5

CHAPTER V.

STATEWIDE ASSESSMENTS OF SGCN AND HABITATS

OUTLINE

A. Distribution and Abundance of SGCN
B. Statewide Assessment of Habitats
C. Threats and Actions by Major Habitat Type

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.

Taxa	Group	Scientific Name	Common Name	Status[1]
Birds	Cranes	*Grus americana*	Whooping Crane	FE/SE
Birds	Cranes	*Grus canadensis*	Sandhill Crane	SC
Birds	Herons, Egrets, and Bitterns	*Ardea alba*	Great Egret	SC
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	*Nyctanassa violacea*	Yellow-crowned Night-heron	SE
Birds	Herons, Egrets, and Bitterns	*Nycticorax nycticorax*	Black-crowned Night-heron	SE
Birds	Nightjars	*Antrostomus vociferus*	Eastern Whip-poor-will	SC
Birds	Nightjars	*Chordeiles minor*	Common Nighthawk	SC

Taxa	Group	Scientific Name	Common Name	Status[1]
Birds	Rails	*Gallinula galeata*	Common Gallinule	SE
Birds	Rails	*Laterallus jamaicensis*	Black Rail	SE
Birds	Rails	*Rallus elegans*	King Rail	SE
Birds	Rails	*Rallus limicola*	Virginia Rail	SE
Birds	Raptors	*Accipiter striatus*	Sharp-shinned Hawk	SC
Birds	Raptors	*Asio flammeus*	Short-eared Owl	SE
Birds	Raptors	*Buteo lineatus*	Red-shouldered Hawk	SC
Birds	Raptors	*Buteo platypterus*	Broad-winged Hawk	SC
Birds	Raptors	*Circus cyaneus*	Northern Harrier	SE
Birds	Raptors	*Falco peregrinus*	Peregrine Falcon	SC
Birds	Raptors	*Haliaeetus leucocephalus*	Bald Eagle	SC
Birds	Raptors	*Ictinia mississippiensis*	Mississippi Kite	SC
Birds	Raptors	*Pandion haliaetus*	Osprey	SE
Birds	Raptors	*Tyto alba*	Barn Owl	SE
Birds	Shorebirds	*Arenaria interpres*	Ruddy Turnstone	SC
Birds	Shorebirds	*Bartramia longicauda*	Upland Sandpiper	SE
Birds	Shorebirds	*Calidris canutus rufa*	Rufa Red Knot	SE
Birds	Shorebirds	*Calidris subruficollis*	Buff-breasted Sandpiper	SC
Birds	Shorebirds	*Charadrius melodus*	Piping Plover	FE/SE
Birds	Shorebirds	*Limnodromus griseus*	Short-billed Dowitcher	SC

Taxa	Group	Scientific Name	Common Name	Status[1]
Birds	Shorebirds	*Phalaropus tricolor*	Wilson's Phalarope	SC
Birds	Shorebirds	*Pluvialis dominica*	American Golden-plover	SC
Birds	Shorebirds	*Tringa melanoleuca*	Greater Yellowlegs	SC
Birds	Shorebirds	*Tringa solitaria*	Solitary Sandpiper	SC
Birds	Songbirds	*Ammodramus henslowii*	Henslow's Sparrow	SE
Birds	Songbirds	*Cistothorus palustris*	Marsh Wren	SE
Birds	Songbirds	*Cistothorus platensis*	Sedge Wren	SE
Birds	Songbirds	*Helmitheros vermivorum*	Worm-eating Warbler	SC
Birds	Songbirds	*Lanius ludovicianus*	Loggerhead Shrike	SE
Birds	Songbirds	*Mniotilta varia*	Black-and-white Warbler	SC
Birds	Songbirds	*Setophaga cerulea*	Cerulean Warbler	SE
Birds	Songbirds	*Setophaga citrina*	Hooded Warbler	SC
Birds	Songbirds	*Setophaga kirtlandii*	Kirtland's Warbler	FE/SE
Birds	Songbirds	*Sturnella neglecta*	Western Meadowlark	SC
Birds	Songbirds	*Vermivora chrysoptera*	Golden-winged Warbler	SE
Birds	Songbirds	*Xanthocephalus xanthocephalus*	Yellow-headed Blackbird	SE
Birds	Terns	*Chlidonias niger*	Black Tern	SE
Birds	Terns	*Sternula antillarum athalassos*	Interior Least Tern	FE/SE
Birds	Waterfowl	*Cygnus buccinator*	Trumpeter Swan	SE
Mammals	Bats	*Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat	SC
Mammals	Bats	*Lasionycteris noctivagans*	Silver-haired Bat	SC

Taxa	Group	Scientific Name	Common Name	Status[1]
Mammals	Bats	*Lasiurus borealis*	Eastern Red Bat	SC
Mammals	Bats	*Lasiurus cinereus*	Hoary Bat	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	SC
Mammals	Bats	*Myotis septentrionalis*	Northern Long-eared Myotis	FT/SE
Mammals	Bats	*Myotis sodalis*	Indiana Myotis	FE/SE
Mammals	Bats	*Nycticeius humeralis*	Evening Bat	SE
Mammals	Bats	*Perimyotis subflavus*	Tri-colored Bat	SC
Mammals	Mustelids	*Mustela nivalis*	Least Weasel	SC
Mammals	Mustelids	*Taxidea taxus*	American Badger	SC
Mammals	Rabbits	*Sylvilagus aquaticus*	Swamp Rabbit	SE
Mammals	Rodents	*Geomys bursarius*	Plains Pocket Gopher	SC
Mammals	Rodents	*Neotoma magister*	Allegheny Woodrat	SE
Mammals	Rodents	*Spermophilus franklinii*	Franklin's Ground Squirrel	SE
Mammals	Shrews and Moles	*Condylura cristata*	Star-nosed Mole	SC
Mammals	Shrews and Moles	*Sorex fumeus*	Smoky Shrew	SC
Mammals	Shrews and Moles	*Sorex hoyi*	American Pygmy Shrew	SC
Amphibians	Aquatic Salamanders	*Cryptobranchus alleganiensis*	Hellbender	SE
Amphibians	Aquatic Salamanders	*Necturus maculosus*	Common Mudpuppy	SC
Amphibians	Frogs	*Acris crepitans*	Northern Cricket Frog	SC

Taxa	Group	Scientific Name	Common Name	Status[1]
Amphibians	Frogs	*Lithobates areolatus*	Crawfish Frog	SE
Amphibians	Frogs	*Lithobates blairi*	Plains Leopard Frog	SE
Amphibians	Frogs	*Lithobates pipiens*	Northern Leopard Frog	SC
Amphibians	Frogs	*Scaphiopus holbrookii*	Eastern Spadefoot	NA
Amphibians	Salamanders	*Ambystoma barbouri*	Streamside Salamander	SC
Amphibians	Salamanders	*Ambystoma laterale*	Blue-spotted Salamander	SC
Amphibians	Salamanders	*Ambystoma talpoideum*	Mole Salamander	SE
Amphibians	Salamanders	*Aneides aeneus*	Green Salamander	SE
Amphibians	Salamanders	*Hemidactylium scutatum*	Four-toed Salamander	SC
Amphibians	Salamanders	*Pseudotriton ruber*	Red Salamander	SE
Reptiles	Snakes	*Agkistrodon piscivorus*	Cottonmouth	SE
Reptiles	Snakes	*Cemophora coccinea*	Scarletsnake	SE
Reptiles	Snakes	*Clonophis kirtlandii*	Kirtland's Snake	SE
Reptiles	Snakes	*Crotalus horridus*	Timber Rattlesnake	SE
Reptiles	Snakes	*Farancia abacura*	Red-bellied Mudsnake	SC
Reptiles	Snakes	*Nerodia erythrogaster neglecta*	Copper-bellied Watersnake	FT/SE
Reptiles	Snakes	*Opheodrys aestivus*	Rough Greensnake	SC
Reptiles	Snakes	*Opheodrys vernalis*	Smooth Greensnake	SE
Reptiles	Snakes	*Sistrurus catenatus*	Massasauga	FC/SE
Reptiles	Snakes	*Tantilla coronata*	Southeastern Crowned Snake	SE
Reptiles	Snakes	*Thamnophis butleri*	Butler's Gartersnake	SE
Reptiles	Snakes	*Thamnophis proximus*	Western Ribbonsnake	SC
Reptiles	Turtles	*Clemmys guttata*	Spotted Turtle	SE

