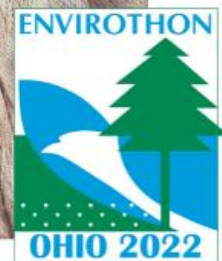


A detailed close-up photograph of a bald eagle's head, showing its white feathers, yellow beak, and intense brown eye. The eagle is looking slightly to the left.

# 2022 NCF-ENVIROTHON OHIO

WILDLIFE RESOURCE  
GUIDE



## 2022 NCF-Envirothon Ohio

### Wildlife Study Resources

#### Key Topic 1: Life History

1. Identify the taxonomic classifications of common Ohio mammals, birds, insects, and plants.
2. Describe the physical and behavioral adaptations of wildlife to different habitats and landscapes.
3. Identify common Ohio wildlife species, including their niches, ranges, and food sources.

#### Study Resources

Resource Title	Source	Located on
Mammals of Ohio, Publication 5344	<i>Division of Wildlife, ODNR, 2016</i>	Pages 3-18
Common Birds of Ohio, Publication 414	<i>Division of Wildlife, ODNR, 2009</i>	Pages 19-20
Common Bees and Wasps of Ohio, Publication 5488	<i>Division of Wildlife, ODNR, 2016</i>	Pages 21-22
Butterflies and Skippers of Ohio, Publication 204	<i>Division of Wildlife, ODNR, 2009</i>	Page 23

**Study Resources begin on the next page!**







# MAMMALS OF OHIO field guide

## DIVISION OF WILDLIFE



## INTRODUCTION

*Text and contributions by:*  
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Wild mammals stir high interest among human observers. A white-tailed deer, black bear, or river otter is sure to draw the eyes of all who see it. Even mice, shrews, weasels and other small furbearers rarely fail to garner a reaction. This may be because we share a close kinship with mammals. After all, everyone reading this IS a mammal – Homo sapiens, to be specific. Our evolutionary roots are much more closely intertwined with other mammals than birds, reptiles, fish or other types of frequently encountered fauna.

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## HOW TO USE THIS GUIDE

Scientific Name    Common Name    Status

Diet

Activity

Family Name

Range:

Hot Spot Map

Tracks

Secondary Photo

Page Number

## MAMMALS OF OHIO

### TABLE OF CONTENTS

02	Introduction
04	Mammals of Ohio
05	About This Book
06	Mammal Classification

08	Species Accounts
64	Extirpated Mammals
66	Occasional Occurrence
68	Extinct Mammals

69	Mammals and People
70	Mammal Ecology
72	Mammal Ups and Downs
74	Mammal Diseases

76	Mammal Scat
78	Glossary
79	Publication Funding

# ABOUT THIS BOOK

Below are symbols and information for quick comparisons and identification. They are located in the same place for each species throughout this publication. Definitions for the scientific terms used in this publication can be found at the end in the glossary.

## ORDER AND FAMILY

Mammal species appear in taxonomic order. Both “order” and “family” classifications are provided for each species. Species are classified based on their evolutionary relationship to one another.

## ACTIVITY

**Diurnal** – Most active during the day

**Nocturnal** – Most active at night

**Crepuscular** – Most active at dawn and dusk

A word about diurnal and nocturnal classifications. In nature, it is virtually impossible to apply hard and fast categories. There can be a large amount of overlap among species, and for individuals within species, in terms of daily and/or seasonal behavior habits. The activity designated for each species represents the most common activity. It is possible for the activity patterns of mammals to change due to variations in weather, food availability or human disturbances. The designation of diurnal or nocturnal represent the most common activity patterns of each species.

## DIET

**Carnivore** – Feeds primarily on meat

**Herbivore** – Feeds primarily on plants

**Insectivore** – Feeds primarily on insects

**Omnivore** – Feeds on both plants and meat

## STATUS

**Endangered** – species is in imminent danger of extinction throughout all or a significant portion of its range

**Threatened** – species that are likely to become endangered in the foreseeable future

**Special Interest** – species occurs periodically and is under minimal management efforts; Ohio is often at the edge of its range

**Concern** – species that might become threatened, under continued or increased stress

**Uncommon** – localized; infrequent

**Common** – widespread and frequent

**Game** – a species that can be legally harvested

## TRACKS

Many mammals can be elusive leaving only a trail of clues that they were present. Careful observation is required to detect their presence. A significant sign that a mammal resides or has passed through an area are the tracks they leave behind. This guide illustrates the tracks of the relevant species to help identify them in the field.

## RANGE

The map represents where the species is found in Ohio. The warmer the color (red) the more likely a species resides in that area, the cooler the color (blue) the less likely it is found in that area.



5

# MAMMAL CLASSIFICATION

In this guide, the mammal orders appear in taxonomic order, meaning they are listed according to how they evolved in relation to each other. In other words, the more “primitive” groups are listed first and the “advanced” mammals are last. The Virginia opossum, a marsupial, has five fingers and toes, which is a characteristic that is considered to be very primitive among mammals. White-tailed deer, on the other hand, have a divided or split hoof considered to be more advanced in evolution. Fewer toes with hooves allow ungulates to take longer strides and run faster than flat-footed mammals with five toes.

## DIDELPHIMORPHIA

Marsupials are a fascinating group because their mode of reproduction is unique among mammals. A chief characteristic of marsupials is the presence of a marsupium, or pouch, on the abdomen of the females. Unlike most mammals, marsupials, such as opossums, are not fully developed when born. The premature young are equipped with tiny front legs so that they can crawl to the female’s pouch immediately after birth, where they will continue to grow and develop.

## RODENTIA

Rodents are the most numerous mammals, with over 2,000 species in the world today. All rodents have incisors that grow continuously and must be kept short by gnawing. Many rodents, such as mice and voles, are important food sources for predators, making them a vital part of the ecosystem. Despite their popularity as prey, rodents are considered to be one of the most successful groups of mammals because of their high reproductive rate and ability to adapt to almost any environment.

## LAGOMORPHA

The order Lagomorpha includes rabbits, hares, and pikas. Rabbits and hares are stout-bodied animals that resemble large rodents with short tails and long ears. Their big feet and strong hind legs are specialized for running and quickly escaping danger. Pikas are found in the western U.S. Like rodents, rabbits and hares have two large incisors (front teeth) that continually grow and must be kept short by gnawing, or else they could grow too long and prevent eating. All species in the rabbit family are herbivores that feed on grasses and other plants.

## INSECTIVORA

As indicated by the order’s name, Insectivora, these animals feed primarily on insects. The insectivore group includes shrews and moles; small mammals that are rodent-like in appearance. Shrews and moles spend much of their time in dark, underground tunnels, thus having little need for the sense of sight. Because of this, the eyes are often very small and vision is reduced. Instead, these insectivores use their exceptional senses of smell and touch to get around and find food.

## CHIROPTERA

Bats are noteworthy because they are the only group of mammals that have wings and can fly. A few other mammals have "gliding membranes" that allow them to soar through air for a short time, but they cannot truly fly like bats and birds.

All Ohio bats are insectivorous and eat flying insects that they catch on the wing, but some species in other parts of the world may feed on fruit, blood, and other vertebrates. Because bats are nocturnal and it is not easy to see in the dark, they use echolocation to navigate and find food at night. Bats echolocate by making high-pitched sounds which produce sound waves that bounce off objects in the environment. The bats listen to the returning echo to determine details about their surroundings. Bats can see though.

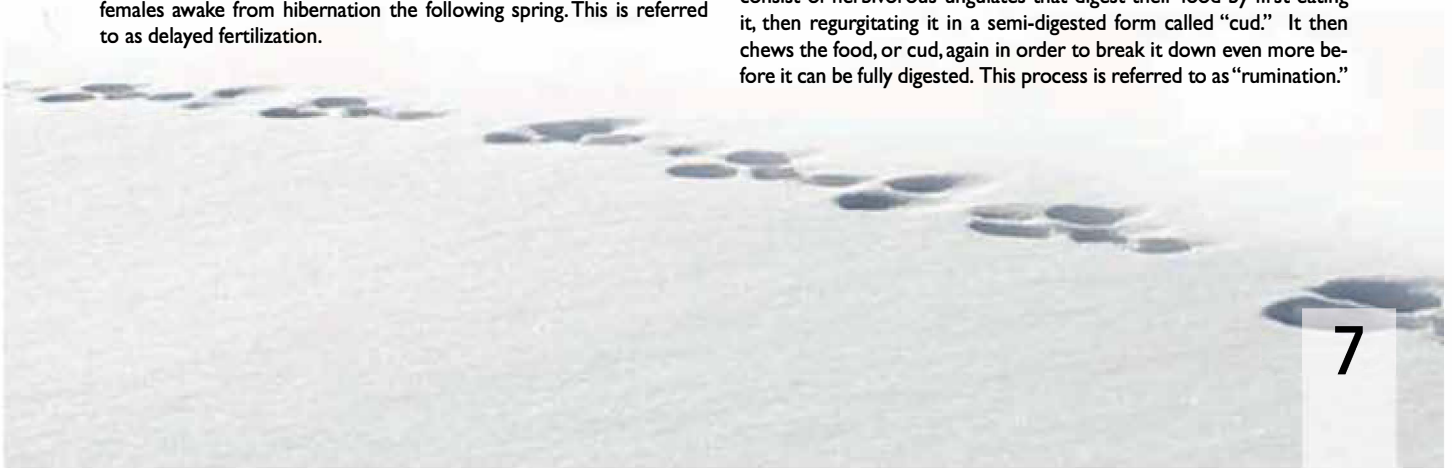
Bats typically mate in the fall, right before winter hibernation begins. However, ovulation and fertilization of the egg are delayed until the females awake from hibernation the following spring. This is referred to as delayed fertilization.

## CARNIVORA

While the term "carnivorous" means to eat meat, not all carnivorous mammals are included in this order. Nor are all those included in Carnivora strictly carnivores. This extremely diverse group includes dogs, cats, bears, raccoons, and weasels. Most carnivores have excellent senses, relatively large brains, and are strong runners. They also have teeth and claws that are specially adapted to cutting and tearing meat. All of these characteristics are beneficial to this group of efficient hunters.

## ARTIODACTYLA

Ungulates are characterized by having hooves. Some may also have horns or antlers. Three species of ungulates once inhabited Ohio: Elk, American bison, and the white-tailed deer. Today, only deer still naturally occur in the state. White-tailed deer are ruminants. Ruminants consist of herbivorous ungulates that digest their food by first eating it, then regurgitating it in a semi-digested form called "cud." It then chews the food, or cud, again in order to break it down even more before it can be fully digested. This process is referred to as "rumination."



7

# *Didelphis virginiana* VIRGINIA OPOSSUM

Status: **Common**/Game

**DESCRIPTION:** An adult is about the size of a house cat, with coarse, grizzled, grayish fur. It has a long, scaly tail, ears without fur, and a long, pointed snout that ends in a pink nose.

**HABITAT:** Quite adaptable and can be found in suburbia and the city. Ideal habitat, however, is an area with woods, wetlands, and farmland interspersed.

**REPRODUCTION:** A female opossum carries 12-13 young internally for approximately two weeks before they are born. Opossums are undeveloped and tiny (1/15 ounce) at birth. The offspring must crawl to a teat in the female's pouch to survive. At about three months of age, young opossums emerge from the pouch for short periods and will hitch a ride on the adult female's back to get from place to place.

**DID YOU KNOW?:** The opossum "plays dead" when frightened, by essentially passing out when confronted with danger. This technique usually causes the predator to lose interest and wander off. Then the opossum wakes up a short time later and goes about its business.

### RANGE



### TRACKS

Front

Back



Photo by Donna Heatfield

8





# Bobcat

*Lynx rufus*

Status: **Uncommon**

**DESCRIPTION:** The coat color varies to include light gray, yellowish brown, buff, brown, and reddish brown. The ear tufts are short and the tail is bobbed (short) with black banding on the upper surface. The bobcat's larger cousin, the lynx, which is not found in Ohio, has longer ear tufts and a black tip on its tail.

**HABITAT:** A variety of habitats, including forests, old fields, and brush land. They often sleep in hidden dens, hollow trees, or rocky crevices.

**REPRODUCTION:** Breeding may occur at anytime throughout the year; mostly it occurs from December through May. The young are fully weaned at eight weeks and they will disperse and begin life on their own in the fall and late winter.

**DID YOU KNOW?:** Bobcats had largely disappeared from Ohio by 1900. Recovery of forests and other factors have allowed the cats to rebound, and there were over 400 reports in 2013.

## RANGE



## TRACKS

Front



Back



Photo by Geoffrey Kuchera

# Gray Fox

*Urocyon cinereoargenteus*

Status: **Game**

**DESCRIPTION:** The coat color is a salt and pepper gray. A black stripe runs from the base of the tail and ends in a black tip. Its belly is white and a reddish band separates it from the gray sides.

**HABITAT:** Gray foxes live in mostly wooded areas and partially open brush land with little human presence.

**REPRODUCTION:** Breeding takes place in early spring. An average of four kits are born after a 53-day gestation period. While the female is nursing her offspring, the male will bring her food. By fall of the same year, the family unit breaks up when the young are mature enough to go out on their own.

**DID YOU KNOW?:** Gray foxes are the only canids (dogs), in North America that can climb trees. This species appears to be declining in Ohio.

## RANGE



## TRACKS

Front



Back



Photo by Tim Daniel



# COYOTE

*Canis latrans*

Status: **Common/Game**

**DESCRIPTION:** A slender animal, very similar in appearance to a medium-sized dog and much smaller than a wolf, a species not found in Ohio. The majority of coyotes are gray, though some show a rusty, brown or off-white coloration. It has a bushy tail which is usually tipped with black.

**HABITAT:** The coyote's strength is that it can adapt and exploit most any habitat to its advantage, including forests, clearcuts, and woodlots in rural and urban areas.

**REPRODUCTION:** Mating occurs between late January and March. A litter of about six young are born two months later. Both adults hunt for food and feed the young. At about three weeks of age, the young leave the den under the watch of the adults.

**DID YOU KNOW?:** Although coyotes are small, they are the largest of the three members of the Canid (dog) family found in Ohio. The other two canids are the gray fox and the red fox.

## RANGE



## TRACKS

Front



Back



Photo by The Green Man/Shutterstock.com



51

# RED FOX

*Vulpes vulpes*

Status: **Common/Game**

**DESCRIPTION:** Most commonly a rusty-red or reddish yellow color from its face down its back and sides. Its undersides, throat area, and cheeks are white. The legs, feet, and outside of the ears are black; its long, bushy tail has black hairs mixed with the red and ends in a white tip.

**HABITAT:** Red foxes are found in a variety of habitats, including mixed, cultivated, and wooded areas, as well as brush lands.

**REPRODUCTION:** Mating occurs in the winter and a litter of one to 10 kits is born in the spring. The male brings food to the nursing female until the young are weaned. They accompany the adults on hunting trips where they learn basic survival skills.

**DID YOU KNOW?:** Red foxes are solitary animals and do not travel in packs like wolves, which are not found in Ohio. They also hunt like cats because they stalk their prey. Black and silver forms of the red fox occur occasionally.

## RANGE



## TRACKS

Front



Back



Photo by Pim Leijen



52



# *Castor canadensis* AMERICAN BEAVER

Status: **Common/Game**

**DESCRIPTION:** Beavers are large furbearers with webbed feet, a flattened, paddle-like tail, and huge front teeth. They also have transparent eye membranes and closable nostrils and ears; adaptations suited for an aquatic existence.

**HABITAT:** Beavers are found in forested ponds, lakes, and rivers.

**REPRODUCTION:** Beavers are generally monogamous; young are born between April and July, after a gestation period of about 128 days. The kits are born furred, with their eyes open, and are able to swim within 24 hours.

**DID YOU KNOW?:** The beaver is North America's largest rodent, weighing up to 60 pounds. They eat bark and cambium, which is the softer growing tissue under the bark of trees. Their lodges, which are comprised of branches and mud, can reach massive dimensions and can be used for many years. The largest known beaver dam, in Alberta, Canada, is 2,790 feet long.

## RANGE



## TRACKS

Front

Back



Photo by Jody Ann

16

# *Sylvilagus floridanus* EASTERN COTTONTAIL

Status: **Common/Game**

**DESCRIPTION:** A large rabbit with a brownish-gray body, long ears, and a small white tuft of a tail that resembles a cotton ball.

**HABITAT:** Open areas bordered by thickets or brushy areas. Cottontails prefer old fields with bunch grasses and weeds but will also be found in suburban areas if brushy escape cover is near.

**REPRODUCTION:** The nest is a shallow depression made in the ground, lined with dry grass and fur from the female's body. The young are born helpless with very fine fur and closed eyes that do not open for four to five days. The female conceals the young in the nest and only returns once or twice per day to feed them. Females can have up to 5 litters of young per season (Feb-Sept).

**DID YOU KNOW?:** Cottontails are common prey for hawks, owls, foxes, coyotes, weasels, and humans. The rarely seen courtship display is spectacular. The male leaps vertically high in the air while the female runs underneath him. He twists 180 degrees in mid-air, landing to face his prospective mate.

## RANGE



## TRACKS

Front

Back



Photo by Jim McCormac



30



# *Myotis lucifugus* LITTLE BROWN BAT

Status: **Concern**

**DESCRIPTION:** The fur is a sleek, glossy brown ranging from dark brown to reddish brown on the back with a slightly paler underside. The muzzle is furred and the ears are relatively short with a blunt tragus (prominence on middle of external ear). Hairs on the toes extend beyond the claws and there is no calcar, which distinguish this species apart from Indiana bat.

**HABITAT:** As a colonial species, they form large, summer maternity colonies roosting in trees, bat boxes, barns, and buildings. In the winter, the species migrates relatively short distances to hibernaculum (e.g., caves or mines) that provide stable temperatures just above freezing.

**REPRODUCTION:** Mating occurs in the late summer and early fall during fall swarming. Delayed fertilization allows females to store the male sperm through hibernation and fertilize their eggs after emerging. Most females give birth to only one young a year, although some instances of twins have been recorded. Gestation is 50-60 days during spring and summer. Young bats are weaned and able to fly at approximately four weeks of age.

**DID YOU KNOW?:** Most Ohio bats are descriptively little and brown, including the species little brown bat. To determine species identification, experienced scientists often need to observe closer details.

**RANGE**

Summer

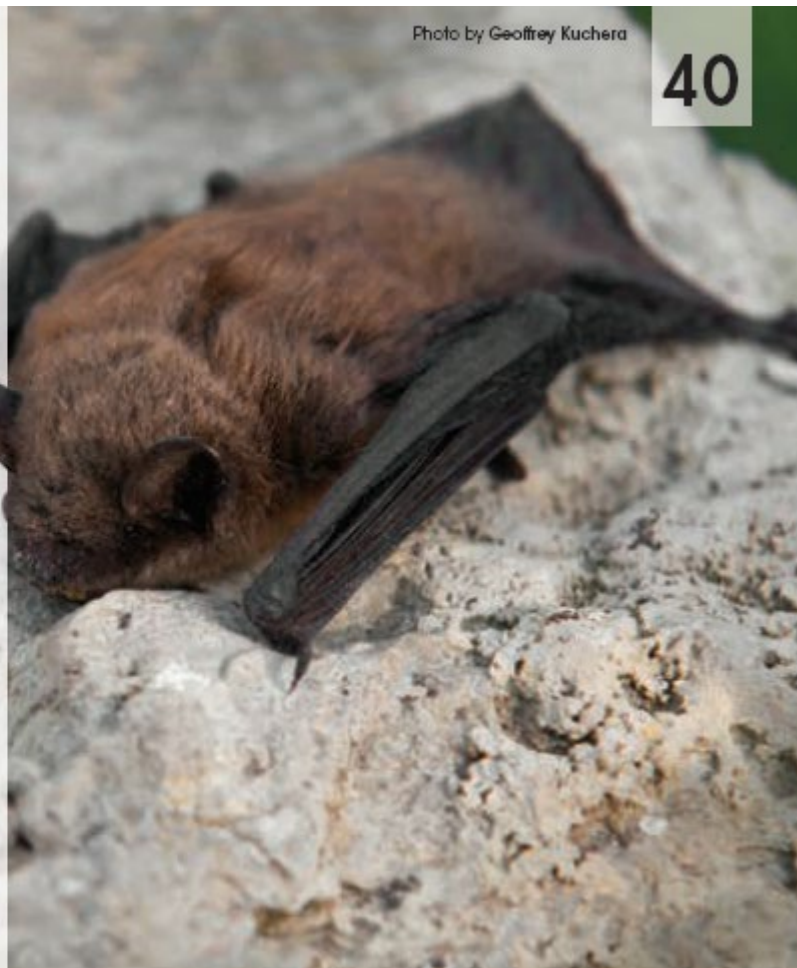


Winter



Photo by Geoffrey Kuchera

40



# *Myotis septentrionalis* NORTHERN LONG-EARED BAT

Status: **Threatened**

**DESCRIPTION:** The fur is similar to little brown bats with less variation in the tones of brown. This species is distinguished from the other *Myotis* species with their slightly larger ears which extend just beyond the tip of the nose when laid forward.

**HABITAT:** In the summer, northern long-eared bats inhabit forests and woodlands with smaller maternity roosts. Females will often move flightless pups every two to three days during the summer. In the winter, the species migrates relatively short distances to hibernaculum (e.g., caves or mines), which provide stable cool temperatures just above freezing.

**REPRODUCTION:** Mating occurs in the late summer and early fall during fall swarming. Delayed fertilization allows females to store the male sperm through hibernation and fertilize their eggs after emerging. Most females give birth to only one young a year. Gestation is 50-60 days during spring and summer. Young bats are weaned and able to fly at approximately four weeks of age.

**DID YOU KNOW?:** Northern long-eared bat populations and other species have been severely affected by white-nose syndrome. In Ohio, populations have declined by over 95 percent.

**RANGE**

Summer



Winter



Photo by Jennifer Norris

41



# AMERICAN MINK

*Neovison vison*

Status: **Common/Game**

**DESCRIPTION:** Has a long, narrow body with a bushy tail. The fur is usually a rich chocolate brown, but can look almost black. Looks much like a large ferret, but wild ferrets do not occur in Ohio.

**HABITAT:** Mink are found near running waters of streams and rivers and the standing waters of marshes and lakes, especially in wooded or brushy areas.

**REPRODUCTION:** Mating occurs in the winter. The female usually makes a den in a burrow along the bank of a stream or lake, or under a stump or log. The gestation period is variable due to delayed implantation.

**DID YOU KNOW?:** Like its distant relative the skunk, the mink has anal scent glands which can excrete a fluid that smells like musk. Mink are voracious predators, often killing more than they can eat and caching extra prey in burrows.

## RANGE



## TRACKS

Front

Back



Photo by Erni/Shutterstock.com

59

# AMERICAN BADGER

*Taxidea taxus*

Status: **Concern**

**DESCRIPTION:** A stocky animal with a white stripe that extends back over the head from the nose. White fur surrounds the eyes and black cheek patches, or "badges," for which they are named. The rest of the body is a shaggy mix of silvery gray, black, and buff colors and the feet are black.

**HABITAT:** Badgers prefer short-grass habitats, such as fields and pastures, typically with dry sand or loamy soils.

**REPRODUCTION:** Though mating occurs earlier, implantation of the fertilized egg is delayed until winter. One to five young are born in the spring, in a grass lined, underground nest. They are lightly furred and blind at birth.

**DID YOU KNOW?:** The badger has many adaptations for burrowing in the soil, including webbed toes, long claws, and an extra transparent eye membrane. Their large burrows are conspicuous and often the best evidence that badgers are in the area.

## RANGE



## TRACKS

Front

Back

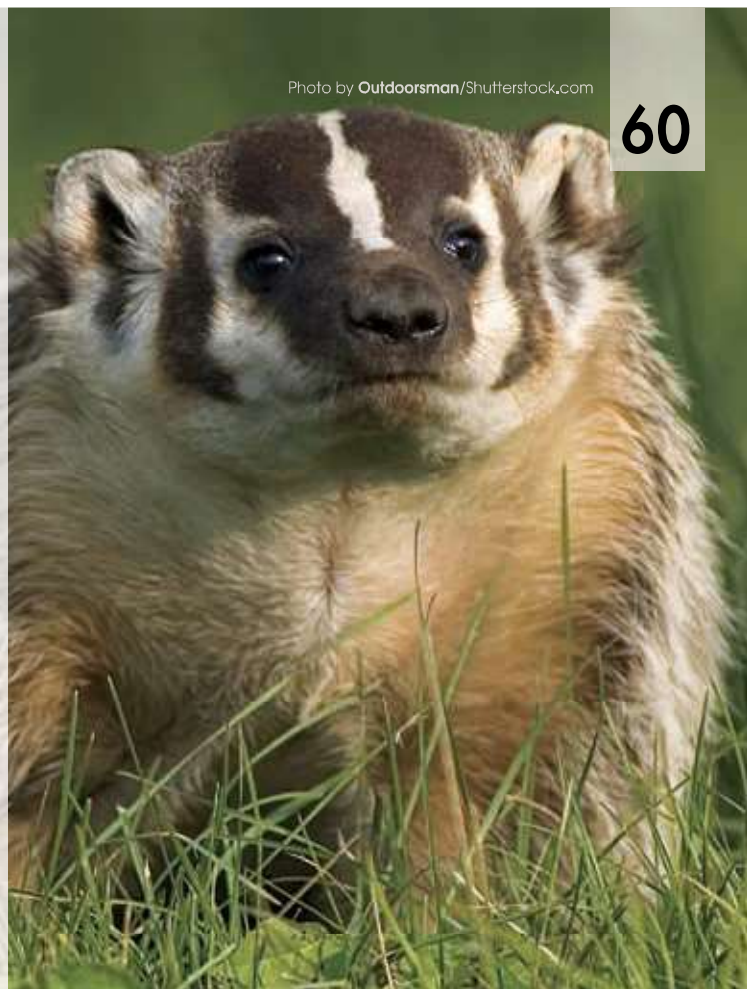


Photo by Outdoorsman/Shutterstock.com

60



# WHITE-TAILED DEER

*Odocoileus virginianus*

Status: **Game**

**DESCRIPTION:** Has two seasonal coats; a reddish-tan spring and/or summer coat and a grayish winter coat. White patches are found around the eyes, on the throat, belly, tail (underside), and insides of the legs. When running, the large white tail, flipped up high, can be the easiest way to spot the deer.

**HABITAT:** A variety of habitats, including woods, farmlands, brushy areas, dense thickets, and edges.

**REPRODUCTION:** Courtship activities among deer begin in mid-October. Bucks (males) will chase does (females) over a period of five or six days prior to mating. Eventually the two will separate and the buck will go on to breed with more does before the breeding, or rutting, period ends. The female has one or two fawns in the summer.

**DID YOU KNOW?:** Young male deer leave their mother and become solitary after one year, but young females often stay with the mother for two years.

## RANGE



## TRACKS



Photo by Tom Reichner

63

## EXTIRPATED MAMMALS

Extirpated means locally extinct, and while the mammals on the following list no longer occur in Ohio, they are still found elsewhere. The primary reasons for the loss of these species were habitat loss, and persecution by humans in the days before wildlife laws existed.

**GRAY WOLF, *Canis lupus*.** Wolves were common throughout much of the state until 1800. Their predatory habits brought them into great conflict with people. Bounties for wolf hides were paid by the state, and the gray wolf was eradicated by the 1850's.

**AMERICAN MARTEN, *Martes americana*.** These large weasels were widely distributed, at least in northern Ohio, prior to European settlement. Martens are denizens of large tracts of sparsely populated older-growth forests. Wholesale logging of forested areas followed by human settlement drove them from the state by 1850 or so.

**FISHER, *Martes pennant*.** An even larger weasel than the marten, fishers disappeared around the same time and for the same reasons as the marten. There are faint signs that fishers may return, though. There have been a few records in recent years in eastern Ohio. Successful reintroduction programs in Pennsylvania and West Virginia may account for the Ohio sightings, as populations in those states continue to expand.

**COUGAR, *Puma concolor*.** Also known as mountain lion, panther, or puma, the cougar was probably widely distributed in Ohio prior to European settlement. This species has the largest distribution of any mammal in the western hemisphere, but it has been driven out of many regions due to habitat loss and settlement by humans. Cougars probably disappeared from Ohio by the mid-1850's.



Fisher  
Photo by Geoffrey Kuchera



**CANADIAN LYNX**, *Lynx canadensis*. Ohio was at the extreme southern limits of this northern cat's range, and it was limited to extreme northeast Ohio. Expanding human settlement and habitat changes had pushed the lynx from the state by the middle of the 19th century.

**SOUTHERN RED-BACKED VOLE**, *Clethrionomys gapperi*. This beautiful vole, with its rufous-red pelage, was never common or widespread. It is a northern species, reaching the southern limits of its range in northeastern Ohio. There are only a few records, the last from 1960. Targeted efforts to locate this species in recent years have failed.

**ELK**, *Cervus elaphus*. This mega-herbivore is one of the world's largest deer species. The largest bulls can weigh nearly half a ton. Elk were widespread in the state prior to European settlement, but were vanquished by overhunting, habitat loss, and expanding human settlements by the early 1800's.

**AMERICAN BISON**, *Bison bison*. Prior to European settlement, bison ranged widely throughout the state, in large numbers. As the human population expanded, hunting pressure became increasingly heavy. The last bison shot in Ohio was in Lawrence County in the same year that Ohio achieved statehood, 1803.



Elk  
Photo by Paul Staniszewski

65

## MAMMALS OF OCCASIONAL OCCURRENCE

**NORTH AMERICAN PORCUPINE**, *Erethizon dorsata*. The second-largest rodent in North America, porcupines occur across the northern U.S. and Canada. They range near Ohio in Michigan and Pennsylvania, and were once common in northernmost Ohio. While porcupines disappeared by 1900, a number of recent reports suggests they may be recolonizing from the east.

**ROOF RAT**, *Rattus rattus*. Sometimes known as the black rat, this rodent arrived here from its native Eurasian range early in the settlement of Ohio. Like the brown rat, it got here as stowaways in people's cargo and commodities shipments. Roof rats did not seem to become widely established and were soon displaced once the larger more aggressive brown rat arrived.

**NUTRIA**, *Myocastor coypus*. This large aquatic rodent is similar to a beaver or muskrat, and is indigenous to Central and South America. There were a number of attempts to establish nutria fur farms in the early 1930's, and some animals escaped or were released. Feral nutria were reported from 14 counties, but fortunately this species did not persist. Nutria colonies can be damaging to the ecology of wetlands in areas where this mammal is not native.

**ORD'S KANGAROO RAT**, *Dipodomys ordii*. Efforts were made in the early 1900's to establish this species of the western Great Plains along the shores of Lake Erie in Lake County. The site of the introduction was the area now protected as Headlands Dunes State Nature Preserve. The populations apparently thrived for a few decades, but vanished by the 1960's if not earlier.



Nutria  
Photo by Tomas Kouba



**MEXICAN FREE-TAILED BAT**, *Tadarida brasiliensis*. Also known as the Brazilian free-tailed bat, this species has turned up at least two times in Ohio. Some bat species are powerful flyers capable of extended flights, and can turn up far from their normal range. This species' normal range is from the southern half of the U.S. south through much of South America.

**GRAY BAT**, *Myotis grisescens*. This species is rare and local in a limited range, from Kentucky and Missouri south to the Gulf Coast. There is one Ohio record, along the Ohio River.

**RAFINESQUE'S BIG-EARED BAT**, *Corynorhinus rafinesquii*. There are only two Ohio specimens, both from Adams County, collected in 1953 and 1960. This species' range covers much of the eastern U.S., from Kentucky south to Florida. While there is no evidence that it is a regular member of Ohio's bat fauna, its core range lies very near Ohio.

**SEMINOLE BAT**, *Lasiurus seminolus*. This migratory tree bat is very similar to the red bat. It has turned up in Ohio on a few occasions. The core range is from southern Tennessee south to the Gulf Coast, west to eastern Texas, and east to the Carolinas.



Rafinesque's Big-eared Bat  
Photo by Eric Isselee

67

## EXTINCT MAMMALS

Mammal-watching in what is now Ohio would have been very different during the Pleistocene Epoch. The Pleistocene, which is popularly known as the "Ice Age", began about 2.5 million years ago. A cooling climate stimulated the formation of massive glaciers, which eventually flowed southward into this region. As the last of the Pleistocene glaciers retreated from Ohio about 14,000 years ago, they left a greatly altered landscape thanks to the bulldozing effect of the giant ice sheets. The habitats left in the glacier's wake were boreal forests, bogs and other peatlands – habitat types that one would now have to travel far to the north to find.

Post-glacial animal life featured mega-fauna: huge mammals such as the woolly mammoth, giant ground sloth, mastodon, short-faced bear, giant beaver, long-horned bison, stag-moose, and others. The mammoth is related to African elephants, and was about the same size. Males could exceed six tons in weight. Mastodons were even larger, with the largest males weighing over 15 tons and standing nearly ten feet tall at the shoulders. The giant beaver could exceed seven feet in length and weigh 275 pounds – many times the size of the American beaver familiar to modern-day humans. Large specimens of the short-faced bear could weigh over a ton and stand 12 feet in height when reared up on the back legs. Stag-moose belong to the same family as the familiar white-tailed deer, but dwarfed the deer. A bull stag-moose might weigh nearly a ton and tower to 8 feet in height – many times larger than the largest buck white-tail. All of these mammals went extinct

about 10,000-12,000 years ago, at the onset of the Holocene Epoch. One theory for their disappearance is overhunting by the earliest Homo sapiens to arrive in North America, a group known as Paleoindians. These people entered North America via the Bering Land Bridge in the same time period that the prehistoric mega-fauna went extinct. A rival theory implicates climate change. Rapidly warming weather on the heels of the Ice Age did not favor large cold-hardy mammals, and they could not adapt rapidly enough to the changing climate. Many scientists feel that it was probably a combination of these two factors that ultimately did in the mastodons and other Ice Age mega-fauna.



Woolly Mammoth  
Artwork by Nicolas Primola



# MAMMALS AND PEOPLE

People have long surrounded themselves with other mammals. The earliest domesticated mammals were probably dogs, originally culled from wild wolves and selected and bred for desirable traits. Wolf-dogs were probably tamed at least 12,000 years ago, with the original purpose of helping their human masters to hunt large game. Today, there are nearly 350 breeds of dogs, representing all manner of sizes, shapes, and uses. The 50+ breeds of cats can be traced back to the domestication of the African wildcat in the Middle East about 10,000 years ago. As agrarian communities began to flourish, cats probably served a valuable role in controlling rodents, a function they still perform today. Americans keep an estimated 150 million pet dogs and cats. Perhaps 9 million horses keep equestrians occupied. An army of 90 million cattle provides steak and milk products. The survival and well-being of *Homo sapiens* depends in large part on our fellow mammals.



Undomesticated wild mammals are hugely important to the ascent of man. In North America, it was the beaver that was a major catalyst for initial exploration and settlement by European colonists. By the early 1600's tens of thousands of beaver pelts were being harvested annually in the northeastern states. Depletion of eastern populations of this valuable furbearer sparked westward exploration as trappers sought new stocks. Several decades prior to the famed 1849 California Gold Rush, there was a "California Fur Rush" spawned by the thirst for beaver pelts. The Hudson's Bay Company was founded in 1670 in large part to exploit trade in beaver pelts and other furs. John Jacob Astor launched the rival American Fur Company in 1808, and it made him a fortune – Astor became the first multimillionaire in the United States.

While trapping is much reduced from the earliest days of North American exploration, the craft still has many practitioners. Hunting is another way in which mammals contribute to the economy and serve as an important source of food.

