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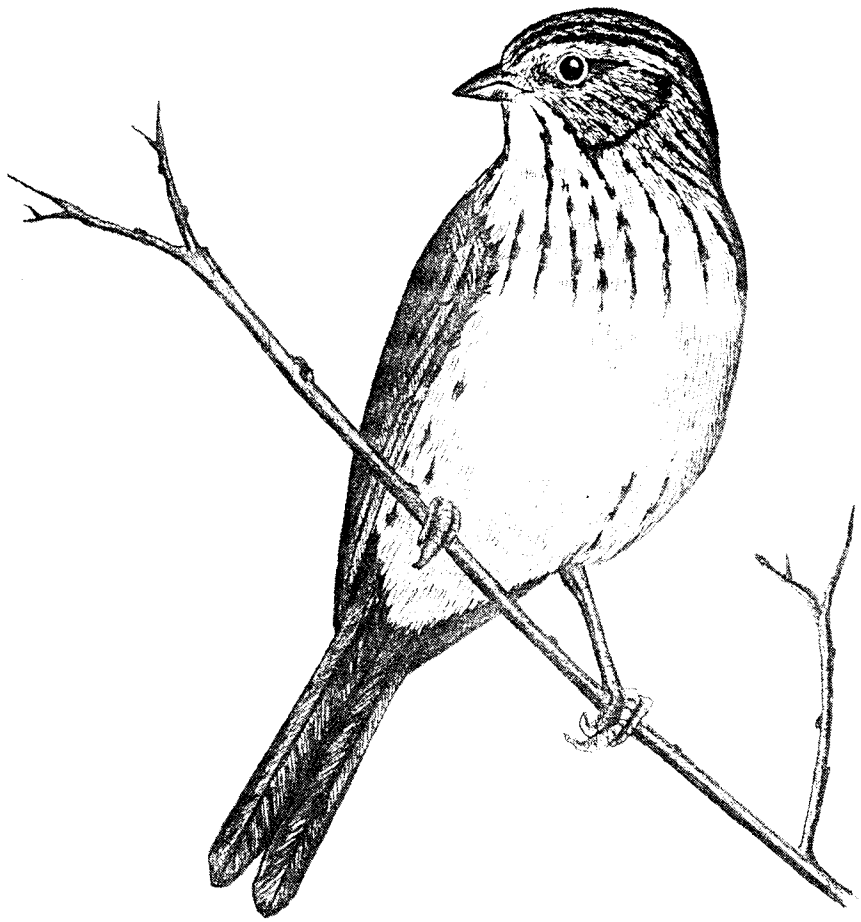
HABITAT SUITABILITY INDEX MODELS: BAIRD'S SPARROW



Fish and Wildlife Service
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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HABITAT SUITABILITY INDEX MODELS: BAIRD'S SPARROW

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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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The cover of this document was illustrated by Jennifer Shoemaker. Word processing was provided by Dora Ibarra and Carolyn Gulzow.

Funding for tne development of this model was provided to the U.S. Fish and Wildlife Service's Habitat Resources Program (Region 6) by the U.S. Bureau of Reclamation under the provisions of the Fish and Wildlife Coordination Act. Additional funds were provided by the U.S. Bureau of Reclamation's Program Related Engineering and Scientific Studies - Environmental, Evaluation, and Planning Project.

BAIRD'S SPARROW (*Ammodramus bairdii*)

HABITAT USE INFORMATION

General

The Baird's sparrow (*Ammodramus bairdii*) is principally found in native prairie and other habitats of similar structure in Montana, North and South Dakota, and the Canadian provinces of Alberta, Manitoba, and Saskatchewan (Cartwright et al. 1937). The Baird's sparrow has a disjunct distribution in the U.S. Northern Great Plains, with highest breeding densities in northwestern North Dakota, northeastern Montana, and the northwestern portions of the Great Plains (Kantrud 1982). Winter range includes Arizona, New Mexico, western Texas, and northern Mexico (Lane 1968).