Taxa	Group	Scientific Name	Common Name	Status[1]
Reptiles	Turtles	*Emydoidea blandingii*	Blanding's Turtle	SE
Reptiles	Turtles	*Kinosternon subrubrum*	Eastern Mud Turtle	SE
Reptiles	Turtles	*Macrochelys temminckii*	Alligator Snapping Turtle	SE
Reptiles	Turtles	*Pseudemys concinna*	River Cooter	SE
Reptiles	Turtles	*Terrapene carolina*	Eastern Box Turtle	SC
Reptiles	Turtles	*Terrapene ornata*	Ornate Box Turtle	SE
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	Cavefish	*Amblyopsis hoosieri*	Hoosier Cavefish	SE
Fish	Lampreys	*Ichthyomyzon fossor*	Northern Brook Lamprey	SE
Fish	Perches	*Ammocrypta clara*	Western Sand Darter	SC
Fish	Perches	*Etheostoma maculatum*	Spotted Darter	SC
Fish	Perches	*Etheostoma proeliare*	Cypress Darter	SC
Fish	Perches	*Etheostoma tippecanoe*	Tippecanoe Darter	SC
Fish	Perches	*Etheostoma variatum*	Variegate Darter	SE
Fish	Perches	*Percina copelandi*	Channel Darter	SE
Fish	Perches	*Percina evides*	Gilt Darter	SE
Fish	Pikes	*Esox masquinongy ohioensis*	Ohio River Muskellunge	SC
Fish	Pygmy Sunfish	*Elassoma zonatum*	Banded Pygmy Sunfish	SC

Taxa	Group	Scientific Name	Common Name	Status[1]
Fish	Sculpins	*Cottus cognatus*	Slimy Sculpin	SC
Fish	Sturgeons	*Acipenser fulvescens*	Lake Sturgeon	SE
Fish	Suckers	*Catostomus catostomus*	Longnose Sucker	SC
Fish	Suckers	*Moxostoma valenciennesi*	Greater Redhorse	SE
Fish	Sunfish	*Lepomis symmetricus*	Bantam Sunfish	SE
Fish	Trout-perches	*Percopsis omiscomaycus*	Trout-perch	SC
Fish	Trouts and Salmons	*Coregonus artedi*	Cisco	SC
Fish	Trouts and Salmons	*Coregonus clupeaformis*	Lake Whitefish	SC
Mollusks	Mussels	*Cyprogenia stegaria*	Fanshell	FE/SE
Mollusks	Mussels	*Epioblasma obliquata perobliqua*	White Catspaw	FE/SX
Mollusks	Mussels	*Epioblasma torulosa rangiana*	Northern Riffleshell	FE/SE
Mollusks	Mussels	*Epioblasma torulosa torulosa*	Tubercled Blossom	FX/SX
Mollusks	Mussels	*Epioblasma triquetra*	Snuffbox	FESE
Mollusks	Mussels	*Fusconaia subrotunda*	Longsolid	SX
Mollusks	Mussels	*Lampsilis abrupta*	Pink Mucket	FE/SX
Mollusks	Mussels	*Lampsilis fasciola*	Wavyrayed Lampmussel	SC
Mollusks	Mussels	*Obovaria subrotunda*	Round Hickorynut	SE
Mollusks	Mussels	*Plethobasus cicatricosus*	White Wartyback	FE/SX
Mollusks	Mussels	*Plethobasus cooperianus*	Orangefoot Pimpleback	FE/SX
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	*Pleurobema rubrum*	Pyramid Pigtoe	SX

Taxa	Group	Scientific Name	Common Name	Status[1]
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

[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 (50 CRF 17.11, Appendix E). 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 or unpublished 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 statuses 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 except that they cannot be harvested.

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 2005 CWS was published:

Table 5-2. Status and rank of Indiana's SGCN.

Level	Direction	Change	Species
Federal	Downlisted	FT › No Status	Bald Eagle
	Elevated	No Status › FC	Massasauga
		No Status › FT	Rabbitsfoot
		No Status › FE	Northern Long-eared Myotis[1] Snuffbox
		FC › FT	Copper-bellied Watersnake
		FC › FE	Sheepnose Rayed Bean
	Delisted	FE › FX	Tubercled blossom

Level	Direction	Change	Species
State	Downlisted	SC › No Status	River Otter Bobcat Eastern Spadefoot
		SE › SC	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 Northern Cricket Frog Streamside Salamander Eastern Box Turtle
		No Status › SE	Mole Salamander
		SC › SE	Cerulean Warbler Plains Leopard Frog Round Hickorynut Rayed Bean
	Delisted	SE › SX	Tubercled Blossom White Catspaw Longsolid Pink Mucket White Wartyback Orangefoot Pimpleback Pyramid Pigtoe

[1]*Not currently federally endangered but likely to be listed in the near future.*

[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 P.

Distribution of SGCN Across Habitats and Planning Region

Figure 5-1 below 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 H and a complete list of habitat and subhabitat definitions can be found in Appendix H.

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; Appendix E includes additional information on distribution of SGCN across planning regions.

All six planning regions had similar numbers of bird (43-46), mammal (11-17), 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 three and the highest in the Valleys and Hills region with ten. 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 P.

