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NCF-ENVIROTHON MISSISSIPPI STUDY RESOURCES



WILDLIFE

2026

Wildlife

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Any hyperlinks included in the study resources, apart from those explicitly listed as Resources on the Key Topics page and featuring a dedicated page in the resources (such as YouTube videos), are considered supplemental material ONLY. While they can provide extra information, they are not mandatory study resources.

**NCF-Envirothon 2026 Mississippi
Wildlife Study Resources**

Key Topic #1: Wildlife Biology

1. Distinguish between major taxonomic classifications of wildlife in Mississippi, their typical roles in ecosystems, and their habitat requirements (including mammals, birds, fish, reptiles, amphibians, and insects).
2. Analyze physical and behavioral adaptations (such as mimicry, camouflage, freeze response, hibernation, special organs, etc.) and describe how these adaptations benefit wildlife.
3. Differentiate between a territory and a home range and discuss how each is important for wildlife species.

Resource Title	Source	Located on Page
The Amniotic Egg	<i>Merck, J. (2015). The Amniotic Egg. University of Maryland.</i>	4
Animal Home Ranges and Territories	<i>Johnston, R. (n.d.). Animal Home Ranges and Territories: How Wildlife Protects space and resources.</i> https://wanderingthru.com/home-ranges-and-territories/	6
Home Range Movements	<i>Home Range movements: Understanding seasonal deer movement. (n.d.).</i> https://www.mossoak.com/our-obsession/blogs/deer/home-range-movements-understanding-seasonal-deer-movement	9
Tracking Beavers	<i>Beeson, V. (2020, March 10). Tracking Beavers: Researchers study American beavers for wildlife management College of Forest Resources Mississippi State University.</i> https://www.cfr.msstate.edu/news/article.php?id=701	13
Number of organisms discovered in the world up to 2025	<i>Statista. (2026, February 5). The number of organisms discovered in the world up to 2025.</i>	15
Camouflage	<i>Camouflage. (n.d.).</i> https://education.nationalgeographic.org/resource/camouflage/	17
Estimating Species Populations	<i>Marley, S. (2018, February 22). Estimating Species Populations – a critical step in understanding ecological processes. Animal Ecology in Focus.</i> https://animalecologyinfocus.com/2018/01/26/estimating-species-populations/	20

The Amniotic Egg

John Merck

Synapomorphies:

- The amniotic egg: An air-breathing egg characterized by a shell and extraembryonic membranes. These enclosed the amniote embryo in a private pond during its development and mediated gas-exchange with the external environment.
- Claws or nails at the end of digits. This novelty allows digging, and burying of eggs. (So are these characters fully independent?)
- An egg-tooth on the snout to facilitate hatching. (Again independent?)
- Complete loss of water-breathing larva.
- Complete loss of lateral line system
- Internal fertilization by means of a penis.
- Two sacral vertebrae.
- Formation of the astragalus (a large tarsal that articulates with the tibia) from the fusion of at least three previous tarsals.



Amblyrhynchus cristatus the Galapagos marine iguana

In a way, claiming that these are seven separate characters seems dishonest since all but the last two are associated with one important life-style change: All amniotes reproduce using an air-breathing egg or its derivative.

This is huge. The egg of a lissamphibian is relatively small and simple. The embryo develops inside the perivitelline space enclosed by a Vitelline capsule, outside of which is a thick jelly capsule. Gas exchange is a limiting factor. Gasses enter and leave the egg by simple diffusion. Complicating this, the eggs are often laid in a gelatinous mass where diffusion through the egg mass is slow. Embryos have comparatively low metabolic rates and must hatch at an early developmental stage so as not to asphyxiate.

Major features of the amniotic egg:

- It is an air-breathing egg, in contrast to those of other vertebrates.
- Components of the egg:
 - A semipermeable leathery or calcareous shell.
 - Albumen (and other proteins)
 - Three extraembryonic membranes:
 - Chorion: Encloses the embryo, yolk and other membranes. Facilitates gas exchange with exterior.
 - Amnion: Encloses the embryo
 - Allantois: Receives nitrogenous waste products from embryo (including CO₂) and facilitates gas exchange. It develops into the urinary bladder.
 - Yolk sack Encloses the yolk mass and facilitates the transfer
 - of water and nutrients to the embryo.

Together, these components manage the exchange of gasses, water, and nutrients between the embryo, yolk, albumen, and exterior. NOTE: These membranes are outgrowths (i.e. parts of) of the embryo.

- Large reserve of yolk compared to anamniotes. Lissamphibians divide the yolk mass between the various body cells through complete cleavage of the ovum (see earlier lecture). In amniotes, the yolk mass is too large for this. Thus, while the animal pole of the zygote cleaves, forming a disk of cleaving cells on the surface of the yolk, the yolk, itself, doesn't.
- This arrangement has been variously modified. In placental mammals, the yolk and shell are suppressed, and the membranes modified into the placenta and umbilical cord. In birds and crocodylians, the shell membrane is heavily calcified to form a rigid shell.

Possible advantages of the amniotic egg:

- Enable embryos to develop more quickly and to a greater extent prior to hatching.
- Free animals from dependency on bodies of water for reproduction and larval stage.
- Reduce competition for pools of water in which larvae can mature Avoid predation on larvae by aquatic predators.

The odd reproductive strategies of some frogs reflect that they, too experience these selective pressures. Some colorful examples:

- [Foam nests \(result\)](#)
- [Mouth/stomach/vocal sac brooding](#)
- Direct development

But these strategies require very specific environments and/or make heavy demands of parents. The amniotic egg, while metabolically expensive, can be laid and forgotten. Scenarios of its origin are, necessarily, speculative, but the general consensus is that its precursor would have been:

- a relatively large egg, like that of oviparous caecilians (right). It would have:
 - required some kind of membrane to hold it together
 - needed to be internally fertilized
 - required the embryos to employ some kind of gas-exchange structure (like the gills of caecilian embryos.)
- laid by a relatively small animal, capable of finding moist microclimates.



Caecilian broods eggs from [British Museum of Natural History](#)

The evolution of the egg, the mechanism of internal fertilization, and the extraembryonic membranes must have proceeded in lockstep. Indeed, oviparous caecilians seem to have convergently (?) evolved something like an amniotic egg precursor.

Animal Home Ranges and Territories: How Wildlife Protects Space and Resources

Author: Ryan Johnston

Animals naturally require space to survive. If too many individuals crowded the same area, food, water, and mates would quickly become scarce. To manage resources and reduce conflict, animals establish **home ranges** and, in some cases, **territories**. In this post, we explore what these areas are, how animals defend them, and why they are crucial for survival.

What is a Home Range?

A **home range** is the area an animal regularly uses to feed, rest, and carry out its daily activities. Movement within this range may be irregular, guided by factors like water and food availability. For example, **troops of primates** may move between fruiting trees within their home range. Borders are often defined by unsuitable habitats—like a **bushbaby** avoiding open grasslands—even if they are within its home range. As long as the three essentials—**food, water, and shelter**—are met, the animal will remain in its home range.



When a Home Range Becomes a Territory

A **territory** is established when an animal or group begins actively defending an area. This usually occurs when resources are abundant and reliable. If resources diminish or are plentiful enough that defense isn't necessary, animals may not maintain a territory.

Some territories are specialized. For example, **antelope males** may set up temporary territories during rutting season focused solely on females. **Rhino bulls** may allow neighbors access to water, provided they submit and respect the resident male's authority over females

When does a home range become a set territory? This is quite simple, as soon as a resident animal, or group of animals begins to keep the area and what it has to offer to itself or themselves. This will happen when the resources are so good and reliable that the area will be under constant use by the animal. If this changes though and things start to disappear, then it may not be worth defending the area as the cost may outweigh the reward. On the opposite side of the scale though, if there is enough for everyone, it won't be worth defending either. It is not worth putting time and effort into protecting something that no other animal wants anyway.

A territory has to be able to sustain an animal as long as it stays there and protects the area. Sometimes the area is set up for one resource rather than for the other two. A good example of this is certain antelope setting up temporary territories during their rutting time. These males will spend very little time eating or drinking and so their territory is just for the ladies. Rhino bulls will let neighbouring bulls enter their territory for water, as long as they move in, drink and then move out again. They must show submission to the territorial male if he is around and not try anything with the ladies whilst they are across visiting.

How Animals Advertise Their Space

Communication is vital for signaling ownership. **Scent marking** is one of the most common methods. Animals patrol and leave signals using **urine, dung, or scent glands**. Middens, used by **rhinos and civets**, provide information about the resident's health, group size, and strength. While scent doesn't physically deter intruders, it acts as a warning.



Vocalizations are another key form of communication. **Lion roars** or a **female leopard's rasping call** signal health, dominance, and readiness to defend a territory. These cues also inform potential mates of the resident's presence.

Defending An Area

Animals generally tolerate overlapping home ranges, avoiding conflict as long as paths and resources don't intersect. Territory defense, however, is more aggressive. Animals often

attempt **visual displays or vocal warnings** before fighting. Subordinates—young, small, or weak intruders—may be given a “pass,” avoiding unnecessary confrontation.

When an intruder challenges a resident for ownership, fights may occur. While animals try to avoid direct combat, evenly matched rivals may engage in prolonged battles. For instance, **hippo bulls** have been known to fight for days, sometimes resulting in fatal injuries.



Why Home Ranges and Territories Matter

Ultimately, the decision to maintain a home range or territory depends on the benefits gained from an area. Defending a resource-rich space ensures access to essentials, protects young, and maximizes survival chances. In some species, this may even require **fighting to the death**, as losing the area could mean being forced into unsuitable habitats with insufficient resources.

Understanding these behaviors highlights the intricate balance animals maintain to survive in the wild and demonstrates how critical space and resources are for their survival.

HOME RANGE MOVEMENTS: UNDERSTANDING SEASONAL DEER MOVEMENT

Bob Humphrey | Originally published in *GameKeepers: Farming for Wildlife Magazine*.

November 14, 2019

The buck first showed up on October 3rd and provided a very pleasant and unexpected surprise considering we'd been running trail cameras since late August. My enthusiasm was tempered however by the time stamp on the image: 12:31 AM. The buck we named "Tall Boy" showed up again four days later and an hour earlier, and then vanished for a month...and the rest of bow season.

The next time he posed was an hour before daylight. That really got us going as the gun season was open and the rut kicking in. But we never laid eyes on him and despite running a half dozen cameras strategically over a square mile or so, we didn't capture another image of him for three weeks. The next picture was taken $\frac{3}{4}$ of a mile away and again in the dark. Then Tall Boy went underground and didn't surface again until after the December muzzleloader season. At least he'd made it through hunting season, but clearly more work needed to be done if we were going to sort out this buck's home range and movement patterns before the next season.

We'd all like to know a lot more about where, when and how deer move about their regular haunts, but we can't all go out and conduct a full-blown research project involving satellite telemetry and GPS collars. What we can do; however, is use general trends uncovered by that type of research, combined with what little we can glean from game cameras and personal observation and apply it to our own hunting grounds. Along the way, we might even learn a little bit about how to improve the odds of deer moving where we want them to by manipulating the habitat.



Deer density can also be a factor as bucks may have to move more often and farther to find a mate in low density areas, and less in high density areas.

Definitions

In order to better understand home range movements we must first better understand what is meant by "home range." In layman's terms it is the area occupied by an individual throughout the year. Biologists prefer more accurate descriptions. One widely accepted definition, by W.H. Burt is: "That area traversed by an individual in its normal activities of food gathering, mating and caring for young." That seems clear enough but Burt also added: "Occasional incursions outside the area, perhaps exploratory in nature, should not be considered part of the home range." That part is somewhat debatable, especially when it comes to whitetails, as we'll see.

Since the advent of radio, and now GPS satellite collars, deer biologists can now define home range as where an individual spends 95 percent of its time over the course of an entire year. This definition also excludes those

erratic forays or excursions. They then further refine this to include a Core Area, where a deer spends 50 percent of its time - places like bedding and preferred feeding areas.

Folks sometimes use the term territory to describe where a deer lives but there's a distinct difference between "home range" and "territory." A home range is the area merely occupied by an individual. A territory is something that is defended. Whitetails are, in general, not territorial. There are exceptions. In spring, at or around the time a doe is about to give birth she will drive off other deer from the birthing territory. This is a very temporary arrangement and will only last until the fawn can get up and walk on its own, perhaps a day or two. In the fall, a buck that is paired up with a hot doe will drive off any potential rivals so in essence, he is defending whatever patch of ground that doe happens to be standing on at that precise moment. But otherwise, deer are not territorial.

Clarification

One of the most universally accepted tenets among deer hunters is that "a white-tailed deer has a home range of approximately one square mile." That's not necessarily true; and it's easy to see why. The size of a whitetail's home range is influenced by numerous factors that can vary considerably from one region or location to another to certain conditions or season to another, which we'll address in a bit. However, if you were to compile all the data on whitetail home ranges throughout North America and calculate the average, it would probably come close to just over that one square mile. It's important to remember that's an average. The high end could be as much as ten to fifteen square miles where there is poorer quality habitat or low deer density, or in the "big woods" of some of the northern tier states or some states west of the Mississippi where they may have to travel long distances to meet their needs. Or it may be less than a square mile in rich agricultural land or densely developed areas.

Movement Variables

The principal factor influencing how much, how far and where within its home range a deer moves is habitat, which consists of food, cover and water. The greater the quantity and quality of those habitat variables, the less a deer will have to move to find them. The lesson here for the land manager should be obvious. Increase the quality and lessen the variability of your habitat and you'll attract and hold more deer. And for the hunter, those deer will move more within their and your home range.

Of course there is a law of diminishing returns, especially with bucks. As anyone who has ever seen a bachelor group can attest, bucks are quite social during late summer. That changes in the fall as hormones begin to flow and aggressive interactions increase. And while several studies suggest this may be a reason yearling bucks relocate their home range, one recent study found that not to be the case with older deer.

A South Carolina study found core areas of four adult bucks overlapped somewhat, three to a great degree. And this was during the hunting season when they should have been potential rivals. It's likely that while they were in the same general locale they may not have been in the same immediate vicinity of each other, at least not at the same time. Like rival siblings, they didn't move out of the house, they just moved to different rooms. Still, it shows that even intraspecific aggression will not prompt adult bucks to abandon their home range, or core areas.

Much the same is true for hunting pressure. Several studies have found that rather than move out, mature bucks simply moved less during daylight, and more in thick cover in response to increased human (hunter) presence. That's another important thing to know. You may not drive your hit list bucks off the property, but you will make them harder to kill if you pressure them too much.



Research suggests that aggressive interaction may be a factor in yearling buck dispersal, but older bucks are far less likely to change home ranges once they're established.

The Dating Game

Eventually bucks will have to move if they want to find a mate, and biologists have identified three different strategies they use to do so. When we think of buck movement during the rut, most hunters probably picture



By combining general conclusions from research with what you can learn about your own herd in their own habitat, you may be able to gain greater insight into local deer movements.

nomadic deer that travel far and wide, (perhaps as much as five miles or more from their core area) for an extended period of several days. This is not an uncommon scenario particularly, but not necessarily, when does are fewer and farther between. And both our definitions exclude these forays from the home range.

Some bucks make periodic excursions, traveling well outside their core areas and home ranges, but typically returning within 12-24 hours. Even more interesting, one study found that many of these bucks have two or more focal points - between 60 and 140 acres in size - within their home ranges that they re-visit every two days or so. Perhaps of greater interest to the hunter, researchers also found the focal points of several individual bucks overlapped during peak rut, and speculated bucks might be spacing their visits to assess female receptiveness. This suggests the traditionally accepted model of bucks visiting doe groups might actually have some basis in fact and offers some justification for including these excursion sites in a buck's home range.

Finally, some bucks are "home bodies." They remain largely within their home range, spending a considerable amount of that time in

core areas, even during peak rut. It should be noted that one study found some of these sedentary bucks had one core area while others had multiple cores. Perhaps does were in good supply, or it could simply have been individual personalities, which actually influences movements more than most realize.

That last part is a very important thing to keep in mind when it comes to deer behavior but particularly with older deer - like humans, they all have distinct personalities. Some are homebodies while others have a wanderlust. However, like college kids, they always eventually return home.

Seasonal Shifts

Another reason deer may shift home ranges and/or core areas is diet shifts. It's been researched, discussed and written about ad nauseam so I won't go into too much detail. Suffice to say, deer movements change when food availability or preference changes. Most gamekeeper-types already know that deer transition from predominantly proteins to increased carbohydrates and foods with higher fat content as summer changes to fall.

You need to understand what that means in the areas you hunt. Where I live, the deer are in the clover fields almost every night in August and early September but gradually shift away from the fields and into the woods where apples and acorns begin to drop as the days grow cooler and shorter.

Different foods ripen or become more available at different times. I witnessed this on a Kansas hunt where the deer had been regularly seen in the soybean fields until we arrived to hunt. Initially we thought it was our appearance and the associated disturbance. Then we realized ripe persimmons were dropping and deer were literally walking non-stop across bean fields to get them.

In the northeast, white oak acorns fall first, and often over a fairly short duration. The deer gobble the sweeter nuts up while they can in deference to the bitterer, but larger red oak acorns that will continue to drop over a more prolonged period and get more attention later. Midwestern and western hunters know how dramatically **deer movement can change** when the corn or alfalfa is cut. Every area is different and you need to figure out yours.



In agricultural areas like the Midwest, where the kitchen is next to the bedroom, deer may have relatively small home ranges.

Shifting Seasons

Another thing that can influence home range movement is climate. Deer hunters living east of the Mississippi and south of the Mason-Dixon Line may not fully appreciate just how dramatic the changes can be. Those of us in the North Country or western mountains know the difference.

I occasionally hunt an area of northern Maine that lies along the Canadian border. While local folks hunt whenever the season is open, older hunters have learned to save their energy until the mercury drops and the snow accumulates. Just over the border lies a large traditional wintering area (see sidebar) and deer will migrate to it from as far as ten to twenty miles away once winter conditions set in. Much the same occurs in mountainous areas of western states where deer and elk move down into the valleys. In slightly milder climates it's common to see deer move to and congregate in areas of dense bottomland softwood cover and/or south facing slopes. And it's also important to manage for these important winter habitats if you're in these areas.



Various studies found between 50 and 80 percent of yearling bucks will disperse from their natal home range to set up a new one elsewhere, often some distance from the original.

Conclusion

To recap, after about the age of two, a deer will spend most or all of the remainder of its life within a defined area called a home range. Most of that time will be spent within a smaller portion of that is called a core area. The most notable exception is when bucks leave core areas and sometimes home ranges in search of a mate — sometimes.

Otherwise, core areas may shift seasonally with changes in food availability or preference, but deer will still remain within their home range. And that home range can range from very small to very large depending on habitat quality, deer densities and other variables. In good habitat and a

moderate climate it may be a relatively small area. In more severe climates a deer's home range may consist of summer and winter core areas that could be as much as ten to twenty miles apart. All that information is helpful but deer are individuals. If you want to figure out the one at the top of your hit list, you've got to put in your time in the field.

The information presented on this page may be outdated. It may refer to situations which have changed or people who are no longer affiliated with the university. It is archived as part of Mississippi State University's history.



March 10, 2020

WILDLIFE NEWS

(Photo Credit: Submitted)

Tracking Beavers: Researchers study American beavers for wildlife management

By: Vanessa Beeson

The American beaver, once prized for its pelt, is now frequently considered a nuisance for the extensive damage they can cause to crops, timber, and roadways. There is limited economic data on the damage caused by beavers, however, estimates for southern states reach millions of dollars.

Since beavers are a species of management concern across the U.S. and especially in the South, MSU researchers are investigating beaver ecology to help improve management practices of their populations for either their positive environmental effects as a keystone species or as agricultural and infrastructure pests.

Isidro Barela, a master's student in the Department of Wildlife, Fisheries and Aquaculture from Belen, New Mexico, is undertaking research to predict likely areas on the landscape where beaver may live. If land managers can identify where beavers may occur, they may be able to better manage damage that might arise from a nuisance situation.

"I am very interested in beavers as a species because of their capability to manipulate their environment on such a large scale and their impacts on riparian communities," Barela said. "I am also very interested in the geospatial field. This research allowed me to apply these two interests into a research project that may contribute to the overall body of scientific knowledge of beaver ecology as well as predictive modeling, which may improve management practices for the American beaver."

By also pursuing the geospatial and remote sensing minor in the Department of Geosciences, Barela can combine wildlife and geospatial science to evaluate two very different approaches used to predict habitat suitability for the American beaver. One modeling technique is known as Maxent, a method that uses data about known beaver locations to predict habitat suitability. The other method,

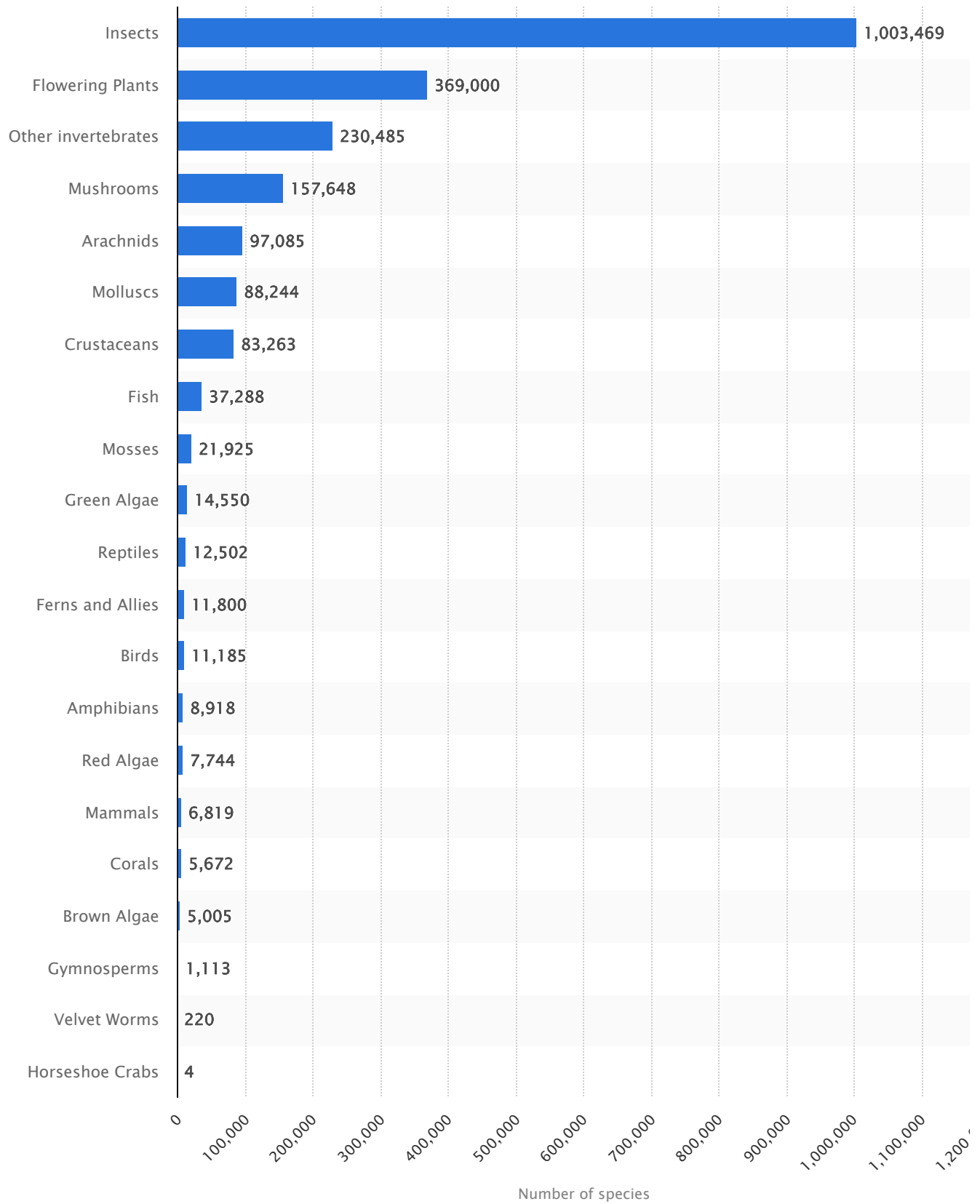
Expert Opinion Models, also predicts habitat suitability but uses environmental variables identified and ranked by beaver experts to make predictions.

The results from the research found that both modeling approaches performed well, but the Expert Opinion Models may have better performance at predicting greater areas of suitable habitat. Dr. Leslie Burger, assistant extension professor in the Department of Wildlife, Fisheries and Aquaculture and Barela's graduate co-advisor, said, "Isidro explored ways in which managers can use habitat models, satellite imagery, and professional opinions to predict where beavers might occur on the landscape."

When asked about his personal experience as a MSU Bulldog, Barela said, "What I enjoyed the most about my time at MSU is the graduate student community. While I've been here, I have made friends and met colleagues from all over the world. The diversity of graduate students at MSU made my experience here very enjoyable. This diversity allows individuals to learn from different experiences, cultures, and ways of thought that allow communities to grow culturally and professionally."

This research was funded by USDA APHIS Wildlife Services and the MSU Forest and Wildlife Research Center."

Number of organisms discovered in the world up to 2025, by group



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Release date

October 2025

Region

Worldwide

Survey time period

2025

Supplementary notes

IUCN = International Union for Conservation of Nature and Natural Resources.

Citation formats

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The number of organisms discovered in the world up to 2025

Published by [Zeynep Dierks](#), Feb 5, 2026

As of 2025, nearly 2.2 million animal and plant species had been categorized worldwide, about one million of which were insects. In comparison, around 6,800 different types of mammals have been categorized.

CAMOUFLAGE

Camouflage, also called cryptic coloration, is a defense mechanism or tactic that organisms use to disguise their appearance, usually to blend in with their surroundings. Organisms use camouflage to mask their location, identity, and movement.

GRADES

5 - 12+

SUBJECTS

Biology, Ecology, Geography

PHOTOGRAPH

Eastern Screech Owl

Camouflage, also called cryptic coloration, is a defense or tactic that organisms use to blend in with their surroundings. Background matching is perhaps the most common camouflage tactic. The feathers on this eastern screech owl, for instance, almost perfectly match the bark on trees it sits in.

PHOTOGRAPH BY STEVE IRVINE,
MYSHOT



Camouflage, also called cryptic coloration, is a defense or tactic that organisms use to disguise their appearance, usually to blend in with their surroundings. Organisms use camouflage to mask their location, identity, and movement. This allows prey to avoid predators, and for predators to sneak up on prey.

A species' camouflage depends on several factors. The physical characteristics of the organism are important. Animals with fur rely on different camouflage tactics than those with feathers or scales, for instance. Feathers and scales can be shed and changed fairly regularly and quickly. Fur, on the other hand, can take weeks or even months to grow in. Animals with fur are more often camouflaged by season. The arctic fox, for example, has a white coat in the winter, while its summer coat is brown.

The behavior of a species is also important. Animals that live in groups differ from those that are solitary. The stripes on a zebra, for instance, make it stand out. However, zebras are social animals, meaning they live and migrate in large groups called herds. When clustered together, it is nearly impossible to tell one zebra from another, making it difficult for predators such as lions to stalk an individual animal.

A species' camouflage is also influenced by the behavior or characteristics of its predators. If the predator is color-blind, for example, the prey species will not need to match the color of its

surroundings. Lions, the main predator of zebras, are color-blind. Zebras' black-and-white camouflage does not need to blend in to their habitat, the golden savanna of central Africa.

Camouflage Tactics

Environmental and behavioral factors cause species to employ a wide variety of camouflage tactics. Some of these tactics, such as background matching and disruptive coloration, are forms of mimicry. Mimicry is when one organism looks or acts like an object or another organism.

Background matching is perhaps the most common camouflage tactic. In background matching, a species conceals itself by resembling its surroundings in coloration, form, or movement. In its simplest form, animals such as deer and squirrels resemble the "earth tones" of their surroundings. Fish such as flounder almost exactly match their speckled seafloor habitats.

More complex forms of background matching include the camouflage of the walking stick and walking leaf. These two insects, both native to southeast Asia, look and act like their namesakes. Patterns on the edge of the walking leaf's body resemble bite marks left by caterpillars in leaves. The insect even sways from side to side as it walks, to better mimic the swaying of a leaf in the breeze.

Another camouflage tactic is disruptive coloration. In disruptive coloration, the identity and location of a species may be disguised through a coloration pattern. This form of visual disruption causes predators to misidentify what they are looking at. Many butterflies have large, circular patterns on the upper part of their wings. These patterns, called eyespots, resemble the eyes of animals much larger than the butterfly, such as owls. Eyespots may confuse predators such as birds and misdirect them from the soft, vulnerable part of the butterfly's body.

Other species use coloration tactics that highlight rather than hide their identity. This type of camouflage is called warning coloration or aposematism. Warning coloration makes predators aware of the organism's toxic or dangerous characteristics. Species that demonstrate warning coloration include the larva and adult stages of the monarch butterfly. The monarch caterpillar is brightly striped with yellow, black, and white. The monarch butterfly is patterned with orange, black, and white. Monarchs eat milkweed, which is a poison to many birds. Monarchs retain the poison in their bodies. The milkweed toxin is not deadly, but the bird will vomit. The bright coloring warns predator birds that an upset stomach is probably not worth a monarch meal.

Another animal that uses aposematism is the deadly coral snake, whose brightly colored rings alert other species to its toxic venom. The coral snake's warning coloration is so well known in the animal kingdom that other, non-threatening species mimic it in order to camouflage their true identities. The harmless scarlet king snake has the same black, yellow, and red striped pattern as the coral snake. The scarlet king snake is camouflaged as a coral snake.

Countershading is a form of camouflage in which the top of an animal's body is darker in color, while its underside is lighter. Sharks use countershading. When seen from above, they blend in with the darker ocean water below. This makes it difficult for fishermen—and swimmers—to

see them. When seen from below, they blend in with lighter surface water. This helps them hunt because prey species below may not see a shark until it's too late.

Countershading also helps because it changes the way shadows are created. Sunlight illuminates the top of an animal's body, casting its belly in shadow. When an animal is all one color, it will create a uniform shadow that makes the animal's shape easier to see. In countershading, however, the animal is darker where the sun would normally illuminate it, and lighter where it would normally be in shadow. This distorts the shadow and makes it harder for predators to see the animal's true shape.

Creating Camouflage

Animal species are able to camouflage themselves through two primary mechanisms: pigments and physical structures.

Some species have natural, microscopic pigments, known as biochromes, which absorb certain wavelengths of light and reflect others. Species with biochromes actually appear to change colors. Many species of octopus have a variety of biochromes that allow them to change the color, pattern, and opacity of their skin.

Other species have microscopic physical structures that act like prisms, reflecting and scattering light to produce a color that is different from their skin. The polar bear, for instance, has black skin. Its translucent fur reflects the sunlight and snow of its habitat, making the bear appear white.

