Indiana Department of Natural Resources

2016 WILDLIFE SCIENCE REPORT

ON THE COVER

The wood duck (*Aix sponsa*) is one of the most striking ducks in North America. Males are brightly colored with red irises, hues of iridescent purple, blue and green in their head and wing feathers, and a white "chin strap." Females are more subdued in color. They are mostly brown with white eye rings. Both sexes have crested heads.

Wood ducks are considered a medium-size perching duck. They typically inhabit wet woodlands, nest in tree cavities, and perch on branches using their long-clawed toes. Unlike most waterfowl, they are comfortable flying through wooded landscapes. As cavity nesters, they take readily to man-made nest boxes. They are the only North American duck that will raise two broods of young in one season.

Wood ducks range from southern Canada to Mexico and Cuba. They reside in shrubby or wooded wetlands, preferring shallow streams and oxbow formations. These habitats offer abundant food and protection from predators and weather. The majority of the wood duck's diet is plant based but the species will also eat insects and snails.

In the early 1900s the wood duck was nearly extinct due to habitat loss, unregulated bag limits, and extensive hunting seasons. The Migratory Bird Treaty Act, enacted in 1916, promotes the survival of wood ducks and other migratory birds.

By the 1940s, hunters were able to legally bag a single wood duck. During the 2016 waterfowl hunting season, the daily bag limit for ducks in Indiana was six, no more than three of which could be wood ducks. Efforts such as wetland restoration, habitat protection, hunting regulations, and nest box installations have helped restore North America's wood duck population. Today there is an estimated population of 3 million breeding birds, making the wood duck one of the most successful conservation stories in North America.

Banding waterfowl continues to be an important management tool for biologists. Band recovery data provide vital information that helps determine migration routes, harvest rates, and even survival rates for some waterfowl species. In Indiana, banding takes place through a cooperative partnership between the Division of Fish & Wildlife (DFW), the U.S. Fish & Wildlife Service (USFWS), and the U.S. Geological Survey (USGS) through the Bird Banding Laboratory. DFW staff banded 934 wood ducks in 2016. Anyone who finds a banded bird of any species is strongly encouraged to report the band number by calling 1-800-327-BAND or online at *reportband.gov*. (Photo by Steve Gifford)

Photograph Note

DNR photographers Frank Oliver and John Maxwell, along with Wildlife Science Unit staff, took many of the copyrighted photos in this publication. Others are in the public domain unless otherwise noted.

American white pelicans at Willow Slough Fish & Wildlife Area in Newton County during migration.

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Crosley Fish & Wildlife Area in southeast Indiana covers more than 400 acres, including ponds, rolling hills and approximately 7.5 miles of Muscatatuck River shoreline.

WILDLIFE SCIENCE UNIT ADMINISTRATION

INTRODUCTION

State law (IC 14-22-2) charges the DFW with the protection, reproduction, care, management, survival and regulation of wild animal populations in Indiana in such a manner that will best serve the interests of the resource and people of the state. To better achieve this legislative mandate, professional staff in the Wildlife Diversity and Wildlife Research sections merged in 2014 to form the Wildlife Science Unit. Although their responsibilities, funding sources, focal species and user groups may differ, both share the fundamental mission to conserve and manage wild animal populations throughout Indiana.

The Wildlife Science Unit is a comprehensive, science-based, resource management program that carries out an array of activities to fulfill its statutory obligations. Population management (i.e., species restoration, regulation of take, periodic or total protection of a species), research, surveys, habitat acquisition and improvement, and education are some of the tools staff members use to meet these responsibilities.

This annual report offers a brief look at some of the notable highlights and accomplishments of the Wildlife Science Unit in 2016. We share this information to enlighten Hoosiers to the intrinsic value of Indiana's rich wildlife resources and the conservation efforts underway to ensure they persist for present and future generations to enjoy.

PERSONNEL CHANGES

Personnel changes occurred in the Wildlife Science Unit in 2016 that allowed three important positions to be filled. Joe Caudell was hired as the deer biologist, the assistant deer biologist position was filled by Olivia Vaught, and Taylor Rasmussen joined as the nongame mammalogist. Joe and Taylor are both new to the Indiana Department of Natural Resources (DNR). All three positions are stationed in the Bloomington Field Office.

Before joining the DNR, Joe was an assistant professor of wildlife biology at Murray State University in Kentucky, where he taught a variety of wildlife management and wildlife biology courses. Joe obtained his B.S. from the Warnell School of Forest Resources at the University of Georgia and his M.S. and Ph.D. from Utah State University, working on brown tree snakes (*Boiga irregularis*) and eared grebes (*Podiceps nigricollis*), respectively. Joe was a wildlife disease biologist with the U.S Department of Agriculture's (USDA) Wildlife Services from 2004 to 2013, working in Maine, Las Vegas and Indiana. He has worked with exotic and invasive species and wildlife disease in the U.S. and abroad since 1998. Joe's research interest centers on various aspects of deer management, wildlife wound ballistics, and wildlife economics.

Taylor graduated from Morningside College with a B.S. in biology. He received his M.S. from Fort Hays State University (biology) working on Franklin's ground squirrels (*Spermophilus franklinii*), an endangered species in Indiana. Taylor is originally from eastern South Dakota and grew up hunting and fishing in the prairie pothole region. His research has encompassed mostly small mammals, including work with shrews, bats and rodents. Taylor's major interest is protecting wildlife and preserving it for future generations to enjoy.

Joe Caudell joined the Indiana Department of Natural Resources in 2016 as the state's deer biologist.

Taylor Rasmussen holds a hoary bat while mist netting in western Kansas.

Olivia Vaught joined the Indiana Department of Natural Resources in 2016 as the assistant deer biologist.

Olivia graduated from Purdue University with a B.S. in wildlife biology. She first joined the DFW in 2015 as a naturalist aide analyzing northern bobwhite (*Colinus virginianus*) habitat use. She then took a full-time position in the Indianapolis office as an environmental review biologist before returning to Bloomington. Olivia has field experience conducting bird and vegetation surveys and trapping small mammals in southern Indiana forests.

FUNDING

Wildlife Diversity

The past year had its share of good and bad news in terms of funding to benefit nongame and endangered species in Indiana. Nationally, the most significant event was the March release of the Blue Ribbon Panel (BRP) report on the future of fish and wildlife conservation in the United States. The BRP, a broad assemblage of national business and conservation leaders from outdoor recreation retail and manufacturing, energy and automotive industries, private landowners, educational institutions, conservation organizations, sportsmen's groups, and state fish and wildlife agencies, was charged to examine how conservation is currently funded and to propose a new mechanism that will conserve all fish and wildlife resources.

After nearly two years of study and consideration of more than 20 funding options, the BRP recommended to dedicate up to $1.3 billion annually of existing revenue from the development of energy and mineral resources on federal lands and waters to the Wildlife Conservation Restoration Program. These dollars would afford the states the resources required to carry out their State Wildlife Action Plan (SWAP), written to address rare, declining, and at-risk species, or, collectively, species of greatest conservation need (SGCN).

The BRP report culminated with the introduction of H.R. 5650, "Recovering America's Wildlife Act of 2016,"

2016 WILDLIFE SCIENCE UNIT STAFF

Indianapolis Office: 317-234-9586
Scott Johnson, Program Manager
sjohnson@dnr.IN.gov

Bloomington Office: 812-334-1137
Dawn Slack, Supervisor

Joe Caudell, Deer Biologist
jcaudell@dnr.IN.gov

Olivia Vaught, Assistant Deer Biologist
ovaught@dnr.IN.gov

Adam Phelps, Waterfowl Biologist
aphelps@dnr.IN.gov

Sarabeth Klueh-Mundy, Nongame Herpetologist

Jason Mirtl, Assistant Nongame Herpetologist
jmirtl@dnr.IN.gov

Taylor Rasmussen, Nongame Mammalogist
trasmussen@dnr.IN.gov

Cassie Hudson, Assistant Nongame Mammalogist
chudson@dnr.IN.gov

Tim Shier, Assistant Nongame Mammalogist
tshier@dnr.IN.gov

Allisyn-Marie Gillet, Nongame Ornithologist
agillet@dnr.IN.gov

Steve Burcham, Clerk
sburcham@dnr.IN.gov

Vacant, Farmland Biologist

Vacant, Furbearer Biologist

Edinburgh Office: 812-526-5816
Brant Fisher, Nongame Aquatic Biologist
bfisher@dnr.IN.gov

JoAnne Davis, Assistant Nongame Aquatic Biologist
jodavis1@dnr.IN.gov

Mitchell Office: 812-849-4586
Steve Backs, Ruffed Grouse and Wild Turkey Biologist
sbacks@dnr.IN.gov

Amy Kearns, Assistant Nongame Ornithologist
akearns@dnr.IN.gov

Roger Hunter, Clerk
rhunter@dnr.IN.gov

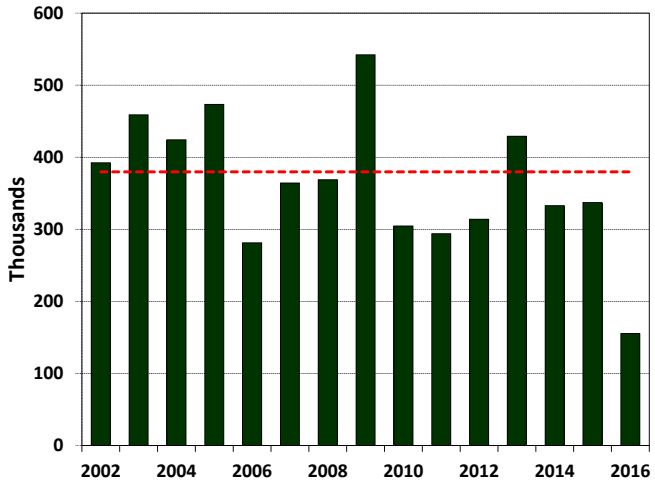
Naturalist Aides: Tim Arlowe, Sara Brighty, Clint Cunningham, Sadie Dainko, Kelly DeRolf, Caleb Dessauer, Jordan Holmes, Megan Kuechle, Jaclyn O'Connor, Mitchell Sargent, Torrey Silliman, Carolyn Straiker, Zachary Wesner

DONATE TO SUPPORT WILDLIFE CONSERVATION

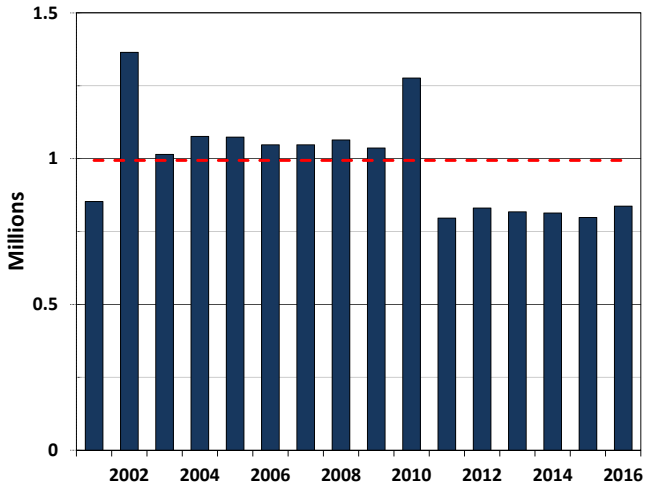
The DFW invites you to play an active role in conserving Indiana's nongame and endangered wildlife by donating to the Indiana Nongame Wildlife Fund. Wildlife Diversity activities are supported by public donations to this fund. No state tax dollars are earmarked for these projects. Money from the Nongame Wildlife Fund is used as a match to receive federal grant funding. For every $5 received in donations another $9 is provided via federal grants. The money donated goes directly toward the protection and management of more than 750 species in Indiana, from shorebirds and salamanders to endangered Indiana bats and snuffbox mussels.

To donate, follow one of these easy steps:

- Donate online at *endangeredwildlife.IN.gov*.
- Donate all or part of your state tax refund using Schedule 5/Schedule IN-DONATE. The Indiana Nongame Wildlife Fund three-digit code is 200.
- Send a check to:
  Indiana Nongame Wildlife Fund
  402 West Washington Street, Room W273
  Indianapolis, IN 46204



Annual donations to the Indiana Nongame Wildlife Fund from 2002 to 2016 (in thousands). The red dashed line represents the 14-year average from 2002 to 2015 of approximately $380,000.



Indiana's annual apportionment of funds from the U.S. Fish & Wildlife Service's State Wildlife Grant program from 2001 to 2016 (in millions). The red dashed line represents the 15-year average from 2001 to 2015 of approximately $994,000.

into Congress in July. This historic wildlife funding initiative would provide a permanent and dedicated source of revenue for states to conserve their SGCN, with Indiana receiving up to $22 million annually for these purposes.

The DFW again received federal monies through the USFWS State and Tribal Wildlife Grants (SWG) program. The SWG program, authorized by Congress in 2001, provides funds to help conserve declining fish and wildlife species before they become threatened or endangered. These dollars, unfortunately, are not permanent but subject to annual federal budget battles. Indiana's 2016 apportionment of $836,759 was slightly more than in recent years but below the 15-year average of about $1 million. We are grateful to our many university partners who continue to provide the required 35% non-federal match that allows us to use our SWG funds to their full potential.

Contributions to the Indiana Nongame Wildlife Fund, used exclusively to support Wildlife Diversity activities, declined drastically in 2016. Most donations to this fund are received when Indiana citizens donate part or all of their refund while filing their annual state income taxes. Recent changes to the state's tax forms, which included a competing fund and additional paperwork, combined to result in the lowest donation total to the fund since it was established 35 years ago. The Nongame Wildlife Fund received $155,521 in 2016, a 60% decline from the average annual donation over the last 14 years ($379,800). The DFW appreciates every contribution. Staff members are exploring ways to increase donations to the Nongame Wildlife Fund and to better communicate to Hoosiers how their generous gifts support nongame and endangered species conservation in Indiana.

Additional USFWS funds were received from a competitive white-nose syndrome (WNS) grant ($18,252) and an Endangered Species Act Section 6 grant ($59,900). The WNS grant will fund counts of wintering bat populations. Detecting mudpuppies (*Necturus*

maculosus) using non-invasive environmental DNA approaches is the subject of the endangered species grant. The mudpuppy is the obligate reproductive host of the salamander mussel (*Simpsonaias ambigua*), a species of special concern that also is under review for federal listing. There are only two known healthy populations of salamander mussels in Indiana. In other historical locations, they are likely imperiled, not reproducing, or have disappeared entirely. Future conservation efforts for this mussel, such as reintroductions or augmentations within its historic Indiana range, will require knowledge of mudpuppy populations in targeted drainages to be successful.

Wildlife Research

Survey and monitoring activities conducted by Wildlife Research staff are financed by state hunting and trapping licenses and federal Pittman-Robertson (PR) Act funds. PR monies are derived from an 11% federal excise tax on sporting arms, ammunition and archery equipment, and a 10% federal excise tax on handguns. When hunters and shooters purchase these items, the manufacturers pay the excise tax. These revenues are deposited into the Wildlife Restoration Trust Fund and administered by the USFWS. Funds are made available as grants through the USFWS to each eligible state, based on the size of the state and its number of licensed hunters. The grants fund up to 75% of the eligible costs with the other 25% supplied by the state—usually from license revenue—but other partners, such as universities, may provide the match.

State wildlife agencies use PR funds to support many programs such as habitat and species restoration, research, management, land acquisition, hunter access, facilities construction and maintenance, archery and shooting ranges, and hunter education. Projects that target the restoration and conservation of wild mammals and birds are eligible for Wildlife Restoration (WR) funds. During 2016, WR funds totaling $588,481 were used to conduct wildlife research projects in Indiana, including a new study of the ecological role and recreational contribution of mallard (*Anas platyrhynchos*) populations that occupy urban environments in central Indiana.

RULE CHANGES

Indiana's fish and wildlife resources are governed by state laws and administrative rules that set forth the requirements that regulate wild animals. The DFW has statutory authority for wild mammals, birds, reptiles, amphibians, fish, crayfish and freshwater mussels.

Administrative rules are typically reviewed biennially, and any necessary changes are made through the approval of the Natural Resources Commission. The current biennial rule revision process, which typically takes more than a year to complete, was initiated in 2016. Ideas on fishing, hunting, trapping and other fish and wildlife related regulations in Indiana were received from DFW staff and the general public. Public comments on those ideas were submitted through the DFW's online GotINput system. The process will continue in 2017, when rule proposals will be presented to the Natural Resources Commission for preliminary adoption.

Two categories are used to designate the status of rare species in Indiana: endangered and special concern. Species designated as special concern are defined as any animal species requiring monitoring because of known or suspected limited abundance or distribution, or because of a recent change in federal status or required habitat. Species designated as endangered are defined as any animal species whose prospect for survival or recruitment within Indiana is in jeopardy and is in danger of disappearing from the state. This designation also includes all animal species listed as threatened or endangered by the USFWS that occur in Indiana.

Whereas endangered species receive legal protection by state law pursuant to the Indiana Nongame and Endangered Species Conservation Act (IC 14-22-34), species of special concern do not have equivalent levels of protection, and some can still be taken from the wild. No changes were made to the state's list of endangered and special concern species in 2016. The current list can be found at *endangeredwildlife.IN.gov.*

OPPORTUNITIES TO VOLUNTEER

A common question heard around the DFW is "how can I help?" Specific questions involve helping with scientific research, conserving species in need, and cleaning up the environment. A new DFW program makes answering those questions easier.

In 2014, the DFW began using a volunteer management program called CERVIS. The program allows biologists to easily advertise projects for which they need assistance. CERVIS also provides a convenient way for the general public to sign up for activities that peak their interest.

Perhaps you would like to monitor bats roosting on your property, conduct weekly waterfowl surveys at select DFW properties, perform routine maintenance on bluebird boxes, clean up public access sites by adopting a ramp, or teach kids to fish at the DNR's fishing pond at the State Fair. All of these options and more are available.

To get started, visit the DNR Volunteer Program page at *wildlife.IN.gov/8301.htm* and select "Apply to volunteer." You can set up your profile to receive emails about projects that pertain to your interests and skills. Regardless of whether you choose to receive those emails, you can peruse the list of one-time events and service projects currently open for registration at any time.

The DNR thanks all who volunteered to help make its programs successful in 2016. The time and effort contributed by each individual, young and old, was greatly appreciated. Although the program is relatively new, approximately 475 volunteers logged more than 5,800 hours in 2016.

WILDLIFE DIVERSITY

AMPHIBIANS & REPTILES

Crawfish Frog

The crawfish frog (*Lithobates areolatus*) is a large, heavy-bodied frog with unique habitat requirements and an unmistakable call.

Crawfish frogs have dark-brown to black spots bordered by cream. They have a short, blunted snout and a prominent line down their back called the dorsolateral fold. A full-sized individual can reach 2.5–3 inches.

Naturalist aides Sadie Dainko and Carolyn Straiker place a crawfish frog trap in a breeding wetland in Greene County.

Wildlife Diversity herpetologist Sarabeth Klueh-Mundy holds a crawfish frog.

An adult crawfish frog rests at the edge of a breeding wetland.

They are a little larger than a green frog, but smaller than a bullfrog.

Male crawfish frogs migrate to breeding ponds around St. Patrick's Day each year, then call for 1–4 weeks, depending on the weather. The call of a single frog sounds like a long, loud snore. Several frogs calling at once are said to resemble the sound of hogs at feeding time. Their call can carry for more than a mile. Biologists conduct surveys during the spring mating season. That is the only feasible time to do so because the crawfish frog can be nearly impossible to find for 10.5 months out of the year. During that span, they stay in crayfish burrows that serve as their homes.

In 1878, the first crawfish frog in Indiana was recorded from Benton County. Historical data show that this frog once existed in 16 different counties, but six of those counties have not had a verified record for at least 45 years. In 1988, the crawfish frog became a state endangered species. Recent research suggests that only 1,000 crawfish frogs are left in Indiana, and the majority of those exist in two main populations. In order for the crawfish frog to ever be re-established in the state by means of reintroduction or translocations, biologists would first need to learn not only the genetics of the remaining populations, but also the ability of those populations to fight disease.

In 2016, Wildlife Diversity biologists assisted Purdue University in a statewide crawfish frog genetics project. To begin, all historical locations (except the two main populations) were placed on a map. The locations

were then grouped into five main clusters. Clusters included Daviess, Greene, Sullivan, Vigo, and Spencer counties. Teams of biologists and students were assigned to a cluster. They waited for the warm, rainy weather that would prompt the frogs to migrate to the breeding ponds. Frogs were captured and checked for malformations. Following standard procedures for extracting DNA from frogs or toads (*anurans*), a portion of toe material was removed from the rear foot. A total of 51 samples were collected in 2016. More will be collected in 2017.

Eastern Box Turtle

The Eastern box turtle (*Terrapene carolina*) is one of two turtles in Indiana that spends the majority of their time on land. They can easily be identified by their high-domed shell and their ability to pull their head and limbs inside their shell, which protects them from predators. The color of their shells can vary in shades of yellow, orange and brown. The pattern on the shells differs from turtle to turtle. New research has shown that each turtle's pattern is distinctive enough that pattern-recognition software can be used to distinguish one turtle from another.

Eastern box turtles are often seen on roads after warm rains. This puts them at risk for getting hit by vehicles. If you see a box turtle crossing the road and want to move it out of harm's way, ensure your safety first, then place the turtle off the side of the road in the direction it was facing. Never take a turtle and relocate it somewhere else. Eastern box turtles have a homing behavior. They will try to get back to their home area. Relocating box turtles puts them at greater risk of crossing roads and getting hit by cars. Relocation also places undue stress on the turtles.

Due to factors such as road mortality, disease, and over-collection for the pet trade, the Eastern box turtle's numbers are declining across their range. In 2004, the Eastern box turtle was placed on Indiana's special concern list and designated as "special protected." This status places it under the same protections as endangered species receive. Without a special permit, it is illegal to possess an Eastern box turtle or any of its parts, including the shell or eggs, in Indiana.

