

ON THE EDGE

A Guide to Managing Land for Bobwhite Quail



Acknowledgement

Foremost we are indebted to the Virginia Department of Game and Inland Fisheries, particularly to Steve Capel and Irv Kenyon, for allowing us to use material published in *Beyond The Food Patch: A Guide To Providing Quail Habitat*. We are grateful to the numerous contributions by Missouri researchers Jeff Janvrin, Ernie Wiggers, Wes Burger, Mark Ryan, Eric Kurzejeski, Ron Drobney, John Schulz, Steve Sheriff, Craig Scroggins, Eileen Dowd, Rich Cannon, Elena Seon, Brian Root, Tina Vangilder, Leslie Burger, Vicki Heidy, Eliodora Chamberlain, Ted Seiler, Jim Savage, John Lewis, Jack and Jean Stanford, Clifford Caldwell, LeRoy Korschgen, Ned Gruenhagen, Erynn Call, and Beth Emmerich.

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Where Have All the Quail Gone?

Quail thrive in the edges where shrubs and trees meet grassland, cropland, and weedy areas. Between settlement times and the early 20th century, Missouri had lots of edge habitat, and our state was a paradise for quail. Now, development, invasive plants, and many modern farming practices have pushed Missouri's quail to the edge of existence. Read more about these landscape changes in the History of Quail in Missouri on Page 5.

UPDATED AND EXPANDED TO HELP YOU BRING BACK THE QUAIL CALL

If you're holding this book, you want to see and hear more quail on your land. Our updated, expanded guide can help you create or improve the kinds and scale of habitat quail need to thrive. We first published *On the Edge* in 2003. Our second edition still features life-cycle information, population dynamics, habitat needs, and common management myths. New information includes a four-step habitat-restoration process, detailed treatment specifications, and an annotated list of references.

BEFORE YOU BUILD IT, MAKE SURE QUAIL ARE NEARBY

We applaud any landowner's desire to manage for quail, but for your efforts to succeed, you must already have some quail on or near your land (see Page 82). This is because Missouri no longer has a statewide quail population. Rather, it has isolated populations that depend entirely on local habitat management efforts. Unfortunately, building an island of habitat in a "quail desert" does not guarantee that you will attract a distant covey to your place.

Forming landowner cooperatives (see Page 30) where remnant populations already exist, or having the capacity to manage for quail on thousands of contiguous acres remains the best hope for restoring bird populations in these areas.

LOTS OF HELP FOR HARD WORK

On the Edge can get you started restoring quail habitat, but it's hard work, and it takes commitment. Fortunately, you've got an army of dedicated researchers and experienced land managers to help you. The Missouri Department of Conservation and our partners can consult with you on your land, provide information and instruction, and even help you find funding and equipment. Turn to Page 89 in the back and get acquainted with the federal, state, and local habitat specialists in your county, and look up some of the nonprofit organizations, too. All of these people, agencies, and organizations are dedicated to helping Missouri landowners like you and your neighbors bring quail back from the edge of existence in our state.

Want to bring quail back from the edge? Use this book to learn quail's basic habitat needs and where, when, and how to meet them.

*We hope you enjoy using the second edition of **On the Edge**, and we hope you'll call us and our partners for more help and support. Good luck!*



History of Quail in Missouri

Quail evolved on the edges of Missouri's prairies and on Ozark glades and savannas, where they found:

- Grass for nesting and winter roosting
- Seeds from native weeds, legumes and wildflowers, and insects to eat
- Fruits and cover from shrubby draws
- Acorns, pine nuts, other seeds and winter shelter from savannas and oak/pine woodlands

Elk, bison, wildfires, tornados, floods, and periodic droughts were major forces that created good conditions for quail. Bobwhite numbers naturally fluctuated dramatically, with numbers increasing in areas where these forces created quail habitat.

EUROPEAN SETTLERS CREATE ABUNDANT QUAIL HABITAT

European settlement in Missouri brought vast changes to the landscape. These changes benefited some wildlife and hindered others. In the early 19th century, settlers started a cycle that greatly benefited quail. They cleared the forest and broke the thick prairie sod. Their crop fields and bluegrass pastures were small, surrounded by split-rail fences and Osage-orange hedgerows where annual weeds and brush flourished. These settlers created vast new areas of edge, and there quail prospered.

Shelby County, Missouri, 1844: "Jan. 10th, Went Partridge hunting—caught 77; Jan. 11th, caught 41; Jan. 12th, Partridge hunting again—caught 91; Jan 22nd, Went Partridge hunting—caught 103. Caught 28 at one drive."

—Alexander Slayback

So went the bobwhite quail hunting season of Alexander Slayback, an attorney in northeast Missouri. As was the custom of the day, Slayback, along with a hunting companion or two on horseback, herded the quail into walk-in nets. Such large catches of quail, or partridges as they were often called, were common across the Midwest and made bobwhite popular for commercial trapping and shipment to East Coast markets. Records from Wisconsin and

Below: Cropping practices before 1970 also contributed important elements of good quail habitat. Modern farming practices contribute little to quail habitat needs.





Cliff White

Above: Large fields, common in modern farming operations, lack many quail needs.

Nebraska in the 1800s show individual shipments of 55,000 and 18,700 quail, respectively, totalling nearly 12 tons. This era of extreme exploitation did not last long. By the turn of the century, a scarcity of quail greatly reduced or eliminated hunting in many places in the Midwest.

THE 20TH CENTURY: BOOM AND BUST

Biologists estimate there were about 1.7 million quail statewide at the end of the 1800s. In the 1900s, Missouri witnessed the best and worst of quail abundance and hunting. In the absence of plentiful deer and turkey populations in the first half of the century, most Missouri hunters pursued small game. Rabbits, quail, and squirrels were abundant and easily accessible. By the late 1960s, quail populations and hunter numbers soared. The greatest number of days afield by quail hunters was 1.2 million in 1970 and 1971. During the better years, hunters bagged more than two quail a day on average. The highest daily bag was 3.2 in 1969. The hunters' passion was fueled by an abundance of quail.

Although biologists cannot accurately estimate quail numbers on a statewide basis, there were likely around 13 million during the heyday of quail hunting in the late 1960s. During the last half of the 20th century, the Missouri Department of Conservation's hunter and quail surveys documented the roller-coaster nature of quail life. As the century came to a close, the surveys also showed a seemingly permanent, long-term downward trend. *See chart below.*

EXPERTS WARN THAT QUAIL ARE HEADED FOR TROUBLE

Quail once were a by-product of agriculture, but land-use changes increasingly leave little for them. Biologists identified three main threats:

- 1) Intensive use of land for crop production and cattle grazing
- 2) Loss of land to development and a growing human population
- 3) Loss of brushy cover to natural successional growth toward trees and forests

Quail researchers recognized that pressures to produce more food with fewer costs would reduce quail habitat. Missouri's long-time quail expert, Jack Stanford, crisscrossed the state in the late 1960s and early 1970s educating Missouri landowners and hunters about these habitat changes and their effect on quail and other wildlife.

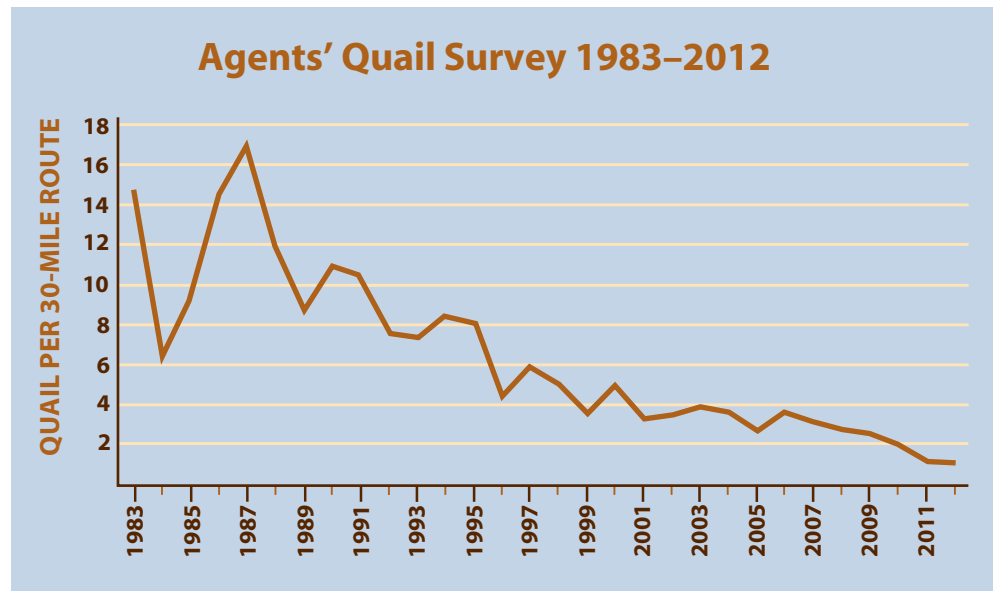
Intensive Agriculture Takes Toll

As agriculture evolved in the 20th century, Missouri's landscape began to change dramatically. To be profitable, farming had to become increasingly efficient. Small fields gave way to larger ones as thousands of acres of brushy woods, draws and hedgerows disappeared to become extra rows of corn, soybeans, or fescue pasture. Without these woody covey headquarters, where the birds rest and find shelter from the elements and predators, quail simply cannot survive.

Many modern croplands are inadequate quail habitat in other ways, too.

Quail once were a by-product of agriculture, but intensive farming practices increasingly leave less habitat.

Below: *Declining quail populations over the last 30 years are the result of the deterioration of quail habitat.*





Above: Intense use of fescue pastures leaves little food or cover for quail.

Below: Urban sprawl permanently eliminates quail habitat.

Trees Replace Brushy Cover

By clearing forests, pioneer farmers created the thick, low-growing, woody cover for escape and protection from the elements that quail need. Over the decades, trees replaced the brushy, woody cover through natural processes. Since the 1960s, brushy, woody cover in ditches has been converted to sod waterways. In addition, Missouri's growing deer herd has further reduced this essential brushy understory.

Widespread use of herbicides has indirectly hurt quail by eliminating most weeds. Further, traditional crop rotations of corn, soybeans, and wheat oversown with lespedeza or clover have given way to less diverse corn/soybean combinations, as well as double-cropping soybeans after winter wheat is harvested. The net effect of these changes is less food (bugs and seeds) and in-field cover for quail.

Farmers also began to use Missouri's grasslands, pastures, and hay fields more intensively, in many cases heavily grazing forests, woodlots and hedgerows in the process. Also detrimental to quail was the replacement of annual lespedezas, bluegrass, and native grasses by tall fescue. As a result of the loss of quail-friendly pasture plants, vast areas of land have become less hospitable to quail.

Urban Sprawl Eliminates Quail Habitat

When people move from cities to the country, they create more roads, highways, golf courses, and other landscape changes that diminish quail habitat. Today as more people are moving to small acreages, they bring suburban landscaping ideas with them. As a result, quail suffer from large stretches of well-manicured lawns and clean fencerows.

1960s TINKERING

At various times since the birth of the Missouri Department of Conservation in 1937, desperate quail hunters, agency personnel, and entrepreneurs have sought to provide a more abundant and consistent crop of game birds. In mid-century, biologists attempted controlling quail predators and releasing pen-raised quail with the intention of boosting quail populations.





Noppadol Praothong

By the turn of the 21st century, all state natural resource agencies had discontinued these practices because they weren't economical and didn't permanently increase quail populations. For more information on why these practices don't work, see Page 85.

Above: *This wooded area shows good quail habitat. It has been trimmed to allow sunlight to reach the woodland floor, where it can stimulate forb and shrub growth.*

QUAIL'S FUTURE IS IN LANDOWNERS' HANDS

We began the 21st century facing the reality that quail will not thrive unless we manipulate land on their behalf. Without such effort, quail will exist at low levels in most places and disappear altogether in some areas. The greatest challenge is to learn the art of quail management, which is based on scientific knowledge and refined through experience.

The following chapters are designed to help Missouri landowners who want to produce a thriving quail population. For further information or assistance with your land, call the Conservation Department staff in your area. See Page 89 for contact information.



Population Dynamics

Quail are among the species whose life is defined by high annual mortality and high reproduction. Major causes of loss are:

- Egg eaters, such as mammals and snakes
- Animals capable of preying on full-sized quail, which include some of the above, plus raptors and hunters

Quail also succumb to the ravages of weather, with spectacular losses easily observed when frozen quail are found in snowdrifts and icy fields, and less conspicuous deaths from hail, heat, and drowning. Many quail are weakened by energy-sapping weather and shortages of food, with predators taking the final toll on these doomed birds. In such cases, predators get blamed for quail losses that would have occurred anyway.

From fall to spring, more than half of the quail will die, and during summer another third of the adults will die. All told, Missouri's annual losses of quail are often greater than 90 percent. With such high losses, there's a tremendous need for population recovery each year through nesting and brood rearing. Fortunately, quail evolved many strategies to produce abundant offspring.

REPRODUCTION

A review of many studies finds that spring-to-fall quail abundance increases 160 percent on average, and more than 300 percent in some cases. Quail achieve this high productivity in a variety of ways:

- Hens lay large clutches of 10–20 eggs.
- Hens quickly start a second or third nest if initial nests are destroyed.
- Hens are not strictly monogamous as once thought, sometimes laying a clutch of eggs and then moving on to find another mate while the first mate incubates the initial nest. Males incubate about 25 percent of the nests, according to research in Missouri and other states.
- Sometimes hens complete incubation only to abandon their brood after a few weeks. Biologists speculate that these abandoned broods are old enough to fend for themselves, or that other quail adopt them. In any case, the hen is now free to start another nest.