Food

Small insects are the principal food of the Baird's sparrow during the breeding season (Cartwright et al. 1937), although the winter diet probably consists primarily of weed seeds (Lane 1968). Nestlings are fed a variety of insects, with grasshoppers (Orthoptera) forming the bulk of the diet (Cartwright et al. 1937). Grasshoppers accounted for 64% of the nestling food items in Saskatchewan, while spiders (Araneae) made up 16% of the food items (Maher 1979).

Water

A population of Baird's sparrows in Manitoba studied by Cartwright et al. (1937) was located greater than 1.6 km (1.0 mile) from a water source; dew provided the only water. The proximity of standing water is apparently not a critical factor in determining habitat selection by the Baird's sparrow, although well-drained sites appear to be preferred over wetter sites (Lane 1968).

Cover

Cover needs during the breeding season are described in the following section. No description of winter habitat requirements for the Baird's sparrow was located in the literature.

Reproduction

Stewart (1975:255) described optimum natural habitats for the Baird's sparrow as "...extensive, idle, or lightly grazed tracts of mixed-grass prairie and local pockets of wet-meadow zone or tall-grass prairie along the periphery of prairie ponds and lakes or along intermittent streams." Midheight bunch

grasses, with a short grass understory and dense litter, provide nesting habitat (Kantrud, pers. comm.).

The Baird's sparrow has been described as inhabiting open grasslands with abundant residual vegetation (i.e., dead herbaceous vegetation from the previous growing season) (Salt and Salt 1976). Baird's sparrow territories in North Dakota grasslands were characterized by mean 100% visual obstruction (Robel et al. 1970) of residual vegetation of 1.3 ± 0.06 dm (5.1 ± 0.24 inches) (Renken 1983). However, this was not significantly different from visual obstruction measurements in grasslands without Baird's sparrow territories, nor significantly different from unused portions of the territories. The only difference in structural characteristics between used and unused portions of territories was a slightly greater coverage of litter on used portions. Optimum habitat has been described as mixed grass prairie with visual obstruction measurements from 2 to 4 dm (7.9 to 15.7 inches) during the nest construction period in May, and a mean height range of 2.5 to 10 dm (9.8 to 39.4 inches) for the dominant midgrasses during the breeding season (Kantrud, pers. comm.). Increasing vegetative height or density beyond these levels may impede movement and decrease the value of the habitat. The highest breeding densities observed by Kantrud and Kologiski (1982) occurred on lightly grazed habitats with soils classified as typic borolls. The height of herbaceous vegetation on these sites averaged 30 cm (12 inches), and the average amount of bare soil on these sites was only 5%. The dominant vegetative canopy on undisturbed native fescue (Festuca scabrella) grasslands preferred by the Baird's sparrow in Alberta was greater than 20 cm (7.9 inches) in June and July, while disturbed habitats unused by Baird's sparrow had dominant vegetative heights of less than 20 cm (7.9 inches) in June and July (Owens and Myres 1973). Baird's sparrows in Saskatchewan preferred grasslands that lacked shrubs (Maher 1979). Renken (1983) suggested that breeding Baird's sparrows are not associated with shrubs. Breeding Baird's sparrows were not found on idle native prairie in her North Dakota study area, but were found on grazed native prairie and areas planted with dense nesting cover. Idle native prairie averaged 18% shrub cover while grazed prairie and areas of dense nesting cover had a shrub cover of only 0.9 and 0.1%, respectively. A canopy cover of tall shrubs [greater than 1 m (3.3 ft)] that exceeds 25% has a strong negative influence on the habitat suitability for the Baird's sparrow (Kantrud, pers. comm.), although males use scattered shrubs as song perches (Cartwright et al. 1937; Lane 1968).

Territories of Baird's sparrow in undisturbed native fescue grasslands in Alberta ranged from 3 to 9 per 16.2 ha (40 acres) (Owens and Myres 1973). No territories were located on study plots classified as mowed, grazed, fallow, or seeded. In the same study area, results of roadside surveys through native grassland and cultivated routes indicated that approximately seven times as many Baird's sparrows occurred on the native grassland route. Significantly more Baird's sparrow territories occurred on undisturbed sites than on either grazed or cultivated sites, and more occurred on grazed sites than on cultivated sites. In cultivated or heavily grazed areas, Baird's sparrows were restricted to dense stands of tame hay or to the denser grass present in low-lying areas. The species is considered to be "...most susceptible to habitat change brought about by agriculture" (Owens and Myres 1973:709).

