Building partnerships and establishing consensus on regional priorities across the Upper Midwest and Great Lakes Landscape Cooperative

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Summary

Global change impacts ecological systems at all scales, yet natural resource managers do not possess the necessary resources to effectively manage all impacts. Thus, prioritization of conservation objectives is essential to respond and adapt efficiently to environmental change. Through a series of interactive workshops conducted across the Upper Midwest and Great Lakes region, we facilitated the exchange of information between scientists and managers and encouraged collaboration to address anticipated challenges. Additionally, we engaged workshop participants in a facilitated exercise to identify a list of priority terrestrial wildlife species for potential inclusion in a climate vulnerability assessment. In 2011, we conducted ten workshops across the region according to partner needs and objectives. Each agenda was unique to the area, but often included presentations and discussions on regional climate change and adaptation, coalition building and methods/tools for conducting vulnerability assessments. Each workshop resulted in a list of priority species which was then combined to generate a regional priority list. The top species identified during this process included eastern massasauga, white-tailed deer, Blanding's turtle, ruffed grouse and snowshoe hare. Using this list, our objective for the second phase of this project is to develop a quantitative vulnerability assessment for a subset of the identified species.

1. Introduction: Climate Change and Collaborative Natural Resource Management

In addition to habitat loss and fragmentation, invasive species, and pollution, global climate change has become a principal issue in biodiversity conservation and natural resource management (Root and Schneider 2006, Lindenmayer et al. 2008, Mawdsley et al. 2009). Global environmental change has (e.g. Root et al. 2003, Parmesan and Yohe 2003) and will continue to have profound impacts on ecological systems across multiple scales (Thomas et al. 2004, Bellard et al. 2012). To reduce the severity of global climate change, mitigation[1] of greenhouse gas emissions is imperative (IPCC 2007); because, climate change attributable to carbon dioxide emissions is "irreversible" for at least 1000 years (Solomon et al. 2009), adaptation[2] is also imperative (IPCC 2007). To achieve conservation goals in a future of unparalleled change, scientists and managers must: 1) work together to understand the resultant changes in population, communities, and ecosystems and 2) develop adaptation strategies to reduce the vulnerability[3] or increase the resilience[4] of natural systems (West et al. 2009, Mastrandrea et al. 2010).

To understand the impacts of climate change on species or systems, an important process in widespread application is vulnerability assessment[5]. With a history in environmental risk assessment, a vulnerability analysis categorizes the "degree to which a system is likely to experience harm due to exposure to a hazard", detailing the system's exposure, sensitivity and resilience to climate change and its associated impacts (Turner et al. 2003). Because of variation in institutional goals, resources, and available data, there exists a wide variety of approaches to vulnerability assessment in ecology and natural resource management (see Glick and Edelson 2011); however, a common goal is that the output, a measure of the sensitivity of the target species or system to climate change, informs decision-making. To achieve this goal, sustained interaction between scientists and managers is essential (Mastrandea et al. 2010); in contrast, when managers and scientists work in isolation, research findings may not address management objectives or relevant findings are not translated into management plans. Close scientist-manager linkages—from identifying the target species/system and collecting data to developing and implementing an adaptation strategy—may serve multiple uses: 1) information exchange, particularly on complex topics with high uncertainty, 2) effective decision-making on commonly identified problems, 3) coordination of activities and sharing of resources, and 4) increased individual/organizational

[1] The development and implementation of policies to reduce greenhouse gas emissions and enhance carbon sinks (IPCC 2007).
[2] The development and implementation of Initiatives and measures to reduce the vulnerability of natural and human systems to actual or anticipated climate change (IPCC 2007).
[3] The degree to which a system is susceptible to adverse effects of climate change as a function of exposure, sensitivity, and adaptive capacity (IPCC 2007).
[4] A resilient system absorbs disturbances but retains its structure and function (IPCC 2007).
[5] Also known as impact assessment or risk assessment

capacity (Wondolleck and Yaffee 2000). Successful scientist-manager collaborations often yield successful conservation outcomes.[6]

One of the first exercises in collaborative natural resource management is to identify shared goals and interests. With limited resources available for conservation efforts, the identification of common priorities is increasingly important (Possingham et al. 2001). Collaborative management may result in more coordination, shared resources, and improved communication (Selin et al. 2000)— reducing duplication and the knowledge and resource burden on organizations. Because vulnerability analyses are often a collaboration between scientists and managers, a first step is to identify shared priorities: what are the species/systems of interest to this group? Although there are many techniques available to answer this question (O'Connor et al. 2003), two features are common to many successful collaborative initiatives: "open decision making and inclusiveness" (Selin et al. 2000). Such processes may initiate long-term partnerships for biological conservation.

