Wildlife Species Associations with Specific Attributes of the Wetland Vegetation Communities of Michigan

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1.0 Introduction

This report is intended to provide a foundation for eventually developing one module of the Michigan Rapid Assessment Method (MiRAM). Specifically, it provides information on specific attributes of wetlands that can be used, along with information on species ranges, to help predict the assemblage of wildlife species most likely to be found in a particular wetland or wetland community type. Such information is important for determining which wetlands may contribute the most to regional biodiversity, and which might be enhanced to improve that capacity. In turn, that information is important to decisions regarding assessment of impacts, mitigation requirements, and design of compensatory wetlands.

This report does not provide a ready-to-go set of integrated models for scoring the habitat functions of a specific wetland. Developing that capacity would require considerably more resources than were available for this initial phase. Nonetheless, the information presented herein will greatly expedite the future development of such a module as part of MiRAM, as resources may become available.

This report is organized as follows. Section 2.0 provides information for predicting individual species likely to occur regularly, either as migrants or breeders, within various wetland vegetation communities and within wetlands having specific attributes. This information is also compiled in an accompanying electronic database. Section 3.0 provides a brief synthesis of this information, summarizing the key factors important to each of the major groups (guilds) of wildlife.

The basic process used to prepare this report proceeded as follows:

1. I created a database of the wetland communities vs. counties from maps provided by the MNFI.
2. Based on professional judgment, I selected 348 of the 399 species in the MIWILD database as being "wetland-associated" during their breeding season. Several wetland-dependent bird species that do not breed in Michigan, but which occur regularly during migration and/or winter, were also included. The MIWILD database that I consulted was developed by Scott Thomasma and others, with sponsorship by the USDA Forest Service and Michigan Department of Natural Resources.
3. Based on my professional knowledge, some literature, and multiple queries of the MIWILD database (which does not use the new MNFI classification), I associated each of the 348 species with one or more of the 33 wetland community types (indicating present or absent).
4. Using the MIWILD species-county database and the databases from #1 and #3 above, I queried to create a database that lists a species as occurring in a county only if at least one of the vegetation community types it associates with is also present in the county. Maps showing the estimated county distribution of the community types had been drafted by the MNFI. The resulting database has 119,815 records and is sorted by community type.
5. From my experience as a wildlife biologist, I identified 21 additional attributes needed to predict the particular assemblage of species likely to occur regularly in a given wetland. I then cross-walked these with the community types and with each of the 348 wildlife species, and described the associations narratively (Section 2.0).
6. I prepared the synthesis (Section 3.0) from my professional knowledge and a review of the database outputs.

2.0 Predicting the Composition and Richness of Wildlife Communities in Michigan Wetlands

The particular species that occur regularly in any given wetland in Michigan are determined primarily by geography and climate; the depth, seasonal persistence, and extent of surface water; and the forms and spacing of vegetation. In concept, these factors and observable attributes that define and augment them can be used to predict the species and species groups (guilds) most likely to occur in a given wetland. In this section, specific attributes that predict species composition are described, their occurrence within the various wetland community types is described (Table 1), and species whose occurrence they can help predict are listed (Table 2). This approach was taken, rather than printing lists of species directly by community type, because of the considerable variation in these attributes within any given community type. This list of attributes is not all-inclusive, but rather focuses on attributes that together are important predictors of the largest numbers of wetland-dependent wildlife species.

Table 1. Estimated degree of association of various habitat attributes with Michigan's 33 wetland community types

For column headings see abbreviations at end. Occurrences based on professional opinion only.
1= primary association; 2= secondary association; blank= usually absent or very limited association

	Deep	Shallow	Vernal	SatHerb	Moss	Robust	SSdecid	SSever	TreeDecid	TreeEver	BigTree	Snags	LWD	Stable	Mud	Flow	Bank
Submergent Marsh	1																
Emergent Marsh	2	1	2	2		1									1		
Great Lakes Marsh	2	1	2	2		1						2			1		1
Wooded Dune & Swale Complex		2	2	2		2	1		2		2	2	2		2		
Coastal Plain Marsh		1	2	2		1	2								1		
Inland Salt Marsh			1	1	2										1		
Interdunal Wetland		2	1	1	2	2	2	2	2						2		
Coastal Fen		1	2	2		1	1	1				1			1		
Northern Fen		1	2	2	2	2	2	2		2				1			
Patterned Fen		1	2	2	1	2		2		2				1	2		
Poor Fen		1	2	2				2		2				1	2		
Prairie Fen		1	2	2					2					1	2		
Lakeplain Wet-Mesic Prairie		2	1	1													
Lakeplain Wet Prairie		2	1	1													
Wet-Mesic Prairie		2	1	1			2							2	2		
Wet-Mesic Sand Prairie		2	1	1										2	2		
Wet Prairie		2	1	1											2		
Intermittent Wetland			1	1	2		2	2	2						1		
Northern Wet Meadow		2	1	1		2	2	2			2	2	2	2			
Southern Wet Meadow		2	1	1		2						2	2	2			
Bog		2	1	1	1	2		1						1			
Muskeg		2	1	1	1	2		1		1				1			
Northern Shrub Thicket							1	1	2	2	2	2	2	2			
Poor Conifer Swamp								1		1		1	1	2			

	Deep	Shallow	Vernal	SatHerb	Moss	Robust	SSdecid	SSever	TreeDecid	TreeEver	BigTree	Snags	LWD	Stable	Mud	Flow	Bank
Northern Hardwood Swamp							2	2	1		1	1	1	2			
Rich Tamarack Swamp								1		1		1	1	2			
Rich Conifer Swamp							2	1	2	1	1	1	1	2			
Hardwood-Conifer Swamp							2	1	2	1	1	1	1	2			
Southern Hardwood Swamp							2		1		1	1	1	2			
Southern Shrub-Carr						2	1		2			2	2				
Inundated Shrub Swamp							1		2			1					
Wet-Mesic Flatwoods							2		1		1	1	1				
Floodplain Forest							2		1		1	1	1		1	1	1

Abbreviations of the habitat attributes (column headings):
Deep= Extensive and/or Deep Surface Water
Shallow= Shallow Persistent Surface Water with Herbaceous Vegetation
Vernal= Shallow Seasonal (Vernal) Surface Water with Herbaceous Vegetation
SatHerb= Surface Water Absent and Herbaceous Vegetation Dominates
Moss= Moss Substrate; Acidic Conditions; Limited Surface Water; Few Trees
Robust= Robust Emergents
SSdecid= Deciduous Shrub Cover
SSever= Evergreen Shrub Cover
TreeDecid= Deciduous Trees
TreeEver= Evergreen Trees
BigTree= Large-diameter Trees
Snags= Snags
LWD= Downed Wood
Stable= Seasonally Predictable Water Levels
Mud= Proximity to Exposed Bare Substrate
Flow= Proximity to Flowing Water
Bank= Proximity to Exposed Banks

2.1 Extensive and/or Deep Surface Water

Species associated with this attribute mostly feed below the water surface on fish and aquatic invertebrates. Thus, the wetland type in which they are most likely to occur is Submergent Marsh, and secondarily in Emergent Marshes and Great Lakes Marshes that contain or adjoin large, deep, open bodies of water. For most of the species that associate with this attribute, their use of wetlands is facultative – that is, they may use the deeper non-wetland waters as much or more than wetlands. Some of these species occur only in coastal locations. The species that are most likely to associate with this attribute are marked in the "Deep" column of Table 2a.

2.2 Shallow Persistent Surface Water with Herbaceous Vegetation

This attribute consists of areas dominated by emergent herbaceous vegetation, in which lentic surface water persists through at least mid-summer during most years. This attribute is assumed to occur most commonly within the following wetland communities:

Emergent Marsh
Great Lakes Marsh
Coastal Plain Marsh
Coastal Fen
Northern Fen
Patterned Fen
Poor Fen
Prairie Fen

It is assumed to occur less consistently within other wetland types that include:

Northern Wet Meadow
Southern Wet Meadow
Lakeplain Wet Prairie
Lakeplain Wet-mesic Prairie
Wet Prairie
Wet-mesic Prairie
Wet-mesic Sand Prairie
Interdunal Wetland
Bog
Muskeg
Wooded Dune and Swale Complex

The species that are most likely to associate with this attribute are shown in Table 2a. This wetland community type may contribute the most to biodiversity in regions dominated by forest cover, because of complementarity of characterizing species.

2.3 Shallow Seasonal (Vernal) Surface Water with Herbaceous Vegetation

This attribute consists of areas dominated by emergent herbaceous vegetation, but lentic surface water does not persist through at least mid-summer during most years, and in some cases may be present only for 2 weeks following heavy precipitation or runoff. This attribute is assumed to occur most commonly within the following wetland communities:

Intermittent Wetland
Northern Wet Meadow
Southern Wet Meadow
Lakeplain Wet Prairie
Lakeplain Wet-mesic Prairie
Wet Prairie
Wet-mesic Prairie
Wet-mesic Sand Prairie
Inland Salt Marsh
Interdunal Wetland
Bog
Muskeg

Perhaps less frequently, it occurs within other wetland types, especially along their upland edge, and those types may include:

Coastal Fen
Northern Fen
Patterned Fen
Poor Fen
Prairie Fen
Emergent Marsh
Great Lakes Marsh
Coastal Plain Marsh
Wooded Dune and Swale Complex

When this attribute comprises the entirety of a wetland, and the wetland lacks a surface water connection to other water bodies, many amphibians and aquatic invertebrates which do not tolerate well the presence of fish can thrive, because the lack of persistent surface water eliminates most fish.

This wetland community type may contribute the most to biodiversity in regions dominated by forest cover, because of complementarity of characterizing species. Species that are most likely to associate with this attribute are shown in Table 2a.

2.4 Surface Water Absent and Herbaceous Vegetation Dominates

This attribute consists of areas dominated by emergent herbaceous vegetation, but lentic surface water is almost always absent. Yet, these areas are considered wetlands if the upper soil layers remain saturated for periods that are sufficiently long to exclude upland vegetation. The prolonged saturation discourages colonization and persistence of many tree species. This attribute is assumed to occur most commonly within the following wetland communities:

Intermittent Wetland
Northern Wet Meadow
Southern Wet Meadow
Lakeplain Wet Prairie
Lakeplain Wet-mesic Prairie
Wet Prairie
Wet-mesic Prairie
Wet-mesic Sand Prairie
Inland Salt Marsh
Interdunal Wetland
Bog
Muskeg

Perhaps less frequently, it occurs within other wetland types, especially along their upland edge, and those types may include:

Coastal Fen
Northern Fen
Patterned Fen
Poor Fen
Prairie Fen

Emergent Marsh
Great Lakes Marsh
Coastal Plain Marsh
Wooded Dune and Swale Complex

This wetland community type may contribute the most to biodiversity in regions dominated by forest cover, because of complementarity of characterizing species. Species most likely to associate with this attribute are shown in Table 2a.