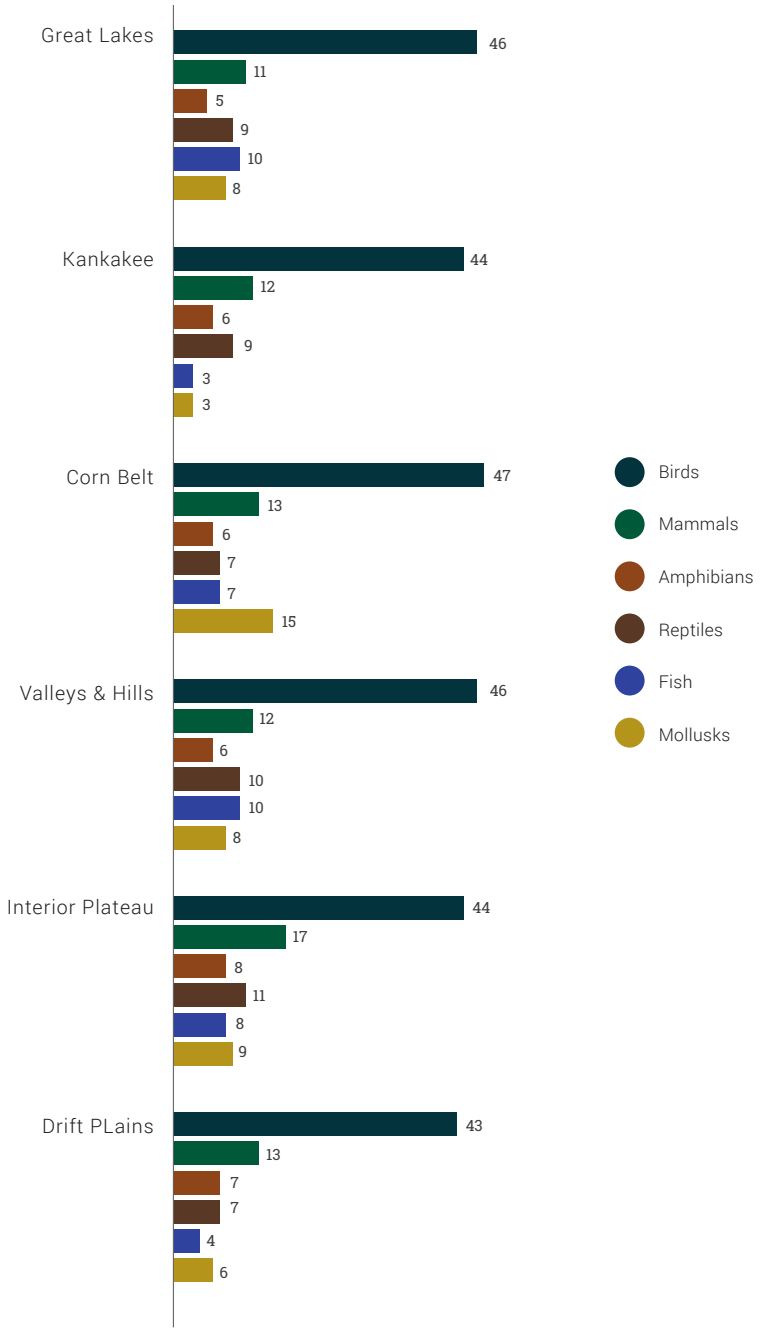

Figure 5-1. Number of species found in each planning region by taxa.

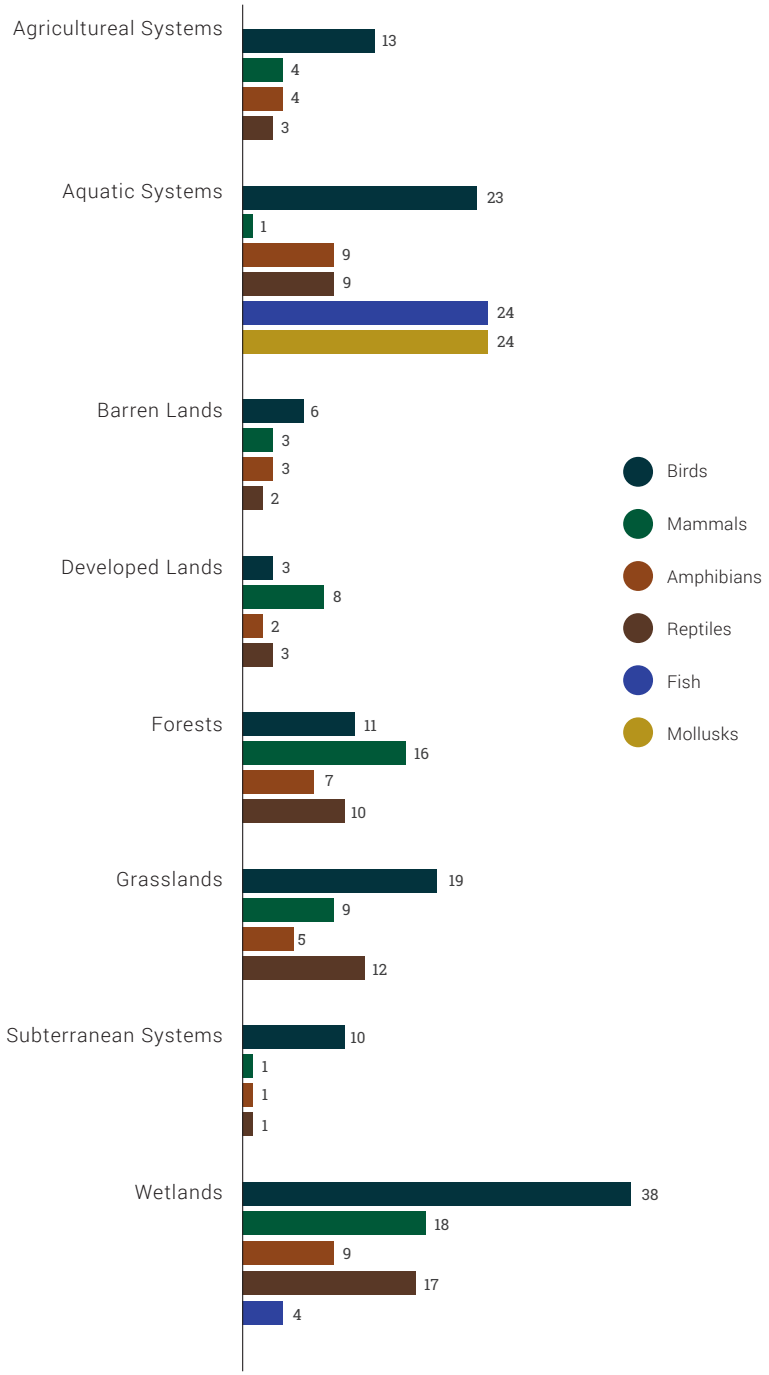

Figure 5-2. Number of species occurring in each major habitat type by taxa.

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 G.

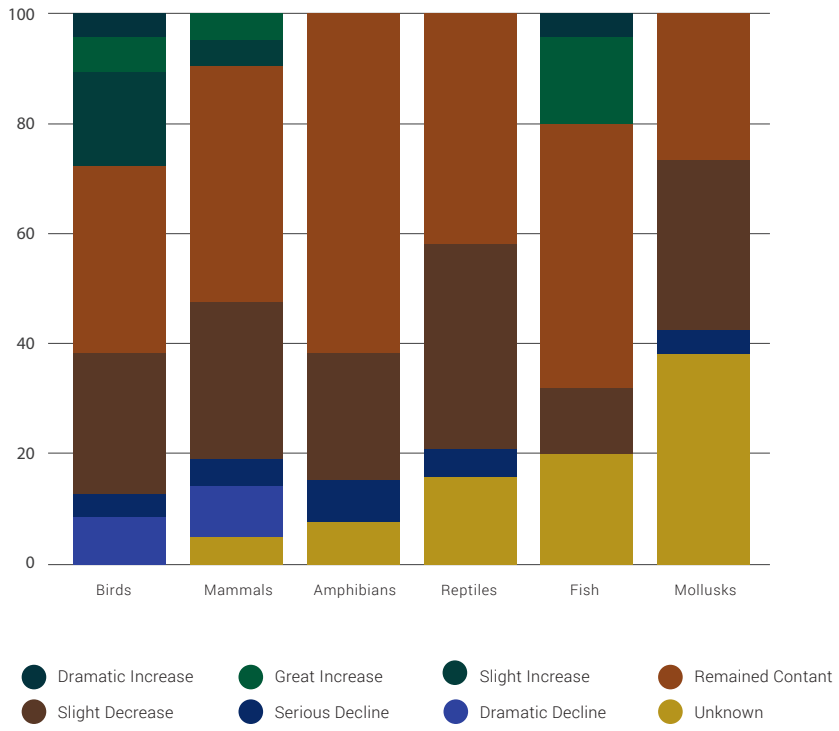

Figure 5-3. Perceptions of trends in abundance of SGCN since 2005 by taxa.