The management implications of nesting season length are clear. Suitable nesting cover must be available from April–September. The majority of Missouri's quail production begins with nesting in May. Many attempts will fail. About 50 percent of incubated nests hatch chicks, and

Over thousands of years of struggle with predators and severe weather, quail have evolved a tremendous capacity to overcome such losses but only when plenty of nesting and brood-rearing habitat is available.

Left: *The greatest chance for nest success lies in the availability of season-long cover for second or third nesting efforts.*

No predator specializes in quail, and many of their enemies eat other quail predators.

Below (top): *A number of different mammals, such as opossums, take a toll on eggs and nests.*

Below (bottom): *Feral cats account for millions of songbird kills yearly, but have little impact on quail.*



Jim Rathert



Gaëtan Priour, www.pfxmin.org

of the unsuccessful nests, about 90 percent fail due to predation. In many cases the incubating adult is also killed. The greatest chance for nest success lies in the availability of season-long cover for second or third efforts.

It takes a hen 15 days to lay a typical 14-egg clutch. Much of the variability in the number of days required for nesting is due to clutch size. Typically the number of eggs per clutch declines with each subsequent nesting effort. Incubation requires 23 days.

AVOIDING PREDATION: THE QUAIL'S WAY OF LIFE

There is no question that predators kill quail. In fact, research from as far back as the 1930s found that predators account for more than half of the quail deaths each year. Quail are vulnerable to predators during their entire life cycle, even before they are hatched.

Not all predators are created equal. Mammalian predators (fox, skunk, raccoon, and cats), avian predators (hawks, owls, and crows), small rodents, and snakes are all predators on quail. Some species of predators consume eggs, others will consume newly hatched chicks, while others will eat adult birds. But none of these predators focus ALL of their feeding activities on quail. They are all opportunistic consumers. This was first shown in the 1950s during a research project conducted by the Missouri Department of Conservation. Researchers found quail remains in just 2 percent of more than 1,000 red fox stomachs examined and in less than 1 percent of 770 coyote's stomachs. Fewer than 1 in 100 feral housecat stomachs contained quail. The study clearly showed that these predators subsist largely on rabbits, mice, and rats. In addition, the study showed that avian predators also consumed more mice and snakes than quail.

Some Predators Can Be Allies

Another important factor to consider is the relationship between predators and their effect on quail predation. Research in Missouri and other states identified snakes and cotton rats as major consumers of quail eggs. Fortunately for quail, predators such as hawks, owls, coyotes, and bobcats help quail by keeping the snakes and rat populations in check. The same relationship exists with red-tailed hawks, which is beneficial to quail for a couple of reasons. First, they prey heavily on snakes and rodents. This is why they hunt along roadsides in fall. Grain harvest has peaked and waste grain is scattered along the side of the highway. Once the mice and rats find the grain, the hawks arrive for a free and easy meal. The second way a red-tailed hawk benefits quail is their displacement of Cooper's hawks, a species supremely adapted to preying on quail.

Another relationship to note is that between the coyote and the red fox. A lot of research has been done on the interaction between coyotes and red fox in a landscape and the resulting effect on nesting birds. Many of those projects are carried out in the Prairie Pothole Region of the northern Great Plains on nesting waterfowl, and the results are staggering. The majority

of those research projects showed an increase of at least 15 percent in the nest success for waterfowl in a landscape with coyotes compared to a similar landscape absent of coyotes. Some reasons for the difference are likely due to the coyotes' larger home range, which reduces predators that target birds. Coyotes prefer small mammals and don't actively search out nests or adult birds. Foxes on the other hand are stealthy predators that have been known to flush a hen from her nest and lie in wait for her return. Finally, coyotes are aggressive toward fox, skunks, and raccoons, and push them out to the less preferred habitats, resulting in fewer stomachs to feed.

Predators, as well as severe weather, obviously play a major role in the lives of quail, but the species has certain characteristics to overcome such losses. Some of those characteristics include having multiple partners during the breeding season, males incubating eggs while females begin another clutch, and having precocial young (having the capability to feed independently shortly after being hatched). High production, however, requires abundant nesting and brood-rearing habitat in conjunction with mild weather patterns. This stresses how important quality habitat is for quail production to become successful.



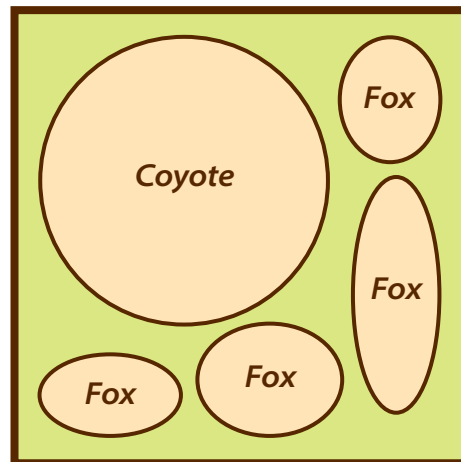
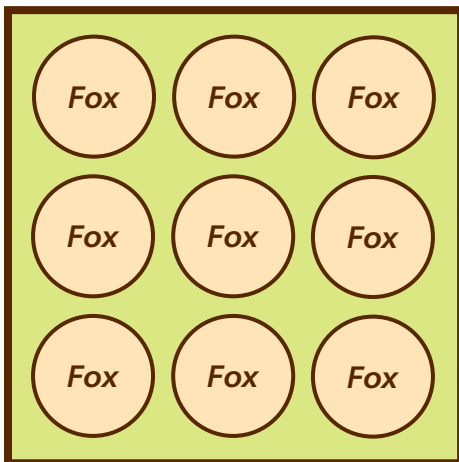
David Stopper



Noppadol Paothang

Above (left): The black rat snake eats quail eggs, but it also consumes rodents, such as cotton rats, that also prey on quail eggs.
Above (right): Harriers and other hawks, such as the Cooper's hawk, sometimes kill adult quail, but they also help control and displace many other quail predators.
Below: Research projects have found that coyotes could, in fact, deter other predators from entering areas with quail, resulting in fewer predators in the area.

Below: The diagram illustrates the difference in home range of the coyote and the red fox in matching blocks of nesting habitat.



Aaron Kuehl



Jim Rathert



Above: *Roosting behavior helps quail withstand cold winter weather.*

WEATHER: CAUSE OF SHORT-TERM BUST OR BOOM

Of the many factors that affect bobwhite, weather is second only to habitat. The difference between these two forces is that severe weather provides a short-term effect, usually less than a few years, whereas habitat deterioration can be permanent.

The importance of weather was clearly seen in the 1960s, a decade truly exemplifying the boom-bust quail cycle. Late winter weather in 1960 decimated the state's quail population, but within a few years quail rebounded and a modern-day peak was reached by the end of the decade. Other busts have occurred as a result of drought and cool, wet springs. Each year many quail are lost to snow, ice, hail, cold, heat, and drought, with the extent of the losses as varied as the weather patterns and quality of habitat.

When comparing quail populations and precipitation, we can see a direct correlation with lower quail populations following above-normal precipitation during the peak of nesting and brood rearing in May, June, and July, or above normal snowfall.

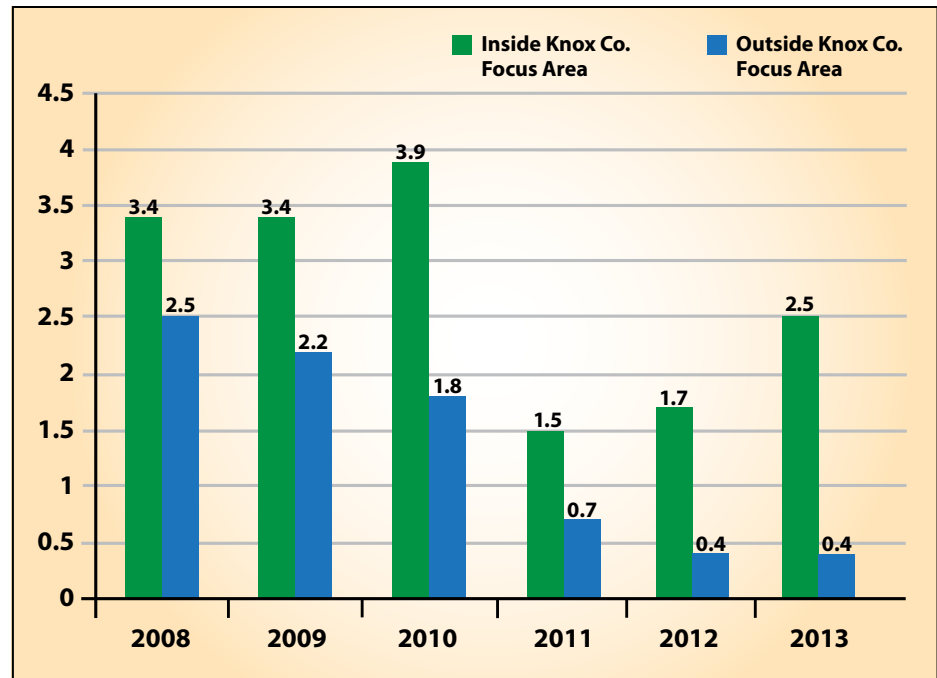
Once soils saturate during a heavy or prolonged rain, water pools in nests, which cools the eggs or kills hatching chicks. Quail chicks cannot regulate their own body temperature for the first couple of weeks after hatching. Again, during heavy or long-term rain events, water pooling on the soil surface, wet vegetation, or torrential rains kill many new hatchlings. As a result of this excessive rainfall during the nesting and early broodrearing season, landowners will see newly hatched chicks as late as September as quail continue to attempt to nest through the summer to compensate for nests or broods destroyed in June and July.

Based on this correlation of excessive precipitation and low quail populations, a likely reason for the long-term decline in quail numbers may be weather related. The University of Missouri Climatologist relates that, "beginning in the early 1980s, an unprecedented wet period has evolved in Missouri. Since 1981, 18 out of 28 years (approximately 64 percent) had above normal precipitation and 16 out of the past 21 winters (approximately 76 percent) have been wetter than normal."

During periods of higher than normal snowfall, quail food and cover is buried and exposes the birds to higher than normal rates of predation. When snow depth is more than 4 inches, quail lose access to food on the surface of the soil because their legs and feet are not suited to scratch through the snow cover, and adding layers of ice compounds the issue. The longer

snow stays on the surface of the soil, the higher the quail mortality rate will become. Covey headquarters, food plots, and patches of weeds are extremely important during periods of excessive snowfall.

In most areas of the state where management is occurring, our quail populations are still higher than areas not being managed, in spite of our extreme weather. A case in point is the Knox County Quail Focus Area (QFA), where Missouri Department of Conservation staff and local volunteers conduct extensive fall covey-call counts each year, both within and outside the focus area. This area was hit in January 2011 with over 20 inches of snow that did not melt for two months. Then in June 2011 it was also subjected to 10–12 inches of rain and cooler-than-average temperatures. This chart shows the results of the Knox County surveys over the years and a drastic decrease in coveys, both inside and outside the QFA in 2011. However, in spite of the weather, there are still more quail in the QFA than outside. Quail numbers are nearly triple on land where cooperators are managing for quail than in areas outside the QFA, where no management is done.



Above: Fall covey count surveys in our quail focus areas indicate that quail have responded to landowner efforts within the focus area to create quail habitat. On land outside the focus area, quail continue to decline due to lack of habitat.

HARVEST: BALANCE BETWEEN BIOLOGY AND TRADITION

As with every game animal, quail hunting is regulated to provide both optimum recreation and continued survival of a healthy population. Regulating quail harvest on a statewide basis involves practical as well as theoretical considerations, all of which must be based on sound information.

For many years, biologists have debated the effect of harvest on year-to-year quail abundance. Southern plantation managers take the most conservative approach, often harvesting less than 25 percent of the population, usually by shooting only on a covey rise and not pursuing scattered birds. Such restrictions reflect the hunters' desire to maximize contacts with coveys because heavily hunted quail quickly adopt evasive behaviors, such as running, flushing wild,

To work properly, small game hunting must occur before highest natural mortality takes place in late winter.



Above: *Quail populations in good habitat can readily withstand regulated hunting.*

Too much harvest can depress quail abundance, and the allowable harvest depends on the quality of the habitat.

and seeking out the most impenetrable cover. Although such restrictive hunting can provide more contacts with coveys, there's no evidence that it produces proportionally more quail in the spring and fall. A key to regulated small game hunting is that it must take place before the majority of the natural deaths of quail occur.

Missouri's research on quail in optimum habitat on public land revealed that many of the quail saved from the gun end up being killed by predators and winter weather, resulting in a natural decline by spring in breeding birds every year. The high natural mortality observed after the hunting season confirmed the belief that closing hunting season of small game species like quail in mid-January does not reduce abundance of animals available for breeding. To work properly, small game hunting must occur before most natural mortality takes place. In the Midwest, predators and winter weather take a relatively large toll on quail after the first of the year. By working within the constraints of nature, in this case mortality during winter, we are able to hunt small game without harming year-to-year abundance. The closing of Missouri's quail season in January is a compromise between biology, hunting traditions, and logistics.

How many birds can be harvested without causing a population decline?

Studies in the 1990s in Missouri and decades earlier in Illinois indicate that harvesting as much as 50 percent of the quail population does not harm long-term abundance. However, both

studies also found that too much harvest can depress quail abundance. For example, 83 percent harvest in 1994 on Missouri's research site depressed breeding numbers. Furthermore, quail are more vulnerable to harvest on private lands because the habitat generally is less abundant and of lower quality. The Illinois research, which took place in mediocre quail habitat, warned that harvest should not regularly exceed 50 percent.