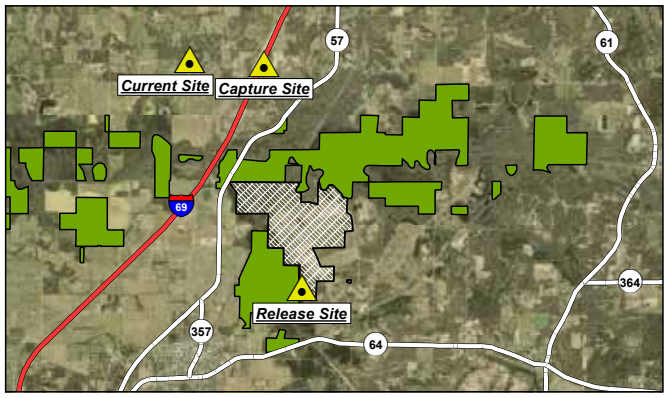
Wildlife Diversity biologists have been conducting a research project with Eastern box turtles at the Patoka River National Wildlife Refuge (NWR) since 2010. In response to the growing concerns about box turtle declines across the country and about how construction of a new interstate would affect local populations, biologists rescued more than 300 Eastern box turtles from the proposed Interstate 69 right-of-way during 2010, 2011 and 2012. Each turtle was weighed, measured and given a unique identification number before being placed in a secure, semi-natural environment.

Based on scientific research, it was determined unsafe to return these turtles to where they came

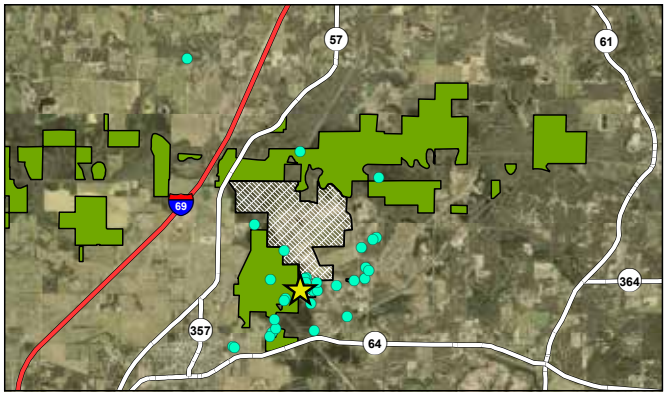
The pattern on the upper portion of the shell (carapace) varies greatly between individual Eastern box turtles.

The pattern on the lower portion of the shell (plastron) on Eastern box turtles can vary as well. These turtles have each been given a unique identification number.

This Eastern box turtle has a transmitter attached to its shell with epoxy. Turtles were tracked via radio-telemetry two to three times per week.



The movements of one of the I-69 box turtles—original site of capture in 2010, the release site at the Columbia Mine Preserve in 2015, and the current location. The area shaded in green is the Patoka River National Wildlife Refuge. This turtle traveled 4.5 miles as the crow flies from the release site to its current location, which is close to the original site of capture.



The release point of the I-69 turtles (yellow star), and their current locations (blue dots). The green area is the Patoka River National Wildlife Refuge. The white thatched area is the Columbia Mine Preserve.

Naturalist aide Caleb Dessauer tracks an Eastern box turtle that was part of the relocation study on Columbia Mine Preserve.

One of the I-69 Eastern box turtles sets out to its new home on the Columbia Mine Preserve in 2015.

from after completion of the interstate, given the high mortality rates of turtles near large, busy roads. Due to the turtles' homing instinct, the alternative was not as easy as merely releasing the turtles in a new area. To reset the turtles' site-fidelity instinct, they were moved to an enclosure in their new habitat in 2013. Current information indicates that a minimum of two years is required to help them adopt a new home area.

In spring 2015, the turtles collected from the I-69 right-of-way were released into their new home on the Columbia Mine Preserve at Patoka River NWR. A total of 50 turtles were outfitted with radio transmitters and tracked two to three times per week during the active season in 2015 and 2016, and once per week during hibernation. Location, temperature and habitat use were recorded.

Box turtles that resided on this parcel of land before the I-69 turtle introduction were radio-tracked during 2013 and 2014. Data from the I-69 turtles will be compared to those of the resident turtles to assess the success of the translocation.

Some interesting facts about box turtles:

1. Turtles do not leave their shells and search for larger ones as they grow. Instead, the shell grows with them. The shell and the body of the turtle are all one piece. Their spine is located in the top of the shell

(carapace), which protects their tissues and organs. If you see a shell without a turtle, it means that the turtle has died;

2. Turtles have a home range, which is a defined area in which they move to find food, mates and hibernation spots;

3. Turtles can live to be 100 years old in the wild.

Kirtland's Snake

The Kirtland's snake (*Clonophis kirtlandii*), best known for its red belly bordered by a row of black dots, is a small to medium-sized snake, measuring 13–18 inches long. It is the only snake within its genus and has a distribution limited to Indiana, Illinois, Ohio, Michigan and Kentucky.

Kirtland's snakes inhabit the edges of streams, ditches and ponds, and are often found in association with the Eastern gartersnake (*Thamnophis sirtalis*) and Dekay's brownsnake (*Storeria dekayi*). They are also found in developed urban or residential areas, often hiding under trash or other debris. Urban populations are often destroyed during development or poached by collectors. Kirtland's snakes are currently known from 38 counties in Indiana, but a majority of the records are pre-2002. This state-endangered species has been petitioned for federal listing.

A Kirtland's snake shows off its red belly bordered by rows of black dots.

Wildlife Diversity biologists conducted opportunistic surveys in 2016 within Washington, Scott, Marion, Hamilton, Lawrence, Monroe and Vermillion counties. Surveying for this species is difficult due to the snake's tendency to spend a majority of its time underground in crayfish burrows. In the future, Wildlife Diversity biologists will work with university researchers to determine if environmental DNA (eDNA) can be used to detect the presence of Kirtland's snakes. If successful, presence or probable absence in an area will be determined in one visit, rather than in the multiple visits it often takes during conventional surveys.

Streamside Salamander

The streamside salamander (*Ambystoma barbouri*) looks virtually identical to the small-mouthed salamander (*Ambystoma texanum*). In fact, the streamside salamander was not recognized as a separate species until 1989. Both species are generally dark-gray with light-gray speckles, average between 4–7 inches in total body length, and have 14 costal grooves (indentations along the side of the body). The differences between the two are habitat use and reproductive biology.

Salamanders in the genus *Ambystoma* are typically known for breeding in small ponds that dry up in most years. The streamside salamander, however, migrates to small, rocky creeks to breed. Females will lay eggs on the underside of rocks or logs within the water. Eggs are laid in a single layer, unlike small-mouthed

The streamside salamander is unique within the genus* Ambystoma *for its use of streams, like the one pictured here, instead of ponds, for breeding.

A male streamside salamander found within a stream in Jefferson County in January.

salamander eggs, which are laid in a globular sausage-shaped mass around a twig or stem.

Surveys for streamside salamanders were conducted in January at historical locations in Jefferson, Switzerland and Scott counties. A male was observed under a rock at one of the locations. This species has been petitioned for federal listing. Little is known about its current distribution in Indiana. Surveys will continue in 2017.

Salamander Disease Surveillance

Wildlife diseases are becoming more and more prevalent. In the reptile and amphibian world, biologists deal with *Batrachochytrium dendrobatidis* (Bd), a chytrid fungus that affects amphibians; ranavirus; and snake fungal disease. The most recent emerging pathogen is *Batrachochytrium salamandrivorans*, otherwise known as Bsal.

Bsal is a chytrid fungus that only affects salamanders. So far, it has not been found in the United States, but has caused mass die-offs in Europe. Some preliminary studies concluded that Bsal would have similarly devastating effects on certain native species of salamanders if it were to be transported to the United States. It is thought that Bd originated in Asia and was transported to Europe via the pet trade. In Asia, the fungus is native and non-lethal. European salamanders have no means of fighting the disease.

To help prevent the transport of Bsal to the U.S., the USFWS published an interim rule that listed 201 species of salamanders as injurious under the Lacey Act. First passed in 1900, this Act became the first federal law to protect wildlife. The law prohibits the import and interstate trade of listed species. A species can be listed as injurious if it poses a threat to the welfare and survival of wildlife or the resources that wildlife depends upon. Species listed under the Act were found to be potential carriers of Bsal. Of those 201 species, only the Eastern newt, siren, slimy salamander, red-backed salamander, ravine salamander, and zigzag salamander are native to Indiana.

The red-backed salamander was one of the species sampled for Bsal testing at Patoka River NWR.

In spring 2016, the USFWS and USGS initiated a Bsal surveillance program to conduct active surveillance for the presence of Bsal at certain locations, one of which is the Patoka River NWR. Wildlife Diversity biologists collected 30 samples from a combination of Eastern newts, slimy salamanders, red-backed salamanders, and two-lined salamanders even though they are not currently listed. Samples were gathered by swabbing seven different locations on each salamander. Two swabs were used on each individual and then placed in separate vials. The snout-vent length, a standard measurement for amphibians that measures the distance between the tip of the snout to the cloaca, was recorded, as was location, life-history stage, and capture technique (net, trap, etc.). All specimens were checked for the presence of lesions and released at the point of capture. This surveillance program will form a baseline for future research.

To prevent the spread of disease:

- Do not release any pet salamander, of any species from any origin, into the wild.
- Do not transport and release any salamanders from one location to another.
- If recreating or conducting field work and you come into contact with mud or water, clean your shoes and equipment with a 3% bleach solution.

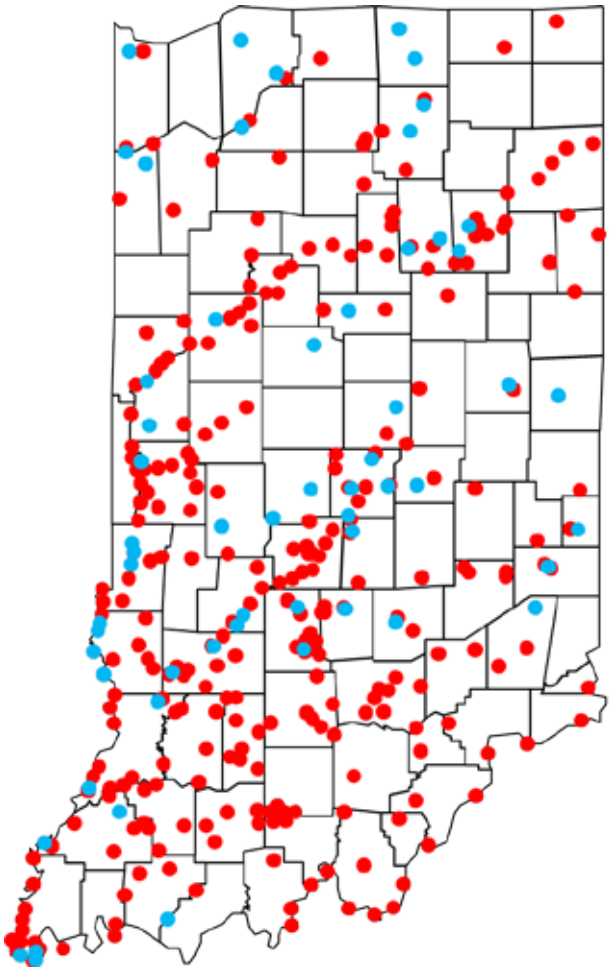
BIRDS

Bald Eagle

Each year, biologists catalog new bald eagle (*Haliaeetus leucocephalus*) nest sites throughout Indiana. Reports from property managers and the public bring to our attention newly discovered bald eagle nests, as well as recent information about known nests. This knowledge is then used to inform bald eagle conservation in the state.

The number of bald eagle nests has grown considerably over the past several years. The last statewide bald eagle breeding survey, which was conducted by helicopter in 2010, documented 120 eagle pairs. Approximately 20 new nests were reported a year later. Thirty-five additional nests were discovered in 2012 and 2013. Twenty-eight and 24 new bald eagle nests were observed in 2014 and 2015, respectively. In 2016, 65 new nests were reported, although many were new nests in territories that previously had nests. Five of these nests represent new Indiana county records for Clinton, Elkhart and Randolph counties. Bald eagle nesting is now documented in 83 of Indiana's 92 counties. The current population is estimated at 300 breeding pairs.

In addition to nest monitoring, wintering eagles are surveyed to determine long-term bald eagle trends in the region and to form the declared statuses of bald eagle populations throughout North America. These surveys are part of the U.S. Army Corps of Engineers'



Previously known bald eagle nests (red) and new nests discovered in 2016 (blue) in Indiana.

National Midwinter Bald Eagle Survey, which has been conducted in Indiana since 1979. In 2016, wintering eagles were counted from the ground at 11 locations that were often on DFW properties or public lakes. Monitoring was also done by helicopter at 17 routes along rivers that are typically inaccessible by foot.

Among all 28 survey sites, the greatest concentrations of eagles were found along the Wabash River between Vermillion and Parke counties (100), the Mississinewa night roost (87), Monroe Lake (37), and along the Wabash River between Warren and Fountain counties (27). A total of 388 individuals were tallied, which is more than double the previous 10-year average of 180 eagles for the state. Sampling effort was greatly increased this year, which likely contributed to the dramatic increase in the number of bald eagles counted. Only four routes were surveyed by helicopter in 2015, whereas 17 routes were surveyed in 2016.

To represent population trends more precisely, annual ground survey data are comparable because of consistency in sampling effort between years. At the 10 sites surveyed from the ground in both of the past two years, 176 bald eagles were counted compared to 155 in 2015. This represents a 14% increase.

Winter bald eagle counts can vary dramatically between years depending on the severity of winter and the availability of prey (fish and waterfowl) and open water. Indiana attracts more eagles during cold winters when more northern birds are forced to venture south for food. However, long term monitoring data suggest a stable upward trend of bald eagles wintering in Indiana. A 2015 article in the Journal of Raptor Research analyzed data collected from the National Midwinter Bald Eagle Survey and reported a significant yearly increase of 3.6% in Indiana's wintering adult bald eagle population and 3.9% for its immature eagles from 1986–2010. Our current data support this 25-year trend. More bald eagles are observed wintering in Indiana each year. Nationwide, the population is increasing by 0.6% each year.

The growth in the bald eagle population is a major accomplishment for conservation. After World War II, the effects of DDT and other pesticides caused dramatic declines in numerous raptor species, and bald eagles were no exception. Banning of DDT in 1972 later led to some nationwide recovery. Statewide recovery was then enhanced by restoration efforts from 1985–1989. During this time, 73 eaglets from Wisconsin and Alaska

C14, one of the first bald eagles reintroduced to Indiana, is recovered after being found with a broken wing and cared for by the experts at the Indiana Raptor Center. (Photo by Laura Edmunds)

were raised and released at Monroe Lake to restore a breeding population in Indiana. By 2007, our national symbol was declared recovered and removed from the federal endangered species list. Indiana followed suit in 2008 after reaching a goal of 50 nesting pairs. This was a significant achievement—no eagles were known to have nested in the state from about 1900–1988.

One of these 73 eaglets was rescued in April after being found emaciated and with a dislocated wing. Bald eagle C14 was recovered near Worthington and rehabilitated by the Indiana Raptor Center in Nashville. Records revealed that the eagle was 28 years old, making it arguably the oldest wild bald eagle in Indiana. Last year C43, a 27-year-old bald eagle, was found flying over Monroe Lake. At that time, she was considered the oldest wild bald eagle in Indiana. C14 and C43 are powerful reminders of the tireless and determined effort to recover this species and symbols of hope for our state's endangered species.

Barn Owl

Barn owls (*Tyto alba*) are ghostly pale with whitish underparts and buffy light-brown upper parts. They have black eyes and a heart-shaped face. This feature prompts some to call them the monkey-faced owl. Barn owls feed at night, most often on voles and mice. They never hoot. Instead, they make eerie, raspy calls.

Habitat loss has caused barn owls to become rare in Indiana. Their numbers depend on the availability of grassland habitat and suitable nest sites, as well as winter severity and predation by great horned owls (*Bubo virginianus*) and raccoons (*Procyon lotor*). They need open areas of permanent grassland such as pastures, hayfields, prairies and the margins of wetlands to find food. They also need cavities in large trees and human structures like haylofts, steeples, silos and other buildings to nest and raise their young. Most of these conditions can be found in small pockets in southern Indiana. Areas like Lawrence, Orange, Daviess, Crawford and Greene counties are where they are most likely to be spotted.

In an effort to provide barn owls with secure nesting sites that are protected from raccoons and other predators, the DNR has built more than 300 nest boxes and erected them in barns and other structures in suitable habitat statewide over the past three decades. Placing nest boxes in a barn or other building protects owls from predators so they can successfully raise more young. Although many of these structures have been destroyed, existing boxes are checked periodically, and new ones erected for this secretive and rare owl.

In 2016, 13 barn owl nests were reported and 29 new barn owl nest boxes were installed. One of these nests represents a new Indiana county record for Allen County.

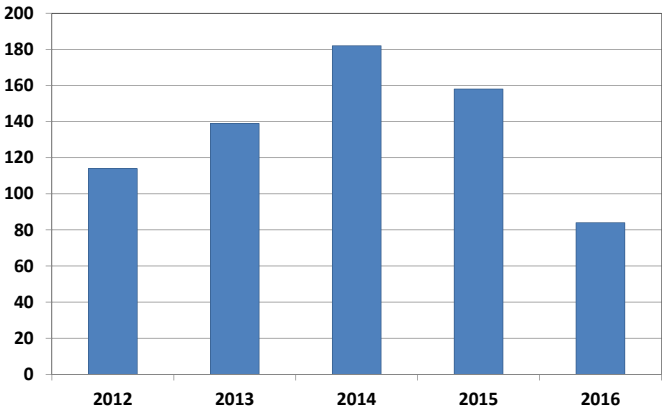
Wildlife Diversity biologists are seeking reports of barn owls, especially if they are nesting. Please email reports to Amy Kearns at *akearns@dnr.IN.gov.*

An adult barn owl brooding young in a nest box. The white down of a chick is visible in the lower right corner.

Interior Least Tern

The least tern (*Sternula antillarum*) is the smallest species of tern in the United States. Its black cap, white forehead and bright yellow bill distinguish it from other terns. Least terns feed on small fish and aquatic invertebrates, and nest on the ground on beaches, salt flats, sand bars or gravel islands in open areas. The current population is found along the coasts and within the interior, following major rivers like the Mississippi, Ohio and Wabash. Human use and modification of breeding habitat in these rivers have caused significant declines in the interior population and rendered it federally endangered.

As a ground-nesting bird found along major rivers, the interior least tern is greatly influenced by water. Water around islands or river bars benefits least tern nesting colonies by making them less accessible to ground predators. However, when water is abundant, rivers become high and river bars become smaller, which in turn reduces suitable habitat available for



Annual number of least tern fledglings produced in Indiana from 2012–2016.

Two interior least tern eggs and one newly hatched chick, with its feathers still wet, in a nest at Goose Pond Fish & Wildlife Area in late June.

nesting. Heavy rains also flood nests and cause abandonment or major losses of eggs and chicks.

In the past, high water in key nesting areas along the Mississippi River resulted in least terns venturing north to Indiana in search of nesting sites, but water levels in southwestern Indiana along the Wabash and Ohio rivers have been high in recent times due to river channelization and damming. This has reduced the amount of sandbars or islands available for nesting. Now adult least terns are being observed nesting in Indiana at human-constructed sites close to these rivers.

The first least terns sighted in Indiana in 2016 were reported on May 14 at Cane Ridge Wildlife Management Area (WMA). By early June, most of the locations where terns traditionally nested had breeding colonies. A maximum of 220 adults was recorded in the colony at Gibson Lake near the Wabash River. Sixteen miles east, at Wheeling Bottoms, a maximum of six adults was observed at one time, and the colony produced about three young. At the American Electric Power (AEP) Rockport Plant in Spencer County, 60 adults were noted. Sixteen adults returned to Goose Pond FWA in Greene County, where six nests were attempted on an island designed for them. These nests, together, successfully fledged at least one young. The last report of a least tern in Indiana was on August 19 and was of a single molting adult adjacent to Gibson Lake.

Working closely with Duke Energy, the USFWS, and AEP, least tern nesting was diligently monitored at two main locations, and steps were taken to ensure breeding success. This occurred in Gibson County, where least terns nested on properties owned and managed by Duke Energy and the USFWS (Cane Ridge WMA), and in Spencer County at the AEP Rockport Plant.

In Gibson County, an estimated 165 nests produced a conservative estimate of 70 fledglings in 2016. A total of 105 nests were found during the early part of the breeding season. Another 60 were tallied later. More than half of all nests and young produced were on the center dike of Gibson Lake (95 nests). The remainder was at Cane Ridge WMA (70). No nesting occurred at Tern Bar Slough Wildlife Diversity Area, although least terns were seen foraging and loafing. Pump problems again limited water levels, and nesting islands at Tern Bar Slough were left without a protective moat for most of the season.

At the AEP Rockport Plant, which is located along the Ohio River about 50 miles southeast of the Gibson Lake colony, an electric fence was placed around the main nesting site to reduce predation by mammals and prevent Canada Geese (*Branta canadensis*) from loafing on the dike. At least seven young were produced from 51 nests.

The number of fledglings produced in 2016 was low compared to the number produced in previous years. This may suggest high levels of predation and other sources of nest failure late in the nesting cycle. This was later confirmed by photo evidence of mammals depredating nests at colonies in Gibson County in early July.

Management of interior least terns is challenging. It consists of maintaining nesting sites to keep them free of dense vegetation, using fencing and manipulating water levels to deter ground predators, and employing least tern decoys to attract birds to suitable sites. These efforts have resulted in more than adequate production in four out of the last five years, and in a steadily increasing population of least terns in Indiana since their discovery in the state in 1986.

Loggerhead Shrike

The loggerhead shrike (*Lanius ludovicianus*) is a songbird slightly smaller than a robin. Its striking appearance includes a broad black mask through the eyes, a gray back and breast, a white spot on black wings, and white edges on a black tail.

Despite their small, robin-like stature, shrikes have habits similar to those of a sizeable raptor. Their strong, hooked bill allows them to take prey that is comparatively large. They do not have talons like raptors to pull food apart. Instead, they hang their prey from thorns or barbed wire which provides an anchor

In Orange County, the first loggerhead shrike nest of the year was found with three nestlings. Sheep's wool was used to line the nest.

while they tear it into bite-sized pieces. Prey hung in this way can also be stored for later. This behavior has earned them the nickname of "butcher bird," which is unique to North American shrikes.

Shrikes have a diverse diet of prey, including beetles, grasshoppers, wasps, spiders, mice, voles, house sparrows, snakes and frogs. They hunt from perches, scanning the ground from a utility wire, post, fence or plant stalk, and pouncing on prey spied below.

Habitats for shrikes consist of grasslands, deserts, shrublands and agricultural areas. Shrikes prefer smaller fields planted to a variety of crops bordered by shrubby hedgerows and fence lines, and livestock pasture with short vegetation. Nests are substantial structures made of small twigs and grass, lined with horse hair or wool, and placed in a shrub or small tree. Eastern red cedars and rose bushes are favorite nesting sites in Indiana, especially when they are isolated within a fencerow. Shrikes sometimes nest twice in one season, especially if the first nesting attempt fails.