In response to the need for effective conservation partnerships, the Department of the Interior established a network of Landscape Conservation Cooperatives (LCC) to address large-scale environmental problems and encourage collaborative problem solving.[7] In 2010, we received support from the Upper Midwest and Great Lakes LCC to implement an inclusive process to engage natural resource managers and identify shared priorities for terrestrial wildlife species under climate change.[8] In year 2, we will develop a vulnerability assessment for a subset of their priority species. The following is a report of year 1 activities, including a summary of the process and outcomes from the collaborative initiative across the Upper Midwest.

[6] See examples from Wilmsen et al. (2008) for case studies and lessons for collaborative natural resource management.

[7] Developed in response to Secretarial Order No. 3289 (September 14, 2009), LCCs are conservation science partnerships between private, public, Tribal, state and federal agencies for the conservation of fish, plant and wildlife resources within their boundaries.

[8] Principal Investigators: Karl Martin, Ph.D. (Wisconsin Department of Natural Resources) and William Karasov (University of Wisconsin-Madison). Grant title: *Identification of the Most Climate Vulnerable Terrestrial Species and Natural Communities in the Upper Midwest and Great Lakes Landscape Conservation Cooperative*.

2. Project Overview

2.1 Project Objectives

In Year 1 of the project, our goals were to:

1) to exchange information and foster communication and collaboration among scientists and managers on climate change and natural resource management, and

2) identify terrestrial species that are shared priorities for climate change vulnerability assessment.

2.2 Process

To achieve these goals, we organized ten interactive workshops with state, provincial, Federal, Tribal, and non-governmental partners across the region.

From pre-existing climate change contact lists and communication with regional coordinators, we first identified potential partners across the region (Table 1).

Table 1. Locations and primary contacts for the workshops.

LOCATION	PRIMARY CONTACT	DATE
Pennsylvania	Sally Just PA Department of Conservation and Natural Resources	July 8, 2011
Iowa	Katy Reeder IA Department of Natural Resources	August 1, 2011
Michigan	Christopher Hoving MI Department of Natural Resources	August 10-11, 2011
Native American Fish and Wildlife-Great Lakes Meeting	Heather Stricker Forest County Potawatomi Community	September 15, 2011
Minnesota	Ann Pierce MN Department of Natural Resources	September 26-27, 2011
USFWS T&E Program	T.J. Miller US Fish and Wildlife Service	October 5, 2011
Illinois	Kristopher Lah US Fish and Wildlife Service	October 27, 2011
Wisconsin	Tara Bergeson WI Department of Natural Resources	September and October, 2011
Ontario	Gary Nielsen Ontario Ministry of Natural Resources	December 7, 2011
Ohio	Heather Elmer OH Department of Natural Resources	December 15-16, 2011

With their assistance, we developed materials and workshop agendas tailored to both local/state and regional interests. Partners determined the overall theme[9] for the workshop, presentation topics, length of the workshop, how to approach stakeholder involvement, and how to integrate with existing efforts.[10] Depending on themes and objectives, we scheduled workshops for 1 to 1.5 days in length. To promote inclusiveness, we asked partners to consider inviting a diverse audience, representing various groups and agencies involved in terrestrial wildlife conservation in their area. We also encouraged invitations to a breadth of taxonomic and habitat experts to ensure adequate representation of the regional biodiversity. To promote open discussion and consensus-building, we asked that invite lists not exceed 30 people. To stimulate discussion in advance of the workshop, we emailed preparatory materials to participants and encouraged them to consult with colleagues unable to attend.

2.3 Objective 1: Exchanging information and fostering collaboration

Once the theme was established for a workshop, we worked with partners to develop presentations, discussions and activities to best achieve the objectives and engage participants. The workshops typically included a minimum of one presentation directly related to partner interests. Where appropriate, we provided the presentations, but encouraged and often invited additional speakers to broaden the disciplinary perspective and encourage collaboration. For example, at two of the workshops, the respective state climatologist gave a presentation on regional climate trends and observations. In other workshops, agency or university partners spoke to ongoing research into impacts of climate change on wildlife, existing climate change adaptation initiatives and how to incorporate structured decision making into climate change planning. Other sample components to the workshops included a panel discussion on communicating climate change to the public, and small group discussions on identifying resources and ways forward for developing climate change coalitions. We often closed each workshop session with a discussion from a regional partner on links to existing and anticipated climate change programs.