Camouflage can change with the environment. Many animals, such as the arctic fox, change their camouflage with the seasons. Octopuses camouflage themselves in response to a threat. Other species, such as nudibranchs—brightly colored, soft-bodied ocean “slugs”—can change their skin coloration by changing their diet.

Chameleons change colors in order to communicate. When a chameleon is threatened, it does not change color to blend in to its surroundings. It changes color to warn other chameleons that there is danger nearby.

Some forms of camouflage are not based on coloration. Some species attach or attract natural materials to their bodies in order to hide from prey and predators. Many varieties of desert spiders, for instance, live in burrows in the sandy ground. They attach sand to the upper part of their bodies in order to blend in with their habitat.

Other animals demonstrate olfactory camouflage, hiding from prey by “covering up” their smell or masking themselves in another species' smell. The California ground squirrel, for instance, chews up and spits out rattlesnake skin, then applies the paste to its tail. The ground squirrel smells somewhat like its main predator. The rattlesnake, which senses by smell and body heat, is confused and hesitant about attacking another venomous snake.

Animal Ecology in Focus

Estimating Species Populations – a critical step in understanding ecological processes

Understanding the size of animal populations is necessary – but also extremely challenging. Andrea Campos Candela, a PhD student with the Fish Ecology Lab in the Mediterranean Institute for Advanced Studies (<http://imedea.uib-csic.es/?lang=en>) (IMEDEA-CSIC) talks us through this problem.

“How many animals are there?”

Understanding ecological processes and the dynamics of wild animal populations is dependent on our answer to such seemingly simple question. Further, recognizing changes in population over time and geographically or due to environmental events, human impacts and even the climate change effects is critical to understanding ecological processes. Despite its great relevance, addressing this fundamental scientific issue is still a challenge in ecology.



Underwater image sampling is wide spreading in marine ecology (Image: Pablo Arechavala López)

Animal density is the number of animals in a unit area. Discovering this relies on going out to the countryside or under the sea and *counting, counting and counting.* However, “*how to count*” remains a long-standing issue. Since the beginning of ecological science, the search for methods to count faster and better, allowing robust statistical analysis has arisen many intriguing scientific debates.

Among other factors, *animals do not sit still.* Counting moving animals is no easy task but challenging, even without considering limited visibility or the desire for continuous, remote, repeatable monitoring. By using camera traps in terrestrial ecosystems, or baited cameras underwater, we may make robust, verifiable observations. Yet still, our data represents a limited snapshot of the environment.

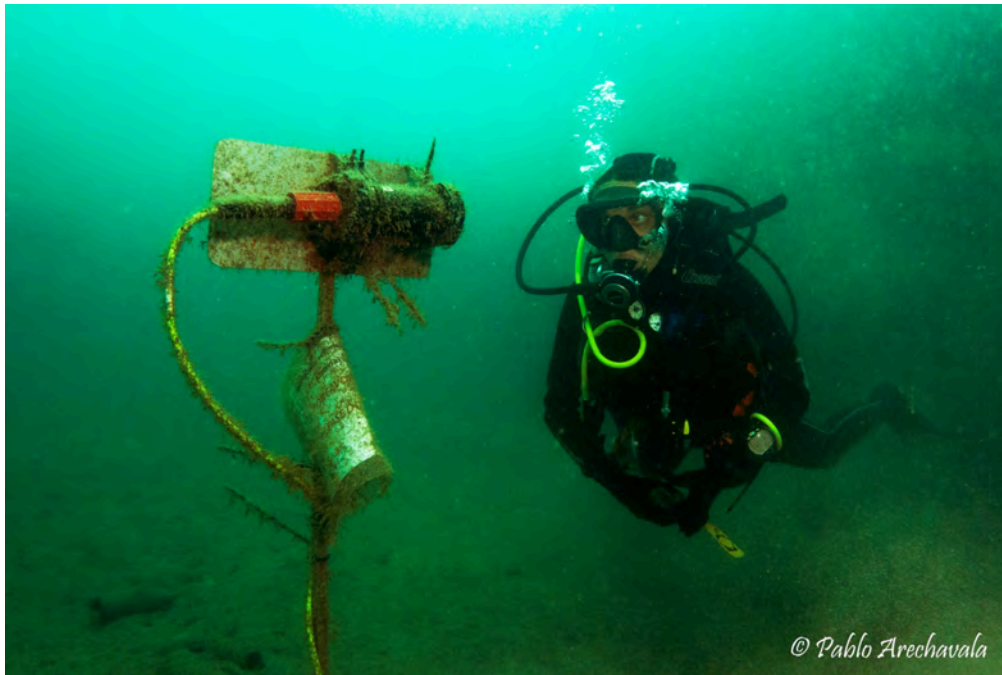
However, one property of animal behavior may help in such a challenge: their **Home Range**. Animals typically move in space within certain limits of what we interpret as their territory or their proper “home” or Home Range. This behavior occurs broadly among mammals, reptiles, birds, and fish. Mathematically, we consider this home range ‘stationary’ in time and space. As such, the likelihood of discovering an individual at a certain point decreases with the distance of our point of observation from the centre of its Home Range. Given how widespread this behavior is among different taxa we wondered how such a stationary property of the movement could be used in estimating animal absolute densities.



Camera trapping is an extended method for the study of terrestrial mammals (Image: Gonzalo Mucientes).

However, we still need data. What kind of? How do we collect it? Taking advantage of modern technology, managers and scientists have gained powerful tools for improving terrestrial and aquatic wildlife surveys with the recent **technological advances in wildlife video recording**. Using unmanned aerial vehicles (UAVs) we can monitor a wide range of wildlife, including birds, terrestrial and aquatic mammals. In aquatic systems, miniaturization of underwater video recording devices and the installation of cabled video observatories have broadened the remote, long-term and high frequency monitoring of fish and their environments. Meanwhile, onshore, camera devices triggered by the movement of animals (camera trapping) increase the sample time for mammals' studies and therefore the opportunities to improve our knowledge of *how many animals there are*.

Combining the mathematical properties of the Home Range behaviour and the count of animals in each frame of a camera record, we can estimate the density of the animals with greater certainty. Recording a period of time long enough for animals to visit their whole Home Range (which is, talking statistically, when the stationary probability density function of Home Range centres can be recovered), **the absolute animal density can be robustly estimated from averaged counts across independent frames divided by the area surveyed by each camera**. Testing our hypothesis, we mathematically simulated the movement and population density of various taxa, including birds, reptiles, mammals and fish, from different terrestrial and aquatic environments. The results of our work show that this method predicts the density of species across taxa with a very little error!



Andrea undertaking a periodic maintenance check of Sub-Eye, the underwater-cabled coastal observatory in Port d'Andratx, Balearic Islands. (Image: Pablo Arechavala López).

However, we do not think that this is the end of the road. Our team continues working to improve the mathematical development and application of our model. We aim to answer, for instance, what would happen when the detection of the animal is not hundred percent. We hope this new mathematical model, together with the new opportunities offered by the recent technological development of video cameras, will help us to solve this classic enigma of the ecology, but it will also contribute to the conservation of many threatened species in our ecosystems.

Deriving this new formula overcomes some former skepticisms in ecology, such as the fact that recounting the same individual several times could be a problem for estimating abundances. Therefore, we may revisit the classical problem of ecology from a new perspective; *how many fish are there really in our seas? How many reptiles are there in our mountains? How many birds in our forests? How many animals are there in our study areas?* We still have a lot of exciting work ahead of us!!

NCF-Envirothon 2026 Mississippi

Wildlife Study Resources

Key Topic #2: Wildlife Ecology

4. Identify the essential components of a habitat and identify suitable habitat for select Mississippi wildlife species.
5. Describe different habitat features that are important to wildlife (such as ecotones, edges, snags, downed logs, riparian areas, early successional stages, etc.).
6. Identify the importance of major migratory flyways.
7. Explain the importance of pollinators in natural and agricultural ecosystems.

Resource Title	Source	Located on Page
Attract More Wildlife through Timber Management	<i>Attract more wildlife through timber management</i> Mississippi State University Extension Service. (n.d.). https://extension.msstate.edu/publications/attract-more-wildlife-through-timber-management	24
Native Pollinators: Butterflies and Moths	<i>NATIVE POLLINATORS: BUTTERFLIES AND MOTHS.</i> (2016). In USDA. United States Department of Agriculture.	26
Ecology & Management of the Northern Bobwhite	<i>Ecology & Management of the Northern Bobwhite</i> Mississippi State University Extension Service. (n.d.).	28
Ecology and Management of Rabbits in Mississippi	Mississippi State University Extension Service. (n.d.). <i>Ecology and management of rabbits in Mississippi.</i> https://extension.msstate.edu/sites/default/files/publications/P2467_web.pdf	47
Ecology and Management of Squirrels in Mississippi	<i>Ecology and Management of Squirrels in Mississippi</i> Mississippi State University Extension Service. (n.d.). https://extension.msstate.edu/publications/ecology-and-management-squirrels-mississippi	58
Wildlife-Food Plots	<i>Food plots</i> Mississippi State University Extension Service. (n.d.). https://extension.msstate.edu/natural-resources/wildlife/food-plots	65
Wildlife-Habitat Management	<i>Habitat Management</i> Mississippi State University Extension Service. (n.d.). https://extension.msstate.edu/natural-resources/wildlife/habitat-management	66
Migratory Bird Program Administrative Flyways	<i>Migratory Bird Program Administrative Flyways.</i> (n.d.). U.S. Fish & Wildlife Service. https://www.fws.gov/partner/migratory-bird-program-administrative-flyways	68
The importance of pollinators-Promote Pollinators	Lisaboendermaker. (2023, July 25). <i>The importance of pollinators.</i> Promote Pollinators.	71



Attract More Wildlife through Timber Management

Mississippi's 19.8 million acres of forestland are valuable and produce many renewable benefits, including timber, recreational opportunities, watershed and erosion protection, and wildlife habitat. Unfortunately, many landowners are unaware of the many benefits forestlands can provide.

For example, many people believe that unmanaged, natural forests are best for game. Consequently, the average acre of Mississippi forestland produces less than its potential in both timber and wildlife habitat. Properly managed forests can not only yield greater amounts of wood products but also provide high-quality habitat for many of the state's wildlife species.

Timber and wildlife management are not mutually exclusive. Often, as a result of more diverse timber and wildlife management programs, today's landowners receive additional income from recreational leases and other so-called non-forestry ventures. Supplemental income from this practice can be significant and is often used to pay for items such as property tax liability.

Where to Start

A common reason for leaving forestland unmanaged is that landowners believe forest management is too expensive. This is simply not the case if you plan well and make cost-conscious decisions. Prioritize your management objectives by timber stand. A property may have multiple stands with a variety of management objectives depending on stand characteristics or goals for wildlife management. For example, the primary objective for one stand could be timber, and the objective for another might be quail habitat.

Professional help is as near as your telephone and is often free. Many agencies, such as the Mississippi Forestry Commission (<https://www.mfc.ms.gov>) and the Mississippi Department of Wildlife, Fisheries, and Parks (<https://www.mdwfp.com/>), provide free services to help you identify your management goals and plan activities to reach those goals. Private consultants offer similar services. In this phase, you will write a management plan that states your goals for the property and a schedule of management practices you will use to help meet them.

When implementing the plan, you can adjust practices to meet your goals and budget. For example, if turkeys are a management objective, you will need to provide proper habitat for nesting and brood-rearing. This can be done by harvesting small areas, thinning, making fire lanes and access roads, or improving and maintaining existing forest openings.

Wildlife Needs

Many of Mississippi's wildlife species depend on the forest to live. Some, such as deer, turkeys, and squirrels, spend most of their lives in the forest. All wildlife have four basic needs: food, water, space, and cover. Generally speaking, wildlife will prosper in areas with multiple habitat types. A diverse forest habitat combines different timber types, age classes, and stand conditions in one area.

Often only minor efforts are needed to manipulate habitat so that it becomes more attractive to your target wildlife species. Even-aged timber management can provide diversity by locating different age stands close to one another. For example, research has shown that properly managed clear-cut areas close to young and mature pine timber stands can provide excellent quail and deer habitat for several years.

Additionally, when developing a wildlife management program, it is important to look closely at nearby properties and consider how they will influence your wildlife program. This is a key element of forest stewardship and is especially important when managing small ownerships. For example, instead of creating openings in a small forest next to an existing opening, the space might be better used to implement some other practice that helps you reach your overall management goals.

Management Techniques

For many years, foresters and wildlife managers have acknowledged the value of forest openings for wildlife. Timber harvesting creates openings that may be large or small. Other disturbances, such as prescribed burning and herbicide application, can greatly improve wildlife habitat for many species while benefiting timber production.

Combining appropriate forest management techniques into your management plan can prove beneficial to both wildlife and timber.

Cutting Methods for Regeneration

Regeneration cutting is performed by removing trees from an area to allow regeneration of a new forest. In clear-cutting, all trees are harvested at the same time, whereas in seed tree and shelterwood harvests, high-quality trees are left and used to regenerate the forest naturally (Figure 1). Once desirable regeneration is obtained, the remaining overstory trees are removed so that the newly regenerated forest can grow. These cutting techniques are used to harvest marketable timber and to create the best environment for young trees to establish and grow.

Following a harvest, many shade-intolerant plants begin to grow in openings. Wildlife often prefer the highly palatable and nutritious plant species that arise in these settings. Additionally, due to increased light and nutrient availability in these openings, these plants often provide comparably greater quantities of available fruit and seed for food.

Many landowners are concerned with the negative impacts of harvests on wildlife. However, negative effects can be reduced by considering the size, shape, and distribution of harvested areas in your harvest plan. Small (20 to 100 acres), irregularly shaped cuts next to larger stands of different ages will provide diverse habitat preferred by many wildlife species. You can use these methods to regenerate pine and hardwood stands.

Improvement Cuttings

During the natural development of a forest, young trees compete for space, light, water, and nutrients. Some species, and individual stems of a given species, will outcompete others and become dominant in the forest. Dominant trees in even-aged forests are typically large and fast-growing.

The purpose of improvement cuttings (including, but not limited to, thinnings) is to remove trees of species undesirable to your management goals, trees that are damaged or unhealthy, trees that are of low quality, or trees that you do not think will survive until the next cutting. Foresters use improvement cuttings to improve the overall quality of a forest. Such harvesting creates space for crop trees to grow and allows more sunlight to reach the forest floor. This light aids the growth of many low-growing plants valuable for wildlife.

However, these benefits are short-lived. In a few years, the forest canopy will close again and shade out most of the forage plants established post-harvest. Improvement

cuts can be made later to help wildlife and increase the stand's timber value.

Some wildlife species need cavity trees for nesting and shelter. Therefore, when implementing an improvement cut, try to keep several good cavity trees per acre. Cavity trees should be selected based on the presence of an existing cavity large enough to be used by wildlife species of interest. Often, cavity trees are food-producing species, such as oak, hickory, blackgum, beech, or bald cypress. These are useful to many wildlife species, and leaving them does not result in a significant decrease in timber production.

Prescribed Burning

Prescribed burning is a practice used to accomplish management objectives for a stand. Fire promotes an early successional stage in the understory of a timber stand (Figures 2 and 3). Periodic use of prescribed fire can maintain these early successional stages and help provide ample cover and forage for wildlife.

Burn frequency depends on the species of wildlife you are attempting to attract. For example, when managing pines to maximize the potential for quail, you may want to burn more frequently than if managing for deer. Think about what your target wildlife feeds on, as well as its preferred cover type. In the case of quail, you are trying to produce as many seeds and insects as possible while maintaining cover approximately 2 feet high. Conversely, deer would have difficulty finding sufficient cover in optimal quail habitat and would prefer more herbaceous or woody vegetation.

As previously discussed, it is often better to have a diversity of cover types and forage on your property. This can be achieved using a burn rotation. A burn rotation is simply a schedule for burning a portion of your property on a yearly, or multi-year, basis. Rotating burning time on different portions of your property allows for a variety of different successional stages at all times (Figure 4). This system yields a more diverse habitat and lowers the workload for managers compared to burning the entire property every year.

Early successional plants promoted through prescribed fire have the same essential needs as your timber stand. If desired understory species are not obtained in the year following a burn, you may need to perform a thinning operation. Removing selected stems in the stand will allow more light, water, and nutrients for the understory. Other advantages of a properly conducted burn include wildfire fuel reduction, woody and herbaceous competition control, and improved visibility and accessibility.

Prescribed burning can be a valuable tool for forest and wildlife management, but it must be used properly. Contact your local

NATIVE POLLINATORS: BUTTERFLIES AND MOTHS

Introduction

This fact sheet provides helpful information to aid in the identification of native pollinators in Mississippi. Thousands of native pollinators can be found in Mississippi. However, special emphasis has been placed on pollinators that may be declining across their native ranges. Native pollinators are adapted to local climate conditions, soils and plant life, and require limited management or maintenance. The information provided primarily focuses on native butterflies and moths that are commonly viewed in gardens and natural habitats within Mississippi. These pollinators play a crucial role in ecosystem functions and agricultural food production.



Natural Resources Conservation Service

Helping People Help the Land

Monarch (*Danaus plexippus*)

Family: Nymphalidae, Wingspan 3 ½ to 4 inches



Monarch Butterfly (*Danaus plexippus*) adult on milkweed (*Asclepias* spp.)
Photo By: Glynda Clardy/NRCS

This butterfly species is one of the best known butterflies in North America, the larvae feed entirely on milkweed (*Asclepias* spp.) which makes them toxic to predators (e.g., birds and other insects). The bright color contrasts of both larvae and adults are recognized as warning signs by predators which generally abstain from eating these foul tasting insects. Monarch butterflies are often seen in open fields and along roadsides where milkweeds grow. Monarch butterflies have one of the longest migrations of any species (up to

3,000 miles). They travel from Canada and the United States to central Mexico starting in late summer, and are commonly seen in Mississippi in September and October. This migration of millions of butterflies ends at approximately 12 roosting sites in Mexico. The butterflies hang together in trees until March of the following year, then mate and begin their journey northward. The females then lay eggs on milkweed plants along the way. Once these eggs hatch and the offspring mature, they then follow their parents' path north. This reproductive cycle continues, until September - October. Therefore, the butterflies that migrate in the fall are about 3 to 4 generations removed from the original butterflies that made the previous year's fall migration. Besides milkweed for the larvae, nectar sources such as asters and goldenrods are vital for the adults, particularly during migration.



Monarch Butterfly (*Danaus plexippus*) chrysalis and larvae (left to right)
Photo By: Glynda Clardy/NRCS

Gulf Fritillary (*Agraulis vanillae*)

Family: Nymphalidae, Wingspan 2 1/2 to 3 ½ inches



Gulf Fritillary Butterfly (*Agraulis vanillae*) larvae on maypop (*Passiflora incarnata*)
Photo By: Glynda Clardy/NRCS

This butterfly species is another example of butterflies with obligate relationships with plants. Gulf fritillary butterflies are commonly found throughout Mississippi gardens, the larvae feed entirely on native passionflowers such as maypop (*Passiflora incarnata*). The larvae are toxic; this factor serves as great protection against predators. In addition, the larvae appear to be covered with stinging hairs, however this is mere mimicry as they do not sting. Adult gulf fritillary butterflies are normally found along forest edges and open areas. The underwings of this brightly colored butterfly are pale with large silver spots.

Spicebush Swallowtail (*Papilio troilus*) – Family: Papilionidae, Wingspan 3 to 4 inches

Mississippi's Official State Butterfly is found only in the eastern United States. This species is commonly found in deciduous forests and shaded swamps. Larvae feed on sassafras and spicebush (*Lindera* spp.). Several other swallowtail species commonly occur in Mississippi such as: Eastern Tiger Swallowtail, Zebra Swallowtail, Eastern Black Swallowtail, and Pipevine Swallowtail. The Pipevine Swallowtail and female (black form) Eastern Tiger Swallowtail can be easily confused with the Spicebush Swallowtail. Adult swallowtails sip nectar and commonly gather at mud puddles. The larvae of several species of swallowtails, for example the Eastern Black Swallowtail, feed only on host plants in the carrot family, including wild carrots, parsley, dill, fennel, and Queen Anne's lace.

Mitchell's Satyr (*Neonympha mitchelli*) – Family: Nymphalidae, Wingspan 1 ½ to 1 ¾

This butterfly is a federally protected endangered species recently identified in northeast Mississippi near Tishomingo State Park in wetlands associated with beaver ponds. The adults live only two weeks and may never eat or drink. Larvae feed on one or more species of grass-like plants called sedges. This species is one of the rarest in the world and is generally associated with rare calcareous wetlands called prairie fens.

Whites and Sulphurs (*Phoebis* spp.) – Family: Pieridae, Wingspan 1.5 to 2.5 inches

These species are common butterflies that are usually white or yellow as their name implies and are often seen in gardens or grassy fields. They vary in size from tiny to large, and several different species occur throughout Mississippi. These butterflies remain active until late fall by feeding on fall flowering plants. The Sulphur larvae feed on marigolds, sneezeweeds, and legumes, such as clovers. The larvae of most whites feed on mustard-family plants, such as cabbage, mustard, collards, turnips, kale, and broccoli.

Skippers – Family: Hesperidae, Wingspan 1 to 2 inches

Skipper is a common name used to describe numerous species of small dull orange to brown butterflies that resemble moths. Many species are found across Mississippi and are often difficult to tell apart. These butterflies get their name “skipper” because while they feed on nectar they tend to skip from flower to flower with a characteristic rapid, erratic flight pattern. They can be distinguished from other butterflies and moths by the hooked bulb at the end of each antenna. Moths entirely lack this bulb.

Sphinx Moths and Hawk Moths – Family: Sphingidae

Several species occur in Mississippi. One common sphinx moth, known as the Hummingbird Moth, feeds on nectar during the day and is sometimes mistaken for a hummingbird. Other sphinx and hawk moth species may only be seen during dawn or dusk, and some are only seen at night. The larvae of some sphinx moths are considered pests because they feed on tomatoes and sweet potatoes. Tomato hornworm larvae are green with a black horn located on their rear, while the sweet potato hornworm larvae vary in color.



Geometer Moths – Family: Geometridae

These are small, dainty, drab-colored moths whose shape is similar to butterflies'. However they only forage at night when no butterfly would be out foraging. Their family name, Geometridae, means “earth-measurer”, referring to their caterpillars' unusual locomotion. These caterpillars are commonly called inchworms.

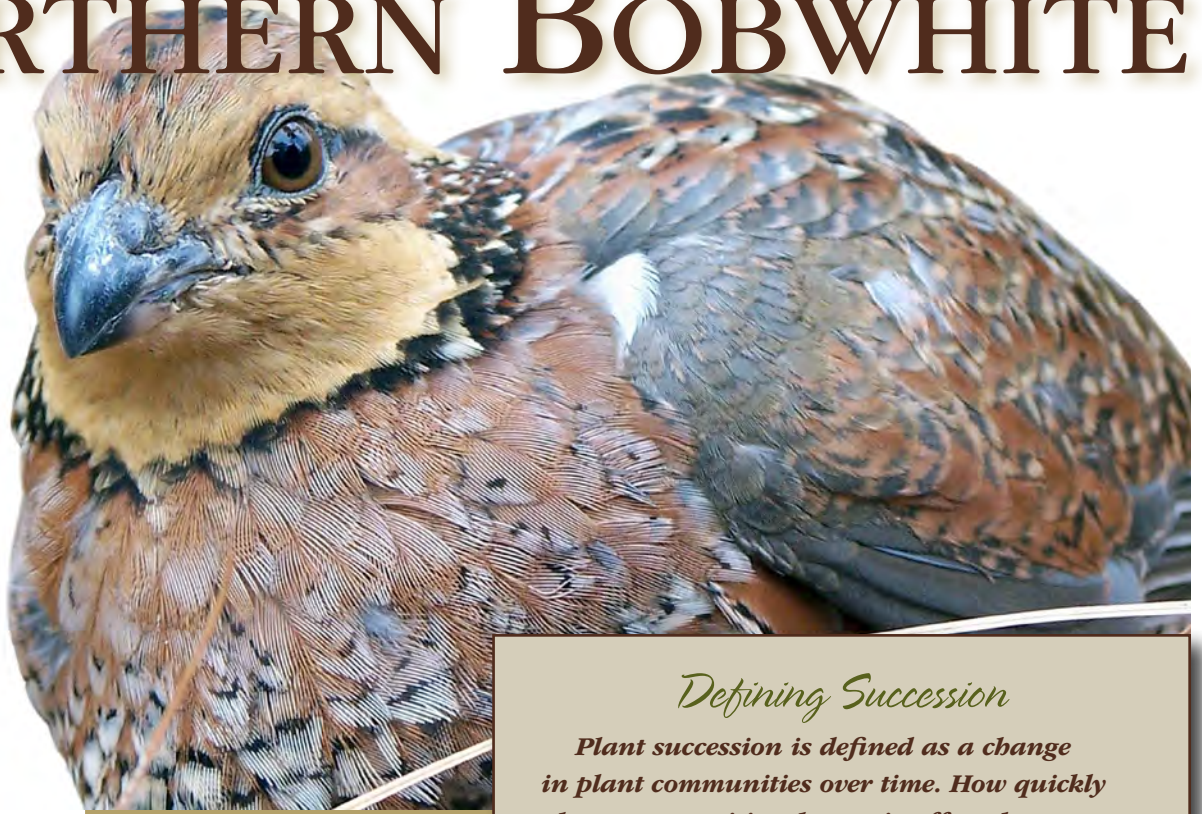
More on Native Pollinators

- The *Pollinator Partnership* offers different planting guides tailored to specific ecoregions in the United States. Each guide contains native plant and pollinator information. To get the guide specific to your ecoregion visit the *Pollinator Partnership* website: www.pollinator.org
- *Establishing Habitats for Mississippi's Native Pollinators*, Mississippi Chapter of the Soil and Water Conservation Society and The Jamie L. Whitten Plant Materials Center operated by the USDA Natural Resources Conservation Service: http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/mspmctn9081.pdf
- *Attracting Native Pollinators*, *The Xerces Society Guide to Protecting North America's Bees and Butterflies* www.xerces.org/
- For more information on how to create habitat for native pollinators contact your local NRCS office: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/ms/contact/local/>.

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Ecology & Management of the NORTHERN BOBWHITE



Abundant bobwhite populations were once an accidental byproduct of land management

practices as early settlers carved out small family farms in large expanses of southeastern forestland. Just as human activity once accidentally created good habitat for bobwhites, changes in the ways we use land have diminished bobwhite habitat quality. In Mississippi and other southeastern states, bobwhite and other wildlife species that depend on early successional plant communities have declined over the last several decades to historically low population levels (*see Figure 1*).

The main cause of the decline in bobwhite populations has been loss of habitat associated with advanced natural plant succession (closed-canopy forests), industrialization of farming and forestry, reduced use of prescribed fire, and extensive conversions of native plant communities to non-native, invasive grasses such as fescue and bermudagrass. Other factors, such as predation and increasing isolation of remaining bobwhite populations, along with deteriorating habitat quality, further contribute to bobwhite population declines.

Defining Succession

Plant succession is defined as a change in plant communities over time. How quickly plant communities change is affected by environmental factors such as soil fertility, moisture, and temperature. Early successional plant communities follow some form of environmental disturbance and are characterized at first by annual grasses and forbs. In most areas of the Southeast, annual plant communities quickly progress to perennial grasses and forbs within a few years. Within 4 to 5 years of no disturbance, early successional plant communities are lost as shrubs and trees colonize the site. Early successional plant communities are maintained by disturbances such as fire, hurricanes, tornadoes, or tillage. The goal of bobwhite management is to mimic natural soil or vegetation disturbances, typically by tree harvest, prescribed fire, or disking, to maintain early successional plant communities.



The intensification of timber and fiber production has reduced available bobwhite habitat in forested regions.



Figure 1. Northern bobwhite population trend measured by counts of calling males along 25-mile Breeding Bird Survey routes in Mississippi, 1966 to 2005.

Agriculture has been a two-edged sword for bobwhites. Early agricultural development created habitat, but intensification of agriculture destroyed habitat. In recent decades, conversion of farmlands back to forestland has further eliminated habitat.

Bobwhites thrive in habitats composed of native grasses, forbs, and shrubs. Early agriculture in Mississippi provided habitat for many grassland wildlife species in the form of weedy field margins, fence rows, and other odd areas. Interconnected, small family farms created millions of acres of small agricultural fields and unimproved pastures that once provided nesting, brood-rearing, and protective cover for bobwhites. Since the end of World War II, agricultural production methods have progressively become more extensive and intensive, and chemical control of weeds and insects has increased dramatically.

Grazing practices have also changed significantly over the years. Livestock once grazed on native grasses and other native vegetation. Farmers moved livestock among native grass fields and woodlots, producing a patchwork of grazed and ungrazed areas. Today, most pastures and hay fields have been converted to “improved” stands of non-native grasses such as fescue, bermudagrass, or bahiagrass, and are intensively grazed by animals confined to

smaller areas. Non-native grasses provide poor habitat for bobwhites and most other wildlife.

Average farm sizes in Mississippi increased from 54 acres in 1942 to 262 acres in 2005, while the number of farms decreased from 269,000 to 42,200 during the same period. As farming became more intensive and industrialized, less productive acreage and less competitive farms were removed from production.

The 1980s saw some of the greatest losses of cropland acreage in Mississippi and other regions of the United States. During this time, hundreds of thousands of former cropland acres were simply abandoned and allowed to grow up in woods or were converted to hardwood or pine plantations or non-native grasslands (such as fescue). These broad-scale land-use changes, many of which have been subtle over time, eliminated large expanses of interconnected grassland wildlife habitat associated with farming in Mississippi.

Just as agricultural practices have changed, forestry practices have also changed. The intensification of timber and fiber production (such as short-rotation, high-tree-density pine plantations and greater use of chemical site preparation for forest regeneration) have reduced available bobwhite habitat in forested regions.

ANNUAL CYCLE

Winter Covey

From fall through early spring, birds live in a social unit called a covey. Winters are difficult for bobwhites because the weather is cold, food is scarce, and predators are abundant. At night, bobwhites roost on the ground in a circle to conserve energy and for security. Only three to five birds in each covey will survive to spring.

Winter

Fall Shuffle

In early fall, broods live together in large groups of 20 to 30 birds. By October, birds will have settled into winter coveys of 12 to 15 individuals. The population (number of birds in an area) is highest



Spring Breakup

In early spring, coveys break up, and male birds begin their familiar “bobwhite” whistle to attract females.

Pair Bonds

Individual males and females will form pair bonds that may last for a single nesting attempt, multiple nesting attempts, or the entire breeding season.

Summer

Nesting

Bobwhites build their nests on the ground in a clump of dead grass to camouflage it. The female will lay about 12 eggs. The male or female incubates the eggs for 23 days. Nesting is a dangerous time because many predators eat eggs and adults. Only one of every three nests hatches.

Hatching & Brood-Rearing

After the eggs hatch, the male or female leads the chicks to brood habitats. Young chicks eat mostly insects because they contain the protein and nutrients chicks need to grow. The parent protects the chicks from danger and keeps them warm. A family of bobwhite chicks is called a “brood.”