2.5 Moss Substrate; Acidic Conditions; Limited Surface Water; Few Trees

This attribute consists of naturally acidic areas dominated by mosses, with little or no surface water at any season, and without significant tree cover. This attribute defines Bog and Muskeg, the latter assumed to have greater (but still limited) tree cover. Secondarily, smaller patches may be associated with Patterned Fen, Northern Fen, and Intermittent Wetland. Species most likely to associate with this attribute are shown in Table 2a.

2.6 Robust Emergents

This attribute consists of tall, robust, herbaceous plant species such as bulrush, cattail, and common reed (*Phragmites*). Surface water is often present for long durations beneath a sometimes-dense and nearly monotypic canopy provided by these plants. This attribute is assumed to occur most commonly within the following wetland communities:

Emergent Marsh
Great Lakes Marsh
Coastal Plain Marsh
Coastal Fen

Perhaps less frequently, it can occur within some other wetland types, and those may include:

Northern Wet Meadow
Southern Wet Meadow
Northern Fen
Patterned Fen
Poor Fen
Inland Salt Marsh
Interdunal Wetland
Wooded Dune and Swale Complex
Southern Shrub-carr
Bog
Muskeg

Species most likely to favor wetlands having this attribute are so marked in Table 2a.

2.7 Deciduous Shrub Cover

This attribute consists of deciduous woody vegetation less than 20 ft in height, and excluding Tamarack. If present at all, surface water is present only for short durations (seldom more than a few

months annually). This attribute is assumed to occur most commonly within the following wetland communities:

Northern Shrub Thicket
Southern Shrub-carr
Wooded Dune and Swale Complex
Inundated Shrub Swamp
Coastal Fen

Less frequently, it can occur within (and especially along upland edges of) other wetland types which may include:

Northern Wet Meadow
Intermittent Wetland
Interdunal Wetland
Hardwood-conifer Swamp
Northern Hardwood Swamp
Rich Conifer Swamp
Southern Hardwood Swamp
Wet-mesic Flatwoods
Floodplain Forest
Coastal Plain Marsh
Northern Fen
Prairie Fen
Wet-mesic Prairie

For most of the species that associate with this attribute, their use of wetlands is facultative – that is, they may use the deciduous shrub areas in nearby uplands as much or more than those in wetlands. Thus, whether the deciduous shrubs occur within the wetland or in nearby uplands matters little to many species. Species most likely to associate with this attribute are shown in Table 2. This wetland community type may contribute the most to biodiversity in regions dominated by openlands or evergreen shrubland, because of complementarity of characterizing species.

2.8 Evergreen Shrub Cover

This attribute consists of evergreen woody vegetation or Tamarack less than 20 ft in height. If present at all, surface water is present only for short durations (seldom more than a few months annually). This attribute is assumed to occur most commonly within the following wetland communities:

Northern Shrub Thicket
Hardwood-conifer Swamp
Poor Conifer Swamp
Rich Conifer Swamp
Rich Tamarack Swamp
Bog
Muskeg
Coastal Fen

Less frequently, it occurs within (and especially along upland edges of) other wetland types which may include:

Northern Hardwood Swamp
Patterned Fen
Poor Fen

Northern Fen
Interdunal Wetland
Intermittent Wetland
Northern Wet Meadow

For most of the species that associate with this attribute, their use of wetlands is facultative – that is, they may use the evergreen shrub areas in nearby uplands as much or more than those in wetlands. Thus, whether the evergreen shrubs occur within the wetland or in nearby uplands matters little to many species. Species most likely to associate with this attribute are shown in Table 2b. This wetland community type may contribute the most to biodiversity in regions dominated by openlands and deciduous shrubland, because of complementarity of characterizing species.

2.9 Deciduous Trees

This attribute consists of deciduous woody vegetation (excluding Tamarack) taller than 20 ft. If present at all, surface water occurs only for short durations (seldom more than a few weeks annually). This attribute is assumed to be present most commonly within the following wetland communities:

Wet-mesic Flatwoods
Floodplain Forest
Southern Hardwood Swamp
Northern Hardwood Swamp

Less frequently, it occurs within (and especially along upland edges of) other wetland types which may include:

Northern Shrub Thicket
Southern Shrub-carr
Wooded Dune and Swale Complex
Inundated Shrub Swamp
Intermittent Wetland
Interdunal Wetland
Hardwood-conifer Swamp
Rich Conifer Swamp

For most of the species that associate with this attribute, their use of wetlands is facultative – that is, they may use the deciduous forested areas in nearby uplands as much or more than those in wetlands. Thus, whether the deciduous trees occur within the wetland or in nearby uplands matters little to many of these species. Species most likely to associate with this attribute are shown in Table 2b. This wetland community type may contribute the most to biodiversity in regions dominated by openlands or evergreen forest cover, because of complementarity of characterizing species.

2.10 Evergreen Trees

This attribute consists of evergreen woody vegetation or Tamarack taller than 20 ft. If present at all, surface water is present only for short durations (seldom more than a few weeks annually). This attribute is assumed to occur most commonly within the following wetland communities:

Rich Conifer Swamp
Rich Tamarack Swamp
Poor Conifer Swamp
Hardwood-conifer Swamp
Muskeg
Northern Fen

It is assumed to occur less consistently within other wetland types which may include but are not limited to the following (especially along their upland edges):

Northern Shrub Thicket
Patterned Fen
Poor Fen

For most of the species that associate with this attribute, their use of wetlands is facultative – that is, they may use the evergreen forested areas in nearby uplands as much or more than those in wetlands. Thus, whether the evergreen trees occur within the wetland or in nearby uplands matters little to many of these species. Species most likely to associate with this attribute are shown in Table 2. This wetland community type may contribute the most to biodiversity in regions dominated by openlands or deciduous forest cover, because of complementarity of characterizing species.

2.11 Large-diameter Trees

This attribute consists of stands of mature trees with diameters (dbh) larger than about 21 inches. If present at all, surface water is present only for short durations (seldom more than a few weeks annually). This attribute is assumed to occur most commonly within the following wetland communities:

Floodplain Forest
Southern Hardwood Swamp
Northern Hardwood Swamp
Hardwood-conifer Swamp
Rich Conifer Swamp
Wet-mesic Flatwoods

It is assumed to occur less consistently within or along the edges of other wetland types which may include the following:

Northern Shrub Thicket
Northern Wet Meadow
Wooded Dune and Swale Complex

Whether the large trees occur within the wetland or in nearby uplands matters little to many wildlife species. Species most likely to associate with this attribute are shown in Table 2b. This wetland community type may contribute the most to biodiversity in regions dominated by openlands, because of complementarity of characterizing species.

2.12 Snags

This attribute consists of standing dead trees with diameters (dbh) larger than about 8 inches Often, the trees are dead because of past or ongoing water level increases within the wetland, e.g., due to

beaver or rising lake levels. This attribute is assumed to occur most commonly within the following wetland communities:

Floodplain Forest
Wet-mesic Flatwoods
Inundated Shrub Swamp
Southern Hardwood Swamp
Northern Hardwood Swamp
Hardwood-conifer Swamp
Rich Conifer Swamp
Poor Conifer Swamp
Rich Tamarack Swamp
Coastal Fen

It is assumed to occur less consistently within (or along the edges of) other wetland types which may include the following:

Northern Shrub Thicket
Southern Shrub-carr
Northern Wet Meadow
Southern Wet Meadow
Great Lakes Marsh
Wooded Dune and Swale Complex

Whether the snags occur within the wetland or in nearby uplands matters little to many wildlife species. Species most likely to associate with this attribute are shown in Table 2.

2.13 Downed Wood

This attribute consists of logs and other pieces of downed wood, mostly with diameters (dbh) larger than a few inches. Accumulations often occur when woody vegetation has been killed by past or ongoing water level increases within the wetland. This attribute is assumed to occur most commonly within the following wetland communities:

Floodplain Forest
Wet-mesic Flatwoods
Southern Hardwood Swamp
Northern Hardwood Swamp
Hardwood-conifer Swamp
Rich Conifer Swamp
Poor Conifer Swamp
Rich Tamarack Swamp

It is assumed to occur less consistently within (or along the edges of) other wetland types which may include the following:

Northern Shrub Thicket
Southern Shrub-carr
Northern Wet Meadow
Southern Wet Meadow
Wooded Dune and Swale Complex

Species most likely to associate with this attribute are shown in Table 2b.

Whether the downed wood occurs within the wetland or in nearby uplands matters little to many wildlife species. However, for some species, downed wood that is partly submerged (i.e., partly above the water surface) is particularly important. Such horizontal pieces provide perches to Green Heron, Spotted Sandpiper, Northern Waterthrush, Louisiana Waterthrush, Belted Kingfisher, turtles, cormorants, and a few other species.

2.14 Seasonally Predictable Water Levels

This attribute consists of surface water areas that experience little vertical fluctuation during the breeding seasons of amphibians and shoreline-nesting birds. What constitutes little fluctuation, and the specific seasonal dates during which that must occur, depends on the species. Michigan wetlands that proportionally have the largest inputs of ground water tend to have the most seasonally-predictable water levels. These are assumed to include the following:

Northern Fen
Patterned Fen
Poor Fen
Prairie Fen
Bog
Muskeg

It is assumed to occur less consistently in the following wetland types:

Northern Wet Meadow
Southern Wet Meadow
Wet-mesic Prairie
Wet-mesic Sand Prairie
Northern Shrub Thicket
Southern Hardwood Swamp
Northern Hardwood Swamp
Hardwood-conifer Swamp
Rich Conifer Swamp
Poor Conifer Swamp
Rich Tamarack Swamp

Species most likely to associate with this attribute are shown in Table 2c.

2.15 Proximity to Exposed Bare Substrate

This attribute consists of patches of sand or mud that are unvegetated or vegetated only very sparsely, and saturated but not water-covered for long periods. Technically, such areas are not considered jurisdictional wetlands unless they are very small and delineated as inclusions within a wetland-nonwetland mosaic. The paucity of vegetation can be due to frequent scouring by floods, frequent and severe water level fluctuations, intense grazing, tillage, very low soil fertility, or other factors. This attribute is assumed to be associated most commonly with the following wetland communities:

Intermittent Wetland
Emergent Marsh
Great Lakes Marsh
Coastal Plain Marsh
Inland Salt Marsh
Coastal Fen

Floodplain Forest

It is assumed to occur less consistently within (or along the edges of) other wetland types which may include the following:

Wet Prairie
Wet-mesic Prairie
Wet-mesic Sand Prairie
Wooded Dune and Swale Complex
Interdunal Wetland
Northern Fen
Patterned Fen
Poor Fen
Prairie Fen

Species most likely to associate with this attribute are shown in Table 2c.

