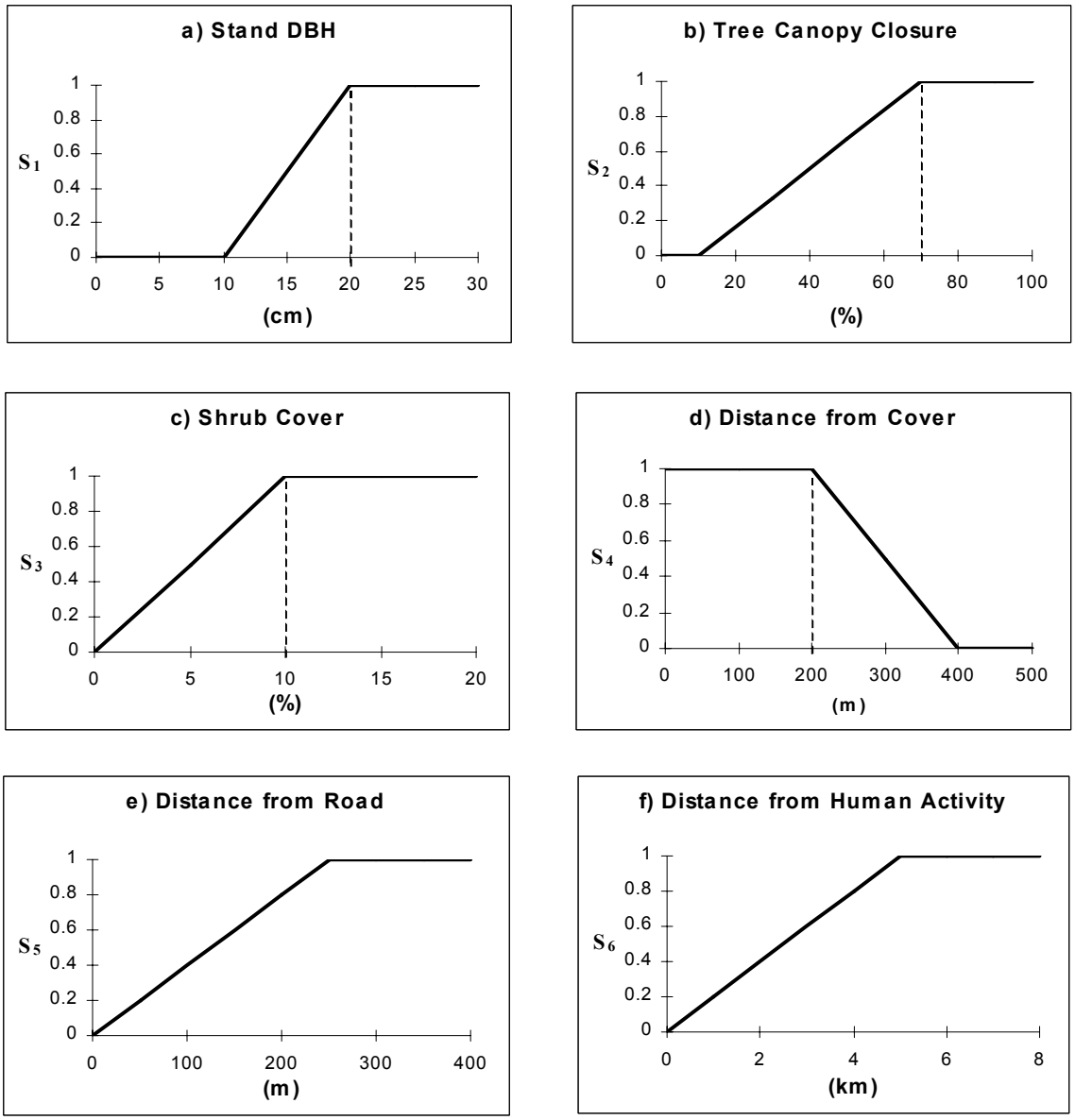


**Figure 1.** Graphical relationships between habitat variables and HSI components in the black bear model.

### 7.4 EQUATIONS

The black bear HSI model is developed as two separate equations; one for foraging habitat and one for escape cover.

A. Cover

This equation assumes dbh ($S_1$) and percent tree canopy closure ($S_2$) are valuable in determining the suitability of habitat for escape cover. These variables are considered equal and non-compensatory (this means low values of one variable cannot be compensated by high values of the others).

$$\text{HSI-cover} = S_1 \times S_2$$

B. Foraging

This equation assumes percent shrub cover ($S_3$) and distance from cover ($S_4$) are valuable in determining the habitat suitability for food. These variables are also considered equal and non-compensatory.

HSI-foraging = $S_3$ x $S_4$

C. Habitat Effectiveness

Habitat close to roads and human activity ($S_5$ & $S_6$) is considered less suitable for bears because of an increased mortality risk caused by vehicle collisions, hunting or bears habituating to humans and becoming a danger to the public. Habitat Effectiveness is determined by multiplying $S_5$ and $S_6$ with the HSI-cover score and HSI-foraging score from above.

Effective Cover Habitat = HSI-cover x $S_5$ x $S_6$

Effective Foraging Habitat = HSI-foraging x $S_5$ x $S_6$

D. Summer/Fall Habitat

No information on the interspersion of foraging habitat to cover was found in the literature. It was assumed that within a typical home range size of 10 $km^2$, there must be 2000 HU of effective cover and 4500 HU of effective forage before an area is considered suitable summer/fall habitat.

## 8. SOURCES OF OTHER MODELS

U.S. Fish and Wildlife Service has a HSI model developed for black bears (Allen 1987).

**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) of this model was developed by the Weldwood of Canada, Hinton Division, 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.

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