



Indiana Department of Natural Resources
2017 WILDLIFE SCIENCE REPORT





Water cascades through a partially frozen stream at Splinter Ridge Fish & Wildlife Area in Jefferson County. Streamside salamanders (Ambystoma barbouri) deposit their eggs beneath submerged rocks at this and other streams in southeast Indiana.

ON THE COVER

The Blanding's turtle (*Emydoidea blandingii*) is one of Indiana's most imperiled turtles and a species of conservation concern across much of its North American range. The species occurs in the northern third of Indiana, inhabiting shallow aquatic habitats such as marshes, swamps and inlets of lakes. Although predominantly aquatic, Blanding's turtles travel overland to other wetlands or nesting sites, and may be struck by vehicles while crossing roads. Road mortality, combined with delayed sexual maturity (females may not reproduce until they are at least 10 years old) make conserving populations a formidable challenge. In 2017, researchers at Indiana University-Purdue University Fort Wayne (IPFW) received a State Wildlife Grant from the Indiana Division of Fish & Wildlife (DFW) to evaluate the present status of Blanding's turtles and their wetland-associate spotted turtle (*Clemmys guttata*) in Indiana. The ultimate goal of this three-year project is to define ecologically relevant population units to inform management and conservation strategies for these two species in Indiana.

2017 was a significant year for Indiana's amphibians and reptiles, as new projects came on line and ongoing studies continued to produce interesting results. One of the most exciting events was the release of 80 captive-raised juvenile hellbenders (*Cryptobranchus alleganiensis*) into the Blue River. These hellbenders were collected as eggs from the Blue River and raised in captivity for four years at Purdue University. The release was a landmark event for hellbender conservation in Indiana, and was the product of more than a decade of collaborative research between Purdue University and the DFW.

Purdue researchers also began studying another aquatic salamander, the mudpuppy (*Necturus maculosus*). Mudpuppies play a unique role by serving as the only host for juvenile salamander mussels (*Simpsonaias ambigua*), which parasitize mudpuppies by attaching to their gills. This project will look for mudpuppies by identifying their genetic material in the environment, known as environmental DNA or eDNA. Identifying where mudpuppies occur will allow biologists to evaluate the feasibility of reestablishing salamander mussels in previously occupied waterways. Mudpuppies and salamander mussels are both species of special concern in Indiana.

A federal review on the rangewide status of Kirtland's snakes (*Clonophis kirtlandii*) by the U.S. Fish & Wildlife Service (USFWS) concluded the species did not warrant federal listing. The snakes, however, remain protected as a state-endangered species in Indiana and are listed in almost every state in which they occur. Kirtland's snakes are notoriously secretive and difficult to find. Scientists at IPFW are exploring ways to use eDNA to detect their presence without actually seeing them. If successful, this technique would provide an additional survey tool and would save time and money while locating new populations. (Photo by Alan Resetar)

Photography Note

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

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Indiana’s remaining Allegheny woodrat populations live in the steep cliffs overlooking the Ohio River.

WILDLIFE SCIENCE ADMINISTRATION

INTRODUCTION

The mission of the DFW is to professionally manage Indiana's fish and wildlife for present and future generations, balancing ecological, recreational, and economic benefits. At its simplest, the role of the Wildlife Science Unit in this mission is to provide fundamental and fact-based information to guide resource management decisions. This is challenging, vitally important work that drives the informed stewardship of Indiana's wildlife resources. In 2017, Wildlife Science added a much needed wildlife health component to lead the DFW in tackling the myriad of known and emerging diseases that can affect Indiana wildlife.

Our annual report offers a brief glimpse into Wildlife Sciences' major programs. We hope you find it both informative and inspiring, and that you discover something new about Indiana's wildlife resources and the efforts in place to ensure they persist for Hoosiers now and in the future.

PERSONNEL CHANGES

In 2017, the Wildlife Science Unit was fully staffed for the first time, after the filling of five key positions. Matt Broadway was hired as the small game biologist, and the furbearer biologist position was filled by Geriann Albers. Nancy Boedeker became Indiana's first wildlife veterinarian. Theresa Bordenkecher joined the unit as wildlife science supervisor, and Nate Engbrecht was hired as the new herpetologist. Matt, Geriann, Nancy, and Theresa are new to the Indiana Department of Natural Resources (IDNR). All positions are stationed in the Bloomington Field Office except Nancy, who has an office at the Animal Disease Diagnostics Laboratory on the Purdue University main campus.

A Florida native, Matt obtained his B.S. at Auburn University and his M.S. from the University of Wisconsin-Stevens Point, where he studied the demographics of greater prairie chickens (*Tympanuchus cupido*). Between degrees, Matt worked as a technician on many research projects, including those on northern bobwhite (*Colinus virginianus*), greater sage-grouse (*Centrocercus urophasianus*), lesser prairie chickens (*T. pallidicinctus*), and white-tailed ptarmigan (*Lagopus leucura*). He spent a year with the University of Georgia, the Tall Timbers Research Station and the Land Conservancy in Florida before joining the DFW. Matt's interests outside wildlife include mountain biking, archery, hiking, camping and gardening.

Geriann earned her B.S. from the University of



Matt Broadway and girlfriend Kristen visit Great Smokey Mountain National Park in North Carolina.



Geriann Albers joined the Indiana Department of Natural Resources in 2017 as the furbearer biologist.

Illinois and her M.S. from West Virginia University. She studied coyote (*Canis latrans*) diets in West Virginia. Before earning her M.S., Geriann was a technician working on badger (*Taxidea taxus*), red fox (*Vulpes vulpes*), river otter (*Lontra canadensis*) and coyotes in various states. After graduating from West Virginia, she spent three years as assistant furbearer biologist and trapper education coordinator for the Wisconsin Department of Natural Resources and 1½ years as



Nancy Boedeker (center) assists staff from Purdue University in releasing an eastern hellbender into the Blue River in November 2017.

assistant furbearer and black bear biologist for the North Carolina Wildlife Resources Commission.

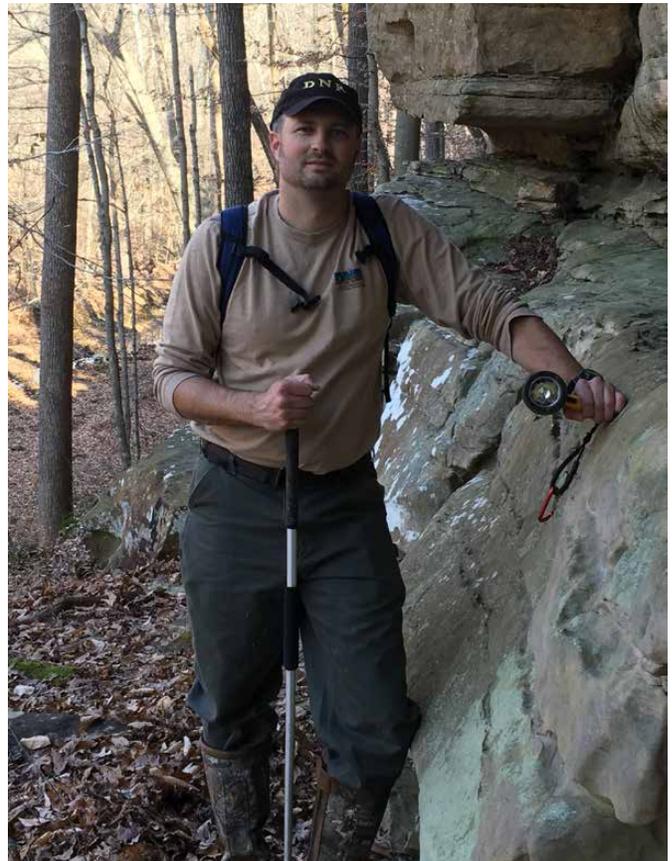
Nancy has a B.A. in biology from Brown University and earned her D.V.M. from the University of Tennessee. In 2018, she is scheduled to receive her M.S. in conservation medicine from the University of Edinburgh Veterinary School in Scotland. Nancy completed her residency in zoo medicine at the University of California-Davis and San Diego Zoo in 2005. She served 10 years as the veterinary medical officer at the Smithsonian National Zoo in Washington, D.C., where she provided clinical care to the diverse collection animals and participated in conservation-based research and wildlife reintroduction projects. Nancy was director of wildlife health at Cape Wildlife Center and worked at Zoo New England before coming to Indiana. Her interests include hiking, camping, kayaking, photography and travel.

Theresa obtained her B.S. in biology from the University of Indianapolis and her M.S. in ecology from Indiana State University, working on pollination ecology. She has worked for the Indiana Department of Environmental Management and the USFWS, and has taught biology at the University of Indianapolis. Theresa has field experience working with various wildlife species as well as native and invasive plants.

Nate grew up in Bremen, Indiana and earned his B.A. with a double major in environmental biology and communication from Bethel College, and his M.S. in biology from Indiana State University, where he researched Indiana's state-endangered crawfish frogs (*Lithobates areolatus*). He spent four years as a naturalist aide under Indiana's first herpetologist, Zack Walker, conducting statewide surveys and researching eastern box turtles, timber rattlesnakes, and eastern hellbenders. After his first stint with IDNR, Nate worked for the USFWS radio-tracking federally



Theresa Bordenkecher enjoys a birding hike at Shades State Park.



Nate Engbrecht began working as the DFW nongame herpetologist in July 2017.

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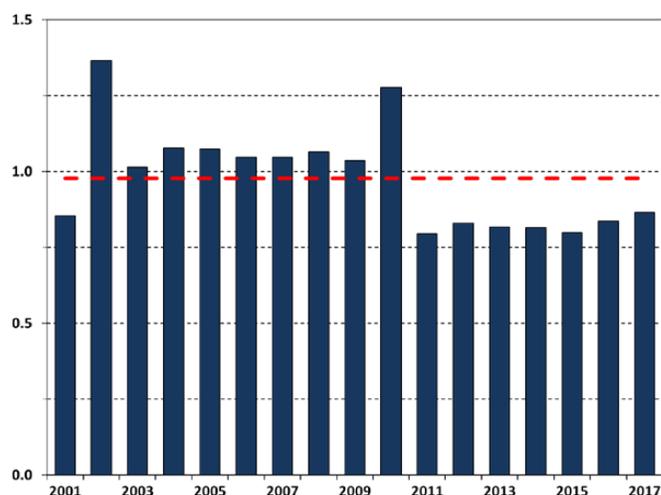
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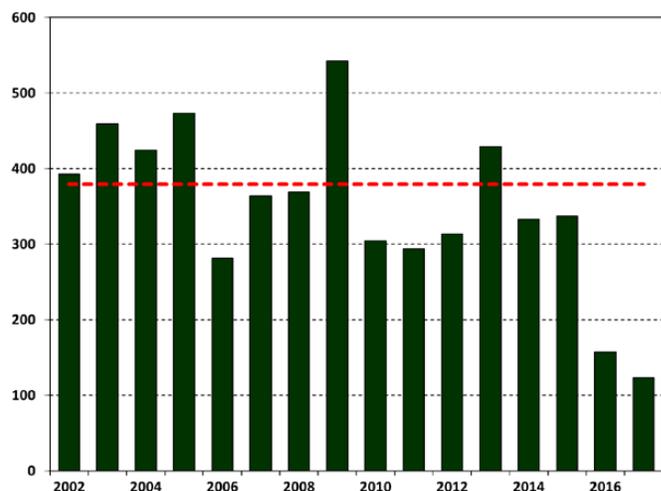
endangered Wyoming toads (*Anaxyrus baxteri*), and as a senior staff scientist with the engineering and environmental consulting firm Cardno. Nate's research interests are closely tied to amphibian and reptile biogeography and conservation.

FUNDING

Wildlife Science programs are financed by both state and federal dollars. Sources of state funds are revenue from the sale of Indiana hunting and trapping licenses, and donations to the Indiana Nongame Wildlife Fund. Federal monies come to the DFW in a variety of ways but the two primary channels for wildlife conservation are the Pittman-Robertson (PR) Act and the State and Wildlife Grant (SWG) program.



Indiana's annual apportionment (in millions) from the U.S. Fish & Wildlife Service's State Wildlife Grant program from 2001 to 2017. The red dashed line represents the 17-year average of \$977,100.



Annual donations (in thousands) to the Indiana Nongame Wildlife Fund from 2002 to 2017. The red dashed line represents the 14-year average from 2002 to 2015 of approximately \$380,000.

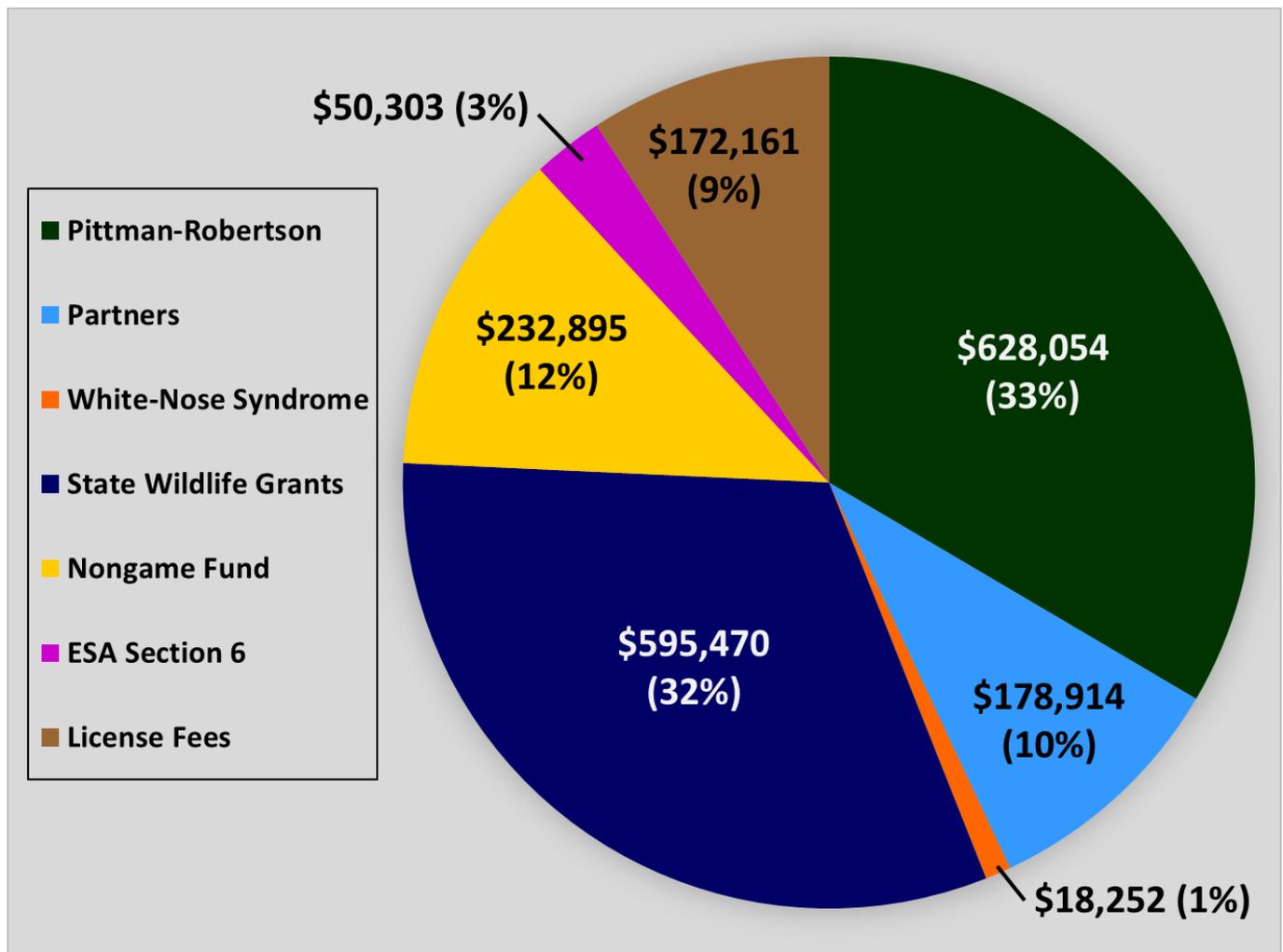
PR monies are derived from an 11% federal excise tax on sporting arms, ammunition and archery equipment, and a 10% federal excise tax on handguns. When hunters and shooters purchase these items, the manufacturers pay the excise tax. This revenue is deposited into the Wildlife Restoration Trust Fund and administered by the USFWS. Funds are made available as grants 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. The remaining 25% is supplied by the state, usually from license revenue, but other partners, such as universities, may provide the match.

The SWG program, authorized by Congress in 2001, provides funds to address rare, declining and at-risk species. Unfortunately, these dollars are not permanent and subject to annual federal budget adjustments. Indiana's 2017 apportionment of \$865,254 was its highest since 2010 but was still below the 17-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 monies to their full potential.

Additional federal funds were received in 2017 from a competitive white-nose syndrome (WNS) grant (\$30,000) and an Endangered Species Act (ESA) Section 6 grant (\$60,256). The WNS grant will be used to monitor bat populations, increase bat survival in affected caves, reduce the risk of WNS transmission, and outreach and education. Field surveys for the federally endangered rusty patched bumble bee (*Bombus affinis*) in Indiana are the subject of the ESA grant.

Contributions to the Indiana Nongame Wildlife Fund, used exclusively for nongame and endangered species conservation, suffered yet another sharp decline in 2017. Most donations to this fund are received when Indiana citizens donate all or part of their refund while filing their annual state income taxes. Recent changes to the state's tax forms, which included competing checkoffs and additional paperwork, resulted in the



Wildlife Science programs spent nearly \$1.9 million from seven different funding sources in 2017. About two-thirds of this total was provided through the Pittman-Robertson Act and the State Wildlife Grants program.

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.

Activities to benefit these species are supported by public donations to this fund. No state tax dollars are earmarked for these projects. In addition, money from the Nongame Wildlife Fund is used as a match to receive federal funding. For every \$5 received in donations, an additional \$9 is provided in federal grants. The money donated goes directly toward the conservation of more than 750 species in Indiana, from cranes and frogs to bats and darters!

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

Help Indiana's Rare Wildlife

For every \$5 donated an additional \$9 is awarded from federal funds.
No state tax dollars are used.

\$5 + \$9 = \$14
Your Donation Matched Funds
 for WILDLIFE

750 Species
DEPEND ON YOU



Including:
Bald Eagles, Bats,
Green Salamanders,
Box Turtles, Badgers,
Mussels, Barn Owls,
Peregrine Falcons,
Black Bears, and
many more



Donate Today
EndangeredWildlife.IN.gov

lowest donation total since the fund was established in 1982. The Nongame Wildlife Fund received \$123,758 in 2017, a 67% decline from the average annual donation (\$379,800) before changes in the state tax forms. Most alarming is that about \$225,000 from this fund is needed annually as the state match for SWG projects and activities conducted by Wildlife Science personnel. The DFW appreciates every contribution. Staff continues to explore 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.

Nationally, the most significant wildlife conservation event was the reintroduction of "Recovering America's Wildlife Act" (H.R. 4647) in Congress in December 2017. This historic funding initiative would dedicate \$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 provide states the resources needed to carry out their State Wildlife Action Plan (SWAP) and, collectively, conserve 12,000 species of greatest conservation need (SGCN) nationwide. The monies provide a permanent and dedicated

source of revenue for states to conserve their SGCN, with Indiana receiving up to \$20 million annually for these purposes.

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.

Two categories are used to designate rare and at-risk 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. Several changes were made to Indiana's list of special concern species in 2017. The black bear (*Ursus americanus*), northern bobwhite, American woodcock (*Scolopax minor*) and American eel (*Anguilla rostrata*) were added to the special concern list. The red-shouldered hawk (*Buteo lineatus*), longnose sucker (*Catostomus catostomus*), Ohio River muskellunge (*Esox masquinongy ohioensis*), lake whitefish (*Coregonus clupeaformis*), cypress darter (*Etheostoma proeliare*) and Tippecanoe darter (*E. tippecanoe*) were removed from the special concern list. 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 assisting in wildlife surveys, conserving rare and at-risk species, or cleaning up the environment. A DFW program called CERVIS now makes answering these questions easier.

CERVIS is a volunteer management program that the

DFW began using in 2014. The program allows staff to 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 that roost on your property, conduct weekly waterfowl surveys at a nearby DFW property, perform routine maintenance on bluebird boxes, clean up public access sites by adopting a ramp, or teach kids to fish at the IDNR 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.

Thanks to all who volunteered to help make IDNR programs successful in 2017. The time and effort contributed by each individual, young and old, was greatly appreciated. Although the program is relatively new, 481 volunteers logged nearly 5,700 hours in 2017.



Sandstone outcrops from the forest floor in Perry County. Rock outcrops provide habitat for a variety of wildlife, including bats, snakes and salamanders.

WILDLIFE SCIENCE PROGRAMS

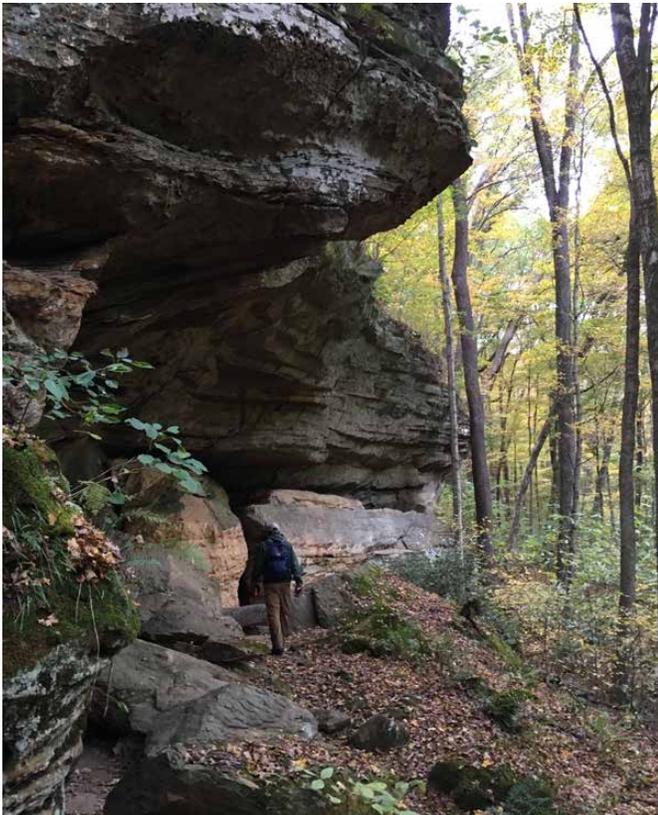
NONGAME AMPHIBIANS & REPTILES

Green Salamander

Green salamanders (*Aneides aeneus*) are among Indiana's rarest amphibians. They occur in small, isolated



Green salamanders are readily identified by their distinct green lichen-like markings.



DFW biologists survey for green salamanders along rock outcrops in southern Indiana forests.

populations deep in southern Indiana's hill country. The main portion of their range is in the Appalachian Mountain region, from Mississippi to Pennsylvania, but Indiana's populations are outliers. They exist approximately 100 miles from the main part of the species' range.

Because of their rarity and extremely limited distribution in Indiana, DFW herpetologists have been monitoring green salamander populations for several years by revisiting known sites and surveying new areas to locate additional populations. During 2017, biologists continued surveying for the salamanders in new areas, particularly at sites beyond the limits of where they are currently known to occur. Green salamanders were observed at three previously known sites. Most individuals were juveniles and subadults. In early December, biologists located the salamanders at a new site in Crawford County. This is the second most northern site in Indiana and brings the total number of Indiana localities to nine. Green salamanders are a state-endangered species in Indiana, and DFW staff will continue surveying for additional populations in 2018.

Kirtland's Snake

Kirtland's snakes are relatively small, docile snakes identified by their distinct pink bellies, edged with rows of small black spots. They are unusual among Indiana's reptiles because the range of the species is relatively small, and it's centered approximately over Indiana.

Kirtland's snakes favor moist soils and occupy variable habitats ranging from grassy marshes to forested



Kirtland's snakes have a distinct pink belly, lined with rows of dark spots.

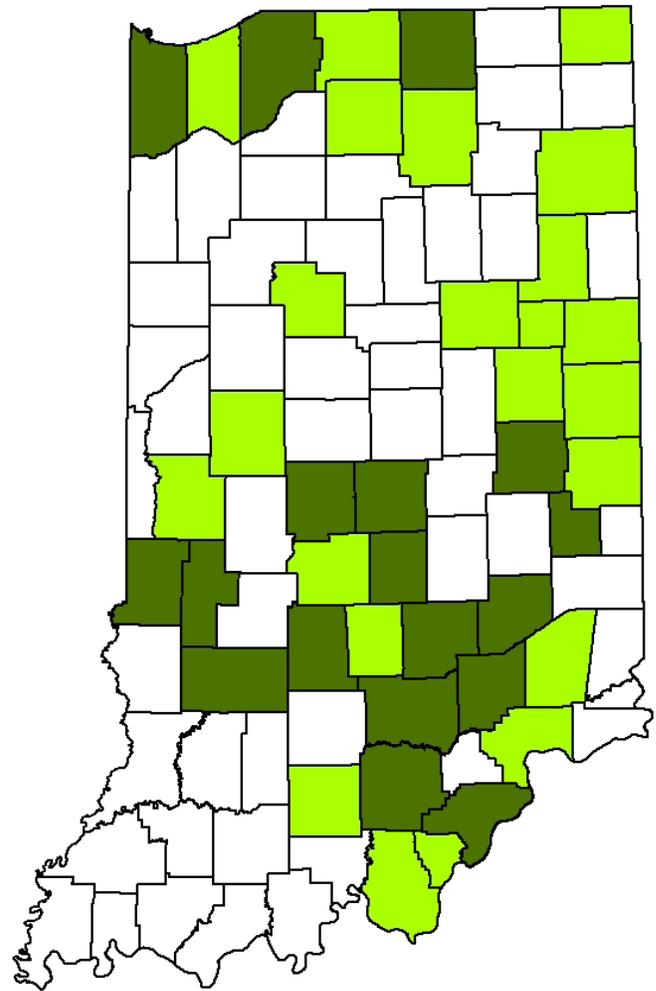
floodplains and the edges of lakes and streams. They also can be found in urban lots and suburban neighborhoods beneath trash and other debris. They are secretive, and make a habit of hiding under cover and within crayfish burrows. This behavior may help explain their persistence in urban settings.

Historically, Kirtland's snakes occurred throughout most of Indiana. However, a recent status assessment revealed that only a few modern records (2002–present) for the snakes occur in the northern half of the state. Most recent records are from portions of southcentral and southeast Indiana. Kirtland's snakes are of conservation concern in most states where they occur, and are listed as state-endangered in Indiana. A 2017 status review of the Kirtland's snake by the USFWS, however, determined that protection of the species under the Endangered Species Act is not currently warranted.

