



Habitat Suitability Index Model Availability for Wetland Cover Types

PURPOSE: This technical note summarizes information from 66 Habitat Suitability Index (HSI) models for wildlife species that use wetland cover types. Items of information include the specific wetlands for which the models apply, States in which the species occur, and taxonomic groupings. The information is presented in a series of tables, so that users can quickly determine the number and variety of HSI models available for application in wetland habitats in their geographic work area. The data presented apply only to wildlife species and do not include HSI models for fish species.

BACKGROUND: Wetland protection has emerged as an important concern in environmental planning across the United States (Steiner and others 1994). Federal and State regulatory agencies must assess impacts to these wetlands and determine the need for alternative plans or mitigation. The Habitat Evaluation Procedures (U.S. Fish and Wildlife Service 1980) and Habitat Suitability Index (HSI) models (Schamberger, Farmer, and Terrell 1982) are useful tools in quantifying habitat value for fish and wildlife and comparing project or mitigation alternatives. Over 150 HSI models have been developed for a wide range of species that occupy upland, wetland, and aquatic habitats.

Only models published in the U.S. Fish and Wildlife Service's Biological Report Series (Schamberger, Farmer, and Terrell 1982) are reviewed.

HSI MODELS FOR WETLAND TYPES: The cover type classification system developed for HSI models contains 10 specific types for wetland and deepwater habitats (Table 1) (U.S. Fish and Wildlife Service 1981), and this system will be used to describe wetland HSI model availability. The wetland classification system developed by Cowardin and others (1979) contains much more detail than the HSI model system. The relation of the 10 HSI model wetland cover types to the wetland classification system developed by Cowardin and others (1979) is described in Appendix E of the U.S. Fish and Wildlife Service (1981) manual. Users are encouraged to review this appendix to gain a more thorough understanding of the similarities and differences between the two systems.

Of the first 17 models developed in the HSI model series, none applied to wetland cover types. Wetland models, however, are well represented in the remainder of the series, and comprise 10 of the last 17 published models. The herbaceous wetland cover type has the most species HSI models available ($n = 37$), followed by deciduous forested wetlands ($n = 33$), deciduous scrub-shrub wetlands ($n = 26$), and lacustrine wetlands ($n = 25$) (Table 2). Evergreen wetland types have fewer models than their deciduous counterparts (EFW has 22 and ESW, 16 versus DFW, 33 and DSW, 26). The marine wetland cover type has the fewest ($n = 5$) models available.

Seventeen HSI models have only a single wetland cover type listed for which the model applies, with seven of these restricted to the estuarine type. Ten HSI models apply to seven or more wetland cover types. There are a number of wildlife species more typically thought of as "upland" species that also use wetland types. For example, the fox and gray squirrel models can both be applied in deciduous forested wetlands, and herbaceous wetlands may provide nesting cover for the greater prairie-chicken. However, most wetland HSI models are for species typically thought to be closely associated with wetland habitats.

Table 1 Wetland Cover Type Classification System Used for HSI Models (U.S. Fish and Wildlife Service 1981)	
Wetlands	
Forested wetlands	
Evergreen forested wetland (EFW)	
Deciduous forested wetland (DFW)	
Scrub-shrub wetlands	
Evergreen scrub-shrub wetland (ESW)	
Deciduous scrub-shrub wetland (DSW)	
Herbaceous wetland (HW)	
Shore, bottom wetland (SBW)	
Deepwater habitats	
Riverine (R)	
Lacustrine (L)	
Estuarine (E)	
Marine (M)	

HSI MODELS FOR GEOGRAPHIC AREAS: Information on the geographic distribution of HSI models was obtained from the models, when included there, or from checklists and field guides. Forty-nine of the 50 States have HSI models available for some wetland cover type (Table 3). Hawaii is the only State with no HSI wetland models. States with 35 or more wetland models available are Alabama, Louisiana, Minnesota, Mississippi, North Carolina, South Carolina, and Texas. States with fewer than 25 wetland models are Alaska, Arizona, Nevada, New Mexico, New York, Rhode Island, Utah, and West Virginia. For some species, the HSI models were not developed to cover the entire geographic range of the species. Thus, some of the species in Table 3 occur in more States than are listed, but the listed States accurately reflect the coverage described in the HSI model.