Likewise, a Missouri Department of Conservation study of mediocre farm land habitat in northeast Missouri left biologists wondering if hunting could depress quail abundance. In that study, an alarmingly high proportion of the quail died from predation, weather, and other causes. This led biologists to wonder if the area's 30 percent harvest of quail could permanently depress populations in this type of habitat.

The bewildering aspect of harvest management is in applying results from studies on relatively small areas to statewide hunting. Extreme variation in hunting pressure, weather, and the quality of habitat across the state makes it difficult to apply a one-plan-fits-all regulation. These variations, even from one county to the next, can be so dramatic that statewide regulations can result in overharvest for one population while another, perhaps only a few miles away, is scarcely touched. However, with today's widespread poor habitat, quail are increasingly vulnerable to overharvest. The key to management is understanding the species' ability to survive and reproduce under current conditions and in the context of known hunting pressure.

Simply making minor adjustments in season length and bag limits is not the answer. Only a tiny fraction of hunting trips produces a limit of eight quail. Lowered bag limits rarely have any significant impact on spring breeding populations. The potential benefits of a slightly shorter season or a slightly smaller bag limit are likely to be wiped out by predation and extreme weather. As a result, the Conservation Department does not limit hunting opportunity unnecessarily. Statewide regulations are designed to allow the maximum recreation and harvest without harming year-to-year quail abundance.

Ultimately, the effects of quail harvest lie in the hands of those who harvest them. Only quail hunters can decide when enough birds have been taken from their favorite hunting spots. They know their own hunting grounds better than any state agency possibly could. Wise quail hunters/managers keep detailed records of the proportion of quail harvested and avoid going too far above the 50-percent level. This is particularly true where good quail habitat is limited and isolated.

Hunting to Assess Quail Numbers

Serious quail hunters should, as a matter of course, keep records of their hunts to document when and where they found quail, as well as to assess dog performance. Measurement of hunting activity as an index of quail numbers requires that you keep detailed records of:

- Weather
- Where and how long you hunted
- Number of hunters and dogs
- Number and size of coveys
- Number of quail harvested

Harvest is mostly a measurement of your hunting ability. But it could provide a perspective of reproductive success for any given year or help evaluate the abundance of quail from year to year. Because day-to-day ability to find quail is highly variable, mostly due to scenting conditions that vary with the weather, it is best to hunt the same area more than once. A study of hunters indicates that, on average, hunters find about 50 percent of the quail on an area, but that on any given day, all or none of the birds could have been found. Be sure to keep all these factors in mind when assessing your quail population.



Quail Habits and Habitat Needs

To improve quail populations on your land, it's important to identify the cover types and conditions required for each stage of the quail's life cycle. Bobwhite do well on property when a mixture of the components below are present on each 40 acres. The exact proportions of the various vegetative types are not as important as how the various types are situated in relation to each other and how they are managed.

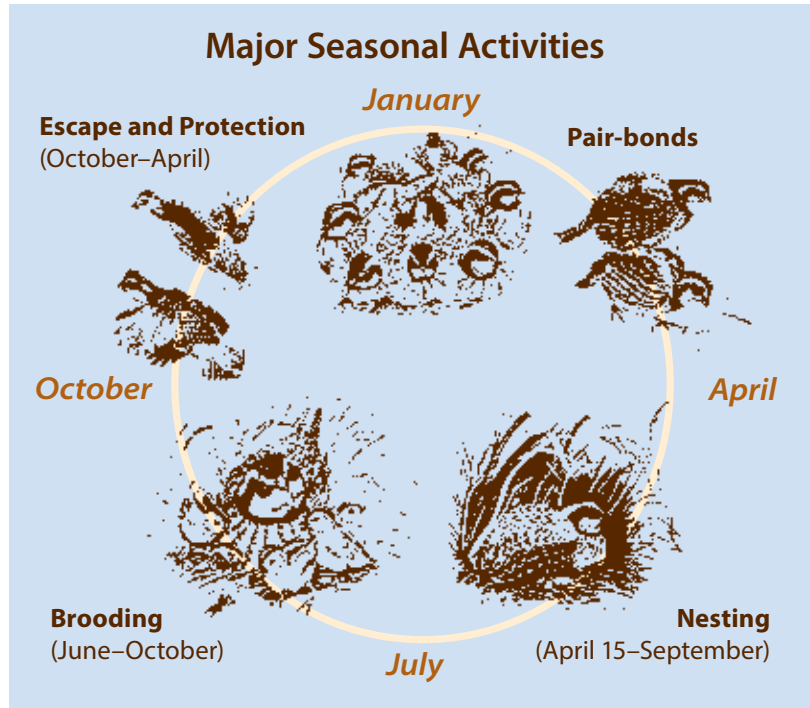
Use the information below to identify which of the six essential habitat components you already have on your land and which ones you need to develop.

NESTING AND NESTING COVER

A single nesting cycle requires about 45 days, beginning with nest-site selection and nest construction. Quail build nests on the ground, typically with leaves and stems of dead grasses and forbs. Nest sites are usually where a clump of grass or other suitable vegetation forms a canopy to hide the incubating bird and the eggs. Quail often build nests within 50 feet of an edge or opening with bare ground, where the hen can easily forage and dust. Studies in Missouri and other states found most nests in old fields that contained a mixture of grasses, legumes, forbs, and small woody plants such as briars, vines, shrubs, and saplings.

Preferred nesting cover includes a mix of erect grasses, forbs, and scattered shrubs or brambles at a moderate density and height. Idle land, in or near the old-field stage, provides the cover most frequently used for nesting. Native pastures that are moderately grazed, filter strips, and the edges of crop fields, woods and roadways often contain the mix and density of plants quail seek for nesting. Old fields and areas with similar characteristics will continue to be used for nesting as long as a diversity of herbaceous plants dominate and the ground surface is not covered with a dense mat of vegetation. No-till row crops are sometimes used for late-season nesting.

When considering the availability of nesting cover, look for areas with scattered clumps of native warm-season grasses or cool-season grasses, such as orchard grass, timothy and red top.



The greatest chance for nest success lies in the availability of season-long cover for second or third efforts.

Left: Good brooding cover will have bare ground underneath a dense canopy of vegetation. Disturb a portion of each quail unit annually to maintain good brooding cover.

Quail nests are frequently located within 50 feet of an edge or opening with bare ground, where the nesting bird can easily forage.

Below: The more subdued coloration of the female helps conceal the birds during nesting and brood rearing.



Photo Courtesy of the Virginia Department of Game and Inland Fisheries

These grasses can be good indicators of potential nesting cover, but other conditions must be considered as well. A frequent mistake is to assume that grassland, regardless of its condition, will be selected for nesting. Although grasses are frequently used for nest construction and provide the nest canopy, a solid stand of thick grass, even native warm-season grass, is not desirable nesting cover. Neither are recently fallowed fields because they seldom have adequate grasses.



MDC photo

Quail prefer to nest in areas with a mixture of grasses, forbs and woody cover. Properly managed quail-friendly grasses are used for nesting, roosting, brooding and escape cover. Dense, unmanaged grass is generally not suitable for quail.

Left: Dense, unmanaged grass

Below (left): Perfect stand of grass

Below (right): Nesting cover site



MDC photo



MDC photo

BROODING AND BROOD COVER

Brooding is the act of an adult quail covering its chicks with its body or wings to protect the young. Hens brood chicks throughout the night during their first few weeks. Daytime brooding occurs as needed to protect chicks from danger or the elements, such as cold, rain, wind, and direct sun.

Brooding also has come to mean all of the activities associated with rearing chicks during their formative weeks. Feeding is a notable example. Adults control their brood with low vocalizations as they forage, keeping the chicks close enough so all can assemble quickly if the need arises. Chicks are extremely vulnerable to the elements and predation at this time, even with the close care of an adult. Less than one-half of the chicks live until winter.

Brood cover should be dominated by plants that have well-spaced, sturdy stems with little foliage near the ground. Overhead foliage must be dense enough to provide sufficient cover to give chicks and adults protection from predators. Examples of good brood cover include the following:

- Exotic and native forbs and annual weeds including ragweed, croton, and foxtail
- Legumes including lespedezas, clover, partridge pea, beggarweeds, and tick trefoils
- Corn, milo, and soybeans if residue from the previous year is present.

Bare ground is also an essential element of good brood cover because a newly hatched, quarter-ounce chick is very fragile. Thick vegetation, whether erect or lying on the ground, makes it impossible for chicks to travel or forage for seeds and insects.

Along with providing protection and ease of movement, good brood cover contains an abundance of insects. For this reason, the terms “brooding” and “bugging” are sometimes used interchangeably. Although chicks do eat some weed seeds and greens, they get more protein, which is essential for them to develop rapidly, from insects. Eighty to 95 percent of a chick’s diet consists of insects during its first few weeks.

The amount of food needed requires hours of foraging. Commonly eaten invertebrates include spiders, leafhoppers, beetles, grasshoppers, crickets, stinkbugs, ants, flies, and snails. Brood cover that is open enough for chicks to pursue and capture insects reduces foraging time and the vulnerability of chicks and adults to predators and the elements.



Above: Leaving some unharvested corn in a field allows quail-friendly plants to grow between the rows the following year.



Above: Contents of a quail chick crop. The diet of quail chicks is primarily insects and other invertebrates. Good brood cover has an abundance of small insects and is open enough for chicks to pursue and capture them.

For winter survival, the best combination is to provide high-energy seeds, along with protective cover.

Below: Common ragweed provides both food and cover for quail in the winter.



MDC photo

FEEDING AND FEEDING COVER

Typically, quail have two daily feeding periods: one beginning at daylight and continuing for several hours, the second beginning during mid-afternoon and continuing until roosting. Abundance and quality of the food items influence the length of feeding periods. Timing and length of feeding periods may be altered by adverse weather as well as disturbances, particularly those serious enough to cause the birds to flush. Birds that have been flushed may miss a meal entirely.

Quail take practically all their food from or within 8 inches of the ground's surface. Bobwhite are not strong scratchers and are incapable of reaching food that is buried in the soil, snow and ice or in a heavy accumulation of dead vegetation. Fortunately the list of quail foods is extremely long.

All seeds, however, are not of equal value to quail. Legumes, with their high protein levels, are most important during the production season from April to September to help hens produce eggs and to provide energy for chicks to grow. High protein seeds include clover, beggarweeds, tick trefoils, partridge peas, blackberries, dogwoods, panic grass, crab grass, annual lespedezas (Korean or Kobe), and perennial native lespedezas (slender and roundhead, but not the noxious exotic sericea lespedeza).

During cold weather from October–March, proteins are less important to quail survival than are high-energy foods. According to various studies of fall and winter bobwhite food habits, the most frequently consumed foods are seeds of native or naturalized forbs and most grains, such as ragweed, foxtail, corn, soybeans, milo, sunflower, millet, sorghum, annual lespedezas, perennial native lespedezas, and grasses. The relative value of seeds to quail during winter can be calculated from the seeds' energy value and size. See chart on Page 23. Moreover, Missouri research on energy needs of quail can be combined with these seed characteristics to calculate the number of seeds of different plant species required to meet the energy requirements of a single quail over a 24-hour period. For example, at 32 degrees Fahrenheit, a quail requires 49 kernels of corn, 122 soybeans, 7,248 sumac seeds or 32,570 switchgrass seeds. The energy value of seeds, however, is just a small part of what a quail faces during a cold winter day. For example, soybean fields typically have zero cover value. So although soybeans offer a quick, high-energy meal, they do not provide cover from predators and insulation from cold, windy conditions. The best combination is to have high-energy seeds and protective cover.

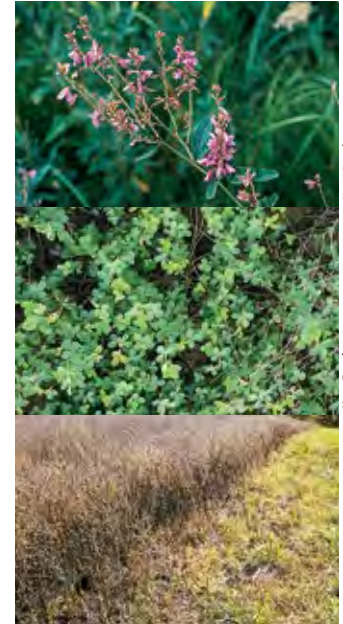
Indeed, Missouri researchers found that quail living in weedy fields have more fat than quail that live in corn and soybean fields. A little bit more fat, or stored energy, is a good thing for quail. If faced with severe winter weather, quail in the weedy fields have the capacity to live a few days without food, whereas less fit birds

Energy Value of Seeds

The relative value of seeds to quail during winter can be calculated from the seeds' energy value and size. Below is listed the number of seeds needed per 24-hour day to meet energy needs of a single quail during different temperatures.

Temperature:	70 F	32 F	0 F	0 F
Activity level:	Low	Low	Low	High
Corn	41	49	69	94
Soybean	103	122	174	236
Milo	666	788	1,121	1,520
Sunflower	1,165	1,379	1,961	2,660
Black locust	1,250	1,479	2,104	2,854
Partridge pea	3,601	4,261	6,062	8,223
Common ragweed	3,870	4,580	6,515	8,837
Smooth sumac	6,125	7,248	10,310	13,985
German millet	8,418	9,962	14,171	19,222
Korean lespedeza	9,480	11,218	15,959	21,647
Switchgrass	27,524	32,570	46,331	62,846

Below: From top, beggar's lice, Korean lespedeza, and common ragweed, along with many cultivated crops, are favorite foods of bobwhite quail.