In response to the federal review of the species, DFW herpetologists are revisiting historic localities where the snakes were previously reported and plan to survey new areas for additional populations. In 2017, DNR biologists visited historic localities in Randolph and Marion counties, but did not find any Kirtland's snakes.



Even adult Kirtland's snakes are relatively small, typically reaching only 13–17 inches in total body length.



Kirtland's snake distribution in Indiana. Counties shaded in dark green have modern records (2002–2017). Counties shaded in light green have only historic records (before 2002).

The small size and reclusive nature of Kirtland's snakes present a challenge for research and monitoring. Researchers at IPFW are investigating ways to document the presence of Kirtland's snakes by searching for the snake's genetic material in the environment, also called environmental DNA or "eDNA." This technique, if proven useful, will provide researchers with a tool for detecting this species without physically seeing it. That's especially helpful when searching for a species that spends most of its life hiding.

NONGAME BIRDS

Bald Eagle Population Soaring

Each year, biologists catalog new bald eagle (*Haliaeetus leucocephalus*) nest sites throughout Indiana. Reports from property managers, conservation officers and the public bring to our attention newly discovered nests and recent information about known nests.

The number of bald eagle nests has grown considerably over the past several years. The last statewide



C43 was one of the first bald eagles reintroduced to Indiana and perhaps one of the state's oldest. In 2017, she was spotted near Monroe Lake for the third consecutive year. (Photo by Stuart Forsythe)

bald eagle breeding survey, which was conducted by helicopter in 2010, documented 120 eagle pairs. Since then, 274 new nests have been discovered.

Because of extreme weather or abandonment, nests may fall out of trees or become unkempt over time. Those that remain intact likely host a pair of bald eagles. In 2017, 231 nests were reported, 208 of which appeared in good shape. These nests produced at least 149 chicks. Sixty-two nests were new, one of which was the first known eagle nest in Boone County. Bald eagles are now known to nest in 84 of Indiana's 92 counties. The current population is estimated at 300 breeding pairs.

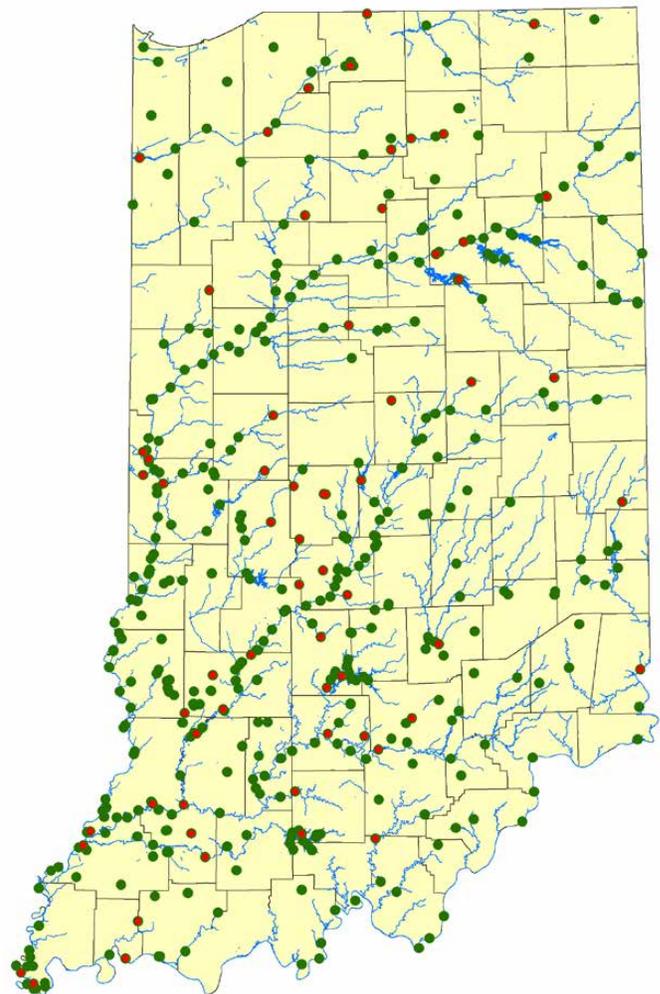
In addition to nest monitoring, wintering eagles are surveyed to monitor long-term population trends in the region and to inform the status of bald eagles throughout North America. These surveys are part of the U.S. Army Corps of Engineers' National Midwinter Bald Eagle Survey, which has been conducted in Indiana since 1979. In 2017, eagles were counted from the ground at 10 locations, mainly DFW properties or public lakes. Aerial monitoring was also done by helicopter at 10 routes along rivers that are less accessible by foot. Overall, 274 individuals were tallied at these sites, which exceeds the 10-year average of 197 eagles for the state. This is fewer than those counted during the same period in 2016 (388), but eight fewer sites were surveyed from the air.

Ground surveys represent population trends more precisely because of consistent sampling from year to year. At nine sites surveyed from the ground in the past two years, 190 bald eagles were counted compared to 168 in 2016, a 13% increase. The largest concentrations were found at a roost near Sugar Creek's West Union Bridge (100 eagles), the Mississinewa night roost (34), Salamonie River roost (29), and Monroe Lake (28).

Winter eagle counts vary depending on the severity of winter, availability of prey (fish and waterfowl)

and open water. Indiana attracts more eagles during cold winters when northern birds are forced to venture south for food. However, long-term data suggest a consistent upward trend of bald eagles wintering in Indiana. A recent article in the *Journal of Raptor Research* reported a significant yearly increase of 3.6% in Indiana's wintering adult eagle population and 3.9% in the immature population from 1986–2010. Our current data support this 25-year trend. We are seeing more bald eagles winter in Indiana each year. Nationally, the population is increasing by 0.6% each year.

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



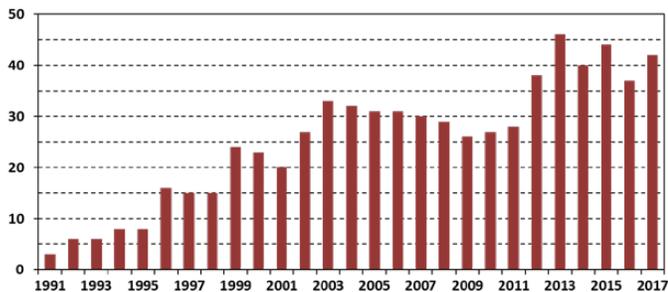
Previously known bald eagle nests (green) and new nests discovered in 2017 (red) in Indiana.

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.

Remarkably, C43, a female that was one of the original released eaglets, has been spotted around Monroe Lake. She was first reported in 2015 after 20 years of going undetected and has since been photographed annually. This year, she was found by Stuart Forsythe in the Middle Fork area of Monroe Lake. C43 can be identified by the silver bands around both legs and the wear on her left wing where her patagial tag was once attached. By now, she should be around 29 years old, which arguably makes her the oldest bald eagle in Indiana. C43 is a powerful reminder of the tireless and determined effort to recover this species, and a symbol of hope for all of our state’s endangered species.

Peregrine Falcon

Peregrine falcons (*Falco peregrinus*) declined sharply in the mid-1900s because use of pesticides, such as DDT, reduced nesting success. They were listed as an endangered species by the USFWS in 1970. Today, because of reintroductions, more than 300 breeding pairs



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



An adult peregrine falcon delivers a banded pigeon to its young at a nest box at the NIPSCO R.M. Schahfer Generating Station in Wheatfield. This photo was taken by a trail camera used to determine the birds’ identities. Both adults were unbanded.



Retired DFW biologist John Castrale and DFW biologist Allisyn Gillet band a peregrine falcon chick in front of local media in New Albany in May 2017.

occur in the Midwest. This figure is several times that of the 60–80 pairs thought to have been present historically. Indiana’s population has expanded similarly. In 2013, peregrine falcons were removed from the state’s list of endangered species. They are now considered a species of special concern.

Breeding by peregrine falcons in Indiana has remained relatively stable during the last five years. Twenty-one locations had peregrines present during part of the 2017 nesting season, compared to 22 in 2016. Sixteen nesting attempts were documented, 13 of which were successful. Forty chicks were banded, and 42 young fledged. Three nests failed, with eggs that did not hatch or were broken. Biologists took blood samples to monitor the birds’ health and collected unhatched eggs for analyses. No signs of trichomoniasis (or “frounce”), an upper digestive tract disease that is often fatal in young birds, was found.

Much is known about individual falcons because many young are banded each year. The 10 identified adults in territories where eggs were laid in 2017 originated from seven states: Indiana (three falcons), Kentucky and Michigan (two each), and one each from Ohio, Missouri and Wisconsin. The remaining 20 adults were either unbanded or not observed well enough to identify.

All 16 peregrine nest attempts in Indiana in 2017 were located in highly developed and populated areas. Four were in downtown urban areas on office buildings; the remainder were in industrial areas on power plants, steel mills and lime plants. Indiana’s breeding population of peregrine falcons has remained productive during the last five years. Post-delisting monitoring will continue, with volunteer help, to ensure the population remains stable.

Since 2014, falconers have been permitted to trap an unbanded juvenile peregrine in the fall for falconry.

These birds are juvenile migrants that originate from breeding populations in Arctic regions. One bird was captured in Indiana in 2014, but none have been since although permits were issued annually. Only two birds were allowed to be taken in Indiana in 2017, and only 12 falcons could be captured in the entire Mississippi Flyway.

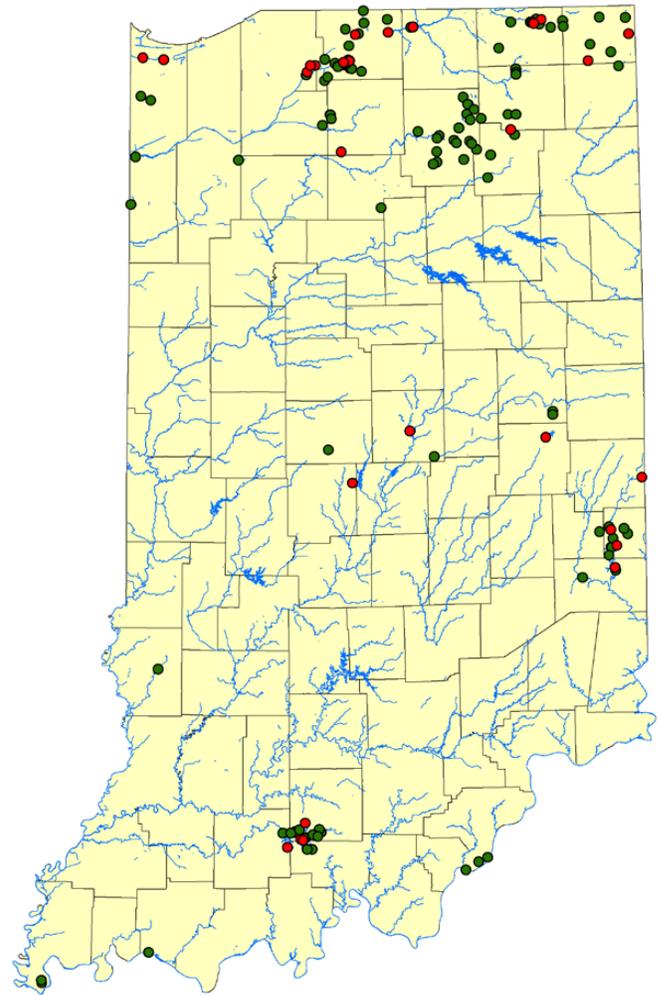
Osprey

Ospreys (*Pandion haliaetus*) are large, eagle-like birds that were commonly found in Indiana during migration, hovering, diving and catching fish in lakes and rivers. Historically, few would remain to nest, building large stick nests in dead trees near shorelines or on islands.

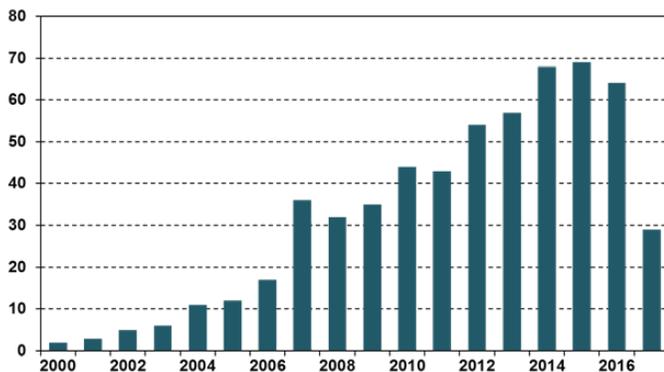
To restore osprey to Indiana, 96 young birds taken from nests in coastal Virginia were released at Patoka Lake and Jasper-Pulaski, Minnehaha, and Tri-County Fish & Wildlife Areas (FWA) between 2003 and 2006. Indiana's osprey population has since shown steady growth, and exceeded its delisting goal of 50 breeding pairs in 2014. Today, osprey are proposed for removal from the Indiana list of endangered species.

Osprey nests are monitored through reports from Indiana DNR staff and the public. In 2017, only 36 nesting sites were checked compared to 78 in the previous year. Of these, 29 had ospreys or osprey nests present (64 in 2016), with 20 pairs believed to have laid eggs. At least 29 chicks were produced (32 in 2016). The actual number is likely greater because it is difficult to observe all young in the nest from the ground.

Active osprey nests are known from 18 Indiana counties, including new records for Hendricks and Henry counties in 2017. Loosely formed colonies are found in St. Joseph (five nesting pairs) and Orange, LaPorte, and Lake (three each) counties. Public properties with the largest concentrations of nests are Patoka Lake, Pigeon River FWA, Potato Creek State Park, and Brookville Lake. In 2017, osprey nests were located on 15 communication or utility towers, nine



Distribution of osprey nests from 2012 to 2016 (green), and those reported as active in 2017 (red).



Annual number of osprey territories in Indiana, 2000–2017. The decline in 2017 is likely due to fewer nests reported by the public rather than loss of actual territories.

nesting platforms, stadium lights and dead trees (two each), and a structure associated with grain storage.

Companies that service communication and utility towers often contact the DFW for guidance when encountering osprey nests, and most delay maintenance until after the nesting season. Vacant nests can be removed from towers without a permit, but companies are encouraged to keep part of the nest at a location on the tower where it is less likely to interfere with its operation.

Nesting platforms, including all five at Patoka Lake, are readily used by ospreys. In 2017, a banded osprey with a juvenile was photographed on a Patoka Lake tower. The banded individual was H18, one of 16 original ospreys released at Patoka Lake. H18 is now 14 years old and is breeding successfully, as evidenced by the attending juvenile on the nesting platform.

This bird and its offspring remind us of the success of our reintroduction programs and provide a positive outlook for ospreys in Indiana. As long as unpolluted waterways, healthy fish populations, and suitable nest sites exist, our osprey population will continue to



Banded osprey H18 with a juvenile on a nesting platform at Patoka Lake. (Photo by Stuart Forsythe)

thrive. However, knowing whether the population is recovering depends on public reports of osprey nesting activity. The number of reports at the end of the 2017 nesting season was 54% lower than in 2016. What may appear to be a large decline in the number of osprey nests likely reflects a lower reporting rate. DFW staff encourage the public to report osprey nest locations and provide updates on breeding activity, such as nest building, incubation, food deliveries and begging chicks. These reports can be sent to: agillet@dnr.IN.gov.

Barn Owl Management

Barn owls (*Tyto alba*) are a state-endangered species in Indiana identified by their ghostly pale appearance, black eyes and heart-shaped face. They are nocturnal, feeding mostly at night often on small mammals like mice and voles. One adult barn owl eats, on average, three to four



Nest boxes provide a safe place for barn owl chicks because they reduce their risk of predation and their chances of falling out of the nest.



Amy Kearns, assistant nongame ornithologist, stands beneath a newly installed barn owl nest box. Nest boxes are installed directly over a 5-inch by 5-inch opening cut into the wall of a barn, more than 20 feet above the ground. This limits access to predators like raccoons, and owls can nest in sealed barns that would otherwise be inaccessible.

small mammals a day. A nesting pair and several owlets will consume nearly 3,000 prey items during a year, making them an effective form of pest control around farms that is both economical and non-toxic.

Habitat loss has caused barn owls to become rare in Indiana. Their numbers depend on the availability of grassland habitat, suitable nest sites, and protective cover from predators such as great horned owls (*Bubo virginianus*) and raccoons (*Procyon lotor*). Barn owls need open areas of permanent grasslands such as pastures, hayfields, prairies and the margins of wetlands to find food. They also need cavities in large trees or structures such as haylofts, steeples, and silos in which to nest and raise their young. Many of these conditions exist in small pockets of southern Indiana, including Daviess, Gibson, Greene, Lawrence, Orange, and Warrick counties.

To aid barn owl populations in Indiana, the DFW has installed more than 300 nest boxes during the past 30 years to provide secure nesting sites that are protected from severe weather and predators. DFW staff and volunteers install boxes in barns and other structures surrounding suitable habitat across the state. Thirty-seven new boxes were installed in 2017, and 15 nest sites were reported active.

Many of these structures have been destroyed over the years, but new boxes are erected each year, and existing boxes are inspected periodically. A comprehensive check of 243 priority nest boxes began in fall 2017 and will continue into early 2018 to determine if

boxes were occupied since their last check. The presence of pellets (regurgitated fur and bones) and white wash (owl droppings) is evidence that barn owls used the box. Unhatched eggs and the carcasses of owlets suggest that barn owls nested in the box.

Nest boxes will continue to be placed by DFW staff and volunteers in barns and other buildings to help barn owls raise additional young. If you observe a barn owl, especially a nesting pair, contact Wildlife Science staff.

Loggerhead Shrike

The loggerhead shrike (*Lanius ludovicianus*) is a predatory songbird that is slightly smaller than a robin. Its striking appearance includes a broad black eye mask, gray back and breast, and a white spot on black wings. Despite their small stature, shrikes have habits similar to those of a large raptor. They hunt from perches and pounce on prey they spy below. Their strong, hooked bill and tomial tooth (the pointed projection on the upper part of the bill) allow them to sever the vertebrae of comparatively larger prey. But because shrikes lack talons to tear prey into smaller pieces, they hang their prey from thorns or barbed wire, allowing them to pull their meal apart with just their bill. This behavior has earned them the nickname of “butcher bird,” a moniker that is unique to North American shrikes.

Shrikes occur year-round in grassland and agricultural areas of Indiana. During the breeding season, nesting shrikes are often found near livestock, gardens and small crop fields bordered by shrubby fencerows. Multiflora rose bushes and eastern red cedars that occur in isolated patches along fencerows are ideal nest sites.

Loggerhead shrikes have been undergoing alarming population declines in eastern North America and are an endangered species in many states. Reasons for the



Loggerhead shrikes are banded to help biologists monitor movements of this endangered species. During banding, each bird's sex and age are determined, and feather samples are collected.



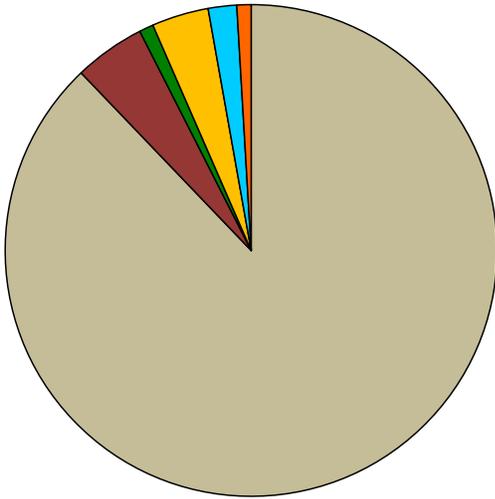
Biologists determined that this individual shrike spent the 2016–17 winter in his Daviess County nesting territory by observing its unique combination of colored leg bands. (Photo by Michael Brown)

declines are puzzling and may include factors such as loss of quality breeding habitat, pesticide use, and increasing human development on wintering grounds. In Indiana, shrike numbers have declined dramatically. A survey between 1999 and 2000 recorded 58 nesting territories statewide, but annual breeding surveys now document fewer than 10 nesting territories.

In 2017, DFW biologists and volunteers located seven territories with breeding pairs in historical nesting areas, compared to five in 2016. Five territories were in Orange County, with one each in Daviess and Greene counties. These seven pairs had an average nest success of 50%, compared to those in 2016 who had a success rate of 37.5%. Four nests failed likely due to predation and one from unknown causes. Six nesting attempts occurred between March and May. Four of those (67%) were successful. The four remaining attempts occurred between May and June. Only one was successful. Six of seven territories (86%) were in areas where shrikes were recently seen. Two (29%) had successfully nested last year. Nearly 80% of all nesting attempts were located on Amish or Mennonite farms. In total, 19 shrike fledglings were confirmed in 2017, compared to 10 confirmed during 2016.

Four adults and one fledgling of 12 shrikes banded in 2016 were re-sighted, producing return rates of 33% and 44% for, respectively, fledglings and adults. Additionally, 22% of the adults banded in 2016 returned to nest in the same territory. However, 12 of 15 (80%) nesting adults likely had new nesting territories in 2017.

Twenty-three new shrikes were captured and banded in 2017, compared to 11 in the previous year. Among these, 11 were adults, nine were aged as After-Second-Year (ASY), and two were aged as Second-Year (SY). Ten of these adults nested this year. All banded males



- Arthropods
- Small Mammals
- Birds
- Amphibians & Reptiles
- Earthworms
- Unknown Vertebrate

Arthropods such as spiders, beetles, grasshoppers, wasps, and other insects represented 88% of the 107 shrike prey items examined in 2017.

that nested were ASY, whereas 60% of banded nesting females were ASY. The remaining 40% of banded nesting females were aged as SY. One nesting male and two nesting females were not banded because their territories were found late in the season when birds were more difficult to capture.

Prey items that shrikes consumed, delivered to their young, or hung on thorns or barbed wire were periodically counted to determine shrike diets. Arthropods such as beetles, grasshoppers, wasps, and spiders represented 88% of the 107 shrike food items observed in 2017. Other prey items included mice, voles, house sparrows, snakes and frogs.

Indiana's loggerhead shrike work contributes significantly to a coordinated effort with that of other states through the Loggerhead Shrike Working Group. This group seeks to fill knowledge gaps that hinder shrike conservation through coordinated and collaborative research and monitoring aimed at stabilizing and reversing population declines.

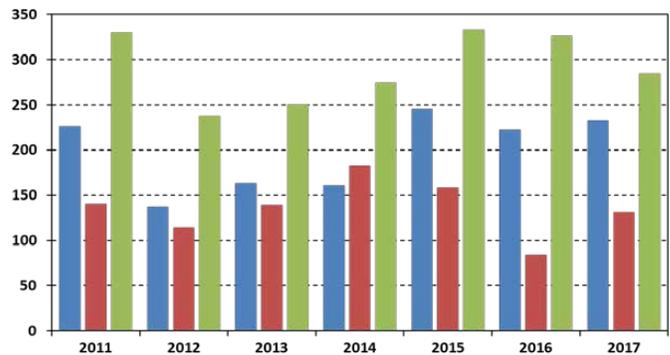
Landowners can help shrikes and other wildlife by preserving fencerows and the shrubs that grow along them. Because shrikes usually nest in isolated bushes and trees along fencerows, eliminating these linear features effectively destroys nesting habitat for this unique bird. If fencerows must be cleared, landowners may consider waiting until after the nesting season (late April to late August) to give young birds a better chance to survive. Fencerows provide nesting habitat for many native birds and food and cover for other wildlife,

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

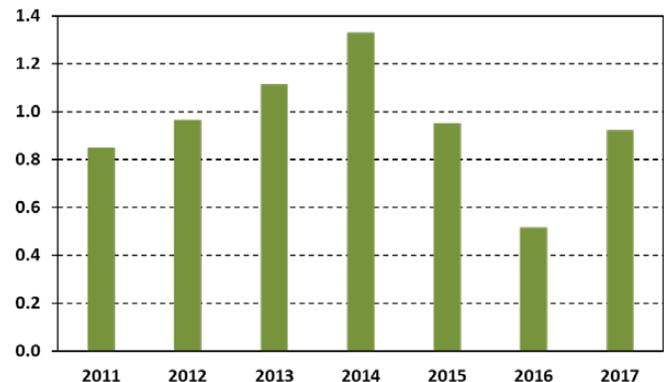
Interior Least Tern

The least tern (*Sternula antillarum*) is the smallest tern in North America. It is distinguished by its black cap, white forehead, and bright yellow bill. Existing populations are found along the coasts and in the interior, following major waterways such as the Mississippi, Ohio and Wabash rivers. High water levels due to channelization and damming of rivers have reduced the amount of sandbars or gravel islands available for terns to nest. As a result, the interior least tern population was listed as federally endangered in 1985.

Least terns make a depression, known as a scrape, in the ground near water and lay their eggs directly in the scrape. Ground-nesting near water affords least terns many benefits, but also poses many risks. Water surrounding islands or river bars makes colonies less accessible to ground predators. However, when water is abundant, rivers rise. This causes bars and islands to shrink, thereby reducing nesting habitat. Heavy rains also flood nests and cause abandonment or major losses of eggs and chicks.



Annual number of least tern nests (blue), fledglings (maroon), and adults (green) observed in Indiana, 2011–2017.



Number of least tern fledglings per adult pair in Indiana, 2011–2017.



In order to lay their eggs directly on the ground, least terns create a small depression called a scrape. Here, in mid-June at Goose Pond FWA, an egg and a chick sit in the nest scrape, while an older chick has wandered from the nest.

Because of high water in key river areas, least terns now nest in Indiana at five human-constructed sites: Duke Energy’s Gibson Lake and USFWS’s Cane Ridge Wildlife Management Area (WMA) near the lower Wabash River, the American Electric Power (AEP) Rockport Plant on the Ohio River, Goose Pond FWA, and Wheeling Bottoms. DFW staff work closely with partners to monitor tern colonies and take measures to ensure breeding success at these sites.

In Gibson County, an estimated 168 nests produced a conservative estimate of 123 fledglings in 2017. Of these, 103 were found early in the breeding season, while another 65 were tallied later. More than half of all nests and young produced in 2017 were at Cane Ridge WMA (86 nests). The remainder were on the center dike of Gibson Lake (82 nests).

At the AEP Rockport Plant, an electric fence was erected around the main nesting site to reduce predation by mammals and prevent Canada geese (*Branta canadensis*) from loafing on the dike. At least five young were produced from 59 nests. Ten adult terns returned to Goose Pond FWA, where six nests were attempted on a man-made island. These nests together successfully fledged at least three young. No nesting was documented at Wheeling Bottoms in 2017.

The number of tern fledglings produced in 2017 was average compared to previous years. Productivity was 0.923 fledglings per pair, which is greater than the productivity of 0.515 fledglings per pair in 2016. Both figures exceed the published rate of 0.51 fledglings per pair needed to maintain a viable least tern population.