White-tailed deer, rabbits, squirrels, and raccoons are popular game mammals.

Hunting and trapping contributes over \$850 million annually to Ohio's economy.

69

## MAMMAL ECOLOGY

Mammals are intimately intertwined with natural systems; their roles are vital to maintaining ecological balance. Some species serve as prey for predators, other species are predators. Mammals are important dispersers of plants. Chipmunks, squirrels, and mice are hoarders of acorns, hickory nuts, beechnuts and many other species of plant fruit. They lose plenty of seeds in the process, and thus are important in spreading plant populations. Beavers are engineers extraordinaire and their dams often create highly diverse wetland communities that greatly spike local biodiversity. Muskrats are important in maintaining openings in otherwise dense marshes by harvesting prodigious amounts of cattails and other aquatic plants. Muskrat-managed wetland openings spike wildlife diversity. Bats consume extraordinary numbers of insects and are an essential check and balance on insect species that could otherwise overwhelm their environments. Small rodents, especially mice and voles, are a major food source for carnivores. Meadow voles, for example, have boom and bust cycles. When vole populations are at peaks, tremendous numbers of wintering hawks and owls can congregate around habitats rich in voles. Burrowing mammals such as groundhogs, moles, and thirteen-lined ground squirrels create warrens of tunnels that may be used by other animal species, including foxes, small rodents, snakes, crayfish, and various insects.



Eastern Fox Squirrel  
Photo by Kenneth Keifer



In general, most mammals are “keystone species” – organisms whose behavior and actions have a disproportionate impact on their localized environment. Their presence is critical to the ecological well-being of the habitats in which they live, and their disappearance is likely to have dire consequences for many other organisms. Even in death, mammals are important. Many species of scavengers make quick work of carcasses. While vultures, opossums, raccoons and other large species are conspicuous carrion consumers, they are but the tip of the iceberg. Numerous species of insects such as blow flies and flesh flies, and burying, carrion and rove beetles, are just a few of the myriad insects that help dispose of carcasses. In turn, these insects often become food for other animals.



Turkey Vulture  
Photo by Jim McCormac

71

## MAMMAL UPS AND DOWNS

Following colonization of the Ohio Country by Europeans, the original tapestry of Ohio's pre-settlement habitats was rapidly altered. Historically, ninety-five percent of the state was swathed in forest: oak-hickory woodlands on high ground, beech and maple on richer soils, and elm-ash associations on poorly drained sites. What wasn't woodland was largely prairie, which once blanketed about 1,500 square miles of Ohio. Various wetland types covered nearly a fifth of the state. By the late 1800's, forest cover had been reduced by nearly 90%. To date, about 90% of our wetlands have been lost. The original prairie has been hardest hit. Over 99% of this ecosystem, which harbored some of the greatest biodiversity in North America, has been destroyed.

Such wholesale habitat alteration had profound impacts on mammal populations. At one time, American elk and bison were common in Ohio. These megafauna disappeared by the 1830's. The gray wolf was common in the state prior to the 1800's, but had probably vanished by the mid to late 1800's. Mountain lions and lynx also roamed pre-settlement Ohio forests, but they too largely disappeared by the mid-1800's. Snowshoe hares occupied the extreme northeast corner of the state, but vanished in the 1800's.

Not all is gloom and doom, though. Several other mammal species were vanquished from Ohio on the heels of the *Homo sapiens* invasion, but have returned, or show signs of



Bison  
Photo by Jane Rix



a comeback. As Ohio's forests have recovered – about one-third of the state is now wooded – several forest-dependent mammals have staged comebacks. Bobcats had probably largely disappeared by 1900. Several documented reports in the 1960's and '70's offered hope that the charismatic little wildcats might return. And return they have. There were 200 verified sightings in 36 counties in 2013, mostly in southeastern Ohio, along with an additional 236 unconfirmed sightings. Evidence suggests that black bears were common prior to 1850, but the last one was reportedly killed in Paulding County in 1881. Reports started to surface in the late 1900's and in 2014 an estimated 88 bears were reported. River otters were probably common throughout Ohio prior to settlement, but had become very rare by the onset of the 20th century, and may have vanished by 1980. In 1986, the Ohio Division of Wildlife began an otter reintroduction program. The results were swift and stunningly successful. As many as 5,000 of the large charismatic weasels now populate the state and it has been removed from the endangered list.

Bobcat

Photo by Tim Daniel



73

## MAMMAL DISEASES

*It is part of the Ohio Division of Wildlife's mission to manage wild animal populations and their habitats and to ensure that they are healthy and benefit the citizens of Ohio. We take this mission seriously and want to update our sportsmen and women with current information about these diseases.*

### CHRONIC WASTING DISEASE

Chronic wasting disease (CWD) is a fatal disease of the central nervous system of mule deer, white-tailed deer, Rocky Mountain elk, and moose. CWD is a prion disease (not a bacteria or virus) caused by abnormal proteins that ultimately destroy brain tissue. This type of disease is known as a transmissible spongiform encephalopathy (TSE).

In early stages of infection, animals may not show any clinical signs of the disease. Except in the later stages of the disease, most deer with CWD do not appear sick, typically only displaying subtle behavioral changes. As the disease advances, animals will begin to lose body condition and behavioral changes become much more pronounced. Deer with late-stage CWD will often appear emaciated or "boney" – thus the name "wasting disease."

Research has shown that CWD may be transmitted through direct contact (animal-to-animal) and indirectly from the soil (or other surface) to the animal. Since transmission can be facilitated via the movement of carcasses and animal parts, a number of states (including Ohio) have regulations on carcass transportation. Additionally, while the risk of disease transmission through the use of deer urine or other lures is currently unknown, hunters are discouraged from using these products.

There is no strong evidence that CWD affects humans, however, hunters can take some common-sense precautions, such as not harvesting deer that appear sick or otherwise abnormal and wear-

ing rubber gloves while field dressing and processing deer.

The Division of Wildlife, along with the Ohio Departments of Agriculture (ODA) and Health, and USDA Animal and Plant Health Inspection Service Veterinary Services (APHIS-VS) expanded the surveillance that has been conducted biannually for tuberculosis in addition to ODNR's existing, aggressive monitoring for disease.

Anyone who sees deer that appear to be sick or are displaying abnormal behavior should immediately report the occurrence to the Division of Wildlife.

### RABIES

Rabies is caused by a virus that can be contracted by all mammals, including humans. Wild animals most commonly infected in Ohio are raccoons, skunks, foxes, and bats. People and their pets are at risk to contract rabies from exposure through contact with wild animals.

Symptoms include: Change in behavior; frothing or slobbering from the mouth; uncoordinated movements; spasms; tremors; and paralysis.

The best protection against rabies is prevention. Do not allow pets to roam free. All furred pets should be vaccinated. Do not feed, touch, or adopt wild animals as pets, and be cautious of stray dogs or cats.



## WHITE NOSE SYNDROME

White nose syndrome (WNS) is caused by a cold-loving fungus, *Pseudogymnoascus destructans* (PD). Although PD in different life stages can be found year-round on infected bats (sometimes only visible through a microscope), the disease is most obvious during cold winters while the bats are hibernating. During the winter, the cold-loving fungus grows exhibiting white tufts on the muzzles (hence the name) and wing membranes of infected bats. However, if bats are aroused they may not display the typical signs of white-nose syndrome. Despite many scientists across North America and Europe actively evaluating the bat species that are most affected, researching the disease, surveying caves for the presence of the species, and evaluating strategies for disease management, there are still many unknowns about this disease.

One big question still unanswered fully—how to prevent WNS from killing bats. It is thought that the PD fungus is not unlike other skin fungi, such as ringworm or athlete's foot consuming dead skin cells. However, unlike these other skin fungi, PD also consumes the vital and sensitive living skin cells on a bat's wing membrane. So, it itches and hurts a lot—and is enough to waken hibernating bats, who burn precious fat reserves every time they stir from their hibernation. It has been estimated that one of these non-essential awakenings (bats do sometimes naturally wake during hibernation) uses up the equivalent of one month's fat reserve used during hibernation. Disturbed frequently by the irritating fungus, hibernating bats quickly deplete their energy reserves and begin to starve. Some bats may also seek to explore the winter skies for insects and freeze to death. Wing membranes

on bats provide more than the functional flight role, the membrane is critical in preventing water loss during hibernation, exchange of gas, maintaining blood pressure, and providing heat exchange. Although some suggest that bats are literally irritated to death, the fungus on this critical organ likely impacts the overall health of infected bats which reduces their survival.

The Division of Wildlife is working cooperatively with partner agencies to continue to monitor bat population in Ohio, survey for WNS, and implement management strategies in attempt to reduce the spread of WNS. These hibernacula counts can provide indices of changes in bat winter populations. In Ohio, our hibernacula survey results from pre-WNS (pre-2011) to the most current (2014, post-WNS) results, suggest an 85% decline in the winter bat population. Additionally, from 2011 and 2014, the DOW and volunteers have conducted standardized acoustic surveys across the state to evaluate our summer bat population numbers and distribution. Similar to the recorded declines in Ohio hibernacula, the summer declines documented during the acoustic surveys are potentially also indicative of declining numbers of bats as a result of WNS.

For more information on these and other mammal diseases, visit [wildohio.gov](http://wildohio.gov).



75

## MAMMAL SCAT

“Scat!—starts with an ‘s’ and ends with a ‘t’. It comes out of you and it comes out of me. I know what you’re thinking, but don’t call it that. Be scientific and call it scat! If you want to find out what animals eat, take a look at what they excrete. Found in their scat are all kinds of clues, parts of the food that their body can’t use.”

Next to tracks, scat is one of the best clues that scientists and wildlife enthusiasts can use to learn more about the mammals found in their area. And this thirty year old camp song is a great way to help kids understand that scat can be a useful tool to help identify not only what local mammals are eating, but what mammal species are in the area, how healthy they are, where they travel, and more.

Biologists can identify an animal in the area by the size and shape of their scat, in addition to other clues like tracks. Some scat are tubular in shape, others are pellets. The larger the scat, the larger the animal and vice versa. Obviously, this can change depending on the health of the animal or their reaction to something in their diet. A carnivore tends to have more fur, feathers and bones in their scat. An herbivore will show hulls of seeds and other indigestible parts of the plants they consume. Omnivores will have both. For example, the scat of fox and coyote will often be tubular shaped and tipped with fur. A white-tailed deer will excrete pellets that show bits of grass and leaves. A raccoon’s scat could have berry seeds, fish scales, insect parts and leaf parts all in the same small tubular blobs. Most mammals are consistent in what they eat and therefore their scat is fairly consistent in appearance. In general though, omnivores have the widest variation in their scat due to their widely varying diets. This can make for tough identifications and one should always look for tracks around the scat pile to confirm the identification.

Coyote Scat

Photo by Jim McCormac





In addition to the contents, species identification can also be somewhat determined by the location and the deposit habits of the animal. Most animals walk slowly or stop to defecate, leaving tell-tale lines or piles. This is true for deer, rabbits and most of the canine species. Raccoons have what are called latrines, very specific spots they will routinely use along their travel routes. Trappers and hunters use these kinds of clues to help find the best spot to set up. Other animals drop scat in no particular place as they move around, making it harder to find their clues. Skunks, foxes, muskrats, beavers and most in the weasel family have anal scent glands and leave a musky scent when they excrete their scat. This can also be a clue to help identify the depositor. The location of scat can be a clue to the mammal's whereabouts. If you find a pile of tiny black pellets on your porch next to the wall, look up because you might find that you have a bat roosting under your porch roof.

All of these clues are important and fun to try and find. You can really learn a lot about the wildlife in your neighborhood, park or property just by learning your scat.

Deer Scat  
Photo by Tyler Olson

77

## GLOSSARY

**Altricial** — young which are helpless when born, unable to care for themselves at birth

**Carnivore** — that which feeds primarily on meat

**Cervid** — animal distinguished by males having antlers

**Coniferous** — relating to trees or shrubs bearing cones and evergreen leaves

**Courtship** — specialized behavior in animals that leads to or initiates mating

**Crepuscular** — most active at dawn and dusk

**Deciduous** — plants, trees, and shrubs that shed their foliage at the end of the growing season

**Delayed fertilization** — in most bats, mating occurs during fall, but the egg is not fertilized until after hibernation in April. This strategy allows the female bats to use stored energy reserves to survive hibernation instead of producing a fetus.

**Delayed implantation** — in certain animals, the embryo does not implant immediately following fertilization, but remains in a state of suspended growth or a diapause. A diapause allows for birth to occur under the most favorable of conditions.

**Diurnal** — most active during the day

**Echolocation** — a sensory system in certain animals, such as bats, in which usually high-pitched sounds are emitted and their echoes interpreted to determine the direction and distance of objects. This system is primarily used for finding prey and to avoid obstacles in low-light conditions.

**Ecosystem** — a system formed by the interaction of a community of organisms with their physical environment

**Endangered** — species is in imminent danger of extinction throughout all or a significant portion of its range

**Endothermic** — of or relating to an organism that generates heat to maintain its body temperature, typically above the temperature of its surroundings; warm-blooded

**Extinct** — no members of particular species surviving anywhere in the world

**Extirpated** — no members of a particular species surviving in certain portions of its original range, but surviving elsewhere

**Gestation period** — the period of carrying young in the uterus; the duration of pregnancy

**Habitat** — an area or environment where a plant or animal normally lives or can be found; the kind of environment in which an organism is able to find adequate food, water, shelter and space for survival

**Herbaceous** — green and leaflike in appearance or texture; characteristic of a non-woody herb or plant part

**Herbivore** — that which feeds primarily on plants

**Hibernation** — period of time when an animal becomes inactive or dormant, usually during winter. Allows an animal to survive harsh conditions using less energy than when active.

**Incisor** — a tooth adapted for cutting and gnawing, located at the front of the mouth

**Insectivore** — that which feeds primarily on insects

**Litter** — the offspring produced at one birth

**Mammary Gland** — milk-producing glands in female mammals that begin secreting milk when young are born

**Marsupial** — a mammal of which females have a pouch where the young are fed and carried

**Monogamous** — having a single mate for one reproduction event, season or possible lifespan

**Morphology** — the branch of biology that deals with the form and structure of organisms without consideration of function; study of the form and structure of an organism

**Nocturnal** — most active at night

**Omnivore** — that which feeds on both vegetable and animal substances

**Opposable** — a digit that rotates at the joint so that it can be placed opposite any of the other digits

**Ovulation** — discharge of eggs from the ovary

**Polygamous** — one male which mates with several females

**Precocial** — young born with hair or fur, eyes open, and the ability to move about immediately after birth

**Prehensile** — adapted for seizing, grasping, or holding, especially by wrapping around an object: an opossum's prehensile tail

**Primitive** — relating to an early or original stage; primary or basic

**Regurgitate** — to cast up partially digested food

**Species of concern** — species in need of concentrated conservation efforts; receives no legal protection

**Taxa** — a scientific grouping of living things

**Taxonomic Order** — an order for a list of taxa that depicts evolutionary relationships

**Threatened** — species that are likely to become endangered in the foreseeable future

**Vertebrate** — having a backbone or spinal column



## Cedar Waxwing *Bombicilla cedrorum*

### TRACK #54

This species might be thought of as the “**hear-  
ing** test bird”; waxwings’ calls are so high-  
**ing** pitched that people with high **frequency** **hear-  
ing** loss can’t hear them. They emit soft, quiet  
whistled *tsee-tsee-tsee* sounds, and knowing  
this call will produce many more waxwings,  
as traveling flocks constantly vocalize as they  
pass overhead. Cedar waxwings are big fruit  
consumers, and nomadic flocks often visit or-  
namental berry trees.

### RANGE:

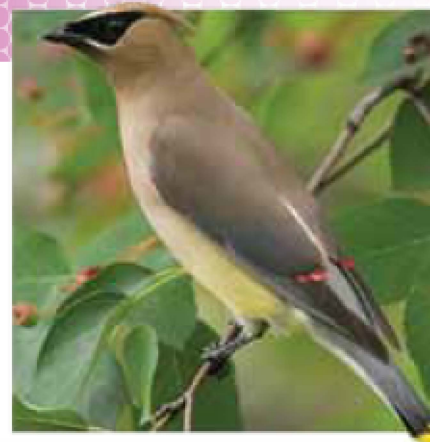
Statewide.

### HABITAT:

Very nonadict, flocks can turn up anywhere,  
but are especially attracted to berries;  
breeders prefer riparian woodlands.

### BEST SPOTS:

Easily found along rivers in streams in  
summer; seek ornamental berry-producing  
trees and shrubs in fall and winter.



© PHOTO BY BILL HEDAN

## Eastern Meadowlark *Sturnella magna*

### TRACK #93

The clear, ringing song of **this** colorful black-  
bird is commonly heard wherever large  
grasslands and meadows are found. While  
meadowlarks have declined significantly in  
recent decades, they still remain **common**  
throughout much of Ohio. Its western coun-  
terpart, the Western meadowlark, is very rare  
**in** the state and looks nearly identical. The  
two species are best separated by their very  
different songs.

### RANGE:

Statewide.

### HABITAT:

Meadows, pastures, hayfields, grasslands.

### BEST SPOTS:

Easily found statewide; abundant in  
reclaimed **strip** mine grasslands.



© PHOTO BY GARY NESEARS

## Field Sparrow *Spizella pusilla*

### TRACK #78

Although field sparrows have **trilling** songs  
like several other species, this one is proba-  
bly the easiest to recognize. They have a very  
sweet, melodic quality, and the **trill** speeds up  
towards the end. The song sounds much like  
a ping-pong ball that is dropped and bounces  
to a stop. Field sparrows often overwinter  
**in** the southern half of the state, but become  
quite **secretive** and lurk in dense brush.

### RANGE:

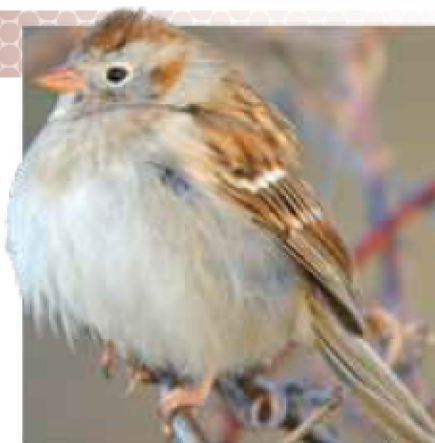
Common in suitable habitat statewide.

### HABITAT:

Old fields, abandoned pastures,  
open woods, orchards, woodland edges.

### BEST SPOTS:

Easily found statewide.



© PHOTO BY: ROBERT ROYSE

## COMMON YELLOWTHROAT *GEOTHLYPIS TRICHAS* • JEE-O-THLY-PIS [FINCH OF THE EARTH] TREE-KASS [A THRUSH; NOT VERY APROPOS]

### TRACK 94

Yellowthroats are one of the most common  
warblers breeding in the state, and their loud  
*wichity wichity wichity* song is commonly heard  
in all types of wetlands. They normally lurk  
in dense vegetation and are hard to see, but  
making squeaking or pishing sounds often  
lures them briefly into view. This **is** also a  
hardy warbler, and occasionally will attempt  
to overwinter in marshes. Then they may be  
best detected by listening for their loud *tchek*  
call note, often given in response to pishing.

### RANGE:

Statewide.

### HABITAT:

All manner of wetlands;  
occasionally drier brushy fields.

### BEST SPOTS:

Easily found in suitable  
habitats throughout Ohio.



male

PHOTO BY: © ROBERT ROYSE



## Indigo Bunting *Passerina cyanea*

### TRACK #89

A ubiquitous species of the countryside, indigo buntings are nonstop singers even throughout the heat of summer. It is an abundant species; some estimates of the overall population have put the total at 40 million pairs. Their song is a long, complex series of warbling whistles; a helpful identification tip is that most of the notes are sung in pairs. Indigo buntings often sing from telephone wires or other conspicuous spots.

### RANGE:

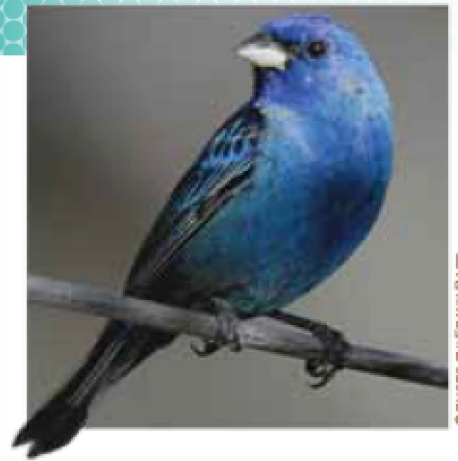
Statewide.

### HABITAT:

All types of open country, woodland edges and openings, orchards.

### BEST SPOTS:

Easily found throughout Ohio.



© PHOTO BY: FRANK BARD

## Eastern Bluebird *Sialia sialis*

### TRACK #46

One of our most celebrated birds, bluebird fanciers have erected thousands of nest boxes throughout Ohio which have helped to greatly expand populations of this attractive species. Bluebirds are a type of thrush, closely related to the American robin, and males deliver a soft, pleasing warbling song. In flight, bluebirds often emit a whistled *tu-wee* call, and knowing that sound will lead to detection of birds flying overhead.

### RANGE:

Common statewide; many overwinter.

### HABITAT:

All types of open country: farm land, golf courses, meadows and pastures.

### BEST SPOTS:

Most easily found where nest boxes have been erected, such as in many county parks.



© PHOTO BY: ROBERT ROYCE

## TREE SWALLOW *Tachycineta bicolor* • TAK-EE-SEE-NET-AH [SWIFT MOVER] BI-COL-OR [TWO COLORS]

### TRACK 86

This is our hardest swallow; the first spring arrivals may appear in late February/early March, and linger into late November. Tree swallows are cavity nesters, and the proliferation of nest boxes erected for Eastern bluebirds has also benefited this species. The largest numbers of tree swallows are always around wetlands, and in late September/early October, enormous congregations can form, sometimes numbering into the thousands. Tree swallows give melodious, liquid twitters and higher pitched chirps.

### RANGE:

Common statewide.

### HABITAT:

Open country with water nearby; peak numbers in large marshes and wetland complexes, particularly with dead, standing timber.

### BEST SPOTS:

Delaware WA, Magee Marsh WA and vicinity, Killbuck WA, Spring Valley WA, reservoirs statewide in migration.



Photo by: © GARY MESZAROS

## Northern Bobwhite *Colinus virginianus*

### TRACK #5

Once a common bird throughout Ohio, bobwhites have declined significantly and are mostly found in limited areas in the southern fourth of the state. The male's characteristic song, a cheery, whistled *Bob-white!* – often delivered from high in a tree – is a perfect example of onomatopoeia, or a word that is closely imitative of a sound.

### RANGE:

Distributed primarily in the southern fourth of Ohio.

### HABITAT:

Open country interspersed with brushy thickets, scattered trees, grasslands, reverting fields, and pastures.

### BEST SPOTS:

Crown City, Tranquility and Woodbury wildlife areas are excellent places to look for Northern bobwhites.



© PHOTO BY: TIM DANIEL



# WESTERN HONEY BEE

*Apis mellifera* (Ape-is • mel-if-er-ah)

## FAMILY: APIDAE (BEES)

**HABITAT:** abundant in all habitats from urban to agricultural to wilderness.

**LIFE CYCLE:** Honey bees are highly social insects. Colonies are founded by "swarming" in which part of an existing colony leaves with a queen to seek a new location for a hive. Swarms are harmless, as there are no honey stores or brood (eggs, larvae, pupae) for worker bees to defend. Scout bees find a suitable space, such as a hollow tree, to set up house, then report to the swarm and perform a "dance" that indicates the location. Worker bees construct combs made of wax that they secrete from glands between their abdominal segments. Colonies persist through the winter thanks to honey stored in hexagonal cells in the comb. Only the queen lays eggs.

**REMARKS:** Also known as the "European Honey Bee," this species was brought to North America by settlers to Jamestown in 1622. Our forefathers had no idea whether native bees could pollinate their crops; plus, the bees furnished honey and beeswax. "Colony Collapse Disorder" likely represents a combination of impacts from parasitic mites, malnutrition over the winter, perhaps poor genetics from inbreeding, and other factors. It is causing substantial bee losses in many areas. When a worker bee stings, barbs on the stinger hold it fast. As the bee pulls away, vital organs are ruptured and it eventually dies. Honey bees rate a "2" on the Schmidt Pain Index (page 8), the sting described as "Like a match head that flips off and burns on your skin."

**SIZE:** (BODY LENGTH)

FEMALE 12 mm

MALE 15-16 mm

QUEEN 16-20 mm

12

ODNR DIVISION OF WILDLIFE | COMMON BEES AND WASPS OF OHIO  
PHOTO BY: ©JIM MCCORMAC



ON INDIAN-BLANKET, GAILLARDIA PULCHELLA

# COMMON EASTERN BUMBLE BEE

*Bombus impatiens* (Bom-bus • im-pay-shens)

## FAMILY: APIDAE (BEES)

**HABITAT:** Common in gardens, parks, fields, vacant lots, and along forest edges.

**LIFE CYCLE:** This social species is one of few native bees that seem to be prospering. Mature colonies are exceptionally large, with up to 450 workers at season's end. Nests are built underground, in an abandoned rodent burrow or similar cavity. Bumble bees secrete wax from glands in the abdomen and use it to craft brood cells and "honeypots" for storing small quantities of nectar. Each brood cell can contain more than one larva, and is expanded as the larvae grow. The colony collapses at the end of autumn after new queens and males have been reared. Only queens survive the winter in hibernation.

**REMARKS:** There are 16 species of *Bombus* bumble bees in Ohio. The Common Eastern Bumble Bee can be confused with the Two-spotted Bumble Bee, *Bombus bimaculatus*, but the latter species is brighter yellow in most specimens. *B. impatiens* is employed widely in commercial greenhouses, particularly for pollination of hothouse tomatoes. Bumble bees "buzz pollinate," vibrating their wing muscles at a frequency that dislodges pollen, causing the grains to rain down on the bee. Look for queens and workers on red clover flowers especially. Males, which appear later in the year, seem to prefer asters and goldenrod. This bee has an unusually long flight season, from at least April through October in Ohio. Bumble bees rank high among our most important pollinators.

**SIZE:** (BODY LENGTH)

FEMALE 8.5-16 mm

MALE 12-17 mm

QUEEN 17-21 mm

13

ODNR DIVISION OF WILDLIFE | COMMON BEES AND WASPS OF OHIO  
PHOTO BY: ©KIM PHILLIPS (PRIMARY) • ©JIM MCCORMAC (SECONDARY)





# LEAFCUTTER BEES

*Megachile* spp. (Meg-ah-chi-le)

## FAMILY: MEGACHILIDAE (SOLITARY BEES)

**HABITAT:** Common in gardens, parks, meadows, prairies, and along forest edges.

**LIFE CYCLE:** Females of these solitary bees collect pollen in dense brushes of hairs (scopa) on the underside of the abdomen. The scopa can often be orange, red, or yellow. Most species nest in pre-existing cavities, but others nest in the ground. Females fashion barrel-shaped vessels from oval pieces snipped from leaves, or sometimes flower petals. Perfectly round pieces are cut for the "lid." Cutting a piece of leaf takes mere seconds, the bee rolling her cargo as she goes so she can fly away immediately. She completes one cell at a time, placing a ball of pollen and nectar inside as food for a single larval offspring. Several of these barrels are stacked along the length of the tunnel or burrow.

**REMARKS:** Leafcutter bees fly from May to September. Twenty-nine species, some of them introduced, are known in Ohio. They typically visit a variety of flowers for nectar, but may harvest pollen from only a few. The Alfalfa Leafcutter Bee, *M. rotundata*, is employed to pollinate lowbush blueberry in the eastern U.S., alfalfa in the west. Males of some *Megachile* species have enlarged hairy tarsi ("feet") on their front legs. They cover the eyes of the female during courtship and mating. Odor glands produce a seductive scent dispersed by the fringe of hairs.

**SIZE: (BODY LENGTH)**

FEMALE 8 -20 mm

MALE 6 -15 mm



24

ODNR DIVISION OF WILDLIFE | COMMON BEES AND WASPS OF OHIO  
PHOTO BY: © JACO VISSEER (PRIMARY) • © KIM PHILLIPS (SECONDARY)

# MINING BEES

*Andrena* spp. (An-dre-na)

## FAMILY: ADRENIDAE (MINING BEES)

**HABITAT:** Abundant in gardens, parks, meadows, prairies, and forest understorey.

**LIFE CYCLE:** This is a diverse genus (509 species north of Mexico; 100 Ohio species), so generalizations are risky. Though solitary, many females may nest in close proximity in favored sites. Nests can be in bare spots in the lawn, at the base of shrubs, or beneath leaf litter. Burrows are basically vertical but forked with lateral branches, each tunnel ending in one or two brood cells. Females line the cells with a waxy substance that soaks into the soil and prevents the walls from crumbling. Each cell is provisioned with a ball of pollen and nectar that feeds a single larva. Winter is passed as a prepupa or pupa. There is usually one generation annually.

**REMARKS:** Mining bees resemble *Halictus* and *Lasioglossum* bees (family Halictidae), and polyester bees (*Colletes*, family Colletidae), but female *Andrena* have a distinctive band of pale hairs on the inner margin of each eye. Those hairs may wear off in older specimens, but the underlying depressions (facial foveae) are still discernible. These bees can fly at cooler temperatures than other bees. Many species can only be identified by association with the flowers they visit. Males may form aerial leks at the tips of tree branches, attracting the attention of females. Most *Andrena* fly March to June, but some occur in late summer or fall.

**SIZE: (BODY LENGTH)**

FEMALE 10 -14 mm

MALE 8 -11 mm



33

ODNR DIVISION OF WILDLIFE | COMMON BEES AND WASPS OF OHIO  
PHOTO BY: © KIM PHILLIPS (PRIMARY) • © ED PHILLIPS (SECONDARY)



# VICEROY *Limenitis archippus* (Le-men-ee-tis • ar-kip-us)

BRUSHFOOT FAMILY (Nymphalidae)

DISTRIBUTION



WINGSPAN: 2.6"-3.2"

PAGE: FORTY-SEK

46



**HABITAT:** Most often seen around wetlands and moist habitats with cottonwoods and willows, but can occasionally appear in nearly any open habitat.

**HOST PLANTS:** Cottonwood (*Populus deltoides*), pussy willow (*Salix discolor*), black willow (*S. nigra*) and sandbar willow (*S. interior*).

**DISCUSSION:** The viceroy butterfly is often confused with the monarch. However, it can easily be separated from that species by the

presence of a narrow black curved bar across the middle of the dorsal hindwing. They are also smaller than monarchs and have a more rapid, less buoyant flight, holding their wings flat when gliding rather than the v-shaped glide of the monarch. Viceroys are usually found close to stands of willow, the most frequent larval host plant. It was widely believed that the viceroy was a classic Batesian mimic of

the toxic monarch, and predators would consequently avoid this species. We now know that viceroys are distasteful in their own right, and unpalatable to eat. Birds quickly learn to avoid both of these species. The homely looking caterpillars resemble bird droppings and are the only bird scat mimic caterpillars that have horns. There are two broods a year and viceroys overwinter in the larval stage.

OCCURRENCE: Ja Fb Mr Ap Ma Jn Ju Ag Sp Oc Nv Dc

photography | CATERPILLAR: CHERYL HARNER; VENTRAL: DAVE PARSHALL; DORSAL: DAVE PARSHALL

# MONARCH *Danaus plexippus* (Dan-ay-us • plex-ih-pus)

BRUSHFOOT FAMILY (Nymphalidae)

DISTRIBUTION



WINGSPAN: 3.5"-4"

PAGE: FORTY-NINE

49



**HABITAT:** Occurs commonly in nearly any open landscape, often turning up in gardens and highly urbanized areas.

**HOST PLANTS:** Common milkweed (*Asclepias syriaca*), swamp milkweed (*A. incarnata*), and butterfly-weed (*A. tuberosa*). May use others of the thirteen species of milkweed found in Ohio.

**DISCUSSION:** Without doubt, the most widely recognized butterfly in Ohio and North America. In addition, the life cycle of the monarch is probably the best known in the butterfly world. It is also the longest-lived butterfly found in Ohio, with some adults surviving more than ten months. Most of the monarchs produced in Ohio and elsewhere in the north make an incredible fall migration to high elevation fir forests in Mexico. After overwintering there, they return

north in increments, stopping along the way to lay eggs and thus recolonize the southern states. It is the offspring of this first spring brood, and even second or third broods, that returns to Ohio and points north. Males can easily be told from females by the presence of small black scent glands on a vein of the dorsal hindwing. Caterpillars are distinctive, and are commonly found eating milkweed plants. The chrysalis is also easy to recognize, and is often placed rather conspicuously, hanging from all manner of plants. Because monarch caterpillars eat milkweed, which contains toxins called cardiac glycosides, they and the adults are foul-tasting and shunned by birds and other predators. The fall migration of monarchs is one of nature's great spectacles. Resting swarms can number in the thousands, and

cloak entire trees. Canadian monarchs cross Lake Erie, and often occur in profusion on islands in Ohio, such as South Bass and Kelleys islands. The biggest recorded Ohio concentration dates from 1892, when millions of monarchs poured into Cleveland after crossing Lake Erie. Protection of the fir forests where monarchs winter, in the Michoacan state of Mexico, is vital to conserving eastern North American monarch populations. In excess of 100 million butterflies descend upon these forests, drawing ecotourists from around the world. Fortunately, the Mexican government has recently taken strong measures to protect these forests from illegal logging, which was threatening the butterflies, and millions of additional trees will be planted to help reforest monarch wintering sites.

OCCURRENCE: Ja Fb Mr Ap Ma Jn Ju Ag Sp Oc Nv Dc

photography | CATERPILLAR: TIM DANIEL; VENTRAL: TIM DANIEL; DORSAL: TIM DANIEL



## 2022 NCF-Envirothon Ohio

### Wildlife Study Resources

#### Key Topic 2: Habitat Management

4. Evaluate different habitats for suitability for a variety of wildlife species.
5. Describe and apply best management practices for threatened and endangered species.
6. Explain the impact of invasive species on local ecosystems.
7. Describe and apply different management practices for controlling invasive species.