Whether the exposed substrate occurs within the wetland or adjoins it matters little to many wildlife species. Of particular importance are large (>5 acres) mudflats that are exposed as the result of gradually falling water levels during the migrations of shorebirds (generally May and July-September), riverine bars important to nesting Piping Plover, Spotted Sandpiper, and some other species, and mudflats that are near structures suitable for species that use mud for nest construction, e.g., Cliff Swallow.

2.16 Proximity to Flowing Water

This attribute consists of surface water that visibly flows, usually in channels, during any time of the year, and lacks vegetation (except for perhaps some submerged aquatic plants). Technically, such areas are not considered jurisdictional wetlands unless they are delineated as inclusions within a wetland-nonwetland mosaic. Whether the flowing water occurs within the wetland or adjoins it matters little to many wildlife species. This attribute can occur within or adjoining any wetland community type, but is most likely to characterize Floodplain Forest . Species that may prefer this attribute are so marked in Table 2c.

2.17 Proximity to Exposed Banks

This attribute consists of vertical or nearly-vertical banks of sand or mud that are unvegetated, and adjoin streams, rivers, or lakes. Technically, such areas are not considered jurisdictional wetlands but are often delineated as inclusions within a wetland-nonwetland mosaic. The paucity of vegetation can be due to frequent scouring by floods, frequent and severe water level fluctuations, intense grazing, very low soil fertility, excessive shade, chronic erosion, or other factors. This attribute is assumed to be associated most commonly with Floodplain Forest and Great Lakes Marsh, but can be associated with any wetland that adjoins flowing water or a lake. Species most likely to require or prefer this attribute are shown in Table 2c.

2.18 Proximity to Island

This attribute describes lands surrounded by perennial water of sufficient depth and width to discourage access by mammalian predators. Technically, some such areas are not considered

jurisdictional wetlands but are often delineated as inclusions within a wetland-nonwetland mosaic. Use by particular species will depend on the density of vegetation, with some species preferring bare substrate. The paucity of vegetation can be due to frequent scouring by floods, frequent and severe water level fluctuations, very low soil fertility, chronic erosion, or other factors. This attribute is assumed to be associated most commonly with Floodplain Forest and Great Lakes Marsh, but can be associated with any lake or river. Species most likely to require or prefer this attribute are shown in Table 2c.

2.19 Proximity to Artificial Structures for Nesting

This attribute concerns the proximity of a wetland to artificial structures used by nesting birds and mammals, whether those structures be placed intentionally for wildlife (e.g., nest boxes) or used incidentally (e.g., barns, bridges). Such structures logically tend to be more available in developed areas, but can occur anywhere. Species likely to use this attribute are listed in Table 2c.

2.20 Proximity to Openland

This attribute concerns the proximity of a wetland to openland, which is herbaceously-vegetated land with little or no tree cover and minor shrub cover. This attribute can be associated with any wetland community type, but may be *least* likely to occur with the following types due to their coincidence with land use patterns in Michigan:

Bog
Muskeg
Patterned Fen
Poor Fen
Rich Tamarack Swamp
Poor Conifer Swamp

Species most likely to require or prefer this attribute are so marked in Table 2c. A subset of these species make heavy use of **cropland**, especially particular types of cropland. These include many waterfowl, which during the winter may supplement the foods found in wetlands with crop residues.

2.21 Proximity and Connection to Large Vegetated Patches and/or Corridors

This attribute concerns the inclusion of a wetland within, or its proximity and/or degree of connection to, a large patch of native vegetation. Many wildlife species are believed to be area-sensitive but exact relationships of population size and viability to patch size have been determined empirically for only a few species. Even then, such relationships are confounded by many interacting habitat quality variables, e.g., within-patch structural diversity, outside-patch land use patterns and intensity. For the most area-sensitive species, larger patches provide isolation from nest parasitizers, some predators, and chronic human disturbance, as well as providing a more Predictable microclimate and structural diversity. Among wetland species, limited evidence suggests that those marked in Table 2c might be the ones least likely to occur in very small isolated patches of their preferred habitat, i.e., are the most area-sensitive.

Table 2a. Species associations with hydroperiod attributes and herbaceous vegetation

Abbreviations of the habitat attributes (column headings):
Deep= Extensive and/or Deep Surface Water
Shallow= Shallow Persistent Surface Water with Herbaceous Vegetation
Vernal= Shallow Seasonal (Vernal) Surface Water with Herbaceous Vegetation
SatHerb= Surface Water Absent and Herbaceous Vegetation Dominates
Moss= Moss Substrate; Acidic Conditions; Limited Surface Water; Few Trees
Robust= Robust Emergents

Bold font indicates species of special importance in Michigan due to rarity or limited distribution.

	Deep	Shallow	Vernal	SatHerb	Moss	Robust	Distribution
AMPHIBIANS							
Blue-spotted Salamander	1	1	1	1			Statewide
Spotted Salamander	1	1					Statewide
Marbled Salamander							Region VI
Smallmouth Salamander			1	1			Region VI
Tiger Salamander	1	1	1	1			Region VI, VII, VIII
Four-toed Salamander	1	1	1	1	1		Statewide
Eastern Redback Salamander							Statewide
Mudpuppy	1	1					Statewide
Eastern Newt	1	1	1	1	1		Statewide
Lesser Siren	1	1					Region VI
American Toad	1	1	1	1	1		Statewide
Fowler's Toad	1	1	1	1			Region VI, VII
Northern Cricket Frog		1	1	1	1		Region VI
Gray Treefrog	1	1	1	1	1		Statewide
Western Chorus Frog	1	1	1	1	1		Region VI, VII, Menominee Co.
Spring Peeper	1	1	1	1	1		Statewide
Bullfrog	1	1	1	1			Statewide
Green Frog	1	1	1	1	1		Statewide
Pickerel Frog	1	1	1	1	1		Statewide
Northern Leopard Frog	1	1	1	1			Statewide
Mink Frog	1	1			1		Region VIII, IX
Wood Frog	1	1	1	1	1		Statewide
BIRDS							
Common Loon	1	1					Region VII, VIII, IX
Pied-billed Grebe	1	1	1				Statewide
Horned Grebe	1	1	1				mostly coastal; locally common migrant
Red-necked Grebe	1						VIII (rare breeder); locally common migrantmostly along coast
Double-crested Cormorant	1	1					Region VII, VIII, IX
American Bittern		1	1	1	1	1	Statewide
Least Bittern		1	1	1		1	Statewide
Great Blue Heron		1	1	1			Statewide
Great Egret		1	1	1			Region VI, VII
Cattle Egret		1	1	1			Region VI, VII
Green Heron	1	1	1				Region VI, VII
Black-crowned Night-Heron	1	1	1				Region VI

	Deep	Shallow	Vernal	SatHerb	Moss	Robust	Distribution
Yellow-crowned Night-Heron	1	1	1				Region VI
Tundra Swan		1	1	1			mostly coastal; uncommon to abundant migrant
Trumpeter Swan		1	1	1			rare resident; VI, VII, VIII,
Mute Swan		1	1				Statewide
Snow Goose		1	1	1			Statewide; rare to locally common migrant
Canada Goose	1	1	1	1			Statewide
Wood Duck	1	1	1	1			Statewide
Green-winged Teal	1	1	1	1			Region VI
American Black Duck	1	1	1	1	1		Statewide
Mallard	1	1	1	1			Statewide
Northern Pintail	1	1	1	1			Region VI
Blue-winged Teal	1	1	1	1			Statewide
Northern Shoveler	1	1	1	1			Region VII, VIII
Gadwall	1	1	1	1			Region VI, VII
American Wigeon	1	1	1	1			Rare breeder VI, VIII, IX; common migrant statewide
Canvasback	1	1					Region VI
Redhead	1	1					Region VI, VII
Ring-necked Duck	1	1			1		Region VII, VIII, IX
Greater Scaup	1	1					common migrant statewide
Lesser Scaup	1	1					Region VI
Long-tailed Duck	1						common migrant mainly on coast
Common Goldeneye	1	1					Region VII, VIII, IX
Bufflehead	1	1					Region VI
Hooded Merganser	1	1					Statewide
Common Merganser	1	1					Region VII, VIII, IX
Red-breasted Merganser	1	1					Region VII, VIII, IX
Ruddy Duck	1	1	1				Region VI
Turkey Vulture		1	1	1	1		Region VI, VII
Osprey	1	1	1	1			Statewide
Bald Eagle	1	1	1	1			Statewide
Northern Harrier		1	1	1	1		Statewide
Sharp-shinned Hawk		1	1	1			Statewide
Cooper's Hawk			1	1			Statewide
Northern Goshawk							Statewide
Red-shouldered Hawk		1	1	1			Statewide
Broad-winged Hawk		1	1	1			Statewide
Red-tailed Hawk		1	1	1			Statewide
Rough-legged Hawk		1	1	1			Region VI, VII
Golden Eagle		1	1	1			Region IX
American Kestrel		1	1	1			Statewide
Merlin		1	1	1			Region VIII, IX
Peregrine Falcon	1	1	1	1			Region VIII, IX
Ring-necked Pheasant		1	1	1		1	Region VI, VII
Spruce Grouse				1	1		Region VII, VIII, IX
Ruffed Grouse				1			Statewide
Sharp-tailed Grouse			1	1			Region VIII, IX
Wild Turkey			1	1			Region VI, VII
Northern Bobwhite			1	1			Region VI
Yellow Rail			1	1	1		Statewide

	Deep	Shallow	Vernal	SatHerb	Moss	Robust	Distribution
King Rail		1	1	1		1	Region VI
Virginia Rail		1	1	1		1	Statewide
Sora		1	1	1	1	1	Statewide
Common Moorhen	1	1	1			1	Region VI, VII
American Coot	1	1	1		1	1	Statewide
Sandhill Crane		1	1	1	1		Statewide
Black-bellied Plover		1	1	1			uncommon migrant statewide
American Golden-Plover		1	1	1			uncommon migrant statewide
Semipalmated Plover		1	1				common migrant mainly on coast
Piping Plover							Region VI, VII, VIII
Killdeer		1	1	1			Statewide
Greater Yellowlegs		1	1				Statewide
Lesser Yellowlegs		1	1				Statewide
Solitary Sandpiper		1	1				Statewide
Spotted Sandpiper		1	1				Statewide
Upland Sandpiper			1	1			Statewide
Ruddy Turnstone		1	1				Statewide
Semipalmated Sandpiper		1	1				Statewide
Western Sandpiper		1	1				Statewide
Least Sandpiper		1	1				Statewide
White-rumped Sandpiper		1	1				Statewide
Baird's Sandpiper		1	1				uncommon migrant statewide
Pectoral Sandpiper		1	1				Statewide
Dunlin		1	1				Statewide
Stilt Sandpiper		1	1				Statewide
Short-billed Dowitcher		1	1				uncommon migrant mainly on coast
Common Snipe		1	1	1	1	1	Statewide
American Woodcock			1	1			Statewide
Wilson's Phalarope	1	1	1				Region VI
Bonaparte's Gull	1	1					Region VI
Ring-billed Gull	1	1	1	1			Statewide
Herring Gull	1	1	1	1			Statewide
Great Black-backed Gull	1	1	1				Region VI, VII
Caspian Tern	1	1					Region VII, VIII
Common Tern	1						Statewide
Forster's Tern	1	1	1				Region VII, VIII
Black Tern	1	1	1				Statewide
Mourning Dove			1	1			Statewide
Black-billed Cuckoo							Statewide
Yellow-billed Cuckoo							Region VI, VII
Barn Owl		1	1	1			Region VI
Eastern Screech-Owl			1	1			Statewide
Great Horned Owl		1	1	1			Statewide
Snowy Owl			1	1			Region VIII, IX
Barred Owl			1	1			Statewide
Great Gray Owl			1	1			Region IX
Long-eared Owl			1	1			Statewide
Short-eared Owl		1	1	1			Statewide
Boreal Owl			1	1			Region VII, VIII, IX
Northern Saw-whet Owl			1	1			Statewide

