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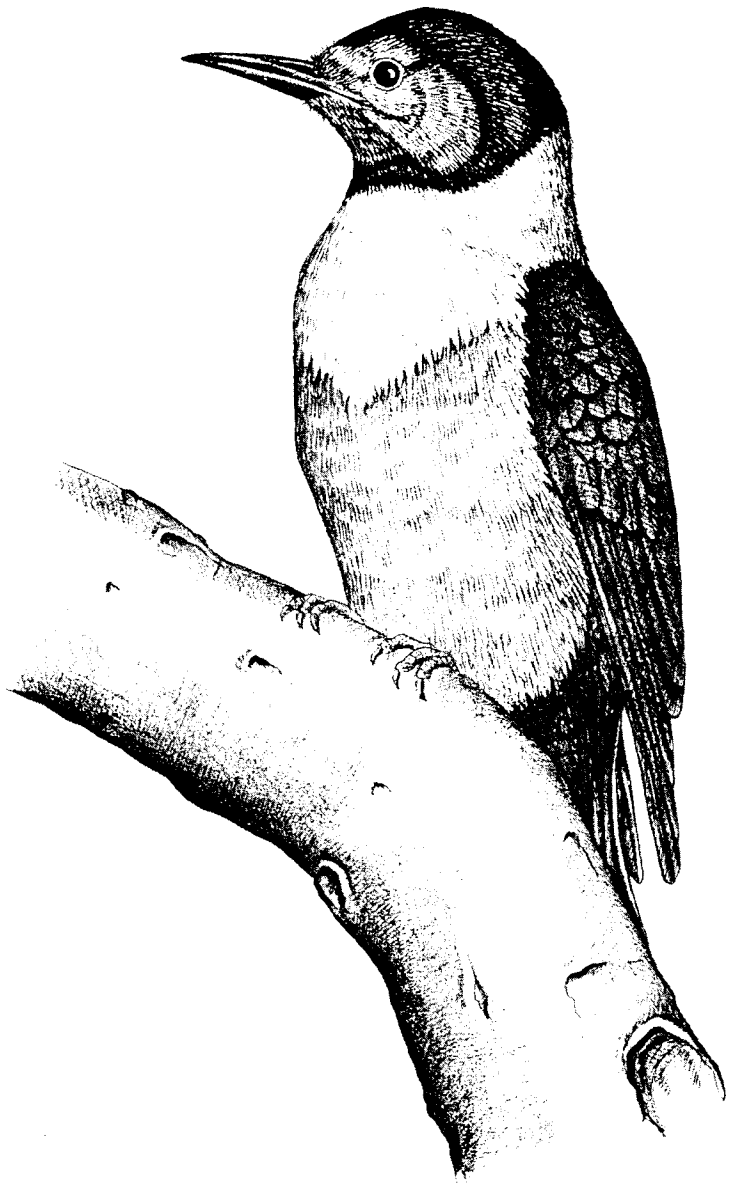
HABITAT SUITABILITY INDEX MODELS: LEWIS' WOODPECKER



Fish and Wildlife Service

U.S. Department of the Interior

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HABITAT SUITABILITY INDEX MODELS: LEWIS' WOODPECKER

by

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

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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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LEWIS' WOODPECKER (Melanerpes lewis)

HABITAT USE INFORMATION

General

The Lewis' woodpecker (Melanerpes lewis) inhabits open forest stands and feeds primarily on insects from spring to fall and on mast crops during the winter (Bock 1970). It occurs regularly in Western North America "... from eastern Colorado west to the Pacific, and from British Columbia to northernmost Mexico" (Bock 1970:80). The species may be a year-round resident in suitable habitats (Bock et al. 1971).

Food

The Lewis' woodpecker is an opportunistic feeder that breeds where insects are locally abundant and winters where abundant mast crops are available (Snow 1940; Bock 1970). The selection of some habitats for breeding and rejection of others probably reflects differences in insect abundance. The diet may also include various fruits, berries, and seeds in late summer. The Lewis' woodpecker may stockpile food in cracks and holes near the nest site (Constantz 1974), and breeding adults may store insects in cracks for later feeding to the nestlings (Bock 1970).