#### Study Resources

Resource Title	Source	Located on
Introduction to Grassland Management	<i>Private Land Partnerships Fact Sheet Series, 2021</i>	Pages 25-28
Eastern Wild Turkeys	<i>Private Land Partnerships Fact Sheet Series, 2021</i>	Pages 29-31
Renovating native warm-season grass stands for wildlife	<i>Brookes et al., Purdue Extension, FNR-548-W, 2017</i>	Pages 33-51
Incorporating Wildlife Needs into Forest Management Plans	<i>Rodewald and Brittingham, OSU Extension, W-1-2001</i>	Pages 52-55
Managing for Forest Songbirds	<i>Rodewald, OSU Extension, W-6-2001</i>	Pages 56-57
Dead Trees as Resources for Forest Wildlife	<i>Santiago and Rodewald, OSU Extension, W-18-2004</i>	Pages 58-59
Attracting Pollinators to the Garden	<i>Ellsworth, OSU Extension, ENT-47-2014</i>	Pages 60-63
Constructing Healthy Habitat for Monarchs	<i>Monarch Joint Venture Fact Sheet Series, 2022</i>	Pages 64-65
Pollinator Habitat Establishment Recommendations	<i>Ohio Pollinator Habitat Initiative, 2018</i>	Pages 66-71
Checklist of Actions to Promote Pollinators in Yards, Gardens, and Parks	<i>Xerces Society, 2019</i>	Pages 70-71
In the Thick of It: How Invasive and Exotic Shrubs Affect Breeding Birds	<i>Rodewald, Birding Magazine, 2012</i>	Pages 72-77
Natural History of Forest & Cave Dwelling Bats	<i>USDA, Forest Service, 2021</i>	Pages 78-79

**Study Resources begin on the next page!**



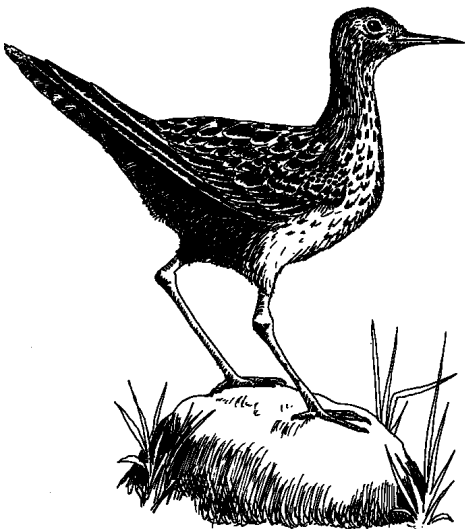




## INTRODUCTION TO GRASSLAND MANAGEMENT

The nearly 7,000 kinds of grasses make up the most widespread plant family in the world. Grasslands in Michigan range from mowed lawns to idle fields to grainfields. Before settlement, grasslands of several types were scattered throughout Michigan, such as wet meadows, oak and pine barrens, dry sand prairies, and tall grass prairies. One grassland that most people think of is the tallgrass prairie, which was primarily a Midwest ecosystem that extended into southwest Lower Michigan. These prairies were unlike anything the settlers had ever seen, and they supported more than 300 species of wildflowers and grasses, some of which grew to a height of nine feet.

Many experts consider North American grasslands to be a fairly recent development in geologic



upland sandpiper

time. Thousands of years ago, huge glaciers covered much of Michigan. About 14,000 years ago, the climate became warmer and the glaciers began to melt and retreat. Prairies, barrens, and wet meadows began to establish themselves on landscapes that were level or gently rolling on sandy or loamy soils. After the glaciers were gone, the climate cooled and the conifer forests of northern Michigan, including the Upper Peninsula, appeared. Vegetation changed over the next several thousand years with warmer, drier periods favoring grasslands in sandy and loamy channels, rolling hills, and flat lakeplains, and the spread of oak and hickory into southern Michigan.

Perhaps as important as climate is the element of fire to establish and maintain Michigan's grasslands. Whether caused by lightning or set purposely by Native Americans, fire helped prairies to grow by stimulating grass and wildflowers to reproduce, reducing competition from weeds, and discouraging the encroachment of shrubs and trees. No one knows exactly how many prairies existed in Michigan before settlement, but researchers have identified 39 known prairie areas, mostly in the southern Lower Peninsula. These prairies ranged in size from less than 100 acres to 25 square miles and may have totaled approximately 2.3 million acres.

least shrew



### Value to Wildlife

Grasslands support a variety of wildlife species. In fact, some kinds of birds cannot live in any other ecosystem. Northern harriers, sharp-tailed grouse, upland sandpipers, bobolinks, and savannah and Henslow's sparrows thrive best in grassland habitats of at least 100 acres. Grasslands smaller than 50 acres will attract bobwhite quail, bluebirds, red-winged blackbirds, American goldfinches, dickcissels, common yellowthroats, and vesper, field, and song sparrows. Other species, such as the Eastern meadowlark, grasshopper sparrow, and sedge wren, can prosper in grasslands from 10 to 20 acres. Mammals also find grasslands valuable, such as the meadow and prairie vole, 13-lined ground squirrel, and badger.

Because grasslands provide nesting, brood rearing, and roosting cover, they are important to quail, pheasants, and wild turkeys. Pheasants in particular also find native grasses such as switchgrass, Indiangrass, and the bluestems suitable for winter shelter because the grasses stand up to snow.



Deer use grasslands for food at birth to their fawns there. Rabbits raise their young and find food and security in grassland edges. They are also home to mice, shrews, voles, some kinds of snakes, and a host of avian and ground predators including hawks, owls, raccoons, skunks, opossums, foxes, and coyotes.

## Taking Inventory

When you evaluated your land, as explained in the **Habitat Planning** section of this manual, what grasslands, if any, did you find? If you own a native grassland, consider yourself lucky. You may be able to restore the grassland to full productivity by eliminating as much competition as possible and then interseeding desirable plant species. Or you may own an old field that was once in crop production and is now left idle. Field borders, old fencerows, farm lanes and other corridors, and odd areas that can not be plowed or disked offer further opportunities for grassland establishment. Your active hayfields are a type of grassland, too. They can be managed for livestock forage and wildlife. The current quality of your grasslands will depend on soil and water conditions, and plant composition. Each combination may attract different wildlife species.

This **Grassland Management** section has chapters on warm season and cool season grasses, grass planting, converting old fields to grasslands, restoring a prairie, and prescribed burning. What follows is an overview of each.

## Warm Season Grasses

There are two basic kinds of grasses--warm season and cool

season. Wildlife thrive in both. Warm season grasses are usually referred to as prairie grasses and include Indiangrass, big bluestem, little bluestem, switchgrass, and prairie cordgrass. Native to Michigan, they grow best under the heat of a summer sun followed by warm nights. You can see them mixed with colorful native wildflowers at public



switchgrass

and private prairie areas and sometimes along roadsides and railroad rights-of-way. Besides their value to wildlife, warm season grasses can provide forage for livestock and add beauty to the landscape.

They are four reasons why wildlife biologists usually prefer warm season grasses for wildlife cover: (1) they hold up to the elements, (2) they are native to Michigan, (3) they can be planted along with wildflowers, and (4) they live a long time. Often called bunch grasses because they grow in clumps, these plants do not break down easily under heavy winds or deep snow. Their disadvantages are that they are initially more costly to plant than other types of grass and typically take up to three years to establish. Patience is the key to success. Once native grasses take hold, however, they need little attention and will live many years through proper maintenance. Maintaining them through prescribed burning every few years will keep them healthy and productive for wildlife. Other management options include light grazing by livestock, periodic mowing, or the spot application of a selective herbicide.

## Cool Season Grasses

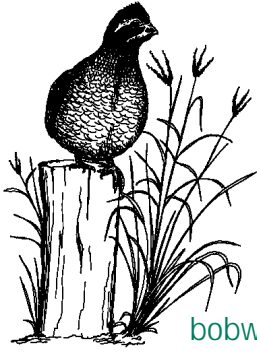
Most of the grasses you see in Michigan are cool season grasses not native to the state. These include brome grass, timothy, and orchardgrass. Native cool season species include Canada wildrye, redtop, and June grass. Alfalfa and clover are cool season legumes that are planted with cool season grasses because the legumes fix nitrogen for themselves and other plants, provide food for many kinds of insects, and offer habitat diversity for wildlife. Cool season grasses and legumes grow best when the daytime temperatures on spring and fall days reach 65 to 75 degrees Fahrenheit followed by cool nights.



redtop

Cool season stands are valuable to wildlife because they provide nesting and cover in spring and summer and sometimes roosting cover in summer and fall. Most landowners are familiar with these grasses. Advice on planting and equipment are easy to come by, and the stands are easy and more affordable than warmseason grasses to establish. Annual mowing will keep them productive although the stands lose vigor over time and may need to be replanted. They also tend to break down under wind and snow.





bobwhite quail

## What to Plant and Where

What should you plant, and where should you plant it? Consult your overall Management Plan before deciding to plant cool season or warm season grasses. Many landowners whose goal is to provide year-round habitat for pheasants, quail, and grassland songbirds plant both types side by side, along with a nearby food plot containing corn, buckwheat, millet, and sunflowers or a similar mixture of preferred wildlife foods. However, warm season grasses should be planted before cool season grasses to ensure full stand development. If your property is small and you are able to provide only one component of habitat, consider working with neighbors who might be willing to furnish other needs.

Planting more than one kind of grass will provide the variety of grass heights and density for good nesting habitat, especially for waterfowl, pheasants, and songbirds. Mixing in legumes in cool season plantings and wildflowers in warm season stands will encourage insects, which in turn provide food for wildlife. Stiff-stemmed legumes and wildflowers provide perching sites for meadowlarks, sparrows, and other birds. The wildflowers offer a source of nectar for hummingbirds and bee species.

What species of grasses, legumes, and wildflowers you establish depend on soil type, depth, texture, and fertility. Certain grasses and legumes grow better on dry sites, and other types thrive on wet sites. Warm season grasses, for example, tend to grow well on sandy, droughty, or excessively drained sites. Most cool season grasses perform better on well-drained soils of sandy loam.

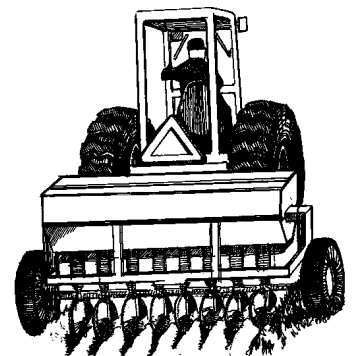
Besides soil considerations, other site conditions include drainage and erosion concerns and potential weed problems. Check with your Conservation District office for a Soil Survey map, which will identify erosion potential as well as soil types on your property. Identify plants already growing on the site you are considering for grass planting. Also learn what you can about the history of cropping or other land use. This information will help you to know what to plant and how much effort will be needed to maintain the grassland once it is established.

To increase the value of grasslands to wildlife, especially smaller sites of five to 20 acres place them next to or near other suitable grassland habitat. Examples are hayfields, pastures, and wetlands. Your grassland will help wildlife the most if the landscape around your property is also in grasslands or associated habitats. The best defense against predation is to plant a large grassland area rather than a small one. Ten acres is better than five acres, and 20 acres is better than 10 acres. If a larger planting is not possible or practical, you can help protect nesting birds from predation by edge-loving raccoons, hawks, opossums, and skunks, and parasitism by brown-

headed cowbirds by placing the grassland at least 50 yards from hedgerows, woodlots, and dead trees. The buffer between these habitat types can be planted to shrubs. The shape of the grassland planting is also important, especially small grasslands. To reduce predation, plant in circles or squares rather than in linear strips.

## Old Fields

Idled farm fields, borders and corridors can often be converted to grasslands if the site and soil conditions are favorable. After those determinations are made, you will need to identify what stage of natural succession the field is in. What is currently growing there? Are the plants annuals or perennials? Have shrubby plants like dogwood, blackberry, and sumac already begun to invade? Are there any trees? If so, what kind? Before converting an old farm field to a grassland, you must eliminate the existing vegetation. Burning, mowing, disking and the application of selective herbicides are all methods used to return an old field to bare-soil conditions. Old fields may not be as beneficial to some grassland species as planted prairies; however, they, too, provide food, shelter, and security for many species.





# INTRODUCTION

## Prairie Restorations

Pure prairies are ecosystems that are relatively free from the invasion of shrubs and trees. They occur where sites are too wet or too dry for woody vegetation to grow, or where plant succession has been checked through fire. If you have a prairie on your property, chances are it will be a prairie remnant that is degraded, but that might be restored. Doing some detective work at the local library and the county Conservation District office may turn up clues such as historical photos. Talking to neighbors and former owners may yield more information. Armed with a good identification guide of native grasses and wildflowers, you might be able to identify remnant prairie plants. Or perhaps a local expert will walk your property with you and help with identification.

If you have a former prairie and want to restore it, you may need to remove shrubs and trees, by mowing, burning or herbicide use. In some cases you may be able to interseed the site, preferably with seed from native plants from the immediate area or begin a new planting altogether.

Excessive weed growth is the biggest hurdle to establishing a lush grassland that has maximum benefit to wildlife. Native grass plantings in particular may take three to five years to dominate the site, especially if weeds were not controlled during the first year after

planting. During that first year of life, native grasses grow mostly below the ground as their root systems develop. Because little growth appears above ground where weeds are likely rampant, many landowners become needlessly discouraged. Once the stand is established, though, periodic burning will keep it healthy. Other methods to maintaining grasslands include strip mowing in alternating years, light grazing by livestock, and spot treatment of problem weeds or invading shrubs with a selective herbicide.

## Prescribed Burning

A prescribed burn is a fire purposely set to achieve a predetermined objective. Prescribed burns are often used today to kill or set back the growth of undesirable vegetation such as woody plants or noxious weeds and to promote the regrowth of warm season plants such as switchgrass. Most burns take place in the spring, however depending on what you hope to accomplish a fall burn may be in order.

These fires need to be conducted by individuals who are trained and experienced in fire management. Before prescribed burns take place a burn plan has to be developed and burning permits secured from the local fire authorities. Safety from personnel injury and damage to property is always the first concern when planning a fire.

In summary, grasslands in Michigan are important ecosystems for many species of birds and mammals. Whether you restore former grasslands, convert old fields, or create new grasslands, patience is one key to success. Another key is regular maintenance, to control natural succession. The benefits, however, include providing valuable wildlife habitat, livestock forage, and landscape diversity that is pleasing to behold.

**FOR ADDITIONAL  
CHAPTERS CONTACT:**  
Michigan United  
Conservation Clubs  
PO Box 30235  
Lansing, MI 48909  
517/371-1041



**Private Land Partnerships:** This partnership was formed between both private and public organizations in order to address private lands wildlife issues. Individuals share resources, information, and expertise. This landowner's guide has been a combined effort between these groups working towards one goal: Natural Resources Education. We hope this manual provides you with the knowledge and the motivation to make positive changes for our environment.

FOR ADDITIONAL ASSISTANCE: CONTACT YOUR LOCAL CONSERVATION DISTRICT

# EASTERN WILD TURKEYS



The eastern wild turkey can be found from northern Florida and Mississippi to Maine and northern North Dakota. Before the first settlers arrived in Michigan, wild turkeys were established mainly in the southern part of the state. They were absent in the northern Lower Peninsula and Upper Peninsula due to the colder weather and deep snows.

Turkeys prosper in a mix of forest and agricultural lands. Because of habitat loss and unregulated market hunting, Michigan wild turkey populations plummeted in the late 1800's and by the turn of the 20th century few observations were reported. By the 1950's Michigan's wildlife biologists began a reintroduction program releasing birds in southwestern Michigan and later in the northern Lower and Upper Peninsulas. Since the 1960's, turkey populations have grown in northern Michigan even though they have been subject to severe winters. In many areas of northern Michigan, supplemental feeding seems to play a major role in winter survival. Wild turkeys are also located throughout southern Michigan and flocks are growing and expanding.

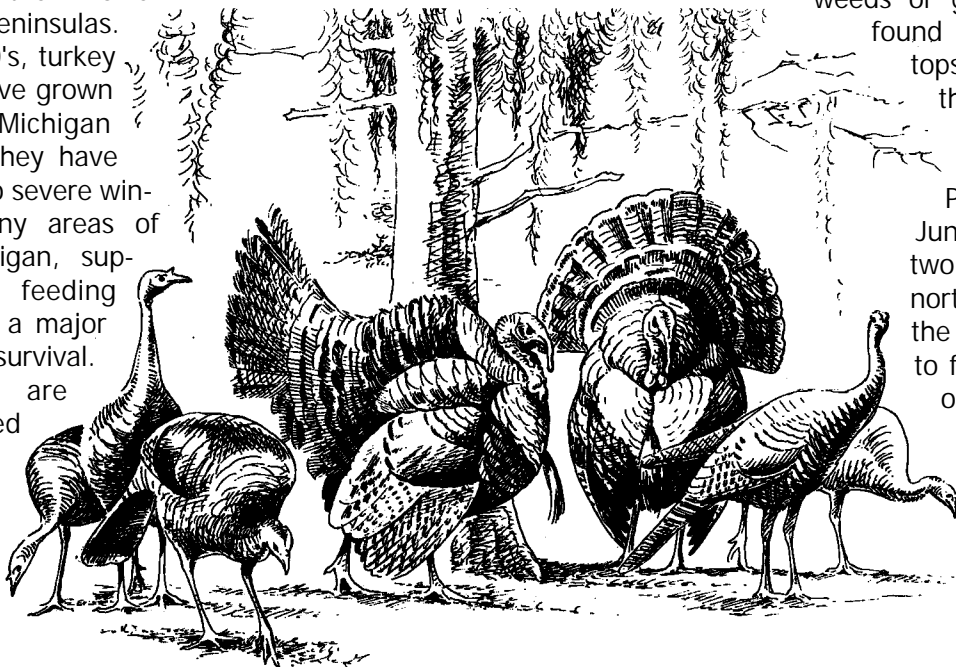
The home range of wild turkeys is one to four square miles or about 640 to 2,000 acres. Michigan landowners who are able to provide the necessary habitat components are likely to have turkeys on their property, especially if they live in a region of the state that does not receive more than 60 inches of snow each year.

Turkeys have exceptional hearing and eyesight. The bird's ability to run at 15 to 18 miles per hour and to fly on five-foot-wide wings at speeds approaching 55 miles per hour also make it a challenging quarry for predators. Many landowners simply enjoy seeing turkeys. Because the birds may travel several miles each day, opportunities for seeing them are good if habitat needs are met.

## Life Cycle

Turkeys are social birds and in winter often separate into three distinct groups: adult males (toms), young males (jakes), and females (hens) of all ages. These flocks begin to disperse in late winter or early spring when courtship and mating rituals begin. Toms set up territories and begin gobbling, strutting, and displaying in hopes of attracting a harem of hens. Most hens, regardless of age, will breed with a gobbler each spring.

Egg laying begins in April, and each hen will lay a clutch of 11 to 12 eggs over a two-week period. She usually chooses the base of a large, mature tree or stump, such as an oak or beech, in fairly open, isolated woods. However, some hens may nest in idle fields of weeds or grass. Nests are also found next to downed tree tops and brush piles. When the clutch is complete, the hen will incubate her eggs for 28 days. Peak hatching occurs in June in southern Michigan; two to three weeks later in northern Michigan. Until the young poults are able to fly (at about two weeks old) and roost in the lower branches of trees, they are very susceptible to predation.



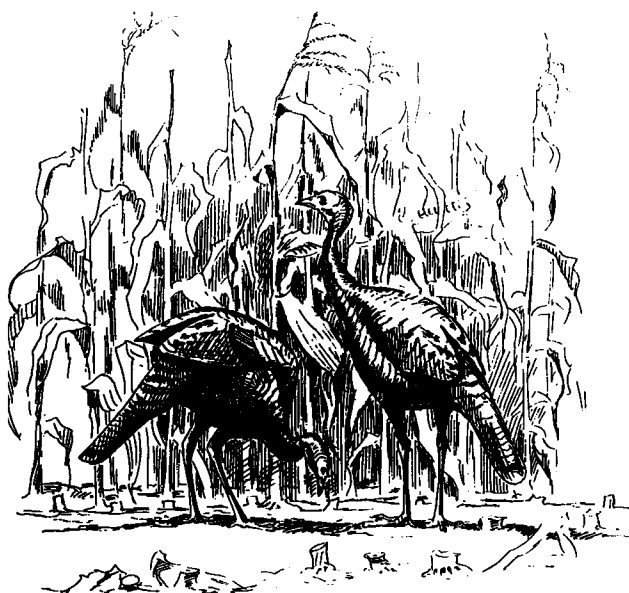


Nest predators such as crows, raccoons, skunks, opossums, domestic pets, and human disturbances are the biggest threat to successful hatching. Adult wild turkeys have few, if any, natural enemies. Although coyotes will sometimes kill an adult bird, turkey densities are seldom significantly affected, even in areas where coyotes are plentiful.

## Food and Water

The diet of an adult wild turkey includes about 90 percent plant matter and 10 percent animal matter. Hens consume about 1/3 pound of food daily; adult gobblers may eat 1/2 to 1 pound of food each day. Turkey foods fall into four main categories: mast (nuts and fruits), seeds, greens, and insects. In winter they prefer hard and soft mast including acorns, beechnuts, crabapples, and hawthorns. They will also eat waste grains in harvested fields of corn, buckwheat, soybeans, oats, and grain sorghum.

Turkeys foraging in agricultural areas in the fall and spring eat mostly waste grains, wild plants, insects, and young grasses. Corn, buckwheat, and wheat are outstanding sources of fall, winter, and spring foods. More information on



planting these crops are available in the **Cropland Management** section.

As spring changes into summer, hens typically lead their young to open areas with succulent ground vegetation including grasses, sedges, and a variety of forbs and legumes, especially clover. These fields of grass and legumes contain protein-rich insects, which make up 75 percent or more of the poults' diet until four or five months old. Insects include grasshoppers, ground beetles, flies, caterpillars, ants, and crickets. As the poults grow, the seeds of ragweeds, sunflowers, and grasses are favored along with the fruits of dogwood, wild grape, cherry, sumac, and blackberries. Wildlife managers generally agree that artificial feeding of wild turkeys can overly concentrate the birds in a small area, making them more susceptible to poaching and the spread of disease.

Water is another important necessity. Turkeys need water almost daily, and hens rarely nest farther than a quarter-mile from a

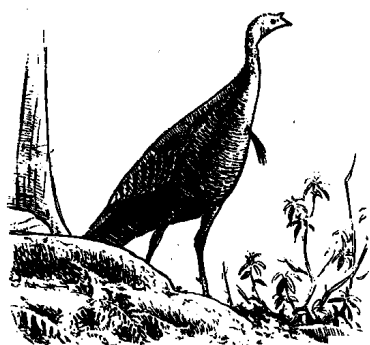
reliable water source such as a creek, spring, seep, or farm pond.

## Cover

Prime cover includes a mixture of open areas within a mature (or nearly mature) forest containing a variety of tree species including white and red oaks, hickories, ash, beech, and white and jack pine. Turkeys use these mature trees as roosting sites but seldom roost in the same place on successive nights. Therefore, several suitable roosting locations scattered throughout their range are needed. Understory trees, and trees/shrubs at woodland edges or in openings also provide cover. Such trees and shrubs include ironwood, musclewood, hazelnut, beech, wild plum, serviceberry, mountain ash, wild black cherry, dogwood, crabapple, black locust, hawthorn, and pin and chokecherries.

Although turkeys can survive in areas that are only 10 percent forested, their survival improves when mature woods comprise 30 to 50 percent of the available habitat. Turkeys like open, mature woods but will also use timber stands that have grown beyond the small-pole (2-inch to 9-inch diameter) stage, if the understory is not too dense. Turkeys prefer varied habitats and also make use of brushlands and openings as well as pastures and row-cropped and idle farm fields. Travel corridors for turkeys include forested streams and river floodplains, which connect adjacent woody cover.

On cold, winter nights turkeys often seek two to five acre stands of dense mature conifers, which



will provide thermal protection as well as roosting sites. Mature woods that contain nut-producing trees (oaks, beeches, hickories) are especially important in winter because they yield carbohydrate-rich food.

Grass and clover meadows produce high quantities of insects and can provide outstanding brood rearing habitat. Mixes of grasses, clover or alfalfa can be used. Refer to the **Grassland Management** section for more information on grass varieties, seeding rates, and methods.

## Habitat Considerations

In Michigan, the ideal habitat mix is 20 to 30 percent bottomland hardwoods, 10 to 30 percent mature oaks, 5 to 10 percent conifers, 10 to 15 percent shrubs, 20 to 30 percent croplands and 15 to 25 percent grasslands, clover pastures or idled fields. In good-quality habitat, the area will safely support one bird per 30 acres or one flock for every 640 to 800 acres. But unless you own a lot of land--1,000 acres or more--it is unlikely that turkeys will remain on your property year-round because they need a large amount of living space. Even so, there are many things you can do to attract wild turkeys to your property at various times of the year. General management options include:

- (1) managing woodlots of any size to maximize favored wild foods and cover
- (2) creating or maintaining openings

- (3) providing year round food needs.

The following are specific management considerations for eastern wild turkeys:

- In areas where good thermal cover is limited, and where pines can naturally occur, plant a four to eight acre stand of pines. With proper management in 20 to 40 years this will provide necessary cover.

- Rivers or creek bottoms, swamps and lowland hardwoods should be protected and maintained because of their importance as a corridor to turkey and many other wildlife species. Corridors should be at least 100 feet wide.

- Mature hardwood stands should contain some younger trees that will eventually replace those that are harvested for timber or die of natural causes.

- Manage mixed stands of deciduous (leaf-bearing) trees to maintain and encourage those trees that produce nuts, fruits, or seeds. Encourage these kinds of trees by cutting species

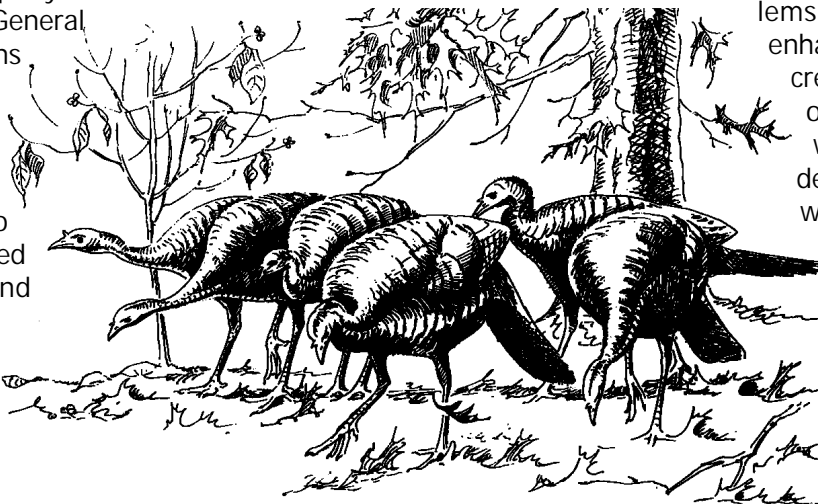


## Nuts and berries are essential components of the turkey's diet.

that provide little benefit to turkeys. Proper thinning of trees, therefore, may be necessary. Consult with a professional forester for details and also refer to the **Forest Management** section.

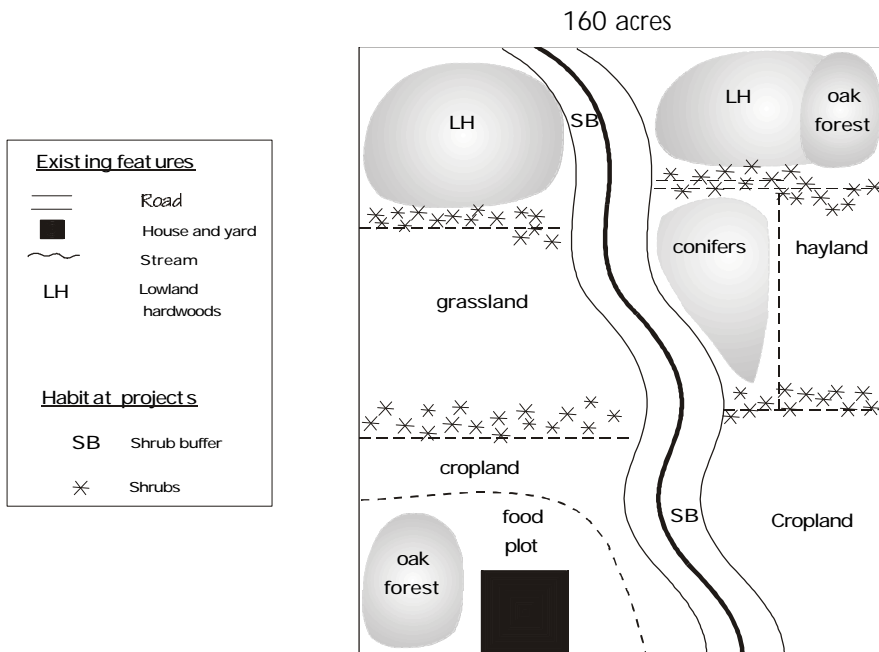
## Managing Openings

Openings can vary in size from a half-acre or less to more than 10 acres. Actual size is less important than where the opening is located and what is planted there. Openings should be large enough to admit sunlight to create forage growth. For example, linear openings such as power line rights-of-way, should be at least 60 feet wide. The optimum shape of an opening is long and rectangular with an irregular boundary that follows the land contours, provided you do not create erosion problems. If possible, maintain or enhance existing openings before creating new ones. Too many openings within a small area will fragment your forest and detrimentally impact a variety of wildlife species. Within a 100 acre forest, maintain three to five acres of openings. Several small openings are usually better than a single large one. However, if your area is severely fragmented, do not create more openings.





# WILD TURKEYS



This map is an example that demonstrates the many management options discussed throughout this chapter. The option(s) you choose should depend not only on your goals, but the location, condition, and present use of your land.

What to plant in an opening depends on your goals and turkey needs. Do you want to provide an additional source of food or establish permanent brood habitat or both? Are you planning to offer supplementary food during the summer (clover) or winter (corn)? Do you want low-maintenance plants that will be available over several years, or do you want to replant the opening each year with a grain crop?

## Concerns

No matter how we manage our property for wildlife, our decisions will always have impacts. For example, if

we manage mature woodlands for turkeys we will discourage brushland species such as grouse and catbirds. Creating openings may produce habitat for turkeys and deer, but may increase cowbird or raccoon predation.

Habitat that is managed for wild turkeys also tends to benefit deer, squirrels, black-capped chickadees, and woodpeckers. You should also be aware that creating or enhancing habitats may invite unwanted guests. For example, if you plant trees and shrubs, in the hopes of attracting wild turkeys and songbirds, you most likely will also entice deer, rabbits, and mice that can become a nuisance by

eating the new plantings and even killing them. Free-roaming dogs and cats may also be attracted to any habitat that suddenly has an abundance of wildlife.

In summary, eastern wild turkey populations have returned to Michigan and prospered since their reintroduction. If your property contains a mix of forest and agricultural lands, you may be able to manage for turkeys. However, be aware of the negative impacts that this management may have on other wildlife.

## FOR ADDITIONAL CHAPTERS CONTACT:

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**Private Land Partnerships:** This partnership was formed between both private and public organizations in order to address private lands wildlife issues. Individuals share resources, information and expertise. This landowner's guide has been a combined effort between these groups working towards one goal: Natural Resources Education. We hope this manual provides you with the knowledge and the motivation to make positive changes for our environment.

FOR ADDITIONAL ASSISTANCE: CONTACT YOUR LOCAL CONSERVATION DISTRICT





## Renovating native warm-season grass stands for wildlife

### *A Land Manager's Guide*

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## Table of Contents

<b>Introduction</b> .....	2
<b>Management Practices</b> .....	4
Disking .....	5
Prescribed Fire .....	5
Herbicide Application .....	6
Interseeding Forbs .....	6
<b>Common Issues in Planted NWSG Stands</b> .....	7
Rank Native Grasses .....	7
<b>Problematic Herbaceous Plants</b> .....	10
Johnsongrass .....	10
Other Nonnative Warm-Season Grasses .....	11
Nonnative Cool-Season Grasses .....	11
Canada Thistle & Other Nonnative Thistles .....	12
Sericea Lespedeza .....	12
Wild Parsnip .....	13
Crownvetch .....	14
Other Common Broadleaf Plants .....	14
<b>Woody Encroachment</b> .....	15
Pioneering Woody Plants .....	15
Nonnative Invasive Woody Species .....	16
<b>Conclusion</b> .....	19
<b>Acknowledgements</b> .....	19
<b>Additional Resources</b> .....	19
<b>Appendix A</b> .....	20
<b>Appendix B</b> .....	21

## Introduction

Many wildlife species use or require fields and other areas of early successional vegetation to meet their habitat requirements. Northern bobwhite, wild turkey, ring-necked pheasant, grassland and shrubland songbirds, eastern box turtles, and eastern cottontails all use open areas dominated by forbs, grasses, and shrubs in spring and summer for nesting and raising young. In winter, fields and other openings can provide cover as well as seed for upland game birds and over-wintering songbirds. White-tailed deer frequently use early successional plant communities as fawning areas in the summer and bedding areas throughout the year. Additionally, many of the forbs and brambles (e.g., common ragweed, pokeweed, asters, and blackberry) common in these areas are highly selected forages by white-tailed deer and provide excellent sources of nutrition.

Native warm-season grass and forb mixtures (NWSG) are promoted through various state and federal conservation programs as a means of creating and managing early successional plant communities and as an alternative to nonnative grasses. NWSG are planted to provide cover and food for various wildlife species, to provide cattle forage, to control soil erosion, and to enhance water quality. These plantings typically contain a mixture of tall (big bluestem, indiangrass, switchgrass) or medium-stature (little bluestem, sideoats grama) native grasses with a variety of forb species.



Many people may look at this stand of indiangrass and big bluestem and think it has the correct composition and structure for wildlife. However, this rank stand of native grasses is not what you want for most wildlife species. Too much grass is a common problem in planted NWSG stands.

Planting native grasses and forbs through cost-share programs has become a common practice to create and maintain early successional plant communities for wildlife. However, several problems commonly occur when trying to establish or enhance early succession vegetation by planting NWSG. Common problems include dense native grass, competition by undesirable plants from the seedbank, lack of proper management, and cost associated with planting, especially seed.

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The most common problem with planted NWSG is the grass itself! Conservation organizations and cost-share programs commonly recommend or require planting 3–6 pounds PLS (pure live seed) of grass seed per acre. In the past, recommendations often included 6–10 pounds of grass seed per acre, and many of these stands still exist and are in desperate need of renovation. Even with 4 pounds PLS of grass seed per acre included in the mixture, a successful planting will result in more than 50% coverage of grass within 3 years. Extremely thick (or “rank”) native grasses is a frequent issue when tall native grasses, such as big bluestem, switchgrass, and indiangrass, are planted. Not only did past planting recommendations consist of high seeding rates of tall grasses, but they also had relatively few forbs with a light seeding rate. More recently, recommendations for planting have included reduced rates (<4 lbs/acre) of grass, favoring medium-height grasses versus tall grasses, and mixtures have incorporated an increased density and diversity of forbs aimed primarily at improving the value of these plantings for pollinators.

It is a common misconception that fields dominated by native grasses with very few “weeds” are best for wildlife. With the exception of grassland songbirds, there are no wildlife species in the eastern United States that need more than 30%–50% grass cover. Northern bobwhite, pheasants, and ground-nesting songbirds certainly use native grass litter for nesting, but they also will build nests from most any other herbaceous material and place nests near other vegetation that provides structure similar to grasses. For bobwhite, a density of 250 to 10,000 native-grass clumps per acre is more than sufficient for nesting



Bobwhite commonly use native grasses for nesting, but they also use dead material from a wide variety of other plants like giant foxtail. This picture illustrates the point that native grasses are not the only material bobwhite use for nesting, especially in areas where herbaceous vegetation is not lacking.

### Seedbank management: a sensible alternative to planting native grasses

Planting native grasses and forbs has become the standard practice to establish early successional vegetation for wildlife. However, on a majority of sites, it is not necessary to plant native grasses or forbs because a wide variety of plants that are desirable for wildlife are waiting to be released from the seedbank. In cool-season and warm-season pastures or old-fields, killing the existing grass cover will provide an opportunity to release the seedbank. In crop fields, allowing the field to remain fallow after harvest will release the seedbank.

The seedbank often contains both desirable and undesirable plant species, but these species are still present if you plant native grasses. Therefore, if undesirable species are present in the seedbank, you still have to deal with them! Furthermore, if you plant native grasses and forbs, most herbicide applications used to control undesirable plants will also kill the planted vegetation.