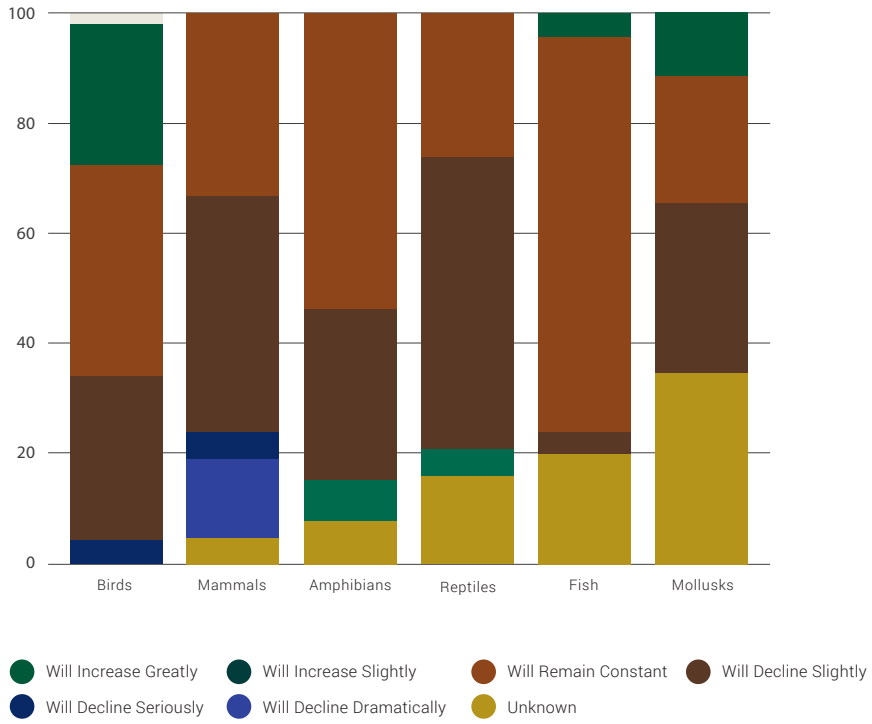

Figure 5-4. Predicted trends in abundance of SGCN by 2025 by taxa.

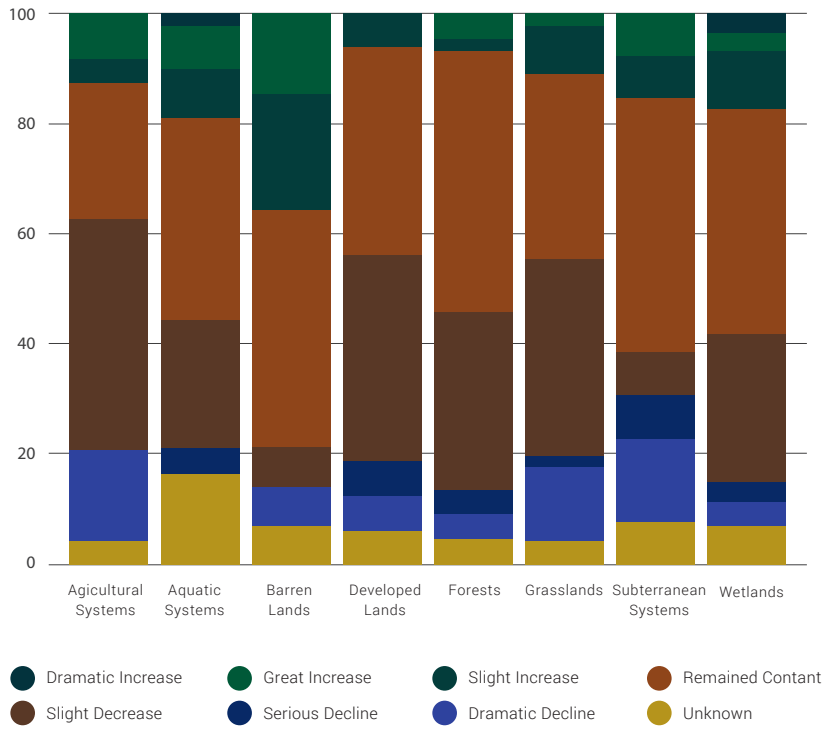

Figure 5-5. Perceptions of trends in abundance of SGCN since 2005 by major habitat type.

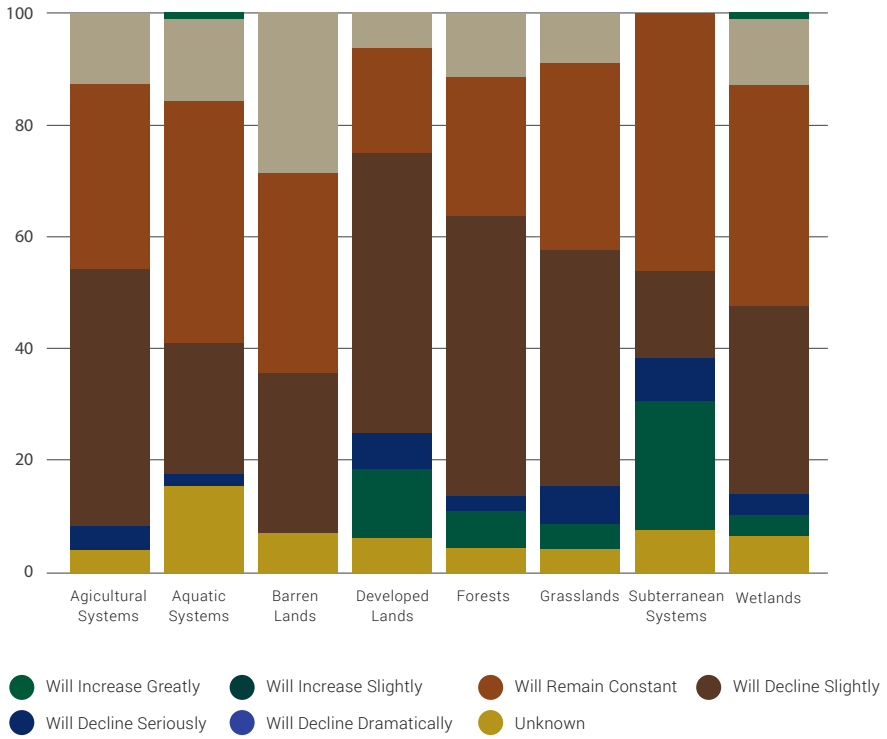

Figure 5-6. Predicted trends in abundance of SGCN by 2025 by major habitat type.

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 insect 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 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 2005 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 below (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 watch in Indiana.

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

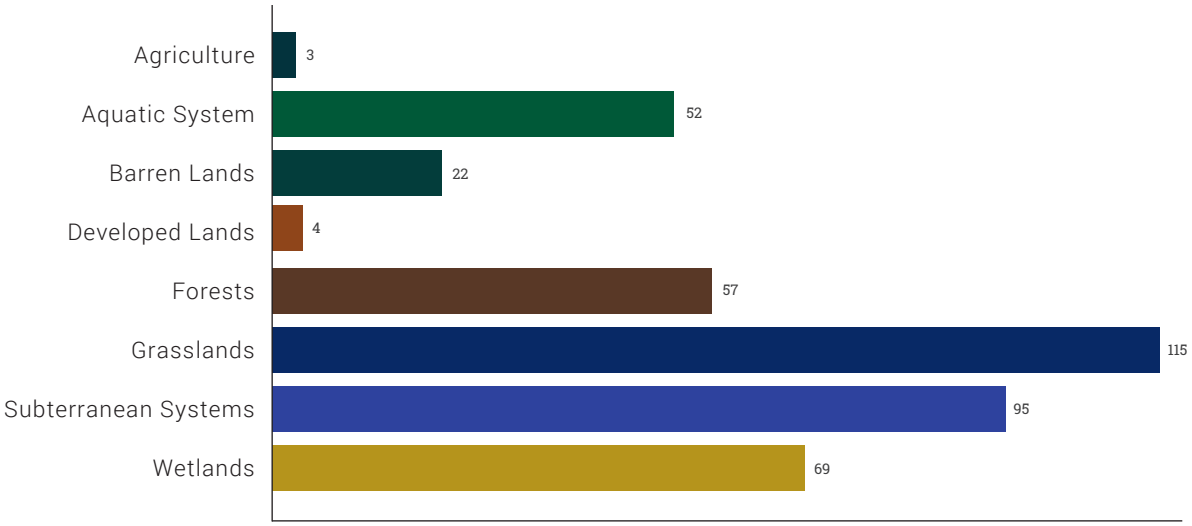

Figure 5-7. Number of listed invertebrate species occurring in each major habitat type in Indiana.

