Biological Services Program
and
Division of Ecological Services

FWS/OBS-82/10.29
SEPTEMBER 1982

HABITAT SUITABILITY INDEX MODELS: EASTERN MEADOWLARK

Fish and Wildlife Service

U.S. Department of the Interior

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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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September 1982

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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

	Page
PREFACE	iii
ACKNOWLEDGMENTS	v
HABITAT USE INFORMATION	1
General	1
Food	1
Water	1
Cover	1
Reproduction	2
Interspersion	2
Special Considerations	2
HABITAT SUITABILITY INDEX (HSI) MODEL	2
Model Applicability	2
Model Description	3
Model Relationships	5
Application of the Model	7
SOURCES OF OTHER MODELS	9
REFERENCES	9

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EASTERN MEADOWLARK (*Sturnella magna*)

HABITAT USE INFORMATION

General

The eastern meadowlark (*Sturnella magna*) is an omnivorous ground feeder (Willson 1974) that nests in open fields throughout the eastern and south-central United States (Robbins et al. 1966).

Food

Approximately 74% of the annual diet consists of animal matter and includes mainly beetles, grasshoppers, caterpillars, and occasionally flies, wasps, and spiders (Beal 1926, cited by Gross 1958). Crickets and grasshoppers comprise 26% of the annual diet, and beetles make up 25% of the annual diet. The remainder of the diet consists of vegetable matter, mainly grain and weed seeds. Seeds of smartweed (*Polygonum* spp.), ragweed (*Ambrosia* spp.), corn, wheat, rye, and oats are eaten in the winter months when insects are scarce (Gross 1958). Fruits, such as wild cherries (*Prunus* spp.), strawberries (*Fragaria* spp.), and blackberries (*Rubus* spp.), may also constitute a small percentage of the diet. During adverse winter weather, eastern meadowlarks have been observed to feed on road kills (Hubbard and Hubbard 1969).

Water

No data on drinking water requirements for the eastern meadowlark were located in the literature, although captive eastern meadowlarks do bathe in and drink free water (Gross 1958).

Cover

The eastern meadowlark is primarily found in grasslands, meadows, and pastures (Gross 1958). Meadowlarks inhabited old field successional stages in Georgia from 1 (grass-forb) to 15 years (grass-shrub) after the fields were no longer farmed (Johnston and Odum 1956). This species inhabited fields where shrub coverage was less than 35%, regardless of grass cover in the area. Feeding and loafing cover areas in Missouri that had high use were characterized as grasslands with no forbs or scattered forbs present, while areas where forbs were dominant had little use (Skinner 1975). Maximum use was observed in grazed grasslands between 10 and 30 cm tall (4 and 12 inches), with scattered forbs present.

Reproduction

The preferred nesting habitat of the eastern meadowlark in Illinois was pasture, followed in descending order by hayfields, soilbank fields, winter wheat fields, idle areas, and fallow areas (Roseberry and Klimstra 1970). The density of nesting meadowlarks in pastures was inversely related to the intensity of grazing. Highest nesting densities occurred during the 2 years when pastures were not grazed, and numerous dead grass stems and vigorous stands of grass (fescue) were present. Nesting densities in haylands were highest in a mixed-grass hayfield. Use of alfalfa fields, wheat fields, and fallow areas for nesting was low because these areas lacked sufficient grassy cover to provide suitable nesting habitat. Idle areas were little used when shrubs and trees became abundant. The average height of nesting cover was 38 cm (15 inches), with the majority of nests located in cover 25 to 50 cm (10 to 20 inches) high. The presence of dead grass stems at ground level and the absence of woody vegetation or numerous shrubs in the immediate vicinity of the nest site seemed necessary for nesting.

Nests of the eastern meadowlark are built in shallow depressions and have a dome-shaped roof constructed of grass, frequently interwoven with clumps of grasses or weeds (Gross 1958). Elevated singing and lookout perches, such as telephone wires, electric power lines, mounds of earth, farm implements, or fence posts, are used by males.

