INDIANA

STATE WILDLIFE ACTION PLAN

ACKNOWLEDGEMENTS

Numerous people assisted in the development of Indiana's State Wildlife Action Plan. Partners involved in the process participated in one or more of the surveys, spending significant time providing valuable information. Those organizations and individuals are listed in Appendix U.

Support was provided from key partners and individuals throughout. These individuals worked greatly with the Division of Fish and Wildlife in one or more of the major stages to establish the direction, to gather and refine expert data, and to compile and prepare the final document. We thank everyone for their input, time, and efforts. This document would not be possible without you.

Division of Fish and Wildlife Core Team

- Michelle Cain, Wildlife Information Specialist
- Sandy Clark-Kolaks, Southern Fisheries Research Biologist
- Steve Donabauer, Northern Fisheries Research Biologist
- Brant Fisher, Nongame Aquatic Biologist
- Kent Hanauer, Private Lands Wildlife Biologist
- Julie Kempf, Federal Aid Coordinator
- Nate Levitte, Pigeon River FWA Property Manager
- Adam Phelps, Waterfowl Research Biologist
- Sam Whiteleather, Wildlife Staff Specialist
- Shannon Winks, Private Lands Wildlife Biologist
- Amanda Wuestefeld, Assistant Director

Advisory Team

- Dan Arndt, Duke Energy
- John Bacone, Indiana DNR, Nature Preserves
- David Bausman, Indiana State Department of Agriculture
- Cliff Chapman, Indiana Land Protection Alliance
- Kevin Crane, Indiana Department of Environmental Management
- Andrew DeWoody, Purdue University, Department of Forestry & Natural Resources
- Gary Dinkel, U.S. Forest Service
- Chris Gonso, Indiana DNR, Forestry
- Justin Harrington, Indiana DNR, State Parks and Reservoirs
- Laura Hilden, Indiana Department of Transportation
- Liz Jackson, Indiana Forest & Woodland Owners Association
- Jeff Kiefer, U.S. Fish and Wildlife Service
- Raoul Moore, Indiana Forest & Woodland Owners Association
- Mike Mycroft, Indiana DNR, State Parks and Reservoirs
- Brian Nentrup, Pheasants Forever
- Mark Reiter, Indiana DNR, Fish and Wildlife
- Joe Robb, U.S. Fish and Wildlife Service
- Justin Schneider, Indiana Farm Bureau
- Mike Sertle, Ducks Unlimited
- John Shuey, The Nature Conservancy
- Barb Simpson, Indiana Wildlife Federation
- Stacy Sobat, Indiana Department of Environmental Management
- Dave Stratman, U.S. Natural Resources Conservation Service
- Robert Swihart, Purdue University, Department of Forestry & Natural Resources

Development Partners

- Jack McGriffin, Indiana Department of Natural Resources
- Kristin Brier, Indiana Department of Environmental Management
- Eppley Institute for Parks and Public Lands
    - Austin Hochstetler and Steven Wolter
- Purdue University, Department of Forestry and Natural Resources
    - Rita Blythe, Robert Chapman, Colleen Hartel, Zhao Ma, and Patrick Zollner
- TrendyMinds, Inc.
    - Kristina Bender, Andrew Cruez, and Lori Ludwig

FOREWORD

Aletter from our director.

Indiana's fish and wildlife play a vital role in the improved quality of life for all Hoosiers. The Indiana Department of Natural Resources (DNR), Division of Fish and Wildlife (DFW) is tasked with the responsibility to professionally manage Indiana's fish and wildlife for present and future generations on both private and public lands. The vast majority of Indiana's lands are privately owned. The DNR recognizes we will achieve greater success in our goal to conserve fish and wildlife resources through collaboration and continued partnerships with private landowners and conservation organizations.

Congress also has recognized the importance of partnerships and integrated conservation efforts, and has charged each state and territory in the country to develop a State Wildlife Action Plan (SWAP) by October 2015 as an update to the Comprehensive Wildlife Strategy (CWS) from 2005.

In the development of the SWAP, the DNR contacted over 950 interested professionals throughout the state and region to create a network of technical experts and on-the-ground natural resource managers. The SWAP is a reflection of those partnerships and ongoing collaboration of conservation organizations to increase habitat and landscape scale benefits and to focus on common goals identified within the SWAP.

Conservation doesn't just happen. It requires resources and collaboration. The SWAP is a habitat-based plan to benefit all Indiana fish and wildlife including Indiana's Species of Greatest Conservation Need (SGCN). Game species have long benefitted from federal funding through the Wildlife and Sport Fish Restoration Programs (hunter and angler funded). For nearly eight decades, these DNR programs have had great success in managing game species and providing hunting and fishing opportunities for Hoosiers. To achieve similar conservation success for wildlife species that are not hunted or fished, a permanent, stable funding base is required, both from federal sources and state matching funds. This action plan is a necessary step toward that goal and receiving the federal funding associated with State Wildlife Grants. As a member of the International Association of Fish and Wildlife Agencies, DNR will work with other states and our partners to establish and maintain the level of support required to implement the SWAP.

Hoosiers have always worked together to build the future, whether in manufacturing, agriculture or wildlife conservation. Remembering that a wise tinkerer keeps all the parts, we intend to conserve all our natural resources to sustain economic development and contribute to quality of life for our citizens and visitors.

With a rich base of conservation partners contributing and shaping the SWAP, we know this plan has something to offer every Hoosier willing to work towards conservation in the state. We are grateful to those who helped create this guiding

document for habitat and SGCN conservation in Indiana and invite all Hoosiers to help us continue to move forward. Join us as we use this plan to guide programs and initiatives that will conserve wildlife for your grandchildren and beyond.

We believe in Hoosier heart and ingenuity. We look forward to working with all our partners to ensure the future of our critical natural resources on which all fish, wildlife, and Hoosiers depend.

Sincerely,

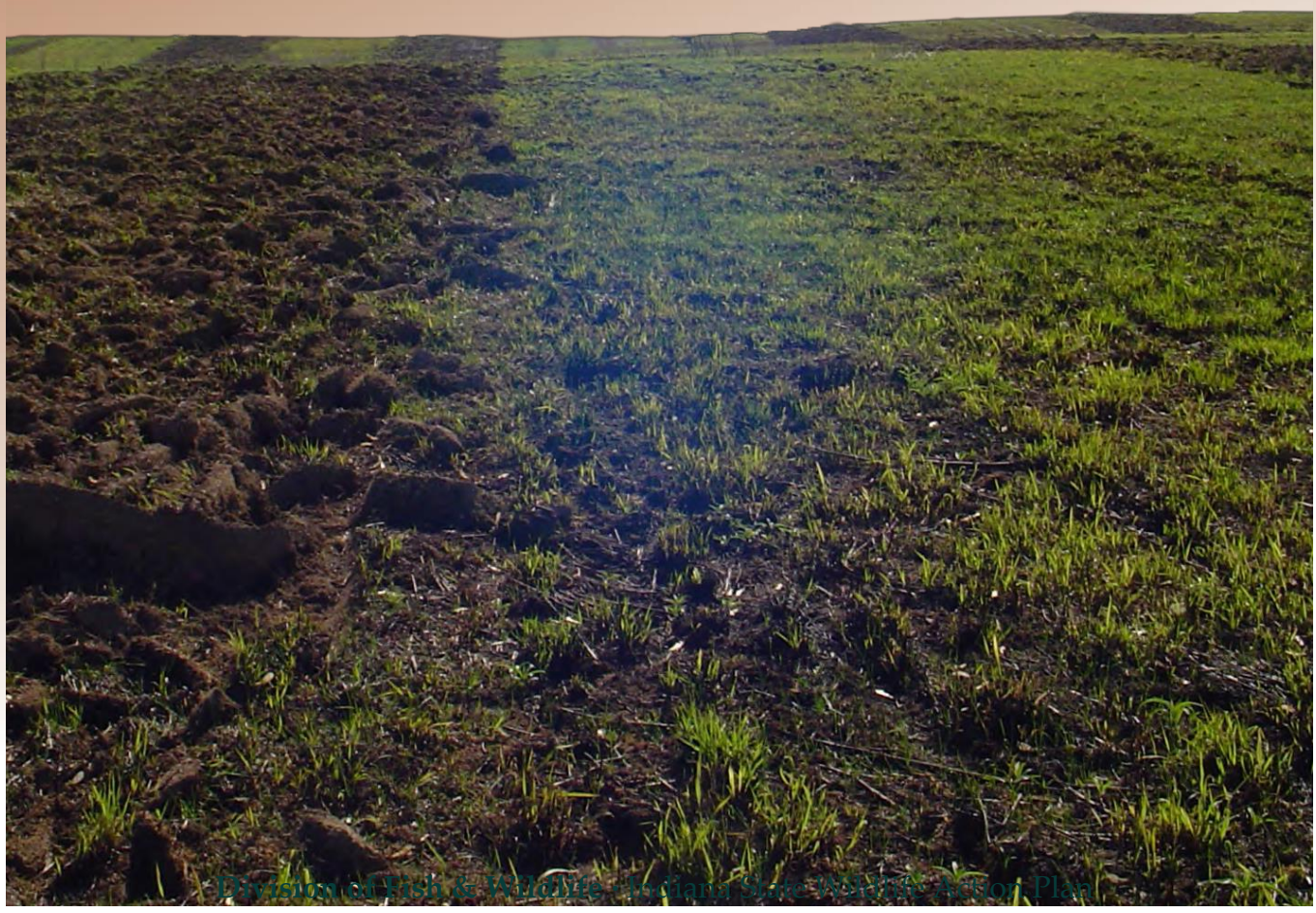
Cameron Clark

Director, Indiana Department of Natural Resources

1

CHAPTER I.

EXECUTIVE SUMMARY



IN 2005, INDIANA CREATED ITSFIRST STATE WILDLIFE ACTION PLAN (SWAP).

That initial plan was known as Indiana's Comprehensive Wildlife Strategy (CWS). With theadvent of this first plan, the IndianaDepartmentofNatural Resources(IDNR),theDivision of Fish and Wildlife (DFW), and the broader conservation community, have been able to expand and strengthen fish and wildlife programs. This document is the first revision of that initial effort.

The SWAP is a guide, rather than a detailed habitat or species management plan, for preserving the state's fish and wildlife resources. This document was designed as a living document and a strategic vision with a goal of preserving our state's fish and wildlife diversity. Most importantly, this document forms a framework for developing and coordinating conservation actions involving all conservation partners and safeguarding all fish and wildlife species.

A Core Team of DFW personnel was established to assist the project leaders (Julie Kempf and Amanda Wuestefeld) in the completion of the SWAP. An Advisory Team, representing conservation partners from a wide variety of conservation organizations and agencies, was also created. These two groups, and the greater conservation community, can be credited with the development and implementation of the SWAP.

The following vision and mission statements were developed for the SWAP:

- **Vision:** Indiana's SWAP will be a national leader in guiding a diverse conservation community toward the shared goal of enhancing and conserving fish and wildlife resources.

- **Mission:** The purpose of Indiana's SWAP is to manage, conserve, and enhance habitats' and populations' stability for diverse fish and wildlife resources. By 2025, the SWAP will be fully integrated throughout Indiana's conservation community. The SWAP will serve to bridge the efforts of dedicated natural resources professionals and stewards, which will ultimately enrich the quality of life for all Hoosiers.

Four main themes were identified as key for the plan's success: environment, conservation community, funding, and citizens. As both the Core Team and Advisory Team met, these four themes continually came to the forefront of the discussion; each identified issue or action needed tied to one or more of these four themes. The overall success of the SWAP will rely on successful outcomes in each ofthesethemes.

The CWS utilized 60 different habitat types within eight major habitat categories. For the SWAP, planning regions were developed in order to better focus conservation efforts. The Core Team, with approval from the Advisory Team, developed thefollowing regions: Great Lakes, Kankakee, Corn Belt, Valleys and Hills, Interior Plateau, and Drift Plains. They also applied the eight distinct habitat types from the CWS to the regional framework. The identified habitat types are: Agricultural Lands, Aquatic Systems, Barren Lands, Developed Lands, Forests, Grasslands, Subterranean Systems, and Wetlands.

Public knowledge, input, and acceptance of the SWAP are crucial for its success. With that in mind, public input was sought and welcomed throughout the development of the first revision. Three regional kickoff meetings were held in 2013 where meeting participants offered opinions and feedback regarding the direction of the SWAP. The information gathered from these meetings aided in shaping the SWAP.

Similar to the original CWS, in-depth surveys were created and utilized in 2014 to consult with noted experts on habitat, species, and ecological issues. These surveys sought specific data on the current status of species and habitats as well as threats to each of them. Experts were consulted as to what actions could be utilized to best reduce threats and increase or stabilize declining species populations and/ or habitat quality. Members of the public and the conservation community were Given another opportunity for input while reviewing the survey results. This public input along with that of the experts was also utilized to develop a number of Conservation Opportunity Areas (COA) within the plan's regional framework.

The intent of this revision should be seen as a much more ambitious goal than simply meeting the eight essential elements identified by Congress. The coming-together of the Core Team, Advisory Team, the greater conservation community, and the public as a whole should be seen as an effort to work collaboratively toward our common goals. The intent of the SWAP is to avoid "random acts of conservation" and to help people care more for land and resources. It is the intent of the DFW for this document to serve as the guide not only for future

DFW operations but also for that of the conservation community as a whole.

2

CHAPTER II.

TABLE OF CONTENTS

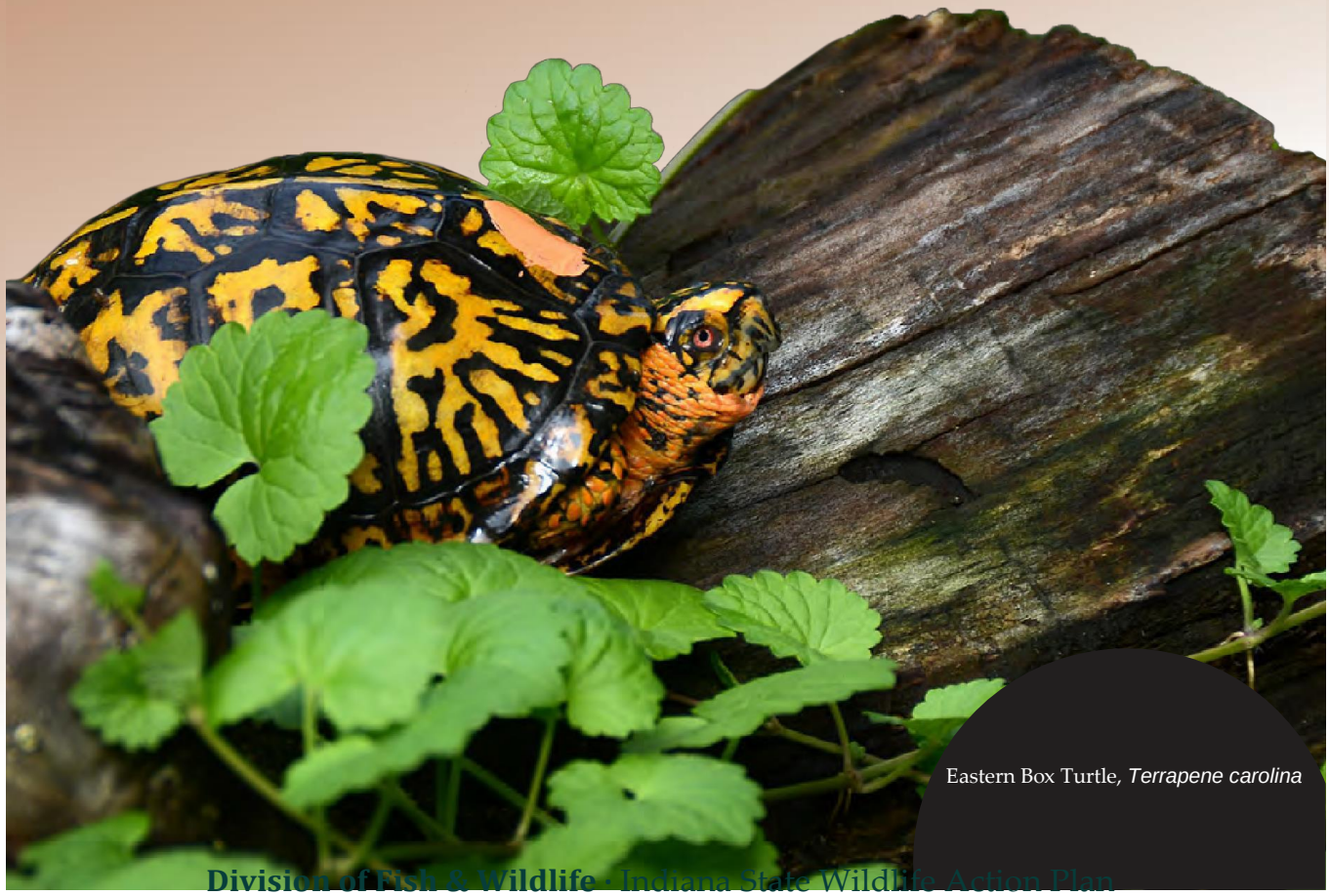
Redside Dace, *Clinostomus elongatus*

Chapter titles are hyperlinked to their corresponding sections within the SWAP.

3

CHAPTER III.

INTRODUCTION AND PURPOSE



Eastern Box Turtle, *Terrapene carolina*

THE GOAL OF THE REVISION IS THAT IT WILL GO FAR BEYOND JUST SECURING STATE WILDLIFE GRANT (SWG) FUNDING FOR INDIANA. THE OVERARCHING PURPOSE OF THE SWAP IS TO UNIFY CONSERVATION ACROSS THE INDIANA LANDSCAPE.

An important element of the congressional guidelines for the SWAP requires that all states commit to reviewing and, if necessary, revising their SWAP at least every ten years.

Indiana's original SWAP, known as the CWS, was completed in 2005. This was Indiana's first attempt at providing a comprehensive overview of conservation in the state and resulted in notable successes. The CWS played a key role in determining species for the State Acres for Wildlife Enhancement (SAFE) program and provided funding for several collaborative projects including research of Eastern Hellbender populations in the Blue River, the ecology and population genetics of Eastern Box Turtles in Indiana, and the population genetics of the Allegheny Woodrat in Indiana. Funding was also provided for several land acquisitions including the Sorbo and Strube tracts in the Knobstone Escarpment/Knobs area, Floyd County (343 acres), and the Bloomington DFW Office (Girl Scout Office Complex), Monroe County (11.8 acres), among others.

REVISING THE ORIGINAL 2005 CWS TO INCREASE EFFECTIVENESS, APPLICABILITY, AND MAGNITUDE:

While successful, the CWS fell short in unifying the conservation community and in guiding landscape conservation actions. The plan was utilized mostly by agencies within the IDNR and lacked applicability to the conservation community as a whole. For these reasons, it was considered critically important that Indiana's conservation partners participate and provide input throughout the entire revision process. It is hoped that the foundation of the SWAP will be a unified conservation community.

The goal of the revision is that it will go far beyond just securing SWG funding for Indiana. The SWAP's overarching purpose is to unify conservation across the Indiana landscape. In order to have the most lasting and significant impact on habitat, and consequently our fish and wildlife resources, the conservation community must work together. So-called "random acts of conservation" must be avoided by focusing our resources on shared goals and working together through partnerships. What follows in the pages of this document is a road map for successful landscape conservation.

CONGRESSIONAL GUIDELINES AND REQUIREMENTS:

States are given great latitude in creating their SWAP, but must ensure that all of the original eight elements are met. The following is a list of the eight elements and where they are located in the document:

1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the DFW deems appropriate, that are indicative of the diversity and health of the state's wildlife (Chapter V, Appendix F, and Appendix G).

2. Descriptions of locations and relative conditions of key habitats and community types essential to SGCN (Chapter V).
3. Descriptions of problems which may adversely affect SGCN or their habitats (Chapter V and Appendix G-M), and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of SGCN and habitats (Chapter V and Appendix N).
4. Descriptions of conservation actions proposed to conserve the identified species and habitats and priorities for implementing such actions (Chapter V, Chapter VI, and Appendices H-M).
5. Proposed plans for monitoring SGCN and their habitats, for monitoring the effectiveness of the conservation actions (Chapter VII), and for adapting these conservation actions to respond appropriately to new information or changing conditions (Chapter VIII).
6. Descriptions of procedures to review the strategy at intervals not to exceed ten years (Chapter IX).
7. Plans for coordinating the development, implementation, review, and revision of the SWAP with federal, state, and local agencies, and Indian tribes that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats (Chapter IV and Chapter IX).
8. Congress also affirmed through this legislation that broad public participation is an essential element of developing and implementing these plans (Chapter IV), the projects that are carried out while these plans are developed, and the SGCN that Congress has indicated such programs and projects are intended to emphasize.

INDIANA'S SWAP: WHAT IT IS, AND WHAT IT ISN'T

Indiana's SWAP provides an overview of conservation threats in Indiana and identifies needed actions. The SWAP includes biological aspects of wildlife and habitat conservation in the state, as well as information on the conservation organizations currently conducting on-the-ground efforts. It identifies conservation needs, organizations working in those arenas, and overlapping areas of interest for potential partnerships.

The SWAP is not an operational plan. It does not identify specific tasks, assignments, or schedules for achieving conservation. The intent is that the SWAP will guide and encourage development and/or compilation of operational plans within the DNR and from DNR's many conservation partners. Developing operational plans and creating partnerships are the next steps in the process.

The major change and focus from the CWS to the SWAP is the creation of planning regions to better focus actions and priorities based on regional resources, needs, and threats. This change was a result of recommendations from staff and partners. The map below shows the Indiana planning regions. More information on Indiana's planning regions can be found in Chapter VI.

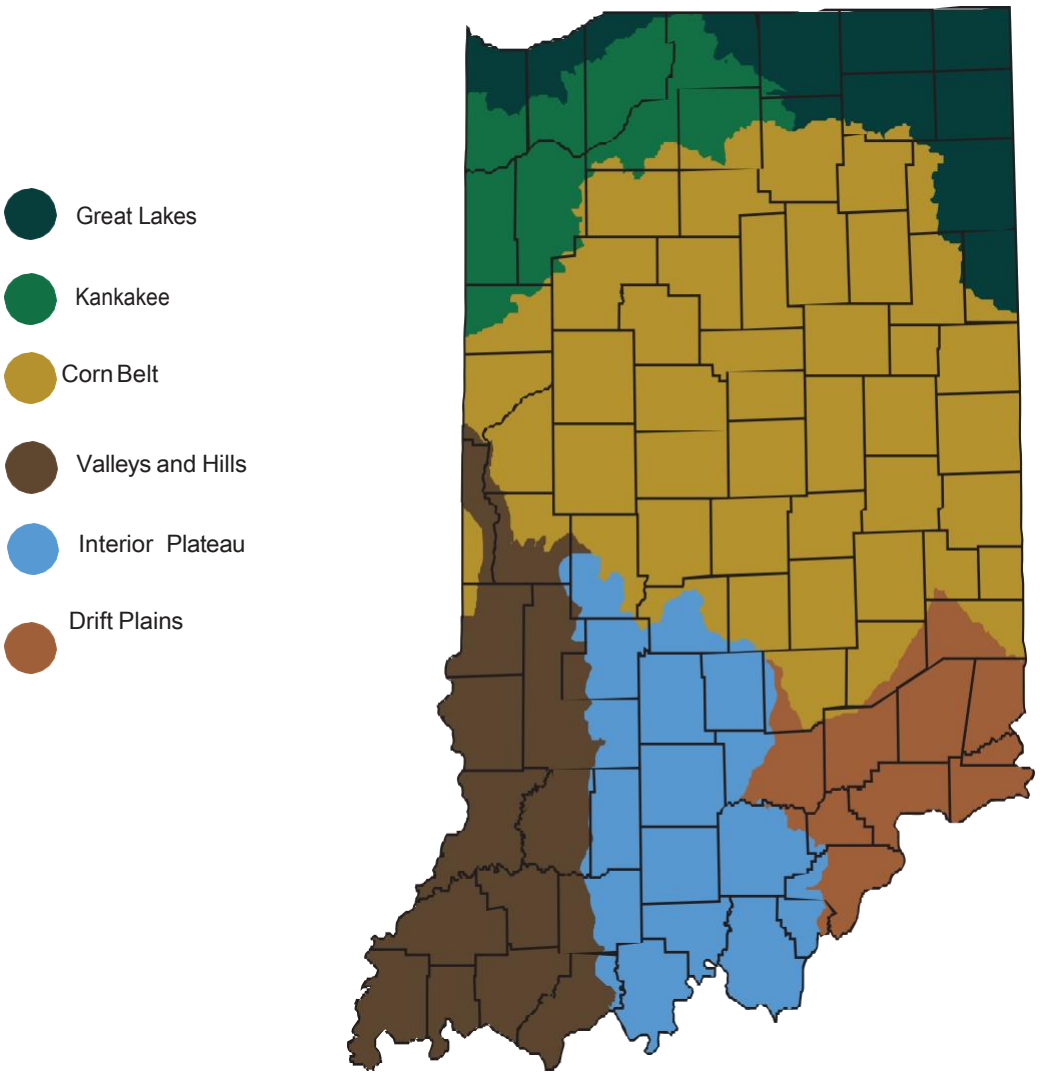


Figure 3-1. Indiana planning regions for the SWAP.

4

CHAPTER IV.

PUBLIC INVOLVEMENT AND PARTNERSHIP SOLICITATION

Crawfish Frog, *Lithobatesareolatus*

IN THE DEVELOPMENT OF THE SWAP, THE DFW SOUGHT TO EXPAND PUBLIC AND PARTNER PARTICIPATION.

A participation framework provided guidelines for including partnersatvarious levels of involvement. Potential partners were engaged through a comprehensive and multidisciplinary approach.

A weakness identified by the Core Team in the 2005 CWS was the lack of participation and buy-in from the public and partners. In the development of the SWAP, the Core Team realized early on that partner involvement would vary based on interest, resources, and goals. A participation framework provided guidelines for including partners at various levels of involvement. Potential partners were engaged through a comprehensive and multidisciplinary approach. By using a host of interactive methods, partners were able to check-in and participate at any point throughout the process. The main avenue for interested partners to gain information was through the SWAP website (www.swap.dnr.in.gov).

ADVISORY TEAM

The Advisory Team was organized to serve as a sounding board, information source, and disseminator of SWAP for the Core Team. Participation by the Advisory Team was frequent throughout with in-person meetings (generally every two to four months), emails, and phone calls over two years. The following were identified as key partners and were invited to participate on the Advisory Team:

A. Federal Agencies

- U.S. Department of Agriculture (USDA)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Forest Service (USFS)
- U.S. Geological Survey (USGS)
- U.S. Natural Resources Conservation Service (NRCS)

B. State Agencies

- Indiana Department of Natural Resources (IDNR)
- Indiana Department of Environmental Management (IDEM)
- Indiana State Department of Agriculture (ISDA)
- Indiana Department of Transportation (INDOT)
- Purdue University
- Indiana University

C. Organizations

- Indiana Wildlife Federation (IWF)
- Ducks Unlimited (DU)
- Indiana Farm Bureau (IFB)
- Indiana Land Protection Alliance (ILPA)
- The Nature Conservancy (TNC)
- Duke Energy
- Pheasants Forever (PF)
- National Wild Turkey Federation (NWTF)
- Indiana Forest & Woodlands Owners Association (IFWOA)
- American Electric Power (AEP)

D. Indian Tribes

There are no federally recognized Indian tribes in Indiana.

CONSERVATION COMMUNITY

Initial Scoping Phase

In order to engage more partners, the Core Team revisited a comprehensive list of some 570 potential partners generated for the CWS. This list was the starting point for partner identification in the 2015 revision. The list was expanded to 760 potential partners based on recommendations from the Core Team, Advisory Team, and an online organization survey.

The online Conservation Organization Survey was created and distributed in November of 2013 to all potential partners and made available to the public in order to gather information about conservation goals, areas of the state, and the typesof habitats in which they work, species of interest, and resources available. One representative was asked to fill out the survey for their organization. A total of 85 individuals participated in the survey from 74 different organizations. Two private landowners also participated in the survey (Appendix Q).

In the summer of 2013, the DFW hired Indiana University's Eppley Institute for Parks and Public Lands to provide recommendations for technical data collection and ways to continue partner involvement throughout the revision process. The Eppley Institute organized and facilitated three regional kick-off partner meetings in Indianapolis, Corydon, and Lakeville, and a web-based meeting (webinar) in early fall of 2013. Personal invitations were sent via email to the 760 identified potential partners. Press releases, websites, and other media outlets were also utilized to publicize the events. A total of 150 participants attended a regional meeting, and 21 participated via the webinar. The Eppley Institute also conducted a follow-up meeting to provide a comprehensive overview of the initial meetings.

From information gathered at the meetings, the Eppley Institute concluded a mixed-method approach (technical surveys, in-person meetings, social media, and electronic/virtual discussion forums) was needed to maximize stakeholder engagement and increase involvement (Appendix T).

Technical and Data Gathering Phase

In the spring of 2014, the DFW hired Purdue University's Department of Forestry and Natural Resources to work with the Core Team in the SWAP revision process to:

1. Update the baseline data obtained in the CWS for SGCN and habitats
2. Incorporate planning regions
3. Determine threats and the associated actions for SGCN and their habitats
4. Develop a system to prioritize these actions
5. Establish a system to monitor the effectiveness of these actions

Prior to Purdue University releasing their online technical surveys, two focus groups were convened in April and June of 2014. These focus groups included members of the Core Team, Advisory Team, and species technical experts.

The purpose of the first focus group was to discuss and identify potential threats to SGCN and their habitats in Indiana over the next ten years and the conservation

actions needed to address these threats (Appendix R). The threats and conservation actions identified by the focus group were then used to help develop and refine the technical surveys.

The purpose of the second focus group was to identify for each planning region the habitat types of interest, conservation actions likely to be implemented to conserve these habitats over the next ten years, and pool of candidate indicator species to refine the focus of landscape-level modeling. Results from this second focus group can be found in Appendix S.

The first technical survey, the Species Survey, was geared towards SGCN experts and was initiated on July 11, 2014. Experts were considered those individuals who work extensively with SCGN or have a depth of knowledge of them and/or their associated habitats. A total of 166 individuals participated in the survey, providing a total of 486 useable species responses covering 110 different species (Appendix O).

The second technical survey, the Habitat Survey, targeted people, agencies, and organizations that managed or had knowledge about habitats in Indiana, and was initiated on August 11, 2014. In order to better engage partners that maintain a more regional focus, the survey was organized by Indiana planning regions. Survey participants could complete the survey for those regions they felt were pertinent to them. The survey link was sent to 974 conservation professionals, stakeholders, species experts, property managers, and property owners. A total of 362 individuals participated in the survey, providing a total of 257 respondents providing useable answers, covering 827 region habitat combinations (Appendix P).

Public Collaboration

Throughout the development of the SWAP, members of the public were invited to participate in several ways. The DFW created a website (www.swap.dnr.in.gov) to communicate pertinent updates as needed. The initial scoping phase and the online surveys were made available to all who wished to participate. Emails and phone calls were additional ways to reach DFW staff to provide feedback.

In order to present the vast amount of data generated from the two surveys and to discuss the results with partners, the DFW and Purdue University hosted six regional stakeholder meetings in September and October of 2014. Again, these meetings were made available to anyone interested, partners and members of the public alike. The results from the Species and Habitat Surveys were presented, and stakeholders had opportunities to comment and ask questions. The meetings were held in close proximity to the planning regions in Plymouth, Noblesville, Butlerville, and Bicknell. Attendance at the six meetings ranged from 16 to 30 people. A total of 136 people attended the meetings with more than 20 organizations and several landowners represented. For those who could not attend the regional stakeholder meetings, results were and a public comment form were available on the SWAP website.

A full draft of the SWAP revision was placed on the DFW website for final commenting on 8/28/15. This allowed members of the Advisory Team, DFW staff, the rest of the conservation community and members of the public to comment and provide feedback prior to final completion of the SWAP. Most comments received in this final period were questions about errors that were ultimately corrected. There were also several comments relating to the COA map; generally

about the inclusion/exclusion of areas. Several comments were specific to the commenting organizations and were addressed individually. Further, as noted in the SWAP, the COA map is not intended to be static and may evolve during implementation to address concerns as it relates to the SWAP criteria and process. Other significant comments relating specifically to more detailed actions will be incorporated into the implementation plan for the SWAP.

5

CHAPTER V.

STATEWIDE ASSESSMENTS OF SPECIES OF GREATEST CONSERVATION NEED AND HABITATS

Bald Eagle, *Haliaeetus leucocephalus*

IN ORDER TO CONSERVE SGCN AND THEIR HABITATS IN INDIANA, THE DFW USES ALL OF THE TOOLS OF AMODERN SCIENTIFIC MANAGEMENT PROGRAM, INCLUDING SURVEYS AND MONITORING, RESEARCH, POPULATION AND HABITAT MANAGEMENT, EDUCATION, LAND ACQUISITION AND REGULATION.

OUTLINE

A. *Distribution and Abundance of SGCN*
B. *Statewide Assessment of Habitats*
C. *Threats and Actions by Major Habitat Type*
D. *Conservation Opportunity Areas*

A. DISTRIBUTION AND ABUNDANCE OF SGCN

Introduction and Purpose

Congressional guidelines dictate that the SWAP must identify and be focused on species in greatest need of conservation. The first element requires that the SWAP present, "Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife."

The purpose of this section is to identify Indiana's current SGCN, and to discuss their distribution throughout the state, current population abundance, past and future trends in abundance, and how the health of their populations and habitats are assessed.

How SGCN are Identified

Indiana's SGCN are identified using the published list of federally endangered, threatened or candidate species and Indiana's list of endangered species and species of special concern (Table 5-1).

Table 5-1. Current federal and state status of Indiana's SGCN as of January, 2019.

Taxa	Group	Scientific Name	Common Name	Status[1]
Amphibians	Aquatic Salamanders	*Cryptobranchus alleganiensis*	Hellbender	SE
Amphibians	Aquatic Salamanders	*Necturus maculosus*	Common Mudpuppy	SC
Amphibians	Salamanders	*Ambystoma laterale*	Blue-spotted Salamander	SC
Amphibians	Salamanders	*Ambystoma talpoideum*	Mole Salamander	SE
Amphibians	Salamanders	*Ambystoma barbouri*	Streamside Salamander	SC
Amphibians	Salamanders	*Hemidactylium scutatum*	Four-toed Salamander	SC
Amphibians	Salamanders	*Pseudotriton ruber*	Red Salamander	SE
Amphibians	Salamanders	*Aneides aeneus*	Green Salamander	SE
Amphibians	Frogs	*Acris blanchardi*	Blanchard's Cricket Frog	SC
Amphibians	Frogs	*Lithobates areolatus*	Crawfish Frog	SE
Amphibians	Frogs	*Lithobates blairi*	Plains Leopard Frog	SE
Birds	Waterfowl	*Cygnus buccinator*	Trumpeter Swan	SE
Birds	Quail and Grouse	*Colinus virginianus*	Northern Bobwhite	SC
Birds	Quail and Grouse	*Bonasa umbellus*	Ruffed Grouse	SC
Birds	Nightjars	*Chordeiles minor*	Common Nighthawk	SC
Birds	Nightjars	*Antrostomus vociferus*	Eastern Whip-poor-will	SC
Birds	Rails	*Laterallus jamaicensis*	Black Rail	SE
Birds	Rails	*Rallus elegans*	King Rail	SE

Taxa	Group	Scientific Name	Common Name	Status[1]
Birds	Rails	*Rallus limicola*	Virginia Rail	SE
Birds	Rails	*Gallinula galeata*	Common Gallinule	SE
Birds	Cranes	*Grus canadensis*	Sandhill Crane	SC
Birds	Cranes	*Grus americana*	Whooping Crane	FE/SE
Birds	Shorebirds	*Pluvialis dominica*	American Golden-plover	SC
Birds	Shorebirds	*Charadrius melodus*	Piping Plover	FE/SE
Birds	Shorebirds	*Bartramia longicauda*	Upland Sandpiper	SE
Birds	Shorebirds	*Arenaria interpres*	Ruddy Turnstone	SC
Birds	Shorebirds	*Calidris canutus rufa*	Rufa Red Knot	FE/SE
Birds	Shorebirds	*Calidris subruficollis*	Buff-breasted Sandpiper	SC
Birds	Shorebirds	*Limnodromus griseus*	Short-billed Dowitcher	SC
Birds	Shorebirds	*Scolopax minor*	American Woodcock	SC
Birds	Shorebirds	*Tringa solitaria*	Solitary Sandpiper	SC
Birds	Shorebirds	*Tringa melanoleuca*	Greater Yellowlegs	SC
Birds	Shorebirds	*Phalaropus tricolor*	Wilson's Phalarope	SC
Birds	Terns	*Sternula antillarum athalassos*	Interior Least Tern	FE/SE
Birds	Terns	*Chlidonias niger*	Black Tern	SE
Birds	Herons, Egrets, and Bitterns	*Botaurus lentiginosus*	American Bittern	SE
Birds	Herons, Egrets, and Bitterns	*Ixobrychus exilis*	Least Bittern	SE
Birds	Herons, Egrets, and Bitterns	*Ardea alba*	Great Egret	SC
Birds	Herons, Egrets, and Bitterns	*Nycticorax nycticorax*	Black-crowned Night-heron	SE
Birds	Herons, Egrets, and Bitterns	*Nyctanassa violacea*	Yellow-crowned Night-heron	SE
Birds	Raptors	*Pandion haliaetus*	Osprey	SC
Birds	Raptors	*Ictinia mississippiensis*	Mississippi Kite	SC
Birds	Raptors	*Haliaeetus leucocephalus*	Bald Eagle	SC
Birds	Raptors	*Circus cyaneus*	Northern Harrier	SE
Birds	Raptors	*Accipiter striatus*	Sharp-shinned Hawk	SC
Birds	Raptors	*Buteo platypterus*	Broad-winged Hawk	SC
Birds	Raptors	*Tyto alba*	Barn Owl	SE
Birds	Raptors	*Asio flammeus*	Short-eared Owl	SE
Birds	Raptors	*Falco peregrinus*	Peregrine Falcon	SC
Birds	Songbirds	*Lanius ludovicianus*	Loggerhead Shrike	SE
Birds	Songbirds	*Cistothorus platensis*	Sedge Wren	SE
Birds	Songbirds	*Cistothorus palustris*	Marsh Wren	SE
Birds	Songbirds	*Ammodramus henslowii*	Henslow's Sparrow	SE

Taxa	Group	Scientific Name	Common Name	Status[1]
Birds	Songbirds	*Xanthocephalus xanthocephalus*	Yellow-headed Blackbird	SE
Birds	Songbirds	*Sturnella neglecta*	Western Meadowlark	SC
Birds	Songbirds	*Helmitheros vermivorum*	Worm-eating Warbler	SC
Birds	Songbirds	*Vermivora chrysoptera*	Golden-winged Warbler	SE
Birds	Songbirds	*Mniotilta varia*	Black-and-white Warbler	SC
Birds	Songbirds	*Setophaga citrina*	Hooded Warbler	SC
Birds	Songbirds	*Setophaga kirtlandii*	Kirtland's Warbler	FE/SE
Birds	Songbirds	*Setophaga cerulea*	Cerulean Warbler	SE
Fish	Lampreys	*Ichthyomyzon fossor*	Northern Brook Lamprey	SE
Fish	Sturgeons	*Acipenser fulvescens*	Lake Sturgeon	SE
Fish	Freshwater Eels	*Anguilla rostrata*	American Eel	SC
Fish	Carps and Minnows	*Clinostomus elongatus*	Redside Dace	SE
Fish	Carps and Minnows	*Hybopsis amnis*	Pallid Shiner	SE
Fish	Carps and Minnows	*Notropis anogenus*	Pugnose Shiner	SC
Fish	Carps and Minnows	*Notropis dorsalis*	Bigmouth Shiner	SC
Fish	Carps and Minnows	*Rhinichthys cataractae*	Longnose Dace	SC
Fish	Catfish	*Noturus stigmosus*	Northern Madtom	SC
Fish	Trouts and Salmons	*Coregonus artedi*	Cisco	SC
Fish	Suckers	*Moxostoma valenciennesi*	Greater Redhorse	SE
Fish	Cavefish	*Amblyopsis hoosieri*	Hoosier Cavefish	SE
Fish	Sunfish	*Lepomis symmetricus*	Bantam Sunfish	SE
Fish	Perches	*Etheostoma variatum*	Variegate Darter	SE
Fish	Perches	*Percina copelandi*	Channel Darter	SE
Fish	Perches	*Percina evides*	Gilt Darter	SE
Fish	Trout-perches	*Percopsis omiscomaycus*	Trout-perch	SC
Fish	Sculpins	*Cottus cognatus*	Slimy Sculpin	SC
Fish	Pygmy Sunfish	*Elassoma zonatum*	Banded Pygmy Sunfish	SC
Fish	Perches	*Ammocrypta clara*	Western Sand Darter	SC
Fish	Perches	*Etheostoma maculatum*	Spotted Darter	SC
Mammals	Shrews and Moles	*Sorex fumeus*	Smoky Shrew	SC
Mammals	Shrews and Moles	*Sorex hoyi*	American Pygmy Shrew	SC
Mammals	Shrews and Moles	*Condylura cristata*	Star-nosed Mole	SC
Mammals	Bats	*Myotis austroriparius*	Southeastern Myotis	SC
Mammals	Bats	*Myotis grisescens*	Gray Myotis	FE/SE
Mammals	Bats	*Myotis leibii*	Eastern Small-footed Myotis	SC
Mammals	Bats	*Myotis lucifugus*	Little Brown Myotis	SE

Taxa	Group	Scientific Name	Common Name	Status[1]
Mammals	Bats	*Myotis septentrionalis*	Northern Long-eared Myotis	FE/SE
Mammals	Bats	*Myotis sodalis*	Indiana Myotis	FE/SE
Mammals	Bats	*Lasionycteris noctivagans*	Silver-haired Bat	SC
Mammals	Bats	*Perimyotis subflavus*	Tri-colored Bat	SE
Mammals	Bats	*Nycticeius humeralis*	Evening Bat	SE
Mammals	Bats	*Lasiurus borealis*	Eastern Red Bat	SC
Mammals	Bats	*Lasiurus cinereus*	Hoary Bat	SC
Mammals	Bats	*Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat	SC
Mammals	Rabbits	*Sylvilagus aquaticus*	Swamp Rabbit	SE
Mammals	Rodents	*Spermophilus franklinii*	Franklin's Ground Squirrel	SE
Mammals	Rodents	*Geomys bursarius*	Plains Pocket Gopher	SC
Mammals	Rodents	*Neotoma magister*	Allegheny Woodrat	SE
Mammals	Bears	*Ursus americanus*	Black Bear	SC
Mammals	Mustelids	*Mustela nivalis*	Least Weasel	SC
Mammals	Mustelids	*Taxidea taxus*	American Badger	SC
Mollusks	Mussels	*Cyprogenia stegaria*	Fanshell	FE/SE
Mollusks	Mussels	*Epioblasma obliquata perobliqua*	White Catspaw	FE/SE
Mollusks	Mussels	*Epioblasma torulosa rangiana*	Northern Riffleshell	FE/SE
Mollusks	Mussels	*Epioblasma triquetra*	Snuffbox	FE/SE
Mollusks	Mussels	*Lampsilis fasciola*	Wavyrayed Lampmussel	SC
Mollusks	Mussels	*Obovaria subrotunda*	Round Hickorynut	SE
Mollusks	Mussels	*Plethobasus cyphyus*	Sheepnose	FE/SE
Mollusks	Mussels	*Pleurobema clava*	Clubshell	FE/SE
Mollusks	Mussels	*Pleurobema cordatum*	Ohio Pigtoe	SC
Mollusks	Mussels	*Pleurobema plenum*	Rough Pigtoe	FE/SE
Mollusks	Mussels	*Potamilus capax*	Fat Pocketbook	FE/SE
Mollusks	Mussels	*Ptychobranchus fasciolaris*	Kidneyshell	SC
Mollusks	Mussels	*Quadrula cylindrica cylindrica*	Rabbitsfoot	FT/SE
Mollusks	Mussels	*Simpsonaias ambigua*	Salamander Mussel	SC
Mollusks	Mussels	*Toxolasma lividum*	Purple Lilliput	SC
Mollusks	Mussels	*Venustaconcha ellipsiformis*	Ellipse	SC
Mollusks	Mussels	*Villosa fabalis*	Rayed Bean	FE/SE
Mollusks	Mussels	*Villosa lienosa*	Little Spectaclecase	SC
Mollusks	Snails	*Campeloma decisum*	Pointed Campeloma	SC
Mollusks	Snails	*Lymnaea stagnalis*	Swamp Lymnaea	SC
Reptiles	Turtles	*Macrochelys temminckii*	Alligator Snapping Turtle	SE
Reptiles	Turtles	*Kinosternon subrubrum*	Eastern Mud Turtle	SE

Taxa	Group	Scientific Name	Common Name	Status[1]
Reptiles	Turtles	*Clemmys guttata*	Spotted Turtle	SE
Reptiles	Turtles	*Emydoidea blandingii*	Blanding's Turtle	SE
Reptiles	Turtles	*Terrapene carolina*	Eastern Box Turtle	SC
Reptiles	Turtles	*Terrapene ornata*	Ornate Box Turtle	SE
Reptiles	Turtles	*Pseudemys concinna*	River Cooter	SE
Reptiles	Snakes	*Thamnophis butleri*	Butler's Gartersnake	SE
Reptiles	Snakes	*Thamnophis radix*	Plains Gartersnake	SC
Reptiles	Snakes	*Thamnophis proximus*	Western Ribbonsnake	SC
Reptiles	Snakes	*Nerodia erythrogaster neglecta*	Copper-bellied Watersnake	FT/SE
Reptiles	Snakes	*Clonophis kirtlandii*	Kirtland's Snake	SE
Reptiles	Snakes	*Opheodrys aestivus*	Rough Greensnake	SC
Reptiles	Snakes	*Opheodrys vernalis*	Smooth Greensnake	SE
Reptiles	Snakes	*Cemophora coccinea*	Scarletsnake	SE
Reptiles	Snakes	*Tantilla coronata*	Southeastern Crowned Snake	SE
Reptiles	Snakes	*Farancia abacura*	Red-bellied Mudsnake	SC
Reptiles	Snakes	*Agkistrodon piscivorus*	Cottonmouth	SE
Reptiles	Snakes	*Sistrurus catenatus*	Eastern Massasauga	FT/SE
Reptiles	Snakes	*Crotalus horridus*	Timber Rattlesnake	SE

[1]*FE – federally endangered, FT – federally threatened, FC – federal candidate, FX – federally extirpated, NA – no federal status, SE – state endangered, SC – state special concern, SX – state extirpated, NA – no state status*

Changes to the SGCN List

Under the Indiana Nongame and Endangered Species Conservation Act, endangered species are defined by IC 14-22-34-1 as, "Any species or subspecies of wildlife whose prospects of survival or recruitment within Indiana are in jeopardy or are likely within the foreseeable future to become so due to any of the following factors:"

1. The destruction, drastic modification, or severe curtailment of the habitat of the wildlife.
2. The overutilization of the wildlife for scientific, commercial, or sporting purposes.
3. The effect on the wildlife of disease, pollution, or predation.
4. Other natural or man-made factors affecting the prospect of survival or recruitment within Indiana.
5. Any combination of the factors described in subdivisions one through four.

Any species appearing on the U.S. list of endangered and threatened wildlife are state endangered (Table 5-1). Additionally, any federally threatened species that occur in Indiana are also state-endangered. The term threatened is not defined in any Indiana statute; however, threatened is defined in Indiana Administrative Code (IAC). Since there is no regulatory distinction between threatened and endangered, Indiana no longer uses the threatened category. Any species or subspecies deemed vulnerable enough to require the protection of the state Endangered Species Act (ESA) is considered endangered.

Species are added or removed from the state-endangered species list through the administrative rule process at least every two years. Recommendations to add or remove species originate in a Technical Advisory Committee (TAC). The DFW has established five TACs, one for each major taxon: Mammals, Birds, Amphibians and Reptiles, Fish, and Mollusk and Crustacean. Each committee is comprised of the chair and one to nine additional members, primarily from Indiana colleges and universities, with experience in Indiana relative to the taxon covered by that committee. Each TAC has one DFW staff member assigned based on their position as a species expert within the division. The TACs previously considered only resident wildlife and bird species breeding in Indiana, but have recently made an effort to consider the needs of migratory species as well.

For a given species, a TAC makes a listing recommendation based on the consideration of several factors, including overall population size, comparison of current distribution relative to historic distribution, threats to the species, and the status of closely related taxa or other species occupying a similar niche. The experts in each TAC use their best professional judgment, experience, and applicable publications and reports to determine if the prospect for a given species' survival in Indiana is in jeopardy. The TACs tend to be conservative: when there is insufficient data upon which to make a definitive determination, the committees recommend protection for a species facing significant risk. This precaution provides the maximum protection of Indiana law and elevates the monitoring and research priority of that species. The status of all SGCN are reviewed annually by the TACs, and additions and deletions are recommended. Species are removed from this list when their prospects for survival in the state are known to be secure.

The process of adding or removing species from the list per the administrative rule process, provides ample opportunity for public comment. Species of special concern are not afforded legal protection and their addition or removal is done internally and does not require administrative rule. Comments may be included in writing to an administrative law judge and/or by direct testimony to the NRC, the legal body with authority to adopt Department of Natural Resources (DNR) administrative rule or through NRC website at: http://www.in.gov/nrc/. Additionally, the DNR allows individuals to submit comments at the beginning of each rule change process through an online system every two years.

The status of species newly discovered in Indiana, such as the Green Salamander and the Mole Salamander, can be problematic. Historically, systematic surveys were not conducted for all taxa, and a species presence in the state may be a result of recent range expansion. However, the TACs reason that disjunct populations or populations at the edge of their range may represent distinct gene pools that warrant conservation. For these species, removal from the list is not defined by reaching a specific population level or distribution but rather by the degree to which the known population is secure from threat.

In addition to listing species as endangered, species may be listed as special concern. Species are generally listed as special concern because experts suspect the species' population is declining or their distribution is shrinking, the species has undergone a recent change in federal or state status, or the species may simply be difficult to survey. Special concern status raises the survey and monitoring priority of these species and stimulates encounter reports from the scientific community, but these species have no official legal protection.

In order to conserve SGCN and the broader array of wildlife in Indiana, the DFW uses all the tools of a modern scientific management program, including surveys and monitoring, research, population and habitat management, education, land acquisition, and regulation. By virtue of being rare or occupying remote or

inaccessible habitats, scientific information is limited for many SGCN, and some continue to go undetected. SGCN lists are subject to change as more knowledge about the species distribution and abundance becomes available. The following changes have occurred to the SGCN list since the CWS was published:

Table 5-2. Changes to the status of Indiana's SGCN since 2005.

Level	Direction	Change	Species
Federal	Downlisted	FT › No Status	Bald Eagle
	Elevated	No Status › FC	Eastern Massasauga
		No Status › FT	Rabbitsfoot Rufa Red Knot[1]
		No Status › FE	Northern Long-eared Myotis Little Brown Bat Tri-colored Bat Snuffbox
		FC › FT	Copper-bellied Watersnake
		FT > FE	Rufa Red Knot[1]
		FC › FE	Sheepnose Rayed Bean
	Delisted	FE › FX	Tubercled blossom

Level	Direction	Change	Species
State	Downlisted	SC › No Status	River Otter Bobcat Eastern Spadefoot Northern Leopard Frog Red-shouldered Hawk Longnose Sucker Ohio River Muskellunge Lake Whitefish Cypress Darter Tippecanoe Darter
		SE › SC	Osprey Bald Eagle Peregrine Falcon Southeastern Myotis Four-toed Salamander Red-bellied Mudsnake
	Elevated	No Status › SC	Ruddy Turnstone[2] Buff-breasted Sandpiper[2] Short-billed Dowitcher[2] Wilson's Phalarope[2] American Golden-plover[2] Greater Yellowlegs[2] Solitary Sandpiper[2] Eastern Small-footed Myotis Blanchard's Cricket Frog Streamside Salamander Eastern Box Turtle Plains Gartersnake Rufa Red Knot[1] Ruffed Grouse Northern Bobwhite American Woodcock American Eel Black Bear
		No Status › SE	Mole Salamander
		SC › SE	Cerulean Warbler Plains Leopard Frog Round Hickorynut Rayed Bean Rufa Red Knot[1]
	Delisted	SE › SX	Tubercled Blossom Longsolid Pink Mucket White Wartyback Orangefoot Pimpleback Pyramid Pigtoe

[1]*Elevated in 2014 to FT/SC and in 2018 to FE/SE*

[2]*A suite of migratory bird species were listed as special concern to represent the needs of migratory species throughout the state.*

In the Species Survey, technical experts were prompted to give their recommendations for additions to or deletions from the SGCN list, along with reasoning or data to support their recommendations. Many thorough responses were received, and all responses will be passed to the TACs for consideration in their next review of the SGCN list. For the full text of responses to these survey questions, see Appendix O.

Distribution of SGCN Across Habitats and Planning Region

Figure 5-1 illustrates the distribution of Indiana's SGCN across habitat types throughout the state. A given species can occur in multiple habitat types depending on its life stage or habitat availability, and most species are found in multiple planning regions. The uneven distribution of SGCN across habitat types may be a reflection of the fact that some habitats are naturally smaller in size, widely scattered, or may have historically supported low biodiversity. Also, some habitat types are better studied or receive more attention due to economic and aesthetic values. A complete list of distribution of SGCN across habitat and subhabitat types can be found in Appendix G and a complete list of habitat and subhabitat definitions can be found in Appendix D.

The uneven distribution of SGCN across planning regions is likely due to the presence of natural features unique to each region. For example, the Great Lakes Region includes the Lake Michigan shoreline and associated dune habitat, and a number of SGCN are associated with this key habitat. Chapter VI includes descriptions and maps of Indiana's SWAP planning regions; Appendices H-L includes additional information on distribution of SGCN across planning regions.

All six planning regions had similar numbers of bird (43-48), mammal (11-18), and reptile (7-11) species. However, fish and mollusk species did have greater differences by planning region with the lowest fish SGCN in the Kankakee region at four and the highest in the Valleys and Hills region with nine. Mollusk SGCN was also lowest in the Kankakee at three and highest in the Corn Belt with 15. Full results can be found in Appendix O.

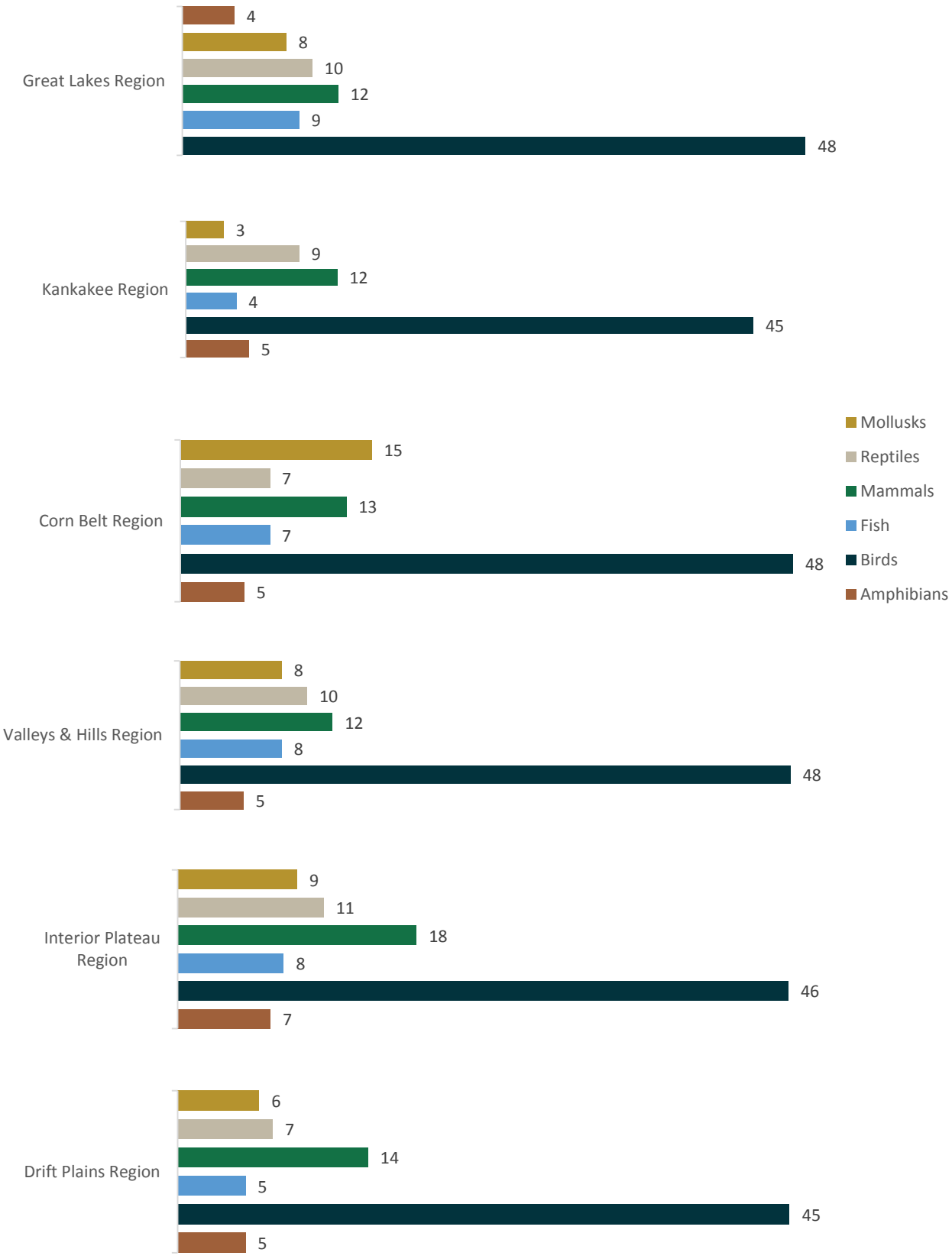


Figure 5-1. Number of SGCN occurring in each planning region by taxa

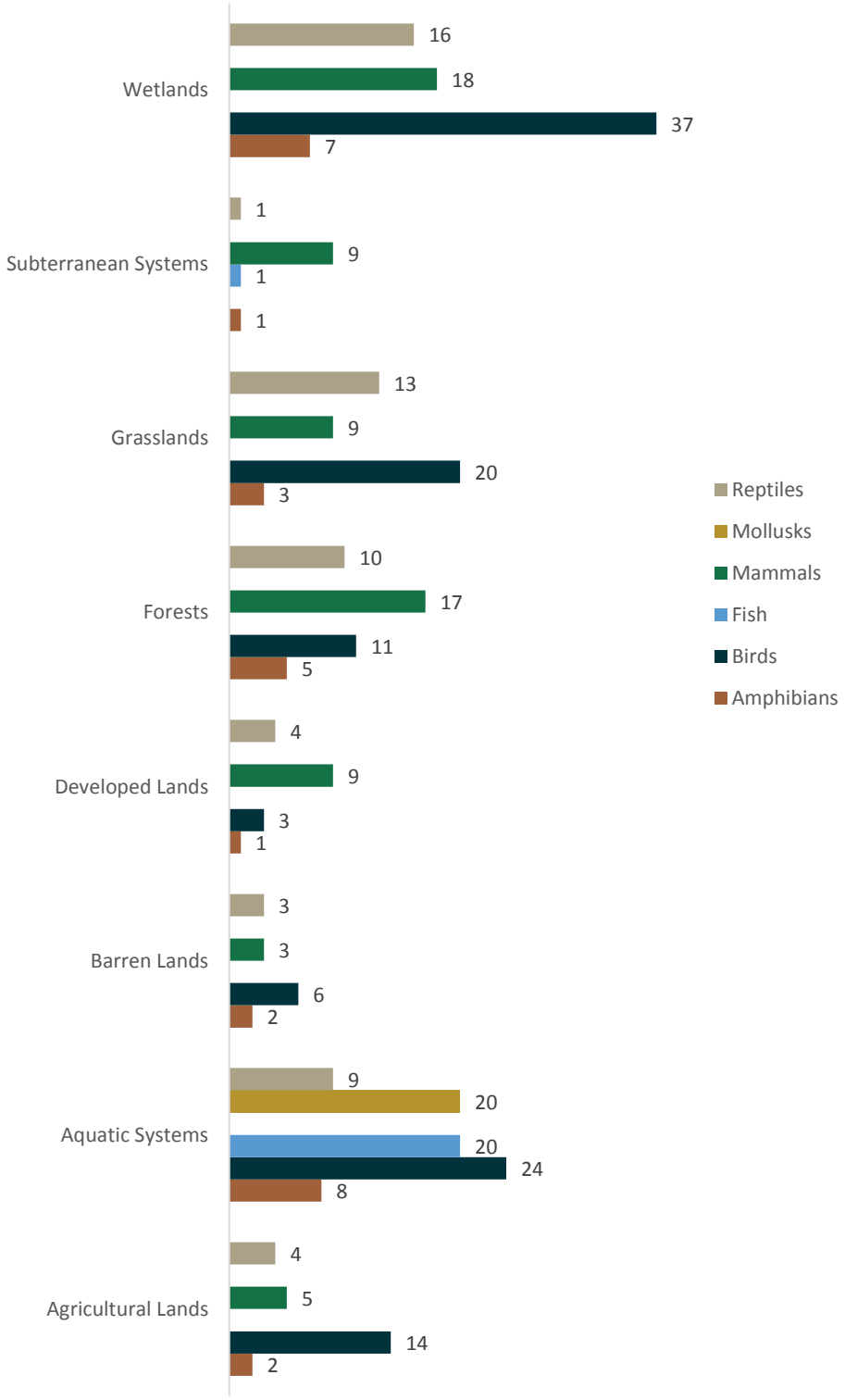


Figure 5-1. Number of SGCN occurring in each habitat type by taxa

Trends in Abundance of SGCN

The following graphics show past and future trends in abundance for Indiana's SGCN, summarized by taxa and major habitat type. After selecting a species in the Species Survey, technical experts were asked to estimate that species trend in abundance since 2005 and provide a prediction for its trend in relative abundance over the next decade using the following scale:

A. Trend in abundance since 2005:
   a. Dramatic increase (>50%)
   b. Great increase (25-50%)
   c. Slight increase (5-25%)
   d. Remained constant
   e. Slight decline (5-25%)
   f. Serious decline (25-50%)
   g. Dramatic decline (>50%)

B. Predicted trend in abundance by 2025:
   a. Will increase dramatically (>50%)
   b. Will increase greatly (25-50%)
   c. Will increase slightly (5-25%)
   d. Will remain constant
   e. Will decline slightly (5-25%)
   f. Will decline seriously (25-50%)
   g. Will decline dramatically (>50%)

Responses were then averaged for each species, and DFW staff checked the final estimates for accuracy. A full breakdown of relative abundance and trends in abundance for each species can be found in Appendix F.