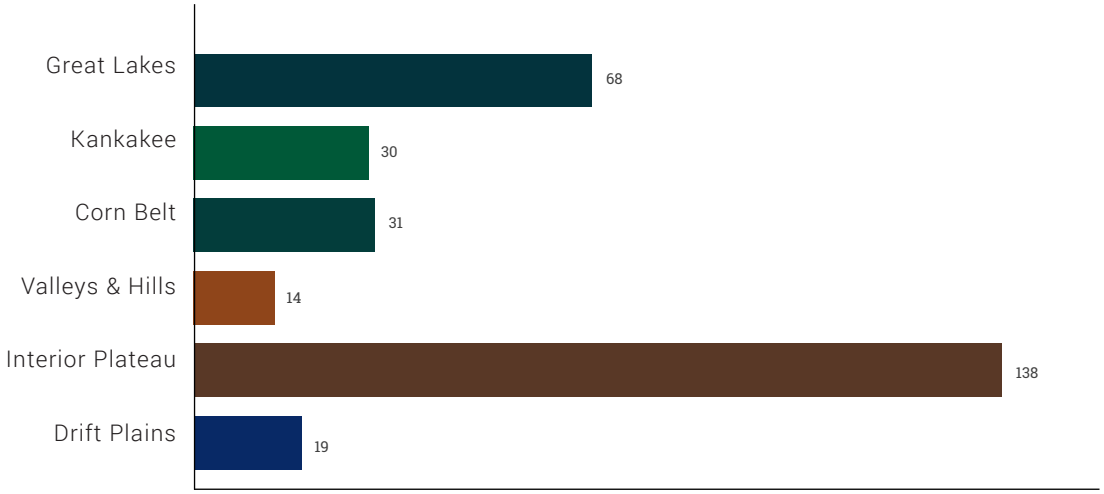

Figure 5-8. Number of listed invertebrate species occurring in each planning region.

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 allow 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 2005 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 broad, yet reasonable representation of the wildlife and habitats 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 too many differences of wildlife and habitats 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 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 2005 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 2005 CWS, we compared NLCD data from 2001 and 2011. The NLCD uses its own land cover classification scheme, which we adapted to fit the eight major habitat types (Appendix B).

The following major habitat types are used for the 2015 SWAP (Appendix D):

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

7. **Subterranean Systems:** Connected underground rooms and passages beyond natural light penetration
8. **Wetlands:** Temporarily or permanently flooded habitats, often supporting aquatic vegetation

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.

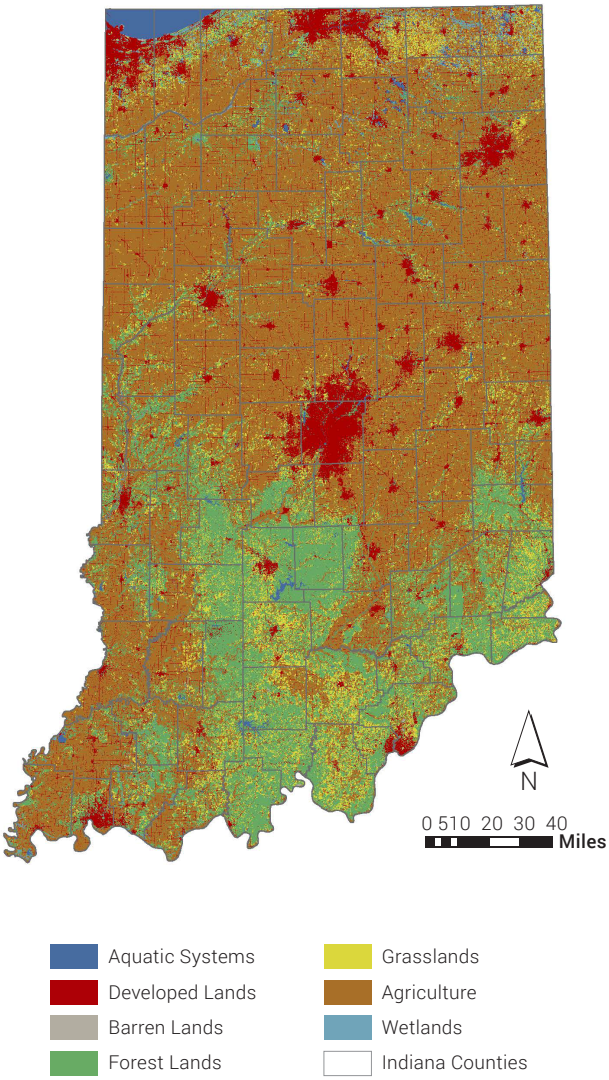

Figure 5-10. Spatial distribution and abundance of the major habitat types in Indiana.

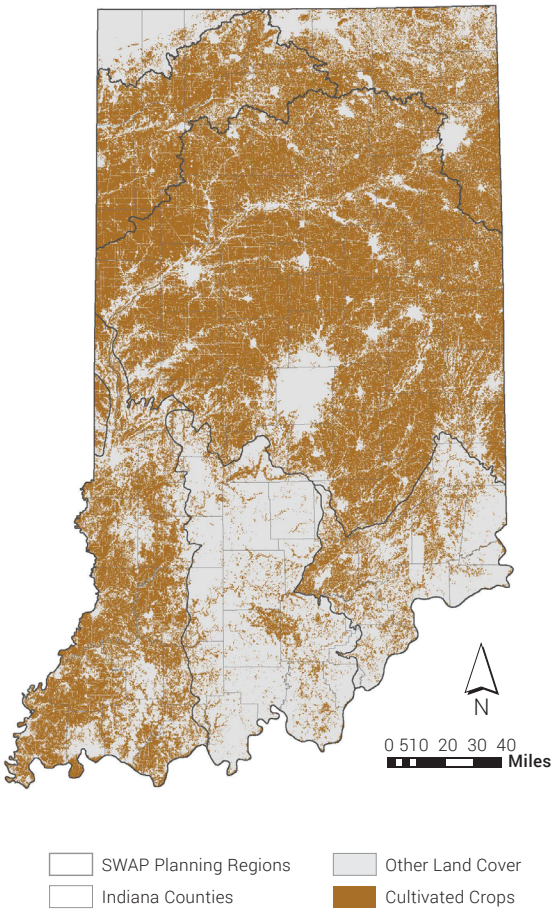

Figure 5-11. Agricultural systems in Indiana from 2011 NLCD.