Summer Life

The chicks grow rapidly and begin to fly in as little as 2 weeks. They spend their days feeding, taking dust baths, hiding from predators, and resting.

Prescribed burning of pastures and upland forests was a common practice in Mississippi. Its use has declined because of misunderstanding and negative public perception of fire, increased human population density, and potential liability risks associated with smoke and fire. Bobwhites do not tolerate the thick vegetative conditions that develop in forests that are seldom burned. Decreased use of prescribed fire is one of the main factors that have contributed to bobwhite declines in the Southeast.

Life History and Ecology

Understanding bobwhite life history and ecology provides the background for managing this bird. By understanding the various aspects of a bobwhite’s life and seasonal habitat needs, it is easier to understand how to manage bobwhite habitat.

Courtship and Nesting

Early spring is a time of dispersal for bobwhites preparing for reproduction. Habitat use shifts from shrubby and woody habitats used in winter to more open, grassy portions of the landscape. During the breeding season, it is not uncommon for about 25 percent of the population that survives the winter to move to new areas more than 2 miles from their winter range. These birds are likely looking for mates and new habitats.

The familiar two- or three-note “bobwhite” whistle of males in early spring to attract a female is the earliest sign the reproductive season is starting. Courting pairs form first in March and April. Pairs form and break, then re-form throughout the breeding season, from May to September. In one breeding season, individual bobwhites may pair and try to nest with as many as three different mates.

Pairs form and break, then re-form throughout the breeding season, from May to September.



Bobwhites have a long breeding season, often lasting more than 150 days. This long breeding season provides opportunities for multiple nesting attempts and contributes to the bobwhite's high reproductive potential. Individual nesting attempts may require 35 to 48 days from making the nest to hatching. Peak hatch is around mid-July. Some broods may hatch as early as early May and as late as early October. Nests are incubated by either the male or the female, but bobwhites rarely share incubation duties. Females incubate most of the early-season nesting attempts, but males incubate an average of 25 to 30 percent of all nests. Male incubation is most common during the middle of the breeding season. Often the female initiates and incubates a clutch, while the male incubates a clutch the female laid earlier. Bobwhites readily re-nest when nests are destroyed by predation, weather, or human activities. Some females may produce more than one brood per season.

Bobwhites usually select a nest site where native grasses are the main plant type. Good nesting cover has fairly dense, upright grass cover close to areas with ample bare ground concealed by overhead grass, forb, and shrub cover. These more open, weedy areas provide foraging habitat for the newly hatched chicks.

Male bobwhites build nests in a slight depression in the soil, using available grasses and debris, which often include broomsedge or pine straw. Nest building takes about a day, and the hen generally lays about one egg daily until she has produced the complete clutch of eggs (average clutch is 12 eggs). This usually requires 15 to 20 days after the nest is built, often with a slight delay between building and the beginning of egg-laying.

Within 2 to 5 days of laying the last egg, the female or male starts incubation. Both attending adults and nests are highly vulnerable to mortality during incubation. Predators, agricultural machinery, or weather events destroy about 55 to 70 percent of nests. The attending adult is killed in about 25 percent of nest failures.

Because females incubate 70 to 75 percent of nests, they typically experience greater mortality than males during the nesting season.

If the nest is successful, the eggs hatch after about 23 days of incubation. Once hatching begins, most chicks emerge within 1 to 2 hours. About 33 percent of birds succeed on the first nesting attempt, and bobwhite hens may re-nest two to three times, whether the first brood was successful or not. Despite this high reproductive potential, not all pairs successfully produce a brood because of weather, predation, and other disturbances. Through repeated re-nesting, about 75 percent of the birds surviving the breeding season ultimately hatch one or more clutches.

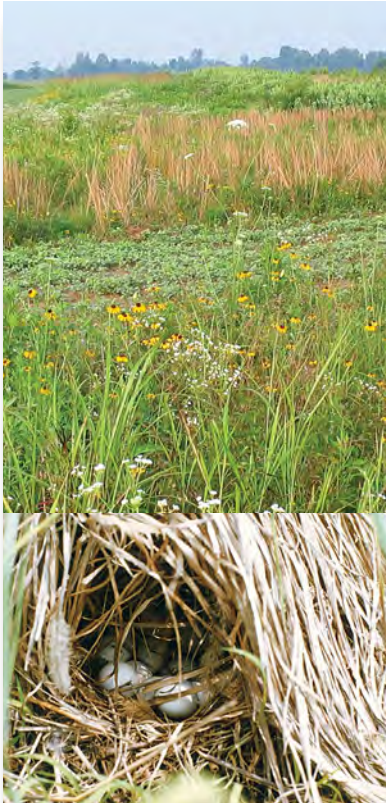
Brood-Rearing

When bobwhite chicks hatch, they are covered in down, with eyes open, and can move around. Newly hatched chicks weigh about 0.25 ounce and are not much larger than bumblebees, but they can forage for themselves soon after hatching.

As soon as the chicks are dry, the hen leads them away from the nest to begin foraging on insects and other invertebrates. They are very alert, move around on the ground quite readily, and cannot fly for the first 2 weeks after hatching. Attending adults watch the chicks closely, and the brood may cover 2 to 100 acres during the flightless period. Hens take the chicks to insect-rich areas with overhead cover for protection from predators, intense heat, or wet conditions and where small chicks can move freely along the ground and through vegetation to feed. Annual plant communities provide good brood cover.

The first 2 weeks after hatching are the most critical, because 50 percent or more of chicks may be lost to predation or bad weather. The attending adult broods, or covers the chicks with its wings, during the night and much of the day to keep them warm and protect them from predators. Bobwhites are dedicated parents and hesitate to leave flightless chicks, even

Good nesting cover has fairly dense, upright grass cover close to areas with ample bare ground concealed by overhead grass, forb, and shrub cover.





Hens take the chicks to insect-rich areas with overhead cover for protection from predators, intense heat, or wet conditions and where small chicks can move freely along the ground and through vegetation to feed.

when attacked by a predator. Although predation is high during incubation, adult mortality associated with attending flightless chicks is twice as great as incubating a nest.

Between weeks two and six, chicks develop juvenile plumage and flight abilities. By 6 weeks of age, chick diets shift from only insects to insects along with seeds, berries, and other plant material. At 8 weeks, hens are readily identified from cocks by the brown feathering in the throat patch; cocks have a white throat patch and a black eye stripe and collar. At 12 to 16 weeks, the size of young bobwhites closely resembles that of adults. By the age of 21 weeks, bobwhites have the plumage they wear into the next breeding season. Juveniles can still be identified from adults for a full year by the more-pointed ninth and tenth primary wing feathers and buff-colored tips of the greater primary coverts.

Summer life for birds of all ages consists of daytime activities of traveling, feeding, dusting to clean feathers, and loafing. They may feed during early morning, rest during

midmorning, loaf, sleep, and dust during the middle of the day, and feed during the 2 to 3 hours before dark. The bobwhite's preferred way to travel is on foot. Flying requires more energy than walking and running and exposes birds to predators such as hawks and owls. Shrubby cover such as plum thickets or briar patches provide both secure loafing cover and escape cover for bobwhites during these daily activities.

Covey Structure

By late summer, bobwhites begin to show the characteristic night roosting habits of forming a circle on the ground with tails together and heads pointing out. This may have important social, escape, and heat conservation benefits.

In late summer and early fall, birds begin to mix from brood to brood and form coveys, or social groups, of 20 to 30 birds. These coveys may reduce to groups of 10 to 15 birds as each covey settles into its winter range. This period is often called the "fall shuffle," and populations have reached their peak for the year. As fall and winter arrive, food is most abundant, birds move about less, and the tight-knit coveys are 75 to 80 percent juvenile birds. Depending on habitat quality, each covey may require 20 to 160 acres or more to meet its needs.

As much as 50 to 75 percent of the early fall population may die by the following spring. As winter progresses, cover and food resources become more limited. Protective cover such as plum thickets or briar patches throughout an area can provide critical cover after grass and forb covers have deteriorated during winter.

For birds that survive winter, longer daylight and warmer weather in spring trigger the gradual breakup of coveys. The bobwhite calls begin in earnest, and pairing begins again as the next breeding season arrives.



Annual plant community.

During the "fall shuffle," populations have reached their peak for the year. As fall and winter arrive, food is most abundant, birds move about less, and the tight-knit coveys are 75 to 80 percent juvenile birds.





Figure 2. Plant succession is the change in plant communities over time.

Bobwhite habitat is no longer an accidental byproduct of land use but must be intentionally created.

Habitat Management

Although bobwhites can adapt to grasslands, agricultural crops, and woodlands if properly managed, too much of one results in lack of another and reduces habitat quality. Many modern land use practices simplify the landscape by producing too much of one plant community or land use type while excluding others. For example, intensive agricultural and forestry practices emphasize food and fiber production but eliminate the patchy landscape bobwhites require.

With the gradual (and sometimes radical) land use changes that have occurred in Mississippi during the last half-century, proactive bobwhite habitat management has become imperative to maintain harvestable populations of bobwhites and, in some cases, just to maintain localized populations. Bobwhite habitat is no longer an accidental byproduct of land use but must be intentionally created.

Open Lands

Open lands include agricultural land uses such as row crops, pastures, hay fields, Conservation Reserve Program (CRP) grasslands, and nonagricultural grasslands such as prairies and old fields. Because of the open nature of these land uses, they

are often the easiest habitats to manage for bobwhites, and existing bobwhite “seed” populations are usually associated with these land uses. Many effective habitat management tools are available to create or enhance bobwhite habitat in open lands. One or more of the following management options that are compatible with production goals can be used to increase the amount of usable bobwhite habitat in cropland habitats.

Old fields provide suitable bobwhite habitat for 2 to 3 years after abandonment because grasses, forbs, and shrubs colonize fields when they are no longer cultivated. Many crop fields were removed from agricultural production and allowed to go back to natural grass cover during the early to mid-1980s. This explains why this period experienced some brief bobwhite population booms. However, plant succession causes abandoned fields to “grow out” of bobwhite habitat within a few years.

Without soil disturbances from prescribed fire or disking, abandoned fields are invaded by brush and characterized by heavy litter (such as dead grass) accumulation, thick vegetation at the ground level, and little bare ground and plant diversity. Like abandoned fields, crop fields converted to pine or hardwood plantations provide suitable



Brush invasion in an old field.



Dense, perennial grasses.

Without soil disturbances, abandoned fields are invaded by brush and characterized by heavy litter accumulation, thick vegetation at the ground level, and little bare ground and plant diversity.

bobwhite habitat for a short time; but as trees capture the site and canopy closure prevents sunlight from reaching the forest floor, ground cover conditions favorable for bobwhites are quickly lost.

In modern agricultural systems, the availability of idle, native herbaceous vegetation most often limits bobwhite populations. In these landscapes, developing suitable, idle vegetation and/or converting non-native, invasive grasses such as fescue and bermudagrass to native warm-season grasses (NWSG) are essential parts of bobwhite habitat management.

Converting cropland to NWSG and forbs can produce quality bobwhite habitat, but this management option is feasible only if you do not want to continue cropping

Native Forbs with Commercial Availability

- Ragweed (*Ambrosia artemisiifolia*)
- Partridge pea (*Chamaecrista fasciculata*)
- White prairie clover (*Dalea candida*)
- Purple prairie clover (*Dalea purpurea*)
- Illinois bundleflower (*Desmanthus illinoensis*)
- Smooth ticktrefoil (*Desmodium laevigatum*)
- Stiff ticktrefoil (*Desmodium obtusum*)
- Florida beggarweed (*Desmodium tortuosum*)
- Narrow leaved sunflower (*Helianthus angustifolius*)
- Common sunflower (*Helianthus annuus*)
- Maximilian sunflower* (*Helianthus maximiliani*)
- Oxeye (*Heliopsis helianthoides*)
- Roundhead lespedeza (*Lespedeza capitata*)
- Slender lespedeza (*Lespedeza virginica*)
- Coneflowers (*Radtibida* spp.)
- Blackeyed susan (*Rudbeckia hirta*)

*Not native to Mississippi, but native to western United States; not known to be invasive in Mississippi.

Native Grasses with Commercial Availability

- Big Bluestem (*Andropogon gerardii*) – Adapted to more neutral soils (such as prairie and Delta)
- Broomsedge (*Andropogon virginicus*) – Adapted to almost all soils in Mississippi; readily colonizes many sites naturally; limited commercial availability
- Sideoats Grama (*Bouteloua curtipendula*) – Adapted to a variety of soil types
- Sand Lovegrass (*Eragrostis trichodes*) – Adapted to poorer, dry soils
- Switchgrass (*Panicum virgatum*) – Adapted to a variety of soil types
- Little Bluestem (*Schizachyrium scoparium*) – Adapted to a variety of soil types
- Indiangrass (*Sorghastrum nutans*) – Adapted to a variety of soil types
- Purpletop (*Tridens flavus*) – Adapted to poorer, dry soils
- Eastern Gamagrass (*Tripsacum dactyloides*) – Adapted to a variety of soil types

*For more information on native warm-season grasses, see Extension Publication 2435 *Native Warm-Season Grass Restoration in Mississippi*.



Native warm-season grasses and forbs.

Conversion of 5 to 10 percent of cropland acreage to native grass and forb field buffers can increase local bobwhite populations by 200 percent.



Native warm-season grass and forb field buffer along a crop field edge (summer).



Native warm-season grass field buffer in winter.



Field buffer dividing grazing paddocks (fenced to protect from livestock), managed for bobwhite cover.

particular fields. An alternative practice is rotational fallow field crop management (often called flex-fallow), but this management option temporarily removes some acreage from production and reduces cropping potential.

Native grass and forb field buffers established along field edges are a flexible grassland habitat management practice for cropland. Field buffers let landowners create wildlife habitat and continue cropping their fields by sacrificing only minimal amounts of cropland. Field buffers should be at least 30 feet wide for bobwhite habitat, and wider buffers are usually better (buffers usually range from 30 to 120 feet wide). Conversion of 5 to 10 percent of cropland acreage to native grass and forb field buffers can increase local bobwhite populations by 200 percent.

Similar to croplands, converting pasture/hay lands to NWSG can greatly increase the value of these production systems for bobwhite habitat. NWSG can be very productive hay and grazing lands, but you must carefully use rotational grazing to avoid overgrazing.

As with cropland, idle field buffers around pastures and hay fields can provide habitat for bobwhites. Pasture/hay buffers let producers sacrifice small amounts of forage production lands. You can create these buffers by fencing out portions of pastures and leaving margins of hay fields uncut. Field buffers along pastures and hay fields require regular maintenance if these forage lands contain bahiagrass, bermudagrass, and/or fescue. If these non-native forage grasses are present, you have to treat the buffer with herbicide to eradicate non-native grasses, and desirable vegetation has to be established. Regular herbicide treatments along the field and buffer edge are necessary to control spread of invasive grasses into buffers from the field margin.

In Mississippi, nearly 1 million acres of former cropland have been enrolled in the Conservation Reserve Program (CRP). Many CRP contracts were not specifically developed for early successional wildlife habitat. CRP grass covers, both whole-field

and conservation buffer enrollments, were often established in non-native grasses such as fescue or bermudagrass. These CRP conservation covers may be converted to bobwhite habitat by eradicating non-native grasses with appropriate herbicides and establishing native grasses and forbs (these stands may be eligible to re-enroll in CRP as a native grass cover). Management activities on CRP lands must be part of an approved Conservation Plan of Operation, so consult with USDA-Farm Service Agency (FSA) personnel before beginning management activities.

Old fields and CRP grasslands that were allowed to regenerate to native vegetation but were not actively managed can also be renovated for grassland wildlife habitat. Because many of these idle grass fields have not been actively managed to maintain early successional habitat, woody brush or non-native, invasive vegetation has moved into these grasslands and reduced their bobwhite habitat value.

Woody brush such as cedar, sweetgum, and green ash and non-native, invasive vegetation such as kudzu and bermudagrass often require herbicidal treatment for long-term control. Controlling non-native, invasive vegetation is more economical and effective if you treat invasive species when they first appear. This is especially true of cogongrass, which is ranked as the seventh worst weed in the world. It is more common in South Mississippi, but isolated infestations have been detected throughout the state. Learn to identify this invasive species, and if you find it, control it. For more information about detecting and controlling cogongrass, contact one of the agencies listed in the Technical Assistance section of this publication or the Mississippi Department of Agriculture and Commerce (<https://www.mdac.ms.gov>), Bureau of Plant Industry, Plant Pest Programs (662.325.7761).

Although mowing or clipping is the most common practice used to manage vegetation on CRP and other grass stands, it produces poor grassland wildlife habitat. Mowing reduces cover height, favors



Mowing reduces cover height, favors perennial grasses, and creates a dense litter layer along the ground.



perennial grasses, and creates a dense litter layer along the ground. If bobwhites and other grassland wildlife habitat are a priority, mow only to control brush or to maintain roads.

Strip-disking and prescribed fire are the main tools for properly managing established native grass stands for bobwhites. Prescribed burning should always be conducted by a certified prescribed burn manager, who will develop a written burn plan and get appropriate permits before burning. Check with the appropriate county office of the Mississippi Forestry Commission for more information about prescribed burning regulations. Another reference on prescribed fire is MSU Extension Publication 2283 *Prescribed Burning in Southern Pine Forests: Fire Ecology, Techniques, and Uses for Wildlife Management*. A good reference on light disking for wildlife habitat is *Light Disking to Enhance Early Successional Wildlife Habitat in Grasslands and Old Fields: Wildlife Benefits and Erosion Potential* available through the USDA-Natural Resources Conservation Service or from the

MSU Natural Resources Enterprises website (<https://www.naturalresources.msstate.edu/>).

Disking can be done from October through March. Fall disking tends to promote hard-seeded forbs and legumes, whereas spring disking promotes annual grasses. Fall disking may be more effective in stimulating important food plants for bobwhites. On sites with an agricultural history, spring disking may promote agricultural pest species. Creating an annual plant community does not require seedbed-quality site preparation. Light disking (one to three passes with the disk set at 3 to 5 inches deep) can effectively stimulate germination of desirable annual plants. Prescribed burning is generally done winter to early March, but weather conditions will determine when prescribed burns should be conducted.

Rotational strip-disking maintains a mixture of annual and perennial plant communities. To minimize erosion, strip-disk on the contour. You can implement strip-disking on a 2- to 3-year rotation, disking half to one third of fields each year in a strip pattern. This rotational pattern of soil disturbance maintains 1-, 2-, and 3-year-old plant communities and produces bobwhite nesting and brood-rearing cover next to one another within each field. You can rotationally burn fields in a similar strip fashion to disking, or you can divide larger fields with disked strips into halves or thirds, burning each block every 2 or 3 years.

Disking and prescribed fire produce annual plant communities that provide essential food and cover resources for bobwhites and other grassland wildlife. Annual plant communities are characterized by grasses and forbs (especially legumes) that occur after a soil disturbance. Some examples of annual plants include ragweed, partridge pea, and panic grasses. Annual plants produce an abundance of seeds many birds and small mammals use. They also support diverse insect communities that provide critical nutrients for nesting birds and growing chicks. You can plant commercially



Prescribed burning.



Strip disking.



Vegetation response after prescribed burning or strip disking.



Scattered thickets of native shrubs provide escape and loafing cover for bobwhites.



available forbs (especially legumes) to enhance grassland stands that are lacking an adequate forb component. (*See Native Forbs with Commercial Availability on page 7.*)

Although you do not want woody brush to dominate native grass stands for bobwhite habitat, you do want to protect or create some scattered patches of shrubby cover. Scattered thickets of native shrubs like wild plums, dogwoods, winged sumac, and vines such as blackberry provide escape and loafing cover for bobwhites. Protect existing shrub thickets (cut fire breaks around thickets if you use prescribed burning), or plant seedlings to enhance protective cover in native grass stands. Maintain or create about 10 to 20 percent of grasslands (including cropland field buffers) in shrubby cover. If you are creating scattered shrub thickets by planting, develop thickets about 100 to 300 yards apart. Because of the protective cover they offer during winter, these shrub thickets often serve as “covey headquarters.” Coveys somewhat center their daily activities about these shrubby thickets to stay in close contact with secure cover.

You can improve woody habitats next to crops or grass fields (such as fencerows and small woodlots) for bobwhite habitat by what is commonly referred to as “edge feathering.” Edge feathering produces favorable bobwhite cover in much the

same way as a forest clear cut. Bobwhites often move into young forest clearcuts because grasses, forbs, and shrubs thrive for several years after timber harvests remove large trees that shade the ground. These clear cuts often provide ideal bobwhite habitat for about 3 to 5 years. Edge feathering requires removing most of the larger trees to let sunlight reach the ground, favoring growth of native grasses, forbs, and shrubs.

You can use cut trees for timber or firewood or leave them on the site. You can partially cut some trees so the tree falls over but stays partly attached to the stump. This way, the tops and limbs remain alive for some time. Stump sprouts from cut hardwoods produce thickets that can be beneficial for bobwhite escape cover.

If you edge feather next to grassland field buffers or large patches of native



Edge feathering.

Native Shrubs to Protect or Plant

- American Beautyberry (*Callicarpa americana*)
 - Flowering Dogwood (*Cornus florida*), Gray Dogwood (*C. racemosa*)
 - Eastern Red Cedar (*Juniperus virginiana*)
 - Wild Plums (*Prunus americana*, *P. angustifolia*, and others)
 - Winged Sumac (*Rhus copallinum*), Smooth Sumac (*R. glabra*)
 - Blackberry and Dewberry (*Rubus* spp.)
 - Blueberry, Sparkleberry, Huckleberry (*Vaccinium* spp. and *Gaylussacia* spp.)
 - American Holly (*Ilex opaca*), Yaupon (*I. vomitoria*)
 - Wax Myrtle (*Myricaceae cerifera*)
-

grassland, a narrow cut (15 to 20 feet wide) may be satisfactory. But if edge feathering is the only habitat management practice you plan, a wide cut (30 feet or wider) is necessary. You can leave scattered mast-producing trees (such as oaks, pines, and cherries) in the feathered edge for additional food resources. You can enhance these areas by planting native grasses, forbs, and shrubs if a desirable plant community does not establish naturally.

Pine Forests

Pine forestlands are the main forest systems managed for bobwhite habitat in Mississippi, although upland hardwoods can also be managed for bobwhite habitat. Areas that are mostly forestland may be more difficult to manage for bobwhite habitat, especially if bobwhite populations have been absent for some time. However, large tracts of upland forest managed for bobwhites can be very productive. Proper pine forest management on a large scale offers some of the greatest opportunities to increase bobwhite habitat and populations in many areas of Mississippi.

Several habitat management tools are available to create or enhance bobwhite habitat in pine forests. Reducing tree density is the first step in developing the grass and forb ground cover bobwhites and other grassland wildlife require. Most pine forests in the Southeast do not support bobwhites because they are too heavily stocked with trees that form a closed canopy. Thinning reduces stem density and opens the forest canopy, letting more sunlight reach the ground and stimulating growth of ground-layer vegetation.

In Mississippi, most species of pines can be commercially thinned for the first time at 13 to 18 years of age, depending on the site. Basal area, or the total cross-sectional area of wood in the stand, is relatively easy to measure and relates well to herbaceous ground cover in forest stands. Typical timber thins reduce basal area to about 70 square feet per acre, but thinning stands to a basal area of 50 square feet per acre or less produces better bobwhite habitat. If bobwhite habitat is a greater priority than

timber production, a basal area as low as 30 square feet per acre produces the best habitat. In most cases, periodic thins are necessary to maintain lower basal areas as trees continue to grow after each thin. Individual landowner objectives vary, so consultation with a registered forester and a wildlife biologist can help determine the best balance that meets both wildlife and timber objectives.

Just as thinning stimulates growth of grasses and forbs, it also favors growth of hardwood brush and trees that shade out desirable grasses and forbs if left unmanaged. Prescribed fire on a 2- to 3-year rotation is the most cost-effective tool to control undesirable brush invasion. When fuel conditions are appropriate for burning, thinned pine stands should be prescribe-burned during winter to early spring. Prescribed burning should always be conducted by a certified prescribed burn manager, who will develop a written burn plan and get permits before burning. Check with the Mississippi Forestry Commission office for more information about prescribed burning regulations.

If prescribed fire is not an option, light disking on a 2- to 3-year rotation between thinned trees during fall or winter is an alternative for relatively clean sites. Always be especially cautious when disking in woodlands to avoid damaging tree trunks and roots and to avoid personal injury or equipment damage.

Soil disturbance, such as prescribed fire or disking, enhances habitat quality for bobwhites and other grassland birds because it inhibits woody brush growth, promotes annual plant communities, reduces plant residue, and increases bare ground on the forest floor. Plant communities that develop after fire or disking also produce quality food and cover for deer, rabbits, turkeys, and other wildlife. If soil is not disturbed, plant community composition changes over several years, and annual plants are replaced by perennial forbs and grasses and, eventually, woody plants. By planning soil disturbances on a 2- to 3-year rotation, you can manage plant succession to develop a complex of



different habitats that meet the seasonal habitat requirements of a number of wildlife species. For example, first-year burn areas typically produce good bobwhite brood cover by reducing litter accumulation and stimulating growth of annual plant communities that are rich in insects, whereas areas that have not been burned for 2 to 3 years provide better nesting cover because these areas will have more perennial grass and litter cover for building and hiding nests.

You can develop a rotational burning plan by creating 30-acre or smaller burn units and burning half to a third of these units one year, another half to a third the next year, and so on. Thus, you only burn a given unit every 2 to 3 years, but you burn some portion of the property each year. You can develop a rotational disking plan similarly. Disk a half to a third of suitable areas each year in a rotational way so you disk all suitable areas every 2 to 3 years.

Often, fire has been kept out of pine stands for so long that you can no longer control invasive hardwood species with low-intensity prescribed fires or disking. After thinning pine stands, if hardwood tree species dominate the ground or middle-canopy vegetation layer, you may have to treat these stands with a selective herbicide such as Imazapyr (such as Arsenal AC). You enhance chemical control of invasive hardwoods when you use prescribed fire in the dormant season after applying herbicide (wait at least 6 months after application before burning for greatest herbicide effectiveness). Once you control these hardwood species with herbicide, future fire or disking treatments on a 2- to 3-year rotation should provide better control of hardwood invasions.

With some planning, you can protect some mast/fruit-producing hardwoods and shrubs (such as wild plum, dogwoods, and oaks) from prescribed fire and herbicide treatments. These scattered hard and soft mast-producing trees and shrubs can provide food and cover resources for bobwhites and other wildlife.



Thinned pine stand that was not managed with selective herbicide or prescribed fire.



Thinned pine stand managed with selective herbicide and prescribed fire.



Woodland strip disking.

Control invasive, non-native vegetation (for example, kudzu or cogongrass) in forest stands with herbicide treatments. Herbicidal control of all types of invasive vegetation is more economical and effective if you treat invasive species when they first appear. Contact a wildlife biologist or forester to develop a plan for controlling invasive vegetation. Cogongrass especially is extremely invasive and seriously harmful to native plants and wildlife habitat. Learn to identify this invasive species, and if you find it, control it. For more information about detecting and controlling cogongrass, contact one of the agencies listed in the Technical Assistance section of this publication or the Mississippi Department of Agriculture and Commerce (<https://www.mdac.ms.gov>), Bureau of Plant Industry, Plant Pest Programs (662.325.7761).

A good way to produce more grassland wildlife habitat in forestland is to create forest openings. For bobwhites, 10 percent or more of forested acreage should be maintained in early successional openings. You can create these in established woodlands by clear cutting 1- to 5-acre patches throughout forest stands. You can easily create openings during commercial thinning of pine stands. Plan ahead and have a forester mark out forest openings when marking timber for thinning.

For mid-rotation pine plantations, you can create interconnected forest openings in a hub-and-spoke design. The hub-and-spoke opening has a central opening (hub) with open lanes (spokes) radiating through the pine stand, like a wagon wheel. You can create hub-and-spoke openings by removing several adjacent rows of trees when you thin a pine plantation. Hub-and-spoke lanes should be at least 30 feet wide to maintain grassy cover for bobwhites. The maximum width of lanes depends on how much timber acreage you are willing to remove from production (generally, the



A good way to produce more grassland wildlife habitat in forestland is to create forest openings. For bobwhites, 10 percent or more of forested acreage should be maintained in early successional openings.

wider the lanes, the better). You can also use hub-and-spokes as fire breaks for prescribed burning of mid-rotation pine stands.

You can also develop forest openings by widening or heavily thinning woodland roadsides and keeping log-decks or skid trails open. You can use forest openings for permanent or rotational food plots planted to appropriate supplemental food crops. Openings can also be used as log-decks during later timber harvests. Use prescribed fire or disking on a 2- to 3-year rotation (described above) to manage forest openings.

Supplemental Food Plantings

Supplemental food plantings, or food plots, may not always be necessary, but food plantings may provide some critical food resources during late winter and early spring when food is most limited. For bobwhite management, you should favor hard-seeded food plantings such as partridge pea, beggarweeds, or lespedezas (other than sericea). Leave grains such as corn and sorghum standing, so more seed will be carried on the stalk later into fall and winter.

In many cases, you can produce important bobwhite foods without planting anything. As mentioned earlier, two very effective and affordable tools for bobwhite management are prescribed fire and light disking. Some sites have a good existing seedbank of forbs (especially legumes) and annual grasses that are good bobwhite foods. After prescribed-burning or lightly disking an area, a wildlife biologist can quickly determine whether a site has an abundance of natural food plants, or if enhancing the seedbank through plantings is necessary.

A number of reseeding annual plants can be established to provide important bobwhite food. With proper management, these plants can be maintained for several years without replanting. Of all these plants, partridge pea and kobe lespedeza may be the most popular across the Southeast. Although these legume seeds are fairly expensive, it is important to



For mid-rotation pine plantations, you can create interconnected forest openings in a hub-and-spoke design.



Food plots may not always be necessary, but food plantings may provide some critical food resources during winter when food is most limited.

remember that a single planting can provide food for several years if you manage stands with prescribed burning or light disking from fall to winter.

Where grain crops are grown, one way to provide bobwhites with supplemental food and cover is simply to leave a border of crop standing around the edge of a field. This is a cost-effective way to provide a variety of agricultural foods, some of which can be difficult to cultivate in small patches because of intense deer browsing. Crop strips as narrow as 10 feet wide can provide a lot of bobwhite food on field edges. These strips will be more effective, though, if you leave them next to field buffers (described earlier). If you lease lands for farming, you can have a contract developed to require the farmer to leave a small portion of the crop standing, typically in exchange for a reduced land rental rate.

Food plot size and shape are important because they influence the amount of edge around a plot, which occurs where different types of plant communities come together (such as where a forest is next to a field). Planting several small food plots, rather than a few large ones, and making those plots an irregular shape maximizes the amount of edge and makes food plots more valuable for bobwhites.



