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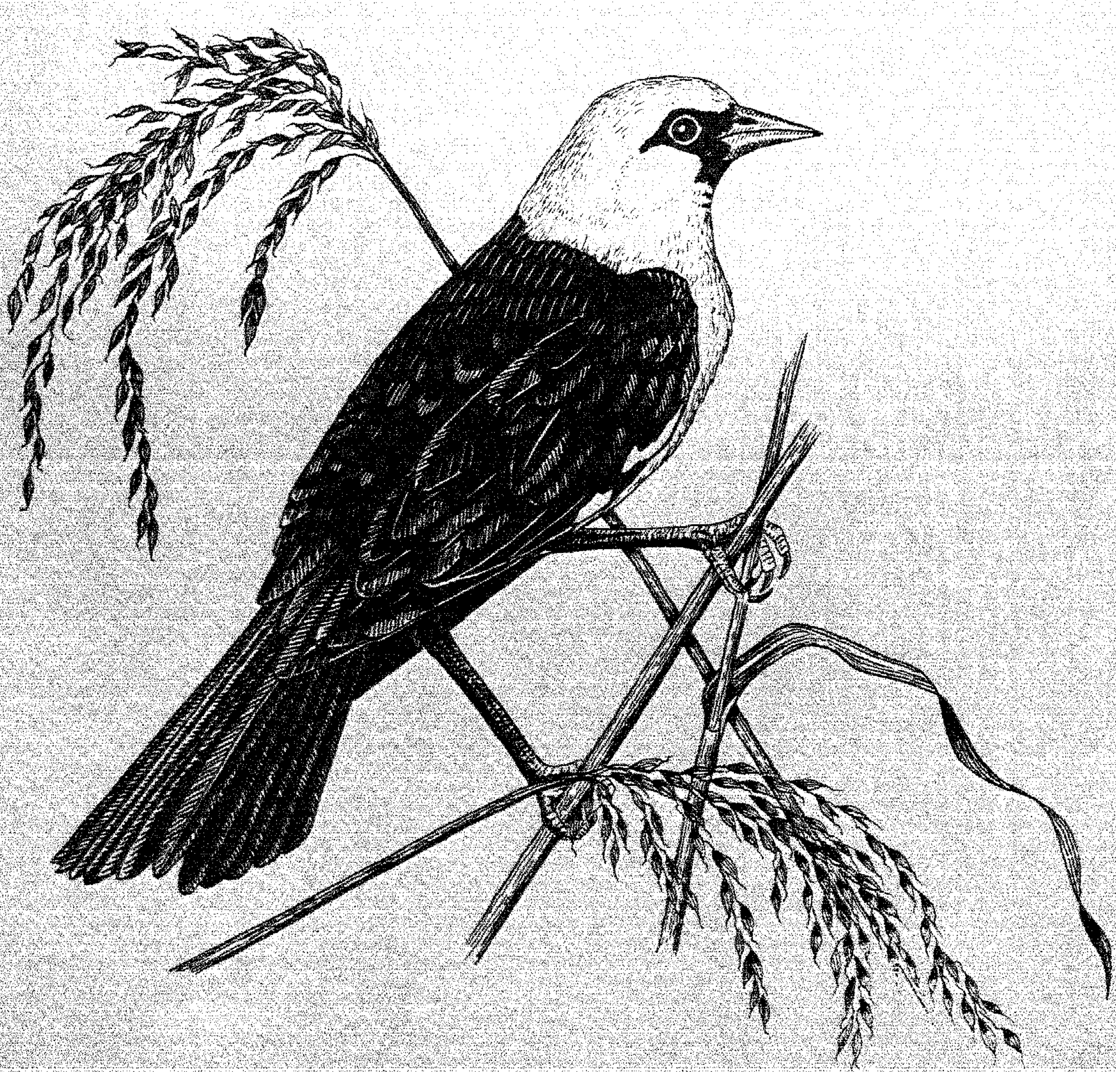
HABITAT SUITABILITY INDEX MODELS: YELLOW-HEADED BLACKBIRD



Fish and Wildlife Service

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HABITAT SUITABILITY INDEX MODELS: YELLOW-HEADED BLACKBIRD

by

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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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CONTENTS

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YELLOW-HEADED BLACKBIRD (*Xanthocephalus xanthocephalus*)

HABITAT USE INFORMATION

General

The yellow-headed blackbird (*Xanthocephalus xanthocephalus*) is a common breeding bird in marshes throughout the arid and semiarid portions of western North America (Willson and Orians 1963). Preferred habitats are inland lakes, ranging from fresh to alkaline, with emergent vegetation and permanent water (Weller, pers. comm.).