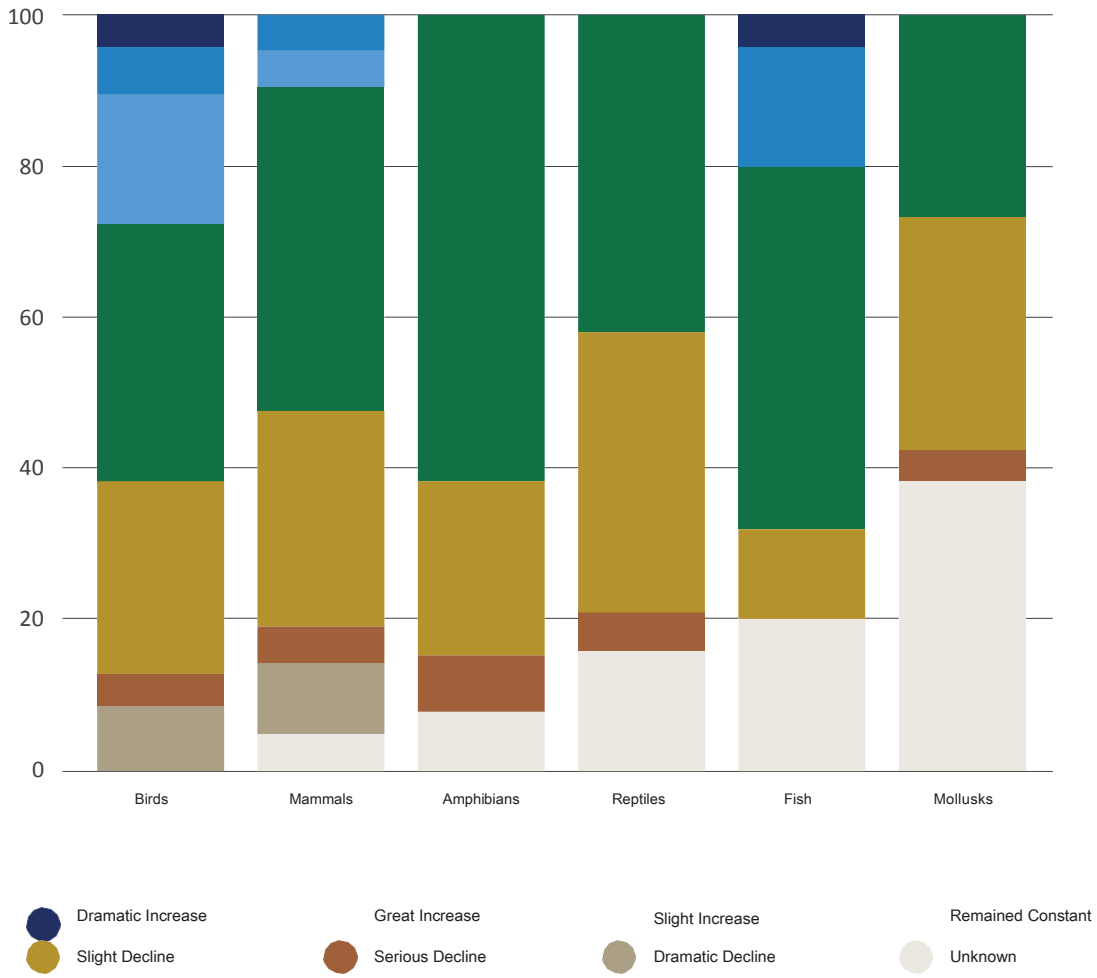


Figure 5-3. Perceptions of trends in abundance of SGCN from 2005 to 2014 by taxa.

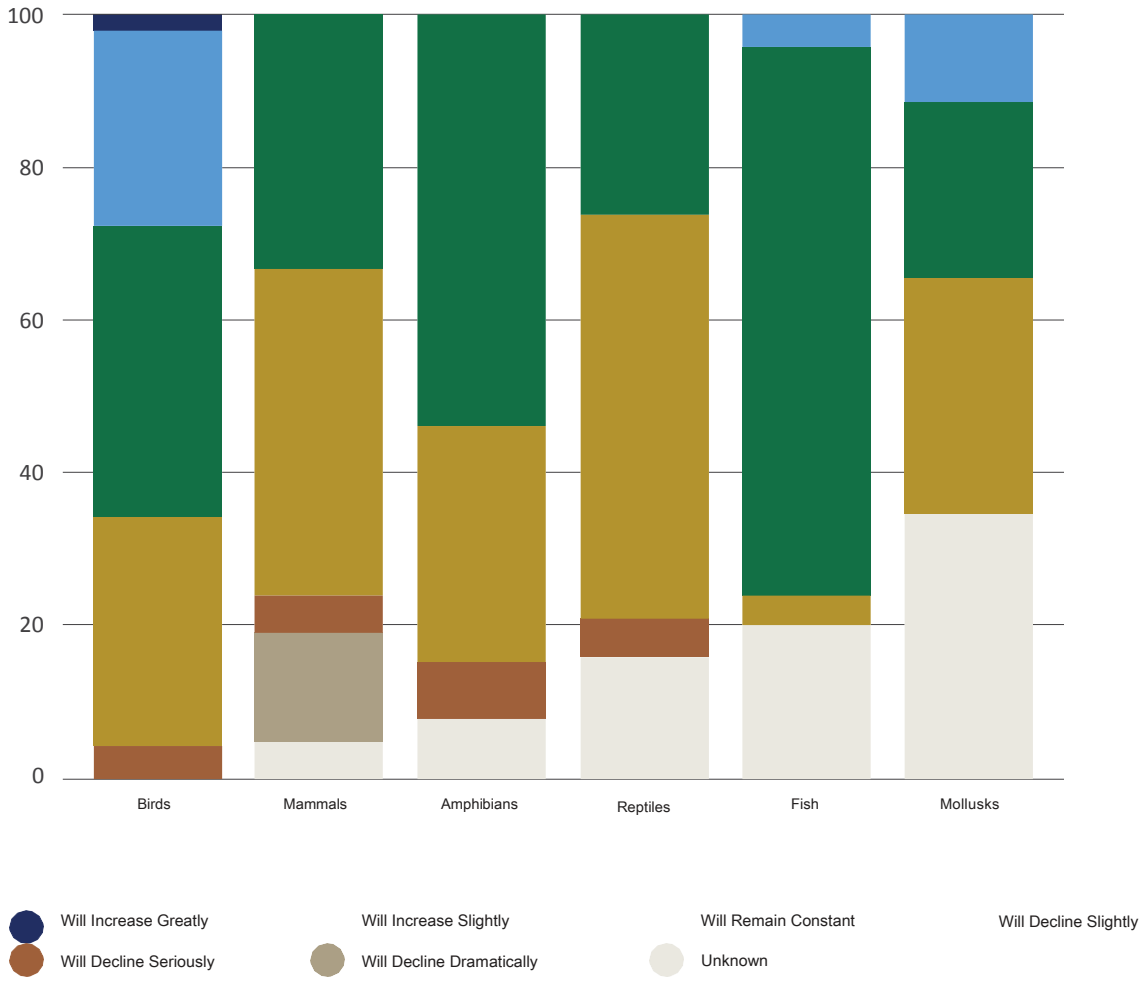


Figure 5-4. Predicted trends in abundance of SGCN from 2014 to 2025 by taxa.

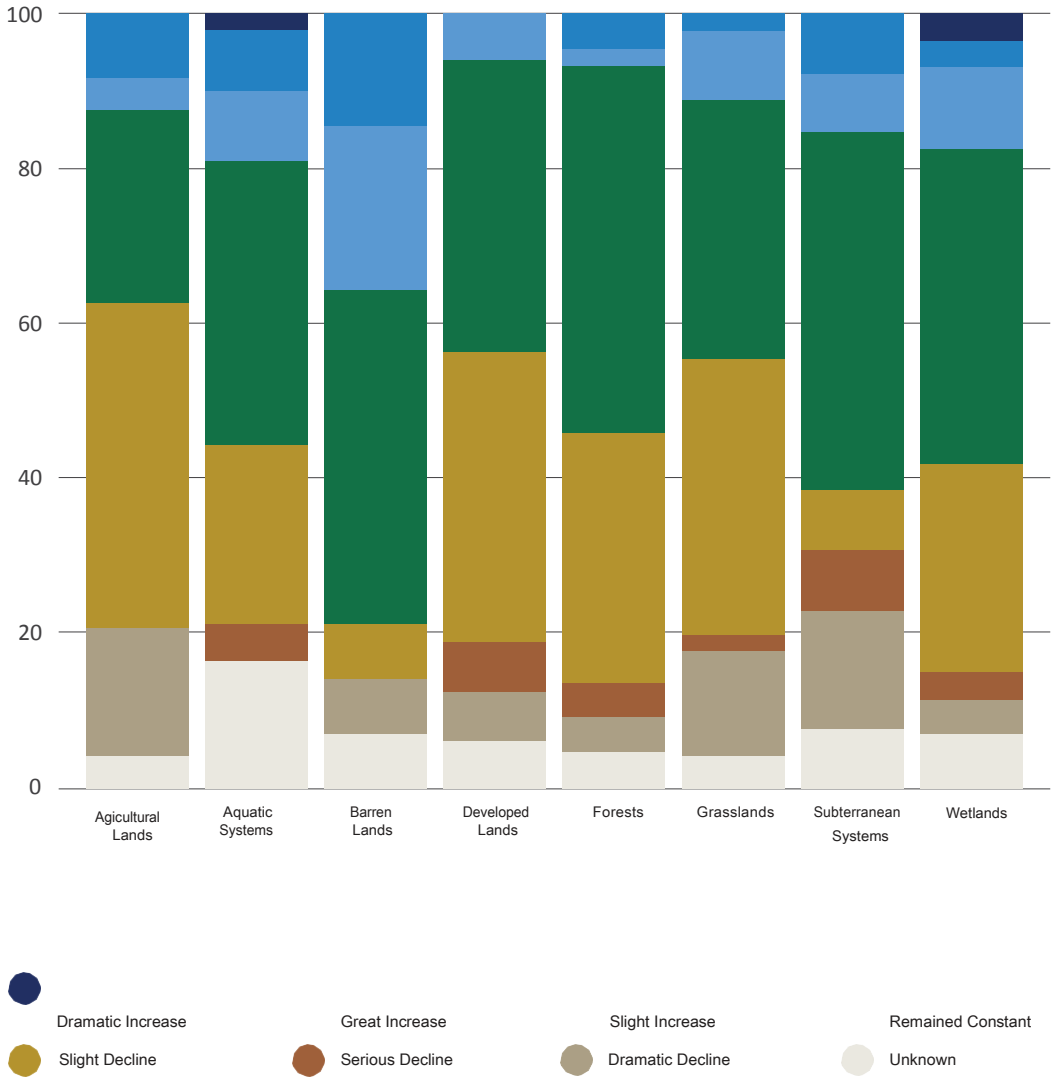


Figure 5-5. Perceptions of trends in abundance of SGCN from 2005 to 2014 by major habitat type.

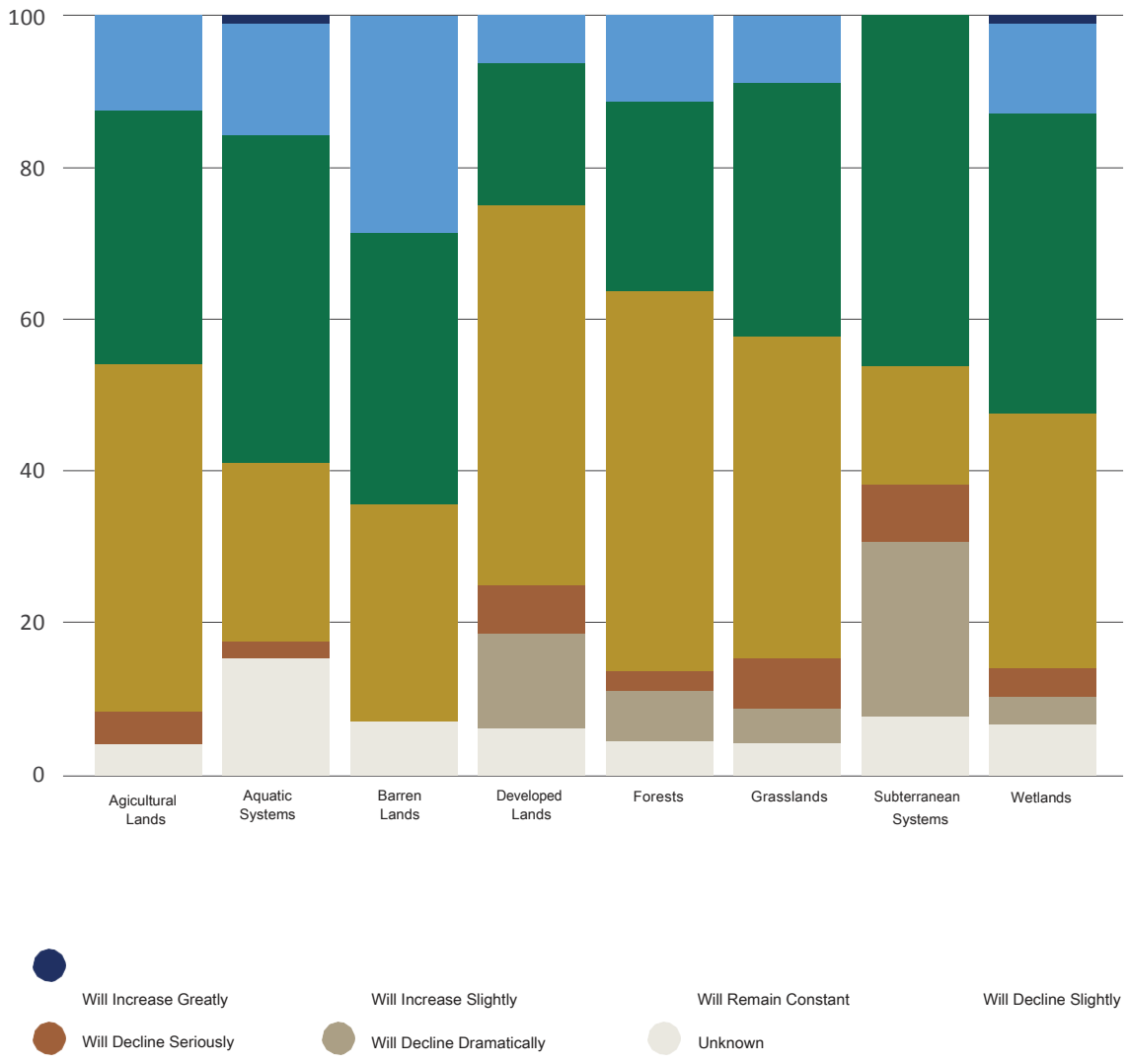


Figure 5-6. Predicted trends in abundance of SGCN from 2014 to 2025 by major habitat type.

Threatened and Endangered Invertebrates

Insects and other invertebrates, other than mollusks, are not protected by Indiana statute. A list of endangered insects has been developed based on the recommendation of invertebrate experts working in Indiana. Listed insects occur primarily in rare habitats, so most conservation efforts for these species consist largely of conservation and protection of these rare habitats. These actions are within the purview of the Indiana DNR Division of Nature Preserves, which works closely with the DFW on this and other related issues. As resources allow, systematic surveys of all insect orders should be conducted to provide a more holistic assessment of the status of Indiana's insect fauna.

Although the DNR does not currently have statutory responsibility or expertise in direct conservation and management practices for most groups of invertebrate wildlife, these groups are included in the SWAP in order to facilitate a wider perspective on wildlife conservation and include these important organisms in the planning process. The CWS listed the names and statuses of all rare invertebrates. For this update, that information has been taken several steps further with the collection of data on habitat and range of rare invertebrates. Associating rare invertebrates with their respective habitat types can promote and inform management and conservation of rare habitats. Also, understanding where rare invertebrate species occur throughout the state will allow planning regions to take invertebrates into consideration when shaping regional priorities.

Appendix E documents the status, rank, and range of all Indiana's endangered, threatened, rare, and watch list invertebrates. Since 2005, more than 360 invertebrate species have been added to this list, many of which are Lepidopterans (butterflies and moths). Two species, the Bleeding Flower Moth and the Ice Thorn (snail), were removed from the list. In 2005, 79 species were listed as state-endangered and 51 were considered special concern. In 2015, 129 species are state-endangered, 125 are state-threatened, 184 are considered rare, and an additional 45 are on the state's watch list. There are two federally-endangered insect species on Indiana's list — Mitchell's Satyr and the Karner Blue. One other federally-endangered species, Hine's Emerald, is now considered extirpated in Indiana.

Habitat and range data for each species was collected by searching the NatureServe Explorer online database or consulting with local entomologists. Habitat for most subterranean species was identified using Whitaker and Amlaner (2012). Summaries of these results follow on the next page (Table 5-3), and Appendix E lists full habitat and subhabitat associations for each species for which information was available.

Table 5-3. Number of invertebrate species in each order/class listed as endangered, threatened, rare, or on the watch list as of 2015.

Order/Class	Number of Species
Lepidoptera (butterflies and moths)	234
Odonata (dragonflies and damselflies)	62
Collembola (springtails)	40
Homoptera (true bugs)	32
Coleoptera (beetles)	24
Orthoptera (grasshoppers, etc.)	20
Malacostraca (malacostracans)	13
Ephemeroptera (mayflies)	12
Trichoptera (caddisflies)	9
Hymenoptera (ants)	8
Diplopoda (millipedes)	6
Gastropoda (snails)	6
Neuroptera (lacewings)	6
Copepoda (copepods)	4
Ostracoda (ostracods)	4
Pseudoscorpiones (pseudoscorpions)	4
Araneae (spiders)	3
Diptera (flies)	2
Mecoptera (scorpionflies)	2
Tricladida (flatworms)	2
Actinedida (mites)	1
Branchiopoda (shrimp)	1
Diplura (diplurans)	1
Opiliones (harvestmen)	1

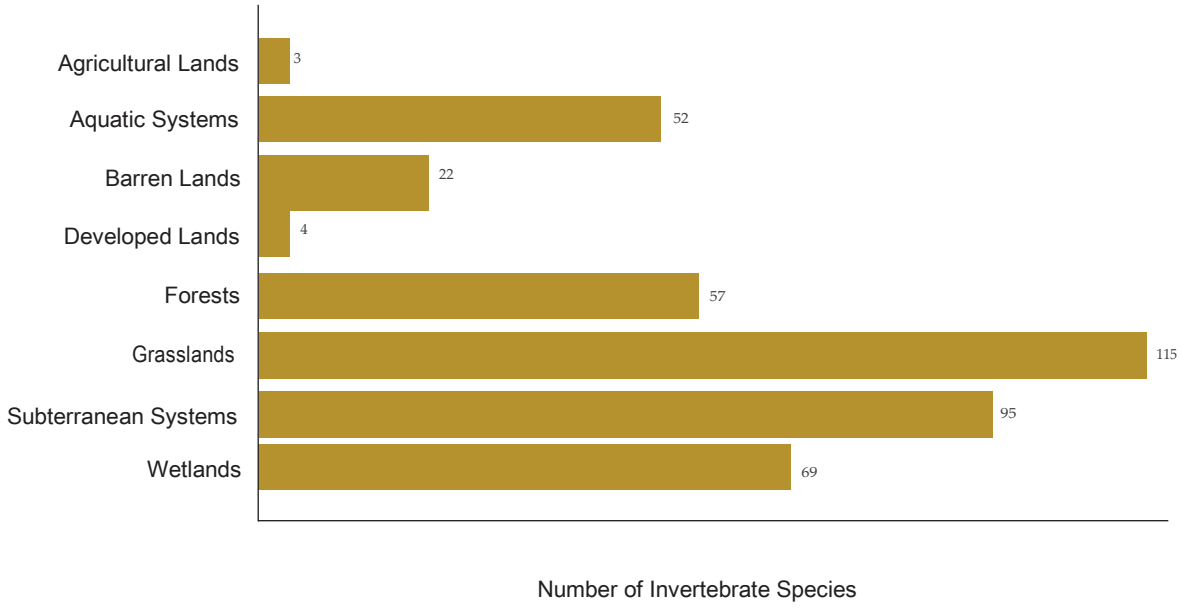


Figure 5-7. Number of listed invertebrate species occurring in each major habitat type in Indiana for 2015.

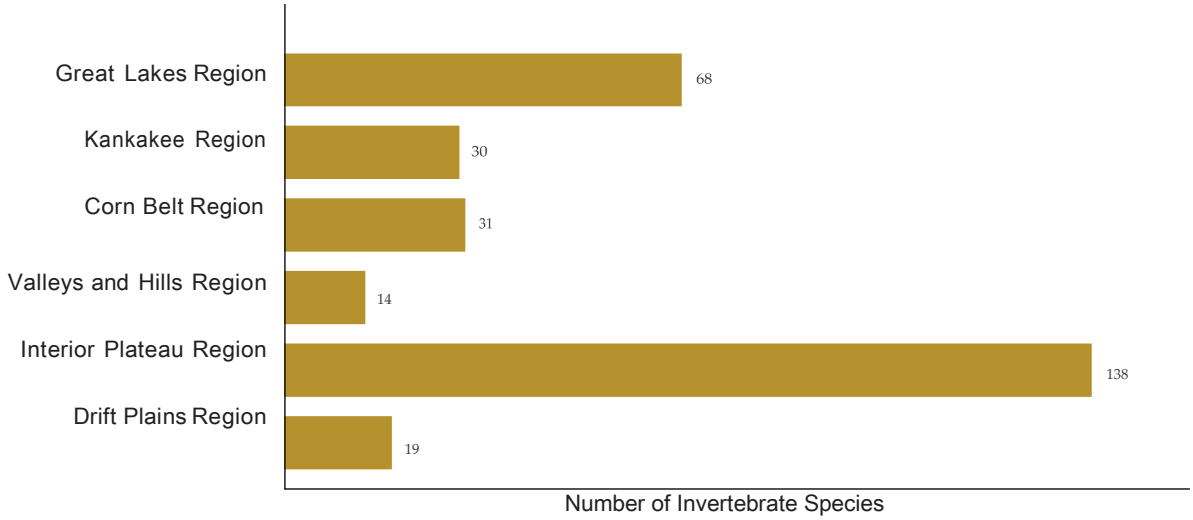


Figure 5-8. Number of listed invertebrate species occurring in each planning region for 2015.

B. STATEWIDE ASSESSMENT OF HABITATS

Introduction and Purpose

Congressional guidelines dictate that the SWAP must:

1. Describe the location and relative condition of key habitats and community types essential to the conservation of Indiana's SGCN.
2. Identify the problems and threats that may adversely affect SGCN of their habitats.

This section addresses each of these components through a variety of perspectives. Habitat conditions are presented from the perspective of SGCN and from wildlife habitats in general. This perspective allows for connection of habitats between SGCN and all other species.

Development of Planning Regions

Indiana's SWAP includes planning regions to better focus actions and priorities based on regional resources, needs, and threats. The CWS viewed wildlife habitat at the statewide level, and described threats and actions from this broad perspective. However, describing regions within Indiana's SWAP explicitly recognizes that each habitat, including needs, threats, and actions associated with the habitat type, varies across the state. A regional approach also helps to identify priorities and focus organizations on the most relevant actions for a given area. Accordingly, this chapter gives an overview of the federal elements summarized at the state level, and the proceeding chapters give a more detailed analysis of conditions, threats, and actions at the planning region level.

The planning regions for Indiana's SWAP were selected to reflect both aquatic and terrestrial systems. To increase the potential for conservation and management, it was important to consider both aquatic and terrestrial systems when creating the regions. The regions are a broad, yet reasonable representation of the wildlife and habitat differences within Indiana's landscape.

To outline the planning regions, a variety of regional maps for Indiana were reviewed, including multiple watershed classifications using the Hydrologic Unit Codes (HUC), Bird Conservation Regions, Omernik's Ecoregions, Bailey's Ecoregions, and Homoya's Natural Regions. For Indiana's SWAP, regions chosen were first based on the three major watersheds present in Indiana — the Kankakee River, Great Lakes, and the Ohio River. The Kankakee and Great Lakes regions are adequate representations of their natural communities without further subdivision. However, the Ohio River watershed consists of two-thirds of Indiana, and contains a variety of wildlife and habitats that are too diverse to be an effective planning region. Therefore, the Ohio River watershed was further divided using Omernik's level three ecoregions for southern Indiana — the Corn Belt Region, the Valleys and Hills Region, and the Interior Plateau Region. This resulted in an initial total of five planning regions.

Regions based on Omernik's and Homoya's systems are very similar for southern Indiana. The main difference is another distinct region of southeast Indiana within Homoya's system. After further discussion with experts during the SWAP data collection process, it was determined that the southeast portion of the state has distinct ecological features and should be a separate planning region. Therefore, the five planning regions became six, and were modified to separate the Drift Plains Region from the Corn Belt Region using Omernik's level four ecoregions.

This end result is a total of six planning regions (Chapter VI). Below are the results of the final map for Indiana's SWAP planning regions (Fig. 5-9).

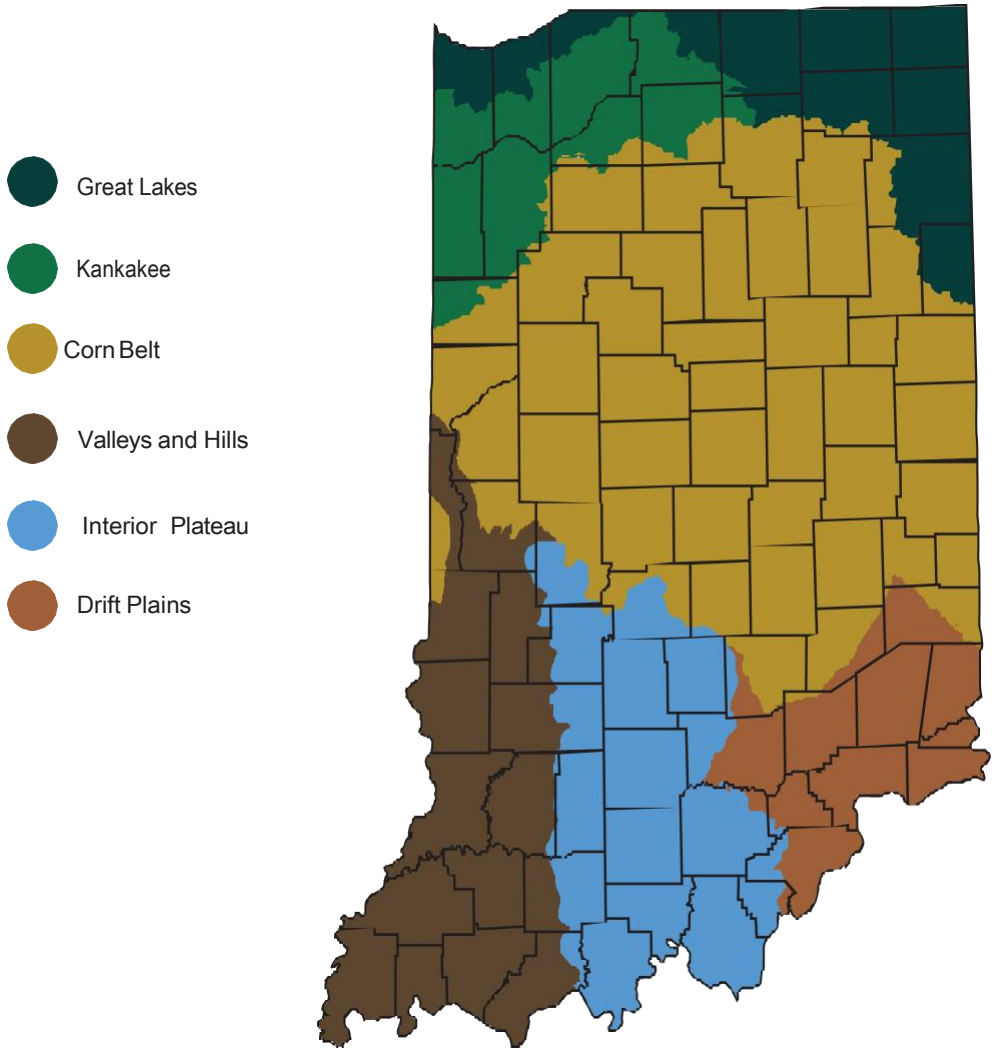


Figure 5-9. Indiana's 2015 SWAP planning regions.

Classification of Habitats

Habitat can be classified in many ways. Each classification scheme chosen often depends upon the intended purpose and the resources available. Conservation organizations and initiatives often develop habitat classifications relative to a particular species of interest; for example, bird habitat is often classified by flyways, Bird Conservation Regions, or Important Bird Areas. Conservation organizations such as The Nature Conservancy take an ecoregion approach and identify natural community types representative of the ecoregion. Other organizations classify lands based on land-use, such as the USDA Forest Service Forest Inventory and Analysis (FIA). However, none of these classification schemes are holistic, as they don't measure both traditional habitat types and human-impacted and developed lands.

The Teaming with Wildlife Best Practices Guide (2012) encourages states to use a well-accepted standardized classification scheme to classify wildlife habitats. Doing so achieves consistency across state plans, and improves the chances of regional collaborative efforts. For the CWS, a customized habitat classification system was developed for the state of Indiana. The system involved eight major habitat types and more than 60 subhabitats. This revision retains the main elements of the 2005 system by still focusing on the eight major habitat types, but substitutes the standardized NatureServe classification system for 2005's subhabitats (Appendix B).

In order to track habitat changes, or conversions of land from one habitat type to another, multiple land cover data sets collected in the same manner over time are required. The National Land Cover Database (NLCD) has made this type of data available for the past decade (http://www.mrlc.gov/). In order to assess changes in habitats since the CWS, NLCD was compared from 2001 and 2011. The NLCD uses its own land cover classification scheme, which were adapted to fit the eight major habitat types (Appendix B).

The following major habitat types are used for the SWAP (Appendix D):

- **Agricultural Lands:** Lands devoted to commodity production, including intensively managed non-native grasses, row crops, fruit and nut-bearing trees
- **Aquatic Systems:** All water habitats, both flowing and stationary, but not including wetlands
- **Barren Lands:** Lands dominated by exposed rock or minerals with sparse vegetation
- **Developed Lands:** Highly impacted lands, intensively modified to support human habitation, transportation, commerce, and recreation
- **Forests:** A plant community extending over a large area dominated by trees, the crowns of which form an unbroken covering layer or canopy
- **Grasslands:** Open areas dominated by grass species

- **Subterranean Systems:** Connected underground rooms and passages beyond natural light penetration
- **Wetlands:** Temporarily or permanently flooded habitats, often supporting aquaticvegetation

Location of Habitats in Indiana

Habitat types described above are distributed throughout the SWAP planning regions in Indiana. The figures below illustrate the spatial distribution and abundance of the major habitat types throughout the state.

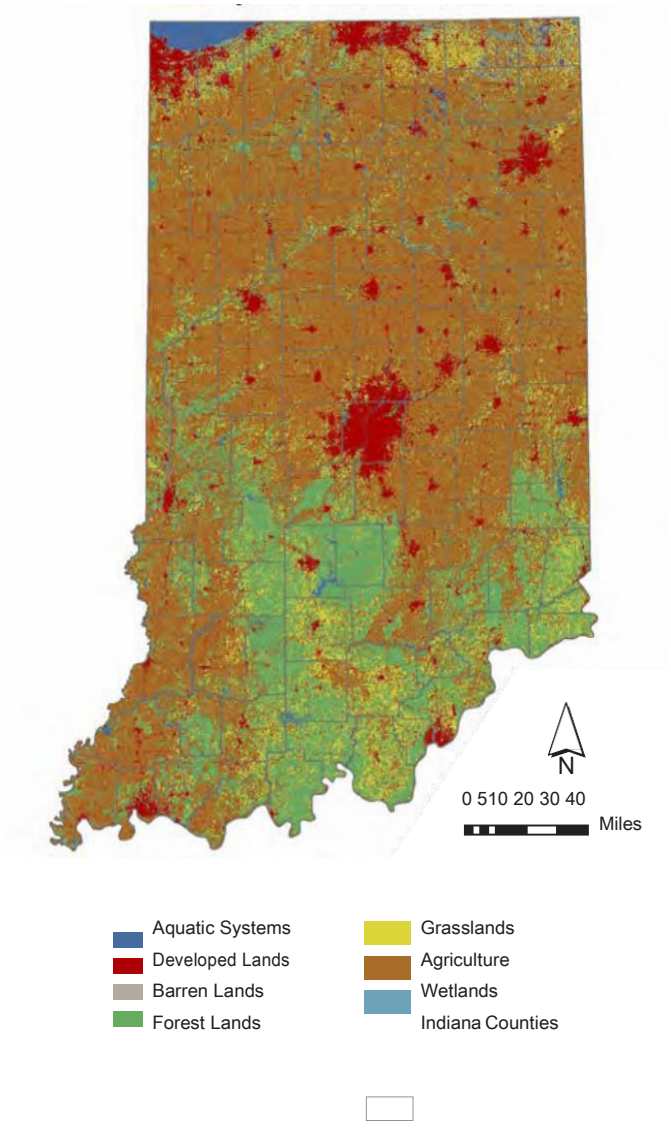


Figure 5-10. Spatial distribution and abundance of the major habitat types in Indiana.

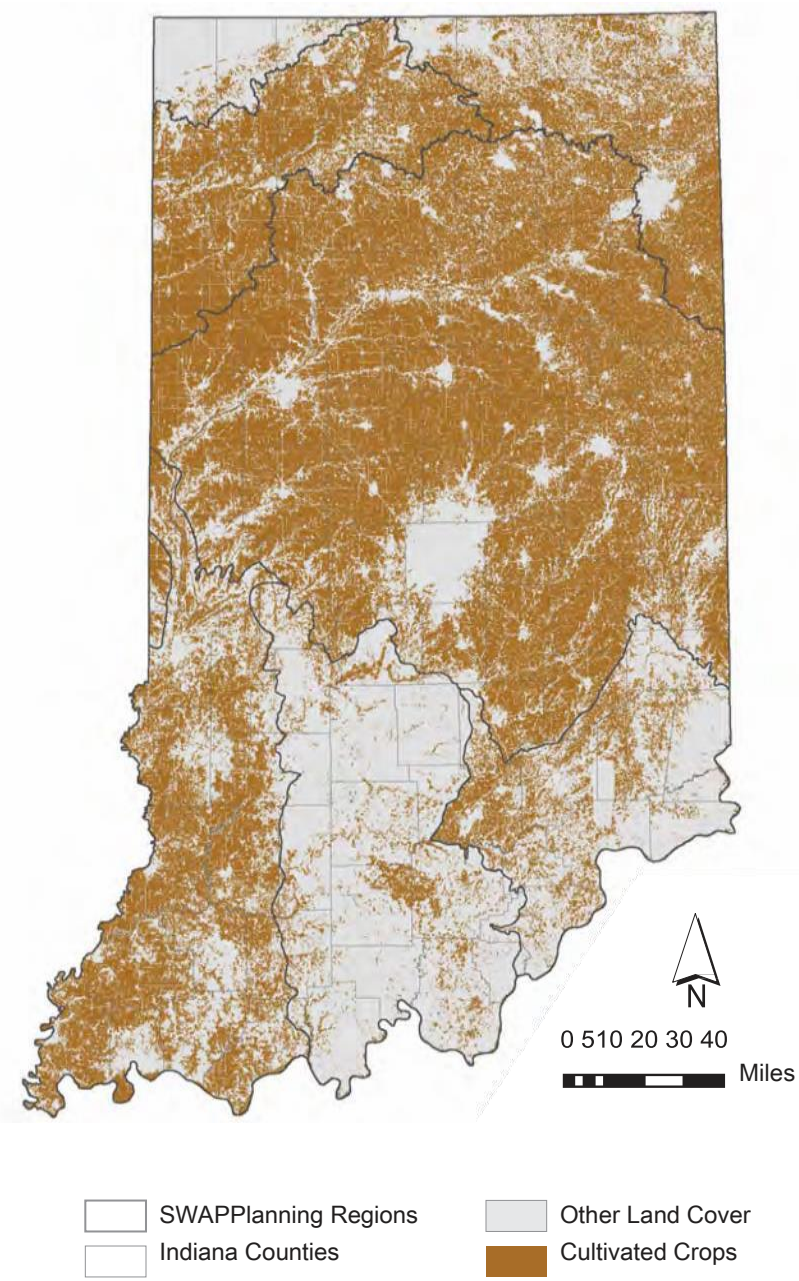


Figure 5-11. Agricultural systems in Indiana from 2011 National Land Cover Database.

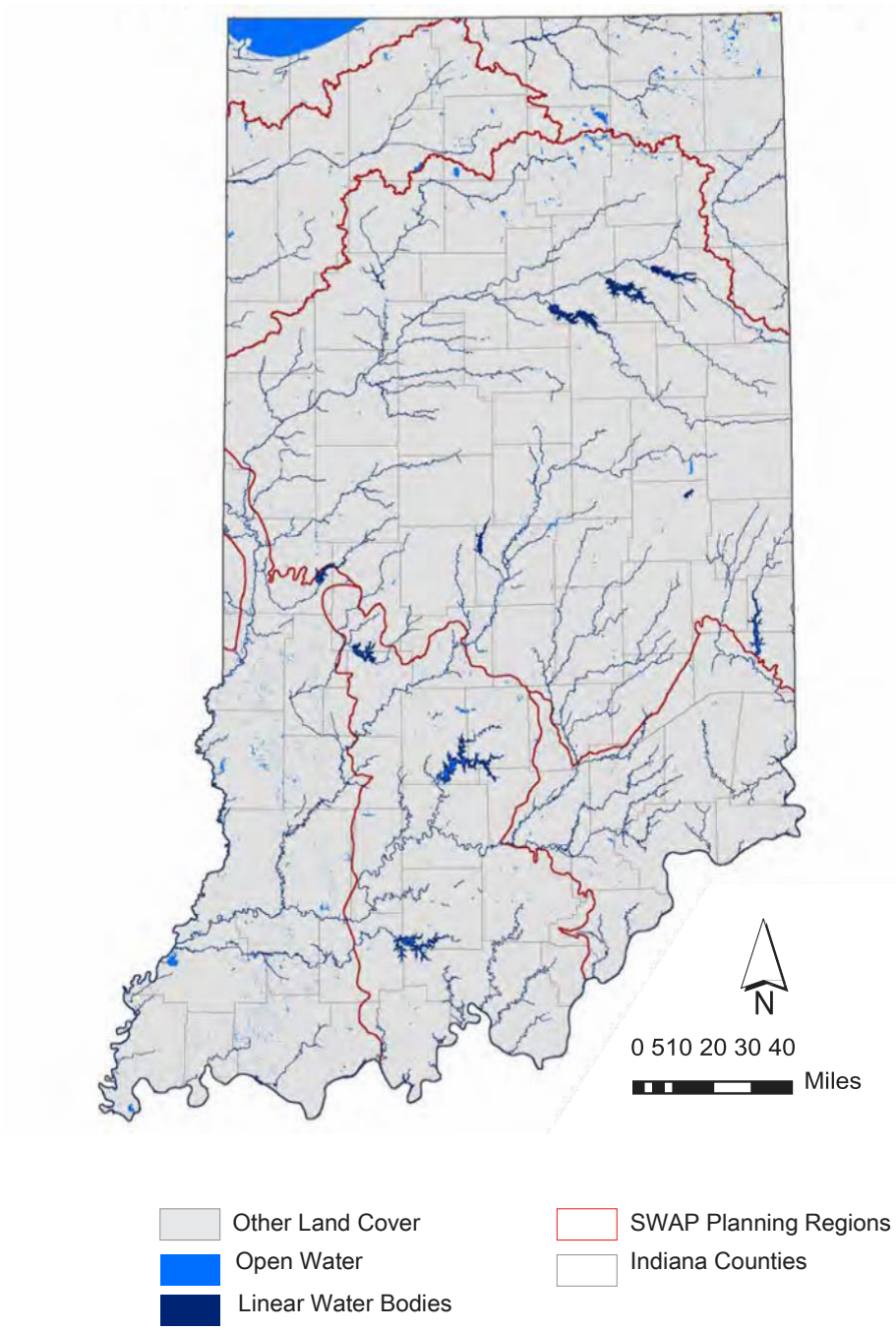


Figure 5-12. Aquatic systems in Indiana including lakes and reservoirs, streams and rivers, and the Indiana portion of Lake Michigan from 2011 NLCD.

Figure 5-13. Barren lands in Indiana from 2011 NLCD are shown to be the least abundant major habitat type in Indiana.

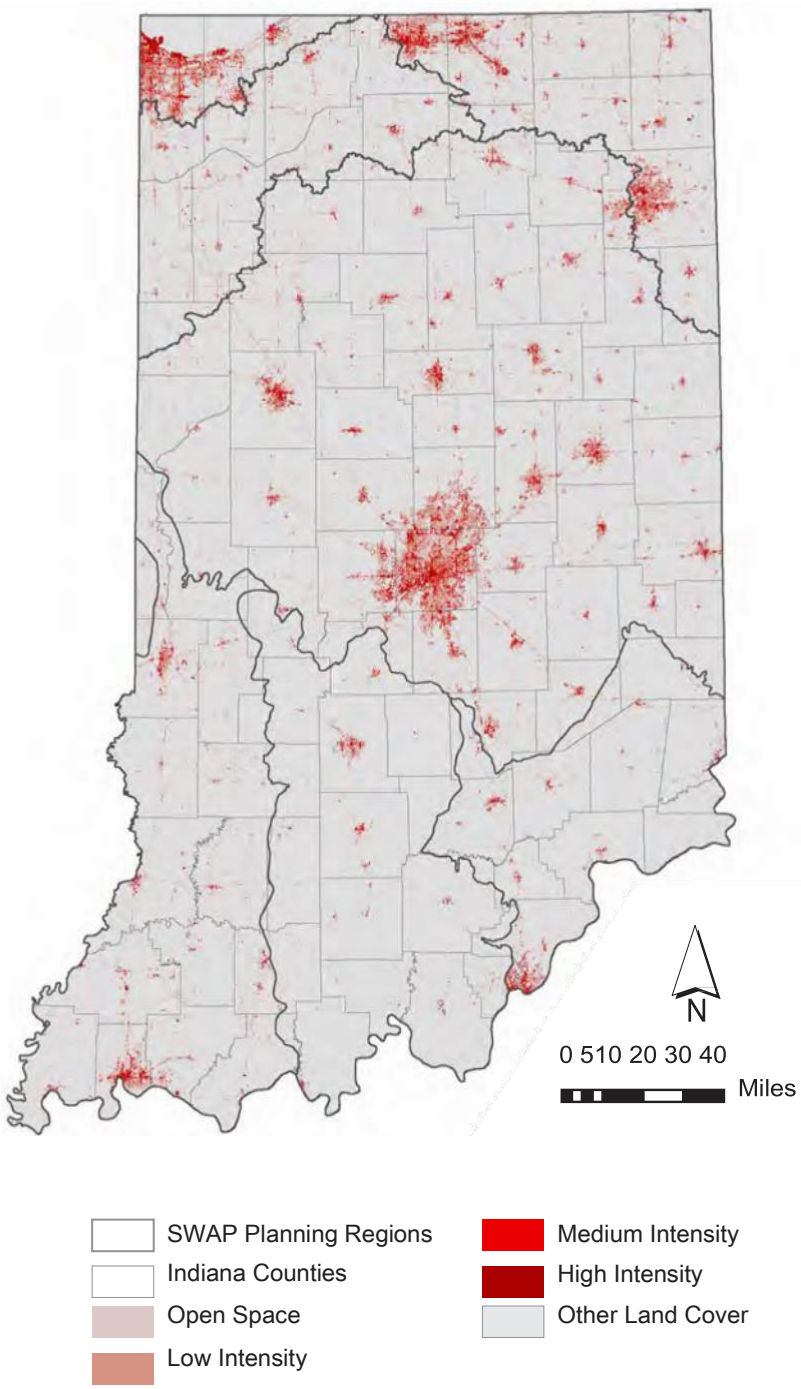


Figure 5-14. Developed lands in Indiana from 2011 NLCD concentrated around Chicago, IL, Gary, South Bend, Fort Wayne, Indianapolis, and Evansville, IN, and Louisville, KY.

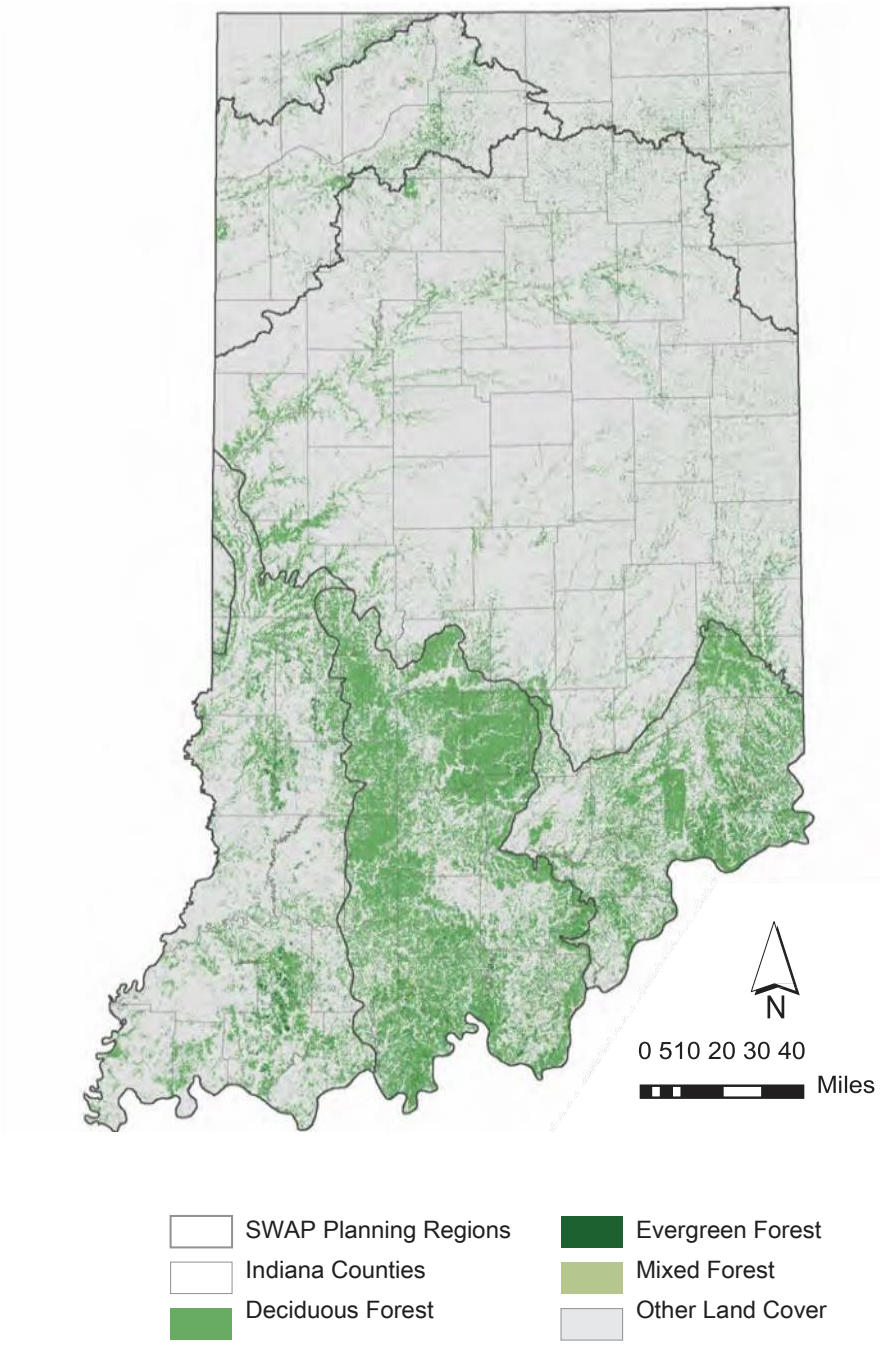


Figure 5-15. Forest lands in Indiana from the 2011 NLCD, concentrated in the unglaciated southern third of the state.

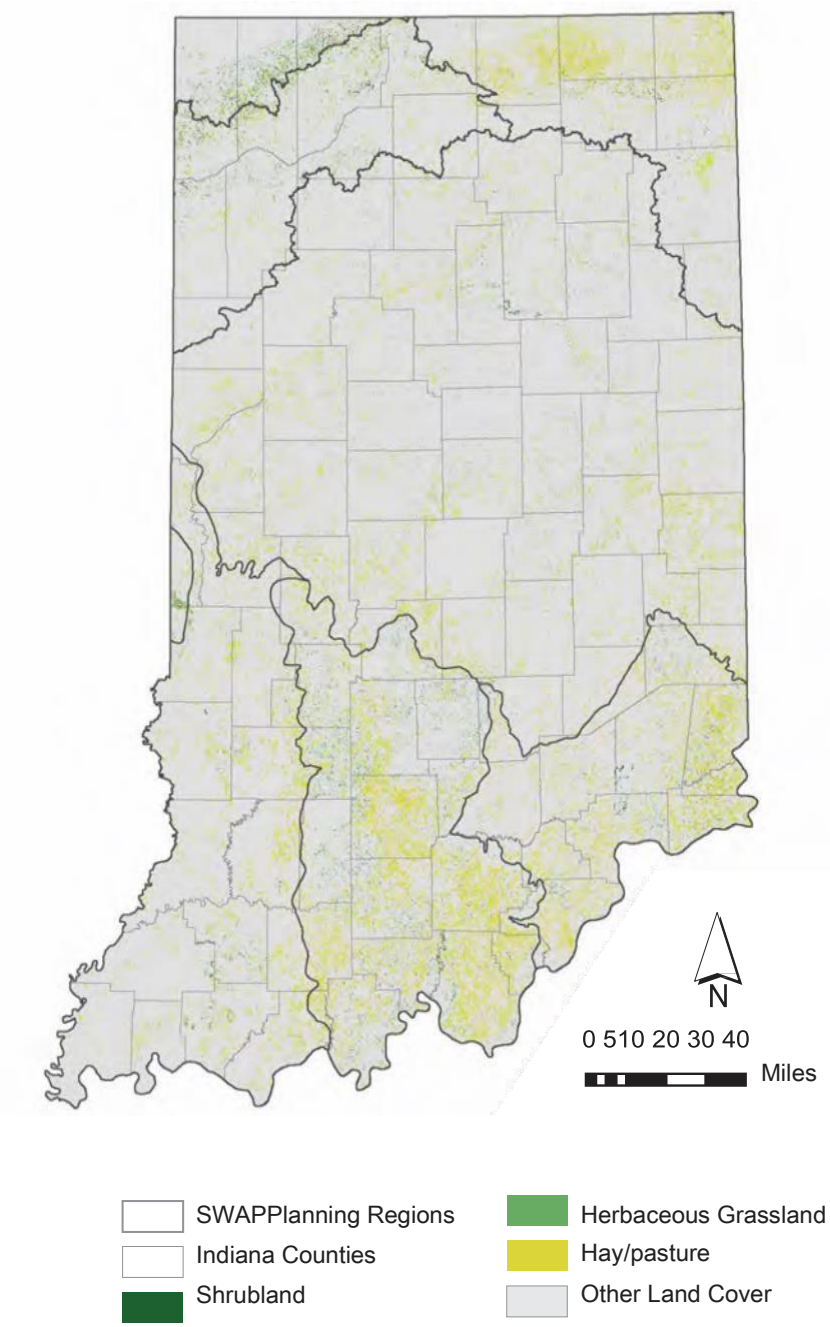


Figure 5-16. Grasslands in Indiana from the 2011 NLCD, found primarily in the southern and extern northern parts of the state.

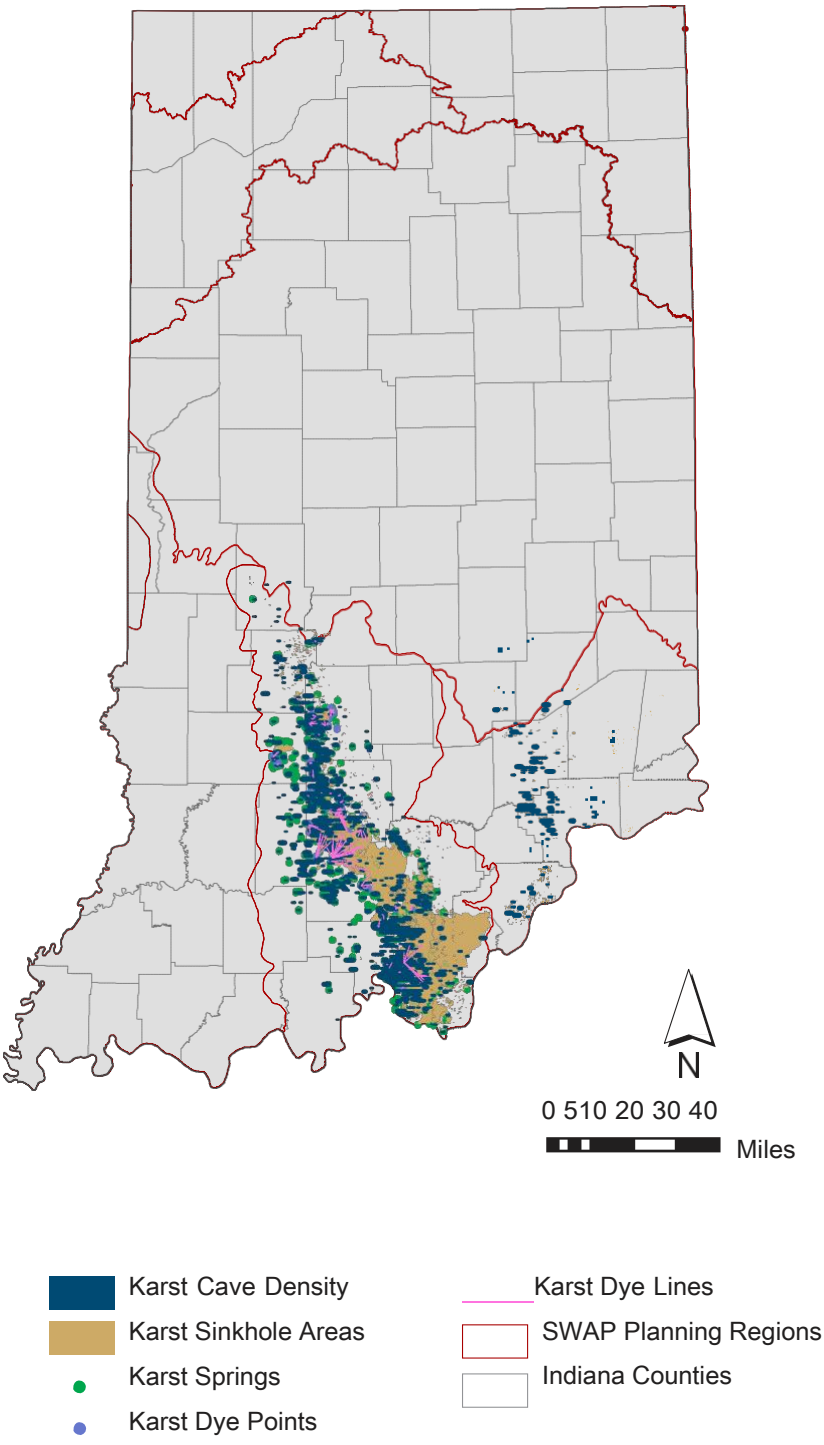


Figure 5-17. Subterranean systems in Indiana from the Indiana Geological Survey, this map of the karst regions of Indiana shows cave densities, sinkhole areas, springs, dye points, and dye lines.

Figure 5-18. Wetlands in Indiana from the 2011 NLCD found throughout the state but are particularly concentrated in the extreme southwestern and northern areas.

Changes in Habitats

ArcGIS 10.1 (http://www.arcgis.com) was used to analyze changes in habitats over a ten-year span (2001-2011) from NLCD raster data. Using the 2001 through 2011 data, the percent of habitat lost, gained, and the net change for each habitat type was determined (Table 5-4, Fig. 5-19, and Fig. 5-20).

At the state level, gains in land cover occurred in aquatic systems, barren lands, developed lands, and wetlands, and losses occurred for agriculture, forests, and grasslands. High gains were seen for developed lands, and most of the habitats that declined were likely lost to developed lands.

Table 5-4. Land cover changes by major habitat type in Indiana from 2001-2011.

Planning Region	Major Habitat Type	Acres – 2001	Percent of Total	Acres – 2011	Percent of Total	Aces Lost	Percent Loss	Acres Gained	Percent Gained	Net Change	Percent Changed
GREAT LAKES	Agriculture	1,106,485	45.2	1,092,297	44.6	15,893	1.4	1,705	0.2	-14,187	- 1.2
	Aquatic Systems	186,024	7.6	186,231	7.6	358	0.2	655	0.4	297	+0.2
	Barren Lands	5,823	0.2	6,303	0.3	390	6.7	871	15	481	8.3
	Developed Lands	469,228	19.2	498,393	20.4	5	0	29,170	6.2	29,165	6.2
	Forest Lands	195,094	8	191,729	7.8	4,675	2.4	1,311	0.7	-3,365	-1.7
	Grasslands	301,897	12.3	292,105	11.9	11,263	3.7	1,471	0.5	-9,792	-3.2
	Wetlands	182,856	7.5	180,256	7.4	2,795	1.5	195	0.1	-2,599	-1.4
	Total Acres:	**2,447,405**		**Total Acres Changed:**		**35,379**					

Planning Region	Major Habitat Type	Acres – 2001	Percent of Total	Acres – 2011	Percent of Total	Aces Lost	Percent Loss	Acres Gained	Percent Gained	Net Change	Percent Changed
Kankakee	Agriculture	1,378,889	72.1	1,375,276	71.9	5,051	0.4	1,437	0.1	-3,614	- 0.3
	Aquatic Systems	12,858	0.7	13,194	0.7	130	1.0	466	3.6	336	2.6
	Barren Lands	1,829	0.1	2,199	0.1	415	22.7	785	42.9	370	20.2
	Developed Lands	152,061	8.0	157,805	8.3	3	0.0	5,747	3.8	5,744	3.8
	Forest Lands	189,671	9.9	188,271	9.8	2,357	1.2	957	0.5	-1,400	-0.7
	Grasslands	122,365	6.4	120,504	6.3	3,464	2.8	1,604	1.3	-1,861	-1.5
	Wetlands	54,564	2.9	54,989	2.9	453	0.8	878	1.6	425	0.8
	Total Acres:	**1,912,237**		**Total Acres Changed:**		**11,874**					

Planning Region	Major Habitat Type	Acres – 2001	Percent of Total	Acres – 2011	Percent of Total	Aces Lost	Percent Loss	Acres Gained	Percent Gained	Net Change	Percent Changed
Corn Belt	Agriculture	725,175	72.1	7,208,100	71.6	52,551	0.7	3,476	0.0	-49,075	-0.7
	Aquatic Systems	75,942	0.8	78,172	0.8	625	0.8	2,855	3.8	2230	2.9
	Barren Lands	3,597	0.0	4,649	0.0	559	15.5	1,611	44.8	1052	29.2
	Developed Lands	1,152,208	11.4	1,207,606	12	6	0.0	55,404	4.8	55,398	4.8
	Forest Lands	982,404	9.8	976,687	9.7	6,267	0.6	550	0.1	-5,717	-0.6
	Grasslands	537,231	5.3	532,729	5.3	7,685	1.4	3,093	0.6	-4,592	-0.9
	Wetlands	56,132	0.6	56,836	0.6	479	0.9	1,183	2.1	704	1.3
	Total Acres:	**10,064,779**		**Total Acres Changed:**		**68,171**					

Planning Region	Major Habitat Type	Acres – 2001	Percent of Total	Acres – 2011	Percent of Total	Aces Lost	Percent Loss	Acres Gained	Percent Gained	Net Change	Percent Changed
Valleys and Hills	Agriculture	1,959,569	55.8	1,948,438	55.5	12,987	0.7	1,856	0.1	-11,131	-0.6
	Aquatic Systems	71,458	2.0	74,624	2.1	841	1.2	4,007	5.6	3,165	4.4
	Barren Lands	1,876	0.1	6,234	0.2	288	15.3	4,646	247.6	4,358	232.3
	Developed Lands	307,775	8.8	318,303	9.1	6	0.0	10,534	3.4	10,528	3.4
	Forest Lands	885,847	25.2	875,290	24.9	11,836	1.3	1,278	0.1	-10,558	-1.2
	Grasslands	237,437	6.8	239,776	6.8	2,062	0.9	4,402	1.9	2,339	1.0
	Wetlands	47,981	1.4	49,279	1.4	387	0.8	1,685	3.5	1,298	2.7
	Total Acres:	**3,511,944**		**Total Acres Changed:**		**28,407**					

Planning Region	Major Habitat Type	Acres – 2001	Percent of Total	Acres – 2011	Percent of Total	Aces Lost	Percent Loss	Acres Gained	Percent Gained	Net Change	Percent Changed
Interior Plateau	Agriculture	435,504	13.1	434,702	13.1	1,989	0.5	1,187	0.3	-802	-0.2
	Aquatic Systems	42,472	1.3	44,441	1.3	114	0.3	2,083	4.9	1,969	4.6
	Barren Lands	3,259	0.1	4,576	0.1	191	5.8	1,507	46.2	1,317	40.4
	Developed Lands	165,495	5.0	169,979	5.1	4	0.0	4,488	2.7	4,484	2.7
	Forest Lands	2,042,049	61.4	2,035,608	61.2	6,827	0.3	386	0.0	-6,441	-0.3
	Grasslands	632,424	19.0	631,572	19.0	2,721	0.4	1,869	0.3	-852	-0.1
	Wetlands	5,334	0.2	5,659	0.2	27	0.5	352	6.6	325	6.1
	Total Acres:	**3,326,537**		**Total Acres Changed:**		**11,872**					

Planning Region	Major Habitat Type	Acres – 2001	Percent of Total	Acres – 2011	Percent of Total	Aces Lost	Percent Loss	Acres Gained	Percent Gained	Net Change	Percent Changed
Drift Plains	Agriculture	601,203	29.4	601,766	29.4	4,992	0.8	5,555	0.9	563	0.1
	Aquatic Systems	17,250	0.8	18,017	0.9	130	0.8	897	5.2	767	4.4
	Barren Lands	2,276	0.1	2,813	0.1	41	1.8	578	25.4	537	23.6
	Developed Lands	152,246	7.4	158,728	7.8	4	0.0	6,486	4.3	6,482	4.3
	Forest Lands	956,369	46.7	950,668	46.5	6,489	0.7	788	0.1	-5,700	-0.6
	Grasslands	314,652	15.4	310,655	15.2	6,883	2.2	2,886	0.9	-3,997	-1.3
	Wetlands	2,264	0.1	3,611	0.2	42	1.9	1,390	61.4	1,348	59.6
	Total Acres:	**2,046,259**		**Total Acres Changed:**		**18,581**					

Planning Region	Major Habitat Type	Acres – 2001	Percent of Total	Acres – 2011	Percent of Total	Aces Lost	Percent Loss	Acres Gained	Percent Gained	Net Change	Percent Changed
Statewide Totals	Agriculture	12,738,717	54.7	12,660,472	54.3	93,462	0.7	15,217	0.1	-78,245	-0.6
	Aquatic Systems	406,003	1.7	414,768	1.8	2,198	0.5	10,963	2.7	8,764	2.2
	Barren Lands	18,660	0.1	26,773	0.1	1,883	10.1	9,997	53.6	8,114	43.5
	Developed Lands	2,398,842	10.3	2,510,642	10.8	27	0	111,827	4.7	111,799	4.7
	Forest Lands	5,251,422	22.5	5,218,242	22.4	38,451	0.7	5,271	0.1	-33,180	-0.6
	Grasslands	2,146,075	9.2	2,127,322	9.1	34,077	1.6	15,324	0.7	-18,753	-0.9
	Wetlands	349,126	1.5	350,627	1.5	4,183	1.2	5684	1.6	1,500	0.4
	Total Acres:	**23,308,845**		**Total Acres Changed:**	**174,220**						

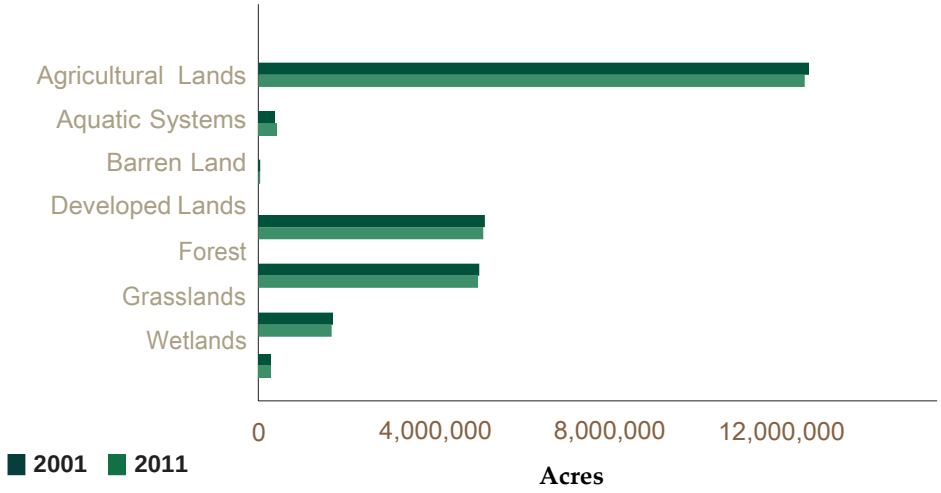


Figure 5-19. Land cover distribution from NLCD in Indiana from 2001 to 2011.

