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# HABITAT SUITABILITY INDEX MODELS: DOWNY WOODPECKER



Fish and Wildlife Service

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U.S. Department of the Interior

**This model is designed to be used by the Division of Ecological Services  
in conjunction with the Habitat Evaluation Procedures.**

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April 1983

**HABITAT SUITABILITY INDEX MODELS: DOWNY WOODPECKER**

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## PREFACE

This document is part of the Habitat Suitability Index (HSI) Model Series (FWS/OBS-82/10), which provides habitat information useful for impact assessment and habitat management. Several types of habitat information are provided. The Habitat Use Information Section is largely constrained to those data that can be used to derive quantitative relationships between key environmental variables and habitat suitability. The habitat use information provides the foundation for HSI models that follow. In addition, this same information may be useful in the development of other models more appropriate to specific assessment or evaluation needs.

The HSI Model Section documents a habitat model and information pertinent to its application. The model synthesizes the habitat use information into a framework appropriate for field application and is scaled to produce an index value between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). The application information includes descriptions of the geographic ranges and seasonal application of the model, its current verification status, and a listing of model variables with recommended measurement techniques for each variable.

In essence, the model presented herein is a hypothesis of species-habitat relationships and not a statement of proven cause and effect relationships. Results of model performance tests, when available, are referenced. However, models that have demonstrated reliability in specific situations may prove unreliable in others. For this reason, feedback is encouraged from users of this model concerning improvements and other suggestions that may increase the utility and effectiveness of this habitat-based approach to fish and wildlife planning. Please send suggestions to:

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## DOWNY WOODPECKER (Picoides pubescens)

### HABITAT USE INFORMATION

#### General

Downy woodpeckers (Picoides pubescens) inhabit nearly all of North America where trees are found (Bent 1939). They are rare or absent in arid desert habitats and most common in open woodlands.

#### Food

The downy woodpecker is primarily an insectivore; 76% of the diet is animal foods, and the remainder is vegetable food (Beal 1911). Beetles, ants, and caterpillars are the major animal foods, and vegetable foods include fruits, seeds, and mast. Downy woodpeckers feed by digging into the bark with the bill, by gleaning along the bark surface, and, infrequently, by flycatching (Jackson 1970).

Downy woodpeckers in Illinois foraged more in the lower height zones of trees than in the tree canopies and foraged more often on live limbs than on dead limbs (Williams 1975). Similarly, downy woodpeckers in Virginia foraged primarily on live wood in pole age and mature forests (Conner 1980). Downy woodpeckers in New York spent 60% of their foraging time in elms (Ulmus spp.) (Kisiel 1972). They foraged most frequently on twigs 2.5 cm (1 inch) or less in diameter, and drilling was the foraging technique used most often. Downy woodpeckers are not strong excavators and do not excavate deeply to reach concentrated food sources, such as carpenter ants (Camponotus spp.) (Conner 1981).

Downy woodpeckers in Virginia foraged in the breeding season in habitats with a mean basal area of 11.3 m<sup>2</sup>/ha (49.2 ft<sup>2</sup>/acre). Habitats used for foraging during the postbreeding and winter seasons had significantly higher mean basal areas of 21.4 m<sup>2</sup>/ha (93.2 ft<sup>2</sup>/acre) and 17.2 m<sup>2</sup>/ha (74.9 ft<sup>2</sup>/acre), respectively. Downy woodpeckers in New Hampshire fed heavily in stands of paper birch (Betula papyrifera) that were infected with a coccid (Xylococchus betulae) (Kilham 1970). The most attractive birches for foraging were those that were crooked or leaning, contained broken branches in their crown, and had defects, such as cankers, old wounds, broken branch stubs, and sapsucker drill holes. Downy woodpeckers invaded an area in Colorado in high numbers during the winter months in response to a severe outbreak of the pine bark beetle (Dendroctonus ponderosae) (Crockett and Hansley 1978). This outbreak of beetles had not resulted in increased breeding densities of the woodpeckers at the time of the study.



Downy woodpeckers foraged more on tree surfaces during summer than in winter (Conner 1979). They increased the amount of time spent in subcambial excavation in winter months, probably in response to the seasonal availability and location of insect prey. Downy woodpeckers appear to broaden all aspects of their foraging behavior in the winter in order to find adequate amounts of food (Conner 1981).

Downy woodpeckers in Ontario extracted gall fly (Eurosta solidaginis) larvae from goldenrod (Solidago canadensis) galls growing near forest edges (Schlichter 1978). Corn stubble fields supported small winter populations of downy woodpeckers in Illinois (Graber et al. 1977).