Baird's sparrows in Manitoba were also considered to be extremely sensitive to cultivation, mowing, and burning, although grazed habitats were used (Cartwright et al. 1937).

Baird's sparrows on native grasslands in North Dakota were equally abundant in areas of light or moderate grazing, but were less abundant on heavily grazed sites (Kantrud 1981). Baird's sparrows preferred lightly grazed or ungrazed mixed prairies in Alberta (Karuziak et al. 1977 cited by Kirsch et al. 1978) and ungrazed prairies in Saskatchewan (Maher 1973). Breeding pairs of Baird's sparrows on uncultivated grasslands in the Northern Great Plains were twice as common on lightly grazed sites as on moderately grazed sites and three times as common on lightly grazed sites as on heavily grazed sites (Kantrud and Kologiski 1982). Stewart (1975) stated that heavily grazed grasslands may be used by the Baird's sparrow, but only to a limited extent. The impact of grazing is reduced in areas containing patches or clumps of unpalatable grasses or short shrubs (Kantrud, pers. comm.).

Grazing impacts may vary across the range of the Baird's sparrow. Idle grasslands may support highest concentrations in arid areas, while lightly or moderately grazed grasslands may attract highest densities in the moister, eastern parts of the range (Kantrud, pers. comm.). Grazing or burning may increase the use of long-idled mixed grass prairie of the mesic type that has become heavily dominated by introduced cool season grasses or native shrubs.

Baird's sparrows are found in other agricultural areas, including fallow or currently unmowed hayfields (Kantrud 1981), retired croplands, or fields of domestic grasses and legumes (Stewart 1975). Their order of decreasing value as habitat for the Baird's sparrow is as follows: areas seeded to native grasses; idle tame grasses or retired cropland; grazed tame grasses; mowed native or tame grasses; alfalfa; and croplands (Kantrud, pers. comm.).

Moist sites may be used more extensively in dry years or in the more arid parts of the range (Salt and Salt 1976; Kantrud pers. comm.), although Lane (1968) concluded that the species prefers well-drained sites. An apparent southward expansion of the breeding range may have resulted from the increased height and density of vegetation during a wet period (Kantrud and Faanes 1979).

Kantrud and Kologiski (1982:17) describe optimum habitat for the Baird's sparrow as "...lightly grazed grassland on typic borolls." These boroll soils are the cool or cold soils of the organically rich, fertile Mollisol order, common to prairie vegetation (Brady 1974). The highest densities of Baird's sparrows were on typic borolls, followed by drier aridic borolls, with the warmer ustolls and the cold, dry borollic Aridisols having the lowest measurable sparrow population of the soils studied (Kantrud and Kologiski 1982). The distribution of these soils in the Northern Great Plains is shown in Kantrud and Kologiski (1982) and Kantrud (1982). Dominant plants that occurred in greater than average abundance on plots with the highest densities of Baird's sparrows included spikemoss selaginella (Selaginella densa), fringed

sagebrush (Artemisia frigida), junegrass (Koeleria pyramidata), and needle-and-thread (Stipa comata) (Kantrud and Kologiski 1982). Stewart (1975) listed the following plants as characteristic of the mixed-grass prairie habitat used by the Baird's sparrow: blue grama (Bouteloua gracilis); needle-and-thread; green needlegrass (Stipa viridula); western wheatgrass (Agropyron smithii); little bluestem (Andropogon scoparius); prairie junegrass (Koeleria cristata); and needleleaf sedge (Carex stenophylla).

Interspersion

Male Baird's sparrows were reported defending territories of approximately 0.4 to 0.8 ha (1 to 2 acres) (Lane 1968).