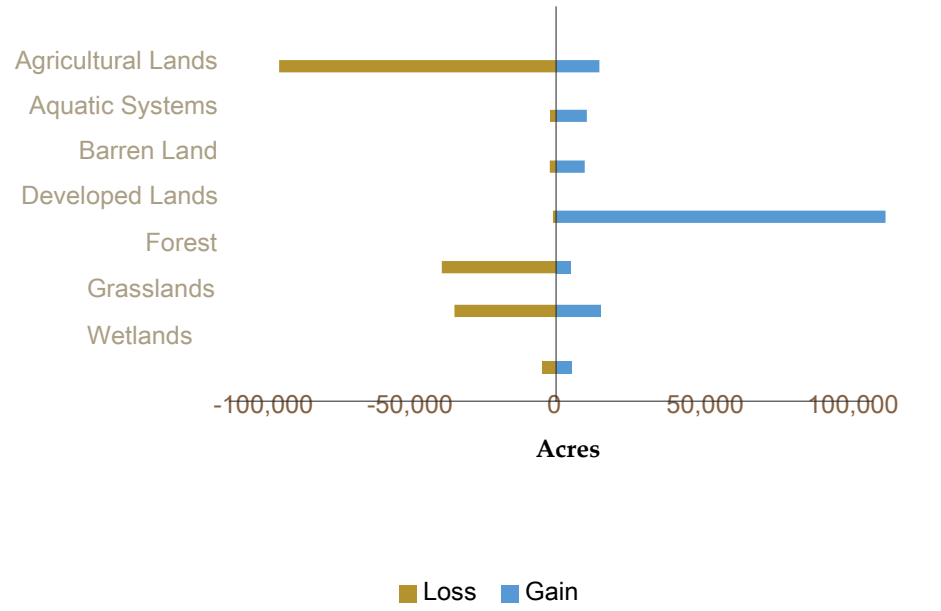


Figure 5-20. Losses and gains in land cover from NLCD in Indiana between 2001 and 2011.

Relative Condition of Habitats

Element two of the Congressional guidelines mandates that the SWAP describes the extent and condition of habitats essential to SGCN.

Two surveys were conducted — a Species Survey and a Habitat Survey. This section summarizes the results of these two surveys from conservation professionals and species experts.

Species Survey

Species experts were asked to evaluate the current overall conditions and total amount of habitat related to a single species. Survey respondents reported on species populations in various habitat types, and if these habitats could sustain populations over the next ten years. Respondents also indicated if suitable habitats exist that are not currently occupied by the species. Exact wording of the Species Survey questions can be found in Appendix O.

Because species may utilize more than one single major habitat type, results here are aggregated across species. A full summary of these data is available in Appendix O.

Species Survey respondents were asked to evaluate current conditions on a five-point scale ranging from 1), very poor, to 5), very good. Overall, 50.8% of respondents reported habitat quality to be satisfactory for an individual species and 26.7% reported poor habitat quality.

Survey respondents were also asked to evaluate the total amount of habitat available for a given species from 1), very limited, to 5), very abundant. Overall, 43.4% of respondents reported available habitat as limited and 24.7% reported very limited.

Nearly forty-two percent (41.8%) of respondents reported that species were not persisting in habitats that were not suitable to sustain them. The majority of respondents, 51.5%, responded that habitats that are suitable to sustain species exist but are not currently occupied by species. This was specifically evident for mollusks, where 82.8% of respondents indicated this is the case for species of in this taxon.

Habitat Survey

Respondents for the Habitat Survey were asked to answer questions for a specific habitat type within a specific region, due to the broad nature of the definition of major habitat types, habitat conditions outlined in this chapter are aggregated at the state and regional level. Habitat-specific conditions for the eight major habitat types are detailed in Chapters V for each of the six SWAP planning regions in Indiana. Exact wording of these questions, and a full summary of these results, can be found in Appendix P.

Habitat Survey respondents were asked to evaluate the current overall quality of a major habitat type within a region on a five point scale ranging from 1), very poor, to 5), very good.

When aggregated at the state level, habitat quality is described as poor by 36.1% or satisfactory by 34.8% of the majority of respondents. These results were consistent across individual planning regions, leaning slightly more towards satisfactory in the Great Lakes Region by 39.4%, the Valleys and Hills Region by 36.8%, the Interior

Plateau Region by 39.6%, and the Drift Plains Region by 39.2%. The Kankakee Region was described as poor by 45.7% of respondents along with the Corn Belt Region by 41.9% of respondents.

Trends in Habitat Conditions

Respondents from the Species Survey and the Habitat Survey were asked to evaluate trends in habitat conditions since 2005 and anticipated changes over the next ten years in regards to both quality and quantity of habitats. Results of both surveys are outlined below.

Species Survey

Respondents from the Species Survey were asked to evaluate trends in habitat conditions and total amount of habitat since 2005, as well as predict changes over the next ten years for a single species in the state. A full summary of this data is available in Appendix O.

Over the past ten years, 50.7% of respondents reported that the overall quality of habitat for species has remained about the same and 48.9% reported that habitat quality is expected to remain about the same over the next ten years.

In general, 54% reported that total amount of habitat had remained about the same over the past ten years. 52% anticipated that the total amount of habitat for species to remain about the same as well, over the next ten years.

Habitat Survey

Respondents from the Habitat Survey were asked to report on trends in habitat quality and quantity for major habitat types within individual planning regions. Results are aggregated at the regional level, and summaries of the results for each habitat type are included in Chapter V and Appendix Q.

C. THREATS AND ACTIONS BY MAJOR HABITAT TYPE

Introduction and Purpose

Congressional guidelines dictate that the SWAP must:

1. Determine the actions necessary to conserve SGCN and their habitats, and establish priorities for implementing such conservation actions.
2. Describe additional efforts needed to identify factors that may assist in restoration and improved conservation of SGCN and their habitats.

This section addresses each of these components through a variety of perspectives. Threats and actions for SGCN and habitats are all presented from the perspective of SGCN and from wildlife habitats in general. Conserving habitats for SGCN, often results in habitat conservation for all wildlife species. Therefore, Indiana's SWAP is not just a plan for SGCN but is a habitat-based plan for all species. The plan is intended to emphasize threats and actions for key habitats and communities for SGCN and all wildlife species.

Problems Affecting Habitats and Species

Element three partially requires the description of threats to SGCN and their habitats. The SWAP identifies a habitat-centric perspective in order to manage

for the conservation of species in Indiana. Both surveys asked respondents to identify threats for each major habitat type within a region by rating them on a four-point scale of significant threat to not a threat with an "I don't know option" and implemented a hierarchical approach. Threats were broken up into major categories, which were drawn from Salafsky et al. (2008). The following is a definition of each:

- **Residential and Commercial Development:** Threats from human settlements or other nonagricultural land uses with a substantial footprint
- **Agriculture and Aquaculture:** Threats from farming and ranching as a result of agricultural expansion and intensification, including silviculture, mariculture, and aquaculture
- **Energy Production and Mining:** Threats from production of non-biological resources
- **Transportation and Service Corridors:** Threats from long, narrow transport corridors and the vehicles that use them, including associated wildlife mortality
- **Biological Resource Use:** Threats from consumptive use of "wild" biological resources including deliberate and unintentional harvesting effects; also persecution or control of specific species
- **Human Intrusions and Disturbance:** Threats from human activities that alter, destroy, and disturb habitats and species associated with non-consumptive uses of biological resources
- **Natural Systems Modification:** Threats from actions that convert or degrade habitat in service of "managing" natural or semi-natural systems, often to improve human welfare
- **Invasive and Other Problematic Species and Genes:** Threats fromnon-native and native plants, animals, pathogens/microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread, and/or increase in abundance
- **Pollution:** Threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources
- **Climate Change and Severe Weather:** Threats from long-term climate changes that may be linked to global warming and other severe climatic or weather events outside the natural range of variation that could wipe out a vulnerable species or habitat
- **Other Stressors:** Additional threats and stressors directly affecting habitats, such as diseases and genetic diversity issues

Each category contained a list of specific threats that were displayed if a respondent had assigned a threat category a rating of significant or moderate threat. Respondents were also able to identify other threats they did not feel were represented in the survey. Ratings were converted to a numerical scale, excluding responses indicating the "I don't know" option, to calculate a mean response, which was used to rank categories.

Species Survey

Survey respondents were asked to rate threats to a SGCN. A full summary of this data is provided in Appendix O. Below, the relative rank of threats to SGCN within the state has been identified (Table 5-5). Threats were averaged across all species to determine overall major threats to all SGCN. Agriculture and aquaculture were rated as the most significant threat across all species.

Residential and commercial development, human intrusion and disturbance, and invasive and other problematic species and genes were mid-ranked threats across taxa. The exception to this is mammals, where invasive and other problematic species was actually identified as the most significant threat.

Within residential and commercial development, housing and urban development was identified as a specific threat to species.

Within human intrusion and disturbance, recreational activities, such as ATV use, were rated as a moderate to minor threat. Respondents also identified specific recreational activities, such as caving and spelunking as threats to bat species, presumably for their potential transmission of White-nose Syndrome.

Climate change and severe weather received a mean rating between moderate and minor threat. However, changing frequencies of drought and shifting and alteration of habitats were both specific threats rated between significant and moderate across species.

Pollution was also rated moderate to minor across all taxa. However, this category was ranked much higher for fish, mollusks, and amphibians. For all three taxa, the most significant specific threat was agricultural, residential, and forestry effluents.

Energy production and mining was rated particularly high for mammals. Renewable energy was indicated as the priority threat for this taxa. Respondents identified wind power as a particular concern for bat species.

Transportation and service corridors were ranked higher for reptiles compared to other taxa. Within this category, typical roads and railroads were identified as a threat to species in this taxon; this threat was rated significant to moderate while other specific threats were rated moderate to minor or even minor to not a threat.

Across all species, biological resource use and other stressors received mean ratings between minor threat and not a threat. Reptiles alone, however, rated this biological resource use as a category between moderate and minor. Overuse and harvesting of species was rated as a significant to moderate specific threat within this category.

Table 5-5. Ranking of threat categories for SGCN.

Category	All Taxa	Amphibians	Birds	Fish	Mammals	Mollusks	Reptiles
Agriculture and aquaculture	1	2	2	1	2	1	2
Natural systems modifications	2	1	1	3	6	2	1
Residential and commercial development	3	3	3	4	4	4	3
Human intrusion and disturbance	4	6	4	6	5	6	5
Invasive and other problematic species and genes	5	7	5	7	1	7	7
Climate change and severe weather	6	5	7	5	7	5	8
Pollution	7	4	8	2	8	3	10
Energy production and mining	8	9	6	9	3	8	9
Transportation and service corridors	9	8	9	8	9	9	4
Biological resource use	10	11	11	10	11	10	6
Other stressors	11	10	10	11	10	11	11

Table 5-6. Ranking of specific threats within categories for SGCN.

Category/Specific Threat	All Taxa	Amphibians	Birds	Fish	Mammals	Mollusks	Reptiles
Agriculture and Aquaculture	**1**	**2**	**2**	**1**	**2**	**1**	**2**
Conversion of habitat to annual crops	1	1	1	3	1	3	2
Annual and perennial nontimber crops	2	2	2	1	2	1	1
Livestock farming and ranching	3	4	3	2	3	2	3
Wood and pulp plantations	4	5	4	4	4	4	4
Aquaculture	5	3	5	5	5	5	5
Natural Systems Modification	**2**	**1**	**1**	**3**	**6**	**2**	**1**
Natural habitat conversion	1	1	1	2	1	2	1
Dams and water management/use	2	2	2	1	4	1	4
Over-mowing of natural areas	3	4	4	4	2	4	3
Fire and fire suppression	4	3	3	5	3	5	2
Log jam removal	5	5	5	3	5	3	5
Residential and Commercial Development	**3**	**3**	**3**	**4**	**4**	**4**	**3**
Housing and urban areas	1	2	1	1	1	1	1
Commercial and industrial areas	2	1	2	2	2	2	2
Tourism and recreation areas	3	3	3	3	3	3	3
Human Intrusion and Disturbance	**4**	**6**	**4**	**6**	**5**	**6**	**5**
Recreation activities	1	1	1	1	1	1	1
Invasives and Other Problematic Species and Genes	**5**	**7**	**5**	**7**	**1**	**7**	**7**
Invasive/alien species	1	2	1	1	1	1	1
Problematic native species	2	3	2	2	3	2	2
Diseases from domestic populations and unknown sources	3	1	3	3	2	3	3
Introduced genetic material	4	4	4	4	4	4	4
Climate Change and Severe Weather	**6**	**5**	**7**	**5**	**7**	**5**	**8**
Shifting and alteration of habitats	1	2	1	2	2	2	1
Changing frequency, duration, and intensity of drought	2	1	2	3	4	1	2
Temperature extremes	3	3	5	1	3	4	4
Changing frequency and duration of floods	4	5	3	4	5	3	5
Shifting seasons/phenology	5	4	4	5	1	5	3

Category/Specific Threat	All Taxa	Amphibians	Birds	Fish	Mammals	Mollusks	Reptiles
Pollution	**7**	**4**	**8**	**2**	**8**	**3**	**10**
Agriculture, residential, and forestry effluents	1	1	3	1	4	1	1
Point source pollution	2	2	1	4	1	3	3
Chemical spills	3	3	2	5	3	4	2
Household sewage	4	5	7	2	7	2	4
Runoff from roads/service corridors	5	4	4	3	6	5	5
Garbage and solid waste	6	6	6	6	8	6	6
Excess energy	7	8	8	7	5	7	8
Air pollution	8	7	5	8	2	8	7
Energy Production and Mining	**8**	**9**	**6**	**9**	**3**	**8**	**9**
Mining and quarrying	1	1	2	3	2	1	1
Fossil fuel energy production	2	3	1	1	3	2	3
Renewable energy production	3	4	3	4	1	4	4
Oil and gas drilling	4	2	4	2	4	3	2
Transportation and Service Corridors	**9**	**8**	**9**	**8**	**9**	**9**	**4**
Roads and railroads	1	1	1	1	1	1	1
Utility and service lines	2	2	2	2	2	2	2
Shipping lanes	3	3	4	3	3	3	3
Flight paths	4	4	3	4	4	4	4
Biological Resource Use	**10**	**11**	**11**	**10**	**11**	**10**	**6**
Accidental mortality or bycatch	1	1	1	1	1	1	1
Overuse and harvesting species	2	3	3	2	2	2	2
Forestry practices	3	2	2	3	3	3	3
Other Stressors	**11**	**10**	**10**	**11**	**10**	**11**	**11**
Diseases	1	1	2	2	1	2	1
Low genetic diversity	2	2	1	1	2	1	2

Habitat Survey

The Habitat Survey utilized the same-tiered approach to identifying threats to fish and wildlife habitats as outlined for the species survey. Results here are aggregated at the statewide and regional level. Specific threats to major habitat types within each region are identified in Chapter VI. Write in options are relevant to habitats within regions and are thus also discussed within regional chapters. Rankings of threat categories for habitats at the regional level are outlined in Table 5-7. Rankings of specific threats for habitats at the regional level are outlined in Table 5-8.

The invasive and problematic species and genes, agriculture and aquaculture, and residential and commercial development were rated as significant to moderate threat categories at the statewide level. The remaining categories were rated between moderate to minor threats. No threat category received a rating of minor to not a threat at the statewide level.

At the statewide level, invasive and other problematic species and genes were identified as the most significant threat to fish and wildlife habitats within Indiana. Within this category, invasive and alien species were identified as the most significant threat to habitats across the state. This specific threat received a mean rating of 1.31 with one being the most significant score and four being the least significant score. Problematic native species, plant diseases, and introduced genetic material were rated as moderate to minor threats within this category.

Agriculture and aquaculture was ranked highly within the state and rated as the most significant threat category in the Kankakee Region, Corn Belt Region, Valleys and Hills Region, and Drift Plains Region. Conversion of habitat to annual crops and already existing annual and perennial non-timber crops were both rated as significant to moderate threats for the state. Livestock farming and ranching was identified as a moderate to minor threat.

Residential and commercial development was rated as a significant to moderate threat category. Housing and urban development was rated as the most significant specific threat statewide within this category. Commercial development was also rated as a significant to moderate threat statewide.

Natural systems modification was rated as a moderate threat statewide. Conversion of habitat to other land uses, in general, was rated as the most significant threat within this category and on average rated as a significant to moderate threat.

Respondents were additionally given a free-response opportunity to provide anticipated and emerging threats for habitats within each region. Full results are available in Appendix P.

Table 5-7. Ranking of threat categories to habitats within each region.

Category	Statewide Rank	Great Lakes Region	Kankakee Region	Corn Belt Region	Valleys and Hills Region	Interior Plateau Region	Drift Plains Region
Invasive and Other Problematic Species and Genes	1	1	2	2	2	1	3
Agriculture and Aquaculture	2	3	1	1	1	3	1
Residential and Commercial Development	3	2	3	3	3	2	2
Natural Systems Modification	4	4	4	4	7	5	5
Human Intrusion and Disturbance	5	6	5	6	6	6	4
Pollution	6	5	7	5	5	4	6
Climate Change and Severe Weather	7	7	6	8	10	9	10
Transportation and Service Corridors	8	8	9	9	8	7	8
Other Stressors	9	9	8	7	9	8	7
Energy Production and Mining	10	11	11	10	4	10	9
Biological Resource Use	11	10	10	11	11	11	11

Table 5-8. Ranking of specific threats to habitats within each region.

Category/Specific Threat	Statewide Rank	Great Lakes Region	Kankakee Region	Corn Belt Region	Valleys and Hills Region	Interior Plateau Region	Drift Plains Region
Invasives and Other Problematic Species and Genes	**1**	**1**	**2**	**2**	**2**	**1**	**3**
Invasive/alien species	1	1	1	1	1	1	1
Problematic native species (e.g., overabundant native deer or algae)	2	2	2	2	2	2	2
Plant diseases	3	3	3	3	3	3	3
Introduced genetic material (such as crop, seed stock, biocontrol, stocked/released species, etc.)	4	4	4	4	4	4	4
Agriculture and Aquaculture	**2**	**3**	**1**	**1**	**1**	**3**	**1**
Conversion of habitat to annual crops	1	1	1	1	1	1	1
Annual and perennial nontimber crops	2	2	2	2	2	2	2
Livestock farming and ranching	3	3	3	3	3	3	3
Wood and pulp plantations	4	4	4	4	4	4	4
Aquaculture	5	5	5	5	5	5	5
Residential and Commercial Development	**3**	**2**	**3**	**3**	**3**	**2**	**2**
Housing and urban areas	1	1	1	1	1	1	1
Commercial and industrial areas	2	2	2	2	2	2	2
Tourism and recreation areas (e.g., sites with a substantial footprint – golf courses, campgrounds, etc.)	3	3	3	3	3	3	3
Natural Systems Modification	**4**	**4**	**4**	**4**	**7**	**5**	**5**
Conversion of natural habitats to other land uses	1	1	1	1	1	1	1
Dams and water management/use	2	2	2	2	2	2	2
Over-mowing of natural areas	3	3	3	3	3	3	3
Fire and fire suppression	4	4	4	4	4	4	4
Log jam removal	5	5	5	5	5	5	5
Human Intrusion and Disturbance	**5**	**6**	**5**	**6**	**6**	**6**	**4**
Recreation activities (e.g., ATVs, trail use, horseback riding, high-speed boating, canoeing)	1	1	1	1	1	1	1

Category/Specific Threat	Statewide Rank	Great Lakes Region	Kankakee Region	Corn Belt Region	Valleys and Hills Region	Interior Plateau Region	Drift Plains Region
Pollution	**6**	**5**	**7**	**5**	**5**	**4**	**6**
Agriculture, residential, and forestry effluents	1	1	1	1	1	1	1
Runoff from roads/service corridors	2	2	2	2	2	2	2
Point source pollution from commercial/industrial sources	3	3	3	3	3	3	3
Household sewage and urban water waste	4	4	4	4	4	4	4
Air pollution (e.g., smoke, mercury emissions)	5	5	5	5	5	5	5
Chemical spills	6	6	6	6	6	6	6
Garbage and solid waste	7	7	7	7	7	7	7
Excess energy (e.g., noise/light pollution, warm water discharge, etc.)	8	8	8	8	8	8	8
Climate Change and Severe Weather	**7**	**7**	**6**	**8**	**10**	**9**	**10**
Changing frequency, duration, and intensity of drought	1	1	1	1	1	1	1
Changing frequency, duration, and intensity of floods	2	2	2	2	2	2	2
Shifting and alteration of habitats due to climate change	3	3	3	3	3	3	3
Shifting seasons/phenology	4	4	4	4	4	4	4
Temperature extremes	5	5	5	5	5	5	5
Transportation and Service Corridors	**8**	**8**	**9**	**9**	**8**	**7**	**8**
Roads and railroads	1	1	1	1	1	1	1
Utility and service lines	2	2	2	2	2	2	2
Flight paths	3	3	3	3	3	3	3
Shipping lanes	4	4	4	4	4	4	4
Other Stressors	**9**	**9**	**8**	**7**	**9**	**8**	**7**
Diseases	1	1	1	1	1	1	1
Low genetic diversity (due to reduced population size, speciesinbreeding, etc.)	2	2	2	2	2	2	2

	Statewide Rank	Great Lakes Region	Kankakee Region	Corn Belt Region	Valleys and Hills Region	Interior Plateau Region
Energy Production and Mining	**10**	**11**	**11**	**10**	**4**	**10**	**9**
Fossil fuel energy production	1	1	1	1	1	1	1
Shale gas development (e.g., fracking)	2	2	2	2	2	2	2
Mining and quarrying	3	3	3	3	3	3	3
Oil and gas drilling	4	4	4	4	4	4	3
Renewable energy production	5	5	4	5	5	5	5
Biological Resource Use	**11**	**10**	**10**	**11**	**11**	**11**	**11**
Forestry practices (e.g., silvicultural methods leading to the lack of early successional habitat)	1	1	1	1	1	1	1
	Indicates a tie						

Conservation Actions Needed

After responding to questions about major threats to species in the Species Survey, respondents were asked to provide their thoughts on the conservation actions most directly relevant to the species in the question. This series of three questions were free-response in form, meaning that there were no restrictions on the amount of text respondents could provide.

The first question asked in the Species Survey was, "What actions are the most directly relevant to addressing threats to the conservation of the species selected over the next ten years?" Action scenarios included: actions currently being implemented, planned actions, or actions that are important regardless of if they had been implemented or planned. The second question asked was, "What effective actions were taken in the past decade that directly benefited species, how effective these actions were, and how effective potential actions might be to benefit species?" The final question asked was, "What are the major barriers to implementing the conservation actions identified?"

A summary of the responses organized by each species for which they were received can be found in Appendix O. Individual summaries may be useful if conservation of a specific SGCN or group of species is part of a management agency's objectives; this information can be found in Appendix O.

Habitat Perspective

The Habitat Survey utilized a tiered approach, similar to the threats sections, to identify priority conservation actions. Element four of the Congressional guidelines requires that the SWAP describe conservation actions proposed to conserve identified species and habitats as well as outlining priorities for their implementation. This section outlines conservation actions identified on a regional basis for each of the major habitat types. The Habitat Survey asked

respondents to identify conservation actions for each major habitat type within a region by rating them on a four-point scale of importance from very important to not important with an "I don't know" option. This section utilized the same hierarchal approach implemented in the threats section. Actions were broken up into major categories, which were drawn from Salafsky et al. (2008). The following is a definition of each:

- **Land and Water Protection:** Actions to identify, establish, or expand parks and other legally protected areas, and to protect resource rights
- **Land, Water, and Species Management:** Actions directed at managing, conserving, or restoring sites, habitats, the wider environment, or the species of concern
- **Education and Awareness:** Actions directed at people to improve understanding and skills, and influence behavior
- **Law and Policy:** Actions to develop, change, influence, and help implement formal legislation, regulations, and voluntary standards
- **Livelihood, Economic, and Other Incentives:** Actions that use economic and other incentives to influence behavior
- **External Capacity Building:** Actions to build the infrastructure to do better conservation

Each category contained a list of specific actions that was drafted from Salafsky et al. (2008) and feedback from the Advisory Team and Core Team during the survey drafting process. Respondents were shown a list of specific actions from a category only if they had assigned that category a rating of very important or moderately important for each of the major habitat types within a region.

Only certain actions were displayed for each habitat type due to the habitat-specific nature of some land management and protection actions. Respondents were also able to write in other actions they did not feel were represented in the survey. Write in responses can be found in Chapter VI, and a full summary of the text provided can be found in Appendix T.

Ratings of categories and specific actions were converted to a numerical scale, excluding the "I don't know" option, and aggregated to provide a regional ranking. A breakdown of the categories by statewide rankings and regional type rankings (Table 5-9) and specific actions (Table 5-10) are outlined below. A full summary of the survey results can be found in Appendix P.

Across the state, all six action categories were rated as very to moderately important conservation actions. Land, water, and species management was rated as the most important action category for the state. In general, actions to restore natural habitats, re-establish disturbance regimes, control invasive species, and reduce loss of further habitats were fairly ubiquitous across habitat types and regions.

Land and water protection was ranked second on the statewide level, reinforcing the general importance respondents felt for observable on-the-ground type conservation actions. Protection of wetlands and grasslands was a priority across regions as well as protecting corridors.

Education and awareness was ranked third on the statewide level. General education programs and education programs for K-12 were priorities across all regions statewide.

Rated forth statewide was law and policy. Priorities were to improve compliance with and enforcement of current polices and increase compliance of existing rules and regulations for aquatic systems statewide.

Livelihood, economic, and other incentives were ranked last among conservation action categories but were still rated as very to moderately important. Within this category, respondents emphasized the relative importance of managing recreational opportunities to be compatible with habitat conservation, promoting nonmonetary values of resources, and promoting conservation payment programs.

Respondents were then asked to prioritize actions on a regional basis in an environment to simulate the limited resources available for conservation actions within the state. Respondents were shown a list of conservation actions they had previously identified as very important for any of the major habitat types within the region, including habitat-specific actions, and actions they had identified themselvesthroughfree-responseoptions. Respondentswere askedtoallocate 100 "effort points," which was a representation of limited funding, expertise, and labor, to prioritize actions within the region. Each action's effort was averaged to provide a regional ranking of priority actions. A summary of these actions can be found in Chapter VI, and a full summary of the text provided can be found in Appendix P.

Table 5-9. Ranking of action categories for habitats within each Indiana planning region.

Category	Statewide Rank	Great Lakes Region	Kankakee Region	Corn Belt Region	Valleys and Hills Region	Interior Plateau Region	Drift Plains Region
Land/Water/Species Management	1	1	1	1	1	2	1
Land/Water Protection	2	3	2	3	2	1	3
Education and Awareness	3	2	3	2	3	3	2
Law and Policy	4	4	4	4	4	4	5
External Capacity Building	5	5	6	5	5	5	4
Livelihood, Economic, and Other Incentives	6	6	5	6	6	6	6

Table 5-10. Ranking of specific actions for habitats within each Indiana planning region.

Category/Specific Threat	Statewide Rank	Great Lakes Region	Kankakee Region	Corn Belt Region	Valleys and Hills Region	Interior Plateau Region	Drift Plains Region
Land/Water/Species Management	**1**	**1**	**1**	**1**	**1**	**2**	**1**
Restore habitats and natural systems in grasslands	1	14	1	4	2	18	6
Restore habitats and natural systems in wetlands	2	4	3	12	3	6	7
Re-establish natural disturbance regimes in barren lands	3	2		3	1	4	39
Reduce losses of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)	4	6	8	9	6	3	10
Control invasive species in forests	5	7	2	8	11	8	8
Restore habitats and natural systems in barren lands	6	3		7	13	5	40
Re-establish natural disturbance regimes in grasslands	7	33	4	11	5	17	5
Control invasive species in subterranean systems	8					7	1
Restore and integrate diversity of habitats into crop-production dominated landscapes	9	5	18	6	20	16	20
Link existing habitat blocks through corridor enhancement in agricultural lands	10	12	10	13	10	15	14
Control invasive species in wetlands	11	8	5	14	22	26	13
Control invasive species in barren lands	12	1		1	35	9	56
Link existing habitat blocks through corridor enhancement in barren lands	13	34		2	37	1	60
Promote diversity of wetland types and successional stages	14	24	17	25	4	21	17
Control invasive species in developed lands	15	17	14	10	36	10	57
Restore and integrate diversity of habitats into developed landscapes	16	19	15	5	47	2	64
Link existing habitat blocks through corridor enhancement in developed lands	17	18	6	32	24	11	2
Protect adjacent buffer zones	18	16		22	27	12	22
Control invasive species in aquatic systems (e.g., Asian carp, zebra mussels, invasive aquatic plants)	19	11	23	30	18	19	43
Reduce stream bank erosion	20	20	24	21	17	23	11
Land/Water Protection	**2**	**3**	**2**	**3**	**2**	**1**	**3**
Acquire currently unprotected wetlands	1	2	1	1	1	1	3
Acquire currently unprotected subterranean systems	2					2	1
Acquire currently unprotected grasslands	3	6	2	2	4	6	8
Preserve currently existing corridors	4	4	3	3	5	4	2

Category/Specific Threat	Statewide Rank	Great Lakes Region	Kankakee Region	Corn Belt Region	Valleys and Hills Region	Interior Plateau Region	Drift Plains Region
Acquire currently unprotected aquatic systems (manage and/or educate for easement habitat values)	5	7	5	5	3	10	4
Reduce conversion to cropland	6	8	6	4	2	8	5
Acquire conservation easements to protect important wildlife habitats	7	5	4	6	6	7	7
Acquire currently unprotected barren lands	8	1		7	9	3	10
Acquire currently unprotected forests	9	3	7	9	8	5	9
Build/strengthen CRP partnerships	10	9	8	8	7	9	6
Education and Awareness	**3**	**2**	**3**	**2**	**3**	**3**	**2**
Educational programs in general	1	1	1	1	2	2	1
Educational programs specifically for K-12	2	2	3	2	1	1	2
Training programs for stakeholders	3	3	2	3	3	3	3
Improvement of signage and other communication materialsinconservation areas	4	4	4	4	4	4	4
Law and Policy	**4**	**4**	**4**	**4**	**4**	**4**	**5**
Improve compliance with and enforcement of current policies	1	3	2	1	1	4	2
Increase compliance of existing rules and regulations for aquatic systems	2	1	3	5		2	7
Reduce urban sprawl through planning and zoning	3	7	4	2	2	1	3
Increase regulations on invasive species	4	2	1	3	3	3	1
Change current laws, policies, and regulations. Please specify:	5	5	6	4	5	5	6
Establish submergent vegetation control guidelines	6	6	5	6		7	5
Set private sector standards and codes	7	4	8	7	4	6	4
Establish rules and guidelines for piers and other structures	8	8	9	9		9	9
Establish legal lake levels	9	9	7	8		8	8
Livelihood, Economic, and Other Incentives	**5**	**5**	**6**	**5**	**5**	**5**	**4**
Manage recreational opportunities to be compatible with fish and wildlife habitats	1	1	1	2	2	3	3
Promote nonmonetary values of natural systems within the state	2	2	2	1	4	1	2
Promote conservation payment programs (e.g., payment for ecosystem services, conservation easements)	3	4	3	3	1	2	1

Category/Specific Threat	Statewide Rank	Great Lakes Region	Kankakee Region	Corn Belt Region	Valleys and Hills Region	Interior Plateau Region	Drift Plains Region
Support substitution of alternatives for environmentally	4	3	4	4	5	4	4
Link natural resources to livelihoods through nature	5	5	5	6	6	5	5
Promote market forces (e.g., creation of a nitrogen trading market, promotion of alternative agricultural markets) as a tool for conservation	6	6	6	5	3	6	6
External Capacity Building	**6**	**6**	**5**	**6**	**6**	**6**	**6**
Strengthen conservation financing	1	2	1	1	3	1	4
Promote use of research and science in conservation decision-making processes	2	1	4	2	2	2	1
Develop alliances and partnerships (e.g., between	3	3	2	3	1	3	2
Increase state's capacity for research and monitoring of conservation actions	4	4	3	4	4	4	3
Promote green infrastructure	5	5	5	5	5	5	5
Develop institutions and civil society	6	6	6	6	6	6	6

Additional Efforts Needed

All respondents to the Habitat Survey were asked to report their agency or organization's effectiveness in implementing and monitoring conservation actions within the state. A full summary of this data can be found in Appendix P.

Nearly 58% of Habitat Survey respondents strongly or moderately agreed that their agency or organization has a clear policy about measuring the effectiveness of conservation actions. However, when asked if their agency has a clear process for measuring effectiveness of conservation actions, the response was much lower, with only 35.9% moderately agreeing, 27.8% slightly agreeing, and 20.3% disagreeing with this statement.

Less than half of the respondents (40.1%) strongly or moderately agreed that their agency or organization has a clear set of metrics that can be used to evaluate effectiveness of actions. The majority of respondents (75.3%) strongly or moderately agreed that their agency or organization is willing to take advantage of future or emerging opportunities to further their conservation agenda.

From these responses, it is clear that most agencies and organizations may need to develop more clear processes and metrics for evaluation of conservation actions throughout the state. Collaboration with state agencies as a result of SWAP will provide opportunities to do so.

Survey respondents were asked in the form of a free-response question to identify barriers for their agency or organization's ability to implement conservation actions and list resources that would be needed to overcome them. Table 5-11 below is a partial word count of relevant phrases included by respondents. A full list of these results can be found in Appendix P.

Table 5-11. Frequency of occurrence of relevant words and phrases in reporting barriers to implementing conservation actions within the state from Species Survey.

Words/Phrase	Number of occurrences
Funding/money/financial/dollars	59
Staff/personnel/manpower/employees	45
Resources	33
Management	25
Program	19
Land	16
Planning	14
Public	14
Agencies	12
Efforts	12

Inadequate funding was identified as a major barrier by the most respondents. Concerns about capacity to complete projects stemming from lack of personnel and volunteer labor were also often reported. The lack of staff was reported to cause "non-wildlife" duties to fall into other staff's realm of responsibilities, which can detract from the effectiveness of organizations' abilities to implement conservation actions. Lack of collaboration and engagement, both across agencies and with stakeholders was identified as a major barrier to implementing conservation actions. This was also noted by several respondents who pointed to the large amount of private land. Engaging landowners, especially in agricultural systems, is key to conserving certain wildlife habitats.

Respondents were also presented with a specific set of ecological, economic, and social and political situations and asked to evaluate their agency or organization's ability to respond to changing conditions.

For changing ecological conditions, respondents thought that their agencies were either somewhat able or not able to respond to the specific scenarios presented. While respondents generally thought their agencies were equipped to somewhat aptly respond to changing species populations (40.7%) and habitat conditions (42.1%), other scenarios were not evaluated as well. More than half of the respondents reported that their agency would not be able to respond to genetically modified species spreading into natural systems (52.3%), changing temperatures (66.3%), increasing frequency in extreme weather (71.7%), increasing frequency, duration, and intensity of floods (63.6%), changing water availability and use (58.6%), and emerging diseases (54.3%). Given the previous rating of climate change and severe weather events as a threat to habitats across Indiana, agencies and organizations lack an apparent ability to mitigate these issues. Conservation within the state over the next ten years

may require increasing the capacity to respond to these potential changing ecological factors.

In general, respondents also reported that their agencies or organizations would not be able to respond to the suite of changing economic factors listed. Over half of the respondents reported that their agencies would not be able to respond to changes in demand for commodity crops and biofuel crops (68.3%), which is particularly pressing given the identification of agriculture and aquaculture as a significant threat to habitats within Indiana. Respondents also reported that they suspect their agencies are unable to respond to changing renewable energy production footprint in the state (46.2%), changing non-renewable energy production footprint in the state (69.3%), and changing availability of funding for wildlife conservation and management (72.1%).

More than half of the respondents reported that their agency would be unable to respond to changes in regulatory acts. Fifty percent (50.3%) mentioned the ESA, while 59.1% mentioned the Clean Water Act (CWA), and 65.2% mentioned the Clean Air Act (CAA). Respondents reported that their agency would be somewhat able to respond to other social and political factors — 60.6% public support for natural resource management and conservation activities and 50.5% changing participation in wildlife-dependent and other recreational activities. Although residential and commercial development was identified as a significant threat within the state, 40.2% of respondents reported that their agencies or organizations would not be able to respond to urbanization and 47.2% reported they would not be able to respond to changes in land use.

Statewide Conservation Threats and Actions

In addition to the threats and actions identified in the surveys, the DFW recognized the need to identify statewide threats aligned with specific actions. Several threats and actions were identified as ubiquitous for SGCN and habitats across the entire state. These include:

- **Habitat Loss:** Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
- **Invasive Species:** Build external capacity by forming and facilitating partnerships, alliances, and networks of organizations to address invasive species
- **Law and Policy:** Develop, change, influence, and help implement formal legislation, regulations, and voluntary standards
- **Dams and Water Management and Use:** Remove unnecessary dams and fit necessary dams with effective fish passage structures

Landscape Modeling Efforts

As part of the surveys and data analysis conducted by Purdue University, both aquatic and terrestrial landscape-level models were developed. These models were intended to help prioritize actions for SCGN and identify quality habitats. However, feedback from both agency staff and conservation partners indicated that these models caused more concerns than guidance in the development of the SWAP. The Core Team decided that due to the expressed concerns regarding modeling, that detailed related to modeling were moved to Appendix C and not included in the main body of the document. However, the Core Team did feel this exercise may be

useful for future iterations of the SWAP.

Terrestrial models were built for 14 representative species; with the number of species representing each region ranging from six to seven (a species could represent more than one region). Thirty-eight models were conducted using cover types from the 2011 NLCD to estimate the quality of current habitat conditions. The terrestrial models resulted in habitat suitability scores on maps for each of the selected species but did not take into account all possible details that make habitat of high or low quality for a species, therefore did not serve as a predictor if a species was present only that the habitat as suitable for that species. Additionally, habitat suitability maps for each region were created to composite habitat suitability across all species in the model. Because of the varying habitat needs of the species included in the model, no single area can represent excellent habitat for all of them, therefore no areas could be deemed excellent. Areas with a score of good represent the best habitat for the widest variety of species and varying habitat types. The full results of this modeling can be found in Appendix C.

While the entire modeling project was not a clear guiding factor for the SWAP or priority actions, the individual species models may be helpful for further analysis and monitoring of habitats suitable for specific species. Additionally, the complete modeling project could be helpful in implementation or future iterations of the SWAP.

The modeling for aquatic systems was built to predict and visualize stream quality across the state of Indiana. Aquatic modeling for streams was conducted by combining field data, statistical analysis, and GIS techniques. The Indiana Department of Environmental Management (IDEM) maintains a database of characteristics associated with water quality and stream health at 1750+ sampling locations throughout the state, collected between 1996 and 2013. For each site, two indices are calculated: an index of biotic integrity (IBI; Simon and Dufour 2005) which is an indicator of stream quality based on fish species presence, abundance, and health and the qualitative habitat evaluation index (QHEI; Ohio EPA 2006) which is based on stream and riparian zone habitat characteristics. Although these indices are calculated based on a suite of habitat characteristics for one stretch of stream, it was an important factor when looking at overall stream quality.

An additional 25 landscape-level variables were used to approximate and predict variability in these indices as measures of stream health and water quality such as mean annual flow and riparian buffer zones (Appendix C). While this data did provide a statewide snapshot of stream habitat and fish community quality, the predictive model was not utilized in the development of the SWAP, rather this data was considered when creating Conservation Opportunity Areas. The detailed methods and models can be found in Appendix C.

D. CONSERVATION OPPORTUNITY AREAS

Conservation Opportunity Areas (COA) are intended to guide conservation activities at a landscape level. Landscape conservation is a developing theme across the country and throughout Indiana. Building off the successes of other Indiana landscape initiatives, like Goose Pond Fish and Wildlife Area and the Healthy Rivers Initiative, DFW has identified opportunities on the landscape to focus conservation efforts over the next decade. These COA were identified as a way to direct actions toward specific areas on Indiana's landscape. Several guiding principles were identified as the rationale for the designation of a COA:

- Enhance and conserve fish and wildlife and their habitats
- Support biological diversity (real or potential)
- Provide opportunities for increasing and developing partnerships
- Guide organizations to important landscapes and areas
- Focus on deliberate acts of conservation
- Focus conservation funds
- Support long-term viability
- Concentrate actions on habitats, ecosystems, and landscapes

This is the first attempt at identifying COA and will be an evolving feature, as resources and priorities are developed and identified in each area. It is recognized that COA will not be the only areas in Indiana that DFW or its partners will be working, but it is believed that these spaces hold the greatest potential for successful cooperation and conservation.

The goal is that each COA would represent opportunities across Indiana to impact a variety of habitats and species. In order for an area to be designated as a COA several questions were taken into consideration:

- Does the area have SGCN?
- Does the area have unique habitat communities?
- Does the area have long term viability?
- Are partners or DNR working in the area?
- Is the area under threat?
- Is there habitat connectivity or the possibility of connectivity?
- Are there grants or funding opportunities in the area?
- Is there ongoing work in the area or public support?

In order to answer these questions a variety of resources were utilized including: public, partner and DFW staff input, the Heritage Database, the Species and Habitat Surveys, partner priority areas, the public lands database, and the Farm Bill private lands database. A concerted effort was made to identify at least one COA in each of the six regions to enforce the regional approach of the SWAP.

Four overarching habitat themes became apparent from results of the Habitat Survey and public input: river corridors, natural lake catchments, terrestrial habitats, and urban areas. These themes helped provide further guidance in the identification of COA. Each theme provides unique opportunities and these opportunities will be driven by the conservation community and guided by the threats and actions identified within the SWAP.

The river corridors were identified for their unique aquatic habitat and species diversity but also for the opportunities to affect the habitats within the immediate 4-mile river corridors and ultimately the associated watersheds.

The natural lake catchment COA identified were based on the habitat potential for species and the potential of the habitats within the catchments. Natural lake catchments were delineated for seven cold water and 22 cool water natural lakes. Because lake eutrophication(i.e., nutrient loading) is a leading cause of natural lake degradation, these catchment delineations are intended to bridge the gap between terrestrial and aquatic conservation efforts that aim to sustain or enhance the water quality of streams and rivers that directly drain into them. This would ensure the long-term vitality of these unique aquatic habitats and adding valuable habitat for terrestrial SGCN.

Terrestrial habitat COA were primarily based around areas of existing conservation efforts and those with the potential for increased connectivity and large-scale habitat project potential throughout the state. Selected areas include known diverse or unique habitat features, SGCN, and the ability to have positive impacts on the surrounding communities through improved habitat.

Throughout the SWAP revision process, it was consistently stated that engaging the general public in conservation was the key to successful wildlife and habitat management in Indiana. For this primary reason, urban areas serving the greatest populations in Indiana were selected for implementation strategies to engage these populations in the work of the conservation, while educating them on the relationship of healthy sustainable wildlife populations with the health of future communities.

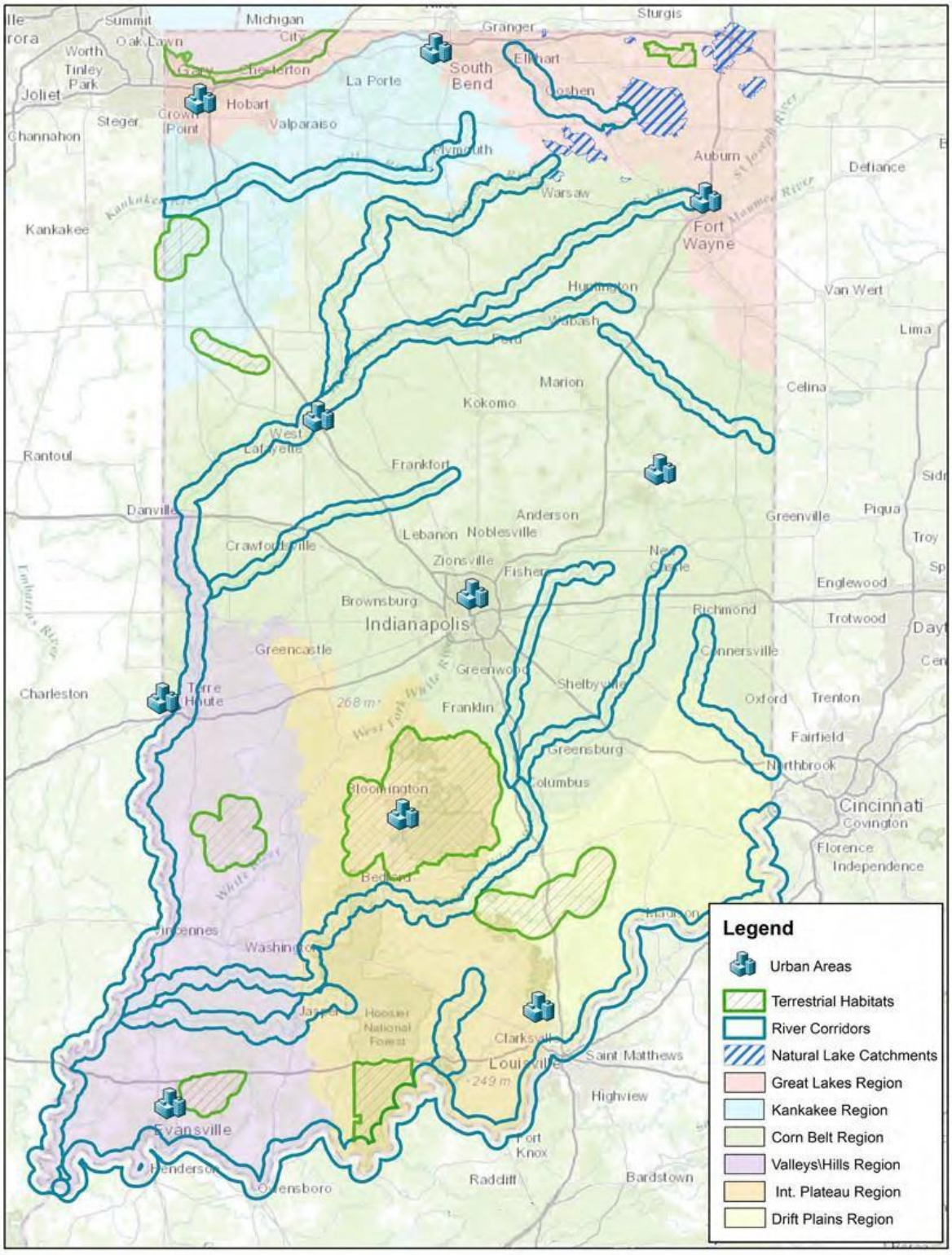


Figure 5-22. Indiana conservation opportunity areas.

6

CHAPTER VI.

INDIANA'S PLANNING REGIONS

INDIANA'S SWAP INCLUDES PLANNING REGIONS TO BETTER FOCUS ACTIONS AND PRIORITIES BASED ON REGIONAL RESOURCES, NEEDS, AND THREATS.

OUTLINE

A. Great Lakes Region
B. Kankakee Region
C. Corn Belt Region
D. Valleys and Hills Region
E. Interior Plateau Region
F. Drift Plains Region

A. GREAT LAKES REGION

Figure 6-1. Outline of the Great L

Introduction

This section summarizes habitat conditions, threats to SGCN and their habitats, and conservation actions for species and habitats in the Great Lakes Region. This section also reviews land cover changes over the past decade and identifies unique habitat types in this region. Summaries of threats to and conservation actions for SGCN and their habitats that were generated from two surveys can be found at the end of this section.

In addition to the threats and actions identified in the Habitat Survey and the Species Survey, the DFW recognized the need to identify threats aligned with specific actions. Several threats and actions were identified as ubiquitous across all six regions. These include:

- **Habitat Loss:** Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
- **Invasive Species:** Build external capacity (form and facilitate partnerships, alliances, and networks of organizations to address invasive species)
- **Law and Policy:** Develop, change, influence, and help implement formal legislation, regulations and voluntary standards
- **Dams and Water Management and Use:** Remove unnecessary dams and utilize necessary dams with effective fish passage structures

The DFW also identified specific threats and actions for each SWAP region based on DFW priorities. These threats were identified due to their high level of relevancy to the specific region and the workability of the associated actions. These threats and actions for the Great Lakes Region include:

- **Fish Passage:** Remove dams and create fish ladders
- **Pollution:** Reduce nutrient and toxin loads (e.g., heavy metals, pharmaceuticals, fertilizers, and pesticides)
- **Habitat Loss to Barrens and Bogs/Fens:** Build external capacity by forming partnerships and networks, raising and providing funds and resources for conservation organizations to maintain and protect barrens and bogs/fens

Current Habitat Conditions

During the Species Survey, respondents were asked to identify SGCN within the Great Lakes Region. A full summary of the Species Survey results can be found in Appendix O.

Table 6-1. SGCN present in the Great Lakes Region.

Taxa	Scientific Name	Common Name
Amphibians	*Necturus maculosus*	Common Mudpuppy
Amphibians	*Ambystoma laterale*	Blue-spotted Salamander
Amphibians	*Hemidactylium scutatum*	Four-toed Salamander
Amphibians	*Acris blanchardi*	Blanchard's Cricket Frog
Birds	*Cygnus buccinator*	Trumpeter Swan
Birds	*Colinus virginianus*	Northern Bobwhite
Birds	*Chordeiles minor*	Common Nighthawk
Birds	*Antrostomus vociferus*	Eastern Whip-poor-will
Birds	*Laterallus jamaicensis*	Black Rail
Birds	*Rallus elegans*	King Rail
Birds	*Rallus limicola*	Virginia Rail
Birds	*Gallinula galeata*	Common Gallinule
Birds	*Grus canadensis*	Sandhill Crane
Birds	*Grus americana*	Whooping Crane
Birds	*Pluvialis dominica*	American Golden-plover
Birds	*Charadrius melodus*	Piping Plover
Birds	*Bartramia longicauda*	Upland Sandpiper
Birds	*Arenaria interpres*	Ruddy Turnstone
Birds	*Calidris canutus rufa*	Rufa Red Knot
Birds	*Calidris subruficollis*	Buff-breasted Sandpiper
Birds	*Limnodromus griseus*	Short-billed Dowitcher
Birds	*Scolopax minor*	American Woodcock
Birds	*Tringa solitaria*	Solitary Sandpiper
Birds	*Tringa melanoleuca*	Greater Yellowlegs
Birds	*Phalaropus tricolor*	Wilson's Phalarope
Birds	*Sternula antillarum athalassos*	Interior Least Tern
Birds	*Chlidonias niger*	Black Tern
Birds	*Botaurus lentiginosus*	American Bittern
Birds	*Ixobrychus exilis*	Least Bittern
Birds	*Ardea alba*	Great Egret
Birds	*Nycticorax nycticorax*	Black-crowned Night-heron
Birds	*Pandion haliaetus*	Osprey
Birds	*Ictinia mississippiensis*	Mississippi Kite
Birds	*Haliaeetus leucocephalus*	Bald Eagle
Birds	*Circus cyaneus*	Northern Harrier
Birds	*Accipiter striatus*	Sharp-shinned Hawk
Birds	*Buteo platypterus*	Broad-winged Hawk
Birds	*Tyto alba*	Barn Owl
Birds	*Asio flammeus*	Short-eared Owl
Birds	*Falco peregrinus*	Peregrine Falcon
Birds	*Lanius ludovicianus*	Loggerhead Shrike
Birds	*Cistothorus platensis*	Sedge Wren
Birds	*Cistothorus palustris*	Marsh Wren
Birds	*Ammodramus henslowii*	Henslow's Sparrow
Birds	*Xanthocephalus xanthocephalus*	Yellow-headed Blackbird

Taxa	Scientific Name	Common Name
Birds	*Sturnella neglecta*	Western Meadowlark
Birds	*Helmitheros vermivorum*	Worm-eating Warbler
Birds	*Vermivora chrysoptera*	Golden-winged Warbler
Birds	*Mniotilta varia*	Black-and-white Warbler
Birds	*Setophaga citrina*	Hooded Warbler
Birds	*Setophaga kirtlandii*	Kirtland's Warbler
Birds	*Setophaga cerulea*	Cerulean Warbler
Fish	*Ichthyomyzon fossor*	Northern Brook Lamprey
Fish	*Acipenser fulvescens*	Lake Sturgeon
Fish	*Anguilla rostrata*	American Eel
Fish	*Notropis anogenus*	Pugnose Shiner
Fish	*Rhinichthys cataractae*	Longnose Dace
Fish	*Coregonus artedi*	Cisco
Fish	*Moxostoma valenciennesi*	Greater Redhorse
Fish	*Percopsis omiscomaycus*	Trout-perch
Fish	*Cottus cognatus*	Slimy Sculpin
Mammals	*Condylura cristata*	Star-nosed Mole
Mammals	*Myotis lucifugus*	Little Brown Myotis
Mammals	*Myotis septentrionalis*	Northern Long-eared Myotis
Mammals	*Myotis sodalis*	Indiana Myotis
Mammals	*Lasionycteris noctivagans*	Silver-haired Bat
Mammals	*Nycticeius humeralis*	Evening Bat
Mammals	*Lasiurus borealis*	Eastern Red Bat
Mammals	*Lasiurus cinereus*	Hoary Bat
Mammals	*Spermophilus franklinii*	Franklin's Ground Squirrel
Mammals	*Ursus americanus*	Black Bear
Mammals	*Mustela nivalis*	Least Weasel
Mammals	*Taxidea taxus*	American Badger
Mollusks	*Lampsilis fasciola*	Wavyrayed Lampmussel
Mollusks	*Pleurobema clava*	Clubshell
Mollusks	*Ptychobranchus fasciolaris*	Kidneyshell
Mollusks	*Simpsonaias ambigua*	Salamander Mussel
Mollusks	*Venustaconcha ellipsiformis*	Ellipse
Mollusks	*Villosa fabalis*	Rayed Bean
Mollusks	*Villosa lienosa*	Little Spectaclecase
Mollusks	*Campeloma decisum*	Pointed Campeloma
Mollusks	*Lymnaea stagnalis*	Swamp Lymnaea
Reptiles	*Clemmys guttata*	Spotted Turtle
Reptiles	*Emydoidea blandingii*	Blanding's Turtle
Reptiles	*Terrapene carolina*	Eastern Box Turtle
Reptiles	*Thamnophis butleri*	Butler's Gartersnake
Reptiles	*Thamnophis radix*	Plains Gartersnake
Reptiles	*Thamnophis proximus*	Western Ribbonsnake
Reptiles	*Nerodia erythrogaster neglecta*	Copper-bellied Watersnake
Reptiles	*Clonophis kirtlandii*	Kirtland's Snake
Reptiles	*Opheodrys vernalis*	Smooth Greensnake
Reptiles	*Sistrurus catenatus*	Eastern Massasauga

During the Habitat Survey, respondents were asked to evaluate the overall quality of fish and wildlife habitats in the Great Lakes Region (Fig. 6-2), estimate changes in overall quality since 2005 (Fig. 6-3), and predict changes in overall quality over the next ten years (Fig. 6-4). Each respondent was asked to respond for one or more of the eight major habitat types within the region and results were aggregated at the regional level. A full list of the Habitat Survey results can be found in Appendix P.

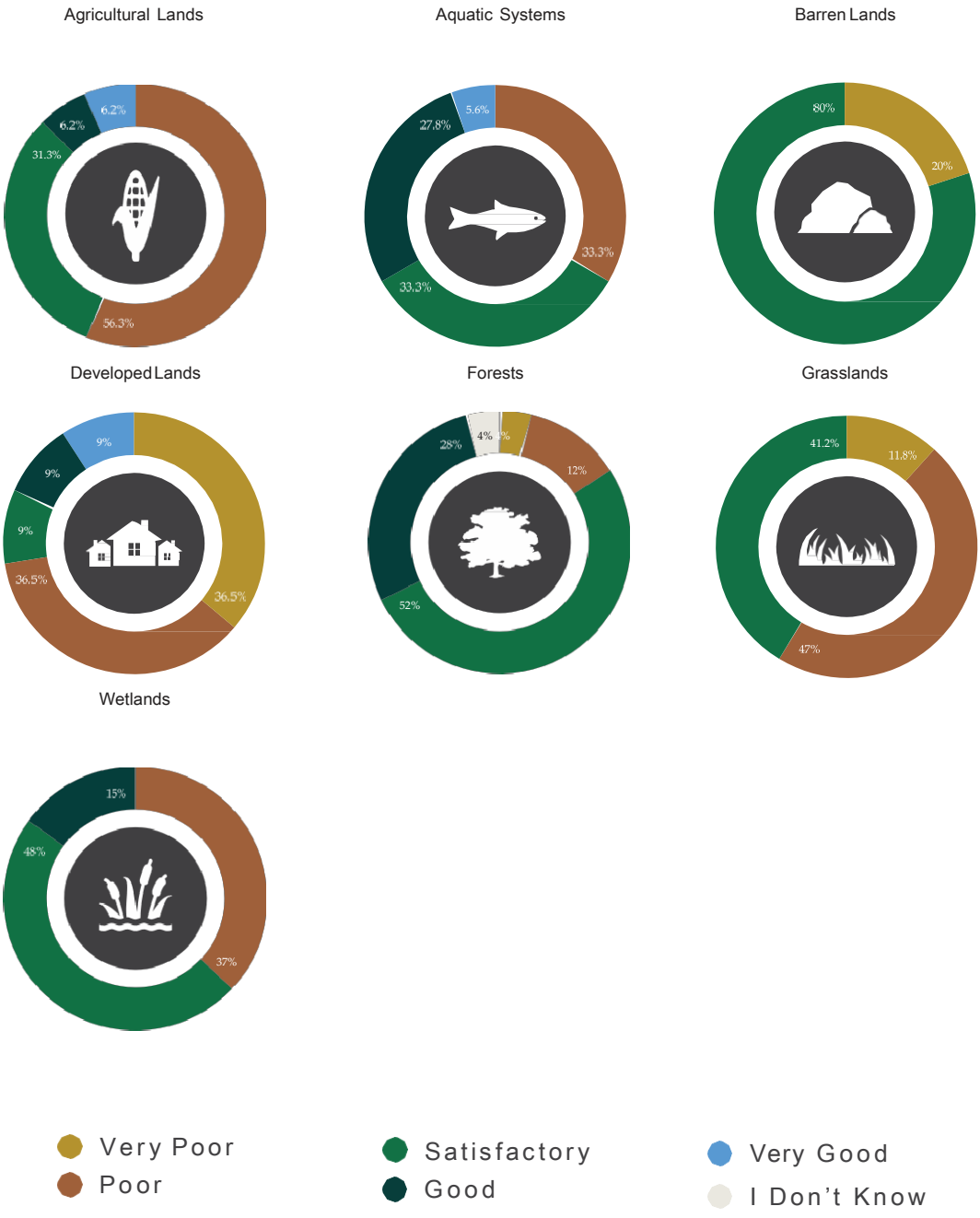


Figure 6-2. Overall quality of fish and wildlife habitats in the Great Lakes Region in 2014.

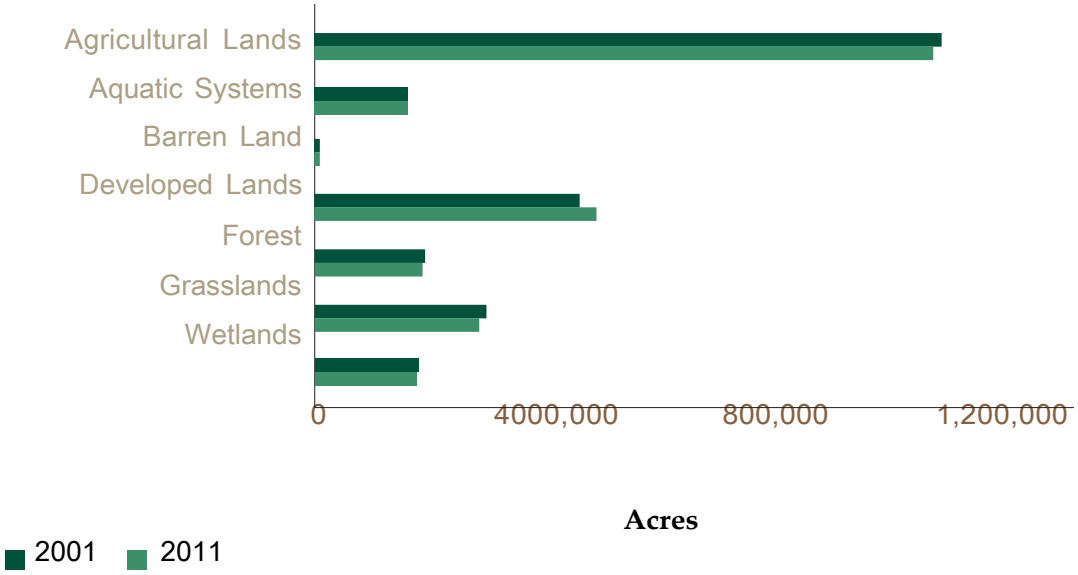
Figure 6-3. Estimated change in the overall quality of fish and wildlife habitats from 2005 to 2014 for each of the major habitat types in the Great Lakes Region.

