



UNIVERSITY OF MISSOURI CENTER FOR AGROFORESTRY

# INTEGRATING AGROFORESTRY PRACTICES FOR WILDLIFE HABITAT

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Agricultural practices and land-use decisions influence wildlife habitat and use by wildlife. Some actions can enhance habitats, while others negatively impact wildlife. Certain land-use practices have resulted in a decrease in the quality and diversity of available wildlife habitat on the farm. For example, more efficient farming practices, larger field sizes and the loss of field borders, such as those provided by windbreaks and brushy fence rows, have generally had a negative impact on habitat.

Agroforestry practices can be used to provide many benefits to a farm, such as improved water quality, soil stabilization and income opportunities. Agroforestry also can be used to provide diversity to a farm and enhance the potential to provide habitat for a variety of wildlife species.

When agroforestry is applied, the resulting land uses are often able to accommodate the needs of a variety of wildlife species – as well as offering opportunities for shorthand long-term income and environmental sustainability.

Through integrated combinations of trees, shrubs and grasses, agroforestry practices can provide a means to increase the availability of habitat for certain wildlife without sacrificing the potential to achieve a landowner's agronomic and economic goals and objectives.

The University of Missouri Center for Agroforestry, founded in 1996, works to

*The agroforestry practices of forest farming, silvopasture, alley cropping, riparian forest buffers and windbreaks involve the deliberate integration of trees, shrubs and grasses with agricultural practices (crops and/or livestock). Benefits include:*

- Opportunities for diversified income from value-added or alternative agricultural products
- Opportunities for long-term income, including timber sales
- Improved soil and water quality; reduction in nonpoint source pollution and erosion
- Enhanced wildlife habitat and biodiversity
- Sustained land resources for future generations

develop the science of using combinations of agricultural and forestry practices to achieve a more diverse, sustainable agricultural system. This collaborative effort is uncovering new information about the wildlife benefits of agroforestry practices through the use of alley cropping, windbreaks and riparian forest buffers, in addition to the alternative income opportunities the practices can provide.

Wildlife habitat is the combination of physical and environmental factors that a species requires for survival and reproduction. This includes the composition and structure of the vegetation on the land and encompasses seasonal variation to that composition and structure.



Whether designing land-use goals with wildlife, short/long-term income or stewardship objectives in mind, consider the various components that define wildlife habitat:

- Food
- Cover
- Water
- Space

Once knowledge of the life history, biology and habitat requirements of the species are known, you can begin to identify the limiting factors that might exist on your property and conduct management practices that provide the needed resources. To be successful, develop a plan of action (a wildlife management plan) and begin to integrate wildlife considerations (such as habitat management techniques) along with your other ongoing land management objectives. Having a plan to work from will help ensure success. Often, many of the habitat improvement practices that are discussed will be beneficial for a diversity of wildlife species.

This guide provides a general overview on managing habitats for the following wildlife species of interest to many private landowners:

- White-tailed deer
- Eastern wild turkey
- Bobwhite quail
- Waterfowl
- Mourning doves

In addition, specific plants that can be used to provide food and cover are identified, as well as suggestions on how to integrate management practices that benefit the desired species. Information is also provided on methods that can be used to reduce management costs and the potential income opportunities that can result.

## White-Tailed Deer

### *Habitat Needs*

White-tailed deer have adapted to a variety of habitat conditions across Missouri. Good white-tailed deer habitat contains the right mix of available foods and cover throughout the year. The size and shape of a deer's home range

will vary with habitat quality, deer density, sex, time of year and the deer's age. Deer that live in better habitats (ample amounts of food and cover) often are able to satisfy all of their daily requirements in a smaller area, while deer that live in less diverse habitats usually must travel greater distances to find suitable food and cover. An adult buck will usually have a larger home range than does and young bucks; however, this is dependent on the time of year and the overall quality of the habitat. Home range refers to the area used by a deer throughout a given timeframe or season. By providing the appropriate mix of cover types on your property, you can begin to manage for all the habitat needs of deer throughout the year.



*White-tailed deer prefer to use habitats with an abundance of forest or woodland edge, as opposed to large, dense areas of forest. Farms with small wood-lots, forested riparian areas and woody draws mixed with crop fields provide excellent habitat for deer, and for this reason deer populations have thrived in agricultural areas.*

### *Water Sources*

Water is critical for survival; however it is most often not a limiting factor for deer in Missouri. Deer may acquire water from vegetation or surface water, such as ponds and streams. Good deer habitat contains accessible surface water available throughout the year.

### *Food and Forage*

Deer are ruminants, and therefore will use a variety of foods including hard and soft mast



(acorns and other seed and fruit produced on trees, shrubs and brambles), herbs, grasses, twigs, green leaves and agricultural crops. Deer are very selective feeders and will seek out preferred plant species. Most often their preference is for browse material, which may include vines, shrubs and young trees, and mast production such as acorns. Deer have the ability to select plants that offer the most nutrition at particular times of the year. As fall and winter approach, deer prefer to eat acorns (white and black oak). When acorn production is low, deer will transition to other readily available food sources, including agricultural crops like alfalfa, clover, wheat, corn and soybeans.

As a daily average, deer may consume up to 8 pounds of green food for every 100 pounds of body weight. As a percentage of their body weight, bucks will consume the most food in the spring while does will consume the most food in the fall, just prior to breeding.

Because deer food preference and need changes seasonally, it is important to provide readily available foods throughout the year. Acorns are rich in carbohydrates and are one of the most important food items during the winter. It is preferable to manage woodlands and wooded edges for a variety of hard-mast producers. Oaks will typically produce large mast crops one year out of every three years. It is also typical that an oak will not bear acorns until it is 15- 25 years of age. Forest management for deer habitat should seek to maintain about 15-20 acorn-bearing, red and white oaks per acre.

### Cover

Deer rely on a variety of cover types during each season of the year. When evaluating your property for deer, keep in mind deer are creatures of the edge. This means they prefer areas where two or more cover types come together, such as where a shrubby thicket adjoins an agricultural field. Deer utilize both open woods and areas with thick shrubs and brush such as clearcuts for escape cover. In

addition, abandoned pastures provide concealment cover for does and young fawns as well as nutritious food plants.

## Management Guidelines: White-Tailed Deer

### Evaluating Deer Habitat

Missouri's relatively mild winters, diverse habitat conditions, and good mixture of crop fields and woody cover provide deer with ideal conditions throughout the state. It is important to evaluate your property with a habitat appraisal before making habitat management decisions. (*Refer to MU Extension Guide: Enhancing white-tailed deer habitats on your property: habitat evaluation extension2.missouri.edu/g9492*). In Missouri, most land ownership consists of many small parcels, and it becomes important to cooperate with neighbors to help achieve habitat management goals.

### Managing Woodland Habitats

As mentioned earlier, deer are creatures of the edge and their instincts draw them to woody cover and to the edges of woody cover. Edges can be made more valuable for deer by creating an undulating pattern (more edge per area is created when edges are not in a straight line). This can be accomplished by leaving brushy draws that periodically protrude into fields, or by mowing or disking field edges in an irregular/wavy pattern.

A good rule of thumb would be to keep edges of fields and pastures in shrubs or young trees by periodically brush hogging (once every 5-7 years). Allow quality trees that are 50 feet or more from the edge to develop into their full potential as timber and mast producers. This maintains the shrubby component that is important for high-quality deer habitat and minimizes the competition for light and moisture that would otherwise develop from larger trees spaced closer to farm production areas. More detailed information on woodland management for white-tailed deer can be found in the "additional references" section.



### Food Plots

In addition to managing field edges, you may have dense pockets of woods that need to be opened up. Small temporary or permanent openings can be created to provide diversity in these woodlands. One popular opening is a “green-browse” food plot. These areas are typically 1 to 5 acres in size and placed at the rate of about 1 per 40 acres of woodland.

“Green-browse” food plots can be planted into wheat and red clover in forest openings. Grain food plots can also be planted. Crops such as corn, milo or soybeans can become hotbeds for deer activity, bringing together multiple habitat requirements on a relatively small parcel of land.