Food

The breeding season diet and foraging techniques of the yellow-headed blackbird tend to vary from the eastern to western portion of its range (Voigts 1973; Orians 1980). Yellow-headed blackbirds in western study areas foraged primarily on emerging aquatic insects in marsh habitats during the breeding season (Willson 1966; Orians and Horn 1969; Orians 1980). Insects from the order Odonata (dragonflies and damselflies) were the dominant food items in these studies; however, odonates were not required for nesting success. Breeding season diets of yellow-headed blackbirds in an Iowa marsh consisted of a wide variety of arthropods, dominated by dipterans, odonates, and lepidopterans (Voigts 1973). The blackbirds foraged in upland areas for extended periods of time when insect abundance on the marsh was low.

Variations in diet and foraging techniques may relate to differences in the relative productivity of wetlands and uplands of the regional habitats occupied by the yellow-headed blackbird. Lakes and marshes in arid and semi-arid habitats tend to concentrate more nutrients and have higher aquatic insect productivity (Orians 1980). Conversely, lakes and marshes in more humid areas tend to dilute and flush out regularly and, therefore, do not concentrate as many nutrients. Areas with relatively dry and unproductive uplands may force blackbirds to be more dependent on the marsh for food, whereas uplands in more humid habitats are lush and diverse and provide a large and varied food source for foraging blackbirds (Voigts 1973). However, yellow-headed blackbirds must have wetlands to survive, and their use of upland foods only occurs after establishment of a nest site in a marsh containing suitable food resources for brood rearing (Weller, pers. comm.).

The amount of aquatic insects potentially available to yellow-headed blackbirds is a function of available marsh nutrients, permanence of water, the amount and distribution of submergent and emergent vegetation, and the presence of fish (Orians 1980). In the western portion of the yellow-headed blackbird's range, lakes with high specific conductivities also exhibit high aquatic insect production. Yellow-headed blackbirds in a British Columbia study did not breed in lakes with specific conductivities less than 1,100 micromhos/cm, and breeding densities increased as conductivity approached 3,500 micromhos/cm (Orians 1966). At specific conductivities greater than 4,000 micromhos/cm, emergent vegetation did not grow, and birds were limited by a lack of nesting and foraging sites. However, water samples from Rush Lake, Iowa, ranged from 390 to 760 micromhos/cm at 25° C, and this lake supported breeding populations of yellowheads (Voigts 1973). Furthermore, wetlands in the upper Midwest, with measured specific conductivities exceeding 4,000 micromhos/cm at 25° C, regularly supported emergent vegetation (Stewart and Kantrud 1972). It appears that "... specific conductance is not a precise measure of productivity when used alone to compare widely separated areas with large climatic and geological differences" (Voigts 1973:398).

The majority of common odonates in Washington require permanent water in order to overwinter (Orians 1980). Lakes that dry up during late summer have much lower rates of aquatic insect emergence than lakes with permanent water (Orians 1980), and the emergence begins too late to be of much value to breeding yellow-headed blackbirds (Orians, pers. comm.).

The negative influence of carp (*Cyprinus carpio*) is primarily due to habitat destruction, rather than actual predation on aquatic insects (Orians 1980). Lakes with high carp populations are frequently characterized by high turbidity levels and an absence of submerged vegetation, while those without carp more often have clear water and abundant submerged vegetation, which provides perches and shelter for insects.

Distribution and accessibility of emerging aquatic insects at a particular site is strongly related to the arrangement of emergent vegetation (Orians 1980). Favored foraging locations for yellow-headed blackbirds are near water, around the edge and base of emergent vegetation, and on lake shores with no emergent vegetation (Linsdale 1938; Willson 1966; Orians 1980). Interior portions of large patches of emergent vegetation are poor sources of food for yellow-headed blackbirds, and the broader the expanse of emergent vegetation, the fewer insects will be produced per unit area (Orians 1980). Less dense or scattered areas of emergent vegetation allow greater penetration of sunlight, which probably increases aquatic insect production (Willson 1966). Scattered emergent vegetation also improves the foraging success of yellow-headed blackbirds by concentrating emerging aquatic insects as the insects move toward the shore and onto the vegetation.