Carefully consider and plan where to establish food plots. For example, the best food plots are next to areas with good escape cover, such as a plum or briar thicket. If you do not have escape cover, you can develop shrubby thickets next to food plots.

When establishing annual food plots, think about rotating food plot plantings each year and leaving part of the plot unplanted (fallow). In some cases, bobwhites benefit more from the native plant community in a fallow food plot than from the actual food planting itself. An example of this would be to establish strip plots of grain sorghum along the border of a grass field. The next year, leave that plot undisturbed and establish a similar strip plot beside the fallow plot. The soil disturbance created by preparing a good seedbed for planting encourages growth of many beneficial grass and weed species. Also, these fallow areas create a habitat that allows bobwhite chicks to move around freely and harbors plenty of insects for chicks to feed on.

A wildlife biologist can provide more information on managing food plantings for bobwhites.

Plants for Supplemental Food Plantings

Natives

Ragweed (*Ambrosia artemisiifolia*)
 Partridge pea (*Chamaecrista fasciculata*)
 Smooth ticktrefoil (*Desmodium laevigatum*)
 Stiff ticktrefoil (*Desmodium obtusum*)
 Florida beggarweed (*Desmodium tortuosum*)
 Roundhead lespedeza (*Lespedeza capitata*)
 Slender lespedeza (*Lespedeza virginica*)

Introduced or cultivated

Kobe lespedeza
 Korean lespedeza
 Browntop millet
 Sorghum or milo
 Egyptian wheat
 Corn
 Soybeans
 Field peas (also called cow peas)
 Sunflowers
 Wheat or oats and clovers (for bobwhites, plant clovers at 10 pounds per acre or less); cool-season planting, leave undisturbed throughout the summer

Landscape-Level Habitat Management

The kinds of habitats and resources bobwhites need must be developed at proper scales to maintain populations. Because bobwhites are not migratory, they need large portions of the landscape maintained in suitable habitat. Some science-based estimates suggest 2,000 to 4,000 acres of usable habitat is required to sustain viable populations in a given area. Relatively small (less than 1,000 acres), isolated land holdings managed for bobwhites can be productive habitat, and small acreages can help survival and reproduction. However, populations inhabiting small acreages are more susceptible to random environmental catastrophes (such as drought and ice storms), and processes such as gene flow and successful dispersal of individuals among populations may be minimal. Smaller properties managed for bobwhite habitat are more effective if several are managed within a mile of one another.

Figure 3 shows the concept of landscape-level habitat management. Each shape represents a landowner's property (acreage given inside the polygons) within the total 5,800-acre landscape. The green properties represent landowners who are actively managing for bobwhite habitat. In this example, 1,335 acres are being actively managed, which seems like a lot of habitat. However, when you look at the whole landscape, it is clear these are relatively isolated "islands" of habitat.

Assume some landowners next to green habitat management properties have also gotten involved in bobwhite management through local promotional efforts or habitat initiatives. The brown properties represent additional properties managed for bobwhite habitat. The amount of managed property has more than doubled (2,724 acres managed), and now much more interconnected habitat makes it easier for bobwhites to move between managed properties.

This illustration is very simple, since population response is a function of the quality and quantity of habitat and whether or not there are existing "seed" populations

of birds in the landscape. However, it demonstrates the concept of landscape-scale management by positively affecting a large part of the overall landscape.

Since bobwhite populations respond better to management over several thousand acres, landowners with smaller acreages may want to consider working with a group of neighboring landowners



Pine woodland management.



Field buffers along row crop fields.



Edge feathering along the interface of woods and fields.

Figure 3. Landscape-level habitat management, where several smaller properties within 1 mile of one another are managed for bobwhite habitat, can be effective.

to form a landowner wildlife management cooperative. A cooperative combines small acreages of neighboring landowners to create larger tracts of managed habitat. Forming a landowner cooperative requires that a group of neighboring landowners share common wildlife management goals and effectively work together to achieve those goals. A wildlife biologist or registered forester may be able to provide information on developing a successful landowner cooperative.

Smaller properties managed for bobwhite habitat are more effective if several are managed within a mile of one another.

Conservation Programs for Private Landowners

Before beginning management of a property for bobwhites, have a bobwhite habitat management plan in place. Agricultural producers can work with a wildlife biologist to develop a farm-wildlife plan that includes habitat management practices that are economical and practical for farm operations. Forest landowners can develop an integrated forest-wildlife management plan with a wildlife biologist and a registered forester to implement practices that accomplish both wildlife habitat and timber management objectives. Several conservation programs can assist private landowners with implementation costs of farm and forest wildlife management practices. You can find contact information for the agencies that administer each of these programs in the Technical Assistance section of this publication.

Financial assistance for habitat management may be available through one or more USDA conservation programs. The Conservation Reserve Program (CRP), Environmental Quality Incentives Program (EQIP), and Conservation Security Program (CSP) are available for landowners with eligible land uses. CRP, EQIP, and CSP are available to landowners with land in agricultural production; landowners managing forests for forest products such as timber are eligible for EQIP, but the property must meet criteria to be considered a farm. CRP provides conservation practices for field-level management. EQIP and CSP are more oriented toward whole-farm management. Management practices available through EQIP depend on the county where a property is located. CSP is limited to producers in specific watersheds, and different priority watersheds are chosen for CSP every year. For landowners who have acreage enrolled in existing CRP grass (such as CP10) or forest (such as CP11) conservation covers, mid-contract management cost-shares are available for prescribed fire, herbicide application, and light disking. Contact the Farm Service Agency office for more information

regarding CRP. For landowners interested in whole-farm management programs, contact the Natural Resources Conservation Service (NRCS) office for more information on EQIP or CSP.

The Wildlife Habitat Incentives Program (WHIP) is available to any private landowner. WHIP offers cost-shares for a wide variety of habitat management practices to develop bobwhite habitat in both open lands and nonindustrial private forestlands. Some of the practices WHIP cost-shares include prescribed fire, herbicidal control of invasive vegetation, native vegetation establishment, and forest regeneration. Contact the NRCS office about WHIP.

The Forest Resource Development Program (FRDP) is available to any non-industrial private forest landowner. FRDP provides cost-shares for forest management practices such herbicidal control of invasive vegetation and forest regeneration. The Healthy Forests Reserve Program (HFRP) assists private landowners in restoring rare forest ecosystems (such as longleaf pine) through active management and stewardship. HFRP provides landowners with conservation easements and cost-shares for appropriate forest management practices. Contact the NRCS office about HFRP or the Mississippi Forestry Commission office for more information about and FRDP.

The Landowner Incentive Program (LIP) provides state wildlife agencies with funds to enhance, restore, and protect imperiled habitats and benefit at-risk wildlife species on private lands. In Mississippi, the longleaf pine region of the southeast, the Blackland Prairie of the northeast and central sections, and bottomland hardwood areas of the Delta were chosen as those of greatest conservation need under LIP. Mississippi's LIP will cost-share practices such as site preparation, prescribed burning, tree and native warm season grass plantings, and herbicide applications. Biologists from the Mississippi Department of Wildlife, Fisheries, and Parks and Wildlife Mississippi provide technical guidance to landowners who participate in LIP.



Several conservation programs can assist private landowners with implementation costs of wildlife management practices. Planning ahead helps accomplish specific management goals.

Wildlife Mississippi also has prairie and longleaf pine restoration programs available to eligible landowners. Contact Wildlife Mississippi for information about their prairie and longleaf restoration programs.

Delta Wildlife provides technical assistance and cost-share for habitat development to landowners in the Delta region. Contact Delta Wildlife for information about their habitat management programs.

You can apply many of the same habitat management practices with each program, but there are differences in eligibility and financial incentives under each program. Depending on land uses, you may be able to apply a combination of conservation programs for greatest conservation and financial benefits. Remember, planning ahead helps accomplish specific management goals by applying a suite of programs and practices that accomplish management objectives and make the most financial sense.

Population Monitoring and Harvest Considerations

Fall Population Estimation

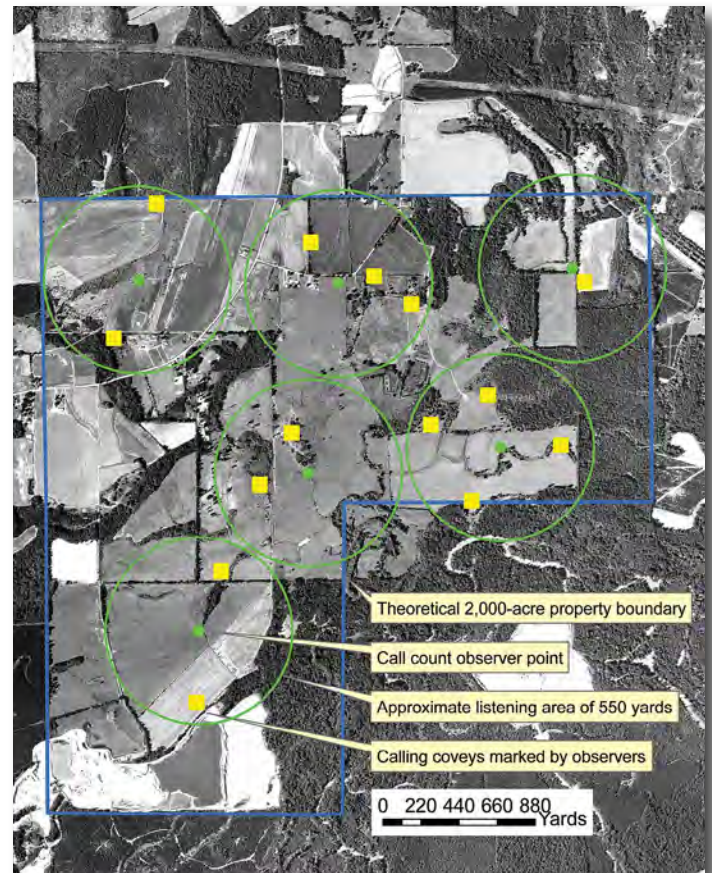
Population monitoring allows you to evaluate the effectiveness of your habitat management program. You can use covey-call surveys to estimate fall bobwhite population sizes. Covey-call counts should be conducted from mid-October to mid-November. The best calling period is usually during last 2 weeks of October. Covey-call counts should be conducted on days with little to no cloud cover or wind and high barometric pressure. Coveys typically call about 30 minutes before sunrise, and most coveys in an area start calling about the same time.

To conduct a covey-call count, get an aerial photograph or other type of map of the property where you can accurately determine locations to station observers. Having some copies of the map is also helpful to mark calling covey locations during the count. Distribute observer point locations around the property in places where observers can effectively hear

calling coveys. Do not put survey points in areas that are not good bobwhite habitat or where there is a lot of noise (as in a closed-canopy pine plantation or along a busy highway). With practice, observers with good hearing can hear calling coveys to a distance of about 550 yards (0.3 mile), which equals an effective survey area of about 200 acres. This hearing distance was estimated for relatively flat, open habitats—fields or open woods—so should apply to most areas managed for bobwhites in Mississippi. Space each call count observer point at least two times the estimated hearing distance (1,100 yards) from any other count point to reduce chances of more than one observer counting the same coveys.

It is best to survey all count points on the same morning (on smaller acreages, a couple of observers may be enough to survey all points). It is also a good idea to survey each point two to three different mornings, and use the average or greatest count of coveys at a given point for population estimates. On some larger properties, there simply are not enough observers to survey all points in a single morning. In this situation, survey the area in blocks each available morning based on number of available observers.

To use these covey counts to estimate bobwhite population sizes, flush as many coveys as you can find to estimate covey sizes, or you can assume that 12 birds is a reasonable



estimate of average covey size. Once you estimate the average size of coveys, multiply the number of coveys you counted by the average covey size. This gives you an estimate of bobwhite population size. You can get more accurate estimates from covey-call surveys by adjusting for the proportion of coveys that do not call. More details and information on advanced applications of the covey-call count technique are available on the Tall Timbers Research Station website (visit <https://talltimbers.org>).

Harvest Management

If you are interested in managing a property for hunting bobwhites, carefully consider harvest rates. After you make some estimates about bobwhite population sizes, you can decide how many birds to take during the hunting season. Some harvested birds would have died due to predation or bad weather, but others would have lived to the breeding season if not harvested. Thus, hunting can negatively affect populations if not carefully managed, because hunting almost always removes some birds that would have survived until the breeding season, with an opportunity to reproduce.

The best way to control harvest is to remove only a certain percentage of the estimated fall population. For example, covey-call counts in October suggest population size is about 100 birds, and perhaps it is acceptable to the manager to harvest 20 percent (20 birds, including cripples) of this fall population. Assuming that 30 to 60 percent of the remaining birds were lost to other sources of mortality, a population of 32 to 56 birds would be carried into the breeding season. This is a simplified scenario, as some birds will move in and out of the population.

In the Southeast, managers should limit harvest to no more than 20 to 25 percent of the fall population as a general rule. If the surrounding landscape is more favorable to bobwhites, you may allow more liberal harvests in the 20 to 25 percent range. If a

given property is essentially an “island” of bobwhite habitat surrounded by relatively unfavorable habitat, you should harvest more conservatively.

Summary

Bobwhites thrive in habitats characterized by native grasses, forbs, and scattered shrubs. Historically, annual burning of fields, grasslands, and open pine forests, along with associated moderate livestock grazing and cropping, provided the right patchwork or “mosaic” of early successional habitats that bobwhite and other grassland wildlife required. As human activity once accidentally created optimal habitat for bobwhites, changes in the ways people use lands have contributed to declining bobwhite habitat quality. Millions of acres of small agricultural fields that once provided nesting, brood-rearing, and protective cover for the bobwhite have been converted to less favorable land uses such as intensive agricultural production, closed-canopy forests, and urban development. By understanding the various aspects of a bobwhite’s life and seasonal habitat needs, it is easier to understand how to apply management tools and prescriptions to produce desirable bobwhite habitat.

Open lands, including agricultural habitats, Conservation Reserve Program grasslands, and nonagricultural grasslands, are often the easiest habitats to manipulate for bobwhite management because of the relative ease of developing grassy cover and because existing bobwhite “seed” populations are usually associated with these habitats.

Bobwhite habitat in open lands can be enhanced by developing suitable idle habitats, converting non-native, invasive grasses such as fescue and bermudagrass to native warm-season grasses and forbs, using rotational fallow field crop management, establishing native grass and forb field buffers around edges of crop fields, and edge feathering. Strip-disking and prescribed fire are useful



tools for managing native grass stands for bobwhite habitat. Although dense infestations of woody brush in grass fields are undesirable, creating and protecting some scattered patches of shrubby cover is desirable. Actively managing habitats maintains the combination of plant communities that meet bobwhite seasonal habitat requirements.

Forestland may be more difficult to manage for bobwhite habitat, especially if bobwhite populations have been absent for some time, but large tracts of managed upland forest can be productive bobwhite habitat. Proper pine forest management on a large scale offers some of the greatest opportunities to increase bobwhite habitat and populations in many areas of Mississippi. Habitat management tools used to create or enhance bobwhite habitat in forestlands include thinning to reduce tree density, creating forest openings, regular soil disturbances (prescribed fire or disking) to maintain grassy ground cover conditions, and selective herbicides as necessary to control hardwood brush invasions.

Supplemental food plantings or food plots may provide some critical food resources for bobwhites in late winter and early spring when food resources become limited. In some cases, bobwhites benefit more from the native plant community in a fallow food plot than from the food planting itself. Once you determine the number, size, shape, and location of food plots, you can select the types of plants to propagate.

The seasonal habitats bobwhites require need to be developed at the right scale to maintain populations. Relatively small (less than 1,000 acres), isolated land holdings managed for bobwhites can be productive habitat, and smaller acreages might have locally positive effects on survival and reproduction. However, smaller habitat areas are probably more effective if several land holdings within a mile of each other are managed for bobwhite habitat. Since bobwhite populations respond more effectively to management over several thousand acres, landowners with smaller acreages may want to consider working with a group of neighboring landowners to form a landowner wildlife management cooperative.

Consult with qualified natural resource management professionals (such as wildlife biologists and registered foresters) to develop a comprehensive resource management plan. Several conservation programs are available to landowners seeking financial assistance to develop bobwhite habitat. Working with natural resource management professionals can make it easier to determine program eligibility and select conservation programs that accomplish your resource management objectives.

Finally, understanding bobwhite population dynamics and harvest management helps prevent poor resource use decisions. Carefully managing bobwhite harvest helps ensure long-term bobwhite population sustainability.

Ecology and Management of Rabbits in Mississippi



Rabbits have long been an important game species in Mississippi. Rabbit populations responded well to early agricultural practices because those practices created ideal rabbit habitat. By the 20th century, hunting for survival was less common, and sport or recreational hunting became more popular. In the last 30 years, rabbit numbers have declined because of changes in land use and management.

Rabbit populations have declined because of conversion of fields to closed-canopy forests, industrialization of farming and forestry, less use of prescribed fire, and the widespread change of native plant communities to nonnative, invasive grasses like tall fescue and bermudagrass. Using proper management, you can increase local rabbit numbers for more hunting opportunities. Understanding the life history and ecology of different rabbit species provides the background for managing rabbits. If you know about rabbits' lives and seasonal habitat needs, it is easier to understand how to manage their habitat.

Life History and Ecology

General Characteristics

Two species of rabbits are found in Mississippi: the cottontail rabbit and the swamp rabbit, or cane-cutter. Both are relatively common to all regions of the state, but cottontails are more widely distributed.

Adult cottontails are smaller than swamp rabbits. Besides the relative size of adults, you can tell the difference between cottontail rabbits and swamp rabbits from some prominent features. The tops of cottontails' feet are light tan to whitish. They have a distinct rusty nape (back of neck) patch. Adult cottontails average about 2½ pounds. Average home range size (the area an animal spends most of its time) of female cottontail rabbits is 2½ acres; average home range size of males is 2½ to 7 acres.

Swamp rabbits' feet are darker brown. They have shorter, rounder ears and no rusty nape patch. Adult swamp rabbits average about 4 to 6 pounds. Average home range size of female swamp rabbits is 4½ acres; average home range size of males is 4½ to 6 acres. Actual home range size of both species will vary, depending on habitat quality and quantity.

Habitat Requirements

Cottontails are adapted to many grassy and brushy habitats and are most common in upland areas made up of native grasses, forbs (broadleaf plants), and shrubs. Swamp rabbits are more common in the brushy, lowland areas associated with wetlands, streams, and drainage ditches. These plant communities provide cover and food for rabbits.

Food Habits

Both cottontail and swamp rabbits eat a variety of plant foods, including green foliage and blossoms of grasses and forbs, fruits, and bark, twigs, or buds of trees and shrubs. Rabbits also eat a number of cultivated crops, such as bean crops (soybeans, field peas, etc.), clover, and small grains (wheat, oats, etc). Rabbits sometimes damage crops and plants used for landscaping.

Breeding

Cottontails typically breed from January through September. The pregnancy period is about 28 days for cottontails. Young cottontails are born blind and mostly hairless. Average litter size is four to five for cottontails, and the largest litters are produced during May and June. A single female cottontail can easily have four to five litters per year.

Swamp rabbits usually breed from February to mid-July. Pregnancy lasts about 40 days for swamp rabbits. Because of the longer pregnancy period, swamp rabbits are more developed when they are born. Average litter size is three to four for swamp rabbits, and female swamp rabbits usually have only two to three litters per year.

Females of both species prepare a grass and fur-lined nest (called a form) in a shallow hole, typically in grassy or other hidden areas. The mother nurses the young in the nest at dawn and dusk. Young grow and develop quickly after birth. After about 2 weeks, young leave the nest and no longer depend on their mother.

Survival and Mortality

Rabbits have high death rates. Yearly death rates for cottontail populations may be as high as 80 percent. The population survives despite its high death rate because of rabbits' reproductive potential. Average life span is about 15 months for cottontails and about 2 years for swamp rabbits. The main causes of death are predators (including hunters), bad weather, collisions with vehicles, field and brush mowing, and disease. Domestic dogs and cats, hawks, owls, coyotes, bobcats, foxes, and snakes often prey on rabbits. Rabbits are susceptible to many diseases and parasites.

The bacterial disease tularemia is probably the most fatal to rabbits. Tularemia is a serious disease that can be transmitted to humans. Infected rabbits may exhibit no outwardly visible symptoms but are often easily caught by humans or dogs. The disease is most often diagnosed because of white lesions on the liver and spleen. Promptly seek medical attention if you suspect you have had contact with a tularemic rabbit.

Habitat Management Practices

Several management practices can improve rabbit habitat. The next few paragraphs describe ways you can manage habitat for rabbits. In some cases, cost-share programs can help private landowners pay for these practices. Conservation programs for habitat management are discussed later.

Native Warm-Season Grass Management

Native warm-season grasses and forbs are best for rabbits. Native grasses, such as broomsedge, little bluestem, eastern gamagrass, and indiagrass, provide good cover for rabbits. These bunch grasses grow from spring through fall. Native forbs that complement native warm-season grasses by providing both food and cover include partridge pea, native lespedezas, blazing stars, ragweed, and many others. Without management, native grasses become too thick and reduce bare ground and forb cover. Periodic burning and disking help keep native grasses, forbs, shrubs, and bare ground in the right amounts and arrangement to provide good wildlife habitat. For more on establishing and managing native warm-season grasses for wildlife, see MSU Extension Publication 2435 *Native Warm-Season Grass Restoration in Mississippi*. Another good resource is University of Tennessee Extension Publication 1746 *A Landowner's Guide to Native Warm-Season Grasses in the Mid-South*. Ask a wildlife biologist to help you plan native warm-season grass establishment or management.

Herbicide Treatments

Herbicides can help restore neglected wildlife habitats. Usually, grassland habitat in old fields, native grasslands, and upland forests is lost when woody brush, such as green ash or cedar, takes over. Woody brush dominates grassland habitat because of lack of management such as prescribed fire. Scattered brush thickets provide cover for rabbits, but when woody brush completely covers grass fields and upland forests, it shades out desirable grasses and forbs and makes hunting difficult. Keep about 10 to 15 percent of grass fields or upland forests in scattered shrubs or thickets for good rabbit cover. With the right herbicides and management, you can reclaim grassland habitats that have been invaded by brush. After you get the brush under control, maintain grassland habitats with prescribed fire or disking.

Nonnative, invasive plants, such as tall fescue, bermudagrass, bahiagrass, and cogongrass, also damage grassland wildlife habitats. Apply herbicides appropriately to get rid of invasive plants, restore native plant communities, and improve habitat for rabbits and other upland wildlife. No single herbicide treatment will be right for every problem. You may have to try several herbicide combinations or treatments. Ask a wildlife biologist, registered forester, or other experienced natural resources management professional for advice on herbicide treatments.

Forest Management

Timber thinning can improve rabbit habitat in woodlands. Thin pine stands to average basal areas (total cross-sectional area of wood) of 60 square feet per acre or less. This average allows enough sunlight for grasses and forbs to grow in the ground layer. You will have to thin younger pine stands again to keep grassy ground cover as the canopy closes in the years after thinning. If you thin younger pine stands to an average basal area of 50 square feet per acre or less, you can go longer between thinning and still keep ground cover. See the MSU Forest and Wildlife Research Center brochure *Pine Forestland Management for Wildlife* for more information about managing pine forests to improve wildlife habitat. Get a copy of this brochure from the Mississippi Department of Wildlife, Fisheries, and Parks or at <http://www.fwrc.msstate.edu/pubs/forestland.pdf>.

You can also thin hardwood stands to improve rabbit habitat. As with pines, the goal of hardwood thinning is to allow enough sunlight in the ground layer for grasses and forbs to grow. However, thinning hardwood stands is more difficult than thinning pine stands, especially if you are also managing for timber production. Consult a registered forester to help you develop a management plan for forest stands.

After thinning, use prescribed fire, disking, or both to encourage growth of grasses and forbs in upland forests. Forest openings, or small clear-cuts within forest stands, create extra grassland habitat in larger forest stands.

Openings of ¼ to 1 acre are large enough for rabbits. A consulting forester can mark openings when marking timber for thinning. Timber harvest contractors can cut forest openings during thinning operations. Besides providing wildlife habitat, forest openings are handy loading areas during timber harvesting operations.

Timber stand improvement can enhance timber quality and wildlife habitat in forest stands. Timber stand improvement usually means cutting or selectively applying appropriate herbicides to remove less desirable timber trees. Spaces in the middle or upper canopy layers created by the tree removal may increase grasses and forbs in the ground layer, providing food and cover for rabbits. See MSU Extension Publication 1281 *Timber Stand Improvement* for more information on timber stand improvement practices. Ask a registered forester for more information on timber stand improvement. It is a good idea to work with both a wildlife biologist and a registered forester to develop a forest and wildlife management plan that balances wildlife and timber management goals.

Shrub Cover and Brush Piles

Although too much brush cover is undesirable, scattered shrub thickets (including wild plums, blackberry and other briars, dogwoods, or sumacs) provide good protective cover. You can make brush piles where shrub cover is rare. Brush piles are cheap, fairly easy to build, and make almost instant cover. You can make brush piles by cutting brush, trees, or limbs and piling them up in open areas. You can also fell several large trees on top of one another to create cover. You can pile almost any woody debris to create brush piles. Brush piles should be 5 to 6 feet tall and at least 10 to 20 feet wide. You will need to pile more woody debris on the pile after several years of decay. Provide shrub cover or brush piles every 100 yards or so. Keep about 10 to 15 percent of grass fields or upland forests in scattered shrubs, thickets, or brush piles for rabbit cover. Be sure to protect desirable shrub thickets or brush piles from disking or burning. If you use prescribed burning, simply disk firebreaks around desirable shrub thickets or brush piles.

Prescribed Burning

Prescribed burning in fields, grasslands, and open woodlands reduces brush growth and encourages growth of new grass and nutritious annual plants, such as ragweed and native legumes. Rotational burning makes a patchwork of burned and unburned areas in fields or upland forests and maintains a mix of annual and perennial plants. Divide fields or grasslands into strips or patches with disked firebreaks and burn each strip or patch every 3 to 4 years. Divide upland forest stands into 5- to 20-acre blocks with bare soil firebreaks and burn every other block every 3 to 4 years. This setup creates more manageable units for burning and provides a mix of recently burned and unburned stands. Recently burned areas are better feeding areas because burning improves edible grasses and forbs. Areas that have not been burned for 2 to 4 years provide cover. Ask a wildlife biologist or registered forester to help you plan prescribed burns for specific wildlife or forestry goals.

Always get a certified prescribed burn manager to carry out or oversee a prescribed burn. The manager develops a written burn plan and gets the appropriate permits before burning. Check with the Mississippi Forestry Commission for more information about prescribed burning regulations. Another useful reference on prescribed fire is MSU Extension Publication 2283 *Prescribed Burning in Southern Pine Forests: Fire Ecology, Techniques, and Uses for Wildlife Management*.

It is often recommended that firebreaks be established in vegetative cover. This is acceptable when firebreaks are not being used. However, when a site is burned, it is best to have bare soil firebreaks. When not in use, seed firebreaks with winter wheat, oats, or clover for a winter cover. Ryegrasses, except for native species, are not recommended because they are invasive. Seed with suitable, noninvasive cover plants for a summer cover every year to keep firebreaks open and easier to maintain.

Disking

Disking is another management practice that can be used to promote the growth of annual grasses and forbs needed by rabbits. Disking can be used in areas where burning is not possible. Light disking that incorporates at least 50 percent of the aboveground residue can stimulate and maintain natural food plants for rabbits. It can also reduce brush infestations in fields, grasslands, and open woodlands. Light disking for wildlife habitat management does not require a seedbed-quality preparation. Leaving some residue in disked areas is good. Disking can be done from October through February. Fall disking tends to promote forbs and legumes, and spring disking promotes annual grasses. Fall disking may help stimulate more food plants for rabbits. On sites with an agricultural history, spring disking may promote agricultural pest species such as johnsongrass.

Rotational strip disking maintains a mixture of annual and perennial plant communities. In rotational strip disking, you disk 30- to 60-foot strips every 2 to 3 years, and you disk at least some of the area every year. Recently disked areas provide young grasses and forbs that are valuable rabbit foods. Areas that have not been disked for 2 or 3 years provide more perennial grass cover. Disking on a 2- to 3-year rotation helps prevent open ground from being taken over by brush. Disk along the contour of the land to minimize erosion. You can get a good reference on disking for wildlife habitat titled *Light Disking to Enhance Early Successional Wildlife Habitat in Grasslands and Old Fields: Wildlife Benefits and Erosion Potential* through the Mississippi Natural Resources Conservation Service or from the Natural Resources Enterprises website (<http://www.naturalresources.msstate.edu/>) by searching under the "Resources," "Wildlife Management," and "Bobwhite Quail" links.

Mowing

Mowing is often used to manage grassland habitats. Mowing temporarily reduces brush and grass cover. However, mowing entire fields is the worst management practice for wildlife habitat. Perennial, woody brush continues to sprout back after mowing, and mowing reduces the most desirable natural rabbit food plants. Rotational prescribed burning or disking is better for maintaining quality grassland wildlife habitat. Selective herbicide treatment and management with regular burning or disking treatments are the best ways to manage brush. Mowing can help prepare sites with thick, perennial grass cover for strip disking. Mowing can also cut back plants for better herbicide application and coverage. If you mow to create shooting lanes for rabbit hunting, do it as little as possible. Consider using strips disked during fall for shooting lanes. Mow a narrow strip on one or both sides of the disked strip to use for a walking path. These disking treatments will increase natural food plants the following spring and summer. If you must mow, wait until after nesting season has ended (October) and avoid mowing entire fields.

Supplemental Food Plantings

With proper management, native plants will provide enough rabbit foods. Food plantings can provide extra food resources for rabbits, especially during winter months. Food plantings should be near protective cover, such as tall grass, thickets, or brush piles. Winter food plantings include wheat, oats, clovers, and smooth or hairy vetch. Summer foods are usually plentiful, but warm-season food plantings may help if native forbs are hard to come by. If warm-season forbs are scarce, try planting alyceclover, partridge pea, or Kobe or Korean lespedeza for summer feeding.

Habitat Management Practices for Cottontail Rabbits

Management practices are designed to alter the habitat to provide food and cover for rabbits. Typically, food is available, but protective cover is often in short supply. There are several management tools that can help you create and improve rabbit habitat. For those who are interested in quail, the management practices described here are compatible for both species. If quail are a priority, manage for quail, and rabbit populations will also respond. See MSU Extension Publication 2179 *Ecology and Management of the Northern Bobwhite* for more information on quail management.

Fields and Grasslands

Open lands include old fields, native grasslands, Conservation Reserve Program (CRP) fields, and agricultural crop and grazing or hay lands. These habitats usually support existing rabbit populations and can easily be improved for rabbits.

You can create cover for rabbits in crop fields, pastures, or hay fields by making 30- to 120-foot field buffers around the perimeter of fields. Fence in buffers or other idle habitats created in grazing lands. Use herbicides to remove any nonnative grasses, such as tall fescue, bermudagrass, or bahiagrass, from the buffer area. You can then plant buffers with native warm-season grasses and forbs, winter wheat, or oats and clover and allow them to remain fallow. A conservation program may cost-share the establishment of these buffers.