Loggerhead shrikes have been undergoing alarming population declines in the eastern United States. They are a state endangered bird in Indiana and many other states. Reasons for this decline are puzzling and likely include a combination of factors. The loss of quality breeding habitat, the use of pesticides, and increasing human development on its wintering grounds in the southern United States are among the many threats this species faces. Loggerhead shrikes were included on Indiana's state endangered list when it was first developed in 1981, and they remain there today.

In 1999–2000, Wildlife Diversity biologists did extensive surveying for shrikes and found 58 occupied territories. In the years since, shrikes have declined dramatically. Fewer than 10 nesting territories have been reported annually in the entire state since surveys resumed in 2010.

Each spring and summer, biologists conduct surveys in areas with historical shrike nesting territories. Color bands are placed on the legs of shrikes to help identify them as individuals from a distance. Nearly all nests found in recent years have been located on or adjacent to traditional Amish farms. In 2016, three nesting territories were located in Daviess County, one in Orange County, and one in Lawrence County. Seven nests were found. Three nests successfully fledged young. Four nests were lost due to suspected predation. One nesting attempt failed after strong storms knocked the nest out of the tree. Color bands were placed on the legs of eight adults and three fledglings.

Landowners can help shrikes and other wildlife by preserving their fencerows and the shrubs that grow along them. Because shrikes typically build their nests in isolated bushes and trees along fencerows, eliminating these linear features effectively destroys the nesting habitat for this unique species. In order to help shrikes, if fencerows need to be cleared, it is best to wait until after nesting season (late April to late August) to give young birds a better chance to survive. Fencerows provide nesting habitat for other native birds besides shrikes and food and cover for game species like deer, rabbits and bobwhite quail.

The unique combination of color bands on the legs of this loggerhead shrike in Daviess County identifies him for tracking.

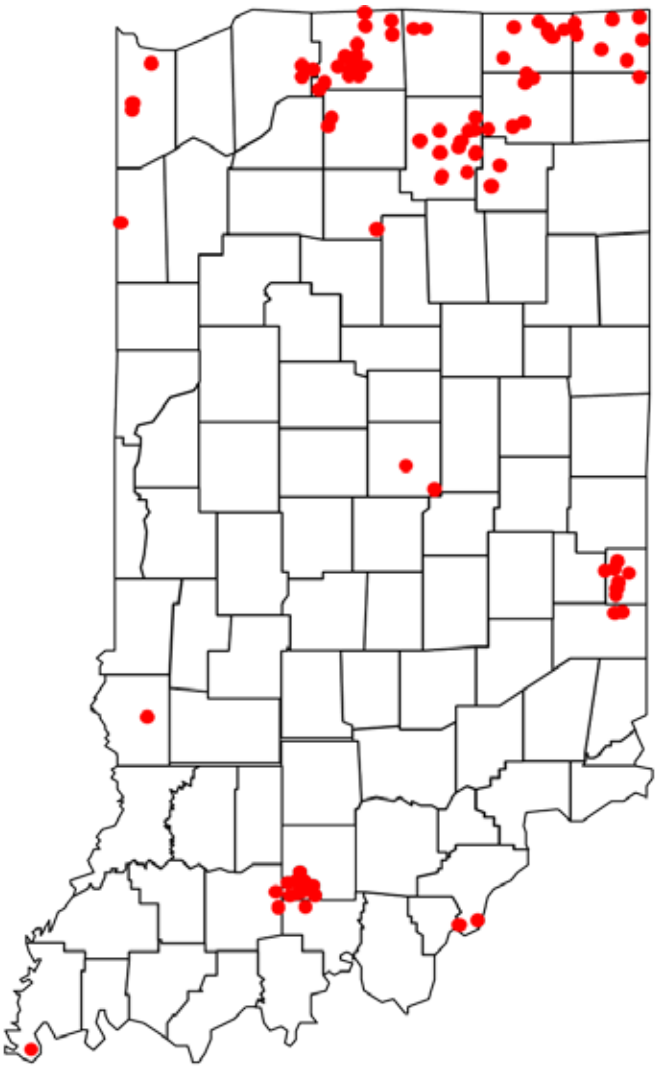
Farms with healthy, shrubby fencerows have a greater diversity of native wildlife than those without, and many of these native species are beneficial for insect and pest control.

Osprey

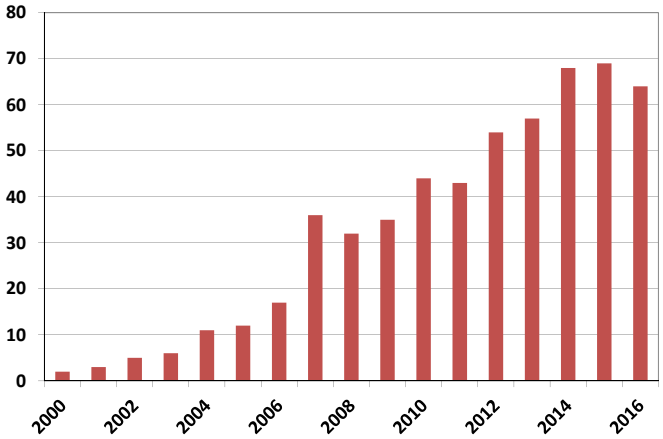
Ospreys (*Pandion haliaetus*) are large, eagle-like birds that are fascinating to watch. They are most commonly found during spring and fall migrations while hovering, diving and catching fish in the open waters of Indiana's lakes, ponds and rivers. Historically, a few remained to nest, building large stick nests in dead trees near the shoreline or on islands in lakes, rivers or wetlands. Now osprey nests are often found on man-made structures, including cell towers, utility poles and nesting platforms built specifically for them.

From 2003–2006, a total of 96 young ospreys were collected from nests in coastal areas of Virginia and raised and released at four locations in Indiana in an attempt to restore this state-endangered bird. As a result of this effort and the erection of nesting platforms in a partnership between the Indiana DNR and private groups and individuals, the state's osprey population has grown steadily. For the fifth consecutive year, the number of osprey pairs exceeded the state's delisting recovery goal of 50. Ospreys are now being considered for removal from the Indiana list of endangered species.

Monitoring efforts continued for ospreys in Indiana during 2016, with 78 sites checked. The sites included previous nests, nesting platforms, and locations with reports of new nests. Eleven new nests were found. Overall, 64 sites had ospreys or osprey nests present (compared to 69 in 2015), with all 64 (62 in 2015) pairs believed to have laid eggs. Of those, 22 (59 in 2015) were reported as successful. At least 32 (102 in 2015) chicks were produced, but this is a significant underestimate because it is difficult to observe all young in the nest from the ground. The number of reports at the end of the nesting season this year was far lower than in previous years. Therefore, what may seem like a large decline in the number of successful nests and chicks produced may possibly be a reflection of reduced sampling effort during the time when adults were rearing young.



Locations of osprey pairs or nests in Indiana in 2016.



Annual number of osprey territories in Indiana from 2000–2016.

Known active osprey nests are present in 16 of Indiana's 92 counties. Of these, one represents a new Indiana county record for Fayette County. Loose colonies of osprey nests can be found in Kosciusko (15 nests or pairs), St. Joseph (14), Union (5), and LaGrange (5) counties. Public areas with the largest concentrations of osprey nests are Patoka Lake, Pigeon River FWA, Potato Creek State Park and Brookville Lake. Most of this year's nests were built on communication towers (25). However, nests also occupied nesting platforms (15), utility towers or poles (13), structures associated with grain storage (3), dead trees (2), stadium lights (2), a chimney, an abandoned crane, and a live swamp white oak (one each).

As ospreys increasingly use communication and utility towers, companies that service the equipment

are encountering and recognizing osprey nests. Many companies contact the DFW for guidance. Most are willing and able to delay maintenance on the towers until after nesting season. Although vacant nests can be removed from towers without a permit, companies are encouraged to maintain at least part of the nest structure at a location on the tower where it is less likely to interfere with the tower's operation.

The outlook for ospreys in Indiana is promising. As long as unpolluted waterways, healthy fish populations, and suitable nest sites exist, Indiana's osprey population will likely thrive in coming years.

Peregrine Falcon

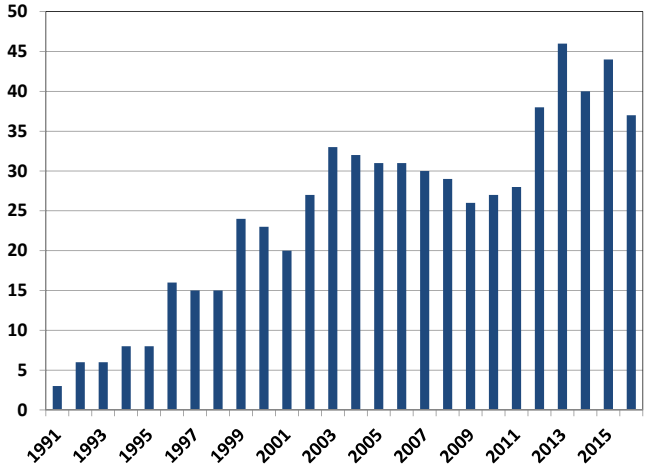
More than 300 breeding pairs of peregrine falcons (*Falco peregrinus*) are present in the Midwest. This total is several times greater than the 60–80 pairs estimated to have been present historically. Indiana's population has also expanded. In 2013, peregrine falcons were removed from the state list of endangered species. They are now considered a species of special concern.

Falconers today are permitted to trap an unbanded juvenile peregrine in the fall to be used for falconry. Only two birds are allowed to be taken in Indiana in 2016, and only 12 falcons can be captured in the entire Mississippi Flyway. In 2014, one passage (i.e., non-locally produced) peregrine was captured for falconry. In 2015 and 2016, permits were issued to trap but no peregrines were captured. Peregrine falcons taken by falconers are most likely migrants from populations breeding in Arctic regions.

Breeding by peregrine falcons in Indiana has remained stable and relatively unchanged for the past five years. In 2016, a total of 22 locations had peregrines present during part of the nesting season, compared to 21 locations in 2015. Fifteen nesting attempts were documented (compared with 15 in 2015), 12 were successful (14 in 2015), 32 chicks were banded (41 in 2015), and 37 young fledged (44 in 2015). Five chicks were not banded because two sites were inaccessible for banding.

An adult peregrine falcon feeds its young in a nest box at the Indiana Power and Light Plant in Petersburg in April 2016. Photo taken from the nest camera by Gigi Caito.

Four banded peregrine falcon chicks at the Indiana Power and Light Plant in Petersburg in May 2016.



Annual number of peregrine falcon chicks fledged in Indiana since the beginning of the reintroduction program in 1991.

Only two nests had eggs or chicks that did not survive. Another pair may have laid eggs, but chicks were not observed later. At seven sites, falcons were present but showed no evidence of nesting. Eight blood samples were taken and four unhatched eggs were collected. A new nest box was also installed at one location. Signs of trichomoniasis, sometimes called frounce in falcons, were not found in chicks this year. Trichomoniasis is an upper digestive-tract disease that is often fatal in young birds.

Because many young falcons are banded in the nest each year, much is known about them. Of the adults in the 15 territories where eggs were laid, 12 were unbanded, 12 were identified by their leg bands, and six individuals were not observed well enough for

identification. Identified adults had origins in seven different states: Indiana (4), Kentucky (2), Ohio (2) and Michigan, Illinois, Wisconsin, and Missouri (1 each). All breeding adults were produced in the wild except one that was hacked in Missouri. Ages of females ranged from 3–7 years of age. Males were 5–9 years old. Reports of recovered bands have also provided updates on peregrines banded in Indiana. For example, a female banded in Gary in 2010 was found dead on the roof of the plant where she was first banded.

All 15 peregrine nest attempts in Indiana in 2016 were close to a large body of water. Indiana's nesting pairs were found near Lake Michigan (6 nests), the Ohio River (2), White River (2), Wabash River (2), and the St. Mary's, Kankakee, and St. Joseph's rivers (1 each). Three nests were in downtown urban areas on office buildings. One was on a casino. The remainder were in industrial areas on power plants, steel mills, and lime plants (11).

Data from the past five years of surveys have provided evidence that Indiana's breeding population remains productive. Despite that, we will likely continue our post-delisting monitoring efforts, with the help of volunteers, to help ensure that the population is stable.

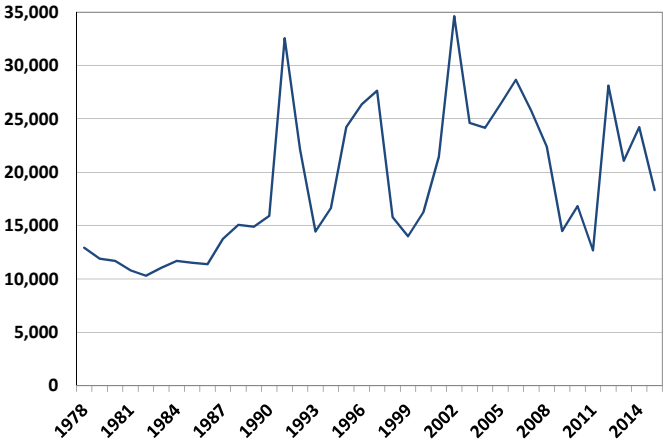
Sandhill Crane

The sandhill crane (*Antigone canadensis*) is a long-legged, long-necked waterbird that flies with its neck outstretched. It can be confused with the somewhat similar-appearing but unrelated great blue heron (*Ardea herodias*), which is sometimes inappropriately referred to as the blue crane. During fall and spring migrations, groups of 50–100 are most commonly encountered either flying in a loose V-formation, circling as they catch updrafts, or descending to a field to feed or roost for the night. An individual is almost always seen with its mate, family group, or flocks numbering from a couple of dozen to the hundreds. Their bugling calls are usually heard before the flock is seen.

Sandhill cranes can be observed foraging in agricultural fields near roosting sites during the day. They eat waste grain, as well as a variety of aquatic plants, invertebrates and small vertebrates. At night, they roost in the shallow water of marshes or in fields.

The population in eastern North America nests in marshes in the upper Great Lakes states and southern Canada. Since the early 1980s, nesting has been noted in Indiana and now occurs in the northern quarter of the state. Cranes have also been seen in breeding pairs during the summer as far south as Wilbur Wright FWA in Henry County and Goose Pond FWA in Greene County. It is believed that sandhill cranes will expand their breeding range throughout southern Indiana as the eastern population of sandhill cranes increases in size.

To monitor annual changes in abundance and detect long-term population trends, the USFWS coordinates a fall survey of the eastern population. Much of the



Annual peak numbers of sandhill cranes counted during fall surveys at Jasper-Pulaski Fish & Wildlife Area from 1978–2015.

population stops at Jasper-Pulaski FWA and neighboring properties in northwest Indiana before venturing south to wintering areas in Tennessee, Georgia and Florida. Public properties and other areas with a history of stopovers by sandhill cranes were surveyed in 2015 during two survey periods starting on October 28 and November 9. Surveys for this year are currently underway at the time of this writing, so the following results represent data collected in 2015.

During the first survey period, Jasper-Pulaski FWA hosted the most sandhill cranes (7,010). Fewer were present at the Northern Indiana Public Service Company (NIPSCO) power plant (1,516), a private property adjacent to Kingsbury FWA (1,200), Pigeon River FWA (287), Boot Lake (88), Pisgah Marsh (34), Willow Slough FWA (6), and Lieber Preserve (2). No cranes were observed at many of the sites in southern Indiana: Kingsbury FWA, Atterbury FWA, Brookville Lake, Ewing Bottoms in Jackson County, Goose Pond FWA, Muscatatuck NWR, Tri-County FWA, Knightstown Reservoir, and Monroe Lake.

During the second survey period, Jasper-Pulaski FWA again had the most sandhill cranes, reaching 7,820. Fewer cranes were observed at the NIPSCO power plant (2,634), private property adjacent to Kingsbury FWA (1,500), Pigeon River FWA (1,348), Boot Lake (159), Goose Pond FWA (88), Willow Slough FWA (3), and Lieber Preserve (2). No cranes were found at Kingsbury FWA, Atterbury FWA, Brookville Lake, Ewing Bottoms, Monroe Lake, Muscatatuck NWR, Tri-County FWA and Knightstown Reservoir. Many sandhill cranes had not yet moved south into Indiana from Wisconsin, Michigan and other northern locales.

In addition to the USFWS fall count, weekly crane surveys were conducted at Jasper-Pulaski FWA. Counts exceeded 7,000 birds by the end of October. More than 10,000 were observed beginning in December. The survey then ended on December 16. Crane numbers peaked on that day (18,330), so it remains uncertain

whether the amount of cranes exceeded this number after this date. Because surveys were not carried out afterward, December 16 was treated as the date of peak numbers. This number is below the previous 10-year average peak count of 21,260 sandhill cranes at Jasper-Pulaski FWA, but may be the result of having ended the survey before the actual peak count was reached.

Whooping Crane

One of the rarest bird species in the world, whooping cranes (*Grus americana*) migrate through Indiana in spring and fall, and sometimes spend much of the winter in our state's wetlands.

Standing 5 feet tall, they can be easily identified by their size, as well as by their deep red crowns and black mustaches against an almost entirely blank canvas of snowy, white feathers. Their beautiful plumage and size often grab viewers' attention, especially when they are mixed in with a flock of their smaller, drabber cousin species, the sandhill crane.

It is crucial that humans view these endangered birds from a distance and not attempt to approach or feed them. Whooping cranes that learn to approach vehicles for food often die after being hit by cars. Illegal shooting is also a concern—several cranes were shot by poachers in the state in recent years.

In fall 2016, there were only 109 whooping cranes in the Eastern migratory flock, the population that migrates through Indiana. These birds nest in Wisconsin, where reproduction attempts have been plagued by predators, parasitic black flies, infertility and nest abandonment.

Currently, the whooping crane population is not self-sustaining, but is augmented each year by a handful of young birds that are introduced to the wild in a variety of ways. The most famous technique, when the birds are raised by humans in white crane costumes and taught to migrate by following an ultralight aircraft, was discontinued after 2015. At the time of writing, one chick that hatched in the wild during the 2016 nesting season in Wisconsin continues to survive, while 12 additional chicks are being released singly or in pairs near wild whooping cranes without chicks. This technique, termed parent-rearing, allows chicks raised by captive whooping crane parents to later be "adopted" by wild pairs. Hopes are high that parent-reared chicks will be better at raising their own chicks and avoiding predators.

Male whooping crane #12-09 spent the winter in southern Indiana and migrated to Wisconsin for the summer breeding season. (Photo by Steve Gifford)

Colonial Waterbirds

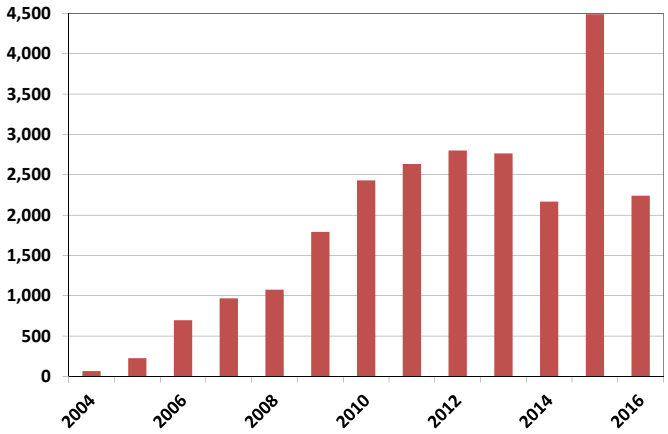
"Colonial waterbird" may refer to any aquatic birds that nest close to each other. These include herons, egrets, cormorants, terns and gulls. In Indiana, colonies of black-crowned night-herons (*Nycticorax nycticorax*), great egrets (*Ardea alba*), and double-crested cormorants (*Phalacrocorax auritus*) are counted annually along the shore of Lake Michigan. Both heron and egret species are state-listed and are monitored for the early detection of possible population declines. Double-crested cormorants are not endangered, but are viewed with concern in the Midwest because increasing populations pose a potential threat to local fisheries. In addition, they compete for nest sites with less common heron and egret species.

Indiana is also involved in the Great Lakes Colonial Waterbird Survey, which requires the periodic assessment of two large gull colonies along Lake Michigan. Nests were last counted in 2011. Tallies of 9,517 ring-billed gull (*Larus delawarensis*) and 205 herring gull (*Larus argentatus*) nests were taken at ArcelorMittal Steel West, and 23,899 ring-billed and 28 herring gull nests at ArcelorMittal Steel East. These sites represent the main waterbird survey locations.

At ArcelorMittal Steel West, black-crowned night-herons had a thriving colony in the 1990s until beavers destroyed virtually all the trees the birds used for nesting. Regrowth has occurred, and night-herons and great egrets now nest at this site along the Indiana Harbor at Lake Michigan, which is adjacent to the large colony of breeding gulls. Great egret nesting was first observed at this site in 2009.

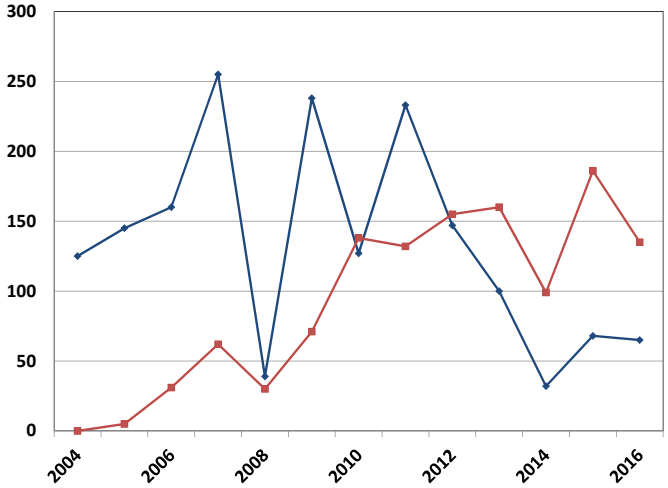
Surveys of these birds were conducted on May 31, 2016. Fifteen black-crowned night-heron nests were found, a decrease from 39 nests in 2015. The number of great egret nests declined as well (73 in 2016 versus 95 nests in 2015). All nests were in trees or shrubs. Nesting cormorants have yet to be found at ArcelorMittal Steel West.