Water

Dietary water requirements were not mentioned in the literature. Habitat requirements related to water are discussed in other sections of this narrative.

Cover

Cover needs of the yellow-headed blackbird are assumed to be the same as reproductive needs and are discussed in the following section.

Reproduction

Yellow-headed blackbirds nest only over standing water, primarily in emergent vegetation (Roberts 1932; Bent 1958; Weller and Spatcher 1965; Orians 1966; Miller 1968). Habitats with stable, permanent water are preferred (Roberts 1932; Bent 1958; Orians 1966). The average water depth under 59 nest sites in western Canada was 30.8 cm (12.1 inches) (Miller 1968), while averages from several marshes in Iowa ranged from 25.4 to 56.9 cm (10 to 22.4 inches) (Weller and Spatcher 1965). Any water depth greater than 15.2 cm (6 inches) is probably adequate for nesting yellow-headed blackbirds (Weller, pers. comm.).

Yellow-headed blackbirds require robust vegetation to support the nest structure (Weller and Spatcher 1965). Most nests are constructed in cattails (*Typha* spp.), bulrush (*Scirpus* spp.), or tall reeds (*Phragmites communis*) (Bent 1958). Other vegetation which may be utilized for nesting includes rushes (*Juncus* spp.) (Lederer et al. 1975), tamarix (*Tamarix gallica*) (Fautin 1940), and willows (*Salix* spp.) (Linsdale 1938; Weller and Spatcher 1965).

Interspersion

Nesting territories contain an abundance of edge between emergent vegetation and open water (Ellarson 1950; Weller and Spatcher 1965; Orians 1980). Willson (1966) reported greater nesting success in territories containing 55 to 79% emergent cover than in those areas containing 71 to 94% emergent cover. Densities of nesting yellow-headed blackbirds in a 160 ha (400 acre) northern Iowa lake and marsh were highest when the ratio of emergent vegetation to open water areas [> 2.7 m (9 ft) wide] was approximately 50/50 (Weller and Fredrickson 1974). Densities decreased as either open water or emergent cover approached 100% coverage of the area.

The highest breeding densities of yellow-headed blackbirds have been reported on small marshes. Roberts (1909) observed approximately 30 nesting pairs on a 0.4 ha (1.0 acre) marsh, and Fautin (1940) found 12 territories on a 0.15 ha (0.38 acre) marsh.

Highest breeding densities within marshes themselves generally occur in areas where the majority of food items are taken from open lands away from the marsh (Fautin 1940; Willson 1966), sometimes at distances exceeding 1 km (0.6 mi) (Lederer et al. 1975). Yellow-headed blackbirds tend to select marshes in open country and avoid placing nests near large trees (Weller and Spatcher 1965; Miller 1968; Orians 1980).

Territories on study sites in California and Washington varied in size from 36 to 4,076 m^2 (43 to 4,875 yd^2) (Willson 1966).

Special Considerations

Yellow-headed blackbirds frequently feed on crops during fall and winter and may contribute to crop damage in some areas (Weller 1969; Crase and Dehaven 1978). Habitat needs of the yellow-headed blackbird reflect marsh conditions that are attractive to many other birds, making it a good "indicator" species (Weller 1969).

HABITAT SUITABILITY INDEX (HSI) MODEL

Model Applicability

Geographic area. This model was developed for application within the entire breeding range of the yellow-headed blackbird.

Season. This model was developed to evaluate the breeding season habitat of the yellow-headed blackbird.

Cover types. This model was developed to evaluate habitat in herbaceous wetlands (HW) (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 areas for yellow-headed blackbirds was not found in the literature. However, based on reported colony sizes, it is assumed that a minimum habitat area required for yellow-headed blackbird use would be 0.15 ha (0.38 acre) (Fautin 1940).

Verification level. Previous drafts of this model were reviewed by Gordon Orians (Orians, pers. comm.) and Milton Weller (Weller, pers. comm.). Specific comments from these reviewers have been incorporated into the present model.

Model Description

Overview. This model considers the ability of the habitat to meet the food and reproductive needs of the yellow-headed blackbird as an indication of overall habitat suitability. Cover and water needs are assumed to be met by food and reproductive requirements. Although yellow-headed blackbirds utilize both wetland and upland habitats, it is assumed that wetland habitat quality is the limiting factor in determining their abundance. Therefore, this model assesses habitat quality only in herbaceous wetlands.