Twenty-six of the 66 species models apply to 10 or fewer States, and 17 apply to 40 or more States. The following widely distributed species apply to all States except Hawaii:

- | | |
|-------------------|----------------------|
| Beaver | Hairy woodpecker |
| Belted kingfisher | Muskrat |
| Downy woodpecker | Red-winged blackbird |
| Great blue heron | |

The U.S. Fish and Wildlife Service divides the conterminous United States into six regions (Figure 1). Regions 2 and 4 have the most HSI wetland models available (52 and 53, respectively), primarily because of the large number of models in those regions that apply to the estuarine cover type (Table 4). Region 1 has the fewest wetland models available (31). Deciduous forested wetlands and herbaceous wetlands have the most models in each of the six regions.

HSI MODELS BY TAXONOMIC GROUPS: Birds are the dominant taxonomic group in wetland HSI models, comprising 70 percent of the 66 wetland models. The percentages of other major taxonomic groups are as follows: mammals (18 percent), reptiles and amphibians (8 percent), and invertebrates (4 percent). Within the bird group, the breakdown of major groups of species models is:

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Table 2 Matrix of Wetland HSI Models and the Wetland Cover Types to Which They Apply										
Species Name and Publication Number	DFW	EFW	DSW	ESW	SBW	HW	L	R	E	M
Red-spotted newt (111)	X					X	X			
Bullfrog (138)	X	X	X	X	X	X	X	X		
Snapping turtle (141)	X	X	X	X	X	X	X			
Slider turtle (125)	X		X			X	X	X		
American alligator (136)					X	X			X	
Western grebe (69)						X				
Eastern brown pelican (90)									X	X
Great blue heron (99)	X	X	X	X	X	X	X	X	X	
Great egret (78)	X	X	X	X	X	X		X	X	
Roseate spoonbill (50)	X		X						X	
White ibis (93)	X	X	X	X	X	X			X	
Wood duck (43)	X		X			X		X		
Northern pintail (145)					X	X	X			
Northern pintail (Gulf coast wintering) (121)					X	X	X		X	
Blue-winged teal (breeding) (114)					X	X	X			
Mottled duck (52)			X		X	X			X	
Mallard (winter habitat) (132)	X		X		X	X	X	X		
American black duck (wintering) (68)									X	X
Gadwall (breeding) (100)					X	X	X			
Greater white-fronted goose (wintering) (116)					X	X				
Lesser scaup (wintering) (91)					X	X	X		X	X
Lesser scaup (breeding) (117)						X	X			
Redhead (wintering) (53)									X	

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Table 2 (Continued)										
Species Name and Publication Number	DFW	EFW	DSW	ESW	SBW	HW	L	R	E	M
Black brant (63)									X	
Canvasback (breeding) (82)			X			X	X			
Lesser snow goose (wintering) (97)					X	X	X		X	
Black-bellied whistling-duck (breeding) (150)	X		X			X	X			
Osprey (154)	X	X	X	X		X	X	X		
Black-shouldered kite (130)						X				
Bald eagle (breeding season) (126)							X		X	
Greater prairie-chicken (102)						X				
Eastern wild turkey (106)	X									
American coot (115)						X	X	X		
Clapper rail (51)									X	
Greater sandhill crane (140)	X	X	X	X	X	X	X	X		
American woodcock (wintering) (105)	X	X	X	X						
Laughing gull (94)									X	
Least tern (103)					X		X	X	X	X
Forster's tern (breeding) (131)									X	
Barred owl (143)	X	X								
Belted kingfisher (87)							X	X		
Pileated woodpecker (39)	X	X								
Lewis' woodpecker (32)	X									
Downy woodpecker (38)	X	X								
Hairy woodpecker (146)	X	X								
Black-capped chickadee (37)	X	X								