[9] Examples include: coalition-building for climate change adaptation, vulnerability assessment methods and case studies, climate change impacts on wildlife, and recent and future changes to regional climate.

[10] In some instances, the workshop was adapted for existing working groups on climate change and related themes, while other workshops were standalone.

2.4 Objective 2: Identifying shared priorities

To generate the list of priority species, we developed a facilitated discussion to engage participants in a prioritization exercise. First, we asked the participants to identify and define common priorities for terrestrial species conservation and management. We provided several examples: Threatened and Endangered (T&E) species, Species of Greatest Conservation Need (SGCN), economically important species, and culturally important species. Participants often selected from the above and generated additional categories to identify three to four value categories for inclusion in the list generation (Table 2). The value categories were determined via a facilitated discussion with all participants to represent the shared management and conservation priorities of the area.

Table 2. The value categories used in the workshops and the number of times they were selected.

VALUE CATEGORY	TOTAL
Threatened & Endangered/Species of Greatest Conservation Need/Species at Risk/Rare	8
Climate Sensitive	7
Other	7
Economically Important	5
Culturally Important	1
Distribution Breadth	1
Extinction Threat	1
Game Species	1
Habitat Representative	1
System Indicator	1

Next, depending on group size and expertise, participants divided themselves into breakout sessions based on either habitat (often forests, wetlands and grasslands) or taxonomic (reptile/amphibians, birds, invertebrates and mammals) expertise. In each breakout group, participants were to consider the group-identified value categories and identify up to 20 species. We provided breakout groups with a list of additional ecological and data driven factors to consider (Appendix A) and a list of the regional SGCN. We included the SGCN list to provide a sense of what species might be of regional importance across the UMGL LCC, however participants were not confined to the inclusion of solely regional species. An effort was made to identify taxa to the species level, but occasionally broader groups were identified when expertise was absent or taxonomic knowledge insufficient (i.e., arthropod pollinators).

To fully complete a quantitative vulnerability assessment, a sound working knowledge of a species life history and baseline data are required. Consequently, we asked each breakout group to apply a data/knowledge filter to the list of 20 species and within each value category, ranking species according to the amount of available information. This resulted in a subset of priority species that were of high management concern to participants, but also potentially with sufficient knowledge to evaluate their vulnerability to climate change.

Following the breakout sessions, we reconvened the large group and consolidated their lists by breakout group and value categories, resulting in a species-value matrix. Participants then had the opportunity to question colleagues and or comment on the output from the different breakout sessions. The group examined the list to ensure taxonomic and habitat diversity and considered additional criteria, such as species of public interest (i.e., game species), emblematic species for the state or province (i.e., state birds) and species of high management expenditures (i.e, white-tailed deer). Through discussion and consensus, the group agreed upon a final list that represented their shared values and priorities.[11]

[11] Two workshops were modified additionally given time and logistical constraints. Our workshop at the Native American Fish and Wildlife Society-Great Lakes Regional Conference was allotted a time window of 1.5 hours, so the list generation was open ended and no maximum was placed on the total number of species. Additionally, our workshop with the US Fish and Wildlife Service Region 3 Threatened and Endangered Species Coordinators Meeting focused exclusively on the T&E species, so their taxonomic scope was widened to include plants and aquatic animals.

3. Outcomes

In total, the collective participation in the workshops amounted to 225 participants representing 62 different agencies (Figure 1). The majority of participants were from state/provincial agencies (51% of total participants), however federal government agencies were well-represented (21% of total participants). Additional government representation came from county and city level staff, including biologists, park planners, and natural resource managers. Conservation groups included regional chapters and national representatives from major conservation NGOs (i.e., Audubon and The Nature Conservancy), as well as local conservation groups and science education centers (Appendix B).