Jim Rathert

Jim Rathert

Cliff White

will die more quickly of hypothermia or be forced to venture out into the inhospitable cold environment. During these times, quail are highly vulnerable to predators.

Greens are an important spring and summer food, and serve as a supplement during fall and winter. Soft, ripe fruits are seasonally important, as are agronomic grains left standing or spilled during harvest. Insects in the spring and summer make up about 15 percent of a quail's total annual food consumption. Juvenile and adult quail often eat insects, which are especially important to nesting hens and fast-growing chicks. Fields with weeds and legumes attract insects that quail need.

For fall and winter feeding, idle lands in the fallow stage are among the best because they have bare ground, cover, and — usually — an array of seed-producing annual forbs for food. Old fields also provide suitable feeding areas if there is not too much litter.

Food items found in old fields include perennial forbs and fruit-bearing woody plants. Some of the grass seeds quail often use, those of panic, crab and foxtail grasses, also are usually present in old fields. The fruit of pioneer woody species, including dogwood, sumacs, coral berry, and sassafras, provide another source of food in old fields and fencerows. The mast of oaks and hickories are important food items found in woodland areas. Nuts and acorns are eaten whole or as fragments.

ROOSTING AND ROOSTING COVER

Beyond revealing that quail are using an area, evidenced by piles of small, white-capped droppings, nighttime roosting is a major activity that otherwise receives little attention. It deserves more. Quail roost from sunset to sunrise but will extend this inactive period during frigid weather.

Quail roost on the ground in grassy-weedy areas throughout the year except during severe wind or precipitation. They may roost alone or in pairs, but most commonly they roost in a disk formation when their numbers permit. Like the spokes of a wheel, each member of the disk positions itself with its tail towards the center and head outward. Roosting in this fashion is a social behavior, but during cold weather, it's also an aid to survival. Such a formation allows each member to benefit from the body heat of others. Temperature within the disk is regulated by the quality of roosting cover and how tightly the birds huddle together. Missouri research shows the importance of the quail's defense against cold weather. It found that a lone quail starts to burn extra energy to stay warm when the temperature falls below 70 degrees Fahrenheit.

Roosting is probably the only bobwhite activity where dense overhead cover is usually not required. Research shows that quail use crop fields, grasslands, and old fields for roosting. Apparently the birds' camouflage and motionless state while roosting eliminate the need for cover overhead. The open skyward view also allows birds to flush unobstructed during darkness when approached by predators. Quail roost on both bare soil and vegetation litter. Dark-colored bare soil that receives sunlight could provide a warmer surface during night and keep quail warmer. On the other hand, vegetation litter insulates quail from frozen soil. Roosts often are located on a south or southwest slope where the afternoon sun is direct and has warmed the ground. Quail prefer mid-slope or lower elevations for roosting, presumably to avoid winds at higher elevations.

Below: Edge feathering provides secure loafing and escape cover.



Noppadol Paothong

Open herbaceous cover provides year-round roosting areas. Common plants include native warm-season grasses, broad-leaved forbs, and grasses. During and after snow and ice storms, quail use woody cover or stiff-stemmed herbaceous vegetation, such as big bluestem, Indian grass, and switchgrass. Fescue and other cool-season grasses do not provide good cover because they collapse under snow or ice.

Missouri research has revealed some of the secrets of quail roosting. Of the two favorite roosting habitats, weedy grasslands and woody draws, the latter provides the warmer cover. Further, taller grasslands do not provide warmer cover than very short grasslands. This is because wind speed at the height of roosting quail, about 3 inches above the ground, is near zero even if vegetation is absent. So why do quail roost so often in fields of medium-to-tall herbaceous vegetation? Researchers suspect the quail are trying to avoid detection from predators perched in trees or walking the edge of fields. The research also has found relatively high predation on quail when the birds move to woody cover after snow and ice storms.

Below: Blackberry and coral berry are important escape cover for quail in winter, as these quail show.

ESCAPE AND ESCAPE COVER

In his recording, *There's Nothing I Can Do About it Now*, Willie Nelson sings that he “survived every situation by knowing when to freeze and when to run.” There is probably not a day in its life when a quail is not faced with this decision and with survival at stake. Unfortunately, even with their added ability to fly, bobwhite survival is not assured.

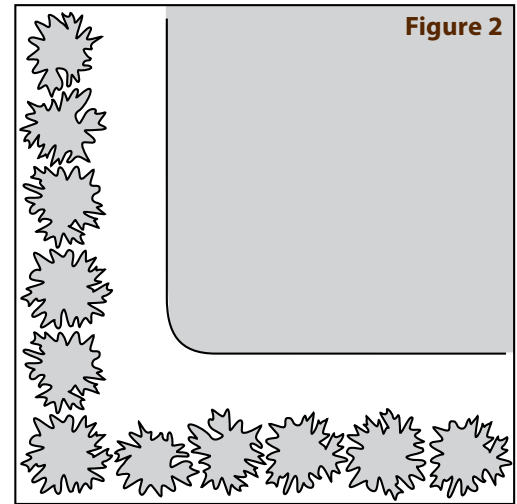
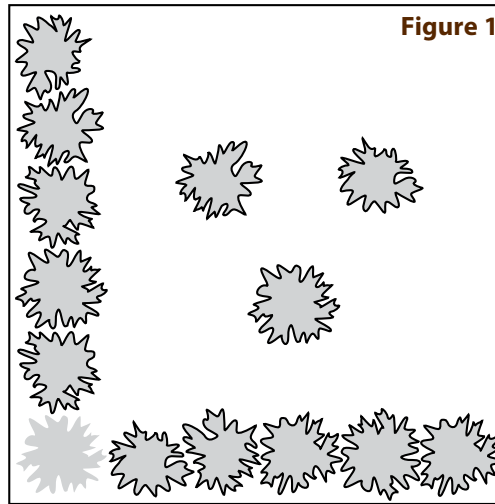
Missouri research on heavily hunted conservation areas found quail often run from the approach of hunters, especially if the hunters are noisy. Other quail evaded hunters and their dogs by holding tight in heavy grass. Surrounded by green grass, the quail's scent is often difficult to detect. What dogs usually smell from a bird is shed skin cells. So if a quail flies and hides in green grass, initially there are few skin cells for the dog to detect and a strong chemical background odor from the live grass helps mask the scent. Heavily hunted quail also spent more time in or near woody cover, whether thick brush or large woods, both of which are difficult to hunt.

Other researchers found that a quail's first reaction to a flying hawk is to freeze and remain absolutely motionless from 10 seconds to several minutes. By freezing and with the help of their well-suited camouflage, quail can frequently avoid detection in almost every situation except on snow. Although the average bobwhite flight speed is 20 miles per hour, flying is usually the quail's last resort, unless the danger is great and safe cover is nearby.



Bill White

Left: Missouri research shows that quail spend most of their time within 70 feet of woody cover. Strategic placement of woody shrubs allows quail to safely use most of the field in Figure 1. In Figure 2, quail will not be as safe if they venture too far from the brushy edge into the gray shaded area.



To a degree, any concealing vegetation can serve as escape cover. More often, though, escape cover implies dense cover, usually a thicket combining trees, blackberry, coral berry, other brush, and vines. This type of cover is an absolute requirement within a covey's winter range. According to research on Texas rangeland where there are many scattered patches of woody thickets, the average flight distance for quail is 141 feet. Similarly, Missouri research found that quail in winter spend most of their time within 70 feet of woody cover. Crop fields and large grasslands — such as pastures, old fields, and prairies — can be made more suitable for quail if good woody cover is within 100 feet or so of the center of the open land.

Covey Headquarters

Usually an element of escape cover is the covey headquarters. Quail occupy these areas during midday for loafing and dusting, and for protection and roosting during severe weather. Small wood lots with a dense understory or a finger of woodland extending into openings will sometimes serve as winter headquarters. Within crop fields, outcroppings of trees with brushy cover beneath also are used for this purpose. With a dependable food supply nearby and without undue disturbance, quail will use these areas for extended periods. Headquarters of different coveys are rarely, if ever, shared and tend to be well separated.

DUSTING AND DUSTING AREAS

Essential to its wellbeing, and one that it appears to enjoy, is the quail's habit of dusting. Dusting helps maintain quail feathers and reduces insect parasites. A depression, or dusting bowl, is scratched and pecked free of vegetation and the soil finely ground 3 or 4 inches deep. When dusting, quail immerse their breasts in the bowl and throw dust across their backs with their beaks and feet. Several birds will sometimes enter the bath together and shower one another with dust. During rainy periods, dust baths are sometimes located under the elevated portion of downed logs.

As long as there is some recent soil disturbance throughout the area, you need make no further effort to provide dusting sites. Cow paths, anthills, watering holes, roads, and trails often provide these areas for quail. If there is no disturbance, disking can create the needed bare soil.

Favoring Pollinators Favors Quail

The majority of pollinators in Missouri are insects such as native bees, honeybees, beetles, flies, moths, and butterflies. Through the process of foraging, both native and non-native pollinators provide pollinating services to roughly the entire suite of native flowering plants. Native flowering plants include forbs, legumes, shrubs, and trees.

Animals pollinate approximately 75 percent of the crop plants grown worldwide for food, fiber, beverages, condiments, spices, and medicines. It has been calculated that pollinators deliver one out of every three to four mouthfuls of the food we eat and beverages we drink.

Bobwhite quail and native pollinators share many of the same habitat needs and will use the same habitat-development practices. They both need bare ground and a diversity of plants, and they both benefit from the control of invasive species. In addition, they both use shrubs, native wildflowers, and bunch grasses. When we promote pollinator habitat we promote quail, too.

Right: More than 400 species of bees in Missouri rely on the same habitats as bobwhite quail.



MDC photo



Step 1: Assess Your Land's Potential

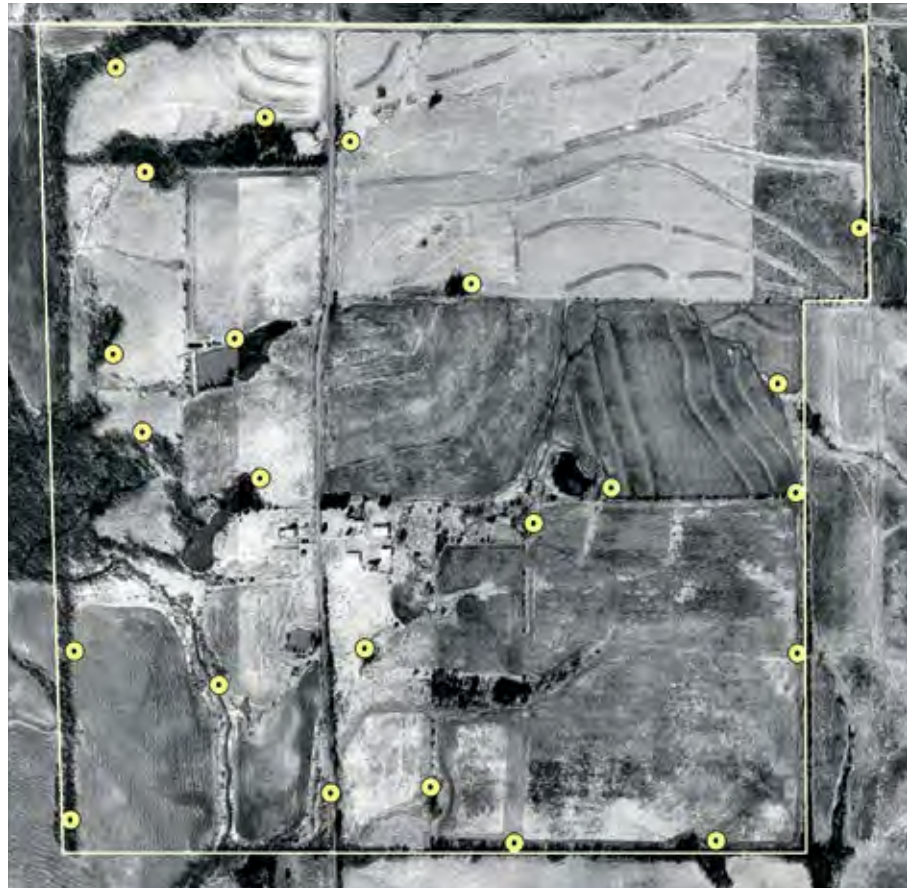
If you are interested in managing for quail on your property, there are important questions you must answer about the availability and condition of quail habitat components. These answers identify the scope of your land's potential for quail, and, consequently, the amount of effort required to bring quail back. Take inventories of current conditions by answering the following:

- What is the nature and distribution of vegetation on your land? Use the information in the previous chapter to assess your land. Use aerial photographs or topography maps to identify existing and potential quail habitat.
- What do neighboring lands offer for quail? If your land is a small island of potential quail habitat in a sea of poor quail habitat, your chances of success are slim until you get cooperation from neighbors.
- How many and where are the coveys? Obtain quail numbers by various methods, including hunting activity, incidental field observations, breeding-season whistle counts, and October covey whistle counts. See Step 4: Track Quail Numbers on Page 82 for details.

Good quail management is an art that is learned from science and experience. It requires hard work and a good understanding of the following:

- The quail's biological needs
- The techniques and timing to create them
- The capability of your soils

Below: Aerial photos can help plan quail habitat-improvement efforts and identify covey headquarters. The yellow dots indicate covey flushes during a hunt.



HELP QUAIL BY FORMING A CO-OP

Phrases such as “Where have they all gone?” and “It’s nothing like the good old days” have become commonplace when Missourians discuss the state’s quail population. Rather than bemoan the decline of quail, landowners in northwestern Missouri are doing something to reverse the trend.