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Table 2 (Concluded)										
Species Name and Publication Number	DFW	EFW	DSW	ESW	SBW	HW	L	R	E	M
Marsh wren (139)			X	X		X	X	X	X	
Veery (22)	X	X	X							
Yellow warbler (27)			X							
Red-winged blackbird (95)						X				
Yellow-headed blackbird (26)						X				
Black bear (144)	X	X	X	X		X				
Fisher (45)	X	X								
Mink (61) (127-R)	X	X	X	X		X	X	X		
Bobcat (147)	X		X							
Moose (155)	X	X	X	X		X	X	X		
White-tailed deer (123)	X	X	X	X		X				
Gray squirrel (19) (135-R)	X									
Fox squirrel (18)	X									
Beaver (30)	X	X	X	X		X	X	X		
Muskrat (46)						X		X	X	
Snowshoe hare (101)	X	X	X	X						
Swamp rabbit (107)	X	X	X	X		X				
Gulf of Mexico American oyster (57)									X	
Hard clam (77)									X	
Littleneck clam (59)									X	X
Total for cover type	33	22	26	16	17	37	25	17	23	5

(Sheet 3 of 3)

Table 3																									
Matrix of Wetland HSI Models and the States in Which Each Species Occurs																									
Species Name (USFWS Publication Number)	State of Occurrence (Alabama-Montana)																								
	AL	AK	AZ	AR	CA	CO	CT	DE	FL	GA	ID	IL	IN	IA	KS	KY	LA	ME	MD	MA	MI	MN	MS	MO	MT
Red-spotted newt (111)	X						X	X				X			X	X	X	X	X	X		X			
Bullfrog (138)	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Snapping turtle (141)	X			X		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Slider turtle (125)	X			X				X	X		X	X	X	X	X	X						X	X		
American alligator (136)	X							X									X						X		
Western grebe (69)					X	X				X			X									X			X
Eastern brown pelican (90)								X									X								
Great blue heron (99)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Great egret (78)	X							X	X								X						X		
Roseate spoonbill (50)	X							X									X						X		
White ibis (93)	X							X	X								X						X		
Wood duck (43)	X			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Northern pintail (145)														X								X			X
Northern pintail (Gulf coast wintering) (121)																	X								
Blue-winged teal (breeding) (114)														X								X			X
Mottled duck (52)																	X								
Mallard (winter habitat) (132)				X							X					X	X						X	X	
American black duck (wintering) (68)								X											X						

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Table 3 (Continued)																										
Species Name (USFWS Publication Number)	State of Occurrence (Alabama-Montana)																									
	AL	AK	AZ	AR	CA	CO	CT	DE	FL	GA	ID	IL	IN	IA	KS	KY	LA	ME	MD	MA	MI	MN	MS	MO	MT	
Gadwall (breeding) (100)																							X			X
Greater white-fronted goose (wintering) (116)																	X									
Lesser scaup (wintering) (91)	X							X	X								X							X		
Lesser scaup (breeding) (117)	X				X						X												X			X
Redhead (wintering) (53)	X							X									X						X			
Black brant (63)					X																					
Canvasback (breeding) (82)																							X			X
Lesser snow goose (wintering) (97)	X																X						X			
Black-bellied whistling-duck (breeding) (150)																										
Osprey (154)	X				X	X	X	X	X	X	X						X	X	X	X	X	X	X			X
Black-shouldered kite (130)					X																					
Bald eagle (breeding season) (16)					X	X	X	X			X	X	X	X	X	X		X	X	X	X	X			X	X
Greater prairie-chicken (102)				X		X						X	X	X	X							X	X		X	
Eastern wild turkey (106)				X			X	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	

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Table 3 (Continued)																										
Species Name (USFWS Publication Number)	State of Occurrence (Alabama-Montana)																									
	AL	AK	AZ	AR	CA	CO	CT	DE	FL	GA	ID	IL	IN	IA	KS	KY	LA	ME	MD	MA	MI	MN	MS	MO	MT	
American coot (115)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Clapper rail (51)	X				X		X	X	X	X							X		X	X			X			
Greater sandhill crane (140)					X	X					X	X	X								X	X				X
American woodcock (wintering) (105)	X			X					X	X							X							X		
Laughing gull (94)	X								X								X							X		
Least tern (103)	X			X	X	X	X	X	X	X				X	X	X	X	X	X	X			X	X		
Forster's tern (breeding) (131)																	X		X							
Barred owl (143)	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Belted kingfisher (87)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pileated woodpecker (39)	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lewis' woodpecker (32)			X		X	X					X															X
Downy woodpecker (38)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hairy woodpecker (146)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black-capped chickadee (37)		X			X	X	X	X			X	X	X	X	X	X		X	X	X	X	X		X	X	
Marsh wren (139)	X		X		X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X
Veery (22)			X			X	X	X			X		X					X	X	X	X	X				X
Yellow warbler (27)	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Red-winged blackbird (95)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