In contrast to most other woodpeckers, the Lewis' spends more time flycatching and ground-brush foraging than probing for insects (Bock 1970). A breeding population in a pine (Pinus spp.) forest in California spent 60% of their feeding time flycatching, 30% ground-brush foraging, and 10% gleaning insects from tree surfaces. A breeding population in an oak (Quercus spp.) woodland spent relatively similar amounts of time in the above activities, but also spent 11% of their feeding time utilizing previously stored acorns. Lewis' woodpeckers breeding in riparian cottonwood (Populus spp.) groves and farmland cottonwood fence rows in southeastern Colorado fed largely by flycatching over adjacent grazed pastures or plowed fields (Bock, pers. comm.). There is no evidence that chiseling, typical of most woodpeckers, is ever used as a foraging technique by the Lewis' woodpecker (Bock 1970).

Lewis' woodpeckers winter in areas of abundant mast, such as oak woodlands or commercial nut orchards, especially almonds and walnuts (Bock 1970), or adjacent to corn fields (Bock et al. 1971; Hadow 1973). Acorns formed a major portion of the diet of the Lewis' woodpecker from September through April in Utah (Snow 1940). Individuals (rarely a pair) collect and store mast in natural crevices, such as cracks in trees or utility poles (Snow 1940; Bock 1970). Within oak woodlands, areas with a diversity of oak species probably provide a more dependable mast supply than oak woodlands dominated by a single species. However, mast diversity in any specific area may not be critical to winter survival because the Lewis' woodpecker is highly opportunistic and will

move to areas of high mast availability (Bock, pers. comm.). Winter caches are defended both against inter- and intraspecific competitors (Snow 1940; Hadow 1973). A wintering population in a California oak woodland spent about 72% of their feeding activities harvesting and storing mast, 15% flycatching, and 13% gleaning insects from tree trunks (Bock 1970). Despite the large amount of time invested in collecting, storing, and defending mast supplies, Hadow (1973) suggested that insects are preferred in winter whenever they are available and that the mast stores serve as reserve food supplies.

Flycatching activities (hawking) start from prominent perches, including stumps, fenceposts, utility poles, and tall trees (Bock 1970). When ground-brush scanning, Lewis' woodpeckers scan their surroundings from low perches, such as stumps or shrubs.

Water

No information regarding water requirements for the Lewis' woodpecker was found in the literature.

Cover

Habitats used by Lewis' woodpeckers are characterized by their openness (Bock 1970). Open forests allow sufficient visibility and movement for the Lewis' woodpecker to flycatch effectively and also allow the development of a shrubby understory that supports terrestrial insects. Vertical interspersion of vegetative strata is important in evergreen forests and in burns in meeting habitat requirements for breeding and, to a lesser degree, for winter habitat. Although logged or burned habitats may provide suitable habitat for 10 to 30 years following the disturbance, the habitat will be unsuitable if it does not contain a shrub stratum (as a result, for example, of overgrazing or intensive forest management). However, the presence of a shrubby understory is apparently of less importance in riparian groves, farmstead fence rows, and oak woodlands (Bock, pers. comm.). Although the reasons for such a difference in the importance of shrubs is unclear, it may be due to different feeding strategies in coniferous and burned habitats compared to riparian and oak habitats.

Scanning perches are an important, but not usually limiting, component of year-round habitat (Bock 1970).

Reproduction

The Lewis' woodpecker is restricted, as a breeding species, to areas below the upper montane life zone (Bock, pers. comm.). Parklike ponderosa pine (Pinus ponderosa) stands provide the major breeding habitat of the Lewis' woodpecker throughout its range (Bock 1970). The combination of an open canopy, a brushy understory, and an abundance of insects describes breeding habitat for the Lewis' woodpecker in ponderosa pine forests. Logged or burned coniferous forests that are structurally similar to parklike pine stands also provide suitable breeding habitat. At lower elevations, breeding habitat is provided by riparian cottonwood groves, fence rows in agricultural areas, and oak woodlands (Bock, pers. comm.). Suitable conditions for breeding in these

habitats are provided by the same structural features important in ponderosa pine forests, except that shrub cover is apparently not a critical habitat feature. Areas dominated by agricultural lands may be used by Lewis' woodpeckers if sufficient nest trees are available in fence rows, along roads, or around buildings (Bock et al. 1971). Pinyon-juniper (Pinus edulis-Juniperus spp.) woodlands are infrequently occupied, possibly because such woodlands typically occur on dry sites that may not support sufficient insect prey (Bock 1970).