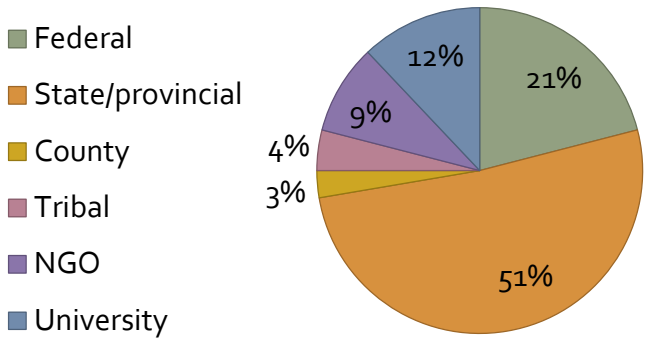

Figure 1. Breakdown of participants by organization

Using the lists from the 10 workshops, we identified the top 30 species shared across the workshops (Table 4). Listed in 8 out of the 10 workshops, Eastern massasauga distinctly emerged as the top regional priority for a climate vulnerability assessment. More generally, however, only 5 reptile and amphibian species were on the final list, as compared to 12 bird species, 10 mammals and 3 invertebrate species. The low number of invertebrates is likely a function of the amount of knowledge available to conduct a vulnerability assessment, as well as the difficulty in obtaining input from invertebrate experts throughout the workshops.

Across the entire compiled list, there were 181 species identified (Appendix B). Similar to the list of 30 species, birds had the highest representation (39%), followed by mammals (27%), reptiles and amphibians (20%) and invertebrates (14%). Some regional trends in shared priority species emerged. In general, MI, MN and WI tended to share a higher proportion of priority species with each other than across the region (30% of the species were found on at least two lists), while IA, IL and OH had more similar species than with other states (24%). For the eastern region of the study, ON, MI, PA and WI shared 23% of the priority species.

Table 5. The top 30 species identified as priorities across all 10 workshops.

TAXA	COMMON NAME	SCIENTIFIC NAME	FWS	IA	IL	MI	MN	NAFWS	OH	ON	PA	WI	SUM
Reptile/Amphibian	Eastern massasauga	*Sistrurus catenatus catenatus*	x	x	x	x			x	x	x	x	8
Mammal	White-tailed deer	*Odocoileus virginianus*		x			x	x	x	x	x	x	7
Reptile/Amphibian	Blanding's turtle	*Emydoidea blandingii*		x	x	x	x	x	x	x			7
Bird	Ruffed grouse	*Bonasa umbellus*		x		x		x		x	x	x	6
Mammal	Snowshoe hare	*Lepus americanus*				x	x	x		x	x	x	6
Bird	Cerulean warbler	*Dendroica cerulea*		x	x			x	x		x		5
Bird	Golden-winged warbler	*Vermivora chrysoptera*			x		x			x	x	x	5
Invertebrate	Hine's emerald dragonfly	*Somatochlora hineana*	x		x	x				x		x	5
Invertebrate	Karner blue butterfly	*Plebejus melissa samuelis*			x	x	x	x	x				5
Mammal	Little brown bat	*Myotis lucifugus*	x		x				x	x	x		5
Mammal	Moose	*Alces alces*				x	x	x		x		x	5
Reptile/Amphibian	Timber rattlesnake	*Crotalus horridus*		x	x		x		x		x		5
Bird	Black tern	*Chlidonias niger*			x	x	x					x	4
Bird	Common loon	*Gavia immer*				x	x	x				x	4
Bird	Eastern meadowlark	*Sturnella magna*		x		x	x					x	4

TAXA	COMMON NAME	SCIENTIFIC NAME	FWS	IA	IL	MI	MN	NAFWS	OH	ON	PA	WI	SUM
Bird	Henslow's sparrow	*Ammodramus henslowii*		x	x	x						x	4
Bird	Ring-necked pheasant	*Phasianus colchicus*		x			x		x			x	4
Bird	Wild turkey	*Meleagris gallopavo*				x		x		x	x		4
Invertebrate	Bumblebee sp.	*Bombus* sp.		x				x	x		x		4
Mammal	American marten	*Martes americana*				x		x		x		x	4
Bird	Bobolink	*Dolichonyx oryzivorus*		x	x				x				3
Bird	Greater prairie-chicken	*Tympanuchus cupido*			x		x					x	3
Bird	Red-headed woodpecker	*Melanerpes erythrocephalus*			x			x	x				3
Mammal	American badger	*Taxidea taxus*					x	x				x	3
Mammal	Beaver	*Castor canadensis*			x	x		x					3
Mammal	Gray fox	*Urocyon cinereoargenteus*		x	x			x					3
Mammal	Indiana bat	*Myotis sodalis*	x		x				x				3
Mammal	Northern flying squirrel	*Glaucomys sabrinus*						x			x	x	3
Reptile/Amphibian	Mole salamanders	*Ambystoma* sp.							x	x	x		3
Reptile/Amphibian	Red-backed salamander	*Plethodon cinereus*								x	x	x	3