Management of interior least terns is challenging. Nesting sites must be kept free of dense vegetation, and fencing or water level manipulation is often needed to deter ground predators. Least tern decoys may

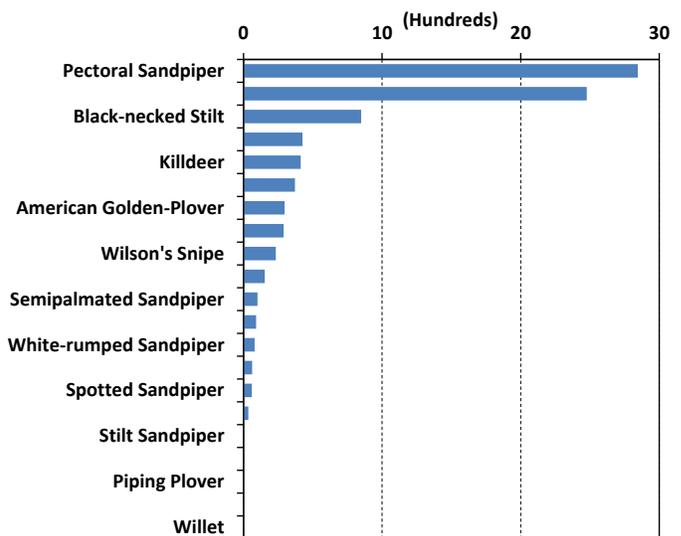
be helpful in attracting adults to suitable nest sites. These efforts have resulted in more than adequate production in four of the last five years and a steadily increasing population of least terns in Indiana since their discovery in the state in 1986.

Shorebird Migration

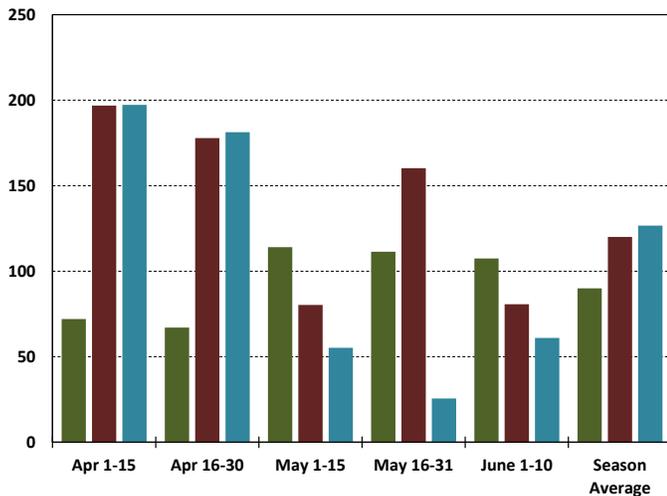
Goose Pond FWA is one of the largest wetland restoration projects in the country. Located near the migratory pathways of the Wabash River and East Fork of the White River, this 9,000-acre property boasts a variety of habitats from upland grasslands to shallow wetlands. In 2015, DFW biologists began conducting surveys of its use by spring and fall migrating shorebirds to evaluate the property’s importance as a stopover site.

Compared to other North American birds, shorebirds undertake some of the most remarkable seasonal migrations. Species like the white-rumped sandpiper (*Calidris fuscicollis*) are among the long-distance migrants that may venture between wintering grounds at the southern tip of South America and their nesting territories in the Canadian Arctic. Shorebirds must build adequate fuel reserves during stopovers to survive these journeys. Having quality foraging habitat at migratory stopover sites is essential.

Thirty-six different shorebird species have been recorded at Goose Pond FWA during spring and fall migration, including the federally endangered piping plover (*Charadrius melodus*). Additionally, eight birds listed as a SGCN in Indiana are regular visitors or breeders. In 2015, surveyors counted 13,192 shorebirds representing 30 species, whereas surveys in 2016 recorded 12,146 shorebirds of 25 different species. Surveyors recorded 8,805 shorebirds of 21 different species during the 2017 spring survey. Data from fall surveys will be available early in 2018.



Number of 11 species of shorebirds detected during spring surveys at Goose Pond FWA in 2017.



Number of shorebirds observed per hour in two-week periods during spring surveys in 2015 (green), 2016 (maroon), and 2017 (blue) at Goose Pond FWA.



This federally endangered piping plover found a place to rest and feed at Goose Pond FWA on April 17, 2017. Stopping locations are crucial for migratory birds in order for them to reach their breeding and wintering areas. (Photo by Michael Brown)

Notable spring records include a piping plover in Main Pool West on April 17. Its unique leg bands identified it as an individual that hatched in 2015 on North Manitou Island on Sleeping Bear Dunes National Lakeshore in Michigan. Surveyors also documented Goose Pond’s first record of a ruff (*C. pugnax*) in mid-April in Main Pool West and East. Ruffs are a Eurasian shorebird and a rare vagrant to Indiana.

A count of 80 white-rumped sandpipers on June 1 was a new spring migration and summer season record for this species. The previous spring migration highest count was 50 birds in Delaware County in 1978. On April 25, 60 long-billed dowitchers (*Limnodromus scolopaceus*) were recorded, also a new spring record for the state. This high was

surpassed on May 2, when 183 individuals were tallied at Goose Pond.

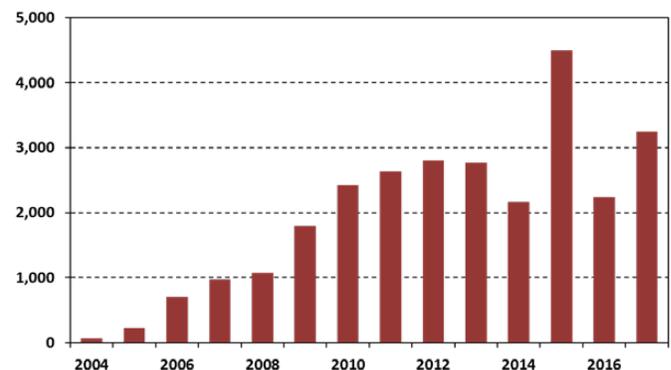
Pectoral sandpipers (*C. melanotos*; 2,845 individuals) were the most abundant species, representing 32% of the total shorebirds. Other plentiful species included the lesser yellowlegs (*Tringa flavipes*; 2,477; 28%), black-necked stilt (*Himantopus mexicanus*; 849; 10%), greater yellowlegs (*T. melanoleuca*; 425; 5%), and killdeer (*C. vociferous*; 413; 5%). These five species accounted for nearly 80% of all shorebirds with 16 other species representing the remaining 20% of the total spring count.

Such findings demonstrate the importance of Goose Pond FWA as a critical stopover site for migratory shorebirds. Surveys will continue in 2018 to further investigate shorebird use of this nationally recognized wetland complex.

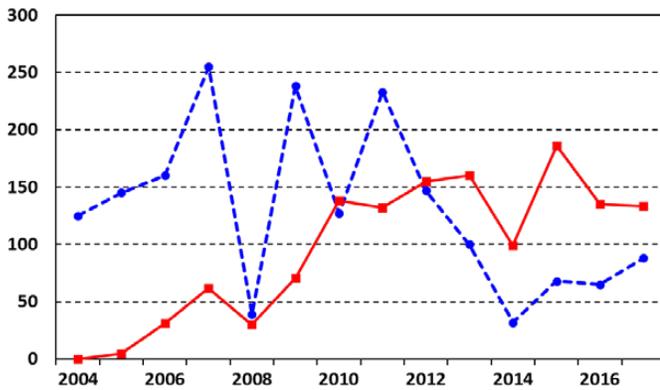
Colonial Waterbirds

“Colonial waterbird” refers to any species of aquatic bird that nests close to one another, including 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*) on Lake Michigan’s shoreline are surveyed each year. Both heron and egret species are state-listed and monitored to detect changes in abundance. Although not endangered, double-crested cormorants are of concern in the Midwest because their growing populations pose a potential threat to local fisheries. Cormorants also compete for nest sites with less common heron and egret species.

At ArcelorMittal Steel West, black-crowned night-herons had a thriving colony in the 1990s until beavers (*Castor canadensis*) destroyed most of the trees they use for nesting. Regrowth has occurred and night-herons and great egrets now nest at this site along the Indiana Harbor at Lake Michigan. Nesting by great egrets was first observed here in 2009. Counts of colonial waterbirds were conducted on May 23, 2017.



Number of double-crested cormorant nests at the ArcelorMittal Steel plant in Lake County, 2004–2017.



Number of black-crowned night heron (dotted blue line) and great egret (solid red line) nests at the ArcelorMittal Steel plant in Lake County, 2004–2017.



Counting double-crested cormorant nests at the ArcelorMittal Steel plant in May 2017.

Eight black-crowned night-heron nests were found, a decrease from the 15 nests seen in 2016. The number of great egret nests also declined (45 in 2017 compared to 73 in 2016). Nesting cormorants have yet to be observed at ArcelorMittal Steel West.

At ArcelorMittal Steel East, 3,250 double-crested cormorant nests were counted. This is a 45% increase from the number found in 2016 (2,240 nests), but consistent with results since 2010. The number of great egret nests also increased, with 88 recorded compared to 62 in 2016. Eighty black-crowned night-heron nests were tallied, which represents a 60% increase from 2016 (50 nests). Abundance, however, still remains low. The maximum count of night-heron nests since surveys began in 2004 is 255.

These three species of waterbirds tend to segregate themselves in the main nesting colony. Double-crested cormorants nest on the ground, close to Lake Michigan's shoreline. Great egrets use the few remaining trees farther from shore. Black-crowned night-herons nest in shrubs or in the lower portions of trees used by

egrets, but also nest next to gulls on the rocky perimeter of two small impoundments. All great egret and night-heron nests were in trees or shrubs, compared to only 39 cormorant nests (1% of total). At ArcelorMittal, ground-nesting birds are protected from many mammalian predators by the water of Lake Michigan and the extensive industry on the remaining sides.

Gull and tern populations were also estimated at this site. Some 35,000 ring-billed gulls (*Larus delawarensis*) were counted at both ArcelorMittal Steel West and East. A colony of Caspian terns (*Hydroprogne caspia*) was found with around 90 nests. This colony went unnoticed from 2012 to 2015, but was rediscovered in 2017, nesting 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

Northern Indiana

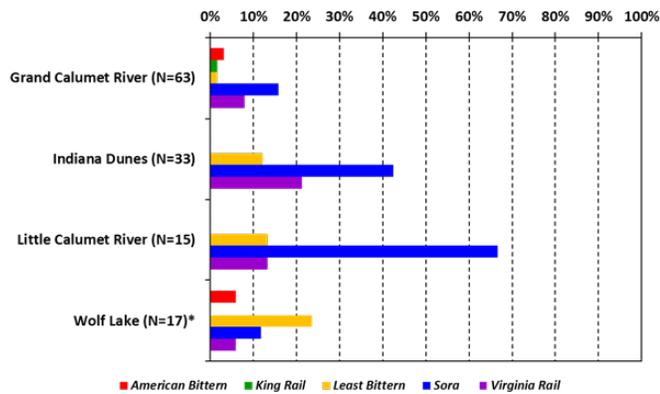
(Stephanie Beilke, Audubon Great Lakes)

In 2015, Audubon Great Lakes initiated a study of breeding marshbirds in the Calumet region, which comprises the southern coast of Lake Michigan from Chicago, east across northern Indiana to the southwestern tip of Michigan. Study sites were limited to Illinois, but the project expanded the next year to include Wolf Lake and the Grand Calumet River in Indiana. The study expanded again in 2017 to include the Little Calumet River and Indiana Dunes State Park and National Lakeshore.

Eighteen survey routes were grouped into one of four sites based on geography: Grand Calumet River, Indiana Dunes, Little Calumet River and Wolf Lake. Surveys were conducted with permission from, and in partnership with, the Hammond Port Authority, DNR,



Four marshbird survey sites in the Calumet Region of northern Indiana.



Percentage of survey points occupied by American bittern, king rail, least bittern, sora and Virginia rail at four wetland complexes (sites) in the Calumet region of Indiana in 2017. N represents the number of survey points per site. During the first survey period, only five of the 17-point count surveys were completed at Wolf Lake.

Lake County Parks, Little Calumet River Development Commission, National Park Service, Shirley Heinze Land Trust and The Nature Conservancy of Indiana. Routes were divided into four to ten points that could be surveyed in a single morning between 30 minutes before sunrise and three hours after sunrise.

In 2017, a team of 12 bird monitors, including Audubon Great Lakes staff, partners, and volunteers, surveyed 128 points on 18 routes. A total of 368 surveys occurred during three two-week time periods from May 1 through June 15. Each survey consisted of five minutes of passive listening followed by five minutes of audio broadcast of vocalizations of five target species: common gallinule (*Gallinula galeata*), least bittern (*Ixobrychus exilis*), pied-billed grebe (*Podilymbus podiceps*), Virginia rail (*Rallus limicola*) and sora (*Porzana carolina*).

Rails and bitterns, which included both target and non-target species, were detected at 38% of the points in the Indiana Calumet region. Sora had relatively high occupancy at Little Calumet River (detected at 67% of points) and Indiana Dunes (detected at 42% of points). Virginia rail was detected at 21% of the points at Indiana Dunes, whereas least bittern was detected at 24% of the points at Wolf Lake. American bittern was heard at one point on Wolf Lake and two in the Grand Calumet River complex. A king rail was detected only once, also in the Grand Calumet River, which was the first detection of this marshbird in the three-year span.

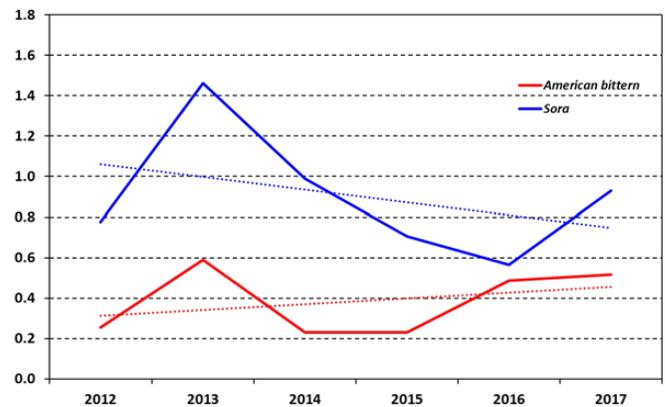
Because this suite of marshbirds is responsive to the quality and composition of wetland vegetation, habitat features are likely key factors that influence where they occur in the Calumet. Results from surveys in 2015 and 2016 suggest wetlands and marshbird populations in the Calumet are in relatively poor condition. However, 2017 detections of American

bittern, least bittern, king rail and Virginia rail (all endangered species in Indiana) may indicate positive change in the region.

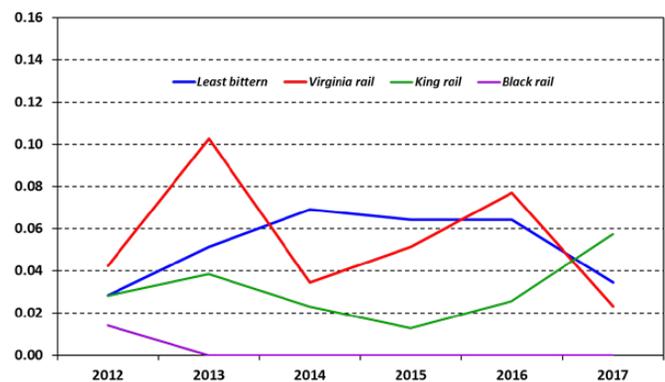
Further study is needed to understand the relationship between marshbird occupancy and habitat quality in the Calumet. Audubon Great Lakes, with partner organizations including the DNR, will begin to collect detailed habitat and landscape data in 2018. This information will advise land managers of important habitat characteristics to consider when restoring wetlands for breeding marshbirds.

Southern Indiana

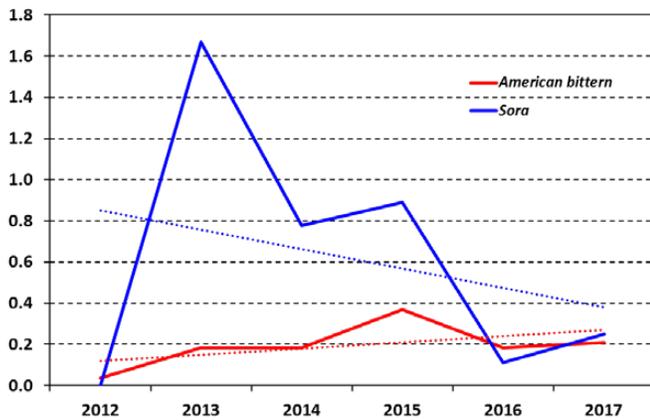
Marshbirds are a diverse group of birds that include bitterns, rails, gallinules and grebes. These species are difficult to survey because they reside in dense emergent vegetation and are inconsistently vocal during the breeding season. Little is known about their numbers, population trends, or responses to habitat changes and land management practices.



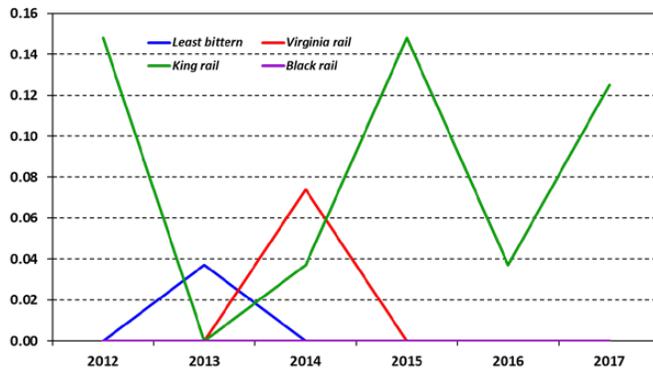
Number of detections per survey point visit per year for American bittern and sora at Goose Pond FWA, 2012–2017. Population trends are shown as dotted lines.



Number of detections per survey point visit per year for least bittern, Virginia rail, king rail and black rail at Goose Pond FWA, 2012–2017.



Number of detections per survey point visit per year for American bittern and sora at Tern Bar Slough WDA, 2012–2017. Population trends are shown as dotted lines.



Number of detections per survey point visit per year for least bittern, Virginia rail, king rail and black rail at Tern Bar Slough WDA, 2012–2017.



A king rail in early June. (Photo by David Gruver)

Playbacks of vocalizations were occasionally used in Indiana to determine the distribution and relative abundance of marshbirds. In 2010, the Indiana office of the National Audubon Society established a long-term survey at Goose Pond FWA in Greene County. This 9,000-acre property of shallow wetlands, ditches and upland grasslands provides abundant habitat for rails and bitterns. Surveys were conducted to determine marshbird presence and relative abundance and how species diversity and populations change over time. In 2012, the DFW assumed responsibility for the survey and also established a second survey area at 840-acre Tern Bar Slough Wildlife Diversity Area (WDA) in Gibson County.

DFW staff and volunteers conducted surveys during three two-week periods from mid-April through May. Participants visited a series of predetermined points and listened for target species for 11 minutes per point. They listened silently for the first five minutes and played calls of each target species during the final six minutes to increase the likelihood of a detection. Target species included American bittern (*Botaurus lentiginosus*), least bittern, king rail (*Rallus elegans*), Virginia rail, sora and black rail (*Laterallus jamaicensis*).

In 2017, 26 points on eight routes at Goose Pond FWA were surveyed during the first two survey windows and 35 points in the last. Nine points on two routes at Tern Bar Slough WDA were surveyed in the first two periods, while six points were surveyed in the last. A total of 150 detections of target species were heard in 2017, a 44% increase from the 104 detections in 2016. All target species were detected except for black rail. Due to annual variation in survey effort, results are represented by the number of marshbird detections per survey point visit. Using this estimate, 1.35 marshbird detections were made per survey point visit in 2017, compared to 0.99 in 2016.

As has been the case since surveys began, American bitterns and soras were the most commonly detected target species at both locations. In 2017, American bitterns, king rails and soras were detected more frequently at both Goose Pond FWA and Tern Bar Slough WDA than in 2016. Trend lines suggest that American bittern detections are increasing at both sites, whereas sora detections are decreasing. However, data are insufficient to draw trend conclusions with high confidence.

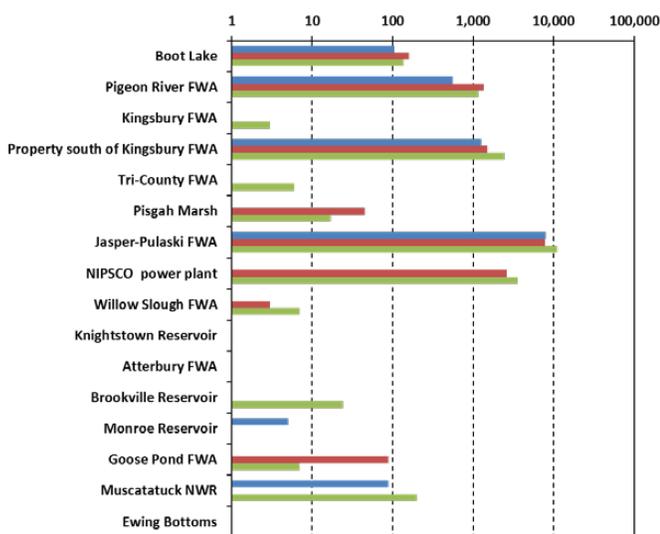
The few detections of least bittern, Virginia rail, king rail, and black rail are expected because all rail and bittern species except sora are endangered in Indiana. Loss and degradation of wetland habitats are primary factors driving these population declines. However, restoration projects such as Goose Pond FWA and Tern Bar Slough WDA demonstrate that quality wetlands can be restored. The few detections that were made of marshbirds at these sites demonstrate that wetland birds can discover and use these habitats, and wetland restoration projects are of immense value to state-endangered wildlife.

Sandhill Crane

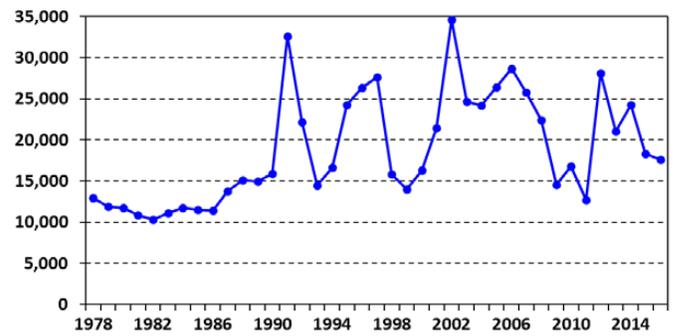
The sandhill crane (*Antigone canadensis*) is a long-legged, long-necked waterbird sometimes confused with the similar-appearing, but unrelated, great blue heron (*Ardea herodias*). During fall and spring migration, groups of 50–100 sandhill cranes are often seen flying high in a loose V-formation, circling to catch updrafts, or descending to a field to feed or roost for the night. A single crane is usually seen with its mate or family group, or in flocks numbering from a couple of dozen to the hundreds. Their bugling calls are usually heard before the flock is seen.

The eastern population of sandhill cranes nests in marshes in the upper Great Lakes states and southern Canada. Since the early 1980s, that population has been expanding, with increasing nesting in northern Indiana. Breeding pairs are sighted during the summer as far south as Wilbur Wright FWA in Henry County and Goose Pond FWA in Greene County. Sandhill cranes are expected to expand their breeding range throughout southern Indiana as the eastern population continues to increase in size.

The USFWS coordinates annual fall surveys of the eastern population to monitor changes in abundance. Much of the population stops at Jasper-Pulaski FWA in northwest Indiana before continuing south to overwinter in Tennessee, Georgia and Florida. Each fall, public properties and other areas with a history of stopovers are surveyed during two periods starting on October 28 and November 9. Surveys in 2017 were underway at the time this report was compiled. The following represents survey results from fall 2016.



The number of sandhill cranes observed at 16 properties during the survey period that began on October 28 in 2014 (blue), 2015 (maroon), and 2016 (green). Values are shown in logarithmic scale to better compare disproportionately high numbers at Jasper-Pulaski FWA and the NIPSCO power plant. Properties are arranged north to south.



Annual peak number of sandhill cranes counted during fall surveys at Jasper-Pulaski FWA, 1978–2016.

The number of sandhill cranes migrating through Indiana in 2016 was greater than that observed the previous year, despite having surveyed fewer sites. A total of 12,435 cranes were counted at 14 sites during the first survey period in 2016 (8,593 in 2015). Jasper-Pulaski FWA hosted the most cranes (8,060). Fewer birds were present at the NIPSCO power plant (1,906), a private property next to Kingsbury FWA (1,305), Pigeon River FWA (964), Boot Lake (180), Pisgah Marsh (9), Willow Slough FWA (5), Muscatatuck NWR (4) and Goose Pond FWA (2). No cranes were observed at Kingsbury FWA, Atterbury FWA, Brookville Lake, Ewing Bottoms in Jackson County, or Monroe Lake.

During the second period, 18,574 cranes were counted (10,920 in 2015) at 15 sites. Jasper-Pulaski FWA again had the most birds (10,985). Fewer cranes were observed at the NIPSCO power plant (3,584), private property next to Kingsbury FWA (2,450), Pigeon River FWA (1,154), Muscatatuck NWR (200), Boot Lake (137), Brookville Lake (24), Pisgah Marsh (17), Goose Pond and Willow Slough FWAs (7 each), Tri-County FWA (6), and Kingsbury FWA (3). No cranes were seen at Atterbury FWA, Ewing Bottoms, and Monroe Lake.

In addition to the USFWS fall count, weekly crane surveys were conducted at Jasper-Pulaski FWA. Counts exceeded 6,000 birds by the end of October and more than 10,000 were observed in mid-November. The survey ended on December 13, when crane numbers were at their peak (17,600 birds). Because surveys ended, this date was considered the peak abundance, although additional cranes may have arrived later. This figure is below the average 10-year high of 21,725 cranes at Jasper-Pulaski FWA, perhaps because the survey ended before an actual peak was reached.

Whooping Crane Conservation

One of the rarest birds in the world, whooping cranes (*Grus americana*) migrate through Indiana in spring and fall and often overwinter in our state's wetlands. Standing five feet tall, whooping cranes are easily identified by their size and their dark red



Whooping cranes are a rare and endangered bird species that winters in Indiana. This photograph was taken with a large telephoto lens from a blind to avoid disturbing the birds. (Photo by Dan Kaiser)

crowns and black mustaches, which contrast against their almost entirely blank canvas of snowy, white feathers. Their beautiful plumage and size grab viewers' attention, especially when they mix with a flock of their smaller, drabber cousin species, the sandhill crane.

Whooping cranes that migrate through Indiana are part of the experimental Eastern Migratory Population (EMP). This effort was started in 2001 by state and federal agencies and non-profit organizations to reintroduce a self-sustaining migratory population of whooping cranes to the eastern United States. Most birds in the EMP are marked with unique colored leg band combinations so individual birds can be identified from a distance with spotting scopes or binoculars. Some birds also carry satellite or radio transmitters that are used to follow migration but have a limited lifespan and must be replaced



DFW biologists Allisyn Gillet and Amy Kearns help replace a whooping crane's radio transmitter that stopped working. Researchers use the colored leg bands and transmitters to track these endangered birds. (Photo by Dan Kaiser)

occasionally. Tracking improves our understanding of crane migration ecology and the threats cranes face throughout their life cycle. In February 2017, DFW biologists worked with the International Crane Foundation, the Whooping Crane Eastern Partnership, and Operation Migration by assisting in the capture of an adult female crane. Her faulty radio transmitter was replaced with a working unit, and a dead satellite transmitter was removed. After release, she was closely monitored and behaved normally with her mate.