You can also buffer drains within fields. Establish native warm-season grasses and shrubs in them to improve cover for rabbits. Disk or burn a third of the buffer during fall or winter each year after the second or third year of establishment. To provide winter and spring foods, seed

portions of the buffer disked during fall with wheat or oats and clover. You can add native warm-season grass and shrub corridors, or cover strips, through the insides of large crop fields or pastures to create more cover for rabbits. Fence in pasture corridors to keep out livestock.

Old fields or CRP fields established in tall fescue, bermudagrass, or bahiagrass do not provide good rabbit habitat. These are nonnative, sod-forming grasses that exclude many desirable native plants, and many native wildlife species are not adapted to their growth habits. Converting tall fescue, bermudagrass, or bahiagrass to native warm-season grasses and forbs will provide habitat for both rabbits and quail. If your field is enrolled in CRP, you will need to change the CRP contract before you change the established cover. Consult the USDA-Farm Service Agency to modify CRP contracts. Ask a USDA-Natural Resources Conservation Service or Mississippi Department of Wildlife, Fisheries, and Parks wildlife biologist for more information about how to work with the Farm Service Agency to change a CRP contract to improve wildlife habitat.

Prescribed burning and rotational strip disking are cost-effective ways to maintain grass and forb cover in old fields, native grasslands, and CRP fields. Rotational burning encourages new grass growth, reduces excess brush growth, and stimulates growth of nutritious annual plants like ragweed and native legumes. Rotational strip disking can maintain food plants for rabbits and reduce brush infestations in fields and grasslands. Before burning or disking in CRP fields, ask the Farm Service Agency to make sure these practices are allowed by the CRP contract. If not, in most cases the contract can be changed to include prescribed burning as a management option. A Natural Resources Conservation Service or Mississippi Department of Wildlife, Fisheries, and Parks wildlife biologist can tell you how to work with the Farm Service Agency to modify a CRP contract to enhance wildlife habitat.

Establish or keep some shrub thickets at regular intervals in old fields, field buffers, CRP fields, and other grassland areas to provide protective cover. You can make brush piles where shrub cover is scarce. Remember to protect shrub or brush-pile cover from disking or burning. If you use prescribed burning, disk firebreaks around desirable shrub thickets or brush piles.

Forest Lands

You can manage upland pine, hardwood, and mixed pine-hardwood forests for rabbits. Bottomland hardwood stands may support some cottontails and can be managed for both swamp rabbits and cottontails. (See swamp rabbit management section.) For forestlands to be productive habitat for rabbits, they must produce an abundance of grasses and forbs in the understory, or ground layer. To accomplish this, many forest stands need to be thinned and prescribe-burned at regular intervals.

Apply prescribed fire to thinned pine stands every 3 to 4 years to stimulate seed germination and reduce litter (pine straw, dead grass, etc.), which limits growth of grasses and forbs. Apply selective herbicides to control brush if hardwood brush is too thick in the ground and middle-canopy layers of pine forests. Protect some scattered patches of brushy cover from herbicide and fire throughout forest stands.

You can enhance upland hardwood stands by commercial thinning or timber stand improvement using an individual stem treatment. Once the canopy is opened and sunlight can reach the forest floor, you can apply prescribed fire on a 3- to 5-year rotation to stimulate desirable plants and reduce undesirable hardwood sprouts. Smaller stands that do not have desirable timber species may be easier to thin by hand cutting or directly applying selective herbicide using a method like the "hack-and-squirt" technique (see MSU Extension Information Sheet 1573 *Tree Injection with Reduced Labor Requirements*).

Opening the canopy and applying prescribed fire should create a grassland community underneath fire-tolerant hardwoods. Conduct prescribed burning in hardwood stands very carefully. Always check with a registered forester or wildlife biologist before burning in hardwood stands. Oaks such as post, blackjack, scarlet, bluejack, and turkey oak and hickories such as shellbark and shagbark hickory are relatively fire tolerant. These species also produce food for deer, turkey, quail, and other wildlife. Although these may not be valuable timber stands, they will provide habitat for a number of game and nongame species.

If prescribed fire is not an option, you can enhance rabbit habitat in thinned pine plantations with woodland strip disking. The stands must be fairly free of exposed stumps, logging slash, and other debris. Disk one-third of thinned rows in plantations or one-third of the area around saw timber-aged trees each year. Be careful when disking in woodlands to avoid personal injury and damaging trees or equipment. A heavy-duty disk is recommended for woodland strip disking.

You can create forest openings ¼ acre to 1 acre in size to enhance rabbit habitat. Maintain openings with rotational disking, alternating food plantings, or prescribed burning. If you use prescribed burning to manage woods, simply let fires burn through openings. Remember to protect some patches of thicket cover by disking firebreaks around them.

Habitat Management Practices for Swamp Rabbits

Swamp rabbits depend mostly on bottomland forests, wetland habitats, and grassland habitats next to streams, drainages, or wetlands. Conserving these habitats and maintaining food (grasses, forbs, and vines) and cover (cane and other thickets) are essential for increasing swamp rabbit populations.

Thinning bottomland hardwood forests or timber stand improvement treatments can improve swamp rabbit habitat by increasing sunlight on the ground. Increasing sunlight on the ground promotes growth of grasses and forbs that provide food and cover. Creating ¼-acre to 1-acre forest openings throughout forests also enhances grass and forb cover. You can pile debris from thinning or cutting in portions of forest openings to create escape cover.

If you harvest timber in bottomland hardwood forests (clear-cuts), do not clear-cut within 100 to 200 feet on either side of the stream (200 to 400 feet total). These areas are called streamside management zones. Thinning, timber stand improvement treatments, and maintaining scattered thickets can enhance swamp rabbit habitat in streamside management zones.

You can enhance grassy habitats next to wetlands with prescribed fire or strip disking. Rotationally burn or disk every 3 to 4 years to maintain new growth of grasses and forbs. Disked strips can be planted with summer and winter food plantings to increase food.

Before managing a property for rabbits, put a wildlife habitat management plan in place. Farmers can work with a wildlife biologist to develop a plan that includes affordable, practical habitat management practices. Forest landowners can meet with a wildlife biologist and a registered forester to write a management plan for both forest and wildlife goals.

Several conservation programs can help private landowners with start-up costs of farm and forest wildlife management practices. Many of the same habitat management practices can be applied under different conservation programs, but there are differences in eligibility and financial incentives under each program. You cannot apply more than one conservation program to an acreage. You may be able to apply a combination of conservation programs to different acreage on the same property to get the most benefit. If you plan ahead, you can use several programs and practices to help meet your management goals in a way that makes financial sense. Wildlife biologists from the Mississippi Department of Wildlife, Fisheries, and Parks' Private Lands Habitat Program and Small Game Program or USDA-Natural Resources Conservation Service (NRCS) can help you plan for wildlife management and choose conservation programs.

See the tables on the following pages for more information about available programs.

Nongovernmental Organizations

Delta Wildlife provides technical assistance and cost-share for habitat development to landowners in the Delta region. Contact Delta Wildlife for information about their habitat management programs. Wildlife Mississippi has prairie and longleaf pine restoration programs available to eligible landowners in the Blackland Prairie and longleaf pine regions of Mississippi. Contact Wildlife Mississippi for information about their prairie and longleaf restoration programs.

Technical Assistance for Private Landowners

The following agencies are available to provide wildlife and/or forest management planning or technical assistance:

Delta Wildlife, Inc.

<http://www.deltawildlife.org/>

662.686.3370

Mississippi Department of Wildlife, Fisheries, and Parks

<http://www.mdwfp.com/>

601.432.2199

Mississippi Forestry Commission

(Registered foresters available to assist landowners with forest management planning)

<http://www.mfc.state.ms.us/>

601.359.1386

MSU Forest and Wildlife Research Center

<https://www.fwrc.msstate.edu/>

662.325.2952

MSU Wildlife and Fisheries Extension

<https://www.cfr.msstate.edu/wildlife/>

662.325.3174

USDA-Farm Service Agency

(Administers the Conservation Reserve Program)

<http://www.fsa.usda.gov/>

601.965.4300

USDA-Natural Resources Conservation Service

(Wildlife biologists and registered foresters provide landowner technical assistance)

<http://www.ms.nrcs.usda.gov/>

601.965.4339

Wildlife Mississippi

<http://www.wildlifemiss.org/>

662.686.3375

More Information

Publications and information sheets produced by the Mississippi State University Extension Service and mentioned in the text are available on the Mississippi State University Extension Service website (extension.msstate.edu) or through county Extension offices.

Hunting and Harvest Management

In areas where there are plenty of rabbits, rabbit hunting is a relatively easy, low-cost, and exciting sport. When in the field, remove entrails (guts) from harvested rabbits right away. Keep harvested rabbits cool. The hide can be removed later. To avoid disease risks, it is a good idea to carry rubber gloves and hand sanitizer to the field for dressing rabbits. If you enjoy hunting rabbits but do not like to eat them, try to find someone who can use the meat. Always dress game promptly and properly before giving it to others.

The rabbit-hunting season in Mississippi is open from mid-October through February, although some public lands may have specific dates on which rabbit hunting is open. Consult hunting regulations to find exact hunting season dates; hunting season dates can be found on the Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) website (<http://www.mdwfp.com/>) or by contacting an MDWFP office. Check area regulations to determine when rabbit hunting is allowed on public hunting areas.

Rabbit hunting is often done with dogs, usually beagles. However, you may also enjoy walking through cover alone or in a group to flush or “jump” rabbits. Hunt grass fields, thickets, fencerows, woody edges, and open woods to find rabbits. Kicking around brush piles and shrub thickets in grassy areas will often yield rabbits. Safety is always a top priority on any hunting trip. Be aware of where other hunters, dogs, buildings, and roads are. Wear an orange vest or hat so other hunters can see you.

Private landowners may be willing to allow hunters access to their property to hunt rabbits, especially in agricultural areas, where rabbits may damage crops. Always ask permission from the landowner before hunting on private property. Do not take game other than species you have to permission to take legally. Obey all game laws. Be courteous, and do not leave litter (including shotgun shells) behind. Drive vehicles only on clearly established roads. If no fee is charged to hunt, it is a good idea to provide a small token of appreciation to the landowners for allowing hunting on their property. This may be as simple as periodically offering a few dressed rabbits or some other gift. Ethical and polite hunters are more likely to be invited back.

In areas with relatively large amounts of quality habitat, legal harvest of rabbits has little impact on rabbit populations. Remember that if surrounding areas do not have good rabbit habitat, populations in isolated “islands” of habitat are more likely to be negatively affected by intense hunting pressure than in areas where habitat is plentiful in the surrounding area. Areas without much acreage in fields, grasslands, or open forests will likely not support good numbers of cottontails. If quality bottomland and wetland habitats are scarce, swamp rabbits will be few in number.

Quality cover is the main factor that determines rabbit population productivity. If you want higher rabbit populations and habitat is lacking on a large scale, consider ways to affect the surrounding land. You may try working with nearby landowners to increase rabbit habitat over a larger area. A wildlife biologist can assist groups of landowners with common wildlife goals who are interested in developing a cooperative wildlife management strategy.

Summary

Cottontail and swamp rabbits are relatively common to all regions of Mississippi. Within the last 30 years, rabbit populations have declined a lot because of changes in land use and management. With proper management, local rabbit populations can be increased for more hunting opportunities. Often, rabbit habitat can be created relatively easily. You can use a number of habitat management practices to enhance rabbit habitat quality, including prescribed burning, light disking, native warm-season grass restoration, developing protective thicket cover, and forest thinning. Several conservation programs are available to assist private landowners with habitat management. Wildlife biologists from state, federal, and private natural resource management agencies are also available to help private landowners with wildlife management planning and selecting conservation programs and practices for wildlife management.

Conservation Programs for Private Landowners

Name of Conservation Program	What it Does	Who Qualifies	Who Administers it	Additional Notes
Conservation Reserve Program (CRP)	<p>Provides technical and financial assistance to address soil, water, and related natural resource concerns on lands.</p> <p>Encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage, such as marginal pastureland, to vegetative cover such as native grasses, wildlife plantings, trees, filter strips, or riparian buffers.</p> <p>Provides an annual rental payment for the term of the multi-year contract.</p> <p>Provides cost-sharing to establish and manage vegetative cover practices.</p>	Eligible farmers and ranchers.	<p>USDA-Farm Service Agency</p> <p>USDA-Natural Resources Conservation Service (NRCS) provides technical assistance, conservation planning, and practice implementation.</p>	<p>For landowners who have acreage enrolled in existing CRP forest conservation covers (such as CP11), mid-contract management cost-shares are available for prescribed burning and herbicide application. To be eligible for cost-shares, mid-contract management practices must be incorporated into the CRP contract and management plan before any management is implemented.</p> <p>If mid-contract management practices are not already required by the contract, contract holders must modify their Conservation Plan of Operation to reflect the timing, frequency, and extent of approved mid-contract management practices.</p> <p>For more information, see Mississippi State University Forest and Wildlife Research Center brochure <i>Conservation Reserve Program Mid-Contract Management: Practices for Wildlife Habitat Improvement in Mississippi</i>, available at http://www.fwrc.msstate.edu/pubs/midcontract.pdf. Copies may also be obtained from the Mississippi Department of Wildlife, Fisheries, and Parks.</p>
Conservation Security Program (CSP)	<p>Supports ongoing stewardship of private agricultural lands by providing payments for maintaining and enhancing natural resources.</p> <p>Gives financial and technical help to protect and improve soil, water, air, energy, plant, and animal life.</p> <p>Encourages conservation on working lands (cropland, pasture, grassland) and forested land that is part of a farm.</p>	<p>Limited to producers in specific watersheds.</p> <p>Different priority watersheds are chosen for CSP every year.</p>	NRCS	
Environmental Quality Incentives Program (EQIP)	<p>Addresses specific resource concerns that will improve air and water quality; reduce soil erosion; improve riparian, aquatic, and forestland habitats; and address wildlife issues.</p>	<p>Agricultural producers who face threats to soil, water, air, and related natural resources on their land.</p> <p>Management practices available through EQIP depend on the county where a property is located because each county has specific natural resource concern priorities.</p>	NRCS	<p>Some counties have wildlife habitat management practices available through EQIP and/or practices that are not specifically designated for wildlife but may be used to enhance wildlife habitat. Landowners managing forests are advised to contact their local NRCS office for specific eligibility requirements as well as local county resource concern priorities.</p>
Forest Resource Development Program (FRDP)	<p>Provides cost-shares for forest management practices such as herbicidal control of invasive vegetation and forest regeneration.</p>	Available to any non-industrial private forest landowner.	Mississippi Forestry Commission	

<p>Grassland Reserve Program (GRP)</p>	<p>Offers landowners the opportunity to enhance grasslands on their property.</p> <p>Helps landowners restore and protect grassland, rangeland, pastureland, shrubland, and certain other lands.</p> <p>Provides assistance for rehabilitating grasslands.</p> <p>Conserves vulnerable grasslands from conversion to cropland or other uses.</p> <p>Conserves valuable grasslands by helping maintain viable ranching operations.</p> <p>Provides conservation easements and restoration agreements to restore, protect, and enhance grasslands.</p>	<p>Contact your NRCS office for more information.</p>	<p>NRCS</p> <p>Farm Service Agency</p> <p>Forest Service</p>	
<p>Healthy Forests Reserve Program (HFRP)</p>	<p>Voluntary program established for the purpose of restoring or enhancing forest ecosystems, such as longleaf pine, to 1) promote the recovery of threatened and endangered species, 2) improve biodiversity, and 3) enhance carbon sequestration.</p> <p>Provides financial incentives, through conservation easements and/or 10-year restoration agreements, for appropriate forest management practices that will meet program management objectives.</p>	<p>Contact your NRCS office for more information.</p>	<p>NRCS</p>	
<p>Wetlands Reserve Program (WRP)</p>	<p>Provides technical and financial assistance to eligible landowners to address wetland, wildlife habitat, soil, water, and related natural resource concerns.</p> <p>Provides financial incentives, through conservation easements and/or 10-year restoration agreements, to restore, protect, and enhance wetlands, including bottomland hardwood forests, while retiring marginal land from agriculture.</p>	<p>Contact your NRCS office for more information.</p>	<p>NRCS</p>	
<p>Wildlife Habitat Incentives Program (WHIP)</p>	<p>Encourages the creation of high-quality wildlife habitats that support wildlife populations of national, state, and local significance.</p> <p>Offers technical and financial assistance to develop or improve upland, wetland, riparian, and grassland habitat in both open lands and non-industrial private forestlands.</p> <p>Offers cost-shared practices for prescribed fire; herbicidal control of invasive vegetation; establishment of buffers, transition zones, and hedgerows; native vegetation establishment; and wetland management.</p>	<p>Available to agricultural and nonindustrial private forest landowners.</p>	<p>NRCS</p>	

Ecology and Management of Squirrels in Mississippi



Squirrels have long been important game species in Mississippi. Although squirrel hunting is still very popular in Mississippi, squirrel hunter and harvest numbers have decreased over the last 20 years. This is probably because of increased big-game hunting opportunities and less interest in hunting in general. Squirrel hunting is a great way to introduce new hunters to hunting, especially young people. Where squirrel numbers are high, squirrel hunting is a relatively easy, low-cost, and exciting sport. Hunttable squirrel populations are found throughout Mississippi, but there are still ways to enhance squirrel habitat and hunting opportunities. Understanding the life history and ecology of squirrels is critical when managing their populations.

Life History and Ecology

General Characteristics

Two game species of squirrels live in Mississippi: the eastern gray squirrel and the eastern fox squirrel. Both species are fairly common to all regions of the state, but gray squirrels are more common. Fox squirrel populations have declined greatly in many areas because of changes in land use and management.

You can tell the difference between gray and fox squirrels using some obvious features. Adult fox squirrels are a good bit larger than adult gray squirrels. An average adult gray squirrel is about 8 to 10 inches long from head to hind end, with a 7- to 10-inch tail. It weighs just over 1 pound. An average adult fox squirrel is about 10 to 15 inches long from head to hind end. It has a 9- to 14-inch tail and weighs 1½ to 2½ pounds. Gray squirrels have pink paw soles, and fox squirrels have black paw soles.

As the name implies, the fur of gray squirrels is mostly grayish but grizzled with red, black, and white hair. You may rarely find a black or albino (no skin or hair color) gray squirrel. Two subspecies of fox squirrels are in Mississippi. The "hill country" fox squirrel is the more common fox squirrel subspecies in open upland areas throughout the state. Its body is a combination of black, brown, and orange, with a black mask and white on the nose, ears, and paws. Individual squirrels often have slight variations in mask and white colorations on the nose, ears,

and paws. The Delta fox squirrel is limited mainly to the Delta region. It has both a black and rusty red color phase. It does not have the mask and white colorations of the upland subspecies.

Habitat Requirements

Gray squirrels generally occupy mature forests. Mature, hardwood, and mixed pine-hardwood forests will support more gray squirrels than typical loblolly pine forests. However, longleaf pine forests probably support more squirrels than loblolly and other pine forests because longleaf pines produce lots of large seeds, and the more open nature of longleaf pine forests produces good upland fox squirrel habitat.

In the past, fire-maintained upland hardwood forests supported good numbers of upland fox squirrels and gray squirrels. This type of habitat is now rare in Mississippi. Delta fox squirrels live mostly in mature hardwood forests or woodlots in their range. Squirrels depend on forest habitats, but all species of squirrels will go into residential areas, pecan and fruit orchards, agricultural fields, and other nonforest areas to take advantage of available food and cover.

Both species of squirrels use leaf nests and cavity dens. Squirrels build nests of leaves and twigs, usually 25 feet or more from the ground. They also use hollow trees and tree cavities for dens. Squirrels use leaf nests and dens to rest, hide, warm up or cool down, and rear young.

Food Habits

Both gray and fox squirrels eat different kinds of plant, fungi, and animal foods. Squirrels will eat mast (acorns, nuts, seeds, and fruits) from many different trees and shrubs. Oak, hickory, beech, pecan, and black walnut mast are very good squirrel foods. Pine seed (especially longleaf pine) is also an important squirrel food, especially when oak and hickory mast is scarce. Fruits of black and tupelo gums, dogwood, black cherry, wild plums, mulberry, viburnum, and paw-paw are also preferred foods. Squirrels eat mushrooms and other fungi, insects, grubs

and other invertebrates, and eggs. During spring, squirrels eat tender young leaves and buds. In some areas, squirrels can actually damage agricultural or orchard crops like corn and pecans.

Breeding

Both gray and fox squirrels have two major breeding periods in Mississippi. They also breed some throughout the year. The winter breeding period results in young born January to March. The summer breeding period results in young born June to August. The summer breeding period is usually more productive.

Gray squirrels have more than one mate, whereas fox squirrels generally have one mate. Adult females (2 years and older) often have two litters per year, but young females generally have one litter per year. Both species average three young per litter. Pregnancy lasts about 44 to 45 days for both species.

Squirrels birth and rear their young in either leaf nests or dens. Young squirrels are born blind, deaf, and mostly hairless. By 5 weeks of age, young have a full coat of fur. By 10 to 12 weeks, squirrels are fully weaned and no longer depend on their mother.

Survival and Mortality

Squirrels have fairly high death rates, but squirrel numbers stay steady when enough quality habitat is available. In the wild, squirrels live about 18 months. Food availability probably affects survival more than any other factor. The amount of food changes from year to year depending on weather and other factors, and squirrel populations often change in response.

Squirrels die because of predators (including hunters), bad weather, car accidents, and disease. Domestic cats, hawks, owls, bobcats, foxes, and snakes commonly prey upon squirrels. Botfly larvae, also called wolves, are their most noticeable parasite but do not negatively affect squirrels very often. Mange, or scabies, is a disease caused by a certain type of mite. Mange irritates skin and causes hair loss and is most common in squirrels during late winter and early spring. Ticks, fleas, and other parasites are also common.

Common Habitat Management Practices

The following sections describe some ways you can improve squirrel habitat. In some cases, cost-share programs may help pay for these practices. Several cost-share programs are described later in this publication.

Forest Management

Timber stand improvement is a way to improve timber quality and wildlife habitat in forest stands. Timber stand improvement usually means removing some trees by cutting or using herbicides. By removing less desirable trees, you make more room for desirable trees. See MSU Extension Publication 1281 *Timber Stand Improvement* for information about timber stand improvement practices, or ask a registered forester for more information.

Keep in mind that timber stand improvements that increase timber profit may not make the best squirrel habitat. For example, many den trees, hickories, and soft mast producing trees may be removed in a timber stand improvement done just for increasing timber value. Thus, it is a good idea to involve both a registered forester and a wildlife biologist in forest management planning to balance timber and wildlife management objectives.

Although squirrels are often associated with hardwood forests, pine and mixed pine-hardwood stands also produce some squirrel habitat. In upland forest stands, thinning and prescribed fire will not negatively affect squirrel populations. These treatments actually improve upland fox squirrel habitat and may help ground layer plants produce more food. They also make hunting easier by reducing underbrush. See MSU Forest and Wildlife Research Center brochure *Pine Forestland Management for Wildlife* (<http://www.fwrc.msstate.edu/pubs/forestland.pdf>) for more information about managing pine forests to improve wildlife habitat. You can also get a copy of this brochure from the Mississippi Department of Wildlife, Fisheries, and Parks.

On appropriate sites, bottomland hardwood and longleaf pine forest restoration can improve squirrel and other wildlife habitats for the future. The long-term benefits of restoration may take years but can serve future generations.

Herbicide Treatments

For squirrel management, herbicides are used mostly in timber stand improvement. However, you may also use selective herbicides to control nonnative, invasive plants like privet, tropical soda apple, cogongrass, and others that decrease the habitat quality of native forests. No single herbicide treatment will be right for every problem. You often must use several herbicide combinations or treatments to control invasive vegetation. Ask a wildlife biologist, registered forester, or other experienced professional for advice about herbicide treatments.

Prescribed Burning

Prescribed burning is not often associated with gray squirrel management, but burning open woodlands improves habitat for upland fox squirrels. Burning upland woodlands can also make hunting easier by reducing brush in the ground layer. Divide upland forest stands into 5- to 20-acre blocks with bare soil firebreaks. Burn alternate blocks on a rotation every 3 to 4 years. Burning only every other block allows you to keep some ground cover, and smaller blocks can be more safely burned. Work with a wildlife biologist, a registered forester, or both to plan prescribed burns for your wildlife or forestry goals.

To gain liability protection provided by the Mississippi Prescribed Burn Act, a certified prescribed burn manager must carry out or supervise any prescribed burn. To be afforded this liability protection, the burn manager must write and strictly follow a burn plan and obtain a permit before burning. Check with your Mississippi Forestry Commission county office for prescribed burning regulations. Also see MSU Extension Publication 2283 *Prescribed Burning in Southern Pine Forests: Fire Ecology, Techniques, and Uses for Wildlife Management*.

Artificial Dens

If mature trees with natural cavities are scarce, you can build artificial dens for squirrels. They often use leaf nests, but tree cavities or artificial dens are usually more secure and sheltered from bad weather. Cavities and artificial dens are more important in colder areas.

Application of Habitat Management Practices for Gray Squirrels

You can manage upland pine, hardwood, and mixed pine-hardwood forests for squirrels. To manage for squirrels, focus on natural foods and den sites. If gray squirrel habitat is a priority, keep some hardwood stands intact. If you harvest timber by clear-cutting, do not cut 100 to 200 feet on either side of stream channels (200 to 400 feet total). Leaving these areas intact protects water quality and provides habitat for squirrels and other wildlife.

On bottomland sites that lack desirable tree species, hardwood forest restoration is a good way to increase future habitat for gray squirrels. It may take 30 years or more to grow hardwood stands from seedlings that provide good squirrel habitat. Ask a registered forester experienced in hardwood regeneration to plan hardwood timber harvests to increase the chance of regenerating desirable trees. For more information about bottomland

hardwood management, see MSU Extension Publication 2004 *Bottomland Hardwood Management: Species/Site Relationships*.

Pine and mixed pine-hardwood stands managed for timber provide some squirrel habitat because pine seeds and any hardwood mast that is available provide food. To increase food for squirrels, keep some mast-producing hardwood trees and shrubs in pine stands. Save den trees or build and install artificial dens in all forest types to maximize secure den sites. Develop an integrated forest and wildlife management plan with a registered forester and wildlife biologist to achieve your timber and wildlife management objectives.

Application of Habitat Management Practices for Fox Squirrels

To manage for upland fox squirrels, upland forest stands must be thinned and managed with prescribed fire to maintain an open stand. In both pine and upland hardwood stands, reduce canopy cover to about 60 percent or less. Keep desirable mast-producing trees. Oaks such as post, southern red, blackjack, scarlet, and burr oak can survive prescribed fires. You may want to thin smaller woodlots by hand-cutting and applying herbicide using cut-stem treatments or the "hack-and-squirt" technique (see MSU Extension Information Sheet 1573 *Tree Injection with Reduced Labor Requirements*).

Apply prescribed fire every 3 to 5 years to keep these stands open. Burning in upland hardwood stands must be done very carefully. To minimize injury to upland hardwoods, use low-intensity, cool-season fires. Always consult a registered forester or wildlife biologist first. Upland hardwood stands maintained by fire will not typically be high-value timber stands, but they will provide more suitable habitat for fox squirrels and many other game and nongame species.

You can manage longleaf pine stands for upland fox squirrels with prescribed fire every 2 to 3 years. On appropriate sites, longleaf pine forest restoration can increase future habitat for both fox and gray squirrels. Longleaf pines can be burned safely in the year after establishment, but do not burn longleaf pine seedlings after they start height growth (emergence of a "candle"). You can burn in late fall or winter once they are 6 feet tall. Thin older longleaf pine stands when necessary.

Use prescribed fire to maintain good fox squirrel, deer, turkey, quail, and rabbit habitat. For more information, get *Restoring and Managing Longleaf Pine: A Handbook for Mississippi Landowners* from the conservation organization

Wildlife Mississippi. Save some mast-producing hardwood trees (fire-tolerant species like blackjack, bluejack, post, southern red, and turkey oak) and shrubs in longleaf pine stands for squirrel food.

In the Delta, use bottomland hardwood forest conservation and restoration to increase future habitat for both Delta fox and gray squirrels. Review the section on gray squirrel management to find out how to plan for timber harvests in bottomland hardwoods. Consult both a registered forester and a wildlife biologist to balance your forest and wildlife management goals.

As with gray squirrels, keep some den trees for fox squirrels. If den trees are lacking, building and installing artificial dens throughout forest stands may increase availability of secure den sites.

Conservation Programs for Private Landowners

Conservation programs can help you with start-up costs of some farm and forest wildlife management practices. Several conservation programs may support the same management practice, but there are different requirements and rewards for each program. You can apply only one conservation program to a plot of land. You may be able to use a combination of conservation programs on different plots in the same property. If you plan ahead, you can use several programs and practices to help meet your management goals in a way that makes financial sense. Wildlife biologists from the Mississippi Department of Wildlife, Fisheries, and Parks' Private Lands Habitat Program and Small Game Program or USDA-Natural Resources Conservation Service (NRCS) can help you plan for wildlife management and choose conservation programs.

See the tables on pages 6 and 7 for more information about available programs.

Nongovernmental Organizations

Delta Wildlife provides technical assistance and cost-share for habitat development, such as bottomland hardwood restoration, to landowners in the Delta region. Wildlife Mississippi has hardwood and longleaf pine restoration programs available to eligible landowners. Contact these organizations for information about their habitat restoration programs.

Technical Assistance for Private Landowners

The following agencies can give wildlife and/or forest management planning or technical assistance to private landowners:

Delta Wildlife Inc.

<http://www.deltawildlife.org/>
662.686.3370

Mississippi Department of Wildlife, Fisheries, and Parks

<http://www.mdwfp.com/>
601.432.2199

Mississippi Forestry Commission

(Registered foresters available to assist landowners with forest management planning)
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662.325.2952

MSU Wildlife and Fisheries Extension

<http://www.cfr.msstate.edu/wildlife/education.asp>
662.325.3174

USDA-Farm Service Agency

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Wildlife Mississippi

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662.686.3375

More Information

Publications and information sheets produced by the Mississippi State University Extension Service and mentioned in the text are available at *extension.msstate.edu* or through county Extension offices.

Hunting and Harvest Management

Compared to other small-game species, such as rabbits and quail, squirrel numbers have remained high. Squirrel hunting is good in many areas of Mississippi. Squirrel meat is also tasty and healthy when properly prepared. Remove guts from harvested squirrels within a few hours of harvest, and keep them cool. The hide can be removed later. Take rubber gloves and hand sanitizer for dressing squirrels in the field. Do not waste; if you enjoy hunting squirrels but not eating them, give the meat to someone who will use it. Always dress game promptly and properly before giving it to others.