At ArcelorMittal Steel East, 2,240 double-crested cormorant nests were counted. This is nearly half the amount of nests found in 2015 (4,489), but consistent



Annual number of double-crested cormorant nests at the ArcelorMittal Steel plant in Lake County from 2004–2016.

A black-crowned night-heron incubating eggs or brooding chicks in a young cottonwood tree in East Chicago in May 2016.



Annual number of black-crowned night-heron (blue) and great egret (red) nests at the ArcelorMittal Steel plant in Lake County from 2004–2016.

Great egret chicks in the nest in East Chicago in May 2016.

with survey results since 2010. Great egret nests declined, with 62 recorded, compared to 91 nests found in 2015. Fifty black-crowned night-heron nests were also discovered, which represents a small rise in nests found since 2015 (29), but numbers remain low compared to overall trends. The maximum count at this site when the survey first began was 255 nests.

These three species of waterbirds tend to segregate themselves in the main nesting colony. Double-crested cormorants nest closest to the Lake Michigan shoreline on the ground. Great egrets mainly use the few remaining trees farther from the shore. Black-crowned night-herons will nest in shrubs or the lower portions of trees used by great egrets, but some nests are on rock, along the perimeter of two small impoundments at this site and adjacent to gull nests. All of the great egret nests and night-heron nests were in trees or shrubs, compared to 4% of double-crested cormorant nests. The remaining 2,153 cormorant nests were on the ground. Ground-nesting birds are relatively safe at this site because they are protected from most mammalian predators by the water of Lake Michigan and heavy industry on the remaining sides.

In addition, gull and tern populations were estimated at this site. Twenty-thousand ring-billed gulls were observed occupying both ArcelorMittal Steel West and East. A colony of Caspian terns (*Hydroprogne caspia*) was found with 329 nests. This colony went unnoticed from 2012 to 2015 and was rediscovered in 2016 on the gravel roof of a building. Continued monitoring at these sites will be used to guide the management of nesting areas for priority species and controlling double-crested cormorants.

Marshbirds

Marshbirds are a diverse array of birds from different groups that include bitterns, rails, gallinules and grebes. These birds are difficult to survey because they

A king rail calling at Goose Pond Fish & Wildlife Area in late April. (Photo by Don Allen)

reside in dense emergent vegetation and are inconsistently vocal during their breeding season. As a result, little is known about their numbers, population trends, and responses to habitat changes and land management practices.

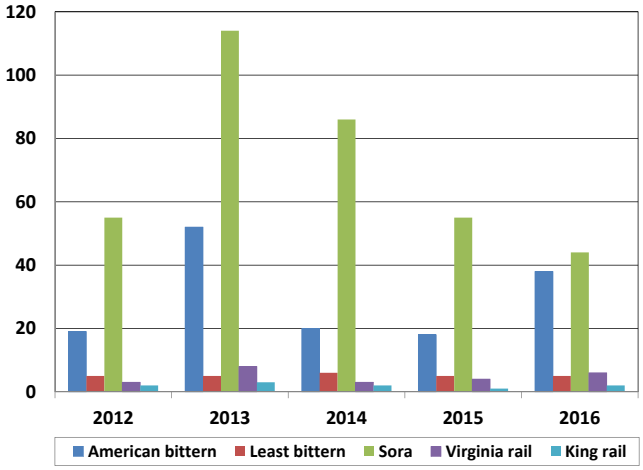
Short-term surveys employing playbacks of vocalizations have been used occasionally in the past in Indiana. The primary purpose was to learn about the distribution and relative abundance of marshbirds.

In 2010, a long-term survey was established at Goose Pond FWA in Greene County by the Indiana office of the National Audubon Society. This nearly 9,000-acre property of shallow wetlands, ditches and upland grasslands was expected to provide extensive habitat for rails and bitterns. Surveys were conducted to determine the presence and relative density of rail and bittern species at Goose Pond FWA and study how species diversity and populations change over time. In 2012, the DFW became the responsible party for this survey and established additional routes at the 840-acre Tern Bar Slough in Gibson County.

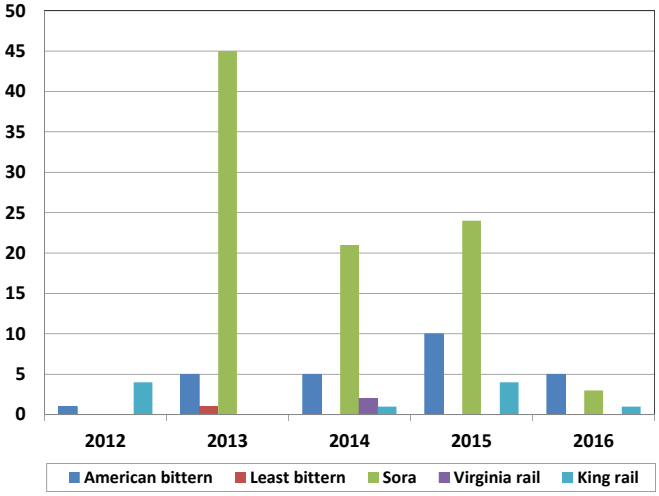
Agency staff and volunteers surveyed 26 points along eight routes at Goose Pond FWA and nine points along two routes at Tern Bar Slough in 2016. Surveys occurred during three two-week time periods from mid-April through May. Target species recorded were American bittern (*Botaurus lentiginosus*), least bittern (*Ixobrychus exilis*), king rail (*Rallus elegans*), Virginia rail (*R. limicola*) and sora (*Porzana carolina*). Non-target species included pied-billed grebe (*Podilymbus podiceps*), common gallinule (*Gallinula galeata*), American coot (*Fulica americana*), Wilson's snipe (*Gallinago delicata*), sedge wren (*Cistothorus platensis*), marsh wren (*C. palustris*) and swamp sparrow (*Melospiza georgiana*).

A total of 104 unique detections were logged of target species in 2016, a decline from the 121 logged in 2015. Soras and American bitterns were the most common species detected at both locations. Soras and Virginia rails are mostly migrants in southern Indiana. Bittern species and king rails are regular breeders. All species except least bitterns are detected most commonly on earlier surveys due to the timing of migration and higher calling frequencies before egg-laying.

All rail and bittern species except sora are on the Indiana list of endangered species. This is likely due to the destruction and degradation of marshes and other wetlands over the years. These factors make quality wetlands difficult to find. Restoration projects like Goose Pond FWA and Tern Bar Slough demonstrate that quality wetlands can be restored. Numerous detections of marshbirds at these sites further demonstrate that wetland birds will readily discover and use these habitats, and especially, that these wetland restoration projects are of value to state endangered wildlife.



Number of marshbirds detected at 26 survey points at Goose Pond Fish & Wildlife Area from 2012–2016.



Number of marshbirds detected at nine survey points at Tern Bar Slough from 2012–2016.

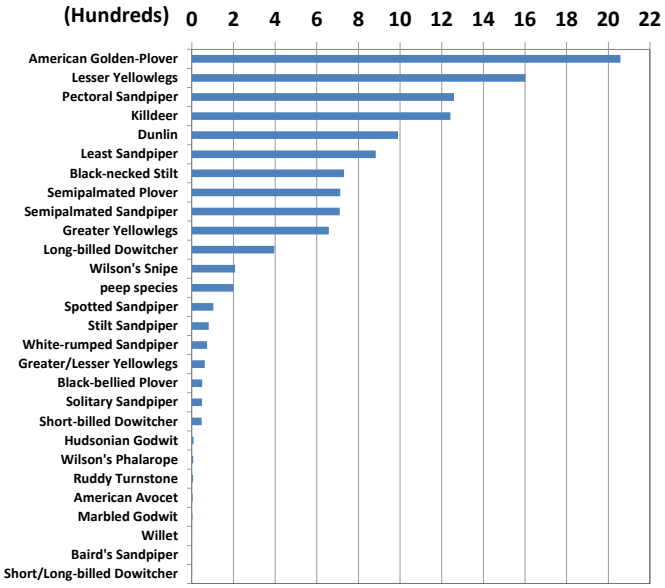
Shorebirds

Goose Pond FWA is one of the largest wetland restorations in the United States. It boasts a variety of habitat, from upland grasslands to shallow wetlands, and is located near the migratory pathways of the Wabash and White rivers. These characteristics make Goose Pond FWA an important stopover point for shorebirds.

As a group, shorebirds experience some of the most remarkable migrations compared to other groups of birds in North America. Species like white-rumped sandpipers (*Calidris fuscicollis*) are long-distance migrants that may venture between wintering grounds as far south as the southern tip of South America and nesting territories as far north as the Canadian Arctic. For them, the presence of suitable foraging habitat could mean the difference between life and death. Shorebirds must build adequate fuel reserves during stopovers to survive these journeys. Doing so may require individuals to increase their body size by upward of 10% of their current size per day.

To date, 35 shorebird species, including the federally endangered piping plover (*Charadrius melodus*), have been recorded at Goose Pond FWA. Eight species that are of greatest conservation need in Indiana regularly visit or breed on the property. In 2015, surveyors counted 13,192 shorebirds representing 30 different species. These findings demonstrate that Goose Pond FWA provides critical stopover habitat for migratory shorebirds.

Furthermore, at the time of writing, shorebird surveyors observed and recorded 12,146 individual shorebirds of 25 different species at Goose Pond FWA during the 2016 spring and fall survey periods. American golden-plovers (*Pluvialis dominica*; 2,058 individuals) were the most numerous, representing 16.9% of individual shorebirds surveyed. More than 1,000 individuals of three other species were recorded including lesser yellowlegs (*Tringa flavipes*; 1,602; 13.2%), pectoral sandpiper (*Calidris melanotos*; 1,259; 10.4%), and killdeer (*Charadrius vociferous*; 1,242; 10.2%). Together, these four species represent 50.72% of all observed individuals. Twenty-one species represent the remaining 49.28% of individuals recorded. Surveys will be continued in 2017 to further investigate shorebird presence and population trends at Goose Pond FWA.



Number of shorebirds (in hundreds) detected during the 2016 shorebird survey at Goose Pond FWA. The term "peep species" refers to a group of five sandpiper species that are difficult to distinguish during any time of the year: white-rumped, Baird's, Western, semipalmated, and least sandpipers.

FISH & FRESHWATER MUSSELS

Ohio River Trawling

A modified (Missouri) benthic trawl was used to sample for channel darter (*Percina copelandi*) at several locations in the mainstem Ohio River in Crawford, Harrison and Switzerland counties. This type of benthic trawl (enclosed by a small mesh cover) is specifically designed to collect small fishes.

The channel darter is a state endangered fish that once inhabited many of the larger rivers within the Wabash River drainage of Indiana. Unfortunately, it has not been collected from these areas in more than 50 years, and may now be extirpated from that area. There have been a few random collections of channel darter by other researchers from the mainstem Ohio River in recent times although the species' distribution in the Ohio River along the Indiana border is not well understood. Sampling with the Missouri benthic trawl was attempted to gain a better understanding of the channel darter's distribution in the Ohio River and to determine the habitats it uses.

Channel darter was successfully collected from two locations in Switzerland County. In both instances,

A channel darter collected from the Ohio River in Switzerland County.

Wildlife Diversity assistant biologist JoAnne Davis waits to pull in a trawl for channel darter in the Ohio River.

A river darter collected from the Ohio River in Switzerland County.

Missouri benthic trawl sampling gear.

the trawl was pulled in about 6–8 foot deep water over rocky (cobble/gravel) substrate. In one location, several other darter species were also collected: rainbow darter (*Etheostoma caeruleum*), banded darter (*E. zonale*), logperch (*Percina caprodes*), and river darter (*P. shumardi*).

Other species commonly collected with the trawl from all sites included shoal chub (*Macrhybopsis hyostoma*), silver chub (*M. storeriana*), emerald shiner (*Notropis atherinoides*), river shiner (*N. blennius*), channel shiner (*N. wickliffi*), and young-of-the-year freshwater drum (*Aplodinotus grunniens*) and channel catfish (*Ictalurus punctatus*).

Sampling will continue in following years to better define the distribution of the channel darter in the mainstem Ohio River.

Northern Riffleshell Augmentation in the Tippecanoe River and Clubshell Reintroduction in the Eel River

Northern riffleshell (*Epioblasma torulosa rangiana*) and clubshell (*Pleurobema clava*) were once both widely distributed within the Ohio River and Lake Erie drainages of Indiana.

Northern riffleshell has not been seen live for many years in Indiana but is still considered extant in the Tippecanoe River. Clubshell is still reproducing in the upper section of the Tippecanoe River and is still found live in Fish Creek, but reproduction, if occurring there, is at very low levels. Augmenting and strengthening the Northern riffleshell population in the Tippecanoe River and re-establishing a clubshell population in another Indiana drainage (Eel River in the upper Wabash River drainage) would provide a better opportunity for the continued persistence of both species in Indiana.

The salvage of adult Northern riffleshell and clubshell (among other species) from the Hunter Station

Manchester University students place clubshell in the Eel River in Cass County.

Manchester University students and faculty place clubshell in the Eel River in Miami County.

A pilot-study clubshell from the Eel River in Cass County, nearly a year after placement.

Placing Northern riffleshell in the Tippecanoe River in White County. Manchester University, The Nature Conservancy, and the Fisheries Section of the DFW helped.

(U.S. 62) bridge replacement project on the Allegheny River in Pennsylvania has provided an unprecedented opportunity to augment and reintroduce populations of both species within their historical ranges. Pennsylvania, Illinois, West Virginia, Kentucky and Ohio have already initiated augmentation/reintroduction projects. In 2015, Indiana received approval from the Pennsylvania Fish & Boat Commission to partner in this project, along with Manchester University and the USFWS (Carterville Fish and Wildlife Conservation Office and Bloomington Ecological Services Field Office).

Before receiving adult mussels from Pennsylvania, a lot of effort was spent finalizing locations for augmentation/reintroduction in the Tippecanoe and Eel rivers. Three sites in each river were chosen, permanent grid markers were installed, and quantitative mussel sampling was completed. At least 30 quarter-meter squared quadrats were dug at each site to determine mussel densities before release of Northern riffleshell and clubshell.

One-hundred-fifty Northern riffleshell and 150 clubshell arrived in Indiana via overnight FedEx (packed in a cooler with moist burlap and some ice) in September 2015. All mussels came with a pit tag already epoxied to one valve and a small, numbered plastic tag attached to the other valve. These pilot-study mussels were placed at the three sites in each receiving river (50 per site) and monitored for survival in October 2015 and June 2016.

In October 2015, all 300 released mussels were relocated. None had moved outside their original area of placement. Five individuals at each site were dug up and checked. All were still alive and closed tightly upon handling. Many were seen actively filtering at each site and many (especially the clubshell) were buried deep into the substrate.

The 300 pilot-study mussels were monitored again in June 2016. For Northern riffleshell in the Tippecanoe River, all 50 pit-tagged mussels were found at two of the three sites; 46 of 50 were found at the third. At each site, five random mussels were dug up to see if they were still alive. Four out of five were alive at two of the sites and three out of five were found alive at the third. Overall, 11 out of 15 were found alive (73%). This is a good survival rate for Northern riffleshell compared to the rate in other states that have moved Northern riffleshell from the Hunter Station bridge location.

All 50 mussels were re-found at two of the three Eel River sites where clubshell were reintroduced—49 of 50 were found at the third site. All 15 mussels dug up to check for survival were alive (100%). With these promising results, Indiana was granted more adults of each species for continued augmentation/reintroduction by the Pennsylvania Fish and Boat Commission.

Near the end of July 2016, 3,000 adult clubshell arrived in Indiana via overnight FedEx, on ice, packed in coolers. Only one died in transit. An additional

Northern riffleshell filtering after placement in the Tippecanoe River in Pulaski County.

Placing Northern riffleshell in the Tippecanoe River in Pulaski County. Manchester University, USFWS, The Nature Conservancy, and the Fisheries Section of the DFW helped.

two clubshell arrived as mudders (had been dead for a while but were thought to have been alive when pulled from the Allegheny). Ten percent of the clubshell arrived with a pit tag attached to one of their valves. The rest were marked with green glitter superglued to their shell to distinguish that they were placed in 2016.

Near the beginning of August, 3,000 adult Northern riffleshell arrived in Indiana from the Hunter Station bridge project on the Allegheny River in Pennsylvania. Of the 3,000 Northern riffleshell, around 2% were dead on arrival. Interestingly, almost all were males. Similarly to the clubshell, 10 percent of the Northern riffleshell arrived with a pit tag attached to one of their valves. The rest were marked with green glitter superglued to their shell.

The 2,997 clubshell and 2,934 Northern riffleshell were placed in the Eel River and Tippecanoe River, respectively, at the three sites where pilot studies were started in 2015. At each location, they were placed at a density of eight per square meter within the previously designated 8 x 20 meter grid. This was a monumental effort made much easier by the assistance of Manchester University students/faculty, USFWS, The Nature Conservancy, and DFW Fisheries Section staff.

In October 2016, the augmented Northern riffleshell in the Tippecanoe River and introduced clubshell in the Eel River (at three sites) were monitored. To date, of the 442 pit-tagged Northern riffleshell placed since September 2015, 50 (11%) are known dead. Nine (2%) are unaccounted for. Of the 2,642 glittered Northern riffleshell placed in August, 103 (4%) are known dead. To date, of the 449 pit-tagged clubshell placed since September 2015, only 1 (< 1%) is known dead and four (0.9%) are unaccounted for. Of the 2,698 glittered clubshell placed in July, none are known dead, although low visibility restricted some monitoring efforts. Northern riffleshell and clubshell will be monitored again in spring 2017.

Snuffbox Augmentation in the Tippecanoe River

Once present in multiple watersheds of Indiana, the state and federal endangered snuffbox (*Epioblasma triquetra*) has only been found live within three of those locations in recent times: Salamonie River (Huntington County), Tippecanoe River (White County), and Sugar Creek (Shelby County). The species is likely only secure in about a 10-mile stretch of the Salamonie, where multiple individuals and juveniles have been found. The other two populations seem precarious at best. If they are still present, they may no longer be reproducing. Augmenting one of these popula-

Wildlife Diversity assistant biologist JoAnne Davis prepares a snuffbox culture cage and base to be placed in Lake Shafer.

Tippecanoe River downstream of Norway Dam where logperch were collected.

Female snuffbox from the Salamonie River used for propagation.

tions would provide a better chance of the continued persistence of snuffbox in Indiana. Federal funding was procured in 2012 to start a snuffbox augmentation project in the Tippecanoe River using female snuffbox from the Salamonie River population.

A third year of snuffbox propagation was successfully completed near the end of April 2016. Procedures were similar to those used in 2015 but with a few modifications. The entire process was completed in two days. On April 19, five cage bases were filled with substrate and placed in Lake Shafer. During the same day, four female snuffbox were collected from the Salamonie River. These were kept in a mesh bag (tied to a tree root) in the Salamonie River so they could be retrieved the next day.

On April 20, a total of 97 logperch (*Percina caprodes*) were collected (with seines) from the Tippecanoe River downstream of Norway Dam. They were then transported to the Salamonie River, and the previously collected female snuffbox were secured. A streamside laboratory was set up and glochidia (parasitic freshwater mussel larval stage) were extracted from the four female snuffbox and used to infect the lopgerch. This was accomplished by gently prying open the shell of each female just far enough that a small cork could be placed between the valves to provide access to the gills and to keep the valves open. Each gill was then pricked a couple of times along its length using a small needle attached to a syringe. After each prick, glochidia were flushed from the gill into a small container with a steady stream of water from the syringe.

The 97 logperch were separated into 10 one-gallon containers of water (about 10 logperch per container). Collected glochidia from each of the four female snuffbox were used to infect 2–3 one-gallon containers of logperch. Each container had its own air stone, which was used to keep the glochidia in suspension. The gills of a few logperch were checked periodically under a microscope throughout the process to check for infestation rates. There seemed to be good coverage of the gills after about 15–30 minutes, at which time all the logperch were removed from their containers and transferred to a cooler of clean water.

Wildlife Diversity biologist Brant Fisher collects glochidia from a female snuffbox.

Logperch infected with snuffbox glochidia in cage.

Substrate from a pulled cage that was placed in 2015 to be checked for snuffbox.

Young-of-the-year snuffbox from 2016 cage.

Once the culture procedures were completed, the four female snuffbox were returned to the Salamonie River, and the logperch were taken to Lake Shafer and placed in the previously prepared cages. In early May, a cage top was pulled to check the condition of the logperch. All logperch were still alive and gills still had attached glochidia. Logperch were checked again near the end of May, and still seemed to be in good health, with some glochidia still attached.

On July 7, all logperch were released from the cages, hardware cloth at the bottom of the cage tops was removed, and cage tops were secured back onto the cage bases. These cages will remain in place until summer/fall 2017, when they will be pulled and the juvenile snuffbox will be harvested and stocked at augmentation sites in the Tippecanoe River.

Cages placed in spring 2015 were pulled the beginning of October and checked for juveniles. Unfortunately, there was no successful production. This wasn't completely unexpected. Major flooding occurred while infected logperch were in the cages, turning Lake Shafer into a roaring river. The cages stayed in place and maintained their substrate, but any dropped snuffbox juveniles likely washed right out of the cages. Five young-of-the-year snuffbox (from this year's propagation) were collected from one of the cages. This find led to the decision to pull and check one of this year's cages. Twenty-nine young-of-the-year snuffbox were found. New substrate was placed in the cage bottom, and the cage containing the snuffbox was secured back onto the bottom of Lake Shafer. We hope this is a sign of things to come when the additional cages from 2016 are pulled in summer/fall 2017.

MAMMALS

Bats

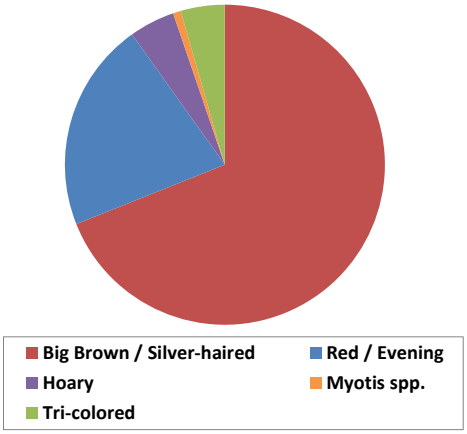
Acoustic bat monitoring stations

Thirteen bat species have been reported from Indiana. Each varies in its social structure (solitary or colonial), roosting habits (tree foliage, tree cavities, caves and mines, or buildings), and time present in the state (year-round or seasonal). Understanding the status and distribution of such a diverse group requires a broad array of monitoring techniques.