Figure 6-4. Predicted changes in overall quality of fish and wildlife habitats over the next ten years for each major habitat type in the Great Lakes Region.

Changes in Land Cover

Most land cover in the Great Lakes Region consists of agricultural lands and developed lands, followed by grasslands, wetlands, and forests (Fig. 6-5). Compared to other Indiana regions, the Great Lakes Region has a high percentage of aquatic systems, mainly due to the presence of Lake Michigan. The region is comprised of 20.4% developed lands, as most of the surrounding Lake Michigan and Chicago-area is developed, and 7.4% wetlands, due to the extensive wetland complexes present in the Eastern portion of the region.

Although the aquatic systems have increased marginally, the Great Lakes Region has experienced loss in most habitat types over the past ten years. Most habitats were lost to urban development, and agriculture lost the most cover in terms of total acreage (Fig. 6-5). Percentage-wise, the greatest net losses were seen in grasslands (3.2%), forests (1.7%), and wetlands (1.4%). The greatest net increases percentage-wise were seen in barren lands (8.3%) and developed lands (6.2%).



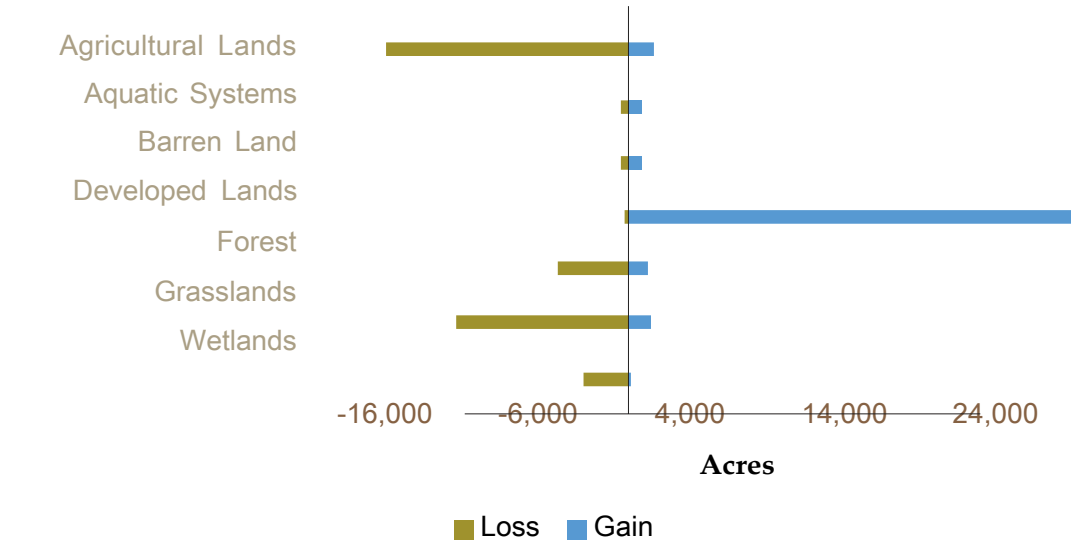


Figure 6-5. Distribution of land cover and losses and gains in land cover in the Great Lakes Region between 2001 and 2011 from NLCD.

Threats Affecting Habitats

Top Threat Categories

The third element requires the description of threats to SGCN and their habitats. The SWAP identifies a habitat perspective in order to manage for the conservation of species in Indiana. This section utilizes the same hierarchical method of identifying and rating threats based on Salafsky et al. (2008) that was outlined in Chapter V. Category rankings and specific threat rankings for habitats in this region are outlined below (Table 6-2). A full summary of the Habitat Survey results for the Great Lakes Region can be found in Appendix P.

For first-level threat categories, invasive and other problematic species and genes, residential and commercial development, agriculture and aquaculture, natural systems modification, pollution, and human intrusion and disturbance had a mean ranking between significant and moderate threat level. Climate change and severe weather, transportation and service corridors, other stressors, biological resource use, and energy production and mining received average ratings between moderate and minor threat. No threat category landed in the minor to no threat range for this region.

The invasive and other problematic species and genes category was identified as the top first-level threat across the region and in each of the major habitat types except for barren lands and developed lands, where it was ranked second and third, respectively.

Within the category, the invasive and alien species category was identified as the top specific second-level threat. Residential and commercial development, including non-agricultural land uses such as housing development and urban areas, was ranked second overall for the region and first as a threat to barren lands and habitats within developed lands. Shoreline development along Lake Michigan and destruction of riparian habitat from development were specifically identified as residential and commercial development threats within this region. Agriculture and aquaculture also generally ranked high regionally and across all habitat types except barren lands and developed lands. Within the category, conversion of habitat to annual crops and already existing non-timber crops were identified as the most significant threats, while aquaculture and timber production received ratings between the minor to no threat range. Changes to drainage through tile installation and nutrient loading were identified as other threats by respondents especially in aquatic systems in this region. Loss of CRP was also identified as a concern.

Climate change and other severe weather received a moderate to minor threat ranking regionally and within each habitat type; however, the majority of respondents anticipated specific threats within this category to increase in significance over the next ten years. Pollution received a high threat ranking within barren lands and developed lands compared to the rest of the habitat types. Other stressors and biological resource use were ranked uniformly low across habitat types within this region. Energy production and mining was also ranked low regionally. Some respondents specifically identified wind farm installation development as a potential threat in this region.

Table 6-2. Threat category ranking to habitats in the Great Lakes Region. First-level threats categories are based on the hierarchical method of identifying threats outlined in Salafsky et al. (2008). Ranked threat categories for the entire region are arranged by each major habitat type (1 - highest threat).

Category	Regional Ranking	Aquatic Systems	Agricultural Lands	Barren Lands	Developed Lands	Forests	Grasslands	Wetlands
Invasive and Other Problematic Species and Genes	1	1	1	2	3	1	1	1
Residential and Commercial Development	2	4	3	1	1	2	3	4
Agriculture and Aquaculture	3	3	4	7	10	4	2	3
Natural Systems Modification	4	6	2	6	5	3	4	2
Pollution	5	2	5	3	2	6	8	6
Human Intrusion and Disturbance	6	5	7	4	4	5	5	5
Climate Change and Severe Weather	7	7	6	8	7	7	6	7
Transportation and Service Corridors	8	8	8	5	6	9	7	8
Other Stressors	9	9	9	9	8	8	9	9
Biological Resource Use	10	11	10	11	9	10	11	10
Energy Production and Mining	11	10	11	10	11	11	10	11

Top Specific Threats in Ranked Order

In the Habitat Survey, respondents were also asked to identify specific threats to major habitat types using the same threat category ranking system outlined in Salafsky et al. (2008). These second-level threats represent subcategories of threats within the major threat categories listed in the table above. The following are the top specific second-level threats to habitats in the Great Lakes Region, aggregated across habitat types:

1. Invasive and alien species
2. Conversion of natural habitats to other land uses
3. Changing frequency, duration, and intensity of drought
4. Changing frequency, duration, and intensity of floods
5. Housing and urban areas
6. Conversion of habitat to annual crops
7. Shifting and alteration of habitats due to climate change
8. Commercial and industrial areas
9. Temperature extremes due to climate change
10. Annual and perennial non-timber crops

In the Species Survey, respondents were also asked to identify threats to individual SGCN using the same threat category ranking system. The following are the top specific second-level threats to SGCN occurring in the Great Lakes Region, aggregated across all species:

1. Natural habitat conversion
2. Conversion of habitat to annual crops
3. Annual and perennial non-timber crops
4. Dams and water management and use
5. Livestock farming and ranching
6. Over-mowing of natural areas

Emerging/Anticipated Threats

Respondents were asked specifically to identify any emerging or anticipated threats over the next ten years for fish and wildlife habitats within the major habitat types for a region in a free-response question.

Respondents identified a concern for continued introduction and spread of invasive species, including Asian Carp in aquatic systems and exotic plant species. Although pollution was mid-ranked for current threats, contaminants like pharmaceuticals and pesticides, as well as plastics in the form of micro-beads, were identified as emerging specific threats in aquatic systems in this region. Respondents also reported an anticipated threat to conservation may be the lack of land being set aside for protection by state agencies as well as loss of the CRP.

Conservation Actions Needed

Top Action Categories

The fourth element requires that the SWAP describe conservation actions proposed to conserve identified species and habitats as well as outlining priorities for their implementation. This section outlines conservation actions identified at the regional level for each of the major habitat types. This section follows the same protocol to rate and rank actions in this region based on Salafsky et al. (2008) that was outlined in Chapter V. A full list of survey results can be found in Appendix P. Category rankings for actions and specific actions are outlined in the list on the following page (Table 6-3).

Land, water, and species management was ranked as the most important first-level category of actions regionally and in aquatic systems, barren lands, and wetlands specifically. Within the categories, means were used to determine the rankings. Because of this, some habitat-specific options with few respondents may have high means regionally. Overall, important actions reflected respondents identifying a need to control invasive species and restore habitats and natural systems in various habitat types. Reducing loss of habitat due to agricultural and residential development was identified as one of the highest rated actions across several habitat types. Reducing nutrient toxin load was also tied for the highest rated action in aquatic systems within land, water, and species management.

Education and awareness was also highly ranked for this region, ranking second regionally and first for agricultural lands, developed lands, forests, and grasslands. Education in general was ranked highest within the category, but

three of the four actions in this category received a rating from respondents between very important and moderately important. Through the free-response option, respondents also indicated a general importance for public participation in conservation through opportunities for stakeholder engagement and development of educational programs specifically addressing topics related to natural lakes and climate change.

Within the law and policy top-level category, respondents emphasized an importance for compliance of current regulations over creation of new ones in general, though some respondents did suggest improving regulations on invasive species, as well as changing regulations with regards to drainage and agricultural runoff.

External capacity building was ranked last regionally, below livelihood, economic and other incentives; however, all categories of actions received an average rating between very important and moderately important. Of the 93 specific second-level conservation actions rated by respondents for this region, 73 received a rating between very important to moderately important. This indicated respondents identifying a range of actions that are vital to conservation within this region across the major habitat types.

Table 6-3. Action category rankings to habitats in the Great Lakes Region. First-level categories are based on the hierarchical method of identifying actions outlined in Salafsky et al. (2008). Ranked action categories for the entire region are broken up by each major habitat type. Additional habitat ranking information and Habitat Survey responses can be found in Appendix P.

Category	Regional Ranking	Aquatic Systems	Agricultural Lands	Barren Lands	Developed Lands	Forests	Grasslands	Wetlands
Land/Water/Species Management	1	1	2	1	2	3	3	1
Education and Awareness	2	2	1	3	1	1	1	4
Land/Water Protection	3	3	5	1	2	2	2	2
Law and Policy	4	4	4	4	4	5	5	3
Livelihood, Economic and Other Incentives	5	5	3	4	4	6	6	6
External Capacity Building	6	6	6	4	4	4	4	5

Top Specific Actions in Ranked Order

In the Habitat Survey, respondents were also asked to identify specific actions for major habitat types using the same action category ranking system outlined in Salafsky et al. (2008). These second-level actions represent subcategories of actions within the major action categories listed in the table above. The following are the top specific second-level conservation actions for habitats in the Great Lakes

Region, aggregated across habitat types:

1. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
2. Preserve currently existing corridors
3. Promote use of research and science in conservation decision-making processes
4. Acquire conservation easements to protect important wildlife habitats
5. Reduce nutrient and toxin loads (e.g., heavy metals, pharmaceuticals, fertilizers, insecticides)
6. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
7. Develop educational programs in general
8. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
9. Strengthen conservation financing
10. Increase acres of riparian buffers

In the Species Survey, respondents used a free-response question to discuss the most relevant conservation actions for individual SGCN. The following are top actions for SGCN occurring in the Great Lakes Region, as summarized from these free-response questions:

1. Educate and engage with landowners and citizens
2. Enhance connectivity of habitats
3. Increase CRP lands
4. Protect large contiguous forested areas
5. Limit conversion of habitat to non-habitat
6. Control invasive plants
7. Minimize disturbance to nesting birds
8. Use burning and mowing as management techniques
9. Protect and manage large wetland complexes

Prioritization of Actions

In order to prioritize these actions within an environment of limited resources, respondents were then asked to distribute hypothetical “effort points” to any action they had previously rated as “very important” for any of the major habitat types within a region. The effort ratings were averaged and then ranked to identify the top five actions for each region. A full list of these results can be found in Appendix

P. Priority actions for the Great Lakes Region include:

1. Control invasive species in aquatic systems (e.g., Asian Carp, Zebra Mussels,

invasive aquatic plants)
2. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
3. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
4. Develop educational programs in general
5. Reduce nutrient and toxin loads (e.g., heavy metals, pharmaceuticals, fertilizers, insecticides)

These top priority actions, sorted by average effort rating, reflect actions from land, water, andspeciesmanagementandeducationandawareness. Respondents placed an emphasis on conservation actions in aquatic systems in this region, as both controlling invasive species in this habitat type and reducing nutrient toxin load will directly benefit fish and wildlife habitats in aquatic systems.

Threats and Actions by Major Habitat Type

The following summaries break down threats and conservation actions in this region by major habitat type, based on responses to the Habitat Survey and the Species Survey. The SGCN that occur there, top threats to SGCN, top actions for SGCN, key threats to habitats, and priority actions for each major habitat type in this region are summarized on the following pages.

Threats and actions were only included in detail below if a majority of eligible survey respondents, greater than 50%, rated them, to avoid artificially elevating items, which were highly ranked but only by a few respondents. This approach left some threats and action lists with no items for certain habitats, which is illogical from a practical perspective. Therefore, in these situations, the top threats and actions are still listed but are denoted with an asterisk (*) to signify that there may be some items, which seem out-of-place, reflecting a lack of sufficient response for a particular habitat in the survey. This approach and the survey design also caused for some disparities between threats and actions.

Approximately ten items are given for each list below. Lists may be shorter if fewer than ten items were rated by a majority of survey respondents, or longer if there were ties between items.

Top actions for SGCN were summarized from free-response questions about individual species and do not follow the same categorizations as actions for habitats. A full summary of the Habitat Survey responses can be found in Appendix P.

Agricultural Lands

Agricultural lands are defined as lands devoted to commodity production. Examples of agricultural lands include: intensively managed non-native grasses, row crops, fruit and nut-bearing trees, confined feeding operations, and feedlots.

Top threats to SGCN occurring in agricultural lands in the Great Lakes Region:

1. Natural habitat conversion
2. Conversion of habitat to annual crops
3. Annual and perennial non-timber crops

Top conservation actions for SGCN occurring in agricultural lands in the Great Lakes Region:

1. Educate and engage with landowners and citizens (benefits all species)
2. Enhance connectivity of forests and grasslands surrounding agricultural lands (benefits all species)
3. Increase use of CRP partnerships (benefits all species)
4. Implement agricultural practices that improve water quality in aquatic systems and wetlands (for aquatic and wetland species)
5. Maintain shallow-water areas for migrating shorebirds

Top threats to fish and wildlife habitats in agricultural lands in the Great Lakes Region:

1. Conversion of natural habitats to other land uses
2. Conversion of habitat to annual crops
3. Invasive and alien species
4. Changing frequency, duration, and intensity of drought
5. Changing frequency, duration, and intensity of floods
6. Housing and urban areas
7. Agriculture, residential, and forestry effluents
8. Household sewage and urban water waste
9. Introduced genetic material (such as crop, seed stock, bio-control, stocked/released species, etc.)
10. Point source pollution from commercial and industrial sources

Top conservation actions for fish and wildlife habitats in agricultural lands in the Great Lakes Region:

1. Acquire conservation easements to protect important wildlife habitats
2. Restore and integrate diversity of habitats into crop-production dominated landscapes
3. Build and strengthen CRP partnerships
4. Preserve currently existing corridors
5. Link existing habitat blocks through corridor enhancement in agricultural lands
6. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
7. Increase acres of riparian buffers
8. Promote use of research and science in conservation decision-making processes
9. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
10. Develop education programs in general

Aquatic Systems

Aquatic systems are defined as all water habitats, both flowing and stationary. Examples of aquatic systems include: manmade impoundments, natural lakes rivers, streams, oxbows, sloughs, embayments, and backwaters (not including wetlands).

Top threats to SGCN occurring in aquatic systems in the Great Lakes Region:

1. Natural habitat conversion
2. Conversion of habitat to annual crops
3. Housing and urban areas
4. Annual and perennial non-timber crops
5. Commercial and industrial areas
6. Dams and water management and use
7. Livestock farming and ranching
8. Tourism and recreation areas

Top conservation actions for SGCN occurring in aquatic systems in the Great Lakes Region:

1. Enhance public, stakeholder, and landowner education and awareness
2. Reduce sediment and nutrient loads
3. Reduce point and non-point source pollution
4. Protect and restore riparian buffer zones
5. Reconnect floodplains and rivers
6. Remove dams
7. Implement agricultural best management practices to improve water quality
8. Reduce flashiness in watersheds

Top threats to fish and wildlife habitats in aquatic systems in the Great Lakes Region:

1. Invasive and alien species
2. Changing frequency, duration, and intensity of floods
3. Annual and perennial non-timber crops
4. Agriculture, residential, and forestry effluents
5. Shifting and alteration of habitats due to climate change
6. Conversion of habitat to annual crops
7. Changing frequency, duration, and intensity of drought
8. Runoff from roads and service corridors
9. Temperature extremes
10. Commercial and industrial areas

Top conservation actions for fish and wildlife habitats in aquatic systems in the Great Lakes Region:

1. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
2. Reduce nutrient and toxin loads (e.g., heavy metals, pharmaceuticals, fertilizers, insecticides)
3. Preserve currently existing corridors
4. Acquire conservation easements to protect important wildlife habitats
5. Control invasive species in aquatic systems (e.g., Asian Carp, Zebra Mussels, invasive aquatic plants)
6. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)

7. Protect and enhance undeveloped shorelines
8. Improve compliance with and enforcement of current policies
9. Protect adjacent buffer zones
10. Promote use of research and science in conservation decision-making processes

Barren Lands

Barren lands are defined as lands dominated by exposed rock or minerals with sparse vegetation. Examples of barren lands include: sand/dunes, rock outcrops, cliffs, and bare rock.

Top threats to SGCN occurring in barren lands in the Great Lakes Region:

1. Natural habitat conversion
2. Annual and perennial non-timber crops
3. Conversion of habitat to annual crops
4. Dams and water management and use
5. Over-mowing of natural areas
6. Fire and fire suppression

Top conservation actions for SGCN occurring in barren lands in the Great Lakes Region:

1. Educate public about Peregrine Falcon
2. Protect Bald Eagle nest sites
3. Maintain stopover habitat for Kirtland's Warbler along Lake Michigan shoreline

Top threats to fish and wildlife habitats in barren lands in the Great Lakes Region:

1. Invasive and alien species
2. Housing and urban areas
3. Problematic native species (e.g., overabundant native deer or algae)
4. Runoff from roads and service corridors
5. Commercial and industrial areas
6. Tourism and recreation areas (e.g., sites with a substantial footprint, such as golf courses, campgrounds, etc.)
7. Roads and railroads
8. Point source pollution from commercial and industrial sources
9. Agriculture, residential, and forestry effluents

Top conservation actions for fish and wildlife habitats in barren lands in the Great Lakes Region:

1. Acquire currently unprotected barren lands
2. Control invasive species in barren lands
3. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
4. Re-establish natural disturbance regimes in barren lands
5. Restore habitats and natural systems in barren lands
6. Preserve currently existing corridors

7. Protect adjacent buffer zones
8. Develop educational programs in general
9. Acquire conservation easements to protect important wildlife habitats
10. Link existing habitat blocks through corridor enhancement in barren lands
11. Establish training programs for stakeholders

Developed Lands

Developed lands are defined as highly impacted lands intensively modified to support human habitation, transportation, commerce, and recreation. Examples of developed lands include: urban lands, suburban lands, industrial areas, commercial areas, towers for communication and wind power generation, and recreational areas such as golf courses and soccer fields.

Top threats to SGCN occurring in developed lands in the Great Lakes Region:

1. Renewable energy production
2. Invasive and alien species
3. Diseases from domestic populations and unknown sources
4. Fossil fuel energy production
5. Mining and quarrying

Top conservation actions for SGCN occurring in developed lands in the Great Lakes Region:

1. Enhance public education and awareness about bat ecology and issues
2. Reduce urban sprawl and commercial property expansion
3. Manage urban areas for Peregrine Falcons; minimize disturbance during nesting
4. Increase gravel-surfaced rooftop habitat for breeding Common Nighthawks
5. Mitigate road hazards for wildlife

Top threats to fish and wildlife habitats in developed lands in the Great Lakes Region:

1. Conversion of natural habitats to other land uses
2. Housing and urban areas
3. Commercial and industrial areas
4. Temperature extremes
5. Runoff from roads and service corridors
6. Roads and railroads
7. Invasive and alien species
8. Changing frequency, duration, and intensity of floods
9. Shifting and alteration of habitats due to climate change
10. Dams and water management and use

Top conservation actions for fish and wildlife habitats in developed lands in the Great Lakes Region:

1. Preserve currently existing corridors
2. Acquire conservation easements to protect important wildlife habitats
3. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl,

commercial development, etc.)
4. Reduce urban sprawl through planning and zoning
5. Promote green infrastructure
6. Develop educational programs in general
7. Link existing habitat blocks through corridor enhancement in developed lands
8. Restore and integrate diversity of habitats into developed landscapes
9. Control invasive species in developed lands
10. Promote use of research and science in conservation decision-making processes

Forests

Forests are defined as a plant community dominated by trees. Examples of forests include, but are not limited to, all stages of natural forest and plantations.

Top threats to SGCN occurring in forests in the Great Lakes Region:

1. Natural habitat conversion
2. Conversion of habitat to annual crops
3. Housing and urban areas
4. Annual and perennial non-timber crops
5. Invasive and alien species
6. Commercial and industrial areas
7. Diseases from domestic populations and unknown sources
8. Wood and pulp plantations
9. Fire and fire suppression
10. Tourism and recreation areas
11. Livestock farming and ranching
12. Over-mowing of natural areas
13. Recreation activities (e.g., ATVs, trail use, horseback riding, high-speed boating, canoeing)
14. Problematic native species (e.g., overabundant native deer or algae)

Top conservation actions for SGCN occurring in forests in the Great Lakes Region:

1. Protect large contiguous forested areas and reduce forest fragmentation
2. Limit conversion of forests to non-forest land uses
3. Control invasive woody plants to benefit Box Turtles, Whip-poor-wills, and other species
4. Reduce development in forested areas to benefit warblers and other species
5. Protect roost trees for bat species
6. Restore forests and woodlands (benefits all forest species)
7. Create small forest openings to increase diversity
8. Restrict clearing of forested bottomlands for Copper-bellied Water Snakes
9. Provide downed woody debris for the Least Weasel
10. Implement best management practices in forestry

Top threats to fish and wildlife habitats in forests in the Great Lakes Region:

1. Invasive and alien species
2. Housing and urban areas
3. Conversion of natural habitats to other land uses
4. Conversion of habitat to annual crops
5. Commercial and industrial areas
6. Changing frequency, duration, and intensity of drought
7. Point source pollution from commercial and industrial sources
8. Annual and perennial non-timber crops
9. Changing frequency, duration, and intensity of floods
10. Shifting and alteration of habitats due to climate change
11. Temperature extremes

Top conservation actions for fish and wildlife habitats in forests in the Great Lakes Region:

1. Preserve currently existing corridors
2. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
3. Acquire currently unprotected forests
4. Control invasive species in forests
5. Promote use of research and science in conservation decision-making processes
6. Link existing habitat blocks through corridor enhancement in forests
7. Restore habitats and natural systems in forests
8. Increase regulations on invasive species
9. Reduce conversion to cropland
10. Acquire conservation easements to protect important wildlife habitats

Grasslands

Grasslands are defined as an open area dominated by grass species. Examples of grasslands include: haylands, pasture, prairies, savannahs, or reclaimed mine lands.

Top threats to SGCN occurring in grasslands in the Great Lakes Region:

1. Conversion of habitat to annual crops
2. Annual and perennial non-timber crops

Top conservation actions for SGCN occurring in grasslands in the Great Lakes Region:

1. Restore and improve connectivity of grasslands (benefits all grassland species)
2. Reduce woody encroachment on grasslands to benefit the Massasauga, Sedge Wren, and other species
3. Increase CRP grasslands (benefits all grassland species)
4. Implement burning regimes (but plan around active seasons, such as when the smooth green snake is active)
5. Minimize disturbance to nesting grassland birds (e.g., Henslow's Sparrow)
6. Mow properly (reduce mowing for shorebirds and owls)

7. Improve grazing practices
8. Translocation program for Franklin's Ground Squirrels

Top threats to fish and wildlife habitats in grasslands in the Great Lakes Region:

1. Conversion of natural habitats to other land uses
2. Invasive and alien species
3. Conversion of habitat to annual crops
4. Fire and fire suppression
5. Housing and urban areas
6. Annual and perennial non-timber crops
7. Commercial and industrial areas
8. Introduced genetic material (such as crop, seed stock, bio-control, stocked/released species, etc.)
9. Recreation activities (e.g., ATVs, trail use, horseback riding, high-speed boating, canoeing)
10. Over-mowing of natural areas

Top conservation actions for fish and wildlife habitats in grasslands in the Great Lakes Region:

1. Strengthen conservation financing
2. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
3. Control invasive species in grasslands
4. Acquire currently unprotected grasslands
5. Restore habitats and natural systems in grasslands
6. Promote use of research and science in conservation decision-making processes.
7. Reduce conversion to cropland
8. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
9. Promote conservation payment programs (e.g., payment for ecosystem services, conservation easements)
10. Preserve currently existing corridors
11. Build and strengthen CRP partnerships

Wetlands

Wetlands are defined as either ephemeral or permanently flooded habitat. Examples of wetlands include: swamps, marshes, bogs, fens, potholes, wetlands of farmed areas, and mudflats.

Top threats to SGCN occurring in wetlands in the Great Lakes Region:

1. Natural habitat conversion
2. Invasive and alien species
3. Conversion of habitat to annual crops
4. Housing and urban areas
5. Commercial and industrial areas
6. Annual and perennial non-timber crops

7. Dams and water management and use
8. Tourism and recreation areas
9. Problematic native species (e.g., overabundant native deer or algae)
10. Recreation activities (e.g., ATVs, trail use, horseback riding, high-speed boating, canoeing)
11. Fire and fire suppression

Top conservation actions for SGCN occurring in wetlands in the Great Lakes Region:

1. Protect and maintain large wetlands complexes
2. Restore wetlands
3. Protect buffers around wetlands
4. Control invasive plants in wetlands
5. Create shorebird management areas
6. In some cases, actively manage water levels (e.g., Black Tern, Common Gallinule)
7. Mitigate road hazards to amphibians and reptiles when roads cross over wetlands
8. Minimize disturbance to nesting turtles
9. Provide stopover and roosting habitat for cranes

Top threats to fish and wildlife habitats in wetlands in the Great Lakes Region:

1. Invasive and alien species
2. Conversion of natural habitats to other land uses
3. Agriculture, residential, and forestry effluents
4. Runoff from roads and service corridors
5. Housing and urban areas
6. Annual and perennial non-timber crops
7. Commercial and industrial areas
8. Conversion of habitat to annual crops
9. Point source pollution from commercial and industrial sources
10. Chemical spills

Top conservation actions for fish and wildlife habitats in wetlands in the Great Lakes Region:

1. Acquire currently unprotected wetlands
2. Restore habitats and natural systems in wetlands
3. Control invasive species in wetlands
4. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
5. Promote use of research and science in conservation decision-making processes
6. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
7. Acquire conservation easements to protect important wildlife habitats.
8. Preserve currently existing corridors
9. Protect and enhance undeveloped shorelines
10. Protect adjacent buffer zones
11. Promote diversity of wetland types and successional stage

B. KANKAKEE REGION

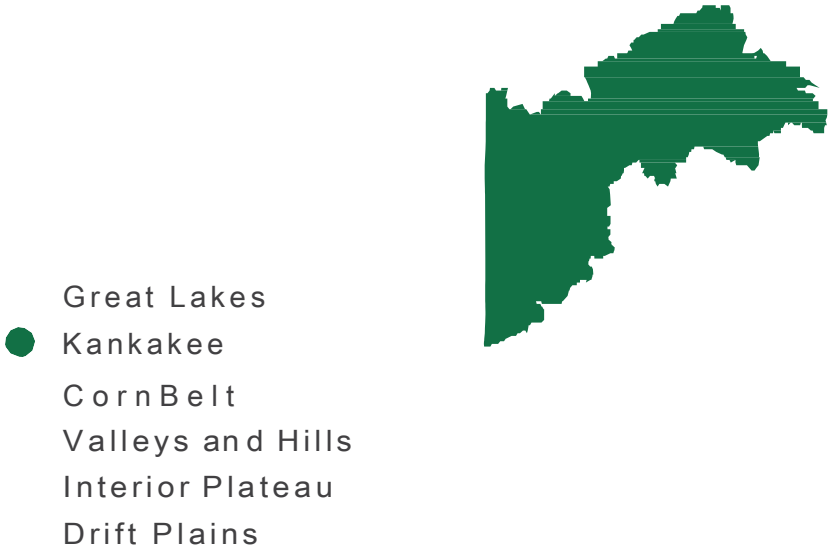


Figure 6-6. Outline of the Kankakee Region in Indiana for the SWAP.

Introduction

This section summarizes habitat conditions, threats to SGCN and their habitats, and conservation actions for species and habitats in the Kankakee Region. This section also reviews land cover changes over the past decade and identifies unique habitat types in this region. Summaries of threats to and conservation actions for SGCN and their habitats that were generated from two surveys can be found at the end of this section.

In addition to the threats and actions identified in the Habitat Survey and the Species Survey, the DFW recognized the need to identify threats aligned with specific actions. Several threats and actions were identified as ubiquitous across all sixregions. These include:

- **Habitat Loss:** Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soilhealth)
- **Invasive Species:** Build external capacity (form and facilitate partnerships, alliances, and networks of organizations to address invasive species)
- **Law and Policy:** Develop, change, influence and help implement formal legislation, regulations and voluntary standards
- **Dams and Water Management and Use:** Remove unnecessary dams and utilize necessary dams with effective fish passage structures

The DFW also identified specific threats and actions for each SWAP region based on DFW priorities. These threats were identified due to their high level of relevancy to the specific region and the workability of the associated actions. These threats and actions for the Kankakee Region include:

- **Habitat Loss of Savannas and Prairies:** Build external capacity by forming partnerships and networks, raising and providing funds and resources for conservation organization to maintain and protect savannas
- **Establish Natural Disturbance Regimes in Savannas and Prairies**
- **Natural Systems Modifications:** Develop and promote farming technologies and practices that have conservation benefits for wetlands

Current Habitat Conditions

During the Species Survey, respondents were asked to identify SGCN within the Kankakee Region. A full summary of the Species Survey results can be found in Appendix O.

Table 6-4. Species of Greatest Conservation Need present in the Kankakee Region.

Taxa	Scientific Name	Common Name
Amphibians	*Necturus maculosus*	Common Mudpuppy
Amphibians	*Ambystoma laterale*	Blue-spotted Salamander
Amphibians	*Hemidactylium scutatum*	Four-toed Salamander
Amphibians	*Acris blanchardi*	Blanchard's Cricket Frog
Amphibians	*Lithobates blairi*	Plains Leopard Frog
Birds	*Cygnus buccinator*	Trumpeter Swan
Birds	*Colinus virginianus*	Northern Bobwhite
Birds	*Chordeiles minor*	Common Nighthawk
Birds	*Antrostomus vociferus*	Eastern Whip-poor-will
Birds	*Laterallus jamaicensis*	Black Rail
Birds	*Rallus elegans*	King Rail
Birds	*Rallus limicola*	Virginia Rail
Birds	*Gallinula galeata*	Common Gallinule
Birds	*Grus canadensis*	Sandhill Crane
Birds	*Grus americana*	Whooping Crane
Birds	*Pluvialis dominica*	American Golden-plover
Birds	*Charadrius melodus*	Piping Plover
Birds	*Bartramia longicauda*	Upland Sandpiper
Birds	*Arenaria interpres*	Ruddy Turnstone
Birds	*Calidris subruficollis*	Buff-breasted Sandpiper
Birds	*Limnodromus griseus*	Short-billed Dowitcher
Birds	*Scolopax minor*	American Woodcock
Birds	*Tringa solitaria*	Solitary Sandpiper
Birds	*Tringa melanoleuca*	Greater Yellowlegs
Birds	*Phalaropus tricolor*	Wilson's Phalarope
Birds	*Sternula antillarum athalassos*	Interior Least Tern
Birds	*Chlidonias niger*	Black Tern
Birds	*Botaurus lentiginosus*	American Bittern
Birds	*Ixobrychus exilis*	Least Bittern
Birds	*Ardea alba*	Great Egret
Birds	*Nycticorax nycticorax*	Black-crowned Night-heron
Birds	*Pandion haliaetus*	Osprey
Birds	*Haliaeetus leucocephalus*	Bald Eagle
Birds	*Circus cyaneus*	Northern Harrier
Birds	*Accipiter striatus*	Sharp-shinned Hawk
Birds	*Buteo platypterus*	Broad-winged Hawk
Birds	*Tyto alba*	Barn Owl

Taxa	Scientific Name	Common Name
Birds	*Asio flammeus*	Short-eared Owl
Birds	*Falco peregrinus*	Peregrine Falcon
Birds	*Lanius ludovicianus*	Loggerhead Shrike
Birds	*Cistothorus platensis*	Sedge Wren
Birds	*Cistothorus palustris*	Marsh Wren
Birds	*Ammodramus henslowii*	Henslow's Sparrow
Birds	*Xanthocephalus xanthocephalus*	Yellow-headed Blackbird
Birds	*Sturnella neglecta*	Western Meadowlark
Birds	*Helmitheros vermivorum*	Worm-eating Warbler
Birds	*Vermivora chrysoptera*	Golden-winged Warbler
Birds	*Mniotilta varia*	Black-and-white Warbler
Birds	*Setophaga citrina*	Hooded Warbler
Birds	*Setophaga cerulea*	Cerulean Warbler
Fish	*Ichthyomyzon fossor*	Northern Brook Lamprey
Fish	*Anguilla rostrata*	American Eel
Fish	*Notropis dorsalis*	Bigmouth Shiner
Fish	*Moxostoma valenciennesi*	Greater Redhorse
Mammals	*Condylura cristata*	Star-nosed Mole
Mammals	*Myotis lucifugus*	Little Brown Myotis
Mammals	*Myotis septentrionalis*	Northern Long-eared Myotis
Mammals	*Myotis sodalis*	Indiana Myotis
Mammals	*Lasionycteris noctivagans*	Silver-haired Bat
Mammals	*Nycticeius humeralis*	Evening Bat
Mammals	*Lasiurus borealis*	Eastern Red Bat
Mammals	*Lasiurus cinereus*	Hoary Bat
Mammals	*Spermophilus franklinii*	Franklin's Ground Squirrel
Mammals	*Geomys bursarius*	Plains Pocket Gopher
Mammals	*Mustela nivalis*	Least Weasel
Mammals	*Taxidea taxus*	American Badger
Mollusks	*Cyprogenia stegaria*	Fanshell
Mollusks	*Venustaconcha ellipsiformis*	Ellipse
Mollusks	*Campeloma decisum*	Pointed Campeloma
Mollusks	*Lymnaea stagnalis*	Swamp Lymnaea
Reptiles	*Kinosternon subrubrum*	Eastern Mud Turtle
Reptiles	*Clemmys guttata*	Spotted Turtle
Reptiles	*Emydoidea blandingii*	Blanding's Turtle
Reptiles	*Terrapene carolina*	Eastern Box Turtle
Reptiles	*Terrapene ornata*	Ornate Box Turtle
Reptiles	*Thamnophis proximus*	Western Ribbonsnake
Reptiles	*Clonophis kirtlandii*	Kirtland's Snake
Reptiles	*Opheodrys vernalis*	Smooth Greensnake
Reptiles	*Sistrurus catenatus*	Eastern Massasauga

During the Habitat Survey, respondents were asked to evaluate the overall quality of fish and wildlife habitats in the Kankakee Region (Fig. 6-7), estimate changes in overall quality since 2005 (Fig. 6-8), and predict changes in overall quality over the next ten years (Fig. 6-9). Each respondent was asked to respond for one or more of the eight major habitat types within the region, and results were aggregated at the regional level. A full list of these survey results can be found in Appendix P.

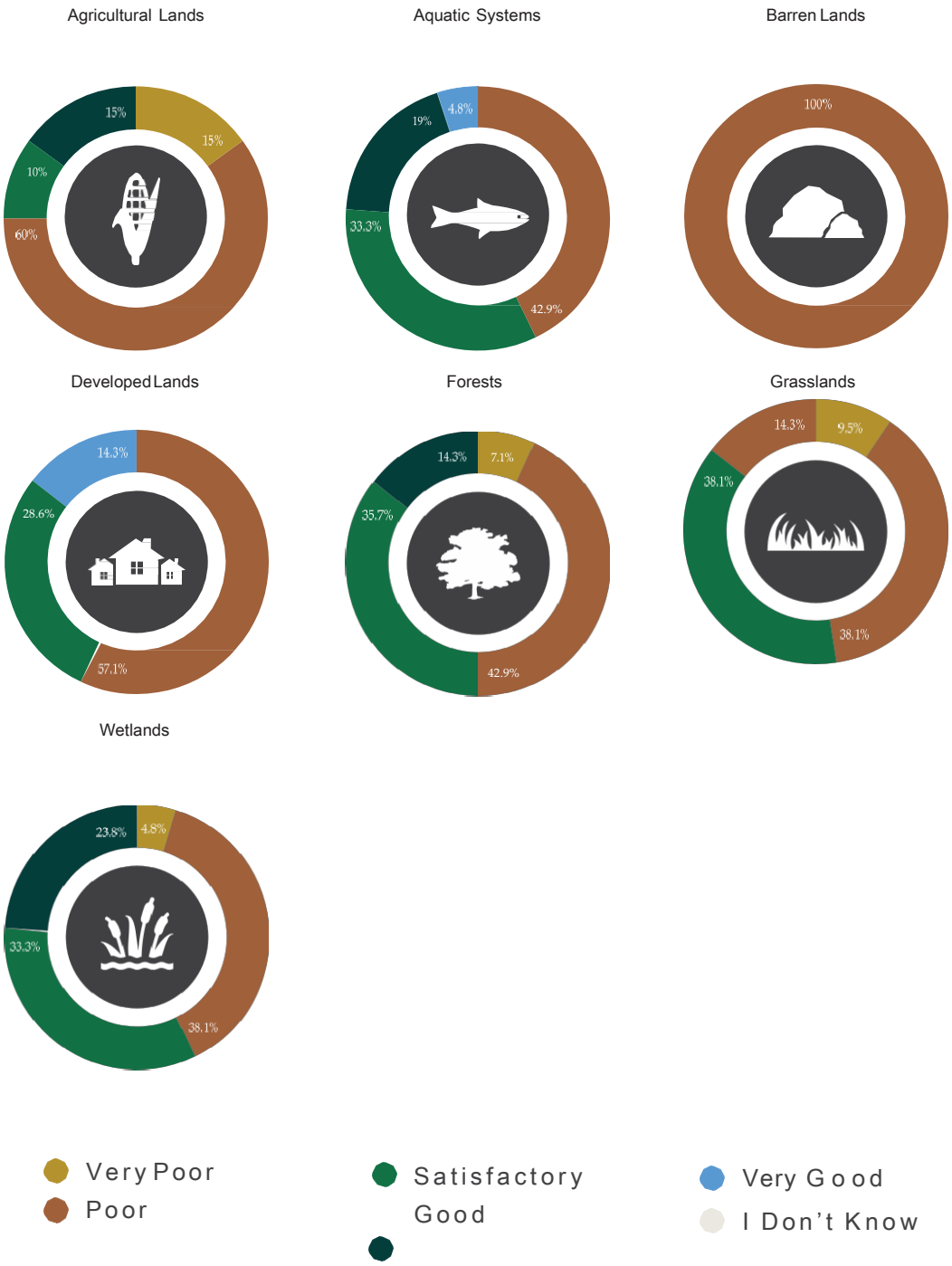


Figure 6-7. Overall quality of fish and wildlife habitats in the Kankakee Region in 2014.

Figure 6-8. Estimated change in the overall quality of fish and wildlife habitats from 2005 to 2014 for each of the major habitat types in the Kankakee Region.

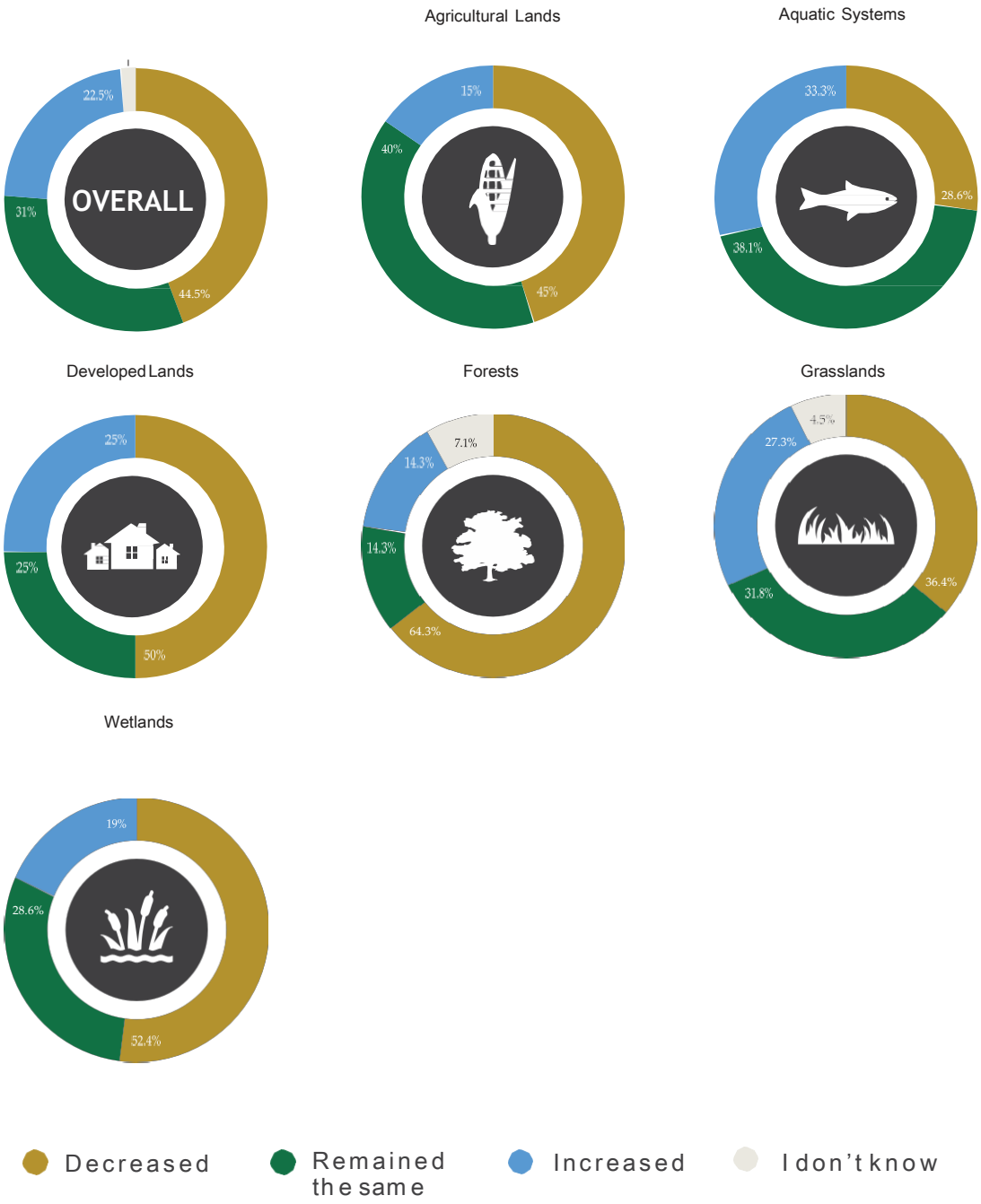
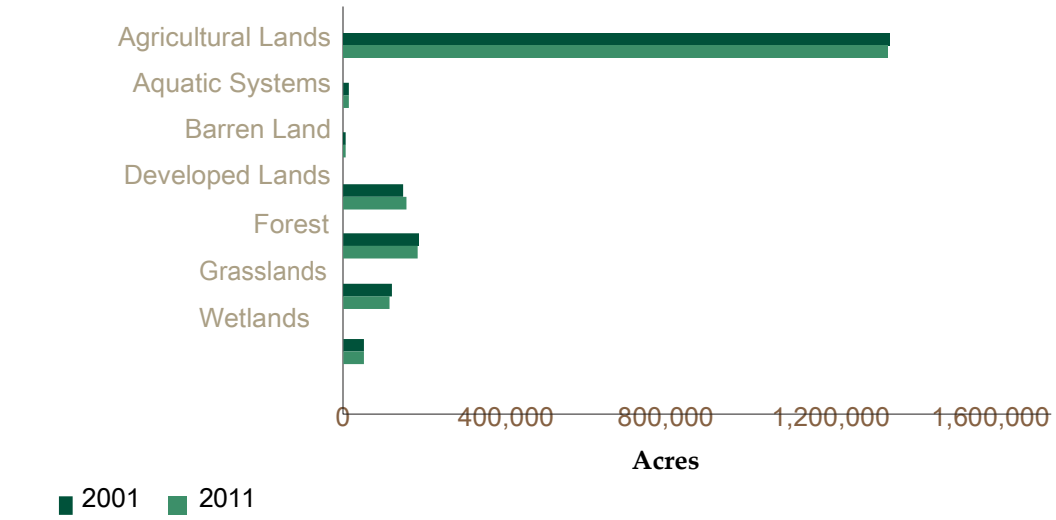


Figure 6-9. Predicted changes in overall quality of fish and wildlife habitats over the next ten years for each major habitat type in the Kankakee Region.

Changes in Land Cover

Most land cover in the Kankakee Region, 71.9%, consists of agricultural lands, 9.8% forests, 8.3% developed lands, and 6.3% grasslands (Fig. 6-10). Compared to other regions in Indiana, the Kankakee Region has the highest percentage of agricultural lands and the lowest percentage of aquatic systems.

Although aquatic systems and wetlands have increased marginally (Table 6-5), the Kankakee Region has experienced loss in many habitat types over the past ten years. Most habitats were lost to urban development, and agriculture lost most cover in terms of total acreage (Fig. 6-10). Percentage-wise, the greatest net losses were seen in grasslands (1.5%) and forests (0.7%). The greatest net increases were seen in barren lands (20.2%), developed lands (3.8%), and aquatic systems (2.6%).



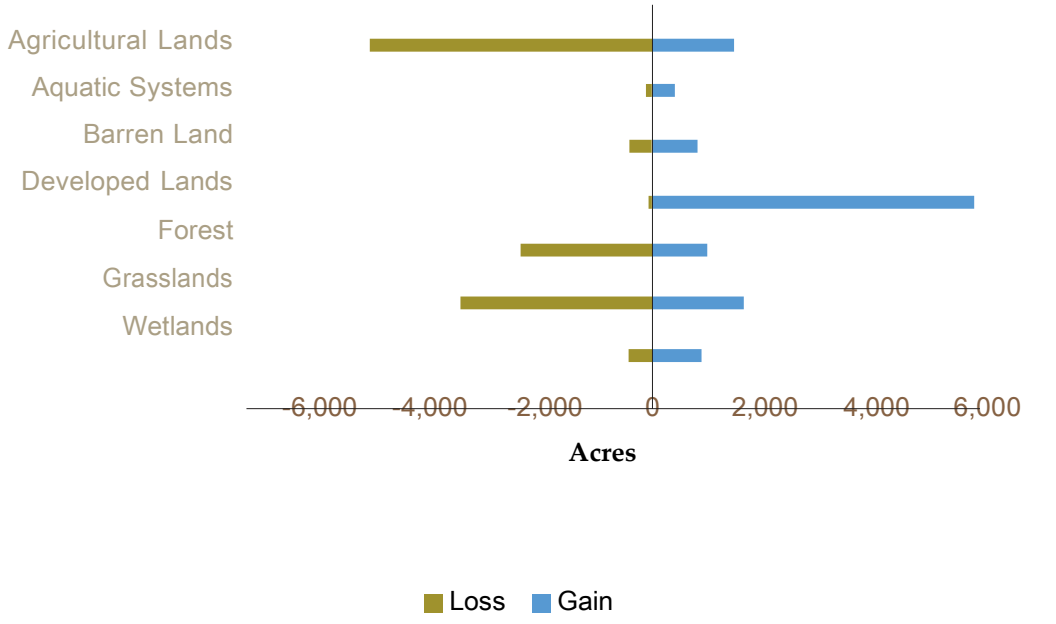


Figure 6-10. The distribution of land cover, and losses and gains in land cover in the Kankakee Region between 2001 and 2011 from NLCD.

Threats Affecting Habitats

Top Threat Categories

The third element requires the description of threats to SGCN and their habitats. The SWAP identifies a habitat perspective in order to manage for the conservation of species in Indiana. This section utilizes the same hierarchical method of identifying and rating threats based on Salafsky et al. (2008) that was outlined in Chapter V. Category rankings and specific threat rankings are outlined below (Table 6-5). A full summary of the Habitat Survey results can be found in Appendix P.

For first-level threat categories, agriculture and aquaculture, invasive and other problematic species and genes, residential and commercial development, natural system modification, and human intrusion and disturbance had mean threat level ratings between significant and moderate. Climate change and severe weather, pollution, other stressors, transportation and service corridors, biological resource use, and energy production and mining had average threat level ratings between moderate and minor. No threat category received an average rating landing between the minor and not a threat levels for the region.

Agriculture and aquaculture was identified as the top threat category across this region and within each of the major habitat types except for developed lands, forests, and grasslands. Invasive and other problematic species and genes were ranked first in forests and grasslands. Residential and commercial development was identified as the top threat to fish and wildlife habitats in developed lands.

Within agriculture and aquaculture, conversion of habitat to annual crops was identified as the top specific second-level threat for the region, followed closely by annual and perennial non-timber crops. Other specific threats in this category received lower average threat levels. Livestock farming and ranching was on average rated within the moderate and minor threat level. Both wood and pulp plantations as well as aquaculture received average ratings between minor and not a threat. Some respondents noted agricultural practices, such as use of insecticide and non-local genotype seeds, may be a threat in this region.

Invasive and other problematic species and genes were ranked highly as a threat to habitats in all land use types with the exception of developed lands. The invasive and alien species category was regionally rated as a significant to moderate threat, while the other specific threats within this category were on average rated as a moderate to minor threat. Respondents identified a concern for problematic native species like beavers and geese.

Development was identified as the highest rated threat to fish and wildlife habitats with developed lands, and a moderately high-ranking threat within other habitat types. Both housing and urban areas and commercial and industrial areas were rated on average as a significant to moderate threat to habitats in this land use type.

Natural systems modification was ranked as the fourth highest threat across the region, and received high to mid rankings in individual habitat types. Natural habitat conversion was ranked as the most specific threat within this category, receiving an average rating of significant to moderate threat regionally. All other threats in this category received a moderate to minor average rating in this region. As a category, human intrusion and disturbance ranked higher than climate change and severe weather, but specific threats within climate change and severe weather received average ratings from significant to moderate, while specific threats within human intrusion and disturbance were rated moderate to minor. Biological resource use and energy production and mining were identified as the lowest ranking threats regionally. These threats ranked low in each habitat type, with the exception of energy production and mining in barren lands. Respondents also identified direct stressors, such as lack of fish and wildlife habitat or alteration of habitat through channelization of streams for aquatic systems.

Table 6-5. Threat category ranking to habitats in the Kankakee Region. First-level threat categories are based on the hierarchical method of identifying threats outlined in Salafsky et al. (2008). Ranked threat categories for the entire region are arranged by each major habitat type (1 - highest threat).

Category	Regional Ranking	Aquatic Systems	Agricultural Lands	Barren Lands	Developed Lands	Forests	Grasslands	Wetlands
Agriculture and Aquaculture	1	1	1	2	3	1	1	1
Invasive and Other Problematic Species and Genes	2	4	3	1	1	2	3	2
Residential and Commercial Development	3	3	4	7	10	4	2	4
Natural Systems Modification	4	6	2	6	5	3	4	3
Human Intrusion and Disturbance	5	2	5	3	2	6	8	5
Climate Change and Severe Weather	6	5	7	4	4	5	5	7
Pollution	7	7	6	8	7	7	6	6
Other Stressors	8	8	8	5	6	9	7	8
Transportation and Service Corridors	9	9	9	9	8	8	9	9
Biological Resource Use	10	11	10	11	9	10	11	10
Energy Production and Mining	11	10	11	10	11	11	10	11

Top Specific Threats in Ranked Order

In the Habitat Survey, respondents were also asked to identify specific threats to major habitat types using the same threat category ranking system outlined in Salafsky et al. (2008). These second-level threats represent subcategories of threats within the major threat categories listed in the table above. The following are the top specific second-level threats to habitats in the Kankakee Region, aggregated across habitat types:

1. Invasive and alien species
2. Conversion of natural habitats to other land uses
3. Conversion of habitat to annual crops
4. Changing frequency, duration, and intensity of floods
5. Changing frequency, duration, and intensity of drought
6. Annual and perennial non-timber crops
7. Housing and urban areas
8. Agriculture, residential, and forestry effluents
9. Shifting and alteration of habitats due to climate change
10. Runoff from roads/service corridors

In the Species Survey, respondents were also asked to identify threats to individual SGCN using the same threat category ranking system. The following is the top specific (second-level) threat to SGCN occurring in the Kankakee Region, aggregated across all species:

1. Natural habitat conversion

Emerging/Anticipated Threats

In a free-response question, respondents were asked specifically to identify any emerging/anticipated threats over the next ten years for fish and wildlife habitats within the major habitat types for a region.

Respondents identified anticipated threats to fish and wildlife habitats tied to expansion of agriculture and loss of CRP grasslands. Other respondents also noted that habitats may be threatened by the increased spread of invasive species and lack of public valuation of wildlife habitats.

Conservation Actions Needed

Top Action Categories

The fourth element of the Congressional guidelines requires that the SWAP describe conservation actions proposed to conserve identified species and habitats as well as outlining priorities for their implementation. This section outlines conservation actions identified on a regional basis for each of the major habitat types following the same protocol to rate and rank actions in this region based on Salafsky et al. (2008) that was outlined in Chapter V. Category rankings for actions, and specific actions are in Table 6-6. A full summary of the Habitat

Survey results can be found in Appendix P.

All categories had average ratings between very and moderately important, indicating respondents observing a need for a variety of management actions within this region. Land, water, and species management was ranked as the most important category of actions regionally and in each individual land use type except for developed lands. Within the categories, means were used to determine the rankings. Because of this, some habitat-specific options with few respondents may have high means regionally. Overall, important actions reflected respondents identifying a need to restore habitats and disturbance regimes as well as control invasive species in multiple habitat types.

Reducing loss of habitat due to agricultural and residential development was identified as one of the highest rated actions across several habitat types; this action was ranked first in aquatic systems and forests. Developing farming technologies and practices also was rated as the most important conservation action for fish and wildlife habitats in agricultural lands and developed lands; this action was also ranked relatively highly among other habitat types as well.

Land and water protection was rated second overall for this region and tied for first with land, water, and species management in barren lands, developed lands, and grasslands. Respondents emphasized a need to acquire currently unprotected lands in various habitat types. Preserving currently existing corridors was ranked as either the first or second action of importance in every habitat type, except for barren lands, which had no respondents. In general, using easements to protect fish and wildlife habitats was also ranked highly across habitat types in this region.

Education and awareness as a category was ranked third overall, though three of the four categories received an average rating between very important to moderately important actions. Improvement of signage and communication materials was, on average, rated between moderately important and somewhat important. Respondents also noted an importance to increase public valuation of resources, particularly in grasslands and wetlands.

Law and policy was ranked fourth overall but second in forests. Increasing regulations on invasive species was identified as a very to moderately important action for forests. Respondents suggested changes in policy regarding drainage, log jam removal, and harvesting in this region. External capacity building and livelihood, economic, and other incentives were the two lowest ranked categories for this region, although strengthening conservation financing was identified as a very to moderately important action for fish and wildlife habitats across multiple land use types.

Table 6-6. Action category ranking to habitats in the Kankakee Region. First-level categories are based on the hierarchical method of identifying actions outlined in Salafsky et al. (2008). Ranked action categories for the entire region and are arranged by each major habitat type.

Category	Regional Ranking	Aquatic Systems	Agricultural Lands	Barren Lands	Developed Lands	Forests	Grasslands	Wetlands
Land/Water/Species Management	1	1	1	1	3	1	1	1
Land/Water Protection	2	2	2	1	1	3	1	2
Education and Awareness	3	3	3	1	1	5	3	3
Law and Policy	4	4	5	1	3	2	5	4
External Capacity Building	5	5	6	1	3	4	4	5
Livelihood, Economic, and Other Incentives	6	6	4	1	6	6	6	6
	Indicates a tie within this habitat type							

Top Specific Actions in Ranked Order

In the Habitat Survey, respondents were also asked to identify specific actions for major habitat types using the same action category ranking system outlined in Salafsky etal.(2008). These second-levelactions representsubcategoriesofactions within the major action categories listed in the table above. The following are the top specific second-level conservation actions for habitats in the Kankakee Region, aggregated across habitat types:

1. Preserve currently existingcorridors
2. Strengthen conservation financing
3. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
4. Acquire conservation easements to protect important wildlife habitats
5. Reduce conversion to cropland
6. Developalliances and partnerships (e.g., between producers, landowners, and conservation professionals)
7. Manage recreational opportunities to be compatible with fish and wildlife habitats
8. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
9. Promote nonmonetary values of natural systems within the state
10. Increase capacity for research and monitoring of conservation actions

The following are top actions for SGCN occurring the Kankakee Region, as summarized from the free-response questions about conservation actions for individual species:

1. Educate and engage with landowners and citizens.
2. Enhance connectivity of habitats
3. IncreaseCRPlands
4. Protect large contiguous forested areas
5. Limit conversion of habitat tonon-habitat
6. Reduce point and non-point source pollution
7. Protect and restore riparian corridors
8. Control invasive plants
9. Minimize disturbance to nesting birds
10. Use burning and mowing as management techniques
11. Protect and manage large wetland complexes

Prioritization of Actions

In order to prioritize these actions within an environment of limited resources, respondents were then asked to distribute hypothetical "effort points" to any action they had previously rated as "very important" for any of the major habitat types within a region. The effort ratings were averaged and then ranked to identify the top five actions for a region.

Full survey results are summarized in Appendix P. Priority actions for this region include the following:

1. Reduce conversion to cropland
2. Acquire conservation easements to protect important wildlife habitats
3. Acquire currently unprotected wetlands
4. Preserve currently existing corridors
5. Develop educational programs in general

The top priority actions reflect an identification of agriculture and aquaculture as a significant threat to fish and wildlife habitats in this region. Education-focused actions and land and water protection actions, such as acquiring easements and unprotected habitats as well as preserving corridors, received a greater amount of hypothetical effort over many of the highly rated land, water, and management actions in each land use type.

Threats and Actions by Major Habitat Type

The following summaries break down threats and conservation actions in this region by major habitat type, based on responses to the Habitat Survey and the Species Survey. For each major habitat type in this region, the SGCN that occur there, top threats to SGCN, top actions for SGCN, key threats to habitats, and priority actions for habitats are listed.

Threats and actions were only included in these lists if the majority of eligible survey respondents, greater than 50%, rated them, to avoid artificially elevating items which were highly ranked, but only by a few respondents. This approach left some threat/action lists with no items for certain habitats, which is illogical from a practical perspective. Therefore, in these situations, the top threats/actions are still listed but are denoted with an asterisk (*) to signify that there may be some items, which seem out-of-place, reflecting a lack of sufficient response for a particular habitat in the survey.

For each list, approximately ten items are given. Lists may be shorter if fewer than ten items were rated by a majority of survey respondents or longer if there were ties between items (e.g. they have exactly the same mean score and exactly the same number of respondents who rated them).

Top actions for SGCN were summarized from free-response questions about individual species and, therefore, do not follow the same categorizations as actions for habitats. The full text of all survey responses can be found in Appendix P.

Agricultural Lands

Agricultural lands are defined as lands devoted to commodity production. Examples of agricultural lands include: intensively managed non-native grasses, row crops, fruit and nut-bearing trees, confined feeding operations, and feedlots.

Top threats to SGCN occurring in agricultural lands in the Kankakee Region:

1. Natural habitat conversion
2. Conversion of habitat to annual crops
3. Annual and perennial non-timber crops
4. Fire and fire suppression
5. Over-mowing of natural areas
6. Dams and water management and use
7. Livestock farming and ranching

Top conservation actions for SGCN occurring in agricultural lands in the Kankakee Region:

1. Increase and maintain CRP lands
2. Establish conservation easements on farmland surrounding protected areas
3. Educate agricultural landowner community
4. Provide incentives to farmers to increase participation in conservation
5. Maintain shallow-water areas for shorebirds
6. Preserve suitable nest sites for Barn Owls
7. Encourage no-till practices

Top threats to fish and wildlife habitats in agricultural lands in the Kankakee Region:

1. Conversion of natural habitats to other land uses
2. Conversion of habitat to annual crops
3. Invasive and alien species
4. Annual and perennial non-timber crops
5. Over-mowing of natural areas
6. Housing and urban areas
7. Runoff from roads and service corridors
8. Dams and water management and use
9. Commercial and industrial areas
10. Point source pollution from commercial and industrial sources
11. Agriculture, residential, and forestry effluents

Top conservation actions for fish and wildlife habitats in agricultural lands in the Kankakee Region:

1. Acquire conservation easements to protect important wildlife habitats
2. Preserve currently existing corridors
3. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
4. Link existing habitat blocks through corridor enhancement in agricultural lands
5. Reduce conversion to cropland
6. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
7. Strengthen conservation financing
8. Promote nonmonetary values of natural systems within the state
9. Manage recreational opportunities to be compatible with fish and wildlife habitats

Aquatic Systems

Aquatic systems are defined as all water habitats, both flowing and stationary. Examples of aquatic systems include: manmade impoundments, natural lakes rivers, streams, oxbows, sloughs, embayments, and backwaters (not including wetlands).