The relationship between habitat variables, life requisites, cover types, and the HSI for the yellow-headed blackbird is illustrated in Figure 1.

The following sections provide a written documentation of the logic and assumptions used to interpret the habitat information for the yellow-headed blackbird and to explain and justify the variables and equations that are used in the HSI model. Specifically, these sections cover the following:

(1) identification of variables that will be used in the model; (2) definition and justification of the suitability levels of each variable; and (3) description of the assumed relationship between variables.

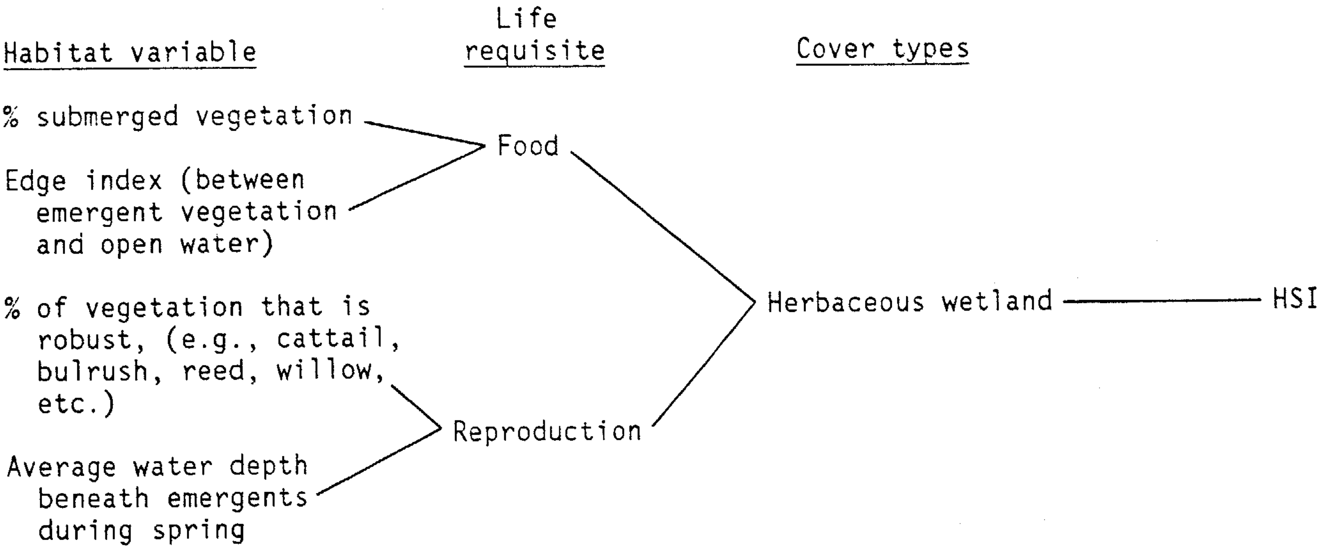


Figure 1. Relationships between habitat variables, life requisites, cover types, and the HSI for the yellow-headed blackbird.

Food component. Yellow-headed blackbird food requirements in wetlands are related to the abundance and accessibility of certain aquatic insects.

The abundance of preferred aquatic insects is related to marsh nutrients, permanence of water, the amount and distribution of vegetation, and the presence of fish. A measure of the abundance of submerged vegetation is assumed to adequately account for all of these factors and to provide the simplest and most practical estimation of productivity of aquatic insects preferred by breeding yellow-headed blackbirds. This assumption is based on the following logic: (1) the preferred aquatic insects require submerged vegetation for their own habitat needs; (2) the quantity of marsh nutrients is positively correlated with the abundance of submerged vegetation; (3) the permanence of water is positively correlated with the abundance of submerged vegetation; and (4) the negative effects of fish, especially carp, are related to habitat destruction, which results in a reduction in the amount of submerged vegetation. Vegetation alone may not always be a reliable indicator of aquatic insect abundance (Orians, pers. comm.). However, direct population counts of insect numbers is impractical for the intended users of this model, and the assessment of submerged vegetation is assumed to be the most accurate and practical indirect method to estimate insect abundance.

It is assumed that lakes with 80% or more of open water areas containing submerged vegetation will be optimum. Lakes with no submerged vegetation may have marginal suitabilities, if emergent vegetation is present that will support insect production.