Like old-fashioned cattle farmers, who shared equipment and labor until every participating neighbor’s cattle were worked, 2C Cooperative landowners in Carroll and Caldwell counties assist each other across property boundaries to implement management practices that improve wildlife habitat. In doing so, they all enjoy the common benefit of seeing, hearing — and bagging — more quail.

Proof that concentrated cooperative landowner efforts can increase quail populations is growing. Quail-covey surveys within the 2C Cooperative show 10 times more birds than areas lacking management activities. We see similar survey results in other quail cooperatives.

To get tips for developing a quail cooperative in your area, contact your local Missouri Department of Conservation private land conservationist. This staff person can give you information about incentives and cost-share programs. He or she can also schedule a visit to evaluate and develop a plan to enhance the wildlife habitat on your property. To find your local private land conservationist, use our *Public Contacts Directory* online at mdc.mo.gov/node/19935.

IDENTIFY CONCEPTUAL HOME-RANGE AREAS

Bobwhite quail typically restrict daily activities to a home range that varies in size depending on the kind, amount, condition, and interspersed of required habitat components. All habitat requirements for the bobwhite quail must be found within this area.

The size and shape of this area are determined by the limits of how far the animal can travel and the overall quality of the habitat that exists within the home range.

Home ranges for bobwhite quail are not marked by permanent boundaries, nor are they the same from one year or season to the next. Because of this, research has suggested that landowners interested in improving their land for bobwhite quail make initial management decisions on the basis of the species’ conceptual home range and the desired intensity of management. The conceptual home range is the area selected by the landowner for bobwhite quail management. This process allows you to arbitrarily set boundaries around the limits of movement for the bobwhite. This also allows you to work on one home range at a time to improve quail habitat. In theory, you should be able to produce at least one covey for each conceptual home range if all limiting factors are addressed.

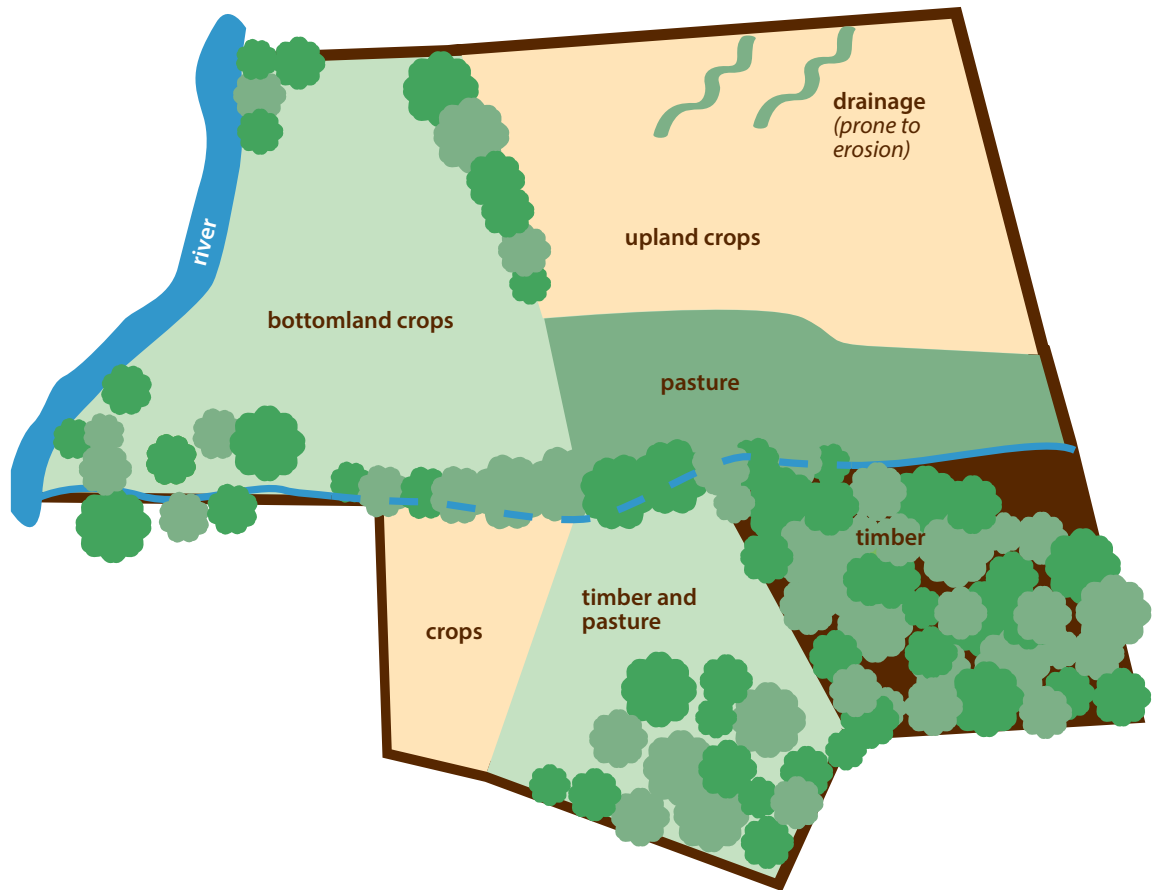


Identifying conceptual home range areas (see aerial maps above) is an important first step as you begin to appraise and evaluate the habitat quality for bobwhites on your farm. **Working with a conceptual home range of less than 15 acres may not be cost-effective.** Likewise, working with a conceptual home range larger than 80 acres does not provide adequate habitat conditions that are in close proximity to one another. In other words, one covey per 15 acres is about as good as you can practically manage quail habitat, and one covey per 80 acres is about as large as you can stretch out the habitat conditions. The quality of habitat within a conceptual home range is determined by the condition of the habitat components within the specified area.

Above: Landowners interested in improving habitats for bobwhite quail can make initial management decisions based on a chosen conceptual home range size. Aerial maps can be used to outline and assess these areas on your farm.

A MODEL FOR QUAIL HABITAT IMPROVEMENT

The illustrations on this page show how a typical Missouri farm lacking adequate quail habitat can be transformed into a place where quail can thrive. Explore the practices on the right to see how you can improve your land for quail and other wildlife.



This Missouri farm lacks managed habitat for quail and other grassland birds. The illustration at right shows several ways the property could be improved for quail by applying a few management practices. Browse the agencies and organizations on Pages 89–91 that can help you with technical and financial assistance to implement these practices.

Install field borders

Leave or plant field borders of annual weeds and native warm-season grasses or forbs to provide good nesting and brood-rearing habitat.

Leave food plots

Leave a few rows of crop standing at the field edge to provide winter food. Leave the rows idle the following spring to provide excellent nesting and brood-rearing habitat.

Renovate fence rows

Drop trees and leave them on the ground to provide escape cover. Eliminate thick grass underneath to make the cover quail-friendly.

Plant grass waterways

Plant native warm-season grasses around drainages to curb erosion and provide good nesting and roosting habitat.

Establish native grasses and wildflowers

Convert cool-season grasses to warm-season grasses and wildflowers to provide better nesting, roosting and brood-rearing habitat.

Plant shrub islands

Plant native shrubs like dogwood, wild plum, or blackberry in dense, 1,500-square-foot islands to provide good escape cover.

Strip disk

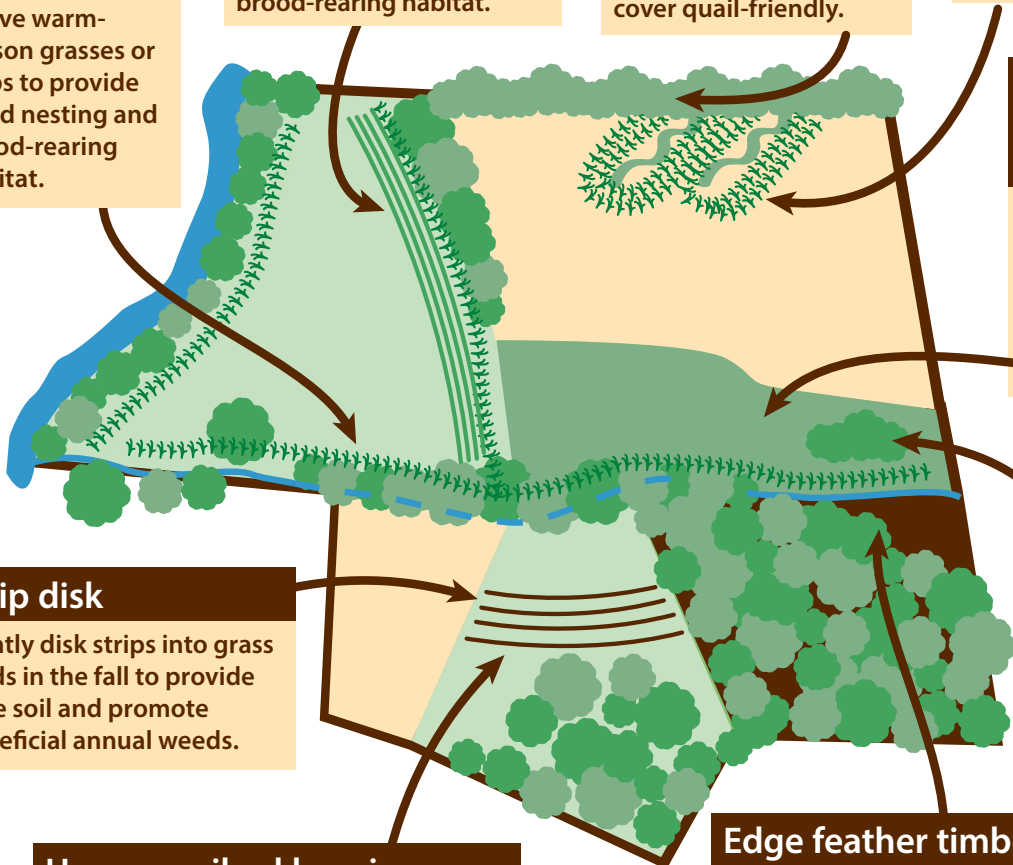
Lightly disk strips into grass fields in the fall to provide bare soil and promote beneficial annual weeds.

Use prescribed burning

Burn cool-season grasses in fall or late spring to thin rank stands and allow insect-attracting forbs to flourish.

Edge feather timber

Edge feather the borders of timber stands by cutting trees in a 50-foot-wide strip. Leave the dropped trees on the ground to create brushy thickets that give quail essential escape and winter cover.



Even in good habitat, quail populations naturally will fluctuate because of weather extremes during winter and the nesting season.

IDENTIFY YOUR LAND'S HABITAT TYPES

Fortunately, bobwhite quail can live and prosper in a wide range of land types and climates, from Canada to the Gulf Coast and from Colorado to the East Coast. Good quail management is compatible with profitable farming operations.

Habitat management for quail benefits hundreds of other species of wildlife, pollinators, and native plants. There are a number of grassland and shrubland birds that are experiencing the same long-term decline as quail. Quail habitat management has been shown to increase populations of these birds, too.

If you are interested in turkeys, deer, pheasant, or rabbits, habitat management for quail can increase food and cover for those species as well. In addition, quail habitat management can be used to improve hunting opportunities. For example, edge feathering can be used to direct deer or turkey travel toward your hunting blind.

CROP FIELDS

Below: *Missouri's crop fields have been enlarged to accommodate large equipment and more efficient farming. As a result, quail habitat has been reduced.*

Crop fields of corn, milo, millet, sorghum, sunflowers, and soybeans provide a large percentage of the quail's winter diet. These large, high-energy seeds allow quail to maintain good body condition when cold weather demands that these small birds ingest enough food to keep from freezing. In addition, quail hens that come through the winter in good condition are able to more fully attain their high reproductive potential during the growing season. These grains also allow quail to meet their energy needs in a minimum of foraging time and reduce their exposure to predators if good escape cover is nearby.

The size of Missouri's crop fields has steadily increased over the last 40 years, leaving little room for the other major components of quail habitat. If these components are available on each 40 acres, the ideal field size would be 10 acres or less. Fifteen-acre fields can provide adequate habitat, especially if they are shaped advantageously. Crop fields larger than 20 acres place major limitations on quail populations, but may be improved by using the following management techniques.

Use contour strip cropping: This practice can allow the land to produce agricultural products and generate income, help control soil erosion, and provide some components of quail habitat. With 50- to 100-foot grass strips between every second or third crop strip, nesting, brood rearing, and food are provided in a relatively small area.



Cliff White

Plant and rotate quail-friendly crops: Cotton, rice, and cucumbers provide few, if any, benefits for quail. In fact, cultural practices — including pesticides, cultivation, and harvest of these crops — nearly prevent any benefits for quail. At the same time, a crop rotation that includes corn, milo, or sunflowers, and soybeans, wheat, and lespedeza in successive years is nearly an ideal situation from a quail's standpoint. This crop rotation also helps control crop insect pests, reduces commercial fertilizer needs and soil erosion, and adds organic matter to the soil. Corn and milo generally provide more benefits to quail than do soybeans and sunflowers because the harvested fields have more cover after harvest if the crop stubble is not mowed, disked, or plowed in the fall.

Extra Touches for Crop Fields

While the cropping approaches described above do not provide quail habitat on every acre throughout the year, they do supply important habitat components at the right times. Landowners who place high priority on quail and have the financial latitude to do so can improve quail habitat further with the following techniques.

Create a buffer: On land that is largely crop with wooded drainages and borders, installing a buffer strip of grasses and legumes that is at least 30 feet wide will help control erosion and filter sediment and pesticides, as well as provide quail nesting, brooding, and roosting habitat. Avoid unnecessary mowing.