Interspersion

Meadowlark territories in Wisconsin varied in size from 1.2 to 6.1 ha (3 to 15 acres) and were commonly 2.8 to 3.2 ha (7 to 8 acres) (Lanyon 1956). The average size of 15 territories in New York was 2.8 ha (7 acres) (Gross 1958).

Special Considerations

Domestic cats and dogs prey on the eggs and young of the eastern meadowlark, and close proximity of nesting sites to human habitations is undesirable (Lanyon 1957). Mowing and heavy grazing by livestock may destroy meadowlark nests (Roseberry and Klimstra 1970).

HABITAT SUITABILITY INDEX (HSI) MODEL

Model Applicability

Geographic area. This model was developed for application within the breeding range of the eastern meadowlark.

Season. This model was developed to evaluate the breeding season habitat of the eastern meadowlark.

Cover types. This model was developed to evaluate habitat quality in the following cover types: Pasture and Hayland (P/H); Grassland (G); and Forbland (F) (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 occupy an area. Specific information on minimum areas required for eastern meadowlarks was not found in the literature. Based on home range data, it is assumed that a minimum of 1.2 ha (3.0 acres) of habitat must exist or the HSI will equal zero.

Verification level. Previous drafts of this model were reviewed by Fred Alsop, and his specific comments were incorporated into the current draft (Alsop, pers. comm.).

Model Description

Overview. This model considers the feeding and reproductive needs of the eastern meadowlark to determine overall habitat quality and assumes that these two life requisites can be combined to assess habitat. It is assumed that cover needs are met by the feeding and reproductive habitat needs and that water will not be a limiting factor. All of the life requirements of the eastern meadowlark can be provided within each cover type in which it occurs.

The relationship between habitat variables, life requisites, cover types, and the HSI for the eastern meadowlark is illustrated in Figure 1.

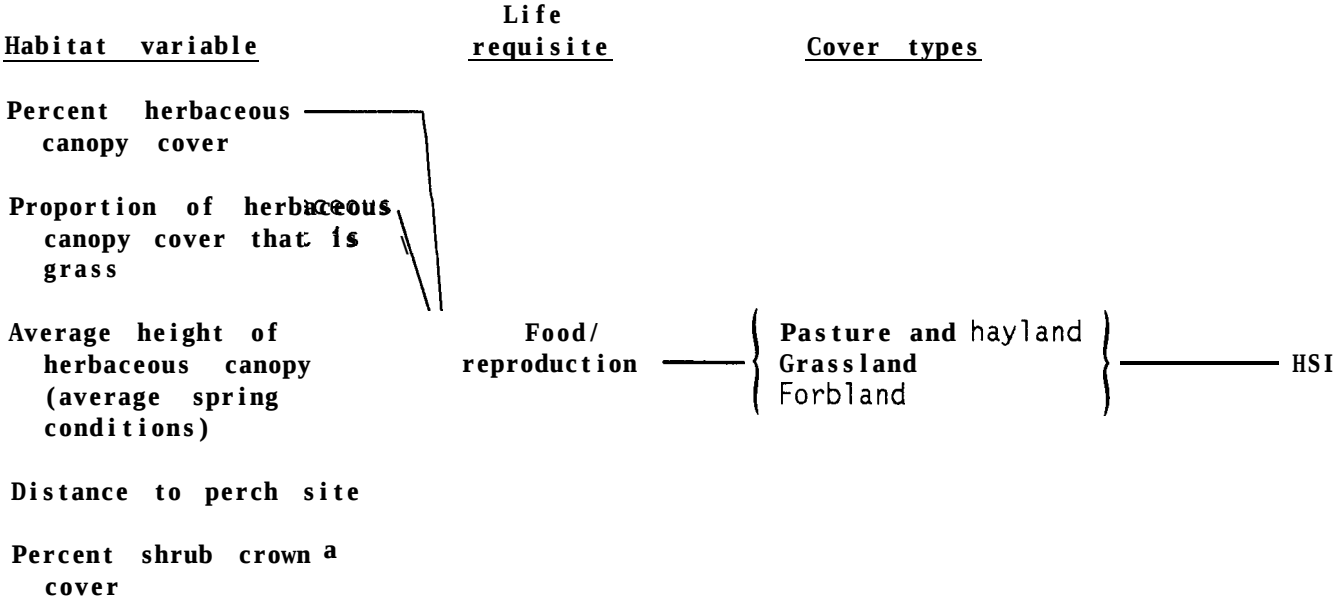


Figure 1. Relationships of habitat variables, life requisites, and cover types in the eastern meadowlark model.