After the seedbank has germinated, herbicides can be used to control undesirable plant species. If vegetation emerging from the seedbank is not desirable, spot-spray undesirable



This field dominated by broomsedge, late boneset, wingstem, and horseweed was a tall fescue and orchardgrass pasture just 2 years before this picture was taken. All that was done to this field was a late-fall application of glyphosate followed by burning in March. Planting was not necessary. Now it provides excellent cover for many wildlife species including the wild turkey in the center of the picture.

species to allow desirable species to grow. In most cases, a desirable early successional plant community will result without planting. If desirable vegetation is not present by the third growing season after releasing the seedbank, then planting desirable vegetation could be considered.



cover, even if the grass was required, which it is not. This density equates to no more than 25% native grass cover in a field. The point is, it is good to have some native grass cover when managing for bobwhite, but it is not necessary, and there is often more than is needed in planted NWSG fields. When managing NWSG stands for most wildlife species, native-grass cover should not exceed 30%–50%. Forbs should represent at least 50% of the vegetation and woody cover may comprise 20%–50% of the field—or more—depending on focal species and management objectives. Certain grassland birds, such as Henslow's sparrow and eastern meadowlark, do well with 50%–80% grass cover.

Regardless of whether or not NWSG are planted, after the existing vegetation in a hay field or pasture is removed, the seedbank will be released and it will contain a mixture of desirable and undesirable species. The same is true when a crop field is no



Often the best composition and structure in planted NWSG stands occurs in the first three years after planting. This is because the stand is dominated by annual or perennial forbs, many of which have arisen from the seedbank such as the asters, goldenrods, horseweed, and common ragweed in this picture. This picture was taken two years after planting and as you can see the native grasses make up a small proportion of the stand. In two to three years without management this field will be dominated by native grass with very little forb component.



One of the main issues in NWSG stands is too much grass. When native grasses become rank, the structure at ground level closes, making it difficult for ground-dwelling wildlife to move and forage.



This is a quail's eye view of a NWSG stand with too much grass. The dense structure at ground level prohibits foraging and movement.

longer planted. Undesirable species germinating from the seedbank should be controlled to favor more beneficial plants. Problematic species, whether from the seedbank or carried in from wind, water, equipment, or animals, also appear throughout the life of the field. A few of the common problematic species include Canada thistle, sericea lespedeza, common teasel, narrowleaf plantain, crabgrass, johnsongrass, bermudagrass, smooth brome, tall fescue, multiflora rose, and autumn olive. These plants compete with desirable native plants and severely reduce the quality of the site for many wildlife species that use or require early successional vegetation. Of course, there also are native species that can become extensive and require management, such as tall goldenrod, blackberry, sweetgum, and red maple.

## Management Practices

The past seeding recommendations as well as the past management or lack of management in planted NWSG stands often failed to provide desirable composition and structure needed by many focal species and have encouraged problems such as rank native grass or excessive woody encroachment. For example, prescribed fire during the dormant season (Feb.-Apr.) and mowing are by far the two most common practices when managing planted NWSG, both of which encourage grass growth and do not control woody encroachment (top-killed stems readily resprout). A much better approach to enhance the composition and structure in a planted NWSG field is to disk the field and/or spray the native grasses and allow the seedbank to respond. That's not to say techniques such as prescribed fire are not beneficial, but these techniques need to be used in an appropriate way or in combination with other techniques. This publication provides recommendations for renovating planted NWSG fields using management techniques including disking, prescribed fire, and herbicide application.





Viewing the structure of the stand to the left through a quail's eye highlights the openness at ground level that promotes foraging and movement and the overhead cover that protects quail, pheasant, and turkey broods.

### Disking

Disking incorporates thatch and aboveground vegetation, thins rank native grasses, and increases coverage of annual forbs and grasses. Disking improves openness at ground level, which makes it easier for ground-dwelling wildlife to move and forage. In some cases, disking can be used to reduce coverage of nonnative plants, but it also can increase coverage of other problematic species. Disking also can be used to reduce woody encroachment. Generally, the positive impact to the structure of the vegetation and increase in desirable plants following disking exceeds the response of undesirable plant species. However, managers should be vigilant and control problematic species (thistles, johnsongrass, etc.), with the appropriate preemergence or postemergence herbicides if they arise after soil disturbance.



Disking multiple passes often is required to disrupt the root system of perennial native grasses and incorporate the thatch in a field of thick native grasses. Light disking will not thin native grasses enough to change the composition or structure of the stand.

Managers also should consider how timing of disking (seasonality) influences the resulting plant composition. Multiple passes of a heavy offset disk are necessary to reduce native grass coverage, as light disking (<3–4 passes) will fail to reduce grass density or encourage forbs. Burning prior to disking clears debris and makes disking more efficient and effective.

### Prescribed Fire

Prescribed fire is the most efficient method for managing early successional vegetation. Fire can be used to consume litter, control woody vegetation, control certain invasive species, and increase forb abundance and diversity in a planted NWSG stand. Prescribed fire can be used at various frequencies and in various seasons to accomplish different management objectives. More frequent fires (1–2 years) will maintain grass-dominated fields favored by grassland songbirds, whereas less frequent fires



Burning during the dormant season is an effective method to remove thatch and can be a great site-preparation tool to use prior to disking or applying herbicide. However, burning during this time of year does not thin native grasses or increase forbs and only top-kills woody vegetation. Fire during late winter or early spring will only maintain the current stand's composition and structure, not enhance it.



Burning during the late growing season (Aug–Oct) will help reduce woody encroachment and stimulate increased forb coverage, but burning at this time will not effectively reduce native grass density. Herbicide applications or heavy disking usually are necessary to reduce native grass coverage.



(3–5 years) will allow for more woody encroachment, which is favored by species such as white-tailed deer, eastern cottontails, upland gamebirds, and shrubland songbirds. However, if fire is used too infrequently, the field will advance towards a young forest and may no longer represent habitat for species that require early successional vegetation.

### Herbicide Application

Herbicide application is another technique land managers can use to manage composition and control undesirable or excessive vegetation in NWSG plantings. Herbicide applications can



Broadcast applications of herbicide, as opposed to spot applications, may be appropriate in NWSG stands that are heavily invaded by problematic species or consist of rank native grasses.

selectively target some problematic species in NWSG plantings, but there are many problematic species that cannot be killed without killing planted native grasses or forbs, such as bermudagrass and sericea lespedeza. Herbicide applications can improve plant composition and structure in NWSG stands, but NWSG stands should not be managed solely with herbicides. Other treatments, such as prescribed fire and disking are recommended to consume thatch and other dead plant material, improve the structure at ground level, and stimulate fresh vegetation growth. Over-reliance on herbicides can increase herbicide tolerance or resistance in certain plant species, making them more difficult to control. Prior to applying herbicides, it is important to understand and follow all laws governing herbicide application and always refer to the herbicide label for instructions on application and application rates.

### Interseeding Forbs

Interseeding forbs is a commonly recommended, but largely unnecessary and expensive practice when renovating planted NWSG fields for wildlife. Interseeding forbs can increase forb abundance and diversity in a NWSG field, but only if native grasses are drastically reduced prior to interseeding. Additionally, when you drastically reduce native grasses, forbs from the seedbank will respond just as prolifically—if not more prolifically—than the interseeded forbs, and will often times outcompete the interseeded forbs. More often than not, forbs germinating from the seedbank are equally beneficial to wildlife as planted forbs, and many of the forbs planted often are already present in the seedbank, but just need a chance to germinate and grow (a good example is partridge pea). Wildlife tend to respond similarly to the change in the structure and composition of the vegetation following native grass reduction, regardless of interseeding. The value of interseeding forbs for wildlife is not from seeds themselves, but from the reduction in native grasses opening the structure at ground level and from the response of the seedbank.

Herbicides listed in the publication are labeled for various non-crop areas such as right-of-ways, conservation reserve program lands, forestry sites, fallow areas, wildlife openings, fencerows, rangeland, or grass pastures or hayfields. The herbicides listed in the text and Appendix B are non-restricted herbicides and can be purchased in-store or ordered from various farm supply stores, co-ops, or chemical suppliers.

Interseeding is rarely needed when renovating planted NWSG fields. Usually, all you need to do is thin the native grasses enough to let the seedbank respond. The field in this picture was a 12-year-old NWSG planting and had been maintained only with prescribed fire conducted in March on a one-to-two year return interval. The field was dominated by native grass until we applied imazapyr (Arsenal®, 48 oz/ac) to thin the grasses, and look what responded. Partridge pea and black-eyed Susan were in the original planting and have been waiting for a chance to germinate.





## Common Issues in Planted NWSG Stands

### Rank Native Grasses

Native grasses typically become rank within 3–5 years after planting. Extensive grass density increases thatch and limits forb germination, which results in reduced insect abundance and limited mobility and foraging for northern bobwhite, wild turkey poults, ground foraging songbirds, eastern cottontails, and ring-necked pheasants. Big bluestem and indiangrass fall over and lay flat during winter unless various forbs or shrubs are present to keep them upright. The interspersed forbs, brambles, and shrubs in NWSG stands is far more beneficial to most wildlife species than the grass itself.



Dense native grass stands, especially those dominated by big bluestem and indiangrass, fall over during the winter. When the stand is devoid of forbs and shrubs that provide support for the grasses, they lay completely flat and provide virtually no cover for most wildlife.

**Disking and native grass density.** Disking is an effective method to not only thin rank native grasses, but also to increase the amount of annual and perennial forbs in the stand. The season of disking influences plant composition. For example, disking early in the growing season (April–May) is more likely to encourage undesirable warm-season annual and perennial grasses and spring forbs, such as crabgrass, johnsongrass, sicklepod, and jimsonweed, but also may encourage species such as foxtails, which produce seed eaten by many birds. Disking during the dormant season (October–March, depending on location), tends to encourage late-flowering forbs—many of which are important seed-bearing plants—such as common ragweed, beggar's lice (*Desmodium* spp.), and beggarticks (*Bidens* spp.).

### Impacts of prescribed fire on thinning native grasses.

Prescribed fire used during the dormant season (January–March) and early growing season (April–May) encourages and increases native-grass density, does not lead to increased forb coverage, and only top-kills woody species. Prescribed fire

during the late-growing season (August–September) increases forb cover and tends to reduce woody encroachment, but does not lead to decreased native grass density. **Regardless of seasonality, you should not expect prescribed fire to thin rank native grasses.** Other techniques, combined with fire, including herbicide applications and disking usually are needed to effectively thin rank native grass.



Disking following a dormant season fire is an effective method to thin native grasses and improve the structure and composition in NWSG fields. Prescribed fire consumes thatch and dead standing material in the field and allows the disk to more easily cut into the soil, thus improving the efficiency of disking.

**Herbicides to thin rank native grasses.** Various herbicides can be used to effectively thin native grasses and increase forbs. However, grass-selective herbicides do not reduce native grasses enough to elicit an increase in forbs and a change in composition. Broad-spectrum and broad-spectrum selective herbicides (e.g., glyphosate and imazapyr) effectively thin native grasses and increase forbs after only one application. Herbicides to reduce native grasses are most effective when applied in late spring or early summer (May–June) when grasses are 18–24 inches tall and prior to flowering, but they also may be applied later in the summer (August–September) prior to grass senescence. If applied in late summer, mowing or burning the stand early in August and allowing at least 3 weeks for native grasses to regrow may increase the effectiveness of the treatment.

We recommend imazapyr (Arsenal®, 48 oz/ac) instead of glyphosate if legumes or brambles are present, because most legumes and brambles are relatively tolerant of imazapyr. However, glyphosate (2 qt/ac) should be used when sericea lespedeza is present, because imazapyr does not control sericea lespedeza. Glyphosate also can be used when the stand has few if any forbs. Burning fields after treatment is recommended to reduce thatch and stimulate the seedbank. If sprayed in May or June, the stand can be burned in July or August to stimulate germination of forbs and grasses before fall.





**SEPTEMBER 2016**

This field was dominated by big bluestem and indiangrass and portions of the field were sprayed to thin native grasses in September 2016. Half of the field was burned in late September 2016, and the other half (including portions of the field sprayed with herbicide) was burned in March 2017.



**JULY 2017**

Following a March prescribed fire alone, the composition of the field has not changed and is still dominated by rank native grasses.



**MAY 2017**

The bottom portion of this picture, with scattered green vegetation and black bare ground, was sprayed with 48 oz/ac of Arsenal in September 2016 and burned in March 2017. The top portion of the picture was burned in March 2017, but was not treated with herbicide. You can clearly see the herbicide reduced the grass density.



**JULY 2017**

Following one September prescribed fire, we see an increase in forbs compared to a March fire, but no change in the amount of native grasses in the field.





Clethodim applied in September at 16 oz/ac followed by a March fire did not reduce the amount of native grass in the field or increase the amount of forbs.



Imazapyr (Arsenal®) applied in September at 48 oz/ac followed by a March prescribed fire effectively reduced the amount of native grass in the field and increased the amount of forbs. The fire also helped to remove the thatch left by the herbicide application.



Glyphosate applied in September at 2 qt/ac followed by a March prescribed fire effectively reduced the amount of native grass in the field and increased the amount of forbs. The fire also helped to remove the thatch left by the herbicide application.



Tilling the firebreak (in between the dashed lines) resulted in a dramatic composition change compared to the portions of the field that were only burned in March. We went from a rank stand of native grasses to a stand dominated by annual forbs such as partridge pea, common common ragweed, and blackeyed Susan.



## Problematic Herbaceous Plants

There are many weeds that can reduce the quality of a NWSG stand. It is important to mention that a “weed” is an undesirable plant for a particular objective, and determining which plant species constitutes a weed varies according to the landowner or land manager’s objectives. A wildlife manager would not—and should not—control the same plants as an agricultural producer, but noxious weeds such as Canada thistle, sericea lespedeza, and johnsongrass or other invasive species always should be controlled in NWSG plantings. Additionally, state laws may require a landowner to control certain noxious weeds.

Herbicide application typically is the most efficient way to treat undesirable plants in NWSG stands, because you often can selectively treat those plants without killing desirable plants across the whole field. Various nonnative and invasive species respond differently to disking and prescribed fire. However, disking and fire can be used when appropriate for various species. There are many more problematic nonnative plants than the ones discussed below, but these include some of the most common problem plants in NWSG stands.



Numerous undesirable plants are outcompeting desirable plants in this field. Cool-season perennial grasses, such as smooth brome, tall fescue, and Kentucky bluegrass as well as problematic forbs such as wild parsnip and musk thistle have invaded this field.

## Johnsongrass

Johnsongrass is a nonnative perennial warm-season grass common in the southern United States. Johnsongrass is present at the time of NWSG establishment in many fields. Excessive johnsongrass can outcompete NWSG seedlings and reduce establishment success, which may lead to a failed planting. Johnsongrass will persist in established stands if left unmanaged, which can lead to a monoculture of johnsongrass that is dense, provides poor structure for some wildlife species, and offers little or no food if forbs are outcompeted. Seedling johnsongrass can be controlled preemergence with an application of imazapic (8 oz/acre). However, johnsongrass arising from rhizomes is not controlled with a preemergence application. Johnsongrass can be controlled postemergence in established NWSG stands with an application of imazapic (12 oz/ac) or sulfosulfuron (2 oz/ac) without harming many NWSG and desirable forbs. Many grasses planted in NWSG stands are tolerant of sulfosulfuron, whereas many grasses and forbs planted in NWSG stands are tolerant of imazapic (refer to herbicide label for specific species). Of course, spot-spraying johnsongrass with glyphosate (2% solution) is an option, if coverage of johnsongrass is not extensive.



Johnsongrass can be problematic in NWSG stands and may be considered noxious in your state. Herbicide applications are the best option for controlling johnsongrass.



### Other Nonnative Warm-Season Grasses

Other problematic nonnative warm-season grasses include bahiagrass, bermudagrass, Chinese silvergrass (*Miscanthus* spp.), cogongrass, crowngrasses (*Paspalum* spp.: dallisgrass and vaseygrass), large crabgrass, jangrass, and old world bluestems. Bahiagrass and bermudagrass are forage grasses most commonly planted in the southeastern United States, but bermudagrass occurs throughout the eastern United States. Jangrass is a common invasive annual grass in forested areas, but it can invade NWSG stands. Ideally, these species should be controlled with herbicides prior to planting, but they also commonly encroach into established NWSG stands. Some of these grasses can be controlled without harming some planted native grasses, but others require herbicides that also kill planted native grasses. Grass-selective herbicides generally are not effective at controlling perennial grasses.



Various warm-season grasses, including bahiagrass (pictured), can also be problematic in NWSG stands. Herbicides are the best option to control these species.

Many of these species are greatly reduced with imazapyr, but for complete control, follow-up applications of imazapyr or glyphosate are required. For example, bermudagrass, crowngrasses, Chinese silvergrass, and old world bluestems are best controlled with applications of imazapyr (Arsenal®, 4–6 pt/ac) by spraying in late spring just prior to flowering. Following an application of imazapyr in late spring or early summer, resprouting or newly germinating grasses can be treated again in late summer by spot-spraying glyphosate. Cogongrass is best controlled with a tank mixture of imazapyr (Arsenal®, 1.5 pt/ac) and glyphosate (1 qt/ac).

Bahiagrass is best controlled with metsulfuron methyl (0.33–0.5 oz/ac) in early summer just prior to flowering. Returning patches can be treated with spot-applications of glyphosate later in summer. Large crabgrass and jangrass can be controlled pre- or postemergence with an application of imazapic (8 oz/ac preemergence or postemergence). All of these grasses will need spot treatment the following year, and perhaps for multiple years,

to completely eradicate the plants. However, the initial herbicide application will reduce coverage of these grasses significantly and allow other plants to respond from the seedbank.

### Nonnative Cool-Season Grasses

Nonnative cool-season grasses including tall fescue, smooth brome, Kentucky and roughstalk bluegrass, timothy, orchardgrass, quackgrass, and reed canarygrass commonly invade NWSG stands, especially when not properly controlled prior to establishment. Taking the time to effectively control cool-season grasses prior to planting with both fall and spring herbicide applications can help mitigate problems later in the life of the planting. Cool-season grasses limit mobility and foraging of upland game bird broods and suppress native vegetation. Cool-season grasses probably are the most common and problematic invaders of early successional areas, but because of differences in phenology (timing of growth) between cool-season and warm-season grasses, cool-season grasses are easily controlled in NWSG stands.



Cool-season grasses, such as tall fescue, orchardgrass, and smooth brome, quickly invade NWSG stands, especially in stands where they were not adequately controlled prior to planting. Cool-season grasses change the structure of the stand at ground level and impede movement and foraging of ground-dwelling wildlife.

### Controlling cool-season grass encroachment with herbicides.

Certain species may respond differently to specific herbicides, and grass-selective herbicides typically are ineffective in eradicating perennial grasses. An application of a glyphosate herbicide (2 qt/ac) in fall/winter after warm-season plants have entered dormancy is most effective on a majority of these grasses. Tall fescue can be controlled with imazapic (12 oz/ac) or glyphosate (2 qt/ac) sprayed in the fall after a couple of frosts. Imazapic does not control orchardgrass, therefore glyphosate (2 qt/ac) is recommended. Smooth brome and reed canarygrass are most effectively controlled with a fall or spring application of



imazapyr (Arsenal®, 1.5 pt/ac). Quackgrass can be controlled with a spring or fall application of glyphosate (2–3 qt) or imazapyr (Arsenal®, 1.5 pt/ac).

Fields that contain cool-season grasses should be prepared prior to spraying to ensure the herbicide is contacting green, growing grass. For fall applications, fields can be hayed or mowed in late summer (September) and sprayed after a couple frosts (Oct.–Dec.). Alternatively, fields can be burned during the late-growing season, allowed to regrow, then sprayed. For spring applications, mow or burn the field during late winter (Feb.–Mar.) and spray in spring just prior to germination of warm-season plants (Apr.–May, depending on location).

#### **Fire, disking, and cool-season grass encroachment.**

Management techniques, such as prescribed fire and disking, are not as effective as herbicide application when controlling cool-season grasses. Disking provides short-term control of cool-season grasses, but follow-up herbicide applications will be needed after disking. Prescribed fire during certain seasons actually can increase cool-season grass infestations. However, prescribed fire can be an effective site preparation tool prior to herbicide application to control cool-season grasses.

#### **Canada Thistle & Other Nonnative Thistles**

Canada thistle is a perennial noxious weed that is common in the Midwest and northeastern United States. Most of the other nonnative thistles, including bull and musk thistle, are biennial. Canada, musk, and bull thistle all overwinter as basal rosettes. Thistles may not be extensive in a field at the time of NWSG establishment, but they can quickly invade and dominate an

established stand. Targeting thistles with herbicide during certain life stages can provide control while limiting damage to desirable species. Thistles are best controlled with clopyralid (0.67–1 pt/ac) or aminopyralid (5–7 oz/ac) from September until the first hard frost or in March and April (rosette stage) in established NWSG stands. Thistles also can be controlled during the growing season—prior to flowering—with 2,4-D, aminopyralid, clopyralid, or dicamba. However, applications during this period will kill desirable forbs. If thistle infestations are small and a growing season application is necessary, spot-spraying should be used to limit damage to nontarget vegetation. Glyphosate also can be used to control small infestations of thistles; this application may be more beneficial in stands where grass density also needs to be reduced.

#### **Sericea Lespedeza**

Sericea lespedeza is a nonnative perennial legume most common in the southern and central Great Plains regions of the United States, but occurs throughout most of the eastern United States. In years past, sericea was promoted for cattle forage, as a source of cover and seed for wildlife, and typically for erosion control on reclaimed mine lands. Sericea can invade established NWSG stands and out-compete native forbs, grasses, and woody plants, reducing the quality of these stands for many wildlife species. Sericea seed is indigestible by most wildlife species and extensive infestations may lead to nutritional deficiencies. Unfortunately, any herbicide used to control sericea lespedeza also will kill desirable forbs. Spot-spray applications should be used to control sericea when infestations are not extensive.



Nonnative biennial (musk thistle; left photo) and perennial (Canada thistle; above) thistles commonly invade NWSG stands and are most effectively controlled with herbicide.





*Sericea lespedeza* is arguably one of the most problematic invaders in NWSG stands. *Sericea* flowers in August or September and is a prolific seed producer, but the seeds have no value to wildlife because they are indigestible.

**Herbicides to control *sericea lespedeza*.** Glyphosate (1–2 qt/ac), triclopyr (1 qt/ac), or a combination of triclopyr and fluroxypyr (Pastureguard HL® 1.5 pt/ac) provide control of *sericea lespedeza* throughout the growing season. However, aminopyralid (used to control thistles) is not effective in controlling *sericea*. Metsulfuron methyl (1 oz/ac) may be applied August through September when greater than 50% of the *sericea lespedeza* is in flower and after some desirable forbs have set seed. Applications at this time may have less detrimental effects to existing forbs, but they also are not as effective as other herbicide applications. Regardless of the herbicide used, multiple applications will be needed to control *sericea* in a stand. We recommend treating infestations with triclopyr and fluroxypyr when *sericea* is 12–18 inches in height (June–July) and then respraying any remaining *sericea* with metsulfuron methyl during flowering (August–September).

**Controlling *sericea* with fire and disking.** Dormant-season prescribed fire alone is not an effective control method for *sericea lespedeza*. In fact, dormant-season fire may increase density of *sericea*. Dormant-season fire can be used to stimulate germination of *sericea* seed in NWSG stands prior to herbicide application to help reduce the seedbank. Alternatively, herbicide can be applied to control *sericea lespedeza* during the growing season and then followed-up with a late-growing season fire prior to *sericea* flowering. Any *sericea* not killed by the initial herbicide application will be consumed by the fire, thus limiting the amount of seed produced. The following year, any *sericea* germinating from the seedbank or resprouting from rhizomes

should be spot-sprayed with herbicide to further reduce the infestation. Disking also is an effective method to reduce *sericea* in a NWSG stand. However, disking will stimulate *sericea* seed in the seedbank and subsequent *sericea lespedeza* should be spot-sprayed with herbicide the next growing season.

### Wild Parsnip

Wild parsnip is an invasive biennial/perennial broadleaf common in planted NWSG stands and other early successional areas. Parsnip is most common in the Midwestern and northern U.S. and can cause phytophotodermatitis, a condition leading to rashes, blistering, and discoloration of the skin after contacting secretions from wild parsnip. Wild parsnip is controlled best with applications of 2,4-D (4 pt/ac), 2,4-D + triclopyr (4 qt/ac), or 2,4-D + dicamba (4–5.6 pt/ac), but also can be controlled with metsulfuron methyl (1.5–2 oz/ac), glyphosate (2 qt/ac), dicamba (2–4 pt/ac), and imazapyr (Arsenal®, 2–3 pt/ac).



Wild parsnip is a nonnative invasive forb common in NWSG stands of the Midwest and northern United States.



### Crownvetch

Crownvetch is a nonnative perennial legume often promoted for erosion control and as a forage for cattle. However, crownvetch is very invasive and quickly invades NWSG stands. Eventually, crownvetch will outcompete native vegetation and form a monoculture. Crownvetch is a cool-season plant and can be controlled when most desirable warm-season vegetation is dormant. Crownvetch is best controlled with products containing triclopyr (1 qt/ac), metsulfuron methyl (0.5 oz/ac), or aminopyralid (5–7 oz/ac). Small infestations also can be controlled with glyphosate (2 qt/ac) or 2,4-D (4–6 pt/ac).



Crown vetch is commonly found along roadsides, but also invades NWSG stands.

### Other Common Broadleaf Plants

Other annual, biennial, and perennial broadleaf plants also might be problematic in planted NWSG stands. Problematic annual species generally will decline over time being most prevalent following soil disturbance and less prevalent when perennial vegetation begins to dominate the site. Many annuals considered problematic in agricultural fields are beneficial to many wildlife species, which is another reason for waiting to plant NWSG until you have evaluated the seedbank.

Native forbs, such as pigweeds, horseweed, common lambsquarters, and common ragweed, may be abundant in a recently planted or disturbed stand (especially in year 1), but are less common in older stands. Pigweeds, common lambsquarters, and common ragweed are prolific seed producers, and a suite of bird species relishes their seed. Horseweed seed is not eaten by many wildlife species, but does provide vertical structure with an open canopy at ground level that is desirable for many wildlife species. These native forbs may represent an issue at establishment or following soil disturbance, but do not need to be controlled

unless they are dense enough to reduce germination or persistence of more beneficial vegetation. Other annual species that may exist in NWSG stands, have little wildlife value, and may warrant control are nonnative annual species including jimsonweed, sicklepod, annual sowthistle, and velvetleaf. Products containing 2,4-D or dicamba can control many undesirable forbs, but also may control desirable vegetation (see Appendix B for products and rates). For example, dicamba controls jimsonweed, kochia, annual sowthistle, sicklepod, pepperweed, mustards, chickweeds, henbit, buttercups, perilla mint, pennycress, and velvetleaf, but dicamba also controls beneficial annuals such as horseweed, pigweed, ragweed, lambsquarters, and sunflower.

Biennial and perennial broadleaf plants typically are more problematic than annuals in existing NWSG fields because they persist and may eventually outcompete desirable vegetation. However, controlling these species in an established NWSG stand likely will require killing existing desirable vegetation. Species of particular concern are those considered prohibited, noxious, or invasive, and may include spotted knapweed, common teasel, curly dock, common dandelion, leafy spurge, narrowleaf plantain, perennial sowthistle, poison hemlock, and sweetclover. Certainly, there are many more problematic broadleaf plants, but these represent some of the more common species. The USDA maintains a list of nonnative, invasive, and noxious plants on their Plants Database website (<https://plants.usda.gov>). We recommend referencing that list to determine the status of certain plant species in your state.

Many herbicides are registered to control problematic biennial and perennial broadleaf plants in non-crop areas. In addition to thistle control, aminopyralid (3–7 oz/ac) provides excellent control of species such as perennial sowthistle, curly dock, and spotted knapweed. Species, such as Queen Anne's lace and poison hemlock, can be controlled with imazapic (8–12 oz), 2,4-D (4–6 pt/ac), triclopyr (0.5–4 qt/ac), 2,4-D + triclopyr (4 qt/ac), and glyphosate (2 qt/ac). Leafy spurge can be controlled with imazapic (8–12 oz/ac), dicamba (2 pt/ac), and glyphosate (2 qt/ac). Several of the more common herbicides are listed in Appendices A and B. Many herbicides applied to control problematic broadleaf plants also will kill desirable vegetation. However, some broad-spectrum selective herbicides (imazapic and imazapyr) may kill undesirable plants without harming some desirable plants. Herbicide labels include a list of plants controlled by that herbicide, but consider those lists a starting point. None represent a complete list of plants controlled. Therefore, in most cases, small spot-spray applications should be used. If the problem plant is extensive, whole-field application may be warranted. In addition, websites are available through Purdue University and the University of Tennessee for various herbicide recommendations for various weed species <http://www.purdueweedsci.com/indexNC.php> and <http://www.utcropl.com/weeds/weed%20home.htm>.



## Woody Encroachment

Certain woody species provide essential thermal and escape cover for upland game birds, eastern cottontail, and white-tailed deer, nesting cover for shrubland songbirds, and a source of seed or browse for various wildlife species. Maintaining 20%–40% woody cover dispersed across a NWSG field provides escape cover and thermal cover needed by a variety of wildlife species. However, grassland songbirds, such as eastern meadowlark, grasshopper sparrow, and Henslow's sparrow, may respond negatively to increases in woody cover. As NWSG fields progress through succession, unwanted pioneering woody species and invasive woody plants encroach in the stand. Undesirable woody vegetation will outcompete grasses and forbs and reduce the quality of these areas for certain species.

### Pioneering Woody Plants

Pioneering woody plants include tree species, such as winged elm, Virginia pine, red maple, sweetgum, yellow-poplar, cottonwood, green ash, black willow, sassafras, sweetgum, eastern redcedar, persimmon, black locust, and honeylocust. These species may provide vertical structure used for perching, thermal protection, or brooding or escape cover when they are young, but over time, they grow taller, out-compete herbaceous vegetation, and dominate the stand. That being said, make no mistake, the presence of some woody species makes the area much more attractive and productive for many wildlife species.



Pioneering tree species (sweetgum and red maple) and sericea lespedeza have invaded this field. In this case, a spot application of triclopyr would be most appropriate because it would control both tree species and sericea. This field could also be burned in late summer to reduce the woody encroachment and prevent sericea from producing seed.

Native shrub species, such as plums, hawthorns, elderberry, dogwoods, sumacs, leadplant, and false indigo, are extremely attractive to many wildlife species that need woody cover and make planted NWSG fields much more desirable to these species. However, you need to provide the correct amount of woody cover in an attractive arrangement for various focal species, and as succession advances, even some of these shrubs can become too dense for various species and management will be needed to control them.



This field is quickly being overtaken by sweetgum, green ash, and red maple. Without management, this field is on its way to becoming a young forest.



Sumac mottes provide excellent thermal cover during the heat of the summer for bobwhite, turkeys, and white-tailed deer. However, sumac can become too dense if not managed.



**Disking and woody encroachment.** Disking can be an effective method to reduce small, pioneering woody plants in a NWSG field. However, if the seedlings grow without manipulation for 3–4 years, they may advance beyond what is feasible to manage with some disking equipment. If this occurs, herbicide application, prescribed fire, or other mechanical treatments (tree grinding, rollerchopping, or chainsawing) will be needed to control woody encroachment.

**Fire seasonality and frequency influences woody control.**

Frequent dormant-season fires (1–2 yr return intervals) may limit woody encroachment and control certain invasive species, but it also will increase native grass density and lead to reduced forb abundance. Infrequent dormant-season fire will top-kill woody stems, but these stems readily resprout. Burning during the latter portion of the summer/early fall (August–October) tends to control woody encroachment better than during the dormant season or early portion of the growing season. However, a single fire rarely causes dramatic shifts in plant composition. Multiple fires are required to see considerable reduction in woody encroachment. Fire may not be possible in some areas, and woody encroachment may advance beyond what is feasible to control with a single prescribed fire, and an herbicide application or mechanical treatment may be warranted.



Late-growing season is the most effective time to conduct prescribed fire with the objective of reducing woody encroachment.

**Herbicides to control pioneering woody species.** Herbicide recommendations to control individual species vary, but certain herbicides can provide control of multiple woody species. Triclopyr (amine [4–6 qt/ac] or ester [2–8 qt/ac] formulation) as a foliar application provides excellent control of woody encroachment as well as sericea lespedeza in NWSG stands. Applications of metsulfuron methyl (2–3 oz/ac), metsulfuron methyl + chlorsulfuron (1.25 oz/ac), or metsulfuron methyl + 2,4-D + dicamba (0.5 oz/ac Part A and 4 pt/ac Part B) can be effective in controlling ash, elm, black locust, yellow-poplar, maple, and willow. Broadcast applications of triclopyr or metsulfuron methyl also will kill desirable forbs. Alternatively, imazapyr (Arsenal®, 4–6 pt/ac), an herbicide commonly used for hardwood control in southern pine plantations, can provide excellent woody control in NWSG stands and many legumes and *Rubus* species (important for wildlife food and cover) are tolerant of imazapyr. Imazapyr does not control unwanted woody legumes, but it also does not control beneficial woody legumes. Products containing 2,4-D (4–6 pt/ac) can be applied to the foliage of undesirable woody vegetation, but these products typically are not as effective as the products listed above.

**Nonnative Invasive Woody Species**

**Nonnative olives.** Nonnative olives (autumn, silverthorn, Russian, and others) are woody shrubs commonly planted in the mid-20th century to provide cover and food for wildlife. When occurring adjacent to a NWSG field, they usually spread throughout the field and may create dense thickets within the field, which can be desirable for some wildlife species, but they are problematic as an invasive species. Nonnative olives can be controlled with foliar applications of triclopyr (Garlon 4®, 4–8 qt/ac) or imazapyr (Arsenal®, 4–6 pt/ac), whereas glyphosate and metsulfuron methyl typically provide limited control.



Nonnative olives are commonly spread across NWSG fields by birds dispersing seed. Olives can quickly invade open areas and they should be controlled with herbicide.

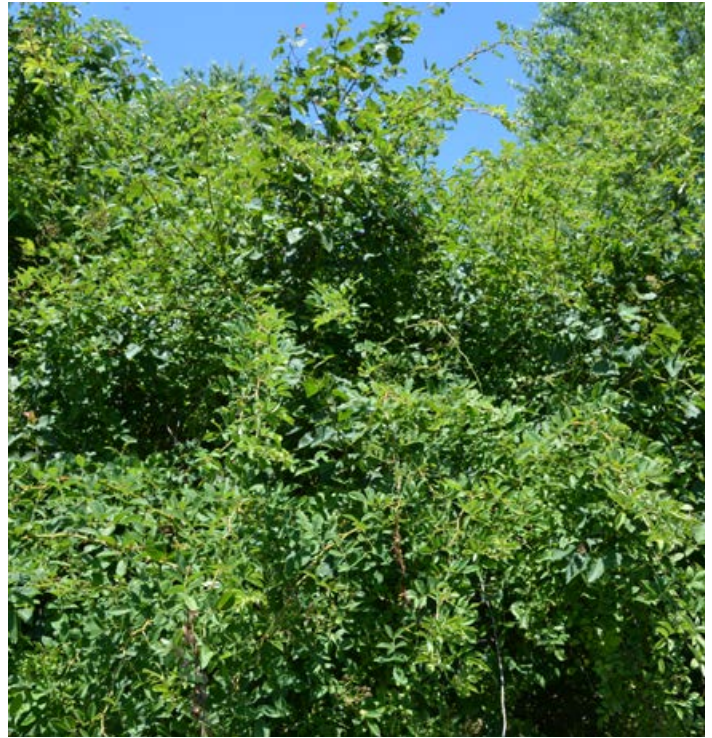


**Bush honeysuckles.** Similar to nonnative olives, Amur, Bell's, Morrow's, and Tartarian honeysuckle—referred to as bush honeysuckles—originally were planted to provide food and cover for wildlife. Infestations are extensive in woodlots throughout the Midwest, Mid-South, and northeast U.S., and bush honeysuckles commonly invade NWSG stands. Bush honeysuckles can be controlled with applications of triclopyr (Garlon 4®, 4–8 qt/ac), imazapyr (Arsenal®, 4–6 pt/ac), or glyphosate (3–4 qt/ac). The early leaf emergence and late leaf drop of bush honeysuckles allow for control during time periods when warm-season plants are dormant.