In fall 2017, the EMP consisted of only 101 whooping cranes. These birds nest in Wisconsin, where breeding has been plagued by predators, parasitic black flies, infertility, and nest abandonments. Because the EMP is not self-sustaining, it is augmented annually by a handful of young birds that are introduced to the wild in various ways. The most renowned technique, when birds are raised by humans dressed in white crane costumes and taught to migrate by following an ultralight aircraft, was discontinued after 2015. Currently, two chicks that hatched in the wild in 2017 in Wisconsin continue to survive. Six additional chicks will be released singly or in pairs near wild adult cranes that lack chicks. This technique, termed parent-rearing, allows chicks raised by captive 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.

It is crucial that humans view these endangered birds from a distance and do 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 Indiana. You can help to conserve whooping cranes by keeping a distance of at least 100 yards and reporting any activity that attempts to harm or disturb these magnificent birds.

NONGAME FISH & FRESHWATER MUSSELS

Nongame Fish Findings

A large population of gilt darter (*Percina evides*), a state-endangered fish, was discovered in the Tippecanoe River below Norway Dam. This location has been sampled at the same time of year, using the same gear, since 2014, while collecting logperch (*P. caprodes*) for snuffbox augmentation. No gilt darters were collected during the first two years, and only one individual was seined in 2016. This newly discovered population is interesting because there is only a small stretch below Norway Dam where the Tippecanoe River is riverine before it changes into Lake Freeman.

It is not known how or why this new population appeared, but it could be related to a major flood in June 2015 that changed Lake Shafer into more of a river than a reservoir. Adults and larvae could have navigated from upstream of Lake Shafer and over Norway Dam during this high-water event. The gilt darter is



Gilt darter from the Tippecanoe River below Norway Dam, White County.



Pugnose shiner from Big Chapman Lake, Kosciusko County.



Greater redhorse from the St. Joseph River, Dekalb County.

still not known to occupy the lowest section of the Tippecanoe River downstream of Lake Freeman.

An alligator gar (*Atractosteus spatula*), the first verified specimen from the state in more than a century, was shot by a bowfisherman in an oxbow along the lower White River in Gibson County. The fish was 63 inches long and weighed 55 pounds. A similar-sized fish was also shot in Lusk Creek in southern Illinois about two weeks before. Both fish were tagged, indicating that they had been stocked by Kentucky as part of their restoration work with this species. Based on size, these fish were around 10 years old and from stockings in 2009 or 2010. Since 2009, Kentucky has stocked alligator gar in its western border counties that flow into the lower Ohio River (along the Illinois/Kentucky border) and Mississippi River. These two roaming gar were males that had reached sexual maturity and were likely looking for spawning companions. Alligator gar is currently on Indiana's list of extirpated fish species, but based on this occurrence, will be reinstated to the current state list.

A single state-endangered greater redhorse (*Moxos-*

toma valenciennesi), was collected from the St. Joseph River in Dekalb County. Although only one fish was collected, it extended the known range of this species in the St. Joseph River downstream five additional miles. Surveys upstream of Cedarville Reservoir in Allen County proved unfruitful, although sampling was difficult because the stretch was very deep.

Pugnose shiner (*Notropis anogenus*), a species of special concern, was collected from Big Chapman Lake in Kosciusko County. This is the first record for pugnose shiner in recent times in Indiana. The fish were collected from deeper (too deep to wade), weedy areas of the lake using electrofishing techniques. Targeted sampling for pugnose shiner will be done in Big Chapman Lake in 2018 during warmer months to better evaluate the species' habitat preference. This information will help determine how best to sample for pugnose shiner in the region's other lakes.

Lake Sturgeon Monitoring

Annual netting for lake sturgeon (*Acipenser fulvescens*) was conducted in the East Fork White River in

Date Collected	Weight (lb)	Fork Length (in)	Total Length (in)
November 10, 1999	44	52.6	58.0
October 14, 2005	61	56.1	61.7
November 13, 2007	61	57.1	63.1
October 12, 2010	73	59.1	65.0
October 4, 2017	66	60.5	66.3

Physical measurements of lake sturgeon 036-284-042, which has been collected five times in the same location on the East Fork White River during the last 18 years. The variation in weight suggests this fish is a female and could represent years just before spawning (with a full complement of eggs) or after spawning (i.e., coming off a spring where it just released eggs).



Assistant nongame aquatic biologist JoAnne Cummings with lake sturgeon 036-284-042 captured during annual netting in the East Fork White River.



Assistant nongame aquatic biologist JoAnne Cummings prepares a snuffbox culture cage and base to place in Lake Shafer.

Martin County. Eight sturgeon were collected from six locations sampled throughout the stretch of the river historically occupied by sturgeon. These fish ranged from 25 to 66 pounds and from 46.5 to 66.3 inches. Two of the eight fish had not previously been collected. Of the six recaptures, three were first captured and tagged in 1999. Radio transmitters were attached to four of the larger sturgeon for future tracking.

Online Fish Identification

A new Fish Identification Form went live on the DFW website in May 2017 (wildlife.IN.gov/9448.htm). It can be used by Hoosiers who need help in identifying their catch. It may also provide an avenue for interesting records for fish species in new locations. A wide variety of species have been submitted thus far including longnose gar (*Lepisosteus osseus*), shortnose gar (*L. platostomus*), bowfin (*Amia calva*), goldeye (*Hiodon alosoides*), skipjack herring (*Alosa chrysochloris*), golden shiner (*Notemigonus crysoleucas*), rosyface shiner (*Notropis rubellus*), creek chub (*Semotilus atromaculatus*), northern hog sucker (*Hypentelium nigricans*), bigmouth buffalo (*Ictiobus cyprinellus*), black buffalo (*I. niger*), warmouth (*Lepomis gulosus*), longear sunfish (*L. megalotis*), spotted bass (*Micropterus punctulatus*) and freshwater drum (*Aplodinotus grunniens*).

Snuffbox Augmentation

Once present in multiple watersheds of Indiana, the endangered snuffbox (*Epioblasma triquetra*) has only been found live in the state in the Salamonie River, Tippecanoe River and Sugar Creek in recent times. Snuffbox are likely only secure in a 10-mile stretch of the Salamonie River, where many individuals and juveniles have been found. The populations in the Tippecanoe River and Sugar Creek seem precarious at best



The Tippecanoe River, downstream of Norway Dam, where logperch were collected.



Female snuffbox from the Salamonie River used for propagation.



The small white dots on the logperch gills are attached glochidia.



A 2016 cage that has been retrieved.



The substrate from a pulled 2016 cage that will be checked for snuffbox.

and, if still present, may no longer be reproducing. Increasing one of these populations would improve prospects for the continued persistence of snuffbox in Indiana. In 2012, federal funding was obtained to start a snuffbox augmentation project in the Tippecanoe River using female snuffbox from the Salamonie River.

A fourth year of snuffbox propagation was successfully completed over a three-day period in 2017. On April 17, five cage bases filled with substrate were placed in Lake Shafer. The next day, four female snuffbox were collected from the Salamonie River and were retained in a submerged mesh bag so they could be retrieved. A day later, 107 logperch were collected using seines from the Tippecanoe River and transported to the Salamonie River, where female snuffbox were held. Glochidia extracted from each female snuffbox were then used to infect the logperch. This was accomplished by inserting a small cork between the valves to allow access to the gills and keep the valves open. Each gill was pricked several times with a small needle attached to a syringe. After each prick, glochidia were flushed from the gill into small containers with a steady stream of water from the syringe.

Logperch were separated into gallon containers of water and then infected with the glochidia. Each container had its own air stone to keep the glochidia in suspension. The gills of several logperch were periodically examined under a microscope to check for infestation. Coverage of the gills was adequate after 15–30 minutes, at which time all logperch were removed from the containers and transferred to a cooler of clean water. Once culture procedures were complete, the female snuffbox were returned to the Salamonie River, and the logperch were placed in the previously prepared cages in Lake Shafer.

The logperch were checked several times, and by early July, their gills were clean. This indicated the



A snuffbox at 16 months old (left) and at four months old (right).



Eighty-one juvenile snuffbox recovered from 2016 cages.



Augmentation site for northern riffleshell in the Tippecanoe River in Pulaski County.

glochidia had dropped off and settled into the bottom of the cages. At that point, the logperch were released, and cage tops were secured onto the cage bases. These cages will remain in place until summer 2018, at which time they will be checked for juvenile snuffbox.

In late August 2017, snuffbox cages that were placed in April 2016 were examined for juveniles. Eighty-one 16-month-old snuffbox, ranging from 0.6 to 0.9 inches in length, were recovered. This was the most successful propagation year to date. Because of their relatively small size, they were placed back into two cages and secured in Lake Shafer for another year of growth. In summer 2018, PIT tags will be attached to each juvenile, and they will be placed at augmentation sites in the Tippecanoe River.

Northern Riffleshell Augmentation & Clubshell Reintroduction

Northern riffleshell (*Epioblasma torulosa rangiana*) and clubshell (*Pleurobema clava*) were both once widely distributed in the Ohio River and Lake Erie drainages of Indiana. Northern riffleshell has not been seen live in Indiana for many years but is still believed to persist in the Tippecanoe River. Clubshell are reproducing in the upper section of the Tippecanoe River and are still found live in Fish Creek, although reproduction, if occurring, is at very low levels. Increasing the northern riffleshell population in the Tippecanoe River and re-establishing a clubshell population in the Eel River would improve prospects for the continued persistence of both species in Indiana.

Salvage of adult northern riffleshell and clubshell, among other species, from a project to replace the Hunter Station bridge on the Allegheny River in Pennsylvania provided an unprecedented conservation opportunity for these species in their historic ranges. The states of Pennsylvania, Illinois, West Virginia, Kentucky and Ohio already have similar projects. In



A northern riffleshell filters water in the Tippecanoe River in White County.



Reintroduction site for clubshell in the Eel River in Miami County.



Clubshell placed in the Eel River are monitored by a student and faculty member from Manchester University.



A marked clubshell from the Eel River nearly two years after placement.



A clubshell filters water in the Eel River in Cass County.

	Total number placed	through October 2016		through September 2017	
		Number known dead	Number unaccounted for	Number known dead	Number unaccounted for
Pit-tagged	442	48 (11%)	10 (2%)	93 (21%)	37 (8%)
Glitter	2,642	103 (4%)	-	201 (8%)	-

Status of 3,084 northern riffleshell placed in the Tippecanoe River in 2015 and 2016.

	Total number placed	through October 2016		through September 2017	
		Number known dead	Number unaccounted for	Number known dead	Number unaccounted for
Pit-tagged	449	1 (<1%)	4 (0.9%)	2 (<1%)	29 (6%)
Glitter	2,698	0 (0%)	-	0 (0%)	-

Status of 3,147 clubshell placed in the Eel River in 2015 and 2016.

2015, Indiana received approval from Pennsylvania to partner in this project.

Before receiving adult mussels, three locations in the Tippecanoe and Eel rivers were chosen, permanent grid markers were installed, and quantitative mussel sampling was completed. At least 30, 0.25-m² quadrats were dug at each site to determine pre-release densities of northern riffleshell and clubshell.

In September 2015, Indiana received 150 northern riffleshell and 150 clubshell via overnight FedEx. Each mussel had a pit tag epoxied to one valve and a small, numbered plastic tag attached to the other valve. The mussels were placed at the three sites (50 per site) in their respective river and monitored for survival.

One month later, each mussel was relocated at its original placement area, and many were seen actively filtering. Thirty were dug up to be checked. All were alive and closed tightly upon handling. This process was repeated in June 2016. Only four of the 150 northern riffleshell were not found, and 11 of 15 (73%) examined were alive. This survival rate is higher compared to other states that moved this species from the Hunter Station bridge. Only one of the 150 clubshell was not found at the three Eel River sites, and all 15 individuals examined were alive. With these promising results, Indiana was granted more adults of each species for continued augmentation and reintroduction.

In late summer 2016, DFW staff placed 2,997 clubshell and 2,934 northern riffleshell in, respectively, the Eel and Tippecanoe rivers at the three sites where pilot releases were conducted the previous year. Ten percent of each species arrived from Pennsylvania with a pit tag attached to one valve. The remainder were marked with green glitter super-glued to their shells to distinguish them from those placed in 2015. At each location, mussels were placed at a density of eight individuals/m² within a previously designated 8 by 20-meter grid. This was a monumental effort made

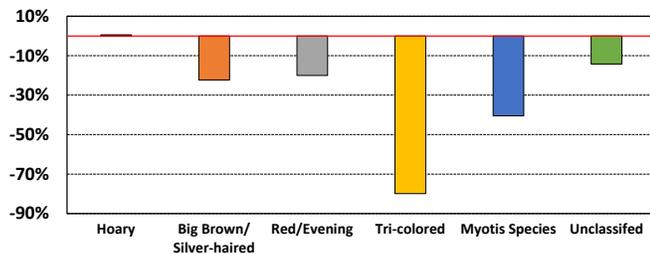
easier by the assistance of Manchester University students and faculty, and staff from the USFWS and The Nature Conservancy.

These relocated mussels have been monitored for survival since placement. In general, large numbers of the PIT-tagged individuals were found during searches, with only a few missing at each site. Although survival of northern riffleshell has not been as high as clubshell, it is similar to what has been observed in other states receiving this species. Only two clubshell are confirmed dead to date. The survival of these animals has been remarkable, and monitoring of these two populations will continue. In the near future, DFW biologists will also look for juveniles to determine if reproduction is occurring. No additional mussels were received from Pennsylvania in 2017, but we hope for future opportunities.

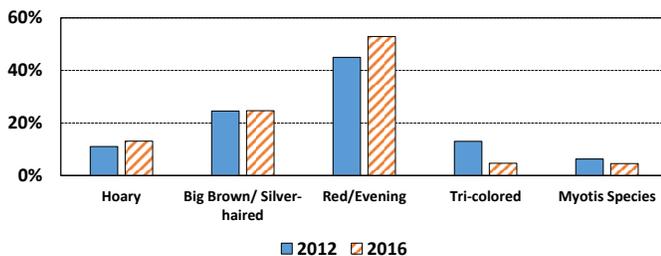
NONGAME MAMMALS

Acoustic Monitoring of Bats

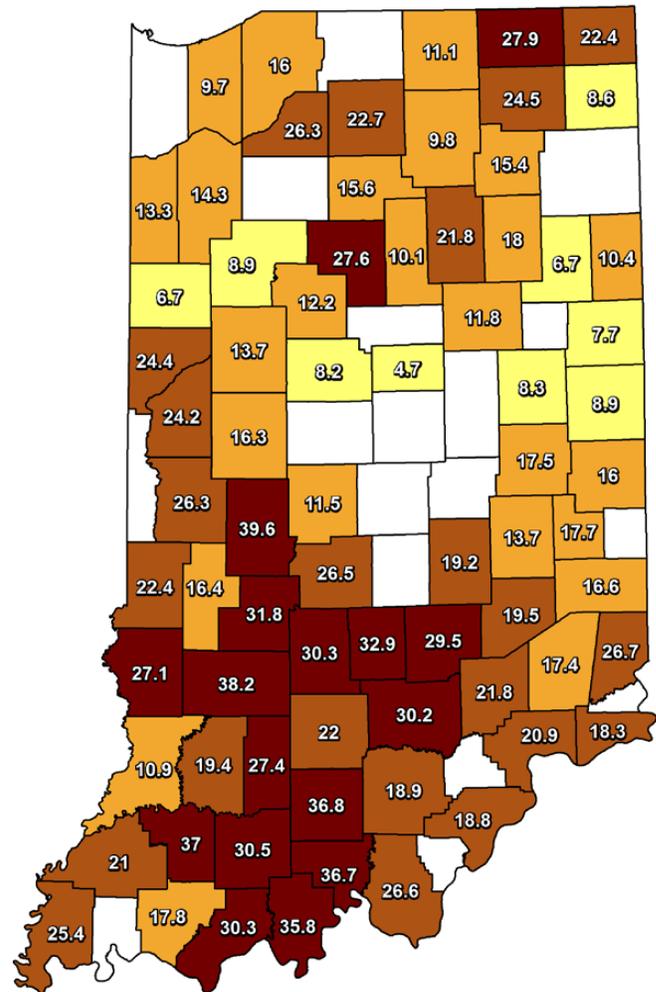
Wildlife Science biologists first used acoustic bat monitoring in 2010 to detect abnormal bat behaviors associated with WNS. This research led directly to the confirmation of WNS in Grotto Cave, a major Indiana bat (*Myotis sodalis*) hibernaculum, and later helped track the progression of the disease throughout



Percentage change in the number of bat calls detected during mobile acoustic surveys from 2012 to 2016. Calls from species that are difficult to differentiate are grouped together. Myotis species include little brown, Indiana, and northern long-eared bats.



The proportion of each species to the whole detected during mobile surveying in 2012 and 2016. Calls from species that are difficult to differentiate are grouped together. Notice the decline in tri-colored bats and Myotis species (little brown, Indiana and northern long-eared bats).



Bats detected per hour by county during mobile surveys in 2016 (maroon: more than 27, brown: 18–27, orange: 9–18, yellow: less than 9, white: no data).

Indiana’s caves and abandoned mines. Mobile acoustic surveys began in 2011, using microphones attached to the roofs of vehicles while driving predetermined routes during summer evenings. In 2014, permanent bat monitoring stations became the most recent addition to the acoustic survey program. Ten stations that record acoustic data from the surrounding environment year-round were installed across the state at local, state and federal properties.

Acoustic WNS surveillance fulfilled its objective and was discontinued in 2014, but mobile and fixed station surveys have continued through 2017. These noninvasive surveys provide a relatively easy means to collect large amounts of data from across the state with less effort than needed for more traditional surveying techniques. These data are then used to assess trends in bat behaviors and populations.

Mobile acoustic bat surveys were conducted from late May to early July in 2017. Data compilation and analysis are ongoing while final results from 2016 were compiled in 2017. In 2016, surveys from 49 counties



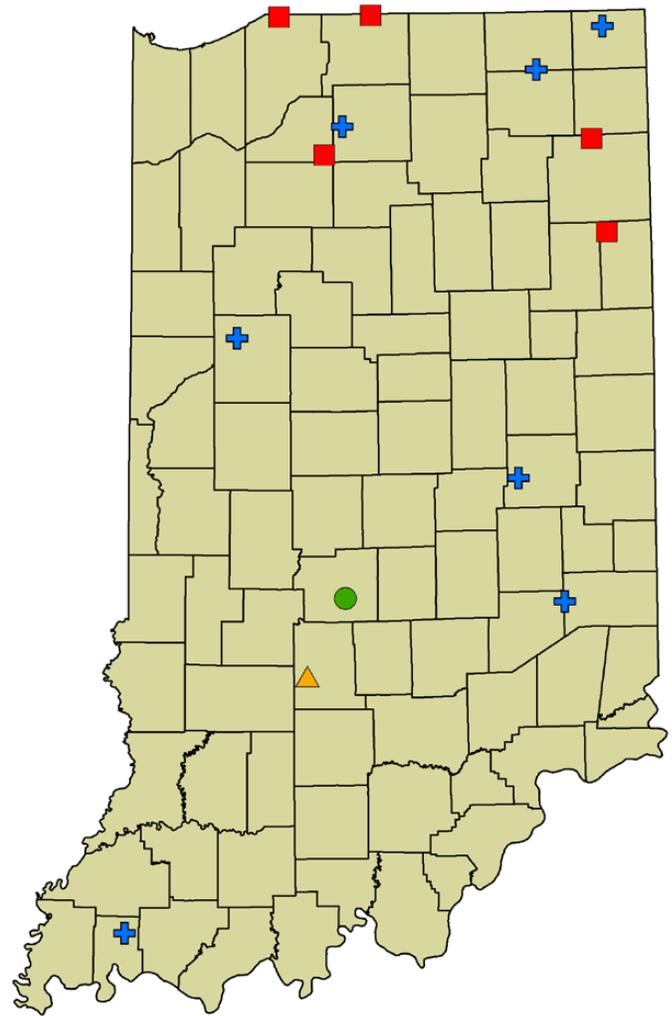
A bat monitoring station at Prophetstown State Park. The microphone at the top of the pole detects bat calls and sends this information to the bat detector, where data are processed and saved. The bat detectors are programmed to turn on shortly before sunset and turn off shortly after sunrise, thus only recording data during periods of potential bat activity.

surveyed regularly since 2012 returned an average of 23 bat calls detected per hour. This is the highest average across these counties since statewide monitoring began in 2012, but still represents a 28% decline from 2012. The most striking result is the sharp decline in tri-colored bats (*Perimyotis subflavus*), particularly in southern Indiana where this species is historically more abundant. Bats in the genus *Myotis*, which includes the little brown bat (*M. lucifugus*), Indiana bat, and northern long-eared bat (*M. septentrionalis*), had the second largest decline. The big brown bat (*Eptesicus fuscus*), a larger hibernating species, and the eastern red bat (*Lasiurus borealis*), a migratory species, showed smaller declines. Only the hoary bat (*L. cinereus*), Indiana's largest species, showed a small increase in abundance from 2012. Regional declines in abundance appeared less severe in the northern lakes region of northeast Indiana, while losses have generally diminished across the state in recent years.

Data analysis for the 10 permanent acoustic bat monitoring stations is evolving. An initial analysis in 2015 revealed basic trends in bat activity attributed to annual hibernation and migration patterns. The tri-colored bat was the first species to disappear from the landscape in autumn. Periods of peak migration of the hoary and silver-haired (*Lasiorycteris noctivagans*) bats could be seen, and species representation was largely dominated by the big brown bat. A full analysis and critique of all data received to date will be conducted in 2018.

Summer Bat Roosts

A total of 14 volunteers monitored 15 active bat roosts in 2017 and returned data. Seven of these roosts were also monitored in 2016. Six roosts were in barns,



Locations of 14 bat roosts monitored by volunteers in 2017 (blue crosses: bat houses, red squares: barns, green circle: outbuilding, orange triangle: house).

seven were in bat houses, and one each on an occupied house (behind the shutters) and an outbuilding. In 2017, about 150 emergence surveys were completed in 14 counties. A range of eight to 340 bats was found in barn roosts, while bat houses had one to 95 bats exiting. As many as 39 bats were found using the occupied house while two bats used the outbuilding.

Three locations have reported data for each year of the program (2015 to 2017). At a barn roost in Adams County, the average bat count has increased annually from 15.2 bats in 2015 to 21.6 bats in 2017, whereas the roost in a LaPorte County barn appears to be decreasing. It averaged 50.5 bats in 2015 and 34.7 bats in 2017. The third site, a bat house in Vanderburgh County, averaged 31.7 and 33.6 bats in 2015 and 2016, respectively, but only 15.3 bats in 2017.

The species most commonly found in buildings and bat houses in Indiana are big brown and little brown bats. Northern long-eared, tri-colored, and Indiana bats may also be found, but to a lesser degree. Bat species



Bats roosting in a bat house attached to a volunteer's home. (Photo by Denise Harter)

have not been verified at all roost sites, and improving species identification is a future goal of the project.

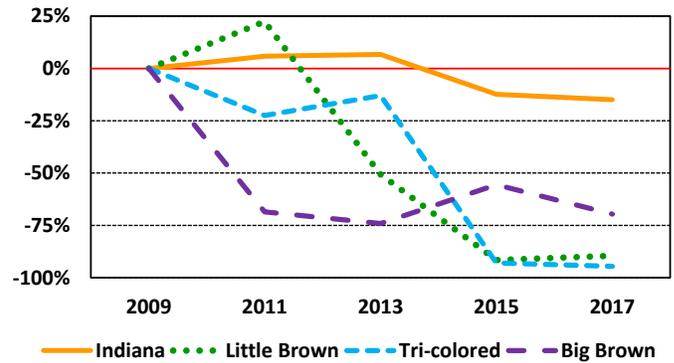
Certain species exhibit higher roost fidelity than others. The five most frequent reasons that bats change summer roost locations are: proximity to feeding areas, disturbance, predation, parasitism, and roost structure and microclimate. All bats in Indiana are insectivores. As insect availability and location varies throughout the summer, bats may change roosts to be closer to feeding areas. Raccoons, snakes, and owls have been known to prey on bats. Their presence could cause bats to relocate. Temperature changes inside the roost may also cause bats to move.

Some bat species may form maternity colonies in human structures, while males are more solitary. Roosts that exhibit an increase in exit counts toward the end of the survey period may indicate a maternity colony. Young are born in early summer, unable to fly and dependent on their mother for food. Later in the summer they become volant (i.e., capable of flying), leaving the roost to feed on their own.

With continued and increased volunteer participation in this project, it is hoped that more definitive information can be learned concerning summer bat populations across the state as well as behavioral patterns within specific roost sites and between species.

Winter Bat Counts

Counts of bats in winter hibernation sites have been conducted in Indiana for more than 30 years. The



WNS was first detected in Indiana in January 2011. This graph shows the percent change in bat populations at 11 major Indiana bat hibernacula since the last pre-WNS counts in 2009 for Indiana bats (solid orange), little brown bats (dotted green), tri-colored bats (short-dash blue), and big brown bats (long-dash purple). The northern long-eared bat was excluded due to low counts across all years. This species had a low of four in 2017 and a high of 16 in 2013.



A member of the winter bat counts surveying team descends into Coon Cave in Monroe County.

work has yielded one of the longest-running datasets known for populations of cave-dwelling bats.

Winter surveys for each hibernaculum are completed biennially to minimize disturbance, alternating each year between large and small hibernacula. Historically, caves used by the endangered Indiana bat were targeted, and these surveys provided insight into the species' progress toward recovery. They also shed light on the status of other hibernating species, including the little brown, northern long-eared, tri-colored, and big brown bats. The value of this information has grown as WNS, a fungal disease affecting bats during hibernation, continues to affect bat populations throughout eastern North America.

Nearly seven years have passed since WNS was first detected in Indiana in January 2011. Surveys in



A cluster of hibernating Indiana bats in Coon Cave. One bat seems especially eager to be at front and center.

2017 in 11 of the largest known hibernacula now show declines of about 95% and 90% for tri-colored bats and little brown bats, respectively. Other species experienced smaller declines, but all cave-hibernating bats were less abundant in 2017 compared to their pre-WNS levels. Many hibernacula had shown steady growth in Indiana bat populations from 2001 to 2013, but an 18% decline occurred between 2013 and 2015, followed by a 3% decline between 2015 and 2017.

Wildlife Science biologists have also observed some movement of bat populations between caves. In Harrison County, for example, Twin Domes Cave was once home to more than 70,000 hibernating Indiana bats. In 2017, fewer than 800 remained there, while the population at nearby Jug Hole Cave increased from about 21,000 in the 1990s to more than 68,000 in 2017. It is unknown how much such shifting in populations may be in response to conditions associated with WNS.