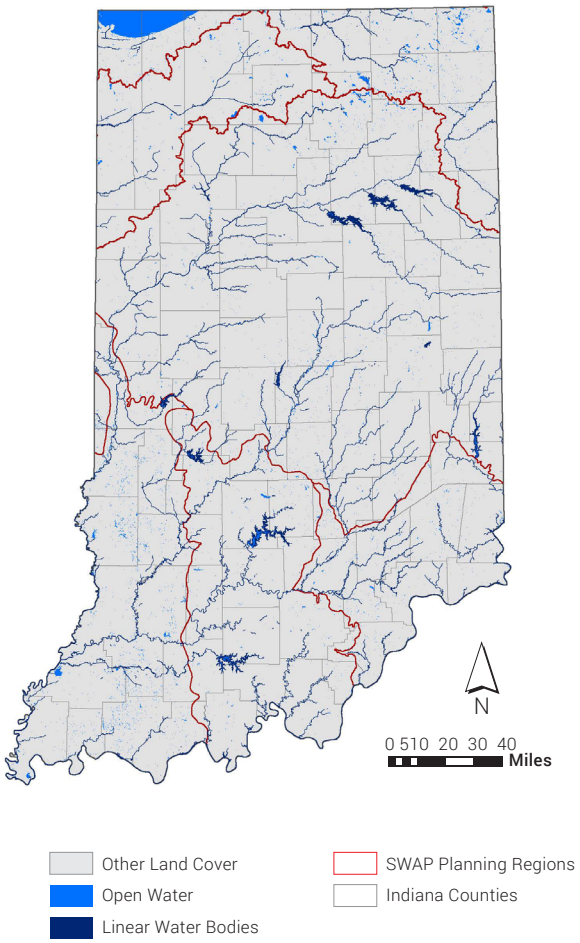

Figure 5-12. Aquatic systems in Indiana including lakes and reservoirs, streams and rivers, and the Indiana portion of Lake Michigan.

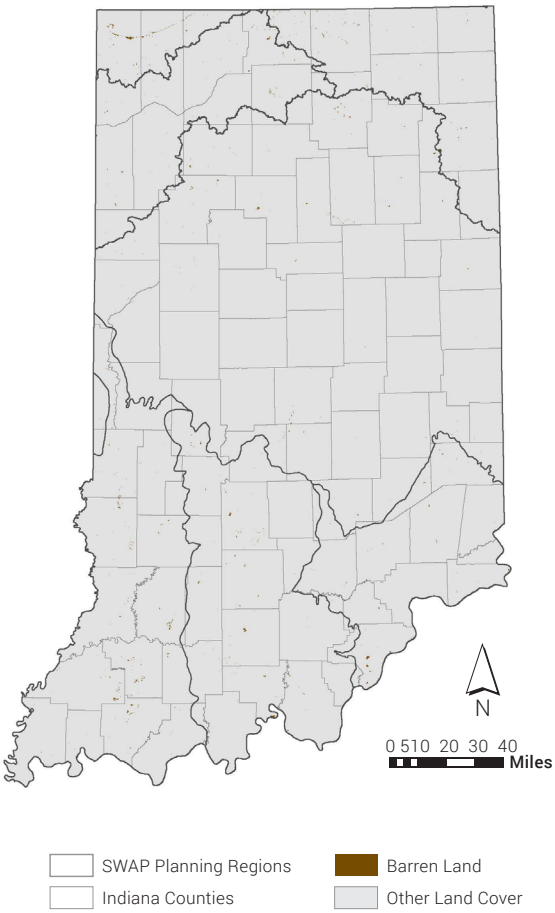

Figure 5-13. Barren lands in Indiana from 2011 NLCD are shown to be the least abundant major habitat type in Indiana.

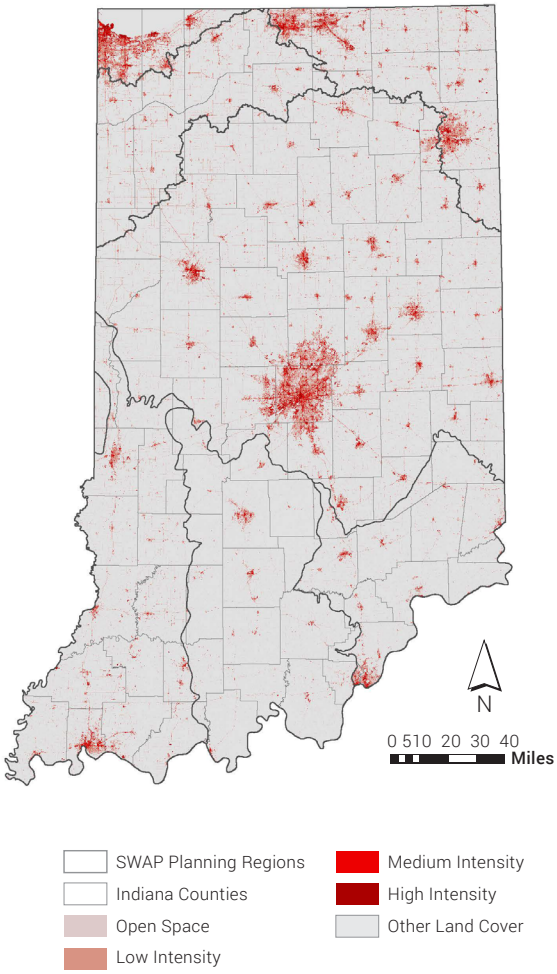

Figure 5-14. Developed lands in Indiana from 2011 NLCD concentrated around Chicago, IL, Gary, South Bend, Fort Wayne, Indianapolis, and Evansville, IN, and Louisville, KY.

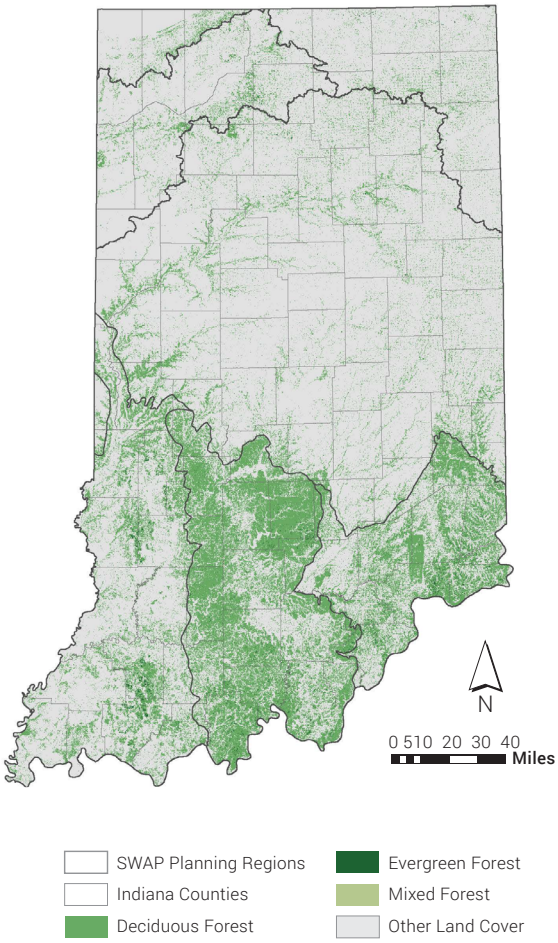

Figure 5-15. Forest lands in Indiana from the 2011 NLCD, concentrated in the unglaciated southern third of the state.

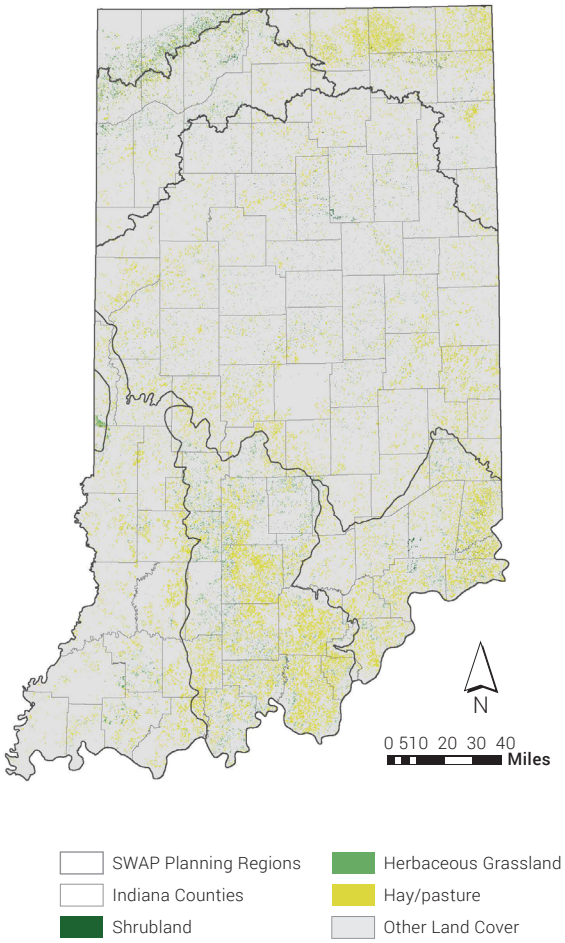

Figure 5-16. Grasslands in Indiana from the 2011 NLCD, found primarily in the southern and extern northern parts of the state.