Top threats to SGCN occurring in aquatic systems in the Kankakee Region:

1. Natural habitat conversion
2. Conversion of habitat to annual crops
3. Annual and perennial non-timber crops
4. Dams and water management and use

Top conservation actions for SGCN occurring in aquatic systems in the Kankakee Region:

1. Improve water quality
2. Protect aquatic systems
3. Restore and protect riparian corridors
4. Clean polluted areas
5. Reduce point and non-point source pollution
6. Implement agricultural BMPs
7. Manage water levels in rivers and lakes
8. Preserve nest sites for Ospreys and Bald Eagles
9. Maintain bottomland floodplain habitat
10. Restrict recreational overuse on rivers
11. Protect habitat from dredging
12. Remove dams
13. Reduce siltation and nutrient inputs
14. Maintain and increase flows and flow volumes

Top threats to fish and wildlife habitats in aquatic systems in the Kankakee Region:

1. Agriculture, residential, and forestry effluents
2. Invasive and alien species
3. Conversion of natural habitats to other land uses
4. Changing frequency, duration, and intensity of floods
5. Annual and perennial non-timber crops
6. Changing frequency, duration, and intensity of drought
7. Runoff from roads and service corridors
8. Conversion of habitat to annual crops
9. Point source pollution from commercial and industrial sources
10. Commercial and industrial areas

Top conservation actions for fish and wildlife habitats in aquatic systems in the Kankakee Region:

1. Preserve currently existing corridors
2. Acquire conservation easements to protect important wildlife habitats
3. Promote use of research and science in conservation decision-making processes
4. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
5. Acquire currently unprotected aquatic systems (manage and/or educate for easement habitat values)
6. Reduce nutrient and toxin loads (e.g., heavy metals, pharmaceuticals, fertilizers, insecticides)
7. Develop education programs in general
8. Strengthen conservation financing
9. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
10. Increase state's capacity for research and monitoring of conservation actions

Barren Lands

Barren lands are defined as lands dominated by exposed rock or minerals with sparse vegetation. Examples of barren lands include: sand/dunes, rock outcrops, cliffs, and bare rock.

Top threats to SGCN occurring in barren lands in the Kankakee Region:

1. Natural habitat conversion
2. Annual and perennial non-timber crops
3. Conversion of habitat to annual crops
4. Dams and water management and use
5. Over-mowing of natural areas
6. Fire and fire suppression

Top conservation actions for SGCN occurring in barren lands in the Kankakee Region:

1. Educate public about Peregrine Falcon
2. Protect Bald Eagle nest sites

Top threats to fish and wildlife habitats in barren lands in the Kankakee Region:

1. Invasive and alien species
2. Problematic native species (e.g., overabundant native deer or algae)
3. Plant diseases
4. Introduced genetic material (such as crop, seed stock, bio-control, stocked/released species,etc.)
5. Chemical spills
6. Point source pollution from commercial/industrial sources
7. Air pollution (e.g., smoke, mercury emissions)
8. Household sewage and urban water waste
9. Garbage and solid waste
10. Excess energy (e.g., noise/light pollution, warm water discharge, etc.)

Top conservation actions for fish and wildlife habitats in barren lands in the Kankakee Region:

- *No survey responses were received for actions in this habitat type in this region*

Developed Lands

Developed lands are defined as highly impacted lands intensively modified to support human habitation, transportation, commerce, and recreation. Examples of developed lands include: urban lands, suburban lands, industrial areas, commercial areas, towers for communication and wind power generation, and recreational areas such as golf courses and soccer fields.

Top threats to SGCN occurring in developed lands in the Kankakee Region:

1. Renewable energy production
2. Diseases from domestic populations and unknown sources
3. Fossil fuel energy production
4. Mining and quarrying

Top conservation actions for SGCN occurring in developed lands in the Kankakee Region:

1. Enhance public education and awareness regarding bat ecology and issues
2. Reduce urban sprawl and commercial property expansion
3. Manage urban areas for Peregrine Falcons; minimize disturbance during nesting
4. Increase gravel-surfaced rooftop habitat for breeding Common Nighthawks
5. Mitigate road hazards for wildlife

Top threats to fish and wildlife habitats in developed lands in the Kankakee Region:

1. Runoff from roads and service corridors
2. Housing and urban areas
3. Commercial and industrial areas
4. Changing frequency, duration, and intensity of drought
5. Invasive and alien species
6. Point source pollution from commercial and industrial sources
7. Air pollution (e.g., smoke, mercury emissions)
8. Excess energy (e.g., noise and light pollution, warm water discharge, etc.)
9. Changing frequency, duration, and intensity of floods
10. Roads and railroads
11. Conversion of natural habitats to other land uses

Top conservation actions for fish and wildlife habitats in developed lands in the Kankakee Region:

1. Preserve currently existing corridors
2. Acquire conservation easements to protect important wildlife habitats
3. Establish training programs for stakeholders
4. Promote nonmonetary values of natural systems within the state
5. Manage recreational opportunities to be compatible with fish and wildlife habitats
6. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
7. Promote use of research and science in conservation decision-making processes
8. Develop education programs in general

Forests

Forests are defined as a plant community dominated by trees. Examples of forests include, but are not limited to, all stages of natural forest and plantations.

Top threats to SGCN occurring in forests in the Kankakee Region:

1. Natural habitat conversion
2. Shifting and alteration of habitats
3. Conversion of habitat to annual crops
4. Housing and urban areas
5. Annual and perennial non-timber crops
6. Commercial and industrial areas
7. Invasive and alien species
8. Diseases from domestic populations and unknown sources
9. Fire and fire suppression
10. Wood and pulp plantations
11. Tourism and recreation areas
12. Over-mowing of natural areas
13. Livestock farming and ranching
14. Recreation activities
15. Problematic native species

Top conservation actions for SGCN occurring in forests in the Kankakee Region:

1. Protect large contiguous forested areas and reduce forest fragmentation
2. Limit conversion of forests to non-forest land uses
3. Control invasive woody plants to benefit Box Turtles, Whip-poor-wills, and other species
4. Reduce development in forested areas to benefit warblers and other species
5. Protect roost trees for bat species
6. Restore forests and woodlands (benefits all forest species)
7. Create small forest openings to increase diversity
8. Provide downed woody debris for the Least Weasel
9. Implement best management practices in forestry

Top threats to fish and wildlife habitats in forests in the Kankakee Region:

1. Invasive and alien species
2. Conversion of natural habitats to other land uses
3. Conversion of habitat to annual crops
4. Annual and perennial non-timber crops
5. Roads and railroads
6. Housing and urban areas
7. Problematic native species
8. Fire and fire suppression
9. Recreation activities (e.g., ATVs, trail use, horseback riding, high-speed boating, canoeing)
10. Utility and service lines

Top conservation actions for fish and wildlife habitats in forests in the Kankakee Region:

1. Control invasive species in forests
2. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
3. Reduce conversion to cropland
4. Increase regulations on invasive species
5. Manage recreational opportunities to be compatible with fish and wildlife habitats
6. Preserve currently existing corridors
7. Strengthen conservation financing
8. Acquire currently unprotected forests
9. Restore habitats and natural systems in forests
10. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
11. Increase state's capacity for research and monitoring of conservation actions

Grasslands

Grasslands are defined as an open area dominated by grass species. Examples of grasslands include: haylands, pasture, prairies, savannahs, or reclaimed mine lands.

Top threats to SGCN occurring in grasslands in the Kankakee Region:

1. Conversion of habitat to annual crops
2. Annual and perennial non-timber crops
3. Livestock farming and ranching

Top conservation actions for SGCN occurring in grasslands in the Kankakee Region:

1. Restore and improve connectivity of grasslands (benefits all grassland species)
2. Reduce woody encroachment on grasslands to benefit the Massasauga, Sedge Wren, and other species
3. Increase CRP grasslands (benefits all grassland species)
4. Implement burning regimes (but plan around active seasons, such as when the Smooth Greensnake is active)
5. Minimize disturbance to nesting grassland birds (e.g., Henslow's Sparrow)
6. Mow properly (reduce mowing for shorebirds and owls)
7. Improve grazing practices
8. Establish translocation program for Franklin's Ground Squirrels

Top threats to fish and wildlife habitats in grasslands in the Kankakee Region:

1. Invasive and alien species
2. Conversion of habitat to annual crops
3. Conversion of natural habitats to other land uses
4. Annual and perennial non-timber crops
5. Housing and urban areas
6. Fire and fire suppression
7. Roads and railroads
8. Commercial and industrial areas
9. Over-mowing of natural areas
10. Introduced genetic material (such as crop, seed stock, bio-control, stocked/released species, etc.)

Top conservation actions for fish and wildlife habitats in grasslands in the Kankakee Region:

1. Restore habitats and natural systems in grasslands
2. Acquire currently unprotected grasslands
3. Preserve currently existing corridors
4. Re-establish natural disturbance regimes in grasslands
5. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
6. Reduce conversion to cropland
7. Control invasive species in grasslands
8. Promote diversity of grassland types and successional stages
9. Acquire conservation easements to protect important wildlife habitats
10. Promote conservation payment programs (e.g., payment for ecosystem services, conservation easements)
11. Promote nonmonetary values of natural systems within the state

Wetlands

Wetlands are defined as either ephemeral or permanently flooded habitat. Examples of wetlands include: swamps, marshes, bogs, fens, potholes, wetlands of farmed areas, and mudflats.

Top threats to SGCN occurring in wetlands in the Kankakee Region:

1. Natural habitat conversion
2. Invasive and alien species
3. Conversion of habitat to annual crops
4. Housing and urban areas
5. Commercial and industrial areas
6. Annual and perennial non-timber crops
7. Tourism and recreation areas
8. Problematic native species
9. Dams and water management and use
10. Recreation activities
11. Fire and fire suppression
12. Over-mowing of natural areas

Top conservation actions for SGCN occurring in wetlands in the Kankakee Region:

1. Protect and maintain large wetlands complexes
2. Restore wetlands
3. Protect buffers around wetlands
4. Control invasive plants in wetlands
5. Create shorebird management areas
6. In some cases, actively manage water levels (e.g., for Black Tern, Common Gallinule)
7. Mitigate road hazards to amphibians and reptiles when roads cross over wetlands
8. Minimize disturbance to nesting turtles
9. Provide stopover and roosting habitat for cranes

Top threats to fish and wildlife habitats in wetlands in the Kankakee Region:

1. Invasive and alien species
2. Conversion of natural habitats to other land uses
3. Changing frequency, duration, and intensity of drought
4. Changing frequency, duration, and intensity of floods
5. Housing and urban areas
6. Conversion of habitat to annual crops
7. Commercial and industrial areas
8. Runoff from roads and service corridors
9. Agriculture, residential, and forestry effluents
10. Shifting and alteration of habitats due to climate change

Top conservation actions for fish and wildlife habitats in wetlands in the Kankakee Region:

1. Acquire currently unprotected wetlands
2. Strengthen conservation financing
3. Restore habitats and natural systems in wetlands
4. Preserve currently existing corridors
5. Control invasive species in wetlands
6. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
7. Promote conservation payment programs (e.g., payment for ecosystem services, conservation easements)
8. Manage recreational opportunities to be compatible with fish and wildlife habitats
9. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
10. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)

C. CORN BELT REGION

Figure 6-11. Outline of the Corn Belt Region in Indiana for the SWAP.

Introduction

This section summarizes habitat conditions, threats to SGCN and their habitats, and conservation actions for species and habitats in the Corn Belt Region. This section also reviews land cover changes over the past decade and identifies unique habitat types in this region. Summaries of threats to and conservation actions for SGCN and their habitats that were generated from two surveys can be found at the end of this section.

In addition to the threats and actions identified in the Habitat Survey and the Species Survey, the DFW recognized the need to identify threats aligned with specific actions. Several threats and actions were identified as ubiquitous across all sixregions. These include:

- **Habitat Loss:** Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soilhealth)
- **Invasive Species:** Build external capacity (form and facilitate partnerships, alliances, and networks of organizations to address invasive species)
- **Law and Policy:** Develop, change, influence and help implement formal legislation, regulations and voluntary standards
- **Dams and Water Management and Use:** Remove unnecessary dams and utilize necessary dams with effective fish passage structures

The DFW also identified specific threats and actions for each SWAP region based on DFW priorities. These threats were identified due to their high level of relevancy to the specific region and the workability of the associated actions. These threats and actions for the Corn Belt Region include:

- **Habitat Fragmentation:** Preserve and restore habitat corridors
- **Natural System Modifications (Residential/Commercial Development):** Build external capacity by forming partnerships and networks, raising and providing funds, and resources to develop conservation-minded urban planning

Current Habitat Conditions

During the Species Survey, respondents were asked to identify SGCN within the Corn Belt Region. A full summary of the Species Survey results can be found in Appendix O.

Table 6-7. Distribution of SGCN across the Corn Belt Region.

Taxa	Scientific Name	Common Name
Amphibians	*Necturus maculosus*	Common Mudpuppy
Amphibians	*Ambystoma laterale*	Blue-spotted Salamander
Amphibians	*Hemidactylium scutatum*	Four-toed Salamander
Amphibians	*Acris blanchardi*	Blanchard's Cricket Frog
Amphibians	*Lithobates blairi*	Plains Leopard Frog
Birds	*Cygnus buccinator*	Trumpeter Swan
Birds	*Colinus virginianus*	Northern Bobwhite
Birds	*Chordeiles minor*	Common Nighthawk
Birds	*Antrostomus vociferus*	Eastern Whip-poor-will
Birds	*Laterallus jamaicensis*	Black Rail
Birds	*Rallus elegans*	King Rail
Birds	*Rallus limicola*	Virginia Rail
Birds	*Gallinula galeata*	Common Gallinule
Birds	*Grus canadensis*	Sandhill Crane
Birds	*Grus americana*	Whooping Crane
Birds	*Pluvialis dominica*	American Golden-plover
Birds	*Charadrius melodus*	Piping Plover
Birds	*Bartramia longicauda*	Upland Sandpiper
Birds	*Arenaria interpres*	Ruddy Turnstone
Birds	*Calidris subruficollis*	Buff-breasted Sandpiper
Birds	*Limnodromus griseus*	Short-billed Dowitcher
Birds	*Scolopax minor*	American Woodcock
Birds	*Tringa solitaria*	Solitary Sandpiper
Birds	*Tringa melanoleuca*	Greater Yellowlegs
Birds	*Phalaropus tricolor*	Wilson's Phalarope
Birds	*Sternula antillarum athalassos*	Interior Least Tern
Birds	*Chlidonias niger*	Black Tern
Birds	*Botaurus lentiginosus*	American Bittern
Birds	*Ixobrychus exilis*	Least Bittern
Birds	*Ardea alba*	Great Egret
Birds	*Nycticorax nycticorax*	Black-crowned Night-heron

Taxa	Scientific Name	Common Name
Birds	*Nyctanassa violacea*	Yellow-crowned Night-heron
Birds	*Pandion haliaetus*	Osprey
Birds	*Ictinia mississippiensis*	Mississippi Kite
Birds	*Haliaeetus leucocephalus*	Bald Eagle
Birds	*Circus cyaneus*	Northern Harrier
Birds	*Accipiter striatus*	Sharp-shinned Hawk
Birds	*Buteo platypterus*	Broad-winged Hawk
Birds	*Tyto alba*	Barn Owl
Birds	*Asio flammeus*	Short-eared Owl
Birds	*Falco peregrinus*	Peregrine Falcon
Birds	*Lanius ludovicianus*	Loggerhead Shrike
Birds	*Cistothorus platensis*	Sedge Wren
Birds	*Cistothorus palustris*	Marsh Wren
Birds	*Ammodramus henslowii*	Henslow's Sparrow
Birds	*Xanthocephalus xanthocephalus*	Yellow-headed Blackbird
Birds	*Sturnella neglecta*	Western Meadowlark
Birds	*Helmitheros vermivorum*	Worm-eating Warbler
Birds	*Vermivora chrysoptera*	Golden-winged Warbler
Birds	*Mniotilta varia*	Black-and-white Warbler
Birds	*Setophaga citrina*	Hooded Warbler
Birds	*Setophaga kirtlandii*	Kirtland's Warbler
Birds	*Setophaga cerulea*	Cerulean Warbler
Fish	*Ichthyomyzon fossor*	Northern Brook Lamprey
Fish	*Anguilla rostrata*	American Eel
Fish	*Clinostomus elongatus*	Redside Dace
Fish	*Coregonus artedi*	Cisco
Fish	*Moxostoma valenciennesi*	Greater Redhorse
Fish	*Percina evides*	Gilt Darter
Fish	*Etheostoma maculatum*	Spotted Darter
Mammals	*Condylura cristata*	Star-nosed Mole
Mammals	*Myotis lucifugus*	Little Brown Myotis
Mammals	*Myotis septentrionalis*	Northern Long-eared Myotis
Mammals	*Myotis sodalis*	Indiana Myotis
Mammals	*Lasionycteris noctivagans*	Silver-haired Bat
Mammals	*Perimyotis subflavus*	Tri-colored Bat
Mammals	*Nycticeius humeralis*	Evening Bat
Mammals	*Lasiurus borealis*	Eastern Red Bat
Mammals	*Lasiurus cinereus*	Hoary Bat
Mammals	*Spermophilus franklinii*	Franklin's Ground Squirrel
Mammals	*Geomys bursarius*	Plains Pocket Gopher
Mammals	*Mustela nivalis*	Least Weasel
Mammals	*Taxidea taxus*	American Badger

Taxa	Scientific Name	Common Name
Mollusks	*Cyprogenia stegaria*	Fanshell
Mollusks	*Epioblasma torulosa rangiana*	Northern Riffleshell
Mollusks	*Epioblasma triquetra*	Snuffbox
Mollusks	*Lampsilis fasciola*	Wavyrayed Lampmussel
Mollusks	*Obovaria subrotunda*	Round Hickorynut
Mollusks	*Plethobasus cyphyus*	Sheepnose
Mollusks	*Pleurobema clava*	Clubshell
Mollusks	*Ptychobranchus fasciolaris*	Kidneyshell
Mollusks	*Quadrula cylindrica cylindrica*	Rabbitsfoot
Mollusks	*Simpsonaias ambigua*	Salamander Mussel
Mollusks	*Toxolasma lividum*	Purple Lilliput
Mollusks	*Villosa fabalis*	Rayed Bean
Mollusks	*Villosa lienosa*	Little Spectaclecase
Mollusks	*Campeloma decisum*	Pointed Campeloma
Mollusks	*Lymnaea stagnalis*	Swamp Lymnaea
Reptiles	*Clemmys guttata*	Spotted Turtle
Reptiles	*Emydoidea blandingii*	Blanding's Turtle
Reptiles	*Terrapene carolina*	Eastern Box Turtle
Reptiles	*Terrapene ornata*	Ornate Box Turtle
Reptiles	*Pseudemys concinna*	River Cooter
Reptiles	*Thamnophis butleri*	Butler's Gartersnake
Reptiles	*Thamnophis proximus*	Western Ribbonsnake
Reptiles	*Nerodia erythrogaster neglecta*	Copper-bellied Watersnake
Reptiles	*Clonophis kirtlandii*	Kirtland's Snake
Reptiles	*Opheodrys aestivus*	Rough Greensnake
Reptiles	*Opheodrys vernalis*	Smooth Greensnake
Reptiles	*Cemophora coccinea*	Scarletsnake
Reptiles	*Tantilla coronata*	Southeastern Crowned Snake
Reptiles	*Farancia abacura*	Red-bellied Mudsnake
Reptiles	*Agkistrodon piscivorus*	Cottonmouth
Reptiles	*Sistrurus catenatus*	Eastern Massasauga
Reptiles	*Crotalus horridus*	Timber Rattlesnake

During the Habitat Survey, respondents were asked to evaluate the overall quality of fish and wildlife habitats in the Corn Belt Region (Fig. 6-12), estimate changes in overall quality since 2005 (Fig. 6-13), and predict changes in overall quality over the next ten years (Fig. 6-14). Each respondent was asked to respond for one or more of the eight major habitat types within the region, and results were aggregated at the regional level. A full list of these survey results can be found in Appendix P.

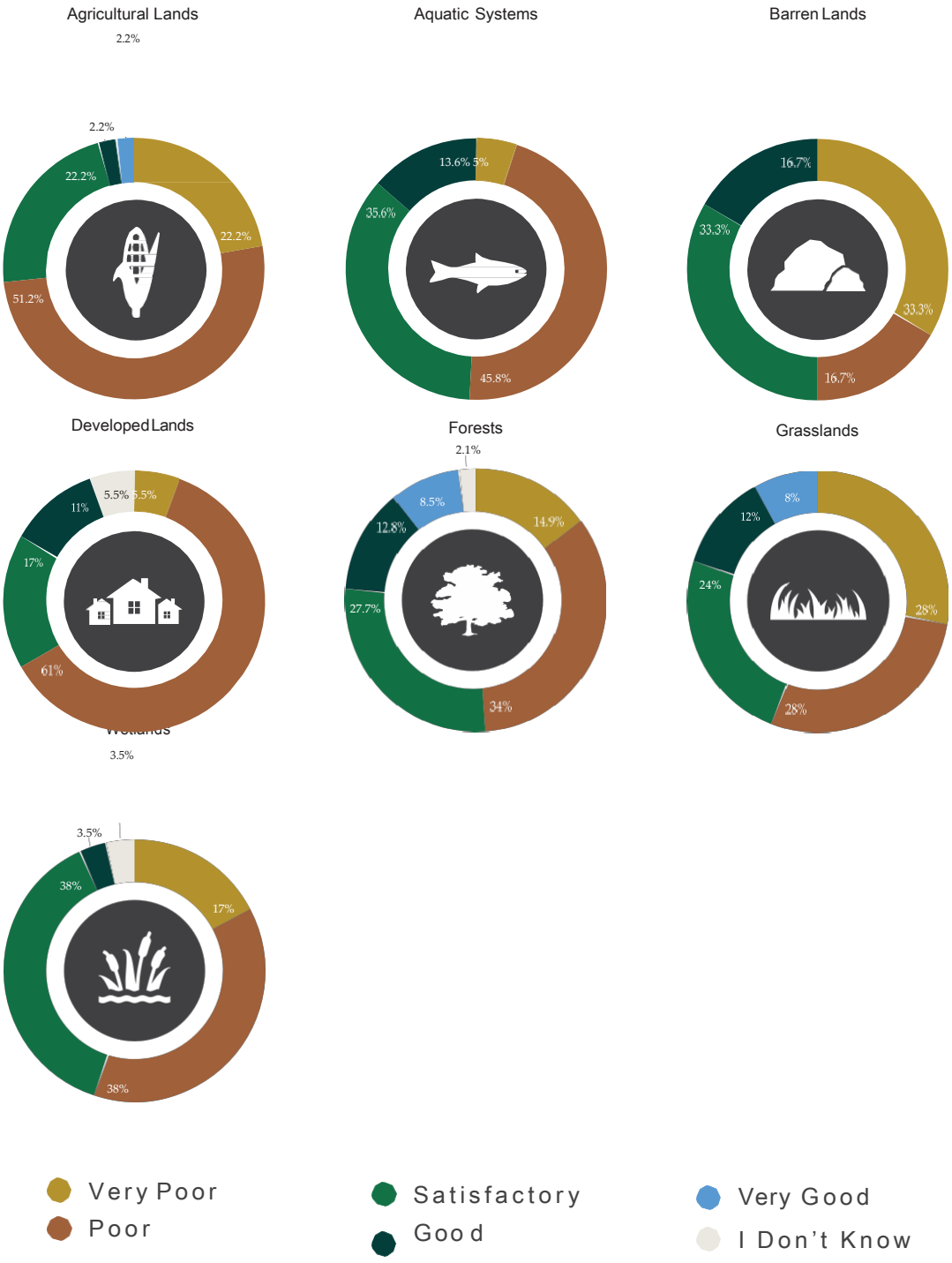


Figure 6-12. Overall quality of fish and wildlife habitats in the Corn Belt Region in 2014.

Figure 6-13. Estimated change in the overall quality of fish and wildlife habitats from 2005 to 2014 for each of the major habitat types in the Corn Belt Region.

Figure 6-14. Predicted changes in overall quality of fish and wildlife habitats over the next ten years for each major habitat type in the Corn Belt Region.

Changes in Land Cover

Most land cover in the Corn Belt Region, 71.6%, consists of agricultural lands, followed by 12% developed lands, 9.6% forests, and 5.3% grasslands (Fig. 6-15). Compared to other regions, the Corn Belt Region has a high percentage of agricultural and developed lands, and a low percentage of wetlands and barren lands.

Although the aquatic systems and wetlands increased marginally (Table 6-8), the Corn Belt Region has experienced loss in many habitat types over the past ten years. Most habitats were lost to urban development, and agriculture lost the most cover in terms of total acreage (Fig. 6-15). Percentage-wise, the greatest net losses were seen in grasslands (0.9%), agricultural lands (0.7%), and forests (0.6%). The greatest net increases were seen in barren lands (29.2%), developed lands (4.8%), and aquatic systems (2.9%).

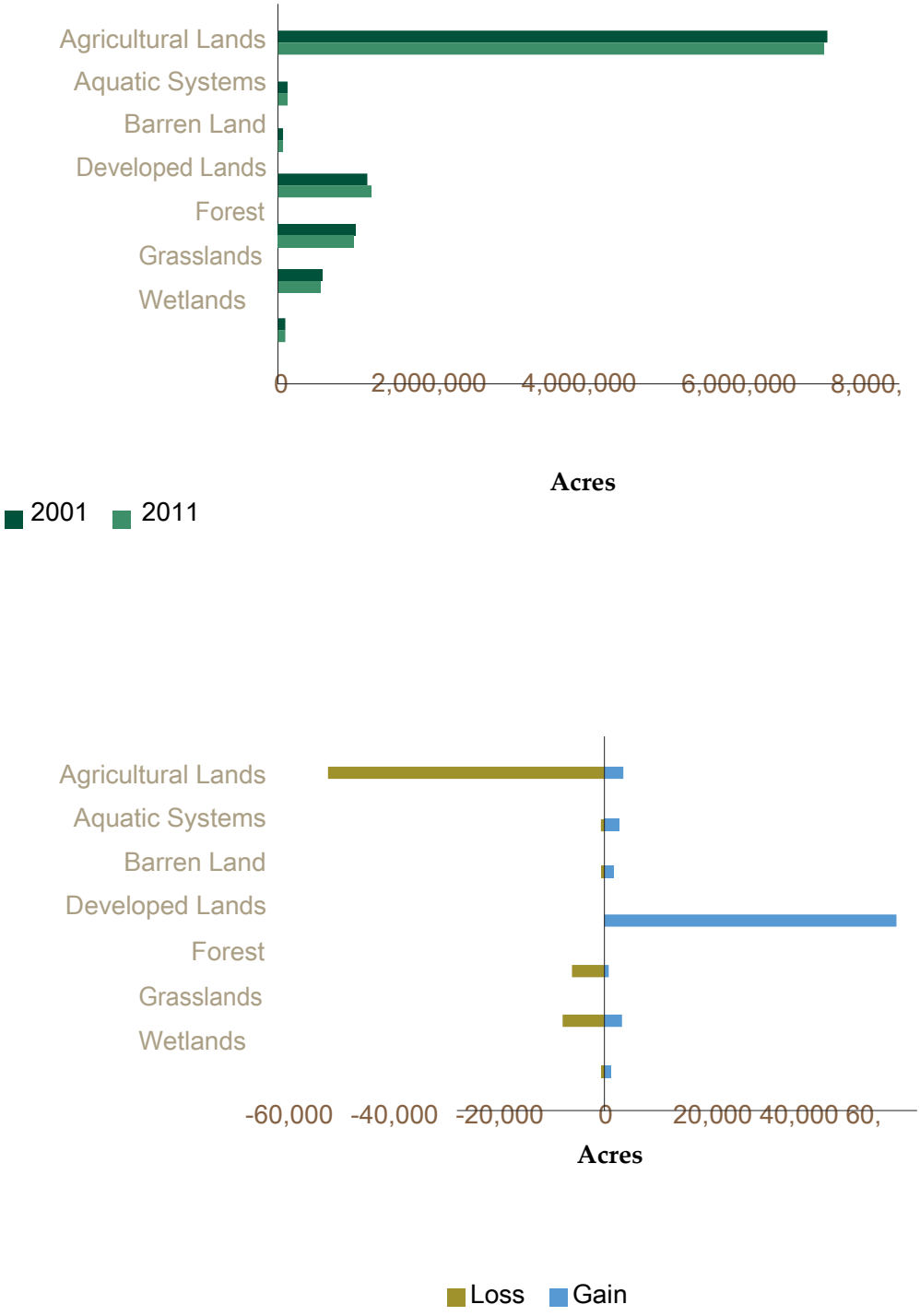


Figure 6-15. Distribution of land cover and losses and gains in land cover in the Corn Belt Region between 2001 and 2011 from NLCD.

Threats Affecting Habitats

Top Threat Categories

The third element requires the description of threats to SGCN and their habitats. This SWAP identifies a habitat perspective in order to manage for the conservation of species in Indiana. This section utilizes the same hierarchical method of identifying and rating threats based on Salafsky et al. (2008) that was outlined in Chapter V. Category rankings and specific threat rankings for habitats in this region are outlined below (Table 6-8). A full summary of the Habitat Survey results for the Corn Belt Region can be found in Appendix P.

First-level threat categories in this region received an average rating of above moderate to minor threat. Agriculture and aquaculture, invasive and other problematic species and genes, residential and commercial development, natural systems modification, and pollution received mean ratings from significant to moderate threat levels. Human intrusion and disturbance, other stressors, climate change and severe weather, transportation and service corridors, energy production and mining, and biological resource use received category ratings between moderate to minor threat level. No threat category received an average rating in the minor threat to not a threat for this region.

Agriculture and aquaculture were ranked first when aggregated regionally. Within agriculture and aquaculture, conversion of habitat and annual and perennial non-timber crops were, on average, rated as significant to moderately specific second-level threats. Aquaculture and wood and pulp plantations rated in the minor to no threat level in this region. Invasive and other problematic species and genes were also highly rated as a category across the region and ranked first in barren lands and forests. Invasive and alien species were the highest ranked specific threat across land types within this category. Residential and commercial development was ranked first in developed lands; both housing and urban areas and commercial and industrial areas were, on average, rated in the significant to moderately specific threat level for fish and wildlife habitats within this land type.

Natural systems modification was mid-ranked regionally but was ranked first within wetlands specifically. Conversion of habitat was identified as a significant to moderately specific threat to fish and wildlife habitats within wetlands. Dams and water management and use was also, on average, rated as a significant to moderately specific threat to fish and wildlife habitats in wetlands specifically, while it was rated as moderate to minor or minor to no threat in other land types.

Table 6-8. This table shows threat category rankings to habitats in the Corn Belt Region. First-level threats are based on the hierarchical method of identifying threats outlined in Salafsky et al. (2008). Ranked threat categories for the entire region are arranged by major habitat type (1 - highest threat).

Category	Regional Ranking	Aquatic Systems	Agricultural Lands	Barren Lands	Developed Lands	Forests	Grasslands	Wetlands
Agriculture and Aquaculture	1	1	1	3	9	2	1	3
Invasive and Other Problematic Species and Genes	2	3	2	1	5	1	3	2
Residential and Commercial Development	3	4	3	5	1	3	4	5
Natural Systems Modification	4	5	5	7	4	5	2	1
Pollution	5	2	4	6	2	7	7	4
Human Intrusion and Disturbance	6	6	7	2	3	4	5	7
Other Stressors	7	8	6	4	8	6	8	6
Climate Change and Severe Weather	8	7	8	8	7	9	6	8
Transportation and Service Corridors	9	9	9	10	6	8	9	9
Energy Production and Mining	10	11	10	9	10	11	10	11
Biological Resource Use	11	10	11	11	11	10	11	10

Top Specific Threats in Ranked Order

In the Habitat Survey, respondents were asked to identify specific threats to major habitat types using the same threat category ranking system outlined in Salafsky et al. (2008). These second-level threats represent subcategories of threats within the major threat categories listed in the table above. The following are the top specific second-level threats to habitats in the Corn Belt Region, aggregated across habitat types:

1. Invasive and alien species
2. Conversion of natural habitats to other land uses
3. Conversion of habitat to annual crops
4. Housing and urban areas
5. Agriculture, residential, and forestry effluents
6. Runoff from roads and service corridors
7. Commercial and industrial areas
8. Annual and perennial non-timber crops
9. Point source pollution from commercial/industrial sources
10. Household sewage and urban water waste

In the Species Survey, respondents were asked to identify threats to individual SGCN using the same threat category ranking system. The following are the top specific second-level threats to SGCN occurring in the Corn Belt Region, aggregated across all species:

1. Natural habitat conversion
2. Conversion of habitat to annual crops
3. Annual and perennial non-timber crops
4. Livestock farming and ranching
5. Dams and water management and use
6. Over-mowing of natural areas

Emerging/Anticipated Threats

In a free-response question, respondents were asked specifically to identify any emerging or anticipated threats over the next ten years for fish and wildlife habitats within the major habitat types for a region. A brief summary of the responses includes:

- A loss of forest cover was occurring in this region
- Some respondents identified specific subhabitat types, such as the Savanna Woodlands, as declining in this landscape
- Respondents also identified fragmentation of habitats as a concern for this region, especially in an agricultural matrix with little or no corridors and connective habitat leading to increasingly isolated forested areas
- Prevalent invasive species, such as bush honeysuckle, may also be a threat in remaining privately owned woodlots

Conservation Actions Needed

Top Action Categories

The fourth element of the Congressional guidelines requires that the SWAP describe conservation actions proposed to conserve identified species and habitats as well as outlining priorities for their implementation.

This section outlines conservation actions identified on a regional basis for each of the major habitat types. This section follows the same protocol to rate and rank actions in this region based on Salafsky et al. (2008) that was outlined in Chapter V. A full list of survey results can be found in Appendix P. Category rankings for actions and specific section-level actions are outlined in Table 6-9.

Land, water, and species management ranked first regionally and within aquatic systems, agricultural lands, and grasslands. Within the categories, means were used to determine rankings. Because of this, some habitat-specific options with few respondents may have higher threat averages regionally. Overall, top ranked actions within this category reflect a need to control invasive species, restore

natural habitats, and re-establish natural disturbance regimes in a variety of habitat types. Reducing loss of fish and wildlife habitats was identified as the top ranking action within this category for agricultural lands, developed lands, and wetlands; this action was ranked second for forests and grasslands. Developing and promoting farming technologies with conservation benefits was also highly ranked with several land types.

Education and awareness was also ranked highly for this region and was ranked first for developed lands and forests. Educational programs in general (specifically K-12) received average ratings between very and moderately important actions for this region. Respondents identified a need to improve public valuation of resources within this region through education. Respondents also wrote in college- level education as an important action. While improvement of signage was rated between moderately and somewhat important for this region, one respondent specifically identified Spanish language signage as needed in this region.

Land/Water protection was rated first as a category for barren lands and wetlands. In both habitat types, preserving currently existing corridors was rated as the most important action. Regionally, protection of specific habitat types (i.e., wetlands, grasslands, etc.) was also identified as important. Reducing conversion to cropland also received a mean rating of very to moderately important in this region.

While law and policy ranked lower as a category regionally, respondents identified improving compliance and enforcement of current policies as a very to moderately important action. Respondents suggested changes to policies regarding a variety of topics. Revising the drainage code was listed as important for aquatic systems. Changes to deer harvest were suggested as important in this region; respondents suggested both outlawing captive/“canned” deer hunts as well as expanding areas included in the “earn-a-buck” mandate in this region. Respondents emphasized a need for increasing regulations on invasive species, particularly suggesting a ban on the sale of known invasive plants, such as bush honeysuckle and winter creeper.

Table 6-9. Action category rankings to habitats in the Corn Belt Region. First-level action categories are based on the hierarchical method of identifying actions outlined in Salafsky et al. (2008). Ranked action categories for the entire region are arranged by major habitat type.

Category	Regional Ranking	Aquatic Systems	Agricultural Lands	Barren Lands	Developed Lands	Forests	Grasslands	Wetlands
Land/Water/Species Management	1	1	1	2	2	2	1	2
Education and Awareness	2	2	2	2	1	1	2	3
Land/Water Protection	3	3	5	1	3	3	3	1
Law and Policy	4	4	4	4	4	4	4	4
Livelihood, Economic, and Other Incentives	5	6	3	6	6	5	6	6
External Capacity Building	6	5	6	4	5	6	5	5
	Indicates a tie within this habitat type							

Top Specific Actions in Ranked Order

In the Habitat Survey, respondents were also asked to identify specific actions for major habitat types using the same action category ranking system outlined in Salafsky etal.(2008). These second-levelactions representsubcategoriesofactions within the major action categories listed in the table above. The following are the top specific second-level conservation actions for habitats in the Corn Belt Region, aggregated across habitat types:

1. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
2. Preserve currently existing corridors
3. Promote use of research and science in conservation decision-making processes
4. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
5. Strengthen conservation financing
6. Develop education programs in general
7. Reduce conversion to cropland
8. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
9. Increase acres of riparian buffers
10. Reduce nutrient and toxin loads (e.g., heavy metals, pharmaceuticals, fertilizers, insecticides)

The following are top actions for SGCN to occur in the Corn Belt Region, as summarized from the free-response questions about conservation actions for individual species:

1. Educate and engage with landowners and citizens
2. Enhance connectivity of habitats
3. Increase CRP lands and use of conservation easements
4. Protect large contiguous forested areas
5. Implement agricultural practices that improve water quality in aquatic systems and wetlands
6. Limit conversion of habitat to non-habitat
7. Restore and protect riparian corridors
8. Control invasive plants
9. Use burning and mowing as management techniques
10. Protect and manage large wetland complexes

Prioritization of Actions

In order to prioritize these actions within an environment of limited resources, respondents were asked to distribute hypothetical "effort points" to any action they had previously rated as "very important" for any of the major habitat types within a region. The effort ratings were averaged and then ranked to identify the top five actions for each region. A full list of these results can be found in Appendix P. Priority actions for the Corn Belt Region include:

1. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
2. Reduce conversion to cropland
3. Strengthen conservation financing
4. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
5. Preserve currently existing corridors

Reducing loss of habitat through agricultural expansion and conversion to cropland echo the identification of agriculture as a threat within this region. Overall, these priority actions are primarily management and protection actions, although strengthening of conservation financing will be vital to successful implementation.

Threats and Actions by Major Habitat Type

The following summaries break down threats and conservation actions in this region by major habitat type, based on responses to the Habitat Survey and the Species Survey. For each major habitat type in this region, the SGCN, top threats to SGCN, top actions for SGCN, key threats to habitats, and priority actions for habitats are summarized on the following pages.

Threats and actions were only included in detail below if a majority of eligible survey respondents, greater than 50%, rated them, to avoid artificially elevating items, which were highly ranked but only by a few respondents. This approach left some threats and action lists with no items for certain habitats, which is illogical from a practical perspective. Therefore, in these situations, the top threats and actions are still listed but are denoted with an asterisk (*) to signify that there may be some items, which seem out-of-place, reflecting a lack of sufficient response for a particular habitat in the survey. This approach and the survey design also caused for some disparities between threats and actions.

Approximately ten items are given for each list below. Lists may be shorter if fewer than ten items were rated by a majority of survey respondents, or longer if there were tires between items.

Top actions for SGCN were summarized from free-response questions about individual species and do not follow the same categorizations as actions for habitats. A full summary of the Habitat Survey responses can be found in Appendix P.

Agricultural Lands

Agricultural lands are defined as lands devoted to commodity production. Examples of agricultural lands include: intensively managed non-native grasses, row crops, fruit and nut-bearing trees, confined feeding operations, and feedlots.

Top threats to SGCN occurring in agricultural lands in the Corn Belt Region:

1. Natural habitat conversion
2. Conversion of habitat to annual crops
3. Annual and perennial non-timber crops
4. Fire and fire suppression
5. Over-mowing of natural areas
6. Dams and water management and use
7. Livestock farming and ranching

Top conservation actions for SGCN occurring in agricultural lands in the Corn Belt Region:

1. Educate and engage with landowners and citizens
2. Use conservation easements on farmland surrounding protected areas
3. Increase and maintain CRP partnerships
4. Implement agricultural practices that improve water quality in aquatic systems and wetlands (for aquatic and wetland species)
5. Maintain shallow-water areas for migrating shorebirds

Top threats to fish and wildlife habitats in agricultural lands in the Corn Belt Region conversion of natural habitats to other land uses:

1. Invasive and alien species
2. Conversion of habitat to annual crops
3. Agriculture, residential, and forestry effluents
4. Changing frequency, duration, and intensity of floods
5. Annual and perennial non-timber crops
6. Housing and urban areas
7. Changing frequency, duration, and intensity of drought
8. Plant diseases
9. Shifting seasons/phenology

Top conservation actions for fish and wildlife habitats in agricultural lands in the Corn Belt Region:

1. Preserve currently existing corridors
2. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
3. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
4. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
5. Promote use of research and science in conservation decision-making processes
6. Reduce conversion to cropland
7. Increase acres of riparian buffers
8. Restore and integrate diversity of habitats into crop-production dominated landscapes
9. Acquire conservation easements to protect important wildlife habitats
10. Build and strengthen CRP partnerships

Aquatic Systems

Aquatic systems are defined as all water habitats, both flowing and stationary. Examples of aquatic systems include: manmade impoundments, natural lakes rivers, streams, oxbows, sloughs, embayments, and backwaters (not including wetlands).

Top threats to SGCN occurring in aquatic systems in the Corn Belt Region
Natural habitat conversion:

1. Conversion of habitat to annual crops
2. Annual and perennial non-timber crops
3. Housing and urban areas
4. Commercial and industrial areas
5. Dams and water management and use
6. Livestock farming and ranching
7. Tourism and recreation areas

Top conservation actions for SGCN occurring in aquatic systems in the Corn Belt Region:

1. Implement agricultural best management practices to improve water quality
2. Reduce point and non-point source pollution
3. Clean polluted areas
4. Enhance public, stakeholder, and landowner education and awareness
5. Protect, restore, and maintain riparian corridors
6. Reduce recreational overuse
7. Maintain floodplain habitat
8. Stabilize banks
9. Remove dams
10. Preserve nest sites for Bald Eagles and Osprey
11. Control invasive aquatic vegetation

Top threats to fish and wildlife habitats in aquatic systems in the Corn Belt Region:

1. Invasive and alien species
2. Conversion of natural habitats to other land uses
3. Agriculture, residential, and forestry effluents
4. Changing frequency, duration, and intensity of floods
5. Annual and perennial non-timber crops
6. Changing frequency, duration, and intensity of drought
7. Temperature extremes
8. Shifting and alteration of habitats due to climate change
9. Conversion of habitat to annual crops
10. Housing and urban areas

Top conservation actions for fish and wildlife habitats in aquatic systems in the Corn Belt Region:

1. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
2. Reduce nutrient and toxin loads (e.g., heavy metals, pharmaceuticals, fertilizers, insecticides)
3. Preserve currently existing corridors
4. Develop education programs in general
5. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
6. Strengthen conservation financing
7. Reduce conversion to cropland
8. Reduce stream bank erosion
9. Acquire conservation easements to protect important wildlife habitats
10. Restore habitats and natural systems in aquatic systems

Barren Lands

Barren lands are defined as lands dominated by exposed rock or minerals with sparse vegetation. Examples of barren lands include: sand/dunes, rock outcrops, cliffs, and bare rock.

Top threats to SGCN occurring in barren lands in the Corn Belt Region:

1. Natural habitat conversion
2. Annual and perennial non-timber crops
3. Conversion of habitat to annual crops
4. Dams and water management and use
5. Over-mowing of natural areas
6. Fire and fire suppression

Top conservation actions for SGCN occurring in barren bands in the Corn Belt Region:

1. Educate public about Peregrine Falcon
2. Protect Bald Eagle nest sites
3. Maintain stopover habitat for Kirtland's Warbler

Top threats to fish and wildlife habitats in barren lands in the Corn Belt Region:

1. Invasive and alien species
2. Conversion to other land uses
3. Plant diseases
4. Housing and urban areas
5. Commercial and industrial areas
6. Problematic native species
7. Recreation activities (e.g., ATVs, trail use, horseback riding, high-speed boating, canoeing)
8. Fire and fire suppression
9. Over-mowing of natural areas
10. Introduced genetic material (such as crop, seed stock, bio-control, stocked/released species, etc.)

Top conservation actions for fish and wildlife habitats in barren lands in the Corn Belt Region:

1. Control invasive species in barren lands
2. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
3. Improve drainage management
4. Increase acres of riparian buffers
5. Protect adjacent buffer zones
6. Reduce nutrient and toxin loads (e.g., heavy metals, pharmaceuticals, fertilizers, insecticides)
7. Re-establish natural disturbance regimes in barren lands
8. Improve enforcement and compliance of current policies
9. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)

Developed Lands

Developed lands are defined as highly impacted lands intensively modified to support human habitation, transportation, commerce, and recreation. Examples of developed lands include: urban lands, suburban lands, industrial areas, commercial areas, towers for communication and wind power generation, and recreational areas such as golf courses and soccer fields.

Top threats to SGCN occurring in developed lands in the Corn Belt Region:

1. Renewable energy production
2. Invasive and alien species
3. Diseases from domestic populations and unknown sources
4. Fossil fuel energy production
5. Mining and quarrying

Top conservation actions for SGCN occurring in developed lands in the Corn Belt Region:

1. Public education and awareness about bat ecology and issues
2. Reduce urban sprawl and commercial property expansion
3. Manage urban areas for Peregrine Falcons; minimize disturbance during nesting
4. Increase gravel-surfaced rooftop habitat for breeding Common Nighthawks
5. Mitigate road hazards for wildlife

Top threats to fish and wildlife habitats in developed lands in the Corn Belt Region:

1. Invasive and alien species
2. Housing and urban areas
3. Commercial and industrial areas
4. Conversion of natural habitats to other land uses
5. Roads and railroads
6. Problematic native species
7. Runoff from roads and service corridors
8. Point and non-point source pollution
9. Plant diseases
10. Air pollution (e.g., smoke, mercury emissions)

Top conservation actions for fish and wildlife habitats in developed lands in the Corn Belt Region:

1. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
2. Preserve currently existing corridors
3. Restore and integrate diversity of habitats into developed landscapes
4. Control invasive species in developed lands
5. Reduce nutrient and toxin loads (e.g., heavy metals, pharmaceuticals, fertilizers, insecticides)
6. Manage urban woodlots
7. Develop education programs in general
8. Develop education programs specifically for K-12
9. Acquire conservation easements to protect important wildlife habitats
10. Link existing habitat blocks through corridor enhancement in developed lands

Forests

Forests are defined as a plant community dominated by trees. Examples of forests include, but are not limited to, all stages of natural forest and plantations.

Top threats to SGCN occurring in forests in the Corn Belt Region:

1. Natural habitat conversion
2. Conversion of habitat to annual crops
3. Housing and urban areas
4. Commercial and industrial areas
5. Annual and perennial non-timber crops
6. Invasive and alien species
7. Diseases from domestic populations and unknown sources
8. Wood and pulp plantations
9. Fire and fire suppression
10. Tourism and recreation areas
11. Over-mowing of natural areas
12. Livestock farming and ranching
13. Recreation activities
14. Problematic native species

Top conservation actions for SGCN occurring in forests in the Corn Belt Region:

1. Protect large contiguous forested areas and reduce forest fragmentation
2. Limit conversion of forests to non-forest land uses
3. Enhance forest connectivity
4. Control invasive woody plants
5. Reduce development in forested areas
6. Protect roost trees for bat species
7. Restore forests and woodlands
8. Implement best management practices in forestry
9. Create small forest openings to increase diversity
10. Provide downed woody debris for the Least Weasel
11. Remove Brown-headed Cowbirds

Top threats to fish and wildlife habitats in forests in the Corn Belt Region:

1. Invasive and alien species
2. Conversion of natural habitats to other land uses
3. Housing and urban areas
4. Conversion of habitat to annual crops
5. Problematic native species
6. Runoff from roads and service corridors
7. Point source pollution from commercial/industrial sources
8. Commercial and industrial areas
9. Plant diseases
10. Agriculture, residential, and forestry effluents

Top conservation actions for fish and wildlife habitats in forests in the Corn Belt Region:

1. Control invasive species in forests
2. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
3. Reduce conversion to cropland
4. Preserve currently existing corridors
5. Promote use of research and science in conservation decision-making processes
6. Develop education programs in general
7. Develop education programs specifically for K-12
8. Increase acres of riparian buffers
9. Strengthen conservation financing
10. Increase regulations on invasive species

Grasslands

Grasslands are defined as an open area dominated by grass species. Examples of grasslands include: haylands, pasture, prairies, savannahs, or reclaimed mine lands.

Top threats to SGCN occurring in grasslands in the Corn Belt Region:

1. Conversion of habitat to annual crops
2. Annual and perennial non-timber crops
3. Livestock farming and ranching

Top conservation actions for SGCN occurring in grasslands in the Corn Belt Region

1. Restore and improve connectivity of grasslands
2. Reduce woody encroachment on grasslands
3. Prevent conversion of grassland to cropland
4. Increase CRP grasslands
5. Use conservation easements
6. Implement burning regimes
7. Minimize disturbance to nesting grassland birds (e.g., Henslow's Sparrow)
8. Mow properly (reduce mowing for shorebirds and owls)
9. Improve grazing practices
10. Restore prairies

Top threats to fish and wildlife habitats in grasslands in the Corn Belt Region:

1. Invasive and alien species
2. Conversion of natural habitats to other land uses
3. Conversion of habitat to annual crops
4. Housing and urban areas
5. Annual and perennial non-timber crops
6. Commercial and industrial areas
7. Over-mowing of natural areas
8. Recreation activities (e.g., ATVs, trail use, horseback riding, high-speed boating, canoeing)
9. Introduced genetic material (such as crop, seed stock, bio-control, stocked/released species, etc.)
10. Problematic native species

Top conservation actions for fish and wildlife habitats in grasslands in the Corn Belt Region:

1. Reduce conversion to cropland
2. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
3. Strengthen conservation financing
4. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
5. Restore habitats and natural systems in grasslands
6. Increase state's capacity for research and monitoring of conservation actions
7. Promote use of research and science in conservation decision-making processes
8. Acquire currently unprotected grasslands
9. Re-establish natural disturbance regimes in grasslands
10. Build and strengthen CRP partnerships

Wetlands

Wetlands are defined as either ephemeral or permanently flooded habitat. Examples of wetlands include: swamps, marshes, bogs, fens, potholes, wetlands of farmed areas, and mudflats.

Top threats to SGCN occurring in wetlands in the Corn Belt Region:

1. Natural habitat conversion
2. Invasive and alien species
3. Conversion of habitat to annual crops
4. Housing and urban areas
5. Commercial and industrial areas
6. Annual and perennial non-timber crops
7. Tourism and recreation areas
8. Dams and water management and use
9. Problematic native species
10. Recreation activities
11. Fire and fire suppression

Top conservation actions for SGCN occurring in wetlands in the Corn Belt Region:

1. Protect and maintain large wetland complexes
2. Restore wetlands.
3. Protect buffers around wetlands
4. Control invasive plants in wetlands
5. In some cases, actively manage water levels (e.g., for Black Tern, Common Gallinule)
6. Mitigate road hazards to amphibians and reptiles when roads cross over wetlands
7. Minimize disturbance to nesting turtles
8. Manage for high-diversity marshes
9. Encourage enrollment in wetland protection programs
10. Protect and create vernal pools for amphibians

Top threats to fish and wildlife habitats in wetlands in the Corn Belt Region:

1. Invasive and alien species
2. Agriculture, residential, and forestry effluents
3. Conversion of natural habitats to other land uses
4. Shifting and alteration of habitats due to climate change
5. Commercial and industrial areas
6. Changing frequency, duration, and intensity of floods
7. Housing and urban areas
8. Household sewage and urban water waste
9. Livestock farming and ranching
10. Conversion of habitat to annual crops
11. Point source pollution from commercial and industrial sources

Top conservation actions for fish and wildlife habitats in wetlands in the Corn Belt Region:

1. Promote use of research and science in conservation decision-making processes
2. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
3. Preserve currently existing corridors
4. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
5. Protect natural water regimes (e.g., withdraws, warm-water discharge).
6. Develop education programs in general
7. Acquire currently unprotected wetlands
8. Control invasive species in wetlands
9. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
10. Protect adjacent buffer zones
11. Reduce nutrient and toxin loads (e.g., heavy metals, pharmaceuticals, fertilizers, insecticides)

D. VALLEYS AND HILLS REGION

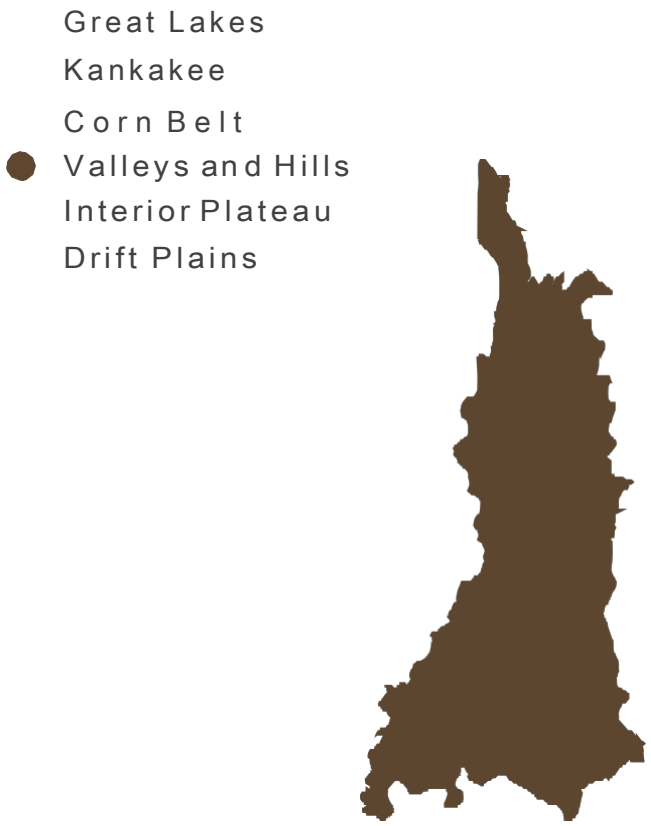


Figure 6-16. Outline of the Valleys and Hills Region in Indiana for the SWAP.

Introduction

This section summarizes habitat conditions, threats to SGCN and their habitats, and conservation actions for species and habitats in the Valleys and Hills Region. This section also reviews land cover changes over the past decade and identifies unique habitat types in this region. Summaries of threats to and conservation actions for SGCN and their habitats that were generated from two surveys can be found at the end of this section.

In addition to the threats and actions identified in the Habitat Survey and the Species Survey, the DFW recognized the need to identify threats aligned with specific actions. Several threats and actions were identified as ubiquitous across all sixregions. These include:

- **Habitat Loss:** Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soilhealth)
- **Invasive Species:** Build external capacity (form and facilitate partnerships, alliances, and networks of organizations to address invasive species)
- **Law and Policy:** Develop, change, influence and help implement formal legislation, regulations and voluntary standards
- **Dams and Water Management and Use:** Remove unnecessary dams and utilize necessary dams with effective fish passage structures

The DFW also identified specific threats and actions for each SWAP region based on DFW priorities. These threats were identified due to their high level of relevancy to the specific region and the workability of the associated actions. These threats and actions for the Valleys and Hills Region include:

- **Natural System Modifications:** Re-establish river floodplain connectivity
- **Habitat Degradation of Reclaimed Mine Lands Grasslands:** Buildexternalcapacity by forming partnerships and networks, raising and providing funds and resources for conservation organizations to maintain and protect grasslands
- **Habitat Degradation to Forests:** Control invasive species

Current Habitat Conditions

During the Species Survey, respondents were asked to identify SGCN within the Valleys and Hills Region. A full summary of the Species Survey results can be found in Appendix O.

Table 6-10. Species of Greatest Conservation Need present in the Valleys and Hills Region.

Taxa	Scientific Name	Common Name
Amphibians	*Necturus maculosus*	Common Mudpuppy
Amphibians	*Ambystoma talpoideum*	Mole Salamander
Amphibians	*Acris blanchardi*	Blanchard's Cricket Frog
Amphibians	*Lithobates areolatus*	Crawfish Frog
Amphibians	*Lithobates blairi*	Plains Leopard Frog
Birds	*Cygnus buccinator*	Trumpeter Swan
Birds	*Colinus virginianus*	Northern Bobwhite
Birds	*Chordeiles minor*	Common Nighthawk
Birds	*Antrostomus vociferus*	Eastern Whip-poor-will
Birds	*Laterallus jamaicensis*	Black Rail
Birds	*Rallus elegans*	King Rail
Birds	*Rallus limicola*	Virginia Rail
Birds	*Gallinula galeata*	Common Gallinule
Birds	*Grus canadensis*	Sandhill Crane
Birds	*Grus americana*	Whooping Crane
Birds	*Pluvialis dominica*	American Golden-plover
Birds	*Charadrius melodus*	Piping Plover
Birds	*Bartramia longicauda*	Upland Sandpiper
Birds	*Arenaria interpres*	Ruddy Turnstone
Birds	*Calidris subruficollis*	Buff-breasted Sandpiper
Birds	*Limnodromus griseus*	Short-billed Dowitcher
Birds	*Scolopax minor*	American Woodcock
Birds	*Tringa solitaria*	Solitary Sandpiper
Birds	*Tringa melanoleuca*	Greater Yellowlegs
Birds	*Phalaropus tricolor*	Wilson's Phalarope
Birds	*Sternula antillarum athalassos*	Interior Least Tern
Birds	*Chlidonias niger*	Black Tern
Birds	*Botaurus lentiginosus*	American Bittern
Birds	*Ixobrychus exilis*	Least Bittern
Birds	*Ardea alba*	Great Egret
Birds	*Nycticorax nycticorax*	Black-crowned Night-heron
Birds	*Nyctanassa violacea*	Yellow-crowned Night-heron
Birds	*Pandion haliaetus*	Osprey
Birds	*Ictinia mississippiensis*	Mississippi Kite
Birds	*Haliaeetus leucocephalus*	Bald Eagle
Birds	*Circus cyaneus*	Northern Harrier
Birds	*Accipiter striatus*	Sharp-shinned Hawk

Taxa	Scientific Name	Common Name
Birds	*Buteo platypterus*	Broad-winged Hawk
Birds	*Tyto alba*	Barn Owl
Birds	*Asio flammeus*	Short-eared Owl
Birds	*Falco peregrinus*	Peregrine Falcon
Birds	*Lanius ludovicianus*	Loggerhead Shrike
Birds	*Cistothorus platensis*	Sedge Wren
Birds	*Cistothorus palustris*	Marsh Wren
Birds	*Ammodramus henslowii*	Henslow's Sparrow
Birds	*Xanthocephalus xanthocephalus*	Yellow-headed Blackbird
Birds	*Sturnella neglecta*	Western Meadowlark
Birds	*Helmitheros vermivorum*	Worm-eating Warbler
Birds	*Vermivora chrysoptera*	Golden-winged Warbler
Birds	*Mniotilta varia*	Black-and-white Warbler
Birds	*Setophaga citrina*	Hooded Warbler
Birds	*Setophaga cerulea*	Cerulean Warbler
Fish	*Acipenser fulvescens*	Lake Sturgeon
Fish	*Anguilla rostrata*	American Eel
Fish	*Noturus stigmosus*	Northern Madtom
Fish	*Lepomis symmetricus*	Bantam Sunfish
Fish	*Percina copelandi*	Channel Darter
Fish	*Elassoma zonatum*	Banded Pygmy Sunfish
Fish	*Ammocrypta clara*	Western Sand Darter
Fish	*Etheostoma maculatum*	Spotted Darter
Mammals	*Myotis grisescens*	Gray Myotis
Mammals	*Myotis lucifugus*	Little Brown Myotis
Mammals	*Myotis septentrionalis*	Northern Long-eared Myotis
Mammals	*Myotis sodalis*	Indiana Myotis
Mammals	*Lasionycteris noctivagans*	Silver-haired Bat
Mammals	*Perimyotis subflavus*	Tri-colored Bat
Mammals	*Nycticeius humeralis*	Evening Bat
Mammals	*Lasiurus borealis*	Eastern Red Bat
Mammals	*Lasiurus cinereus*	Hoary Bat
Mammals	*Sylvilagus aquaticus*	Swamp Rabbit
Mammals	*Mustela nivalis*	Least Weasel
Mammals	*Taxidea taxus*	American Badger
Mollusks	*Cyprogenia stegaria*	Fanshell
Mollusks	*Obovaria subrotunda*	Round Hickorynut
Mollusks	*Plethobasus cyphyus*	Sheepnose
Mollusks	*Pleurobema cordatum*	Ohio Pigtoe
Mollusks	*Potamilus capax*	Fat Pocketbook
Mollusks	*Ptychobranchus fasciolaris*	Kidneyshell
Mollusks	*Quadrula cylindrica cylindrica*	Rabbitsfoot

Taxa	Scientific Name	Common Name
Mollusks	*Villosa lienosa*	Little Spectaclecase
Reptiles	*Macrochelys temminckii*	Alligator Snapping Turtle
Reptiles	*Kinosternon subrubrum*	Eastern Mud Turtle
Reptiles	*Terrapene carolina*	Eastern Box Turtle
Reptiles	*Pseudemys concinna*	River Cooter
Reptiles	*Thamnophis proximus*	Western Ribbonsnake
Reptiles	*Nerodia erythrogaster neglecta*	Copper-bellied Watersnake
Reptiles	*Clonophis kirtlandii*	Kirtland's Snake
Reptiles	*Opheodrys aestivus*	Rough Greensnake
Reptiles	*Farancia abacura*	Red-bellied Mudsnake
Reptiles	*Agkistrodon piscivorus*	Cottonmouth

During the Habitat Survey, respondents were asked to evaluate the overall quality of fish and wildlife habitats in the Valleys and Hills Region (Fig. 6-17), estimate changes in overall quality since 2005 (Fig. 6-18), and predict changes in overall quality over the next ten years (Fig. 6-19). Each respondent was asked to respond for one or more of the eight major habitat types within the region and results were aggregated at the regional level. A full list of the Habitat Survey results can be found in Appendix P.