Maximum reported breeding densities of Baird's sparrows are 11.5 pairs/40 ha (100 acres) on ungrazed grasslands in Saskatchewan (Maher 1979), 13.8 pairs/40 ha in North Dakota (Stewart and Kantrud 1972), and 22.5 pairs/40 ha of undisturbed grasslands in Alberta (Owens and Myres 1973). The average density on grazed grasslands in Saskatchewan was 2.1 pairs/40 ha (100 acres) (Maher 1979), while the statewide average density of Baird's sparrows in North Dakota was 0.8 pairs/40 ha (Stewart and Kantrud 1972). Renken (1983) estimated 3.8 territorial males/40 ha (100 acres) on grazed native prairie in North Dakota and 2.1 males/40 ha on areas planted with dense nesting cover. However, territories on grazed plots were established prior to grazing on sites that had been ungrazed for 3 to 4 years prior to the study.

HABITAT SUITABILITY INDEX (HSI) MODEL

Model Applicability

Geographic area. This HSI model was developed for application throughout the breeding range of the Baird's sparrow (Fig. 1). The breeding range map depicted in Figure 1 was developed from several sources (American Ornithologists' Union 1957; Peterson 1980; Kantrud 1982), and the boundaries should be considered approximations of the breeding range of the Baird's sparrow in the United States. However, Baird's sparrow populations are not uniformly distributed throughout this range; a more detailed map of breeding distribution in the U.S. Northern Great Plains may be found in Kantrud (1982:26). The breeding range is "... from southern Alberta ..., southern Saskatchewan ..., and southern Manitoba ... south to Montana ..., northwestern and central South Dakota ..., southeastern North Dakota ..., and central western Minnesota" (American Ornithologists' Union 1957:542).

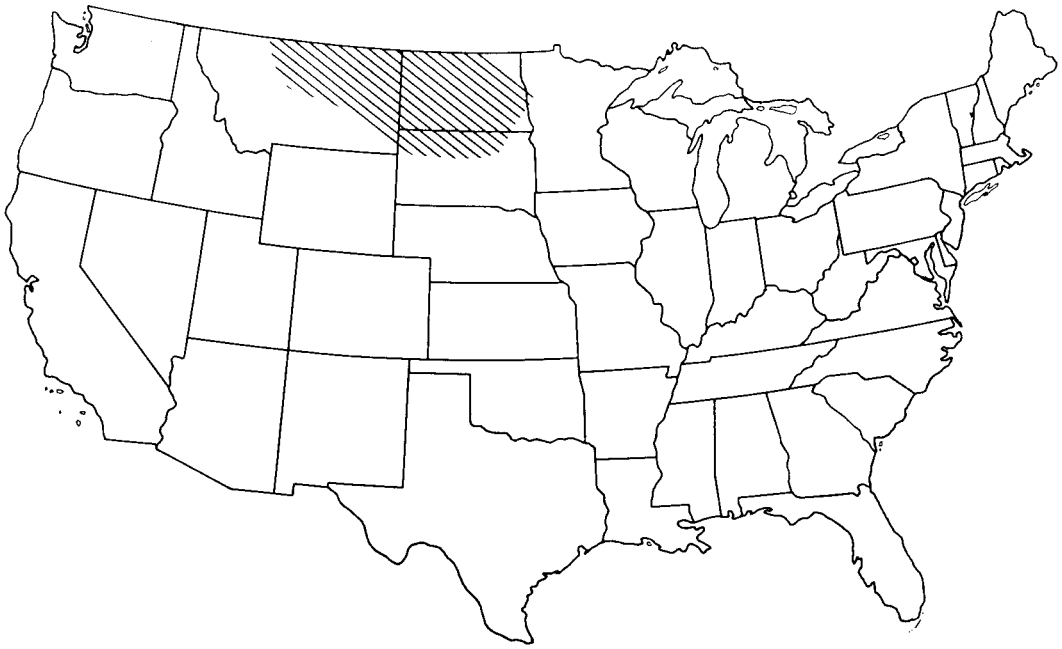


Figure 1. Geographic applicability of the Baird's sparrow HSI model in the United States.