These temporary openings can also serve as regeneration areas for the development of young trees and shrubs and become valuable for cover and browse. One of the critical components to deer habitat management will be addressed in answering how to integrate quality habitat with existing agricultural practices. Agroforestry provides several practices for integrating various woody species with existing crops and/or pastures. (*These practices are highlighted under the section "Agroforestry Practices for Deer and Wild Turkey."*)

The agroforestry practices of **alley cropping**, **riparian forest buffers** and **windbreaks** are especially well suited for creating edges of desirable plant species and thereby integrating deer habitat management with agricultural production.

Additionally, the practice of **forest farming** can be used to manage woods for improved timber growth, while also developing favorable understory plant.

### Population Management

Landowners have the opportunity to implement various population management strategies to help accomplish their goals and objectives. A high percentage of does have twin fawns, so deer reproductive rates in Missouri are high. Predation and farming activities are the primary causes of mortality of fawns less than two months of age.

Timing of activities, such as mowing or haying, can be shifted to favor desirable wildlife species. However, this may also involve a shift to grasses that develop, or reach harvest stages, at a different time or season. For instance: Moving from a cool-season grass mixture to warm-season grasses and adjusting haying to an activity occurring later in the summer.

- Hunting is the leading cause of deer mortality in most of Missouri and an important management tool in governing deer abundance in any particular area.
- Legal hunting is the most efficient method to keep deer numbers at or below the cultural carrying capacity (the maximum number of deer that the public will accept before the negative aspects of high deer numbers become intolerable).

When managing for deer, the question of landowner goals and objectives must be answered prior to implementing management practices. Some would rather have few deer on their property, while others would like to maximize their numbers.

Concepts such as Quality Deer Management promote managing for healthy deer populations to ensure a quality hunting experience and promote a philosophy among hunters and landowners of managing deer populations that exist within environmental, biological and social boundaries. By managing for a more balanced deer herd, problems can often be reduced and goals of interest better achieved.



## Eastern Wild Turkey



*Eastern wild turkey in wooded area*

### Habitat Needs

Today the eastern wild turkey thrives, but the species' past has not been without challenges. Early in our nation's history, hunting was unregulated. In addition, settlement practices and farming often resulted in forested lands being cleared, and by 1920, the wild turkey remained in only 21 of the 39 original states of its historical range. Habitat management has restored sound populations of the wild turkey to most of its natural range.

In Missouri, wild turkey restoration programs were initiated in the 1950s when the Missouri Department of Conservation began to restock birds in the Ozarks. Currently, all 114 counties have large populations of wild turkey sufficient to support hunting.

Wild turkeys use different habitats during the various seasons; however, they spend about six months of the year in "winter habitat," which is characterized by having at least 50 percent of the range in mature hardwood forests. Turkeys also make extensive use of open fields that border these forests. Nesting habitats are varied, but hens will usually nest near the edge of an open field or hay field. Turkeys have a fairly large home range; however, the size of the area will depend on the availability of foods and cover.

*A diversity of habitat types that provide seasonal food and cover requirements is the key to having large numbers of wild turkeys.*

### Roosting

Suitable turkey habitat includes a scattering of mature mast hardwoods (for food and roosting sites), understory shrubs that provide soft mast, such as dogwood and wild cherry, and a variety of open pastures and fields to provide nesting and brood-rearing sites. The importance of having mature timber is highlighted by the roosting preference of turkey. While turkey will roost on the ground, they are most often associated with roosting overnight in trees to avoid predators. When roosting in trees, turkeys prefer to use open-crowned, mature timber. Often this timber will be connected to a large area of woods and will have a water source close by.

- Insects provide newly hatched poults with a good source of protein. Patches of legumes that attract insects are excellent habitats for young broods.
- It is recommended to establish shrubby escape cover close to insect-attracting patches.
- In large tracts of forest land, small woodland openings (one-half to 3 acres in size) provide a good mix of herbaceous material and good access to cover for escape from predation.

### Water

Turkeys require an open source of water. They will use ponds and lakes, streams and spring seeps.

### Food

Turkeys also will make use of crops such as corn, soybeans and milo. Food plots and grain crop residues can provide a high-energy food source to sustain turkeys during the winter and



early spring when other food sources are scarce.

However, the preferred foods of turkey are found in association with forested lands. Both red and white oak acorns are a primary food source. Other seeds or fruits from species such as dogwoods, hawthorns, wild grapes, cherry and persimmon also will be used. In addition to food from trees and vines, turkey will eat buds, leaves and insects.

### ***Breeding, Nesting, Brood Rearing***

Turkeys do not have specific habitat needs associated with mating. However, field edges adjacent to woody cover are excellent locations to view the spectacular show-and-tell antics that toms use to impress and attract hens.

Turkeys nest on the ground. Most often nests will be located where a dense understory or thicket exists, underbrush/slash piles, or downed treetops. Nests will often be found along field edges. Because of the light that reaches vegetation at the ground level (as opposed to darker forested environments), the undergrowth on field edges is usually thicker, and comprised of a number of woody/ shrubby species of vegetation. This type of habitat interface provides cover and insects, both needed by turkey broods. Agroforestry practices can be used to maintain these habitats in close proximity to one another.

### **Management Guidelines: Wild Turkey**

Wild turkey generally have a fairly large home range (350 to >1,000 acres). Therefore, it is essential to provide a mix of habitat requirements if you want to attract and keep turkeys on smaller tracts of land. Habitat containing a mix of mature timber and open fields is essential.

To maintain tracts of mature trees, it is often necessary to stagger management and harvesting practices so that areas of mature timber are left undisturbed.

One method is to harvest timber in blocks. The acreage harvested should be spaced so mature timber is always available next to harvested blocks. Harvests also will need to be spaced over time to allow harvested areas to grow back prior to cutting the mature timber that may be adjacent to them.

An alternative method is to harvest single or small groups of trees from within the forest. • To properly conduct single or group tree harvests, and sustain the composition of the forest, careful monitoring of the regeneration is necessary. Regeneration of a forest is dependent on available sunlight. Many species, such as oaks, require substantial sunlight for regeneration. Several trees will need to be removed to increase the available sunlight for seedlings to become established.

Whether through block or group openings or single tree harvests, it is important to manage forest lands so that all the important habitat components are available – either on your property or on adjacent lands. Refer to the “additional references” section for more detailed information on managing your property for wild turkeys.

### **Agroforestry Practices for Deer and Wild Turkey**

Although deer and turkey both use wooded tracts, they also will make extensive use of woody edges and open fields. Because of the preference that both species have in a diversity of plant communities for food and cover requirements, agroforestry practices are ideally suited to create desirable habitat.

### ***Tree configurations in alley cropping or windbreaks***

Every hunter has observed how a deer uses a woody edge or shrubby fence row as a travel corridor. By planting select trees and shrubs in configurations such as alley cropping or windbreaks, a greater amount of woody edge can be created in or around a given field. Use of



oak species can be especially beneficial since acorns provide an important food source. Combining this planting with species of shrubs provides opportunities to meet both food and cover needs that are beneficial throughout the year.

For wild turkeys, the alley cropping practice can create areas with trees, shrubs and open areas that provide good nesting and brood-rearing locations. In addition, the acorn crops provide turkeys with mast that can be used during the winter.

### *Agroforestry Practices for Deer and Wild Turkey*

- Alley cropping and windbreaks: Creates woody edges for food and cover, especially if oaks are put into the practices specifically for acorn production.
- Riparian forest buffers: Incorporates multiple rows of trees, shrubs and grasses; this complexity may offer enhanced benefits for deer and turkey.
- Silvopasture: Provides habitat for deer and turkey through integrating select trees and select forages. Introducing or managing trees producing desirable mast, in combination with grasses and legumes, can create beneficial habitats.
- Forest farming: While promoting sustainable forest management, areas of food plots and/or green browse can be created.