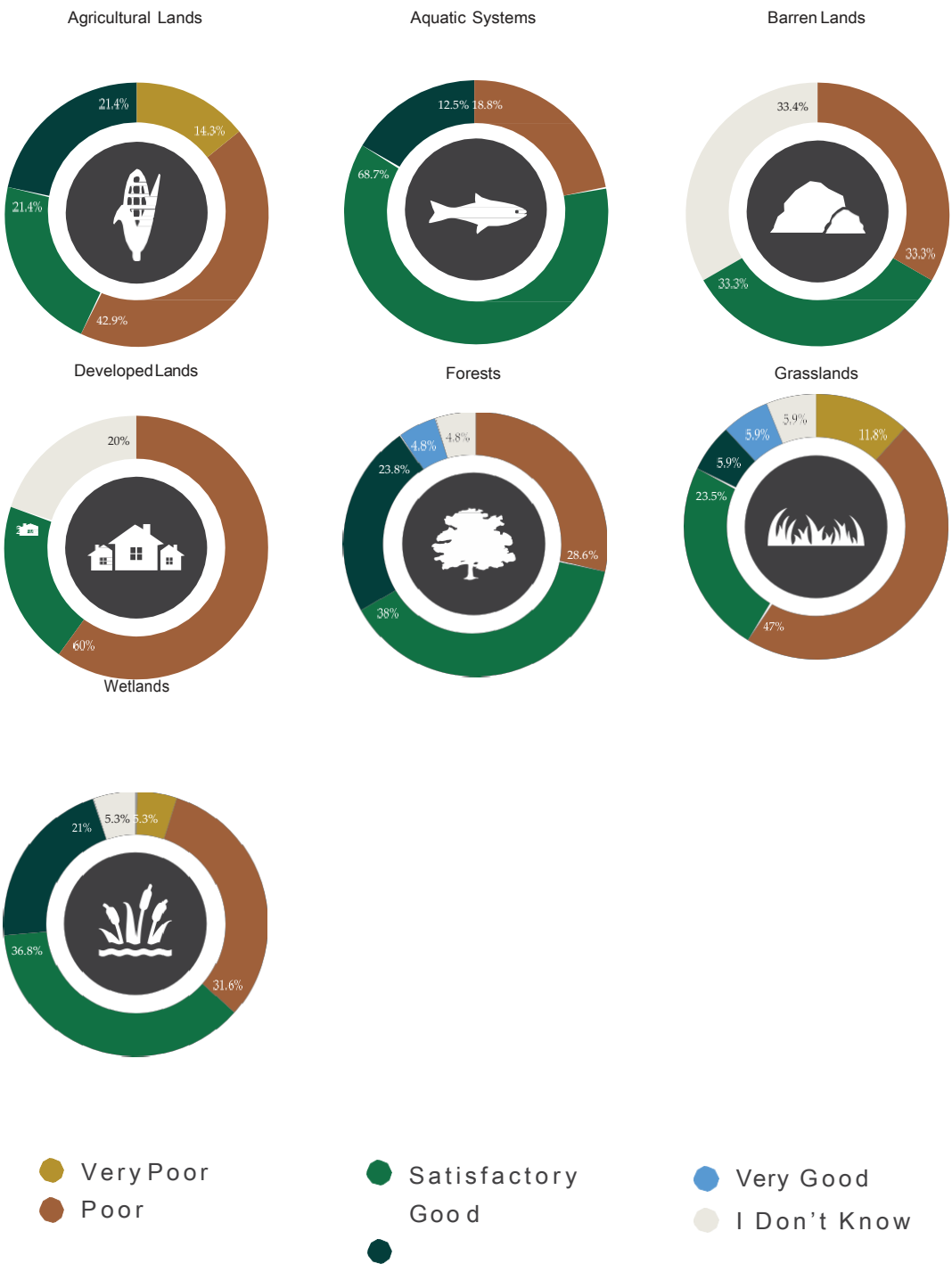


Figure 6-17. Overall quality of fish and wildlife habitats in the Valleys and Hills Region in 2014.

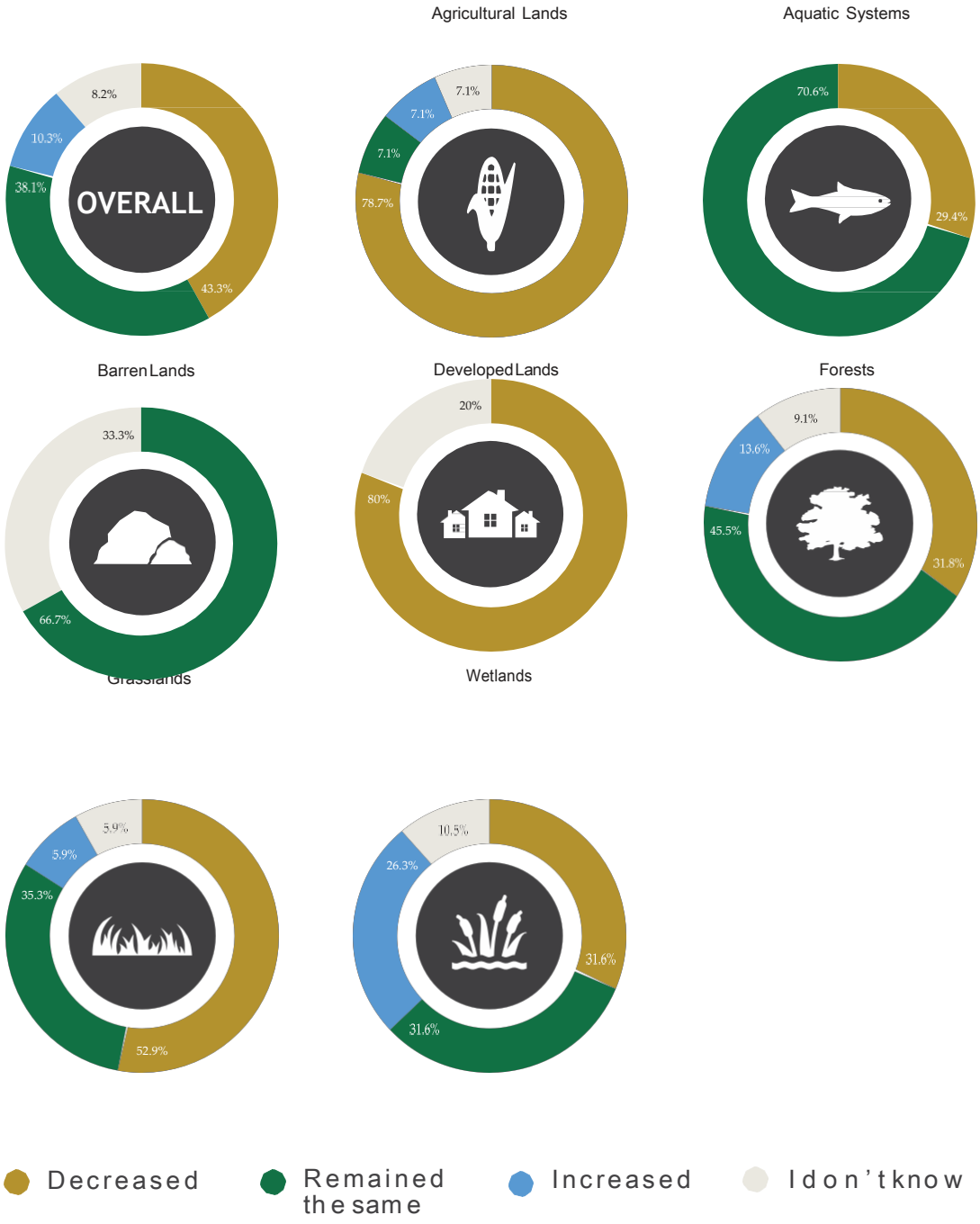


Figure 6-18. Estimated change in the overall quality of fish and wildlife habitats from 2005 to 2014 for each of the major habitat types in the Valleys and Hills Region.

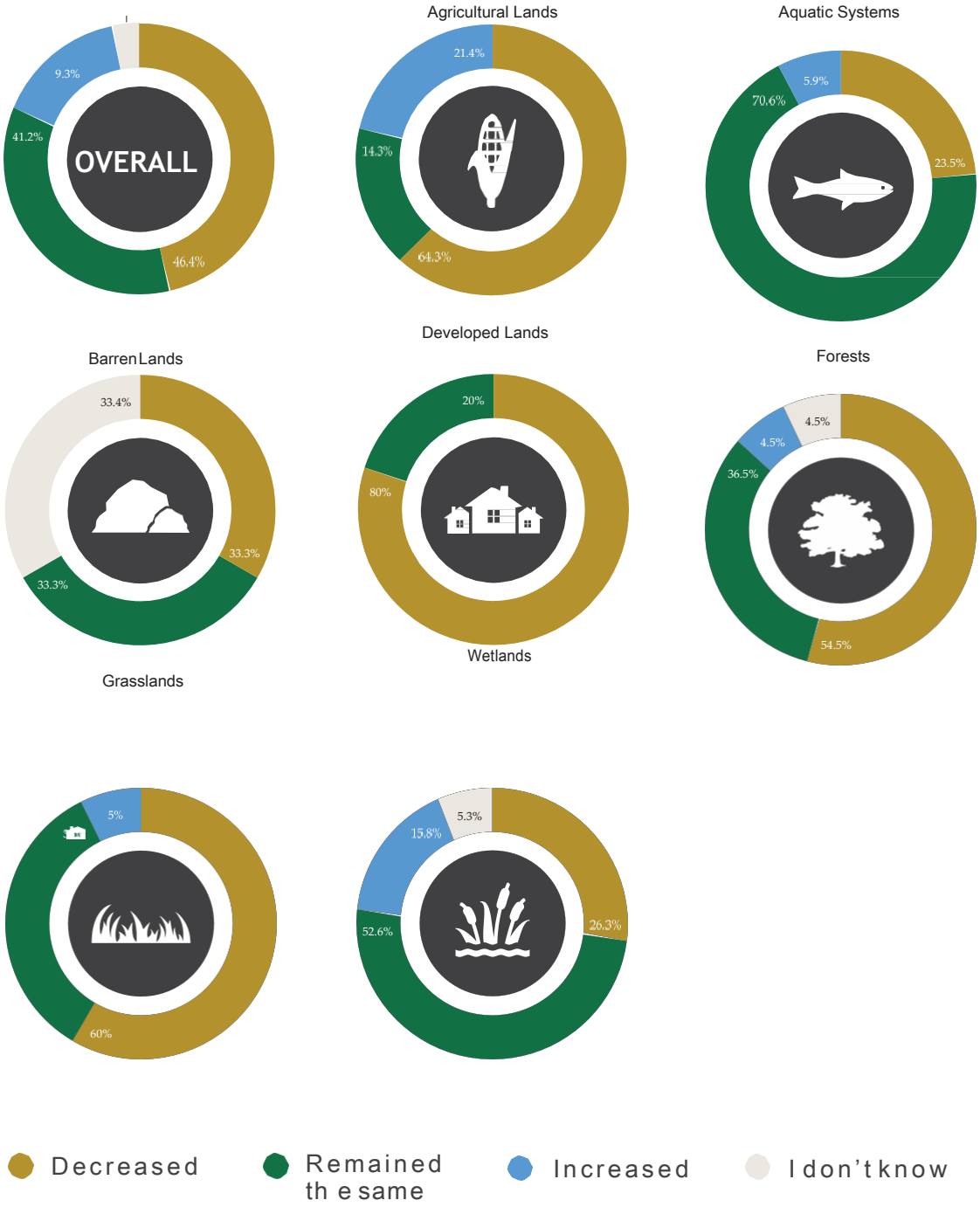
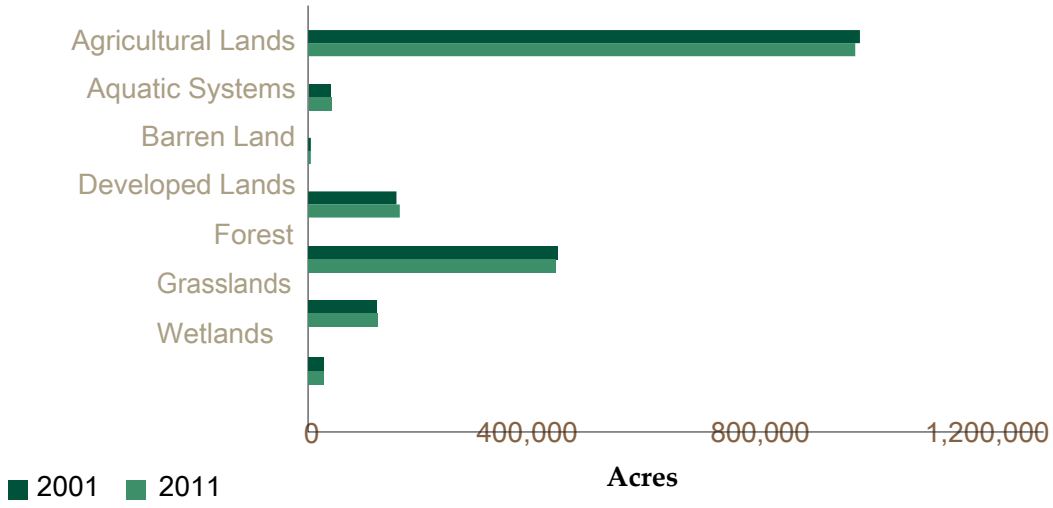


Figure 6-19. Predicted changes in overall quality of fish and wildlife habitats over the next ten years for each major habitat type in the Valleys and Hills Region.

Changes in Land Cover

Most land cover in the Valleys and Hills Region consists of agricultural lands, followed by forests, developed lands, and grasslands (Fig. 6-20). Compared to other Indiana regions, with the exception of the Great Lakes Region, the Valleys and Hills Region has the highest percentage of aquatic systems at 2.1%. This region is comprised of more forests than other northern Indiana regions at 24.9%, but is the least forested region in southern Indiana. Wetlands are more abundant at 1.4% than other regions in southern Indiana.

The Valleys and Hills Region has experienced changes in habitat coverage over the past ten years. Aquatic systems, barren lands, developed lands, grasslands, and wetlands increased, while agriculture and forests decreased (Table 6-11). These habitats were mostly lost to urban development, and agriculture lost the most cover in terms of total acreage (Fig. 6-20). Percentage-wise, the greatest net losses were seen in forests (1.2%) and agricultural lands (0.6%). The greatest net increases were seen in barren lands (232.3%), aquatic systems (4.4%), and developed lands (3.4%). This increase may be due to expansion of surface mining, which is prevalent in the Valleys and Hills Region.



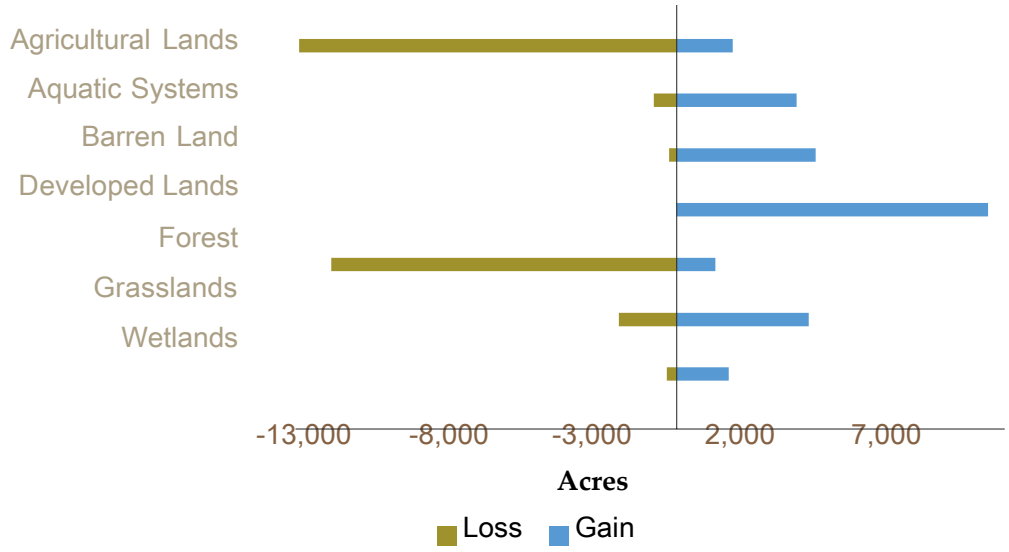


Figure 6-20. Distribution of land cover and losses and gains in land cover in the Valleys and Hills Region between 2001 and 2011 from NLCD.

Threats Affecting Habitats

Top Threat Categories

The third element requires the description of threats to SGCN and their habitats. The SWAP identifies a habitat perspective in order to manage for the conservation of species in Indiana. This section utilizes the same hierarchical method of identifying and rating threats based on Salafsky et al. (2008) that was outlined in Chapter V. Category rankings and specific threat rankings for habitats in this region are outlined below (Table 6-11). A full summary of the Habitat Survey results for the Great Lakes Region can be found in Appendix P.

For first-level threat categories, agriculture and aquaculture, invasive and other problematic species and genes, and residential and commercial development received mean ratings as categories between significant and moderate threats. All other threat categories, with the exception of biological resource use were, on average, rated between a moderate and minor threat. Biological resource use was rated as minor to not a threat as a category.

Agriculture and aquaculture was the top ranked first-level threat regionally and within each habitat type with the exception of developed lands. Conversion of habitat to agriculture as well as annual and perennial non-timber crops in general were identified as the most significant specific second-level threats in this area. Respondents noted particular threats may stem from the draining and destruction of wetlands for agricultural purposes. Livestock was rated as a moderate to minor threat, while both aquaculture and wood and pulp plantations were not identified above a minor threat across habitat types.

The invasive and other problematic species and genes category was rated relatively high across habitat types, but especially highly in grasslands and wetlands. Alien species was identified as the most significant threat across habitat types within this region. Problematic native species, introduced genetic material, and plant diseases were only ranked as moderate to minor threats.

Residential and commercial development was rated third overall but first for habitats in developed lands. Both housing and urban areas and commercial development were specifically rated within this category as significant to moderate threats, while development associated with tourism and recreation areas was identified as a moderate to minor threat.

Energy production and mining was rated slightly higher as a threat in barren lands compared to other habitat types. Both mining and fossil fuel production were identified as significant threats within this category for barren lands and aggregated across all habitat types. Oil and gas drilling and shale gas development were identified as moderate to minor in this region. Renewable energy production was identified as minor to not a threat to fish and wildlife habitats.

Pollution was rated as a more significant threat in aquatic systems and to habitats in agricultural lands compared to other habitat types. Agriculture, residential, and forestry effluents were identified as a significant to moderate threat in both of these habitat types. Point source pollution was additionally identified as a significant to moderate threat for habitats in agricultural lands.

Human intrusion and disturbance and recreational activities as a specific threat within this category were both rated as moderate to minor threats for this region across all habitat types. Natural systems modification as a category was also identified as moderate to minor. However, conversion of habitat to other uses was identified as a significant to moderate threat, reinforcing the significance of this issue as it was identified prior as conversion to agriculture.

Within transportation and service corridors, only roads and railroads were identified as significant to moderate specific threats across habitat types. Utility and service lines were rated as a moderate to minor threat. Both flight paths and shipping lanes were identified as minor to non-threats for this region.

While other stressors as a category was rated as a moderate to minor threat, both diseases and low genetic diversity were individually ranked as significant to moderate threats across habitat types. Climate change and severe weather similarly was ranked lower across habitats as a category, all of the specific threats within this category were identified as significant to moderate threat across all habitat types in this region.

Biological resource use was identified as a minor to non-threat for habitats within this region. However, forestry practices were rated as a moderate to minor threat, with one respondent pointing specifically to lack of sustainable timber management in natural systems modification as a point of stress for fish and wildlife habitats in this region.

Table 6-11. Threat category ranking to habitats in the Valleys and Hills Region. First-level threat categories are based on the hierarchical method of identifying threats outlined in Salafsky et al (2008). Ranked threats are arranged by each major habitat type (1 - highest threat).

Category	Regional Ranking	Aquatic Systems	Agricultural Lands	Barren Lands	Developed Lands	Forests	Grasslands	Wetlands
Agriculture and Aquaculture	1	1	1	1	2	1	1	1
Invasive and Other Problematic Species and Genes	2	3	4	4	3	3	2	2
Residential and Commercial Development	3	5	3	6	1	2	3	5
Energy Production and Mining	4	4	6	2	7	4	4	4
Pollution	5	2	2	5	4	8	9	3
Human Intrusion and Disturbance	6	6	7	8	5	5	6	7
Natural Systems Modification	7	7	5	7	8	7	5	6
Transportation and Service Corridors	8	8	8	9	6	6	7	10
Other Stressors	9	10	10	3	9	9	8	9
Climate Change and Severe Weather	10	9	9	10	11	11	10	8
Biological Resource Use	11	11	11	11	10	10	11	11

Top Specific Threats in Ranked Order

In the Habitat Survey, respondents were also asked to identify specific threats to major habitat types using the same threat category ranking system outlined in Salafsky et al. (2008). These second-level threats represent subcategories of threats within the major threat categories listed in the table above. The following are the top specific second-level threats to habitats in the Valleys and Hills Region, aggregated across habitat types:

1. Invasive and alien species
2. Conversion of habitat to annual crops
3. Conversion of natural habitats to other land uses
4. Housing and urban areas
5. Mining and quarrying
6. Annual and perennial non-timber crops
7. Commercial and industrial areas
8. Agriculture, residential, and forestry effluents
9. Fossil fuel energy production
10. Point source pollution from commercial and industrial sources

In the Species Survey, respondents were also asked to identify threats to individual SGCN using the same threat category ranking system. The following are the top specific second-level threats to SGCN occurring in the Valleys and Hills Region, aggregated across all species:

1. Invasive and alien species
2. Natural habitat conversion
3. Conversion of habitat to annual crops
4. Housing and urban areas
5. Annual and perennial non-timber crops
6. Commercial and industrial areas
7. Dams and water management and use
8. Tourism and recreation areas
9. Recreational activities
10. Livestock farming and ranching

Emerging/Anticipated Threats

Respondents were asked specifically to identify any emerging or anticipated threats over the next ten years for fish and wildlife habitats within the major habitat types for a region in a free-response question.

Respondents anticipate a development "boom" associated with construction of an interstate in coming years, which may increase potential for introduction of exotic and invasive species on top of modifying natural systems. The construction may also lead to fragmentation. Loss of wetland habitat, exotic species establishing in wetland habitats, and mine reclamation areas not being converted to wetland habitat types were a concern for this region as well.

Conservation Actions Needed

Top Action Categories

The fourth element of the Congressional guidelines requires that the SWAP describe conservation actions proposed to conserve identified species and habitats as well as outlining priorities for their implementation. This section outlines conservation actions identified on a regional basis for each of the major habitat types. This section follows the same protocol to rate and rank actions in this region based on Salafsky et al. (2008) that was outlined in Chapter V. A full list of survey results can be found in Appendix P. Category rankings for actions and specific second-level actions are outlined in Table 6-12.

Within this region, land, water, and species management, land and water protection, and education and awareness received average category rankings between very and moderately important. Law and policy, external capacity building, and livelihood, economic, and other incentives received average category ratings between moderately and somewhat important. No action category was

rated between somewhat important and not important, indicating a general importance for a variety of actions within this region.

Land, water, and species management was ranked first regionally and within barren lands, forests, grasslands, and wetlands. Top actions within this region indicate an importance to restore natural systems, disturbance regimes, and diversity of successional stages in a variety of habitat types including grasslands and wetlands. Reducing loss of fish and wildlife habitat to agriculture and development was also identified as an important action, ranking first in developed lands and forests. Developing and promoting farming technologies and practices with conservation benefit ranked first for habitats within aquatic systems, agricultural lands, and wetlands. Mine reclamation was ranked first for barren lands.

Land and water protection was ranked second regionally, first within aquatic systems, and tied for first within barren lands. Acquiring unprotected systems and reducing conversion to cropland was identified important regionally as well as within most individual habitat types, ranking first in barren lands, developed lands, and wetlands. Acquiring easements was ranked first for fish and wildlife habitats within agricultural lands. Building and strengthening CRP partnerships was identified as most important for aquatic systems within this category.

Education and awareness was ranked third regionally as a category; however, it was ranked first for agricultural lands and developed lands. Within this category, educational programs specifically for K-12, educational programs in general, and training programs for stakeholders all received average ratings between very and moderately important.

Law and policy was ranked fourth regionally and varied between ranking fourth and sixth for various habitat types. Across the region, improvement of compliance and enforcement of current policies was ranked first. Some respondents suggested a need for changes to current policies to benefit fish and wildlife habitat within this region and suggested changes to regulations for energy production, including mining, oil, and gas laws.

Livelihood, economic, and other incentives was ranked fifth regionally but third for fish and wildlife habitats in agricultural lands. Promotion of conservation payment programs was ranked first regionally and within aquatic systems, agricultural lands, barren lands, developed lands, grasslands, andforests. Promotion of nonmonetary values of natural systems was ranked first within wetlands.

While external capacity building was ranked sixth regionally, five of the six specific actions were rated between very and moderately important. Developing alliances and partnerships was ranked first regionally and first for agricultural lands, barren lands, developed lands, forests, and grasslands. Strengthening conservation financing was ranked first in aquatic systems and wetlands.

Table 6-12. Action category ranking to habitats in the Valleys and Hills Region. First-level categories are based on the hierarchical method of identifying actions outlined in Salafsky et al. (2008). Ranked action categories for this region are arranged by major habitat type.

Category	Regional Ranking	Aquatic Systems	Agricultural Lands	Barren Lands	Developed Lands	Forests	Grasslands	Wetlands
Land/Water/Species Management	1	3	2	1	3	1	1	1
Land/Water Protection	2	1	5	1	2	2	2	2
Education and Awareness	3	2	1	3	1	3	3	3
Law and Policy	4	4	6	4	5	5	5	4
Livelihood, Economic, and Other Incentives	5	5	3	4	4	4	4	6
External Capacity Building	6	6	4	6	6	6	6	5
	Indicates a tie within this habitat type							

Top Specific Actions in Ranked Order

In the Habitat Survey, respondents were also asked to identify specific actions for major habitat types using the same action category ranking system outlined in Salafsky etal.(2008). These second-levelactions representsubcategoriesofactions within the major action categories listed in the table above. The following are the top specific (second-level) conservation actions for habitats in the Valleys and Hills Region, aggregated across habitattypes:

1. Reduce conversion to cropland
2. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
3. Preserve currently existing corridors
4. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
5. Acquire conservation easements to protect important wildlife habitats
6. Promote use of research and science in conservation decision-making processes
7. Develop education programs specifically for K-12
8. Develop education programs in general
9. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
10. Strengthen conservation financing

The following are top actions for SGCN occurring for the Valleys and Hills Region, as summarized from the free-response questions about conservation actions for individual species:

1. Educate and engage with landowners and citizens.
2. Enhance connectivity of habitats
3. Reclaim coal mine grasslands
4. Restore and protect bottomland hardwood forests and floodplain swamps
5. Protect and restore river corridors
6. Protect large contiguous forested areas
7. Protect and manage large wetland complexes
8. Control invasive plants
9. Use burning and mowing as grassland management techniques
10. Implement agricultural practices that improve water quality

Prioritization of Actions

In order to prioritize these actions within an environment of limited resources, respondents were then asked to distribute hypothetical "effort points" to any action they had previously rated as "very important" for any of the major habitat types within a region. The effort ratings were averaged and then ranked to identify the top five actions for a region. A full list of these results can be found in Appendix P. Priority actions for the Valleys and Hills region include:

1. Preserve currently existing corridors
2. Acquire currently unprotected wetlands
3. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
4. Reduce conversion to cropland
5. Acquire currently unprotected grasslands

While land, water, and species management actions were, on average, rated as most important, land and water protection-based actions, with an emphasis on acquiring wetland and grassland habitats within this region, were also ranked highly.
Promotion of farming technologies and practices that have conservation benefits and reduce conversion to cropland reflect the identification of agriculture as a large threat to fish and wildlife habitats within this region.

Threats and Actions by Major Habitat Type

The following summaries break down threats and conservation actions in this region by major habitat type, based on responses to the Habitat Survey and the Species Survey. The SGCN that occur there, top threats to SGCN, top actions for SGCN, key threats to habitats, and priority actions for each major habitat type in this region are summarized on the following pages.

Threats and actions were only included in detail below if a majority of eligible survey respondents, greater than 50%, rated them, to avoid artificially elevating items, which were highly ranked but only by a few respondents. This approach left some threats and action lists with no items for certain habitats, which is illogical from a practical perspective. Therefore, in these situations, the top threats and actions are still listed but are denoted with an asterisk (*) to signify that there may be some items, which seem out-of-place, reflecting a lack of sufficient response for a particular habitat in the survey. This approach and the survey design also caused for some disparities between threats and actions.

Approximately ten items are given for each list below. Lists may be shorter if fewer than ten items were rated by a majority of survey respondents, or longer if there were tires between items.

Top actions for SGCN were summarized from free-response questions about individual species and do not follow the same categorizations as actions for habitats. A full summary of the Habitat Survey responses can be found in Appendix P.

Agricultural Lands

Agricultural lands are defined as lands devoted to commodity production. Examples of agricultural lands include: intensively managed non-native grasses, row crops, fruit and nut-bearing trees, confined feeding operations, and feedlots.

Top threats to SGCN occurring in agricultural lands in the Valleys and Hills Region:

1. Conversion of habitat to annual crops
2. Annual and perennial non-timber crops

Top Conservation actions for SGCN occurring in agricultural lands in the Valleys and Hills Region:

1. Educate and engage with landowners and citizens
2. Reduce conversion of farmland to development
3. Increase use of CRP partnerships
4. Increase use of conservation easements
5. Implement agricultural practices that improve water quality
6. Maintain shallow-water areas for migrating shorebirds
7. Establish no-plow zones

Top threats to fish and wildlife habitats in agricultural lands in the Valleys and Hills Region:

1. Conversion of habitat to annual crops
2. Conversion of natural habitats to other land uses
3. Commercial and industrial areas
4. Housing and urban areas
5. Mining and quarrying
6. Invasive and alien species
7. Annual and perennial non-timber crops
8. Point source pollution from commercial and industrial sources
9. Agriculture, residential, and forestry effluents
10. Oil and gas drilling

Top conservation actions for fish and wildlife habitats in agricultural lands in the Valleys and Hills Region:

1. Acquire conservation easements to protect important wildlife habitats
2. Reduce conversion of habitat to cropland
3. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
4. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
5. Preserve currently existing corridors
6. Increase acres of riparian buffers
7. Link existing habitat blocks through corridor enhancement in agricultural lands
8. Develop education programs in general
9. Establish training programs for stakeholders
10. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
11. Promote use of research and science in conservation decision-making processes

Aquatic Systems

Aquatic systems are defined as all water habitats, both flowing and stationary. Examples of aquatic systems include: manmade impoundments, natural lakes rivers, streams, oxbows, sloughs, embayments, and backwaters (not including wetlands).

Top threats to SGCN occurring in aquatic systems in the Valleys and Hills Region:

1. Natural habitat conversion
2. Conversion of habitat to annual crops
3. Annual and perennial non-timber crops
4. Dams and water management and use
5. Livestock farming and ranching

Top conservation actions for SGCN occurring in aquatic systems in the Valleys and Hills Region:

1. Implement agricultural best management practices to improve water quality
2. Protect and restore river corridors
3. Enhance public, stakeholder, and landowner education and awareness
4. Reduce point and non-point source pollution
5. Protect/restore riparian buffer zones
6. Restore floodplains and connect to rivers
7. Remove dams
8. Reduce sediment and nutrient loads
9. Reduce bank erosion
10. Protect oxbow lakes and sloughs
11. Restrict draining of floodplain lakes
12. Improve ditch maintenance
13. Prohibit take of mussels

Top threats to fish and wildlife habitats in aquatic systems in the Valleys and Hills Region:

1. Invasive and alien species
2. Agriculture, residential, and forestry effluents
3. Annual and perennial non-timber crops
4. Housing and urban areas
5. Conversion of natural habitats to other land uses
6. Conversion of habitat to annual crops
7. Mining and quarrying
8. Commercial and industrial areas
9. Point source pollution from commercial and industrial sources
10. Fossil fuel energy production
11. Problematic native species

Top conservation actions for fish and wildlife habitats in aquatic systems in the Valleys and Hills Region:

1. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
2. Develop education programs in general
3. Reduce nutrient and toxin loads (e.g., heavy metals, pharmaceuticals, fertilizers, insecticides)
4. Acquire currently unprotected aquatic systems
5. Acquire conservation easements to protect important wildlife habitats
6. Develop education programs specifically for K-12
7. Preserve currently existing corridors
8. Reduce conversion of habitat to annual crops
9. Increase acres of riparian buffers
10. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
11. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)

Barren Lands

Barren lands are defined as lands dominated by exposed rock or minerals with sparse vegetation. Examples of barren lands include: sand/dunes, rock outcrops, cliffs, and bare rock.

Top threats to SGCN occurring in barren lands in the Valleys and Hills Region:*

1. Annual and perennial non-timber crops
2. Natural habitat conversion
3. Conversion of habitat to annual crops
4. Recreation activities
5. Dams and water management and use

Top conservation actions for SGCN occurring in barren lands in the Valleys and Hills Region:

1. Educate public about Peregrine Falcon
2. Protect Bald Eagle nest sites

Top threats to fish and wildlife habitats in barren lands in the Valleys and Hills Region:

1. Conversion of habitat to annual crops
2. Mining and quarrying
3. Fossil fuel energy production
4. Conversion of habitat to other land uses
5. Annual and perennial non-timber crops
6. Livestock farming and ranching
7. Shale gas development
8. Household sewage and urban water waste
9. Agriculture, residential, and forestry effluents

Top conservation actions for fish and wildlife habitats in barren lands in the Valleys and Hills Region:

1. Preserve currently existing corridors
2. Reduce conversion to cropland
3. Build/Strengthen CRP partnerships
4. Mine reclamation
5. Promote conservation payment programs (e.g., payment for ecosystem services, conservation easements)
6. Promote nonmonetary values of natural systems within the state
7. Manage recreational opportunities to be compatible with fish and wildlife habitats

Developed Lands

Developed lands are defined as highly impacted lands intensively modified to support human habitation, transportation, commerce, and recreation. Examples of developed lands include: urban lands, suburban lands, industrial areas, commercial areas, towers for communication and wind power generation, and recreational areas such as golf courses and soccer fields.

Top threats to SGCN occurring in developed lands in the Valleys and Hills Region*:

1. Housing and urban areas
2. Commercial and industrial areas
3. Renewable energy production
4. Conversion of habitat to annual crops
5. Invasive and alien species
6. Diseases from domestic populations and unknown sources
7. Mining and quarrying
8. Fossil fuel energy production
9. Tourism and recreation areas
10. Wood and pulp plantations

Top conservation actions for SGCN occurring in developed lands in the Valleys and Hills Region:

1. Public education and awareness about bat ecology and issues
2. Reduce urban sprawl and commercial property expansion
3. Manage urban areas for Peregrine Falcons; minimize disturbance during nesting
4. Increase gravel-surfaced rooftop habitat for breeding Common Nighthawks
5. Limit mowing along roads

Top threats to fish and wildlife habitats in developed lands in the Valleys and Hills Region:

1. Invasive and alien species
2. Roads and railroads
3. Housing and urban areas
4. Runoff from roads and service corridors
5. Air pollution
6. Annual and perennial non-timber crops
7. Conversion of habitat to annual crops
8. Commercial and industrial areas

Top conservation actions for fish and wildlife habitats in developed lands in the Valleys and Hills Region:

1. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
2. Develop education programs specifically for K-12
3. Increase acres of riparian buffers
4. Link existing habitat blocks through corridor enhancement in developed lands
5. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
6. Promote use of research and science in conservation decision-making processes
7. Preserve currently existing corridors
8. Acquire conservation easements to protect important wildlife habitats

Forests

Forests are defined as a plant community dominated by trees. Examples of forests include, but are not limited to, all stages of natural forest and plantations.

Top threats to SGCN occurring in forests in the Valleys and Hills Region:*

1. Conversion of habitat to annual crops
2. Natural habitat conversion
3. Housing and urban areas
4. Invasive and alien species
5. Commercial and industrial areas
6. Annual and perennial non-timber crops
7. Renewable energy production
8. Diseases from domestic populations and unknown sources
9. Fossil fuel energy production
10. Mining and quarrying
11. Tourism and recreation areas
12. Wood and pulp plantations
13. Fire and fire suppression

Top conservation actions for SGCN occurring in forests in the Valleys and Hills Region:

1. Protect large contiguous forested areas and reduce forest fragmentation
2. Limit conversion of forests to non-forest land uses
3. Restore and protect bottomland hardwood forests
4. Control invasive woody plants
5. Reduce development in forested areas
6. Manage for healthy forest edge habitats
7. Protect roost trees for bat species
8. Restore forests and woodlands
9. Create small forest openings to increase diversity
10. Implement best management practices in forestry

Top threats to fish and wildlife habitats in forests in the Valleys and Hills Region:

1. Invasive and alien species
2. Conversion of habitat to annual crops
3. Housing and urban areas
4. Mining and quarrying
5. Conversion of natural habitats to other land uses
6. Fossil fuel energy production
7. Annual and perennial non-timber crops
8. Problematic native species
9. Commercial and industrial areas
10. Oil and gas drilling

Top conservation actions for fish and wildlife habitats in forests in the Valleys and Hills Region:

1. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
2. Preserve currently existing corridors
3. Restore habitats and natural systems in forests
4. Promote diversity of forest types and successional stages
5. Reduce conversion to cropland
6. Control invasive species in forests
7. Link existing habitat blocks through corridor enhancement in forests
8. Re-establish natural disturbance regimes in forests
9. Develop education programs specifically for K-12
10. Promote conservation payment programs (e.g., payment for ecosystem services, conservation easements

Grasslands

Grasslands are defined as an open area dominated by grass species. Examples of grasslands include: haylands, pasture, prairies, savannahs, or reclaimed mine lands. Top threats to SGCN occurring in grasslands in the Valleys and Hills Region:

1. Conversion of habitat to annual crops
2. Annual and perennial non-timber crops

Top conservation actions for SGCN occurring in grasslands in the Valleys and Hills Region:

1. Restore and improve connectivity of grasslands
2. Reduce conversion of grasslands to coal mines
3. Reclaim coal mine grasslands
4. Increase use of conservation easements
5. Maintain large tracts of grasslands
6. Reduce woody encroachment on grassland
7. Increase CRP grasslands
8. Implement proper burning regimes
9. Minimize disturbance to nesting grassland birds (e.g., Henslow's Sparrow.
10. Mow properly (reduce mowing for shorebirds and owls)
11. Improve grazing practices
12. Preserve low, wet fields

Top threats to fish and wildlife habitats in grasslands in the Valleys and Hills Region:

1. Conversion of habitat to annual crops
2. Invasive and alien species
3. Housing and urban areas
4. Annual and perennial non-timber crops
5. Commercial and industrial areas
6. Livestock farming and ranching
7. Introduced genetic material (such as crop, seed stock, bio-control, stocked/released species,etc.)
8. Problematic native species
9. Tourism and recreation areas
10. Aquaculture

Top conservation actions for fish and wildlife habitats in grasslands in the Valleys and Hills Region:

1. Perform mine reclamation
2. Restore habitats and natural systems in grasslands
3. Acquire currently unprotected grasslands
4. Reduce conversion to cropland
5. Promote diversity of grassland types and successional stages
6. Preserve currently existing corridors
7. Acquire conservation easements to protect important wildlife habitats
8. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
9. Re-establish natural disturbance regimes in grasslands

Wetlands

Wetlands are defined as either ephemeral or permanently flooded habitat. Examples of wetlands include: swamps, marshes, bogs, fens, potholes, wetlands of farmed areas, and mudflats.

Top threats to SGCN occurring in wetlands in the Valleys and Hills Region:*

1. Invasive and alien species
2. Natural habitat conversion
3. Conversion of habitat to annual crops
4. Annual and perennial non-timber crops
5. Dams and water management and use

Top conservation actions for SGCN occurring in wetlands in the Valleys and Hills Region:

1. Protect and maintain large wetlands complexes
2. Restore wetlands
3. Control invasive plants in wetlands
4. Preserve and restore bottomland hardwood forests and floodplain swamps
5. Expand floodplain and upland habitat with multiple wetlands
6. In some cases, actively manage water levels (e.g., Black Tern, Common Gallinule)
7. Enroll lands in Wetlands Reserve Program (WRP)
8. Mitigate road hazards to amphibians and reptiles when roads cross over wetlands
9. Manage for high-diversity marshes
10. Provide stopover and roosting habitat for cranes

Top threats to fish and wildlife habitats in wetlands in the Valleys and Hills Region:

1. Conversion of habitat to annual crops
2. Invasive and alien species
3. Conversion of natural habitats to other land uses
4. Fossil fuel energy production
5. Housing and urban areas
6. Agriculture, residential, and forestry effluents
7. Mining and quarrying
8. Commercial and industrial areas
9. Point source pollution from commercial/industrial sources
10. Annual and perennial non-timber crops

Top conservation actions for fish and wildlife habitats in wetlands in the Valleys and Hills Region:

1. Reduce conversion to cropland
2. Acquire currently unprotected wetlands
3. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
4. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
5. Develop education programs specifically for K-12
6. Restore habitats and natural systems in wetlands
7. Increase compliance of existing rules and regulations for aquatic systems.
8. Promote diversity in wetlands
9. Preserve currently existing corridors
10. Acquire conservation easements to protect important wildlife habitats

E. INTERIOR PLATEAU REGION

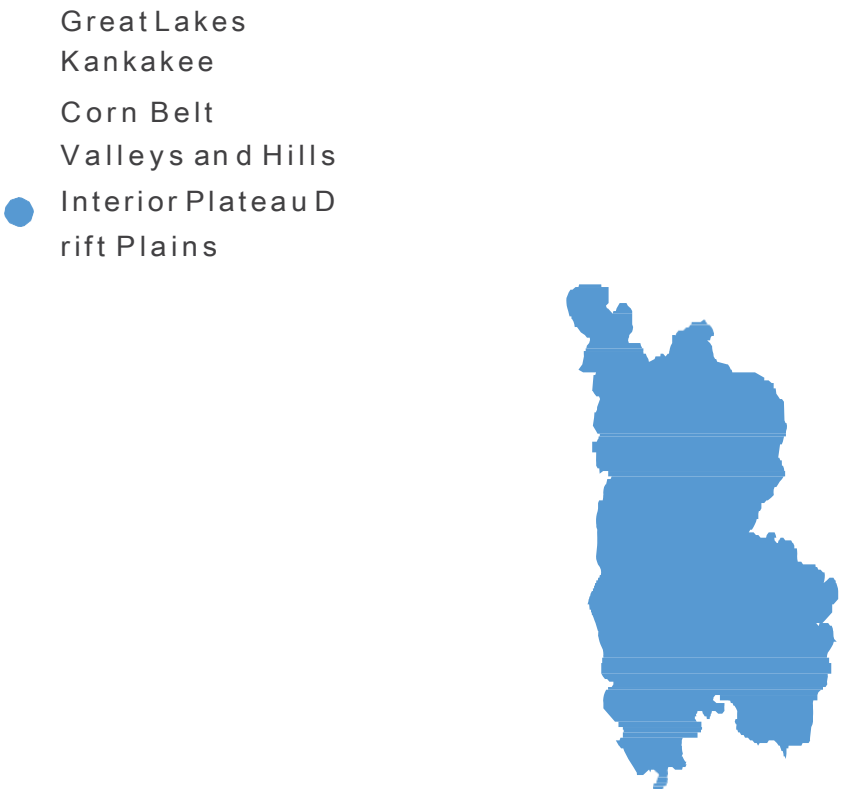


Figure 6-21. Outline of the Interior Plateau Region in Indiana for the SWAP.

Introduction

This section summarizes habitat conditions, threats to SGCN and their habitats, and conservation actions for species and habitats in the Interior Plateau Region. This section also reviews land cover changes over the past decade and identifies unique habitat types in this region. Summaries of threats to and conservation actions for SGCN and their habitats that were generated from two surveys can be found at the end of this section.

In addition to the threats and actions identified in the Habitat Survey and the Species Survey, the DFW recognized the need to identify threats aligned with specific actions. Several threats and actions were identified as ubiquitous across all sixregions. These include:

- **Habitat Loss:** Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soilhealth)
- **Invasive Species:** Build external capacity (form and facilitate partnerships, alliances, and networks of organizations to address invasive species)
- **Law and Policy:** Develop, change, influence and help implement formal legislation, regulations and voluntary standards
- **Dams and Water Management and Use:** Remove unnecessary dams and utilize necessary dams with effective fish passage structures

The DFW also identified specific threats and actions for each SWAP region based on DFW priorities. These threats were identified due to their high level of relevancy to the specific region and the workability of the associated actions. These threats and actions for the Interior Plateau Region include:

- **Habitat Degradation to Karsts:** Restricting access
    - Education of landowners (e.g. sewer, trash, and recreational users)
    - Acquiring and managing lands to buffer karst features
- **Habitat Loss of Early Successional Forest:** Land management (e.g. timber cutting, fire, girdling, and mechanical and chemical treatments)
- **Habitat Degradation to Forests:** Controlling problematic native wildlife
    - Land management (e.g. timber cutting, fire, girdling, and mechanical and chemical treatments)

Current Habitat Conditions

During the Species Survey, respondents were asked to identify SGCN within the Interior Plateau Region. A full summary of the Species Survey results can be found in Appendix O.

Table 6-13: Species of Greatest Conservation Need present in the Interior Plateau Region.

Taxa	Scientific Name	Common Name
Amphibians	*Cryptobranchus alleganiensis*	Hellbender
Amphibians	*Necturus maculosus*	Common Mudpuppy
Amphibians	*Ambystoma barbouri*	Streamside Salamander
Amphibians	*Hemidactylium scutatum*	Four-toed Salamander
Amphibians	*Pseudotriton ruber*	Red Salamander
Amphibians	*Aneides aeneus*	Green Salamander
Amphibians	*Acris blanchardi*	Blanchard's Cricket Frog
Birds	*Cygnus buccinator*	Trumpeter Swan
Birds	*Colinus virginianus*	Northern Bobwhite
Birds	*Bonasa umbellus*	Ruffed Grouse
Birds	*Chordeiles minor*	Common Nighthawk
Birds	*Antrostomus vociferus*	Eastern Whip-poor-will
Birds	*Rallus elegans*	King Rail
Birds	*Gallinula galeata*	Common Gallinule
Birds	*Grus canadensis*	Sandhill Crane
Birds	*Grus americana*	Whooping Crane
Birds	*Pluvialis dominica*	American Golden-plover
Birds	*Charadrius melodus*	Piping Plover
Birds	*Bartramia longicauda*	Upland Sandpiper
Birds	*Arenaria interpres*	Ruddy Turnstone
Birds	*Calidris subruficollis*	Buff-breasted Sandpiper
Birds	*Limnodromus griseus*	Short-billed Dowitcher
Birds	*Scolopax minor*	American Woodcock
Birds	*Tringa solitaria*	Solitary Sandpiper
Birds	*Tringa melanoleuca*	Greater Yellowlegs
Birds	*Phalaropus tricolor*	Wilson's Phalarope
Birds	*Sternula antillarum athalassos*	Interior Least Tern
Birds	*Chlidonias niger*	Black Tern
Birds	*Botaurus lentiginosus*	American Bittern
Birds	*Ixobrychus exilis*	Least Bittern
Birds	*Ardea alba*	Great Egret
Birds	*Nycticorax nycticorax*	Black-crowned Night-heron
Birds	*Nyctanassa violacea*	Yellow-crowned Night-heron
Birds	*Pandion haliaetus*	Osprey

Taxa	Scientific Name	Common Name
Birds	*Ictinia mississippiensis*	Mississippi Kite
Birds	*Haliaeetus leucocephalus*	Bald Eagle
Birds	*Circus cyaneus*	Northern Harrier
Birds	*Accipiter striatus*	Sharp-shinned Hawk
Birds	*Buteo platypterus*	Broad-winged Hawk
Birds	*Tyto alba*	Barn Owl
Birds	*Asio flammeus*	Short-eared Owl
Birds	*Falco peregrinus*	Peregrine Falcon
Birds	*Lanius ludovicianus*	Loggerhead Shrike
Birds	*Cistothorus platensis*	Sedge Wren
Birds	*Cistothorus palustris*	Marsh Wren
Birds	*Ammodramus henslowii*	Henslow's Sparrow
Birds	*Xanthocephalus xanthocephalus*	Yellow-headed Blackbird
Birds	*Sturnella neglecta*	Western Meadowlark
Birds	*Helmitheros vermivorum*	Worm-eating Warbler
Birds	*Vermivora chrysoptera*	Golden-winged Warbler
Birds	*Mniotilta varia*	Black-and-white Warbler
Birds	*Setophaga citrina*	Hooded Warbler
Birds	*Setophaga cerulea*	Cerulean Warbler
Fish	*Acipenser fulvescens*	Lake Sturgeon
Fish	*Anguilla rostrata*	American Eel
Fish	*Hybopsis amnis*	Pallid Shiner
Fish	*Noturus stigmosus*	Northern Madtom
Fish	*Amblyopsis hoosieri*	Hoosier Cavefish
Fish	*Percina copelandi*	Channel Darter
Fish	*Ammocrypta clara*	Western Sand Darter
Fish	*Etheostoma maculatum*	Spotted Darter
Mammals	*Sorex fumeus*	Smoky Shrew
Mammals	*Sorex hoyi*	American Pygmy Shrew
Mammals	*Myotis austroriparius*	Southeastern Myotis
Mammals	*Myotis grisescens*	Gray Myotis
Mammals	*Myotis leibii*	Eastern Small-footed Myotis
Mammals	*Myotis lucifugus*	Little Brown Myotis
Mammals	*Myotis septentrionalis*	Northern Long-eared Myotis
Mammals	*Myotis sodalis*	Indiana Myotis
Mammals	*Lasionycteris noctivagans*	Silver-haired Bat
Mammals	*Perimyotis subflavus*	Tri-colored Bat
Mammals	*Nycticeius humeralis*	Evening Bat
Mammals	*Lasiurus borealis*	Eastern Red Bat
Mammals	*Lasiurus cinereus*	Hoary Bat
Mammals	*Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat
Mammals	*Neotoma magister*	Allegheny Woodrat

Taxa	Scientific Name	Common Name
Mammals	*Ursus americanus*	Black Bear
Mammals	*Mustela nivalis*	Least Weasel
Mammals	*Taxidea taxus*	Badger
Mollusks	*Cyprogenia stegaria*	Fanshell
Mollusks	*Lampsilis fasciola*	Wavyrayed Lampmussel
Mollusks	*Obovaria subrotunda*	Round Hickorynut
Mollusks	*Plethobasus cyphyus*	Sheepnose
Mollusks	*Pleurobema cordatum*	Ohio Pigtoe
Mollusks	*Pleurobema plenum*	Rough Pigtoe
Mollusks	*Ptychobranchus fasciolaris*	Kidneyshell
Mollusks	*Simpsonaias ambigua*	Salamander Mussel
Mollusks	*Villosa lienosa*	Little Spectaclecase
Reptiles	*Macrochelys temminckii*	Alligator Snapping Turtle
Reptiles	*Terrapene carolina*	Eastern Box Turtle
Reptiles	*Pseudemys concinna*	River Cooter
Reptiles	*Thamnophis proximus*	Western Ribbonsnake
Reptiles	*Nerodia erythrogaster neglecta*	Copper-bellied Watersnake
Reptiles	*Clonophis kirtlandii*	Kirtland's Snake
Reptiles	*Opheodrys aestivus*	Rough Greensnake
Reptiles	*Cemophora coccinea*	Scarletsnake
Reptiles	*Tantilla coronata*	Southeastern Crowned Snake
Reptiles	*Agkistrodon piscivorus*	Cottonmouth
Reptiles	*Crotalus horridus*	Timber Rattlesnake

During the Habitat Survey, respondents were asked to evaluate the overall quality of fish and wildlife habitats in the Interior Plateau Region (Fig. 6-22), estimate changes in overall quality since 2005 (Fig. 6-23), and predict changes in overall quality over the next ten years (Fig. 6-24). Each respondent was asked to respond for one or more of the eight major habitat types within the region and results were aggregated at the regional level. A full list of the Habitat Survey results can be found in Appendix P.

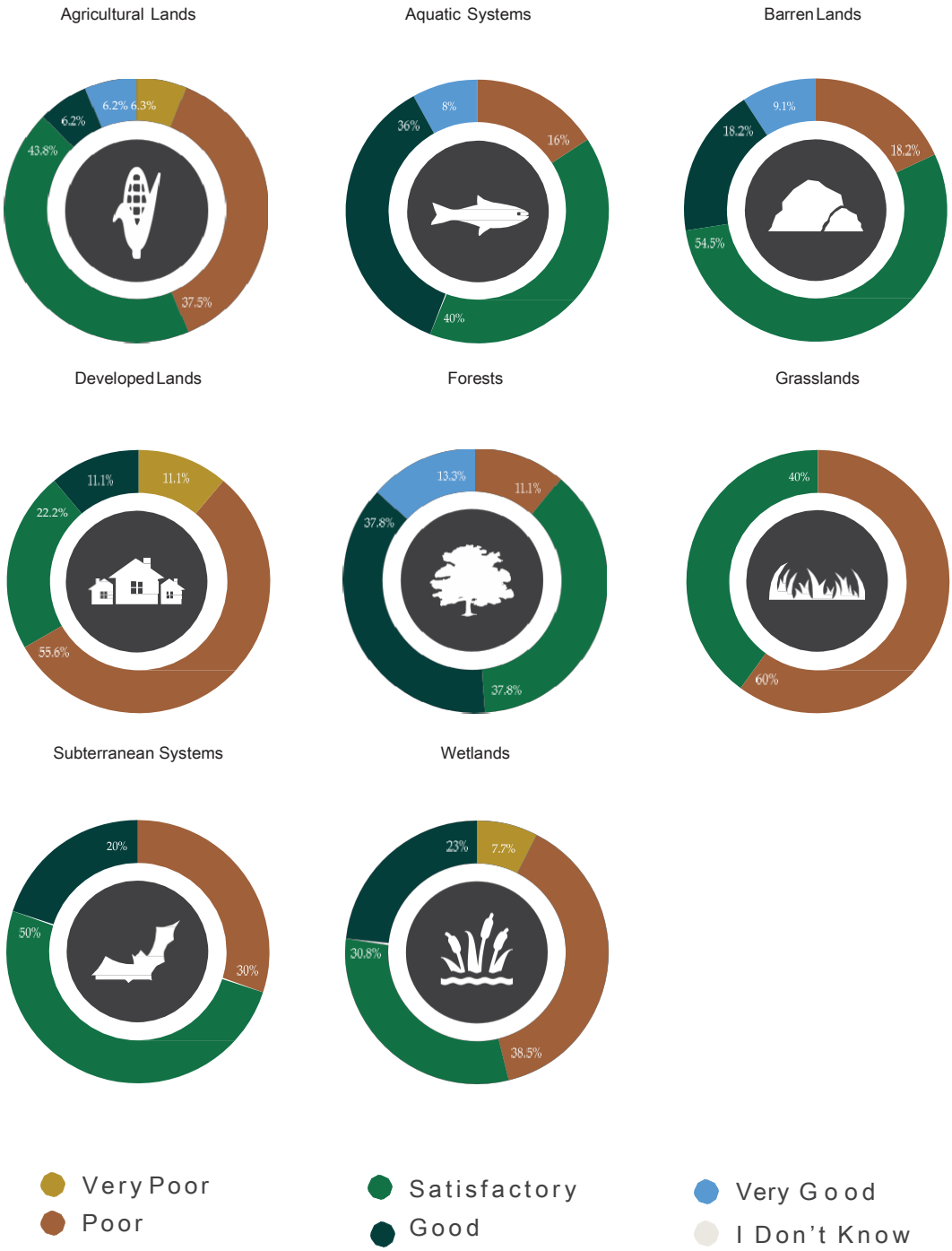


Figure 6-22. Overall quality of fish and wildlife habitats in the Interior Plateau Region in 2014.

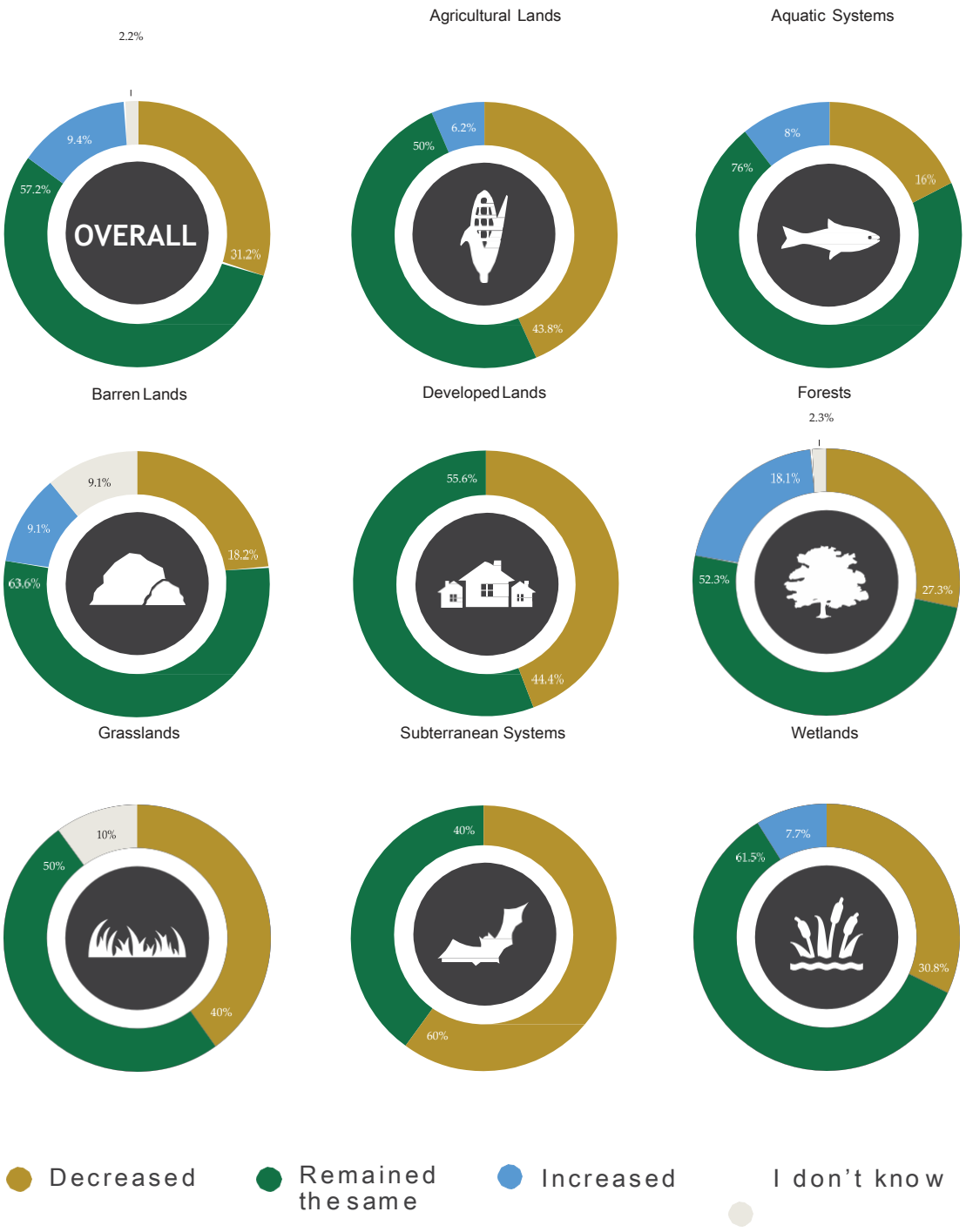


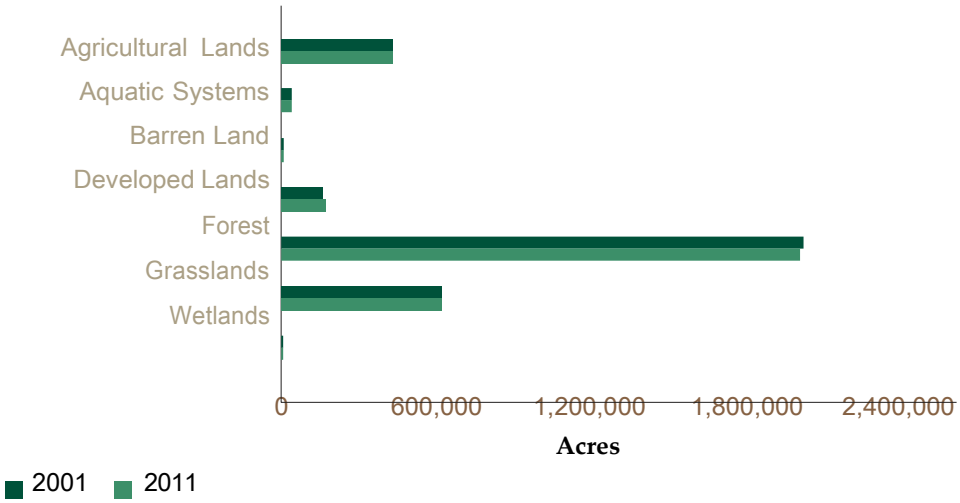
Figure 6-23. Estimated change in the overall quality of fish and wildlife habitats from 2005 to 2014 for each of the major habitat types in the Interior Plateau Region.

Figure 6-24. Predicted changes in overall quality of fish and wildlife habitats over the next ten years for each major habitat type in the Interior Plateau Region.

Changes in Land Cover

Unlike other regions of the state dominated by agriculture, most land cover in the Interior Plateau Region consists of forested land, followed by grasslands (Fig. 6-25). Compared to other Indiana regions, the Interior Plateau Region has the lowest percentage of agricultural lands at 13.1% and developed lands at 5.1%. It is the most forested region in the state and has the highest percentage of grasslands. The region is also home to most of Indiana's karst subterranean systems.

The Interior Plateau Region has experienced changes in habitat coverage over the past ten years. Aquatic systems, barren lands, developed lands, and wetlands increased, and agricultural lands, grasslands, and forests decreased. These habitats were mostly lost to urban development (Fig. 6-25). Percentage-wise, the greatest net losses were seen in forests (0.3%) and agricultural lands (0.2%). The greatest net increases were seen in barren lands (40.4%), wetlands (6.1%), and aquatic systems (4.6%).



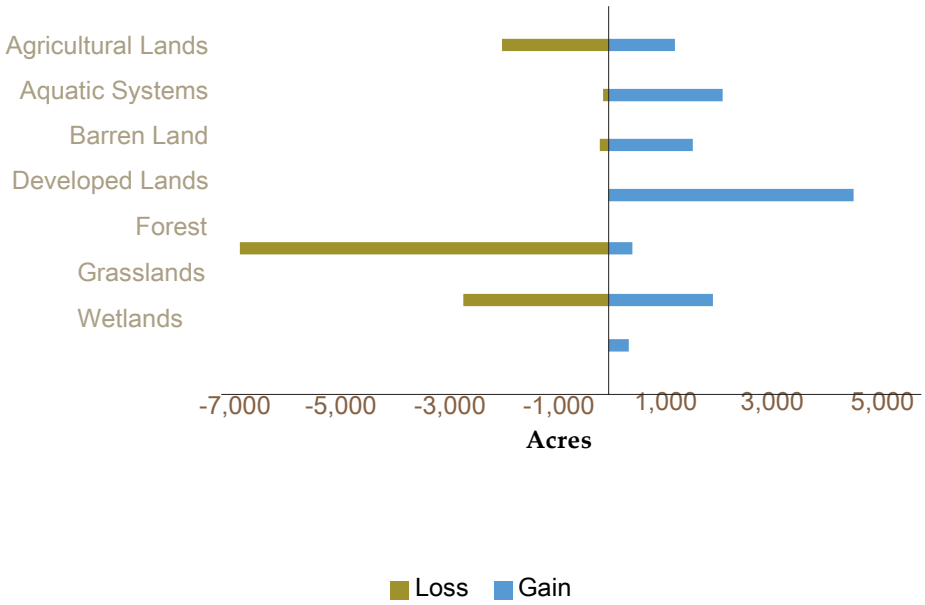


Figure 6-25. Distribution of land cover and losses and gains in land cover in the Interior Plateau Region between 2001 and 2011 from NLCD.