Lewis' woodpeckers are cavity nesters but are not well suited for excavating their own cavities except in dead or dying trees (Bock 1970). The height of nest cavities summarized by Bock (1970) ranged from 1.5 to 51.8 m (5 to 170 ft), although Thomas et al. (1979a) considered the minimum snag height to be 9.1 m (30 ft). Suitable snags have a minimum diameter at breast height of 30.5 cm (12 inches) (Thomas et al. 1979a). An average density of one suitable snag per 0.4 ha (1 acre) is required to support maximum breeding densities of Lewis' woodpeckers in the Blue Mountains of Washington and Oregon (Thomas et al. 1979a). The proportion of the maximum population that can be supported is considered to be positively correlated with snag density; for example, in otherwise equal habitat, an area with an average density of only 0.5 snags per 0.4 ha (1.0 acre) will support only 50% of the maximum breeding population.

Cavity nesters generally face a shortage of nesting sites where trees occur in clumps (Jackman 1975). In areas of high demand for sites, Lewis' woodpeckers may nest within a short distance of each other. Currier (1928) reported three holes that were occupied by Lewis' woodpeckers in each of two trees less than 0.4 km (0.25 mi) apart. Managed forests generally have fewer available nesting sites than do natural forests, because snags and diseased and damaged trees are usually removed (Jackman 1975). Lewis' woodpeckers exhibit a strong pair bond and high nest fidelity, returning to nest in the same cavity in consecutive years (Bock 1970).

Interspersion

Bock (1970) reported that Lewis' woodpeckers defend only the immediate area around the nest site and, in winter, around the stored food (Bock 1970). In contrast, a territory size of 6.1 ha (15 acres) per pair has been reported in the Blue Mountains of Washington and Oregon (Thomas et al. 1979b). Spacing of individuals on wintering grounds is probably determined by food or storage site availability and competition (Hadow 1973). Lewis' woodpeckers in Utah moved 0.6 to 0.9 km (1 to 1.5 mi) from winter habitat to nesting habitat (Snow 1940).

Special Considerations

Although preferred habitat types for breeding and wintering remain structurally similar from year to year, the presence of Lewis' woodpeckers in any given preferred habitat depends heavily on the food supply, either insects or mast (Bock 1970). Because the habitat needs of Lewis' woodpeckers are more specialized in winter than during the breeding season, destruction of winter

range represents a greater potential threat to the species than loss of breeding habitat (Bock, pers. comm.).

Lewis' woodpecker habitat may be adversely affected by grazing, if it eliminates brushy undergrowth, or by forestry practices that eliminate snags or a brushy understory (Jackman 1975). Forest management practices that provide snags, a brushy understory, and slash provide suitable Lewis' woodpecker habitat.

The Lewis' woodpecker has been included in the Audubon Society's Blue List since 1975 (Tate 1981). The list is intended as an early warning list of species exhibiting noncyclical population declines or range contractions. Competition for nest sites from starlings (Sturnus vulgaris) may be a possible cause of the decline. However, evidence also exists that the Lewis' woodpecker has expanded its range into plains habitat in response to maturation of cottonwoods around rural residences and the availability of a mast source in the form of irrigated corn (Hadow 1973). The Lewis' woodpecker is considered a potential sensitive environmental indicator in forest communities dominated by ponderosa pine (Diem and Zeveloff 1980).

Lewis' woodpeckers can apparently do considerable damage to commercial nut orchards during fall and winter (Neff 1926). Large flocks in late summer may damage fruit orchards (Jackman 1975).

HABITAT SUITABILITY INDEX (HSI) MODEL

Model Applicability

Geographic area. This HSI model was developed for use within the breeding and wintering range of the Lewis' woodpecker.

Season. This model was developed to obtain an HSI for breeding habitat and/or winter habitat used by the Lewis' woodpecker.

Cover types. The Lewis' woodpecker is associated with open forest stands during the breeding season and may use any of the following cover types (terminology follows that of U.S. Fish and Wildlife Service 1981): Evergreen Forest (EF); Deciduous Forest (DF); Evergreen Tree Savanna (ETS); Deciduous Tree Savanna (DTS); Desertic Woodland (DW); Deciduous Forested Wetland (DFW); and Cropland (C). For purposes of this model, Evergreen Forest and Evergreen Tree Savanna are considered to represent only those stands dominated by ponderosa pine; evergreen cover types dominated by other species should not be evaluated with this model. Cover types classified as any of the deciduous types (DF, DTS, DW, DFW) are considered to represent only those sites dominated by either cottonwoods or oaks; deciduous types dominated by other species should not be evaluated with this model. Only those croplands in corn production should be evaluated with this model.