### *Windbreaks & Riparian Forest Buffers*

Windbreaks and riparian forest buffers provide similar benefits as alley cropping with rows of trees and shrubs. Each serves specific functions, such as reducing wind speeds or filtering runoff, but the edges they create can be more diverse and more useful to wildlife than areas of alley cropping. Both the riparian forest buffer and the windbreak practices incorporate the use of multiple rows of trees and shrubs, and also may utilize stiff stemmed grasses. This complexity may enhance the benefits available for deer and turkey.

Silvopasture and forest farming practices provide similar types of habitat. Both can be managed so more sunlight is available to produce a companion crop.

### *Silvopasture*

There are two primary methods for creating a silvopasture practice. The most commonly applied method involves planting trees into existing pastures. These trees can then grow to produce shade and shelter which benefits livestock by reducing stress from weather extremes (heat and wind-chill).

The keys to successfully integrating newly planted trees with pasture grazed by livestock is to (1) protect the trees from grazing and (2) space trees widely such that when fully grown 50 percent shade is produced (or plan to thin and reduce tree numbers as they grow). Shade levels of about 50 percent have been identified for producing cool-season grasses and legumes at levels comparable to open conditions.

The best method of protecting trees from grazing animals is the use of fencing. If trees are in rows, electric fencing is effective. If trees are more widely scattered, then use wire cages and solid posts to protect them while young.

For wildlife, properly selected tree species can provide cover and food that pasture alone can not. For example, acorn production from oak trees can serve to attract turkey and deer. If concerns exist about cattle consuming the acorn crop, rotate livestock out to an open pasture during the period of acorn drop.

Of course, an alternative is to plant a different tree, such as eastern black walnut. Where appropriate, walnut and pecan trees have leaf characteristics that tend to produce a light shade that can benefit both livestock and forage productivity.



### **Forest Farming**

Comparatively, the forest farming practice promotes a greater level of shade than does thinning native stands for silvopasture and therefore is more likely to create areas of green browse, vines and shrubs than in a silvopasture practice – offering the benefit of seasonal use by deer and turkey.

When creating a silvopasture or forest farming practice, remember that these resources can also be managed for timber products. Throughout the process of managing the overstory trees, suitable understory environments can be maintained and managed to meet the habitat needs of deer and turkey.

*As a part of the overall woodland management, thinnings should favor desirable species of trees and shrubs, taking into consideration not only their value for wildlife, but also the potential of high-quality trees for timber production.*

## **Bobwhite Quail**



*Bobwhite quail require early stages of plant succession*

### **Habitat Needs**

Bobwhite quail have more complex habitat requirements than many wildlife species, so it is important to begin thinking about how to create habitats that are usable throughout the

year. Bobwhites need a mix of early-successional vegetation (grasses, legumes, shrubs and crop fields) all interspersed together. Quail rely on these interspersed habitats for their food and cover needs. They survive largely by continually refueling and minimizing unnecessary energy loss and expenditure.

Quail are primarily ground-dwelling birds and do not have the same degree of mobility as most other game species (i.e., wild turkey, deer, pheasant, dove and waterfowl). It is generally thought that 20 to 40 acres of area with the right mix of habitats can support a covey of quail. While that amount of area can certainly be managed to support a covey, research suggests that much larger land areas are needed to successfully restore habitats to support a sustainable quail population. This means that landowners who may own small acreages (less than 100 acres or so) can manage habitats for quail; however, they will need to work together with their neighbors to really begin to make a difference.

There are several publications that can help to assess your quail habitat management efforts. These can be found in the “additional references” section. Among the publications identified is the Missouri Bobwhite Quail Habitat Appraisal Guide, MP902, that provides information on evaluating your land for potential bobwhite quail habitat. The appraisal guide can be used as a planning tool to help you identify the habitat components that are in “shortest supply” or limiting on your property and the appropriate management practice(s) required to address deficiencies (nesting, brood rearing, roosting and escape cover).

### **Breeding, Nesting, Brood Rearing**

Bobwhite quail have short life spans, rarely living to two years of age. Most often, 80





percent of the annual population will not survive to see the following year. Although bobwhites have high mortality rates, the species also has the capability to have high reproductive rates.

During the spring, males begin their courtship activity; the familiar “bobwhite” whistle is the earliest sign that the reproductive season is underway. Courting pairs form during April and May and bobwhites may mate and initiate nesting attempts with as many as three different mates.

*“The goal in habitat development may be seen as creating that which minimizes energy expenditures while maximizing opportunities for replenishing energy. Habitat should recognize the needs associated with cold winters and/or hot summers (climatic variation), and the various activities from laying, nesting, brood rearing and resting (types of cover for stages of their life cycle). The elements of the habitat developed, or maintained, must be combined in a manner that balances both access to that habitat and escape from predation. It is through the proper mixing of habitat types that quail are most likely to benefit.”*

– Fred Guthery, "The Technology of Bobwhite Management," (2002)

### Bobwhite quail nesting cover

- Clump grasses between 1 and 2 feet in height make some of the best nesting cover. Most often these are warm-season grasses, such as broomsedge, little bluestem, big bluestem, indiagrass, and switchgrass, but cool-season grasses, such as timothy and orchardgrass, may also be used.
- It is important that residual nesting cover exists during the spring. The recommendation is to stagger management so that cover is available in a given field about every two years. Don't burn all warm-season fields every year.

Nests are often built on a slight depression in the soil with dead grasses and stems left over from the previous year. They are usually located close to edges of grassy fields or field borders, many times within 10-25 feet of a habitat edge. The importance of proximity to bare ground becomes apparent when you consider the needs and size of newly hatched chicks. Most nesting in Missouri begins in mid-May, with peak hatching often occurring in mid-June; however, if initial nest attempts are broken up, quail may nest as late as August. Late-season nesting will often occur following failed nesting attempts earlier in the year.

As soon as all chicks are hatched, they are led away from the nest to what is referred to as brood-rearing cover. Therefore, mobility at the ground level plays a key role in what areas are selected for nesting. Fescue, and other turf grasses, as well as stagnant warm-season grass stands that form mats of vegetation, are undesirable as quail habitat. Unless an area is prone to erosion, management should favor stands of grass and forbs (weeds) that are open at the ground level, which will allow chicks to move freely and satisfy their high-protein diet requirements.

### *Year-Round Cover & Food for Bobwhite Quail*

Early successional stages of plant vegetation are essential habitat for bobwhite quail and must be available throughout the year. Bobwhites are often associated with cover that affords a high level of visual obstruction. This protective cover needs to be provided from both above and from the ground level.

An optimal agricultural landscape for bobwhites typically contains 15 to 20 percent shrubby cover, 20 to 30 percent grassy areas, and 40 to 60 percent row crops, all interspersed closely together.

Embodied in each of these cover types is the desired existence of 20 to 60 percent bare ground, with an overhead canopy of shrubs, grasses, legumes and weedy vegetation. These