Threats Affecting Habitats

Top Threat Categories

The third element requires the description of threats to SGCN and their habitats. The SWAP identifies a habitat perspective in order to manage for the conservation of species in Indiana. This section utilizes the same hierarchical method of identifying and rating threats based on Salafsky et al. (2008) that was outlined in Chapter V. Category rankings and specific threat rankings for habitats in this region are outlined below (Table 6-14). A full summary of the Habitat Survey results for the Great Lakes Region can be found in Appendix P.

For first-level threat categories, both residential and commercial development and invasive and other problematic species were rated as significant to moderate threats, while the remaining categories were rated as moderate to minor threats. The invasive and other problematic species and genes category was identified as the top-ranking threat at the regional level. Invasive and alien species was rated as a significant to moderate specific second-level threat, receiving an average rating closer to significant for all habitat types.

Other specific threats in this category were only rated moderate to minor for the region. Residential and commercial development was rated highly for the region and first in developed lands and subterranean systems. Housing and urban areas was rated as the most significant threat for this region and was rated as a significant to moderate threat for the region. Respondents also wrote in free-response threats that connect to transportation and service corridors.

Agriculture and aquaculture received a mean rating very close to the significant to moderate threshold threat for the entire region. This category was additionally rated as the most significant for aquatic systems in the region. Conversion of habitat to annual crops was rated as a significant to moderate specific threat for the entire region. The pollution category also identified effluents from various sources, including agriculture, as the only significant to moderate threat within this category for the entire region.

Conversion of habitat was rated as the most significant threat within the natural systems modification category for the entire region. Human intrusion and disturbance and recreational activities within the human intrusion and disturbance category received moderate to minor threat ratings within this region.

Transportation and service corridors was rated as a more significant threat for forests and grasslands within this region. Roads and service corridors as a specific threat was rated as a significant to moderate threat for these habitat types. While other stressors, climate change and severe weather, energy production and mining, and biological resource use were rated as moderate to minor threat categories, each contained specific threats that were rated as significant to moderate across the entire region. Both specific threats in other direct stressors, diseases and genetic diversity, were rated in this top threat threshold; however, the diseases category

was consistently rated above low genetic diversity in terms of threat significance across all habitat types. All specific threats within climate change and severe weather were classified as significant to moderate for the entire region. Generally, changing frequency, duration, and intensity of drought and shifting and alteration of habitats due to climate change were identified as the top ranked threats for habitats in this region. Increased flooding because of climate change may be more of a concern in subterranean systems and wetlands.

Shale gas development was rated as the most significant threat across habitat types within energy production and mining. Other fossil fuel production may be more significant in aquatic systems, developed lands, and grasslands specifically. Mining and quarrying is the top rated threat in barren lands, subterranean systems, and wetlands.

Table 6-14. Threat category ranking to habitats in the Interior Plateau Region. First-level threat categories are based on the hierarchical method of identifying threats outlined in Salafsky et al. (2008). Ranked threat categories are arranged for the entire region by each major habitat type (1 - highest threat).

Category	Regional Ranking	Aquatic Systems	Agricultural Lands	Barren Lands	Developed Lands	Forests	Grasslands	Subterranean Systems	Wetlands
Invasive and Other Problematic Species and Genes	1	2	1	1	3	1	1	4	2
Residential and Commercial Development	2	3	2	2	1	2	2	1	3
Agriculture and Aquaculture	3	1	3	6	4	3	5	5	6
Pollution	4	4	7	7	2	9	7	2	1
Natural Systems Modification	5	5	4	3	5	8	9	7	4
Human Intrusion and Disturbance	6	6	6	4	6	6	6	3	5
Transportation and Service Corridors	7	7	5	10	8	4	3	6	7
Other Stressors	8	9	9	5	7	7	4	8	10
Climate Change and Severe Weather	9	8	11	8	10	5	10	10	9
Energy Production and Mining	10	10	8	9	9	10	8	9	8
Biological Resource Use	11	11	10	11	11	11	11	11	11

Top Specific Threats in Ranked Order

In the Habitat Survey, respondents were also asked to identify specific threats to major habitat types using the same threat category ranking system outlined in Salafsky et al. (2008). These second-level threats represent subcategories of threats within the major threat categories listed in the table above. The following are the top specific second-level threats to habitats in the Interior Plateau Region, aggregated across habitat types:

1. Invasive and alien species
2. Conversion of natural habitats to other land uses
3. Housing and urban areas
4. Conversion of habitat to annual crops
5. Agriculture, residential, and forestry effluents
6. Commercial and industrial areas
7. Household sewage and urban water waste
8. Runoff from roads and service corridors
9. Point source pollution from commercial and industrial sources
10. Annual and perennial non-timber crops

In the Species Survey, respondents were also asked to identify threats to individual SGCN using the same threat category ranking system. The following are the top specific second-level threats to SGCN occurring in the Interior Plateau Region, aggregated across all species:

1. Invasive and alien species
2. Natural habitat conversion
3. Housing and urban areas
4. Conversion of habitat to annual crops
5. Commercial and industrial areas
6. Annual and perennial non-timber crops
7. Dams and water management and use
8. Tourism and recreation areas
9. Recreation activities
10. Livestock farming and ranching

Emerging/Anticipated Threats

Respondents were asked specifically to identify any emerging or anticipated threats over the next ten years for fish and wildlife habitats within the major habitat types for a region in a free-response question.

For forests in this region, respondents identified as fragmentation, especially as a result of road development, invasion of forest pests, and escape of genetically modified pesticide resistant species as potential invaders as anticipated threats. Lack of management for early successional species, as well as changes in dominant species of forests impacting ecological communities are expected to threaten forest habitats in this region. There is growing concern about potential for other invasive plant and animal species as well. Expansion of feral swine

populations in the southern part of the state was listed as a potential threat by respondents in this region. Additionally, loss of funding for habitat conservation programs such as CRP were identified as a potential threat.

Conservation Actions Needed

Top Action Categories

The fourth element requires that the SWAP describe conservation actions proposed to conserve identified species and habitats as well as outlining priorities for their implementation. This section outlines conservation actions identified at the regional level for each of the major habitat types. This section follows the same protocol to rate and rank actions in this region based on Salafsky et al. (2008) that was outlined in Chapter V. A full list of survey results can be found in Appendix P. Category rankings for actions and specific actions are outlined in Table 6-15.

Land and water protection, land, water, and species management, education and awareness, and law and policy as categories received ratings, on average, between very and moderately important for this region. Livelihood, economic, and other incentives as well as external capacity received average ratings between moderately important and somewhat important. No category received a mean ranking between somewhat important and not important, indicating the identification of a variety of threats important to conservation of fish and wildlife habitats within this region.

Land and water protection was ranked first regionally and within all land types except for forests. Top actions within this category identified an importance to acquire currently unprotected habitats as well as preserve currently existing corridors between fish and wildlife habitats. Acquiring conservation easements and strengthening CRP partnerships were also ranked as most important for fish and wildlife habitats in grasslands and barren lands respectively.

Land, water, and species management was ranked second regionally, first in forests, and tied for first in agricultural lands. High-ranking actions in this region reflect a need to link habitat blocks, control invasive species, and restore natural systems in a variety of habitat types. Reducing loss of habitat was also identified as a high-ranking action regionally; it also ranked first in aquatic systems, agricultural lands, barren lands, developed lands, and forests within this category. Protecting adjacent buffer zones was also identified as the top ranking action for habitats within subterranean systems.

Education and awareness was ranked third regionally; however, education in general, educational programs for K-12, and training programs for stakeholders were, on average, rated between very important and moderately important. These three actions were ranked first for at least one habitat type within this region, indicating that a combination of them is likely necessary for comprehensive habitat conservation.

Using planning and zoning to reduce urban sprawl was the top ranking action regionally within law and policy. Increasing regulations on invasive species was also identified as the most important specific action for barren lands and forests. Respondents rated compliance and enforcement of current regulations above changing of policies in general but also suggested changes to regulations for sewage and installation of septic systems to benefit aquatic and subterranean

systems. Strengthening and enforcing mine reclamation regulations was also emphasized by respondents in the write-in section to be important for protecting fish and wildlife habitats in this region.

While livelihood, economic, and other incentives as well as external capacity building were ranked fifth and sixth regionally, all specific actions in this region were rated as very to moderately important or moderately to somewhat important. Developing both nonmonetary valuation and promoting conservation payments were identified as the highest ranking specific action for habitat types in livelihood, economic, and other incentives in this region. Strengthening conservation financing was also identified as important regionally and within habitat types, as well as promotion of use of research for decision-making for habitat within agricultural lands and development of partnerships and alliances, specifically for forests and wetlands.

Table 6-15. Action category ranking to habitats in the Interior Plateau Region. First-level categories are based on the hierarchical method of identifying actions outlined in Salafsky et al. (2008). Ranked action categories are arranged for the entire region by each major habitat type. (1 - highest threat).

Category	Regional Ranking	Aquatic Systems	Agricultural Lands	Barren Lands	Developed Lands	Forests	Grasslands	Subterranean Systems	Wetlands
Land/Water Protection	1	1	1	1	1	3	1	1	1
Land/Water/Species Management	2	2	1	2	2	1	2	3	2
Education and Awareness	3	3	4	4	3	2	3	2	3
Law and Policy	4	4	3	6	4	4	5	4	4
Livelihood, Economic, and Other Incentives	5	5	5	3	5	6	4	5	5
External Capacity Building	6	6	6	5	6	5	6	6	6
	Indicates a tie within this habitat type								

Top Specific Actions in Ranked Order

In the Habitat Survey, respondents were also asked to identify specific actions for major habitat types using the same action category ranking system outlined in Salafsky et al. (2008). These second-level actions represent subcategories of actions within the major action categories listed in the table above.

The following are the top specific second-level conservation actions for habitats in the Interior Plateau Region, aggregated across habitat types:

1. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
2. Develop education programs specifically for K-12
3. Preserve currently existing corridors
4. Develop educational programs in general
5. Reduce urban sprawl through planning and zoning
6. Acquire conservation easements to protect important wildlife habitats
7. Increase regulations on invasive species
8. Establish training programs for stakeholders
9. Reduce conversion to cropland
10. Improve compliance with and enforcement of current policies

The following are top actions for SGCN occurring for the Interior Plateau Region, as summarized from the free-response questions about conservation actions for individual species:

1. Educate and engage with landowners and citizens (especially bat ecology and issues)
2. Implement agricultural practices that improve water quality
3. Control invasive plants
4. Protect subterranean systems and limit recreational caving
5. Enhance connectivity of habitats
6. Protect large contiguous forested areas and reduce forest fragmentation
7. Use burning and mowing as management techniques in grasslands
8. Protect and manage large wetland complexes
9. Implement best management practices in forestry
10. Protect and restore riparian buffer zones

Prioritization of Actions

In order to prioritize these actions within an environment of limited resources, respondents were then asked to distribute hypothetical "effort points" to any action they had previously rated as "very important" for any of the major habitat types within a region. The effort ratings were averaged and then ranked to identify the top five actions for each region. A full list of these results can be found in Appendix P. Priority actions for the Interior Plateau Region include:

1. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
2. Control invasive species in forests
3. Reduce conversion to cropland
4. Strengthen conservation financing
5. Acquire currently unprotected forests

Overall, land, water, and species management actions like reducing loss of habitat, controlling invasive species, and reducing conversion to cropland were identified as priority actions in this region and reflect an identification of invasive species, development, and agriculture as high-ranking threat categories within this region. Respondents also prioritized an emphasis on forest habitat protection in land/water protection as well as strengthening conservation financing in order to facilitate the successful implementation of these land-based actions.

Threats and Actions by Major Habitat Type

The following summaries break down threats and conservation actions in this region by major habitat type, based on responses to the Habitat Survey and the Species Survey. The SGCN that occur there, top threats to SGCN, top actions for SGCN, key threats to habitats, and priority actions for each major habitat type in this region are summarized below.

Threats and actions were only included in detail below if a majority of eligible survey respondents, greater than 50%, rated them, to avoid artificially elevating items, which were highly ranked but only by a few respondents. This approach left some threats and action lists with no items for certain habitats, which is illogical from a practical perspective. Therefore, in these situations, the top threats and actions are still listed but are denoted with an asterisk (*) to signify that there may be some items, which seem out-of-place, reflecting a lack of sufficient response for a particular habitat in the survey. This approach and the survey design also caused for some disparities between threats and actions.

Approximately ten items are given for each list below. Lists may be shorter if fewer than ten items were rated by a majority of survey respondents, or longer if there were tires between items.

Top actions for SGCN were summarized from free-response questions about individual species and do not follow the same categorizations as actions for habitats. A full summary of the Habitat Survey responses can be found in Appendix P.

Agricultural Lands

Agricultural lands are defined as lands devoted to commodity production. Examples of agricultural lands include: intensively managed non-native grasses, row crops, fruit and nut-bearing trees, confined feeding operations, and feedlots.

Top threats to SGCN occurring in agricultural lands in the Interior Plateau Region:

1. Conversion of habitat to annual crops
2. Annual and perennial non-timber crops

Top conservation actions for SGCN occurring in agricultural lands in the Interior Plateau Region:

1. Educate and engage with landowners and citizens (benefits all species)
2. Reduce conversion of farmland to development
3. Increase use of CRP partnerships
4. Implement agricultural practices that improve water quality
5. Maintain shallow-water areas for migrating shorebirds
6. Provide incentives to farmers to increase landowner participation

Top threats to fish and wildlife habitats in agricultural lands in the Interior Plateau Region:

1. Conversion of natural habitats to other land uses
2. Invasive and alien species
3. Housing and urban areas
4. Conversion of habitat to annual crops
5. Commercial and industrial areas
6. Air pollution
7. Roads and railroads
8. Runoff from roads and service corridors
9. Agriculture, residential, and forestry effluents

Top conservation actions for fish and wildlife habitats in agricultural lands in the Interior Plateau Region:

1. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
2. Promote use of research and science in conservation decision-making processes
3. Preserve currently existing corridors
4. Reduce conversion to cropland
5. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
6. Link existing habitat blocks through corridor enhancement in agricultural lands
7. Restore and integrate diversity of habitats into crop-production dominated landscapes
8. Acquire conservation easements to protect important wildlife habitats
9. Increase regulations on invasive species
10. Reduce urban sprawl through planning and zoning

Aquatic Systems

Aquatic systems are defined as all water habitats, both flowing and stationary. Examples of aquatic systems include: manmade impoundments, natural lakes rivers, streams, oxbows, sloughs, embayments, and backwaters (not including wetlands).

Top threats to SGCN occurring in aquatic systems in the Interior Plateau Region:

1. Natural habitat conversion
2. Conversion of habitat to annual crops
3. Dams and water management and use
4. Annual and perennial non-timber crops
5. Livestock farming and ranching

Top conservation actions for SGCN occurring in aquatic systems in the Interior Plateau Region:

1. Enhance public, stakeholder, and landowner education and awareness
2. Implement agricultural best management practices to improve water quality
3. Protect and restore riparian buffer zones
4. Reduce sediment and nutrient loads
5. Reduce point and non-point source pollution
6. Remove dams
7. Clean polluted areas
8. Reduce recreational overuse
9. Restore floodplains
10. Reduce bank erosion
11. Limit bycatch of Hellbenders
12. Prohibit take of mussels

Top threats to fish and wildlife habitats in aquatic systems in the Interior Plateau Region:

1. Conversion of natural habitats to other land uses
2. Invasive and alien species
3. Agriculture, residential, and forestry effluents
4. Household sewage and urban water waste
5. Changing frequency, duration, and intensity of drought
6. Point source pollution from commercial and industrial sources
7. Conversion of habitat to annual crops
8. Dams and water management and use
9. Runoff from roads and service corridors
10. Changing frequency, duration, and intensity of floods

Top conservation actions for fish and wildlife habitats in aquatic systems in the Interior Plateau Region:

1. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
2. Develop education programs in general
3. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
4. Reduce nutrient and toxin loads (e.g., heavy metals, pharmaceuticals, fertilizers, insecticides)
5. Preserve currently existing corridors
6. Develop education programs specifically for K-12
7. Establish training programs for stakeholders
8. Strengthen conservation financing
9. Improve compliance with and enforcement of current policies
10. Acquire conservation easements to protect important wildlife habitats

Barren Lands

Barren lands are defined as lands dominated by exposed rock or minerals with sparse vegetation. Examples of barren lands include: sand/dunes, rock outcrops, cliffs, and bare rock.

Top threats to SGCN occurring in barren lands in the Interior Plateau Region:*

1. Natural habitat conversion
2. Housing and urban areas
3. Conversion of habitat to annual crops
4. Tourism and recreation areas
5. Recreation activities
6. Dams and water management and use

Top conservation actions for SGCN occurring in barren lands in the Interior Plateau Region:

1. Educate public about Peregrine Falcon
2. Protect Bald Eagle nest sites
3. Protect rocky cliff habitat for the Eastern Small-footed Myotis and Green Salamander
4. Establish corridors between Allegheny Woodrat habitat

Top threats to fish and wildlife habitats in barren lands in the Interior Plateau Region:

1. Invasive and alien species
2. Problematic native species (e.g. overabundant native deer or algae)
3. Plant diseases
4. Housing and urban areas
5. Commercial and industrial areas

Top conservation actions for fish and wildlife habitats in barren lands in the Interior Plateau Region:

1. Establish training programs for stakeholders
2. Promote conservation payment programs (e.g., payment for ecosystem services, conservation easements)
3. Promote nonmonetary values of natural systems within the state
4. Manage recreational opportunities to be compatible with fish and wildlife habitats
5. Link existing habitat blocks through corridor enhancement in barren lands
6. Protect adjacent buffer zones
7. Re-establish natural disturbance regimes in barren lands
8. Restore habitats and natural systems in barren lands
9. Develop education programs specifically for K-12

Developed Lands

Developed lands are defined as highly impacted lands intensively modified to support human habitation, transportation, commerce, and recreation. Examples of developed lands include: urban lands, suburban lands, industrial areas, commercial areas, towers for communication and wind power generation, and recreational areas such as golf courses and soccer fields.

Top threats to SGCN occurring in developed lands in the Interior Plateau Region:*

1. Renewable energy production
2. Invasive and alien species
3. Diseases from domestic populations and unknown sources
4. Fossil fuel energy production
5. Mining and quarrying

Top conservation actions for SGCN occurring in developed lands in the Interior Plateau Region:

1. Public education and awareness regarding bat ecology and issues
2. Reduce urban sprawl and commercial property expansion
3. Manage urban areas for Peregrine Falcons; minimize disturbance during nesting
4. Increase gravel-surfaced rooftop habitat for breeding Common Nighthawks
5. Mitigate road hazards for wildlife
6. Limit mowing along roads

Top threats to fish and wildlife habitats in developed lands in the Interior Plateau Region:

1. Invasive and alien species
2. Conversion of natural habitats to other land uses
3. Conversion of habitat to annual crops
4. Housing and urban areas
5. Commercial and industrial areas
6. Problematic native species
7. Recreation activities (e.g., ATVs, trail use, horseback riding, high-speed boating, canoeing)
8. Plant diseases
9. Garbage and solid waste
10. Household sewage and urban water waste

Top conservation actions for fish and wildlife habitats in developed lands in the Interior Plateau Region:

1. Preserve currently existing corridors
2. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
3. Reduce urban sprawl through planning and zoning
4. Reduce nutrient and toxin loads
5. Restore and integrate diversity of habitats into developed landscapes
6. Increase acres enrolled in the Classified Forest and Wildlands Program
7. Develop education programs in general
8. Develop education programs specifically for K-12
9. Increase regulations on invasive species
10. Set private sector standards and codes

Forests

Forests are defined as a plant community dominated by trees. Examples of forests include, but are not limited to, all stages of natural forest and plantations.

Top threats to SGCN occurring in forests in the Interior Plateau Region:*

1. Housing and urban areas
2. Natural habitat conversion
3. Invasive and alien species
4. Commercial and industrial areas
5. Diseases from domestic populations and unknown sources
6. Tourism and recreation areas
7. Problematic native species
8. Over-mowing of natural areas

Top conservation actions for SGCN occurring in forests in the Interior Plateau Region:

1. Protect large contiguous forested areas and reduce forest fragmentation
2. Limit conversion of forests to non-forest land uses
3. Control invasive woody plants in the understory
4. Reduce development in forested areas
5. Protect roost trees for bat species
6. Restore forests and woodlands
7. Create small forest openings to increase diversity
8. Implement best management practices in forestry
9. Re-establish bottomland hardwood forests
10. Manage forests adjacent to rocky habitat
11. Manage for healthy forest edge habitats

Top threats to fish and wildlife habitats in forests in the Interior Plateau Region:

1. Invasive and alien species
2. Conversion of natural habitats to other land uses
3. Housing and urban areas
4. Conversion of habitat to annual crops
5. Roads and railroads
6. Plant diseases
7. Problematic native species

Top conservation actions for fish and wildlife habitats in forests in the Interior Plateau Region:

1. Preserve currently existing corridors
2. Control invasive species in forests
3. Acquire currently unprotected forests
4. Acquire conservation easements to protect important wildlife habitats
5. Restore habitats and natural systems in forests
6. Increase regulations on invasive species
7. Promote diversity of forest types and successional stages
8. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
9. Reduce urban sprawl through planning and zoning
10. Develop education programs specifically for K-12

Grasslands

Grasslands are defined as an open area dominated by grass species. Examples of grasslands include: haylands, pasture, prairies, savannahs, or reclaimed mine lands.

Top threats to SGCN occurring in grasslands in the Interior Plateau Region:

1. Conversion of habitat to annual crops
2. Annual and perennial non-timber crops

Top conservation actions for SGCN occurring in grasslands in the Interior Plateau Region:

1. Restore and improve connectivity of grasslands
2. Maintain large tracts of grasslands
3. Reduce woody encroachment on grasslands
4. Increase CRP grasslands
5. Implement burning regimes
6. Minimize disturbance to nesting grassland birds (e.g., Henslow's Sparrow)
7. Mow properly (reduce mowing for shorebirds and owls)
8. Acquire conservation easements.
9. Improve grazing practices
10. Protect low, wet fields, and meadows

Top threats to fish and wildlife habitats in grasslands in the Interior Plateau Region:

1. Housing and urban areas
2. Commercial and industrial areas
3. Conversion of habitat to annual crops
4. Roads and railroads
5. Invasive and alien species
6. Annual and perennial non-timber crops
7. Livestock farming and ranching

Top conservation actions for fish and wildlife habitats in grasslands in the Interior Plateau Region:

1. Reduce urban sprawl through planning and zoning
2. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
3. Develop education programs in general
4. Develop education programs specifically for K-12
5. Acquire currently unprotected grasslands
6. Acquire conservation easements to protect important wildlife habitats
7. Re-establish natural disturbance regimes in grasslands
8. Restore habitats and natural systems in grasslands
9. Set private sector standards and codes
10. Improve compliance with and enforcement of current policies
11. Promote conservation payment programs (e.g., payment for ecosystem services, conservation easements)

Subterranean Systems

Subterranean systems are defined as connecting underground rooms and passages beyond natural light penetration. Examples of subterranean systems include: underground waters, above and below the water table, and terrestrial air-filled habitats ranging from large caves to interstitial crevices below soil horizons.

Top Threats to SGCN Occurring in Subterranean Systems in the Interior Plateau Region:

1. Invasive and alien species

Top conservation actions for SGCN occurring in subterranean systems in the Interior Plateau Region:

1. Protect subterranean systems
2. Limit recreational caving
3. Protect bat hibernacula

Top threats to fish and wildlife habitats in subterranean systems in the Interior Plateau Region:

1. Invasive and alien species
2. Runoff from roads and service corridors
3. Conversion of natural habitats to other land uses
4. Agriculture, residential, and forestry effluents
5. Housing and urban areas
6. Commercial and industrial areas
7. Roads and railroads
8. Chemical spills
9. Household sewage and urban water waste

Top conservation actions for fish and wildlife habitats in subterranean systems in the Interior Plateau Region:

1. Develop education programs specifically for K-12
2. Protect adjacent buffer zones
3. Acquire currently unprotected subterranean systems
4. Develop education programs in general
5. Control invasive species in subterranean systems
6. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
7. Acquire conservation easements
8. Strengthen conservation financing
9. Reduce nutrient and toxin loads
10. Promote nonmonetary values of natural systems within the state

Wetlands

Wetlands are defined as either ephemeral or permanently flooded habitat. Examples of wetlands include: swamps, marshes, bogs, fens, potholes, wetlands of farmed areas, and mudflats.

Top threats to SGCN occurring in wetlands in the Interior Plateau Region:

1. Invasive and alien species
2. Natural habitat conversion
3. Conversion of habitat to annual crops
4. Annual and perennial non-timber crops
5. Dams and water management and use

Top conservation actions for SGCN occurring in wetlands in the Interior Plateau Region:

1. Protect and maintain large wetlands complexes
2. Restore wetlands
3. Improve water quality
4. Protect buffers around wetlands
5. Control invasive plants in wetlands
6. Mitigate road hazards to amphibians and reptiles when roads cross over wetlands
7. Minimize disturbance to nesting turtles
8. Provide stopover and roosting habitat for cranes and shorebirds
9. Conserve ephemeral wetlands
10. Connect wetlands with surrounding upland habitat

Top threats to fish and wildlife habitats in wetlands in the Interior Plateau Region:

1. Conversion of natural habitats to other land uses
2. Invasive and alien species
3. Housing and urban areas
4. Commercial and industrial areas
5. Conversion of habitat to annual crops
6. Point source pollution from commercial and industrial sources
7. Annual and perennial non-timber crops
8. Air pollution
9. Agriculture, residential, and forestry effluents

Top conservation actions for fish and wildlife habitats in wetlands in the Interior Plateau Region:

1. Acquire currently unprotected wetlands
2. Reduce urban sprawl through planning and zoning
3. Restore habitats and natural systems in wetlands
4. Develop education programs specifically for K-12
5. Improve compliance with and enforcement of current policies
6. Reduce conversion to cropland
7. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
8. Improve drainage management
9. Protect adjacent buffer zones
10. Preserve currently existing corridors

F. DRIFT PLAINS REGION

Great Lakes
Kankakee
Corn Belt
Valleys and Hills
Interior Plateau
Drift Plains

Figure 6-26. Outline of the Drift Plains Region in Indiana for the SWAP.

Introduction

This section summarizes habitat conditions, threats to SGCN and their habitats, and conservation actions for species and habitats in the Drift Plains Region. This section also reviews land cover changes over the past decade and identifies unique habitat types in this region. Summaries of threats to and conservation actions for SGCN and their habitats that were generated from two surveys can be found at the end of this section.

In addition to the threats and actions identified in the Habitat Survey and the Species Survey, the DFW recognized the need to identify threats aligned with specific actions. Several threats and actions were identified as ubiquitous across all sixregions. These include:

- **Habitat Loss:** Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soilhealth)
- **Invasive Species:** Build external capacity (form and facilitate partnerships, alliances, and networks of organizations to address invasive species)
- **Law and Policy:** Develop, change, influence and help implement formal legislation, regulations and voluntary standards
- **Dams and Water Management and Use:** Remove unnecessary dams and utilize necessary dams with effective fish passage structures

The DFW also identified specific threats and actions for each SWAP region based on DFW priorities. These threats were identified due to their high level of relevancy to the specific region and the workability of the associated actions. These threats and actions for the Drift Plains Region include:

- **Habitat Loss of Barren Lands and Glades:** Build external capacity by forming partnerships and networks, raising and providing funds and resources for conservation organizations to maintain and protect barren lands and glades
    - Land management (e.g., timber cutting, fire, girdling, and mechanical and chemical treatments
- **Habitat Loss of Wetlands:** Build external capacity by forming partnerships and networks, raising and providing funds and resources for conservation organizations to maintain and protect wetlands

Current Habitat Conditions

During the Species Survey, respondents were asked to identify SGCN within the Drift Plains Region. A full summary of the Species Survey results can be found in Appendix O.

Table 6-16. Species of Great Conservation Need present in the Drift Plains Region.

Taxa	Scientific Name	Common Name
Amphibians	*Necturus maculosus*	Common Mudpuppy
Amphibians	*Ambystoma barbouri*	Streamside Salamander
Amphibians	*Hemidactylium scutatum*	Four-toed Salamander
Amphibians	*Acris blanchardi*	Blanchard's Cricket Frog
Amphibians	*Lithobates areolatus*	Crawfish Frog
Birds	*Cygnus buccinator*	Trumpeter Swan
Birds	*Colinus virginianus*	Northern Bobwhite
Birds	*Bonasa umbellus*	Ruffed Grouse
Birds	*Chordeiles minor*	Common Nighthawk
Birds	*Antrostomus vociferus*	Eastern Whip-poor-will
Birds	*Rallus elegans*	King Rail
Birds	*Gallinula galeata*	Common Gallinule
Birds	*Grus canadensis*	Sandhill Crane
Birds	*Grus americana*	Whooping Crane
Birds	*Pluvialis dominica*	American Golden-plover
Birds	*Charadrius melodus*	Piping Plover
Birds	*Bartramia longicauda*	Upland Sandpiper
Birds	*Arenaria interpres*	Ruddy Turnstone
Birds	*Calidris subruficollis*	Buff-breasted Sandpiper
Birds	*Limnodromus griseus*	Short-billed Dowitcher
Birds	*Scolopax minor*	American Woodcock
Birds	*Tringa solitaria*	Solitary Sandpiper
Birds	*Tringa melanoleuca*	Greater Yellowlegs
Birds	*Phalaropus tricolor*	Wilson's Phalarope
Birds	*Sternula antillarum athalassos*	Interior Least Tern
Birds	*Chlidonias niger*	Black Tern
Birds	*Botaurus lentiginosus*	American Bittern
Birds	*Ixobrychus exilis*	Least Bittern
Birds	*Ardea alba*	Great Egret
Birds	*Nycticorax nycticorax*	Black-crowned Night-heron
Birds	*Nyctanassa violacea*	Yellow-crowned Night-heron
Birds	*Pandion haliaetus*	Osprey
Birds	*Ictinia mississippiensis*	Mississippi Kite

Taxa	Scientific Name	Common Name
Birds	*Haliaeetus leucocephalus*	Bald Eagle
Birds	*Circus cyaneus*	Northern Harrier
Birds	*Accipiter striatus*	Sharp-shinned Hawk
Birds	*Buteo platypterus*	Broad-winged Hawk
Birds	*Tyto alba*	Barn Owl
Birds	*Asio flammeus*	Short-eared Owl
Birds	*Falco peregrinus*	Peregrine Falcon
Birds	*Lanius ludovicianus*	Loggerhead Shrike
Birds	*Cistothorus platensis*	Sedge Wren
Birds	*Cistothorus palustris*	Marsh Wren
Birds	*Ammodramus henslowii*	Henslow's Sparrow
Birds	*Xanthocephalus xanthocephalus*	Yellow-headed Blackbird
Birds	*Helmitheros vermivorum*	Worm-eating Warbler
Birds	*Vermivora chrysoptera*	Golden-winged Warbler
Birds	*Mniotilta varia*	Black-and-white Warbler
Birds	*Setophaga citrina*	Hooded Warbler
Birds	*Setophaga cerulea*	Cerulean Warbler
Fish	*Anguilla rostrata*	American Eel
Fish	*Noturus stigmosus*	Northern Madtom
Fish	*Etheostoma variatum*	Variegate Darter
Fish	*Percina copelandi*	Channel Darter
Fish	*Percopsis omiscomaycus*	Trout-perch
Mammals	*Sorex hoyi*	American Pygmy Shrew
Mammals	*Myotis grisescens*	Gray Myotis
Mammals	*Myotis lucifugus*	Little Brown Myotis
Mammals	*Myotis septentrionalis*	Northern Long-eared Myotis
Mammals	*Myotis sodalis*	Indiana Myotis
Mammals	*Lasionycteris noctivagans*	Silver-haired Bat
Mammals	*Perimyotis subflavus*	Tri-colored Bat
Mammals	*Nycticeius humeralis*	Evening Bat
Mammals	*Lasiurus borealis*	Eastern Red Bat
Mammals	*Lasiurus cinereus*	Hoary Bat
Mammals	*Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat
Mammals	*Ursus americanus*	Black Bear
Mammals	*Mustela nivalis*	Least Weasel
Mammals	*Taxidea taxus*	American Badger
Mollusks	*Plethobasus cyphyus*	Sheepnose
Mollusks	*Pleurobema cordatum*	Ohio Pigtoe
Mollusks	*Ptychobranchus fasciolaris*	Kidneyshell
Mollusks	*Simpsonaias ambigua*	Salamander Mussel
Mollusks	*Toxolasma lividum*	Purple Lilliput
Mollusks	*Villosa lienosa*	Little Spectaclecase

Taxa	Scientific Name	Common Name
Reptiles	*Terrapene carolina*	Eastern Box Turtle
Reptiles	*Nerodia erythrogaster neglecta*	Copper-bellied Watersnake
Reptiles	*Clonophis kirtlandii*	Kirtland's Snake
Reptiles	*Opheodrys aestivus*	Rough Greensnake
Reptiles	*Cemophora coccinea*	Scarletsnake
Reptiles	*Tantilla coronata*	Southeastern Crowned Snake
Reptiles	*Crotalus horridus*	Timber Rattlesnake

During the Habitat Survey, respondents were asked to evaluate the overall quality of fish and wildlife habitats in the Drift Plains Region (Fig. 6-27), estimate changes in overall quality since 2005 (Fig. 6-28), and predict changes in overall quality over the next ten years (Fig. 6-29). Each respondent was asked to respond for one or more of the eight major habitat types within the region and results were aggregated at the regional level. A full list of the Habitat Survey results can be found in Appendix P.

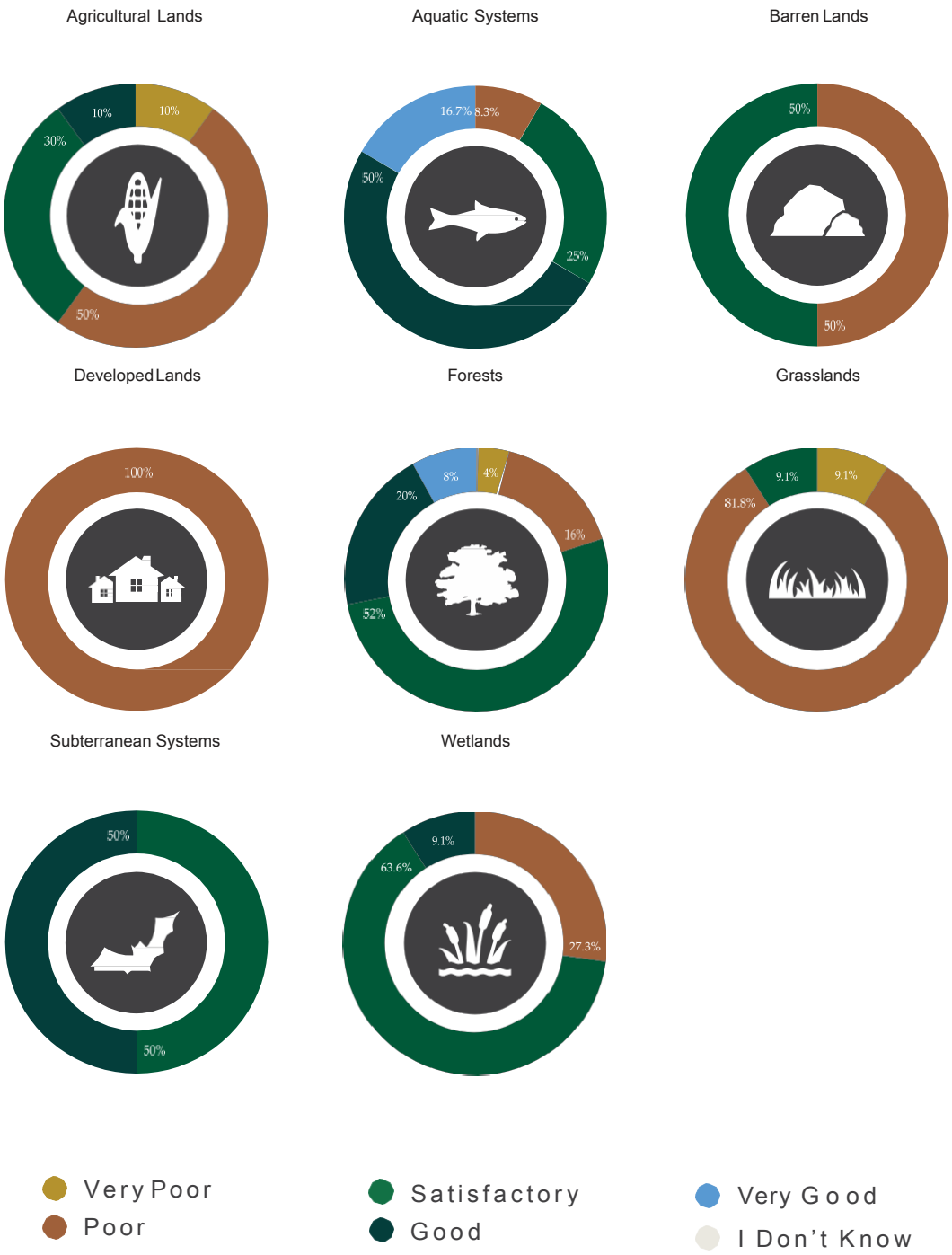


Figure 6-27. Overall quality of fish and wildlife habitats in the Drift Plains Region in 2014.

Figure 6-28. Estimated change in the overall quality of fish and wildlife habitats from 2005 to 2014 for each of the major habitat types in the Drift Plains Region.

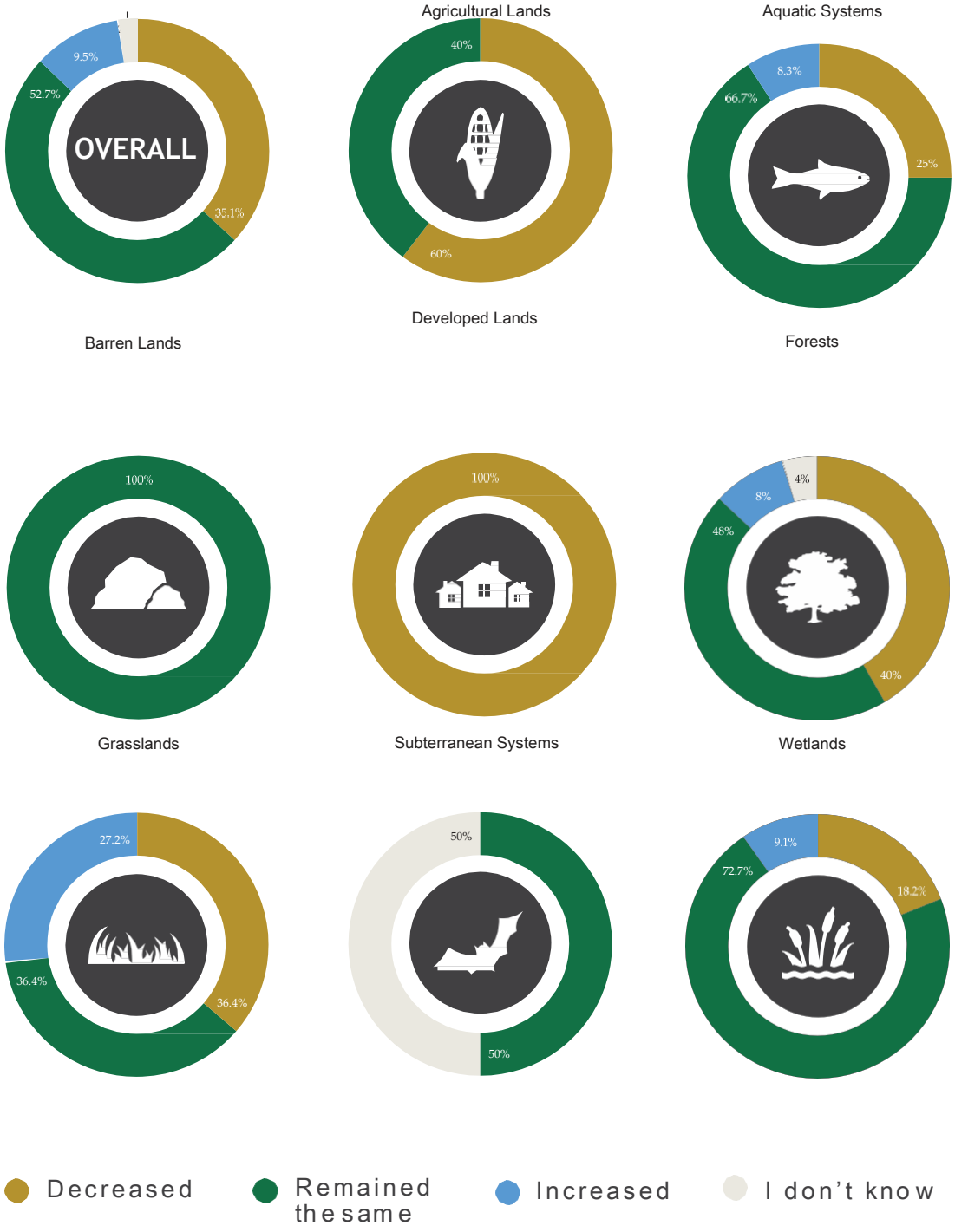
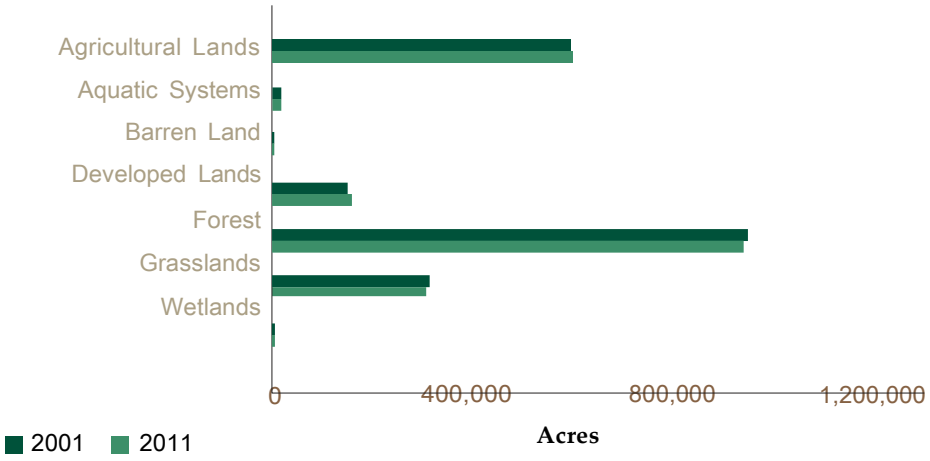


Figure 6-29. Predicted changes in overall quality of fish and wildlife habitats over the next ten years for each major habitat type in the Drift Plains Region.

Changes in Land Cover

Unlike other regions of the state, which are dominated by agricultural lands, most land cover in the Drift Plains Region consists of forested land, followed by agricultural lands and grasslands (Fig. 6-30). Compared to other Indiana regions, the Drift Plains Region has a relatively low percentage of developed lands. The region is also home to limited areas of Indiana's karst subterranean systems.

The Drift Plains Region has experienced changes in habitat coverage over the past ten years. Agricultural lands, aquatic systems, barren lands, developed lands, and wetlands increased while forests and grasslands decreased. These habitats were mostly lost to urban development (Fig. 6-30). Percentage-wise, the greatest net losses were seen in grasslands (1.3%) and forests (0.6%). The greatest net increases were seen in wetlands (59.6%), barren lands (23.6%), and aquatic systems (4.4%). Comprising of only .03% of the total land cover in the region, these habitat types were not abundant to begin with.



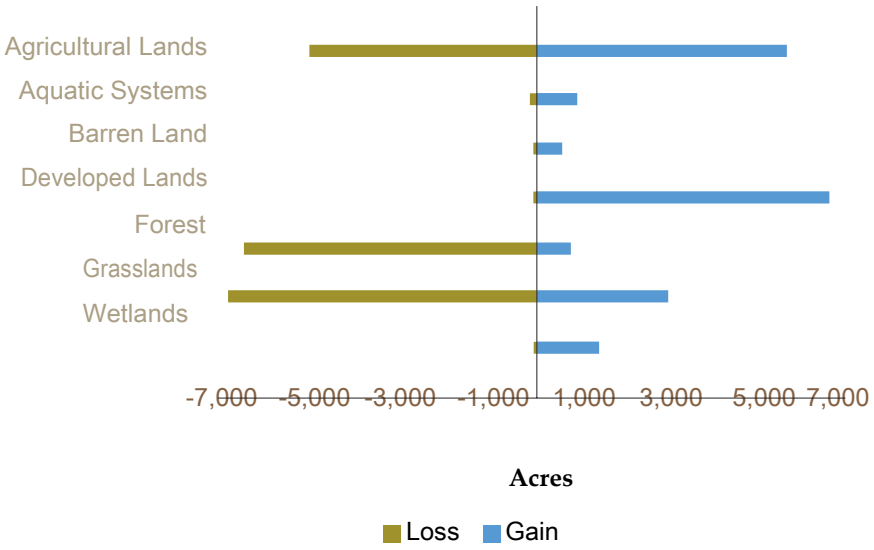


Figure 6-30. Distribution of land cover and losses and gains in land cover in the Drift Plains Region between 2001 and 2011 from NLCD.

Threats Affecting Habitats

Top Threat Categories

The third element requires the description of threats to SGCN and their habitats. The SWAP identifies a habitat perspective in order to manage for the conservation of species in Indiana. This section utilizes the same hierarchical method of identifying and rating threats based on Salafsky et al. (2008) that was outlined in Chapter V. Category rankings and specific threat rankings for habitats in this region are outlined below (Table 6-17). A full summary of the Habitat Survey results for the Great Lakes Region can be found in Appendix P.

For first-level threat categories, all threat categories were rated either significant to moderate or moderate to minor for the region. Agriculture and aquaculture was identified as a significant threat to habitats within this region. Within this category, conversion of habitat to annual crops and annual and perennial non-timber crops were both, on average, rated as significant to moderate specific second-level threats.

Residential and commercial development was ranked highly across different major habitat types; invasive and other problematic species and genes were also rated highly across categories. Invasive and alien species received a mean threat rating between significant and moderate, while other specific threats in this category were rated in the moderate to minor threat level for this region.

Categories ranked below invasive species received regional ratings of moderate-minor threats. Human intrusion and disturbance was ranked as the most significant threat category for barren lands, developed lands, and subterranean systems. Within barren lands and subterranean systems, recreational activities were rated as a significant to moderate threat. Natural system modification was rated as the top threat in wetlands. Within this category, natural habitat conversion was rated as a significant and moderate threat to wetlands.

Within the pollution category, the most significant threats identified were runoff from service corridors, agricultural and residential development, and forestry effluents and point source pollution. Both diseases and low genetic diversity were rated as significant to moderate threats within other stressors, another mid-ranked threat category to this region.

Energy production and mining, climate change and other severe weather, and biological resource use were on average rated closer to minor threats than moderate threats. However, within the climate change category, temperature extremes, shifting seasons, and changing frequency/duration of droughts were rated as significant to moderate specific threats within the region. Forestry practices were also rated as a significant to moderate threat across all habitat types and rated especially high in barren lands, grasslands, and wetlands.

Table 6-17. Threat category ranking to habitats in the Drift Plains Region. First-level threat categories are based on hierarchical method of identifying threats outlines in Salafsky et al. (2008). Ranked threat categories for the entire region are arranged by each major habitat type (1 - highest threat).

Category	Regional Ranking	Aquatic Systems	Agricultural Lands	Barren Lands	Developed Lands	Forests	Grasslands	Subterranean Systems	Wetlands
Agriculture and Aquaculture	1	1	1	3	8	3	1	6	2
Residential and Commercial Development	2	3	3	2	2	2	3	3	3
Invasive and Other Problematic Species and Genes	3	2	2	4	3	1	4	2	7
Human Intrusion and Disturbance	4	8	4	1	1	4	2	1	6
Natural Systems Modification	5	4	6	9	5	7	6	7	1
Pollution	6	5	5	5	6	6	7	4	5
Other Stressors	7	9	7	6	10	5	5	9	4
Transportation and Service Corridors	8	7	9	7	4	10	9	5	9
Energy Production and Mining	9	6	10	8	9	11	10	11	8
Climate Change and Severe Weather	10	10	8	11	11	9	11	8	10
Biological Resource Use	11	11	11	10	7	8	8	10	11

Top Specific Threats in Ranked Order

In the Habitat Survey, respondents were also asked to identify specific threats to major habitat types using the same threat category ranking system outlined in Salafsky et al. (2008). These second-level threats represent subcategories of threats within the major threat categories listed in the table above. The following are the top specific second-level threats to habitats in the Drift Plains Region, aggregated across habitat types:

1. Invasive and alien species
2. Conversion of habitat to annual crops
3. Conversion of natural habitats to other land uses
4. Housing and urban areas
5. Commercial and industrial areas
6. Recreation activities
7. Annual and perennial non-timber crops
8. Plant diseases
9. Problematic native species
10. Livestock farming and ranching

In the Species Survey, respondents were also asked to identify threats to individual SGCN using the same threat category ranking system. The following are the top specific (second-level) threats to SGCN occurring in the Drift Plains Region, aggregated across all species:

1. Natural habitat conversion
2. Invasive and alien species
3. Housing and urban areas
4. Conversion of habitat to annual crops
5. Commercial and industrial areas
6. Annual and perennial non-timber crops
7. Tourism and recreation areas
8. Recreation areas
9. Livestock farming and ranching

Emerging/Anticipated Threats

Respondents were asked specifically to identify any emerging or anticipated threats over the next ten years for fish and wildlife habitats within the major habitat types for a region in a free-response question.

In this region, respondents identified an emerging threat was a growing disconnect to natural resources, which might increase difficulty in sustaining public support for lands devoted to conservation. Other respondents identified more land-based threats like fragmentation and forest pests, such as the emerald ash borer.

Conservation Actions Needed

Top Action Categories

The fourth element requires that the SWAP describe conservation actions proposed to conserve identified species and habitats as well as outlining priorities for their implementation. This section outlines conservation actions identified at the regional level for each of the major habitat types. This section follows the same protocol to rate and rank actions in this region based on Salafsky et al. (2008) that was outlined in Chapter V. A full list of survey results can be found in Appendix P. Category rankings for actions and specific actions are outlined in the list on the following page (Table 6-18).

Regionally, land, water, andspecies management, educationandawareness, land and water protection, and livelihood, economic, and other incentives received average category ratings between very and moderately important. Law and policy and external capacity building were rated between moderately and somewhat important. No action category ranked in the somewhat to not important range, indicating the identification of a wide range and variety of specific actions important to conservation of habitats within the region.

Within land, water, and species management, approximately half of the specific actions were on average rated as very to moderately important regionally. Top-ranking actions identified a need to restore natural systems, promote a diversity of successional stages, and control invasive species in a variety of habitat types. Reducing loss of habitat was also ranked as the most important action in agricultural lands, barren lands, and developed lands while being highly ranked in the remaining habitat types. Species reintroduction was also identified as important in forests, grasslands, and wetlands, with respondents suggesting reintroduction of extirpated native species, native grasses, quail and other game birds, crawfish frog, elk, black bears, wolves, hellbenders, and threatened mussel species.

Education and awareness also ranked highly for this region. Education programs in general, education programs for K-12, and training programs for stakeholders all received mean ratings between very and moderately important for this region.

Land and water protection was ranked third regionally; every specific action except for acquiring currently unprotected barren lands was rated between very and moderately important. Important actions in this region reflects a need to acquire unprotected habitats and preserve currently existing corridors. Reducing conversion to cropland and strengthening CRP partnerships were also identified as the most important actions in multiple habitat types.

Livelihood, economic, and other incentives was ranked between very and moderately important as a category within this region. Promoting conservation payments was ranked fi regionally and within every habitat type within this category. Promoting nonmonetary values of natural systems and managing recreational opportunities to be compatible with fish and wildlife habitats were also both rated as very to moderately important specific actions within this category for this region.
Within law and policy, respondents identified an importance for regulations on invasive species and improving compliance and enforcement of current policies. Using zoning to reduce urban sprawl was ranked as the most important action for habitats in aquatic systems and developed lands. Changing current policy was rated between moderately to somewhat important, but respondents did suggest

policy changes to increase pollution control regulations, reducing turtle harvest, and wetland mitigation.

Promotion of research in conservation decision-making, developing alliances and partnerships, increasing state's capacity for research and monitoring of conservation actions, and strengthening conservation financing were all rated between very and moderately important within external capacity building for this region.

Table 6-18. Action category ranking to habitats in the Drift Plains Region. First-level categories are based on the hierarchical method of identifying actions outlined in Salafsky et al. (2008). Ranked actions for the entire region are arranged by each major habitat type.

Category	Regional Ranking	Aquatic Systems	Agricultural Lands	Barren Lands	Developed Lands	Forests	Grasslands	Subterranean Systems	Wetlands
Land/Water/Species Management	1	2	1	3	3	1	1	1	1
Education and Awareness	2	3	2	3	1	2	2	4	3
Land/Water Protection	3	1	5	1	3	4	3	1	2
Livelihood, Economic, and Other Incentives	4	4	3	1	3	4	4	5	5
Law and Policy	5	6	5	5	1	3	6	1	4
External Capacity Building	6	5	4	5	3	6	5	5	6
	Indicates a tie within this habitat type								

Top Specific Actions in Ranked Order

In the Habitat Survey, respondents were also asked to identify specific actions for major habitat types using the same action category ranking system outlined in Salafsky et al. (2008). These second-level actions represent subcategories of actions within the major action categories listed in the table above. The following are the top specific second-level conservation actions for habitats in the Drift Plains

Region, aggregated across habitat types:

1. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
2. Develop education programs in general
3. Develop education programs specifically for K-12
4. Preserve currently existing corridors
5. Increase acres of riparian buffers
6. Reduce conversion to cropland
7. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
8. Establish training programs for stakeholders
9. Increase regulations on invasive species
10. Acquire conservation easements to protect important wildlife habitats

The following are top actions for SGCN occurring in the Drift Plains Region, as summarized from the free-response questions about conservation actions for individual species:

1. Educate and engage with landowners and citizens (especially regarding bat ecology and issues)
2. Implement agricultural practices that improve water quality
3. Protect large contiguous forested areas and reduce forest fragmentation
4. Control invasive plants
5. Enhance connectivity of habitats
6. Use burning and mowing as management techniques in grasslands
7. Protect and manage large wetland complexes
8. Implement best management practices in forestry
9. Protect/Restore riparian buffer zones
10. Protect subterranean systems and limit recreational caving

Prioritization of Actions

In order to prioritize these actions within an environment of limited resources, respondents were then asked to distribute hypothetical "effort points" to any action they had previously rated as "very important" for any of the major habitat types within a region. The effort ratings were averaged and then ranked to identify the top five actions for each region. A full list of these results can be found in Appendix P. Priority actions for the Drift Plains Region include:

1. Promote diversity of forest types and successional stages
2. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
3. Control invasive species in forests
4. Preserve currently existing corridors
5. Acquire currently unprotected wetlands

Priority actions in this region are mostly drawn from land, water, and species management and land and water protection. Forests-specific and wetland-specific actions, like promoting diversity of successional stages in forests, controlling invasive species in forests, and acquiring currently unprotected wetlands, were all included in this set of priority actions. Preserving currently existing corridors, which is not tied to any specific habitat type, was another land and water protection effort allocated to this region. Strengthening conservation financing was an external capacity building action identified to facilitate the implementation of the other land-based actions.

Threats and Actions by Major Habitat Type

The following summaries break down threats and conservation actions in this region by major habitat type, based on responses to the Habitat Survey and the Species Survey. The SGCN that occur there, top threats to SGCN, top actions for SGCN, key threats to habitats, and priority actions for each major habitat type in this region are summarized on the following pages.

Threats and actions were only included in detail below if a majority of eligible survey respondents, greater than 50%, rated them, to avoid artificially elevating items, which were highly ranked but only by a few respondents. This approach left some threats and action lists with no items for certain habitats, which is illogical from a practical perspective. Therefore, in these situations, the top threats and actions are still listed but are denoted with an asterisk (*) to signify that there may be some items, which seem out-of-place, reflecting a lack of sufficient response for a particular habitat in the survey. This approach and the survey design also caused for some disparities between threats and actions.

Approximately ten items are given for each list below. Lists may be shorter if fewer than ten items were rated by a majority of survey respondents, or longer if there were tires between items.

Top actions for SGCN were summarized from free-response questions about individual species and do not follow the same categorizations as actions for habitats. A full summary of the Habitat Survey responses can be found in Appendix P.

Agricultural Lands

Agricultural lands are defined as lands devoted to commodity production. Examples of agricultural lands include: intensively managed non-native grasses, row crops, fruit and nut-bearing trees, confined feeding operations, and feedlots.

Top threats to SGCN occurring in agricultural lands in the Drift Plains Region:

1. Natural habitat conversion
2. Conversion of habitat to annual crops
3. Annual and perennial non-timber crops

Top conservation actions for SGCN occurring in agricultural lands in the Drift Plains Region:

1. Educate and engage with landowners and citizens
2. Increase use of CRP partnerships
3. Implement agricultural practices that improve water quality
4. Maintain shallow-water areas for migrating shorebirds
5. Establish no-plow zones
6. Provide incentives to farmers to increase landowner participation

Top threats to fish and wildlife habitats in agricultural lands in the Drift Plains Region:

1. Conversion of habitat to annual crops
2. Housing and urban areas
3. Over-mowing of natural areas
4. Commercial and industrial areas
5. Conversion of natural habitats to other land uses
6. Recreational activities
7. Log jam removal
8. Annual and perennial non-timber crops
9. Tourism and recreational areas
10. Livestock farming and ranching

Top conservation actions for fish and wildlife habitats in agricultural lands in the Drift Plains Region:

1. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
2. Build and strengthen CRP partnerships
3. Develop education programs in general
4. Develop education programs specifically for K-12
5. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
6. Preserve currently existing corridors
7. Improve compliance with and enforcement of current policies
8. Link existing habitat blocks through corridor enhancement in agricultural lands
9. Promote conservation payment programs (e.g., payment for ecosystem services, conservation easements)
10. Promote nonmonetary values of natural systems within the state

Aquatic Systems

Aquatic systems are defined as all water habitats, both flowing and stationary. Examples of aquatic systems include: manmade impoundments, natural lakes rivers, streams, oxbows, sloughs, embayments, and backwaters (not including wetlands).

Top threats to SGCN occurring in aquatic systems in the Drift Plains Region:

1. Natural habitat conversion
2. Dams and water management and use

Top conservation actions for SGCN occurring in aquatic systems in the Drift Plains Region:

1. Enhance public, stakeholder, and landowner education and awareness
2. Implement agricultural best management practices to improve water quality
3. Reduce sediment and nutrient loads
4. Reduce point and non-point source pollution
5. Clean up polluted areas
6. Protect and restore riparian buffer zones
7. Reconnect floodplains and rivers
8. Remove dams
9. Reduce bank erosion

Top threats to fish and wildlife habitats in aquatic systems in the Drift Plains Region:

1. Invasive and alien species
2. Conversion of natural habitats to other land uses
3. Annual and perennial non-timber crops
4. Conversion of habitat to annual crops
5. Commercial and industrial areas
6. Problematic native species
7. Housing and urban areas
8. Dams and water management and use
9. Livestock farming and ranching
10. Introduced genetic material

Top conservation actions for fish and wildlife habitats in aquatic systems in the Drift Plains Region:

1. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
2. Increase acres of riparian buffers
3. Reduce conversion to cropland
4. Reduce stream bank erosion
5. Restore habitats and natural systems in aquatic systems
6. Acquire currently unprotected aquatic systems
7. Preserve currently existing corridors
8. Acquire conservation easements to protect important wildlife habitats
9. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
10. Reduce nutrient and toxin loads (e.g., heavy metals, pharmaceuticals, fertilizers, insecticides)

Barren Lands

Barren lands are defined as lands dominated by exposed rock or minerals with sparse vegetation. Examples of barren lands include: sand/dunes, rock outcrops, cliffs, and bare rock.

Top threats to SGCN occurring in barren lands in the Drift Plains Region:

1. Natural habitat conversion
2. Dams and water management and use

Top conservation actions for SGCN occurring in barren lands in the Drift Plains Region:

1. Educate public about Peregrine Falcon
2. Protect Bald Eagle nest sites

Top threats to fish and wildlife habitats in barren lands in the Drift Plains Region:

1. Recreational activities
2. Tourism and recreation areas
3. Housing and urban areas
4. Commercial and industrial areas

Top conservation actions for fish and wildlife habitats in barren lands in the Drift Plains Region:

1. Reduce conversion to cropland
2. Strengthen and increase CRP partnerships
3. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
4. Species reintroduction
5. Develop education programs in general
6. Develop education programs specifically for K-12
7. Training programs for stakeholders
8. Promote conservation payment programs (e.g., payment for ecosystem services, conservation easements)

Developed Lands

Developed lands are defined as highly impacted lands intensively modified to support human habitation, transportation, commerce, and recreation. Examples of developed lands include: urban lands, suburban lands, industrial areas, commercial areas, towers for communication and wind power generation, and recreational areas such as golf courses and soccer fields.

Top threats to SGCN occurring in developed lands in the Drift Plains Region:*

1. Housing and urban areas
2. Commercial and industrial areas
3. Renewable energy production
4. Conversion of habitat to annual crops
5. Invasive and alien species
6. Diseases from domestic populations and unknown sources
7. Mining and quarrying
8. Fossil fuel energy production
9. Tourism and recreation areas

Top conservation actions for SGCN occurring in developed lands in the Drift Plains Region:

1. Enhance public education and awareness (especially regarding bat ecology and issues)
2. Reduce urban sprawl and commercial property expansion
3. Manage urban areas for Peregrine Falcons; minimize disturbance during nesting
4. Increase gravel-surfaced rooftop habitat for breeding Common Nighthawks
5. Mitigate road hazards for wildlife
6. Limit mowing along roads

Top threats to fish and wildlife habitats in developed lands in the Drift Plains Region:

1. Housing and urban areas
2. Commercial and industrial areas
3. Runoff from roads and service corridors

Top conservation actions for fish and wildlife habitats in Developed Lands in the Drift Plains Region:

1. Preserve currently existing corridors
2. Increase acres of riparian buffers
3. Link existing habitat blocks through corridor enhancement in developed lands
4. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
5. Develop education programs in general
6. Develop education programs specifically for K-12
7. Increase regulations on invasive species
8. Reduce urban sprawl through planning and zoning
9. Establish training programs for stakeholders

Forests

Forests are defined as a plant community dominated by trees. Examples of forests include, but are not limited to, all stages of natural forest and plantations.