	Deep	Shallow	Vernal	SatHerb	Moss	Robust	Distribution
Common Nighthawk		1	1	1			Statewide
Chimney Swift		1	1	1			Statewide
Ruby-throated Hummingbird			1	1	1		Statewide
Belted Kingfisher	1	1	1	1			Statewide
Red-headed Woodpecker							Statewide
Red-bellied Woodpecker							Region VI
Yellow-bellied Sapsucker							Region VII, VIII, IX
Downy Woodpecker							Statewide
Hairy Woodpecker							Statewide
Black-backed Woodpecker							Region VII, VIII, IX
Northern Flicker			1	1			Statewide
Pileated Woodpecker							Statewide
Olive-sided Flycatcher		1	1	1			Region VII, VIII, IX
Eastern Wood-Pewee		1	1	1			Statewide
Yellow-bellied Flycatcher		1	1	1			Region VIII, IX
Acadian Flycatcher		1	1	1			Region VI
Alder Flycatcher		1	1	1			Region VII, VIII, IX
Willow Flycatcher		1	1	1			Region VI
Least Flycatcher		1	1	1			Statewide
Eastern Phoebe		1	1	1			Statewide
Great Crested Flycatcher		1	1	1			Statewide
Eastern Kingbird		1	1	1			Statewide
Purple Martin	1	1	1	1			Statewide
Tree Swallow	1	1	1	1			Statewide
Northern Rough-winged Swallow	1	1	1	1			Statewide
Bank Swallow	1	1	1	1			Statewide
Cliff Swallow	1	1	1	1			Statewide
Barn Swallow	1	1	1	1			Statewide
Gray Jay							Region VIII, IX
Blue Jay							Statewide
American Crow		1	1	1			Statewide
Common Raven		1	1	1	1		Region VII, VIII, IX
Black-capped Chickadee							Statewide
Boreal Chickadee							Region VIII, IX
Tufted Titmouse							Region VI
Red-breasted Nuthatch					1		Statewide
White-breasted Nuthatch							Statewide
Brown Creeper							Statewide
Carolina Wren							Region VI
House Wren							Statewide
Winter Wren							Region VII, VIII, IX
Sedge Wren		1	1	1			Statewide
Marsh Wren		1				1	Statewide
Golden-crowned Kinglet							Statewide
Ruby-crowned Kinglet							Region VIII, IX
Blue-gray Gnatcatcher							Region VI
Eastern Bluebird							Statewide
Veery							Statewide
Swainson's Thrush							Region VII, VIII, IX
Wood Thrush							Statewide

	Deep	Shallow	Vernal	SatHerb	Moss	Robust	Distribution
American Robin		1	1	1	1		Statewide
Gray Catbird							Statewide
American Pipit		1	1	1			Statewide
Cedar Waxwing		1	1	1			Statewide
Northern Shrike			1	1			Statewide
Loggerhead Shrike			1	1			Region VI
European Starling		1	1	1			Statewide
White-eyed Vireo							Region VI
Blue-headed Vireo							Statewide
Yellow-throated Vireo							Region VI
Warbling Vireo							Statewide
Philadelphia Vireo							Region VII, VIII, IX
Red-eyed Vireo							Statewide
Blue-winged Warbler							Region VI
Golden-winged Warbler							Statewide
Tennessee Warbler					1		Region VIII, IX
Orange-crowned Warbler							Statewide
Nashville Warbler					1		Region VII, VIII, IX
Northern Parula					1		Region VIII, IX
Yellow Warbler							Statewide
Chestnut-sided Warbler							Statewide
Magnolia Warbler							Region VII, VIII, IX
Cape May Warbler							Region VIII, IX
Black-throated Blue Warbler							Statewide
Yellow-rumped Warbler					1		Region VII, VIII, IX
Black-throated Green Warbler							Statewide
Blackburnian Warbler							Statewide
Yellow-throated Warbler							Region VI
Palm Warbler					1		Region VII, VIII, IX
Bay-breasted Warbler							Region VIII, IX
Blackpoll Warbler							common migrant statewide
Cerulean Warbler							Region VI
Black-and-white Warbler							Statewide
American Redstart							Statewide
Prothonotary Warbler							Region VI
Worm-eating Warbler							VI
Northern Waterthrush		1	1		1		Statewide
Louisiana Waterthrush		1	1				Region VI
Kentucky Warbler							VI
Connecticut Warbler			1	1			Region VII, VIII, IX
Mourning Warbler			1	1			Statewide
Common Yellowthroat		1	1	1	1	1	Statewide
Hooded Warbler							Region VI
Wilson's Warbler					1		VIII
Canada Warbler							Region VII, VIII, IX
Yellow-breasted Chat							Region VI
Scarlet Tanager							Statewide
Northern Cardinal							Statewide
Rose-breasted Grosbeak							Statewide
Indigo Bunting							Statewide

	Deep	Shallow	Vernal	SatHerb	Moss	Robust	Distribution
Dickcissel			1	1			Region VI
Eastern Towhee							Statewide
American Tree Sparrow			1	1		1	Statewide
Savannah Sparrow			1	1			Statewide
Grasshopper Sparrow				1			Statewide
Henslow's Sparrow			1	1			Region VI, VII
Le Conte's Sparrow		1	1	1			Region VII, VIII, IX
Fox Sparrow				1			common migrant
Song Sparrow		1	1	1	1		Statewide
Lincoln's Sparrow		1	1	1	1	1	Region VII, VIII, IX
Swamp Sparrow		1	1	1	1	1	Statewide
White-throated Sparrow					1		Statewide
White-crowned Sparrow			1	1			Region VI
Dark-eyed Junco			1	1			Statewide
Lapland Longspur			1	1			Region VI
Snow Bunting			1	1			Statewide
Bobolink			1	1			Statewide
Red-winged Blackbird		1	1	1		1	Statewide
Eastern Meadowlark		1	1	1			Statewide
Western Meadowlark			1	1			Statewide
Yellow-headed Blackbird		1	1	1		1	Region VI
Rusty Blackbird			1	1			Region VI
Brewer's Blackbird		1	1	1		1	Statewide
Common Grackle		1	1	1		1	Statewide
Brown-headed Cowbird		1	1	1			Statewide
Baltimore Oriole							Statewide
Purple Finch							Statewide
Red Crossbill							Region VII, VIII, IX
White-winged Crossbill							Region VIII, IX
Common Redpoll							Statewide in winter
Pine Siskin							Statewide
American Goldfinch			1	1			Statewide
MAMMALS							Statewide
Virginia Opossum		1	1	1			Statewide
Masked Shrew		1	1	1	1		Statewide
Water Shrew	1	1	1	1	1		Statewide
Arctic Shrew		1	1	1	1		Region VIII, IX
Pygmy Shrew			1	1	1		Region VIII, IX
Northern Short-tailed Shrew		1	1	1			Statewide
Eastern Mole		1	1	1			Statewide
Star-nosed Mole		1	1	1	1		Statewide
Little Brown Myotis		1	1	1			Statewide
Indiana (Social) Myotis		1	1	1			Region VI, VII
Northern Myotis		1	1	1			Statewide
Silver-haired Bat		1	1	1			Statewide
Eastern Pipistrelle			1	1			?
Big Brown Bat		1	1	1			Statewide
Eastern Red Bat		1	1	1			Statewide
Hoary Bat		1	1	1			Statewide
Eastern Cottontail			1	1			Statewide

	Deep	Shallow	Vernal	SatHerb	Moss	Robust	Distribution
Snowshoe Hare			1	1			Statewide
Least Chipmunk			1	1			Region VIII, IX
Eastern Chipmunk		1	1	1			Statewide
Eastern Gray Squirrel							Statewide
Eastern Fox Squirrel							Statewide
Red Squirrel							Statewide
Southern Flying Squirrel			1	1			Region VI
Northern Flying Squirrel			1	1			Statewide
American Beaver	1	1	1	1			Statewide
Deer Mouse		1	1	1	1		Statewide
White-footed Mouse		1	1	1			Statewide
Southern Red-backed Vole			1	1	1		Region VII, VIII, IX
Meadow Vole			1	1			?
Prairie Vole			1	1			?
Woodland Vole							Statewide
Muskrat	1	1	1	1		1	Statewide
Southern Bog Lemming		1	1	1	1		Statewide
Meadow Jumping Mouse		1	1	1			?
Woodland Jumping Mouse							Region VII, VIII, IX
Common Porcupine							Statewide
Coyote		1	1	1	1		Statewide
Gray Wolf		1	1	1	1		Region VIII, IX
Red Fox		1	1	1	1		Statewide
Common Gray Fox			1	1			Statewide
Black Bear			1	1	1		Statewide
Common Raccoon		1	1	1	1		Statewide
American Marten							Region VII, VIII, IX
Fisher							Region VII, VIII, IX
Ermine		1	1	1	1		Statewide
Least Weasel		1	1	1			Statewide
Long-tailed Weasel		1	1	1	1		Statewide
Mink	1	1	1	1			Statewide
Striped Skunk		1	1	1	1		Statewide
Northern River Otter	1	1	1	1			Statewide
Lynx			1	1			Region VII, VIII, IX
Bobcat			1	1	1		Statewide
Elk (Wapiti)			1	1	1		Region VII
White-tailed Deer			1	1	1		Statewide
Moose	1	1	1	1	1		Region VIII, IX
REPTILES							Statewide
Snapping Turtle	1	1			1		Statewide
Painted Turtle	1	1	1	1	1		Statewide
Spotted Turtle	1	1	1	1	1		Region VI, VII
Wood Turtle	1	1	1	1	1		Region VII, VIII, IX
Blanding's Turtle	1	1	1	1			Statewide
Common Map Turtle	1	1					Region VI, VII
Common Box Turtle		1	1	1			Region VI, VII
Slider	1	1					Region VI
Common Musk Turtle	1	1					Region VI, VII
Spiny Softshell	1	1					Statewide