Season. This HSI model was developed to evaluate the quality of habitat for the Baird's sparrow during the breeding season (late May through mid-August).

Cover types. This model was developed to evaluate habitat in the following cover types (terminology follows that of U.S. Fish and Wildlife Service 1981): Grassland (G); Pasture/Hayland (P/H); and Deciduous Shrub Savanna (DSS).

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before an area will be occupied by a species. Territories of male Baird's sparrows range from approximately 0.4 to 0.8 ha (1 to 2 acres). Based on this information, it is assumed that there must be at least 0.8 ha (2 acres) of potential habitat (i.e., the cover types listed above) before an area will be occupied by this species. If an area has less than 0.8 ha (2 acres) of potential habitat available, the HSI for the Baird's sparrow is assumed to be 0.0. Although the minimum habitat area is probably greater than 0.8 ha (2 acres) (Faanes, pers. comm.), no information was found in the literature to more accurately define the minimum habitat area.

Verification level. Previous drafts of this model were reviewed by Harold Kantrud and Craig Faanes, and their comments have been incorporated into this model.

Model Description

Overview. All of the breeding habitat requirements of the Baird's sparrow can be satisfied within grasslands or areas where grasses are the dominant vegetation. Water is not included as a life requisite in this model since no data on water requirements for the Baird's sparrow were located in the literature. Food needs are assumed to be described by the same habitat variables that describe cover and reproduction.

The following section identifies important habitat variables, describes suitability levels of the variables, and describes the relationships between variables. The relationship between habitat variables, life requisites, and cover types used in this model and an HSI value for the Baird's sparrow is shown in Figure 2.

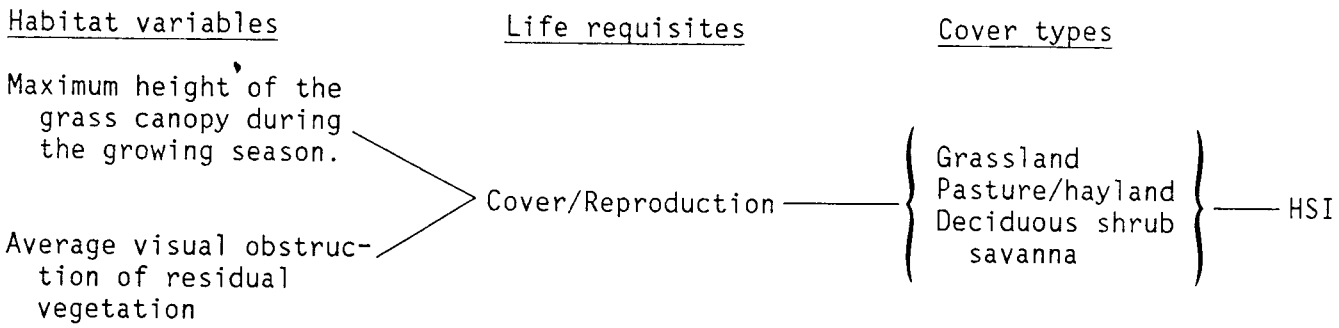


Figure 2. Relationship of habitat variables, life requisites, and cover types in the Baird's sparrow HSI model.

Cover/reproduction component. The Baird's sparrow is found primarily in areas with vegetative structure similar to that of native grasslands. This includes prairie grasses with dense residual vegetation, an upper stratum of midgrasses, and an understory of short grasses.

The suitability of a given habitat for the Baird's sparrow is apparently a function of the grassland structure rather than species composition. In arid portions of the range of the Baird's sparrow, undisturbed grasslands likely are preferred, while lightly grazed sites are preferred in the moister portions of the range (Kantrud, pers. comm.). Moist sites are used during dry periods (Salt and Salt 1976) and probably provide the only habitat in the driest portions of the range (Kantrud, pers. comm.). A southward expansion of the breeding range was an apparent response to changes in vegetative structure during a period of wet years (Kantrud and Faanes 1979). It is assumed that these responses to habitat differences reflect a response to the height and density of vegetation.