The following sections provide a written documentation of the logic and assumptions used to interpret the habitat information for the eastern meadowlark in order 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.

Food/reproduction component. Feeding and reproductive habitat suitability for the eastern meadowlark is related to the height and density of herbaceous vegetation, the abundance of grasses, the presence of shrubs, and the proximity of perch sites. Optimal habitats occur in herbaceous cover types dominated by grasses of moderate heights with low shrub densities and adequate numbers of perches. Meadowlarks prefer very dense vegetation, and optimal herbaceous densities are assumed to occur at greater than 90% canopy cover. Suitability will decrease as the total herbaceous canopy cover decreases, and habitats will not be suitable at canopy covers of less than 20%. Data in the literature indicate that the best habitats are in grasslands with few forbs and that meadowlarks avoid areas where forbs are predominant. It is assumed that optimal conditions will exist when greater than 80% of the herbaceous cover is grass, that suitability will decrease as the relative percent of grass decreases, and that the habitat will not be suitable when less than 20% of the herbaceous cover is grass.

Data in the literature indicate that ideal vegetative heights for foraging and loafing are between approximately 10 and 30 cm (4 and 12 inches) and that the best heights for nesting are between 25 and 50 cm (10 and 20 inches). It is assumed that a large majority of the habitat should be suitable for foraging and loafing to have optimal habitat conditions. Therefore, it is assumed that the best habitats will have an average spring season canopy height of between 12.5 and 35 cm (5 and 14 inches). It is assumed that there will be enough variation in the actual canopy height so that there is a high likelihood of both suitable feeding and nesting heights being present if the average height falls within the range indicated. It is further assumed that, if the average height is less than 2.5 cm (1.0 inches) or greater than 76 cm (30 inches), no suitability will exist.

Ideal meadowlark habitats contain an abundance of perch sites, such as tall forbs, shrubs, trees, fences, or telephone wires. These perches can be within the cover type or on the periphery, such as a forest edge. It is assumed that optimal conditions exist when the average distance from random points in the cover type being evaluated to a suitable perch is less than 30 m (100 ft). This is equivalent to about four perches per 1.2 ha (3.0 acres), the minimum habitat area for the eastern meadowlark. It is assumed that suitability will decrease as the distance to perch sites increases to 60 m (Z00 ft), which is equal to about one perch site per 1.2 ha (3.0 acres). Some habitat suitability may exist even when there are no apparent perch sites, because of the adaptability of the meadowlark in selecting perches.

Suitability of the herbaceous component of the habitat is related to the total herbaceous cover, the relative grass cover, the height of herbaceous vegetation, and the proximity of perch sites. It is assumed that each variable exerts a major influence on overall habitat suitability. A habitat must contain optimal levels of all variables to have maximum suitability. Low

values of any one variable may be partially offset by higher values of the remaining variables. Habitats with low values for two or more of these variables will have low suitability levels.

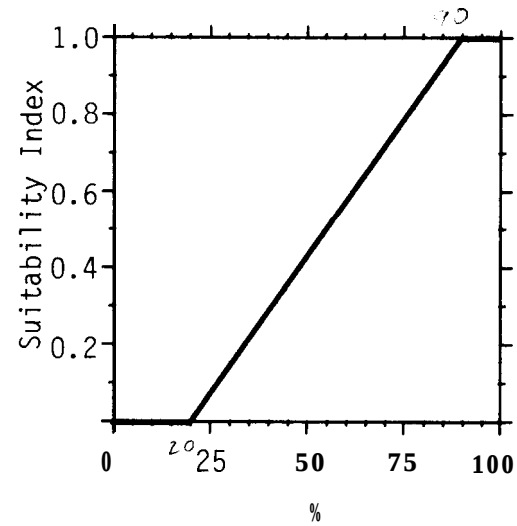
The presence of a moderate or dense shrub cover is a negative influence in meadowlark habitat selection. Optimal habitats contain less than 5% shrub canopy; suitability will decrease as shrub densities increase, and habitat will not be suitable at shrub densities greater than 35%.