4. Next Steps: Vulnerability Assessment

Anticipating the response of biodiversity to climate change and developing appropriate management strategies is a challenge faced by natural resource managers. Tools such as quantitative vulnerability assessments provide the necessary information to predict species' responses to climate change and other stressors. Consequently, we are developing a vulnerability assessment for a subset of the species identified as priorities in phase one of the project. For year 2, we will develop ecological models to assess the impacts of climate change and other stressors on their future distribution and abundance. This assessment will integrate available data and scientific understanding in a transparent process, detailing assumptions and uncertainties, to project population-level responses of target species to climate change. We anticipate completion of the assessment in 2013 and distribution of the findings shortly thereafter.

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Appendix A. The ecological, life history, data and management factors provided to participants to contemplate while determining their list of species.

Direct Impacts of Climate Change

- Advance of spring conditions
- Spatial shift in suitable conditions
- High temperature events
- Altered snow cover
- Drought
- Heavy precipitation/flooding events

Indirect Impacts of Climate Change

- Changes in habitat
- Species interactions

Life History Traits/Characteristics

- Specialized habitat and/or microhabitat requirements
- Narrow environmental thresholds likely to be exceeded
- Dependence on an environmental cue
- Dependence on inter-specific interaction likely to be altered
- Poor dispersal ability
- Disease/parasitism
- Maladaptive behavior
- Coupling with atmosphere-ocean circulation patterns

Management-driven Factors

- Species with public appeal
- Species with regulatory or management challenges
- Species that are already priorities for land managers
- Species with high management expenditures or activity (e.g., reintroductions programs or history of investment)
- Harvested species
- Ecosystem service providers or engineers
- Probability of success

Data-driven Factors

- Species with a lot of existing data (e.g., monitoring or long-term studies)
- Focal species of analyses by group/agency
- Representation in other vulnerability assessments (well- versus under-represented)

Appendix B. All of the participating agencies from the ten workshops.

Aldo Leopold Foundation
Army Corps of Engineers
Bad River Band
Clayton County Conservation, Iowa
Cleveland Metroparks, Ohio
Delaware River Basin Commission, Pennsylvania
Ducks Unlimited Inc.
Fond du Lac Band
Grand Portage Band
Grange Insurance Audubon Center, Ohio
Illinois Department of Natural Resources
Illinois Natural History Survey
Iowa Department of Natural Resources
Lac du Flambeau Band
Lehigh Gap Nature Center, Pennsylvania
Metro Parks, Serving Summit County, Ohio
Metroparks of the Toledo Area, Ohio
Michigan Department of Natural Resources
Michigan Natural Features Inventory
Michigan State University Extension
Minnesota Department of Natural Resources
Moravian College
National Audubon Society
National Audubon Society, Pennsylvania
National Wildlife Federation
Natural Lands Trust, Pennsylvania
Ohio Bird Conservation Initiative
Ohio Department of Natural Resources
Ohio Division of Wildlife
Ontario Ministry of Natural Resources
OSU Ohio Biodiversity Partnership
Pennsylvania State University
Pennsylvania Department of Conservation and Natural Resources
Pennsylvania Fish and Boat Commission
Pennsylvania Game Commission
Pennsylvania Natural Heritage Program
Pennsylvania Sea Grant
Red Lake Band
Stockbridge-Munsee Community
The Field Museum
The Nature Conservancy, Illinois
The Nature Conservancy, Iowa
The Nature Conservancy, Michigan
The Nature Conservancy, Ohio
The Nature Conservancy, Pennsylvania
The Nature Conservancy, Wisconsin
The Ohio State University
The Wilds, Ohio
University of Illinois
University of Minnesota-Twin Cities
University of Minnesota-Duluth-Natural Resources Research Institute
University of Wisconsin-Madison
University of Wisconsin-Stevens Point
US Forest Service
US Geological Survey
US Department of Interior-Bureau of Indian Affairs-Great Lakes Agency
US Fish and Wildlife Service
US Fish and Wildlife Service Joint Venture
US Fish and Wildlife Service/Environmental Protection Agency
Western Michigan University
Wild Resource Conservation Program
Winneshiek County Conservation, Iowa
Wisconsin Department of Natural Resources