The squirrel hunting season in Mississippi is divided into three zones. There are also special youth seasons open before the regular season on private lands and some Wildlife Management Areas within each zone. The regular season is open from October through February. Some public lands may have specific dates when squirrel hunting is open. Check hunting regulations to find exact hunting season dates and daily bag limits. You can find hunting season dates on the Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) website (<http://www.mdwfp.com/>), at MDWFP offices, and in most stores where hunting licenses are sold.

Squirrel hunting with dogs was once popular in Mississippi and is now becoming popular again. Hunting squirrels with treeing dogs is easiest during the late season when more squirrels are feeding on the ground and trees are bare. Still, hunting or slowly walking through the woods alone or in a group is an effective and popular way to hunt squirrels. You will often find good squirrel hunting when squirrel populations are high and hickory nuts or acorns are abundant.

Safety is important on any hunting trip. Know where other hunters, dogs, buildings, and roads are. If you hunt with a rifle, remember that bullets from small-caliber, rimfire rifles can easily travel up to a mile.

In areas with plenty of good habitat, legal squirrel hunting does not negatively affect squirrel populations. The amount of available food and habitat influences squirrel populations more than hunter harvest.

Summary

Gray and fox squirrels are fairly common throughout Mississippi. Except for upland fox squirrels in many areas of the state, squirrel populations have remained abundant for the past 20 years. With good management, you can increase local squirrel numbers for better hunting. Several habitat management practices improve squirrel habitat quality and accessibility for hunting, including timber stand improvement, making artificial dens, and forest restoration. Conservation programs may be available to help private landowners with habitat management. Wildlife biologists from state and federal natural resource management agencies can also help private landowners plan for wildlife management and choose appropriate conservation programs.

Conservation Programs for Private Landowners

Name of Conservation Program	What It Does	Who Qualifies	Who Administers It	Additional Notes
Conservation Reserve Program (CRP)	<p>Provides technical and financial assistance to address soil, water, and related natural resource concerns.</p> <p>Encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage, such as marginal pastureland, to vegetative cover such as native grasses, wildlife plantings, trees, filter strips, or riparian buffers.</p> <p>Provides an annual rental payment for the term of the multi-year contract.</p> <p>Provides cost-sharing to establish and manage vegetative cover practices.</p>	Eligible farmers and ranchers	<p>USDA-Farm Service Agency</p> <p>USDA-Natural Resources Conservation Service (NRCS) provides technical assistance, conservation planning, and practice implementation</p>	<p>For landowners who have acreage enrolled in existing CRP forest conservation covers (such as CP11), mid-contract management cost-shares are available for prescribed burning and herbicide application. To be eligible for cost-shares, mid-contract management practices must be incorporated into the CRP contract and management plan before any management is implemented.</p> <p>If mid-contract management practices are not already required by the contract, contract holders must modify their Conservation Plan of Operation to reflect the timing, frequency, and extent of approved mid-contract management practices.</p> <p>For more information, see Mississippi State University Forest and Wildlife Research Center brochure <i>Conservation Reserve Program Mid-Contract Management: Practices for Wildlife Habitat Improvement in Mississippi</i>, available at http://www.fwrc.msstate.edu/pubs/midcontract.pdf. Copies may also be obtained from the Mississippi Department of Wildlife, Fisheries, and Parks.</p>
Conservation Security Program (CSP)	<p>Supports ongoing stewardship of private agricultural lands by providing payments for maintaining and enhancing natural resources.</p> <p>Gives financial and technical help to protect and improve soil, water, air, energy, plant, and animal life.</p> <p>Encourages conservation on working lands (cropland, pasture, grassland) and forested land that is part of a farm.</p>	<p>Limited to producers in specific watersheds.</p> <p>Different priority watersheds are chosen for CSP every year.</p>	NRCS	
Environmental Quality Incentives Program (EQIP)	<p>Addresses specific resource concerns that will improve air and water quality; reduce soil erosion; improve riparian, aquatic, and forestland habitats; and address wildlife issues.</p>	<p>Agricultural producers who face threats to soil, water, air, and related natural resources on their land.</p> <p>Management practices available through EQIP depend on the county where a property is located because each county has specific natural resource concern priorities.</p>	NRCS	<p>Some counties have wildlife habitat management practices available through EQIP, and/or practices that are not specifically designated for wildlife but may be used to enhance wildlife habitat. Landowners managing forests are advised to contact their local NRCS office for specific eligibility requirements as well as local county resource concern priorities.</p>

Forest Resource Development Program (FRDP)	Provides cost-shares for forest management practices such as herbicidal control of invasive vegetation and forest regeneration.	Available to any nonindustrial private forest landowner.	Mississippi Forestry Commission	
Healthy Forests Reserve Program (HFRP)	<p>Voluntary program established for the purpose of restoring or enhancing forest ecosystems, such as longleaf pine, to 1) promote the recovery of threatened and endangered species, 2) improve biodiversity, and 3) enhance carbon sequestration.</p> <p>Provides financial incentives, through conservation easements and/or 10-year restoration agreements, for appropriate forest management practices that will meet program management objectives.</p>	Contact your NRCS office for more information.	NRCS	
Wetlands Reserve Program (WRP)	<p>Provides technical and financial assistance to eligible landowners to address wetland, wildlife habitat, soil, water, and related natural resource concerns.</p> <p>Provides financial incentives, through conservation easements and/or 10-year restoration agreements, to restore, protect, and enhance wetlands, including bottomland hardwood forests, while retiring marginal land from agriculture.</p>	Contact your NRCS office for more information.	NRCS	
Wildlife Habitat Incentives Program (WHIP)	<p>Encourages the creation of high-quality wildlife habitats that support wildlife populations of national, state, and local significance.</p> <p>Offers technical and financial assistance to develop or improve upland, wetland, riparian, and grassland habitat in both open lands and nonindustrial private forestlands.</p> <p>Offers cost-shared practices for prescribed fire; herbicidal control of invasive vegetation; establishment of buffers, transition zones, and hedgerows; native vegetation establishment; and wetland management.</p>	Available to any private landowners and others.	NRCS	



[Home](#) > [Natural Resources](#) > [Wildlife](#) > **Food Plots**

Wildlife

Food Plots

Planting wildlife food plots is a common practice, especially for white-tailed deer. Many landowners or club members believe that a properly managed habitat and deer herd includes planted food plots. While the contribution of supplemental plantings to deer management should not be overlooked, more benefit can be realized through manipulation of native habitat. Practices such as well-timed prescribed burning of pine forests or proper timber harvesting techniques will provide abundant, high-quality forage and cover for deer at little or no cost to the landowner.

Consistently productive food plots require careful thought and planning before they are implemented. Factors to consider include the following.

Location

Plots should be located on fertile soils with adequate drainage. Cover should be located nearby or scattered across the plot. Food plots should not be established near a public road or waterway due to the increased possibility of poaching.

Size

Plot size and shape may vary with local conditions, but to provide adequate sunlight to meet forage production requirements generally should not be less than one acre.

Spacing

Plots should be scattered over the entire property if possible. It is more beneficial to establish 10 plots 2 acres in size than to have a single 20-acre field. Cost may dictate total acreage planted.

Soil Testing

To ensure productive food plots conduct soil tests for fertilization and lime requirements. The local county agent (MSU-Extension Service office) can provide information on soil sample collection and where to send them for analysis. Be sure list the potential crops to be grown when sending in soil samples for testing.

Planting

Be sure to select a plant species or combination of species that will grow on the particular soil type and site that you have. If unsure, ask the county agent, wildlife biologist, or local seed supplier. Proper seedbed preparation will increase germination and yield more productive food plots. Plant crops at the prescribed seeding rate and during the proper planting season. It is critical that legume seeds (clovers, peas, beans) be inoculated with nitrogen fixing bacteria before planting.



Wildlife

Habitat Management

Wildlife species require suitable or healthy habitats to help maintain or increase population numbers. Habitats provide the food, cover, space, and water needs of different animals. Management of native vegetative species, from forbs (weeds) to mature trees, will impact habitat quality to a much greater extent than will any foodplanting or supplemental efforts. Also, for many wildlife species, habitat management must be incorporated with proper protection and harvest management.

Management Tools

Soil quality determines wildlife habitat and population potential. Soil disturbances, such as timber harvest, disking, mowing, and prescribed burning, can improve wildlife habitat, and, if done correctly, can reduce the need for food plantings. However, to maximize vegetative habitat diversity and to help in wildlife harvest and viewing, you might want a mixture of both.

Disking can prepare seedbeds for planting and change the natural composition of plants by removing thicker, undesirable grasses and creating space for more desirable legumes and seed producers. Disking also increases insect production. The best method of disking is "strip disking." This technique works best with fields (pastures or agricultural) and rights-of-way but may also be used in stands of open timber. The key is to disk strips that are 30 to 50 feet wide to leave similarly undisked strips in between them. Do this alternately across the length of the field or area. You should disk strips every 3 years or so for quail.

Strip disking is excellent for providing nesting and broodrearing habitat, insect production, and important seed (food) production for quail and turkeys. As an example, blackberries, an important food to deer, turkeys, and quail, grow on an average 3-year rotation and can be promoted on a 3-year disking schedule. Aquatic plants (e.g., maidencane and smartweed), which are important duck foods at certain times, can be encouraged by spring and summer disking in drawdown ponds or marshy areas. Legumes (e.g., partridge pea, beggarweed, vetches), forbs (e.g., croton, ragweed), and large seeded grasses can be encouraged with

winter-to-spring disking of fields and plots. Always disk on the contour to prevent or to minimize soil erosion.

Mowing is used primarily for the bobwhite quail and wild turkey. Late-winter (February) and late-summer (August) mowing of grasses attracts insects that are critical in the diets of juvenile birds. Late-summer mowing of grassy plots and fallow fields can increase nutrient availability of plants by providing fresh, green growth. The highest nutrient availability in grasses is in the first 8 inches of growth. Mowing can also help provide browse for deer.

Prescribed burning is the "skillful application of fire to natural fuels, under conditions that allow confinement and obtain planned benefits to forest or wildlife management efforts." Prescribed burning often is the most economical and beneficial tool used in wildlife management. It is also a controversial issue in forest and wildlife management due to potential for landowner liability and smoke management health concerns. Prescribed burning is often used in pine or upland mixed pine hardwood stands to reduce dry fuel hazards, to control hardwood competition, and to prepare sites for replanting of trees. In addition to those timber management benefits, wildlife benefits encouraged through prescribed burning include ground exposure, seed scarification, legume dispersal, hardwood butt sprouts, and the growth of nutrient-rich forbs, vines, and browse. Prescribed burning should be conducted by responsible, trained, experienced persons only! Report all unattended fires to state forestry personnel.

Wildlife

- [Food Plots](#)
- [Habitat Management](#)
- [Hunting](#)



Mississippi State University Extension

130 Bost Drive

Mississippi State, MS 39762



Migratory Bird Program Administrative Flyways

The U.S. Fish & Wildlife Service (USFWS) and its partners manage migratory birds based largely on routes the birds follow as they migrate between nesting and wintering areas.

Based on those routes, four administrative Flyways (Atlantic, Mississippi, Central and Pacific) were established in North America to facilitate management of migratory birds and their habitats. Each flyway has a Council, consisting of representatives from each state, provincial, and territorial agency within that Flyway. The Councils are advised by Flyway technical committees consisting of biological staff from their member agencies. The technical committees evaluate population and habitat information and make recommendations to the Councils on matters of migratory bird conservation.



[Image Details](#)

The Atlantic, Mississippi, and Pacific Flyways each have a USFWS Flyway Representative and assistant who work with the Flyway Council and their technical committees to share information and develop management recommendations. The Central Flyway has only a Flyway Representative who performs those functions.

To obtain more information about each flyway, please visit the links below.

[Shape files and other data](#) (for GIS applications) that are associated with the Flyway Boundaries map.

Atlantic Flyway

The Atlantic Flyway Council is composed of the states of Connecticut, Delaware, Florida, Georgia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Vermont, Virginia, and West Virginia; the Canadian territory of Nunavut and provinces of Newfoundland, New Brunswick, Nova Scotia, Ontario, Prince Edward Island, and Quebec; plus the U.S. territories of Puerto Rico and U.S. Virgin Islands.

The Atlantic Flyway Council contains representatives (usually administrators) from all the agencies that have management responsibility for migratory bird resources in the Flyway.

The Council determines actions required for sound migratory game bird management and makes recommendations to the U.S. Fish and Wildlife Service.

For more information about the Atlantic Flyway Council or Tech Sections, please contact the USFWS' Atlantic Flyway Representative, [Pat Devers](#).

[Upcoming Meetings/Events of Interest](#)

[Data Book](#)

Mississippi Flyway

Administratively, the Mississippi Flyway is composed of the states of Alabama, Arkansas, Indiana, Illinois, Iowa, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Ohio, Tennessee, and Wisconsin, and the Canadian provinces of Saskatchewan, Manitoba and Ontario.

The Mississippi Flyway Council was organized in 1952 and contains representatives (usually agency administrators) from these state agencies (and often provincial representatives from Saskatchewan, Manitoba, and Ontario) that have management responsibility for migratory bird resources in the Flyway. The Council was established to coordinate the management of migratory game birds in the Mississippi Flyway and to promote those activities of its members that serve the long-term benefit to the resources and the flyway as a whole. In addition, the Council provides a point of contact for the Fish and Wildlife Service for the purpose of coordinating federal/state/provincial management activities, providing advice to the Service on long-term and short-term migratory bird management needs of the flyway - including the establishment of harvest regulations so that the welfare of these resources can be properly safeguarded.

The Mississippi Flyway Council Technical Section was established to provide technical expertise and advice to the Council to ensure biologically-based management of migratory game birds. The MFC Technical Section is a forum for cooperative interaction among state, provincial, territorial, tribal, university, conservation-organization and federal biologists, with the goal of implementing integrated management and research programs for migratory game birds.

For more information about the Mississippi Flyway Council or Tech Sections, please contact the USFWS' Mississippi Flyway Representative, [Dave Scott](#).

[Upcoming Meetings/Events of Interest](#)

[Data Book](#)

Central Flyway

The Central Flyway was formed in 1948 and is composed of the states of Montana, Wyoming, Colorado, New Mexico, Texas, Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota, and the Canadian provinces of Alberta, Saskatchewan and the Northwest Territories.

The Central Flyway Council consists of representatives (usually agency administrators) from their respective state, provincial, or territorial wildlife agencies that have management responsibility for migratory bird resources in the Flyway.

Central Flyway Council mission: To provide leadership in the international conservation of migratory game birds and build partnerships among public and private groups interested in this valuable wildlife resource.

Three technical committees serve and advise the Council: one deals with waterfowl, one with migratory shore and upland game birds (e.g., doves, rails, and cranes), and the third deals with migratory nongame bird issues. Each group has meetings each year to share information regarding ongoing research, monitoring, and management issues about migratory game birds.

The Council, in concert with the Technical Committees, determines actions required for sound migratory game bird management and makes recommendations to the U.S. Fish and Wildlife Service.

For more information about the Central Flyway Council or Tech Sections, visit the council website directly below or contact the USFWS' Central Flyway Representative, [Tom Cooper](#).

[Upcoming Meetings/Events of Interest](#)

[Central Flyway Council Website](#)

[Data Book](#)

[Midwinter Survey Report](#)

Pacific Flyway

The Pacific Flyway Council is an administrative body that forges cooperation among public wildlife agencies for the purpose of protecting and conserving migratory birds in western North America. The Council is composed of the director or an appointee from the public wildlife agency in each state and province in the western United States, Canada, and Mexico.

U.S. members of the Pacific Flyway Council include Alaska, Arizona, California, Idaho, Nevada, Oregon, Utah, Washington, and those portions of Colorado, Montana, New Mexico, and Wyoming west of the Continental Divide.

The federal governments of the United States, Canada, and Mexico, and Alaska subsistence harvest management bodies may provide an ex officio representative to the Council. Only U.S. state members vote on U.S. regulatory matters.

The Council has responsibilities in the annual process of setting migratory bird policy and regulations within the United States, and conducts and contributes to migratory bird research and management throughout the United States, Canada, and Mexico.

The Council is given biological advice by both a game and a nongame migratory bird technical committee. These committees are each composed of one biologist from the public wildlife agency in each state and province in the western United States, Canada, and Mexico.

For more information about the Pacific Flyway Council or Tech Sections, please visit the council website directly below or contact the USFWS' Pacific Flyway Representative, [Todd Sanders](#).

[Pacific Flyway Council Website](#)

[Upcoming Meetings/Events of Interest](#)

[Data Book](#)



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The importance of pollinators

Plants depend on pollination. Nearly ninety per cent of wild flowering plants need pollinators like bees to transfer pollen for successful sexual reproduction. In turn, these plants are critical in the functioning of ecosystems. They provide food, form habitats and provide a wide range of other resources for many animal species. Pollinators consequently play a key role in regulating ecosystem services supporting food production, habitats and natural resources.



Globally nearly 90% of wild flowering plant species depend on animal pollination.



They are fundamental for the conservation of biological diversity and for the adaptation of human food production systems to climate change. Pollinators have a crucial and increasing role in the food production process. The production volume of pollinator-dependent crops has increased threefold over the last five decades, making us more dependent on pollination. These crops include fruits and vegetables and are essential for human diets and nutrition, since they provide us with vitamins and minerals.

More than 75% of leading global crop types benefit from animal pollination in production, yield and quality.

Pollinators, like bees, form an important aspect in global economic systems and social activities and traditions. Around five to eight per cent of current global crop production is directly ascribed to animal pollination, which equates to somewhere between 235 and 577 billion American dollars worldwide. They also provide main resources, such as biofuels, fibres like cotton and linen, and construction materials. Socially, pollinators are embedded in local cultures and traditions. They provide resources for the creation of musical instruments, arts and crafts, but also give inspiration to art, music, literature, religions, traditions, technology and education.

Around 5-8% of current global crop production is directly ascribed to animal pollination, which equates to somewhere between 235 and 577 billion American dollars worldwide.



But pollinators are under threat. Both the abundance, diversity and health of pollinators are threatened, as well as the provision of pollination. Click on the tabs below to find out more about the threats to pollinating species and their habitats.

Threats	Observations of decline
<p>What are the threats?</p> <p>Human activities threaten pollinators. Both the abundance, diversity and health of pollinators are threatened, as well as the provision of pollination. In recent decades, climate change has altered the range, abundance and seasonal activities of some wild pollinator species. Humans have altered the natural landscape and changed land use, reducing the natural habitat of wild pollinator species. Simultaneously, environmental pollution has degraded the natural habitats. Habitat destruction, fragmentation and degradation often reduce pollinators' food and nesting resources.</p> <p>Contemporary forms of agriculture have changed the influence of pollinators with a shift to large-scale and artificial forms of pollination. Intensive agricultural management is a leading threat to pollinator species.</p> <p>Controlled forms of pollination by managed pollinators have brought in risks. Mass breeding and large-scale transport of managed bees contributed to an enhanced transmission of parasites and pathogens. This spreads diseases across the entire community of both wild and managed pollinators. Additionally, it increases the occurrence of more dangerous pathogens, alien species invasions and regional extinction of native species.</p>	

Contact: info@promotepollinators.org | [webhosting 4BIS Innovations](#)

NCF-Envirothon 2026 Mississippi

Wildlife Study Resources

Key Topic #3: Wildlife, Conservation, and Society

8. Explain the distinctions between species designations (such as common, rare, endangered, threatened, endemic, extirpated, and extinct) and provide examples of each type.
9. Recognize important issues facing wildlife on a local, state/provincial, national and international scale, propose solutions to current problems, and evaluate viability of solutions.
10. Describe the role and history of hunting in wildlife management and conservation.
11. Identify positive and negative human-wildlife interactions and describe how these interactions are taken into consideration when creating management plans. Identify the costs and benefits of various wildlife management strategies.

Resource Title	Source	Located on Page
Field Guide for all the birds of North America: Extinct Birds	<i>North American Extinct Birds - Extinct Birds of North America - Birds of North America.</i> (n.d.). https://www.birds-of-north-america.net/extinct-birds-of-north-america.html	74
Something Wild: Extirpation-Not Extinction	<i>Something wild: extirpation - NOT extinction.</i> (n.d.). Forest Society. https://www.forestsociety.org/something-wild/extirpation-not-extinction	76
Mississippi Endangered Species	<i>Mississippi Endangered Species.</i> (n.d.). Mississippi Department of Wildlife, Fisheries, and Parks.	78
Migration and Overwintering: Monarch Butterfly	<i>Monarch butterfly migration and overwintering.</i> (n.d.). https://www.fs.usda.gov/wildflowers/pollinators/MonarchButterfly/migration/index.shtml	80
Hunters as Conservationists	<i>Hunters as conservationists.</i> (n.d.). U.S. Fish & Wildlife Service. https://www.fws.gov/story/hunters-conservationists	85
The Extinction of the Passenger Pigeon, <i>excerpt</i>	<i>The extinction of the passenger pigeon.</i> (n.d.). Environment & Society Portal.	86
Resources for New Landowners: Aldo Leopold's Five Tools of Wildlife Management	<i>Resources for new landowners: Aldo Leopold's Five Tools of Wildlife Management</i> Texas A&M NRI. (n.d.).	87
Feral Swine: Damages, Disease Threats, and Other Risk	<i>FERAL SWINE: Damages, Disease Threats, and Other Risk.</i> (n.d.). USDA.	91
Environmental Damage	College of Forest Resources. (n.d.). <i>Damage to the environment</i> Wild pig Info Mississippi State University Extension Service.	95



Classic Collection of North American Birds



"Just for the bird (er)"

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North American Bird Search Box

This search box can be used to find bird species using bird's english, french or latin name, or to identify bird by its 4 letter Alpha Code

 ENHANCED BY Google

Field Guide for all the Birds of North America

Extinct Birds

French: Espèces disparues

Information, images and range maps on over 1,000 birds of North America, including sub-species, vagrants, introduced birds and possibilities

Extinct birds of North America is a list of known types of extinct birds and species of birds that have disappeared from the North American continent since records have been kept.

Most of the recorded extinctions were caused by mankind either by excessive hunting or by the loss of their habitat through farming, forestry and tourism. All of these factors led to the changing of their environment and the birds were unable to adapt.

One example is the Passenger Pigeon which was once seen in great numbers. It went into extinction in the early 1900s due to excessive hunting of the bird.

Hummingbirds

Marsh Birds

Seabirds

Shorebirds

Wading Birds

Waterfowl

Bird Terminology

Bird Terminology

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Links



Illustrated by Brian Douglas

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Click on bird images or names to see pictures of the North American Extinct Birds

Great Auk



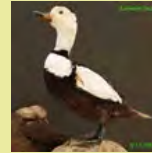
Eskimo Curlew



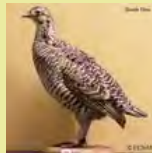
Slender-billed Curlew



Labrador Duck



Heath Hen



Carolina Parakeet



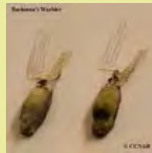
Passenger Pigeon



Seaside Sparrow (Dusky)



Bachman's Warbler



Ivory-billed Woodpecker



Imperial Woodpecker



[Return to Birds of North America Home Page](#)

Reference to Other Bird Site:

[ABA - American Birding Association](#) This site represents an organization that maintains official records of all birds species that have been proven to have been seen inside the perimeters of the North American Continent and the surrounding bodies of water. Regular revised versions are posted to keep the bird list current at all times. This is the list used by all serious birders over their lifetime. You may be aware of the movie called the "Big Year". It was with this list that all the competing birders used in an attempt to set a new record as to how many bird species that could be seen by an individual birder in one calendar year.

Something Wild: Extirpation - NOT Extinction

Forest Society



Wild turkeys were once extirpated in N.H. but were never extinct.

There is a common misconception that wild turkeys were once extinct in New Hampshire but have since returned. Extinction is often confused with extirpation but they are actually two **entirely** different concepts.

Extinct, Extant, Extirpated

Extinct refers to species no longer in existence, having no living representatives – gone everywhere. Things like the brontosaurus, which no longer occurred as of 10's of millions years ago, the woolly mammoth 10-thousand years ago, or the passenger pigeon only 10 decades ago.

Extant describes species that DO exist. Virtually every creature you hear about on *Something Wild* is extant.

Extinct and extant are opposites, leaving **extirpation** somewhere in the middle. Biologists use **extirpated** to describe species that no longer exist in a specific region. Wild turkeys didn't disappear from the entire planet – they just stopped occurring in New Hampshire.

Time and Place

We can't talk about extirpation without talking about the where and the when. Animal ranges are constantly shifting, their margins moving back and forth in response to changes in climate, in their food supply, and also changes in populations of their competitors and predators. That includes changes in response to human activities. When an animal no longer occurs in a particular geographic area – a mountain range or a watershed, or more often some artificial boundary that only humans recognize like a state line – they qualify as extirpated.

In the case of wild turkeys, they were extirpated from New Hampshire (that's the where) in the late 1800's (that's the when) due to a combination of unregulated hunting and changes in habitat. However, now we see them everywhere in the state. N.H. Fish and Game biologists estimate there are 40,000 turkeys in the state. Biologists reintroduced them in the 1970s. They might have returned on their own, but translocation sped up the process.

Birds do it... bees do it... even trees do it!

These terms apply to plants just as well as animals. Botanists have found both hemlock and beech trees migrated hundreds of miles across the eastern U.S. following the end of the last ice age. Hemlock, once extirpated by ice, is now extant in New England once again – all part of a natural process.

The Human Touch

Humans often play a significant role in the extirpation of species, which have led to extinctions. We've been responsible for the elimination of some really common things. Passenger pigeons, possibly the most abundant bird in North America 200 years ago, are now extinct worldwide due to over-hunting. This raises the question of whether or not we should bring a species such as the passenger pigeon back from extinction. The popularity of the Jurassic Park franchise keeps the concept fresh in our minds, and with advances in genetic research we are getting ever closer to having that option. But should we? We have to remember we are part of an almost incomprehensibly complex ecological web. We aren't completely objective on the topic – human values certainly cloud our ability to fully recognize ecological processes at work. Really big changes can occur without any help from us. Just ask the dinosaurs.

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News



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Mississippi Endangered Species

Mississippi Endangered Species

What is an endangered species?

An endangered species, as defined by Mississippi law, is any species or subspecies of wildlife whose survival and continued welfare in the state is in jeopardy or is likely to become so in the near future.

How does a species become endangered?

Although species become endangered for a variety of reasons—such as loss of habitat, disease, and pollution—it has been estimated that man is responsible for the extinction of up to 1,000 species worldwide each year.

How many endangered species are in Mississippi?

Mississippi has 80 species and subspecies of plants and animals, which are officially recognized as endangered. In 2001, the Mississippi Department of Wildlife, Fisheries, & Parks and the Museum took the initiative to assemble data on each of these and to make it available to the public.

+ The Endangered Species of Mississippi packet

+ Additional Information

Mississippi Threatened & Endangered Species



Mammals



Birds



Reptiles



Insects



Plants



Endangered Ray-Finned Fishes



Bivalvia




Amphibians


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Migration and Overwintering

The annual migration of North America’s monarch butterfly is a unique and amazing phenomenon. The monarch is the only butterfly known to make a two-way migration as birds do. Unlike other butterflies that can overwinter as larvae, pupae, or even as adults in some species, monarchs cannot survive the cold winters of northern climates. Using environmental cues, the monarchs know when it is time to travel south for the winter. Monarchs use a combination of air currents and thermals to travel long distances. Some fly as far as 3,000 miles to reach their winter home!

Where Do Monarchs Go?

Monarchs in Eastern North America have a second home in the Sierra Madre Mountains of Mexico. Monarchs in Western North America overwinter in California.

Eastern North American Population

Overwintering in Mexico

The eastern population of North America’s monarchs overwinters in the same 11 to 12 mountain areas in the States of Mexico and Michoacan from October to late March.

Monarchs roost for the winter in oyamel fir forests at an elevation of 2,400 to 3,600 meters (nearly 2 miles above sea level). The mountain hillsides of oyamel forest provide an ideal microclimate for the butterflies. Here temperatures range from 0 to 15 degrees Celsius. If the temperature is lower, the monarchs will be forced to use their fat reserves. The humidity in the oyamel forest assures the monarchs won’t dry out allowing them to conserve their energy.

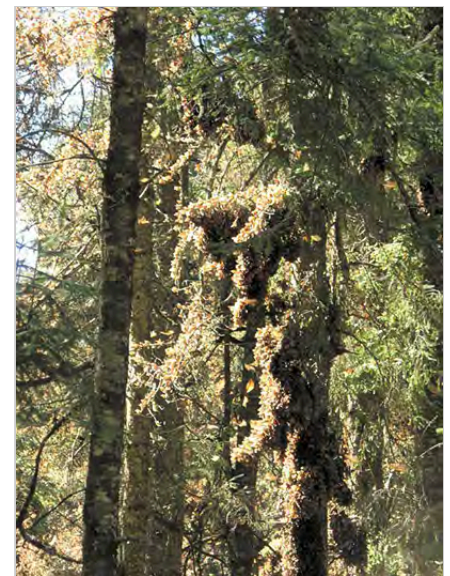
Directional Aids

Researchers are still investigating what directional aids monarchs use to find their overwintering location. It appears to be a combination of directional aids such as the magnetic pull of the earth and the position of the sun among others, not one in particular.



Clustering in Colonies

Monarchs can travel between 50-100 miles a day; it can take up to two months to complete their journey. The farthest ranging monarch butterfly recorded traveled 265 miles in one day.



Monarch butterflies clustering in tree tops at the El Rosario Sanctuary, Michoacan, Mexico. Photo by Sue Sill, LCHPP, Inc.

Monarch butterflies are called **Mariposa monarca** in Mexico.



Monarchs cluster together to stay warm. Tens of thousands of monarchs can cluster on a single tree. Although monarchs alone weigh less than a gram, tens of thousands of them weigh a lot. Oyamel trees are generally able to support the clustering butterflies, but sometimes branches break.

Protection of Oyamel Forest

Conservation

([/wildflowers/pollinators/Monarch_Butterfly/conservation/index.shtml](http://wildflowers/pollinators/Monarch_Butterfly/conservation/index.shtml)) of overwintering habitat is very important to the survival of monarchs. The Mexican Government recognized the importance of oyamel forests to monarch butterflies and created the **Monarch Butterfly Biosphere Reserve** ([/wildflowers/pollinators/Monarch_Butterfly/conservation/index.shtml#monarca](http://wildflowers/pollinators/Monarch_Butterfly/conservation/index.shtml#monarca)) in 1986.

Western North American Population

Monarchs living west of the Rocky Mountain range in North America overwinter in California along the Pacific coast near Santa Cruz and San Diego. Here microclimatic conditions are very similar to that in central Mexico. Monarchs roost in eucalyptus, Monterey pines, and Monterey cypresses in California.

Stories of Biodiversity on the Move, Monarch Butterflies (*Danaus plexippus*)

A Google Earth Tour is posted on YouTube describing the migration of monarch butterflies, and the people that help them out along the way. It was produced by Atlantic Public Media (<http://www.atlantic.org>) in cooperation with the Encyclopedia of Life (<http://www.eol.org>). Producers: Eduardo Garcia-Milagros and Ari Daniel Shapiro.