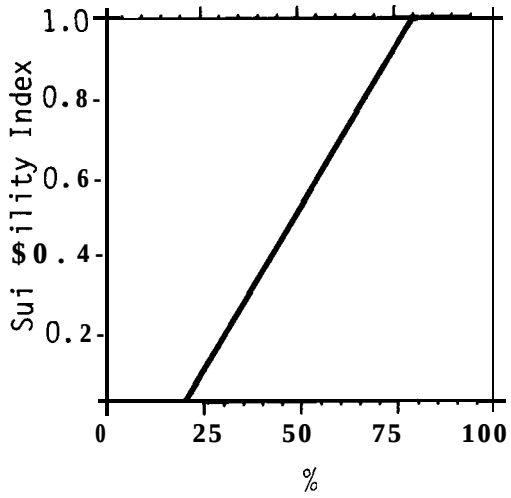
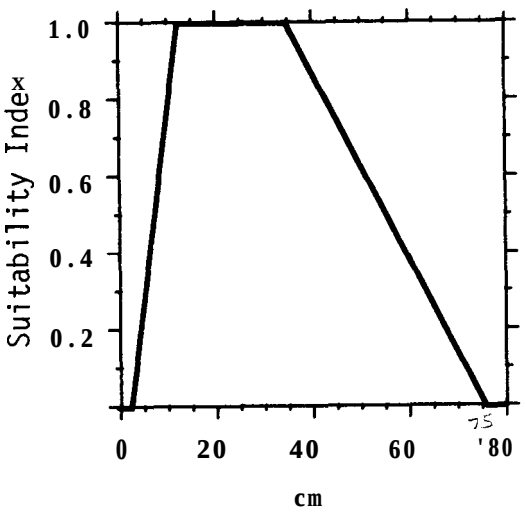
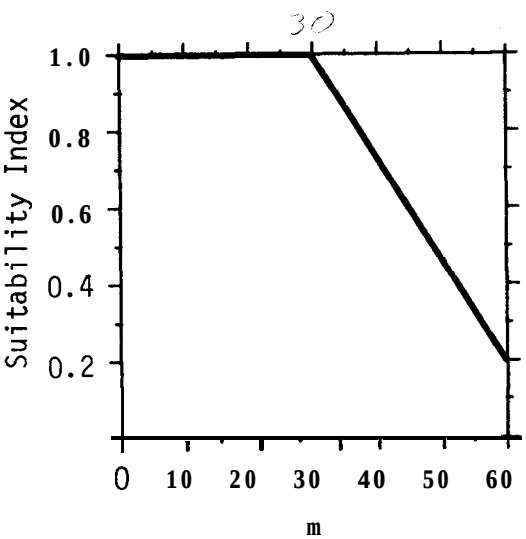
Overall habitat suitability is related to the quality of the herbaceous component described above and the abundance of shrubs. It is assumed that, as shrub densities. increase above 5%, the overall habitat value will decrease, regardless of the quality of the herbaceous component.

Model Relationships

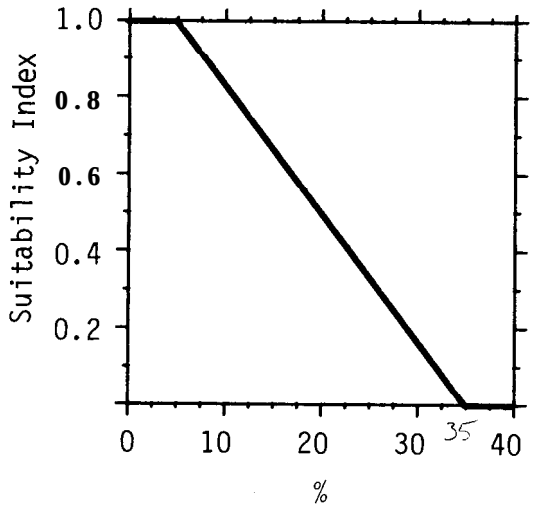
Suitability Index (Si) graphs for habitat variables. This section contains suitability index graphs that illustrate the habitat relationships described in the previous section.