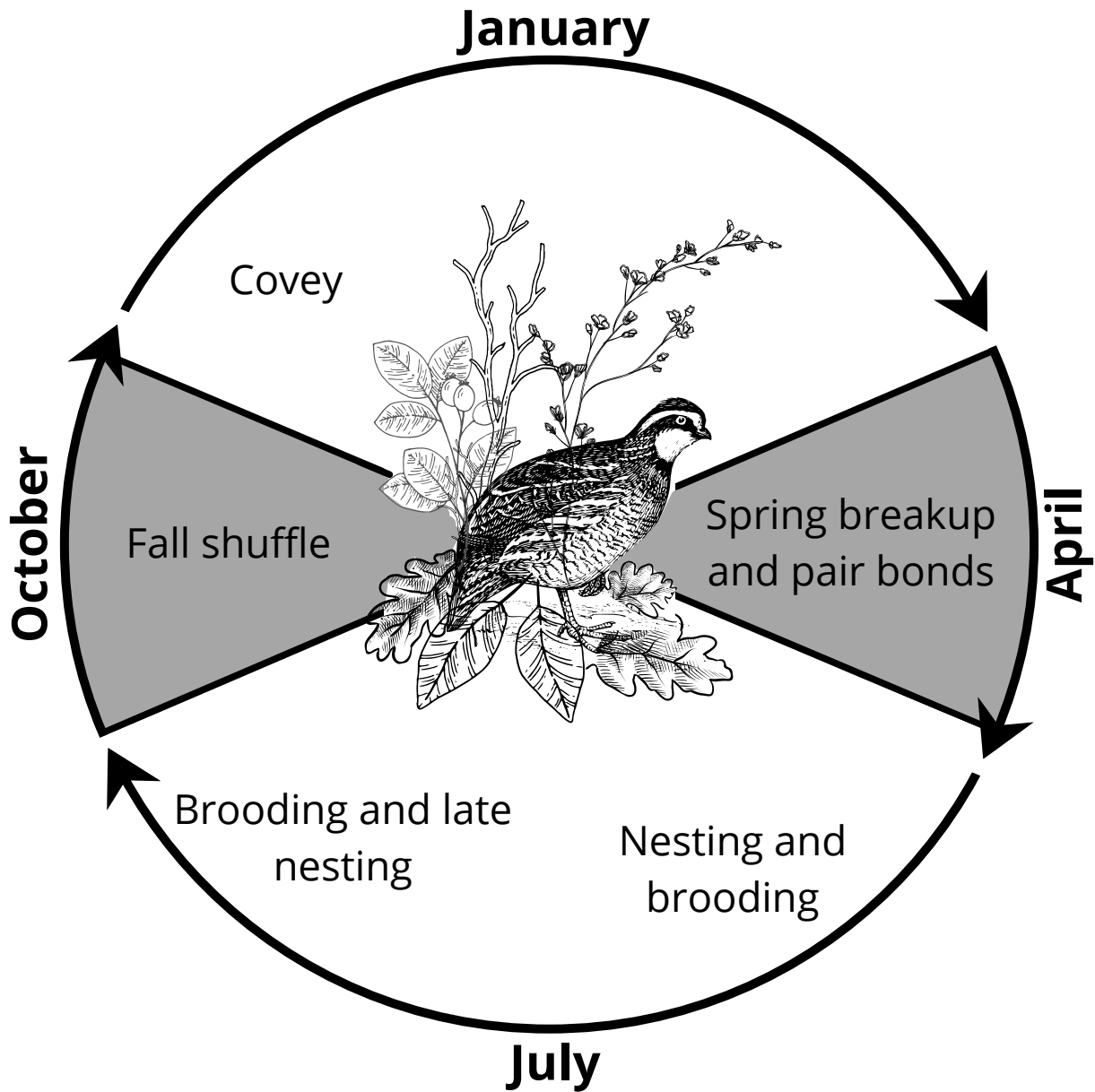


Figure 1: Annual cycle and major events in the life history of bobwhite quail.

### Distribution of Bobwhite Quail Nesting Time

Nest building and until the first egg is laid	Egg laying	Interval between egg laying and start of incubation	Incubation period	Total
5 days	18-20 day	1-7 days	23 days	47-45 days

Table 1: Distribution of Bobwhite Quail nesting time activities



areas of cover provide resting areas for use between feeding periods. They also provide protection from predators and bad weather.

Missouri research has shown that during winter, quail rarely stray further than 70 feet from shrubby cover. Therefore, to make an area suitable for bobwhites, scattered patches of shrubby cover should be spaced every 150 feet and be located next to other important cover types and available food resources. Woody protective cover is an absolute necessity and a habitat type that is often limiting on many farms. With other food and cover located nearby, little covey movement is necessary, energy is conserved, and predation reduced. The idea is to have these “covey headquarters” located across the property. However, these areas are unusable if the understory at ground level is made up of turf grasses like tall fescue.

Bobwhites are seed eaters; however, insects are also important and comprise a large percentage of their summer diet. Insects are essential for chicks as a main source of protein. A variety of foods are found in the diet, from weed and forb seeds (ragweed, annual lespedeza, partridge peas, tick trefoil), grasses and soft mast (fruits and berries) to cultivated crops and hard mast (i.e., acorns). Seed may compose 70 to 95 percent of a quail’s diet depending on whether it is summer or winter.

Although bobwhite quail will utilize all successional stages of vegetation, from recently disturbed bare ground to mature forest, the early successional stages containing abundant annual forb and weed seeds are the most important. As mentioned earlier, early successional vegetation (grasses, legumes and weedy vegetation) must be integrated with patches of early-successional shrubby cover. Without dense, shrubby patches of cover, it is not possible to restore quail populations on your property.

### **Water**

In the Midwest, water is not a limiting factor

for bobwhites. Water requirements are usually met by the intake of green plants, insects, dew and snow.

### **Management Guidelines: Bobwhite Quail**

The question may be asked: Which should I manage for – nesting, escape or cover? The answer is to initially manage for the habitat component that is the most limiting on your property. MU Extension publication MP902 provides a process that can help identify limiting factors and provides management recommendations to assist in getting habitat on the ground. Many farms lack the diversity of habitats that quail need. The most common limiting factors on many farms are brood-rearing cover and shrubby escape cover (at times called covey headquarters).

Another scenario may be that your property has all the habitat components that quail need, but is essentially an “island” of habitat within a landscape that does not have suitable habitat. If this is the case, it becomes extremely important to work with your neighbors and cooperate in the management of habitat for bobwhite quail.

Maintaining optimal habitats for bobwhite quail on your property requires conducting a variety of management practices throughout the year or on a timely basis. For more detailed information, refer to MU Extension Publication, “Establishing and Managing Early Successional Vegetation for Wildlife on Agricultural Lands.” (See resources page for link to this publication, along with other helpful guides for encouraging Bobwhite quail.)

### **Agroforestry Practices for Quail**

Weeds, forbs and annual crops each provide sources of high-energy food for quail. However, studies have shown that by far the highest energy values come from agronomic seed, such as corn, soybean, wheat, grain, sorghum and sunflower crops.





*Sunflower crop at South Farm Research Center in MO*

### **Alley Cropping**

Alley cropping configurations that promote the use of shrubs can enhance habitat for quail by providing food and cover in close proximity to one another.

For the purpose of developing good quail habitat, tree or shrub selection should satisfy two requirements:

- Overhead cover
- Areas of bare ground

**Alley Cropping:** Enhances habitat for quail by providing food and cover in close proximity to one another.

**Windbreaks:** Quail reap the most benefit from windbreaks when they are spaced as close together as possible and incorporate lower-growing shrubs.

**Silvopasture:** The growth of trees (but not necessarily shrub species) will change over time and influence forage growth in an area. Grazing regimes and forage selection are critical for pasture use by quail.

**Riparian Forest Buffers:** Properly designed riparian buffers contain zones of trees, shrubs and warm-season grasses in close proximity to crop fields or pastures and can be extremely beneficial as nesting, brood-rearing and escape cover.

Greater benefits will be achieved when these practices are designed in association with meeting needs identified through a habitat appraisal.

Most shrubs such as dogwoods, wild plum, sumac, blackberry and wild indigo are desirable for the food and cover provided and, due to their low height, they compete minimally with adjacent crops for sunlight. Integrating trees and shrubs for quail management should balance landowner objectives for habitat and long-term income needs from farming.

Additional benefits that result from alley cropping can be achieved by incorporating a 30-foot field border of warm season grasses and legumes (for nesting and brood-rearing cover). When integrating rows of trees/shrubs, place 15 feet of warm-season grass on either side of the tree/shrub row. This will create high diversity in direct association with the crop field. Intentionally incorporating trees, shrubs and grasses adjacent to high-energy crops may greatly enhance habitats for bobwhite quail on your property.

It is important to provide and manage for the habitat components that are in shortest supply, whether this is cover for nesting or brood-rearing areas, or for protection from predators.

### **Windbreaks**

Properly managed and arranged windbreaks can provide benefits similar to alley cropping for bobwhites. However, windbreaks that are spaced too far apart essentially become isolated field borders. These isolated borders can create habitats that are linear and may be used by a variety of mammalian and avian predators during the year.