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous suitable habitat that is required before an area will be occupied by a species. A territory size of 6.1 ha (15 acres) per pair of Lewis' woodpeckers has been reported from Washington and Oregon (Thomas et al. 1979b), although other sources report that a defended territory is maintained only in the vicinity of a nest or winter food cache (Bock 1970). Lewis' woodpeckers will also breed and winter in relatively small areas of fence rows and riparian woodlands (Bock, pers. comm.). Adjacent open cover types are used in such instances for foraging. Because of the opportunistic nature of the Lewis' woodpecker, no minimum habitat area is defined in this model. If a habitat is large enough to be mapped as any of the cover types listed above, it is assumed that enough area of the cover type will be available in most instances to provide potential habitat for the Lewis' woodpecker.

Verification level. Two earlier drafts of an HSI model for the Lewis' woodpecker were reviewed by Dr. Carl E. Bock. His review comments have been incorporated into this model.

Model Description

Overview. The distinguishing characteristic of breeding habitat of the Lewis' woodpecker is openness of the tree canopy, although sufficient trees must be available to provide nest sites. Food and reproductive needs are considered to be the most important life requisites for the Lewis' woodpecker during the breeding season. Cover requirements during the breeding season are assumed to be met by the same set of habitat characteristics that define reproductive habitat. Food is considered to be the most important life requisite during winter. Winter cover needs are assumed to be met by the same set of habitat characteristics that define winter food. Water is not considered limiting to the Lewis' woodpecker during any season.

The following sections identify important habitat variables, describe suitability levels of the variables, and describe the relationships between variables. The relationship between habitat variables, life requisites, and cover types used in this model and an HSI value for the Lewis' woodpecker is shown in Figure 1.

Summer food component. In contrast to typical woodpecker foraging methods, Lewis' woodpeckers rarely use chiseling as a foraging technique. The most common foraging method during the breeding season is flycatching, which requires open scanning perches such as stumps, trees, or fence posts. Other commonly used foraging methods include foraging on the ground or shrubs, and gleaning. Lewis' woodpeckers also feed heavily on fruits and berries during late summer and fall.

Although the occurrence of the Lewis' woodpecker in any specific area during the summer may be sporadic due to available food, characteristics of preferred habitat can be used to determine the habitat potential of a selected cover type. Preferred foraging habitat during the breeding season in ponderosa pine stands (including logged or burned ponderosa pine stands) is characterized by an open canopy and a dense understory. The open canopy allows sufficient vision and mobility for the Lewis' woodpecker to forage by flycatching and a