Accessibility of emerging aquatic insects is a very important factor in determining food suitability for yellow-headed blackbirds. It is assumed that aquatic insect food must be accessible or the habitat will be unsuitable. Wetlands with an abundance of edge between emergent vegetation and open water provide increased opportunities for foraging on emerging aquatic insects and are assumed to be optimum. Wetlands with solid stands of emergents and no open water and, thus, no appropriate edge, are assumed to be unsuitable for yellow-headed blackbirds. The amount of edge can be calculated with an edge index (Patton 1975). However, the relationship between the edge index and food suitability for the yellow-headed blackbird can only be estimated. The literature indicates that the smallest territories for yellowheads are 36 m^2 (43 yd^2) and that maximum population densities occur where open water [> 2.7 m (9 ft) diameter] and emergent vegetation are present at a 50/50 ratio. An area containing a checkerboard pattern of 36 m^2 (43 yd^2) patches of emergent vegetation and open water, in a 50/50 ratio, would apparently provide for the maximum number of territories. Such a habitat condition would yield an edge index of approximately 7.0 when only the area of emergent vegetation is considered in the edge equation. It is assumed, in this model, that an edge index of 7 or greater is optimum and that habitats with an edge index of 0 will be unsuitable. A limitation of using an edge index to estimate habitat suitability is that it does not account for the size of the habitat units being assessed. Therefore, it is suggested that an edge index be calculated for each 900 m^2 (1,077 yd^2) of herbaceous wetland area and the average of these indices used in the suitability index graph.

Overall food value is a function of both food abundance and food accessibility, and a habitat must contain optimum levels of both to have maximum suitability. Habitats with low food abundance can still be suitable for yellow-headed blackbirds if the food is very accessible. Likewise, habitats with poor access to food may have some suitability if food is very abundant. However, if no food is present or if food is present but inaccessible, the wetland will have no suitability as yellow-headed blackbird habitat.

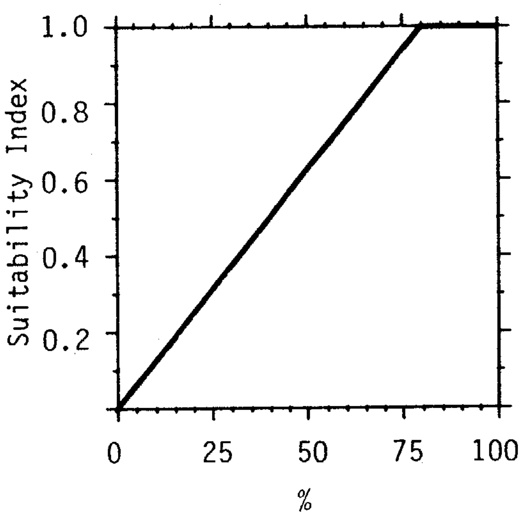
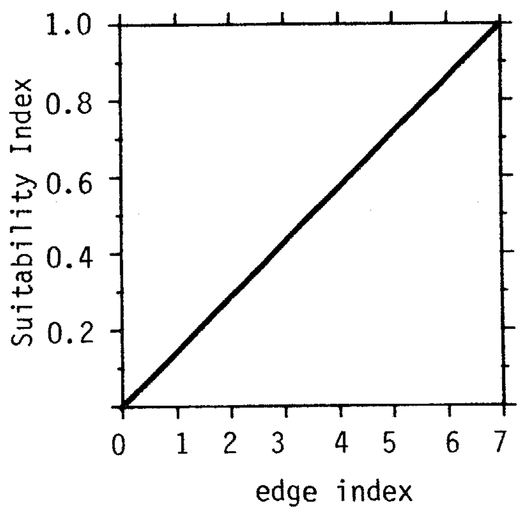
Reproduction component. Reproductive (i.e., nesting) suitability for the yellow-headed blackbird is primarily related to the abundance of robust emergent vegetation and the water depth beneath the emergents. Robust emergent vegetation includes cattails, bulrush, reeds, willows, etc., and it is assumed that optimal marshes contain 100% composition of these plant species. If none of these species are present, the wetland is assumed to have no habitat suitability. Yellow-headed blackbirds nest over water and water depth beneath emergents is an important factor in nesting success. It is assumed that depths exceeding 15 cm (6 inches) during the nesting season are optimum and that a lack of water beneath emergents would indicate no suitability.