Top threats to SGCN occurring in forests in the Drift Plains Region:*

1. Natural habitat conversion
2. Housing and urban areas
3. Conversion of habitat to annual crops
4. Invasive and alien species
5. Annual and perennial non-timber crops
6. Commercial and industrial areas
7. Diseases from domestic populations and unknown sources
8. Fire and fire suppression
9. Wood and pulp plantations
10. Tourism and recreation areas
11. Over-mowing of natural areas
12. Livestock farming and ranching

Top conservation actions for SGCN occurring in forests in the Drift Plains Region:

1. Protect large contiguous forested areas and reduce forest fragmentation
2. Limit conversion of forests to non-forest land uses
3. Control invasive woody plants
4. Restore forests and woodlands
5. Implement best management practices in forestry
6. Reduce development in forested areas
7. Protect roost trees for bat species
8. Create small forest openings to increase diversity

Top threats to fish and wildlife habitats in forests in the Drift Plains Region:

1. Invasive and alien species
2. Housing and urban areas
3. Conversion of habitat to annual crops
4. Problematic native species
5. Commercial and industrial areas
6. Plant diseases
7. Annual and perennial non-timber crops
8. Introduced genetic material
9. Livestock farming and ranching
10. Tourism and recreation areas

Top conservation actions for fish and wildlife habitats in forests in the Drift Plains Region:

1. Control invasive species in forests
2. Preserve currently existing corridors
3. Restore habitats and natural systems in forests
4. Promote use of research and science in conservation decision-making processes
5. Develop education programs in general
6. Develop education programs specifically for K-12
7. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
8. Increase state's capacity for research and monitoring of conservation actions
9. Promote diversity of forest types and successional stages
10. Reduce conversion to cropland

Grasslands

Grasslands are defined as an open area dominated by grass species. Examples of grasslands include: haylands, pasture, prairies, savannahs, or reclaimed mine lands.

Top threats to SGCN occurring in grasslands in the Drift Plains Region:

1. Conversion of habitat to annual crops
2. Annual and perennial non-timber crops

Top conservation actions for SGCN occurring in grasslands in the Drift Plains Region:

1. Restore and improve connectivity of grasslands
2. Prevent conversion of grasslands to cropland
3. Increase CRP grasslands
4. Reduce woody encroachment on grasslands
5. Use burning and mowing as management techniques in grasslands
6. Improve grazing practices
7. Maintain low wet meadows

Top threats to fish and wildlife habitats in grasslands in the Drift Plains Region:

1. Invasive and alien species
2. Conversion of habitat to annual crops
3. Conversion of natural habitats to other land uses
4. Over-mowing of natural areas
5. Housing and urban areas
6. Fire and fire suppression
7. Annual and perennial non-timber crops
8. Recreation activities
9. Livestock farming and ranching

Top conservation actions for fish and wildlife habitats in grasslands in the Drift Plains Region:

1. Promote diversity of grassland types and successional stages
2. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
3. Re-establish natural disturbance regimes in grasslands
4. Restore habitats and natural systems in grasslands
5. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
6. Develop education programs in general
7. Reduce conversion to cropland
8. Promote conservation payment programs (e.g., payment for ecosystem services, conservation easements)
9. Develop education programs specifically for K-12
10. Establish training programs for stakeholders

Subterranean Systems

Subterranean systems are defined as connecting underground rooms and passages beyond natural light penetration. Examples of subterranean systems include: underground waters, above and below the water table, and terrestrial air-filled habitats ranging from large caves to interstitial crevices below soil horizons.

Top threats to SGCN occurring in subterranean systems in the Drift Plains Region:

1. Invasive and alien species
2. Diseases from domestic populations and unknown sources

Top conservation actions for SGCN occurring in subterranean systems in the Drift Plains Region:

1. Protect subterranean systems
2. Limit recreational caving
3. Protect bat hibernacula

Top threats to fish and wildlife habitats in subterranean systems in the Drift Plains Region:

1. Housing and urban areas
2. Runoff from roads and service corridors
3. Recreation activities
4. Invasive and alien species
5. Commercial and industrial areas
6. Roads and railroads

Top conservation actions for fish and wildlife habitats in subterranean systems in the Drift Plains Region:

1. Acquire currently unprotected subterranean systems
2. Preserve currently existing corridors
3. Acquire conservation easements
4. Control invasive species in subterranean systems
5. Restore habitats and natural systems in subterranean systems
6. Develop education programs in general
7. Develop education programs specifically for K-12
8. Establish training programs for stakeholders
9. Increase regulations on invasive species

Wetlands

Wetlands are defined as either ephemeral or permanently flooded habitat. Examples of wetlands include: swamps, marshes, bogs, fens, potholes, wetlands of farmed areas, and mudflats.

Top threats to SGCN occurring in wetlands in the Drift Plains Region:*

1. Natural habitat conversion
2. Invasive and alien species
3. Conversion of habitat to annual crops
4. Annual and perennial non-timber crops
5. Tourism and recreation areas
6. Dams and water management and use

Top conservation actions for SGCN occurring in wetlands in the Drift Plains Region:

1. Protect and maintain large wetlands complexes
2. Restore wetlands
3. Protect buffers around wetlands
4. Control invasive plants in wetlands
5. Create shorebird management areas
6. Mitigate road hazards to amphibians and reptiles when roads cross over wetlands
7. Enroll wetlands in WRP
8. Provide stopover and roosting habitat for cranes
9. Manage for diversity in wetlands
10. Conserve ephemeral wetlands

Top threats to fish and wildlife habitats in wetlands in the Drift Plains Region:

1. Conversion of habitat to annual crops
2. Invasive and alien species
3. Conversion of natural habitats to other land uses
4. Commercial and industrial areas
5. Housing and urban areas
6. Roads and railroads
7. Annual and perennial non-timber crops
8. Runoff from roads and service corridors
9. Point source pollution from commercial and industrial sources
10. Agriculture, residential, and forestry effluents

Top conservation actions for fish and wildlife habitats in wetlands in the Drift Plains Region:

1. Reduce conversion to cropland
2. Increase acres of riparian zones
3. Strengthen conservation financing
4. Develop and promote farming technologies and practices that have conservation benefits (e.g., cover crops, no-till, and soil health)
5. Reduce loss of fish and wildlife habitats (due to agriculture, urban sprawl, commercial development, etc.)
6. Reduce nutrient and toxin loads
7. Restore habitats and natural systems in wetlands
8. Develop education programs specifically for K-12
9. Acquire conservation easements to protect important wildlife habitats
10. Develop alliances and partnerships (e.g., between producers, landowners, and conservation professionals)
11. Promote use of research and science in conservation decision-making processes

7

CHAPTER VII.

PROPOSED PLAN FOR MONITORING SPECIES OF GREATEST CONSERVATION NEED AND HABITATS

Barn Owl, *Tyto alba*

FISH AND WILDLIFE CONSERVATION AND MANAGEMENT IS INTENDED TO PROVIDE STABLE, SELF-SUSTAINING POPULATIONS OF NATIVE SPECIES.

Therefore, species and habitat monitoring efforts contribute to two important aspects of the planning cycle: the inventory stage that assesses the status of the state's natural resources and the evaluation stage that measures the success of conservation efforts.

SPECIES MONITORING

The DFW has operated under a planned management system for over 30 years and conducts a wide variety of survey and monitoring activities (Table 7-1). The public expects the state to have knowledge of the distribution and relative abundance of fish and wildlife. Federal support for survey and monitoring of game and sport fish species has been established in Indiana since 1937.

Additionally, readily observable bird species have benefited from long standing surveys that provide standardized population trend data. Distribution and abundance surveys for other nongame species have increased in Indiana in the last three decades. Records for SGCN are entered into the Heritage Database, which is maintained by the Division of Nature Preserves (DNP). The Heritage Database represents one of the oldest and most complete repositories of SGCN occurrence data available.

Element five of the Congressional guidelines for the SWAP revision requires that species monitoring needs be identified. A review of current monitoring efforts was an important component in the identification of additional monitoring needs. Specific questions were included in the Species Survey (Appendix O) to determine the level of awareness of species monitoring efforts conducted by the state and other entities. In the CWS Technical Expert Survey, in all species groups, except amphibians, those surveyed were more aware of species monitoring by the state than monitoring by other organizations (Table 7-2). In the recent Species Survey, awareness of species monitoring by the state was greater in all species groups (Table 7-3).

State monitoring efforts are used to determine the status of species, set harvest regulations, and prioritize conservation efforts. Historically, the majority of these surveys have been aimed at game or commercially valuable species. In addition to species status information, collectively, these surveys have provided some insight into habitat and environmental health changes in Indiana. More recently, monitoring efforts conducted or supported by the Nongame and Endangered Wildlife Program (formerly the Wildlife Diversity Section, now the Wildlife Science Unit of the Wildlife Section), have provided population status information for a majority of SGCN. Implementing conservation actions needed to prevent species from declining to the point of being endangered requires early detection and intervention. Therefore, four distinct levels of species monitoring are essential for comprehensive conservation:

1. Monitoring of game, commercial, or common species
2. Monitoring of species in declining or at-risk habitats
3. Monitoring of suspected at-risk species
4. Monitoring of known SGCN

As long as appropriate, the DFW will continue the monitoring efforts in Table 7-1, which are the focus of the SWAP and are directly related to the detection (determining the conservation status of a species) or monitoring of SGCN.

The DFW does not have statutory authority for insects and invertebrates, other than mollusks. A list of rare insects has been developed based on the recommendation of insect experts working in Indiana (Appendix E). As a general trend, rare insects occur in rare habitats. Correspondingly, staff to address the needs of federally endangered insects in Indiana has come from the DNP. In Indiana, the DNP has responsibility for rare plants and plant communities. The DFW works with the DNP to protect and manage rare habitats and the species, including insects that depend upon them. As resources (funds, expertise, etc.) allow, a more comprehensive insect inventory should be pursued.

In response to element five of the Congressional guidelines for the SWAP revision, DFW sought to identify gaps in species monitoring coverage. This included consideration of monitoring technique development. In 2005, only bird and fish survey efforts seemed to have achieved some measure of standardization. Bird monitoring efforts have benefited from the unifying influence of federal control under the Migratory Bird Treaty Act (MBTA). Fish monitoring efforts are often related to game fish management needs or environmental monitoring. Considerable effort has been expended to establish standardized fish sampling and analysis protocols relative to water and environmental quality monitoring. Undoubtedly, the use of fish in environmental monitoring has contributed to a better understanding of species abundance and distribution.

Since 2005, a greater level of standardization of monitoring efforts has been achieved for amphibians, especially frogs as a result of the North American Amphibian Monitoring Program (NAAMP), and mammals, especially summer bat populations as a result of statewide mobile and fixed acoustic bat surveys. In 2005, it was indicated that monitoring efforts for amphibians, especially salamanders, all reptiles, and freshwater mussels needed to be increased. In the 2005 CWS, reptiles were identified as the most under-monitored species group by both the state and non-state agencies (Table 7-2). The awareness of species monitoring has increased for all species groups since 2005 (Table 7-4), except for reptiles. All species monitoring would benefit from standardized efforts that would facilitate inter-state or regional comparisons; standardized protocols that allow comparison of population trends between state, regions and sample areas is desirable. Indiana does participate in national and regional efforts to develop effective, efficient and standardized protocols for species or species groups as identified in Table 7-1.

Table 7-5 provides a list of anticipated survey and monitoring needs, derived from expert comments provided in the Species Survey and from DFW biologists. The degree to which these survey and monitoring efforts are implemented and the scheduled plan for implementation depend upon a variety of factors, including funding and available expertise. In response to new information, regional or

national priorities, or efficient inventory opportunities, this list may be amended to provide for efficient, effective conservation. Given the magnitude of the inventory needs, use of properly trained citizen scientists is an option for certain species. Efforts should be applied to determining techniques and protocols that can be successfully conducted by volunteers provided limited training. Method of data verification and volunteer recruitment and retention also need to be explored. A successful volunteer program is expected to require the full-time attention of one or more volunteer coordinators, provided either by the state or a conservation partner.

Table 7-1. Current species monitoring efforts conducted by the DFW.

Species Group	Survey Name	Schedule	Area
Game Mammals and Game Birds	Archers Index - Beaver, Bobcat, Northern Bobwhite, Coyote, Deer, Fox Squirrel, Gray Fox, Gray Squirrel, Ruffed Grouse, Muskrat, Opossum, rabbit, Raccoon, Red Fox, River Otter, Skunk, and Turkey	Annual	Statewide
	Dove - banding	Annual[1]	Statewide
	Duck - breeding	Annual	Statewide
	Goose - breeding survey	Annual	Statewide
	Landowner survey - similar to the small game license survey below but for the 'unlicensed' sportsperson – also includes Deer, Turkey, Coyote, Crow, and Ruffed Grouse	Biennial	Statewide
	Northern Bobwhite - breeding	Annual	Statewide
	Pheasant - breeding	Annual	Northern Indiana
	Pheasant broods/Winter Sex Ratio	Periodic	Northern Indiana
	Small game license holder survey - Northern Bobwhite, Cottontail Rabbit, Fox Squirrel, Gray Squirrel, Mourning Dove, Pheasant, and Woodcock	Biennial	Statewide
	Turkey - harvest	Annual	Statewide
	Woodcock - breeding	Annual[1]	Statewide
	Wood duck - banding	Annual[1]	Statewide
	Canada Goose- banding	Annual	Statewide

Species Group	Survey Name	Schedule	Area
	Waterfowl - weekly inventory	Annual – August through January	Statewide at select state and federal properties
	Waterfowl - riverine surveys	Annual – November through January	Lower Wabash River and portions of the West Fork White River
	Fur Buyer Survey	Annual	Statewide
	Trapper Survey	Biennial	Statewide
	Citizen Science Trail Cam Survey	Annual	Statewide
	Scent Station Survey	Annual	Southern Indiana
	River Otter Harvest Survey	Annual	Statewide
	River Otter - occurrences	Annual – as reported	Statewide
	Bobcat - occurrences	Annual – as reported	Statewide
	Large Mammal Report Form	Annual	Statewide
	Deer - Mandatory Harvest Check	Annual	Statewide
	Deer - Hunter Survey	Every 3 years	Statewide

Species Group	Survey Name	Schedule	Area
Nongame Birds	Bald Eagle – wintering	Annual	Statewide
	Bald Eagle – nesting*	Annual	Statewide
	Barn Owl*	Periodic (<5 year interval)	Statewide
	Breeding birds – atlas*	20 year cycle	Statewide
	Breeding birds – summer counts*	Annual	Statewide
	Breeding birds – survey*	Annual[1]	Statewide – random routes
	Colonial waterbird survey*	Periodic (<5 year interval)	Statewide
	Least Tern*	Annual	Southwestern Indiana
	Osprey*	Annual	Statewide
	Peregrine Falcon*	Annual	Statewide
	Loggerhead Shrike	Annual	Statewide
	Sandhill Crane*	Annual	Statewide
	Secretive marsh birds*	Annual	Selected properties
Nongame Mammals	Allegheny Woodrat*	Periodic	Southern Indiana
	Archer Index – Badger*	Annual	Statewide
	Badger* - occurrences	Annual – as reported	Statewide
	Franklin's Ground Squirrel*	Periodic (<10 year interval)	Northwestern Indiana
	Indiana Bat* - winter hibernacula census	Biennial	Caves in southern Indiana
	Summer bat populations*	Annual[1]	Statewide
	Swamp Rabbit*	Periodic (<10 year interval)	Southwestern Indiana

Species Group	Survey Name	Schedule	Area
Amphibians	Anurans - calling frogs and toads*	Annual[1]	Statewide
	Crawfish Frog*	Periodic (< 5 yr interval)	Southern Indiana
	Green Tree Frog*	Periodic (< 5 yr interval)	Southern Indiana (as range expands)
	General Salamander*	Annual	Statewide
	Green Salamander*	Annual	Southern Indiana
	Hellbender*	Annual	Southern Indiana
	Streamside Salamander*	Periodic (< 5 yr interval)	Southeastern Indiana
	Mole Salamander*	Periodic (< 5 yr interval)	Southwestern Indiana
	Spadefoot Toad*	Periodic (< 5 yr interval)	Southern Indiana
Fish	Game and commercially valuable species	Annual	Statewide in selected streams and reservoirs on a rotating schedule
	Glacial Lakes Status and Trends	Annual	Northern Indiana Glacial Lakes – regional stratified random assessment on a rotating schedule
	Largemouth Bass survey	Annual	Statewide in selected streams, lakes, and reservoirs on a rotating schedule
	Percidae sport fish survey	Annual	Statewide where Percidae are stocked
	Moronidae sport fish survey	Annual	Statewide where Moronidae are stocked
	Commercial fish harvest reporting	Annual	Ohio, Wabash, East Fork White, West Fork White, and Patoka rivers
	Paddlefish and Paddlefish roe survey	Annual	Ohio River
	Shovelnose Sturgeon survey	Annual	Wabash River
	Channel Catfish, Blue Catfish, and Flathead Catfish survey	Annual	Big Rivers in Southern Indiana
	Lake sturgeon*	Annual	Big rivers in Southern Indiana
	Nongame Fish*	Continuous	Statewide

Species Group	Survey Name	Schedule	Area
Freshwater Mussels	Freshwater Mussels (focus on former commercial species)*	10-12 year interval	Big rivers in central and southern Indiana
	Freshwater Mussels*	Continuous	Statewide
Reptiles	Box Turtle*	Periodic (< 5 yr interval)	Statewide with emphasis on south central Indiana
	Ornate Box Turtle*	Periodic (< 5 yr interval)	Northwestern and one location southwestern Indiana
	Kirtland Snake*	Annually	Statewide
	Timber Rattlesnake*	Periodic (< 10 yr interval)	South central Indiana
	Cottonmouth*	Periodic (< 5 yr interval)	Southern Indiana
	Wall lizard*	Periodic as reported	Potentially statewide
	General reptile*	Annual	Statewide

** Efforts include SGCN*
[1] Conducted under a national or regional protocol

Table 7-2. Percentage of respondents from the 2005 CWS Technical Expert Survey that were aware of species monitoring efforts by state agencies and other organizations statewide.

Species Group	State Efforts	Other Organization Efforts
Amphibians	12.5	15.6
Birds	28.3	22.2
Fish	30.2	10.1
Mammals	18.5	7.4
Mussels	15.0	12.5
Reptiles	12.5	4.9

Table 7-3. Percentage of respondents from the 2015 SWAP Species Survey that are aware of which agencies and organizations monitor species groups in Indiana.

	Federal agencies (e.g., USDA Forest Service)		State agencies (e.g., Indiana Department of Natural Resources)		Local agencies (e.g., County Parks & Recreation Department)		Non-profit organizations		For-profit entities		Research entities (e.g., universities)		I don't know		Total Responses
	%	N	%	N	%	N	%	N	%	N	%	N	%	N	
Amphibians	29.4	5	82.4	14	0.0	0	5.9	1	0.0	0	70.6	12	0.0	0	17
Birds	53.1	17	84.4	27	3.1	1	28.1	9	3.1	1	18.8	6	0.0	0	32
Fish	4.5	1	90.9	20	4.5	1	0.0	0	0.0	0	36.4	8	0.0	0	22
Mammals	51.5	34	98.5	65	13.6	9	27.3	18	42.4	28	86.4	57	0.0	0	66
Mollusks	0.0	0	81.3	13	6.3	1	0.0	0	0.0	0	12.5	2	12.5	2	16
Reptiles	14.3	1	100.0	7	14.3	1	0.0	0	0.0	0	71.4	5	0.0	0	7
Total	36.3	58	91.3	146	8.1	13	17.5	28	18.1	29	56.3	90	1.3	2	160

Table 7-4. Percentage of respondents from the 2015 SWAP Species Survey that are aware of current monitoring efforts with respect to species groups in Indiana.

Species Group	Yes	No
Amphibians	38.5	61.5
Birds	46.1	53.9
Fish	51.7	48.3
Mammals	62.3	37.7
Mussels	63.0	37.0
Reptiles	12.9	87.1

Table 7-5. Suggested survey, monitoring, survey technique, survey protocol, and database needs for species in Indiana from 2015 SWAP Species Survey.

Species Group	Species	Schedule	Area	Associated Database Needs
Amphibians	Plains leopard frog	Annual	Northern Indiana	Yes
Birds	Migratory stopover sites	Annual	Selected migratory stopover sites	Yes
	Nesting habitat searches	Annual	Selected habitats	Yes – part of Statewide bird DB
	Owls and Nightjars	Annual	Statewideinsuitable habitat	Yes – part of Statewide bird DB
	Rails, Bitterns, and shorebirds	Annual	Statewide in appropriate wetland habitat on a regular cycle	Yes – part of Statewide bird DB
	Gallinaceous game birds (spring)	Annual	Statewide (random)	Yes – part of Statewide bird DB
	Bird Sighting Database	Continuous	Statewide	Yes – part of a statewide bird DB
Freshwater Mussels	Freshwater Mussels	Annual	A subset of Indiana's small steams on a 5-10 year rotation	Yes
Insects	General insect survey	Continuous	Selected rare habitats on a regular cycle	Yes
Invertebrates	Cave invertebrates	Continuous	Selected cave systems on a regular cycle	Yes

Species Group	Species	Schedule	Area	Associated Database Needs
Mammals	Bats (summer)	Annual	Portions of the state on a regular cycle	Yes
	Bats (winter)	Annual	Known or suspected bat caves on a regular cycle (except Myotis sodalist caves)	Yes
	Bat Band Database	Continuous	Statewide	Yes
	Small mammals (shrews, mice and voles)	Annual	Statewide - representative habitats, by county on a regular cycle	Yes
	River Otter – Statistical Population Reconstruction	Annual	Statewide	Yes
	Bobcat – Statistical Population Reconstruction	Annual	Statewide	Yes
Reptiles	Massasauga	Annual	Northern Indiana	Yes
	Blandings turtle	Annual	Northern Indiana	Yes
	Spotted turtle	Annual	Northern Indiana	Yes
	Lizards	Annual	Statewide or by county on a regular cycle	Yes – part of statewide reptile DB
	Snakes	Annual	Statewide or by county on a regular cycle	Yes – part of statewide reptile DB
	Turtles	Annual	Statewide or by county on a regular cycle	Yes – part of statewide reptile DB
General surveys	Surveys of SGCN, especially in certain habitats.	Annual	Statewide in appropriate habitats on a regular cycle	Yes – part of the Heritage Database
	General Prey Inventories - insect, small mammals, amphibians, etc.	As needed	Specific study sites	No – include in study report

Species Group	Species	Schedule	Area	Associated Database Needs
State Land Surveys	General Nongame survey - All nongame wildlife and insects	Annual	DNR properties	Yes – could be part of each area's database and the Heritage Database
Additional Database Needs	Pit Tag database	Continuous	Statewide	Yes
	Road Kill database (all vertebrate species)	Annual	Statewide - selected roadways on a regular cycle	Yes
	Wildlife disease	Continuous	Statewide	Yes
	Wildlife rehabilitation	Annual	Statewide	Yes
	Window, cell tower and windmill bird and bat kill database	Annual	Statewide	Yes – could be part of a statewide bird DB

HABITAT MONITORING

Habitat inventory and monitoring has been less deliberate and frequent than species monitoring.

In the past, the DNR and the public have depended upon a disjunct collection of separate inventories (e.g., the 10-year USDA Forest Service Forest Inventory and Analysis, National Wetland Inventory, rare community entries in the Heritage Database and others), and specific habitat measures collected in association with specific species inventory surveys. In aquatic systems, collection of corresponding habitat data has been an important component of sampling protocols aimed at aquatic community assessment such as the Index of Biotic Integrity (IBI), which classifies species in part by their habitat requirements, and the Qualitative Habitat Evaluation Index (QHEI) which directly describes habitat characteristics. More recently, bathymetric, vegetation, and bottom hardness mapping has been incorporated as a habitat component of the DNR's Glacial Lakes Status and Trends Monitoring. However, most of these efforts collect data on a limited number of indicator parameters, in selected portions of streams, lakes, or reservoirs. Even the systematic efforts of the EPA and USGS in Indiana fail to provide a complete picture of aquatic system habitat in Indiana.

Monitoring plans for habitats required by SGCN as required by Element three of the SWAP revision have been hampered by an inability to precisely define the habitat type or component upon which the SGCN depends. Monitoring distribution and abundance of major habitat types to provide baseline data for future comparisons provides a critical foundation.

The CWS initiated the first comprehensive inventory of statewide habitat data. A team of specialists, led by four scientists at Indiana State University (ISU), provided a quantitative measure of over 80 habitat features. Measures for major habitat features were based on analysis of Landsat 7 Enhanced Thermal Mapper plus (ETM+) or Terra's Advanced Space-borne Thermal Emissions Reflection Radiometer (ASTER) digital data projects for Indiana. Additionally, ISU provided a historic overview of the changes in the eight major habitat categories in Indiana, as outlined in the CWS, from pre-European settlement to present, in hundred-year intervals, with associated changes in fauna. The results of the habitat analysis and historic overview were published in 2012 by Whitaker and Amlaner – '*Habitats and Ecological Communities of Indiana Presettlement to Present*'.

For the SWAP revision, rather than using a customized habitat classification system that was used in the CWS, the NLCD was utilized. NLCD data was compared from 2001 and 2011 to assess changes in habitats (see Chapter VI for results of this analysis). The land cover classification scheme of the NLCD was adapted to fit the eight major habitat types (Appendix B). This change in analysis was encouraged by the Teaming with Wildlife Best Practices Guide (2012) and should provide a well-accepted standardized classification scheme to allow consistency across state plans and improve the chances for collaborative efforts.

Factors affecting habitats and our understanding of species and habitat interactions change. As an understanding of these factors develops, so does the need to measure specific habitat characteristics. DFW biologists, species experts and conservation partners identified additional habitat survey and monitoring needs. Table 7-6 provides a list of additional habitat monitoring needs as required by Element five of the SWAP revision. The degree to which these monitoring efforts are implemented and the implementation scheduled plan depends upon a variety factors including funding and available technology and expertise. In response to new information, regional or national priorities, or availability of inventory opportunities, this list may be amended to provide for efficient, effective conservation. To accommodate adaptive management, additional habitat characteristics may need to be inventoried.

Table 7-6. Habitat monitoring and associated database needs.

Habitat Type	Habitat Feature	Schedule	Area	Associated Database Needs
All Habitats	Quantitative or index information on the total acreage, geographic distribution, patch size, native vs. non-native, vegetation diversity and relative abundance, ownership, and relative condition of the habitats.	Once per decade	Statewide	Yes
All Habitats	Invasive animals and plants	Continuous	Statewide	Yes – including treatment information and results
All Habitats	Soil maps	Continuous	Statewide	Yes
All Habitats	Land cover/land use	As available	Statewide	Yes
Agricultural Lands	Agricultural statistics	Annual	Statewide	Yes
Aquatic Systems	Aquatic systems - bottom substrate and contour	Continuous	Statewide	Yes

Habitat Type	Habitat Feature	Schedule	Area	Associated Database Needs
Aquatic Systems	Environmental contaminants in waterways	Some streams should be monitored annually others on a rotating schedule	Statewide	Yes
Barren Lands	Rock outcrops	Continuous	Statewide	Yes
Forests	Forest statistics	As available, large public landholding should be monitored annually	Statewide	Yes
Forests	Deer browse impact	Every few years	Statewide	No
Subterranean Systems	Cave locations, cave recharge areas, and general karst feature inventory	Continuous	Southern Indiana	Yes
Wetlands	Restored Wetlands	Continuous	Statewide	Yes

THE EFFECTIVENESS OF THE CONSERVATION ACTIONS TAKEN

Conservation actions should be based on the best available science. Element five of the Congressional guidelines for the SWAP revision address the need for adapting conservation actions in response to new information or changing conditions. To allow for adaptive management, successful survey and monitoring efforts have two necessary components: the technically proficient implementation of survey and monitoring protocols and the effective dissemination of results. Both steps are necessary to direct and evaluate the effectiveness of the conservations actions undertaken. The survey and monitoring efforts proposed by the SWAP relate to the identification of SGCN (especially early identification), identification of threats to these species and their habitats, monitoring known SGCN, and evaluation of conservation actions. The purpose of survey and monitoring activities is to detect population or habitat change. All partners, including the DFW, are expected to respond appropriately to detected change and adapt their conservation activities. Therefore, all partners involved in the implementation of the SWAP have the same responsibility—to conduct well-designed inventory protocols in a technically proficient manner and to make the results of the survey and monitoring efforts available to other partners and interested parties.

The DNR will conduct species and habitat survey and monitoring efforts as resources allow (including, but not necessarily limited to those identified in Tables 7-1, 7-5, and 7-6) and to participate, as appropriate, in regional or national monitoring programs. Along with the results, all aspects of the inventory necessary to the responsible interpretation of the effort will be made available to the partners and other interested parties. Partners are urged to provide their survey and monitoring efforts in a similar manner. Additionally, the DFW will continue to provide relevant data to the Heritage Database. Easily accessed, timely inventory information will allow conservation partners and other interested parties to track progress towards conservation goals and to apply adaptive management where appropriate. Information sharing by all partners will facilitate the application of accurate, timely information to the environmental review process.

Individual conservation goals set by partners may have specific timelines. The success of these efforts may be evaluated by the available monitoring efforts as appropriate to their specific timeline. The effectiveness of the entire SWAP will be evaluated and addressed in subsequent reviews of this document (not to exceed ten years as delineated in Element six).

8

CHAPTER VIII.

USE OF NEW INFORMATION TO ADAPT CONSERVATION ACTIONS DURING IMPLEMENATION

Green Salamander, *Aneides aneus*

CONSERVATION ACTIONS FOR THE SWAP WILL BE ADAPTED WHEN NEW INFORMATION ARISES OR CONDITIONS CHANGE, WITH GUIDANCE FROM THE FIFTH ELEMENT.

Using the best available communications technology, the DFW is sharing information with conservation partners and encouraging dialogue about the SWAP.

Experts and conservation partners participated in the SWAP revision process by providing information about wildlife, including SGCN and habitats. In addition, the revision fostered collaboration and information sharing among the conservation community. The 2005 and 2015 plans established an extensive database of contact information for technical experts and conservation partners. This database allows for conservation partnership opportunities and serves as a tool to contact experts throughout Indiana.

The SWAP is intended to create more extensive collaboration and information sharing as new knowledge, tools, and concepts are developed. As new information, changing conditions, or emerging issues arise, the conservation actions will be adapted. The actions will be adapted based on the best science available on emerging threats and opportunities, such as invasive species, emerging diseases, climate change, market forces, and other threats or opportunities that will influence species and habitats in Indiana over the next decade.

The DFW elected to utilize the Roster of Indiana Animals, Insects, and Plants that Are Extirpated, Endangered, Threatened, or Rare (also described as Special Concern) as our list of SGCN for the SWAP. Inclusion of an animal or plant on the roster is determined based on the best current information available. This list is dynamic and adjustments to the list of SGCN may occur as additional data becomes available. This list is generated with the input of multiple species experts from within and outside of the DFW and DNR. These experts form TACs that review relevant information about the abundance and distribution of species of concern and potential concern and the TACs make recommendations to the NRC for inclusion on the Roster of Indiana Animals, Insects, and Plants that Are Extirpated, Endangered, Threatened, or Rare (also described as Special Concern).

Using the best available communications technology, the DFW is sharing information with conservation partners and encouraging dialogue about the SWAP. Through sharing of habitat and species monitoring efforts, participation in professional organizations, and implementation of the SWAP, the DFW will aid in the sharing of significant information to create adaptive management practices based on science. Communication between partners, as the implementation of the SWAP proceeds, will ensure that conservation actions respond appropriately to new information or changes in condition.

9

CHAPTER IX.

FUTURE STRATEGY FOR REVISION ANDUPDATE

Clubshell, *Pleurobema clava*

ELEMENT SIX OF THE CONGRESSIONAL GUIDANCE DIRECTS THE SWAP BE REVIEWED AT LEAST EVERY TEN YEARS.

The next major revision of the SWAP is scheduled for completion on or before 2025. It is expected to build on the 2015 effort and to benefit from over 20 years of experience gained from the implementation of both the original CWS and the current SWAP.

The CWS established a strong baseline of fish and wildlife resources and conservation actions needed in Indiana. The SWAP is expected to improve usability and implementation throughout the DFW and the conservation community. Development of this revised plan engaged more experts and partners resulting in more trustworthy data. Indiana's SWAP was created with a variety of lenses by providing information for species and habitats at statewide and regional levels. All types of conservation partners should be able to identify how they can fit into the plan to advance conservation of fish and wildlife and their habitats.

Both the CWS and SWAP utilized online surveys to gather information on SGCN and their habitats. In future iterations, this information can be updated and used to replicate this study at regular intervals to track the progress of Indiana's conservation efforts. Comparison of results from each plan will provide the best long-term evaluation of the conservation efforts guided and supported by this congressionally mandated and funded strategic process. While Indiana is making progress on specific conservation actions for species and habitats, the next step for the 2025 plan might be to identify a way to measure large statewide conservation goals and objectives, as well as continuing to work toward assessing habitat quality.

Element seven provides direction to ensure the SWAP provides effective guidance by requiring ongoing coordination with partners in the review, revision,and implementation of the action plan. Indiana has a large number of potential partners in the conservation community to assist in implementing the SWAP. The SWAP Advisory Team, whose members helped to develop the current plan, will continue to be key partners in the implementation and advancement of the SWAP.

The large list of partners found in Appendix U indicates a diversity of conservation organizations with varying geographic, habitat, or wildlife species focus. It is intended that the members of this diverse list will be able to utilize the SWAP, specifically the regional actions so that the conservation community will focus efforts and continue to move fish and wildlife conservation forward in Indiana.

The magnitude of the conservation needs identified in the SWAP highlights that the logical next step is to provide more attention on implementation. This focus will be accomplished through concerted efforts and dedicated staff within DFW to provide more coordination with Indiana's conservation community over the next ten years. Involvement from partners is crucial to making a significant positive change for Indiana's fish and wildlife resources. SWAP coordination provided by the DFW will determine how to engage conservation partners in order to implement and track actions and to build a stronger community focused on relevant conservation needs of the state.

The DFW currently has several different tools to keep partners engaged and communicate the successes and progress implementing the plan. The SWAP website has been used throughout the planning process to keep partners and the public engaged. This site will continue to be a primary platform for official public communication. Additionally, an online collaborative site that has been utilized during the SWAP revision process will allow our Advisory Team and closest partners to communicate and provide input towards specific projects related to the SWAP. The DFW also has had success over the last several years of receiving input directly from the public via an online comment platform called Got Input. All these proven options can continue to be used when engaging the public and partners.

Partner organizations communicate with their members and the public in various ways, such as newsletters, member letters, email, or website updates. All partners will be encouraged to report to their respective audiences on their activities related to SWAP implementation. In order to connect different types of partners to Indiana's SWAP, the DFW is also developing partner strategies for outreach and implementation. These strategies will be used by key DFW staff implementing the SWAP, and our partners' organizations, as we continue to find ways to collaborate more effectively.

Both the DFW and our partners feel strongly that in order for the SWAP to be effective, it will be critical to have a position to coordinate the efforts of the conservation partners to address the threats and actions in the SWAP. As this revised plan is being finalized, the DFW is identifying a position and forming a job description to lead this charge. It is expected this additional support will be the most effective part of the implementation strategy. Ultimately, this will enable the DFW to be more effective at building a strong conservation community that is working together to address the threats to and conservation actions for species and habitats in Indiana.

10

CHAPTER X.

GLOSSARY AND ACRONYMS

A

Abundance

The number of individuals of a particular species.

Advanced Space-borne Thermal Emissions Reflection Radiometer (ASTER)

An imaging instrument onboard Terra, the flagship satellite of NASA's Earth Observing System (EOS). ASTER data is used to create detailed maps of land surface temperature, reflectance, and elevation.

Advisory Team Partners

Organizations or agencies that identified themselves when they completed the conservation partner survey by indicating they wanted to be involved in the development of SWAP and that their organization had a large reach or significant impact on wildlife in Indiana.

Aggregated

A totaling of all data received relative to a designated factor.

Agriculture

Lands devoted to commodity production, including intensively managed non- native grasses, row crops, and fruit and nut-bearing trees.

American Electric Power (AEP)

A major investor-owner electric utility in the United States, delivering electricity to more than five million customers in 11 states.

Aquatic Systems

All water habitats (both flowing and stationary) in Indiana, including lakes, reservoirs, rivers, streams, and other waterways, but excluding wetlands.

B

Barren Lands

Lands dominated by exposed rock or minerals with sparse vegetation.

Best Management Practices (BMP)

Practice, or a combination of practices, that determined to be an effective and practical means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals.

Biodiversity
The number and variety of organisms found within a specified geographic region. The variability among living organisms on the earth, including the variability within and between species and within and between ecosystems.

Bogs
An area having a wet, spongy, acidic substrate composed chiefly of sphagnum moss and peat in which characteristic shrubs and herbs and sometimes trees usually grow. Bogs are usually acid areas, frequently surrounding a body of water. Bogs receive water exclusively from rainfall.

Breeding Range
The geographic region or area in which a species reproduces.

Buffer Zone
An area maintained in a land use that provides a transition zone between two types of habitats. In conservation, buffer zones are neutral areas between wildlife habitats and areas that have been highly disturbed by humans. An area planted with a variety of grasses may be a buffer zone between a wetland and an urban development.

C

Candidate Species
A species of plants or animals classified as a candidate for possible listing as endangered or threatened by a government agency.

Channelization
Straightening of a stream or dredging of a new channel to which the stream is diverted, resulting in the removal of its sinuosity (bends).

Classified Forest and Wildlands Program
Encourages timber production, watershed protection, and wildlife habitat management on private lands in Indiana. Program landowners receive a property tax reduction in return for following a professionally written management plan. In addition to the tax incentive, landowners receive free technical assistance from DNR foresters and wildlife biologists, priority for cost share to offset the cost of doing management, and the ability to “green” certify their forests. The minimum requirement for program enrollment is ten acres of forest, wetland, shrubland, and/or grassland.

Community Types
A group of populations or species that interrelate directly with each other and their specific environment. Characteristics used for identifying community types include factors such as water regimes, soils, substrate type, topographic position (elevation), plant species composition, and animal associations. 61 community types have been identified within Indiana. Information on community types is maintained by the Indiana DNR Division of Nature Preserves Conservation–The protection, preservation, management, or restoration of wildlife and of natural resources such as forests, soil, and water.

Comprehensive Wildlife Strategy (CWS)
A habitat-based model and was the state's first effort to acquire statewide habitat data.

Conservation Community
One that is united or associated with another or others in an activity or a sphere of common interest; organizations or individuals capable of supporting conservation actions.

Conservation Easements
A voluntary binding agreement that permanently limits a particular property to conservation-compatible uses.

Conservation Opportunity Area (COA)
Potential conservation opportunity areas may be significant to the conservation of biodiversity because they contain one or a combination of the following: a large area of natural vegetation, predicted habitat for rare species, or a documented occurrence ofarare species.

Conservation Practices
Specific actions taken to protect, preserve, manage, or restore wildlife and natural resources. Examples include establishing windbreaks, stream bank stabilization, and tree planting. Incentive programs may list the particular kinds of conservation practices for which cost-share funding is available.

Conservation Reserve Program (CRP)
A voluntary program for agricultural landowners. Through CRP, landowners can receive annual rental payments and cost-share assistance to establish long-term vegetative cover practices on eligible farmland.

Contaminant
A toxin, hazardous substance, or pollutant introduced into the environment through human activity, either directly or as a byproduct.

Core Team
A diverse group of DFW employees assigned to work with the project leaders to develop the SWAP.

Culling
Selective removal of particular individuals from a population to achieve an overall improvement in the health of the population. Can be done to reduce overall population size or to remove only individuals with certain undesirable characteristics, such as those that are diseased or of a certain age or size class.

D

Degradation
A decline in conditions or characteristics of wildlife species or habitat to a lower condition, quality or level.

Developed Lands
Highly impacted lands intensively modified to support human habitation, transportation, commerce, and recreation.

Distribution
The geographic area over which a species occurs.

Division of Fish & Wildlife (DFW)
Professionally manage Indiana's fish and wildlife for present and future generations, balancing ecological, recreational, and economic benefits.

Division of Nature Preserves (DNP)
The system's purpose is to provide permanent protection for significant natural areas within the state."

Ducks Unlimited (DU)
The world's leader in wetlands and waterfowl conservation.

E

Endangered Species (Federal Classification)
Any species that is in danger of extinction throughout all or a significant portion of its range.

Endangered Species (State Classification)
Any animal species whose prospects for survival or recruitment within the state are in immediate jeopardy and are in danger of disappearing from the state. This includes all species classified as endangered by the federal government that occur in Indiana.

Environmental Site Assessments (ESA)
An environmental site assessment commonly done prior to commercial or industrial property transactions to assess the likelihood of contamination and the liability for clean-up if contamination is found.

Extirpated (State Classification)
Any animal species that has been absent from Indiana as a naturally occurring breeding population for more than 15 years.

Extrapolation
To infer or estimate by extending or projecting from known information by assuming that the estimated value or condition follows logically from known values.

F

Fens
A type of wetland ecosystem characterized by peaty soil, dominated by grass-like plants, grasses, sedges, and reeds. Fens are alkaline rather than acid areas, receiving water mostly from surface and groundwater sources.

Fish and Wildlife Area (FWA)
Land and habitats where fish and wildlife reside.

Foraging Areas
An area where animals look for food.

Forest Lands
Lands characterized by a plant community extending over a large area and dominated by trees, the crowns of which form an unbroken covering layer or canopy.

Fragmentation
Scattered or patchy distribution of a particular habitat type in an area that once was continuous habitat.

G

Genetic Pollution
The dispersal of genes to natural organisms, especially by cross-pollination or introduction of closely related exotic species or genetically engineered organisms. Resulting progeny may be less well adapted to the local environment.

Geographical Information System (GIS)
A computer system for capturing, storing, checking, integrating, manipulating, analyzing, and displaying map-based data related to positions on the Earth's surface.

Grasslands
Open areas dominated by grass species (e.g., prairies or reclaimed mine lands).

Guild
The group of wildlife species associated with a particular habitat type.

H

Habitat
The type of environment in which an organism or group normally lives or occurs.

Hybridization
Interbreeding of different species or varieties of animals or plants, producing a genetic cross. In some cases, hybrids are sterile or produce offspring that are less well adapted to the environment.

I

Impoundment
A body of water, such as a reservoir, made by damming flowing waters.

Index of Biotic Integrity (IBI)
A scientific tool used to identify and classify water pollution problems.

Indiana Department of Environmental Management (IDEM)
IDEM's mission is to implement federal and state regulations to protect human health and the environment while allowing the environmentally sound operations of industrial, agricultural, commercial, and government activities vital to a prosperous economy.

Indiana Department of Natural Resources (IDNR)
The mission of the Indiana Department of Natural Resources is to protect, enhance, preserve, and wisely use natural, cultural, and recreational resources for the benefit of Indiana's citizens through professional leadership, management, and education.

Indiana Department of Transportation (INDOT)
NDOT is responsible for state roads, interstates and U. S. routes including adjacent overpasses and ramps on these roadways.

Indiana Farm Bureau (IFB)
A leader in auto and homeowners insurance and is the largest writer of farm insurance in the Hoosier state.

Indiana Forest & Woodlands Owners Association (IFOWA)
A nonprofit organization with the goal of promoting good stewardship of Indiana woodlands.

Indiana Land Protection Alliance (ILPA)
A collaboration of land conservation organizations working around the state of Indiana.

Indiana State Department of Agricultural (ISDA)
ISDA will support growth in Indiana agriculture by serving as an advocate at the local, state and federal level; defining and nurturing economic opportunity in the food, fuel and fiber sectors; and enhancing the stewardship of natural resources on agricultural land.

Indiana State University (ISU)
Indiana State University is a public university located in Terre Haute, IN.

Indiana Wildlife Federation (IWF)
Indiana Wildlife Federation is a statewide, non-profit organization of individuals and over 50 Indiana conservation clubs and organizations dedicated to the wise use of our state's natural resources.

Invasive or Non-native Species
A species that is 1) non-native (alien or exotic) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

Invertebrates
Of or relating to creatures without a backbone.

L

Landsat 7 Enhanced Thermal Mapper Plus (ETM+)
A fixed "whisk-broom", eight-band, multispectral scanning radiometer capable of providing high-resolution imaging information of the Earth's surface. It detects spectrally-filtered radiation in VNIR, SWIR, LWIR and panchromatic bands from the sun-lit Earth in a 183 km wide swath when orbiting at an altitude of 705 km.

Landscape-level Conservation
Conservation of areas large enough to contain functioning ecosystems in which crucial natural processes take place. Processes like fire, flooding, and wildlife migration are essential to the health, biological diversity, and long-term sustainability of an ecosystem.

Land Trusts
A trust created to effectuate a real estate ownership arrangement in which the trustee holds legal title to the property that is significant for wildlife or habitat conservation.

M

Migration Routes
The geographic route along which birds, fish or other species customarily migrate.

Migratory Bird Treaty Act (MBTA)
A federal law first enacted in 1916 in order to implement the convention for the protection of migratory birds

Monitoring
To keep track of systematically through collection of information.

N

National Wild Turkey Foundation (NWTF)
The National Wild Turkey Federation is an international non-profit organization dedicated to the conservation of the wild turkey and the preservation of our hunting heritage.

National Wildlife Refuge (NWR)
The Refuge System provides and protects it all on 150 million acres of land and water from the Caribbean to the Pacific, Maine to Alaska, plus more than 418 million acres of national marine monuments.

Natural Lake (Glacial Lake)
A glacial lake is a lake with origins in a melted glacier. They are formed when a glacier erodes the land, and then melts, filling the hole or space that it has created.

NICHES Land Trust (NICHES)
NICHES protects, restoresandsustains Northern Indiana's ecosystems by providing habitat for native species and offering natural places for the education, appreciation and enjoyment of current and future generations.

Non-point Source Pollution
Pollution that comes from many diffuse sources, caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even underground sources of drinking water.

North American Amphibian Monitoring Program (NAAMP)
NAAMP is a collaborative effort among regional partners, such as state natural resource agencies and nonprofit organizations, and the U.S. Geological Survey (USGS) to monitor populations of vocal amphibians. The USGS provides central coordination and database management

O

Operational Documents
Plans that specify particular actions, generally including the timing, cost, and responsible party for the action.

P

Pheasants Forever (PF)
Pheasants Forever is a grassroots, volunteer, membership-based organization. Members are a diverse group of hunters, farmers, ranchers, landowners, conservation enthusiasts, and wildlife officials. The common thread is all want to make a difference for wildlife by conserving or creating habitat.

Planning Regions
The Core and Advisory Teams split Indiana into six planning regions for the purpose of the 2015 SWAP. These planning regions include: Great Lakes Region, Kankakee Region, Corn Belt Region, Valleys and Hills Region, Interior Plateau Region, and Drift Plains Region.

Point Source Pollution
Pollution that generally comes from wastewater discharged from the pipes into rivers, streams, lakes, and the ocean. Examples include industrial facilities and municipal sewage treatment plants.

Q

Qualitative Habitat Evaluation Index (QHEI)

The qualitative habitat evaluation index (QHEI) gives scientists a quantitative assessment of physical characteristics of a sampled stream similar to IBI and ICI biological data. QHEI represents a measure of in-stream geography. By combining evaluations of QHEI and IBI, for example, researchers can gain a well-rounded perspective of both the physical and biological conditions of a particular stream site.

Quartiles

A type of quantile. The first quartile is defined as the middle number between the smallest number and the median of the dataset. The second quartile is the median of the data. The third quartile is the middle value between the median and the highest value of the data set.

R

Range

The geographic region in which a plant or animal normally lives or grows.

Raster Data Set

The raster data model uses a grid to cover the space and the value of each cell (pixel) in the grid to correspond to the characteristic of the geographic feature at the cell location. The cell is the smallest unit in the grid. A grid is a matrix of cells.

Regimes

Trends in the characteristics of a system, such as the typical changes in seasonal water flow or level.

Reintroduction

Restoring a wildlife species to a habitat type or area where the species was known to have existing in the past, but from which it had disappeared.

Relative Abundance

The number of individuals of a particular species as a percentage of the total number of individuals in a given area or community.

Representative Species
A wildlife species selected from a guild to "paint a reasonable mental picture of the associated habitat type" when presented to a diverse user group including biologists, the public, legislators, grant reviewers and other partners. The selected species would automatically generate an association with the habitat-related guild and a desire to protect, enhance or somehow improve that habitat as the strategy is implemented. Representative species also were used as mental tools to focus technical expert input on particular relationships between species and their habitats, as they considered research and conservation needs for these associations.

Restoration
Conservation actions taken to return a degraded habitat to a normal or healthy condition.

S

Savannas
Upland communities of scattered trees, typically oaks, above a ground layer of prairie grasses and forbs. Fire and periodic grazing naturally maintained most of the savannas of the Midwest. Black-oak savannah is the most endangered habitat type in Indiana.

Special Concern (State Classification)
Any animal species about which some problems of limited abundance or distribution in Indiana are known or suspected and should be closely monitored.

Species
A classification of related organisms that can freely interbreed.

Species of Greatest Conservation Need (SGCN)
State and Federally listed species including the following listings; state endangered, state special concern, federally endangered, federal candidate, and federally threatened.

Sprawl
Haphazard growth or extension outward, especially that resulting from real estate development on the outskirts of a city.

Staging Sites
Particular geographic areas used by migrating species to stop as a group for resting along a migration route. Specific staging sites may be consistently used year after year by the same species. For example, Jasper-Pulaski State Park is a staging site for the migration of sandhill cranes.

Stakeholders
One who has a share or an interest in the outcome of a planning or strategic process.

State Wildlife Action Plan (SWAP)
A habitat model that maximizes limited knowledge about wildlife species by focusing on habitats and species that are better known. All species are linked to habitats on which they depend by using representative species as surrogates.

State Wildlife Grants (SWG)
A grant that provides funding to every state and territory to support cost effective conservation aimed at keeping wildlife from becoming endangered.

Stocking
To hatch, grow, or transfer a group of individuals for release into a habitat for the purposes of establishing or augmenting a wildlife population.

Subterranean Systems
Surface openings of underground features and connected rooms and passages beyond natural light penetration, such as caves and “disappearing” rivers.

Successional Change
The gradual and orderly process of ecosystem development brought about by changes in community composition and the production of a climax characteristic of a particular geographic region.

Synergy
Interaction among qualities in the environment that produce an enhanced combined effect, such as a combination of reproductive and habitat factors affecting species survival and distribution.

Systematic
Carried on using step-by-step procedures.

T

Taxa
A taxonomic category or group, such as a phylum, order, family, genus, or species.

Taxonomic Groups
Animal or plant groupings that show evolutionary relationships between organisms.

Technical Advisory Committee (TAC)
The DFW has established five TACs, one for each major taxon: Mammals, Birds, Amphibians & Reptiles, Fish, and Mollusk and Crustacean. Each committee is comprised of the chair and one to nine additional members, primarily from Indiana colleges and universities, with experience in Indiana relative to the taxon covered by that committee.

Technical Expert
A person with specific knowledge or expertise regarding species or habitats found within the state of Indiana.

Terrestrial
Of or relating to or inhabiting the land as opposed to the sea or air.

Territory
A defined area (including land and waters) in possession of and defended by an animal.

The Nature Conservancy (TNC)
A natural resources organization that works to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive.

Threatened Species (Federal Classification)
Any species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Threatened Species (State Classification)
There is no legal classification for state-listed threatened species.

Toxin
A poisonous substance introduced through pollution.

U

U.S. Department of Agriculture (USDA)
Provides leadership on food, agriculture, natural resources, rural development, nutrition, and related issues based on sound public policy, the best available science, and efficient management.

U.S. Fish and Wildlife Service (USFWS)
Work with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.

U.S. Forest Service (USFS)
An agency of the U.S. Department of Agriculture that administers the nation's 154 national forests and 20 national grasslands, which encompass 193 million acres.

U.S. Geological Survey (USGS)
The USGS is a science organization that provides impartial information on the health of our ecosystems and environment, the natural hazards that threaten us, the natural resources we rely on, the impacts of climate and land-use change, and the core science systems that help us provide timely, relevant, and useable information.

U.S. National Resources Conservation Service (NRCS)
NRCS provides farmers and ranchers with financial and technical assistance to voluntarily put conservation on the ground, not only helping the environment but agricultural operations, too.

W

Wetland Reserve Program (WRP)
A voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property.

Wetlands
Areas shallowly flooded temporarily or permanently to cover the base of plants but not prolonged inundation of the entire plant; areas temporarily flooded often supporting aquatic plants and animals; areas temporarily or permanently flooded with woody vegetation taller than six meters; areas of usually shallow wetlands dominated by non-woody plants such as cattail, reeds or rushes; areas with moist non-vegetated soil, often produced in shallow wetlands by advance and retreat of water levels; areas permanently flooded and often supporting aquatic plants and animals; and areas flooded temporarily or permanently with woody vegetation shorter than six meters.

White-nose Syndrome (WNS)
White-nose syndrome (WNS) is an infectious disease associated with a fungus responsible for unprecedented levels of mortality among hibernating bats in North America.

11

CHAPTER XI.

REFERENCES AND ACKNOWLEDGEMENTS

asiurus cinereus
Photo courtesy of Tim Torrance

REFERENCES

Allen, A. W. (1985). Habitat Suitability Index Models: Swamp Rabbit. *U.S. Fish Wildlife Service Biological Report*, *82* (10.107), p. 20.

Association of Fish and Wildlife Agencies, Teaming with Wildlife Committee, State Wildlife Action Plan (SWAP) Best Practices Working Group. (2012). *Best Practices for State Wildlife Actions Plans—Voluntary Guidelines to States for Revision and Implementation,* p. 80. Washington DC: Association of Fish and Wildlife Agencies.

Attum, O., Lee, Y. M., & Kingsbury, B. A. (2009). The Status of the Northern Population of the Copper-bellied Watersnake, Nerodia Erythrogaster Neglecta. *Northeastern Naturalist*,*16*(3), pp. 317-320. doi: 10.1656/045.016.n301

Attum, O., Lee, Y. M., Roe, J. H., & Kingsbury, B. A. (2007). Upland–Wetland Linkages: Relationship of Upland and Wetland Characteristics with Watersnake Abundance. *Journal of Zoology, 271*(2), pp. 134-139. doi: 10.1111/j.14697998.2006.00178.x

Donaldson, B. M. & Echternacht, A. C. (2005). Aquatic Habitat Use Relative to Home Range and Seasonal Movement of Eastern Box Turtles (Terrapene Carolina Carolina: Emydidae) Eastern Tennessee. *Journal of Herpetology*, *39*(2), pp. 278-284. doi:0.1046/j.0269-8463.2001.00587.x

Hamernick, M. G. (2001). Ranges and Habitat Selection of Blanding's Turtles (Emydoideablandingii) at the Weaver Dunes. *Nongame Wildlife Program Final Report*, p. 18. St. Paul, MN: Minnesota Department of Natural Resources.

Homoya, M. A., Abrell, D. B., Aldrich, J. A., & Post, T. W. (1985). The Natural Regions of Indiana. *Proceedings of the Indiana Academy of Science, 94*, pp. 245-268.

Jin, S., Yang, L., Danielson, P., Homer, C., Fry, J., & Xian, G. (2013). A Comprehensive Change Detection Method for Updating the National Land Cover Database to Circa 2011. *Remote Sensing of Environment*, *132,* pp. 159-175.

Larson, M. A., Dijak, W. D., Thompson III, F. R., & Millspaugh, J. J. (2003). Landscape-level Habitat Suitability Models for Twelve Species in Southern Missouri. *General Technical Report NC-233*, p. 51. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station.

Luensmann, P. S. (2006). Terrapene Carolina. *Fire Effects Information System.* U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Retrieved from http: www.fs.fed.us/database/feis/

Ohio EPA. (2006). Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI). *Ohio EPA Technical Bulletin EAS (2006-06-01)*. Retrieved February 4, 2009, from www.epa.state.oh.us

Omernik, J. M. (1987). Ecoregions of the Conterminous United States (Map Supplement). *Annals ofthe Association of American Geographers, 77*(1), pp. 118-125.

Salafsky, N., Salzer, D., Stattersfield, A. J., Hilton-Taylor, C., Neugarten, R., Butchart, S. H. M., Collen, B., Cox, N., Master, L. L., O'Conner, S., & Wilke, D. (2008). A Standard Lexicon for Biodiversity Conservation: Unified Classifications of Threats and Actions. *Conservation Biology, 22*, pp. 897-911. doi: 10.1111/j.1523-1739.2008.00937.x

Rittenhouse, C. D., Dijack, W. D., Thompson III, F. R., & Millspaugh, J. J. (2007). Development of Landscape-level Habitat Suitability Models for Ten Wildlife Species in the Central Hardwoods Region. *General Technical Report NRS-4*, p. 47. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station.

Roe, J. H., Kingsbury, B. A., & Herbert, N. R. (2004). Comparative Water Snake Ecology: Conservation of Mobile Animals that Use Temporally Dynamic Resources. *Biological Conservation, 118*(1), pp. 79-89.

Roe, J. H., Gibson, J., & Kingsbury, B. A. (2006). Beyond the Wetland Border: Estimating the Impact of Roads for Two Species of Water Snakes. *Biological Conservation, 130*(2), pp. 161-168.

Simon, T. P. & Dufour, R. L. (2005). Guide to Appropriate Metric Selection for Calculating the Index of Biotic Integrity (IBI) for Indiana Large and Great Rivers, Inland Lakes, and Great Lakes Nearshore. Bloomington, IN: U.S. Department of the Interior, Fish and Wildlife Service.

Stevens, S. D., Page, D., & Prescott, D. R. C. (2010). Habitat Suitability Index for the Northern Leopard Frog in Alberta: Model Derivation and Validation. *Alberta Special Risk Report, 132*, p. 16. Edmonton, AB: Alberta Sustainable Resource Development, Fish and Wildlife Division.

Tayyebi, A., Pekin, B. K., Pijanowski, B. C., Plourde, J. D., Doucette, J. S., & Braun, D. (2013). Hierarchical Modeling of Urban Growth Across the Conterminous USA: Developing Meso-scale Quantity Drivers for the Land Transformation Model. *Journal of Land Use Science, 8*(4), pp. 422-442.

Terrel, T. L. (1972). The Swamp Rabbit (Sylvilagus aquaticus) in Indiana. *American Midland Naturalist,* pp. 283-295.

Tirpak, J. M., Jones-Farrand, D. T., Thompson III, F. R., Twedt, D. J., & Uihlein III, W. B. (2009). Multiscale Habitat Suitability Index Models for Priority Landbirds in the Central Hardwoods and West Gulf Coastal Plain/Ouachitas Bird Conservation Regions. *General Technical Report NRS-49,* p. 195. Newtown Square, PA: U.S. Department of Agriculture, Forest Service Northern Research Station.

U.S. Geological Survey, Gap Analysis Program (GAP). (2011). *National Land Cover, 2*.

Vale, K. B. & Kissell Jr., R. E. (2010). Male Swamp Rabbit (Sylvilagus aquaticus Habitat Selection at Multiple Scales. *Southeastern Naturalist, 9*(3), pp. 547-562.

Walters, B. L., Ritzi, C. M., Sparks, D. W., & Whitaker Jr., J. O. (2007). Foraging Behavior of Eastern Red Bats (Lasiurus borealis) At an Urban-rural Interface. *The American Midland naturalist, 157*(2), pp. 365-373.

Whitaker Jr., J. O., Amlaner Jr., C. J., Jackson, M. T., Parker, G. R., & Scott, P. E. (2012). Presettlement to Present. *Habitats and Ecological Communities of Indiana.* Bloomington, IN: Indiana University Press.

Whitaker, J. O. & Mumford, R. E. (2009). Mammals of Indiana. *Indiana Natural Science.* Bloomington, IN: Indiana University Press.

Williams Jr., E. C. & Parker, W. S. (1987). A Long-Term Study of a Box Turtle (Terrapene carolina) Population at Allee Memorial Woods, Indiana, with Emphasis on Survivorship. *Herpetologica*, pp. 328-335.

Wisconsin Department of Natural Resources. (2014). Wisconsin Blanding's Turtle Species Guidance. *Bureau of Natural Heritage Conservation, 683*. Madison, WI: Wisconsin Department of Natural Resources.

Zollner, P. A., Smith, W. P., & Brennan, L. A. (2000). Home Range Use By Swamp Rabbits (Sylvilagus aquaticus) in a Frequently Inundated Bottomland Forest. *The American Midland Naturalist, 143*(1), pp. 64-69.

ACKNOWLEDGEMENTS

SWAP survey participation and acknowledgements can be found in Appendix U.

12

CHAPTER XII.

APPENDICES

APPENDICES

- **Appendix A.** Aquatic SGCN Habitat Associations By Order and Watershed
- **Appendix B.** Crosswalk Tables for Habitat Classifications
- **Appendix C.** Detailed Methods for Individual Landscape-level Models
- **Appendix D.** Habitat Classification Schemes and Definitions
- **Appendix E.** Indiana Invertebrate (not including Freshwater Mussels) SGCN: Status, Distribution, and Associations
- **Appendix F.** Relative Abundance and Trends in Abundance of Indiana SGCN
- **Appendix G.** Distribution of SGCN Across Indiana SWAP Planning Regions
- **Appendix H.** Great Lakes Region SGCN Habitat and Subhabitat Tables
- **Appendix I.** Kankakee Region SGCN Habitat and Subhabitat Tables
- **Appendix J.** Corn Belt Region SGCN Habitat and Subhabitat Tables
- **Appendix K.** Valleys and Hills Region SGCN Habitat and Subhabitat Tables
- **Appendix L.** Interior Plateau Region SGCN Habitat and Subhabitat Tables
- **Appendix M.** Drift Plains Region SGCN Habitat and Subhabitat Tables
- **Appendix N.** Most Relevant Conservation Actions for SGCN According to Responses to the Species Survey Free Response Questions
- **Appendix O.** Full Species Survey Results
- **Appendix P.** Full Habitat Survey Results
    - Great Lakes Region
    - Kankakee Region
    - Corn Belt Region
    - Valleys and Hills Region
    - Interior Plateau Region
    - Drift Plains Region
- **Appendix Q.** Conservation Organization Survey
- **Appendix R.** Focus Group One
- **Appendix S.** Focus Group Two
- **Appendix T.** SWAP Facilitation
- **Appendix U.** SWAP Survey Participation and Acknowledgements

Please visit www.swap.dnr.in.gov for access to the SWAP appendices.