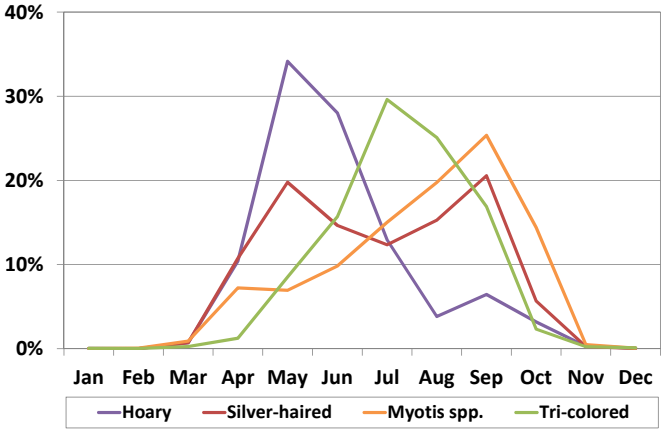
Ten permanent acoustic bat monitoring stations have been operational since August 2014. These stations are active year-round and provide data on bat migration, species distribution and abundance, winter activity levels, and long-term colony stability. Station locations were selected based on geographic distribution and suitable foraging habitat, predominantly along forested edges near rivers or lakes. Participating properties include five state parks, two fish and wildlife areas, one state reservoir, Indiana Dunes National Lakeshore, and Eagle Creek Park.

Data collection is still in its infancy, and a full analysis has yet to be performed. Initial results from September 2014 to August 2015 indicate that virtually

A photo of the Monroe Lake acoustic monitoring station in Monroe County in April 2016.



Composition of bat calls heard from September 2014 through August 2015 at acoustic monitoring stations around the state. Ten stations are placed throughout the state within publicly owned properties. Notice the large composition of big brown/silver-haired bat calls. Big brown bats are historically the most abundant bat species in Indiana.



The annual variance in bat calls per species from September 2014 through August 2015. Notice the peaks during migration periods in the spring and fall for the hoary and silver-haired bats, Indiana's two migratory bat species.

all bats had either migrated or hibernated by early November and are generally absent from the landscape until about mid-March. The tri-colored bat (*Perimyotis subflavus*), one of Indiana's smallest bat species, was the first to become absent from the landscape in autumn 2014. Overall species representation was dominated by the big brown/silver-haired bat (*Eptesicus fuscus/Lasionycteris noctivagans*) group. Big brown bats have historically been the most prevalent species of bat in Indiana. The small representation of the *Myotis* group coincides with other surveys showing declines of these species in the state since the presence of WNS, a disease affecting cave-hibernating bats, was first detected in 2011.

Seasonal activity patterns were supported for several species in the state. Hoary (*Lasiurus cinereus*) and silver-haired bats are both migratory species that move through Indiana in the spring and fall. This is shown with peaks in their call percentages in April-May for the hoary bat, and April-May and September-October for the silver-haired bat. Other year-round residents had call patterns that steadily increased until the end of summer, and then sharply decreased in October and November. This occurred earlier in the year for tri-colored bats and later for species in the *Myotis* group.

Memory cards containing acoustic data from each station are received approximately once a month. During the first two years of the study, 184 memory cards were received. Of those, 28 (15%) were missing either some or all of their data. This is largely due to insect noise during summer months, which can fill the memory cards with garbage files. To highlight this dynamic, the two stations located in fields that are routinely mowed (and therefore have less insect noise) averaged approximately 72,000 detected bat calls during the first two years, while the other eight stations surrounded by taller grasses (and more insect noise) averaged approximately 9,000 detected bat calls. Future efforts involving permanent bat monitoring stations should take this factor into consideration and position bat detectors in locations to minimize interference from insect noise.

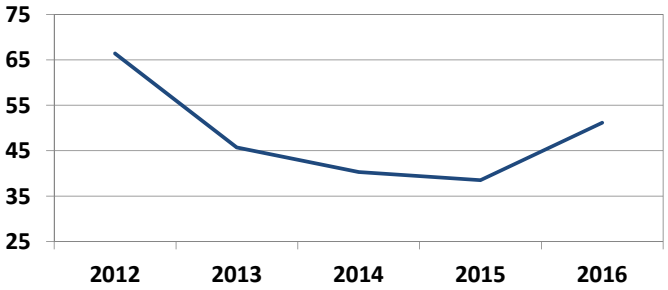
The acoustic bat monitoring stations provide an opportunity for partners at the local, state and federal levels to work together to monitor some of Indiana's most vulnerable, valuable and misunderstood animals. As data continue to be collected, we hope to be able to see more detailed patterns in migration, species distribution and abundance, and long-term trends in the stability of Indiana's bat populations.

Mobile acoustic bat survey

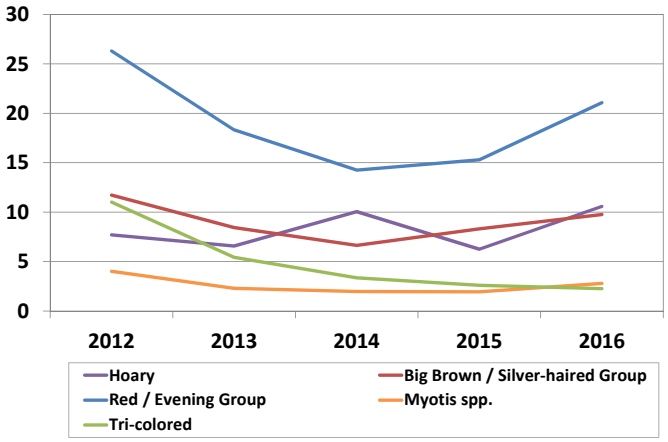
The sixth consecutive year of mobile acoustic bat surveying was completed in 2016. This statewide effort monitors the distribution and relative abundance of resident bats during their reproductive season. The program uses car-mounted microphones connected to bat detectors to record the echolocation calls of bats in the surrounding environment. The same routes are driven each summer, thus allowing biologists to monitor multiple species at different locations throughout the state and across years.

The core set of data features 25 counties that were surveyed a minimum of three times each year from 2012 through 2016. The total number of bat calls detected per survey decreased from 64.6 in 2012 to 51.1 in 2016 (-23%), but this includes an increase in the detection rate from 2015 to 2016. Much of the decline from 2012 to 2015 (-42%) may be attributable to deaths associated with WNS. The rate of change has steadily improved each year: -31% from 2012 to 2013, -12% from 2013 to 2014, -4% from 2014 to 2015, and 33% from 2015 to 2016. We hope this indicates that Indiana's bat populations are beginning to stabilize.

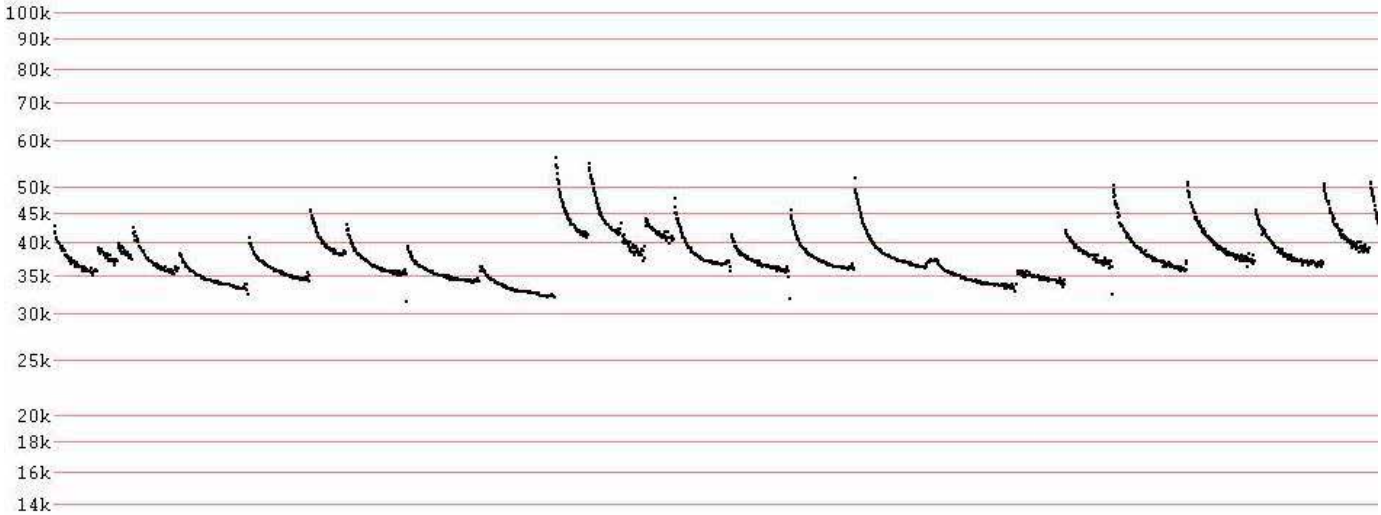
Predictably, those species most dependent upon caves for hibernation suffered the highest drops in detection rates. The tri-colored bat had a drop in calls per survey from 11.0 in 2012 to 2.3 in 2016 (-79%). The *Myotis* group dropped from 4.0 to 2.8 (-30%), but increased from 1.9 in 2015 to 2.8 in 2016 (44%). The



Average number of bat calls recorded per survey per year. The greatest amount of calls recorded per survey occurred in 2012 at 66.4 and the least occurred in 2015 at 38.5. An increase in calls per survey was recorded between 2015 and 2016.



Average number of bat calls recorded per survey per year by species or call specific groups. Groups rebounding after declines and showing highest populations since initial counts in 2012 include red/evening bat, hoary,* Myotis spp.*, and big brown/silver-haired bat. Tri-colored bat call recordings are still declining, with calls recorded at 2.6 per survey in 2015 and 2.3 per survey in 2016.



The frequency and structure of an echolocation call can be used to identify the species of a bat. Eastern red bats emit erratic middle-frequency pulses, typically between 30 and 60 kHz.

Eastern red bat (*Lasiurus borealis*) does not hibernate in caves but also dropped substantially in detection rate. Carcass surveys from wind farms indicate that this species is especially susceptible to deaths associated with wind turbines. This may explain a portion of the species' decline. The detection rates for Indiana's two largest bat species, big brown bat and hoary bat, have fluctuated from year to year and appear relatively stable.

In 2016, 22 surveyors conducted surveys in 76 counties, generating tens-of-thousands of acoustic files. To process such a large quantity of data, task-specific software was used to automatically identify acoustic files that contained bat calls, and to further identify the most likely species for each call. Surveys are scheduled to continue in summer 2017. We hope this work will provide additional evidence that Indiana's bat populations are stabilizing after years of decline.

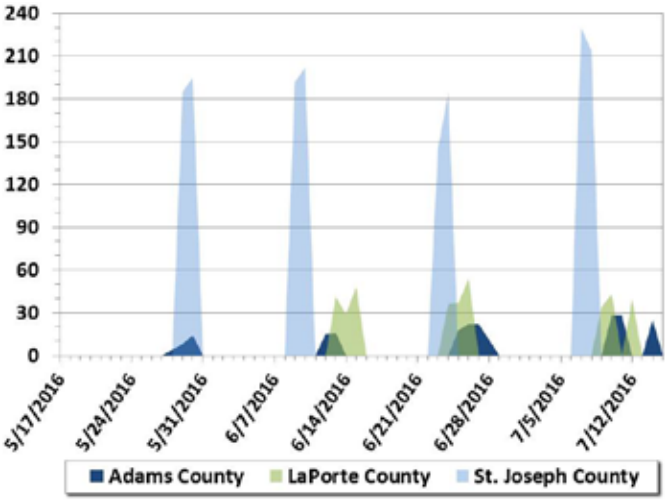
Summer bat roost monitoring

Initiated in 2015, the Summer Bat Roost Monitoring Project continued its second season in 2016. This citizen science project uses volunteers to collect information on the distribution, occupancy and abundance of bat colonies throughout Indiana. Participants must have bats roosting on their property or have permission to enter the property where a roost occurs. Possible roost sites include trees, bat houses, barns, attics, outbuildings and other structures. On each night of surveying, volunteers count the number of bats that exit the roost and record general weather information. Generally, each survey takes less than an hour and is conducted on eight to 12 nights from May 17 to July 15.

In 2016, data were collected from eight participants scattered throughout the state. Three roost sites were located in barns, three were in bat houses, and one each was located in a home and outbuilding. The number of bats counted ranged from four to 230 in barns, one to 59 in bat houses, and fewer than five in the home and outbuilding. The results from the barn sites in Adams and St. Joseph counties suggest the presence of a maternity colony (where female bats gather to give birth), with more bats counted later in the survey

Bats roosting between a lean-to roof and a barn. (Photo by Jon Eggen)

A bat house installed on the side of a log cabin in Wells County. (Photo by Jeff Keplar)



The number of bats exiting three roost sites on the nights they were surveyed during the monitoring period of May 17–July 15, 2016. The sites, in Adams, LaPorte, and St. Joseph counties, were each located in a barn.

period when bats born in the spring become volant (able to fly) and begin feeding on their own.

The DFW hopes to continue gathering data from these, and additional, roost sites in order to study long-term trends. Information from the Summer Bat Roost Monitoring Project will help biologists evaluate roost selection, population trends, species distribution and potential impacts from disease. To learn more about this project or to participate, please email *helpbats@dnr.IN.gov.*

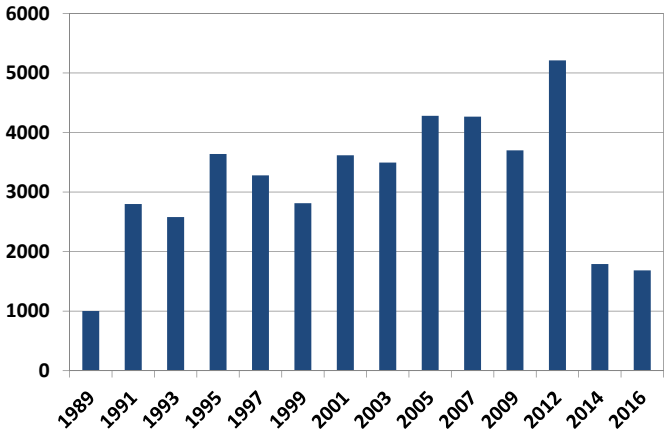
Winter bat counts

Counts of bats in winter hibernation sites have been done in Indiana for more than 30 years. The work has yielded one of the longest-running datasets known for populations of cave-dwelling bats.

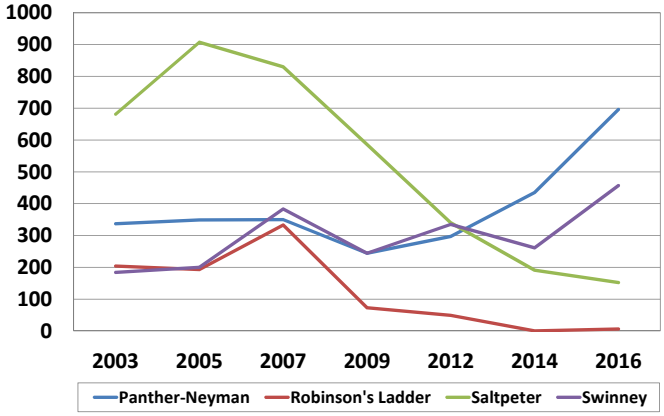
Caves are surveyed every other year to minimize disturbance to bats, with biologists alternating between large and small hibernacula sites each year. Historically, caves used by the endangered Indiana bat (*Myotis sodalis*) have been targeted. Those surveys provide insight into the species' progress toward recovery. They also shed light on the status of other hibernating bat species, including the little brown (*M. lucifugus*), Northern long-eared (*M. septentrionalis*), tri-colored, and big brown bats. The value of this information has risen as WNS continues to negatively affect winter bat populations throughout eastern North America.

Five winters have passed since WNS was first detected in Indiana. Survey results from 21 caves, for which the DFW has pre- and post-WNS counts, show declines of 92% for tri-colored bats, 91% for little brown bats, 49% for big brown bats, and 27% for Indiana bats.

Fifteen caves containing relatively small bat populations were visited in January and February 2016, with total bat populations continuing to decline since the onset of WNS. A cumulative decline of



Number of bats counted at 15 select caves from 1989–2016 during minor hibernacula surveys that take place every other year. Declines in 2014 and 2016 are attributed to white-nose syndrome, which was detected in Indiana in 2011.



Survey results for the Indiana bat at four caves (Panther-Neyman, Robinson's Ladder, Saltpeter, and Swinney) from 2003–2016.

68% has occurred since 2012, when 5,211 bats were counted. This decline slowed to a 6% loss between 2014 and 2016. Caves hit the hardest included Ashcraft (-92%) and Binkley (-93%).

From 2001 to 2007, surveyed caves showed a steady increase in Indiana bat populations; however, a 63% decrease followed between 2007 and 2014. The number of Indiana bats counted in 2016 then increased 40% from 2014 surveys, with a total of 1,337 bats counted in 2016. Biologists observed large increases in Indiana bats at two caves, Panther-Neyman and Swinney, with 60% and 75% increases, respectively. Panther-Neyman increased from 435 Indiana bats to 696, and Swinney increased from 261 to 457. These two caves represented 86% of the Indiana bats found in 2016 surveys with 184 bats found in the 13 other caves collectively.

Little brown bats used to be one of the most common bats in Indiana; however, WNS hit this species particularly hard. In the 15 caves surveyed in 2016, only 215 little brown bats were counted. This represents a decline of 45% from 2014 and a 93% drop from 2012, when the greatest number of little brown bats was reported (3,169). Declines greater than 88% occurred in eight caves between 2012 and 2016. The greatest loss occurred at Leonard Springs, from 473 bats in 2012 to two bats in 2016 (-99%).

Tri-colored bats, the smallest species that winters in Indiana, are usually found in low numbers in many caves. Historically, no more than 700 tri-colored bats have ever been counted from the 15 caves surveyed. However, in 2016, only 58 bats were observed, a decline of 91% from 2012. Despite the low numbers, tri-colored bats were found in all but two caves. The greatest number found in a cave was 12 in Sullivan Cave, which held 170 in 2014 (-93%). Leonard Springs also showed a large decrease with a drop of 110 bats, from 111 in 2012 to just one in 2016 (-99%).

WNS has now been detected in 39 caves in 11 Indiana counties. Although researchers are scrambling

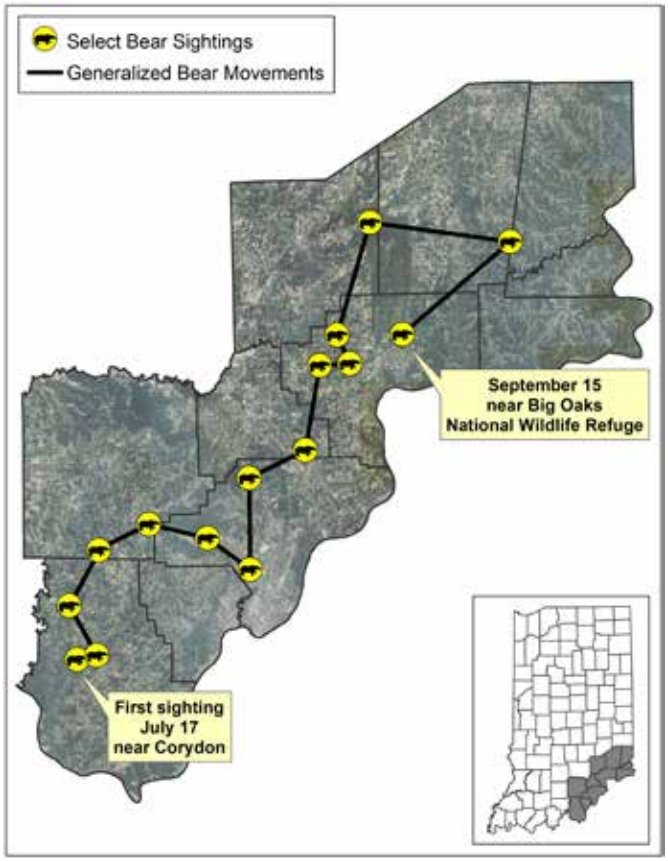
to find a solution for this disease, we are likely years from practical applications of such a solution in the wild. Perhaps now more than ever, conservation efforts that benefit bats are imperative.

Black Bear

In spring 2015, a black bear (*Ursus americanus*) traveling south from Michigan made this species' first confirmed visit to Indiana in 144 years. Black bears were historically abundant across the state, excluding portions of northwest Indiana dominated by prairie. Unregulated hunting and habitat loss caused black bears to be extirpated from Indiana, and much of the Midwest, by 1850. The last confirmed report of a black bear in Indiana was in 1871.

In the last 20 years, bear populations have expanded across the Appalachian range and upper Midwest and have recolonized several states that had previously lost their resident populations. These states include Connecticut, Georgia, Kentucky, Maryland, Missouri, Rhode Island, New Jersey, Ohio, Oklahoma, South Carolina and Texas. More recently, sightings of bears—typically young males—have occurred in Iowa, Illinois, Kansas and Nebraska. Until 2015, Delaware and Indiana were the only states in the continental United States that had not had a confirmed bear sighting in recent history.

In 2016, Indiana had its second black bear visitor in two years, this time entering the state from the south. The initial confirmation of this black bear was on July 18 near Corydon in Harrison County. After the initial confirmation, reports of the bear continued with 33 reports in July, 18 in August, and 7 in September. Reports were received from the general public via phone calls, emails, and submissions to the DNR's Large Mammal Report webpage. Reports came from seven counties (9 from Harrison, 4 from Washington, 15 from Clark, 7 from Scott, 17 from Jefferson, 1 from Jennings, and 4 from Ripley). Sixteen of 58 (28%) reports were verified, either with a photo, video, or by a qualified biologist or conservation officer investigating the report.



A map depicting the generalized movements of the black bear in southern Indiana in 2016. The bear was reported 58 times in seven counties between July and September.