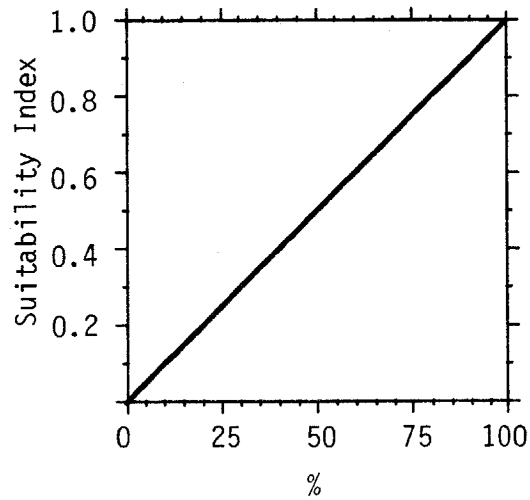
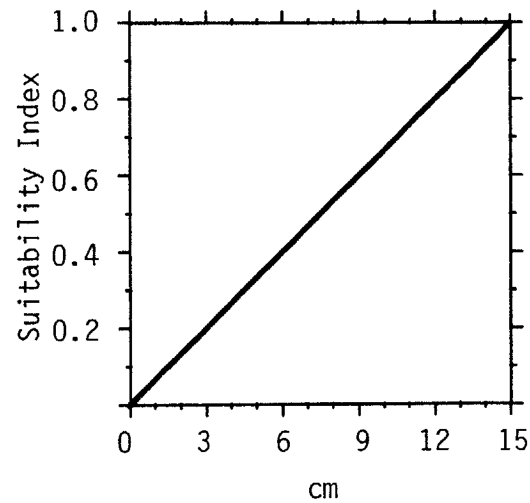
Habitats with either no water beneath emergents or no robust emergent vegetation will be unsuitable. Optimum water depth and the presence of 100%

preferred vegetation species must be present for maximum reproduction to occur. Intermediate levels of these two variables will result in intermediate habitat suitability for reproduction.

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		
HW	V_1	% of open water area containing submerged vegetation.	
HW	V_2	Edge index (between emergents and open water), per 900 m^2 (1,077 yd^2) area.	

HW	V_3	% of vegetation that is robust (i.e., cattail, bulrush, reed, willow, etc.)	
HW	V_4	Average water depth beneath emergents during spring.	

Equations. The suitability index values for appropriate variables must be combined with the use of equations in order to obtain life requisite values for the yellow-headed blackbird. A discussion of the relationship 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 food and reproduction values are presented by cover type in Figure 2.

Life requisite	Cover type	Equation
Food	HW	$(V_1 \times V_2)^{1/2}$
Reproduction	HW	$(V_3 \times V_4)^{1/2}$

Figure 2. Equations for determining life requisite values by cover type for the yellow-headed blackbird.

HSI determination. The HSI value for the yellow-headed blackbird, based on the limiting factor concept, 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 3.

SOURCES OF OTHER MODELS

No other habitat models for the yellow-headed blackbird were located.

Variable (definition)		Cover types	Suggested technique
V_1	Percent of open water area containing submerged vegetation.	HW	Line intercept
V_2	Edge index, between emergents and open water per 900 m^2 (1,077 yd^2) area (a ratio to determine the amount of edge between emergent vegetation and open water). Computed by: $\text{Edge Index} = \frac{l}{2\sqrt{A\pi}}$ where: l = length of edge; A = area of the herbaceous wetland cover type. An edge index of 1.0 is equivalent to a circle, and the greater the deviation from a circular shape, the greater the edge index value will be.	HW	Aerial photos, map measurer, and point grid
V_3	Percent of vegetation that is robust (i.e., cattail, bulrush, reed, willow, etc.) (the percent of all vegetation in the cover type that is robust, as determined by canopy cover).	HW	Line intercept
V_4	Average water depth beneath emergent vegetation during spring.	HW	Graduated rod

Figure 3. Definitions of variables and suggested measurement techniques.

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15. Supplementary Notes

16. Abstract (Limit: 200 words)

Habitat preferences of the yellow-headed blackbird (Xanthocephalus xanthocephalus) are described in this publication. It is one of a series of Habitat Suitability Index (HSI) models and was developed through an analysis of available information on the species-habitat requirements of the species. Habitat use information is presented in a review of the literature, followed by the development of an HSI model, designed for use in impact assessment and habitat management activities.

17. Document Analysis a. Descriptors

Animal behavior
Mathematical models
Birds
Wildlife
Habits

b. Identifiers/Open-Ended Terms

Yellow-headed blackbird
Xanthocephalus xanthocephalus
Habitat Suitability Index
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