WNS has now been detected in 39 caves in 11 Indiana counties, and it is likely pervasive throughout Indiana's caves and abandoned underground mines where bats hibernate. Although researchers are currently testing potential treatments for WNS and have successfully treated bats in a laboratory setting, the ecological safety and logistics of applying these treatments to natural environments remain big obstacles. In addition to bats that benefit from conservation efforts, remnant cave-dwelling bat populations may be able to stabilize on their own before their populations become in jeopardy of extinction.

Swamp Rabbit

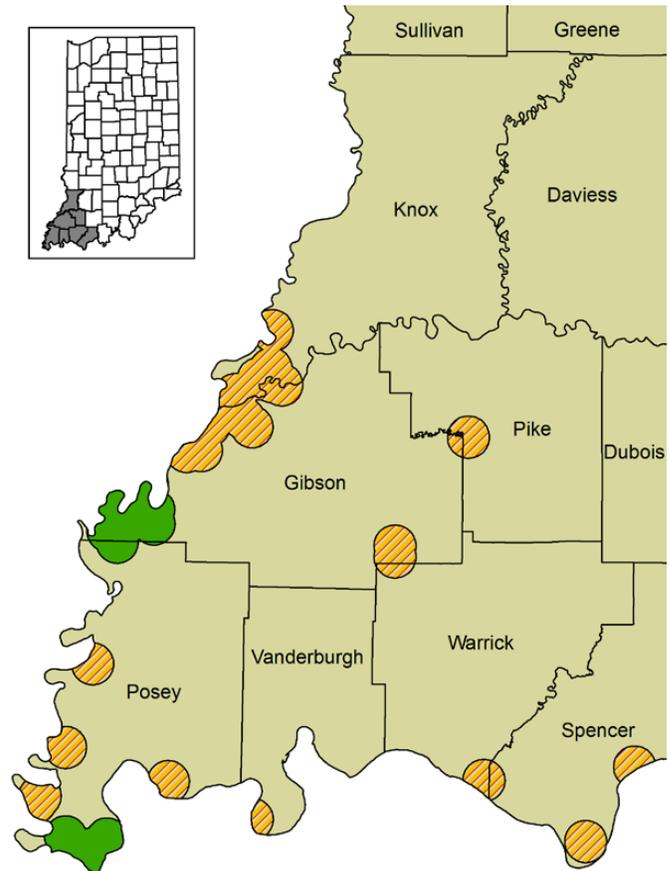
Swamp rabbits (*Sylvilagus aquaticus*) are the largest of the 14 cottontail species. They can be distinguished from their common relative, the eastern cottontail (*S. floridanus*), by their larger size, darker coloration, small ears relative to their large body, and cinnamon rings around their eyes.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

swamp rabbit can reach six pounds, compared to 3.5 pounds for a cottontail.

Swamp rabbits are also referred to as swampers or cane cutters. The latter name comes from their tendency to eat giant cane (*Arundo donax*). As their name implies, they are typically found near water and prefer bottomland hardwood forests that are next 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 range. They are more abundant in Alabama, Mississippi and Louisiana. Today, they are probably 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 its fecal pellets on top of stumps and downed logs. The reason for this behavior is unclear. It's possible



Areas with evidence of existing swamp rabbit populations in 2017 are shown in green, with historical records shown in orange stripe.

that swamp rabbits use the elevated posts to watch for predators. Biologists can determine the species' presence, in part, by searching for pellets on logs during winter, when vegetation is down. Biologists also use artificial logs in swamp rabbit surveys. Artificial



A swamp rabbit approaches a log at the largest known population site remaining in Indiana.



Swamp rabbit fecal pellets left on a moss-covered log. Biologists typically survey swamp rabbits by looking for these latrines on logs in bottomland hardwood forests.



Swamp rabbit fecal pellets on an artificial log that was constructed by attaching carpet to the top of a hollow wooden box. Artificial logs are sometimes used to supplement surveys or for more intensive studies on swamp rabbit populations and behaviors.

logs are box-like structures with carpet placed on top to mimic moss-covered logs. These artificial logs are placed in potential swamp rabbit habitat to help biologist determine their presence.

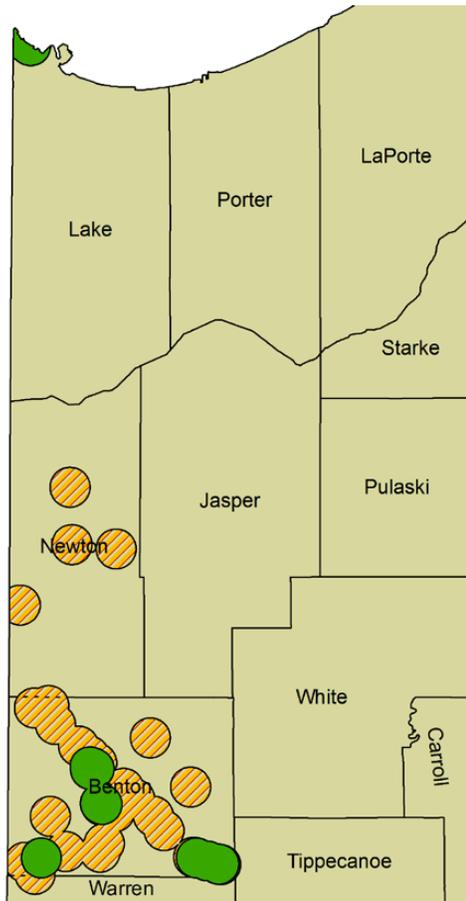
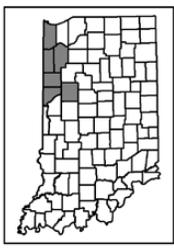
The first comprehensive study of swamp rabbits in Indiana, conducted more than 40 years ago, suggested the species occupied 25 sites in six southwestern counties: Gibson, Knox, Posey, Spencer, Vanderburgh and Warrick. All later field work, however, has found a marked reduction in the occupied range. In 2006, pellets were found at a combined nine sites, only in Gibson and Posey counties.

Wildlife Science biologists conducted fecal pellet surveys from 2015 to 2017. In 2015 and 2016, no conclusive sign was found at sites in Knox, Gibson, and Posey counties. Surveys in 2017, however, confirmed a relatively large population in Gibson County and two smaller populations in Posey County. At the Gibson County site, 106 logs were found with fecal pellets. After these initial surveys, four trail cameras were placed near logs that had larger pellet deposits, and three cameras ultimately captured images of swamp rabbits.

A recent swamp rabbit report was received from Warrick County, which will be investigated in 2018. Future efforts are planned to further study the swamp rabbit population in Gibson County and to pursue options for protecting this habitat that harbors perhaps the last remaining viable population of this species in the state.

Franklin's Ground Squirrel

Franklin's ground squirrels (*Spermophilus franklinii*) are relatively large ground squirrels found in isolated grasslands in northwest Indiana. Once distributed across



Areas of Franklin's ground squirrel captures from 2015 to 2017 are shown in green. Surveys without captures are shown in orange stripe. Surveyed areas represent locations of some of Indiana's larger historical populations. Franklin's ground squirrels were once established in at least 16 counties in northwest Indiana. Additional surveying and public reports are needed to identify other remaining populations in the region.



Wetland Gamebird Area in Benton County provides high-quality habitat for Franklin's ground squirrels and other grassland-dependent wildlife species.

at least 16 counties, the species is now believed to be restricted to six or fewer counties in the extreme northwest.

In 2017, Wildlife Science biologists conducted surveys for this state-endangered species at 11 locations in Benton County and four locations in Newton County. Trapping sessions lasted for two consecutive days across the summer months. Seven squirrels (four males, three females) were captured at two sites. Both were state-owned Gamebird Areas in Benton County where suitable habitat is prevalent. Indiana's largest known Franklin's ground squirrel population is in Lake County along the shore of Lake Michigan.

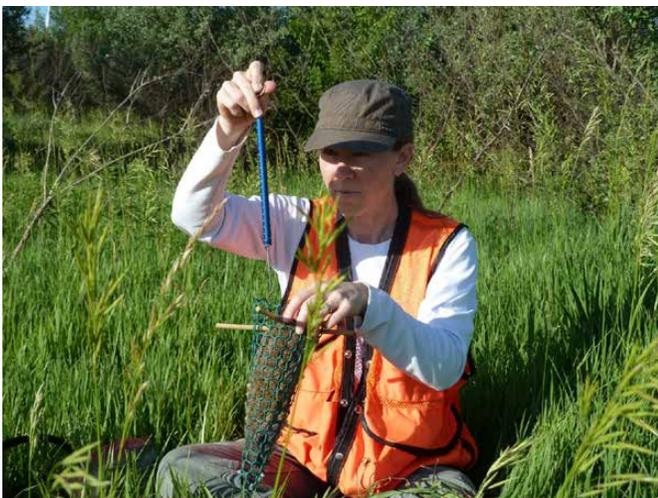
Ideal Franklin's ground squirrel habitat is rare in Indiana's agriculturally dominated landscape. Most grassland habitat exists along roadsides and railroad rights-of-way, and in various patches of managed public lands. Future surveys in Gamebird Areas and along railroad rights-of-way where suitable habitat remains, along with public reports, are needed to better assess the current distribution of this species in the state.

For now, the Franklin's ground squirrel is known to reside in only a few isolated patches of grassland habitat in northwest Indiana. By maintaining these patches and potentially adding more suitable habitat, the state may be able to help this species thrive once again in Indiana's remnant grasslands.

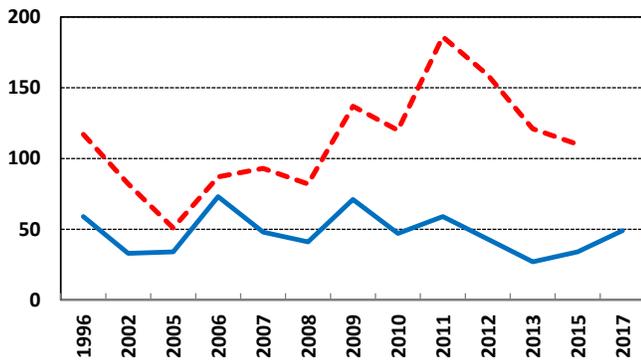
Allegheny Woodrat

The Allegheny woodrat (*Neotoma magister*) was listed as a state-endangered species in 1988 and is one of the rarest and least-observed mammals in Indiana. Woodrats are nocturnal and live in the limestone and sandstone cliffs along the Ohio River. They face numerous threats including habitat fragmentation, reduced genetic diversity, and infection from parasites.

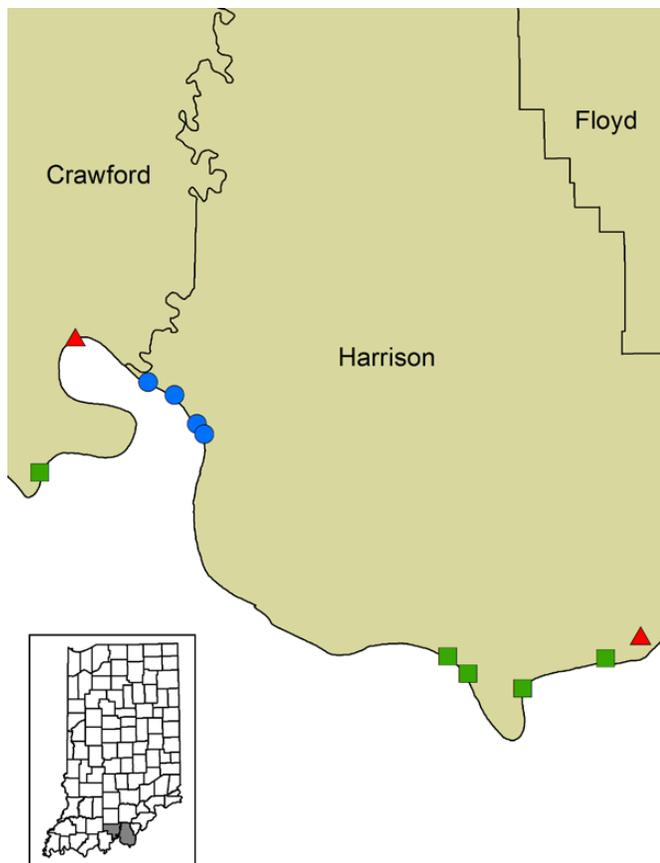
The current distribution of woodrats in Indiana includes about 15 cliff sites scattered along nearly 40 miles of the Ohio River from Rosewood in Harrison County downstream to Alton in Crawford County. Since 1991, Wildlife Science biologists have periodically conducted live-trapping surveys at these sites, as well



Assistant mammalogist Cassie Hudson weighs a captured Franklin's ground squirrel.



Number of Allegheny woodrats captured at all sites (dashed red line, 1996–2015) and in only the Harrison-Crawford State Forest area (solid blue line, 1996–2017).



Populations of Allegheny woodrats surveyed in 2017 (blue circles), to be surveyed in 2018 (green squares), and extirpated (red triangles).

as in other areas with suitable habitat, to monitor the species' distribution and relative abundance. Several conservation projects have also been carried out to help Indiana's few remaining woodrat populations, including translocations from neighboring states (2007–08) and population supplementations from a captive breeding program (2010–12).

Surveyed populations across all sites hit a low of 51 woodrats in 2005, but thanks to conservation efforts, these same populations rebounded to a high of 186 animals in 2011. Populations declined in 2012 and 2013, but the most recent surveys in the Harrison-



A captured Allegheny woodrat is transferred to a mesh cone. Once it's safely inside the cone, biologists collect small tissue samples for genetic testing, apply ear tags, and record other data, including weight, sex, and approximate age.



An Allegheny woodrat is released after capture.



Allegheny woodrats are also known as pack rats due to their habit of collecting items from their surroundings. These items can include anything from leaves and acorns for food to plastic items and small metal objects.



An Allegheny woodrat latrine on the edge of a cliff overlooking the Ohio River.

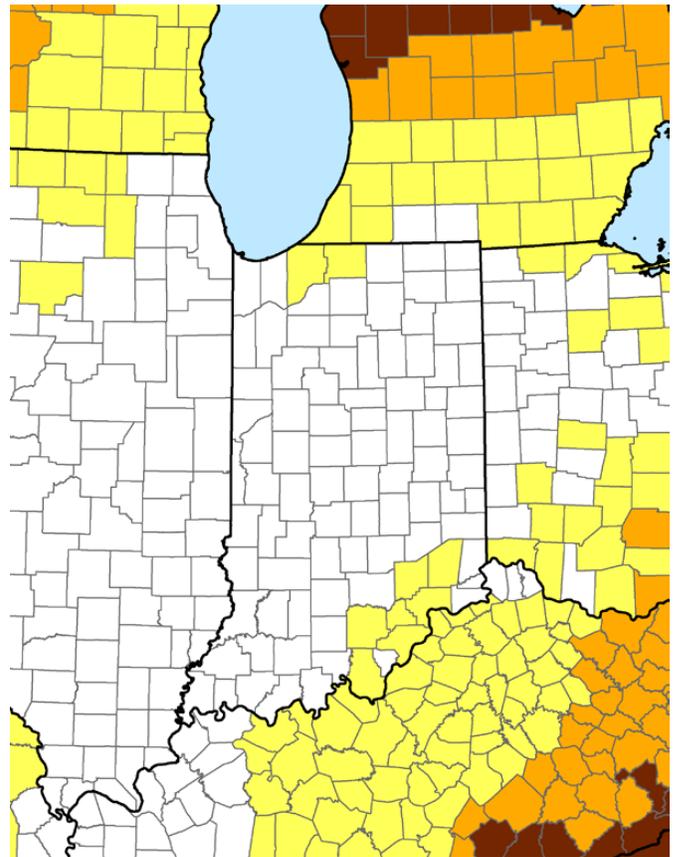
Crawford State Forest (HCSF) area indicate they are once again rebounding. Historically, surveys reveal fluctuations in populations, with peaks followed by declines. Reasons for this trend are unclear but likely include food availability, winter severity, and predator-prey relationships, as well as positive effects of conservation efforts.

Only woodrat populations in the HCSF area were surveyed in 2017. Populations at these sites increased 44% and 81% from 2015 and 2013, respectively. Few woodrats were recaptured from surveys in 2015 and none were found from 2013. Sites not visited in 2017 will be surveyed in 2018, providing a more complete picture of the current status of Allegheny woodrats in Indiana.

Black Bear

In spring 2015, a black bear traveling south from Michigan made this species' first confirmed visit to Indiana in 144 years. Black bears were historically abundant across the state, excluding the prairie-dominated portions of northwest Indiana. Unregulated hunting and habitat loss caused black bears to be extirpated from Indiana and much of the rest 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 region 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 recent years, black bears have come into Indiana from Kentucky and Michigan. The map shows counties with confirmed black bear sightings in yellow. The species' resident range and core range are shown in orange and maroon, respectively.

In 2016, Indiana had its second black bear visitor in two years. The bear entered the state from the south. The first sighting was in July, near Corydon in Harrison County. After the initial confirmation, DFW staff subsequently received 63 reports in 2016, and six reports in 2017. The accuracy of 20 reports was confirmed by photo, video or a qualified biologist's investigation.

This bear presumably hibernated in or near Big Oaks National Wildlife Refuge during the 2016–17 winter. Between March and May 2017, it moved south toward Madison in Jefferson County, where the last report was received. A few days later, two young bears were seen south of Louisville, Kentucky. No further viable reports of a bear in Indiana have been received since October 2017.

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



A black bear track from near Butlerville in Jennings County in March 2017. (Photo by Jeff Pennycuff)

be rare for many years, bears will likely continue to visit Indiana. To report a bear sighting, please go to: wildlife.IN.gov/8497.htm.

Badger

The badger is a medium-sized, solitary carnivore associated with prairies, meadows, hayfields and other grassy habitats in the Great Plains region of North America. This stocky member of the weasel family is specialized for digging and living underground. Badgers have low-slung bodies and powerful forelegs with long, heavy claws that allow them to quickly tunnel through soil to pursue prey, which can include gophers, ground squirrels and other small rodents. Badgers are grizzled yellowish-gray in color with distinctive facial markings that feature a thin white stripe running from the nose over the top of the head, and white cheeks with a dark triangular patch.

Badgers were listed as state-endangered in 1969 but were probably never common in Indiana. In the early 1900s, they were reported from only 12 counties. They gradually expanded southward through the state, most likely due to their protected status and conversion of forest cover to habitats more favorable for grassland-dependent species. By the mid-1990s, badgers were reported from 61 counties. In 2005, they were downgraded from endangered to special concern status.

Reports of badgers have been documented from 76 of Indiana's 92 counties. Most records date from 1980 and later, with the oldest report dating back to 1942. Records from 2016 and 2017 include those from Dekalb, Howard, Jasper, Lagrange, Lake, Montgomery, Newton, Parke, St. Joseph and Steuben counties. Information gathered by Wildlife Science staff suggest



The southern Indiana black bear roams Big Oaks National Wildlife Refuge in October 2016. (Photo by Alan Smithson)

Furbearer	Number Pelts Purchased			Average Pelt Price		Total Value		
	2014-15	2015-16	% change	2014-15	2015-16	2014-15	2015-16	% change
Muskrat	37,830	15,597	-59%	\$4.54	\$2.32	\$171,628	\$36,185	-79%
Raccoon	59,416	11,716	-80%	\$6.33	\$2.77	\$376,327	\$32,453	-91%
Red Fox	1,042	584	-44%	\$19.74	\$9.43	\$20,571	\$5,507	-73%
Gray Fox	155	31	-80%	\$20.20	\$11.93	\$3,131	\$370	-88%
Mink	1,474	893	-39%	\$8.85	\$5.96	\$13,039	\$5,322	-59%
Opossum	1,234	370	-70%	\$1.02	\$0.84	\$1,260	\$311	-75%
Striped Skunk	66	49	-26%	\$3.74	\$2.87	\$247	\$141	-43%
Beaver	1,651	1,647	0%	\$9.09	\$5.93	\$15,000	\$9,767	-35%
Coyote	3,918	2,210	-44%	\$13.09	\$12.42	\$51,297	\$27,448	-46%
River Otter	-	196	n/a	-	\$25.90	-	\$5,076	n/a
Long-tailed Weasel	1	1	n/a	\$1.00		\$1.00		n/a
Total	106,787	33,294	-69%			\$652,500	\$122,580	-81%

Comparison of fur purchases and values between Indiana's 2014–15 and 2015–16 fur harvest seasons.

the 2015–16 fur harvest season. The northeast region had the highest number of fur buyers (16), whereas the southwest region had the fewest (3). Five fur buyers were nonresidents.

During the 2015–16 fur harvest season, fur buyers purchased a total of 33,294 pelts equaling a value of \$122,580. Both are a decrease from the 2014–15 season. Raccoon and muskrat (*Ondatra zibethicus*) accounted for 82% of total pelts purchased. The total fur value and total number of pelts purchased in 2015–16 declined for almost every furbearer species when compared to the numbers from the previous season. Exceptions were beaver, which showed no change, and river otter, which did not have a legal season in 2014–2015. Regulated trapping for river otter in Indiana began in November 2015 and therefore was the first year otter were reported by fur buyers. The lowest reported price paid was \$0.28 (opossum). The highest reported price was \$75 for a river otter.

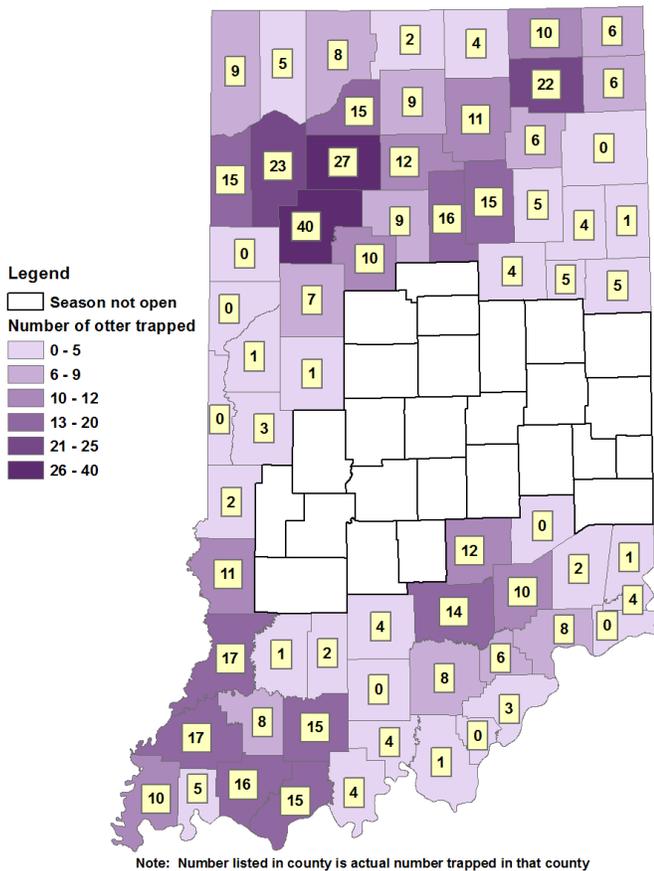
2016–17 River Otter Harvest

After a highly successful reintroduction of river otter in Indiana in the 1990s, otter were removed from the state's endangered species list in 2009. Established

and continuously expanding populations allowed for limited harvest, and Indiana's first regulated river otter trapping season began in November 2015.

A statewide harvest quota of 600 river otter was again established for Indiana's second season that opened on November 15, 2016. Otter trapping was open in 66 of Indiana's 92 counties with a season bag limit of two otter per licensed trapper. Successful trappers were again required to check in their otter through Indiana's online CheckIN game system and deliver the pelt and carcass to a designated check station to obtain a federal CITES tag. Carcasses were collected at check stations, and teeth and reproductive tracts were collected for assessment.

A total of 518 river otter were harvested in the 2016–17 season. This is 82 otter fewer than the statewide quota, and the season remained open until the March 15, 2017 end date. Harvest occurred in 58 of 66 counties open to otter trapping and county-level harvest ranged from 0 to 40 otter. White (n = 40), Pulaski (n = 27), Jasper (n = 23), and Noble (n = 22) counties, all in northern Indiana, reported the highest river otter harvest. Analysis of reproductive and age data from the season are underway. A summary report will be available in early 2018.

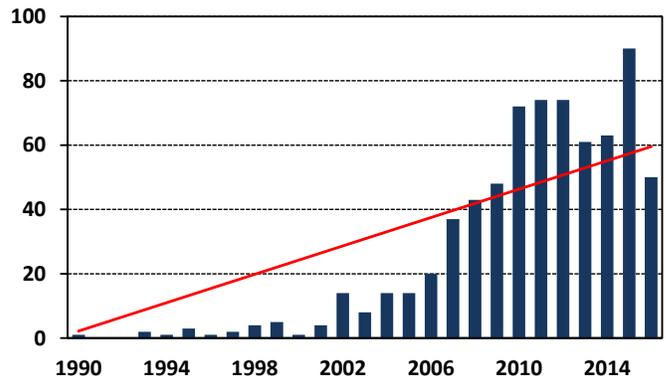


Distribution of 518 river otters harvested in Indiana during the 2016–17 trapping season. Otter were taken in 58 of the 66 counties (88%) open to otter trapping. Twenty-six counties in central Indiana were closed to otter trapping.

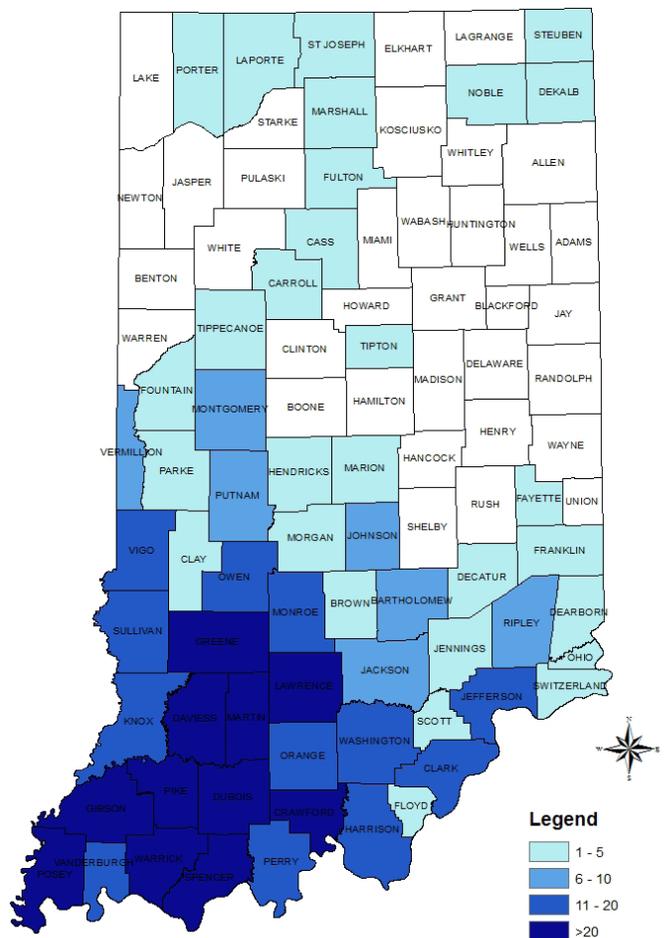
Bobcat

Since the late 1980s, the DFW has recorded the number and location of bobcat mortalities reported annually in Indiana. These reports are an inexpensive means to collect information about bobcats in Indiana and provide insights into the species' status, distribution, and relative abundance. Reports include bobcats that have been struck by vehicles or found dead of unknown causes and those accidentally killed in traps legally set for other furbearers.