Several characteristics can be used to define the structure of grassland habitats (e.g., stem density, canopy cover, height, or residual vegetation). Only height and amount of residual vegetation are considered in this model. These two characteristics are easily measured or estimated and are related to other habitat characteristics (e.g., stem density is reflected in the amount of residual vegetation). Highest densities of Baird's sparrows on undisturbed grasslands occurred where the average vegetative height was about 30 cm (12 inches) (Kantrud and Kologiski 1982). Preferred habitat in Alberta was characterized by a dominant vegetative layer in excess of 20 cm (8 inches) in June and July (Owens and Myres 1973). Kantrud (pers. comm.) considered optimum height conditions to be between 0.25 and 1.0 m (0.8 to 3.3 ft). Based on this information, optimum vegetative height is assumed to exist if the maximum height during the growing season exceeds 25 cm (10 inches). Heights in excess of 1.0 m (3.3 ft) are assumed to restrict movement, although such conditions are unlikely to exist. Heights less than 10 cm (4 inches) are assumed to provide inadequate cover for Baird's sparrows.

In addition to grasses of a certain height, Baird's sparrows require habitats with a large amount of residual vegetation in order to have optimum habitat conditions. Dense residual vegetation at ground level provides cover for nests (Kantrud, pers. comm.) and also can provide early spring cover before new growth is of sufficient height to provide concealment. Visual obstruction measurements (Robel et al. 1970) have been used to quantify the amounts of residual vegetation available. Renken (1983) associated Baird's sparrows with visual obstruction measurements of residual vegetation of 1.3 ± 0.06 dm (5.1 ± 0.24 inches), and Kantrud (pers. comm.) considered optimum visual obstruction measurements to range from 2 to 4 dm (7.9 to 15.7 inches). In this model, grasslands with average visual obstruction measurements of less than 0.5 dm (2.0 inches) are assumed to be unsuitable for Baird's sparrows, while grasslands with average visual obstruction measurements between 1.5 dm (5.9 inches) and 4 dm (15.7 inches) are assumed to represent optimum residual vegetation conditions. It is possible that extremely dense residual vegetation inhibits use by Baird's sparrows. However, in the absence of any evidence to support this possibility, it is assumed in this model that visual obstruction measurements of residual vegetation greater than 4 dm (15.7 inches) also represent optimum conditions.

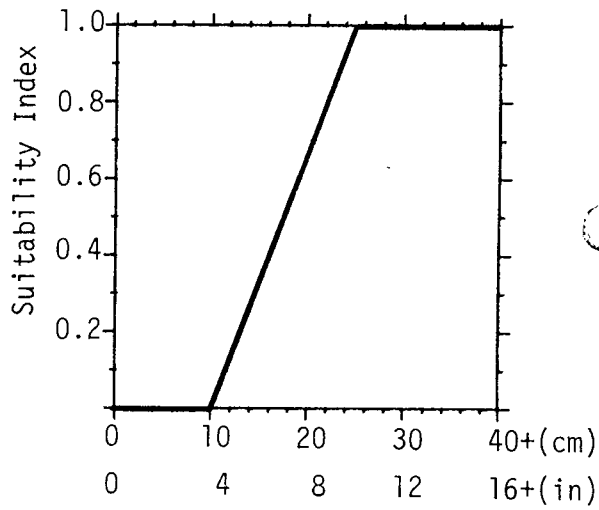
Agricultural activities are not directly evaluated with this model. However, the height of vegetation and the amount of residual vegetation are reflections of the type and extent of agricultural activity. For example, a mowed field may have adequate height but very little residual vegetation. A grassland used for early summer pasture may have adequate residual vegetation but insufficient vegetative height, while late summer grazing may result in adequate height throughout much of the breeding season but leave insufficient residual vegetation. Because Baird's sparrows require suitable levels of both vegetative height and residual vegetation, and because one of these variables may be suitable while the other is unsuitable, the overall cover value of the habitat is assumed to be limited by the variable with the lowest suitability level.