Bush honeysuckle is invading the edge of this NWSG field. A March prescribed fire topkilled the shrub, but it resprouted following the fire. A spot-herbicide application would effectively control bush honeysuckle in this field.

**Multiflora rose.** Multiflora rose is another nonnative shrub promoted by conservation agencies as a “living fence row” for livestock in the mid-1900s. It is terribly invasive and spreads throughout fields and woodlots. Multiflora rose provides excellent cover for species such as northern bobwhite, eastern cottontail, and some shrubland songbirds, but its aggressiveness outweighs its benefits. Native roses (Carolina, prairie, and swamp rose) also provide excellent sources of cover and food, but are not as aggressive as multiflora rose. Multiflora rose is easily controlled by spot-spraying glyphosate (2% solution [2.6 oz/gal of water]), imazapyr (Arsenal®, 1.5% solution [2 oz/gal of water]), metsulfuron methyl (1 g/gal of water), or triclopyr (Garlon 4®, 2–4% solution [5 oz/gal of water]) during the growing season after the plant has fully leafed out. Fire will top-kill multiflora rose, but multiple stems resprout following fire and must be treated with herbicide to ensure control.



Multiflora rose has climbed almost 15 feet into this hawthorn fence row. Can you even see the hawthorn? Its leaves are barely showing in the top of the picture. Native roses — which typically have pink flowers like swamp rose (below) as opposed to white flowers of multiflora rose — provide similar cover and food for wildlife without the invasiveness.





**Callery pear.** Callery or Bradford pear is an ornamental tree used widely in residential landscaping. Originally thought to be incapable of reproducing naturally, varieties of callery pear can cross-pollinate and have become extremely invasive and commonly invade NWSG stands. It typically appears sporadically, but then forms extremely dense clumps that outcompete native herbaceous and woody vegetation. You should aggressively try to control this plant. Callery pear can be killed with glyphosate (2% solution [2.6 oz/gal of water]), imazapyr (Arsenal®, 1.5% solution [2 oz/gal of water]), metsulfuron methyl (1 g/gal of water), or triclopyr (Garlon 4®, 2–4% solution [2.5–5 oz/gal of water]).



The trees with white flowers invading this old-field in southern Indiana are Callery pears. Pears are easy to identify in the spring, because they generally are the first trees to flower. This picture was taken in early March, prior to most trees breaking dormancy.

**Shrub lespedezas.** Federal, state, and non-governmental conservation organizations often cultivated, promoted, and planted bicolor lespedeza, Thunberg lespedeza, and other shrub lespedezas to provide woody cover and seed for northern bobwhite. Make no mistake, shrub lespedezas are NOT needed to manage for northern bobwhite! More common in the southern United States, shrub lespedezas are very invasive and form dense thickets in NWSG stands and throughout woodlands where prescribed fire is used. The invasive nature of this plant quickly shades-out desirable plants. Shrub lespedezas are still cultivated and sold, but are no longer recommended for wildlife, and many states consider them an invasive plant. Prescribed fire is not an effective tool to manage shrub lespedezas because of resprouting, and prescribed fire can enhance the germination of shrub lespedeza seed leading to further invasions. Shrub lespedezas are controlled with applications of triclopyr (Garlon 4®, 4–8 qt/ac), metsulfuron methyl (2–3 oz/ac), or glyphosate (3–4 qt/ac).



Shrub lespedeza commonly invades NWSG stands in the southern United States and the use of prescribed fire only enhances its invasiveness. Herbicide should be used to control invasions.

**Other nonnative woody plants.** Other common nonnative woody plants found in NWSG stands include privets, tree-of-heaven, winged burningbush, common buckthorn, Siberian elm, and white or paper mulberry. Generally, these species and others can be controlled with the same herbicides to control the species above. For example, imazapyr (Arsenal, 4–6 pt/ac) and triclopyr (Garlon 4®, 4–8 qt/ac) will control all of these species. Additionally, glyphosate (2% solution) spot-sprayed also will provide control of most of these species and provides better control of privet compared to triclopyr.



## Conclusion

Planted NWSG stands can provide important cover and food resources for a variety of wildlife species. However, without proper management, these stands quickly lose their benefit to most wildlife by becoming increasingly dense and invaded by undesirable vegetation. Moreover, planting native grasses and forbs is seldom necessary to provide habitat for wildlife that require early successional plant communities. If you are considering planting NWSG, you should evaluate the existing seedbank for at least 3 years after killing existing nonnative cover. Most often, desirable species respond and planting is not necessary.

Disking, prescribed fire, and herbicide applications are effective at renovating planted NWSG stands and improving their value for wildlife. The specific problems associated with a given NWSG stand will dictate which habitat management tool(s) should be used. In certain situations, a combination of techniques will be most effective to improve composition and structure. Herbicides should be considered along with other practices to selectively control undesirable species. They should not be relied upon solely for managing planted NWSG stands. By considering all the habitat management options collectively when making management decisions, you will be more successful in improving the quality of the early successional plant communities on your property.

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# Extension FactSheet

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## Incorporating Wildlife Needs into Forest Management Plans

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Nearly one-third of Ohio is forested, and private individuals own over 90 percent of these forests. Forests are important not only to landowners, recreationists, and natural resource professionals but to many wildlife species as well. Forests provide these species with major habitat requirements: food, cover, water, and space. As a landowner, you have the opportunity to manage all or part of your land in a way that is sensitive to wildlife needs. If you have made the decision to harvest timber from your property, you can decide to protect important habitat components for wildlife while harvesting timber. This fact sheet describes several ways that you can incorporate wildlife needs into your forest management plan. Even adopting one or two suggestions can make your managed land more attractive to wildlife.

### Benefits of Wildlife

As you probably have already experienced on your own land, wildlife can provide many aesthetic and recreational benefits to landowners. Watching a fox hunt for mice, listening to a wood thrush sing, or finding a red-backed salamander hiding under a log can add beauty and enjoyment to your day. Some landowners also enjoy hunting for wildlife on their own land.

Fewer people recognize the ecological services provided by wildlife. Each species performs a specific function in the ecosystem that directly or indirectly benefits the environment and other organisms, including humans. For example, many birds, such as blue jays, disperse acorns and other seeds throughout the landscape. Bats may reduce the numbers of mosquitoes around your home by feeding on them. Similarly, insectivorous birds can benefit trees by consuming insects living on bark, leaves, or branches. Earthworms, beetles, and some rodents turn over the soil and recycle nutrients. Ecologists are continually learning about new complex relationships among organisms and their environment. By providing habitat for wildlife, you ensure that some of these ecological, recreational, and aesthetic benefits will be maintained on your land.

### Forests and Wildlife

Forests provide many wildlife species with major habitat requirements—food, cover, water, and space. When you harvest timber, the quantity, quality, and distribution of these habitat features change. As a result, certain wildlife will be favored in forests at different stages of succession. In forest succession, a grassy field or harvested stand will eventually become a mature forest.

Wildlife may be associated with forests at a particular successional stage because of the types and amounts of habitat that are provided by that stage. See Figure 1 on page 2. For example, early-successional forests have more fruit, seeds, and woody browse but less nuts, acorns, and cavity trees. Older forests have more nuts, acorns, and cavities but fewer fruits, seeds, and woody browse.

Soon after clearcutting or farm abandonment, the land may have areas of bare soil and herbaceous vegetation, such as grass. Grassy areas will provide wildlife with insects, seeds, and herbaceous food and cover. Wildlife such as cottontail rabbits, voles, and field sparrows are attracted to these areas. As succession continues, woody shrubs, seedlings, and saplings invade the area. These provide woody browse and cover as well as berries and seeds for white-tailed deer, rabbits, ruffed grouse, and songbirds (catbirds, towhees, and warblers). As the saplings grow, they usually will develop into dense stands of small trees that provide too much shade to support the shrubs of early-successional forests. These young, pole-sized forests are generally considered the least productive for wildlife, because they lack the woody browse of early-successional areas but do not yet have many features associated with mature forests, such as acorns or tree cavities. Eventually, the forest matures and has large trees that produce acorns, decaying trees with cavities, downed logs, and deep leaf litter. All of these features allow wildlife like salamanders, black bear, flying squirrels, and pileated woodpeckers to thrive.

# Forest succession

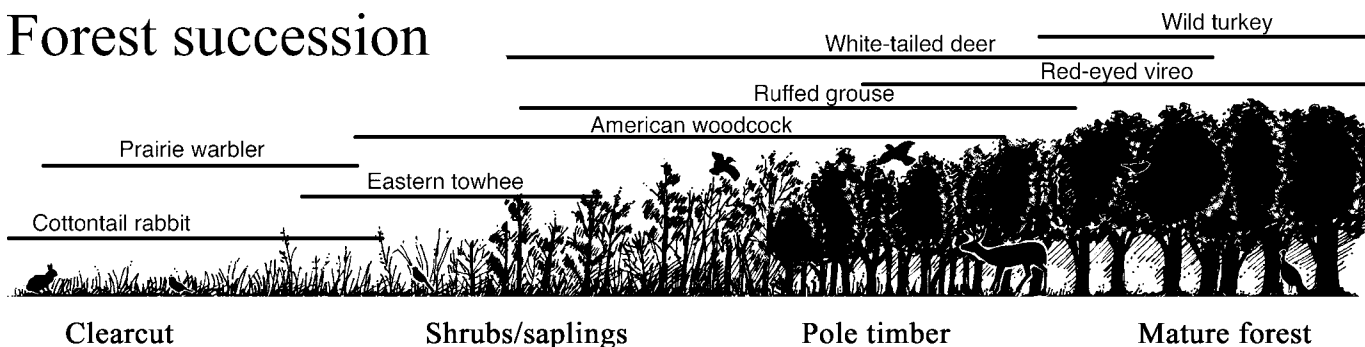


Figure 1: The above figure shows forest succession and examples of associated wildlife.

Depending on the type of harvesting you use, you will be creating or maintaining different successional stages of forest and, as a result, favoring different groups of wildlife. For example, clearcut stands will attract animals, such as eastern cottontail and chestnut-sided warbler, that use shrubs and saplings but will not be regularly used by species that require mature forests. Harvesting methods that retain large numbers of overstory trees can usually still provide suitable habitat to many forest animals, such as ovenbird, wood thrush, and scarlet tanager. Some wildlife species, like the pileated woodpecker, are called habitat specialists and will only be found in forests of one successional stage. Other wildlife are habitat generalists, such as deer, and they may occur in forests of any age.

In addition to requiring particular successional stages, wildlife also differ in the amount or location of the habitat they require. Some area-sensitive species require large amounts of land, whereas other species can live on small parcels of habitat. Many forest songbirds, such as wood thrush and scarlet tanager, are known to be area-sensitive. Location of habitat can also influence wildlife. Even if suitable habitat is available, some species will avoid using areas near a habitat edge (junction between two habitat types). These species are often referred to as interior species and include animals like salamanders and many warblers. Other wildlife, such as turkey, grouse, and deer, prefer using edges of habitat because of the abundant browse and vegetation usually present.

## What Can You Do?

As a landowner, you have the opportunity to manage all or part of your land in a way that is sensitive to wildlife needs. The first step is to define your objectives in terms of income, timber, firewood, wildlife, watershed protection, and aesthetics. In addition to defining your overall goals, you also need to decide on your objectives in terms of wildlife management. For example, do you want to manage only for specific game species, or do you want to manage for species that use mature forests? The next step is to contact a professional forester or a wildlife biologist. Be sure to specify your objectives to that person. Make it clear that you want to incorporate wildlife needs into the timber-harvest plan.

## Forest Management Approaches

There are two very different approaches to forest management: even-aged and uneven-aged management. Even-aged forest management removes most overstory trees from a stand. Ex-

amples are clearcuts (all trees removed), seed-tree cuts (a few trees are left standing to be sources of seeds for regeneration), and shelterwood cuts (more trees are left to provide shelter to regenerating trees). These methods work best when you are trying to regenerate trees that are not tolerant of shade, such as oak. Because the trees will regenerate at the same time, even-aged methods create stands dominated by one age class. Uneven-aged management creates stands with at least three tree age classes by cutting scattered individual trees (single-tree selection) or small groups of trees (group selection). Because stands treated with uneven-aged techniques retain many overstory trees, shade-tolerant tree species, like maple and beech, regenerate best in these stands. Uneven-aged management also may be a good strategy on small parcels of forest if landowners want to realize both timber and wildlife benefits. Based on your goals, the type of forest you have, and other site characteristics, a professional forester can suggest which method is appropriate for your land.

Even-aged and uneven-aged management approaches differ greatly in which wildlife are favored by creating either early- or late-successional stands. From a wildlife perspective, the “best” approach depends on the availability of nearby habitat and the sensitive wildlife species in your area. For example, if you have one of the only large tracts of forest within several miles, then forest wildlife may rely heavily on your land for habitat requirements, and an uneven-aged approach may be best. However, if your land is within a highly forested area, then an open or shrubby harvested stand produced by even-aged techniques might provide important habitat for wildlife associated with early-successional forest.

## How to Incorporate Wildlife Needs into Your Forest Management Plan

**Protect unique or important habitat features, such as vernal pools and spring seeps.** Vernal pools are temporarily filled with water during rainy seasons, and they are critical breeding and hibernating grounds for amphibians because they do not contain fish and other predators. Spring seeps are small streams or ponds with year-round water from belowground sources. Seeps are particularly important in the winter, because they are less likely to freeze and be covered by snow. In addition, important food resources, such as herbaceous vegetation and insects, are often abundant near seeps. Harvesting near pools and seeps can destroy the habitat they provide by affecting



water temperature and quality as well as adjacent food and cover. If possible, do not harvest within at least 100 feet of these important habitat features.

**Retain buffers along streams.** Riparian habitats perform critical ecological functions as well as provide habitat for a rich diversity of flora and fauna. Harvesting near streams not only destroys riparian habitat for terrestrial wildlife but also harms aquatic habitat by increasing water temperature and sedimentation. To reduce the negative impacts, leave buffer strips of unharvested trees (at least 50–100 feet wide) along both sides of streams. Remember to keep roads and skid trails at least 50 feet away from water and minimize the number of stream crossings for roads. If you are logging on a slope, these buffers should be wider.

**Do not harvest all trees.** Retain some live overstory trees in a variety of species and size classes. More wildlife will use harvested stands that contain residual trees because of the perching, nesting, and foraging opportunities they provide. In addition, by retaining at least one individual tree of every species on your land, you increase the probability of some seed production every year. Sometimes retaining a single mature tree of a species uncommon to your woodlot can preserve wildlife values not provided by a common tree species. Aside from providing food and cover to wildlife, the retention of overstory trees and snags can accelerate regeneration of clearcut stands because birds that perch on trees may excrete seeds.

**Enhance the vertical structure within the stand.** Some animals forage or nest only in small saplings or shrubs, whereas others spend most of their time in the forest canopy. By retaining trees, saplings, and shrubs in a variety of size classes, you can provide more vertical layers of forest to wildlife.

**Retain decaying and dead trees (snags).** Woodland owners are often encouraged to remove dead or decaying trees since they have little market value, but these trees are important to wildlife, especially because decay is a slow process. For wildlife use, snags should be greater than 8 inches diameter breast height (dbh). Leaving all standing dead trees is best for wildlife, but at least one large (greater than 18 inches dbh) cavity tree per few acres is needed for larger species that use cavities, such as wood duck, pileated woodpecker, and mergansers. Beech, basswood, and aspen are generally good cavity-producing trees. A professional forester can evaluate any safety threats posed by a particular snag and then recommend actions that you can take to minimize the risk.

**Retain dead and down wood.** Many animals, especially salamanders and small mammals, use logs, slash, and other woody debris for cover, dens, nests, foraging sites, and even as places for courtship displays. If possible leave large logs that will last longer than small logs. Also, try to leave some woody debris in piles to prevent quick decay, especially in wet sites. Brush piles can be placed anywhere but are most useful near edges, food sources, water, or areas with little cover.

**Create irregular rather than straight or abrupt edges to the cut, and reduce the contrast between habitats at edges.** Some wildlife, such as salamanders and certain forest birds, avoid using abrupt edges, and those that use them may experience high rates of predation. Edges are often associated with higher amounts of nest predation, fewer food resources for

### Which live trees should you retain?

- Try to retain some of each tree species on your land. If possible, retain several individuals of each species within the stand.
- Retain trees that produce mast, such as beech, oak, cherry, and dogwood. Mast refers to fruits and seeds of trees and shrubs; it's an important food source for many wildlife. Hard mast (e.g., acorns and beechnuts) is especially important in the fall and winter diets of many wildlife such as white-tailed deer, black bear, wild turkey, woodpeckers, and squirrels. To select trees that have steady seed production potential, choose trees of large size and moderate age with full, rounded crowns. Soft mast (e.g., cherries and grapes) is produced by fruiting trees, shrubs, and vines. Fruiting trees along woodland edges are especially valuable because sunlight stimulates heavy fruiting.
- Retain small groups of conifers (such as pine and hemlock). Because they keep their needles year-round, conifers provide important winter cover for wildlife, especially in snowy areas. Their seed-bearing cones also are a food source for many animals.
- Leave some long-lived trees, such as white oak, sugar maple, yellow birch, American beech, white ash, and red oak.
- Leave small groups of trees. This will provide small islands of habitat for wildlife as well as make trees more stable and resistant to wind.
- Leave trees with loose, rough, or deeply furrowed bark to provide foraging sites for birds that glean insects from bark. Loose bark may also provide roost sites for bats and nest sites for brown creepers.
- Retain living trees with cavities. Tree cavities provide shelter, dens, nests, and foraging sites for many wildlife species. In Ohio, over 50 species of birds and mammals use tree cavities. Some damaged young trees also can be reserved to provide future cavity trees. Trees with fungal conks, dead branches, old scars, and soft or decaying wood (especially heartrot) are good indicators of cavity potential.

some species, warmer air and soil temperatures, drier conditions, and more wind than interior forest. Edges between very different habitats, like between a mature forest and agricultural land, are abrupt and high-contrast. These edges generally have more negative "edge effects" than gradual or low-contrast edges. In addition, edge-adapted species, such as deer, may prefer gradual edges that provide both cover and foraging opportunities. Low-contrast, gradual edges can be made by allowing shrubs, saplings, and some overstory trees to remain along the harvest boundary. Edges can be feathered by retaining more trees closer to the forest interior and gradually fewer trees closer to the harvest area. See Figure 2 on page 4.

**Leave large patches of forest close to other forest patches.** If you are trying to manage for forest-associated species, then you need to consider patch size (how large a piece of habitat is) and the amount of isolation (how far that patch is from other

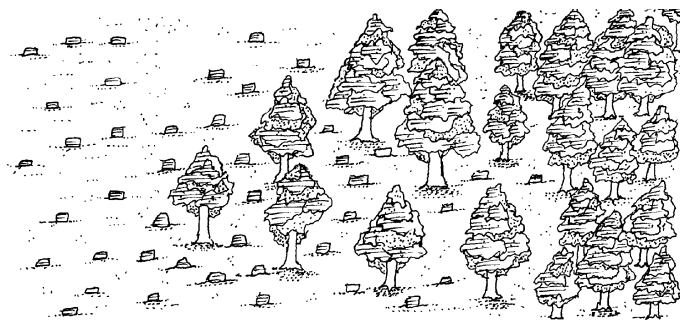


Figure 2 shows a feathered cut to the forest.

patches). Both of these can strongly influence populations of certain forest wildlife. For example, small woodlots, which have a lot of edge relative to forest interior, generally have less diverse and abundant bird communities than in larger forest areas. In addition, dispersal of animals may be impaired when woodlots become isolated, especially for salamanders and mammals. As a result, landowners trying to manage for forest wildlife should try to harvest in a way to leave the largest patch size possible and, if possible, leave patches closer to, rather than farther from, other patches.

**Try to maximize the interior forest of your unharvested stands.** Forest interior is unbroken forest at least 200–300 feet from habitat edges and usually is positively related to the size of a patch of forest (i.e., the larger the patch size, the more forest interior there is). To maximize the amount of interior forest, you can cut around the borders of a forest stand rather than fragment the stand into smaller ones. Also, circular and square-shaped forest patches retain more forest-interior than oblong, rectangular, or irregularly shaped patches.

**Consider leaving a portion of your land unharvested or using longer cutting cycles.** The machines, noise, people, and alteration of habitat associated with harvesting operations are disturbing to most wildlife. Not harvesting in some areas will provide forest wildlife with some habitat that is free of disturbance and intensive human activity.

**Limit the size of your clearcut.** Harvested stands that are very large can inhibit wildlife from using them or even crossing them. In addition, large harvests without residual trees may take longer to regenerate because seed sources are more distant. If you are trying to manage for wildlife that use edges, small clearcuts (e.g., between 5–40 acres in size) may be best. On the other hand, multiple small cuts in forested areas will be detrimental to many animals associated with the forest-interior. Another consideration is that small cuts in areas with high deer density can have difficulty regenerating. Ultimately, the desirable size will depend on your goals, the wildlife species that you want to attract, and characteristics of your woodlands. Again, you should check with a professional forester about appropriate harvest sizes for your land.

**Seed log landings and roads.** As soon as the logging is completed, haul roads and skid trails should be graded to eliminate ruts and then re-vegetated with grasses. Lime, fertilizer,

and mulch may be needed in order to establish good grass cover. Water bars should be installed at intervals of 35–250 feet depending on the length and slope of the road or trail. Unless you intend to do this work yourself, you should put these requirements in the timber sale contract that you have with your logger. If the roads and trails are likely to get heavy use from off-road vehicles, you may want to install to protect these newly-seeded areas.

**Specify all wildlife management prescriptions that you want performed on your land in your timber sales contract.** Do not assume that the forester or logger will automatically know how you want to be sensitive to the needs of wildlife. Ultimately, incorporating wildlife needs into your forest management plan is your responsibility.

## Best Management Practices for Erosion Control on Logging Jobs in Ohio

Grass Seed Mixtures for Disturbed Sites:

### Skid Trails and Road Cuts

Perennial Rye Grass	50%
KY31 Tall Fescue	20%
Potomac Orchard Grass	20%
Red Clover	10%

### Landings and Flat Cuts

Perennial Rye Grass	50%
Red Top Clover	20%
Potomac Orchard Grass	20%
Ledina Clover	10%

## Glossary

**Area-sensitive species:** A species whose occurrence or reproductive success is reduced in small habitat patches.

**Ecosystem:** All living (e.g., plants and animals) and non-living (e.g., water and nutrients) components of the immediate environment and the interactions between them.

**Edge species:** A species that prefers to use habitat edges, such as the interface between a clearcut and a mature forest.

**Forest-interior species:** A species that requires large tracts of forest away from habitat edges.

**Habitat:** The place where a microorganism, plant, or animal lives.

**Habitat generalist:** An organism that can live in a variety of habitats.

**Habitat specialist:** An organism that requires a specific type of habitat, such as an old growth forest.

**Mast:** The fruits, seeds, or nuts of trees and shrubs.

**Snag:** A standing dead tree.

**Succession:** The gradual replacement of one community of plants by another (e.g., an abandoned field ultimately becomes a forest again).

**Vertical structure:** The layers of foliage within a habitat (e.g., ground, understory, subcanopy, and canopy).

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# Extension FactSheet

School of Natural Resources, 2021 Coffey Road, Columbus, Ohio 43210

## Managing for Forest Songbirds

Amanda D. Rodewald, Assistant Professor of Wildlife Ecology and Extension Wildlife Specialist

Songbirds are a diverse group of species that includes crows, jays, wrens, chickadees, warblers, vireos, flycatchers, swallows, thrushes, tanagers, orioles, blackbirds, sparrows, and finches. Songbirds use a variety of habitats—from grasslands to shrubby, early-successional habitats to mature forests. However, each species has a unique set of habitat requirements based on its ecology and behavior. Of the nearly 200 birds that breed in Ohio, over half are associated with forest habitats. These birds provide many aesthetic, recreational, educational, and ecological benefits to the forests and the people that use them.

Over the past few decades, biologists and birdwatchers have become aware of long-term population declines in some species of songbirds. Of particular concern are Neotropical migratory birds—species that breed in North America and migrate to Central and South America and the Caribbean to spend the winter. Minimizing threats (such as deforestation and pesticide use) to Neotropical migratory birds is complex because their critical habitats range over the entire western hemisphere. However, in the United States we can manage breeding areas to provide suitable habitat that will allow birds to successfully raise their young. This fact sheet describes several ways that you can consider the needs of songbirds in your land management plan.

### Forest Succession and Songbirds

Forests at different stages of succession will favor different species of birds. During forest succession a grassy field or harvested stand will eventually become a mature forest. Within a year or two after clearcutting or farm abandonment, the land will often have areas of bare soil and herbaceous vegetation, such as grass and forbs. As succession continues, woody shrubs, seedlings, and saplings invade the area, providing habitat for birds like gray catbirds, eastern towhees, and prairie warblers. As saplings grow, they usually will develop into dense stands of small trees that create too much shade to support many low-growing shrubs and plants. These young pole-sized forests may be the least productive for songbirds because they lack the shrubby growth of early-successional habitats but do not yet have many features associated with mature forests. Eventually, the forest matures and will usually have distinguishable understory, midstory, and canopy layers. Mature forest is used by birds like the scarlet tanager, ovenbird, red-eyed vireo, and wood thrush. Different successional stages have unique bird communities because many bird species are *habitat specialists* and will only be found in forests of one successional stage. However,

others are *habitat generalists* and may occur in forests of any age.

Depending on the type of harvesting you use, you will be creating or maintaining different successional stages of forest and, as a result, favoring different groups of songbirds. For example, clearcut stands will attract birds that use shrubs and saplings but will not be frequently used by species that require mature forests. In contrast, harvesting methods that retain large numbers of overstory trees and a relatively intact canopy can usually still provide suitable habitat for many mature forest birds. From a songbird perspective, the “best” approach may depend on the availability of nearby habitat and the sensitive species in your area. For example, if you have one of the only large tracts of forest within several miles, then forest birds may rely heavily on your land for their habitat requirements. In such cases, an uneven-aged management approach that retains large numbers of canopy trees may be best. However, if your land is within a highly forested area, then a shrubby harvested stand produced by even-aged techniques might provide important habitat for birds associated with early-successional forests. Birds associated with both early- and late-successional forests are important from a conservation perspective.

### Looking Beyond Your Forest Stand

In addition to requiring particular habitat components, birds also differ in the amount or location of the habitat they require.

**Table 1. Examples of Breeding Songbirds Associated With Early-Successional and Mature Forests in Ohio.**

Early-Successional Forest	Mature Forest
Gray Catbird	Eastern Wood Pewee
Brown Thrasher	Acadian Flycatcher
Blue-winged Warbler	Red-eyed Vireo
Yellow-breasted Chat	Yellow-throated Vireo
Chestnut-sided Warbler	Wood Thrush
Prairie Warbler	Cerulean Warbler
Common Yellowthroat	Worm-eating Warbler
Eastern Towhee	Ovenbird
Field Sparrow	Kentucky Warbler
Indigo Bunting	Scarlet Tanager

Some *area-sensitive species* require large amounts of land, whereas other species can live on small parcels of forest habitat. Many forest songbirds, such as wood thrush and scarlet tanager, are known to be area-sensitive. For example, in many parts of the Midwest, scarlet tanagers require more than 200 acres of mature forest to breed. In addition, location of habitat can also influence birds. Even if suitable habitat is available, some species will avoid using areas near a habitat edge (junction between two habitat types). Edges are often associated with higher amounts of nest predation and brood parasitism, fewer food resources for some species, warmer air and soil temperatures, drier conditions, and more wind than interior forest. Species that avoid using edges are often referred to as *interior species* and include many forest birds.

## How to Incorporate Songbird Needs Into Your Forest Management Plan

**Enhance vertical structure within the stand.** Some birds forage or nest only in small saplings or shrubs, whereas others spend most of their time high in the forest canopy. By retaining trees, saplings, and shrubs in a variety of size classes, you can provide more vertical layers of forest and, as a result, more foraging and nesting opportunities for birds.

**Keep forest buffers along streams.** Riparian habitats perform critical ecological functions as well as provide habitat for a rich diversity of flora and fauna. There also is evidence that during migration songbirds prefer to move along wooded riparian corridors. In addition, some breeding birds (such as Louisiana Waterthrush) forage and nest only along forested streams and rivers. Leave buffer strips of unharvested trees along both sides of streams. Although buffers that are greater than 200–300 feet wide will have the greatest use by songbirds, leaving buffers that are at least 50 feet wide will provide some habitat and protect water quality.

**Do not harvest all trees.** Retain some live overstory trees in a variety of species and size classes. More birds will use harvested stands that contain residual trees because of the perching, nesting, and foraging opportunities they provide. In particular, retain trees that produce fruits, seeds, acorns, or nuts. A variety of songbirds will utilize these resources in both the autumn and winter. If you are especially concerned about resident species that remain on your land throughout the year, then retain small groups of conifers (such as pine and hemlock) for winter cover and a food source.

**Retain decaying and standing dead trees (snags).** Woodland owners are often encouraged to remove dead or decaying trees since they have little market value, but these trees are important to wildlife, especially because decay is a slow process. For wildlife use, snags should be greater than 8 inches in diameter at breast height (dbh). Leaving all standing dead trees is best for wildlife, but at least one large (greater than 18 inches dbh) cavity tree per few acres is needed for larger species that use cavities, such as wood duck, pileated woodpecker, and mer-

gansers. A professional forester can evaluate any safety threats posed by a particular snag and then recommend actions that you can take to minimize the risk.

**Create irregular edges when harvesting stands.** Edges between very different habitats, like between a mature forest and agricultural land, are typically abrupt and high-contrast. These edges generally have more negative “edge effects” on forest songbirds than gradual edges. Gradual edges can be encouraged by allowing shrubs, saplings, and some overstory trees to remain along the harvest boundary. Edges also can be “feathered” by retaining more trees closer to the uncut forest and gradually fewer trees closer to the harvested area.

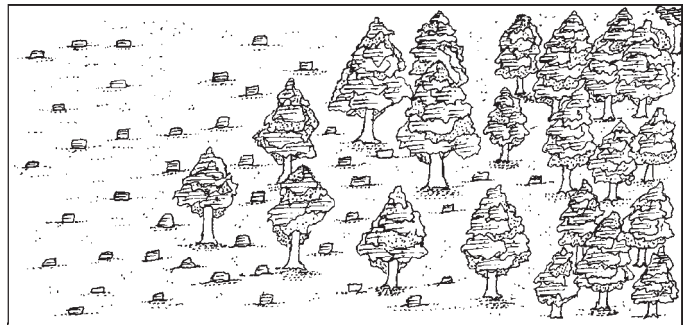


Figure 1 shows a feathered cut to the forest.

**Leave large patches of forest close to other forest patches.** If you are trying to manage for forest-associated species, then you need to consider forest patch size (how large a piece of habitat is) and the amount of isolation (how far that patch is from other patches). Both of these factors can strongly influence populations of area-sensitive forest birds. For example, small woodlots, which have a lot of edge relative to forest interior, generally have less diverse and abundant bird communities than in larger forest areas. As a result, landowners trying to manage for forest wildlife should try to harvest in a way to leave the largest patch size possible.

**Maximize the forest interior area of unharvested stands.** Forest interior is unbroken forest at least 200–300 feet from habitat edges and usually is positively related to the size of a patch of forest (that is, the larger the patch size, the more forest interior there is). To maximize the amount of interior forest, you can cut around the borders of a forest stand rather than fragment the stand into smaller blocks of forest. Also, circular and square-shaped forest patches retain more forest-interior than oblong, rectangular, or irregularly shaped patches.

**Keep your cats inside.** Believe it or not, cats pose serious threats to songbirds and other native wildlife in many urban, suburban, and rural areas. Cats can kill adult birds and nestlings and often destroy the eggs and nests of many species. Recent studies estimate that free-ranging cats may kill over 1 billion birds each year in the United States, making cats among the greatest sources of mortality for songbirds. Keeping your cats indoors will not only prevent predation of wild birds but also will reduce unwanted cat reproduction and the spread of disease.

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# Extension FactSheet

School of Natural Resources, 2021 Coffey Road, Columbus, OH 43210

## Dead Trees as Resources for Forest Wildlife

Melissa J. Santiago and Amanda D. Rodewald, Ph.D.  
School of Natural Resources, The Ohio State University

Although dead wood might seem expendable in a forest or may even be regarded as unsightly, it serves an important role in supporting wildlife and assisting ecological processes. Dead wood may be in the form of *snags* (standing, dead trees), dead limbs, or logs. All provide habitat to numerous animal species and play an important role in nutrient cycling.

### Biological Impacts of Dead Trees

Birds are the most obvious benefactors of dead trees. They use snags, limbs, and logs for perching, foraging, and nesting. In some forests, 30 to 45 percent of the bird species are cavity nesters. In North America alone, 55 avian species nest in cavities. Cavity-nesting birds are classified as *primary excavators* (who can excavate hard wood), *weak excavators* (who can excavate soft, dead wood), or *secondary cavity-users* (who can utilize existing cavities). In Ohio, eastern bluebirds, American kestrels, and wood ducks are examples of species that rely on cavities in dead wood for successful reproduction. Other birds, such as ruffed grouse, will use logs for drumming and courtship displays.

However, birds are not the only creatures that benefit from dead wood. Mammals, amphibians, reptiles, and invertebrates seek refuge in natural cavities and dens. For example, salamanders rely on the security and dampness of soil found beneath a rotting log. Small mammals find cover and relief from the hot midday sun in dead limbs and downed wood, while spiders, beetles, worms, and microbes move and feed within the decaying matter. Additionally, fungi and mushrooms flourish on and around logs, breaking down the organic matter to release important nutrients back into the forest ecosystem.

Logs provide other important ecological functions as well. Decaying logs retain moisture and nutrients that aid in new plant growth. Young trees may sprout from a single downed limb known as a *nurse log*. The soft wood tissue of a nurse log offers an ideal substrate for many young trees during their initial growth and development. Logs also store energy and fix nitrogen. Furthermore, dead wood serves as a ground cover, lessening soil erosion and preventing animals such as deer from over-browsing plant seedlings.

### Dead Tree Management

The potential benefits to wildlife from the retention of dead wood are dependent on several factors. The size, species, level of decay, and location affect the usefulness of dead wood to wildlife. Consider these factors to guide your decisions regarding dead wood retention.



Photo by Jodi Miller

Large snags (greater than 15 inches diameter at breast height and taller than 6 feet) are required for large animal species, such as the pileated woodpecker; whereas, smaller animals may use snags or dead limbs from 4 inches in diameter. In general, retain the greatest number of snags possible, and try to include at least one large snag per acre. Large snags will also stand longer and decay more slowly than their smaller counterparts. The same is true for logs. Those greater than 12 inches and 3 feet long will provide longer lasting habitat than smaller logs. Still, retaining a variety of sizes and types of downed wood is usually the best strategy to establish habitat for wildlife.