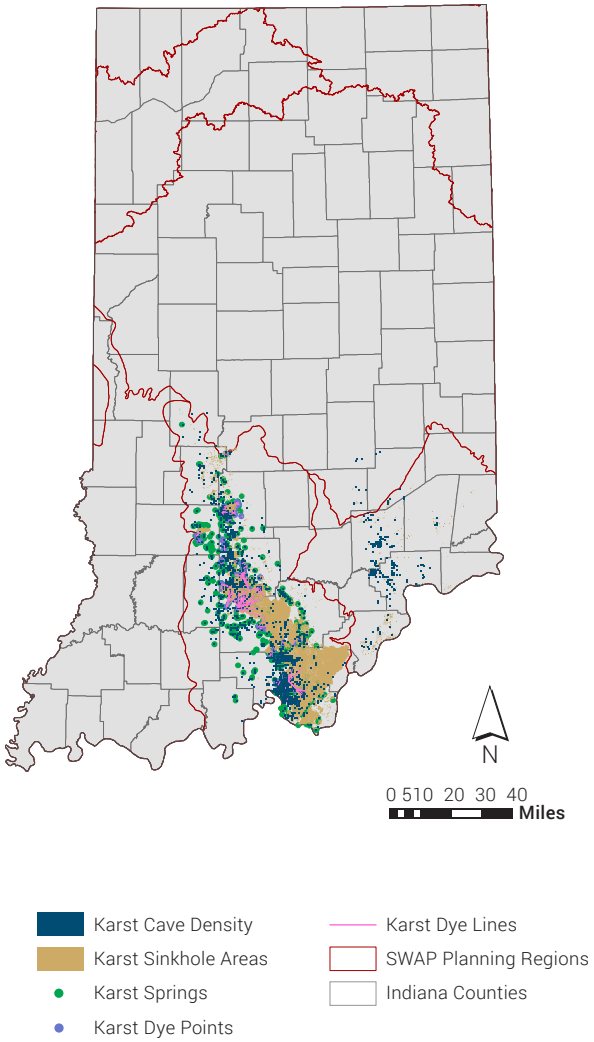

Figure 5-17. Subterranean systems in Indiana from the Indiana Geological Survey, this map of the karst regions of Indiana shows cave densities, sinkhole areas, springs, dye points, and dye lines.

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).

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
1 - GREAT LAKES	Agriculture	1,106,485	45.2	1,092,297	44.6	15,893	1.4	1,705	0.2	-14,187	- 1.3
	Aquatic Systems	186,024	7.6	186,321	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	15.0	481	+ 8.3
	Developed Lands	469,228	19.2	498,393	20.4	5	0.0	29,170	6.2	29,165	+6.2
	Forest Lands	195,094	8.0	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
2 - 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
3 – CORN BELT	Agriculture	7,257,175	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	2,230	+ 2.9
	Barren Lands	3,597	0.0	4,649	0.0	559	15.5	1,611	44.8	1,052	+ 29.2
	Developed Lands	1,152,208	11.4	1,207,606	12.0	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	537,321	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
4 – 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
5 – 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
6 – 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	0.0	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	5,684	1.6	1,500	+ 0.4
	Total Acres:	**23,308,845**		**Total Acres Changed:**	**174,22**						

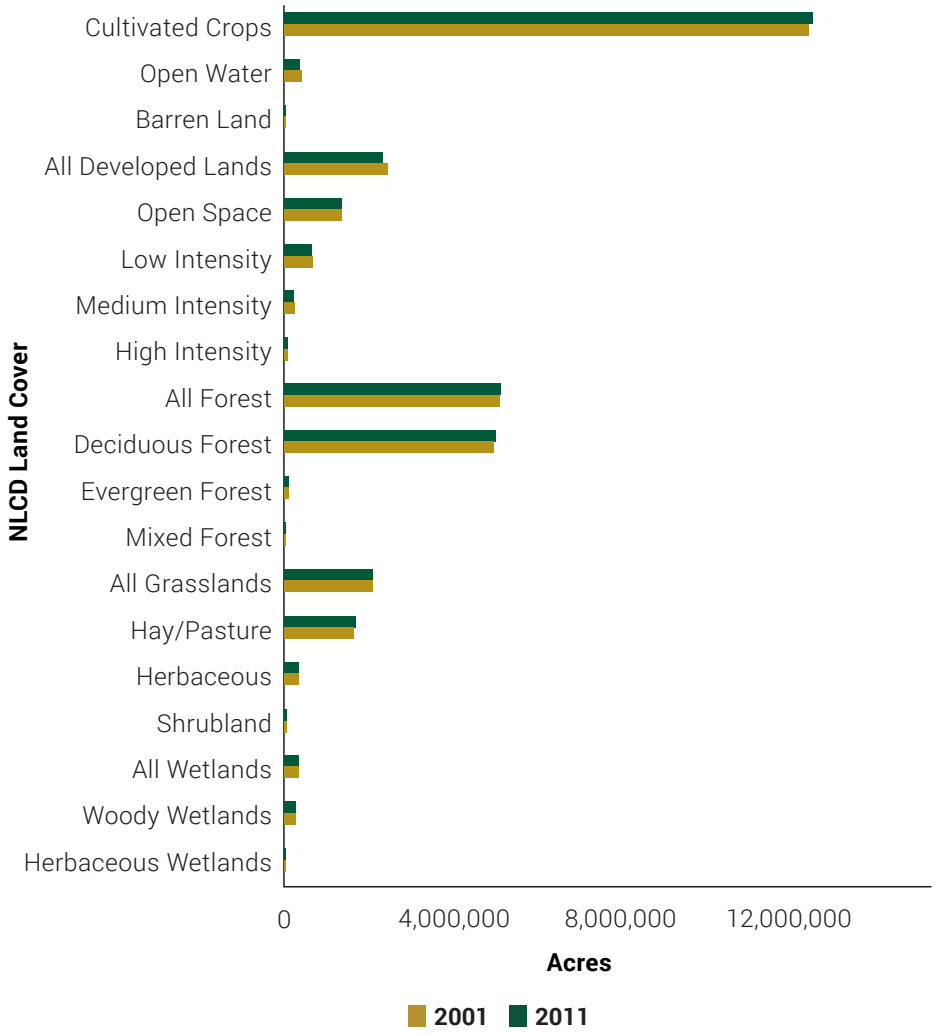

Figure 5-19. Land cover distribution in Indiana from 2001 and 2011.