The black bear in this trail camera photo stayed near Big Oaks National Wildlife Refuge in southern Indiana for more than 3 months. This was the second bear to visit Indiana in two years. (Photo by Blake Dueser)

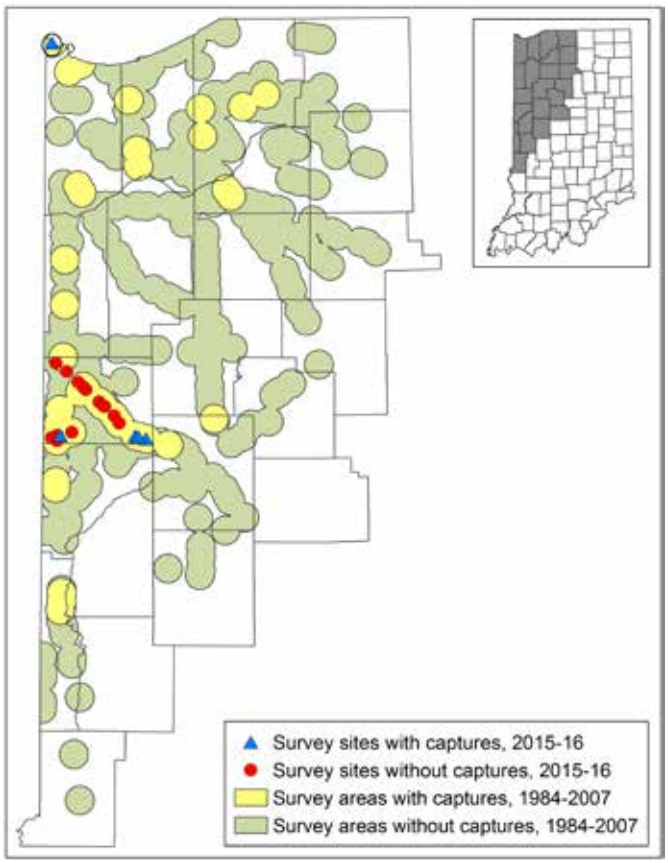
Indiana, like nearly every other state in the eastern United States, will learn to live with bears in time, but as seen elsewhere, problems and negative human-bear interactions are likely to occur. It is essential for state agencies, local governments, and the public to be prepared and make every effort possible to minimize these negative interactions. Though occurrences may be rare for many years, bears will likely continue to visit Indiana. To report a bear sighting or sign of a bear visit, please go to: *www.in.gov/dnr/fishwild/8497.htm.*

Franklin's Ground Squirrel

Franklin's ground squirrels are relatively large ground squirrels found in isolated grasslands in northwest Indiana. Once distributed across at least 16 counties in the northwestern quarter of the state, the species is now believed restricted to six or fewer counties in the extreme northwest. In 2016, Wildlife Diversity biologists

A Franklin's ground squirrel captured in Lake County in 2016. Notice the ear tag in the left ear, marking it as a recapture from the surveys conducted in 2015. Franklin's ground squirrels are identified by their gray coloration, golden rump, and short, almost indistinct ears.

The area northwest of the Whihala Beach survey site. While scouting this area for potential Franklin's ground squirrel populations, Wildlife Diversity biologists heard the squirrel's trilling call.



A map of northwest Indiana showing historical and recent records of Franklin's ground squirrels. Sites surveyed recently are depicted by red circles (where no Franklin's ground squirrels were captured) and blue triangles (where squirrels were captured). The blue triangle with a circle around it represents the site surveyed in July 2016.

conducted surveys for this state-endangered species at one location in Lake County. This was the second consecutive year of surveying in Lake County at the Whihala Beach area, home to the largest-known remaining population of Franklin's ground squirrels in the state.

Trapping occurred for two days at Whihala Beach in July. A total of six Franklin's ground squirrels were caught, consisting of two new individuals and four recaptures from 2015. The sex ratio was divided evenly with three females and three males; five of the six were adults. This total is down from 16 squirrels captured at this site in 2015, although inclement weather did shorten surveying efforts on the second day in 2016. Franklin's ground squirrels were also heard calling during a brief scouting excursion to the northwest of the trap site at Whihala Beach. Future surveying may include this additional area.

In June 2016, biologists talked with CN Railroads and Praxair, Inc. about a collaborative effort to maintain Franklin's ground squirrel habitat in the Whihala Beach area. Minimum habitat disturbance during the squirrel's active period was recommended. Seeding the area with native plants was also recommended to increase the quality of habitat for Franklin's ground squirrels and other native wildlife. Future surveys along these companies' right-of-way properties were also recommended to assess the potential for additional habitat and corridors linking existing populations.

As for now, the Franklin's ground squirrel resides in only a few isolated patches in the northwest part of Indiana. By maintaining these patches of habitat and

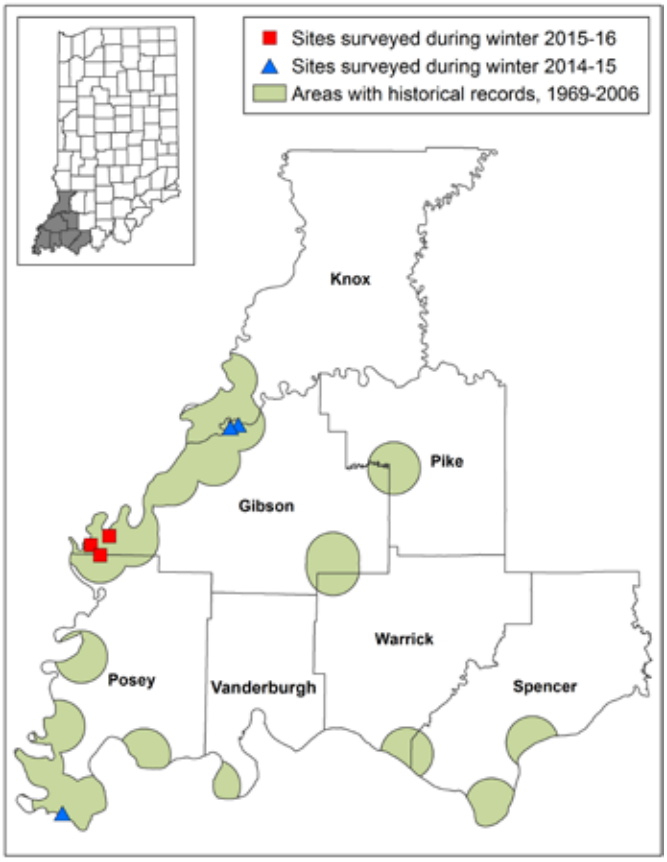
potentially adding more suitable habitat, we hope this species can once again thrive in northwest Indiana.

Swamp Rabbit

Swamp rabbits (*Sylvilagus aquaticus*) are the largest of the 14 cottontail species. They can be distinguished from their common relative, the Eastern cottontail (*S. floridanus*), by their larger size, darker coloration, small ears relative to their large body, and cinnamon rings around their eyes. The maximum weight of a swamp rabbit can reach 6 pounds, compared to 3.5 pounds for an Eastern cottontail.

Swamp rabbits are also referred to as swampers or cane cutters. The latter name comes from their tendency to eat giant cane. As their name implies, they are typically found near water and prefer bottomland hardwood forests that are adjacent to rivers, sloughs, marshes and swamps. In Indiana, they are found only in the extreme southwest corner where the Ohio and Wabash rivers create a landscape seen nowhere else in the state. Features include flat topography, lowland swamps and backwater sloughs.

Swamp rabbits were probably never common in Indiana, which sits at the extreme northern edge of their



A map depicting areas in southwest Indiana where historical swamp rabbit records are located. The blue triangles depict areas the DFW surveyed in winter 2014–2015, and the red squares represent areas surveyed in winter 2015–2016.

An artificial log placed in southern Indiana to survey for swamp rabbits.

An artificial log placed in southern Illinois that has been used as a swamp rabbit latrine.

Potential swamp rabbit pellets found on a cinder block at Twin Swamps Nature Preserve in Posey County in summer 2016. (Photo by Ryan Keller)

range. They are more abundant in Alabama, Mississippi and Louisiana. Today, they are considered by many to be one of the rarest mammals in the state. The draining of large portions of floodplain forests has left only isolated patches of suitable habitat. Widespread loss of wetlands and other factors prompted the swamp rabbit to be listed as state endangered in 1986.

One of the species' most peculiar traits is depositing fecal pellets on top of stumps and downed logs. The reason for this behavior is unclear. It's possible that swamp rabbits use the elevated posts to watch for predators. Biologists determine the species' presence, in part, by searching for pellets during winter, when vegetation is down. Biologists have also implemented the use of artificial logs in their survey protocol. Artificial logs are box-like structures with carpet placed on top to mimic moss-covered logs. These logs are placed in potential swamp rabbit habitat to help biologists determine their presence.

The first comprehensive study of swamp rabbits in Indiana, conducted more than 40 years ago, suggested the species occupied 25 sites in six southwestern counties—Gibson, Knox, Posey, Spencer, Vanderburgh and Warrick. All later field work, however, has found a marked reduction in the occupied range. In 2006, pellets were found at nine sites in Gibson and Posey counties. Wildlife Diversity biologists recently surveyed select sites in 2015 and 2016 and plan to continue surveying efforts during winter 2016–17. In 2015, one site each in Knox, Gibson and Posey counties was surveyed. In 2016, three different sites were surveyed in Gibson and Posey counties. No conclusive sign of swamp rabbits was found either year. However, flooding in 2016 did restrict some surveying, and at one site floodwaters displaced several of the artificial logs dispersed on the landscape.

Continued protection and restoration of large tracts of bottomland hardwood forests, marshes and other wetland habitat would help swamp rabbits persevere. Efforts to connect fragmented habitats with forested corridors would greatly benefit swampers and other species.

The swamp rabbit is distinguished from the more common Eastern cottontail by its larger body size, relatively small ears, darker coloration and cinnamon rings around its eyes. (Photo by Dr. Victoria Bennett)

WILDLIFE RESEARCH

DEER

Deer Damage Control Program

The DNR deer damage control program addresses the immediate damage deer cause to private properties, primarily those of farmers. The program is not a tool to control deer populations, but rather to address localized problems.

The program allows removal of deer outside the deer hunting season only when:

- Damage exceeds $500,
- there is an immediate health or safety threat to people or domestic animals (such as bovine tuberculosis), or
- the management of free-ranging deer are affected on a community, city, or federal property where there is evidence of deer/vehicle collisions, or a state or federally endangered or threatened species could be affected.

The DNR responds to landowner complaints by conducting on-site inspections in certain situations (such as nurseries, vineyards and orchards) and providing appropriate technical advice. If the qualifications set forth in administrative code are met, the DNR may issue a deer damage control permit to a landowner or tenant. Permits are issued for a limited time and authorize certain methods, a specified number of deer that can be taken, and proper disposal of any deer that are taken (which includes keeping them or donating them for human consumption). The permit requires any antlers to be removed and stipulates that no part of the deer, including the antlers, can be sold.

Two white-tailed deer in a cornfield in Monroe County.

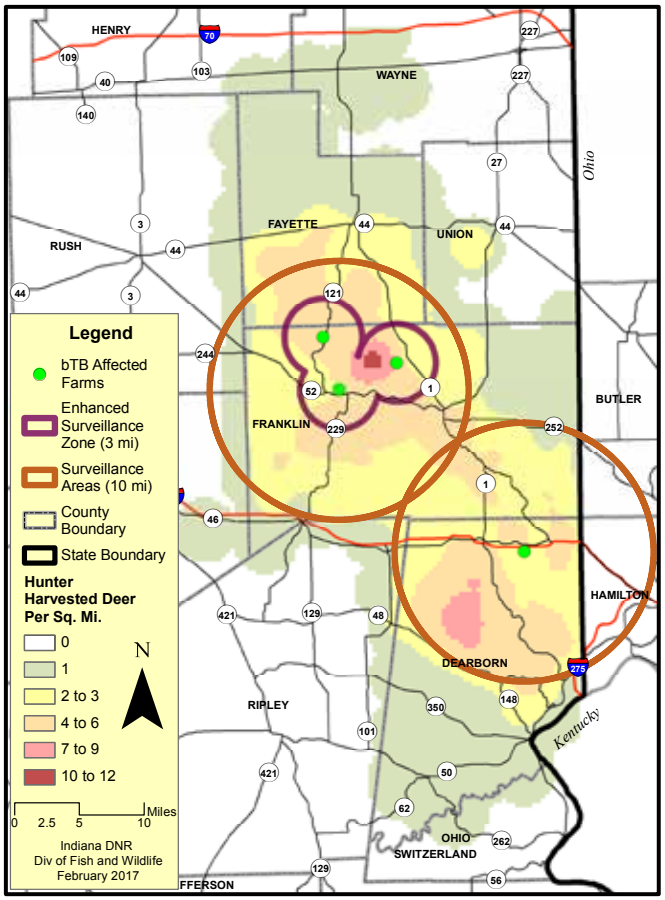
In 2015, the DNR issued 310 permits that resulted in the take of 1,557 deer (10% adult bucks, 10% male fawns, 80% does). Similarly during 2016, the DNR issued 311 permits, which allowed for a maximum take of 4,669 deer. Only 1,559 deer were harvested for a 33% success rate. Of the harvested deer, 140 (9%) were adult bucks, 141 (9%) were male fawns, 1,252 (80%) were does, and 26 (2%) were of unknown age and sex. Soybeans and corn were reported as the most frequently damaged crops. The program provided 112 harvested deer that were donated to families in need, an increase of 67% from 2015.

Bovine Tuberculosis

Bovine tuberculosis (bTB) is a contagious, chronic bacterial disease caused by the bacterium *Mycobacterium bovis.* Typically, the bacterium infects the lungs but it may spread to other organs. *Mycobacterium bovis* collects in the saliva of infected animals and spreads primarily through airborne particles from the respiratory tract; however, the bacteria also spreads through contaminated feed and watering sites from saliva and other bodily discharges or by drinking raw, unpasteurized milk from infected animals. Bovine tuberculosis is most commonly found in cattle, but the bacterium can exist in other species and can infect many mammals, including humans. White-tailed deer are considered reservoir hosts, and the existence of multiple reservoir hosts can make eradication difficult.

Bovine tuberculosis was detected in farmed deer and cattle in late 2008 and 2009 in Franklin County and on a Dearborn County cattle farm in 2011. As a result, the DNR began a surveillance program to determine if bTB had spilled over into wild white-tailed deer in 2009. From 2008–2015, more than 1,400 deer were tested for bTB, and all tested negative. In April 2016, bTB was detected by the Indiana Board of Animal Health (BOAH) and USDA on a cattle farm consisting of two premises in Franklin County. All of the farm's resident wildlife were also removed and tested for bTB, including 20 wild white-tailed deer. Sixteen of the 20 wild deer were tested, and one tested positive for bTB along with a raccoon. As a result, the DNR initiated a more intensive bTB surveillance program during the 2016 deer hunting season in south Fayette, Franklin, and Dearborn counties.

During the 2016 hunting season, the DNR's goal was to test approximately 2,000 hunter-harvested deer for bTB. The DNR targeted bucks more than 2 years old because of their higher value for disease surveillance. While any age and sex of white-tailed deer can become infected with bTB, surveillance from other states has demonstrated that sampling bucks older than 2



Number of hunter-harvested white-tailed deer sampled per square mile for bTB testing in Fayette, Franklin, and Dearborn counties during the 2016 deer hunting season.

years of age is more likely to detect the disease. Therefore, obtaining samples from older age bucks would result in less total deer that need to be tested. If most samples came from does or bucks younger than 2 years old, then more deer would need to be sampled. In general, from a bTB surveillance perspective, a buck older than 2 years old equals about 10 yearling bucks.

The objectives were to 1) determine the apparent prevalence rate of bTB in south Fayette and Franklin counties within a 10-mile radius of the farm affected in 2016 where the first wild white-tailed deer tested positive, and 2) detect the disease at a low prevalence level within a 10-mile radius of the farm affected in 2011 in Dearborn County.

DNR staff collected deer heads from willing hunters at biological check stations and at cooperating taxidermists, processors, and businesses from September 24 through December 11, 2016. Three biological check stations were open from 9 a.m. to 7 p.m. seven days a week. Lymph nodes were collected from the heads and submitted to Purdue's Animal Disease and Diagnostic Lab (ADDL) and the National Veterinary Services Laboratory (NVSL) in Ames, Iowa for bTB testing.

The DNR sampled 2,044 hunter-harvested deer for bTB testing during the 2016 deer hunting season. Of the total samples, 932 (46%) were from deer harvested in Franklin County, 352 (17%) were from deer harvested in Fayette County, and 709 (35 %) were from deer harvested in Dearborn County. Three percent of the samples were from counties outside of the bTB management and surveillance zones (i.e., Decatur, Jackson, Ohio, Ripley, Switzerland, Union, and Wayne counties) or unknown counties. More than half of the deer tested from Franklin (55%), Fayette (58%), and Dearborn (51%) counties were bucks older than 2 years old, for a total of 1,099 older bucks. Older does and deer younger than 2 years old accounted for 46% of all samples taken from the bTB zones. All sampled deer tested negative for bTB in 2016.

Apparent prevalence of bTB within the 10-mile sampling area in south Fayette and Franklin counties was 0.21% with a 95% confidence interval in 2016. The apparent prevalence of bTB in the 10-mile sampling area in Dearborn County was 0% with a 95% confidence interval in 2016.

We can become more confident in our estimate of the true prevalence of bTB in the wild deer population and narrow the range of possible prevalence rates by sampling more deer in future years. The DNR asks for continued support of hunters that hunt within three miles of the 2016 bTB affected farms to submit harvested deer for bTB testing in future deer seasons.

Hunters who harvested a buck older than 2 years old in the bTB management or surveillance zones and submitted the deer for bTB testing were issued an authorization to take an additional buck as an incentive to submit older deer for bTB testing. The authorization was valid for the take of one buck at least 2 years old from Franklin County, Fayette County south of S.R. 44, or Dearborn County north of S.R. 48 until December 11, 2016. The second buck was to be submitted for bTB testing. More than 800 hunters received an authorization to take an additional buck, and 13.8% of those hunters were successful in harvesting a second buck.

Chronic Wasting Disease

Chronic wasting disease (CWD) is a neurodegenerative disease that affects members of the cervid family. Members of the family include white-tailed deer (*Odocoileus virginianus*), mule deer (*O. hemionus*), elk (*Cervis elaphus*) and moose (*Alces alces*). CWD is in a class of prion-caused diseases known as transmissible spongiform encephalopathies (TSE).

There is no cure or vaccine for CWD, and it is fatal. It attacks the animal's brain and causes behavioral changes, excessive salivation and loss of appetite. These symptoms lead to progressive loss of body condition and death. CWD has a long incubation period that averages from 18 to 24 months between infection and clinical signs. Infected animals often appear healthy in the early stages of the disease. In advanced stages, they become emaciated, may lose

fear of humans, stand with legs wide apart, and hold their head and ears low.

CWD spreads through the saliva, feces, urine, and other excreta of infected deer. Researchers at the National Wildlife Health Center (NWHC) found that the prions that cause the disease can be taken up by plants. It is uncertain yet if eating prion-contaminated plant material passes the disease on to the consumer, but prion-tainted plants were found to be infectious when injected into small mammals. The NWHC is conducting additional research to determine how the disease is transmitted among deer and elk, what role infected deer carcasses play in CWD transmission, how artificial feeding affects transmission, and whether small mammals play a role in transmission.

According to the Centers for Disease Control, CWD has spread to at least 20 states and 133 counties. It was first detected as a clinical syndrome in 1967 in Colorado in captive mule deer at a research facility. In 1978, CWD was diagnosed as a spongiform encephalopathy and was found in captive deer and elk in Wyoming. Three years later, the disease was observed in free-ranging elk in Colorado. By 2002, it had been detected in nine states (Colorado, Illinois, Kansas, Minnesota, Montana, Oklahoma, South Dakota, Wisconsin and Wyoming) and two Canada provinces. Twenty-two states and two Canadian provinces documented CWD in 2015. This year, new cases of CWD were reported from three previously documented states (Minnesota, Arkansas, and Wyoming).

In 2013, eastern Wyoming reported 40 percent of its deer had CWD, and in one mule deer herd, approximately 50 percent of the males had been infected. The Iowa DNR reported in 2014 that one in four deer in western Dane County had CWD.

The DFW has been testing samples from hunter-harvested and road-killed deer throughout Indiana as part of the statewide CWD surveillance program. Because diseased prions accumulate in lymphoid and neural tissues, CWD is diagnosed by examination of brain or lymphoid tissue from a dead animal. There is currently no reliable way to test for the disease in living animals. Sick deer reported by citizens are also tested through the targeted surveillance program. In 2015 the DFW collected and tested 363 samples through its active and targeted surveillance program. In 2016, the DFW collected approximately 800 samples for CWD. Since surveillance began in 2002, more than 19,000 samples have been tested by the DFW. All samples have tested negative for CWD.

Epizootic Hemorrhagic Disease

Epizootic hemorrhagic disease (EHD) is a disease caused by the epizootic hemorrhagic disease viruses (EHDV) that belong to the genus *Orbivirus*. It is an acute and often fatal disease of some wild ruminants.

There are 10 serotypes of EHDV worldwide. The Center for Food Security and Public Heath (CFSPH) lists two serotypes currently endemic in North America, EHDV-1 and EHDV-2. Both are widespread in white-tailed deer and periodically cause significant epizootics in deer throughout the United States and Canada. The EHDVs are transmitted by biting midges in the genus *Culicoides* and are better known as no-see-ums. According to the CFSPH, the virus is not directly spread from deer to deer, deer do not always die from the disease, viruses can be present in blood for up to two months, and incubation in deer is five to 10 days.

There are three forms of EHD—chronic, peracute and acute. Deer with the chronic form of EHD may be ill for several weeks and then recover. Deer with the peracute form may experience high fever, anorexia, weakness, respiratory distress, edema of the head and neck, and swelling of the tongue and eye. Deer with the acute form often experience symptoms associated with the peracute form plus extensive hemorrhages in many tissues. Deer with the acute form also often have bloody nasal discharges and develop ulcers in the mouth and on other digestive organs such as the rumen and omasum. Mortality rates published by the CFSPH are high with the peracute and acute forms. Deer with peracute and acute symptoms often die within eight to 36 hours.

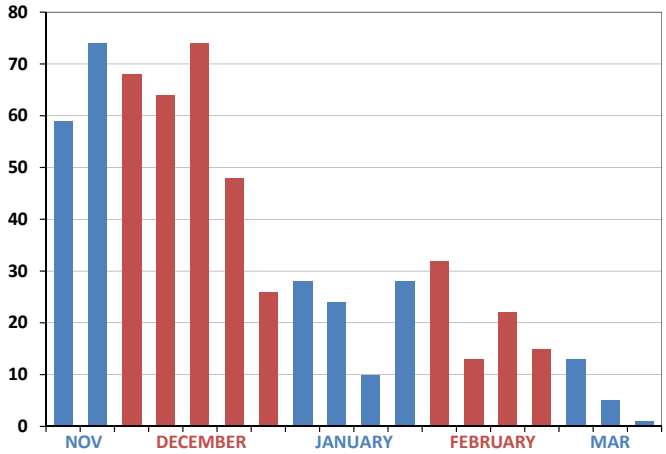
In North America, epizootic outbreaks of EHD occur in the late summer or early autumn and appear to be associated with wet weather. Outbreaks normally stop with the onset of freezing temperatures. According to the CFSPH, mortality rate in white-tailed deer is high (approximately 90%), but the severity of the disease varies from year to year and with geographic location. The disease may not be observed one year and may be widespread the next. The variability of the disease is caused by many environmental factors, including the number of insect vectors, the EDHV serotype, previous host immunity, overall host genetics and deer population density. Deer that survive develop antibodies.