	Deep	Shallow	Vernal	SatHerb	Moss	Robust	Distribution
Kirtland's Snake		1	1	1			Region VI
Ringneck Snake			1	1			Statewide
Rat Snake			1	1			Region VI
Western Fox Snake			1	1			Region VIII, IX
Eastern Fox Snake		1	1	1			Statewide
Eastern Hognose Snake			1	1			Region VI, VII, VIII
Milk Snake			1	1	1		Statewide
Plainbelly Water Snake	1	1	1	1			Statewide
Northern Water Snake	1	1	1	1	1		Region VI, VII, VIII
Queen Snake			1	1			Region VI, VII
Brown Snake		1	1	1	1		Statewide
Redbelly Snake		1	1	1	1		Statewide
Butler's Garter Snake		1	1	1			Region VI, VII
Eastern Ribbon Snake		1	1	1	1		Region VI, VII
Common Garter Snake		1	1	1	1		Statewide
Smooth Green Snake		1	1	1	1		Statewide
Massasauga		1	1	1			Region VI, VII

Table 2b. Species associations with woody vegetation attributes

Abbreviations of the habitat attributes (column headings):
SSdecid= Deciduous Shrub Cover
SSever= Evergreen Shrub Cover
TreeDecid= Deciduous Trees
TreeEver= Evergreen Trees
BigTree= Large-diameter Trees
Snags= Snags
LWD= Downed Wood

Bold font indicates species of special importance in Michigan due to rarity or limited distribution.

	SSdecid	SSever	TreeDecid	TreeEver	BigTree	Snags	LWD	Distribution
AMPHIBIANS								
Blue-spotted Salamander	1		1	1			1	Statewide
Spotted Salamander	1	1	1				1	Statewide
Marbled Salamander		1	1				1	Region VI
Smallmouth Salamander			1				1	Region VI
Tiger Salamander		1	1	1			1	Region VI, VII, VIII
Four-toed Salamander		1	1				1	Statewide
Eastern Redback Salamander		1	1	1			1	Statewide
Mudpuppy							1	Statewide
Eastern Newt	1		1	1			1	Statewide
Lesser Siren							1	Region VI
American Toad	1	1	1	1			1	Statewide
Fowler's Toad	1	1	1				1	Region VI, VII
Northern Cricket Frog	1		1				1	Region VI
Gray Treefrog	1		1	1			1	Statewide
Western Chorus Frog		1	1	1			1	Region VI, VII, Menominee Co.
Spring Peeper	1	1	1	1			1	Statewide
Bullfrog			1				1	Statewide
Green Frog			1				1	Statewide
Pickerel Frog			1				1	Statewide
Northern Leopard Frog			1				1	Statewide
Mink Frog			1				1	Region VIII, IX
Wood Frog	1		1	1			1	Statewide
BIRDS								
Red-throated Loon								?
Common Loon								Region VII, VIII, IX
Pied-billed Grebe								Statewide
Horned Grebe								?
Red-necked Grebe								?
Eared Grebe								?
American White Pelican								?
Double-crested Cormorant			1			1		Region VII, VIII, IX
American Bittern								Statewide
Least Bittern								Statewide
Great Blue Heron				1	1	1		Statewide

	SSdecid	SSever	TreeDecid	TreeEver	BigTree	Snags	LWD	Distribution
Great Egret								Region VI, VII
Cattle Egret								Region VI, VII
Green Heron	1		1					Region VI, VII
Black-crowned Night-Heron	1		1	1				Region VI
Yellow-crowned Night-Heron	1		1					Region VI
Tundra Swan								?
Trumpeter Swan								?
Mute Swan								Statewide
Greater White-fronted Goose								?
Snow Goose								?
Canada Goose								Statewide
Wood Duck			1		1	1		Statewide
Green-winged Teal								Region VI
American Black Duck	1							Statewide
Mallard	1							Statewide
Northern Pintail								Region VI
Blue-winged Teal								Statewide
Northern Shoveler								Region VII, VIII
Gadwall								Region VI, VII
American Wigeon								?
Canvasback								Region VI
Redhead								Region VI, VII
Ring-necked Duck								Region VII, VIII, IX
Greater Scaup								?
Lesser Scaup								Region VI
Long-tailed Duck								?
Common Goldeneye			1		1	1		Region VII, VIII, IX
Bufflehead								Region VI
Hooded Merganser			1		1	1		Statewide
Common Merganser								Region VII, VIII, IX
Red-breasted Merganser								Region VII, VIII, IX
Ruddy Duck								Region VI
Turkey Vulture	1	1	1	1	1	1		Region VI, VII
Osprey			1	1	1	1		Statewide
Bald Eagle			1	1	1			Statewide
Northern Harrier								Statewide
Sharp-shinned Hawk	1	1	1	1				Statewide
Cooper's Hawk	1	1	1	1				Statewide
Northern Goshawk		1	1	1				Statewide
Red-shouldered Hawk			1					Statewide
Broad-winged Hawk			1	1				Statewide
Red-tailed Hawk			1	1				Statewide
Rough-legged Hawk								Region VI, VII
Golden Eagle								Region IX
American Kestrel					1	1		Statewide
Merlin			1	1				Region VIII, IX
Peregrine Falcon			1					Region VIII, IX
Ring-necked Pheasant	1							Region VI, VII
Spruce Grouse		1		1				Region VII, VIII, IX

	SSdecid	SSever	TreeDecid	TreeEver	BigTree	Snags	LWD	Distribution
Ruffed Grouse	1		1					Statewide
Sharp-tailed Grouse	1							Region VIII, IX
Wild Turkey			1					Region VI, VII
Northern Bobwhite	1							Region VI
Yellow Rail								Statewide
King Rail								Region VI
Virginia Rail								Statewide
Sora								Statewide
Common Moorhen								Region VI, VII
American Coot								Statewide
Sandhill Crane								Statewide
Black-bellied Plover								?
American Golden-Plover								?
Semipalmated Plover								?
Piping Plover								Region VI, VII, VIII
Killdeer								Statewide
Greater Yellowlegs								Statewide
Lesser Yellowlegs								Statewide
Solitary Sandpiper								Statewide
Willet								?
Spotted Sandpiper			1					Statewide
Upland Sandpiper								Statewide
Whimbrel								?
Hudsonian Godwit								?
Marbled Godwit								?
Ruddy Turnstone								Statewide
Semipalmated Sandpiper								Statewide
Western Sandpiper								Statewide
Least Sandpiper								Statewide
White-rumped Sandpiper								Statewide
Baird's Sandpiper								?
Pectoral Sandpiper								Statewide
Dunlin								Statewide
Stilt Sandpiper								Statewide
Buff-breasted Sandpiper								?
Short-billed Dowitcher								?
Long-billed Dowitcher								?
Common Snipe	1	1	1					Statewide
American Woodcock	1	1	1					Statewide
Wilson's Phalarope								Region VI
Red-necked Phalarope								?
Bonaparte's Gull								Region VI
Ring-billed Gull								Statewide
Herring Gull								Statewide
Great Black-backed Gull								Region VI, VII
Caspian Tern								Region VII, VIII
Common Tern								Statewide
Forster's Tern								Region VII, VIII
Black Tern								Statewide

	SSdecid	SSever	TreeDecid	TreeEver	BigTree	Snags	LWD	Distribution
Mourning Dove			1					Statewide
Black-billed Cuckoo	1		1					Statewide
Yellow-billed Cuckoo	1							Region VI, VII
Barn Owl						1		Region VI
Eastern Screech-Owl			1			1		Statewide
Great Horned Owl			1	1				Statewide
Snowy Owl								Region VIII, IX
Northern Hawk Owl								?
Barred Owl			1	1	1	1		Statewide
Great Gray Owl				1	1	1		Region IX
Long-eared Owl			1	1				Statewide
Short-eared Owl								Statewide
Boreal Owl				1				Region VII, VIII, IX
Northern Saw-whet Owl				1		1		Statewide
Common Nighthawk			1					Statewide
Chimney Swift			1					Statewide
Ruby-throated Hummingbird	1		1					Statewide
Belted Kingfisher			1					Statewide
Red-headed Woodpecker			1			1		Statewide
Red-bellied Woodpecker			1			1		Region VI
Yellow-bellied Sapsucker			1			1		Region VII, VIII, IX
Downy Woodpecker	1		1	1		1		Statewide
Hairy Woodpecker			1	1		1		Statewide
Black-backed Woodpecker				1		1		Region VII, VIII, IX
Northern Flicker			1	1		1		Statewide
Pileated Woodpecker			1	1	1	1		Statewide
Olive-sided Flycatcher	1	1	1	1				Region VII, VIII, IX
Eastern Wood-Pewee			1					Statewide
Yellow-bellied Flycatcher		1		1				Region VIII, IX
Acadian Flycatcher			1					Region VI
Alder Flycatcher	1	1	1					Region VII, VIII, IX
Willow Flycatcher	1	1	1					Region VI
Least Flycatcher	1		1					Statewide
Eastern Phoebe	1		1					Statewide
Great Crested Flycatcher			1			1		Statewide
Eastern Kingbird	1	1	1					Statewide
Purple Martin			1		1	1		Statewide
Tree Swallow			1			1		Statewide
Northern Rough-winged Swallow			1					Statewide
Bank Swallow								Statewide
Cliff Swallow								Statewide
Barn Swallow								Statewide
Gray Jay		1		1				Region VIII, IX
Blue Jay	1		1					Statewide
American Crow	1	1	1	1				Statewide
Common Raven	1	1	1	1				Region VII, VIII, IX
Black-capped Chickadee	1	1	1	1		1		Statewide
Boreal Chickadee		1		1		1		Region VIII, IX
Tufted Titmouse			1			1		Region VI