See the Monarch Butterflies Migration Google Earth Tour... (<http://www.youtube.com/watch?v=uqDwwuleRYc>)

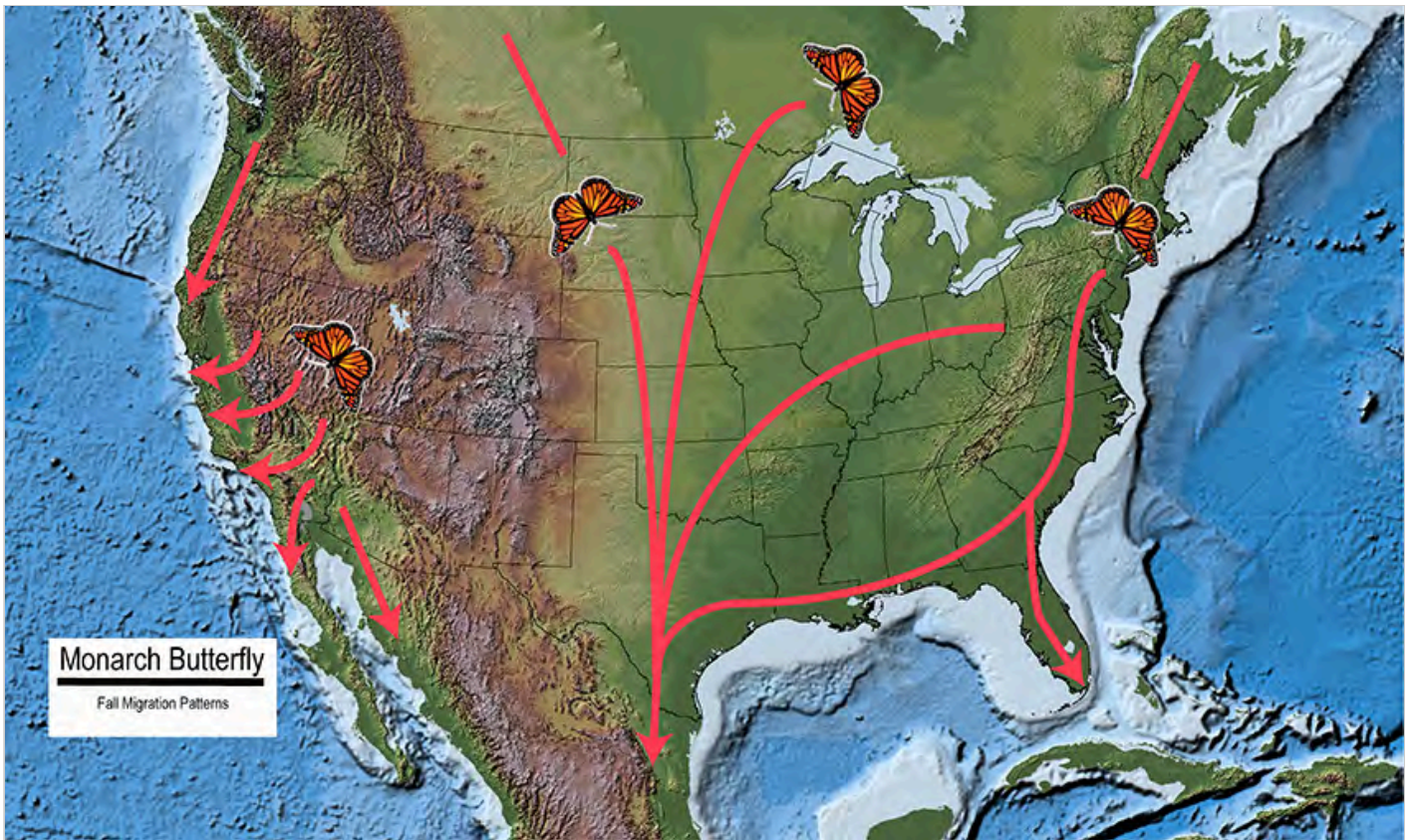


(<http://www.youtube.com/watch?v=uqDwwuleRYc>)

Flyways

Traveling South

Eastern North American monarchs fly south using several flyways then merge into a single flyway in Central Texas. It is truly amazing that these monarchs know the way to the overwintering sites even though this migrating generation has never before been to Mexico!



Monarch Butterfly Fall Migration Patterns. Base map source: USGS National Atlas.

Congregation Sites

Monarchs only travel during the day and need to find a roost at night. Monarchs gather close together during the cool autumn evenings. Roost sites are important to the monarch migration. Many of these locations are used year after year. Often pine, fir and cedar trees are chosen for roosting. These trees have thick canopies that moderate the temperature and humidity at the roost site. In the mornings, monarchs bask in the sunlight to warm themselves.



Monarchs at sunrise on wild black cherry (*Prunus serotina*) tree roost. Photo by Denise Gibbs.



Monarchs basking at sunrise before taking flight from a bayberry (*Myrica pensylvanica*) thicket roost site. Photo by Denise Gibbs.

Use of Peninsulas

Monarchs traveling south congregate on peninsulas. The shape of the peninsula funnels the migrating butterflies. At its tip, the monarchs find the shortest distance across open water. They congregate along the shore to wait for a gentle breeze to help them across.



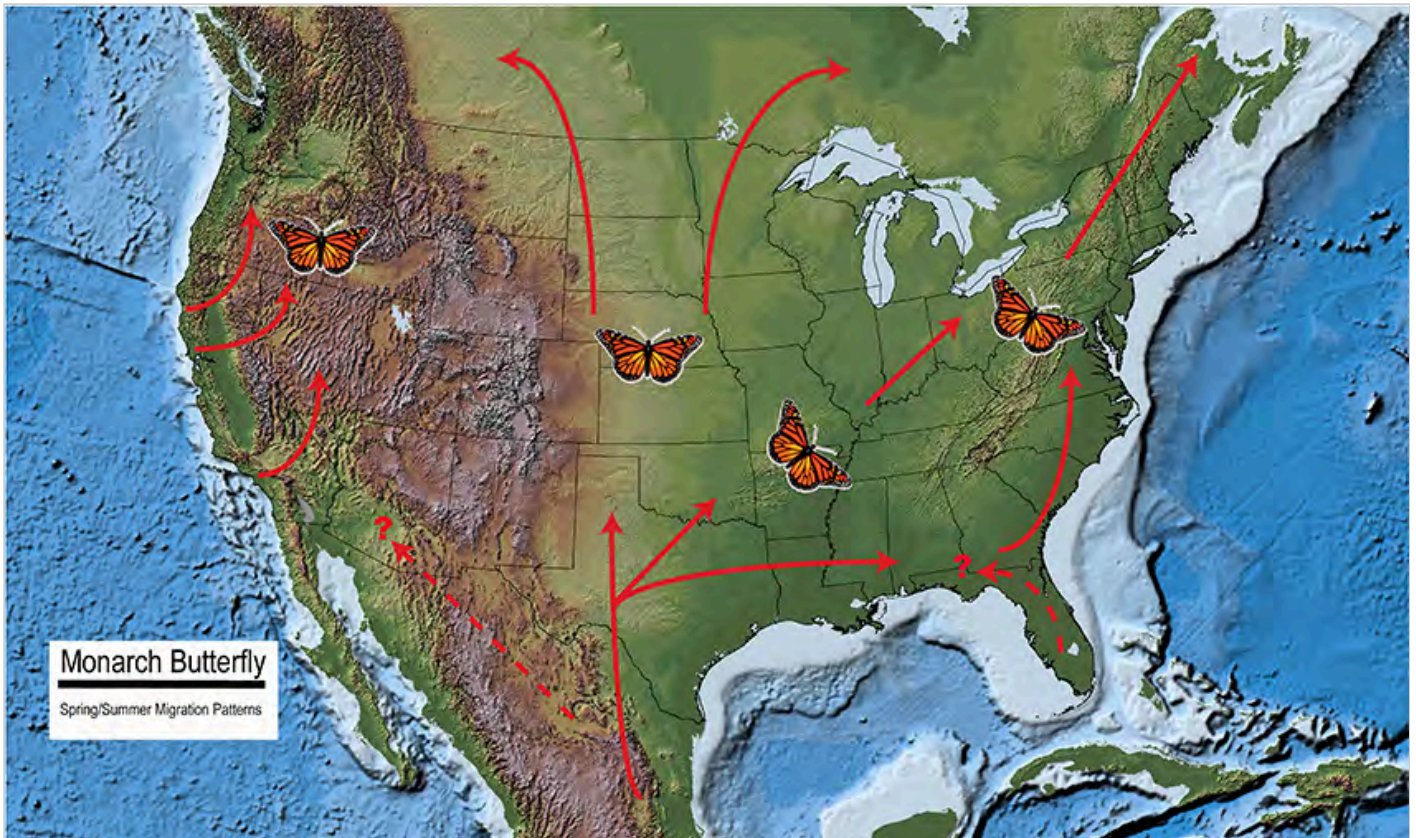
Monarchs bask just after sunrise on a groundsel-tree (*Baccharis halimifolia*) where they roosted for the night, at the edge of Oyster Bay. Photo by Denise Gibbs.



Photo by Dick Walton, Monarch Monitoring Project (<http://www.rkwalton.com/>).

Traveling North

As warm temperatures and lengthening days arrive, the migratory generation (/wildflowers/pollinators/Monarch_Butterfly/biology/index.shtml#migrgen) of monarchs finishes the development they halted prior to their migration. They become reproductive, breed and lay the eggs of the new generation. This starts the northern journey back to North America. Unlike the generation before them, who made a one-generation journey south, successive generations make the journey north.



Monarch Butterfly Spring and Summer Migration Patterns. Base map source: USGS National Atlas.

Multiple Generations

Generation 1 monarchs are the offspring of the monarchs who overwintered in Mexico. Each successive generation travels farther north. It will take 3-4 generations to reach the northern United States and Canada.

Tracking Migration

The northern migration is tracked by an organization called **Journey North**. You can help track the migration of the monarch butterfly by visiting this site.

[Report your sightings!](https://journeynorth.org/sightings/) (<https://journeynorth.org/sightings/>)

The **Western Monarch Milkweed Mapper** project is part of a collaborative effort to map and better understand monarch butterflies and their host plants across the Western U.S. Data compiled through this project will improve our understanding of the distribution and phenology of monarchs and milkweeds, identify important breeding areas, and help us better understand monarch conservation needs.

[Help us track monarchs and milkweed across the West!](https://www.monarchmilkweedmapper.org/)

(<https://www.monarchmilkweedmapper.org/>)

You can learn more about a project to track the southern migration at

[Papalotzin, The Journey of the Monarch Butterfly](https://www.visitwimberley.com/monarchs/slideshowPapalotzin/papalotzin.shtml)

(<https://www.visitwimberley.com/monarchs/slideshowPapalotzin/papalotzin.shtml>)

Report Your Sightings!



(<https://www.monarchmilkweedmapper.org/>)

[Help us track monarchs and milkweed across the West!](https://www.monarchmilkweedmapper.org/)

(<https://www.monarchmilkweedmapper.org/>)



(<https://journeynorth.org/sightings/>)

The Monarch Highway Poster

The landscape that parallels roadways, like the I-35 corridor, can provide natural habitat to support the annual migration of the monarch butterfly. Pollinator Partnership, including a number of state, local and federal government agencies, corporations, and organizations collaborating and supporting pollinators and conservation of their habitat developed this poster to celebrate the monarch butterfly.

The I-35 corridor follows Interstate 35 through six states from Minnesota south to Texas, following the central flyway of monarch migration. In 2016, these states signed a memorandum of understanding that informally named I-35 the “Monarch Highway” and agreed to implement coordinated management practices along the corridor that benefit monarchs and other pollinators.

[Visit Pollinator Partnership to see the poster and read more about The Monarch Highway...](https://www.pollinator.org/shop/poster-2017) (<https://www.pollinator.org/shop/poster-2017>)

Monarch Butterfly

Monarch Butterfly Home

(wildflowers/pollinators/Monarch_Butterfly/index.shtml)



(<https://www.pollinator.org/shop/poster-2017>)



Image Details

Hunters as Conservationists

Hunters are among the most ardent conservationists around.

Theodore Roosevelt, the founder of the National Wildlife Refuge System and a hunter himself, knew it.

“In a civilized and cultivated country, wild animals only continue to exist at all when preserved by sportsmen,” the 26th president of the United States said years ago. “The excellent people who protest against all hunting, and consider sportsmen as enemies of wildlife, are ignorant of the fact that in reality the genuine sportsman is by all odds the most important factor in keeping the larger and more valuable wild creatures from total extermination.”

Department of the Interior officials know it today.

“Hunters are a driving force behind funding many of our nation’s conservation efforts,” a [2017 Interior Department blog](#) said. “After the extinction of the passenger pigeon and the near elimination of the bison and many migratory bird species in the early 1900s, Americans realized the impacts humans could have on wildlife. To ensure that there would be animals to hunt in the future, hunters began to support programs that helped maintain species populations and protected habitat for wildlife.”

Hunters – along with anglers – also were the driving force behind the [North American Model of Wildlife Conservation](#), a set of wildlife management principles established more than a century ago that declare that wildlife belongs to everyone, not just the rich and privileged.

Directly Supporting Conservation Today

Today, hunters directly support wildlife conservation in many ways.

Through the federal [Duck Stamp](#), hunters help protect and restore habitat for migratory waterfowl and other birds and wildlife. The stamp, formally called the federal [Migratory Bird Hunting and Conservation Stamp](#), is required as a license for waterfowl hunting. For every dollar spent on Duck Stamps, ninety-eight cents go directly to purchase vital habitat or acquire conservation easements within the National Wildlife Refuge System. Since 1934, almost 6 million acres of habitat have been conserved with the help of Duck Stamp funds.

Through the Federal Aid in Wildlife Restoration Act, more commonly known as the Pittman-Robertson Act, hunters fund a range of conservation programs. The act sends revenue from an excise tax on firearms, ammunition and other related equipment to state wildlife agencies to be used for wildlife conservation projects, hunter education and outdoor recreation access. Through Pittman-Robertson, sportsmen and women have contributed more than \$14 billion to conservation since 1937. These annual payments to [state fish and wildlife agencies](#) have resulted in the recovery of deer, turkeys and many non-game species – with benefits to hunters and non-hunters alike.

[FIND YOUR HUNT](#)

[FIND REFUGES THAT OFFER HUNTING](#)



Image Details



(/)

The Extinction of the Passenger Pigeon

The passenger pigeon, once one of the most abundant birds in the world, was pushed to extinction by overhunting and habitat destruction in 1914 when the world’s last passenger pigeon died. Deforestation after the European colonization contributed to the bird’s extinction. Prior to colonization Native Americans ate the passenger pigeon without harming their continued existence, but the massive commercial consumption of pigeon meat in the nineteenth and at the beginning of the twentieth century led to its demise. Because the pigeons flew in such large flocks, sometimes hundreds of miles long with billions of birds, many could be easily captured at one time. Beginning in the eighteenth century, commercial hunters began shooting pigeons or using nets to capture them to sell them for meat or as live targets for trap hunting. After the trade of the pigeons had been commercialized by the late 1800s, their population diminished significantly until the last known bird died in captivity in the Cincinnati Zoo in 1914.

Contributed by Katherine Fadelli

Course: Modern Global Environmental History

Instructor: Dr. Wilko Graf von Hardenberg

University of Wisconsin–Madison, US

Tags:

birds (/tags/animals/birds)

pigeons (/tags/animals/birds/pigeons)

extinction (/tags/extinction)

hunting (/tags/hunting)

Themes:

Biodiversity (/themes/biodiversity)

Environmental Knowledge (/themes/environmental-knowledge)

Resources (/themes/resources)

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Resources for New Landowners: Aldo Leopold's Five Tools of Wildlife Management

May 4, 2020

Aldo Leopold - author, philosopher, conservationist, and so-called “Father of Wildlife Ecology” - is a pillar of the modern-day wildlife conservation and management movement. His revolutionary musings on the value of land and wildlife and his intentional management techniques often appear in the discourse on wildlife management.

In *Game Management*, Leopold wrote, “Are we too poor in purse or spirit to apply some of it to keep the land pleasant to see, and good to live in?” This conveys a simple truth for both green and veteran landowners: land management may require hard work, but generates value for the land and our spirits. The most effective land management is that which is intentional.

Perhaps one of Leopold’s most lauded quotes also originated from this work - “The central thesis of game management is this: game can be restored by the creative use of the same tools which have heretofore destroyed it -- axe, plow, cow, fire, and gun.” This does not mean that increasing hunting rates and raising more cattle will improve wildlife populations - the keyword to focus on is creative use of these tools. Through considerate hunting regulation, brush management, and prescribed fires, managing game species becomes a little easier. Although Leopold refers specifically to game management, these tools can be used for and benefit a multitude of wildlife species. Although much of NRI’s work with wildlife focuses on specific species like quail, these can act as indicator species for many other wildlife species which utilize similar habitat components.



*Aldo Leopold wrote, “Are we too poor in purse or spirit to apply some of it to keep the land pleasant to see, and good to live in?”
Photo by Abigail Holmes.*

Axe

The axe tool refers to effective brush management. As almost any Texas landowner who has dealt with mesquite trees will testify - this is not always a simple task. Sculpting the land with brush management requires intentional planning and a watchful eye. If a woody plant is removed in error, it can take years to regrow those key habitat structures. Conversely, if woody plants overtake a tract of land they can become costly to remove. The following resources were developed with the wildlife-conscious landowner in mind, to provide information about the importance of brush has a habitat component and the best ways to manage it.

- Program: [Brush Busters](#)

- Blog: [Brush Control for Small Acreages](#) - description
- The Importance of Brush as a Thermal Refuge:
 - Blog: [Quail Coping with the Cold](#)
 - Blog: [How Quail Handle the Heat](#)
- YouTube Video: [Quail Houses](#)
- YouTube Video: [Half-Cutting Mesquites to Enhance Quail Coverts](#)
- Extension Publication: [Woody Plants for Wildlife: Brush Sculpting in South Texas and the Edwards Plateau](#)



The axe tool includes modern machinery, such as excavators, that can accomplish many brush management tasks efficiently. Photo by Abigail Holmes.

Plow

The plow is not always considered as a tool for wildlife management but can be an effective method of creating supplemental food plots and even shelter for a variety of wildlife species. The following resources focus on primarily on creating wildlife food plots, but it is also important to not overwork the land or harm native biodiversity in pursuit of agricultural abundance.

- YouTube Playlist: [Wildlife Food Plots](#)
- YouTube Video: [Shredding/Mowing for Wildlife Management](#)
- YouTube Video: [Disking for Wildlife Management](#)
- YouTube Video: [White-tailed Deer Food Plots on Livestock Ranches](#)
- YouTube Video: [White-tailed Deer Food Plots: Soil Considerations](#)
- YouTube Video: [Disking for Quail Habitat in the Rolling Plains of Texas](#)

Cow

Raising cattle on a tract of land may seem antithetical to the ideals of wildlife management, but maintaining proper stocking rates and enforcing rotational grazing can allow room for both of these ideals on one property. Preventing overgrazing allows native species to remain a healthy resource to utilize as food and habitat cover.

- Blog: [Cattle as a Tool for Quail Management](#)
- YouTube Video: [Determining Stocking Rate to Benefit Cattle and Quail \(Part 1 of 3\)](#)
- YouTube Video: [Determining Stocking Rate to Benefit Cattle and Quail \(Part 2 of 3\)](#)
- YouTube Video: [Determining Stocking Rate to Benefit Cattle and Quail \(Part 3 of 3\)](#)

- YouTube Video: [Proper Grazing of Quail Nesting Habitat](#)
- YouTube Video: [Grazing Management for Quail](#)
- YouTube Video: [Grazing as a Tool for Wildlife Management:](#)
- Extension Publication: [Using Livestock to Manage Wildlife Habitat](#)



Maintaining proper stocking and grazing rates is one key pillar of wildlife management. Photo by Brittany Wegner.

Fire

Fire is a natural tool for clearing land and creating a mosaic of different successional stages. Prescribed fires are closely monitored, planned events targeted at specific areas of a property to manage brush and forb growth. Safety is key when planning and executing prescribed fires, and it is important to contact the proper experts prior to any prescribed burn.

- [Texas Prescribed Fire Associations](#)
- Extension Publication: [Fire as a Tool for Managing Wildlife Habitat](#)
- YouTube Video: [Wildfires and Quail](#)



*An annual sunflower (*Helianthus annuus*). Photo by Abigail Holmes.*

Gun

The gun tool, referring to hunting, is likely the most popular of these tools among Texans. Hunting can be used to limit the overpopulation of prolific species, reduce the impacts of specific predators in a local area, provide

information on species abundance and sex ratios, and more. It is an excellent tool for conservation as well as recreation. Abiding by state hunting laws and regulations prevents overharvest of sensitive species and allows hunters to continue the practice sustainably.

- TPWD: [Hunting Regulations](#)
- TPWD: [Hunting Licenses, Stamps, & Permits](#)
- USFWS: [Hunting Resources](#)
- Blog: [Economic Value of Hunting](#)
- YouTube Video: [Shooting Techniques for Wild Pigs](#)

These five tools still form the basis for effective and sustainable game and wildlife management, even so many decades after Leopold's death. Through the creative use of the axe, cow, plow, fire, and gun, private land stewards can restore game species and, by extension, many other wildlife species, while increasing the productivity of their land. In *A Sand County Almanac*, Leopold wrote, "Like winds and sunsets, wild things were taken for granted until progress began to do away with them. Now we face the question whether a still higher 'standard of living' is worth its cost in things natural, wild and free." Today, Leopold might argue that a higher standard of living is created by nurturing all things natural, wild, and free, rather than overconsumption of these resources. Private land stewardship to benefit game and wildlife species creates healthier lands for habitat and human consumption.

FERAL SWINE: Damages, Disease Threats, and Other Risks

What Are Feral Swine?

Feral swine (also called wild pigs, Eurasian boar, or feral hogs) are a harmful and destructive invasive species. They are not native to North America. Early explorers and settlers first brought feral swine into the United States in the 1500s as a source of food. The number of feral swine grew further after that; they were introduced repeatedly in different areas of the country and also started crossbreeding with escaped domestic pigs. Today, approximately 6 million feral swine can be found across more than 31 States.

Why Are They a Problem?

The damage feral swine cause is wide-ranging and far-reaching. With populations throughout the United States, this invasive animal—with few natural predators—negatively impacts everything from agriculture and the environment to human health and public safety. Feral swine can multiply faster than any other large mammal; females begin breeding at about 8 months and can produce 2 litters of 4–12 piglets every 12–15 months. The main reasons for their expanded range include accidental escapes or intentional releases from fenced facilities and people moving them illegally to new areas. Damages, costs, and risks from feral swine will only keep rising if their populations continue to expand.



Agriculture

Feral swine damage crops and destroy fields (reducing crop yield) with their feeding, rooting, trampling, and wallowing behaviors. They usually target sugar cane, corn, grain sorghum, wheat, oats, peanuts, and rice, among others. Vegetable and fruit crops, such as lettuce, spinach, melons, and pumpkins, are also attractive to them. Feral swine can also impact the regeneration of forests. By consuming seeds, nuts, and seedlings and damaging land, they keep new trees from growing and can stunt the growth of existing trees.



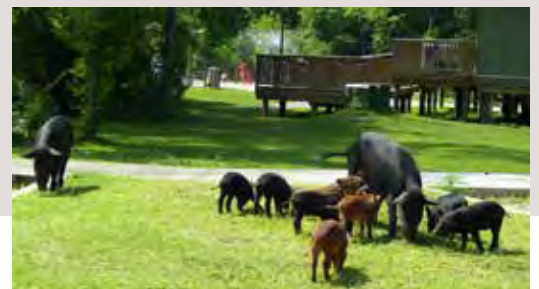
Feral swine can spread diseases to livestock. This causes economic losses such as decreased production, reduced feed efficiency (less food intake affects animal growth and overall health), lower reproductive success and increased mortality in the herd, and higher costs for veterinary care. Feral swine are omnivorous, meaning they eat just about anything. They can kill calves and lambs, and adult livestock are vulnerable to predation while giving birth.

In addition, feral swine degrade pasture grasses; eat, contaminate, and destroy livestock feed; and damage farm property, such as fences, water systems, irrigation ditches, troughs, and levees.

Health and Public Safety

Feral swine can carry at least 30 diseases and nearly 40 types of parasites that may affect people, pets, livestock, and wildlife. Some diseases, such as pseudorabies, are fatal to cats and dogs that may be exposed from direct contact with a feral swine carcass. Feral swine can also transmit foodborne illnesses, such as *E. coli*, toxoplasmosis, and trichinosis. In some areas, feral swine have been the cause of elevated waterborne bacteria levels in streams and irrigation canals, which is another risk for human health.

When in roadways or at airports, feral swine can collide with vehicles and aircraft, putting the safety of drivers, pilots, and passengers at risk. Other public safety risks arise when feral swine are in urban and suburban areas. As they become less afraid of people over time, they have shown aggression toward golfers, picnickers, and others. This behavior is more of a problem when they associate people with food because of handouts and improper waste disposal. In addition, feral swine may be aggressive to dogs and other pets.



FERAL SWINE: Damages, Disease Threats, and Other Risks

Natural Resources

Feral swine cause widespread damage to natural resources. They consume large amounts of vegetation; destroy plants with their rooting, soil compaction, and wallowing behaviors; and in some areas, may eat or uproot protected, sensitive, unique, or rare plants. Often, the damaged land then becomes vulnerable to erosion and non-native, invasive plants.

In addition, soil disturbance and vegetation loss from feral swine damage increases erosion and degrades water quality. Siltation (a form of water pollution) and contamination in streams and coastal areas with swine activity have contributed to declines in aquatic organisms, including freshwater mussels and insects.

Wildlife are impacted by feral swine, too. Since their diets overlap, feral swine and native wildlife end up competing for important and limited natural food sources, such as acorns and other forest tree nuts. Feral swine also reduce the amount of food available in general—they consume seeds, plants, and small animals (including insects, earthworms,

voles, shrews, turtles, amphibians, and ground-nesting birds). Feral swine will destroy nests and eat the eggs of alligators, other reptiles, and ground-nesting birds, such as quail, turkey, and shorebirds. And because feral swine prefer wet environments, they compete with native wildlife for scarce water resources during dry seasons. Feral swine can also have negative effects on threatened and endangered species and their habitats.

Lastly, feral swine can spread diseases to wildlife, some of which can be fatal. The damage they cause also tends to increase mosquito habitat; this, in turn, can increase the prevalence of avian malaria and avian pox, which threaten the health of native birds.



Property

If feral swine are in the area, they can quickly ruin homeowners' efforts to maintain and improve their properties. Destroyed vegetation and wallows reduce the aesthetic value of private properties, as well as public parks and recreational areas. Feral swine foraging, rooting, and wallowing also damages landscaping, golf courses, recreational fields, cemeteries, parks, lawns, and other natural areas.

In addition, adult feral swine weigh from 75 to 250 pounds on average, with some weighing considerably more. As a result, collisions with vehicles and aircraft can mean costly property damage.

Cultural and Historic Resources

Other resources affected by feral swine include national historic sites, tribal sacred sites and burial grounds, cemeteries, and archaeological sites and digs. Feral swine damage structures, destroy vegetation, and disturb soil and land. This can seriously degrade the significance and historic integrity of these sites. Foraging and habitat damage by feral swine can also negatively impact the distribution and abundance of plants and animals that may be used for traditional purposes (for example, sage for Native American ceremonies or herbal medicines).



Want To Learn More?

Call the USDA-APHIS Wildlife Services program in your State at **1-866-4-USDA-WS** or go to **www.aphis.usda.gov/wildlife-damage/stopferalswine** to learn more about the problems caused by this invasive animal, as well as to seek advice and assistance in dealing with feral swine.

The U.S. Department of Agriculture is an equal opportunity provider, employer, and lender.

Program Aid No. 2195b
Revised May 2020



Environmental Damage

Soil

Rooting, wallowing, and trampling activities compact soils, which in turn disrupts water infiltration and nutrient cycling. Also, these soil disturbances contribute to the spread of invasive plant species, which typically favor disturbed areas and colonize them more quickly than many native plants.



Soil Damage Caused by Rooting Pigs

Water Quality

Wild pig activity in streams reduces water quality by increasing turbidity (excessive silt and particle suspension) and bacterial contamination. In time, turbidity and added contaminants affect a variety of native aquatic life, most notably fish, freshwater mussels, amphibians, and insect larvae.

In some streams, feces from wild pigs have increased fecal coliform concentrations to levels exceeding human health standards.

NCF-Envirothon 2026 Mississippi

Wildlife Study Resources

Key Topic #4: Field Skills

12. Identify common local wildlife species from preserved specimens, skulls, skeletons, pelts, tracks, scat, and other animal signs without the use of a key.
13. Identify wildlife based on communication methods (bird and frog calls, etc.).
14. Assess a particular site for wildlife habitat suitability and make recommendations for best management practices.
15. Analyze and interpret an animal's habitat, dietary requirements, and life cycle based on animal signs.
16. Recommend wildlife management practices for a variety of uses (including conservation, connectivity, and hunting) for a variety of landscapes (including grasslands, forests, croplands, wetlands, and urban settings).

Resource Title	Source	Located on Page
Carnivore, Herbivore, or omnivore identification	<i>Searls, T. (2022, December 8). Carnivore, herbivore, or omnivore identification. Skulls hold the clues. Skulls Unlimited International, Inc.</i>	95
Waterfowl ID-Taxonomy: Black-Bellied Whistling Duck, Fulvous Whistling Duck, Emperor Goose, Snow Goose	<i>Discover all types of ducks, geese & other waterfowl. (n.d.). https://www.ducks.org/hunting/waterfowl-id</i>	96
Chuck-will's-widow Audubon Field Guide	<i>Chuck-Will's-Widow. (n.d.). Audubon. https://www.audubon.org/field-guide/bird/chuck-wills-widow</i>	107

Carnivore, herbivore, or omnivore identification. Skulls hold the clues.

December 8, 2022 Tom Searls

Identifying whether an animal is a carnivore, herbivore, or omnivore can be a challenging task, even for experienced naturalists. However, by closely examining the animal's skull, you can gain valuable insights into its diet and behavior. Here are some best practices to help you accurately determine whether an animal skull is that of a carnivore, herbivore, or omnivore.

First, it's important to understand the differences between these three types of animals. Carnivores are animals that primarily eat other animals for their source of nutrition. They typically have sharp teeth, powerful jaws, and a strong bite force to help them capture and eat their prey. Herbivores, on the other hand, are plant-eating animals. They have flatter, grinding teeth that are well-suited for chewing tough plant matter. Omnivores, as the name suggests, are animals that eat both plants and animals. They have a more varied diet and their teeth and jaws reflect this.