Indiana has had its share of EHD outbreaks in wild deer, including a confirmed case in 2015. In 2016, the DNR received calls from the public about potential EHD infections in deer, but no new cases of EHD were confirmed.

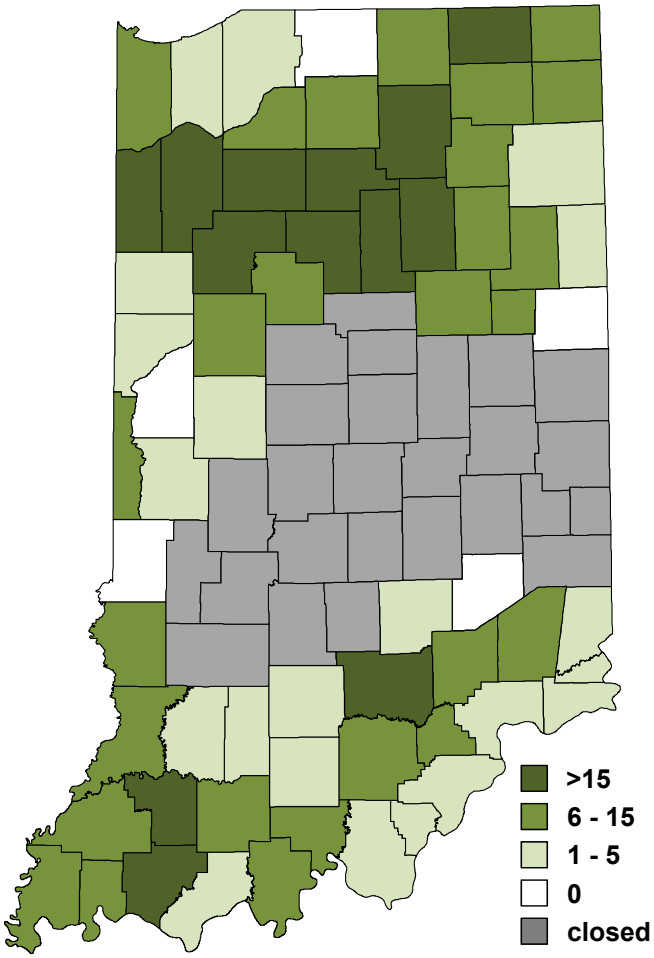
RIVER OTTER

River Otter Trapping Season

The first regulated trapping season for river otters in Indiana began in 2015. This success story was made possible by restoration efforts in Indiana and other Midwestern states. From 1995 to 1999, more than 300 otters obtained from Louisiana were released into optimal riverine and wetland habitats in northern and southern Indiana. Otters flourished in the succeeding years—they established self-sustaining and secure populations, expanded into adjacent habitats, and colonized areas not targeted for restoration. By 2012, otters were found in 76 of Indiana's 92 counties. They were considered common or abundant in nearly half



The number of river otters harvested in Indiana, by week, from Nov. 15, 2015, to March 9, 2016. Nearly 70% of the statewide total was harvested in the first six weeks of the season.



The number of river otters harvested by county in winter 2015–2016. Otters were taken in 61 of the 66 counties open to otter trapping. Twenty-six counties in central Indiana were closed to otter trapping (shaded gray).

of those counties, and populations had grown to the point to withstand a regulated harvest.

Indiana's initial trapping season was open in 66 counties and had a statewide quota of 600 otters and bag limit of two per trapper. Season dates were from November 15, 2015, to March 15, 2016, or until the quota was reached. A valid Indiana trapping license was required. Successful trappers had to register the pelt with the DNR to fulfill federal regulations and provide the skinned carcass for age and reproductive analyses.

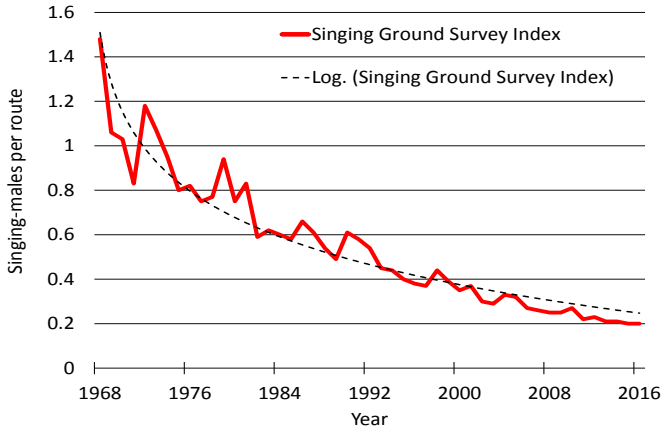
A total of 604 otters were harvested by 407 trappers in 61 counties, prompting the season to close on March 9, 2016. Nearly half of the successful trappers (190; 47%) reached their season bag limit of two otters. Thirteen counties, including 10 in northern Indiana, accounted for half of the total harvest. Leading counties were Jasper and Warrick (33 otters each) and White (32). Successful trappers required an average of 10 trap-days (one trap-day equals one trap set for one day) to harvest an otter. The majority of trappers (90%) felt populations in their area were increasing. Seven believed otter populations were decreasing.

UPLAND GAMEBIRDS

American Woodcock Singing Ground Survey

Five male American woodcock (*Scolopax minor*) were heard on three of 11 survey routes conducted in Indiana during the 2016 woodcock singing ground survey (SGS) in cooperation with the USFWS. The Indiana woodcock SGS Index was 0.045 males heard per stop in 2016 and represented a 1.27% increase from 2015, a 0.03% 10-year decline for 2006 to 2016, and a long-term decline of 4.07% for 1968 to 2016.

The 2016 SGS in both the eastern and central management regions were not significantly different from those of 2015. The 10-year (2006–2016) trends for the SGS indices in the eastern management region (-0.74%/year) and central management region (-0.25%/



American woodcock singing ground survey indices in Indiana from 1968 to 2016.

year) were not significantly different from zero, suggesting stationary populations. Both regions had a significant long-term (1968–2016) declining trend of -0.93%/year for the eastern management region and -0.68 %/year for the central management region.

Woodcock share habitats similar to those of ruffed grouse (*Bonasa umbellus*), which include early successional woodlands or young forest habitats associated with forest disturbance. Woodcock have some specific requirements for moist, well-drained soils and use herbaceous cover along field edges or woodland openings more regularly than ruffed grouse, which are an interior young forest bird species. Moist soil is essential for woodcock because they feed by probing their beak into the ground or leaf duff to find invertebrates and earthworms.

Unfortunately, in a landscape where the forest cover is continually fragmented by land-use conversion, natural forces of vegetative disturbance no longer function as they did historically. In addition, continual public resistance to man-made disturbance on residual tracts of forest cover has decreased the amount of early-succession, moist-soil woodland habitats for woodcock along their migratory routes, on breeding grounds, and in over-winter areas.

Ruffed Grouse Population Status

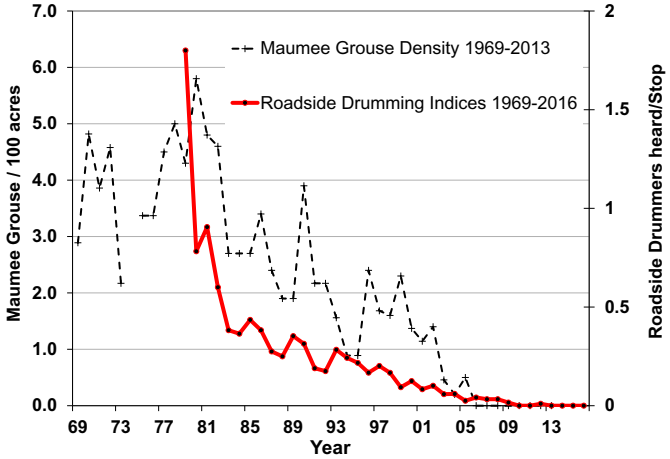
The distribution of ruffed grouse in Indiana has historically fluctuated with changes in the way land is used.

Ruffed grouse require young hardwood forests composed of dense seedling to sapling-size trees and shrubs. In 1931, ruffed grouse occurred in only 12 counties. After reforestation, natural range expansion and successful restoration efforts, the grouse distribution expanded to 41 counties in 1983. That was the widest distribution since 1856.

Population surveys indicate ruffed grouse breeding populations have declined steadily the last 30 years. Populations have decreased to less than 1% of levels recorded during the peak years of 1979–81. A reassessment of ruffed grouse distribution and relative conservation status was conducted in 2008. Data from the Indiana Breeding Bird Atlas (2005–2010) indicate ruffed grouse occurred in less than 1% of the priority blocks surveyed compared to a figure of 10% for the same blocks during the 1985–1990 assessment. In 2008, ruffed grouse were thought to exist in about 10–13 of the 43 counties reported as having ruffed grouse in 1983.

The hunting season for ruffed grouse was suspended beginning in 2015 due to the plight of the bird's declining population levels as it faces the continued diminishing of young-forest habitat. In recent decades, grouse hunting had become more of an excuse to be outdoors with bird dogs for the few dedicated grouse hunters who participated (<100) because of the few birds taken (< 1 bird/2–3 hunters/season).

Annual monitoring of ruffed grouse population levels is done primarily through roadside counts of drumming males during early April and through monitoring various published bird observation reports.



Indices of ruffed grouse breeding population levels in spring. The Maumee grouse density from 1969 to 2013 is depicted by the dashed black line. Results of roadside drumming surveys from 1969 to 2016 are represented by the solid red line.

No drumming male ruffed grouse were heard on the 14 roadside survey routes (15 stops/route) during the 2016 survey period for the fourth consecutive year. Only one grouse was heard in six years. A single grouse (likely a hen) was observed twice along the Hickory Ridge route. The five-year (2011–2016) mean drumming index for the control routes is 0.002 drummers per stop (~1 drummer heard every 500 stops), compared to 1.16 drummers per stop during the peak years of 1979–81, which is nearly a 600-fold decrease. No significant verifiable observations of ruffed grouse were reported via public bird reporting websites outside the known limited grouse distribution range in 2016, nor was there any substantial increase of grouse observation reports in the limited grouse range.

The Appalachian subspecies of ruffed grouse (*B.u. monticola*) is morphologically unique from other ruffed grouse subspecies (all red-phase, longest central tail retrices) and is physiologically best adapted to the southern latitudes of the ruffed grouse continental distribution, tolerating warmer and drier climatic conditions and a diet with higher tannin levels. Populations of this subspecies have already disappeared from Illinois and from southern Missouri, western Kentucky and Tennessee, and Arkansas, with significant declines occurring in Ohio, eastern Kentucky and Tennessee, North Carolina, northern Georgia, southern Michigan, western Pennsylvania and New York, and the Virginias. The implications for biodiversity, if this subspecies disappears from much of its range, will likely become critical as environmental temperature and precipitation gradients move latitudinally northward, a condition related to climate change.

WATERFOWL

Waterfowl Banding

Canada geese and wood ducks are migratory waterfowl that breed statewide in Indiana. Both are abundant and widely sought by waterfowl hunters.

Each year, DFW staff capture members of each species for banding. Geese are captured during their flightless period in the last two weeks of June using funnel traps on dry land. Wood ducks are captured using baited live traps.

The birds are removed from the traps. Age and sex are determined, and a uniquely numbered aluminum band is attached to one leg of each bird.

Data from the banded birds are submitted to the USGS Bird Banding Laboratory in Maryland, which maintains the data from all banded migratory birds nationwide.

Anyone who harvests, sees or finds a banded migratory bird is encouraged to report the band number by calling 1-800-327-BAND or by visiting *reportband.gov.* Information from bird band recovery reports is used to calculate survival and harvest rates, and to determine movement patterns.

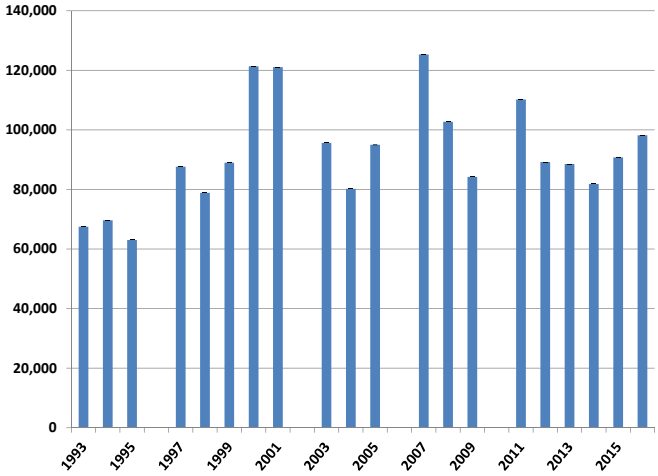
In 2016, a total of 1,690 Canada geese were banded on private and public lands in Indiana. An additional 124 geese were banded as they were relocated from nuisance situations to FWA properties. Just as in 2015, the goal of banding 2,000 geese was not reached. A total of 934 wood ducks were banded. That number was also short of the annual goal (1,285) but far better than 2013–2015, when an average of 394 wood ducks was banded each year. For the first time in several years, water conditions were excellent during wood duck banding in 2016.

Sadie Dainko, a waterfowl technician, removes a wood duck from a floating trap to be banded.

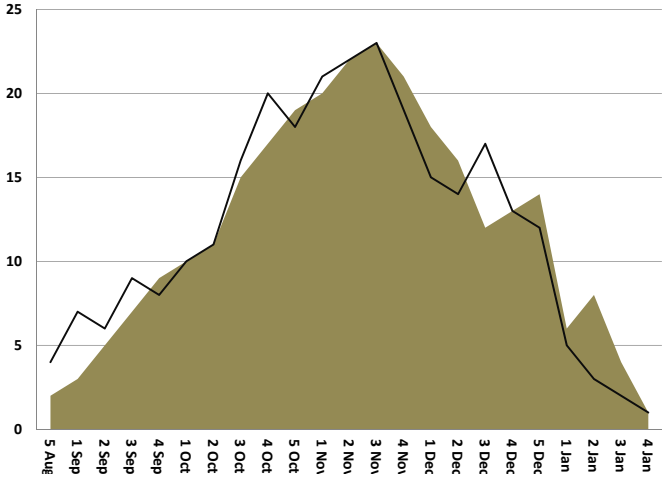
Waterfowl Population Surveys

The DFW performs many waterfowl population surveys. During the April breeding season, statewide helicopter surveys are used to estimate the breeding population of Canada geese, mallard (*Anas platyrhynchos*), blue-winged teal (*A. discors*) and mute swan (*Cygnus olor*). Wood duck breeding populations are not estimated because they nest in tree cavities and are not visible from a helicopter.

Indiana breeding population estimates for 2016 were 98,194 Canada geese and 23,148 mallards. Breeding blue-winged teal numbers were not estimated because



Canada goose breeding population estimates in Indiana, 1993–2016. Populations were not estimated in 2002 or 2010, and the estimate for 2006 was removed due to a low sample size.

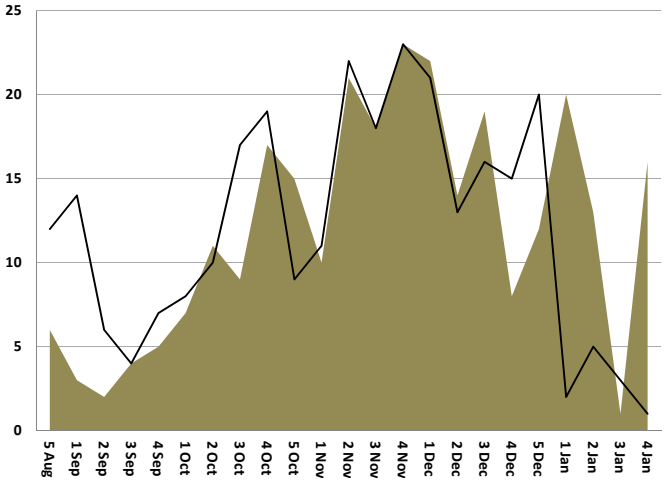


Five-year (2011–2015) duck-migration averages for the north waterfowl hunting zone. The x-axis represents the approximate week of the month, not the date. The y-axis represents rank. The survey occurs for 23 weeks. The week with the highest count has a rank of 23, and the week of the lowest count has a rank of 1. The solid black line is the 2015–16 season only.

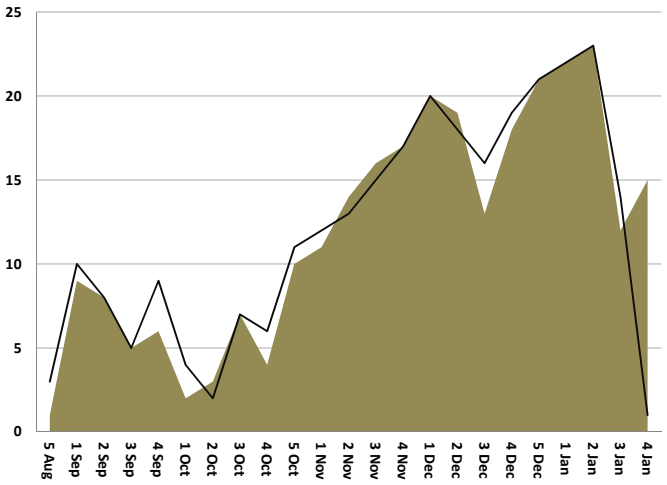
most occurred in large flocks. This indicates that they are migrating birds rather than breeding birds.

Since 1986, weekly waterfowl surveys have been conducted from the last week in August through the end of January on selected state and federal properties throughout Indiana. These data allow the DFW to track yearly and long-range migration timing and distribution as birds move through the state. This information is used to set annual waterfowl season parameters in each waterfowl hunting zone to maximize local hunting opportunities while peak migration is occurring.

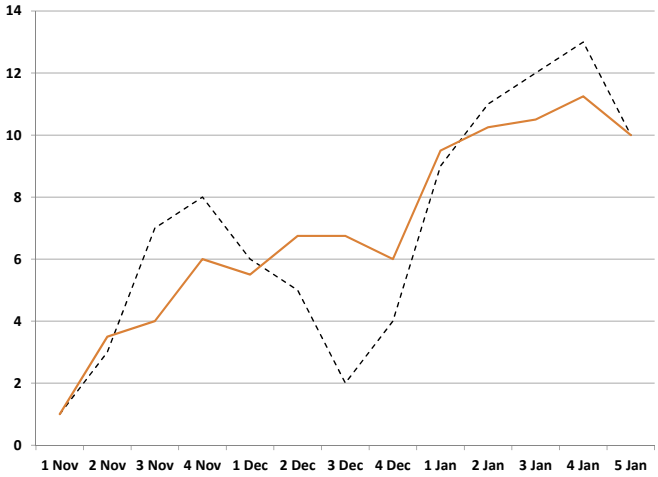
In 2012, Wildlife Research biologists began conducting weekly helicopter surveys of the lower Wabash, White and Ohio rivers from November through January. These flights provide information about winter waterfowl usage on Indiana's major river systems. The 2015–2016 season was the fourth for the



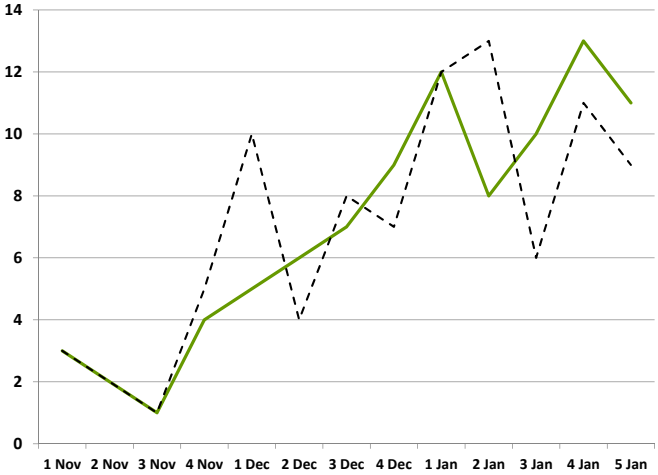
Five-year (2011–2015) duck-migration averages for the central waterfowl hunting zone. The x-axis represents the approximate week of the month, not the date. The y-axis represents rank. The survey occurs for 23 weeks. The week with the highest count has a rank of 23, and the week of the lowest count has a rank of 1. The solid black line is the 2015–16 season only.



Five-year (2011–2015) duck migration averages for the south waterfowl hunting zone. The x-axis represents the approximate week of the month, not the date. The y-axis represents rank. The survey occurs for 23 weeks. The week with the highest count has a rank of 23, while that of the lowest count has a rank of 1. The solid black line is the 2015–16 season only.



Migration rank by week during the 2015–2016 waterfowl survey (dashed line) and the four-year average (solid line) for the lower Wabash River. The x-axis represents the approximate week of the month, not the date. The y-axis represents rank. The survey occurs for 13 weeks. The week with the highest count has a rank of 13, and the week of the lowest count has a rank of 1.



Migration rank by week during the 2015–2016 waterfowl survey (dashed line) and the four-year average (solid line) for the West Fork White River. The x-axis represents the approximate week of the month, not the date. The y-axis represents rank. The survey occurs for 13 weeks. The week with the highest count has a rank of 13, and the week of the lowest count has a rank of 1.

Wabash surveys and the third for the West Fork of the White River. Due to low waterfowl densities, surveys of the Ohio River were discontinued after the first year.

The survey route follows the Wabash River from its confluence with the Ohio River up to the bridge on U.S. 40 in Terre Haute. The West Fork White River is flown from the State Road 39 bridge in Martinsville down to the S.R. 58 bridge that is west of Elnora. The ditches and marshes around Gibson Generating Station, including Gibson Lake and Cane Ridge WMA, are also flown. This is an important area for wintering waterfowl, especially mallard, snow goose (*Chen caerulescens*), and Ross's goose (*C. rossii*).

Waterfowl Hunter Surveys

Hunter surveys assess hunting effort and success, as well as hunter satisfaction, habits and approaches to hunting. The data assist DFW biologists in setting seasons that address the biological parameters of the species hunted and the desires of the hunters who make conservation possible. The DFW sends a survey to waterfowl hunters every three to four years.