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Table 3 (Continued)																										
Species Name (USFWS Publication Number)	State of Occurrence (Alabama-Montana)																									
	AL	AK	AZ	AR	CA	CO	CT	DE	FL	GA	ID	IL	IN	IA	KS	KY	LA	ME	MD	MA	MI	MN	MS	MO	MT	
Yellow-headed blackbird (26)			X		X	X					X	X	X	X	X							X		X	X	
Black bear (144)																					X	X				
Fisher (45)					X		X				X							X		X	X	X			X	
Mink (61) (127-R)	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bobcat (147)	X			X				X	X	X							X		X				X	X		
Moose (155)																					X	X				
White-tailed deer (123)				X					X	X						X	X						X			
Gray squirrel (19) (135-R)	X			X			X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		
Fox squirrel (18)				X		X		X		X		X	X	X	X	X			X		X	X	X	X	X	
Beaver (30)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Muskrat (46)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Snowshoe hare (101)	X	X			X	X	X	X			X							X	X	X	X	X			X	
Swamp rabbit (107)				X						X		X			X	X	X						X	X		
Gulf of Mexico American oyster (57)	X								X								X									
Hard clam (77)	X						X	X	X	X							X	X	X	X			X			
Littleneck clam (59)		X			X																					
Total for state	35	13	14	26	30	27	28	30	33	31	26	27	27	28	25	26	42	27	31	28	30	35	36	29	32	

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Table 3 (Continued)																								
Species Name (USFWS Publication Number)	State of Occurrence (Nebraska-Wyoming)																							
	NE	NV	NH	NJ	NM	NY	NC	ND	OH	OK	OR	PA	RI	SC	SD	TN	TX	UT	VT	VA	WA	WV	WI	WY
Red-spotted newt (111)			X	X		X	X		X			X		X		X			X	X		X		
Bullfrog (138)	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Snapping turtle (141)	X		X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X		X	X	X
Slider turtle (125)					X		X			X				X		X	X			X				
American alligator (136)																	X							
Western grebe (69)	X	X			X			X			X				X			X			X			X
Eastern brown pelican (90)							X							X			X							
Great blue heron (99)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Great egret (78)							X							X			X							
Roseate spoonbill (50)																	X							
White ibis (93)							X							X			X							
Wood duck (43)	X		X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	
Northern pintail (145)								X							X									
Northern pintail (Gulf coast wintering) (121)																	X							
Blue-winged teal (breeding) (114)	X							X							X									X
Mottled duck (52)																	X							
Mallard (winter habitat) (132)																	X							
American black duck (wintering) (68)				X			X													X				

Table 3 (Continued)																								
Species Name (USFWS Publication Number)	State of Occurrence (Nebraska-Wyoming)																							
	NE	NV	NH	NJ	NM	NY	NC	ND	OH	OK	OR	PA	RI	SC	SD	TN	TX	UT	VT	VA	WA	WV	WI	WY
Gadwall (breeding) (100)							X								X									
Greater white-fronted goose (wintering) (116)																	X							
Lesser scaup (wintering) (91)							X							X			X							
Lesser scaup (breeding) (117)	X	X					X				X				X			X			X			X
Redhead (wintering) (53)																	X							
Black brant (63)											X										X			
Canvasback (breeding) (82)							X								X									
Lesser snow goose (wintering) (97)																	X							
Black-bellied whistling-duck (breeding) (150)																	X							
Osprey (154)		X	X	X	X	X	X				X		X	X			X	X	X	X	X		X	X
Black-shouldered kite (130)																	X							
Bald eagle (breeding season) (16)	X	X	X	X		X		X	X		X	X	X		X			X	X	X	X	X	X	X
Greater prairie-chicken (102)	X							X	X	X					X		X							X
Eastern wild turkey (106)	X		X	X		X	X	X	X	X		X	X	X	X	X	X		X	X		X	X	