APPENDIX C. All species identified as priorities in the 10 workshops. Nomenclature following taxonomic standards at: http://www.itis.gov/

TAXA	COMMON NAME	SCIENTIFIC NAME	FWS	IA	IL	MI	MN	NAFWS	OH	ON	PA	WI	SUM
BIRD	American woodcock	*Scolopax minor*		x		x							2
	Bald eagle	*Haliaeetus leucocephalus*		x				x					2
	Barn owl	*Tyto alba*								x			1
	Bell's vireo	*Vireo bellii*										x	1
	Black tern	*Chlidonias niger*			x	x	x					x	4
	Black-billed cuckoo	*Coccyzus erythropthalmus*			x								1
	Black-crowned night heron	*Nycticorax nycticorax*									x		1
	Black-throated blue warbler	*Dendroica caerulescens*					x						1
	Blue winged teal	*Anas discors*				x	x						2
	Bobolink	*Dolichonyx oryzivorus*		x	x				x				3
	Boreal chickadee	*Poecile hudsonica*								x			1
	Boreal owl	*Aegolius funereus*						x					1
	Brown-headed cowbird	*Molothrus ater*				x							1
	Canada goose	*Branta canadensis*		x				x					2
	Cattle egret	*Bubulcus ibis*						x					1

TAXA	COMMON NAME	SCIENTIFIC NAME	FWS	IA	IL	MI	MN	NAFWS	OH	ON	PA	WI	SUM
BIRD	Cerulean warbler	*Dendroica cerulea*		x	x			x	x		x		5
	Common loon	*Gavia immer*				x	x	x				x	4
	Common raven	*Corvus corax*						x					1
	Common tern	*Sterna hirundo*				x							1
	Dickcissel	*Spiza americana*							x			x	2
	Eastern meadowlark	*Sturnella magna*		x		x	x					x	4
	Gadwall	*Anas strepera*						x					1
	Golden eagle	*Aquila chrysaetos*						x					1
	Golden-winged warbler	*Vermivora chrysoptera*			x		x			x	x	x	5
	Gray jay	*Perisoreus canadensis*						x		x			2
	Great gray owl	*Strix nebulosa*						x					1
	Greater prairie-chicken	*Tympanuchus cupido*			x		x					x	3
	Greater scaup	*Aythya marila*				x							1
	Green heron	*Butorides virescens*						x					1
	Henslow's sparrow	*Ammodramus henslowii*		x	x	x						x	4
	King rail	*Rallus elegans*										x	1

TAXA	COMMON NAME	SCIENTIFIC NAME	FWS	IA	IL	MI	MN	NAFWS	OH	ON	PA	WI	SUM
BIRD	Kirtland's warbler	*Dendroica kirtlandii*	x										1
	Lesser scaup	*Aythya affinis*				x			x				2
	Loggerhead shrike	*Lanius ludovicianus*					x						1
	Lousiana waterthrush	*Seiurus motacilla*									x		1
	Mallard	*Anas platyrhynchos*		x		x							2
	Marsh wren	*Cistothorus palustris*							x				1
	Mottled duck	*Anas fulvigula*						x					1
	Mourning dove	*Zenaida macroura*								x			1
	Mute swan	*Cygnus olor*				x							1
	Northern bobwhite	*Colinus virginianus*							x			x	2
	Northern cardinal	*Cardinalis cardinalis*						x					1
	Northern goshawk	*Accipiter gentilis*						x					1
	Northern harrier	*Circus cyaneus*							x				1
	Northern pintail	*Anas acuta*		x				x					2
	Piping plover	*Charadrius melodus*	x			x							2
	Red-headed woodpecker	*Melanerpes erythrocephalus*			x			x	x				3

TAXA	COMMON NAME	SCIENTIFIC NAME	FWS	IA	IL	MI	MN	NAFWS	OH	ON	PA	WI	SUM
BIRD	Red-shouldered hawk	*Buteo lineatus*		x		x						x	3
	Ring-necked duck	*Aythya collaris*					x						1
	Ring-necked pheasant	*Phasianus colchicus*		x			x		x			x	4
	Ruffed grouse	*Bonasa umbellus*		x		x		x		x	x	x	6
	Sandhill crane	*Grus canadensis*		x		x		x					3
	Scarlet tanager	*Piranga olivacea*									x		1
	Sharp-shinned hawk	*Accipiter striatus*									x		1
	Sharp-tailed grouse	*Tympanuchus phasianellus*						x					1
	Trumpeter swan	*Cygnus buccinator*						x					1
	Upland sandpiper	*Bartramia longicauda*				x							1
	Veery	*Catharus fuscescens*							x				1
	Virginia rail	*Rallus limicola*							x				1
	Whip-poor-will	*Caprimulgus vociferus*								x			1
	White-throated sparrow	*Zonotrichia albicollis*					x						1
	Wild turkey	*Meleagris gallopavo*				x		x		x	x		4
	Wood duck	*Aix sponsa*		x					x				2