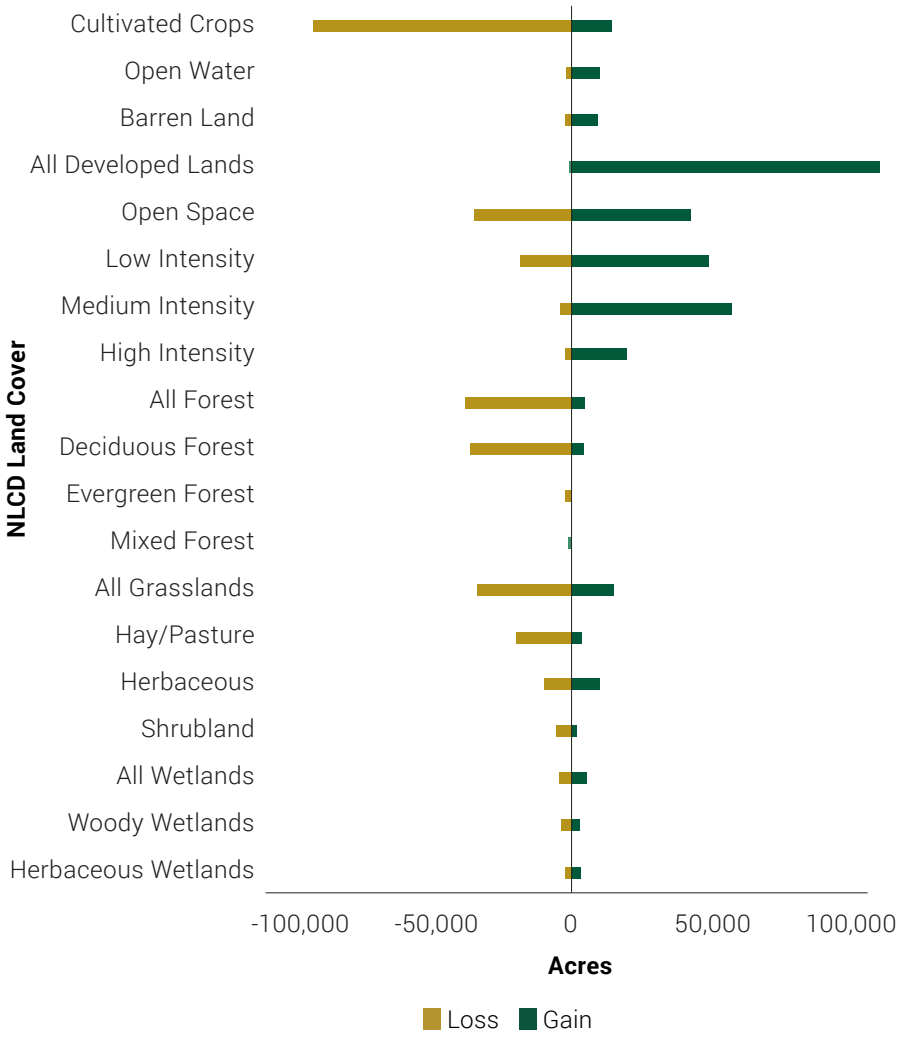

Figure 5-20. Losses and gains in land cover types in Indiana between 2001 and 2011.

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 P.

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 P.

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.

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 these data is available in Appendix P.

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 Chapter V and Appendices I-M.

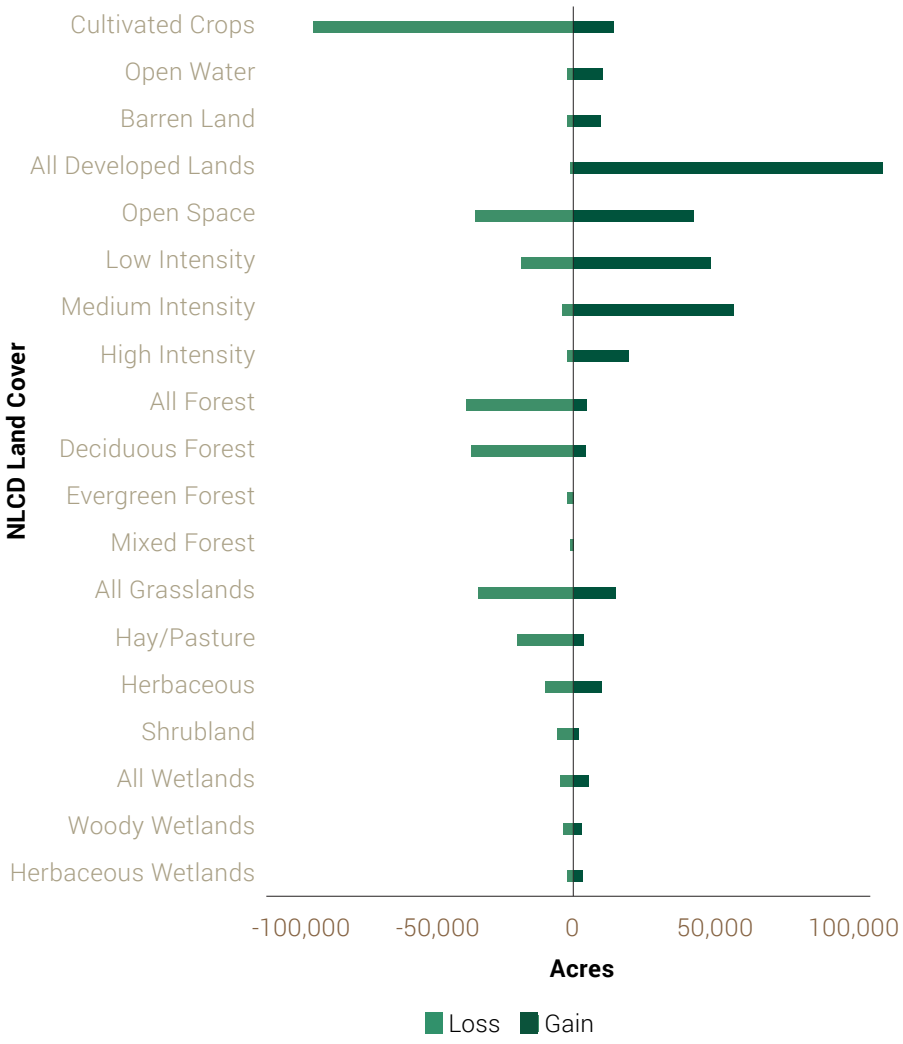

Figure 5-21. Indiana land cover changes from 2001 and 2011.

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 2015 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 from non-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 P. 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 species of greatest conservation need 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 perrenial 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

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 1)	Kankakee (Region 2)	Corn Belt (Region 3)	Valleys and Hills (Region 4)	Interior Plateau (Region 5)	Drift Plains (Region 6)
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 1)	Kankakee (Region 2)	Corn Belt (Region 3)	Valleys and Hills (Region 4)	Interior Plateau (Region 5)	Drift Plains (Region 6)
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
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, species inbreeding, etc.)	2	2	2	2	2	2	2
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 what actions were the most directly relevant to addressing threats to the conservation of that species over the next ten years. Action scenarios included actions currently being implemented, planned, or simply important regardless of whether they had been implemented or planned. The second question aimed to figure out was designed to determine what effective actions of direct species benefit were taken in the past decade, that directly benefitted that species how effective they were had worked and to what degree, and how effective potential actions might be to the effectiveness of potential actions. The final question asked what the major barriers were to implementing those conservation actions.

A summary of the responses organized by for each species for which they were received can be found in Appendix P. 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 E.

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 2015 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 X.

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 themselves through free-response options. Respondents were asked to allocate 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 1)	Kankakee (Region 2)	Corn Belt (Region 3)	Valleys and Hills (Region 4)	Interior Plateau (Region 5)	Drift Plains (Region 6)
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 Action	Statewide Rank	Great Lakes (Region 1)	Kankakee (Region 2)	Corn Belt (Region 3)	Valleys and Hills (Region 4)	Interior Plateau (Region 5)	Drift Plains (Region 6)
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
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 materials in conservation 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
Support substitution of alternatives for environmentally harmful products and processes	4	3	4	4	5	4	4
Link natural resources to livelihoods through nature tourism	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 producers, landowners, and conservation professionals)	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.

57.9% 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.

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. 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, 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).
- **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.