Consider the species of origin of the dead wood when deciding what to keep or remove in a forest. Animals sometimes show a preference for snags of certain tree species. These tree species preferences may vary from region to region. Species of snags retained should reflect the tree species found in the area. It may be appropriate to retain slower-decaying species, such as cedars, over those that tend to rot more quickly, such as alders. Furthermore, deciduous trees are more likely to develop larger cavities than conifers. Plan to allow a variety of trees to age and die naturally in order to provide a continuous source of replacement snags and nurse logs.

The level of snag decay is another important factor to recognize when making management decisions. Harder trees that have recently died, still with bark intact, will stand longer than older, softer snags that have lost their bark over the years. However, in order to maximize the wildlife benefits, keep a variety of soft and hard wood snags. Weak excavators like nuthatches and titmice may need softer wood in which to make their nests. Also, many species will use trees that are only partially dead. *Den trees* often form from hardwoods; they are live trees in which some of the heartwood has rotted out to create cavities.

The location of dead wood will impact opportunities to provide wildlife habitat. Snags should be available throughout the forest stand. Some of the trees can also be clustered. When possible, keep snags dispersed over 60 percent of the total land area. For wildlife benefits, research suggests maintaining 2 to 4 snags per acre. Offering a substantial number of snags will

lessen competition for nesting, foraging, and roosting sites. In areas that have recently been logged, *slash* (timber debris) should not exceed 8 inches depth on 75 percent of the site, in order to facilitate movement of large mammals and reduce fire hazard. Yet, some level of slash provides cover for wildlife and enriches soil quality.

As with any forestry issue, safety should be a top priority. Consult a professional when determining if a snag presents a substantial hazard. In some situations, it may actually be more dangerous to remove a tree than to let it stand. If it is not possible to retain snags on portions of your property, installing nest boxes will offer cavities for some species to reproduce. However, this is impractical on a large scale. For more extensive wildlife habitat, foresters can create snags of adequate size for you in safe locations.

## Conclusion

If we recognize and understand the natural value of snags, dead limbs, and logs, they become more appealing to the human eye. Snags and logs are not signs of “unkempt” forest, nor are they waste materials to be discarded. Rather, dead trees are home to many animals and storage for moisture and nutrients. Because so many animals rely on dead wood during some part of their lives, snag, limb, and log retention is an essential component of any wildlife conservation or management plan.

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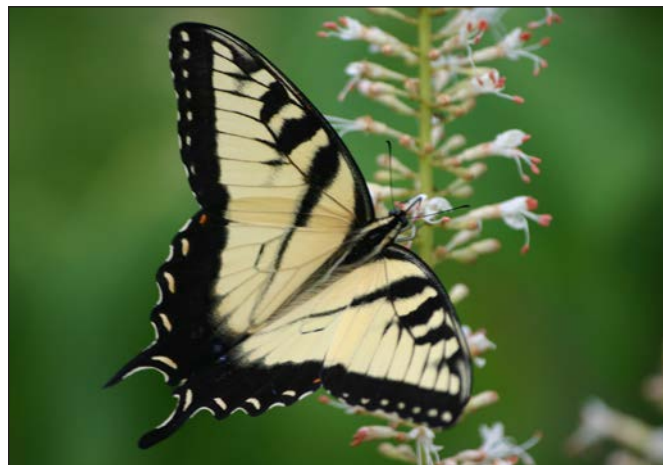
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# Attracting Pollinators to the Garden

Denise Ellsworth, Department of Entomology

Gardeners are increasingly concerned about the status of pollinators in Ohio. Important pollinators such as honey bees, bumble bees and monarch butterflies have gained attention in recent years due to concerns about declining populations. Pollinators are vital to the production of many food crops and provide a service essential to the survival of many native plants. Fortunately, gardeners can take steps to support these and other pollinators through plant selection and simple gardening practices. This fact sheet describes the importance of pollinators, their role in the ecosystem, and actions gardeners can take to help pollinator populations in their yards and gardens.



Swallowtail butterfly drinks nectar from bottlebrush buckeye flowers.

depend on repeat visits by pollinators, so many offer small rewards repeated at regular intervals to encourage return trips.

## How Pollinators Find Flowers

Flowers use a variety of strategies to attract pollinators, including petal color, scent, UV light patterns and nectar guides. Bees in particular use floral qualities such



Lines and coloration on petals help pollinators quickly find rewards.



Bumble bee visits aster flower for pollen and nectar.

## What Is Pollination?

Pollination is the movement of pollen from the male part (anther) of one flower to the female part (pistil) of another flower. Without pollination, most plants can't make seeds and fruits. Many plants are wind pollinated (e.g., grasses, small grain crops, and conifers), but others rely on animals, primarily insects, to carry pollen from flower to flower.

Plants attract pollinators by offering rewards, such as pollen, nectar and floral oils. Flowers also provide shelter and gathering places for pollinating insects. Flowers



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as polarized light patterns, petal texture, temperature, humidity, and electrostatic charge to help them locate flowers.

## The Importance of Animal Pollinators

Animal pollinators are essential to the food we eat. Some scientists estimate that one in three bites of food we take can be traced back to the role of animal pollinators. A 2012 study at Cornell University estimates that bees and other insect pollinators contribute \$29 billion annually to U.S. farm income by pollinating 58 crops, including almonds, apples, berries and squash. Pollinators play a key role in the production of many foods in the home garden.

In addition to their role on farms and gardens, pollinators are essential to the survival of native plants. Approximately 75% of all plant species depend on animal pollinators to move pollen from plant to plant. Without the work of pollinators, many native plants couldn't produce seeds to ensure the plant's next generation. These seeds and the fruit that often accompany them also provide important food sources for approximately 25% of birds and many mammal species.

Key animal pollinators include honey bees, native bees, flies, moths and other insects, as well as birds and some mammals.



The western honey bee is a key agricultural pollinator.  
(Photo courtesy of Karina Weatherbee.)

## Bees: Essential Pollinators

Bees are considered the most important pollinators because they are uniquely adapted to gather and transport pollen. Bees rely on flowers for food to feed their young, so they actively seek out and visit flowers. Bees' fuzzy bodies and branched hairs help female bees collect pollen into special structures, such as pollen baskets on the hind legs or long hairs on the thorax or abdomen.

Bees also forage for food close to their nesting sites, a practice called central place foraging. Bees visit one or only a few flowering species during each foraging trip, even when other flowers are available. This behavior, called flower fidelity or flower constancy, makes bees especially reliable couriers to move pollen to receptive flowers.

The western honey bee is the most dependable agricultural pollinator of many crops. It is not native to North America. Ohio is home to approximately 500 native bee species. These diverse bees play important roles as pollinators of agricultural crops and native plants. (See Ohio Bee Identification Guide at [go.osu.edu/ohiobees](http://go.osu.edu/ohiobees) to learn more about Ohio's native bees.)

Bees can be divided into three broad groups: social bees (bumble bees), solitary ground-nesting bees (such as mining bees), and solitary cavity-nesting bees (including mason bees and leafcutting bees).

Bees are often confused with wasps. Wasps may visit flowers for nectar, but they rely on insects or spiders—not pollen—to feed their young. Solitary wasps are beneficial predators; they are rarely aggressive. Social wasps, such as yellowjackets and hornets can become aggressive and may sting repeatedly.

Social bees like bumble bees will usually only sting when defending their nest. Solitary bees such as mining bees and leafcutting bees are not aggressive. Many of these bees can't penetrate human skin with their stingers.

Animal pollinators and bees in particular are currently facing many threats, such as lack of forage (flowers for food), pests, pathogens, pesticides, invasive plants, climate change and lack of suitable nesting sites. Gardeners can play an important role in pollinator conservation by providing plants and nesting sites for pollinators and by adapting gardening practices to protect pollinators.



Native mining bees frequently nest in sandy soils on south-facing slopes.



# What Gardeners Can Do

## Grow More Flowers

Trees, shrubs and herbaceous plants can provide food and nesting habitat for pollinators. An abundance of different flower shapes, sizes, and colors will appeal to a variety of pollinators. Grouping plants together in sunny locations helps pollinators find and feed on desirable flowers while expending less energy in the search for plants.

By observing flowers in the garden and taking note of any flower visitors, gardeners can learn which plants are most attractive to pollinators. Additionally, many plant lists are available to help with the selection of plants for pollinators (find plant lists at [go.osu.edu/gardensandbees](http://go.osu.edu/gardensandbees)).

Different flower shapes and colors attract different pollinators. For example, red tubular flowers with a nectar reward tend to attract hummingbirds. Daisy-like flowers that provide nectar and pollen in shallow flowers are often visited by bees and flies with shorter mouthparts.

Some cultivars and hybrids don't offer the pollen and nectar rewards that so-called "straight species" do, since the quality and quantity of nectar and pollen are sometimes lost during breeding. Plants bred with "double" flower petals are often inaccessible to pollinators. Gardeners can include less refined plants along with plant cultivars to offer broad pollinator appeal.



Some cultivars with complex petal arrangements and unusual colors are less attractive to pollinators, such as this 'Hot Papaya' purple coneflower.

## Bloom Through the Season

Different species of bees, butterflies and other pollinators are active in Ohio at different times of the year. Queen bumble bees, mourning cloak butterflies and blue orchard bees are active in early spring. Monarch butterflies, worker bumble bees and worker honey bees forage from spring into the cooler days of autumn.

Gardeners can help pollinators by planting flowers with a sequence of bloom throughout the growing season, from early spring through late fall. Early-blooming



Early-blooming maples provide an important pollen and nectar source for bees in early spring.

trees such as maples, willows and redbuds, and late-season perennials like asters and goldenrod provide important food at especially critical times. Consult [www.oardc.ohio-state.edu/gdd/](http://www.oardc.ohio-state.edu/gdd/) for a sequence of native and non-native woody flowering plants for Ohio.

## Key Plants for Pollinators

While literally hundreds of garden plants provide important sources of nectar and pollen for pollinators, try these garden-worthy additions:

- **Trees:** maple, crabapple, linden, serviceberry
- **Shrubs:** ninebark, pussy willow, sumac, viburnum
- **Perennials:** aster, hyssop, milkweed, purple coneflower
- **Annuals:** cosmos, marigold, sunflower, zinnia
- **Herbs:** basil, borage, catmint, lavender, oregano

## Caterpillar Host Plants

While adult butterflies will drink nectar from many types of flowers, immature caterpillar stages require specific plant species to complete development. Monarch caterpillars require milkweed plants, pearl crescent caterpillars feed on New England asters, and black swallowtail caterpillars feed on plants in the carrot family such as parsley and dill. Include butterfly host plants as well as flowers that provide a nectar source to attract egg-laying adult butterflies. Learn more about specific caterpillar food requirements in the ODNR field guide "Butterflies and Skippers of Ohio" at [go.osu.edu/ODNRbutterflies](http://go.osu.edu/ODNRbutterflies).

## Vegetable Garden Pollination

Flowers planted in and near vegetable gardens and fruit plantings help bring pollinators and other beneficial insects into the garden. Annuals, perennials and herbs provide important food sources for insect pollinators, especially in the heat of summer. Consider planting

sunflowers, zinnias, marigolds and cosmos in or near the vegetable garden. Herbs such as lavender, basil, borage, dill, fennel, oregano and catnip will also attract many pollinators.

## Plant Natives

Locally native plants attract native pollinators. Native plants offer nectar, pollen and other nutrients in quantities that native pollinators need. Consider adding more locally native trees, shrubs and herbaceous plants to the garden.

## Provide Nesting Sites

Brush piles, dead standing trees and clumping grasses all provide important nesting and overwintering habitat for bees and butterflies. Cavity-nesting bees make their nests in the pith of twigs like elderberry or sumac, or in abandoned beetle burrows in dead trees. Solitary ground-nesting bees usually nest in sandy, well-drained soils on south-facing slopes.

Artificial nesting sites can be made or purchased to encourage cavity-nesting bees. These structures require routine maintenance, and even periodic replacement, to prevent the build-up of bee pathogens and parasites.



Bumble bees will frequently nest under clump-forming grasses.

Bumble bees prefer to nest in pre-existing cavities with some form of insulation such as old rodent nests or bird nests, both above and below ground. They will also nest under clumps of grass. Purchased or constructed



Dandelions provide an important source of nectar and pollen for pollinators.

bumble bee nesting structures are generally considered unsuccessful at attracting bumble bee queens.

## Other Considerations

A water source in the garden helps thirsty pollinators, especially in the heat of summer. A shallow bowl or birdbath can provide sufficient water. A few sticks placed in the bowl will provide a place for bees and other insects to land and perch, thus preventing insect drowning. Additionally, a muddy puddle may be visited by pollinators like butterflies and mason bees.

Limit pesticide use in the garden. Pesticides can have negative effects on bees and other insects, killing them outright or affecting behavior, longevity or susceptibility to disease. Use an integrated pest management approach with multiple strategies to reduce pest damage. Contact your local Ohio State University Extension office for pest management assistance (see [extension.osu.edu](http://extension.osu.edu)).

Many plants frequently considered weeds do provide food for pollinators, including dandelions, milkweed, goldenrod and clover. Consider tolerating weeds with benefits to pollinators. On the other hand, many invasive weeds outcompete native plants important to pollinators. Eliminate invasive weeds such as privet, garlic mustard, and buckthorn.

To learn more about pollinators and pollinator plants, consult these resources:

- The Xerces Society for Invertebrate Conservation: [xerces.org](http://xerces.org)
- Pollinator Partnership: [pollinator.org](http://pollinator.org)
- The Ohio State University Bee Lab: [beelab.osu.edu](http://beelab.osu.edu)

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# MONARCH JOINT VENTURE

*Partnering across the U.S. to conserve the monarch migration*

[www.monarchjointventure.org](http://www.monarchjointventure.org)

## **Monarch Joint Venture**

The Monarch Joint Venture (MJV) is a partnership of federal and state agencies, non-governmental organizations, businesses and academic programs working together to protect the monarch migration across the United States.

Our mission is to protect monarchs and their migration by collaborating with partners to deliver habitat conservation, education, and science across the United States.

Our vision is thriving monarch populations that sustain the monarch migration into perpetuity and serve as a flagship for the conservation of other plants and animals.

## **Contact us**

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Find additional contact information on our website.

*Photo credits: Pete Berthelsen, Dave Mensink*

## **Constructing Healthy Habitat for Monarchs**

Planting habitat in pocket prairies and large-scale areas in the Midwest

### **Habitat needs**

Restoring and connecting native plant habitat is one of the most important actions we can take to advance conservation efforts. In addition to providing habitat for monarchs and other pollinators, these habitats offer water quality benefits and protect against erosion while supporting many wildlife species. However, millions of acres of habitat have been lost or severely fragmented, so immediate action must be taken to reverse these trends and restore the health of our natural ecosystems.

This handout outlines the process for restoring diverse grassland habitat in the Midwest.



### **Step 1: Identifying a site**

Pollinator-friendly habitat can be established in a variety of areas. While selecting a non-garden site, consider the following:

**Select a sunny or mostly sunny location.** Many pollinators and pollinator plants thrive in open, sunny areas.

**Avoid areas that have a high likelihood of being impacted by overspray.** Incidental spray drift is harmful to monarchs and plants.

**Prioritize marginal areas to reduce maintenance needs.** Drainage ditches, fence rows, areas between structures, or lawns can all be great pollinator habitats.

**Pick somewhere you can show it off!** Pollinator plots have beautiful blooming plants that you and your neighbors will want to admire in a highly visible area.

### **Step 2: Site preparation**

Weeds are the largest issue for new plantings so it is very important to control for them before the habitat installation. This process may require a full growing season. First, the vegetation and planting area should be cleared by burning or mowing to remove excess plant material. If the site is primarily unwanted plants, proceed by using one of the following methods to eradicate weeds.

**Try solarization.** By covering the site with plastic, increased soil temperatures will limit plant growth. This process can take two to three months. It can be costly and is most effective on small sites. This may serve as a good option for chemical-free site preparation and the plastic can be re-used.

**Apply herbicide.** In order to eliminate vegetation, an herbicide can be used. Select an herbicide that leaves little residue in the soil, like glyphosate. You may need multiple applications to reduce the grass and weed pressure on new seedlings.

**Conventional agricultural production.** Cultivate the area using conventional methods for one year to suppress weed growth. Spray and disk the site as needed, then clear, crimp, or chop vegetation before planting the seed mix.

### **Pollinator Habitat Help Desk**

The MJV maintains the Pollinator Habitat Help Desk to answer your questions and connect you with financial and technical assistance programs. Let us help with your next pollinator project!

Email: [habitat@monarchjointventure.org](mailto:habitat@monarchjointventure.org)

Phone: 833-MILKWEED or 833-645-5933

### **Step 3: Selecting and buying seeds**

When buying a seed mix, select a vendor that offers native, locally sourced grasses and wildflowers. Some mixes incorporate introduced legumes, which also have pollinator benefit. Many will have a variety of seed mixes to choose from depending on your objectives and cost considerations. A pollinator seed mix may cost between \$100-\$1,000 per acre. Many programs exist to reduce the cost to the landowner. Farm Bill programs (like CRP, CSP, EQIP), state agencies and county conservation districts can be helpful in funding habitat projects. There are also programs that offer free seed to qualifying applicants. Check out the MJV website at [plantmilkweed.org](http://plantmilkweed.org) for more information.

### **Step 4: Planting**

Seeds can be planted in the fall, spring or winter. There are advantages and disadvantages to each planting time. Seeds can be sown by hand or by machine.

**Hand-seeding:** For small sites, hand-seeding is most cost-effective. Mix a filler into the seed mix like moistened sawdust, compost, or peat moss to broadcast the seeds more evenly. Hand-seeding on larger sites may result in uneven distribution of the seed mix.

**Mechanical seeders:** For larger areas or when equipment is readily available, use mechanical seeding. Drop seeders work best on freshly cultivated soil to maximize seed-to-soil contact. Drill seeders are effective when planting sites that have existing vegetation or indirect soil contact.

### **Step 5: Early maintenance**

Weed control is an important component of management in the first few years to prevent fast-growing weeds from crowding out new seedlings. In the first growing season, the site should be mowed when the average plant height reaches 12-18 inches (about knee-high). Mow to a height of 6-10 inches. If weeds persist, you may mow in the second growing season, but raise the cutting height to 12 inches.

In some cases, targeted use of herbicide may help control problem areas and grasses. Be careful to only spot treat unwanted species and apply on windless days so chemicals are not unintentionally blown onto other desirable plants.

### **Step 6: Long-term maintenance**

Once established, a site should be managed every 2-5 years. This management can include prescribed fire, grazing, or haying/mowing. In order to leave refugia for organisms using the habitat, split management areas into different sections and conduct management activities on a rotational basis. For example, you could mow one half in Year 1 and the other half in Year 2. In Year 3, you don't mow at all, and then in Year 4, mow the first half again. The techniques and timing of activities should be customized to best fit your situation.

This ongoing management helps to remove old growth, reduce woody encroachment, and promote the health of plant communities. When possible, management should occur during early spring or late fall windows to minimize impact on pollinator and wildlife communities.

### **Enhancing an existing site**

Many existing habitat areas provide some benefit, but could be improved to increase their pollinator value. Enhance a site by:

**Adding species:** Aim to fill in gaps in the blooming periods so that pollinators have food sources available all season long. Add milkweed where possible. When adding species, plugs or plants generally establish

best in existing vegetation. If adding seeds, start with a full-site burn or mow to decrease competition and increase seed-to-soil contact. Keep track of species present throughout the season and strive for high diversity systems.

**Spot treating weedy areas:** Identify problem areas and spot treat unwanted species using targeted mowing, mechanical removal, or herbicide application.

**Scheduled management:** Get the habitat on a rotational plan to mow or burn subsections every few years.

**Create shelter for monarchs and other pollinators:** Insects need areas to shelter them from natural enemies and the elements. Many insects use stems, wood piles, or dead vegetation to nest and overwinter.

### **Additional resources**

There are many additional resources about planting pollinator habitat that detail techniques introduced here. A growing list of resources by the MJV and partners can be found at [plantmilkweed.org](http://plantmilkweed.org).



### **Register your habitat and add a sign!**

After you have finished planting your site, consider registering your habitat with an accredited program. Some examples include: Monarch Watch Waystation Program, HabiTally, Bee Friendly Farming and Bee Better Certified. Promote monarch and pollinator conservation by adding a sign to your habitat. Signs are a great way of sharing conservation efforts and can provide passive educational opportunities. The MJV website has examples of educational signs, including some that can be customized for your needs.



# Pollinator Habitat

## Establishment Recommendations



Pollinator Planting; source: US Fish & Wildlife Service

Pollinator plantings are a great way to improve pollinator habitat and biodiversity. Planting native herbaceous and woody species that are beneficial to pollinators throughout the landscape will prove to not only be attractive to pollinators, but also aesthetically pleasing to the eye and attractive to many other species of wildlife.

Establishment of pollinator plantings can be difficult and requires the **Three Ps**.

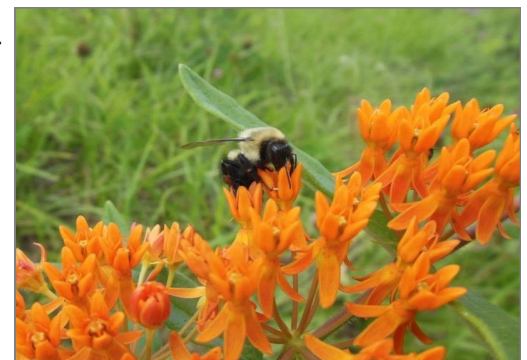
**Planning:** It is very important to plan ahead. Pollinator plantings require lots of thought on species and site selection, site preparation, planting, and maintenance.

**Patience:** Native plants are best for pollinator plantings, and most natives are not quick to establish and flower. It is important to be patient while native plants slowly emerge and set their deep roots to pull moisture and nutrients for the toughest growing conditions.

**Persistence:** Persistence will pay off. Weed control is one of the most challenging and important parts of establishing a successful pollinator planting. Be persistent with monitoring, weed (any undesirable plant) control, and care of your pollinator planting.

### Pollinator planting establishment steps

No two pollinator projects are exactly the same. This is why detailed step-by-step planting instructions are hard to find. Pollinator plantings can range in size from a couple hundred square feet to a couple hundred acres. It is obvious that smaller projects will likely receive more care per unit of area, but the establishment steps are basically the same. Smaller projects (typically < 1 acre) are more conducive to more intense establishment methods, such as solarization, planting plugs, hand-pulling weeds, etc. These steps focus on planting native herbaceous plants, and it is important to consider planting native trees and shrubs attractive to pollinators nearby or in your planting for nest sites, pollen/nectar, and other needs.



Butterfly milkweed

These five pollinator planting establishment steps may not be specific to your project, but provide you with important details that will help you plan and implement your pollinator planting.

**#1 Site selection:** When selecting a site, it is best to consider all site conditions. Poor site selection can stack the deck against you before you plant the first seed. Be sure to consider the following conditions.

- Soil conditions: moisture, compaction, pH, fertility, slope (erosion potential), geographic location, previous pre-emergent herbicide applications
- Light/exposure: important for species selection
- Vegetative cover: current and historical vegetation on the site and adjacent to the site, invasive plant species present or nearby
- Surrounding land use: Avoid sites with adjacent land use (i.e. areas with heavy invasive weed populations) that may negatively impact your pollinator planting.



**#2 Seed selection:** Many mixes of native grasses and wildflowers are available from many different sources. Seed selection is not a step to be skimpy. Be sure to consider the following guidance when making your final selection.

- Select native species that are well adapted to the site conditions. Non-natives are more likely to out-compete native species. Natives are the best source of pollen and nectar and are better acclimated to local growing conditions.
- Grasses are an important part of the mix, but try not to exceed 25% grass. The higher the grass percentage, the quicker grasses will outcompete wildflowers. Native bunch-grass species (i.e. little bluestem & side oats grama) are well suited for pollinator plantings.
- Select native wildflower species that provide pollen and nectar-rich forage for pollinators. A minimum of 3 species for each bloom period (Spring, Summer, Fall) should be included. Important larval food plants for butterflies and moths should also be included (i.e. milkweed).
- Specify PLS (pure live seed) tested seed. Research PLS to further understand if needed.
- Budget enough for the seed. More wildflowers = more \$. Get estimates and seed vendor references prior to making your final decision.
- A temporary nurse crop (i.e. oats, rye) may be beneficial to control weeds and appease public perception. Plantings in the first growing season are usually not very impressive to most because of slow top growth and weed pressure.



Monarch caterpillar foraging on C. milkweed

**#3 Site Preparation:** Site preparation is one of the most important and often inadequately addressed components for project success. Too often this step is rushed resulting in poor establishment along with weed control problems. It is very important to address this step with planning and patience. Site preparation steps depend on existing vegetation growing on the site. Sites with minimal weed pressure (i.e. cropland - soy bean stubble) usually requires less site prep (herbicide applications, mowing & time) than sites that are heavily vegetated with undesirable vegetation (i.e. old pasture with herbaceous and woody perennial plants).



Herbicide application with a boom sprayer



- ID & inventory weed species to be controlled. If site is mowed regularly, allow for 2-3 weeks of growth to ID & inventory.

- Control existing weeds via herbicide application. Tillage methods can be used but are not as effective as herbicide. Systemic contact herbicides (i.e. Round-up, active ingredient = glyphosate) are very effective at controlling most weeds. However, some weeds may be resistant to glyphosate and may require the use of specialty herbicides better suited for control. Sites with any undesirable woody vegetation require specialty herbicides and application to achieve control. When selecting herbicides for site prep, be sure to get professional advice and always follow the label.



The following steps are for sites primarily dominated with cool season grasses (i.e. lawn, pasture, hay land).

- Depending on when you start your project, the first herbicide application should take place in the fall (Sept./Oct.) or spring (April/May). Fall herbicide applications are usually most effective. If starting in the spring, monitor site 2-3 weeks after herbicide application to measure effectiveness of treatment. Monitor vegetation throughout the growing season, and apply herbicide again before weed species produce seed.
- Inventory vegetation late Sept./early Oct. to determine if a fall herbicide application is needed to control weeds. If so, apply herbicide in October prior to the first hard frost.
- Decide whether to plant pollinator mix in Nov./Dec. or following year. If it is likely that perennial weeds will be a problem in the spring, allow for 1 more herbicide application in April/May prior to planting.
- If applying herbicide April/May, determine whether to plant seed in the spring (2 weeks after herbicide application and before June 15th) or use the rest of the growing season to control weeds with herbicide application and plant in the fall. For small projects, you can utilize alternative methods to avoid the use of herbicides. A combination of tillage and solarization with UV-stabilized plastic may be used to kill weeds prior to planting in the fall.

**#4 Planting:** The most common seeding methods are broadcast or sowing seed with a drill. Pollinator seed mixes include seeds of many different sizes, shapes, and weight. The seed is commonly broken down into two groups, “fluffy” (mainly grasses) and “small” (mainly wildflowers) seed. This makes spreading the seed evenly across your project site very challenging if you don’t have the right equipment. Seed shall not be seeded any deeper than 1/4 inch.

**Drill:** Truax and Great Plains are two equipment manufacturers that make a no-till drill capable of sowing both fluffy and small seeds. This method requires minimal site prep and is very efficient and effective at seed placement and distribution. A tractor and operator is required, and it is best to calibrate the drill prior to planting.



Native grass drill

**Broadcast:** This method requires bare ground, which usually means tillage and leveling is needed to prep the site prior to planting. It is best to use a broadcaster that agitates the seed. However, most broadcast equipment does not mix or agitate the seed to achieve even seed distribution. So, care must be taken to broadcast fluffy seed separate from small seeds. A carrier (i.e. pelletized lime, gypsum, or other) may be added to help bulk up and spread the seed mix. It is best to press the seed into the soil with a cultipacker or roller to achieve good seed-to-soil contact. This step is not necessary if frost seeding (seeding onto frozen or snow covered soil). The freezing and thawing action will incorporate



UTV and broadcast seeder

the seed into the soil. If frost seeding, be sure there is a minimal amount of residue (< 30%) on top of the ground to allow good seed-to-soil contact.



**#5 Maintenance:** After the pollinator mix has been planted, it is critical to monitor and maintain the area frequently. The planting should be monitored at least 3 times (Spring, Summer, & Fall) during the growing season. Monitoring and maintenance is most critical the first 5 years. As the planting matures and the native plants dominate the area, maintenance needs will likely decrease. Identification and control of weeds is a critical component to success. Be sure to educate yourself by reading resource materials and attending pollinator habitat/native plant educational opportunities.

- First growing season: Keep weeds from maturing by mowing 8-10 inches before weed seed production starts (usually June/July). Another mowing will be necessary prior to Fall. Don't be concerned about mowing off some of the native plants the first year. If the mower is used on other sites, be sure to clean off the mower prior to mowing to avoid weed seed transfer to your project.
- Second growing season: Mow early in the Spring (March/April) to knock down growth from the previous year if needed. Spot mow and/or spray problem weeds.
- Third growing season and beyond: Spot mow and/or spray problem weeds.

**Final Thoughts:** Pollinator plantings are typically high cost and high maintenance for the first five years. If all the establishment recommendations are followed, maintenance need and expense should decrease as the native plants mature and dominate the stand. Be sure to practice the three P's and follow the steps to achieve success. Your hard work will pay off.



Monarch butterflies on swamp milkweed

**Credits:** This publication was produced by Ohio Pollinator Habitat Initiative (OPHI) partners referencing the following sources.

Information Sources: Pollinator Meadow, Upper Midwest Installation Guide and Checklist; The Xerces Society, Center for Integrated Agricultural Systems, and The University of Wisconsin Madison; [http://www.xerces.org/wp-content/uploads/2013/01/installGuideJobSheet\\_UpperMidwest\\_CnsrvCvr.pdf](http://www.xerces.org/wp-content/uploads/2013/01/installGuideJobSheet_UpperMidwest_CnsrvCvr.pdf)

Cardno—Cincinnati, Michael Adams; [www.cardno.com](http://www.cardno.com)



**For more information about the Ohio Pollinator Habitat Initiative**

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# CHECKLIST OF ACTIONS

## To Promote Pollinators In Yards, Gardens & Parks















### KEY:

-  Promotes foraging resources
-  Helps protect pollinators from pesticide exposure
-  Promotes nesting and overwintering habitat
-  Contributes to pollinator conservation in your community









### LANDSCAPING

- ☐   Plant a **native** wildflower garden that includes species that bloom in succession all season long and are high-value to pollinators (species with ★ on Table 1, page 12).
- ☐   Plant **native** bunchgrasses; these plants are food for rare butterflies and also help provide nesting sites for bees.
- ☐  Reduce lawn footprint by converting as much as possible to *flowering* habitat.
- ☐  Plant **spring**-blooming **native** wildflowers, such as woodland ephemerals in shady areas.
- ☐  Plant **spring**-blooming **native** shrubs and trees, such as willows (*Salix*), maples (*Acer*), and native fruit trees and shrubs.
- ☐  Plant **summer**-blooming **native** wildflowers, such as blazing star (*Liatris*), bee balm (*Monarda*), and numerous others.
- ☐  Plant **summer- or fall**-blooming **native** shrubs, such as wild roses (*Rosa*) or meadowsweet (*Spirea*).
- ☐  Plant **fall**-blooming **native** wildflowers, such as asters (*Symphyotrichum*), native sunflowers (*Helianthus*), and goldenrods (*Solidago*).
- ☐  Plant **native** trees that serve as important host plants for a wide variety of butterflies and moths (species with 🦋 on Table 1, page 12).
- ☐  Plant **native** milkweed (*Asclepias*), violets (*Viola*), pawpaws (*Asimina*), or other regionally appropriate plants that provide critical food for specialist butterflies and moths.
- ☐  Plant species known to provide food for specialist bees in your region (species with 🐝 on Table 1, page 12).
- ☐  Gradually replace perennial and annual landscaping that provides little value to wildlife (e.g., daylilies, hostas, pansies) with more diverse **native** wildflower plantings.
- ☐  If non-native plants are included in landscaping, choose varieties that are known to have value to pollinators (e.g., flowers with ample pollen or nectar) **AND** that are not invasive or aggressive.
- ☐  Remove invasive species from your landscape, as well as any non-native species that appear to be spreading into wild areas (e.g., butterfly-bush).
- ☐  Ensure that new landscaping plants were not treated with neonicotinoids or other related insecticides.











### LAWN & YARD CARE

- ☐    Avoid pesticides (including herbicides, insecticides, and fungicides) on lawns and other landscaping; choose less harmful alternatives such as non-chemical controls.
- ☐   For mowed areas, reduce mowing frequency and increase mowing height, allowing flowering weeds to flourish.
- ☐  Leave dead wood on site, including dead logs, snags, and brush; consider planting flowers around these features, to add intention and aesthetic value.
- ☐  Leave leaf litter on-site—keep a thin layer of leaves on lawn; use the rest to mulch trees/ shrubs/ garden and/or rake to woodland edges if available.
- ☐  Leave bare spots or areas with patchy vegetation in lawn; avoid thick turf and sod.
- ☐  Avoid plastic mulch/ weed barrier, heavy wood chips, and treated wood chips.
- ☐  Leave dead wildflower stems standing over the **winter**; prune them back in **early spring** to 8–12" to create nesting sites for stem-nesting bees.
- ☐  Prune shrubs with pithy stems, to create nesting sites for stem-nesting bees.
- ☐  Leave some areas of lawn unmown to create tall grass habitat.
- ☐  Install a water feature (e.g., bird bath with stones to prevent insects from drowning) for pollinators that need water for nest building or other uses.
- ☐  Seed a “bee lawn” (incorporate clovers & other flowers into new or existing lawn).

### FRUIT & VEGETABLE GARDENS

- ☐   Plant fruit trees and fruit-bearing shrubs, including **native** species when possible (e.g., blueberries [*Vaccinium*], currants and gooseberries [*Ribes*], elderberries [*Sambucus*], chokeberries [*Aronia*])—species with 🦋 on Table 2, page 12).
- ☐   Plant **native** raspberries/ blackberries (*Rubus*); prune in **early spring** to create nest sites for stem-nesting bees.
- ☐  For more continuous fruit and flowers, plant ever-bearing varieties of strawberries (*Fragaria*), raspberries, and other fruits.
- ☐  Plant a tea or herb garden and allow plants like basil (*Ocimum*), mint (*Mentha*), and lavender (*Lavendula*) to flower; most herbs do very well in containers if space is limited (see Table 2, page 12).
- ☐  Plant bee-pollinated vegetables like squash (*Cucurbita*) and tomatoes (*Solanum*) **and** allow pollinator-attractive culinary garden plants—such as lettuce (*Lactuca*) and mustard (*Brassica*)—to bolt in order to provide additional floral resources (see Table 2, page 12).
- ☐  Avoid pesticide use on fruit and vegetable crops; manage pests by using prevention strategies (e.g., crop rotation or selection of resistant varieties) and non-chemical pest control methods (e.g., hand-picking or insectary plantings to promote beneficial insects for natural pest control).