Quail reap the most benefit from windbreaks when they are spaced as close together as possible. A study out of Texas A&M noted that average flight distances for quail were 47 yards (141 feet) and that most quail flew less than 75 yards (225 feet). By using multiple rows of quail-friendly trees, shrubs and grasses, an effective windbreak can also become prime quail habitat, meeting needs associated with having cover and loafing areas near agronomic crops. With appropriate design and spacing,





*Windbreak planting*

windbreak and alley cropping rows offer accessible escape habitat from anywhere in a field.

Regardless of whether the open field contains row crops, grasses or livestock, the distance between windbreaks should be carefully considered and based on the conservation benefits that the windbreak is to provide.

### ***Silvopasture***

Much of the success or failure of a silvopasture practice to support quail depends on the selection of forages, shrubs and trees. When seeking to develop habitat suitable for quail on acreage that also is used for grazing, the challenge is to understand the needs of both livestock and quail. Tall fescue, which is a common pasture grass in Missouri, does not provide suitable habitat for quail because it is a very aggressive grass that produces a dense, matted ground cover. It also out competes other vegetation. Quail, on the other hand, thrive in diversity and need ground cover that allows for their movement.

Although tall fescue pastures can be improved by adding legumes, such as red clover and lespedeza, it is unlikely that those pastures will provide many benefits for bobwhites because the pastures lack the bare ground required for quail mobility.

For incorporation into a silvopasture practice, forages must be relatively shade tolerant. In a silvopasture practice, the growth of trees (but not necessarily shrub species) will change shade levels over time and influence forage growth. It will be necessary to monitor and adjust the density of trees so that equal parts of shade and light are maintained.

### ***Riparian Forest Buffers***

Properly designed riparian buffers that contain zones of shrubs and warm-season grass in close proximity to crop fields or pastures can be extremely beneficial for use as nesting, brood-rearing and escape cover.

The key to riparian buffers is twofold: (1) integrate species that address water quality or erosion issues; and (2) apply management to enhance usability by quail without sacrificing the buffering ability.

Quality field borders for wildlife include a variety of native warm-season grasses,

There are several agroforestry practices that may help connect otherwise isolated islands of habitat on a farm:

**Alley Cropping**, forested riparian buffers and windbreaks each provide for the integration of select trees/shrubs/grasses with agriculture practices that might otherwise not provide cover or nesting and brood-rearing areas for quail.

**Silvopasture** practices can intersperse cover with otherwise grassed areas and enhance the areas that quail can use.

A key component to integrating agroforestry with agricultural production is to identify how best to maximize quail habitat while minimizing production losses. This requires our understanding of the competition that will occur between trees/shrubs/grasses and the agricultural crop.

For more on agroforestry practices and their interactions, please visit [centerforagroforestry.org](http://centerforagroforestry.org).



legumes, wildflowers, forbs and some shrubs. Check with your local USDA Natural Resource Conservation Service, Farm Service Agency or the Missouri Department of Conservation to identify available programs that support habitat development.

### *Forest Farming*

Forest farming practices are not as readily useful for quail habitat as are alley cropping, windbreaks, riparian forest buffers and silvopasture. By nature of the fact that forest farming practices affect interior portions of the woods, they will not typically offer much benefit to quail. However, when, and if, forest farming practices are relatively close to edges where forest and field come together, then practices may create islands of interior cover and habitat. It is likely, though, that quail use will be limited by the distance from forest/field edge.

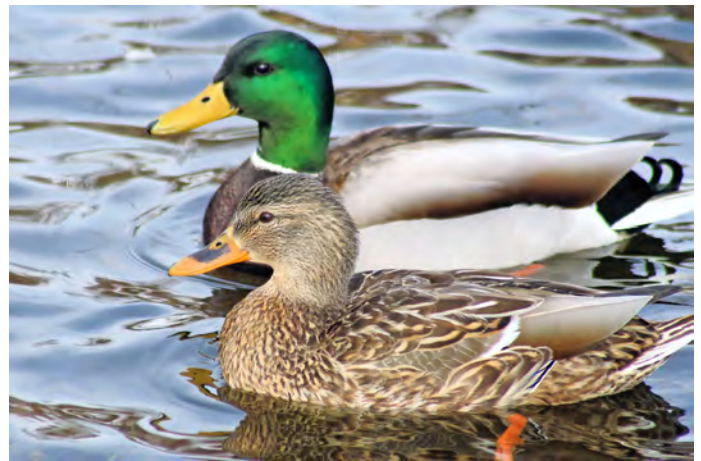
*Conservation practices that promote field borders, such as Habitat Buffers for Upland Birds (or CP33), have been designed to help bobwhite quail recover from dramatic population declines.*

## Waterfowl

### *Habitat Needs*

Waterfowl are another wildlife conservation success story. In the early 1900s, populations of many waterfowl species were reduced to extremely low levels as a result of unregulated hunting and loss of wetland habitats. In response to hunting regulations and wetland conservation programs that have been implemented in North America, most waterfowl species have made a dramatic comeback.

Missouri is home to a few resident waterfowl species, including giant Canada geese and wood ducks. Most waterfowl that utilize Missouri wetland habitats are migratory. Many of these waterfowl species nest in the prairie pothole region of the northern Great Plains and



*Ducks swimming in a pond*

Canada and then migrate south during the fall and winter.

Migrating waterfowl will typically begin moving into Missouri in late August and September; this movement will steadily increase as winter progresses.

Migratory waterfowl are attracted to wetland habitats. An exception to this might be seen in the use of crop fields by migrating snow geese.

In general, a wetland can be identified as a place where water is at, or near, the soil surface for an extended period of the year. Wetlands can be managed so they hold water during those times of the year offering the most benefit to desirable waterfowl species.

Wetlands may be identified by existing plants

- Trees, such as cottonwood, silver maple, and several species of oaks (pin oak, for example), will tolerate areas holding greater moisture.
- Many herbaceous plants are also typically found in wet environments, such as smart weed, and many of the sedges. These and other plants found in wetlands provide beneficial foods for waterfowl.

The timing of flooding a crop field or a tract of timber to attract waterfowl is critical. Before attempting to develop wetland habitats on your property, you should seek professional assistance from a wildlife biologist familiar



with managing waterfowl and wetland habitats.

### **Management Guidelines: Waterfowl**

For many waterfowl species, seasonally impounded waters in the migration flight path will provide excellent habitat. However, the practices of agroforestry focus on improving the habitat through the integration of selected trees and shrubs with grasses or crops – often involving the integration and management of trees.

Two ingredients of extreme importance to developing and managing land that is successful in attracting waterfowl:

- The presence of water.
- The presence of food. (Both work in concert to provide habitat waterfowl will utilize.)

#### *Water and Food*

Waterfowl use areas that have shallow water. Standing water does not need to be deep to provide benefits for waterfowl. In fact, water that is from 6 inches to 2 feet in depth is ideal for many waterfowl species. Most food should be no further than 10 inches from the water surface. This means that depth of water should be varied and managed, depending on the food crop.

In general, water should be put on, or allowed to accumulate, in the fall and drained down in the spring or early summer. Most areas with integrated crops and trees should not be flooded until mid- to late-October (Oct. 15 or later). This allows crops to mature and trees to enter the dormant process. It is important that trees are going dormant prior to flooding, and that water is drawn down (or taken off) prior to bud break in the spring.

Water draw-down is as important as timing of flooding. Water should be allowed to gradually come off a site before trees enter bud swell (just prior to leaf emergence). This process should begin early in the spring. In north Missouri, this is often during mid-March. In

southern Missouri, it is more likely that draw-down should begin in mid-to-late February. One of the best methods of attracting and holding migratory waterfowl is to seasonally flood bottomland timber and crop fields during the winter months.

In addition to the effect that the removal of water has on tree survival, it also plays a key role in the establishment of weeds, such as smartweed, which will become a vital food source when the field is flooded again next fall.

Landowners wanting to have additional food crops, such as sorghums or millets, may seed these additional crops in June or July. Draw-down of water can play a key role in the establishment of waterfowl food crops; plan accordingly so that different foods will be ready by fall flooding dates.