	SSdecid	SSever	TreeDecid	TreeEver	BigTree	Snags	LWD	Distribution
Red-breasted Nuthatch				1		1		Statewide
White-breasted Nuthatch			1			1		Statewide
Brown Creeper			1	1	1	1		Statewide
Carolina Wren	1		1				1	Region VI
House Wren	1		1				1	Statewide
Winter Wren		1	1	1			1	Region VII, VIII, IX
Sedge Wren								Statewide
Marsh Wren								Statewide
Golden-crowned Kinglet				1				Statewide
Ruby-crowned Kinglet		1		1				Region VIII, IX
Blue-gray Gnatcatcher	1		1					Region VI
Eastern Bluebird			1			1		Statewide
Veery	1	1	1	1				Statewide
Swainson's Thrush	1	1		1				Region VII, VIII, IX
Wood Thrush			1					Statewide
American Robin	1	1	1	1				Statewide
Gray Catbird	1	1	1					Statewide
American Pipit								Statewide
Cedar Waxwing	1	1	1	1				Statewide
Northern Shrike	1	1						Statewide
Loggerhead Shrike	1							Region VI
European Starling	1	1	1	1		1		Statewide
White-eyed Vireo	1	1						Region VI
Blue-headed Vireo	1	1	1	1				?
Yellow-throated Vireo			1					Region VI
Warbling Vireo			1					Statewide
Philadelphia Vireo	1		1					?
Red-eyed Vireo	1		1	1				Statewide
Blue-winged Warbler	1							Region VI
Golden-winged Warbler	1							Statewide
Tennessee Warbler	1	1		1				Region VIII, IX
Orange-crowned Warbler	1							Statewide
Nashville Warbler	1	1	1	1				Region VII, VIII, IX
Northern Parula				1				Region VIII, IX
Yellow Warbler	1		1					Statewide
Chestnut-sided Warbler	1							Statewide
Magnolia Warbler		1		1				Region VII, VIII, IX
Cape May Warbler				1				Region VIII, IX
Black-throated Blue Warbler			1					Statewide
Yellow-rumped Warbler				1				Region VII, VIII, IX
Black-throated Green Warbler			1	1				Statewide
Blackburnian Warbler				1	1			Statewide
Yellow-throated Warbler			1					Region VI
Palm Warbler		1						Region VII, VIII, IX
Bay-breasted Warbler				1				?
Blackpoll Warbler				1		1		?
Cerulean Warbler			1		1			Region VI
Black-and-white Warbler			1	1		1		Statewide
American Redstart	1							Statewide

	SSdecid	SSever	TreeDecid	TreeEver	BigTree	Snags	LWD	Distribution
Prothonotary Warbler			1			1		Region VI
Worm-eating Warbler			1					?
Northern Waterthrush	1	1	1	1			1	Statewide
Louisiana Waterthrush	1		1				1	Region VI
Kentucky Warbler	1		1					?
Connecticut Warbler	1	1	1					Region VII, VIII, IX
Mourning Warbler	1	1						Statewide
Common Yellowthroat	1	1						Statewide
Hooded Warbler			1					Region VI
Wilson's Warbler	1			1				?
Canada Warbler	1			1				Region VII, VIII, IX
Yellow-breasted Chat	1							Region VI
Scarlet Tanager			1	1				Statewide
Northern Cardinal	1		1					Statewide
Rose-breasted Grosbeak			1					Statewide
Indigo Bunting	1		1					Statewide
Dickcissel								Region VI
Eastern Towhee	1	1					1	Statewide
American Tree Sparrow	1						1	Statewide
Savannah Sparrow								Statewide
Grasshopper Sparrow								Statewide
Henslow's Sparrow								Region VI, VII
Le Conte's Sparrow								Region VII, VIII, IX
Fox Sparrow	1	1					1	?
Song Sparrow	1	1					1	Statewide
Lincoln's Sparrow		1					1	Region VII, VIII, IX
Swamp Sparrow	1	1					1	Statewide
White-throated Sparrow	1	1						Statewide
White-crowned Sparrow								Region VI
Dark-eyed Junco		1	1	1				Statewide
Lapland Longspur								Region VI
Snow Bunting								Statewide
Bobolink								Statewide
Red-winged Blackbird	1							Statewide
Eastern Meadowlark								Statewide
Western Meadowlark								Statewide
Yellow-headed Blackbird								Region VI
Rusty Blackbird		1		1			1	Region VI
Brewer's Blackbird								Statewide
Common Grackle	1	1						Statewide
Brown-headed Cowbird	1	1	1	1				Statewide
Baltimore Oriole			1					Statewide
Pine Grosbeak				1				?
Purple Finch	1	1		1				Statewide
Red Crossbill				1				Region VII, VIII, IX
White-winged Crossbill				1				Region VIII, IX
Common Redpoll	1							?
Pine Siskin	1	1		1				Statewide
American Goldfinch								Statewide

	SSdecid	SSever	TreeDecid	TreeEver	BigTree	Snags	LWD	Distribution
MAMMALS								
Virginia Opossum	1	1	1	1				Statewide
Masked Shrew	1	1	1	1		1		Statewide
Water Shrew	1	1	1	1		1		Statewide
Arctic Shrew	1	1	1	1				Region VIII, IX
Pygmy Shrew	1	1	1	1		1		Region VIII, IX
Northern Short-tailed Shrew		1	1	1		1		Statewide
Eastern Mole	1		1					Statewide
Star-nosed Mole	1	1	1	1				Statewide
Little Brown Myotis		1	1	1		1		Statewide
Indiana (Social) Myotis			1		1	1		Region VI, VII
Northern Myotis			1	1		1		Statewide
Silver-haired Bat			1	1		1		Statewide
Eastern Pipistrelle		1				1		?
Big Brown Bat						1		Statewide
Eastern Red Bat			1	1		1		Statewide
Hoary Bat			1	1		1		Statewide
Eastern Cottontail	1							Statewide
Snowshoe Hare	1	1	1	1				Statewide
Least Chipmunk				1				Region VIII, IX
Eastern Chipmunk	1		1	1				Statewide
Eastern Gray Squirrel			1					Statewide
Eastern Fox Squirrel			1					Statewide
Red Squirrel				1		1		Statewide
Southern Flying Squirrel			1		1	1		Region VI
Northern Flying Squirrel				1	1	1		Statewide
American Beaver	1	1	1	1				Statewide
Deer Mouse		1	1	1				Statewide
White-footed Mouse	1	1	1	1		1		Statewide
Southern Red-backed Vole	1	1	1	1		1		Region VII, VIII, IX
Meadow Vole								?
Prairie Vole								?
Woodland Vole			1			1		Statewide
Muskrat								Statewide
Southern Bog Lemming			1					Statewide
Meadow Jumping Mouse	1	1						?
Woodland Jumping Mouse			1			1		Region VII, VIII, IX
Common Porcupine			1	1		1		Statewide
Coyote	1	1	1	1				Statewide
Gray Wolf		1		1				Region VIII, IX
Red Fox	1	1	1					Statewide
Common Gray Fox			1					Statewide
Black Bear	1	1	1	1	1	1		Statewide
Common Raccoon	1	1	1	1	1	1		Statewide
American Marten		1		1	1		1	Region VII, VIII, IX
Fisher	1	1		1	1		1	Region VII, VIII, IX
Ermine	1	1	1	1			1	Statewide
Least Weasel	1	1					1	Statewide

	SSdecid	SSever	TreeDecid	TreeEver	BigTree	Snags	LWD	Distribution
Long-tailed Weasel	1	1	1	1			1	Statewide
Mink	1	1	1	1			1	Statewide
Striped Skunk	1	1	1	1			1	Statewide
Northern River Otter	1	1	1				1	Statewide
Lynx		1		1				Region VII, VIII, IX
Bobcat	1	1	1	1				Statewide
Elk (Wapiti)		1		1				Region VII
White-tailed Deer	1	1		1				Statewide
Moose		1		1				Region VIII, IX
REPTILES								
Snapping Turtle							1	Statewide
Painted Turtle							1	Statewide
Spotted Turtle	1	1	1	1			1	Region VI, VII
Wood Turtle	1	1	1	1			1	Region VII, VIII, IX
Blanding's Turtle	1	1	1	1			1	Statewide
Common Map Turtle							1	Region VI, VII
Common Box Turtle	1		1				1	Region VI, VII
Slider							1	Region VI
Common Musk Turtle							1	Region VI, VII
Spiny Softshell							1	Statewide
Kirtland's Snake			1	1			1	Region VI
Ringneck Snake	1	1	1				1	Statewide
Rat Snake	1	1	1				1	Region VI
Western Fox Snake	1	1	1				1	Region VIII, IX
Eastern Fox Snake	1	1	1				1	Statewide
Eastern Hognose Snake	1	1	1				1	Region VI, VII, VIII
Milk Snake	1	1	1				1	Statewide
Plainbelly Water Snake	1	1	1				1	Statewide
Northern Water Snake	1	1	1	1			1	Region VI, VII, VIII
Queen Snake	1	1	1				1	Region VI, VII
Brown Snake	1	1	1	1			1	Statewide
Redbelly Snake	1	1	1				1	Statewide
Butler's Garter Snake	1	1	1				1	Region VI, VII
Eastern Ribbon Snake	1	1	1				1	Region VI, VII
Common Garter Snake	1	1	1				1	Statewide
Smooth Green Snake	1	1	1				1	Statewide
Massasauga	1	1	1	1			1	Region VI, VII

Table 2c: Species associations with other important habitat attributes

Abbreviations of the habitat attributes (column headings):
Stable= Seasonally Predictable Water Levels
Mud= Proximity to Exposed Bare Substrate
Flow= Proximity to Flowing Water
Bank= Proximity to Exposed Banks
Island= Proximity to an Island
Struc= Proximity to Artificial Structures (e.g., nest box or platform, bridge, building)
Open= Surrounding landscape is mainly open land (fields, etc.)
Patch= Species breeds successfully mainly in moderate or large-sized patches of suitable habitat (i.e., is especially area-sensitive)

Bold font indicates species of special importance in Michigan due to rarity or limited distribution.

	Stable	Mud	Flow	Bank	Island	Struc	Open	Patch	Distribution
AMPHIBIANS									
Blue-spotted Salamander	1								Statewide
Spotted Salamander	1								Statewide
Marbled Salamander	1								Region VI
Smallmouth Salamander	1								Region VI
Tiger Salamander	1						1		Region VI, VII, VIII
Four-toed Salamander	1								Statewide
Eastern Redback Salamander	1								Statewide
Mudpuppy	1								Statewide
Eastern Newt	1								Statewide
Lesser Siren	1								Region VI
American Toad	1						1		Statewide
Fowler's Toad	1						1		Region VI, VII
Northern Cricket Frog	1								Region VI
Gray Treefrog	1								Statewide
Western Chorus Frog	1						1		Region VI, VII, Menominee Co.
Spring Peeper	1								Statewide
Bullfrog	1								Statewide
Green Frog	1								Statewide
Pickerel Frog	1						1		Statewide
Northern Leopard Frog	1						1		Statewide
Mink Frog	1								Region VIII, IX
Wood Frog	1								Statewide
BIRDS									
Red-throated Loon									
Common Loon	1				1				Region VII, VIII, IX
Pied-billed Grebe	1								Statewide
Horned Grebe	1								?
Red-necked Grebe	1								?
Eared Grebe	1								?
American White Pelican									?
Double-crested Cormorant					1				Region VII, VIII, IX
American Bittern									Statewide
Least Bittern									Statewide