Use less herbicide: Modern herbicides have improved weed control in crops so dramatically that many fields are nearly weed free. This is good for crop production, but not for quail. Important brood habitat will be created if herbicides are not used on the two outside rows of crop, next to good cover. These unsprayed areas will develop into a weedy, grain-crop strip during the growing season that provides bare ground for easy mobility, overhead cover for protection from predators, more insects for the chicks to eat, and areas where they can dry off after a rain or heavy dew. If this strip is left unharvested in the fall, it also will provide food and cover during the winter. This may look like sloppy farming, but quail love it!

Overseed winter wheat: Another way to provide excellent brood habitat is to overseed winter wheat in January or February with 4 pounds of Korean lespedeza per acre, then leave the field idle after the wheat is harvested. Important quail foods like ragweed and foxtail will grow naturally and, combined with the lespedeza, provide good brood habitat during the summer, along with food and cover for winter.



Noppadol Paothong

Above: Contour strip cropping and good crop rotations reduce soil erosion, build soil fertility, and provide several essentials for quail.

Below: Buffer strips between crop fields and drainages help control erosion, filter sediments and pesticides, and provide quail nesting, brooding, and roosting cover.



Noppadol Paothong



Above: *Intensively used fescue pastures and clean fencerows leave quail out in the cold in the winter.*

Below: *Native shrubs are used as covey headquarters and provide good escape cover, especially in winter.*

GRASSLANDS

Before European settlers arrived, quail thrived on the edges of Missouri's grasslands, prairies, glades, and savannas. Although most of the state's prairie has been converted to other vegetation and uses, Missouri's grasslands can still support good quail populations when the right management techniques are used.

It is imperative that, no matter what kind of grass you plant or manage, it not become too thick. Even native grasses left unmanaged will become too thick for quail use. Several studies have documented that quail prefer nesting in fields with scattered grass plants. Brood movement in thick grass is restricted, and heavy grass cover excludes important food plants. Ideal quail habitat has 25 percent of the soil surface free of plant litter. It takes regular management to maintain this.

Tall-Fescue Pastures

Tall fescue is the most common pasture grass in Missouri. It is aggressive, and the heavy grazing pressure required to maintain its benefits for cattle often limit important quail plants. The challenge is to reduce the dominance of tall fescue so the plants that provide food and cover for quail can coexist.

Plant or protect shrubs: One of the most economical ways is to plant or protect scattered strips of blackberries, plum, sumac, and shrub dogwoods, which the birds will use as covey headquarters.

Don't mow: Fescue pastures that receive continuous heavy grazing and are mowed completely to remove shrubs and weeds are useless for quail. Skipping small strips when mowing pasture weeds provides them cover. Less than 5 percent of a pasture devoted to unmowed shrubs and weeds can make a significant improvement in quail habitat throughout the year. To provide abundant overhead cover for quail, completely forgo maintenance mowing of pasture weeds.

Graze and overseed: To encourage seed-producing plants for quail food, graze solid stands of fescue heavily in late winter and then overseed the pasture with lespedeza and red



MDC photo

clover. Both of these plants will provide nutritious greens for hens and support good insect populations, important foods for nesting hens and rapidly growing chicks. In addition, lespedeza will supply seeds during the fall and winter. If these pastures again receive heavy grazing pressure from April 1 until May 15 and are rested through the summer, the fescue can be adequately suppressed. Further, these actions will allow the growth of plants that provide brood habitat and quail foods, such as ragweed, croton, partridge pea, and lespedeza.

Disk: To provide additional quail food and cover, disk or apply herbicide to small scattered strips throughout the pasture. This will reduce the tall fescue and allow more native annual weeds to grow. See Page 61 for disking instructions. See Page 60 for herbicide application instructions.

Pastures of Other Cool-Season Grasses

Bluegrass, timothy, orchard grass, redtop, and brome can provide cattle pasture and good quail cover if they are managed properly. All these grasses tend to be less aggressive than tall fescue and generally cannot be grazed as intensively and still maintain the stand. Consequently, these cool-season grasses provide better quail habitat because other plants can more easily coexist with them, and residual grass that can be used for nesting and roosting is left in the pasture. Overseeding these pastures with red clover and Korean lespedeza, along with maintaining good strips/patches of shrubs and weeds, makes these pastures reasonable quail cover.



Above: Frequently mowing grass fields removes most quail habitat components.



Avoid Sericea Lespedeza!

Throughout this book, when we recommend lespedezas, we mean Korean, Kobe, or native lespedezas. NEVER plant invasive sericea lespedeza, which has become a noxious weed in the Midwest. For more information about identifying and controlling this pasture- and habitat-destroying pest, please visit our *Sericea Lespedeza Invasive Species Fact Sheet* at mdc.mo.gov/node/9682.

Native Warm-Season Grass Pastures

Native warm-season grasses such as Indian grass, big bluestem and little bluestem benefit quail, and they increase the profitability of a cattle operation. Described as “bunch” grasses because they grow in clumps, these native grasses allow other important quail plants to exist with them and provide easy access for quail to walk between them. On fertile soils with Missouri’s average rainfall, however, even these native grasses can quickly become too dense for good quail habitat. If so, occasional disturbance is necessary for the field to stay productive for quail.

Most cattle operations would benefit if a third of their pastures were in native warm-season grasses, which grow actively and are most nutritious during the warm summer months when cool-season pastures of tall fescue and bluegrass are generally dormant, less nutritious, and unpalatable to the cattle.

Below: Properly managed grazing can be an important tool for keeping grasslands productive for quail.

Plant a variety of grasses: While native warm-season grasses can be planted in monocultures, cattle and quail both benefit if three or more are planted as mixtures. The benefits for quail and livestock can be further increased if these pastures are overseeded with Korean lespedeza as needed to maintain its presence.

Rotate pastures: Pastures of native warm-season grasses should be grazed in rotation and/or at stocking rates that allow an average of 10–12 inches of grass stubble at the end of the growing season. Of course, the object and beauty of grazing these native grasses is that the cattle create a variety of structure that provides roosting, nesting, foraging, and dusting areas, as well as open cow paths for quail to reach them easily. Warm-season grasses grazed in this fashion have the added benefits of providing good habitat for Missouri’s other native grassland birds. Consult University of Missouri Outreach and Extension (listed on Page 90) for information on rotational grazing.

Burn: Native warm-season grass pastures should be burned at three- to four-year intervals to help maintain the vigor, palatability, and nutrition of the grasses. These burns will improve cattle performance, help control the invasion of shrubs, stimulate production of seed by grasses, legumes, weeds, and wildflowers and boost fruiting of



blackberries, dewberries, and other woody shrubs. It's better for quail and other wildlife if the fields are burned in patches, rather than completely, to provide residual cover for escape until the vegetation regrows. Annual burning of an entire pasture is detrimental to good quail populations because the birds use dead grass from the previous year for nesting and escape.

Install fences: Pastures should be designed to exclude forest and woodlots and allow a fringe of dense shrubby cover along their edges wherever practical.

Control woody invaders: While prescribed burning and grazing will help control woody species that start to invade, selective mowing, grazing by goats, or herbicide application eventually will be necessary. When this time arrives, remember that quail require that some fruiting woody shrubs remain in the pasture, but trees should be heavily thinned or removed completely. See Page 65 for woody cover control.

Plant native legumes and wildflowers: Remember that quail evolved in close association with Missouri's native plants. Enhance pastures of warm-season grasses both practically and aesthetically by adding several other native grasses, legumes, and wildflowers. Tall dropseed, sideoats grama, eastern gama grass, beggarticks, Maximilian sunflower, rosinweed, ashy sunflower, partridge pea, and slender lespedeza will benefit cattle, quail, and other native wildlife. Be aware that seed and plugs of some of these species can be expensive, so you may need to limit quantities according to your budget. See Grow Native! on Page 90 for more information about using Missouri native plants to improve pastures and wildlife habitat.

Cool-Season Grass Hay Fields

Cool-season grasses, such as tall fescue, timothy, orchard grass, and bluegrass, have a serious limitation for quail when used for hay. To get the best quality hay from these grasses, they should be harvested in late May and early June. Unfortunately, this is prime nesting time for quail and other grassland birds. Haying the fields at this time destroys many nests and sometimes kills the adults. To help reduce the loss of quail and nests, leave an uncut 50-foot grass border around the field until after July 15. To provide more insects and seed after the hay is harvested, periodically overseed the fields with lespedeza and red clover.



MDC photo

Above: Periodically burning warm-season grass creates bare ground, stimulates quail-food plants, and controls woody invaders.

Unmanaged, Tall Fescue is Detrimental to Quail

- Fescue is an aggressive, cool-season grass that crowds out other plants that quail need.
- Fescue seeds lack the nutrients needed for a healthy quail, according to recent research in Kentucky.
- Unmanaged fescue in fields and waterways become too thick for quail to feed in or move through.
- Fescue pastures are typically grazed heavily year-round and mowed in late summer to remove any weeds and brush, which destroys almost all usable food and cover for quail.



Jim Rathert

Above: Including native legumes and wildflowers in warm-season grass pasture planting provides more complete quail habitat.

Below: Bison once helped create the vegetative and structural diversity in Missouri's prairies that quail need.



Noppadol Poonthong

Native Warm-Season Grass Hay Fields

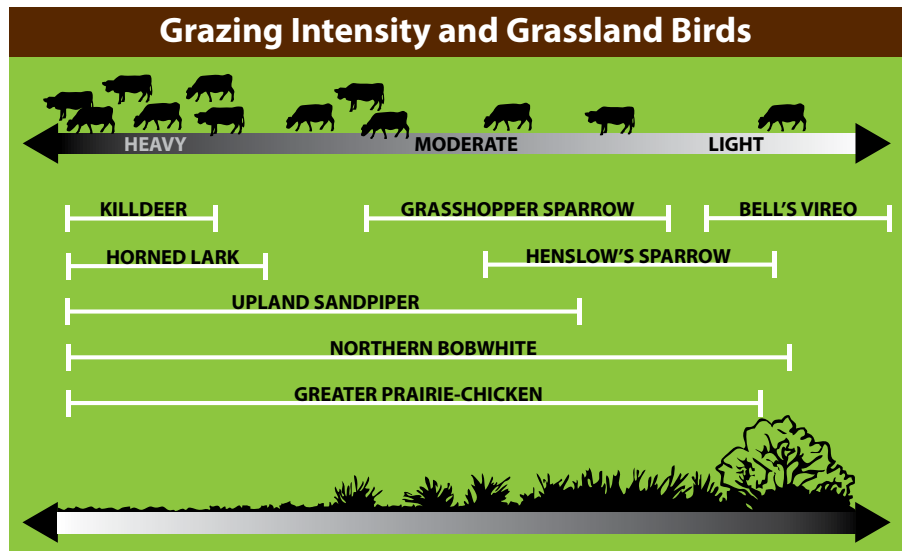
Like pastures, native warm-season grasses can be planted in monocultures for hay, but they are of more benefit to quail if planted in mixtures of native grasses, along with Korean lespedeza and/or native legumes and wildflowers mentioned above. These plantings can be hayed between July 15 and August 15, after the prime quail nesting season, and still have time to regrow and provide food and cover for the rest of the year. You can favor either the grasses or broad-leaved plants according to your objectives. Generally, haying in early July favors the grasses, while haying late in this period reduces the vigor of the grasses and favors the seed-producing plants the following year. Native warm-season grass hay fields, like pastures, need periodic prescribed burns to remain most productive for hay and to benefit quail.

Prairies

Most of Missouri's prairies have been converted to other uses. If you have existing remnants, you already have some valuable quail-habitat components. The addition of some native shrubs and proper management as described in the sections on native warm-season grass pastures and hay can produce good quail habitat and generate income from this scarce resource.

Native warm-season grass, legume, and wildflower seed are increasingly in demand for landscaping, cut flowers, renovating highway rights-of-way, as medicinal herbs, and for lands in the Conservation Reserve Program. Because they are adapted to grow in Missouri, these plants benefit wildlife, are aesthetically attractive, and add nutrients to the soil.

Although each species has somewhat different requirements for good seed production, some general guidelines can be followed. Prescribed burning can increase seed production of most prairie plants, assuming there is good subsoil moisture and average summer weather. The key is the timing. For grass-seed production, a burn conducted in the first half of April will favor grasses and boost seed production. A prescribed burn in late summer or from mid-February to mid-March reduces grass, allowing native legumes and wildflowers to produce more seed. Burning in late summer and late winter generally creates the best quail habitat by creating lots of seed, producing plants and bare ground between less vigorous grasses.



Above: Bobwhite quail can use a range of grazing intensity on pastures. Compared to many other grassland bird species, however, the other habitat needs of quail need to be met within or next to the pasture. For example, a short-grazed or bare pasture will not benefit quail and most other grassland birds if there is not additional cover for nesting, roosting, or broodrearing nearby.

Learn to Burn Safely

Anyone planning a burn should have the training to do it safely. Contact your local Conservation Department or Natural Resource Conservation Service office to learn about short courses and professional assistance to help you learn the safe way to conduct a prescribed burn. See Page 89 for information on locating these offices in your area.

Right: Periodic summer fires are an important tool for rejuvenating and maintaining prairies and warm-season grass plantings.



MDC photo



Ben Dowler

"In early summer months, cattle will gain faster on new warm-season grass than almost any other grass."