#### *Integrating Trees for Waterfowl*

Many trees, including oak, ash and maple, are important food sources and when mature, may also become important nesting sites for wood ducks. Seasonally flooded areas that contain trees are often termed "green tree reservoirs." These areas can be created in a natural manner or in an intensive and artificial manner.

#### *Natural Bottomlands Management with Trees*

Natural management of bottomlands with trees includes identifying where water is entering and exiting the area. Many times wooded streamside corridors can be flooded by simply identifying where a small stream enters a larger stream and constructing a dam or water control structure. Opening and closing these structures allows for the seasonal adjustment of water depths. Trees should not be flooded when in leaf and actively growing.

#### *Creating Water Areas*

Another natural method is to create a pond or water impoundment area above the intended green tree reservoir. When the time is appropriate in the fall, release water to flood the site.



Remember, controlling the amount of water on the site is important, and as little as 6 inches of water may be sufficient to accomplish your objectives.

More intensive methods also may be applied. Levees can be created to form a continuous berm/raised bed (2-3 feet in height) that can be used to hold water on an area. Select trees can then be planted on these berms.

Soil type will play a critical role in determining whether the area will hold water and the type of tree that should be planted. By spacing these berms on the contour, for example 60 to 120 feet apart, it is feasible to integrate crop fields between the trees. These inner-cropped areas can then be seasonally flooded, creating a managed wetland for waterfowl use.

It is also important to manage the woodland during the spring and summer months. Typical management may include planting additional trees or thinning existing stands of timber. Thinning is important because it can help develop a healthy stand of trees with good timber potential. Thinning is also important to keep the stand as open as possible. Sunlight is necessary for new trees to become established and is essential for the establishment and growth of weedy plants.

*Proper thinning of forests can assist in managing for a healthy stand of trees that also are more likely to produce better nut crops for use by waterfowl*

### Agroforestry Practices for Waterfowl

Alley cropping, riparian forest buffers and forest farming (in the right location and under proper management) can each be beneficial in creating or managing waterfowl habitat. Two of the primary attractants for waterfowl are the presence of water and food.

**Alley Cropping:** If applied using techniques including rows of trees planted on raised beds, with cropping in between, it has great potential to enhance waterfowl habitat if flooded. The key is timing and depth of flooding.

**Forest Farming & Riparian Forest Buffers:** Can be managed to allow light to the forest floor, stimulating the growth of many plants waterfowl use for food.

#### *Alley Cropping*

When alley cropping is applied (using techniques including rows of trees planted on raised beds, with cropping in between), it has great potential to enhance waterfowl habitat if flooded. The key is timing and depth of flooding, and the availability of the crop to attract waterfowl species. Keep in mind that shallow water is desirable – in general, only 6 inches of water is needed, and water should not be deeper than 2 feet.

If raised beds are not used, then the established rows of trees will need to be treated like a green tree reservoir. In this case, do not flood until the tree is dormant and stop flooding prior to bud break. Actively growing trees do not typically flourish with wet feet (roots under water).

#### *Forest Farming*

The bottomland forest can be managed as though it were a forest farming practice. Essentially, the broader riparian forest buffer or bottomland forests are managed to allow light to the forest floor. Sunlight is essential for the growth of plants, many of which waterfowl use for food. Because the two practices can be managed for appropriate levels of sunlight, they are useful for attracting waterfowl.





Thinnings reduce overall forest density. The level of thinning will vary by the plants you desire to grow. Most often, agronomic crops will require more sunlight than that needed to grow many seed-producing weed species. Thin to increase the growing room for quality trees, and also for sunlight that encourages the growth of new tree seedlings. With more room to grow, quality trees will more quickly increase in value. Additionally, trees that are free to grow will typically produce better nut and acorn crops.

Conservation programs, such as the Wetland Reserve Program (WRP), can assist landowners in developing wetland habitat. Contact your local USDA NRCS field office for more information.

## Mourning Dove



*A Mourning Dove perched in a tree*

### Habitat Needs

Mourning doves are a native migratory bird species in much of the United States. Their range extends from as far north as Canada to as far south as Mexico and Central America. Although doves are migratory, Missouri offers habitat for doves throughout the year. In any given year, the annual harvest of mourning doves has been equal to the harvest of all other migratory birds combined.

Mourning doves are highly adaptive and will use a wide range of habitat types. Their preferred habitat includes a combination of wooded edges adjacent to open or semi open land. They thrive in a variety of agricultural settings and take advantage of the available foods that are provided by various grain crops and weedy fields.

### Nesting

Mourning doves begin courtship and nesting activity in the early spring, and nesting pairs will stay together throughout the year. Nests are very flimsy and are built out of just about any available material. Doves have been known to use a previous year's nest. They prefer to nest in trees, and if a nest is lost, the pair will re-nest. Most often, nests will be found along field edges, in shrubs, trees or vines, and both deciduous and coniferous trees are used. Mourning doves will continue to nest throughout the spring and summer. Incubation begins immediately following the completion of the two-egg clutch. If conditions are right, the eggs hatch after 14 days and the young birds are fed pigeon milk until they are ready to leave the nest. Soon after they leave the nest, adults begin their preparations for a second brood, frequently using the same nest. As many as three to five broods may be produced each year in Missouri.

### Food and Water

Doves have been known to fly several miles to food and water sources. They prefer to walk to the edge of the water and need bare ground conditions adjacent to water sources. They will use any fresh surface water that is available, including ponds, puddles or streams.

The diet of mourning doves consists almost entirely of seeds from native and farm crops (greater than 99 percent). They are primarily ground feeders, relying on seeing the food on the soil surface. To digest seeds they need grit in their gizzard, and therefore, doves will utilize sources of sand or gravel. There are many native foods used by doves, but a variety



of cultivated crops are also used – including corn, millets and milo. Doves are also attracted to sunflowers. Additional crops that might be considered include sorghum, hybrid sunflowers (black oil), wheat and sesame.

*In all cases, the best management practices that serve to attract doves involve agronomic practices that provide waste grains on the soil surface following harvest.*

### *Roosting and Resting*

Roosting and resting areas are essential. The use of perching sites and resting areas are important prior to doves flying down to feed in a field. Trees that are adjacent to row crop fields and to watering sources provide excellent locations for attracting doves.

### **Agroforestry Practices for Mourning Dove**

There are three agroforestry practices ideally suited for integration with cropped areas intended for mourning doves: windbreaks, alley cropping and forested riparian buffers. Each integrates trees and shrubs with farming practices and can enhance roosting and resting areas in close proximity to food and water sources.

### *Alley Cropping*

The agroforestry practice of alley cropping can be used to enhance a field's appeal to mourning doves. By establishing widely spaced rows of trees in existing crop fields, natural resting areas are produced. While these trees and shrubs can also be managed to produce various wood products and/or nut crops that in the future add to overall farm production, they enhance areas for dove hunting. By spacing rows 60 to 120 feet apart (or wider), doves have places to rest and view the field for waste grain. On fields larger than a couple of acres, this potentially translates to greater use of the total field area by the birds.

**Alley Cropping:** By establishing widely spaced rows of trees in existing crop fields, natural resting areas are produced.

**Windbreaks:** May be used to create a sheltered field environment that also can serve to break larger fields up into smaller units or blocks appropriate for hunting.

**Riparian Forest Buffers:** While sound water conservation is being practiced, valuable wood products are growing and significant roosting and resting areas are provided



*Alleyway between chestnut trees*

### *Windbreaks*

All fields have a border; sometimes these borders are grassy, and other times they are filled with a multitude of unmanaged trees, shrubs and vines. The more appropriate border, such as in the windbreak practice, is one that is managed. It may be used to create a sheltered field environment that, if properly spaced on the landscape, also can serve to break larger fields up into smaller units or blocks. These blocks will allow only certain areas to be hunted while other areas rest.