To identify an animal skull as a carnivore, herbivore, or omnivore, start by examining its teeth. Carnivores have sharp, pointed teeth that are designed for tearing and ripping flesh. Herbivores, in contrast, have flatter, grinding teeth that are used to chew plant matter. Omnivores have a mix of both types of teeth, with sharp teeth for cutting and grinding teeth for chewing.

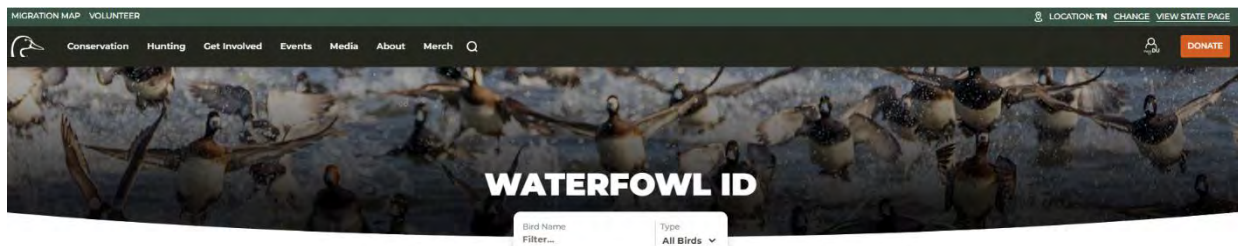
Another key factor to consider is the size and shape of the skull. Carnivores tend to have larger skulls with a more pronounced jawline, as they need powerful jaws and strong bite force to capture and kill their prey. Herbivores, on the contrary, have smaller skulls with a less pronounced jawline, as they do not need as much jaw strength to chew plant matter. Omnivores typically have skulls that are intermediate in size and shape, reflecting their more varied diet.

In addition to the teeth and the skull, you can also look at the size and shape of the animal's eye sockets. Carnivores tend to have larger, forward-facing eyes that provide them with excellent depth perception and binocular vision, which is essential for hunting and catching prey. Herbivores, on the other hand, often have smaller eyes that are positioned on the sides of the skull, giving them a wider field of view to help them detect predators. Omnivores typically have a mix of both types of eye sockets, reflecting their more varied lifestyle.

Finally, it's important to consider the overall shape and structure of the animal skull. Carnivores tend to have more angular skulls with a more pronounced snout, which allows them to exert greater bite force and capture prey more efficiently. Herbivores, on the other hand, have more rounded skulls with a shorter snout, as they do not need as much bite force to chew plant matter. Omnivores typically have a mix of both types of skull shapes, reflecting their more varied diet.

By carefully examining the animal skull and considering the factors discussed above, you can accurately determine whether it is a carnivore, herbivore, or omnivore. With practice, you will develop a keen eye for identifying these characteristics and accurately classify animal skulls.





Black-bellied Whistling-Duck

Male

Average Length

19.4"

Average Weight

1.8 lbs (816 g)

Female

19"

1.85 lbs (839 g)



Overview

The Black-bellied Whistling Duck is a medium-sized tropical to sub-tropical perching duck. In the United States, its range is expanding, extending from southeastern Arizona eastward to coastal South Carolina. In recent years, they have been observed in many Midwestern and East Coast states, and their breeding range is expanding with new records reported regularly. Perched on the ground or in trees, they have an erect posture, pink bills and feet, and a gray face, with a chestnut crown on the head. The neck, back, and breast are a warm chestnut, and the belly is black. In flight, the wing has chestnut tertial and secondary coverts that fade to gray, then to very notable white, contrasting with black secondary and primary feathers.



Black-bellied Whistling Ducks are cavity nesters and readily use nest boxes, though they will nest on the ground in areas lacking cavities or nest boxes. They are vegetarians and will use agricultural grains, especially rice and corn. The population in the United States is primarily migratory, departing most of their range other than coastal South Texas in winter. Birds residing in tropical and subtropical regions do not migrate.

Description

Key Identification Features

- Wing strokes in flight are slower than most ducks; the feet trail behind the tail, and they are typically very vocal.
- The plumage of both sexes is identical. In flight, a large white patch on the secondary and primary coverts contrasts with the black primaries. At rest, their standing posture is erect.

Male/Female Average Length and Weight

- Weight: Males and females overlap in weight ranging from 1.4–2.3 lbs.
- Wingspan: 8.8–10.3 in.

Male and Female Identification

- **Alternate (Breeding) and Basic Plumage:** The plumage of both sexes is identical, as are the alternate and basic plumages. The head and face are gray, with a notable white eye ring. The crown is chestnut, and a black streak extends up the back of the neck to the crown. The bill and feet are pink to pinkish orange. The lower neck, breast, and back are chestnut, the belly, flanks, vent, and tail are black. In flight, a large notable white patch on the secondary and primary coverts contrasts with the black primaries.

In-flight Identification

- In flight, a large white patch on the secondary and primary coverts contrasts with the black primaries. Wing strokes in flight are slower than most ducks, the feet trail behind the tail, and they typically are very vocal.

Vocalizations

- Very vocal. A high pitched, soft whistle described as “pe-che-che-ne” with the “pe” longer and drawn out. In flight, may give “chit-chit-chit.” The alarm call is “yip.”

Similar Species

- Adults are unique and unlikely to be confused with any other species of waterfowl in North America. Juveniles resemble juvenile Fulvous Whistling Ducks, but the presence of white wing patch easily separates these two species.

Habitat Preferences

- Black-bellied Whistling Ducks are typically found in freshwater wetlands, ponds, or lakes, usually with emergent or floating vegetation, but sometimes devoid of emergent vegetation.

Foraging Habits and Diet

- Black-bellied Whistling Ducks are vegetarian with a diet often greater than 90 percent plant material. Vegetation consumed includes seeds of various emergent and aquatic plants. Also feeds on cultivated grains, including rice, sorghum, and corn. Invertebrates are usually less than 10 percent of the diet but include mussels and various aquatic insects.

Breeding Habits

- **Monogamy:** They have monogamous, lifelong pair bonds. They are believed to nest at 1 year of age. The breeding season is long, with nest records from April to October in Texas, but peak nesting activity occurs from mid-May to August.
- **Nest Locations:** Most nests are in natural cavities or nest boxes, with eggs laid directly in cavity debris or wood chips in boxes, and neither sex deposits down in the nest as incubation proceeds.
- **Clutch Size:** The average clutch size in Texas was 13.4 eggs, with much larger clutches resulting from dump nesting or intraspecific nest parasitism. The eggs are white to creamy white, elliptical to oval and average 2.0 by 1.5 in. The incubation period is about 28 days, with males and females alternating incubation of the eggs.

Migration and Distribution

- Fall Migration: Black-bellied Whistling Ducks usually depart breeding areas between August and October.
- Spring Migration: They overwinter in Central and South America and return to breeding areas in late March or April.

Conservation Status

- IUCN Status: Least Concern
- Population Status: The global population is roughly estimated at 1–2 million birds. Black-bellied Whistling Duck numbers appear to be stable to increasing throughout their range, but the species is not subject to large-scale surveys. Christmas Bird Count data suggest an increasing population trend with sightings of 1,822 per year in the 1980s, to 12,227 per year in the early 2000s. They appear to be undergoing a substantial range expansion in the southeastern United States, and increasingly, post-breeding birds are being observed in Midwestern states as well. Breeding Bird Survey data in the United States suggests populations are increasing, perhaps by as much as 8% annually. In some areas, lack of natural cavities may be limiting, and nest boxes may help to increase populations locally.
- Conservation Concerns: The primary threat is habitat loss.
- Conservation Focus: Conservation efforts focus on protecting habitat, constructing nest boxes, and population monitoring.

Harvest Information

- Harvest is believed to be very low, estimated to be below 20,000 annually, with the most harvest occurring in Texas and Louisiana. Harvest is low in part because Black-bellied Whistling Ducks depart their breeding areas before most waterfowl hunting seasons open.

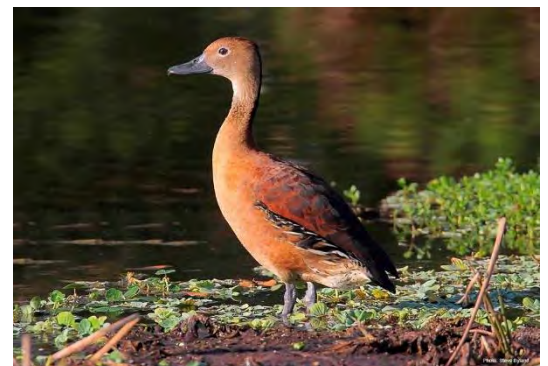


Fulvous Whistling-Duck

Male	Female
<i>Average Length</i> 18"	17.3"
<i>Average Weight</i> 1.72 lbs (780 g)	1.49 lbs (676 g)

Overview

The Fulvous Whistling-Duck is a medium-sized tropical species that occurs in North and South America, Africa, and India to Myanmar. In North America, it occurs in extreme southern California, Mexico, coastal Texas and Louisiana, and the lower half of peninsular Florida. Fulvous Whistling-Ducks are unmistakable in appearance, and the sexes



are identical. Perched on the ground or in trees, they have an erect posture, a blue-gray bill, and gray feet. They are tawny overall, the head has a dark crown, and the back and tail are blackish brown with tawny scalloping, both of which contrast with the white rump band. The grayish neck has darker streaking that suggests a furrowed appearance. The flank and belly are tawny cinnamon. In flight, the wings are deep brown, and crescent shaped white rump is notable.

Description

Key Identification Features

- In flight, the wings are deep brown, and crescent shaped white rump is notable.
- Flight strokes are slow, with the neck stretched outright, and feet extended beyond the tail, and the white rump forms a crescent that contrasts with back and tail.
- The grayish neck has darker streaking that suggests a furrowed appearance. The flank and belly are tawny cinnamon.

Male/Female Average Length and Weight

- Weight: Males and females overlap in mass and range 1.2–2.1 lbs.
- Wingspan: 8.2–8.4 in.

Male and Female Identification

- **Alternate (Breeding) and Basic Plumage:** They are tawny overall, the head has a dark crown, and the back and tail are blackish brown with tawny scalloping, both of which contrast with the white rump band. The bill and feet are dark gray blue. The grayish neck has darker streaking that suggests a furrowed appearance. The flank and belly are tawny cinnamon. In flight, the wings are deep brown, and crescent shaped white rump is notable. Flight strokes are slow, with the neck stretched outright, and feet extended beyond the tail, and the white rump forms a crescent that contrasts with back and tail.

In-flight Identification

- In flight, the wings are deep brown, and crescent shaped white rump is notable. Flight strokes are slow, with the neck stretched outright, and feet extended beyond the tail, and the white rump forms a crescent that contrasts with back and tail.

Vocalizations

- Very vocal. A high pitched, “kit-tee” or “pee-chee” accented on the second syllable.

Similar Species

- Black-bellied Whistling Ducks: Adults are unique and unlikely to be confused with any other species of waterfowl in North America. Juveniles resemble juvenile, Black-bellied Whistling Ducks, but Fulvous Whistling Ducks lack the presence of white wing patches that easily separate the two species.

Habitat Preferences

- Fulvous Whistling-Ducks are typically found in freshwater wetlands, ponds, or lakes, usually with emergent or floating vegetation, and often in rice fields and flooded pasturelands.

Foraging Habits and Diet

- Fulvous Whistling-Ducks are vegetarian with a diet often greater than 95 percent plant material. Vegetation consumed includes seeds of various emergent and aquatic plants. They also feed on cultivated rice. Invertebrates are usually less than 5 percent of the diet but include mussels and various aquatic insects.

Breeding Habits

- **Monogamy:** Fulvous Whistling-Ducks maintain monogamous, lifelong pair bonds.
- **Nest Locations:** Nests are often over water in dense flooded emergent or floating vegetation, and they also may nest on the ground.
- **Clutch Size:** The average clutch size in Louisiana was 14.1 eggs, with much larger clutches resulting from dump nesting or intraspecific nest parasitism. The eggs are white to buffy white, bluntly ovate to oval and average 2.1 by 1.6 in. The incubation period is about 24–25 days with males and females alternating incubation of the eggs

Migration and Distribution

- They are mostly sedentary in Florida. Departs Louisiana and northern areas of coastal Texas August to October. Migrants overwinter in coastal areas of Mexico and return to breeding areas in late March or April.



Conservation Status

- IUCN Status: Least Concern
- Population Status: Global estimates are 1 million in North and South America, 1.1 million in Africa, and less than 20,000 in Asia.
- Conservation Concerns: The primary threats include habitat loss and climate change.
- Conservation Focus: Conservation efforts focus on protecting and restoring habitat.

Harvest Information

Harvest is believed to be extremely low and is estimated to be below 5,000 annually with the most harvest occurring in Florida, Texas, and Louisiana. Harvest is low in part because Fulvous Whistling-Ducks depart their breeding areas before most waterfowl hunting seasons open.

Emperor Goose

Male	Female
<i>Average Length</i> 27"	27"
<i>Average Weight</i> 5.2 lbs (2,359 g)	4.2 lbs (1,905 g)



Overview

The Emperor Goose is a medium-sized goose that spends nearly its entire life near coastal or marine habitats. It has a restricted range with breeding populations in extreme western Alaska and eastern Russia. Their breeding range in Alaska includes coastal salt marshes of the Seward Peninsula south to the Yukon-Kuskokwim Delta. Their winter range includes coastal area of Kodiak and the Aleutian Islands in Alaska, and the Kamchatka Peninsula of Russia.



Emperor Geese are medium-sized, with a short-necked, stocky appearance. Adults have white heads and hindnecks (sometimes stained orange red), black chins and dark forenecks, gray body plumage with subtle black and white barring, and a dark vent and rump that contrasts with a white tail.

Description

Key Identification Features

- Emperor Geese are medium-sized geese, with a short-necked, stocky appearance.
- Adults have a white head and hindneck (sometimes stained orange red), black chin and dark fore neck, gray body plumage with subtle black and white barring, and a dark vent and rump that contrasts with a white tail. In adults of both sexes, the bill is pink, while the legs and feet are orange.
- Immatures are dark gray, with lighter barring or scaling on the back, with dull yellow legs.

Male/Female Average Length and Weight

- Weight: Males 5.3 lbs.; Females 4.2 lbs.
- Wingspan: 14.9 in.

Male and Female Identification

- Alternate (Breeding) and Basic Plumage: Adults have a bicolored head, consisting of white head and hindneck (sometimes stained orange red), black chins, gray black fore neck, and gray body plumage with subtle black and white barring. They have a dark vent and rump that contrasts with a white tail. Adults of both sexes have a pink bill with orange legs and feet. Immature birds are dark gray, with lighter barring or scaling on the back, with dull yellow legs.

In-flight Identification

- The black trailing edge contrasts with the silvery upperwing, and the white tail feathers are dark above and below.

Vocalizations

- They are less vocal than other geese. Calls are a “kla-ha” or “u-lu.”

Similar Species

- Unique in appearance and not easily confused with other geese in North America. Blue phase or intermediate phase Snow Geese will have an entirely white head and neck, compared to the bicolored head and neck of Emperor Geese. The rare dark morph of Ross’s Goose will have a white belly and undertail coverts and is smaller and stockier. In flight, Emperor Geese have a comparatively rapid wing beat compared to other geese.

Habitat Preferences

- **Breeding:** Emperor Geese nest in coastal salt marshes of the Seward Peninsula and Yukon-Kuskokwim Delta, usually on river or slough banks. Nests are often in elevated areas with good visibility, with dense grasses, sedges, and other plants.
- **Migration and Wintering:** During migration and winter, Emperor Geese use large estuaries with intertidal habitats, where they feed extensively on aquatic plants and animals.

Foraging Habits and Diet

- Emperor Geese are omnivorous and feed on a variety of plants including eelgrass, sea lettuce, beach pea, beach rye, and crowberries. They also feed on blue mussels and other intertidal invertebrates during migration and winter.

Breeding Habits

- **Monogamy:** Emperor Geese maintain monogamous, lifelong pair bonds. The timing of pair formation is poorly known. Some Emperor Geese attempt first breeding at age three, but others may wait until year 4 or later.
- **Nest Locations:** The nest is usually a scraped area with dead vegetation added as laying progresses, and usually on an elevated area near water in low shrubs and grasses.
- **Clutch Size:** The average clutch size in North America is 3–6 eggs. The eggs are creamy to dull, elliptical ovate, and average 3.2 by 2.1 in. The average incubation period is 24 days, with females performing nearly all incubation duties. Males provide nest defense.

Migration and Distribution

- **Fall Migration:** Migration begins mid- to late August, with most birds arriving in Aleutian Island wintering areas by November.
- **Spring Migration:** In Spring, birds begin migration in February and arrive in breeding areas in mid-April.



Conservation Status

- **IUCN Status:** Near Threatened
- **Population Status:** Comprehensive long-term population estimates are lacking. Available data suggest the population declined from over 130,000 in the 1960s to less than 45,000 in the 1980s. Since 1986, a spring survey in the YK Delta coastal zone indicated an increasing population index from 10,000–15,000 in late 1980s to 25,000–30,000 in the early 2020s.
- **Conservation Concerns:** Primary threats to Emperor Geese include habitat loss, adverse effects of environmental change, and risks associated with accidental oil spills near key breeding and wintering sites.
- **Conservation Focus:** Conservation efforts focus on careful population management via informed harvest decisions, egg collecting restrictions, and the protection and responsible use of key breeding and wintering sites

Harvest Information

- Prior to 2017, the hunting season for Emperor Geese had been closed for 30 years. The season reopened in 2017, following a permit system that allowed for the harvest of 500 or 1,000 Emperor Geese, depending on population status.
- Harvest regulations follow the Pacific Flyway Emperor Goose Management Plan which calls for an open season when the spring population index exceeds 23,000. In 2024, the spring index fell to 19,000, leading the USFWS, State, and regional wildlife managers to recommend a closed season on Emperor Geese for the 2025–26 season.
- Emperor Geese are important to indigenous subsistence hunters, with estimated harvest of 1,500–4,500 birds and <500 eggs during years when subsistence harvest is permitted.

Snow Goose

Male	Female
<i>Average Length</i> 31"	30"
<i>Average Weight</i> 7.4 lbs (3,357 g)	6.1 lbs (2,767 g)



Overview

The Snow Goose is among the most well-studied waterfowl species, and among the most abundant species of waterfowl in the world. Its breeding range extends from Wrangel Island, Russia, across the Arctic coast and islands of northern Alaska and Canada to Greenland. Snow Geese winter exclusively in North America from Oregon and California east to the mid-Atlantic Coastal states, and south to northern Mexico. Two sub-species are recognized, the widely distributed, abundant Lesser Snow Goose (*C. c. caerulescens*) that occurs across most of central and western North America, and the Greater Snow Goose (*C. c. atlantica*) that occurs in eastern North America. Lesser



Snow Geese winter primarily in the Central Valley of California, the Gulf Coast, and Mississippi Alluvial Valley but may be found in most areas where waterfowl winter. Greater Snow Geese winter on the mid-Atlantic coast from Massachusetts to North Carolina. Lesser Snow Geese have two color morphs, “white” and “blue,” with several intermediate phases, whereas Greater Snow Geese have only the “white” morph.

Adults of the light phase Lesser and all Greater Snow Geese are white, the primary coverts are gray, primary feathers are black, and they have rose red bills and feet, the bill showing the “grin patch” that separates the species from Ross’s Geese. Blue morph Lesser Snow Geese have white heads and necks, with the remainder of the body grayish brown, the wings show gray tinged with blue, the rump is gray, and the belly is grayish brown. Intermediate morphs show variable amounts of white on the belly and flanks. The bill and feet of the blue morph are like the white morph.

Snow Geese breed in large colonies in coastal Arctic areas that usually are at slightly higher elevation and clear of snow and ice earlier. Winter habitat historically was coastal marshes and some inland marshes that provided plants with preferred roots and rhizomes. Snow geese have subsequently adapted to agricultural habitats in migration and winter. They use a range of post-harvest waste grains (rice, corn, wheat, peas, barley) and graze leaves and grub for winter cereal roots (wheat, rye, barley). They gather to forage and roost in flocks at times numbering in the thousands to tens of thousands during migration and winter.

Description

Key Identification Features

- Snow Geese are medium-sized geese.
- The Lesser Snow Goose subspecies has two color morphs, white and blue. The Greater subspecies has only the white phase.
- The white phase is all white, except for gray primary coverts, and black primaries. The bill and feet are rose red, with the bill showing a notable “grin patch” that separates the species from the smaller but similar looking Ross’s Goose.
- The dark morph of the Lesser subspecies has a white head and neck, brown-gray body plumage, gray wing coverts tipped in blue with black primary feathers, and light gray belly, and gray rump. The bill and feet are like those of the light phase.
- Lesser Snow Geese have intermediate plumaged birds with characteristics of both color phases.

Male/Female Average Length and Weight

- **Weight:** Males are usually larger than females, and there is considerable variation and some overlap among subpopulations.
- Greater subspecies adult males 5.8–6.8 lbs.; adult females 5.1–5.7 lbs.
- Lesser subspecies adult males 4.2–6.2 lbs.; adult females 3.8–6.4 lbs.
- **Wingspan:** Males 16.1–17.2 in.; Females 14.9 in.

Male and Female Identification

- **Alternate (Breeding) and Basic Plumage:** The Lesser Snow Goose subspecies has two color morphs, white and blue. The Greater subspecies has only the white morph. The white phase is all white, except

for gray primary coverts, and black primaries. The bill and feet are rose red, with the bill showing a notable “grin patch” that separates the species from the smaller but similar looking Ross’s Goose. The dark morph of the Lesser subspecies has a white head and neck, brown-gray body plumage, gray wing coverts tipped in blue with black primary feathers, and light gray belly, and gray rump. The bill and feet are like the light phase. Lesser Snow Geese have intermediate plumaged birds with characteristics of both color phases. Immature white phase birds are gray overall with grayish pink bills and feet, while immature blue morph birds have brown heads, neck, breast and flanks, white rumps and vents dark gray bills and feet.

In-flight Identification

- Snow Geese have black wing tips, as well as pink legs.

Vocalizations

- Very vocal, usually a loud, high pitched “kow-luk” or “whouk.”

Similar Species

- **Ross’s Geese:** Ross’s Geese are smaller and lack the grin patch on the bill. Blue morph Ross’s Geese are rare but may still be separated by size and lack of grin patch on the bill.
- **Emperor Geese:** Emperor Geese have a unique bicolor head and neck that separate them from blue morph Snow Geese.

Habitat Preferences

- **Breeding:** Snow Geese nest in Arctic coastal tundra habitats. Nest colonies occur in featureless, inland, slightly elevated areas first to clear of snow and ice in spring.
- **Migration and Wintering:** During migration and winter, Snow Geese historically used large coastal and inland marshes but have adapted to large scale agriculture and use rice, corn, wheat, barley, and pea fields, and pastures extensively. Roosts are large open wetlands, lakes or flooded agricultural fields.

Forging Habits and Diet

- **Breeding Season:** Snow Geese graze and grub a variety of vegetation. They feed entirely on vegetation. On breeding areas, they grub and graze a variety of plants, and in some locations can disrupt and change plant communities that have negative effects on other species of birds and wildlife.
- **Migration and Winter:** During migration and winter, they grub subterranean roots and rhizomes, graze green vegetation, and pick seeds of waste wheat, barley, rice, corn, and peas. They may occasionally cause damage in fields of winter cereal plants.

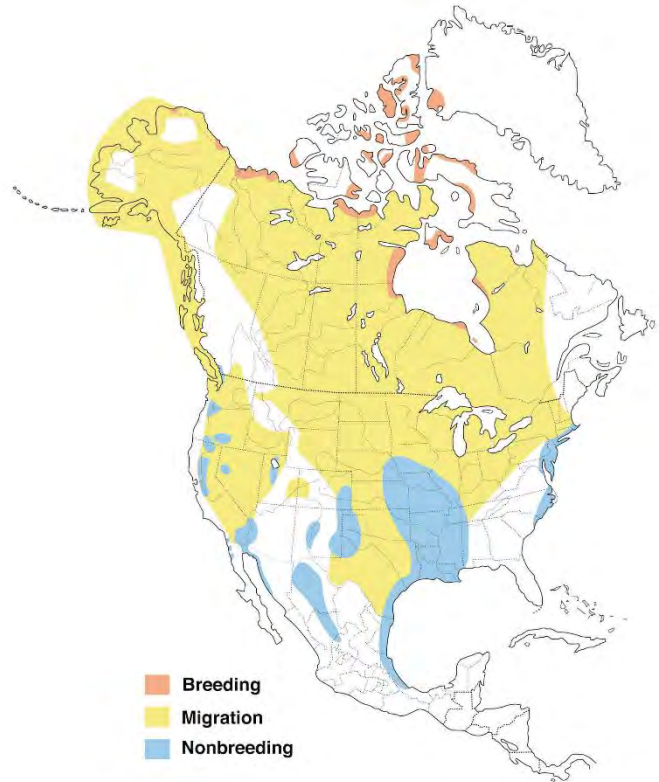
Breeding Habits

- **Monogamy:** Snow Geese maintain monogamous, lifelong pair bonds.
- **Nest Locations:** The nest is usually a scraped area with dead vegetation added as laying progresses and they are sometimes used in multiple years.

- **Clutch Size:** The average clutch size is 3–5 eggs. The eggs are creamy white, oval to sub-elliptical, and average 3.1 by 2.1 in. The incubation period is 24 days, with females performing incubation duties. Males provide nest defense

Migration and Distribution

- **Fall Migration:** Migration begins in late August, with most birds arriving on and staying in fall staging areas from September through November, depending on latitude and influenced by weather conditions. Arrival in wintering areas is from October to December.
- **Spring Migration:** In Spring, birds begin migration in February, arrive and stay in staging areas during March, April, and early May, and usually arrive on breeding areas in late May to June.



Conservation Status

- **IUCN Status:** Least Concern
- **Population Status:** The population of Snow Geese increased exponentially from 1970 (1 million birds) until 2013 (19 million birds) and has declined since that time to 14 million in 2019. The Mid-continent Population is estimated to contain about 83 percent of the total at 12 million birds. The Wrangel Island population is estimated at 440,000, while the Greater Snow Goose subspecies is estimated at 1.4 million birds.
- **Conservation Concerns:** No significant threats, most efforts aimed at reducing the high population level to mitigate impacts on other species of waterfowl, especially in Arctic areas.
- **Conservation Focus:** Managing burgeoning population through carefully increased hunting opportunities.

Harvest Information

Please note that these numbers are the result of combining Blue Goose and Snow Goose harvest data.

- An average of 309,623 Snow Geese were harvested per season across the US during the 2019 through 2022 hunting seasons.
- Snow Goose harvest is highest in the Pacific Flyway, accounting for 30 to 40 percent of the total US harvest.
- The top three states for Snow Goose harvest, based on annual averages across the 2019–2022 hunting seasons, were California (86,576), Texas (35,780), and Arkansas (20,787).

Chuck-will's-widow



At a Glance

The rich, throaty chant of the Chuck-will's-widow, singing its name, echoes through southern woodlands on summer nights. By day, the bird is seldom detected as it rests on horizontal tree limbs or on the ground, where its cryptic dead-leaf pattern offers good camouflage. If disturbed, it flaps away on silent wings, sometimes giving low clucking calls in protest.

CATEGORY Nightjars, Upland Ground Birds	IUCN STATUS Near Threatened
HABITAT Fields, Meadows, and Grasslands, Forests and Woodlands, Shrublands, Savannas, and Thickets	REGION Eastern Canada, Florida, Great Lakes, Mid Atlantic, New England, Plains, Southeast, Texas
BEHAVIOR Flap/Glide	POPULATION 5,700,000

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Range & Identification

Migration & Range Maps

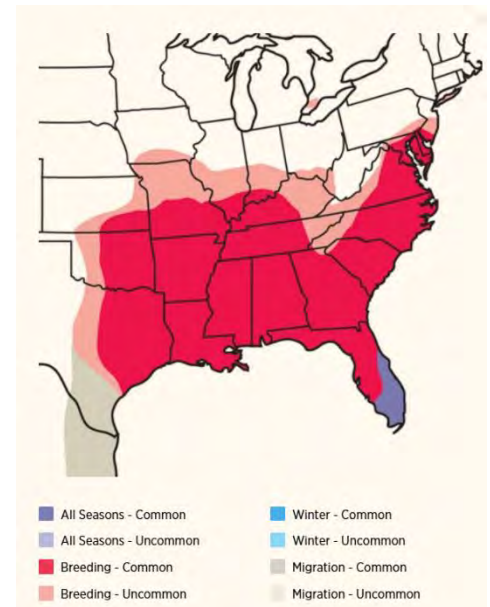
Some spend the winter in Florida but most migrate well south, wintering in the West Indies, Mexico, Central America, and northern South America.

Description

12" (30 cm). Larger than Eastern Whip-poor-will, rich buffy brown all over. Chest often looks



darker than throat (opposite of Whip-poor-will's pattern). Shows less white in tail in flight.

- **SIZE:** About the size of a Crow, About the size of a Robin
- **COLOR:** Black, Brown, Tan, White
- **WING SHAPE:** Long, Pointed
- **TAIL SHAPE:** Long, Rounded, Square-tipped



Songs and Calls

A mellow chuck-will's-widow, repeated over and over, the chuck deep and low, the rest of the call whistled.

 CALL PATTERN	Flat, Undulating
 CALL TYPE	Croak/Quack, Hoot, Odd, Whistle

Audio © Lang Elliott, Bob McGuire, Kevin Colver, Martyn Stewart and others. [Learn more](#)

Habitat

Oak and pine woodlands. Breeds in shady southern woodlands of various types, including open pine forest, oak woodlands, edges of swamps. Winter habitats include subtropical woods and lowland rain forest in the tropics.

Behavior

Eggs

2. Creamy white, usually blotches with brown and gray. Incubation is probably by female only, about 3 weeks. If the nest is disturbed, the adult may move the eggs some distance away.

Young

Apparently cared for by female alone. Female broods young and shelters them during the day; feeds them by regurgitating insects. Age of young at first flight 17 days or more.

Feeding Behavior

Forages at night, perhaps most actively at dusk and dawn and on moonlit nights. Forages by flying out from a perch high in a tree or from the ground to catch flying insects; also forages in continuous flight along the edges of woods. Captures food in its wide, gaping mouth; insects and small birds are swallowed whole.

Diet

Mostly large insects. Feeds on large night-flying insects, especially beetles and moths, also many others. Also occasionally takes small birds, including warblers, sparrows, and hummingbirds.

Nesting

In courtship during daytime, male struts or sidles up to female with his body plumage puffed up, wings drooping, and tail spread; moves with jerky actions, and calls. Nest site is on ground, in rather open area within shady understory of forest. Same site may be used more than one year. No nest built, eggs laid on flat ground on leaves or pine needles.

Conservation

Conservation Status

Thought to be declining in parts of its range, possibly because of loss of habitat.

- IUCN Red List Status: Near Threatened