	Stable	Mud	Flow	Bank	Island	Struc	Open	Patch	Distribution
Great Blue Heron		1			1				Statewide
Great Egret		1			1				Region VI, VII
Cattle Egret					1		1		Region VI, VII
Green Heron									Region VI, VII
Black-crowned Night-Heron					1				Region VI
Yellow-crowned Night-Heron					1				Region VI
Tundra Swan		1					1		?
Trumpeter Swan		1							?
Mute Swan									Statewide
Greater White-fronted Goose		1					1		?
Snow Goose		1					1		?
Canada Goose		1			1		1		Statewide
Wood Duck						1			Statewide
Green-winged Teal	1	1					1		Region VI
American Black Duck	1	1							Statewide
Mallard	1	1			1		1		Statewide
Northern Pintail		1					1		Region VI
Blue-winged Teal	1	1					1		Statewide
Northern Shoveler	1	1					1		Region VII, VIII
Gadwall	1	1					1		Region VI, VII
American Wigeon	1	1					1		?
Canvasback	1								Region VI
Redhead	1								Region VI, VII
Ring-necked Duck	1								Region VII, VIII, IX
Greater Scaup									?
Lesser Scaup									Region VI
Long-tailed Duck									?
Common Goldeneye						1			Region VII, VIII, IX
Bufflehead									Region VI
Hooded Merganser						1			Statewide
Common Merganser	1		1						Region VII, VIII, IX
Red-breasted Merganser	1		1						Region VII, VIII, IX
Ruddy Duck	1								Region VI
Turkey Vulture							1		Region VI, VII
Osprey			1			1			Statewide
Bald Eagle			1						Statewide
Northern Harrier							1	1	Statewide
Sharp-shinned Hawk									Statewide
Cooper's Hawk							1		Statewide
Northern Goshawk									Statewide
Red-shouldered Hawk								1	Statewide
Broad-winged Hawk							1	1	Statewide
Red-tailed Hawk							1		Statewide
Rough-legged Hawk							1		Region VI, VII
Golden Eagle							1		Region IX
American Kestrel						1	1		Statewide
Merlin									Region VIII, IX
Peregrine Falcon									Region VIII, IX
Ring-necked Pheasant							1		Region VI, VII
Spruce Grouse									Region VII, VIII, IX
Ruffed Grouse									Statewide

	Stable	Mud	Flow	Bank	Island	Struc	Open	Patch	Distribution
Sharp-tailed Grouse									Region VIII, IX
Wild Turkey							1		Region VI, VII
Northern Bobwhite							1		Region VI
Yellow Rail									Statewide
King Rail									Region VI
Virginia Rail									Statewide
Sora									Statewide
Common Moorhen	1								Region VI, VII
American Coot	1								Statewide
Sandhill Crane							1		Statewide
Black-bellied Plover		1					1		?
American Golden-Plover		1					1		?
Semipalmated Plover		1					1		?
Piping Plover					1		1		Region VI, VII, VIII
Killdeer		1					1		Statewide
Greater Yellowlegs		1					1		Statewide
Lesser Yellowlegs		1					1		Statewide
Solitary Sandpiper		1					1		Statewide
Willet		1					1		?
Spotted Sandpiper		1	1		1				Statewide
Upland Sandpiper							1	1	Statewide
Whimbrel		1					1		?
Hudsonian Godwit		1					1		?
Marbled Godwit		1					1		?
Ruddy Turnstone		1					1		Statewide
Semipalmated Sandpiper		1					1		Statewide
Western Sandpiper		1					1		Statewide
Least Sandpiper		1					1		Statewide
White-rumped Sandpiper		1					1		Statewide
Baird's Sandpiper		1					1		?
Pectoral Sandpiper							1		Statewide
Dunlin		1					1		Statewide
Stilt Sandpiper		1					1		Statewide
Buff-breasted Sandpiper							1		?
Short-billed Dowitcher		1					1		?
Long-billed Dowitcher		1					1		?
Common Snipe									Statewide
American Woodcock							1		Statewide
Wilson's Phalarope		1					1		Region VI
Red-necked Phalarope							1		?
Bonaparte's Gull		1			1		1		Region VI
Ring-billed Gull		1			1		1		Statewide
Herring Gull		1			1		1		Statewide
Great Black-backed Gull		1			1		1		Region VI, VII
Caspian Tern					1				Region VII, VIII
Common Tern					1				Statewide
Forster's Tern									Region VII, VIII
Black Tern									Statewide
Mourning Dove							1		Statewide
Black-billed Cuckoo								1	Statewide
Yellow-billed Cuckoo								1	Region VI, VII

	Stable	Mud	Flow	Bank	Island	Struc	Open	Patch	Distribution
Barn Owl				1		1	1		Region VI
Eastern Screech-Owl						1	1		Statewide
Great Horned Owl									Statewide
Snowy Owl							1		Region VIII, IX
Northern Hawk Owl							1		?
Barred Owl									Statewide
Great Gray Owl									Region IX
Long-eared Owl							1		Statewide
Short-eared Owl							1	1	Statewide
Boreal Owl									Region VII, VIII, IX
Northern Saw-whet Owl									Statewide
Common Nighthawk						1	1		Statewide
Chimney Swift						1	1		Statewide
Ruby-throated Hummingbird							1		Statewide
Belted Kingfisher			1	1					Statewide
Red-headed Woodpecker							1		Statewide
Red-bellied Woodpecker									Region VI
Yellow-bellied Sapsucker									Region VII, VIII, IX
Downy Woodpecker									Statewide
Hairy Woodpecker								1	Statewide
Black-backed Woodpecker									Region VII, VIII, IX
Northern Flicker						1	1		Statewide
Pileated Woodpecker								1	Statewide
Olive-sided Flycatcher									Region VII, VIII, IX
Eastern Wood-Pewee									Statewide
Yellow-bellied Flycatcher									Region VIII, IX
Acadian Flycatcher								1	Region VI
Alder Flycatcher									Region VII, VIII, IX
Willow Flycatcher									Region VI
Least Flycatcher							1	1	Statewide
Eastern Phoebe						1			Statewide
Great Crested Flycatcher						1			Statewide
Eastern Kingbird							1		Statewide
Purple Martin						1	1		Statewide
Tree Swallow						1	1		Statewide
Northern Rough-winged Swallow				1		1	1		Statewide
Bank Swallow				1			1		Statewide
Cliff Swallow				1		1	1		Statewide
Barn Swallow						1	1		Statewide
Gray Jay									Region VIII, IX
Blue Jay									Statewide
American Crow		1					1		Statewide
Common Raven									Region VII, VIII, IX
Black-capped Chickadee						1			Statewide
Boreal Chickadee									Region VIII, IX
Tufted Titmouse						1		1	Region VI
Red-breasted Nuthatch									Statewide
White-breasted Nuthatch								1	Statewide
Brown Creeper								1	Statewide
Carolina Wren									Region VI
House Wren						1	1		Statewide

	Stable	Mud	Flow	Bank	Island	Struc	Open	Patch	Distribution
Winter Wren									Region VII, VIII, IX
Sedge Wren							1	1	Statewide
Marsh Wren									Statewide
Golden-crowned Kinglet									Statewide
Ruby-crowned Kinglet									Region VIII, IX
Blue-gray Gnatcatcher								1	Region VI
Eastern Bluebird						1	1		Statewide
Veery								1	Statewide
Swainson's Thrush									Region VII, VIII, IX
Wood Thrush								1	Statewide
American Robin									Statewide
Gray Catbird									Statewide
American Pipit		1					1		Statewide
Cedar Waxwing							1		Statewide
Northern Shrike							1		Statewide
Loggerhead Shrike							1		Region VI
European Starling						1	1		Statewide
White-eyed Vireo									Region VI
Blue-headed Vireo									?
Yellow-throated Vireo								1	Region VI
Warbling Vireo									Statewide
Philadelphia Vireo									?
Red-eyed Vireo								1	Statewide
Blue-winged Warbler							1		Region VI
Golden-winged Warbler							1		Statewide
Tennessee Warbler									Region VIII, IX
Orange-crowned Warbler									Statewide
Nashville Warbler									Region VII, VIII, IX
Northern Parula								1	Region VIII, IX
Yellow Warbler									Statewide
Chestnut-sided Warbler									Statewide
Magnolia Warbler									Region VII, VIII, IX
Cape May Warbler									Region VIII, IX
Black-throated Blue Warbler								1	Statewide
Yellow-rumped Warbler									Region VII, VIII, IX
Black-throated Green Warbler								1	Statewide
Blackburnian Warbler								1	Statewide
Yellow-throated Warbler								1	Region VI
Palm Warbler									Region VII, VIII, IX
Bay-breasted Warbler									?
Blackpoll Warbler									?
Cerulean Warbler								1	Region VI
Black-and-white Warbler								1	Statewide
American Redstart								1	Statewide
Prothonotary Warbler						1			Region VI
Worm-eating Warbler								1	?
Northern Waterthrush			1						Statewide
Louisiana Waterthrush			1					1	Region VI
Kentucky Warbler								1	?
Connecticut Warbler									Region VII, VIII, IX
Mourning Warbler								1	Statewide

	Stable	Mud	Flow	Bank	Island	Struc	Open	Patch	Distribution
Common Yellowthroat									Statewide
Hooded Warbler								1	Region VI
Wilson's Warbler									?
Canada Warbler									Region VII, VIII, IX
Yellow-breasted Chat									Region VI
Scarlet Tanager								1	Statewide
Northern Cardinal							1		Statewide
Rose-breasted Grosbeak									Statewide
Indigo Bunting							1		Statewide
Dickcissel							1		Region VI
Eastern Towhee							1		Statewide
American Tree Sparrow							1		Statewide
Savannah Sparrow							1		Statewide
Grasshopper Sparrow							1	1	Statewide
Henslow's Sparrow							1	1	Region VI, VII
Le Conte's Sparrow							1		Region VII, VIII, IX
Fox Sparrow									?
Song Sparrow									Statewide
Lincoln's Sparrow									Region VII, VIII, IX
Swamp Sparrow									Statewide
White-throated Sparrow									Statewide
White-crowned Sparrow							1		Region VI
Dark-eyed Junco							1		Statewide
Lapland Longspur							1		Region VI
Snow Bunting							1		Statewide
Bobolink							1	1	Statewide
Red-winged Blackbird							1		Statewide
Eastern Meadowlark							1	1	Statewide
Western Meadowlark							1	1	Statewide
Yellow-headed Blackbird							1		Region VI
Rusty Blackbird									Region VI
Brewer's Blackbird							1		Statewide
Common Grackle							1		Statewide
Brown-headed Cowbird							1		Statewide
Baltimore Oriole							1		Statewide
Pine Grosbeak									?
Purple Finch									Statewide
Red Crossbill									Region VII, VIII, IX
White-winged Crossbill									Region VIII, IX
Common Redpoll									?
Pine Siskin									Statewide
American Goldfinch							1		Statewide
MAMMALS									
Virginia Opossum							1		Statewide
Masked Shrew							1		Statewide
Water Shrew			1						Statewide
Arctic Shrew									Region VIII, IX
Pygmy Shrew									Region VIII, IX
Northern Short-tailed Shrew							1		Statewide
Eastern Mole							1		Statewide