*Managed windbreaks can produce both excellent bird habitat and a variety of wood products. Incorporated correctly, the windbreak around a dove field can create excellent hunting locations*



### *Riparian Forest Buffers*

The riparian forest buffer, when located adjacent to crop fields, can play a significant role in reducing sedimentation and nutrient flow into stream waters. At the same time sound water conservation is being practiced, valuable wood products are growing and significant roosting and resting areas are provided. Doves need sources of surface water. By providing roosting sites adjacent to watering sources, you are more likely to retain a greater number of doves in a given area.

Doves will use fields of various sizes. However, for hunting safety, it is desirable to manage for larger fields of 20 to 60 acres in size. It also is wise to limit hunting pressure on any given field to about two days per week. Rest periods will give birds time to move back onto a field and settle into a habit of using that field again. Overuse can drive birds away.

When managing a dove field for hunting, it is extremely important to follow federal regulations that pertain to baiting. Federal regulations specify that any practice not considered a “normal agricultural practice” is considered illegal. If you have questions about a management practice, it is advisable to contact an agent with the Missouri Department of Conservation.

## Reducing the Cost

There are several federal and state agencies that offer cost share or easements to landowners who are interested in establishing riparian buffers or improving wildlife habitat

### *USDA Programs*

The USDA Farm Service Agency (FSA) offers funding through numerous conservation programs, including the Conservation Reserve Program and the Continuous Conservation Reserve Program. These programs offer cost share and land easements to landowners

interested in establishing riparian buffers, shelterbelts, field windbreaks, wildlife corridors and wildlife habitats on existing crop land.

The USDA Natural Resources Conservation Service (NRCS) offers funding through the Environmental Quality Incentive Program (EQIP) and the Wildlife Habitat Incentive Program (WHIP). Both of these programs offer various levels of cost share payments for a large number of practices that support wildlife.

### *State and Private Programs*

The Missouri Department of Conservation offers cost-share funds for landowners who are interested in establishing shrub and tree species or putting existing woodlands under management for the benefit of wildlife. In addition, MDC provides technical assistance to private landowners interested in forestry and wildlife management through the Forestry and Private Land divisions.

Private organizations also have funding available to landowners who are interested in improving wildlife habitats. Those organizations include, but are not limited to the National Deer Association, Quail and Pheasants Forever, Ducks Unlimited, and the National Wild Turkey Federation. This list is not exhaustive of all the possible sources of funding for landowners interested in establishing or improving wildlife habitat; however, it provides a good starting point for someone interested in investigating these options further.

### *Lease Hunting*

Landowners interested in developing and managing wildlife habitats for income potential may want to explore lease hunting as an option. Refer to University of Missouri Extension Guide G9420, entitled "Landowners' Guide to Lease Hunting in Missouri," ([extension.missouri.edu/publications/g9420](http://extension.missouri.edu/publications/g9420)) that provides information on developing a lease hunting enterprise.



## Additional Resources

For additional information on managing for specific wildlife species, contact the Missouri Department of Conservation (MDC). The USDA Natural Resources Conservation Service (NRCS) also provides information on managing habitats as well as information on conservation programs that may be offered for eligible landowners. MU Extension also provides educational resources on managing wildlife habitat on your property that may be helpful.

### *White-Tailed Deer*

**Missouri Department of Conservation**  
"Improve Your Property" Wildlife Management Guides: Deer Management  
[mdc.mo.gov/your-property/improve-your-property/wildlife-management/deer-management](https://mdc.mo.gov/your-property/improve-your-property/wildlife-management/deer-management)

**University of Missouri Extension**  
Publication series on enhancing white-tailed deer populations/habitat on your property  
[extension.missouri.edu/programs/wildlife-ecology-and-management/managing-for-white-tailed-deer](https://extension.missouri.edu/programs/wildlife-ecology-and-management/managing-for-white-tailed-deer)

### *Wild Turkey*

**Missouri Department of Conservation**  
Wild Turkey Field Guide  
[mdc.mo.gov/discover-nature/field-guide/wild-turkey](https://mdc.mo.gov/discover-nature/field-guide/wild-turkey)

**University of Missouri Extension**  
Wild Turkey Biology and Habitat Management in Missouri  
[extension.missouri.edu/publications/g9526](https://extension.missouri.edu/publications/g9526)

### *Bobwhite Quail*

**Missouri Department of Conservation**  
Northern Bobwhite Quail Field Guide  
[mdc.mo.gov/discover-nature/field-guide/northern-bobwhite-bobwhite-quail](https://mdc.mo.gov/discover-nature/field-guide/northern-bobwhite-bobwhite-quail)



Check out more resources on the "[Mizzou Agroforestry](#)" YouTube channel!

### **University of Missouri Extension**

Bobwhite Quail Habitat Appraisal Guide  
[extension.missouri.edu/publications/mp902](https://extension.missouri.edu/publications/mp902)

Ecology of Northern Bobwhite Quail in Missouri  
[extension.missouri.edu/publications/g9431](https://extension.missouri.edu/publications/g9431)

Habitat Management Practices for Bobwhite Quail  
[extension.missouri.edu/publications/g9432](https://extension.missouri.edu/publications/g9432)

Establishing & Managing Early Successional Vegetation for Wildlife Agricultural Lands  
[extension.missouri.edu/mp907](https://extension.missouri.edu/mp907)

Field borders for agronomic, economic and wildlife benefits  
[extension.missouri.edu/publications/g9421](https://extension.missouri.edu/publications/g9421)

Quail-Friendly Plants of the Midwest  
[extension.missouri.edu/publications/mp903](https://extension.missouri.edu/publications/mp903)

**Missouri Quail and Pheasants Forever**  
[www.quailforever.org/](http://www.quailforever.org/)

### *Waterfowl*

**Missouri Department of Conservation**  
"Improve Your Property" Wildlife Management Guides: Waterfowl  
[mdc.mo.gov/your-property/improve-your-property/wildlife-management/waterfowl-management](https://mdc.mo.gov/your-property/improve-your-property/wildlife-management/waterfowl-management)

**United States Fisheries & Wildlife Service**  
Migratory Birds Index  
[www.fws.gov/program/migratory-birds](https://www.fws.gov/program/migratory-birds)

**University of Missouri Extension**  
Biology & Management of Wood Ducks  
[extension.missouri.edu/publications/g9439](https://extension.missouri.edu/publications/g9439)



*Mourning Dove***Missouri Department of Conservation**

Mourning Dove Field Guide

[mdc.mo.gov/discover-nature/field-guide/mourning-dove](https://mdc.mo.gov/discover-nature/field-guide/mourning-dove)**MU Extension**

Ecology and Management of Mourning Doves

[extension.missouri.edu/publications/g9416](https://extension.missouri.edu/publications/g9416)

Hunting doves on agricultural lands in Missouri

[extension.missouri.edu/g9417](https://extension.missouri.edu/g9417)