The number of mortalities reported in Indiana has been steadily increasing since the mid-2000s. This indicates a growing, expanding bobcat population. In 2015, the number peaked at 90 reported mortalities (62 road-killed; 32 incidentally trapped or snared; five by other causes), distributed across 32 counties. The following year, this number dropped to 50 reported mortalities in 24 counties. This decline is likely due to staff vacancies in 2016 that hampered reporting and carcass collection and is not related to any change in bobcat populations. Vacancies were not filled until



Number of confirmed bobcat mortalities reported annually (blue bars) in Indiana from 1990 to 2016. The red line represents the long-term average.



Distribution of 705 confirmed bobcat mortalities reported in Indiana from 1990 through 2016.

May 2017, which will likely have a similar effect on the number of mortalities reported in 2017.

Bobcat mortalities are reported most often in fall and winter months, and occur primarily in southern



Furbearer biologist Geriann Albers removes a tooth from a road-killed bobcat. The tooth will be used to determine the animal's age.

counties. Since this survey began, bobcat mortalities have been confirmed in 58 of 92 (63%) Indiana counties.

Public Perception of Mesocarnivores

The DFW contracted with Purdue University to survey Indiana residents regarding their attitudes and opinions toward Indiana's mesocarnivores, which are medium-sized furbearers such as red and gray fox, coyote, raccoon and striped skunk. The project began in late 2015, and the survey portion concluded in late 2016.

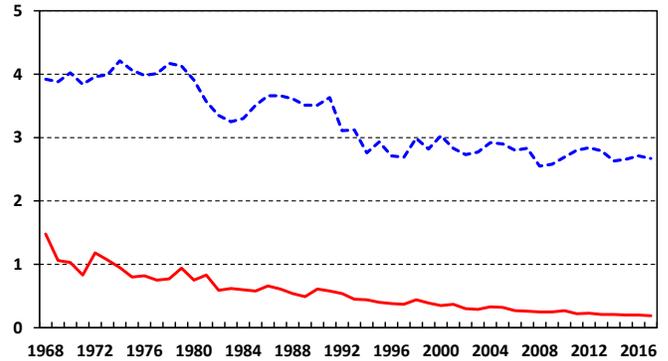
Researchers found that a person seeing wildlife, in general, was unrelated to their concern about possible wildlife conflict, but observing specific species was more often related to reports of conflicts, particularly for raccoons, skunk, red foxes and coyotes. Overall, people had high acceptance of hunting and trapping to resolve conflict with mesocarnivores.

Interview respondents had high levels of fear and unfamiliarity with coyotes, but otherwise were positive or neutral toward other species, including river otter, skunks, raccoons, and red fox. Raccoons caused the most conflict, followed by skunks and coyotes. Many respondents reported raccoon damage but often classified it as "simple to mediate" and, therefore, not of great concern. The full report is at wildlife.IN.gov/3347.htm.

SMALL GAME

American Woodcock Singing Ground Survey

Despite being a popular North American gamebird, populations of American woodcock have declined rangewide from land use changes, habitat loss and forest succession. Woodcock are migratory, which complicates effective management and conservation actions.



The disparity between the average number of peenting male woodcock heard per route in Indiana (solid red line) compared to the entire Central Management Region (CMU; dashed blue line). The CMU includes Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin.

Currently, woodcock management is divided into central and eastern regions. Actions and harvest strategies are based, in part, on annual counts of singing male woodcock during their peak display period. This annual Singing Ground Survey provides an index of species abundance to help monitor regional population trends. Indiana has participated in the Central Management Region (CMR) surveys since their inception in 1968.

Between April 10 and May 5, 2017, surveyors heard five peenting male woodcock on two of 11 routes in Indiana, a 3.6% drop from the number heard in 2016. The 2017 statewide breeding population index (0.19 singing males/route) did not differ from 2016 (0.20/route).

Surveys in the Eastern Management Region (EMR) detected a 7.1% decline in woodcock abundance from 2016, but those in the CMU revealed a 3.6% increase. The 11-year (2007–2017) trend in the EMR showed significant declines, but CMR trends (-0.25%/year) suggested stable populations. Both regions, however, experienced significant annual long-term (1968–2017) declines of 1.05% and 0.56% in the EMR and CMR, respectively.

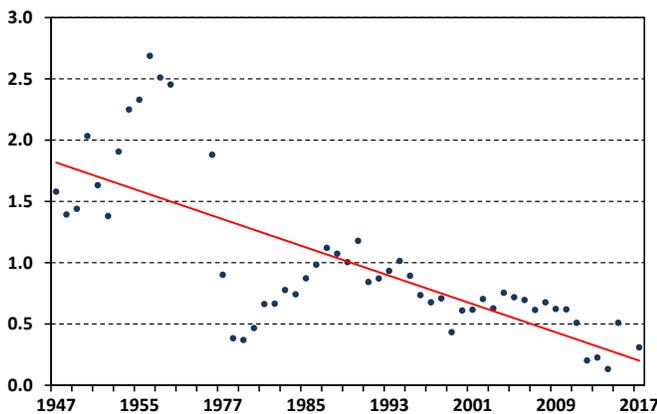
American woodcock have declined markedly from historic numbers in Indiana, and research suggests such changes are related to habitat loss and degradation. Specifically, habitat loss is attributed to timber harvest strategies in southern Indiana and agricultural practices in the central and northern portions of the state. Woodcock require early successional structure in the form of seed and sapling-aged tree recruits. However, seed germination and sapling growth depend on periodic disturbances, such as timber harvest and prescribed burning. Group selection and shelterwood harvest strategies are perhaps the most effective methods for generating quality woodcock habitat. Other early successional stage forest gamebirds such as ruffed grouse have also declined in abundance throughout their Indiana ranges for similar reasons.

Northern Bobwhite Whistle Call Count

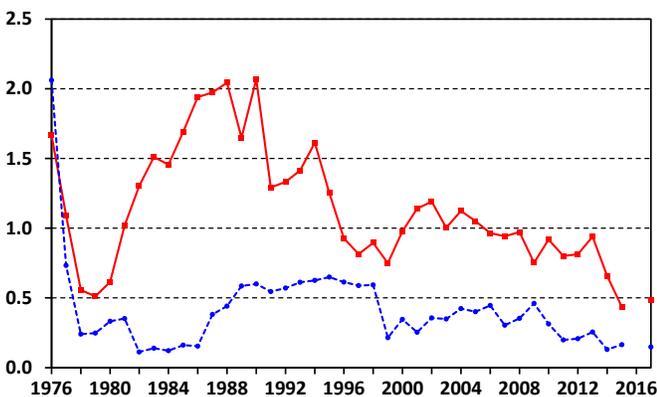
Northern bobwhite quail are a common gamebird in grass- and shrub-land ecosystems throughout the Midwest and eastern United States. They occupy early successional habitats that require periodic disturbances, such as prescribed fire, to maintain the vegetative structure needed for nesting and brood rearing. An early successional shrub component is important to winter survival.

Maintaining such complex vegetation communities is immensely important to the bobwhite management at local scales. Sweeping changes in land cover from agricultural intensification, urban sprawl, and elimination of disturbances have caused sharp declines in bobwhite abundance throughout the species' range, including Indiana. Despite these declines, northern bobwhite remain a popular gamebird among hunters.

The DFW has conducted annual whistle call counts of bobwhites since 1947 to monitor changes in abundance.



Statewide average number of whistling bobwhite heard per stop in Indiana, 1947–2017. The solid red line represents a significant decline in bobwhite abundance during this period.



Average number of whistling bobwhite heard per stop in north (solid red line) and south (dotted blue line) zones in Indiana, 1976–2017. Interstate 74 divides the state into north and south zones.



A male northern bobwhite searches for a mate along a shrubby fence line between vocalizations.

In 2017, staff and volunteers conducted 80 surveys throughout Indiana, counting 371 whistling bobwhites along all routes combined. The average statewide number of bobwhites heard in 2017 (4.65 ± 0.73 males/route) was slightly higher than 2015 (4.06 ± 0.71 males/route), when whistle counts were last conducted.

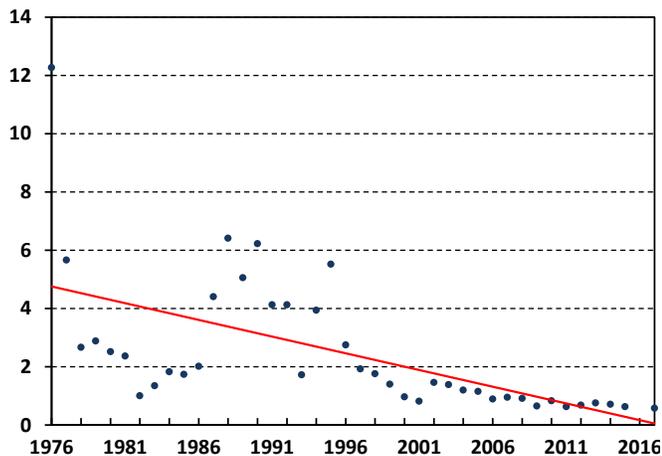
Although declines in the whistle call index are expected and mirror national trends, those during the last 10 years are concerning. Without meaningful efforts to improve habitat conditions at large scales, bobwhite show little sign of recovery. Because 96% of Indiana land is privately owned, increasing landowner participation in management practices to create and maintain early successional habitats will be essential to reversing Indiana's bobwhite population trends.

Ring-necked Pheasant Crowding Counts

The ring-necked pheasant (*Phasianus colchicus*) is an introduced species to the United States, originally native to East Asia. Pheasants proved well adapted to the country's agricultural landscape, where year-round food and cover were plentiful in fencerows, fallow fields, field borders and crop residues.

The interactions of habitat with landscape and weather characteristics are important factors that influence pheasant populations. Fluctuations in abundance are closely related to habitat quality and availability, which are driven by agriculture and land management practices through the Conservation Reserve Program (CRP). Since the late 1980s, farming intensity has increased while enrollment in CRP has decreased, causing pheasant populations to decline.

Nonetheless, ring-necked pheasants remain an important gamebird in the United States among upland and small game hunters in the Great Plains and Midwestern states. Each year, an estimated two million hunters pursue pheasants throughout the country. Because of the birds' economic and social importance, the DFW has conducted spring crowding counts



Average number of crowing male pheasants heard per stop in Indiana, 1976–2017. The solid red line represents a significant decline in pheasant abundance during this period.



A male (right) and female (left) ring-necked pheasant travel through weedy cover to feed in late fall.

annually since 1976 to monitor pheasant populations and adjust harvest regulations, if necessary.

Between April 24 and May 10, 2017, DFW staff and volunteers recorded 225 cock pheasants on 20 routes in 21 counties. Surveyors heard an average of 11.6 cocks/route, which did not differ from the last survey in 2015 (12.6 cocks/route). Overall, the 10-year and long-term trends suggest declines in statewide abundance. During the past 10 years, the average number of cocks heard per route has declined by 47%, while pheasant numbers have declined by more than 78% since 1976.

The long-term decline in Indiana’s ring-necked pheasant population is due to loss of habitat that now supports fewer pheasants and reduces adult and chick survival. Winter survival may decline if escape cover from extreme weather and predators is unavailable. These factors are best mitigated through habitat

management at large scales. Because about 96% of Indiana is privately owned, meaningful pheasant conservation will require providing habitats on private lands. Fortunately, Indiana landowners can take advantage of several federal programs through the CRP administered by the U.S. Department of Agriculture’s Farm Service Agency and offered through the DFW’s Private Lands Program. Three CRP practices create and enhance habitat for upland game, songbirds and pollinators. Filter strips (CP21), wildlife buffers (CP33), and State Acres for Wildlife Enhancement (CP38) that reduce soil erosion and improve water quality also provide nesting and winter cover for ring-necked pheasants and other grassland-dependent wildlife.

RUFFED GROUSE & WILD TURKEY

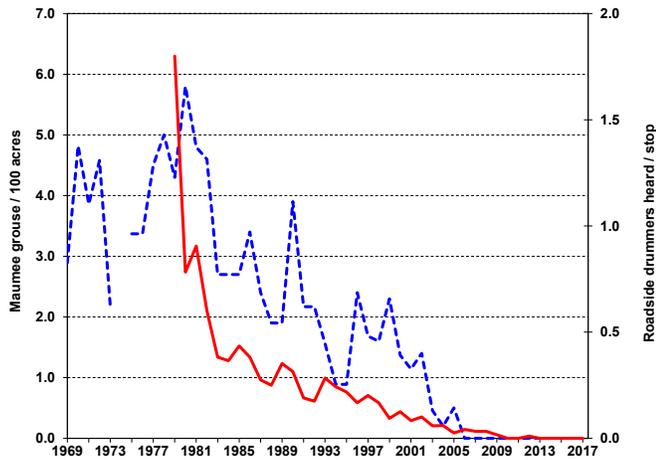
Ruffed Grouse Population Status

The distribution of ruffed grouse (*Bonasa umbellus*) in Indiana has historically fluctuated with changing land use. Grouse require young (0–20 years old) hardwood forests composed of dense seedling to sapling-size trees and shrubs. In 1931, ruffed grouse were found in only 12 Indiana counties. After reforestation, natural range expansion and a successful restoration program, grouse occupied 41 counties by 1983. This was their largest distribution in Indiana since 1856.

Ruffed grouse have declined steadily in Indiana during the last 30 years. Their populations are now at less than 1% of their levels during the peak years of 1979–1981. They occurred in less than 1% of the 2005–2010 Breeding Bird Atlas blocks, compared to 10% for those same blocks in the 1985–1990 atlas. By 2008, ruffed grouse were thought to persist in 10 to 13 of the 41 counties they occupied in 1983. The hunting season was suspended in 2015 due to declining populations from lack of young forest habitat. In the latter decades, grouse hunting in Indiana had become more of an excuse to be outdoors with bird dogs for the few



During spring breeding season, male ruffed grouse perform drumming displays to declare their territory and attract females. (Photo by Matt Soberg)



Indices of ruffed grouse populations in Indiana, 1969–2017. Annual results of roadside drumming surveys are represented by the solid red line. The Maumee grouse density is depicted by the dashed blue line.

(less than 100) grouse hunters and the few birds taken (less than one bird for every two to three hunters each season).

Ruffed grouse populations are surveyed annually by roadside counts of drumming males in early April and published observation reports. No grouse were heard on 14 roadside routes (15 stops/route) in 2017. This is the fifth consecutive year in which no grouse were heard, and only one has been heard in last seven years. The five-year (2013–2017) average drumming index is 0.0 compared to 1.16 during the peak years of 1979–1981. No confirmed observations of grouse from web sites (Breeding Bird Surveys, e-Bird, Christmas Bird Counts) or agency personnel were received outside the limited grouse range in 2017. There was also no increase in observations within this range compared to numbers from previous years.

The Appalachian subspecies of the ruffed grouse (*B. u. monticola*) found in Indiana is morphologically unique from other subspecies and physiologically adapted to southern latitudes of the birds' continental distribution. Populations of this subspecies have disappeared from Illinois and portions of Missouri, Kentucky, Tennessee and Arkansas, with major declines in abundance elsewhere.

Ruffed grouse are a “flagship” or “coal mine canary” species of young forests, a habitat type that is rapidly disappearing from Indiana and the eastern United States. The lack of early successional forests has, in part, caused declines in abundance of wildlife species that use habitats that require periodic vegetation disturbances. The annual rate of decline of early succession woodland and young forests in the eastern United States is 3%, which is only 5.5% of what it was in 1950. This decline is expected to continue. Without natural or anthropogenic disturbances, oak-hickory forests that produce hard and soft mast and invertebrate foods

important to wildlife will be replaced by shade-tolerant species such as sugar maple (*Acer saccharum*). This change in forest type change will dramatically influence populations of ruffed grouse and other wildlife species of conservation concern.

Wild Turkey Population Status

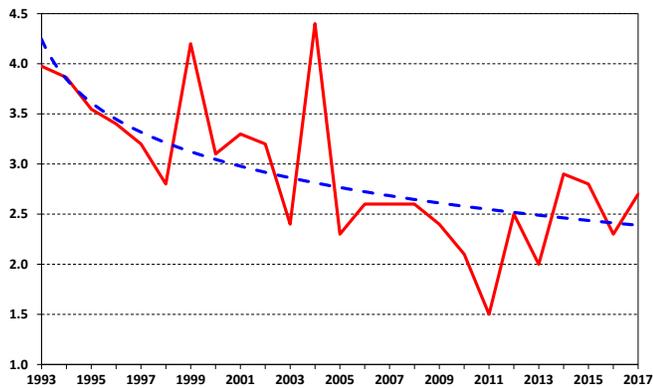
Downward trends in summer brood production of wild turkeys after the post-restoration era have become an increasing concern in the eastern United States, including Indiana. From 1993 to 2015, IDNR biologists and conservation officers annually recorded observations of wild turkey hens and poults, including hens without poults, during July and August. The summer brood Production Index (PI) is the total poults/total adult hens compiled into one index from these observations. The PI is an accurate index of production



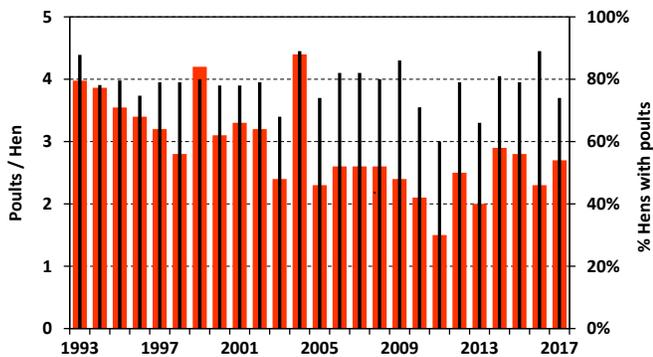
Seven-week-old wild turkey poults with adult hen, warming in sunlight. (Photo by Grace Johnson)



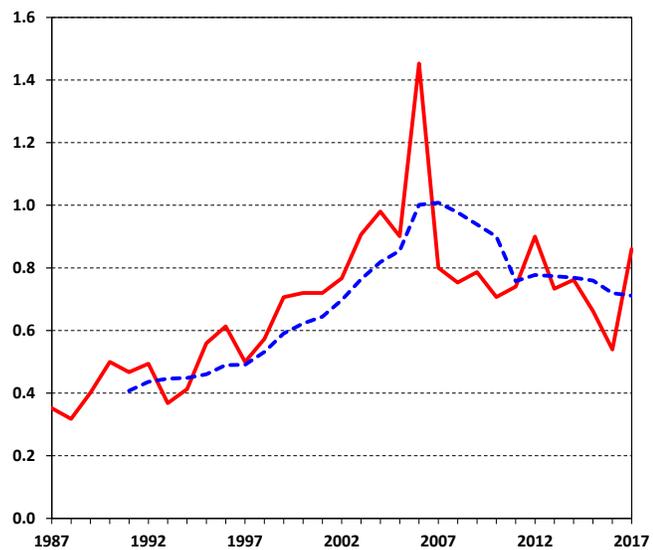
Wild turkey hen with six nearly grown poults searching for bugs in grassy field border. (Photo by Grace Johnson)



Average number of wild turkey poults per adult hen observed during the summer brood season, 1993–2017. Annual results are represented by the solid red line. The dashed blue line depicts logarithmic scale values.



Average number of wild turkey poults per hen (wide orange bars) and percentage of hens observed with poults (narrow black bars), 1993–2017.



Average number of gobblers heard per stop during roadside surveys in Indiana, 1987–2017. Annual results are represented by the solid red line. The dashed blue line depicts the five-year moving average.

because it counts all hens observed, including those without poults. A chronic bias in these data is the tendency of observers to more readily report hens with poults than hens without poults (barren hens), which produces a higher PI than actually occurred. The PI is often higher in August than July due to "gang" brood behavior, when several broods and hens without broods combine into a single brood flock.

In 2016, a new web-based brood reporting system began using an online data-entry software platform. This system facilitates reporting of turkey observations by natural resource agency personnel and interested members of the public during the summer months. The addition of public observations could lead to greater coverage and more observations. Instructions for reporting turkey observations were developed and promoted through agency communications, including a "Wanted Poster" available online as a letter-size card-stock poster or wallet-size cards.

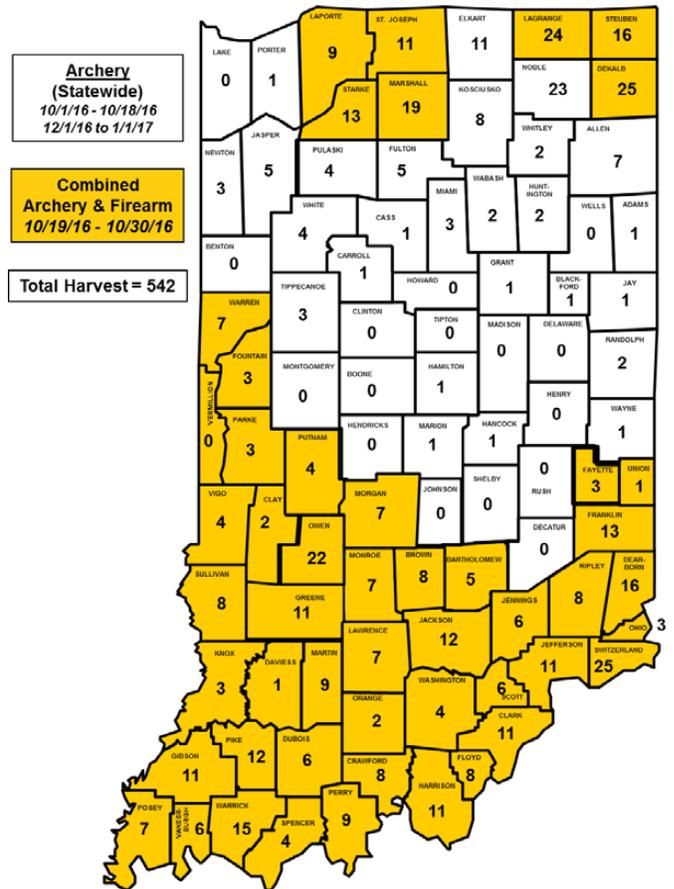
In 2017, a total of 967 usable observations of at least one wild turkey was received from 765 participants during July (69% of observations) and August. This represents a 69% increase in observations and 158% increase in participants from 2016. Observations from non-DNR personnel accounted for 80% of the reports. These reports totaled 7,659 turkeys (2,069 hens, 5,590 poults) from 747 brood observations. The 2017 PI was 2.7 poults/hen, with 74% of the hens with at least one poult. This figure is 17% greater than the 2016 PI of 2.3. Average brood size was 9.5 birds when at least one adult hen with poults was observed. The PI and percent of hens with broods in 2017 did not differ from the previous five-year (2012–2016) values of 2.6 and 74%, respectively.

The average PI has progressively declined from 3–4 in the early 1990s to about 2 from 2005 through 2013, with some signs of recovery to around 2.5 in recent years. The downward trend in the PI is indicative of a turkey population that has transitioned from one with geometric growth during restoration to an established population with stable annual production and growth rates. Regional production is viewed cautiously due to the scarcity of brood reports in portions of the state that traditionally have high spring harvests, such as southeast Indiana. Other potential biases in brood detection among regions include differences in vegetation, road density and topography. However, there was notable improvement in coverage in 2017, and as more people participate, greater coverage across the entire state can be expected.

Roadside gobbler counts are conducted annually from late March to April to monitor the relative abundance of wild turkey populations in areas surveyed. Routes consist of 15 stops on 10–20 miles of rural roadways. Routes are driven at least twice, in opposite directions, and the highest gobbler count heard per stop is used to determine the Gobbling Index (GI). These counts are not indicative of trends in abundance because weather



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



County distribution of the 542 wild turkeys harvested during the 2016–17 fall season.

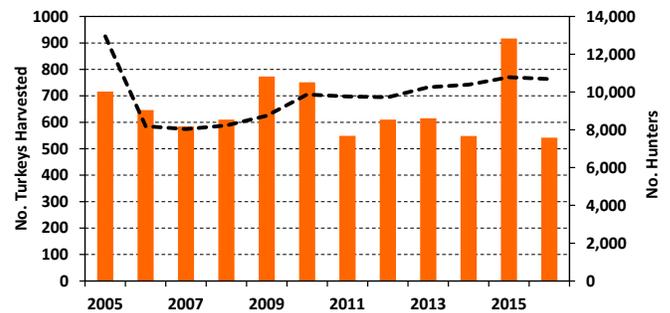
conditions may affect results and two-year-old gobblers (a product of summer production two years prior) are disproportionately more vocal. The GI, however, does provide insight into long-term population trends and information to compare areas relative to one another.

The number of wild turkeys heard gobbling along 14 roadside routes in 19 counties from March 29 to April 19, 2017 was 0.86 gobblers per stop. This figure is 51% greater than the 2016 GI of 0.57 but did not differ from the five-year mean of 0.70. The five-year moving average shows an overall increase from 1987 through 2006, followed by a general decrease.

Fall 2016–17 Wild Turkey Harvest

Hunters harvested 542 wild turkeys during the 12th fall turkey hunting season, 375 fewer birds (41%) than were harvested in 2015–16, but similar to the 2014–15 harvest of 548 birds. Sixty percent of the harvest occurred during the combined shotgun and archery portion of the season, with archery hunters taking 59% of the total harvest. About 52% of the birds were taken on weekends, with 30% taken during the two weekends of the combined archery/firearms portion.

Adult birds were 80% of the harvest, with a juvenile-to-adult ratio of 1:4. Adult males composed the largest proportion (46%) of the harvest, followed by adult



Number of wild turkeys harvested (orange bars) and number of hunters (black dashed line) during fall hunting seasons in Indiana, 2005–2016.

females (34%). 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 by hunters. Ninety-five percent of the harvest occurred on privately owned lands. Counties in which at least 20 birds were harvested were DeKalb (25), Switzerland (25), Lagrange (24), Noble (23) and Owen (22).