— Ken Lenox, fifth generation cattle rancher in south central Missouri, *Today's Farmer*

Native Plants Improve Pasture

Whether you're a livestock producer or just pasturing a few horses for weekend riding, come summer, you can use all the high-quality forage you can get. Especially if it's a drought year. Missouri's native warm-season grasses, such as big bluestem, eastern gama grass, Indian grass and little bluestem will give you exceptional forage long after your exotic cool-season grasses have gone to seed. They also handle flood and drought much better than their cool-season counterparts. Adding forbs such as sunflower and partridge pea creates a native prairie meadow and adds nutritional value to summer forage and winter hay.

STEPS FOR ESTABLISHING NATIVE PASTURE ON YOUR FARM

Whether you're converting pastures to native warm-season grasses or putting in riparian buffers, you'll want to start with a good plan, qualified technical support, and reliable Missouri native seeds and plant materials. Grow Native! recommends this establishment process:

Plan Ahead

- Visit your Missouri Department of Conservation private land conservationist or USDA office to plan your project. Find your private land conservationist on our website at mdc.mo.gov/node/19935.
- Call your Grow Native! seed and plant materials dealer. Grow Native! member wholesalers and retailers carry Missouri-source, tested pure live seed that helps ensure successful establishment of native pasture. Visit grownative.org.

Prepare for Planting

- It's likely you will have to kill and remove existing cover with a non-selective herbicide. Be prepared to spray twice — once in the fall and again in the spring. Consider burning the residue to expose bare ground.

Locate Your Equipment

- Call your private land conservationist, USDA service center, or Grow Native! private contractor to find equipment that will handle native grass seed.

Hire a Grow Native! Trained Contractor

- Don't want to do it yourself? Visit mdc.mo.gov/node/20871 to find a trained and experienced habitat helper to do the job for you.



Grow Native! helps you find and use Missouri native plant seeds and stock. See Page 90 for contact info.

Recommended Pasture Species

Grasses

- Big bluestem
- Canada or Virginia wild rye
- Eastern gama grass
- Indian grass
- Little bluestem
- Sideoats grama

Forbs

- Ashy sunflower
- Compass plant
- Foxglove beardtongue
- Gray-headed coneflower
- Illinois bundleflower
- Lanceleaf coreopsis
- Lead plant
- Maximilian sunflower
- Pale purple coneflower
- Partridge pea
- Pasture rose
- Purple blazing star
- Purple coneflower
- Rattlesnake master
- Round-headed bush clover
- Sensitive briar
- Showy tickclover
- Slender bush clover
- Tickseed coreopsis
- Wild white indigo
- White prairie clover

Below: Properly managed glades can contain many important quail plants and allow the birds to survive in parts of Missouri that are largely dominated by forest.

Glades

Dry, rocky areas with shallow soil, glades occur on south and west slopes in most of Missouri. In parts of the Ozarks they cover entire mountaintops and are known as *balds*. Glades can be managed like prairies for quail, except that they are much drier, have less total production, and need less frequent disturbance.



Prairie and Glade Remnants

There are likely hundreds of acres of restorable prairie and glade in Missouri that are unrecognizable as such. Invading cedar and hardwood trees, bluegrass, and tall fescue often dominate these sites, and the native plants are hard to find. Many times, they become recognizable only after prescribed fire, chainsaw work, or herbicide application gives them room. Heavy grazing from early April to mid May for several years in succession also can help reduce dominance of bluegrass and tall fescue when restoring prairie remnants. See Page 66 for glade-restoration details.

Conservation Reserve Program

Since 1985, the Conservation Reserve Program (CRP) has provided important benefits for wildlife while reducing soil erosion. This federally funded program allows landowners with highly erodible land or who are interested in implementing better wildlife practices to establish permanent vegetative cover, such as grass or trees. In return for taking the land out of production, the landowner is paid a certain amount per acre each year.

Although CRP fields provide benefits for pheasants and other grassland birds, they generally contain a good mixture of annual weeds and grasses for only 2–3 years after planting. During that time, they provide good quail habitat only if there is brushy cover in draws or around the borders of the field. After three years, almost all fields will require periodic disturbance to remain productive for quail. Fields with low soil fertility or rainfall may go four years before needing disturbance.

Jim Rother

Select quail-friendly grasses: Since the main components of all CRP plantings are grasses, the ones selected for planting largely determine how useful the planting will be for quail and how often disturbance will be required to keep the grasses from dominating completely and eliminating the seed-producing plants and bare ground. Native warm-season grasses or a mixture of timothy, red top, and orchard grass are better than tall fescue for quail. All of these grasses are either bunch grasses or are less aggressive than tall fescue.

As in establishing pasture, it's important to include seed-producing plants, such as rosinweed, ash sunflower, Maximilian sunflower, and Korean lespedeza. Landowners who are more interested in wildlife and less in agricultural production will include a larger proportion of little bluestem and smaller portions of Indian grass and big bluestem in their plantings. See *Grow Native!* on Page 90 for more information about using Missouri native plants to improve CRP land for wildlife.

Disk: One of the best techniques for decreasing dominance of the grasses and stimulating the growth of quail-food plants is periodic fall disking. Disking one third of a CRP field annually in 30-foot-wide contour strips and moving the strips to be disked each year can keep the field in good quail habitat and still meet the goals for reducing soil erosion. The accumulated grass litter sometimes becomes so dense that it may be necessary to burn before disking. See Page 61 for strip-disking details.

Burn: Prescribed burning is another technique for reducing the dominance of the grasses and stimulating quail-food plants. When using prescribed fire, timing is critical. Burn at the wrong time, and you may just increase grass dominance. Native warm-season grasses should be burned in summer or late winter. Tall fescue should be burned in late April or early May. Brome, bluegrass, timothy, red top, and orchard grass can be burned anytime from late March to late April to reduce the coverage of these grasses.



David Stonner

Above: Periodic disking of CRP fields is essential to keep them productive for quail.

Sign Up for the Conservation Reserve Program

This voluntary program of the Farm Service Agency (FSA) helps landowners safeguard environmentally sensitive land. Participants plant long-term, resource-conserving covers to improve the quality of water, control soil erosion, and enhance wildlife habitat. In return, FSA provides them with rental payments and cost-share assistance. Contract duration is 10 and 15 years. Call your private land conservationist or USDA office to learn more.



Above: Applying herbicides to fescue and brome before edge feathering and renovating fence rows will help keep these grasses from eliminating bare ground and quail-friendly plants.

Below: Without periodic disturbance, idle areas can become stagnant and largely unusable by quail.

Use herbicides: A variety of grass herbicides applied on part of the field each year will accomplish nearly the same effect as a prescribed burn. The herbicides stunt the grass and allow the other plants to flourish and produce seed. How often you need to spray will depend on the effectiveness of the herbicide and subsequent rainfall. See Page 60 for herbicide-application details.

Create high-energy food: Some CRP practices allow food plots to be planted. Planting corn, milo, and forage-sorghum food plots in some of the disked or sprayed strips provides high-energy food to help quail survive in severe winter weather. Rotating these food strips each year creates ideal brood habitat in the idle plots from the prior two years. See Page 62 for food-plot establishment details.

IDLE AREAS, FENCEROWS, AND DRAINAGES

Many farms have small areas that are left idle, either because they cannot be used for production, or they are being left for wildlife habitat. Sometimes entire properties are purchased and left undisturbed for wildlife. Similarly, shrubby fencerows and drainages can provide important quail habitat. However, all these areas will become less useful for quail if left undisturbed and if they become dominated by fescue, brome, or mature trees. To stay productive for wildlife, these areas need periodic disturbance. Fields with fertile soils need more frequent disturbance than do fields with shallow, clay, or rocky soils. Periodic treatment of encroaching grass and trees is essential to keep these areas in good condition for quail and other wildlife.





Above: Fence rows and drainages with native shrubs provide important quail habitat.
Left: Edge feathering provides areas of excellent quail escape cover.

Tall Fescue

The most common detractor for quail habitat in idle areas is tall fescue. This aggressive cool-season grass invades these areas and crowds out important quail plants. To improve these areas for quail habitat, use the following management techniques.

Use herbicides: The easiest way to thin fescue is to spray it with glyphosate herbicide when it is actively growing in the fall or spring and the desirable native shrubs and grasses are dormant. Applying glyphosate between October 1 and the first hard frost, or between April 1 and May 15, can reduce fescue and allow annual weeds to flourish. If native prairie plants are present, be sure they are dormant before applying the herbicide. See Page 60 for herbicide-application details.

Burn: Under the right circumstances, prescribed burning can accomplish many of the same objectives with less cash outlay. Burning, however, may require more manpower, and the benefits are generally shorter lived. For best results, burn fescue in late April or early May.

Disk: Plowing or heavy disking are effective ways to decrease fescue, but it may harm quail-friendly plants, as well. Unless the idle area is less than an acre in size, disturbing one-third of it each year in rotation generally will create good conditions for quail. See Page 61 for strip-disking details.

Burning fescue during the first two weeks in May reduces the dominance of fescue, creates bare ground, and stimulates quail foods.



Above: Heavy prolonged grazing of forests eliminates quail food and cover plants.

for a longer time. If these cool-season grasses are not sprayed, they become more dominant after the trees are removed. Periodic cutting also allows the landowner to realize some financial return from hedge corner posts salvaged in the process. See Page 65 for woody cover control details.

Leave brush piles (or downed tree structures): Treetops or brush piles left as part of the process provide immediate cover for quail. The goal is to maintain shrubs and tree tops with a high-stem density through which quail can walk easily, but larger animals can't. See Page 56 for downed-tree structure details.

Trees

While trees can help break the wind during severe winter weather — and some tree species provide food — too many trees, too close together, work to the detriment of quail. If idle areas are left undisturbed for many years, trees eventually shade out grasses, shrubs, native legumes and wildflowers, and annual weeds. The area becomes a dense forest and poor quail habitat. The degradation of quail habitat is accelerated if these areas receive prolonged heavy grazing by livestock, or if deer are overabundant in the area and browse out most of the understory plants. Invading trees can be spot sprayed with a foliar herbicide during the growing season, or the trees can be cut and the stumps treated with herbicide. See Page 60 for herbicide-application details.

Trim hedgerows: Even Osage-orange hedgerows, the epitome of quail habitat to many Missouri hunters, should be cut periodically to ensure that the shrubs and forbs are not completely eliminated by the hedge trees. Spraying to remove brome or fescue prior to cutting trees provides improved quail habitat

SAVANNAS

Missouri originally had extensive areas of oak, pine, and mixed oak-pine savannas along the edges of the prairies and glades. These savannas consisted of a scattering of post and blackjack



David Stonner

oak trees and/or short-leaf pine trees with an intermittent understory of shrubs. The ground cover of grasses, legumes, and wildflowers, maintained by periodic fires, provided good quail habitat. Many of the native savanna trees were logged, and the areas remained undisturbed for many years afterwards. In the absence of disturbance, the stumps sprouted thickly to become dense stands of trees that shaded out the other plants that were originally present. Restoring these savannas, if they are present on your land, will improve habitat for quail and restore some of Missouri's native diversity. See Page 68 for open woodland and oak savanna restoration details.

FORESTS AND WOODLANDS

Forests and woodlands can provide important winter shelter and food — if there is enough good escape cover in the form of shrubs and grasses under, between, or near the trees. If that escape cover is absent, it can be created rather quickly.



MDC photo

Above (top): Well-maintained woodlands and savannas can be excellent quail habitat.

Above (bottom): Burning savannas periodically stimulates an abundance of quail foods.



Bill White

Above: Edge feathering quickly creates quail concealment cover along the forest border.

Right: Thinning trees in a forest allows lower-growing plants to flourish and improves quail habitat.

Edge Feathering and Shrub Planting

The quickest way to provide good escape cover is to cut the trees in a 50-foot strip along the forest edge. Sell the logs or use as firewood, leaving the tops for immediate cover. Within a year or two, this strip will sprout with briars, brambles, grasses, and weeds that are ideal quail escape cover. Treating the tree stumps with herbicide will lengthen the time that the strip will furnish good cover without additional cutting. As with fencerow renovation, it's important to spray any fescue or brome before the trees are cut. See Page 55 for edge-feathering details.

Another way to provide the escape cover is to plant a mixture of blackberry, plum, greenbriar, coral berry, sumac, grape, and rough-leaved dogwood along the outside of the forest edge.

This strip will take longer to develop but will eventually provide important habitat for quail and other wildlife. Invading trees should be removed to prevent the strip from becoming forest. See Page 57 for shrub-seeding details.

Planting shrubs to develop the desired cover takes longer and also converts fields and pasture to another use. Edge feathering, if the tree stumps are treated, converts forest to another use. You can choose which approach is best for you considering your objectives and financial situation. Some landowners may choose to do some of both, planting additional species that aren't present after doing edge feathering.

Forest Thinning

The most economical way to create quail habitat in the forest is to periodically harvest trees for lumber or firewood. How you harvest the trees depends on the amount of forest. On property with limited forest area, use group cuts. If the forest is more extensive, use small clearcuts. Both approaches remove the forest canopy and allow lower-growing plants to flourish for four or five years, providing improved quail habitat in the process.

Another way to improve forests and woodlands for quail is to heavily thin the trees with a dozer or chainsaw, then maintain the resulting savanna with periodic burning, disking, and/or cutting and herbicide treatment. See the following section for details on these management practices.

Large-canopied trees with scant understory give predators easy access to quail and provide inadequate protection from winter weather.

Below: After edge feathering, treat tree stumps with herbicide to prevent resprouts.





Step 2: Apply Proven Practices

QUAIL COVEY HEADQUARTERS

Purpose

Escape cover. Covey headquarters (CHQs) are clumps of dense shrubby/woody cover with a canopy at least 3 feet high and little vegetation at ground level. Quail need and use this type of patchy escape cover on a daily basis to avoid hot summer sun and to seek protection from predators and harsh winter weather. Without this habitat component, few quail will be present.