## Follow UMCA on social media:

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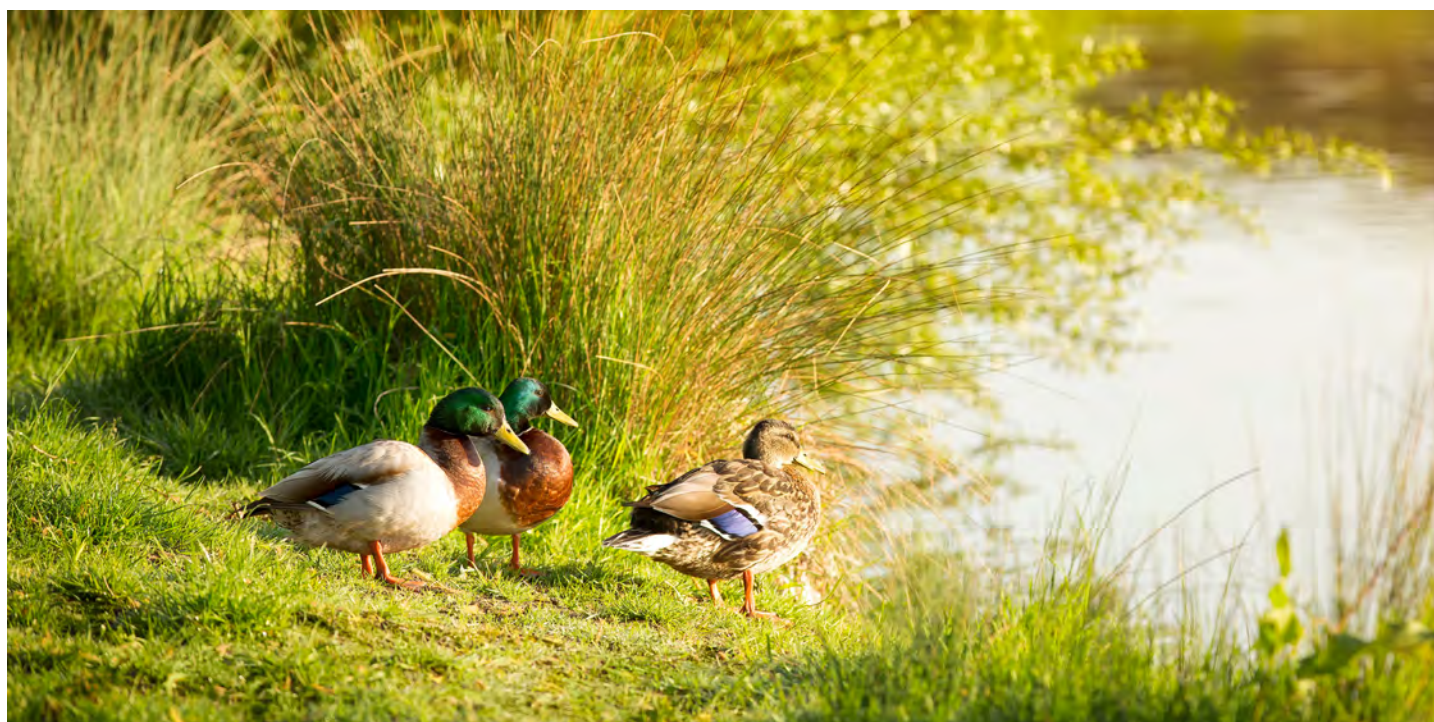
Improving Your Property for Wildlife

[mdc.mo.gov/your-property/improve-your-property](https://mdc.mo.gov/your-property/improve-your-property)**MU Extension**

Wildlife Habitat Ecology &amp; Management

[extension.missouri.edu/programs/wildlife-ecology-and-management](https://extension.missouri.edu/programs/wildlife-ecology-and-management)**The Agroforestry Podcast**

The UMCA's podcast series exploring a wide range of agroforestry topics.

*Listen wherever you get your podcasts.**Three mallard ducks standing near the water's edge*

## About Us

Established in 1998, the University of Missouri Center for Agroforestry (UMCA) is guided by a mission to support the long-term future of rural and urban working farms and forests through land use strategies that achieve economic, environmental, and social sustainability.

UMCA is one of the world's leading centers contributing to the science underlying agroforestry practices, which combine trees and/or shrubs with crops and/or livestock.

Agroforestry practices include:

- alley cropping
- windbreaks
- silvopasture
- riparian and upland perennial buffers
- forest farming
- urban and community food forests.

These practices help landowners create multifunctional working landscapes to provide a wide range of benefits including:

- Diversification of products, markets, and farm income
- Protection and improvement in soil, water, and air quality
- Mitigation and adaptation to climate change
- Conservation of agroecosystem bio-diversity
- Improvements in human health and well-being

UMCA's emphasis on interdisciplinary collaboration brings together researchers and producers from a spectrum of backgrounds and disciplines.

RURAL SOCIOLOGY HORTICULTURE  
 FISHERIES & WILDLIFE AGRICULTURAL ECONOMICS  
 ENTOMOLOGY SOIL, ATMOSPHERIC, &  
 FORESTRY ENVIRONMENTAL SCIENCES  
 PLANT PATHOLOGY ANIMAL SCIENCE  
 AGRONOMY PARKS, RECREATION, &  
 TOURISM

## AGROFORESTRY



*Top: An alley cropping system; Bottom: Ramps in a food forest system.*

## What We Do

**Research** UMCA is an experienced leader in temperate agroforestry research for on-farm applications, including tree crop improvement, the impact of perennial buffers on soil and water quality, the economics and marketing of agroforestry products, and much more.

**Education** UMCA is host to the only agroforestry graduate degree program in the United States, offering graduate certificate, M.S., and Ph.D. programs available both online and on campus. Our students are a source of inspired commitment to the next generation of agroforestry science.

**Outreach & Training** UMCA facilitates the exchange of insights and information between the academic community and producers, farmers, foresters, and other land stewards. Visit our website to sign up for updates about the Agroforestry Training Academy, the Annual Agroforestry Symposium, the Chestnut Roast Festival, field workshops, and more.



## Agroforestry in Action Technical Guide Library

Visit [www.centerforagroforestry.org](http://www.centerforagroforestry.org) to download the following guides, as well as to check for updates and discover new guides.

### Speciality Crop Guides

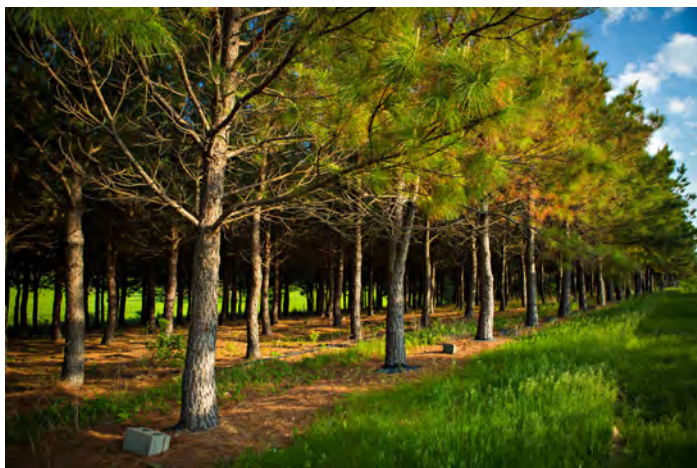
- *Growing Pecans in Missouri*
- *Growing Shiitake in an Agroforestry Practice*
- *Burgundy Black Truffle Cultivation in an Agroforestry Practice*
- *Growing and Marketing Elderberries in Missouri*
- *Growing Black Walnut for Nut Production: Orchard Establishment and Early Management*
- *Growing Black Walnut for Nut Production: Bearing Years Management*
- *Growing and Marketing Chinese Chestnuts*
- *Establishing & Managing a Forest Garden*

### Conservation in Agroforestry Guides

- *Integrating Agroforestry Practices for Wildlife Habitat*
- *Establishing and Managing Riparian Forest Buffers*
- *Succession Planning for Woodland Owners*

### Agroforestry Economics

- *Using NRCS Assistance for Agroforestry and Woody Crop Establishment*
- *Understanding Casualty Loss of Timber*
- *Economic Budgeting for Agroforestry Practices*
- *Tax Considerations for the Establishment of Agroforestry Practices*



*Pine planting at the University of Missouri Horticulture and Agroforestry Research Farm in New Franklin, Mo.*



*Chinese Chestnut*

## UMCA Annual Events

**The Agroforestry Symposium:** Typically held in January or February, the Symposium offers both virtual and in-person programming that seeks to explore the interdisciplinary nature of agroforestry science.

**Agroforestry Training Academy:** UMCA's Academy is an intensive educational program designed for agriculture and natural resources professionals and farmers to gain an in-depth understanding of agroforestry practices, design concepts, species selection and management, economics and marketing, and more. The virtual program occurs every spring with an optional, in-person field experience every summer.

**The Missouri Chestnut Roast Festival:** This is UMCA's signature annual field event at the MU Horticulture and Agroforestry Research Farm in New Franklin, Mo. Visitors learn about agroforestry through tours of on-farm research plots and demonstration areas, presentations from local producers and researchers, and interactions with agroforestry and perennial crop vendors. In addition, the Festival offers kids' activities, and free samples of agroforestry products for the public. Always the first weekend in October.



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**Center for Agroforestry**  
University of Missouri



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