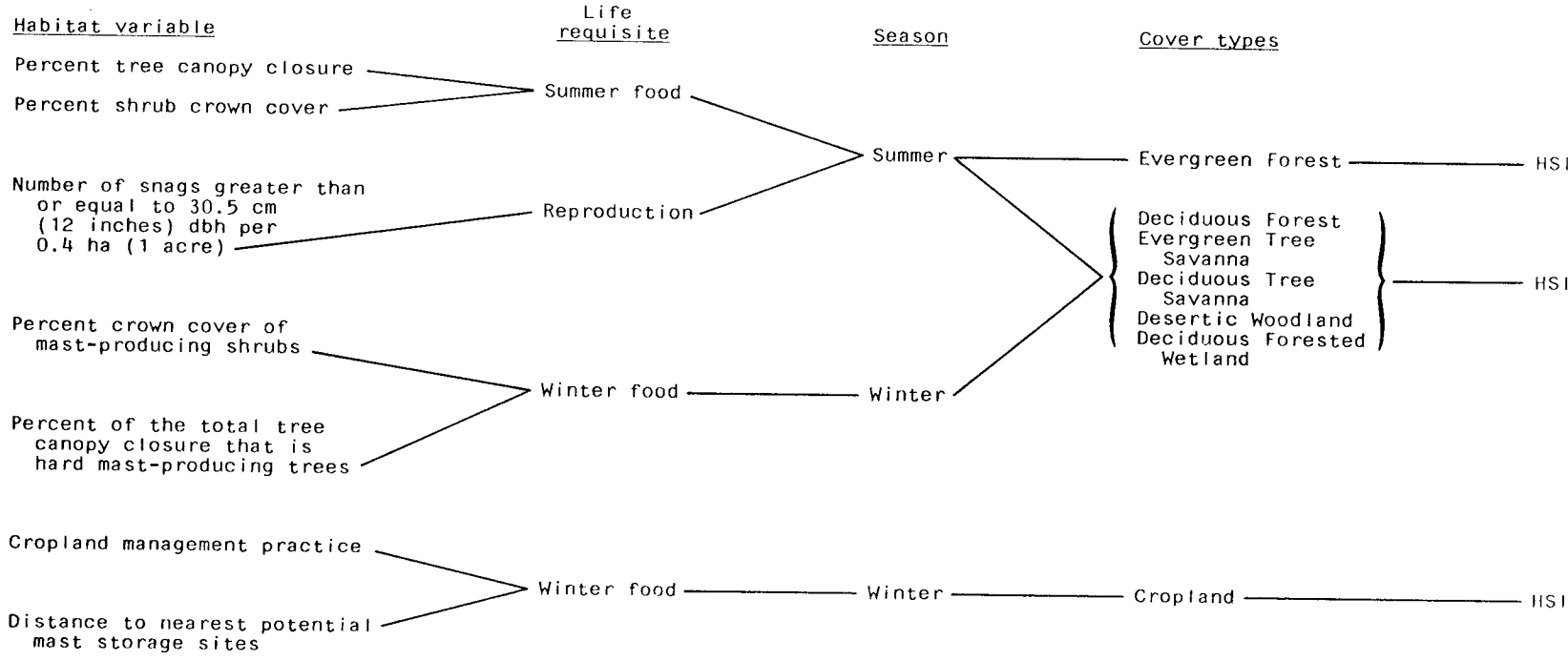


Figure 1. Relationship of habitat variables, life requisites, seasonal habitat, and cover types in the Lewis' woodpecker HSI model.

dense understory provides habitat for numerous insect prey for ground or brush foraging. In this model, it is assumed that canopy conditions will be optimal if tree canopy closure is less than 30% and will be unsuitable if canopy closure exceeds 75%. Optimal understory conditions are assumed to exist if shrub crown cover exceeds 50%. Both understory and canopy conditions must be optimal in order to have optimal conditions in ponderosa pine stands. If tree canopy closure exceeds 75%, or if no shrubs occur in the understory, then it is assumed that the habitat will not be useable by the Lewis' woodpecker. The same habitat features may be used to describe foraging habitat during the breeding season in deciduous cover types, although a dense shrub stratum is apparently unnecessary. In deciduous cover types, the presence of shrubs is considered to add to the food value, but will not be limiting to food suitability.

Winter food component. The winter diet of the Lewis' woodpecker consists primarily of available acorn mast or corn. Mast is stored in caches and is occasionally used early in the breeding season. It is assumed that evergreen forests do not usually provide adequate mast, although evergreen tree savannas may provide adequate mast in the form of Gambel's oak (Quercus gambelii). Potential mast production in nonagricultural types can be evaluated by the amount of mast producing species present in the shrub and tree strata. It is assumed that potential mast production (and winter food suitability) in the shrub stratum increases with increased canopy cover of mast-producing shrubs. Although the same reasoning would appear to hold true for the tree stratum, the Lewis' woodpecker prefers open woodlands. It is assumed in this model that optimal conditions will be approached as the proportion of mast-producing species in the tree canopy increases. Optimal tree canopy conditions are assumed to be the same as described previously under the summer food component. Total food needs may be met by mast from either the shrub or tree strata or from a combination of both food sources.