### Water

Information on the water requirements of the downy woodpecker was not located in the literature.

### Cover

The cover requirements of the downy woodpecker are similar to their reproductive requirements, which are discussed in the following section.

### Reproduction

The downy woodpecker is a primary cavity nester that prefers soft snags for nest sites (Evans and Conner 1979). These woodpeckers nest in both coniferous and deciduous forest stands in the Northwest. Nests in Virginia were common in both edge situations and in dense forests far from openings (Conner and Adkisson 1977). Downy woodpeckers in Oregon occur primarily in deciduous stands of aspen (Populus tremuloides) or riparian cottonwood (Populus spp.) (Thomas et al. 1979). The highest nesting and winter densities in Illinois were in virgin or old lowland forests (Graber et al. 1977).

Downy woodpeckers in Virginia preferred to nest in areas with high stem density, but with lower basal area and lower canopy heights than areas used by the other woodpeckers studied (Conner and Adkisson 1977). They preferred sparsely stocked forests commonly found along ridges (Conner et al. 1975). Preferred nest stands had an average basal area of 10.1 m<sup>2</sup>/ha (44 ft<sup>2</sup>/acre), 361.8 stems greater than 4 cm (1.6 inches) diameter/ha (894/acre), and canopy heights of 16.3 m (53.5 ft) (Conner and Adkisson 1976). Downy woodpeckers in Tennessee were frequently seen feeding in the understory and apparently selected habitats with an abundance of understory vegetation (Anderson and Shugart 1974).

Downy woodpeckers excavate their own cavity in a branch or stub 2.4 to 15.3 m (8 to 50 ft) above ground, generally in dead or dying wood (Bent 1939). There was a positive correlation between downy woodpecker densities and the number of dead trees in Illinois (Graber et al. 1977). Downy woodpeckers rarely excavate in oaks (Quercus spp.) or hickories (Carya spp.) with living cambium present at the nest site (Conner 1978). They apparently require both sap rot, to soften the outer part of trees, and heart rot, to soften the

interior, when hardwoods, and possibly pines, are used for nesting. Downy woodpeckers in Virginia nested mainly in dead snags with advanced stages of fungal heart rot (Conner and Adkisson 1976).

Downy woodpeckers "search image" of an optimal nest site is a live tree with a broken off dead top (Kilham 1974). Suitable nest trees are in short supply in most areas and appear to be a limiting factor in New Hampshire. Downies in Montana appeared to prefer small trees, possibly to avoid the difficulty of excavating through the thick sapwood of large trees (McClelland et al. 1979). The average dbh of nest trees (n = 3) in Montana was 25 cm (10 inches). All 11 nests in an Ontario study were in dead aspen, and the average dbh of four of these nest trees was 26.2 cm (10.3 inches) (Lawrence 1966). Fourteen of 19 nest trees in Virginia were dead, the average dbh of nest trees was 31.8 cm (12.4 inches), and nest trees averaged 8.3 m (27.2 ft) in height (Conner et al. 1975).

Thomas et al. (1979) estimated that downy woodpeckers in Oregon require 7.4 snags, 15.2 cm (6 inches) or more dbh, per ha (3 snags/acre). This estimate is based on a territory size of 4 ha (10 acres), a need for two cavities per year per pair, and the presence of 1 useable snag with a cavity for each 16 snags without a cavity. Evans and Conner (1979) estimated that downies in the Northeast require 9.9 snags, 15 to 25 cm (6 to 10 inches) dbh, per ha (4 snags/acre). Their estimate is based on a territory size of 4 ha (10 acres), a need for four cavity trees per year per pair, and a need for 10 snags for each cavity tree used in order to account for unuseable snags, a reserve of snags, feeding habitat, and a supply of snags for secondary users. Conner (pers. comm.) recommended 12.4 snags/ha (5 snags/acre) for optimal downy woodpecker habitat.

### Interspersion

Downy woodpeckers occupy different size territories at different times of the year (Kilham 1974). Fall and winter territories consist of small, defined areas with favorable food supplies and the area near roost holes. Breeding season territories consist of an area as large as 10 to 15 ha (24.7 to 37.1 acres) used to search out nest stubs, and a smaller area around the nest stub itself. Breeding territories of downies in Illinois ranged from 0.5 to 1.2 ha (1.3 to 3.1 acres) (Calef 1953 cited by Graber et al. 1977). Male and female downy woodpeckers retain about the same breeding season territory from year to year, while their larger overall range has more flexible borders (Lawrence 1966).