Cover Type	Variable	
P/H,G, F	V_1	Percent herbaceous canopy cover.



P/H,G, F	V_2	Proportion of herbaceous canopy cover that is grass.	
P/H, G, F	V_3	Average height of herbaceous canopy (average spring conditions).	
P/H,G, F	V_4	Distance to perch site (such as tall forb, shrub, tree, fence, or telephone wires).	

P/H,G, F	V_5	Percent shrub crown cover.



Equations. In order to determine life requisite values for the eastern meadowlark, the SI values for appropriate variables must be combined through the use of eauations. A discussion and explanation of the assumed relationships between variables was included under Model Description, and the specific equation in this model was chosen to mimic these perceived biological relationships as closely as possible. The suggested equation for obtaining the food/reproduction value is presented below.

Life requisite	Cover type	Equation
Food/Reproduction	P/H,G,F	$(V_1 \times V_2 \times V_3 \times V_4)^{1/2} \times v_5$

HSI determination. The HSI for the eastern meadowlark is equal to the life requisite value for food/reproduction.

Application of the Model

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

Variable (definition)		Cover types	Suggested techniques
V_1	Percent herbaceous canopy cover (the percent of the ground that is shaded by a vertical projection of all nonwoody vegetation).	P/H,G,F	Line intercept
V_2	Proportion of herbaceous canopy cover that is grass (the relative percent of all herbaceous cover that is comprised of grasses).	P/H,G,F	Line intercept
V_3	Average height of herbaceous canopy (average spring conditions) (the average vertical distance from the ground surface to the dominant height stratum of the herbaceous vegetative canopy during average spring conditions).	P/H,G,F	Line intercept, graduated rod
V_4	Distance to perch site (such as tall forb, shrub, tree, fence, or telephone wires) (the average distance from random points to the nearest suitable perch site, within or outside the boundaries of the cover type).	P/H,G,F	Pacing
V_5	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).	P/H,G,F	Line intercept

Figure 2. Definitions of variables and suggested measurement techniques.

SOURCES OF OTHER MODELS

No other habitat models for the eastern meadowlark were identified.

REFERENCES

Alsop, F. pers. comm. (16 July 1981). East Tennessee State University, Kingsport, Tennessee.

Beal, F. E. L. 1926. Some common birds useful to the farmer. U.S.D.A. Farmer's Bull. 630. Cited by Gross 1958.

Gross, A. O. 1958. Eastern meadowlark. Pages 53-80 in A. C. Bent. Life histories of North American blackbirds, orioles, tanagers, and allies. U.S. Natl. Mus. Bull. 211.

Hays, R. L., C. S. Summers, and W. Seitz. 1981. Estimating wildlife habitat variables. U.S. Dept. Int., Fish Wildl. Serv. FWS/OBS-81/47. 173 pp.

Hubbard, J. P., and C. L. Hubbard. 1969. Meadowlarks feeding on road-kills. Wilson Bull. 81(1):107-108.

Johnston, D. W., and E. P. Odum. 1956. Breeding bird populations in relation to plant succession on the piedmont of Georgia. Ecology 37(1):50-62.

Lanyon, W. E. 1956. Territory in the meadowlarks, genus Sturnella. Ibis 98:485-489.

_____. 1957. The comparative biology of the meadowlarks (Sturnella) in Wisconsin. Publ. Nuttall Ornithol. Club 1. Cambridge, Mass. 67 pp.

Robbins, C. S., B. Bruun, and H. S. Zim. 1966. A guide to field identification, Birds of North America. Golden Press, N.Y. 340 pp.

Roseberry, J. L., and W. D. Klimstra. 1970. The nesting ecology and reproductive performance of the eastern meadowlark. Wilson Bull. 82(2):241-267.