	Stable	Mud	Flow	Bank	Island	Struc	Open	Patch	Distribution
Star-nosed Mole							1		Statewide
Little Brown Myotis						1	1		Statewide
Indiana (Social) Myotis						1	1		Region VI, VII
Northern Myotis							1		Statewide
Silver-haired Bat							1		Statewide
Eastern Pipistrelle						1	1		?
Big Brown Bat						1	1		Statewide
Eastern Red Bat							1		Statewide
Hoary Bat							1		Statewide
Eastern Cottontail							1		Statewide
Snowshoe Hare									Statewide
Least Chipmunk									Region VIII, IX
Eastern Chipmunk									Statewide
Eastern Gray Squirrel									Statewide
Eastern Fox Squirrel							1		Statewide
Red Squirrel									Statewide
Southern Flying Squirrel						1			Region VI
Northern Flying Squirrel						1			Statewide
American Beaver			1	1					Statewide
Deer Mouse									Statewide
White-footed Mouse									Statewide
Southern Red-backed Vole									Region VII, VIII, IX
Meadow Vole							1		?
Prairie Vole							1		?
Woodland Vole									Statewide
Muskrat									Statewide
Southern Bog Lemming							1		Statewide
Meadow Jumping Mouse									?
Woodland Jumping Mouse									Region VII, VIII, IX
Common Porcupine									Statewide
Coyote							1		Statewide
Gray Wolf							1	1	Region VIII, IX
Red Fox							1		Statewide
Common Gray Fox							1		Statewide
Black Bear								1	Statewide
Common Raccoon									Statewide
American Marten								1	Region VII, VIII, IX
Fisher								1	Region VII, VIII, IX
Ermine							1		Statewide
Least Weasel							1		Statewide
Long-tailed Weasel							1		Statewide
Mink									Statewide
Striped Skunk							1		Statewide
Northern River Otter			1						Statewide
Lynx								1	Region VII, VIII, IX
Bobcat								1	Statewide
Elk (Wapiti)							1		Region VII
White-tailed Deer							1		Statewide
Moose									Region VIII, IX
REPTILES									

	Stable	Mud	Flow	Bank	Island	Struc	Open	Patch	Distribution
Snapping Turtle									Statewide
Painted Turtle									Statewide
Spotted Turtle									Region VI, VII
Wood Turtle									Region VII, VIII, IX
Blanding's Turtle									Statewide
Common Map Turtle									Region VI, VII
Common Box Turtle									Region VI, VII
Slider									Region VI
Common Musk Turtle									Region VI, VII
Spiny Softshell									Statewide
Kirtland's Snake							1		Region VI
Ringneck Snake									Statewide
Rat Snake							1		Region VI
Western Fox Snake							1		Region VIII, IX
Eastern Fox Snake									Statewide
Eastern Hognose Snake							1		Region VI, VII, VIII
Milk Snake							1		Statewide
Plainbelly Water Snake									Statewide
Northern Water Snake									Region VI, VII, VIII
Queen Snake									Region VI, VII
Brown Snake							1		Statewide
Redbelly Snake							1		Statewide
Butler's Garter Snake							1		Region VI, VII
Eastern Ribbon Snake							1		Region VI, VII
Common Garter Snake							1		Statewide
Smooth Green Snake							1		Statewide
Massasauga							1		Region VI, VII

3.0 Synthesis: General Factors Important to Species Groups

3.1 Amphibians

The occurrence and sustainability of amphibian populations in wetlands is influenced by several factors, the chief of these usually being the wetland's water regime (hydroperiod), isolation from predatory fish, water quality (chemistry, acidity, temperature), and proportion of the surrounding upland landscape that is naturally vegetated. With regard to water regime, amphibians can be functionally grouped as those that breed earlier in the year and often in wetlands that dry up early (temporary wetlands), and those that breed later and usually in more permanently-inundated wetlands. The first group includes species such as Blue-spotted Salamander, Wood Frog, Spring Peeper, and Boreal Chorus Frog. The second includes American Toad, Northern Leopard Frog, Mink Frog, Gray Treefrog, Green Frog, and Bullfrog. The relationship to hydroperiod is at least partly due to the tendency of temporary wetlands to be free of predatory fish. Temporary wetlands (e.g., vernal pools) also may tend to warm up sooner in the spring and frequently have high densities of algae and invertebrates required by subadult amphibians. Among permanent wetlands, those that have not been stocked by (and are inaccessible to) predatory fish are especially important, as are those that experience no rapid water level decline during the period when the aquatic eggs of amphibians (which are often attached to stems of wetland plants near the water surface)

Warmer water and surrounding microclimate accelerates the growth of some amphibians, and those species may thus occur primarily where natal wetlands are not surrounded by a closed forest canopy. The tree canopy reduces water temperature and sometimes causes shorter hydroperiods (less water available to wetlands due to higher evapotranspiration from trees). Connectivity with natural vegetation in the upland landscape is important to many species (e.g., American Toad) which breed in wetlands but depend, for food resources, just as much on uplands during the late summer and autumn. Wide paved roads can interrupt that connectivity. Extensive downed wood and dense ground cover in the adjoining upland is important in maintaining a microclimate favorable for amphibians as they move seasonally among wetlands. Wetlands with circumneutral pH and moderate nutrient levels also are more favorable, although some species (e.g., Mink Frog) can tolerate the acidic conditions found in bogs.

3.2 Reptiles, Mammals

Like amphibians, most aquatic turtles thrive best where wetlands are fishless, forest canopy is not closed, and the surrounding landscape is vegetated naturally. Partly submerged downed wood is important as basking sites to some species. In drier parts of a wetland, downed wood and dense ground cover is important to many small mammals and snakes. Persistent flooding makes parts of many wetlands uninhabitable by most snakes and mammals, although a few (e.g., Northern Water Snake, Water Shrew, Beaver) favor such conditions. For nearly all species, the connectivity with other wetlands is important, as defined by presence of road-free upland areas of natural vegetation. Some species with large home ranges (e.g., American Martin) may be particularly sensitive in this regard. The presence of many species also is determined by wetland proximity to sites for denning (e.g., Black Bear, many snakes) or roosting (e.g., bats, in tree cavities or abandoned buildings).

3.3 Birds

The hundreds of birds species that occur in Michigan can be grouped functionally based on feeding habits and habitat preferences. Dozens of such groups can be defined using the 21 attributes described above, but for the discussion here, a simplistic categorization is used: Waterfowl, Wading Birds, Raptors, and Songbirds.

"Waterbirds" as used here includes ducks, geese, swans, grebes, loons, herons, bitterns, rails, gulls, terns
"Shorebirds" includes most sandpipers, plovers,
"Raptors" includes hawks, eagles, owls.
"Songbirds" includes passerines and upland game birds (grouse, quail).

Waterbird breeding occurrence in specific wetlands is influenced largely by hydroperiod and surrounding land cover. Most species prefer to nest in wetlands that have permanent and relatively stable water levels during the nesting period. Exceptions are species that nest in tree cavities (e.g., Wood Duck) or in uplands near the wetland (e.g., Blue-winged Teal). During migration and winter, however, the larger temporary wetlands are used extensively by many species. An abundance of emergent or shrub cover for concealing nests is important to most species although a few species (Double-crested Cormorant, some gulls and terns) prefer bare or sparsely-vegetated shores and islands that are free of mammalian predators. Within wetlands, a relatively equal mix of vegetation and unvegetated open water is important to many species, as is the proximity of other wetlands, ponds, and lakes. Waterbirds can also be grouped according to food preferences, e.g., loons, cormorants, mergansers, and terns that prefer wetlands with fish access.

Shorebirds in Michigan are mainly long-distance migrants. Most prefer extensive mudflats along rivers and lakes, vernal pools, or other bare or sparsely-vegetated wetlands. The seasonal timing of water level changes is critical to shorebird use of wetlands. Most require water depths of less than a few inches during the late spring and late summer periods.

Raptors are found in wetlands with high densities of rodents, frogs, snakes, and small birds. These tend to be wetlands that are well-vegetated. A few species (e.g., Osprey, Bald Eagle) feed to a greater degree on fish. Availability of perches (e.g., tall trees, fence posts) influences the occurrence of most species. Several species require tree cavities for nesting (e.g., American Kestrel, Northern Saw-whet Owl).

Songbirds are the most species-diverse group and have the widest variety of habitat requirements. Among those that depend most heavily on wetlands (e.g., Marsh Wren, Lincoln's Sparrow), scattered shrubs or robust herbaceous vegetation interspersed at least seasonally with water is important. The presence of snags, either in the wetland or nearby uplands, is essential to several species, e.g., Downy Woodpecker.

4.0 Future Directions

The tables and database provided with this report do not by themselves provide a final, practical tool needed to rapidly assess the habitat functions of wetlands for wildlife. To complete that objective, the following would need to occur:

1. The predicted species associations (1's and 0's representing probable associations with the various attributes and community types) need to be converted to scores on a broader scale (e.g., 0 to 5) in order to provide greater sensitivity to actual differences in habitat suitability and use. This will require additional literature review, analysis of existing data sets, and further input and review from wildlife biologists and birders. In addition, the associations for all species should be indexed to ecoregion, not just to county as they now are. This will require incorporation of data from the Michigan Breeding Bird Atlas Project and other sources.

2. The scores then need to be structured as predictive models for individual species or, where possible and appropriate, for species groups. Although tempting, the scores for each species' habitat attributes should not simply be summed to obtain habitat suitability predictions for a species, but rather should be combined in a logical and ecologically defensible manner appropriate to the species. For some species, it is likely that different scoring models will be needed for different seasons or functions (e.g., breeding vs. wintering, feeding vs. roosting) and perhaps, for different regions of Michigan (e.g., coastal vs. inland wetlands).

3. Ideally, the scoring models should be field-verified through multi-season wildlife surveys of a geographically-balanced sample of wetlands representing the full spectrum of wetland community types and attribute conditions.

4. A "wildlife habitat condition index" that is similar conceptually to the floristic quality index, and comprising one component of an overall "wetland condition index" might be the ultimate objective. Such an index should accord high priority to wetlands most likely to have the greatest wildlife species richness based on the predictive models, but should not penalize wetlands that have few species yet contain species that are regionally rare and/or sensitive to disturbance. Also, such an index must be sensitive to the fact that greatest diversity and/or the regionally-rarest wildlife species do not always occur solely in the least-altered, most-intact wetlands or landscapes of a particular type.

Literature References

Thomasma, S.A., L.E. Thomasma, M.J. Twery, S. Burton, and R. Doepker. 2007. MIWILD version 1.0.1.4. USDA Forest Service and Michigan Dept. of Natural Resources.