Compared to 2015–16, 13 counties had increased fall harvests, 15 experienced no change, and 64 counties had decreased harvests. Sixteen counties open to archery-only hunting did not harvest a single bird. The proportion of the fall harvest to spring harvest by county ranged from 0% to 20%. The statewide fall-to-spring harvest proportion was 4% because of the conservative season structure and relatively low hunter interest. The decline in harvest and hunter success rate from last year was likely influenced by a combination of factors. In 2015–16, five additional days of hunting with firearms, which included a second weekend, were added in the northern counties, possibly attracting more hunter interest that may have dissipated after the initial year. Additionally, statewide summer brood production was down in 2016, but especially so along river drainages in southern and west-central Indiana.

Interest in fall turkey hunting in Indiana remains relatively low compared to the spring season. An estimated 10,688 hunters participated in the 2016–17 fall season and had an estimated success rate of 5%. Despite increases in potential hunter opportunity, participation has yet to return to the high level of the first “novelty” season in 2005.

Spring 2017 Wild Turkey Harvest

Hunters harvested 13,069 wild turkeys in 90 of Indiana’s 92 counties during the 2017 (48th) spring turkey season, as reported to the CheckIN-Game harvest reporting system. The total harvest was 8% greater than the 2016 spring harvest of 12,081 birds.

Harvest exceeded 200 birds in 30 counties, compared to 25 in 2016. Harvests increased from 2016 in 60 counties, decreased in 26 and remained unchanged in six. All regions had proportional increases in harvests, ranging from 4% to 13%, except for east-central Indiana, where no change occurred. The 10 leading counties were Harrison (406 birds), Steuben (359), Greene (344), Jefferson (332), Dearborn (328), Orange (314), Warrick (320), Noble (317), Switzerland (311), Franklin (310), Marshall (303) and Perry (301).

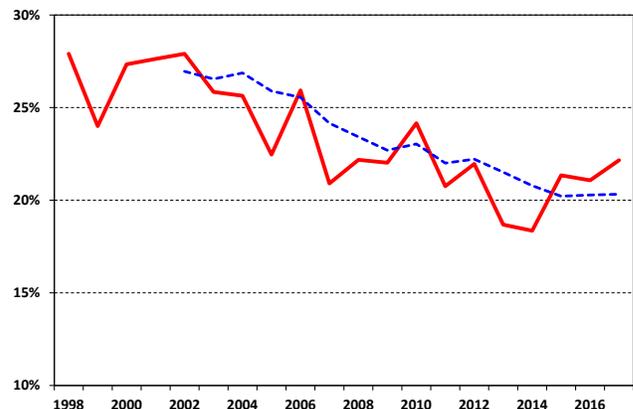
Most birds were harvested early in the season, in early-morning hours. A total of 1,455 birds (11%) was taken during the youth-only weekend. Fifty-eight percent of the regular season harvest (11,614 birds) was taken during the first five days of the 19-day season, with 42% occurring on the three weekends.

Age distribution was 13% juveniles, 39% two-year-olds and 48% three years of age or older. This structure reflects variation in brood production from 2014 to 2016 and the greater vulnerability of adult gobblers to harvest. The mean proportion of juveniles in spring harvests from 1988 to 2005 was 28% but has since declined to an average of 19%. The 13% proportion of juveniles in 2017 was the lowest on record and raises concern for future hunter success and satisfaction. The 2017 age structure suggests fewer 2-year-old gobblers in 2018 than the 39% in 2017, which was also lower

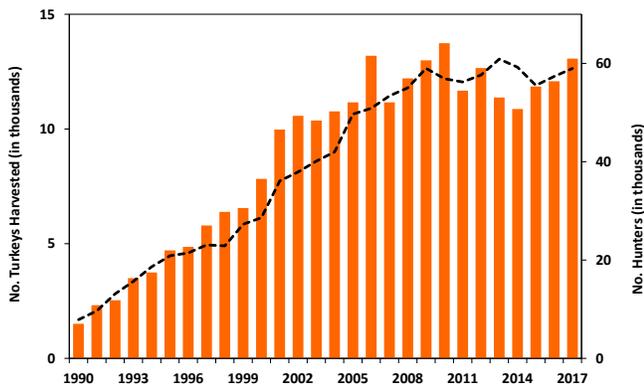
than the previous 10-year mean of 48%. Two-year-olds are the most active gobbler cohort and generally the most vulnerable to harvest. Higher harvest of adult gobblers may, however, be offset by greater recruitment of juveniles into adult age classes in later years, allowing for sustainable harvest levels. Poor produc-



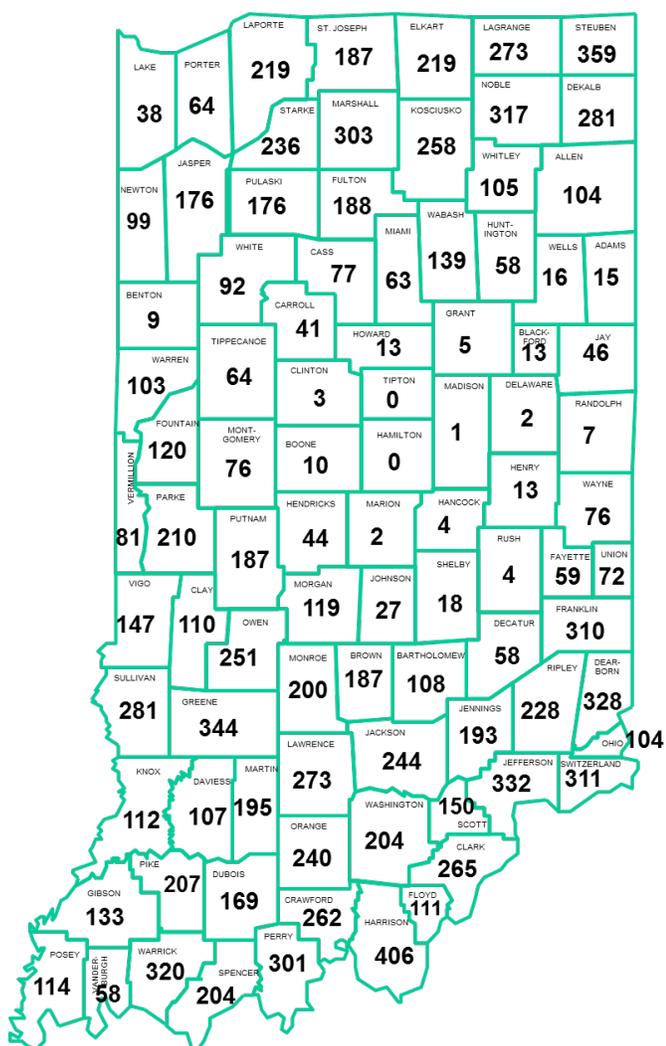
More than 1,450 turkeys were harvested during the youth-only weekend of the 2017 spring season.



Trends in spring wild turkey hunting success, 1998–2017. Annual success is represented by the solid red line. The dashed blue line depicts the five-year moving average.



Number of wild turkeys harvested (orange bars) and number of hunters (black dashed line) during spring hunting seasons in Indiana, 1990–2017.



County distribution of the 13,069 wild turkeys harvested during the 2017 spring season.

tion in 2016, as revealed in the 2017 spring harvest, suggests fewer adult hens in 2018 that may affect production for several years, regardless if weather and habitat conditions favor poult survival.

Annual spring harvest levels have generally stabilized at 11,000 to 12,000 birds since the peak harvest in 2010 (13,742). During this time, the number of hunters afield ranged from 56,000 to 61,000, with success rates from 18% to 24%. The 2017 spring harvest was the third highest, with an estimated 58,980 hunters afield and a success rate of 22%. This was the third consecutive year of slightly improved hunter success. Relative hunter success and harvest levels, however, may not accurately reflect trends in turkey abundance unless hunter effort is considered.

Increases in total harvest and hunter success were likely due to summer production in 2014 and 2015 that was slightly greater than long-term trends yet still below production levels from the restoration era. The general decline in production in Indiana during the last 10 to 12 years has also occurred through the eastern United States as populations stabilized in the post-restoration era with harvests declining to levels below those of peak years. The greatest declines in Indiana are in the southern half of the state where turkey restoration was first completed.

The influence of annual summer production on turkey harvests has created some uncertainty about sustainable harvest levels and future management strategies. Increased harvests and greater proportion of adult gobblers were welcomed by hunters in 2016 and 2017. However, the low proportion of juveniles in the 2017 spring harvest, coupled with low production in 2016, raises concerns about harvest trends and hunter success in the coming years.

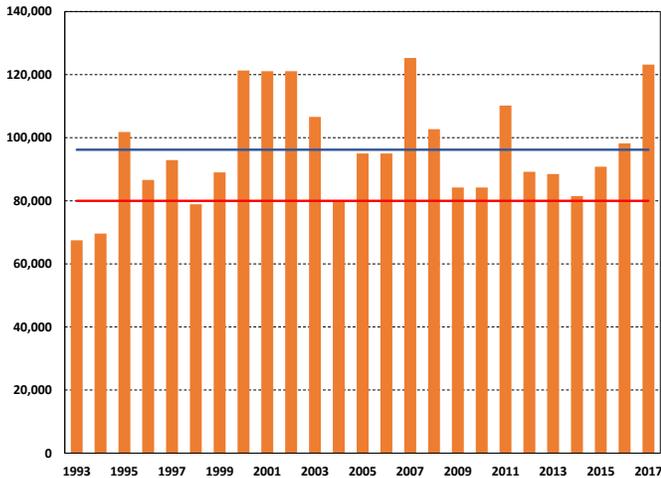
WATERFOWL

Waterfowl Population Surveys

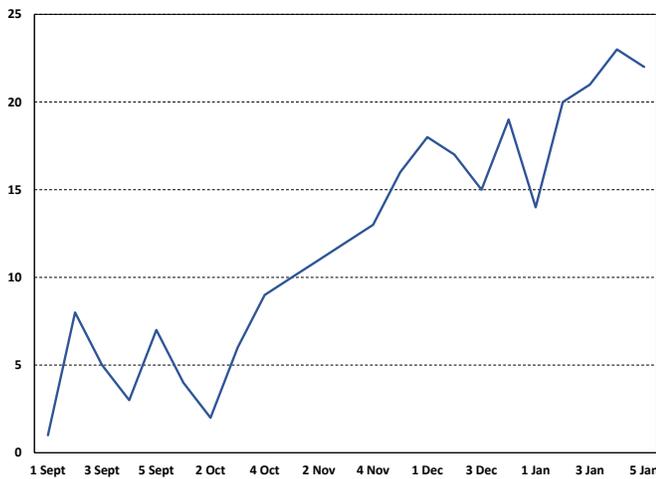
The DFW performs many surveys to determine the distribution and abundance of waterfowl populations in Indiana. In April, helicopters are used to estimate



Mallards breed throughout Indiana, and large numbers of southbound migrating mallards begin arriving in the state in November. Many remain here throughout the winter. (Photo by Ryan Askren)



Breeding Canada goose population estimates for Indiana, 1993–2017. The red (lower) horizontal line represents the state goal of 80,000. The blue (upper) horizontal line represents the average population estimate during the entire period.



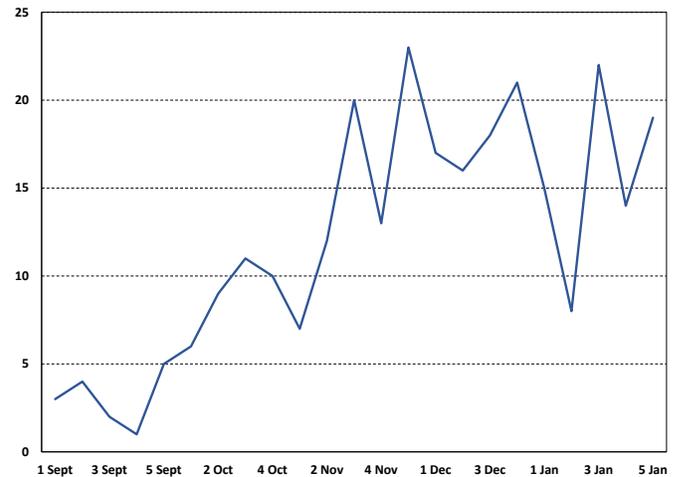
Average migration for all ducks in the South Zone during the 2014–16 seasons. The x-axis represents the week of the month, not the date. The y-axis represents rank. The survey occurs for 23 consecutive weeks. The week with the highest count of ducks has a rank of 23, while that of the lowest count has a rank of 1.

statewide breeding populations of Canada geese, mallard (*Anas platyrhynchos*), blue-winged teal (*A. discors*) and mute swan (*Cygnus olor*). Wood duck (*Aix sponsa*) populations are not estimated because the species nests in tree cavities not visible from a helicopter.

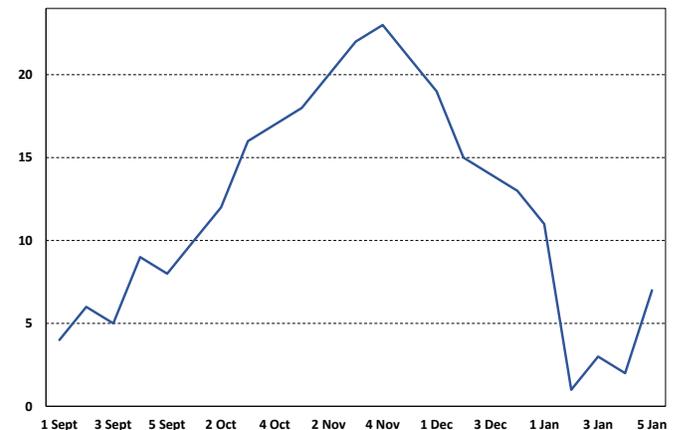
Indiana breeding population estimates for 2017 were 123,175 Canada geese and 20,492 mallards. Numbers of breeding blue-winged teal were not estimated because most occurred in large flocks. This indicates that they are migrating birds rather than breeding birds.

Mute swan populations are rarely estimated from data collected during flights. The distribution of these swans on the landscape is so scattered that it is difficult to get a good estimate using our random plot method. Instead, the DFW works with U.S. Department of Agriculture Wildlife Services staff to determine mute swan distribution and abundance in Indiana.

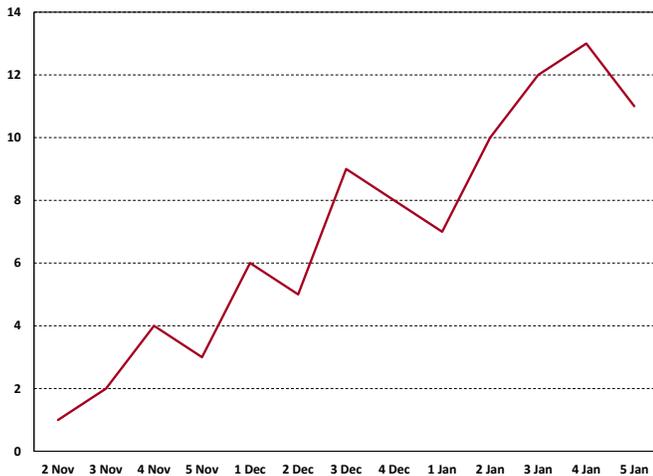
Since 1986, weekly waterfowl surveys have been conducted from the last week in August through the end of January on selected state and federal properties throughout Indiana. These data allow



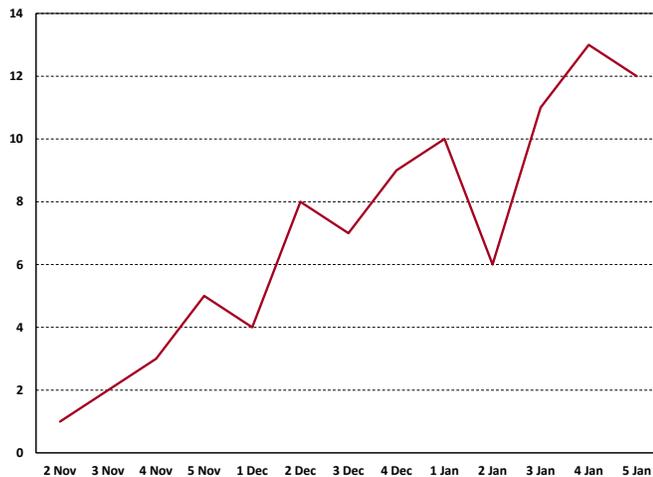
Average migration for all ducks in the Central Zone during the 2014–16 seasons. The x-axis represents the week of the month, not the date. The y-axis represents rank. The survey occurs for 23 consecutive weeks. The week with the highest count of ducks has a rank of 23, while that of the lowest count has a rank of 1.



Average migration for all ducks in the North Zone during the 2014–16 seasons. The x-axis represents the week of the month, not the date. The y-axis represents rank. The survey occurs for 23 consecutive weeks. The week with the highest count of ducks has a rank of 23, while that of the lowest count has a rank of 1.



Average migration for all ducks on the lower Wabash River, from its confluence with the Ohio River upstream to Terre Haute, during the 2014–16 seasons. The x-axis represents the week of the month, not the date. The y-axis represents rank. The survey occurs for 13 consecutive weeks. The week with the highest count of ducks has a rank of 3, while that of the lowest count has a rank of 1.



Average migration for all ducks on the section of the West Fork White River from Martinsville downstream to Elnora during the 2014–16 seasons. The x-axis represents the week of the month, not the date. The y-axis represents rank. The survey occurs for 13 consecutive weeks. The week with the highest count of ducks has a rank of 3, while that of the lowest count has a rank of 1.

the DFW to monitor yearly and long-term migration patterns 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 during peak migration.

In 2012, DFW 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 2016–17 season was the fifth for the Wabash surveys and the fourth 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 upstream to the Interstate 70 bridge in Terre Haute. The West Fork White River is flown from the State Road 39 bridge in Martinsville downstream to the State Road 58 bridge west of Elnora. The ditches and marshes around Gibson Generating Station, including Gibson Lake and Cane Ridge Wildlife Management Area, are also flown. This is an important area for wintering waterfowl, especially mallard, snow goose (*Chen caerulescens*), and Ross’s goose (*C. rossii*).

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 both 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. Information from banded birds is sent to the U.S. Geological Survey’s 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 visiting reportband.gov. Information from band recovery is critical to waterfowl



A newly banded Canada goose expresses her displeasure with the process. (Photo by Deanna Lazowski)

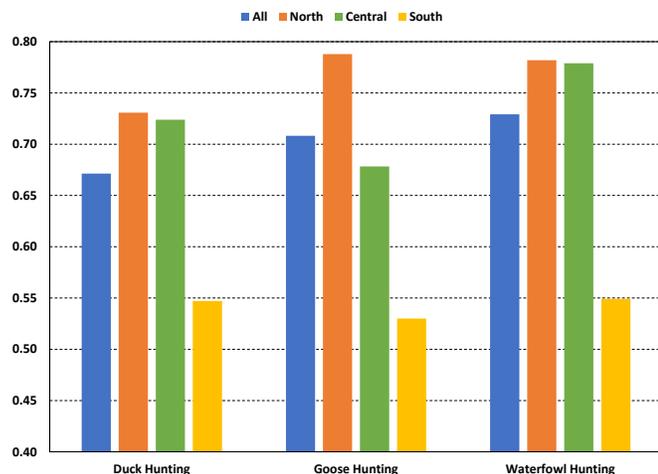
harvest management. The data are used to calculate survival and harvest rates, as well as to determine movement patterns.

A total of 1,556 Canada geese were banded on private and public lands in Indiana in 2017. An additional 19 geese were banded as they were relocated from nuisance situations to FWA properties. Just as in the last two years, the goal of banding 2,000 geese was not reached. A total of 331 wood ducks were banded. That number too was short of the annual goal (1,285) and the 2016 total (934), but in line with the 2013–15 average of 394 wood ducks banded. Water conditions were excellent during wood duck banding in 2017 at most locations, which may have contributed to concentrations of ducks being difficult to locate.

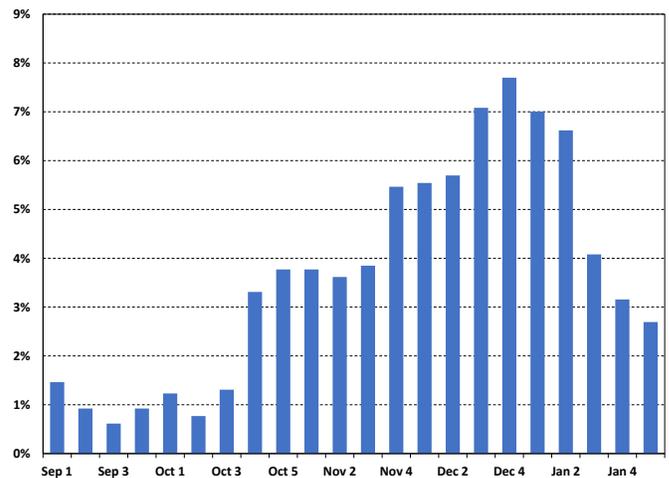
Surveying Waterfowl Hunters

Surveys of waterfowl hunters assess hunting effort and success, as well as hunter satisfaction, habits and approaches to hunting. This information allows DFW biologists to set seasons that incorporate the biology of the species hunted and the desires of the hunters who make conservation possible. The survey is sent to waterfowl hunters every three years.

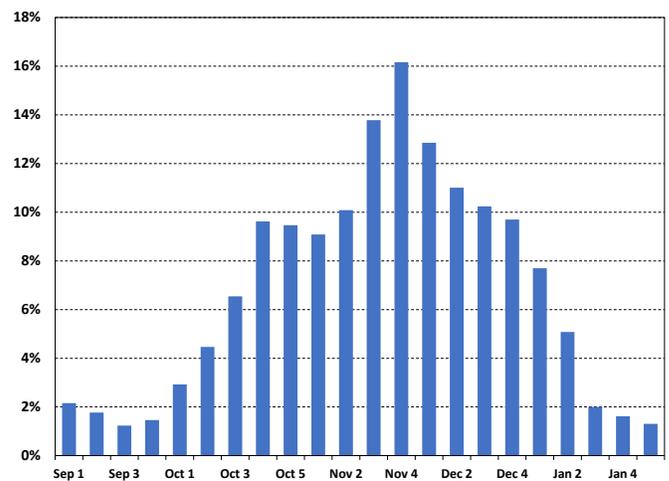
The most recent survey was sent after the 2016–17 season. Five thousand adult resident waterfowl hunters were randomly selected from the federal Hunter Information Program (HIP) database. Of the 5,000 sent, 1,570 (31.4%) were returned. The survey had 22 questions although many had multiple parts. Results reported here represent a small portion of the data from this survey. A full report will be available at wildlife.IN.gov.



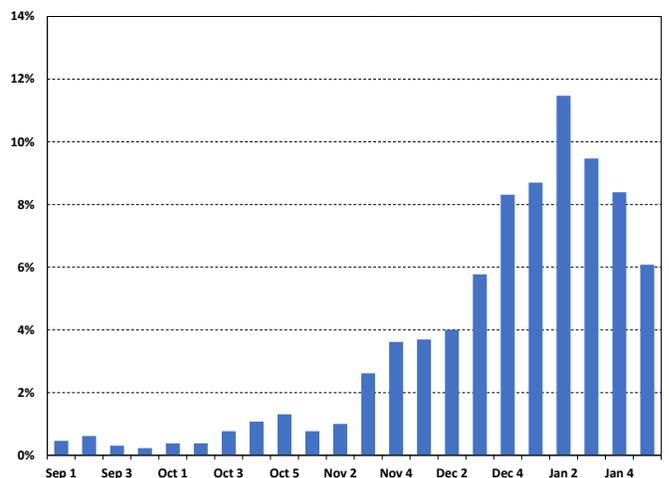
Percentage of hunters reporting being “satisfied” or “very satisfied” with their duck hunting experience, goose hunting experience, and waterfowl hunting experience in Indiana. Each hunt type is separated into all waterfowl hunters (first column) and into zones (last three columns). Satisfaction is lowest for all hunt types in the South Zone, but satisfaction in all zones for all hunt types still exceeds 50%.



Preferred hunt weeks for Central Zone duck hunters. The x-axis represents the week of the month, not the date (“Sep 1” is the first week of September).



Preferred hunt weeks for North Zone duck hunters. The x-axis represents the week of the month, not the date (“Sep 1” is the first week of September).



Preferred hunt weeks for South Zone duck hunters. The x-axis represents the week of the month, not the date (“Sep 1” is the first week of September).

Hunter satisfaction with “overall waterfowl hunting experience” was 73%, which was 12 points higher than in 2014 and the highest satisfaction level since at least 2008. Satisfaction with “overall duck hunting experience” and “overall goose hunting experience” were also high (67% and 71%, respectively).

Although it appears that satisfaction increased for most hunters since 2014, that could be a product of survey design. In addition to “no opinion”, there were five choices (“very satisfied,” “satisfied,” “neutral,” “dissatisfied,” and “very dissatisfied”) on the 2014 survey. However, due to difficulty in interpreting what “neutral” meant, that option was removed in the 2017 survey. Because the proportion of those reporting “no opinion” changed little in 2017, removing “neutral” may have forced respondents to choose between satisfaction and dissatisfaction.

The next survey will be sent after the 2019–20 hunting season.

WHITE-TAILED DEER Deer Management in Indiana

The DFW monitors and manages Indiana’s deer herd using a combination of population indices. Indices are measures that represent what the population is doing (i.e., increasing, decreasing, remaining stable), although they do not calculate the actual size of the population. These indices include the number of deer harvested annually, the amount of crop damage reported by landowners, and the number of deer-vehicle collisions reported to the Indiana Department of Transportation (INDOT). Individually, these factors are not useful, but collectively, they model trends in the deer population over time.

The DFW examines these trends over five- to 10-year periods. Survey data from hunters, landowners and others are also evaluated to determine public opinion about the health, status, and management of Indiana’s deer population. Both trend and survey data are used to determine how to manage the statewide deer population.



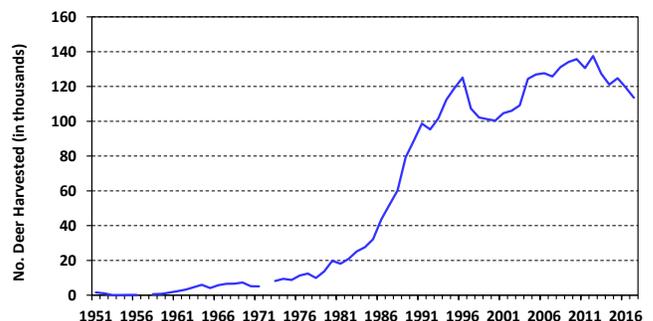
White-tailed deer were present in almost 60% of the nearly 33,000 photos taken during the 2017 Snapshot Indiana project.

In 2012, a management goal to “focus deer herd reduction in a strategically targeted manner to more adequately balance ecological, recreational, and economic needs of the citizens of Indiana” was developed. During the development of this goal, a group of Indiana’s deer stakeholders committee recommended that the plan be revisited every five years.

In May 2017, the DFW invited 13 stakeholder groups to review the current state of Indiana’s deer herd, review the goal established in 2012, and, if deemed necessary, discuss a new management goal. Attendees reviewed information on trends in harvest, deer-vehicle collisions, and hunter opinion and satisfaction. A new management goal was agreed upon by all attendees for the next five-year period to “focus deer herd management in a strategically targeted manner to more adequately balance ecological, recreational, and economic needs of the citizens of Indiana.”