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BIRD	Wood thrush	*Hylocichla mustelina*					x				x		2
	Yellow rail	*Coturnicops noveboracensis*					x					x	2
	Yellow-headed blackbird	*Xanthocephalus xanthocephalus*			x								1
FISH	Pallid sturgeon	*Scaphirhynchus albus*	x										1
INVERTEBRATE	Arthropod pollinators						x						1
	Azure sp.										x		1
	Baltimore checkerspot butterfly	*Euphydryas phaeton*		x									1
	Black-legged tick	*Ixodes scapularis*								x			1
	Bog bean buck moth	*Hemileuca sp.*								x			1
	Bumblebee sp.	*Bombus sp.*		x				x	x		x		4
	Burrowing mayfly sp.	*Hexagenia sp.*							x				1
	Clubshell	*Pleurobema clava*	x										1
	Dakota skipper	*Hesperia dacotae*					x						1
	Deer ticks	*Ixodes scapularis*						x			x		2
	Dragonfly sp.			x							x		2
	Fly poison borer moth	*Papaipema sp.*									x		1

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INVERTEBRATE	Hine's emerald dragonfly	*Somatochlora hineana*	x		x	x				x		x	5
	Illinois cave amphipod	*Gammarus acherondytes*	x										1
	Incurvate emerald dragonfly	*Somatochlora incurvata*				x							1
	Iowa pleistocene snail	*Discus macclintocki*		x									1
	Karner blue butterfly	*Plebejus melissa samuelis*			x	x	x	x	x				5
	Lake Huron locust	*Trimerotropis huroniana*				x				x			2
	Mayflies										x		1
	Mitchell's satyr	*Neonympha mitchellii mitchellii*	x										1
	Monarch butterfly	*Danaus plexippus*						x					1
	Mosquitoes							x			x		2
	Moth sp.								x				1
	Ottoe skipper	*Hesperia ottoe*		x									1
	Rattlesnake master borer moth	*Papaipema eryngii*			x								1
	Rayed bean	*Villosa fabalis*	x										1
	Regal fritillary	*Speyeria idalia*			x						x	x	3
MAMMAL	13-lined ground squirrel	*Spermophilus tridecemlineatus*										x	1

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MAMMAL	American badger	*Taxidea taxus*					x	x				x	3
	American marten	*Martes americana*				x		x		x		x	4
	Appalachian cottontail	*Sylvilagus obscurus*									x		1
	Beaver	*Castor canadensis*			x	x		x					3
	Black bear	*Ursus americanus*						x			x		2
	Bobcat	*Lynx rufus*		x				x					2
	Bog lemming	*Synaptomys cooperi*						x					1
	Canada lynx	*Lynx canadensis*						x		x			2
	Common opossum	*Didelphis marsupialis*						x		x			2
	Common porcupine	*Erethizon dorsatum*									x		1
	Coyote	*Canis latrans*						x					1
	Deer mouse	*Peromyscus maniculatus*						x					1
	Eastern red bat	*Lasiurus borealis*				x							1
	Ermine or Short-tailed weasel	*Mustela erminea*						x					1
	Fisher	*Martes pennanti*						x					1
	Fox squirrel	*Sciurus niger*		x				x					2

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MAMMAL	Franklin's ground squirrel	*Spermophilus franklinii*			x								1
	Gray fox	*Urocyon cinereoargenteus*		x	x			x					3
	Gray squirrel	*Sciurus carolinensis*						x					1
	Gray wolf	*Canis lupus*				x		x					2
	Hoary bat	*Lasiurus cinereus*			x								1
	Indiana bat	*Myotis sodalis*	x		x				x				3
	Least shrew	*Cryptotis parva*			x								1
	Little brown bat	*Myotis lucifugus*	x		x				x	x	x		5
	Long-tailed weasel	*Mustela frenata*						x					1
	Meadow vole	*Microtus pennsylvanicus*					x		x				2
	Moose	*Alces alces*				x	x	x		x		x	5
	Muskrat	*Ondatra zibethicus*					x		x				2
	Northern flying squirrel	*Glaucomys sabrinus*						x			x	x	3
	Northern long-eared bat	*Nyctophilus arnhemensis*					x						1
	Northern river otter	*Lontra canadensis*				x					x		2
	Pine marten	*Martes martes*						x					1