### COMMUNITY ACTION

- ☐   Organize a neighborhood **native** plant or seed exchange (**never** share non-native plants that are aggressive / potentially invasive).
- ☐   Create habitat in community hubs (e.g., libraries, post-offices, schools, or senior centers) or in unused spaces like sidewalk medians.
- ☐   Volunteer with a local park to improve habitat (e.g., removing invasive species or collecting wildflower seeds).
- ☐  Provide signage to explain your pollinator conservation actions to your neighbors.
- ☐  Host a tour of your pollinator friendly yard or garden.
- ☐  Talk about pollinators and their habitat needs to your neighbors, friends, family, local businesses, schools, library, church, etc.
- ☐  Talk to your city officials or local colleges about signing a bee friendly resolution and/or getting certified as a Bee City USA or Bee Campus USA.
- ☐  Participate in a community science project, such as bumble bee or monarch monitoring (see Resources, page 11).

 Print additional copies of this and other habitat assessment tools at: [xerces.org/habitat-assessment-guides](https://xerces.org/habitat-assessment-guides).

# Xerces Society Recommended High Value Plants for Pollinators








































- ★ **POLLINATOR "SUPERFOODS"**—Certain native plants are known to provide exceptional forage for a wide variety of bees and other pollinators, including monarchs. See table below for a list of some of these plants.
- ✱ **FOOD FOR SPECIALIST BEES**—Many native bees are "specialists," only collecting pollen and other resources from specific plants. See table below for a list of plants known to provide food for a number of specialist bees.

- 🦋 **LEPIDOPTERA HOST PLANTS**—The caterpillars of many butterflies and moths can only feed on specific plants. For example, great spangled fritillary larvae only feed on violet leaves. Some plants support an amazing diversity of lepidoptera; e.g., oaks support hundreds of butterflies and moths species. Since most native plants support at least one butterfly or moth, we use 🦋 for a genus supports over five species OR one species that doesn't eat anything else.

**NOTE:** These lists are not exhaustive—see Resource section to identify additional native plants for your site. Some of these plants may not be appropriate for every region/site.

TABLE 1: SUPERFOODS & HOST PLANTS			
HIGH VALUE PLANTS Appropriate for <i>Most</i> Regions			
Native Wildflowers	🦋 Agastache [giant hyssop]—★	🦋 Helianthus [sunflower]—★🦋🦋	🦋 Salvia [sage]—🦋
	🦋 Asclepias [milkweed]—★🦋	🦋 Lupinus [lupine]—🦋	🦋 Solidago [goldenrod]—★🦋🦋
	🦋 Cirsium [thistle (native)]—★🦋	🦋 Monarda/Monardella [bee balm]—★🦋	🦋 Symphyotrichum [aster]—★🦋🦋
	🦋 Echinacea [purple coneflower]—🦋	🦋 Penstemon [beardtongue]—★🦋	🦋 Verbena [vervain]—🦋
	🦋 Euthamia [goldentop]—★🦋	🦋 Ratibida [coneflower]—🦋	🦋 Viola [violets]—★🦋
Native Shrubs & Trees	🦋 Acer [maple]—★🦋	🦋 Pinus [pine]—🦋	🦋 Rubus [raspberry/blackberry]—★🦋
	🦋 Amelanchier [serviceberry]—★🦋	🦋 Prunus [wild plum]—★🦋🦋	🦋 Salix [willow]—★🦋🦋
	🦋 Amorpha [leadplant/false indigo]—★🦋🦋	🦋 Quercus [oak]—🦋	🦋 Sambucus [elderberry]—🦋
	🦋 Ceanothus [wild lilac]—★🦋🦋	🦋 Rhus [sumac]—🦋	🦋 Spiraea [spirea/meadowsweet]—★🦋
	🦋 Cercis [redbud]—🦋	🦋 Ribes [currant]—★🦋	🦋 Vaccinium [blueberry/cranberry]—★🦋🦋
	🦋 Cornus [dogwood]—★🦋	🦋 Rosa [wild rose]—★🦋🦋	🦋 Viburnum [arrowwood/viburnum]—★🦋
Native Grasses	🦋 Andropogon [bluestem]—🦋	🦋 Elymus [wheatgrass, wildrye]—🦋	🦋 Muhlenbergia [muhly]—🦋
	🦋 Bouteloua [grama]—🦋	🦋 Hierochloa [sweetgrass]	🦋 Schizachyrium [little bluestem]—🦋
	🦋 Carex [sedges]—🦋	🦋 Koeleria [Junegrass]—🦋	🦋 Sporobolus [dropseed]—🦋
HIGH VALUE PLANTS for <i>Specific</i> Regions			
Pacific Northwest		Great Plains & Intermountain West	Great Lakes & Northeast
🦋 Baccharis [coyotebrush]—★🦋 🦋 Berberis [barberry]—★🦋 🦋 Clarkia [clarkia]—★🦋 🦋 Cleome [bee plant]—★🦋 🦋 Fragaria [strawberry]—★🦋 🦋 Grindelia [gumweed]—★🦋 🦋 Helenium [sneezeweed]—★🦋 🦋 Phacelia [phacelia]—★🦋 🦋 Rhamnus [buckthorn]—🦋 🦋 Sidalcea [checkerbloom]—★🦋		🦋 Callirhoe [poppymallow]—🦋 🦋 Dalea [prairie clover]—★🦋 🦋 Ericameria [goldenbush, rabbitbrush]—★🦋 🦋 Eriogonum [wild buckwheat]—★🦋 🦋 Geranium [wild geranium]—★🦋 🦋 Heterotheca [false goldenaster]—★🦋 🦋 Machaeranthera [tansyaster]—★🦋 🦋 Oenothera [evening primrose]—★🦋 🦋 Sphaeralcea [globemallow]—★🦋 🦋 Vernonia [ironweed]—★🦋	🦋 Cephalanthus [buttonbush]—★ 🦋 Dalea [prairie clover]—★🦋 🦋 Eutrochium [joe pye weed]—★🦋 🦋 Ilex [holly]—★🦋 🦋 Liatris [blazing star]—★🦋 🦋 Packera [ragwort]—★ 🦋 Pycnanthemum [mountain mint]—★ 🦋 Silphium [cup plant]—★ 🦋 Zizia [Alexanders, zizia]—★ 🦋 Carya [hickory]—🦋
Southwest & California		Midwest & South Central	Southeast & Mid-Atlantic
🦋 Arctostaphylos [manzanita]—★🦋 🦋 Baccharis [coyotebrush]—★🦋 🦋 Berberis [barberry]—★ 🦋 Bidens [beggarticks]—★ 🦋 Eriogonum [wild buckwheat]—★🦋 🦋 Grindelia [gumweed]—★🦋 🦋 Larrea [creosote bush]—★🦋 🦋 Monardella [monardella]—★ 🦋 Phacelia [phacelia]—★ 🦋 Salvia [sage]—🦋		🦋 Boltonia [doll's daisy/false aster]—★ 🦋 Chamaecrista [partridge pea]—★ 🦋 Eutrochium [joe pye weed]—★ 🦋 Helenium [sneezeweed]—★ 🦋 Liatris [blazing star]—★ 🦋 Pycnanthemum [mountain mint]—★ 🦋 Silphium [cup plant]—★ 🦋 Tillia [basswood]—🦋 🦋 Verbesina [wingstem]—★ 🦋 Zizia [Alexanders, zizia]—★	🦋 Baptisia [wild indigo]—★ 🦋 Coreopsis [tickseed]—★ 🦋 Desmodium [tick-trefoil]—★ 🦋 Eutrochium [joe pye weed]—★ 🦋 Gaillardia [blanketflower]—★ 🦋 Helenium [sneezeweed]—★ 🦋 Hibiscus [rosemallow]—★ 🦋 Ilex [holly]—★ 🦋 Liatris [blazing star]—★ 🦋 Vernonia [ironweed]—★

GROWTH FORMS: Wildflower/Forb (🦋) Shrub/Tree (🌳) Grass/Sedge (🌾)

TABLE 2: EDIBLE LANDSCAPING PLANTS WITH VALUE TO POLLINATORS		
 <i>Abelmoschus esculentus</i> [okra]	 <i>Cucumis</i> [cucumber, melon]	 <i>Origanum vulgare</i> * [oregano]
 <i>Allium</i> **† [chives, garlic, leek, onions, shallot]	 <i>Cucurbita</i> * [pumpkin, squash]	 <i>Passiflora</i> * [passionfruit]
 <i>Amelanchier</i> * [juneberry, serviceberry]	 <i>Diospyros virginiana</i> * [common persimmon]	 <i>Persea americana</i> [avocado]
 <i>Asimina</i> * [pawpaws]	 <i>Fagopyrum esculentum</i> * [buckwheat]	 <i>Phaseolus</i> * [bean (common, scarlet runner, wild)]
 <i>Anethum graveolens</i> * [dill]	 <i>Foeniculum vulgare</i> * [fennel]	 <i>Prunus</i> * [almond, apricot, cherry, peach, plum]
 <i>Brassica</i> * [broccoli, cabbage, cauliflower, kale]	 <i>Fragaria</i> * [strawberry]	 <i>Pyrus</i> [pear]
 <i>Calendula</i> [calendula]	 <i>Helianthus annuus</i> * [sunflower]	 <i>Ribes</i> * [currant (black, golden, red)]
 <i>Capsicum</i> * [peppers (bell/chili, habanero)]	 <i>Lavandula</i> [lavender]	 <i>Rosa</i> * [rose (dogrose, hybrid tea, wild)]
 <i>Castanea</i> * [chestnut, chinquapin]	 <i>Malus</i> * [apple, crab apple]	 <i>Rubus</i> * [blackberry, raspberry]
 <i>Citrullus</i> [pine melon, watermelon]	 <i>Matricaria</i> * [chamomile]	 <i>Sambucus</i> * [elderberry (black, blue, red)]
 <i>Citrus</i> [lemon, lime, tangerine]	 <i>Mentha</i> ** [mint]	 <i>Solanum</i> * [eggplant, potato, tomato]
 <i>Coriandrum sativum</i> * [coriander/cilantro]	 <i>Ocimum</i> * [basil]	 <i>Vaccinium</i> * [blueberry, cranberry]
 <i>Corylus</i> * [hazelnut]	 <i>Opuntia</i> * [prickly pear]	 <i>Vicia</i> * [fava bean, vetch]
NOTES: *Must be allowed to bolt/flower †Some or all members of the genus are NATIVE to North America		

NOTES: \*Must be allowed to bolt/flower †Some or all members of the genus are NATIVE to North America



# In the Thick How Invasive of It and Exotic Shrubs Affect Breeding Birds

Not long ago, I opened my e-mail to find an urgent request from a relative. "Help! Can you please help us to stop our neighbor from destroying our bird habitat?" My relative described how a neighbor with aims to "restore" the natural area behind his backyard was removing nearly all of the vegetation. The neighbor had recently implemented similar management nearby that looked, to my relative, like a ravaged and barren landscape. No shrubs, no birds—nothing seemed to use the restored areas.

When confronted, the neighbor explained how the recently removed vegetation had been dominated by plants that were *invasive*, referring to species that can take over and threaten ecosystems by virtue of their high numbers, and *exotic* (or *non-native*), referring to species not originally from a particular area. Removing those plants, the neighbor explained, would allow native plants to reestablish, which ultimately would provide better habitat for birds. With city permits in hand, the neighbor removed the exotic plants and completed what he considered to be a successful restoration. But to my relative this was no success story. Instead of the usual hustle and bustle of birds, the area was still and silent.

You may have encountered similar situations, either firsthand or relayed through friends and family. Even when one knows the threats of exotic species, there can be tension between the temporary losses from short-term disturbance and the long-term gains of restoring native ecological communities. Among scientists and managers, there is a growing dialogue about *restoration*. Should we be so quick in condemning all exotic species as harmful and unwanted? Several ecologists have challenged the conservation community to consider possible positive effects of exotic species, or, at the very least, to ask whether the benefits of their removal justify the investments those efforts demand. Others remind us that invasive organisms represent one of the leading threats to biodiversity around the world, especially on islands.

What is best for birds? If we see birds using exotic plants, does that mean that those exotics benefit birds? Are habitats dominated by invasive plants necessarily worse than suboptimal habitats with native plant species? Those questions are not rhetorical. They are precisely the sorts of questions facing birders and habitat managers alike. As with any complex issue, there is no simple answer.

In this article, I share several lessons that my students and I have learned by studying the interactions between birds and a common exotic shrub in eastern North America, Amur honeysuckle (*Lonicera maackii*). Amur honeysuckle was introduced to the U.S. from Asia in the late 1800s and quickly became

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a popular ornamental plant for landscaping because of its lush vegetation, fragrant flowers, and abundant fruit. Unfortunately, the attractive, animal-dispersed fruits of honeysuckle make it easy for the plant to invade natural areas to the point where honeysuckle can dominate the understory of many habitats. Ecologists have long known that the bush honeysuckles, including Amur, Tartarian (*L. tatarica*), and Morrow's (*L. morrowii*) honeysuckle, can have devastating consequences for native plants, including the spring wildflowers that briefly grace our forests before most other plants have leafed out (Gould and Gorchov 2000, Collier et al. 2002, Gorchov and Trisel 2003, Miller and Gorchov 2004). Honeysuckle also can negatively impact native amphibians (Watling et al. 2011) and ecological services such as pollination (McKinney and Goodell 2010), and it can even promote tick-borne disease (Allan et al. 2010).

But what about the birds? An astute observer may notice the absence of sensitive plants from areas heavily invaded by honeysuckle, but the full range of consequences for birds is more nuanced and can be easily obscured by the sheer number of birds seen using honeysuckle. When I walk through the forest parks near my Columbus, Ohio, home in early spring, I am struck by how readily birds nest in honeysuckle. Some birds, like Northern Cardinals, actually prefer nesting in honeysuckle to many other native plants (Leston and Rodewald 2006). When I tour the same forests in autumn, there are times when the shrubs are in constant motion as birds eat the abundant berries. Does that mean that honeysuckle is good for birds?

As a starting point, let's first ask, what is "good" for birds? Birds need habitat that provides food, water, cover from predators and exposure, and areas for nesting that allow them to reproduce successfully. If we view honeysuckle through this lens, we find some interesting and sometimes surprising patterns.

There is no question that some birds—Northern Cardinals, American Robins, and Gray Catbirds among them—heavily use honeysuckle for nesting and foraging. In general, species that heavily use honeysuckle are *ecological generalists* that occur in a wide range of habitats (Leston and Rodewald 2006, McCusker et al. 2010, Rodewald in press). *Ecological specialists*, in contrast, require very specific habitat features. Unlike many generalist species, specialists are more likely to decline in areas dominated by honeysuckle due to changes in the structure of habitat and the resources provided. One example is the Acadian Flycatcher, a neotropical migratory species that is declining in many parts of the U.S. Acadian Flycatchers prefer to breed in forests with fairly open and spacious understory vegetation, not the dense thickets that honeysuckle tends to create. Not surprisingly, then, Acadians avoid areas dominated by honeysuckle (Bakermans and Rodewald 2006, Rodewald in press; A. D. Rodewald, unpublished data).

You might be wondering, isn't it sufficient to know that at least *some* birds like honeysuckle? Does it really matter which ones? It does. From a conservation perspective, generalists tend to be of lower priority than specialists, as indicated by scores assigned by Partners in Flight, a public-private partnership that aims to conserve birds in the Western Hemisphere. Specialists also are more featured in management plans

Changing patterns of abundance and availability of fruit-bearing plants can induce large-scale shifts in the geographic distribution of native bird populations. A recent study <[tinyurl.com/7gxlfhk](http://tinyurl.com/7gxlfhk)> has shown a shift in the northern limits of the wintering range of the **American Robin**, a result thought to be due in part to increased availability of native and exotic fruits on the wintering grounds. *Franklin County, Ohio; January 2009.*  
Photo by © Robert Royse.







The **Acadian Flycatcher**, an ecological specialist, prefers to nest in forests with relatively spacious shrub layers. Invading honeysuckle quickly fills in the shrub layer, however, and Acadian Flycatchers decline or disappear. *Norfolk County, Ontario; August 1996. Photo by © Michael Patrikeev-VIREO.*

developed by conservation groups, including plans developed as part of the North American Bird Conservation Initiative. Even though generalist bird species undeniably contribute to our enjoyment, serve as good focal species for environmental education, and play important roles in ecosystems, they are usually not as important for regional or global conservation as specialist bird species that are negatively impacted by honeysuckle and other invasive plants.

Another issue is that simply counting birds does not provide enough information to evaluate the ecological consequences of an invasive or exotic plant. That's because human activities can change the environment in ways that contribute to the formation of *ecological traps*. An ecological or evolutionary trap results when a cue that once could be used reliably to indicate quality of a habitat, resource, or mate no longer conveys the correct information; as a consequence, organisms using the cue have lower performance, reproduction, and/or survival. Abundance of a bird or other animal population may actually be higher in ecological traps.

The presence of certain exotic shrubs, like common buckthorn (*Rhamnus cathartica*) and honeysuckle, can increase the risk of nest predation, especially early in the season before other plants have leafed out (Schmidt and Whelan 1999, Borgmann and Rodewald 2004, Rodewald et al. 2010). Nest predation is the primary cause of nest failure in most songbirds. Although many species attempt to nest again after failure, renesting may not compensate for lost productivity. For example, Northern Cardinals that nest in honeysuckle for their first nesting attempt produce 20% fewer young over the entire breeding season and across all of their subsequent nesting attempts compared to birds that place their nests in other plants (Rodewald et al. 2010).

Why does honeysuckle increase the risk of nest predation? Originally, my students and I suspected that the greater vulnerability to nest predation was a byproduct of plant architecture—for example, branching pattern. Nests in honeysuckle are usually closer to the ground than nests in native plants. Lower nests should be more accessible to predators, especially

mammals like raccoons and domestic cats. The branching pattern of honeysuckle also would seem to facilitate climbing for certain predators. Our subsequent work, however, has shown that the risk of nest predation in honeysuckle lessens over the course of the breeding season, despite no change in nest height.

What does change is the vertical distribution of nests in the forest. Early in the season, before leaves of most native plants and canopy trees have emerged, the majority of open-cup nests in our forested sites are located in low shrubs, especially honeysuckle and multiflora rose

(*Rosa multiflora*). If many birds nest in similar places, then it can be easier for predators to locate nests. Later in the season, when nests occur over a much wider range of heights and in a greater diversity of plants, predators cannot follow such simple *search rules* to locate nests. So it turns out that nests in honeysuckle are especially vulnerable to predation early in the breeding season, a time widely considered to be the most favorable for raising young.

Even for species that avoid nesting in honeysuckle, there can be reproductive consequences. Although Acadian Flycatchers seldom construct nests in honeysuckle plants, the number of young fledged by breeding pairs over the breeding



Supposed benefits of exotic and invasive fruit-bearing shrubs and trees may be more than offset by insidious indirect negative consequences. **Cedar Waxwings**, for example, are well known to flock to ornamental plantings; what is less widely known is that waxwing morphology and physiology are affected by what waxwings eat, in ways that are not necessarily beneficial for individuals and populations (see *Birding*, September/October 2007, pp. 62–68). *Kern County, California; February 2009. Photo by © Bob Steele.*



season declines with increasing amounts of honeysuckle in a forest patch (Rodewald in press). This pattern may be related to the observation that honeysuckle is associated with increased risk of brood parasitism by Brown-headed Cowbirds for Acadian Flycatchers (Rodewald 2009). Cowbirds lay their eggs in the nests of other species, which then raise the cowbird young as their own. The problem is that cowbird nestlings are more vocal, get fed more often, and grow faster than flycatcher young. Consequently, brood parasitism can lead to complete reproductive failure for the flycatcher.

Our recent work also shows that honeysuckle can affect the “information” that ornamental traits, such as feather color, convey about an individual bird’s “quality.” The brilliant red color of cardinals is produced by carotenoid pigments, which cannot be synthesized by the bird but must be consumed. Carotenoids from berries and other foods are best known for giving red, orange, and pink birds their colors; another important function of carotenoids is support of immune function. Thus, coloration in many bird species is a good indicator of diet, condition, territory quality, parental investment, and reproductive success (Hill 1991, Hill and Montgomerie 1994, Mougeot et al. 2010).

While this pattern is generally true for cardinals in the rural landscapes of central Ohio, our ongoing research shows that color is a less-useful indicator of condition for male cardinals in honeysuckle-dominated urban forests. In urban forests, the birds in the best condition have duller plumage than expected, whereas birds in poorer condition have brighter plumage than expected. We have also found that, for male cardinals in urban forests, plumage brightness is not related to territory quality (dense understory shrubs are best), timing of breeding (the best birds typically breed earliest in the spring), or reproductive success (the number of young produced over the breed-

ing season). Overall, plumage brightness is a less-reliable signal of male quality for cardinals in urban than rural forests (Jones et al. 2010). Over time, this could result in *relaxed selection* for bright color. In other words, the proliferation of honeysuckle in the environment could trigger an evolutionary change in cardinals—a hypothesis that remains untested.

The widespread availability of “birdseed” and honeysuckle fruit may contribute to the disconnect between male color and condition. Honeysuckles, as a group, offer a rich source of carotenoids, but the genus tends to produce fruit that is lower in fat and protein content than many native fruits (Herrera 1987, Witmer and Van Soest 2002). In this respect, honeysuckle could be considered a carotenoid-rich but nutrient-poor food. Birdseed, in contrast, tends to be nutrient-rich but carotenoid-poor.

In another interesting twist, although honeysuckle is less dense in rural landscapes, it seems to create an evolutionary

Against a backdrop of honeysuckle in early spring, Ohio State undergraduate Sammi Stoklosa handles a male **Northern Cardinal** that has been fitted with color bands, weighed and measured, and sampled for feathers. Students like Stoklosa build field skills while experiencing the pleasure (right) and pain (left) of ornithological research.

Columbus, Ohio;  
April 2011. Photo  
by © Laura Kearns.



Columbus, Ohio; May 2010. Photo by © Desiree Narango.





trap in those areas. Our research has shown that in forests within rural landscapes, the brightest male cardinals are in the best physical condition, secure the most highly preferred territories, and breed earliest in the season. However, despite these seemingly good indicators of high-quality males, the brightest males ultimately produce the fewest young over the course of the breeding season. Why?

Our work suggests that the brightest-colored males prefer and successfully compete for territories containing dense honeysuckle. As previously noted, nesting in honeysuckle exposes birds to high rates of nest predation in the early season. This penalty for nesting in honeysuckle is greater for bright males because they also breed earliest in the season. Duller males, in contrast, ultimately have the advantage because they are less likely to breed in the dense patches of honeysuckle and breed later in the spring (Rodewald et al. 2011). So, in these rural landscapes, the brightest and otherwise highest-quality males produce the fewest young because they breed the earliest in honeysuckle.

You might wonder what all of this has to do with conservation and management. Without an awareness of the more subtle and indirect effects of invasive and exotic plant species, it is easy to make assumptions or draw simple conclusions that do not reflect the complexity of species interactions. Perhaps you have encountered such headlines as “Invasive Plants Can Create Positive Ecological Change” (Penn State 2011) and “Birds Loving Honeysuckle Invaders” (Wall 2011)?

Those two news releases called attention to a recent study showing high use of honeysuckle by fruit-eating and seed-dispersing birds like cardinals, Cedar Waxwings, and Gray Catbirds during the autumn. The authors interpreted high use as evidence that the birds benefit from and may even depend upon honeysuckle (Gleditsch and Carlo 2011). Because fruit-eating birds can be important seed dispersers, the authors suggested that removal of honeysuckle might not only negatively affect certain birds, but also have undesirable ecological and economic consequences. Not surprisingly, the original article and associated press coverage spurred some well-meaning managers of parks and natural areas to question their local efforts to control invasive plants. Although there may be certain situations in which invasive and exotic plants perform ecological services, the article and re-



Honeysuckle produces fruit in late summer and fall. The fruits in turn provide carotenoids, which are pigments that birds can use for both coloration and immune function. The catch is that most honeysuckles provide less nutrition than many native fruits. Columbus, Ohio; September 2004. Photo by © Daniel Shustack.



The characteristic red plumage of adult male **Northern Cardinals** is obtained from carotenoids in the birds' diet. Under normal circumstances, the brightness of a male's plumage is an accurate signal of male "quality." In honeysuckle-dominated urban forests, however, plumage brightness is a less-reliable signal of male quality; see text for details. Columbus, Ohio; April 2005. Photo by © Daniel Shustack.

lated press coverage told only one small piece of the story, one that is easily misinterpreted and taken out of context.

Honeysuckle provides an excellent example of the ways that a single invasive and exotic shrub can have serious, although not immediately obvious, negative effects on birds. By changing the structure of the habitat, honeysuckle can dissuade some sensitive species, such as the Acadian Flycatcher, from occupying habitats. By leafing out in early spring and making it easy for predators to locate nests, honeysuckle can increase the risk of nest predation and depress reproductive output. Honeysuckle also creates a situation in which the best and brightest birds have the lowest reproductive success. Finally, by providing abundant carotenoid-rich, but nutrient-poor fruits, honey-





A **Brown-headed Cowbird** nestling (right) develops faster than its **Northern Cardinal** brood-mate (left). Researchers are trying to work out the complex ways in which cowbird parasitism and honeysuckle invasion interact to affect bird populations. Columbus, Ohio; June 2011. Photo by © Linnea Rowse.

suckle might relax selection for the bright plumages of some of the most colorful birds that frequent our cities and gardens.

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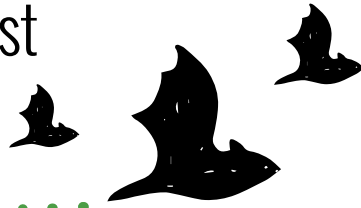
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Amur honeysuckle is among the first woody plants to leaf out in spring in the Midwest and the East. Honeysuckle affects the timing of breeding not only by providing an early-season nest substrate, but also by changing the structure of the entire forest. In the foreground in this photo is an experimental plot from which honeysuckle has been removed. Columbus, Ohio; April 2010. Photo by © Amanda Rodewald.





# Natural History of Forest & Cave Dwelling Bats



There are more than 1364 species of bats in the world. Most bats live in tropical areas, but bats are found almost everywhere, except Antarctica and a few spots in high altitudes. Any spot that a bat stays for an extended period of time is called their roost site. In these roosts, bats rest, socialize, hibernate, and raise pups. More than half of all species of bats use plants as their roosts. Others roost in caves, crevices of rocks, mines, or manmade structures. Some bats roost opportunistically in habitats constructed by other animals. They might use old bird nests or insect nests, or even roost in tree cavities that were carved out by fungus or fire.

Many bats will pick different roost sites for the day and the night. Night roosts are used in between periods of hunting as a safe place to save energy, rest for digestion, hide from predators, socialize with other bats, and to retreat from bad weather. Usually night roosts will be somewhere near good hunting locations, whereas the day roosts—the spots a bat will go to in order to sleep at the end of the night—might be further away. With all roosts, bats try to choose locations that are close to sources of food and water.

## **TREE DWELLING BATS:**

Trees serve as roost sites for bats in both temperate and tropical areas. Dead trees especially provide ideal cavities for roosting. Their peeling bark provides temporary shelter for many species when escaping inclement weather or predators. Bats also choose cavity roosts that will provide them with an appropriate climate in terms of temperature and humidity. Males and females will also often have different requirements when choosing a roost, and sometimes bats will use different roosts depending on the season. Finally, roosts with multiple emergency escape routes are very popular.

Some species have adapted foot and thumb pads that act as a suction cup, allowing these species to take temporary refuge in large curled leaves by sticking themselves to the underside of the leaf's smooth surface. And in the tropics, there are about 20 species of bats that roost in tents of their own construction! These bats will chew rows of holes alongside the vein of broad leaves. The two sides of the leaf will then droop downwards, providing a tent that the bats will use as a temporary shelter.

In temperate regions of western North America and Australia, most bats roost in trees. However, in areas with few native trees remaining, like western Europe and eastern North America, many cavity-roosting bats roost in manmade structures instead. Buildings, bridges, tombs, and bat houses can all serve as roosts for bats in the absence of more natural cavities.

Some bats have evolved different physical characteristics that help them hide from predators while they are roosting. Many bats have a fur color that provides camouflage against predation. Some bats even rest in a unique posture to blend in with their surroundings, resembling dead leaves or other natural parts of their environment.

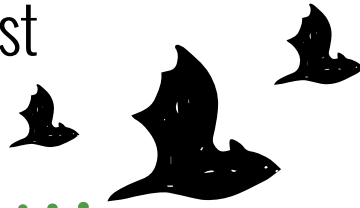
Unfortunately, many bat habitats have been threatened by human activities. Understanding roost needs is imperative when analyzing the impact of human disturbance on bat survival. Conservationists can then use this information to determine how best to help different populations.



*For more information about bats, visit [batweek.org](http://batweek.org) and [batlive.pwnet.org](http://batlive.pwnet.org)*

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# Natural History of Forest & Cave Dwelling Bats



## CAVE DWELLING BATS:

Caves are also popular roosting sites for many species of bats. Although many animals avoid caves due to the lack of light, echolocation allows bats to navigate these dark environments. Different caves can be attractive as roosts to different kinds of bats based on qualities such as altitude, size, shape, humidity, and airflow. In addition to serving as roosts, caves are also often used as hibernation spots (also referred to as hibernacula) for some species of bats. While hibernating, bats lower their internal body temperature significantly to conserve energy. Different spots in a cave can provide a variety of different temperatures, so bats can move around from warmer to cooler spots as needed to find agreeable temperatures throughout the cold months. The various crevices, cavities, rocks, and crude walls also provide plenty of hiding spots from predators. Many cave-dwelling bats will have small, flat skulls that allow them to squeeze into the tight spaces that caves provide.

Caves are also useful to bats for energy-related reasons. Bats have fast metabolisms and high rates of both water and heat loss. Not only does flight take a lot of energy, but bats also have exposed wing membranes and small bodies. This combination causes bats to lose up to a third of their body weight each night in water evaporation. Occupying caves with high humidity can slow this constant dehydration, as the bats will not lose as much water from their bodies if there is already a lot of water in the air. Selecting an appropriate cave can be challenging for the bats. Even the most ideal roosting cave might be too far away from their hunting grounds to be practical—it takes a lot of energy to fly between sites!

## CONSERVATION:

Unfortunately, bats around the world are facing many different issues. Deforestation, urban sprawl, commercial development, and large agricultural expansion are consistently causing habitat loss throughout the world for a variety of wildlife. In some parts of the world, bats in particular are also hunted for their meat or for traditional medicine. Fruit bats are often seen as pests in fruit orchards around the world, due to the misunderstanding that they eat harvestable fruit. In reality, bats usually consume only very ripe fruit from trees, whereas farmers harvest unripe fruit so it will not become overripe before it gets into the market. The use of pesticides and other chemicals can also cause health issues if they get into a bat's system. Pesticides can block the ability of bats to echolocate, making finding food and a roost nearly impossible. Finally, in recent years an invasive disease called White Nose Syndrome has been taking huge tolls on the populations of North American bats. White Nose Syndrome has already killed millions of bats throughout the northern and eastern United States and it is known to be the worst wildlife disease we have ever recorded. Researchers and government departments throughout the country are working on finding ways to combat the effects of the disease.

Bats are also suffering from misinformation and a general lack of knowledge. In many parts of the world, including some parts the media, bats are consistently given a negative portrayal. Many people don't understand the huge environmental and economic benefits that bats provide. Education therefore also plays a huge role in bat conservation, as people are far more likely to want to help bats if they understand them.



For more information about bats, visit [batweek.org](http://batweek.org) and [batlive.pwnet.org](http://batlive.pwnet.org)

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## 2022 NCF-Envirothon Ohio

### Wildlife Study Resources

#### Key Topic 3: Population Management

8. Identify major potential diseases threatening wildlife species and describe their characteristics.
9. Identify threatened and endangered species in Ohio and explain the conservation efforts being made for these species.

#### Study Resources

Resource Title	Source	Located on
Monarch Migration	<i>Monarch Joint Venture Fact Sheet Series, 2022</i>	Pages 81-82
Chronic Wasting Disease, What You Need to Know, Publication 5518	<i>ODNR Division of Wildlife, 2021</i>	Pages 83-84
Threats to Bats	<i>USDA, Forest Service, 2021</i>	Pages 85-87
American Burying Beetle Fact Sheet	<i>USFWS, 1997</i>	Pages 88-89

**Study Resources begin on the next page!**





# MONARCH JOINT VENTURE

*Partnering across the U.S. to conserve the monarch migration*

[www.monarchjointventure.org](http://www.monarchjointventure.org)

*The Monarch Joint Venture is a partnership of federal and state agencies, non-governmental organizations, and academic programs that are working together to protect the monarch migration across the lower 48 United States.*

## MISSION

Recognizing that North American monarch (*Danaus plexippus*) conservation is a responsibility of Mexico, Canada and the U.S., as identified in the North American Monarch Conservation Plan, this Joint Venture will coordinate efforts throughout the U.S. to conserve and protect monarch populations and their migratory phenomena by developing and implementing science-based habitat conservation and restoration measures in collaboration with multiple stakeholders.

Our mission will be achieved by coordinating and facilitating partnerships and communications in the U.S. and North America to deliver a combination of habitat conservation, education, and research and monitoring.

*In the face of declines in monarch numbers and habitat, researchers and conservationists are pooling their efforts under the Monarch Joint Venture to protect monarchs and pollinator habitat.*

## Monarch Migration

The monarch migration is one of nature's most spectacular events. Much as birds migrate to take advantage of resources available across a large landscape, North American monarchs travel up to an astonishing 3,000 miles in an annual migration from their summer breeding habitat to overwintering grounds.

During the summer breeding season, eastern monarchs spread across the eastern U.S. and into southern Canada, laying eggs on milkweed plants. Western monarchs make use of milkweeds across the western states, primarily west and south of the Rockies, and into southwestern Canada.

In the fall, monarchs feast on late-blooming nectar plants along the way to their wintering sites. The eastern monarch population winters in oyamel fir forests in the mountains of central Mexico. While the spring migration northward is completed over the course of two or more generations, the final generation of the year flies the entire way back to these forests, new to them, but visited by

their ancestors a few generations ago. In the same way, monarchs from across the western U.S. return to eucalyptus, Monterey cypress, Monterey pine, and other trees in groves along the Pacific coastline, from Mendocino County south to Baja, Mexico. Climatic conditions at these sites allow monarchs to survive the winter before beginning the return trek to their summer breeding grounds.

## Monarchs and Milkweed

Monarch caterpillars require milkweed to grow and develop into butterflies, and they feed on

many of the over 100 species of milkweed native to North America. These plants, key to monarch survival, are found along roads and highways; in yards, parks, and gardens; in old fields; and in pristine native prairies and other natural habitats.

In addition to the important role that milkweeds play in the lives of monarchs, they are valuable nectar resources for a diverse suite of bees and butterflies. Enhancing monarch habitat will thus benefit many important pollinators.



## Monarch Joint Venture Vision and Projects

The vision of this Joint Venture is abundant monarch populations to sustain the monarch migratory phenomena into perpetuity, and more broadly to promote monarchs as a flagship species whose conservation will sustain habitats for pollinators and other plants and animals.

Ensuring the availability of quality habitat is critical for the conservation of any species. The availability and quality of monarch breeding habitat has diminished in recent years, with a reduced abundance of milkweed in the landscape in the eastern and western U.S. Overwintering habitat for the western monarch population is threatened by habitat destruction and degradation due to development. MJV partners are engaged in work to improve habitat availability and quality for both eastern and western monarch populations. We are implementing a variety of science-based habitat conservation and public engagement projects to better protect monarchs while inspiring America's youth and adults to observe and study nature.