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Table 3 (Continued)																									
Species Name (USFWS Publication Number)	State of Occurrence (Nebraska-Wyoming)																								
	NE	NV	NH	NJ	NM	NY	NC	ND	OH	OK	OR	PA	RI	SC	SD	TN	TX	UT	VT	VA	WA	WV	WI	WY	
American coot (115)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Clapper rail (51)			X	X			X					X		X			X			X					
Greater sandhill crane (140)		X									X							X					X	X	
American woodcock (wintering) (105)							X			X				X		X	X			X					
Laughing gull (94)																	X								
Least tern (103)	X			X	X		X	X		X				X	X	X	X			X					
Forster's tern (breeding) (131)				X			X										X			X					
Barred owl (143)	X		X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Belted kingfisher (87)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pileated woodpecker (39)			X	X		X	X	X	X	X	X	X	X	X		X	X		X	X	X	X	X		
Lewis' woodpecker (32)		X			X						X							X			X			X	
Downy woodpecker (38)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hairy woodpecker (146)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black-capped chickadee (37)	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X
Marsh wren (139)	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X		X	X	X		X	X	X
Veery (22)		X	X	X		X	X	X	X		X	X	X		X			X	X	X	X	X	X	X	X
Yellow warbler (27)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X

Table 3 (Concluded)																								
Species Name (USFWS Publication Number)	State of Occurrence (Nebraska-Wyoming)																							
	NE	NV	NH	NJ	NM	NY	NC	ND	OH	OK	OR	PA	RI	SC	SD	TN	TX	UT	VT	VA	WA	WV	WI	WY
Red winged blackbird (95)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Yellow-headed blackbird (26)	X	X			X			X	X		X				X			X			X			X
Black bear (144)																							X	
Fisher (45)		X	X			X					X								X		X	X	X	
Mink (61) (127-R)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bobcat (147)							X							X		X	X			X				
Moose (155)																							X	
White-tailed deer (123)							X							X		X	X			X				
Gray squirrel (19) (135-R)	X		X	X		X	X	X	X	X		X	X	X		X	X		X	X		X	X	
Fox squirrel (18)	X			X			X	X	X	X		X		X	X	X	X			X		X	X	
Beaver (30)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Muskrat (46)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Snowshoe hare (101)	X	X		X	X		X		X	X	X	X		X	X		X	X	X	X	X	X	X	X
Swamp rabbit (107)										X				X		X	X							
Gulf of Mexico American oyster (57)																	X							
Hard clam (77)			X	X			X					X	X				X			X				
Littleneck clam (59)											X										X			
Total for state	27	23	26	30	20	24	37	30	26	25	28	25	23	35	30	27	45	21	25	34	27	24	29	25

(Sheet 8 of 8)