2017–18 Deer Harvest

The 2017-18 deer hunting season ran from September 15, 2017 through January 7, 2018 and included four statewide seasons: Youth (Sept. 23–24), Archery (Oct. 1–Jan. 7), Firearms (Nov. 18–Dec. 3) and Muzzleloader (Dec. 9–24). In addition to the four statewide seasons, a Special Antlerless Firearms season was available from December 26 to January 7 in 51 counties. A total of 113,595 deer were harvested during the 2017–18 season. This figure included 45,095 antlered deer and 68,500 antlerless deer. This year’s harvest was 5% less than the 2016–17 harvest.



The annual number of deer harvested during hunting seasons in Indiana, 1951–2017. The numbers from 1993 through 2017 include deer that were harvested in State Park deer reductions.

Deer Hunter and Landowner Surveys

In previous years, paper surveys were mailed to a random selection of Indiana licensed deer hunters and property owners who hunt. These surveys collected information on hunter and landowner opinions of deer hunting and deer management, both statewide and in the county in which the individual hunted. In 2017, the surveys were redesigned and expanded to include

questions intended to generate additional information regarding the quality of the hunting experience, the demographics of harvested deer and overall satisfaction of deer management in Indiana. In 2018, a more comprehensive survey that mimics surveys from previous years will be distributed via mail and email to hunters and landowners.

In 2017, an online “After Hunt Survey” was made available for hunters to complete after they checked in their deer. Information was collected about where their deer was harvested in the county, the hunter’s overall hunting experience, and how the hunter felt about the number of deer (bucks and/or does) seen during their hunt. A total of 1,723 of the 3,215 hunters (54%) who attempted the survey completed it. Partial information was collected from the other 1,492 hunters.

A survey is also being developed in 2018 to assess the non-hunting public’s knowledge and opinions of deer management in the state.

Deer Damage Control Program

The DFW’s deer damage control program addresses the immediate damage that deer cause to private properties, primarily those of farmers. The program is designed to resolve localized, short-term problems. It is not a tool to control deer populations on a large scale.

The program allows for the removal of deer outside the hunting season only when damage exceeds \$500, when there is a threat from disease, and when non-lethal measures would be inadequate. The DFW responds to landowner complaints by conducting on-site inspections and providing appropriate technical advice. If non-lethal methods, such as fencing or repellants are deemed ineffective or inappropriate for the situation, the DFW may issue a deer damage control permit. The permit requires any antlers to be removed and be provided to IDNR Law Enforcement or other approved IDNR personnel.

In 2017, the DNR issued 301 permits. For each permit, an average of 13.4 deer were authorized to be taken, but an average of only 6.4 deer were actually taken. A total of 1,862 deer were taken statewide, which represents 1.6% of the cumulative number of deer harvested by hunters in 2017–18 and taken on damage permits. Of the taken deer, 222 (12%) were adult bucks and 1,636 (88%) were male fawns and does. Sex was not reported for four deer.

Soybean and corn were reported as the most frequently damaged crops. The program provided 158 deer that were donated to families in need. Thirty disease permits were issued to landowners because of concern about transmission of bovine tuberculosis (bTB) to livestock. Eleven deer were taken using these permits.

Community Hunting Access Program

The DFW created the Community Hunting Access Program (CHAP) in 2017 to provide opportunities to hunt white-tailed deer in urban areas and to help

reduce deer-human conflicts. The program offers community partners financial and technical assistance to administer hunting programs in their communities. In 2017, one CHAP application was received, but the contract was not completed because of the community’s administrative and logistical concerns about having a hunt in the first year of the program.

Participating communities are encouraged to hire and work closely with certified CHAP Hunt Coordinators (CHCs). The DFW provides a training program for CHCs that teaches how to administer community hunts, manage hunters and navigate the application process as a community representative. In 2017, a total of 10 people attended the inaugural CHC training, and the DFW certified five people as CHCs. Additional information about CHAP is available at wildlife.IN.gov/9420.htm.

WILDLIFE HEALTH

Salamander Chytrid Disease

Salamander chytrid disease is caused by a newly discovered fungus, *Batrachochytrium salamandrivorans* (*Bsal*), that infects the skin of salamanders and newts. First described in 2013, it has caused mass die-offs in the Netherlands. Believed to be of Asian origin, *Bsal* has since been documented in Belgium and Germany. It is not known to occur in North America although there have been few studies to determine its presence.

In 2016 and 2017, biologists sampled amphibians in Madison, Pike and Jefferson counties in Indiana for *Bsal*. A total of 101 samples were taken from eastern newts (*Notophthalmus viridescens*) and northern slimy (*Plethodon glutinosus*), eastern red-backed (*P. cinereus*) and southern two-lined (*Eurycea cirrigera*) salamanders. All samples tested negative for *Bsal*, but



Eastern newts have shown lethal responses in laboratory infections of Bsal. They also may serve as vectors for spreading the disease because they are a wide-ranging species and individuals will migrate long distances to new ponds.

nearly half were positive for *B. dendrobatidis*, a related fungal pathogen known to occur in Indiana that can also affect amphibians.

To prepare for the possible introduction of *Bsal* to North America, the DFW will support regional and national research, possibly including continued surveillance in Indiana amphibians, disease management strategy investigation, pet store surveillance and human dimension surveys. In 2017, the DFW began to require researchers that request permits for fieldwork with reptiles and amphibians to follow biosecurity and decontamination guidelines published by the Northeast Partners in Amphibian and Reptile Conservation in order to help reduce the risk of disease transmission.

Snake Fungal Disease

Snake fungal disease (SFD), caused by the fungus *Ophidiomyces ophiodiicola*, was first identified in Indiana in 2017. SFD is an emerging pathogen of snakes that has been found in more than 15 genera of captive and free-ranging snakes in 21 states.

The fungus was identified in swabs taken from the skin of 13 of 53 snakes tested from Indiana. Species that tested positive were the northern watersnake (*Nerodia sipedon*), racer (*Coluber constrictor foxii*), queen snake (*Regina septemvittata*) and milk snake (*Lampropeltis triangulum*).

The study is part of a multi-year, statewide surveillance project funded by a DNR State Wildlife Grant. It is being conducted by a team of researchers from the University of Illinois and Illinois Natural History Survey and will resume in spring 2018.



Typical lesions of snake fungal disease. (Photo by Matt Allender)

Avian Influenza

Indiana has not experienced an outbreak of highly pathogenic avian influenza (HPAI) since the event in a commercial turkey flock in Dubois County in January 2016. By May 1, 2016, all Indiana poultry farms were released from a quarantine that had resulted from that outbreak.

In 2017, DFW personnel again conducted two forms of HPAI surveillance. Opportunistic sampling consists of collecting wild birds that died of unknown causes that meet the following criteria: individual waterfowl, shorebirds, gallinaceous birds (i.e., grouse, pheasant and wild turkey), raptors and songbirds that died during a mortality event of five or more individuals.

The DFW also conducted surveillance of dabbling ducks as part of the national surveillance plan for HPAI in wild birds. Researchers collected 374 swabs from hunter-harvested waterfowl at State FWAs and from local mallards captured during an urban banding study in greater Indianapolis.

All samples in 2017 were negative for HPAI.

Avian Cholera

The first documented outbreak of avian cholera in Indiana occurred in December 2017 in Gibson County. In response, the DFW, combined with federal and private partners, collected and disposed of waterfowl carcasses at affected sites each week through mid-March 2018. These efforts reduced bacterial contamination of the environment and decreased the risk of transmission to other birds in this area, particularly whooping cranes and raptors. Surveillance of waterfowl populations also increased statewide.

About 700 birds were found dead in association with the outbreak, most of which were snow geese. Infection was also documented in a white-fronted goose (*Anser albifrons*). Tens-of-thousands to hundreds-of-thousands of snow geese and other waterfowl occupy these sites in winter, so the incidence of disease appeared to be very low with no population-level effects expected. Concurrent avian cholera outbreaks were also identified in several other Mississippi Flyway states in 2017.

Rabies

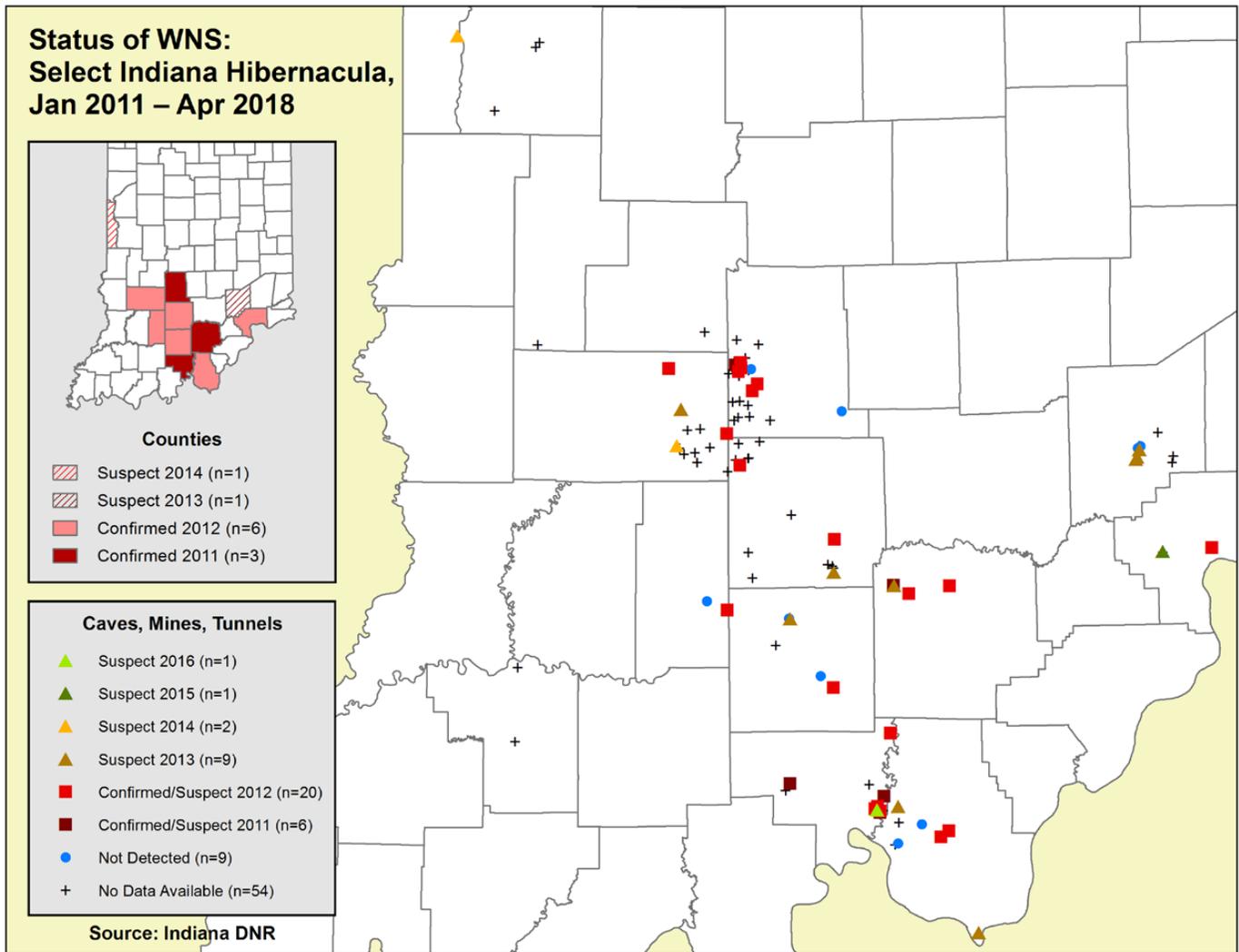
Testing of wildlife for rabies is conducted by the Indiana State Department of Health (ISDH) in cases of known or suspected human exposure. Unlike other mammals submitted for testing in Indiana, bats continue to occasionally test positive. In 2017, 14 of 425 submitted bats (3.3%) tested positive. From 2012 through 2016, only 3.7% of 1,945 bats submitted to the ISDH were rabies positive.

Of terrestrial wildlife in Indiana, the last rabies positive skunk identified was in 2004, the last rabies positive fox identified was in 1990, and the last rabies positive raccoon identified was in 1979.

White Nose Syndrome

WNS-related work in Indiana in 2017 included elements of disease surveillance and population monitoring.

Winter bat surveys in 11 hibernacula documented substantial declines in abundance since the detection of WNS in Indiana in 2011. WNS surveillance again was performed in conjunction with hibernacula



Status of WNS in select bat hibernacula in Indiana, January 2011–April 2018.

surveys. Ten of the 11 caves had prior evidence of the disease from past surveys. No evidence of WNS was found in the 11th cave (Jughole Cave), and no bats from this site were submitted to the USGS NWHC for histopathology because it is in a county known to have WNS-infected hibernacula.

To date, WNS has been detected in 39 hibernacula from 11 Indiana counties. Results from long-standing surveys show that the disease has progressed to levels that caused high rates of mortality for little brown bats (89%), tri-colored bats (93%) and, to a lesser extent, Indiana bats (14%). In 2017, for the first time since WNS was documented in Indiana, winter populations of little brown bats showed a modest increase (12%) from the prior count.

Hemorrhagic Disease

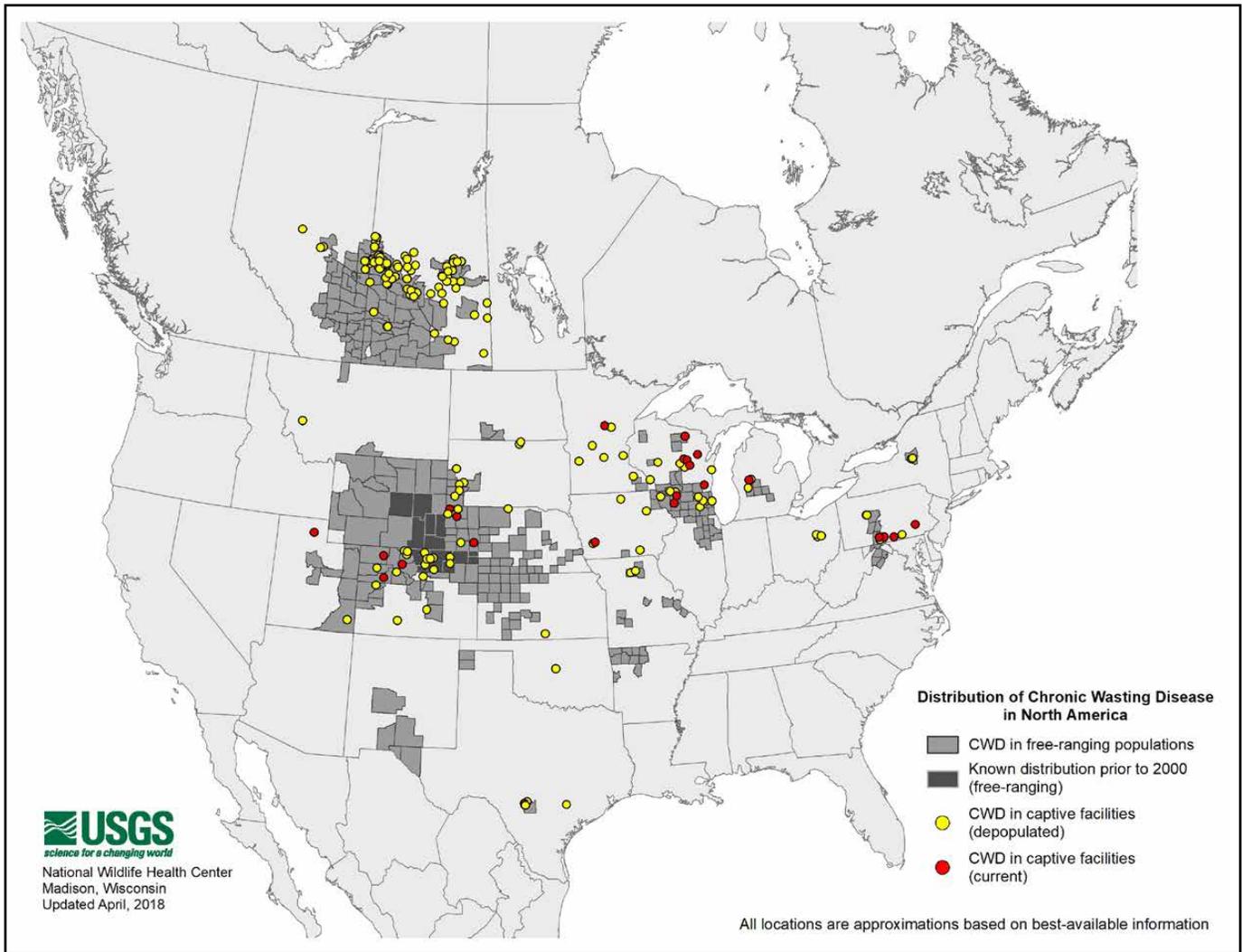
Hemorrhagic disease, caused by the related epizootic hemorrhagic disease (EHD) and bluetongue viruses, is spread to wild ruminants, including white-tailed deer, by biting midges. Often worse in drought years,

outbreaks tend to be cyclic and may cause significant localized mortality in late summer or early fall, before freezing temperatures halt midge activity. The last EHD outbreak in Indiana occurred in 2015. Fewer than 20 deer with signs suggestive of EHD were reported by the public in 2017, but no cases were confirmed.

Chronic Wasting Disease

Chronic wasting disease (CWD) is a fatal, neurodegenerative disease that affects members of the cervid family, including white-tailed deer, mule deer (*O. hemionus*), elk (*Cervus elaphus*) and moose (*Alces alces*). It is in a class of prion-caused diseases known as transmissible spongiform encephalopathies (TSE). First identified in captive mule deer in Colorado in 1967, CWD has spread to wild and captive deer in 24 states and three Canadian provinces. It has also been found in deer species in Europe and Asia.

Since 2002, the DFW has been testing samples from hunter-harvested and road-killed deer as part of the statewide CWD surveillance program. Sick deer re-



Distribution of CWD in North America, April 2018.

ported by the public are also tested annually through targeted surveillance.

In 2017, researchers collected 380 samples with focused effort in northwest Indiana due to its proximity to confirmed CWD cases in wild deer in Illinois. Those confirmed Illinois cases are within 25 miles of the state line. Since surveillance began in Indiana in 2002, DFW biologists have tested more than 20,000 samples. CWD has not been detected in any samples.

In 2018, the DFW will continue statewide testing with increased emphasis in northern Indiana.

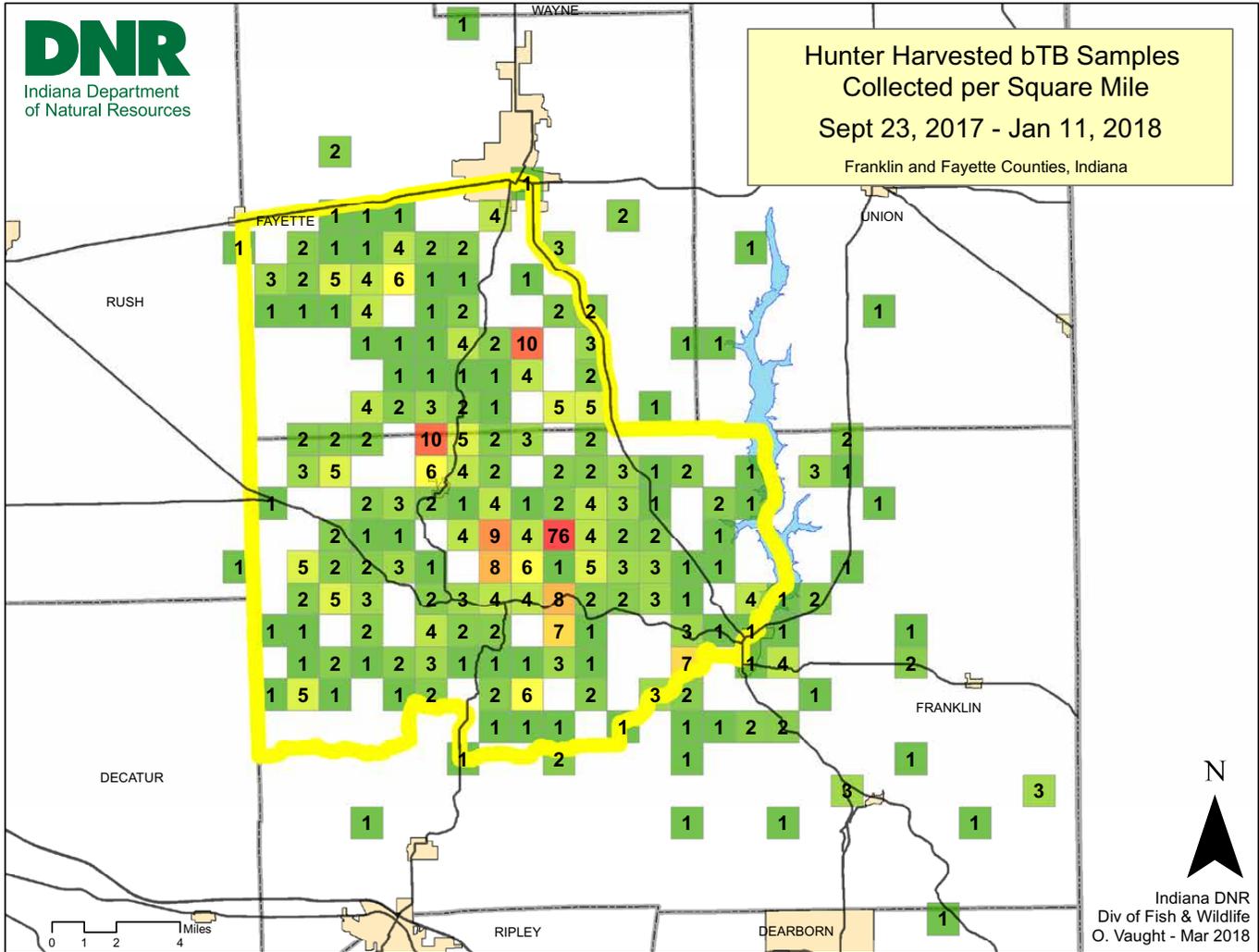
Bovine Tuberculosis

Bovine tuberculosis (bTB) is a contagious, chronic bacterial disease caused by the bacterium *Mycobacterium bovis*. The bacterium typically infects the lungs but may spread to other organs and can infect many mammals, including humans. If infection becomes established in white-tailed deer, they can act as reservoir hosts, and the existence of multiple reservoir hosts can make eradication of bTB difficult.

Bovine tuberculosis was detected in farmed deer and cattle in 2008 and 2009 in Franklin County and in cattle in Dearborn County in 2011. In response, the DFW conducted a surveillance program from 2009 through 2015 to determine if bTB had spilled over into wild deer. Biologists sampled 1,400 deer, all of which tested negative for bTB.

In 2016, bTB was detected in a second Franklin County cattle farm. Resident wildlife were removed from the farm, and one deer and one raccoon tested positive for bTB. Both infections were determined to have been spillover events from livestock. In response, the DFW initiated more intensive bTB surveillance during the 2016–17 and 2017–18 deer hunting seasons in portions of Fayette, Franklin and Dearborn counties.

A total of 2,047 hunter-harvested deer were sampled during the 2016–17 season, all of which tested negative for bTB. In December 2016, however, bTB was identified on a third cattle farm in Franklin County. Resident wildlife on this farm were also removed, and one raccoon tested positive for bTB. It too was demonstrated



Number of hunter-harvested bTB samples collected per square mile in Franklin and Fayette counties in Indiana, September 2017–January 2018.

to be spillover from livestock to wildlife. A total of 541 hunter-harvested deer were sampled during the 2017–18 season, none of which have tested positive for bTB.

These results suggest that, through the 2017–18 hunting season, the prevalence of bTB in wild deer within the Franklin County surveillance zone has remained at levels that are difficult to detect, likely very low to non-existent.

WILD PIGS

Wild pigs (*Sus scrofa*), a non-native and invasive species, were intentionally and illegally released in two regions of southern Indiana in the early 1990s. Genetic analyses linked these pigs to sources in Louisiana and possibly Mississippi. Morphologically, wild pigs exhibit features of Eurasian or Russian boar hybrids rather than those of feral swine of domestic origin. Ongoing DNA profiling of existing populations shows promise as a forensic tool for law enforcement to determine the origin of new populations and a means to evaluate eradication success.

Control of wild pig populations in Indiana was previously conducted through unrestricted shooting. However, combined with recreational sport hunting, this not only proved ineffective in controlling populations, but also often encourages illegal release of more pigs to expand hunting opportunities.

In 2014, Congress approved \$20 million over five years to control and eliminate wild pigs, with emphasis directed at emerging populations in the Midwest farm belt. USDA-Wildlife Services (USDA-WS) hired professional technicians in each state to work with State and federal agencies and cooperating landowners to carry out control techniques such as trapping, snaring, aerial shooting, and selective night shooting. Such methods must be tailored to conditions in the Midwest, where relatively low pig populations, abundant food resources and winter conditions present challenges not likely faced in southern states. Additionally, landowners must learn to integrate multiple control methods and develop patience to capture complete

pig sounder groups (i.e., adult sows and their progeny) for effective removal.

In 2017, USDA-WS technicians removed 226 wild pigs in Indiana, a 74% increase from the 130 removed in 2016. Most pigs (n = 171; 76%) were removed through trapping. Selective night shooting and aerial shooting removed 41 and 11 additional pigs, respectively. Greater success in 2017 was due to additional USDA-WS staff, increased landowner cooperation and continued use of the Judas pig technique. This method involves radio-marking and releasing a subadult pig, allowing it to reassemble with other pig groups. This technique not only helps locate additional pigs, but also provides information about movements and habitat use that will aid future removal efforts. Samples were collected from euthanized pigs and submitted to participating USDA-WS labs for continued disease testing (e.g., classical swine fever, leptospirosis, toxoplasmosis and Seneca Valley virus) and continued DNA profiling.

The proliferation of free-ranging pot-bellied or “Heritage” pig reports in Indiana has become more of an administrative nuisance and unnecessary waste of limited personnel investigation time. Most pot-bellied, Heritage and related hybrid pigs appear to be abandoned, escaped or poorly confined pets or hobby animals. Free-ranging swine of any origin can cause damage to native fauna and flora, their habitats, water resources and personal property and can generally be shot on sight in Indiana with landowner permission. Over the last decade, several pot-bellied or Heritage hybrid pigs have been removed from DNR properties.



USDA-Wildlife Services technicians Jordan Welker and Emily Finch check a bait site in Lawrence County to attract wild pigs. USDA-WS removed 226 wild pigs from Indiana in 2017 using a variety of techniques as part of elimination efforts done in cooperation with the DNR Division of Fish & Wildlife.