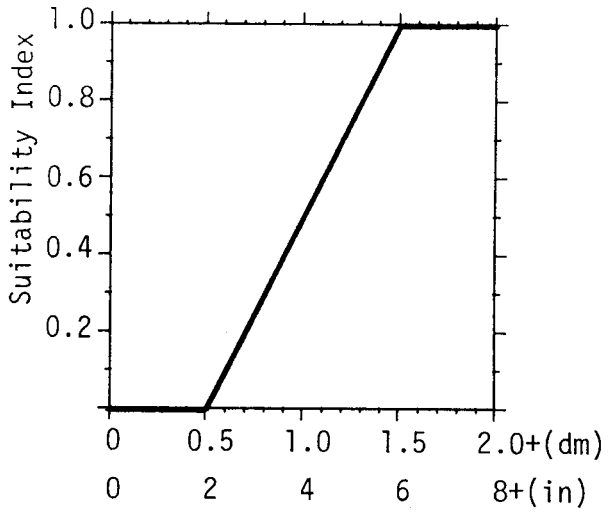
Shrubs may have a significant negative impact on habitat suitability for Baird's sparrows if shrub canopy cover exceeds 25% (Kantrud, pers. comm.). However, shrub canopy cover is not included as a habitat variable in this model because the only cover type with shrubs that is considered in this model is deciduous shrub savanna (DSS), which, by definition, has a shrub canopy cover of 5 to 25% with areas between shrubs dominated by grasses (U.S. Fish and Wildlife Service 1981). Habitat suitability within the DSS cover type can, therefore, be evaluated by the vegetative height and residual vegetation variables described above.

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	
G,P/H,DSS	V_1	Maximum height of the dominant grass canopy during the growing season.



G,P/H,DSS	V_2	Average visual obstruction of residual vegetation (measured prior to spring growth of new herbaceous vegetation).	

Equation. As discussed under Model Description, the cover value for the Baird's sparrow in grassland, pasture/hayland, or deciduous shrub savanna is assumed to equal the lowest suitability index (SI) for the two variables in this model:

$$HSI = \min (SI_{V1}, SI_{V2})$$

HSI determination. The cover/reproduction value determined in this model is assumed to represent the food, reproductive, and cover needs of the Baird's sparrow during the breeding season. The HSI, therefore, equals the cover/reproduction value.

Application of the Model

Use of this model presents a potential problem in that the two critical habitat variables are most easily and accurately measured at different times of the year. Estimates of residual vegetation are best made prior to development of new spring growth, while estimates of the maximum height of the dominant grass canopy are best made after grasses have achieved the majority of their annual growth. Estimates of either variable can be made if measurements are not possible during the preferred periods. Estimates should be based on knowledge of local vegetative communities and land management practices.

Definitions of variables and suggested field measurement techniques are provided in Figure 3.

Variable (definition)		Cover types	Suggested technique
V_1	Maximum height of the grass canopy during the growing season (the average vertical distance from the ground surface to the dominant height stratum in the grass canopy, when the grass canopy is tallest).	G,P/H,DSS	Transect, ocular estimate, graduated rod (Hays et al. 1981).
V_2	Average visual obstruction measurement of residual vegetation [an estimate of the quantity of residual vegetation, expressed as the depth of dead vegetation providing 100% visual obstruction when viewed from a distance of 4 m (13.1 ft); estimated to the nearest 0.5 dm and measured in early spring prior to growth of new vegetation].	G,P/H,DSS	Ocular estimate (Hays et al. 1981), visual obstruction measurement technique (Robel et al. 1970).

Figure 3. Definitions of variables and suggested measurement techniques.

SOURCES OF OTHER MODELS

No other habitat models for the Baird's sparrow were located in the literature.

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16. Abstract (Limit: 200 words)

A review and synthesis of existing information were used to develop a habitat model for Baird's sparrow (Ammodramus bairdii). The model is scaled to produce an index of suitability between 0 (unsuitable habitat) and 1 (optimally suitable habitat) for Baird's sparrow habitat in the Northern Great Plains. Habitat suitability indices are designed for use with Habitat Evaluation Procedures previously developed by the U.S. Fish and Wildlife Service.

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Habitat Suitability Index

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