The most recent survey was sent after the 2013–14 season. The next survey will be sent after the 2016–17 hunting season. That survey is being prepared as of this writing (fall 2016).

Avian Influenza Monitoring

After an outbreak of H7N8 highly pathogenic avian influenza (HPAI) in a commercial turkey flock in Dubois County in January 2016, DFW biologists monitored wild waterfowl around the outbreak area through environmental sampling.

Due to extremely cold conditions, very few wild waterfowl were in the area at the time. Flocks of waterfowl, primarily Canada geese, were located from a helicopter. Biologists returned to those areas to collect environmental samples.

In addition, hunter-killed ducks from the area were tested. Besides Canada goose fecal samples, most samples came from mallards or Canada geese shot by hunters in the Wabash River valley. All samples tested negative for HPAI.

No HPAI sampling was done during routine Canada goose banding in June 2016; however, as part of the "Surveillance Plan for Highly Pathogenic Avian Influenza in Wild Migratory Birds in the United States" (July 2016), 97 mallards and domestic-mallard hybrids were tested during Franklin College's urban mallard banding project in July 2016. All tested negative for HPAI.

In 2016, 34 samples have been taken from hunter-killed teal during the special teal season. The DFW will continue to follow the national surveillance plan through the fall, sampling hunter-killed dabbling ducks in the Kankakee, Wabash, and Ohio watersheds. The DFW will also continue to test appropriate species when these birds are found sick or dead.

Wild birds were tested for HPAI in 2016 in the counties shaded in orange. All results were negative.

WILD TURKEY

Wild Turkey Population Status

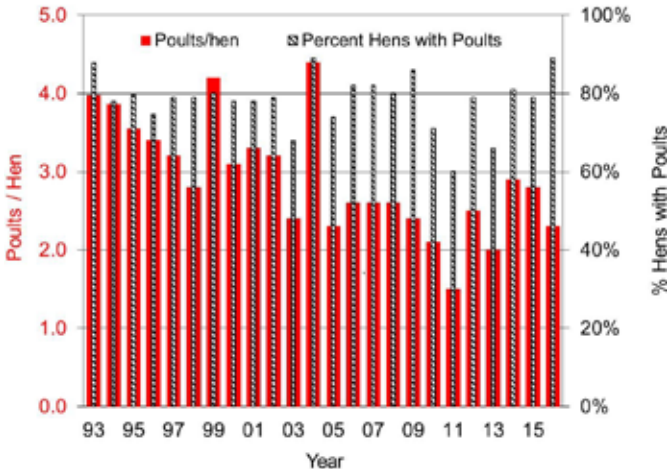
Trends in summer brood production of wild turkeys (*Meleagris gallopavo*) continue to be of concern. Such concern began in the post-restoration era, not only in Indiana, but also across the eastern United States.

From 1993 to 2015, wildlife biologists and conservation officers annually recorded observations of wild turkey hens and poults, including hens without poults, during July and August, on cards. The wild turkey summer brood production index (PI) is calculated from the observations as total poults/total adult hens (poults-to-hen ratio), compiled from July and August into one combined index. The PI is considered the most accurate index of production because it includes all hens, even those without poults.

A chronic reporting bias in the brood observation data is the tendency of observers to report hens with poults more than "barren hens." This practice results in a higher PI than actually occurred. The August production index is generally higher than in July due to "gang" brood behavior that occurs when several individual broods and hens without broods combine into a single brood flock.

In 2016, a new web-based brood reporting system

This poster was used to promote the reporting of wild turkey broods using a new web-based system.



Annual wild turkey brood production indices from 1993 to 2016.

was implemented using a Caspio™ online data entry software platform (*https://www.caspio.com/*). The web-based system allows submission of wild turkey observations by natural-resource agency personnel and interested citizens who observed wild turkeys during the summer months. The inclusion of "citizen scientist" observations could potentially enhance the robustness of the survey by increasing the statewide coverage and the number of observations.

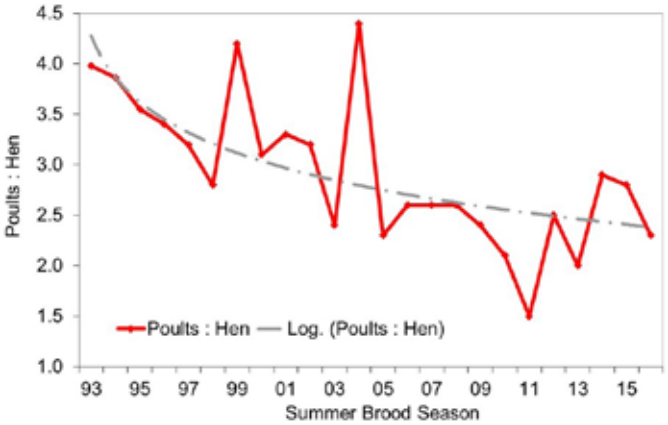
Instructions for reporting wild turkey observations during the survey period were developed and posted on the new web-based system. The new system was promoted through various agency communications and included a "wanted" poster for wild turkey brood observations. The poster was available online, as a letter-sized cardstock poster, or as a wallet-sized card. The materials asked observers to create a personalized username with basic contact information. The observers reported the wild turkey hens, poults and gobblers they saw, and included the county and date. In addition, there was a space for "unknown turkeys observed" and comments.

A total of 591 observation records of at least one wild turkey was received from 297 participants from June through September, with 544 observation records received during the traditional July (360;66%) and August (184;34%) reporting period.

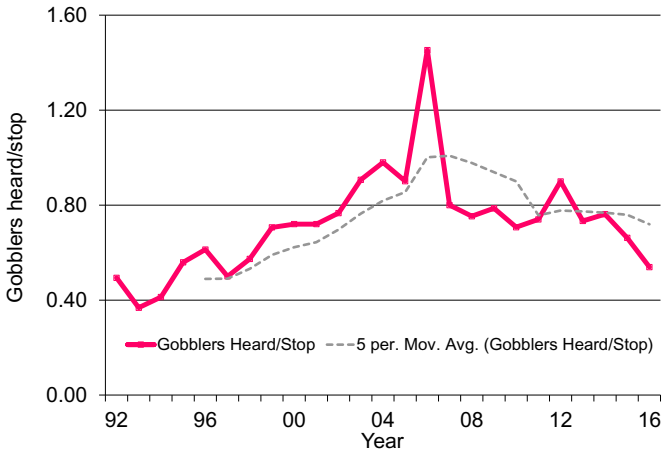
Non-DNR agency publics accounted for 74% of the observation records. The 544 observation reports represented 3,838 wild turkeys (978 hens, 2,220 poults, 376 gobblers, and 264 unknown wild turkeys) with 408 (75%) records usable for determining wild turkey production parameters.

The 2016 estimated PI was 2.3 poults:hen, with 89% of the hens observed with at least one poult. The 2016 PI was 7% lower than the 2015 PI of 2.8. The average size of the 408 broods reported (where at least one adult hen with poults were observed together) was 8.7 birds, also slightly less than the 9.5 brood size in 2015. The overall PI (total poults/total hens observed) was equal to the mean (2.3 PI) estimated for the previous five years.

The average PI has progressively declined since 1993. The general downward log trend in the PI is considered indicative of a wild turkey population transitioning away from a colonizing population with geometric growth during restoration. The new trend leans toward an established population in which the annual production and



The long-term trend of wild turkey brood production in Indiana from 1993 to 2016.



Roadside gobbling indices for wild turkeys from 1992 to 2016.

growth rates level off to maintenance levels, which is characteristic of a relatively stabilized population.

The changes in annual production are generally reflected in the proportion of juvenile males (jakes) in the next spring harvest and again two springs later, in both the spring gobbling survey index and age structure of the spring harvest. This is because 2-year-old males are the most active gobbling cohort and generally the most vulnerable to harvest in the spring.

Long-term trends in turkey populations generally reflect the overall trend in suitable habitat for wild turkeys across the landscape, but recent declines across the eastern United States are likely a manifestation of various density-dependent factors as turkey populations peak after restoration. Downward trends in wild turkey spring harvests and summer production indices were observed throughout the eastern United States in the last decade. Periodic fluctuations above and below the long- term production mean are expected as turkey populations stabilize at lower, "new normal" population levels. The changing population dynamics of maturing wild turkey flocks will likely influence future harvest trends and hunter success and opportunities.

Climatically, spring/early summer 2016 marked the 11th consecutive year of above-normal precipitation and flooding events in the southern two-thirds of the state during either the nesting or early brood rearing period of June through early July. In contrast, some areas in northern Indiana were exceptionally dry during the early brood period and potentially had better production.

Again, the scarcity and uneven distribution of observation reports across the state limited inferences about regional differences in turkey production. In 2017, an effort to increase participation across the state is needed. Data collection should be restricted to July and August, and observation reports should be limited to adult hens (both with and, especially, without broods), poults, and county observed. Including illustrative pictures with instructions may enhance the accuracy of brood reports.

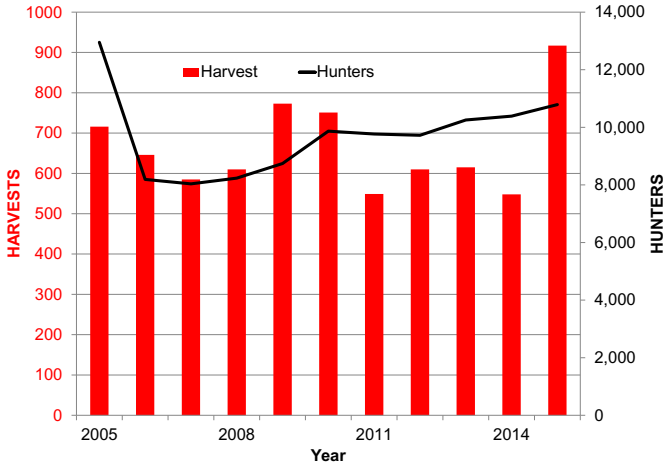
Roadside gobbler trend routes (14 routes; 15 stops/route) are conducted annually from late March to April in conjunction with roadside trend routes for ruffed grouse. Roadside gobbling routes are not accurate indicators of annual trends in wild turkey populations, but they provide some long-term (≥ 5 years) trends and information to compare areas relative to each other. Annual variations can reflect weather conditions during the survey period and may also reflect the proportion of the more-vocal 2-year-old gobblers in the population (a manifestation of summer production two years prior), rather than actual population trends over the long term.

The number of male wild turkeys heard gobbling along 14 roadside trend routes from March 30 to April 19, 2016, was 0.54 gobblers per stop (GI). That figure is 19% less than the 0.66 heard in 2015. The five-year moving average shows a general increase from 1987 to 2006, followed by a general decrease since the 2006 peak. The 2015 statewide gobbling index of 0.54 was less than the five-year mean of 0.71 and was the lowest GI since 1994.

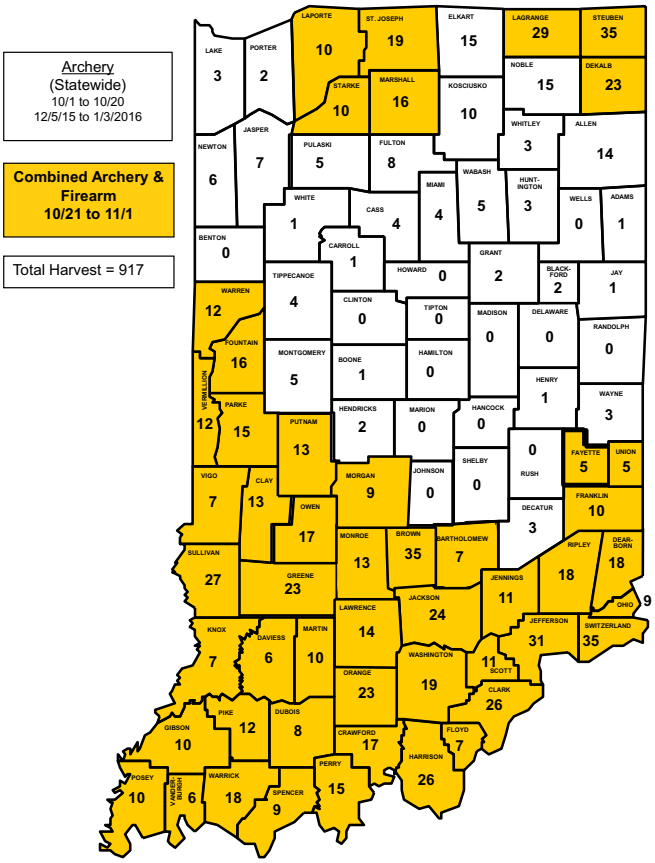
Fall 2015 Wild Turkey Harvest

Hunters harvested 917 wild turkeys during the 11th fall turkey hunting season. A total of 548 birds were harvested in 2014–15. The combined shotgun and archery portion of the season accounted for 57% of the harvest, with archery hunters taking 43% of the total harvest. Adult birds made up 72% of the harvest, with a juvenile to adult ratio of 1:2.5. The proportion of adults in the fall harvest is relatively high and likely reflects a combination of low summer brood success, hunter selection for larger adult birds, and age determination errors.

Ninety-four percent of the harvest occurred on privately owned lands. Counties harvesting ≥ 20 birds were Brown (35), Steuben (35), Switzerland (35), Jef-



The number of wild turkeys harvested in the fall from 2005 to 2015, and the estimated hunter participation.



The 2015–2016 fall wild turkey harvest by county. The white counties represent results from archery season only. The shaded counties represent archery and firearms seasons combined.

ferson (31), Lagrange (29), Sullivan (27), Clark (26), Harrison (26), Jackson (24), DeKalb (23), Greene (23), and Orange (23). The 2015–2016 fall harvest set a record, with an estimated 10,789 hunters harvesting 917 birds for an estimated success rate of 8%.

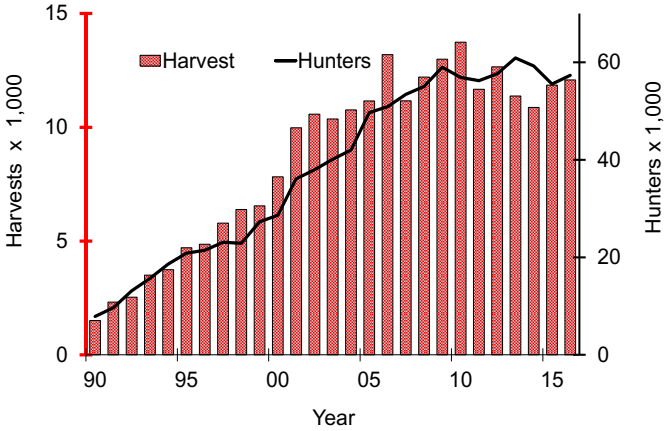
Spring 2016 Wild Turkey Harvest

Hunters harvested 12,081 wild turkeys in 90 of Indiana's 92 counties during the 2016 (47th) spring wild turkey season as reported by hunters to the CheckIN Game harvest reporting system. Ninety-eight percent of hunters checked in game online. The remaining 2% used tele-check. Results from the 2016 spring harvest were 2% higher than the 2015 spring harvest of 11,853.

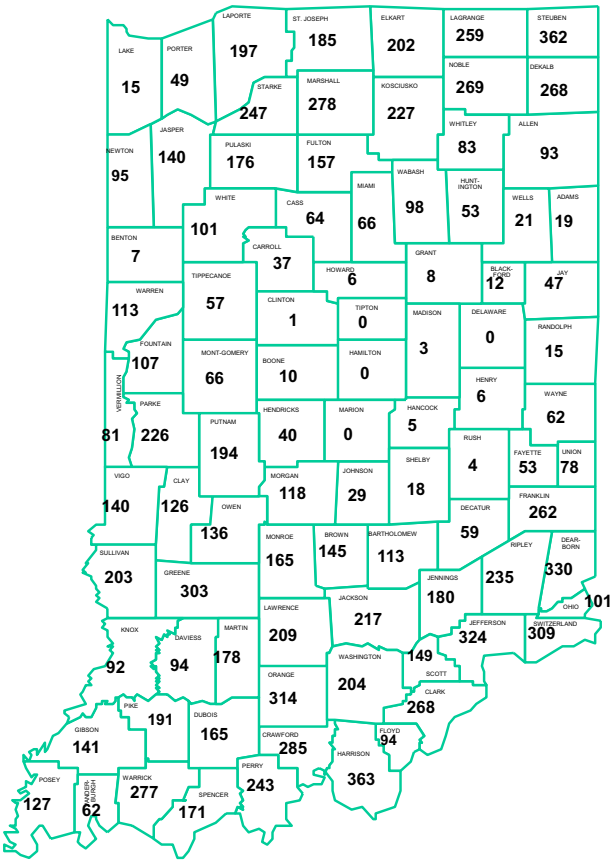
Spring harvests in 25 counties exceeded 200 birds, with 49 counties showing increased harvests compared to those of 2015. Harvests decreased in 41 counties. Two counties recorded no turkeys harvested. The top 10 counties were Harrison (363 birds), Steuben (362), Dearborn (330), Jefferson (324), Orange (314), Switzerland (309), Greene (303), Crawford (285), Marshall (278), and Warrick (277). The majority of the birds were harvested in the early part of the season and the early morning hours.

A total of 1,430 birds (12% of total harvest) were taken during the youth-only weekend before the regular season. The proportion of juvenile turkeys in the spring harvest was 19%. Birds that were 2 years old made up 39% of the harvest. Turkeys that were 3 years old and older made up 42% of the harvest.

The northern region, which is the largest, supported



Annual spring wild turkey harvests and the estimated number of hunters participating from 1990 to 2016.



The number of wild turkeys harvested per county during the spring 2016 season. A total of 12,081 birds were harvested.

Trends in estimated spring wild turkey hunting success.

31% of the harvest, with 52% of the harvest occurring in the southern regions. The estimated number of hunters afield was 57,332 in 2016, with an estimated hunter success rate of 21%.

Annual statewide harvest levels have leveled off since the harvest peak in 2010 (13,742). Recent annual spring harvests have ranged from 11,000 to 12,000 birds. The number of hunters in the field ranged from 55,000 to 60,000. The 2016 harvest was the sixth-highest spring harvest. Hunter numbers have fluctuated slightly the last few years. This trend may be related to the decline in the estimated hunter success rate to around 20%, compared to the 24–28% rate during the peak years.

Reasons for the 2% increase in 2016 were likely related to the continued growth of the relatively younger turkey populations in the north and east-central regions (i.e., relative age in terms of years after restoration).

Summer brood production indices have progressively declined in recent decades, not only in Indiana, but also throughout the eastern U.S., as wild turkey populations mature in the post-restoration era and its harvests decline to levels below those of the peak years. The greatest declines in Indiana have occurred in the older populations in the southern part of the state. In contrast, there is continued growth with higher levels of production in the north and east-central regions. In those regions, restoration efforts were generally completed later. Eventually, a similar leveling off in the northern and east-central populations is also expected, as those populations mature.

WILD PIGS

Wild Pig Status And Elimination Project

Wild pigs (*Sus scrofa*) are an exotic, non-native, invasive species intentionally and illegally released in two different regions of southern Indiana in the early 1990s. The offense was primarily linked to sources in Louisiana and possibly Mississippi.

A DNA analysis of tissues collected from euthanized wild pigs verified this theory but also suggested other sources. Those other sources were pigs likely released several years after the original releases. Morphologically, the euthanized wild pigs exhibited characteristics of the Eurasian or Russian boar hybrids, not feral swine of domestic origin. Ongoing DNA profiling of existing wild pig populations shows promise for use as a forensic tool to assist law enforcement in determining the origin of potential new populations, and as a means for evaluating the success of eradication efforts.

Population control was previously conducted through unrestricted shooting. Unfortunately, unrestricted shooting and recreational sport hunting for wild pigs have proven ineffective in controlling wild pig populations. Instead, these activities have generally encouraged illegal releases of more pigs for the purpose of expanding hunting opportunities.

In 2014, Congress approved $20 million over five years to control and eliminate wild pig populations, directing special emphasis at "emerging wild pig populations" in the Midwest farm belt. USDA-Wildlife Services hired professionally trained technicians in each state to work cooperatively with various state and federal agencies and cooperating landowners to carry out a variety of wild-pig population control techniques, including combinations of trapping, snaring, helicopter shooting, and selective night shooting of pigs not effectively eliminated by use of other techniques.

Wildlife Research biologist Steve Backs with a wild pig trapped and removed as part of the cooperative effort between Indiana DNR and Wildlife Services to eliminate non-native, invasive wild pigs in Indiana. Wild pigs threaten native fauna and flora, damage agricultural crops, and threaten the quality of water resources.

Wildlife technicians John D. McComas and Travis L. Buckle with a trapped wild pig radio-marked to be a "Judas pig," to employ a technique used to locate other groups of wild pigs for elimination. Use of a Judas pig is part of a cooperative effort between Indiana DNR and Wildlife Services in Indiana.

The implementation of pig removal techniques involves adapting techniques and equipment traditionally used in the South to conditions in the Midwest, where the combination of relatively low-level pig populations, abundant food resources and winter conditions have presented challenges that few Southern states have likely faced.

Another ongoing challenge is educating landowners to integrate multiple control methods and develop the patience to capture complete pig sounder groups (adult sows and their progeny) for removal. During the 2016 calendar year, Wildlife Services technicians removed 130 wild pigs from Indiana using a variety of techniques. These included aerial shooting (10); selective or sharp shooting (13); and trapping (107). Removals were facilitated by using the "Judas pig" technique in which a captured sub-adult pig is selected for radio-marking before being released to re-assemble with another group of pigs.

Nine wild pigs were radio-marked with either GPS collars or VHS transmitter ear tags to employ this technique. The Judas pigs not only helped find other groups of wild pigs, but also facilitated a collection of data related to movement patterns and habitat use that will aid future removal efforts. Biological samples were collected from slightly less than 50 dead wild pigs and submitted for disease testing for classical swine fever, leptospirosis, toxoplasmosis, and senecavirus (aka Seneca Valley virus) and for DNA profiling at Wildlife Services labs in Colorado.

The proliferation of pot-bellied pig reports around the state has become more of an administrative nuisance and unnecessary waste of limited personnel investigation time. Most pot-bellied pigs and their hybrids appear to be abandoned, escaped or poorly confined pets. Free-ranging swine of any origin can damage native fauna and flora and their habitats, as well as water resources and personal property.

Free-ranging swine of all types can generally be shot on sight in Indiana with landowner permission. Several pot-bellied hybrids have been removed from Indiana DNR properties.