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MAMMAL	Prairie vole	*Microtus ochrogaster*										x	1
	Pygmy shrew	*Sorex hoyi*			x								1
	Raccoon	*Procyon lotor*						x					1
	Red squirrel	*Tamiasciurus hudsonicus*						x	x				2
	River otter	*Lontra canadensis*						x					1
	Snowshoe hare	*Lepus americanus*				x	x	x		x	x	x	6
	Southern flying squirrel	*Glaucomys volans*			x			x		x			3
	Southern red-backed vole	*Clethrionomys gapperi*					x	x					2
	Spruce grouse	*Falcipennis canadensis*						x				x	2
	Striped skunk	*Mephitis mephitis*						x					1
	Timber wolf	*Canis lupus*										x	1
	Water shrew	*Sorex palustris*										x	1
	White-footed mouse	*Peromyscus leucopus*								x			1
	White-tailed deer	*Odocoileus virginianus*		x			x	x	x	x	x	x	7
PLANT	Decurrent false aster	*Boltonia decurrens*	x										1
	Fassett's locoweed	*Oxytropis campestris var. chartacea*	x										1

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PLANT	Hall's bulrush	*Schoenoplectus hallii*	x										1
	Michigan monkey-flower	*Mimulus glabratus var. michiganensis*	x										1
	Virginia sneezeweed	*Helenium virginicum*	x										1
	Western prairie fringed orchid	*Platanthera praeclara*	x										1
REPTILE/ AMPHIBIAN	American bullfrog	*Lithobates catesbeianus*						x					1
	Blanding's turtle	*Emydoidea blandingii*		x	x	x	x	x	x	x			7
	Blue-spotted salamander	*Ambystoma laterale*				x	x						2
	Bog turtle	*Clemmys muhlenbergii*									x		1
	Bullsnake	*Pituophis catenifer*										x	1
	Eastern box turtle	*Terrapene carolina*							x				1
	Eastern fox snake	*Elaphe gloydi*							x				1
	Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*	x								x		2
	Eastern massasauga rattlesnake	*Sistrurus catenatus catenatus*	x	x	x	x			x	x	x	x	8
	Eastern spadefoot toad	*Scaphiopus holbrookii*							x				1
	Four-toed salamander	*Hemidactylium scutatum*			x		x						2
	Fowler's toad	*Anaxyrus fowleri*				x							1

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REPTILE/ AMPHIBIAN	Gray ratsnake	*Elaphe spiloides*								x			1
	Illinois chorus frog	*Pseudacris illinoensis*			x								1
	Map turtle	*Graptemys pseudogeographica*						x					1
	Mink frog	*Lithobates septentrionalis*										x	1
	Mole salamanders	*Ambystoma sp.*							x	x	x		3
	Northern coal skink	*Eumeces anthracinus anthracinus*									x		1
	Northern cricket frog	*Acris crepitans*		x					x				2
	Northern leopard frog	*Rana pipiens*					x				x		2
	Ozark hellbender	*Cryptobranchus alleganiensis bishopi*	x										1
	Painted turtle	*Chrysemys picta*						x		x			2
	Red-backed salamander	*Plethodon cinereus*								x	x	x	3
	Smooth green snake	*Opheodrys vernalis*		x				x					2
	Snapping turtle	*Chelydra serpentina*						x		x			2
	Spotted turtle	*Clemmys guttata*			x					x			2
	Spring peeper	*Pseudacris crucifer*									x		1
	Tiger salamander	*Ambystoma tigrinum*		x									1

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REPTILE/ AMPHIBIAN	Timber rattlesnake	*Crotalus horridus*		x	x		x		x		x		5
	Western chorus frog	*Pseudacris triseriata*								x			1
	Western hognose snake	*Heterodon nasicus*					x						1
	Wood frog	*Lithobates sylvaticus*			x							x	2
	Wood turtle	*Glyptemys insculpta*					x	x					2
	Yellow mud turtle	*Kinosternon flavescens*			x								1