Downy woodpeckers occupy all portions of their North American breeding range during the winter (Plaza 1978). There is, however, a slight, local southward migration in many areas.

### Special Considerations

Conner and Crawford (1974) reported that logging debris in regenerating stands' (1-year old) following clear cutting were heavily used by downy woodpeckers as foraging substrate. Timber harvest operations that leave snags and

trees with heart rot standing during regeneration cuts and subsequent thinnings will help maintain maximum densities of downy woodpeckers (Conner et al. 1975). Foraging habitat for the downy woodpecker in Virginia would probably be provided by timber rotations of 60 to 80 years (Conner 1980).

## HABITAT SUITABILITY INDEX (HSI) MODEL

### Model Applicability

Geographic area. This model was developed for the entire range of the downy woodpecker.

Season. This model was developed to evaluate the year-round habitat needs of the downy woodpecker.

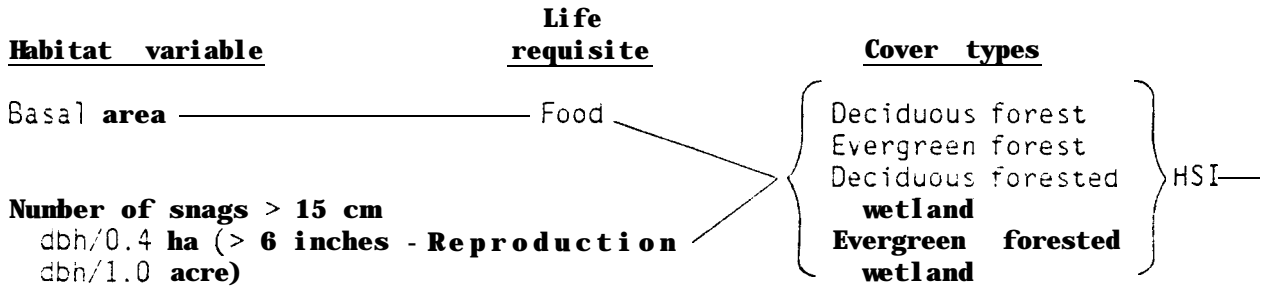
Cover types. This model was developed to evaluate habitat in Deciduous Forest (DF), Evergreen Forest (EF), Deciduous Forested Wetland (DFW), and Evergreen Forested Wetland (EFW) areas (terminology follows that of U.S. Fish and Wildlife Service 1981).

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before a species will live and reproduce in an area. Specific information on minimum habitat areas for downy woodpeckers was not found in the literature. However, based on reported territory and range sizes, it is assumed that a minimum of 4 ha (10 acres) of potentially useable habitat must exist or the HSI will equal zero.

Verification level. Previous drafts of this model were reviewed by Richard Conner and Lawrence Kilham and their comments were incorporated into the current draft (Conner, pers. comm.; Kilham pers. comm.).

### Model Description

Overview. This model considers the ability of the habitat to meet the food and reproductive needs of the downy woodpecker as an indication of overall habitat suitability. Cover needs are assumed to be met by food and reproductive requirements and water is assumed not to be limiting. The food component of this model assesses food quality through measurements of vegetative conditions. The reproductive component of this model assesses the abundance of suitable snags. The relationship between habitat variables, life requisites, cover types, and the HSI for the downy woodpecker is illustrated in Figure 1.



**Figure 1. Relationships of habitat variables, life requisites, and cover types in the downy woodpecker model.**

The following sections provide a written documentation of the logic and assumptions used to interpret the habitat information for the downy woodpecker in order to explain the variables and equations that are used in the HSI model. Specifically, these sections cover the following: (1) identification of variables used in the model; (2) definition and justification of the suitability levels of each variable; and (3) description of the assumed relationship between variables.

**Food component.** Food for the downy woodpecker consists of insects found on trees in forested habitats. Downy woodpeckers occupy a wide variety of forested habitats from virgin bottomlands to sparsely stocked stands along ridges. The highest downy woodpecker densities were most often reported in the more open stands with lower basal areas, but it is assumed that all forested habitats have some food value for downies. Optimal conditions are assumed to occur in stands with basal areas between 10 and 20 m<sup>2</sup>/ha (43.6 and 37.2 ft<sup>2</sup>/acre), and suitabilities will decrease to zero as basal area approaches zero. Stands with basal areas greater than 30 m<sup>2</sup>/ha (130.8 ft<sup>2</sup>/acre) are assumed to have moderate value for downy woodpeckers.