Skinner, R. M. 1975. Grassland use patterns and prairie bird populations in Missouri. Pages 171-180 in M. K. Wali, ed. Prairie: a multiple view. Univ. North Dakota Press, Grand Forks.

U.S. Fish and Wildlife Service. 1981. Standards for the development of habitat suitability index models. 103 ESM. U.S. Dept. Int., Fish Wildl. Serv., Division of Ecological Services. n.p.

Willson, J. F. 1974. Avian community organization and habitat structure. Ecology 55:1017-1029.

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Habitat preferences of the eastern meadowlark (Sturnella magna) are described in this publication, which is one of a series of Habitat Suitability Index (HSI) models. Habitat use information is presented in a synthesis of the literature on the species-habitat requirements of the eastern meadowlark, followed by the development of the HSI model. The model is presented in three formats: graphic, word, and mathematical, and is designed to provide information for use in impact assessment and habitat management activities.

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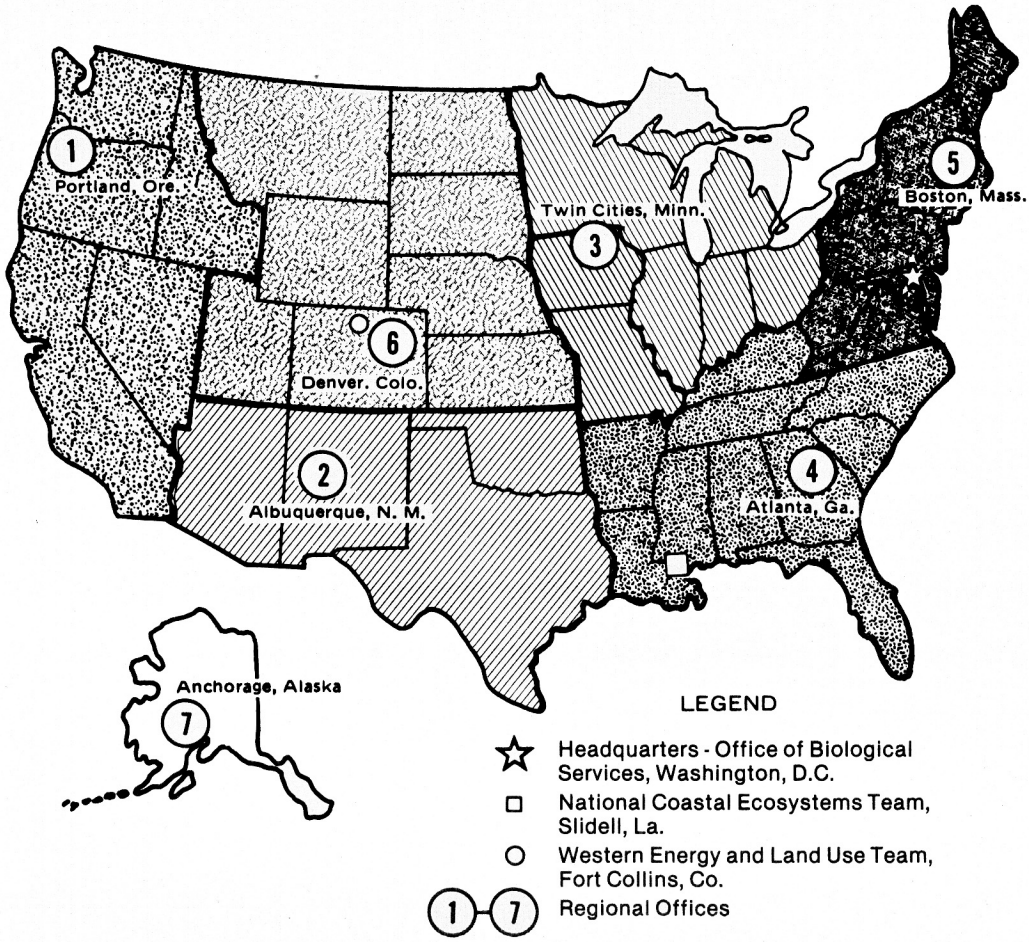

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