Corn is assumed to be the only crop that provides a suitable winter mast source for Lewis' woodpeckers. The suitability of cornfields is a function of the abundance of corn during winter and the availability of mast storage sites. Corn that is left standing throughout the winter will provide an abundant mast supply. Cornfields that are harvested in the fall but have stubble plowed under in the spring are assumed to provide a moderate amount of waste grain throughout the winter. Cornfields that are harvested and fall plowed are assumed to provide only minimal quantities of mast for Lewis' woodpeckers. Lewis' woodpeckers require mast storage sites in the form of trees or utility poles with desiccation cracks. It is assumed in this model that mast sources within 0.8 km (0.5 mi) of potential storage sites will be optimally available. Mast sources located more than 1.6 km (1 mi) from storage sites are considered unavailable to Lewis' woodpeckers. The suitability of mast abundance is modified by the suitability of mast storage sites to obtain an overall winter food value for croplands.

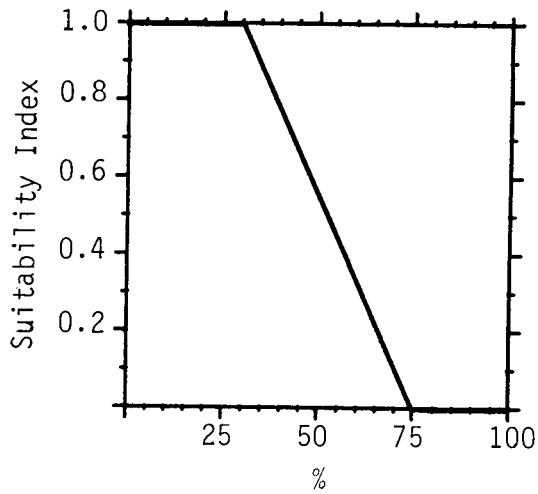
Reproductive component. Lewis' woodpeckers are cavity nesters, but are not well suited for excavation except in dead or dying trees. The presence of dead or dying trees, or existing cavities, is a critical component of breeding habitat. Suitable snags are characterized by a minimum diameter at breast height of 30.5 cm (12 inches) and a minimum height of 9.1 m (30 ft). An

average of at least one snag per 0.4 ha (1 acre) is considered adequate to support maximum breeding densities of Lewis' woodpeckers. The proportion of the maximum population that can be supported by specific habitat conditions is positively correlated with snag density.

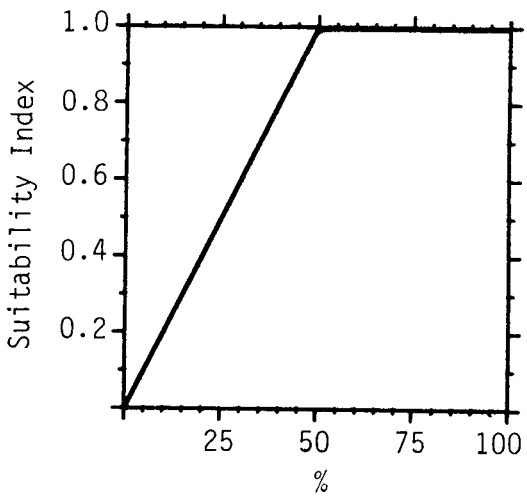
Model Relationships

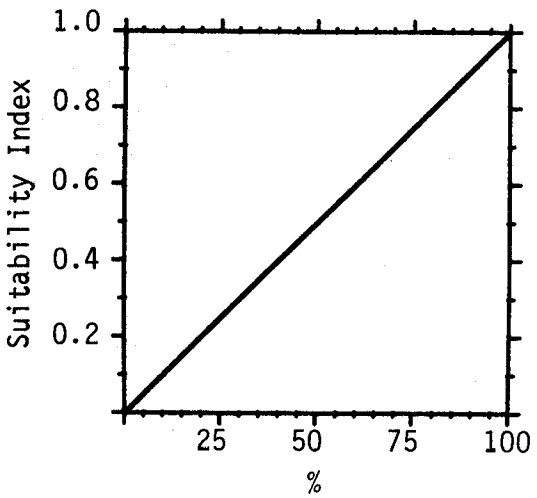
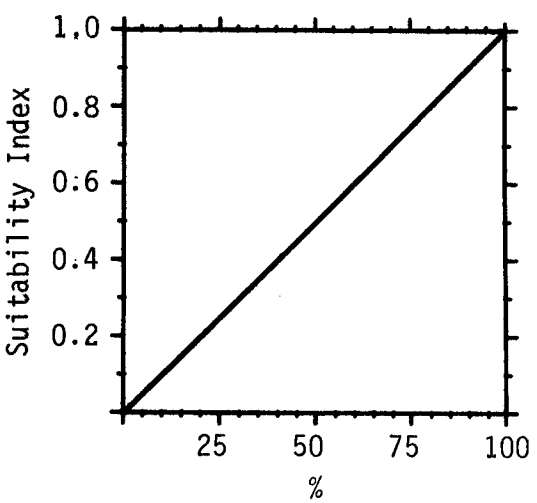
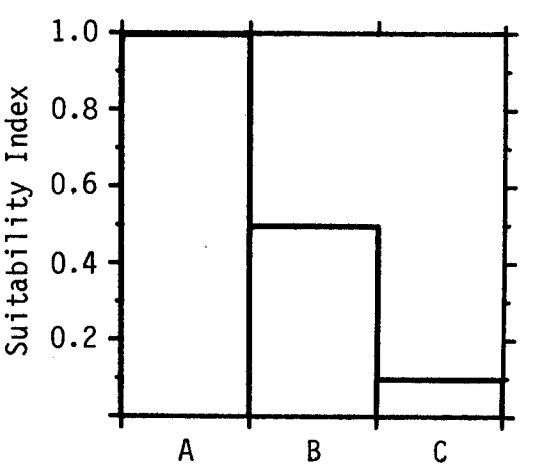
Suitability Index (SI) graphs for habitat variables. This section contains suitability index graphs that illustrate the habitat relationships described in the previous section.