**Reproduction component.** Downy woodpeckers nest in cavities in either totally or partially dead small trees. They require snags greater than 15 cm (6 inches) dbh for nest sites. Optimal habitats are assumed to contain 5 or more snags greater than 15 cm dbh/0.4 ha (6 inches dbh/1.0 acre), and habitats without such snags have no suitability.

### Model Relationships

Suitability Index (SI) graphs for habitat variables. This section contains suitability index graphs that illustrate the habitat relationships described in the previous section.

**Cover  
type**

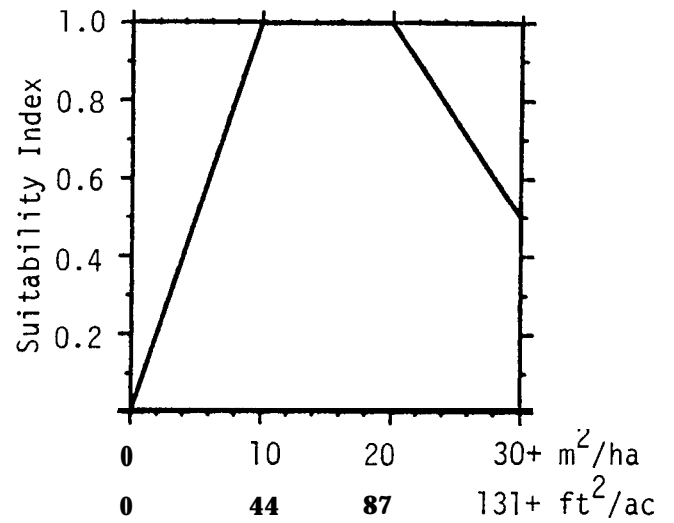
EF,DF,  
EFW,DFW

Variable

V<sub>1</sub>

**Basal area.**

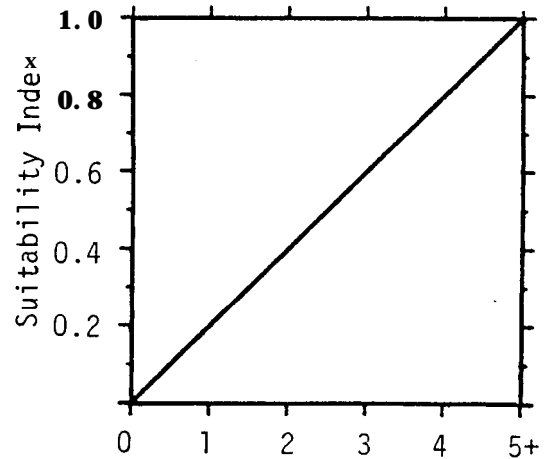
Suitability graph



EF,DF,  
EFW,DFW

V<sub>2</sub>

**Number of snags  
> 15 cm dbh/0.4 ha  
(> 6 inches dbh/  
1.0 acre).**



Life requisite values. The life requisite values for the downy woodpecker are presented below.

<u>Life requisite</u>	<u>Cover type</u>	<u>Life requisite value</u>
Food	EF, DF, EF\ DFW	V <sub>1</sub>
Reproduction	EF, DF, EF\ DFW	V <sub>2</sub>

**HSI determination.** The HSI for the downy woodpecker is equal to the lowest life requisite value.

#### Application of the Model

Definitions of variables and suggested field measurement techniques (Hays et al. 1981) are provided in Figure 2.

<u>Variable (definition)</u>	<u>Cover types</u>	<u>Suggested technique</u>
V <sub>1</sub> Basal area [the area of exposed stems of woody vegetation if cut horizontally at 1.4 m (4.5 ft) height, in m <sup>2</sup> /ha (ft <sup>2</sup> /acre)].	EF, DF, EF\ DFW	Bitterlich method
V <sub>2</sub> Number of snags > 15 cm (6 inches) dbh/0.4 ha (1.0 acre) [the number of standing dead trees or partly dead trees, greater than 15 cm (6 inches) diameter at breast height (1.4 m/4.5 ft), that are at least 1.8 m (6 ft) tall. Trees in which at least 50% of the branches have fallen, or are present but no longer bear foliage, are to be considered snags].	EF, DF, EF\ DFW	Quadrat

**Figure 2. Definitions of variables and suggested measurement techniques.**

## **SOURCES OF OTHER MODELS**

**Conner and Adkisson (1976) have developed a discriminant function model for the downy woodpecker that can be used to separate habitats that possibly provide nesting habitat from those that do not provide nesting habitat. The model assesses basal area, number of stems, and canopy height of trees.**

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