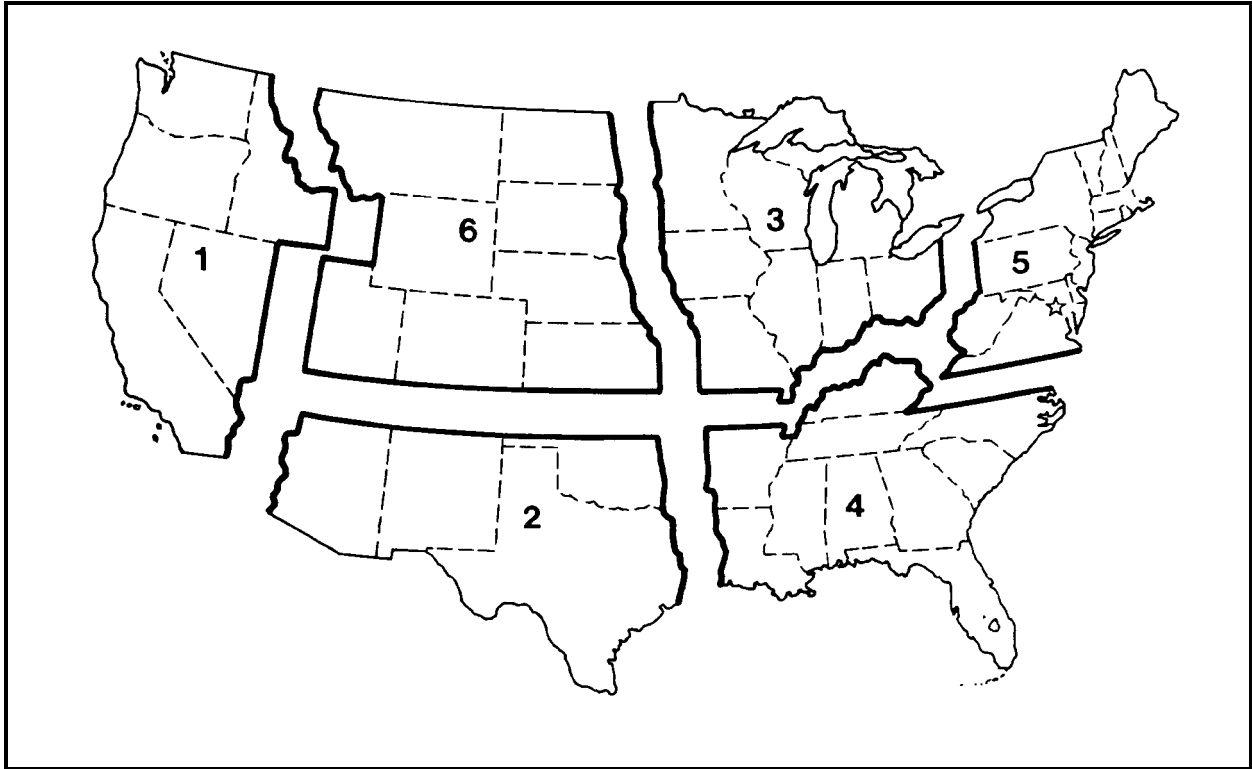


Figure 1. Division of conterminous United States into six USFWS regions

Table 4 Matrix of Wetland HSI Models and the U.S. Fish and Wildlife Service Regions of the Conterminous United States											
Region	Number of Wetland HSI Models per Cover Type										Total
	DFW	EFW	DSW	ESW	SBW	H	L	R	E	M	
1	16	14	11	8	4	15	12	12	8	4	31
2	27	18	21	13	12	27	17	14	20	4	52
3	27	19	20	13	9	27	21	16	5	2	43
4	28	19	22	14	13	28	20	16	21	4	53
5	24	17	16	11	4	17	14	14	9	3	38
6	23	16	16	10	9	23	19	14	6	4	40

Ducks and geese	16 models
Passerines	6 models
Hérons and allies	4 models
Raptors	4 models
Woodpeckers	4 models
Gulls and terns	3 models

Ducks and geese comprise almost one fourth of all wetland HSI models, and these 16 models (14 species) account for 23 percent of the 61 species of ducks and geese in North America (American Ornithologists' Union 1983). Shorebirds are very poorly represented in the HSI model series. There are 84 different species of shorebirds in North America (American Ornithologists' Union 1983), but only one HSI model exists for a shorebird (American woodcock).

The 12 species models for mammals consist of four carnivores, four rodents, two ungulates, and two lagomorphs. No small mammals (mice, voles, etc.) are represented in the mammal wetland models. Reptiles and amphibians are poorly represented in the wetland HSI models, with only five species, mostly from freshwater cover types. In some areas of the United States (for example, the Southeast), reptiles and amphibians comprise a high percentage of the total number of vertebrate species and are strongly associated with wetland types. The increasing concern with the reptile and amphibian vertebrate groups has been widely expressed (Beiswenger 1988, Gibbons 1988, Wyman 1990), and the lack of HSI models for these species represents a significant gap in the HSI model series. There are only three invertebrate species HSI models, none of which occurs in fresh water.

The availability of wetland HSI models appears to reflect both the political importance of species during the time the models were being developed and the amount of habitat information available for model development. From a taxonomic viewpoint, birds are overrepresented and all other groups are underrepresented in HSI models for wetlands. Within the bird HSI models, ducks and geese are the dominant group, comprising over one third of the bird wetland models. Groups such as amphibians, neotropical migratory birds, shorebirds, and invertebrates, which are of growing interest to ecologists, are poorly represented in the HSI model series.

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