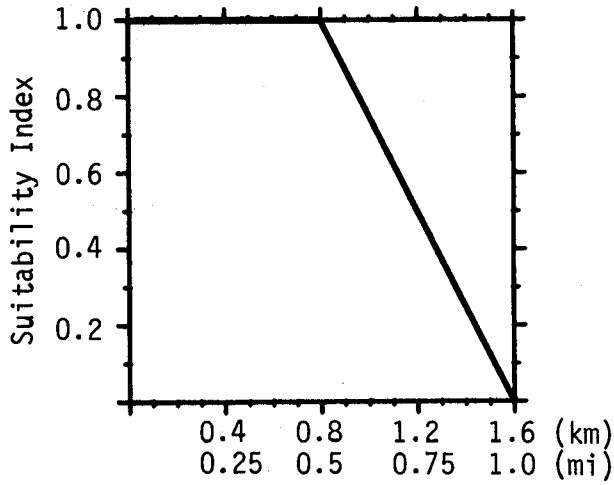
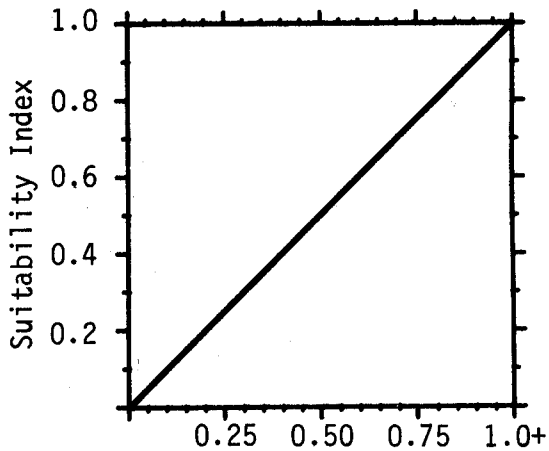
Cover type	Variable	
EF,DF, ETS,DTS, DW,DFW	V_1	Percent tree canopy closure.



EF,DF, ETS,DTS, DW,DFW	V_2	Percent shrub crown cover.



DF,ETS, DTS,DW, DFW	V_3	Percent crown cover of hard mast-producing shrubs.	
DF,ETS, DTS,DW, DFW	V_4	Percent of the total tree canopy closure that is hard mast-producing trees.	
C	V_5	Cropland management practice. A. Corn left standing throughout winter. B. Corn harvested in fall, stubble plowed under in spring. C. Corn harvested and stubble plowed under in fall.	

C	V_6	Distance to nearest potential mast storage site (trees, wooden utility poles).	
EF,DF, ETS,DTS, DW,DFW	V_7	Number of snags ≥ 30.5 cm (12 inches) dbh per 0.4 ha (1 acre).	

Equations. In order to obtain life requisite values for the Lewis' woodpecker, the SI values for appropriate variables must be combined through the use of equations. A discussion and explanation of the assumed relationships between variables was included under Model Description, and the specific equations in this model were chosen to mimic these perceived biological relationships as closely as possible. The suggested equations for obtaining life requisite values are presented in Figure 2.