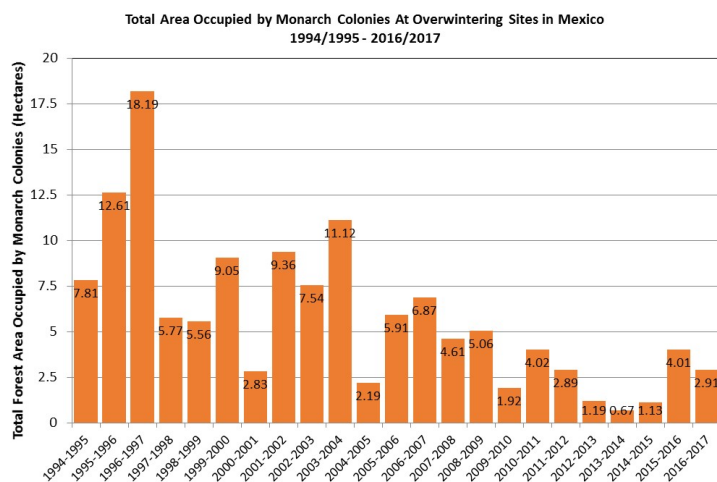


## Monarchs at Risk?

The monarch migration was listed by the International Union for Conservation of Nature as an endangered phenomenon in 1983. In 2010, the World Wildlife Fund included monarchs on its list of the “Top 10 to Watch in 2010”: species that are thought to be in need of close monitoring and protection.

The conservation status of monarch overwintering sites in Mexico receives much attention. However, monarchs face challenges in the U.S. as well. A decline in the number of western monarchs, most of which spend their entire life cycle in the U.S., has been well documented over the past decade. Both eastern and western monarchs are dependent on habitat quality throughout the U.S., which is being threatened by:

- Habitat conversion and changes in land management practices that are reducing the availability of milkweed;
- Possible changes in milkweed availability, quality, and distributions due to effects of climate change;
- Pesticide use to control other insects, with unintended harmful consequences for monarchs;
- Habitat conversion in California, resulting in reduced availability and quality of overwintering sites; and
- Shifting overwintering habitat quality, as the trees in California’s monarch groves age and deteriorate.



Data from 1994-2003 were collected by personnel of the Monarch Butterfly Biosphere Reserve (MBBR) of the National Commission of Protected Natural Areas (CONANP) in Mexico. Data from 2004-2016 were collected by the WWF-Telcel Alliance, in coordination with the Directorate of the MBBR. 2000-01 population number as reported by Garcia-Serrano et al (The Monarch Butterfly: Biology and Conservation, 2004)

## What is a Conservation Joint Venture?

In 1986, the largest cooperative effort ever initiated to protect wetlands, waterfowl, and other wildlife was initiated with the North American Waterfowl Management Plan. In a new approach to conservation, regional partnerships of agencies, non-profit organizations, corporations, tribes, and individuals—called Joint Ventures—were created to implement conservation plans within specific geographical areas.

Joint Ventures increase the efficiency and effectiveness of conservation by bringing together the science, the people, and the resources needed to develop and implement conservation strategies. Due to their remarkable success, Joint Ventures have been generally accepted as the model for moving bird conservation forward in the 21st century.

The similar migratory nature of birds and monarchs, and their use of multiple habitats across a large landscape, make the Joint Venture model ideal for building monarch conservation efforts.

[www.monarchjointventure.org](http://www.monarchjointventure.org)



*Photo credits: Chip Taylor, Wendy Caldwell, Steven Munafo, Jim Ellis*

I would like to support the Monarch Joint Venture and conserve habitat for monarchs:

Enclosed is my gift of \$ \_\_\_\_\_ for the Monarch Joint Venture fund to aid in monarch habitat conservation within the continental United States. Please consider a donation of \$50 or more to support our work.

Name: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_

Zip: \_\_\_\_\_ Country: \_\_\_\_\_

Email: \_\_\_\_\_

Phone: \_\_\_\_\_

Please make checks payable to the **Monarch Conservation and Education Fund**. To donate using a credit card, please visit [monarchjointventure.org](http://monarchjointventure.org); otherwise complete this section and mail it to:

Monarch Joint Venture  
2003 Upper Buford Circle  
135 Skok Hall  
St. Paul, MN 55108



## CARCASS AND MOVEMENT RESTRICTIONS

- If you hunt outside Ohio, familiarize yourself with the state's regulations on carcass movements and consider having your deer tested for CWD.
- Be aware of Ohio's carcass import laws.
- **It is illegal to bring high-risk carcass parts into Ohio unless you transport your deer or elk to a certified taxidermist or processor within 24-hrs of returning to the state.** Please visit [wildohio.gov](http://wildohio.gov) for more information.
- Parts a hunter can transport into Ohio include:
  - Antlers.
  - Antlers attached to a skull cap from which all soft tissue has been removed.
  - De-boned meat.
  - Quarters or other portions of meat with no part of the spinal column or head attached.
  - Meat that is cut and securely wrapped either commercially or privately with no part of the spinal column or head attached.
  - Upper canine teeth from which all soft tissue has been removed.
  - Hides and capes without any part of the head or lymph nodes attached.
  - Finished taxidermy mounts.
  - Soft body tissue wrapped and packaged for use by a diagnostic research laboratory.
- If you hunt in an area where the Division of Wildlife is conducting enhanced surveillance, participate in sampling efforts by having your deer tested. **Hunters harvesting a deer in a declared Disease Surveillance Area are required to present their deer for sampling.** For dates, times and locations refer to the latest Hunting and Trapping digest, or [wildohio.gov](http://wildohio.gov).



## IS IT DANGEROUS TO HUMANS?

- No strong evidence exists that CWD is transmissible to humans.
- The Centers for Disease Control and Prevention (CDC) recommends that hunters have their deer tested when hunting in areas of known CWD occurrence or if they have concerns about the presence of disease, and not to consume the meat of an animal that tests positive.

## HOW CAN I GET MY DEER TESTED FOR CWD?

### FOR DEER HARVESTED WITHIN A DISEASE SURVEILLANCE AREA (DSA):

- Take your deer (only the head is necessary) to a deer inspection station.
- Or, take your deer head to an unmanned sample drop-off location. Locations can be found at <http://wildlife.ohiodnr.gov/species-and-habitats/diseases-in-wildlife>

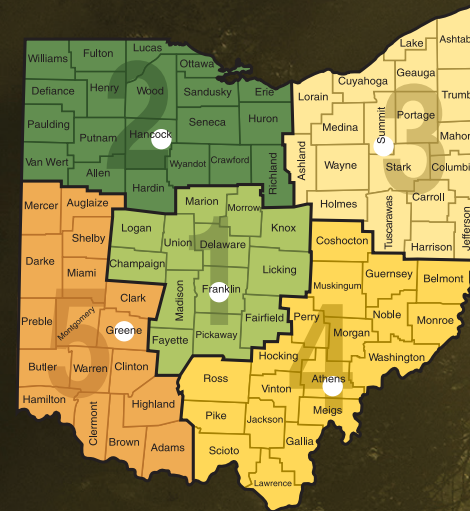
### FOR DEER HARVESTED OUTSIDE OF A DSA:

- The Ohio Department of Agriculture's Animal Disease Diagnostic Laboratory (ADDL) in Reynoldsburg, on the east side of Columbus, accepts deer for testing.
  - CWD testing, including collection and accession fees, is \$83.
  - Contact ADDL (614-728-6220) for more information regarding sample preparation and hours of operation.

## FOR MORE INFORMATION

Division of Wildlife: [wildohio.gov](http://wildohio.gov)  
Chronic Wasting Disease Alliance: [cwd-info.org](http://cwd-info.org)  
National Wildlife Health Center: [usgs.gov/centers/nwhc](http://usgs.gov/centers/nwhc)

The ODNR Division of Wildlife's mission is to conserve and improve fish and wildlife resources and their habitats for sustainable use and appreciation by all.



VISIT US ON THE WEB  
**WILDOHIO.GOV**

FOR GENERAL INFORMATION  
**1-800-WILDLIFE**  
(1-800-945-3543)

TO REPORT WILDLIFE VIOLATIONS  
**1-800-POACHER**  
(1-800-762-2437)  
\*\*AVAILABLE 24 HOURS\*\*

OHIO GAME CHECK  
**OHIOGAMECHECK.COM**  
**1-877-TAG-IT-OH**  
(1-877-824-4864)

HIP CERTIFICATION  
**1-877-HIP-OHIO**  
(1-877-447-6446)



PUBLICATION 5518 R0921



OHIO DEPARTMENT OF NATURAL RESOURCES  
**DIVISION OF WILDLIFE**  
[wildohio.gov](http://wildohio.gov)

## CHRONIC WASTING DISEASE

# CWD

## WHAT YOU NEED TO KNOW

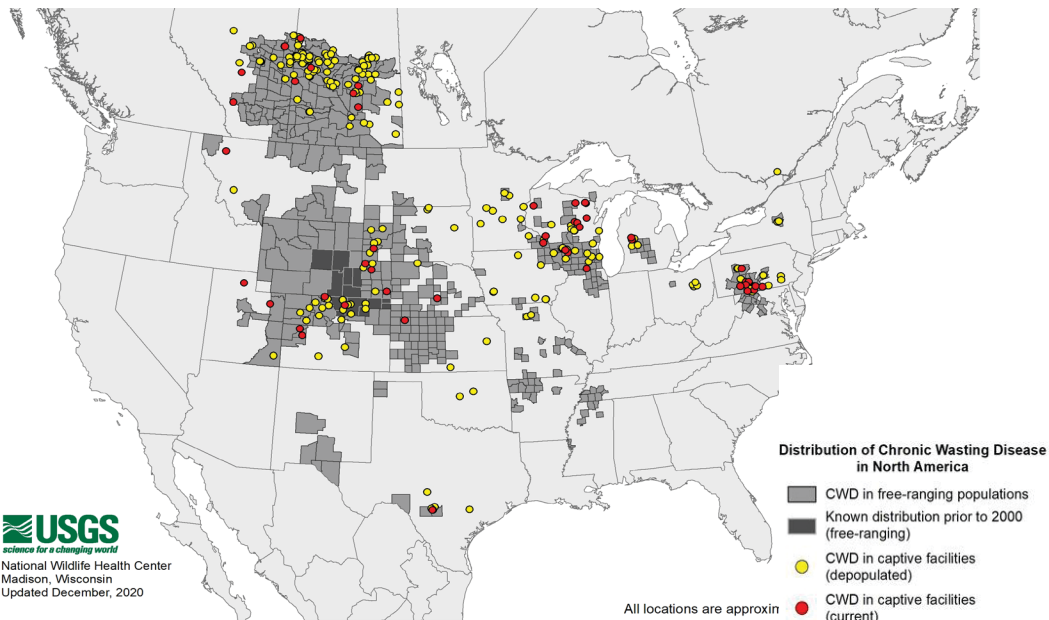


## WHAT IS CWD?

- CWD is a fatal neurological (brain and central nervous system) disease that affects members of the deer family including white-tailed deer, mule deer, elk, moose, and caribou.
- CWD is caused by naturally occurring proteins, called prions, that become misfolded, creating holes in brain tissue and resulting in eventual death.
- CWD is spread through direct animal-to-animal contact or by contact with saliva, urine, feces, carcass parts of an infected animal, or contaminated materials in the environment (plants and soil).
- Prions released into the environment through bodily fluids or diseased carcasses are extremely resistant to degradation and can remain infectious for years.
- Once an animal is infected there is no recovery or cure for CWD.

## WHERE HAS CWD BEEN FOUND?

- CWD has been confirmed in 26 states, 3 Canadian provinces, Finland, Norway, Sweden, and South Korea.
- The first confirmed case of CWD in Ohio was found in a captive deer at a shooting preserve in Holmes County in 2014. Since then, 25 deer from three captive facilities in Holmes and Wayne counties have tested positive for CWD.
- Since 2002, nearly 30,000 wild deer (including nearly 2,500 in the Holmes County region) have been tested for CWD statewide.
- In December of 2020, Ohio confirmed its first CWD-positive wild deer. The mature buck, harvested in late October in Wyandot County, was taken to a local taxidermist as part of routine CWD surveillance.
- A second deer, a yearling doe harvested on January 30th, 2021 as part of a controlled hunt at the Killdeer Plains Refuge, tested positive for CWD. An additional 72 animals were tested following targeted removals on the refuge in March. None of the animals were positive. A disease surveillance area was established, and intensive monitoring will continue for at least three years in all of Wyandot and parts of Hardin and Marion counties.



For more information, visit [www.usgs.gov](http://www.usgs.gov)



## PRECAUTIONS WHEN FIELD DRESSING AND PROCESSING

To decrease risk of CWD exposure, hunters should follow these steps:

- Wear rubber gloves.
- De-bone meat from the animal.
- Disinfect cutting tools and surfaces with a 40% household bleach solution. (For best results, soak at least 5-minutes in solution.)
- Bag leftover carcass parts. Dispose of the bag through your garbage service.
- Minimize handling of brain and spinal tissues.



## CAN I TELL IF A DEER HAS CWD?

- No. Most deer with CWD will appear healthy. It takes at least 16 months for an infected animal to develop clinical symptoms of disease.
- As the disease progresses, animals stagger, carry their heads and ears lowered, drool excessively, and show little or no fear of humans. They will eventually lose body condition and appear weak.
- Many diseases can present the same symptoms as CWD. Testing of brain or lymphoid tissue after death is the only way to confirm CWD.

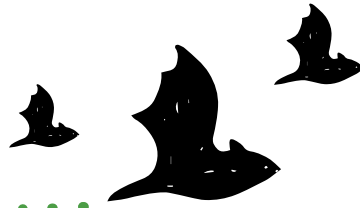
## WHAT SHOULD I DO IF I SEE A DEER WITH THESE SYMPTOMS?

- Do not attempt to disturb, kill, or remove the animal.
- Accurately document the location of the animal.
- Immediately contact your nearest county wildlife officer, or call 1-800-WILDLIFE (1-800-945-3543).

## WHAT CAN I DO TO HELP?

- Keep hunting! Controlling population levels helps prevent the spread of CWD.
- Get the facts! Understand what CWD is, where it has been found, and how it differs from other deer diseases.
- Properly dispose of all deer carcasses and high-risk parts.
- Double bag all high-risk carcass parts and set out with your household garbage for trash pickup. Those without trash pickup can double bag the carcass and take it to a municipal solid waste landfill or bury the carcass (at least 3 feet deep).
- Report any deer that appears sick or displays abnormal behavior.
- Use synthetic lures and attractants instead of urine-based products.
- Avoid placing feed, bait, or mineral licks to attract deer as artificially concentrating animals can increase the rate of disease spread if disease is present.

# Threats to Bats: White-nose Syndrome



- **What is White-nose Syndrome?** White nose syndrome (WNS) is a disease affecting hibernating bats across the United States and Canada. It is caused by a cold-loving fungus, *Pseudogymnoascus destructans* (Pd) that collects and grows around the muzzle and wings of hibernating bats. WNS was first documented in a New York cave in 2006 but has spread as far as west as Washington state and as far south as Mississippi. It was most likely brought over from Europe and is spread primarily from bat-to-bat, but human transmission has also contributed to its spread.
- **What does WNS do to bats?** WNS irritates the bats' skin enough to wake them from hibernation too frequently. This depletes their stored energy leading them to wake from hibernation before their insect food source is available or when it is too cold for them to be out foraging. 90-100% mortality of bats has been observed in certain hibernacula. More than half of all the species in North America hibernate during the winter and are therefore at risk. To date, Pd has been reported in at least 30 states and 5 Canadian provinces and is still spreading.
- **What is the impact of WNS?** WNS has killed more 6 million bats thus far. There is a chance we will lose entire species of bats. Even losing a single species can cause unknown ramifications. Bats are important ecologically and economically. Insect populations will increase, other aerial insectivores could flourish with unknown impact, and we will be much more susceptible to insect-borne diseases. Many of the insects that bats feed on damage farm crops. With a decrease in their natural predators, either these insects will wipe out a huge portion of our food source or farmers will be forced to increase the use of harmful pesticides. This will cost us and our farmers billions of dollars every year.
- **What is being done to stop it?** Scientists around the world are studying this fungal infection and transmission while searching for ways to stop the spread and treatment for bats in their hibernacula. State, federal, and tribal wildlife management agencies along with NGO's have been collaborating on methods to reduce the spread of WNS, as well as actions to reduce human impact on the affected species. The United States and Canada have worked together to create a National Response Plan (available at [www.whitenosesyndrome.org](http://www.whitenosesyndrome.org)) that "details the elements that are critical to the investigation and management of WNS, identifies key action items to address stated goals, and outlines the role(s) of agencies and entities involved in this continental effort." They are meant to provide guidelines to reduce the spread of Pd while conserving species most at risk. Researchers at UC Santa Cruz may have found a bacterium that consumes the fungus and could possibly be a treatment for WNS in the future. For more information on this, visit [www.ucsc.edu](http://www.ucsc.edu).
- **Additional resources.** Learn more about WNS and what you can do to help:
  - [www.whitenosesyndrome.org](http://www.whitenosesyndrome.org)
  - USGS National Wildlife Health Center: [www.nwhc.usgs.gov/disease\\_information/white-nose\\_syndrome/](http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/)
  - National Speleological Society: [www.caves.org](http://www.caves.org)



For more information about bats, visit [batweek.org](http://batweek.org) and  
[batlive.pwnet.org](http://batlive.pwnet.org)

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# Threats to Bats: Wind Turbines



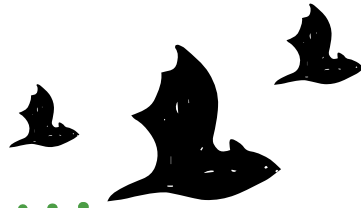
- **What are wind turbines?** Wind energy has become a sustainable alternative to fossil fuels because it can generate electricity without producing air pollutants or greenhouse gases. Wind energy facilities set up huge turbines (that look like giant, sleek windmills) that turn wind into electricity.
- **What do wind turbines do to bats?** Migrating bats (and birds) have collisions with the spinning blades of the turbines and are killed by the millions around the world. Wind energy facilities impact more than 50% of North American bat species. In addition to collision, some bats suffer from barotrauma, lung damage caused by the rapid and excessive pressure change in their thoracic cavity when flying close to a turbine. This impacts arboreal migrating bats particularly. Bats that rely on trees for roosts are most at risk during migration or mating seasons.
- **How do wind turbines impact bats?** Wind power is a growing industry in the United States and around the world. It is a great alternative to fossil fuels because it is a cleaner method, producing fewer pollutants and greenhouse gases. However, with its impact on wildlife, certain precautions need to be put in place to minimize its effect on bats and birds. Identifying ways to make wind turbines safer for bats will allow us to support one conservation effort without impacting another.
- **What is being done to mitigate the effect?** Many years of study have gone into analyzing bat behavior around turbines. Once there was understanding on the interaction between bats and the turbines, actions could be taken to reduce bat mortality around the sites. Wind Turbine-Installed Bat Deterrent systems that amplify ultrasonic output have been attached to turbines with promising results. The high-frequency generators are audible to bats and deter them from approaching the turbines. Research is also being conducted on possible ultraviolet lights to illuminate the turbines at night so that bats can see and avoid them. Additional research has shown that operating turbines at low wind speeds during peak migration season can have a positive effect. Further, a new turbine is in design that will predict high risk conditions for bats and be fashioned with an automatically turn off function. The Bats and Wind Energy Cooperative (BWEC) is a union of government agencies, private industry, academic institutions, and NGOs that work to help bats while supporting this sustainable energy industry. To learn more about their work, visit [batsandwind.org](http://batsandwind.org).
- **Additional resources.** Learn more about wind turbines and wildlife:
  - Bats and Wind Energy Cooperative: [www.batsandwind.org](http://www.batsandwind.org)
  - USGS Fort Collins Science Center: [www.fort.usgs.gov](http://www.fort.usgs.gov)
  - Boston University: Center for Ecology & Conservation Biology - <http://www.bu.edu/cecb/bat-lab-update/bats/wind/video/>
  - Scientific American article: 3 Ways to Keep Bats Away from Wind Turbines: <http://www.scientificamerican.com/article/3-ways-to-keep-bats-away-from-wind-turbines/>



For more information about bats, visit [batweek.org](http://batweek.org) and  
[batslive.pwnet.org](http://batslive.pwnet.org)

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# Threats to Bats: Habitat Loss



- **What is habitat loss?** Habitat loss is a leading threat to bat survival. Fragmentation of habitat, destruction of roosts, and mitigating human wildlife conflict are all causing a decline in bat populations. Clearing land for human consumption eliminates warm, dry, safe, and quiet roost spots used by bats. Commercialism, quarrying, vandalism, urban sprawl, agriculture, and industrial development are well-documented habitat loss contributors. Bats are being displaced from their cave or mine roosts on account of unsuitable guano collection used as a fertilizer source. Cave tourism is also disruptive to roost sites, stirring bats from hibernation causes a depletion of their stored fat energy.
- **What does habitat loss do to bats?** Even minor disturbances can cause a decrease in species survival, from death or abandonment of the roost site. When a roost is abandoned, especially maternal roosts, bats will disperse into smaller groups scattering to less ideal roosts where they are more susceptible to factors that decrease their survival rates. Some mothers will even drop their pups when frightened, not to have another until the next season. Fragmentation of land disrupts foraging especially for migrating bats that follow the same route year after year. Some habitats have been abandoned because of pesticides used in that area. Water pollution, particularly due to pesticide run off is also threatening bat and other wildlife's clean water sources.
- **What is the impact of habitat loss?** Many bats roost in buildings and are commonly excluded in ways that put their survival at risk. This especially affects maternal roosts when pups are the most vulnerable. Bats give birth to 1-2 pups only once a year, so disturbances to an entire maternal colony has a heavy impact on the continuation of that colony. Dispersing a maternal colony can impact the temperature they maintain when roosting together. High temperatures are necessary to successfully raise young.
- **What is being done to stop habitat loss?** Bat organizations have been encouraging the public through educational presentations for awareness accompanied by literature to replace lost habitat with bat houses and conducting surveys for threatened species. Listing caves for access or restricted use is being analyzed by the National Speleological Society. The US Fish and Wildlife Service, US Forest Service, National Park Service, state parks, regional and local park districts, are all working on changing policy to improve the chances for bat species survival. When large infrastructural projects are in their planning stages many of the above organizations encourage planning commissions to include a wildlife friendly green space upon completion as mitigation for lost habitat. To collect enough data to measure impact on species, many in the public have gotten involved in citizen science projects that contribute to bat research.
- **Additional resources.** Learn more about habitat loss and bats:
  - U.S. Forest Service: <http://www.fs.fed.us/biology/wildlife/bats.html>
  - Defenders of Wildlife: <http://www.defenders.org/bats/threats>
  - Bat Conservation Trust: [http://www.bats.org.uk/pages/threats\\_to\\_bats.html](http://www.bats.org.uk/pages/threats_to_bats.html)
  - Bat Week: <http://www.batweek.org/index.php/about/bats-in-buildings>
  - Bat Conservation International: <http://www.batcon.org/why-bats/bats-are/bats-are-threatened>



For more information about bats, visit [batweek.org](http://batweek.org) and [batlive.pwnet.org](http://batlive.pwnet.org)

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## American Burying Beetle Fact Sheet

prepared by the [U.S. Fish and Wildlife Service's New England Field Office](#)

*"It is a warm, midsummer night. Two creatures find a small, dead animal and begin to bury it underground by gradually excavating soil out from under it. Once in the underground chamber, the creatures strip the fur or feathers from the carcass, roll it into a ball, and coat it with secretions, preserving it in a semi-mummified state. They mate. Later, the carcass will be food for the entire family."*

A scene from Stephen King's latest novel? Not at all. The creatures are carrion beetles, also commonly known as burying beetles, and they are one of nature's most efficient and fascinating recyclers. But, like several other insect species, these beetles are nearing extinction. The American burying beetle, the largest of the North American carrion beetles, has so drastically declined in numbers and range that, in July 1989, it was added to the federal Endangered Species List.

### Description

About an inch and a half long, the American burying beetle can be identified by its striking, distinctive coloring. The body is shiny black, and on its wing covers are four scalloped, orange-red markings. Most distinctively, there is an orange-red marking on the beetle's pronotum, a large shield-like area just behind the head. The American burying beetle has orange facial markings and orange tips on the antennae. The beetles are strong fliers, moving as far as a kilometer in one night.

Historical records show that this beetle once lived in 35 states, the District of Columbia, and three Canadian provinces. Now, natural populations are known to occur in only four states: Rhode Island, Oklahoma, Arkansas, and Nebraska. Biologists are not sure what led to the disappearance of this insect from so many areas and are attempting to determine the reasons for its decline. As part of this ongoing research, and in an attempt to establish another beetle population, biologists have released laboratory-raised American burying beetles on Penikese Island in Massachusetts, historical habitat of the animal.



Photo by the U.S. Forest Service

### Life History

Burying beetles are unusual in that both the male and female take part in raising the young. Male burying beetles often locate carcasses first and then attract a mate. Beetles often fight over the carcass, with usually the largest male and female individuals winning. The victors bury the carcass, the pair mates, and the female lays her eggs in an adjacent tunnel. Within a few days, the larvae develop and both parents feed and tend their young, an unusual activity among insects. Brood size usually ranges from one to 30 young, but 12 to 15 is the average size.

The larvae spend about a week feeding off the carcass then crawl into the soil to pupate, or develop. Mature American burying beetles emerge from the soil 45 to 60 days after their parents initially bury the carcass. Adult American burying beetles live for only 12 months.

### Habitat

Historical records offer little insight into what type of habitat was preferred by the American burying beetle. Current information suggests that this species is a habitat generalist, or one that lives in many types of habitat, with a slight preference for grasslands and open understory oak hickory forests. However, the beetles are carrion specialists in that they need carrion the size of a dove or a chipmunk in order to reproduce. Carrion availability may be the greatest factor determining where the species can survive.

### Why are they so rare?

Biologists have not unlocked the mystery why the American burying beetle has disappeared from so many areas. Widespread use of pesticides may have caused local populations to disappear. The dramatic disappearance of this insect from many areas, however, took place before widespread use of DDT. Lack of small carcasses to bury would prevent the species from reproducing, and changes in land use has reduced the quantity of small- to medium-sized birds and mammals preferred by the American burying beetle. Even the extinction of the once ubiquitous passenger pigeon may have had a ripple effect on carrion feeders like this beetle.

Biologists return each year to Penikese Island to study the survival and growth of the beetle population. Hopefully, their annual visits will provide clues about the environmental conditions American burying beetles must have to live and reproduce.

## Why should we be so concerned?

Since the landing of the Pilgrims in 1620, more than 500 species, subspecies and varieties of our nation's plants and animals are known to have become extinct. This recent, catastrophic loss of biological diversity is continuing at an unprecedented rate. Each and every species has a valuable ecological role in the balance of nature, and each loss destabilizes that fragile balance. Once a species is extinct, it is gone forever. Experience has proven that many plants and animals have properties which will prove beneficial to humans as sources of food and medicine. With the loss of each species, we lose a potential resource for improving the quality of life for all humanity.

Carrion beetles, like the American burying beetle, recycle carcasses, ultimately returning valuable nutrients to the soil. In addition, this beetle might be an "indicator species," or one that tells us whether or not its environment is healthy. Understanding why its numbers have decreased so drastically may give us indications of problems with both its habitat and our environment.

*Fact Sheet prepared July 1997*

[Back to Endangered and Threatened Insects page](#)  
[Midwest Endangered Species Home](#)



## 2022 NCF-Envirothon Ohio

### Wildlife Study Resources

#### Key Topic 4: Specimen Identification

10. Identify common wildlife species and describe their characteristics.
11. Describe how the morphology of a skull can be used to determine the diet and eating strategies of an animal.
12. Identify common Ohio wildlife species with and without a field guide.








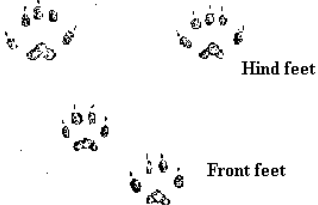






#### Study Resources

Resource Title	Source	Located on
Traceable Tracks	<i>Who Did It Booklet</i> <i>Kings Gap State Park, 2022</i>	Page 91
Wildlife ID- Skulls Session Study Guide	<i>OSU Extension, 2022</i>	Pages 92-93

**Study Resources begin on the next page!**



# Traceable Tracks

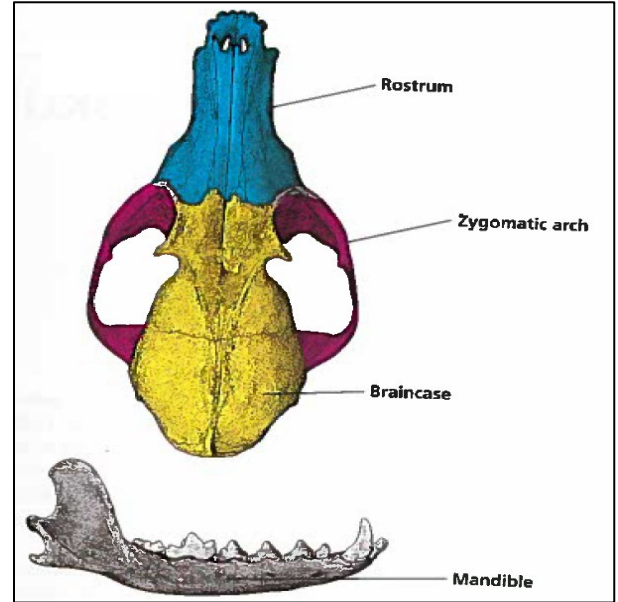
Animal	Description	Photo of Tracks
	<p><u>Gray Fox</u></p> <ul style="list-style-type: none"><li>- Similar to small dog</li><li>- 4 toes and a palm pad</li><li>- Claws are visible</li><li>- Gray Fox prints are smaller than Red Fox</li></ul>	
	<p><u>Gray Squirrel</u></p> <ul style="list-style-type: none"><li>- Small front foot with a larger back foot</li><li>- 4 toes on front foot &amp; 5 on back</li></ul>	
	<p><u>Eastern Cottontail</u></p> <ul style="list-style-type: none"><li>- 4 toe pads on front &amp; back</li><li>- Hairy back foot will often appear as large solid imprint</li><li>- Rarely claws are visible</li></ul>	
	<p><u>Raccoon</u></p> <ul style="list-style-type: none"><li>- 5 fingers &amp; 5 toes resemble human hands</li><li>- Hind prints have elongated heels which often sink into ground</li></ul>	
	<p><u>White-Footed Mouse</u></p> <ul style="list-style-type: none"><li>- Vary tiny footprint with 4 toes on front and 5 toes on the back</li></ul>	
	<p><u>Black Bear</u></p> <ul style="list-style-type: none"><li>- Front Foot: 5 rounded toes with claws (2"-5" long &amp; wide)</li><li>- Hind Foot: 5 rounded toes but 3"-8" long &amp; 2.5"-7" wide with large claws</li></ul>	
	<p><u>White-tailed Deer</u></p> <ul style="list-style-type: none"><li>- Two long &amp; narrow hoof prints</li><li>- If left in deep mud you can sometimes see a dot behind the prints (deer's dewclaw)</li></ul>	
	<p><u>Eastern Chipmunk</u></p> <ul style="list-style-type: none"><li>- Rear tracks ahead of front tracks (jumping pattern)</li><li>- 5 toes on rear track (3/4" long)</li><li>- 4 toes on front track (1" long); may show 2 heal pads</li></ul>	
	<p><u>Virginia Opossum</u></p> <ul style="list-style-type: none"><li>- Varies depending on diet</li><li>- 3/4" diameter &amp; tapers at ends<ul style="list-style-type: none"><li>- 1"-2" in length</li><li>- smooth on sides</li></ul></li></ul>	



# Wildlife ID - Skulls Session Study Guide

## Skull Vocabulary:

- Brain case - the part of the skull that houses the brain
- Rostrum - the portion of the skull anterior to the orbits that generally holds the teeth, the palate, and the entire nasal cavity
- Zygomatic arch - the bones arching outward from the braincase and rostrum to form the orbits, also where jaw muscles attach
- Mandible - the lower jaw
- Maxilla - the upper jaw
- Orbit - the bony socket that contains the eyeball
- Temporalis fossa - the vacant space between the orbit
- Diastema - a vacant space, or gap, between teeth. Often between the incisors and premolars in rodents and lagomorphs (rabbits, hares, and pikas).
- Carnassial teeth - a type of tooth used for shearing. In the order Carnivora the term refers to the last upper premolar and first lower molar, which oppose one another like scissor blades and have a shearing action
- Temporal ridges - ridges traversing the top or sides of the braincase. They may fuse to form a sagittal crest.
- Sagittal crest - a longitudinal median bony ridge dorsal to the braincase, often formed by the joining of the temporal ridges. The Virginia opossum has a well-defined sagittal crest.
- Auditory bullae - inflated bony capsule at the base of the braincase that surrounds the inner ear



## Main Interpretive Features of a Skull:

- Consider the dentition - the kinds of teeth and shapes and what they tell you about that animal's diet
- Envision the development of the temporalis muscles, which give power to the front of the jaws to the incisors and canines (seen in carnivores, omnivores, and some herbivores)
  - Strong temporalis muscles = wide orbits, presence of developed sagittal crest and/or occipital crest
- Envision the development of the masseter muscles, which give power to the back of the jaw to the molars (seen in herbivores that need power to grind up their food)
  - Strong masseter muscles - narrow orbits, deep lower mandible, thick/heavy zygomatic arches
- Think about what senses were strongest in the animal
  - Eyesight (large orbits), smell (long rostrum), hearing (inflated auditory bullae)
- Examine the braincase and how its size relative to the rest of the skull speaks to the animal's intelligence

## **Skulls by Species**

- Coyote
  - long rostrum, large orbits angled forward, inflated auditory bullae, carnassial teeth
  - formula for coyote versus domestic dog - If "A" divided by "B" is 3.1 = coyote (this is 95% accurate)
- Red fox
  - Long rostrum, large orbits angled forward, inflated auditory bullae, carnassial teeth
  - V-shaped temporal ridges, sharp and pointed postorbital processes
- Gray fox
  - Long rostrum, large orbits angled forward, inflated auditory bullae, carnassial teeth
  - V-shaped temporal ridges, short and triangular postorbital processes with sig. depression behind them
- Bobcat
  - Short rostrum, large orbits angled forward, inflated auditory bullae, carnassial teeth
  - Short and squat skull shape
- Beaver
  - Thick zygomatic arches, deep lower mandible, diastema with lack of canines and molars for grinding
  - Orbit point at right angles to the skull and are elevated so they are visible above water line, also the auditory meatus (entrance to auditory bullae) is suspended so it's also above the water
- Virginia opossum
  - Large sagittal crest, large orbits, small brain case, occipital crests well developed
  - More teeth than any other North American mammal - adults have 50 teeth, tiny auditory bullae
- Eastern Cottontail
  - Inflated auditory bullae, narrow orbits, diastema lacking canines with molars
  - Fenestrated skull (cools blood vessels), peg teeth
- Raccoon
  - Omnivorous dentition, short broad rostrum, large orbits, sagittal crest and occipital crest
  - Triangular shaped-skull, large brain case - close to 50% of greatest length of skull, males larger sagittal crest
- Black bear
  - Medium but broad rostrum, narrower orbits, omnivorous dentition, thick zygomatic arches & occipital crest
- White-tailed deer
  - Diastema with no canines, molars for grinding, narrow orbits
  - Antlers - most likely developed for scent communications during mating season (velvet holds highest concentration of oil and scent-producing glands in the entire body, also large glands above orbits for when velvet is gone), some males will urinate on their rack during the rut when their urine is full of "tantalizing" pheromones