Life requisite	Cover types	Equation
Summer food	EF,ETS	$(V_1 \times V_2)^{1/2}$
Summer food	DF,DTS, DW,DFW	$V_1 + V_2$ (N.B. If $V_1 = 0$, the summer food value equals 0.0. If the sum of V_1 and V_2 exceeds 1.0, the summer food value equals 1.0.)
Winter food	DF,ETS, DTS,DW, DFW	$V_3 + (V_4 \times V_1)^{1/2}$ (N.B. If the sum exceeds 1.0, the winter food value equals 1.0.)
Winter food	C	$V_5 \times V_6$
Reproduction	EF,DF, ETS,DTS, DW,DFW	V_7

Figure 2. Equations for determining life requisite values by cover type for the Lewis' woodpecker.

HSI determination. Because the Lewis' woodpecker is opportunistic in both summer (breeding) and winter habitat selection, a cover type may be useful at one time of year without necessarily meeting year-round habitat needs. In those types that provide summer habitat (EF, DF, ETS, DTS, DW, DFW), the summer habitat value is the lowest of the summer food and reproduction life requisites. Winter habitat value in all types, except evergreen forests (i.e., ETS, DF, DTS, DW, DFW, C), equals the winter food value determined for the cover type. The HSI value in those cover types potentially providing year-round habitat (i.e., ETS, DF, DTS, DW, DFW) is equal to the highest of the values for summer habitat and winter habitat. The HSI equals the summer habitat value in evergreen forests and the winter habitat value in croplands. The relationship of the HSI value by cover type to habitat variables and seasonal needs is presented in Figure 1 (p. 6).

Application of the Model

Definitions of variables and suggested field measurement techniques (Hays et al. 1981) are provided in Figure 3.

Variable (Definition)		Cover types	Suggested technique
V_1	Percent tree canopy closure [the percent of the ground that is shaded by a vertical projection of the canopies of woody vegetation greater than 5 m (16.5 ft) in height].	EF,DF,ETS,DTS, DW,DFW	Transect, line intercept, remote sensing
V_2	Percent shrub crown cover [the percent of the ground that is shaded by a vertical projection of the canopies of woody vegetation less than 5 m (16.5 ft) in height].	EF,DF,ETS,DTS, DW,DFW	Line intercept, quadrat, remote sensing
V_3	Percent crown cover of hard mast-producing shrubs [the percent of the ground that is shaded by a vertical projection of the canopies of woody vegetation less than 5 m (16.5 ft) in height that produce hard mast, such as acorns (e.g., Gambel's oak)].	ETS,DF,DTS, DW,DFW	Line intercept, quadrat, remote sensing
V_4	Percent of the total tree canopy closure that is hard mast-producing trees (the proportion of the estimate for V_1 that is made up of trees producing hard mast, such as acorns, walnuts, or almonds).	ETS,DF,DTS, DW,DFW	Transect, line intercept, remote sensing

Figure 3. Definitions of variables and suggested measurement techniques.

Variable (Definition)		Cover types	Suggested technique
V_5	Cropland management practice (an evaluation of the winter availability of corn based on management of corn crops. Management categories are: corn left standing, spring plowing, and fall plowing).	C	On-site inspection
V_6	Distance to nearest potential mast storage site (an evaluation of the availability of trees or wooden utility poles for storage of corn mast in winter caches).	C	Remote sensing, ruler
V_7	Number of snags ≥ 30.5 cm (12 inches) dbh per 0.4 ha (1 acre) [the number of standing dead trees or partly dead trees at least 30.5 cm (12 inches) dbh and at least 9.1 m (30 ft) tall].	EF,DF,ETS,DTS, DW,DFW	Quadrat

Figure 3. (concluded).

SOURCES OF OTHER MODELS

No other habitat models for the Lewis' woodpecker were located.

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Habitat preferences of Lewis' woodpecker (Melanerpes lewis) are described in this publication, which is one of a series of Habitat Suitability Index (HSI) models. A review and synthesis of the literature is followed by development of a model of the species-habitat requirements of Lewis' woodpecker. Habitat suitability indexes are designed for use with Habitat Evaluation Procedures previously developed by the U.S. Fish and Wildlife Service.

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