Specifications

- Establish at least 0.1–1.0 acre of dense shrubby/woody cover per 5–40 acres adjacent to wildlife-friendly plantings of grasses/legumes/forbs and adequate bare ground. The minimum size of a CHQ is 30 feet by 50 feet, totaling 1,500 square feet. It takes three CHQs of this size to equal 0.1 acre. In general, optimum CHQs are 3–12 feet in height. For optimal quail habitat, the CHQs should be no more than 150 feet apart and next to early successional vegetation such as managed wildlife-friendly grasses/legumes/forbs, field borders, food plots, or cropland.
- Kill existing grass (regardless of type) before installing new headquarters and around existing CHQs. Removing this vegetation provides good growing conditions for annual food plants and shrubs and maintains an open structure along the ground that allows for easy quail movement. It may be necessary to re-treat any invasive grasses every 2–5 years within and next to CHQs.
- It will generally take at least five years for planted shrubs to gain enough growth to provide adequate protective cover. To provide instant usable protective cover while the shrub plantings are developing, simultaneously use edge feathering and/or downed tree structures (see following pages) in close proximity to the newly planted shrubs.

Below: With proper control of weedy competition, a CHQ planting will take at least five years to gain enough growth to provide adequate protective cover.





Cliff White

Above: Edge feathering can be done with a chainsaw or tree shear — do not use bulldozers.

Below: Use herbicide to eradicate existing grass such as tall fescue, before edge feathering.



Bill White

Different Ways to Make Covey Headquarters

You can create effective covey headquarters using the different management practices described below. We recommend improving existing CHQs or dropping existing vegetation before planting new CHQs. Find complete instructions for the following practices in this section.

Edge feathering: This practice uses downed trees, shrubs, vines, and herbaceous vegetation to create a transitional zone of woody escape cover between cropland and grassland and the wooded edge.

Downed tree structures (DTS): This temporary source of woody cover can be used where adequate cover does not already exist. Use trees that are well branched and resistant to decay, such as Osage orange, pin oak, or cedar.

Improve existing shrub thickets: Remove any trees adjacent to or overtopping an existing shrub thicket. Once they attain a

height of 15 feet, use a chainsaw or clipper to completely renovate existing shrub CHQs. Do not treat the shrub stumps with an herbicide since re-sprouting and/or suckering is desired. Treat encroaching fescue, brome, and other grasses with an herbicide after the shrubs go dormant in the fall. Re-treat every 2–5 years to keep the grasses suppressed.

Planted CHQs: This option can mimic a natural, single-species shrub thicket, or you can include different kinds of native shrubs to increase natural diversity (and create better habitat). Plant bare-root or container-grown native shrubs, such as gray or rough-leaved dogwood, American or Chickasaw plum, or blackberry. Other good species include hazelnut, elderberry, chokecherry, nannyberry, witch hazel, false indigo bush, or aromatic sumac. Do not use weed mats in the planting because you want to encourage spreading and suckering. If you're concerned about deer damage, choose species deer tend to avoid, such as aromatic sumac, false indigo bush, and blackberry. Placing shrub protectors around planting stock will also help deter deer and rabbit damage.

Maintenance

- Exclude livestock from CHQs.
- Use herbicides to suppress invasive vegetation and to control noxious weeds.
- Protect new CHQs from management practices such as prescribed burning or disking. Plantings should be protected from non-selective herbicide applications.

EDGE FEATHERING

Purpose

Provide adequate shrubby cover at ground level for quail and other upland wildlife.

Specifications

- Create 0.1–1.0 acre of dense woody cover 3–12 feet high with bare ground underneath per 5–40 acres of wildlife habitat. The minimum size of an area to renovate is 30 feet by 50 feet. It takes three, 30-by-50-foot areas to equal 0.1 acre. Ideally, 10–25 percent of wildlife habitat should consist of dense woody cover.
- Treat existing grass, especially sod-forming grasses such as tall fescue and smooth brome, with an approved contact herbicide before cutting trees. This will create bare ground and provide good growing conditions for annual food plants and shrubs. Studies have shown that quail will avoid good dense woody cover if there is an understory of sod-forming grass.
- Pick at least a 30-by-50-foot area where you can cut all trees over 12 feet tall. Leave native shrubs like dogwood or plum if they are less than 12 feet tall. If the shrubs are greater than 12 feet tall, cut them off at ground level and do not treat the stumps. Cutting down older stems will encourage new shoot growth.
- Cut down every tree using only chainsaws or tree shears — no bulldozers. Leave trees where they fall or windrow them along the fence or woody draw. Do not push the trees into a dense pile.
- Treat cut tree stumps with an appropriate herbicide to prevent re-sprouting. Do not treat Osage orange tree stumps when renovating an old hedgerow.
- Edge feather small sections at a time. Cut 50- to 100-foot-long sections spaced out every 150 feet. Continue this process each year until the entire fence line or woody draw has been treated.

Maintenance

- Exclude livestock from treated areas.
- Use herbicides to suppress invasive vegetation and to control noxious weeds.
- Expect renovated woody draws/fencelines to last 5–7 years. Enhance these areas by periodically re-cutting woody sprouts or cut new areas along the woody draw/fence line.
- Treat invading sod-forming grasses every three years.
- Supplement edge feathered and downed tree structure CHQs with new felled trees when the existing downed material begins to rot away.

Below: During edge feathering, leave trees where they fall or windrow them along the fence or woody draw.





MDC photo

Above: *Downed tree structures should be placed in large fields with inadequate shrubby cover.*

DOWNED TREE STRUCTURES

Purpose

Provide shrubby/woody escape cover, which is often the missing habitat component for bobwhite quail in fields managed for early successional wildlife.

Specifications

- Create 0.1–1 acre of dense woody cover per 5–40 acres of wildlife-friendly habitat. The minimum size of a downed tree structure is 30 feet by 50 feet and a total of 1,500 square feet in size. It takes three downed tree structures of this size to equal 0.1 acre.
- For optimal quail habitat, the downed tree structures should be no more than 150 feet apart and be placed next to early successional vegetation such as managed wildlife-friendly grasses/legumes/forbs, field borders, food plots, or cropland.
- Choose a minimum of eight well-branched, durable trees that are at least 20 feet tall (do not count the unbranched trunk), and have a trunk approximately 10 inches wide at breast height. When complete, the interlaced branches will cover at least 1,500 square feet.

- Downed trees should not be pushed into dense brush piles. These structures are intended to be open to allow space for the movement of quail and other upland wildlife within the structure. Drag the downed trees to the desired location and place in a loose arrangement. Oak, hickory, cedar, and Osage orange make good downed tree structures. Elm, cottonwood, and willow do not make good down tree structures.
- Kill existing grass (regardless of type) with an approved herbicide before installing downed tree structures. This provides good growing conditions for annual food plants and shrubs, and it keeps the structure free of thick grasses that will impede movement of quail and other wildlife.
- Downed tree structures should be used to enhance new shrub plantings or placed in large fields or field borders with inadequate shrubby cover. For additional benefits, plant shrubs, such as shrub dogwoods, American plum, blackberry, indigo bush, or aromatic sumac, in and around structures. A mix of plants provides greater vegetative diversity.

Maintenance

- Exclude livestock from downed tree structures.
- Use herbicides to suppress invasive vegetation and to control noxious weeds.
- Over time, downed trees will eventually deteriorate. Enhance each structure by periodically adding more downed trees.
- Protect downed tree structures from prescribed burning by disking firebreaks around each structure before the prescribed burn.

DIRECT SEEDING OF SHRUBS

Purpose

Establish covey headquarters/escape cover on open areas, where site can be prepared and protected.

Specifications

Site Preparation: The size of the area prepared must be at least 1,500 square feet (30 feet by 50 feet). Three 1,500-square-foot covey headquarters are approximately 0.10 of an acre. Any vegetation that would hinder planting or provide excessive competition to the seeding should be removed with appropriate treatment. Base site preparation activities on anticipated direct seeding method and seed-predation pressures. For spring seeding, begin site preparation in the fall with a spring follow up. For fall seeding, begin site preparation in mid-summer with an additional early fall

Quick Tip

Before establishing new plantings, install DTS and mark them with a permanent post and PVC pipe to protect plantings from tractor damage when disking.

Below: Quail use downed tree structures for loafing and escape cover. During extreme weather they use them for roosting.



Bob Borman

follow up. If high seed predation is expected, seed predator numbers and/or habitat should be reduced. Prior to seeding, adequate protection from fire and livestock should be established.

Site preparation techniques:

- Mechanical means such as plowing, disking or roto-tilling
- Chemical control of vegetation
- Prescribed burning based on a current approved prescribed-burn plan

Existing shrubs or trees may be maintained if the site is to be inter-planted, and the retained plants will provide functions consistent with the planned use. For wildlife purposes, consider retaining some trees and shrubs that will provide den sites or mast production while the new planting is becoming established. Undesirable plants that will hamper planting or provide excessive shade should be removed or killed.

Seed collection: If seeds are field collected, place seeds in porous bags to prevent heat buildup. Keep seeds cool and plant immediately. Careful observation of seed fall and the amount of seed visible on the shrubs before seed fall will help in deciding when to collect seed. Shrub-species-per-acre rates are based on 3,000 seeds per acre for drilling or hand planting and 6,000 seeds per acre for a broadcasting method. See the following chart for information about seeding wild plum.



MDC photo

Above: Wild plum seed can be easily collected in late summer and planted immediately for a cheap and effective covey headquarters.

Wild plum

Seed maturity	June–October
Planting time	Immediately after ripening, but no later than September 1
Germination	Spring following summer/fall seed dispersal
Prechilling	90–150 days
Clean seeds/pound	850 seeds
Pounds/acre rate	3.5 pounds

Seeding methods and rates: Care must be taken to completely cover the seed and achieve good soil-seed contact. Use the deeper planting depths for larger seeds, herbicide pretreatments, if seed predation pressure is anticipated, or if surface soil moisture is limiting.

One or more of the following seeding methods should be used:

- **Broadcast:** Broadcast the seed evenly over the planting area, and cover seeds with mineral soil (1–2 inches). Roll the planted area to assure good soil-seed contact.
- **Strip:** Broadcast the seed evenly over the prepared strips. Cover with mineral soil (1–2 inches). Roll the planted area to assure good soil-seed contact.

- **Spot:** Plant 2–3 seeds per spot, 1–4 inches deep. Cover with mineral soil and seal planting hole with adequate pressure.
- **Machine:** Plant seeds 1–4 inches deep. Cover with mineral soil and use packing wheels.

Operation and Maintenance: Care After Direct Seeding

Weed control: Eliminate competing vegetation for 1–5 years after planting. Weed control is an important factor in tree and shrub seedling survival, especially for hardwood species. Use cultivation and herbicide to control weeds.

Mechanical or hand cultivation should be kept at least 6 inches from the seedling and no deeper than 3 inches to avoid damage to the seedling and roots. Additional methods may be needed to control weeds closer to the seedling. The use of herbicides usually provides good weed control. **Mowing generally does not provide adequate control** after establishment since the weeds are still competing for nutrients and water. Also, mowing can damage or kill tree seedlings.

- **Weed control:** High mowing (>10 inches) to control flowering and seed development of weeds in the establishment year can be beneficial.
- **Pest management:** Control of weeds (which may hide rodents or rabbits), repellents, and hunting should be considered to reduce damage from wild animals. New seedlings should be monitored for potential wildlife, insect, and disease problems and appropriate control measures taken if problems are found.
- **Livestock exclusion:** Plant injury or death should be controlled through preventative measures. Domestic animals that might graze on seedlings should be excluded.
- **Replanting:** Some sites may have unsatisfactory germination or plants may die over time due to a variety of causes. The decision to re-plant for some or all of the losses or failures will be based on whether or not the remaining plants will likely meet the desired purpose(s) and any program requirements. After two growing seasons, a final status check of the plantings or regeneration should be conducted.
- Consider permanently marking CHQ plantings to help identify them when conducting management practices or weed control.

Quick Tip

Place DTS over new seeding to reduce deer damage and increase quail use before the shrubs mature.

Below: Use of herbicides in shrub seedlings provides good weed control.



Cliff White



MDC photo

HERBICIDE APPLICATION FOR PLANT SUCCESSION MANAGEMENT

Purpose

Set back grasses, although it may also be used to improve habitat quality on fields dominated by perennial forbs or broad-leaved plants. To provide enhanced wildlife habitat, complete herbicide spraying next to areas of shrubby cover, such as covey headquarters, downed tree structures, edge feathering, or shrub thickets.

Above: Herbicides are generally required to suppress or eradicate undesirable grasses such as fescue.

Specifications

Plant type	Recommended spraying dates
Cool-season grasses (fescue, orchard grass, brome, etc.)	March 15 – May 15 or October 1 – December 1
Warm-season grasses (Indian grass, big bluestem, etc.)	May 1 – September 15

- Read herbicide label and evaluate for factors including the effectiveness of control on targeted plant(s), non-target species impacts, toxicological risks, and off-site movement of chemicals. Follow all label directions.
- Apply herbicide in 25- to 75-foot-wide strips along the contour, with an area of undisturbed vegetation twice as wide between the sprayed strips.
- Apply herbicide in blocks on approximately $\frac{1}{3}$ of the field each year.
- Perform prescribed burning or mowing prior to herbicide application. (Allow 6–8 inches of regrowth before application.)
- Perform disking or prescribed burning after the herbicide application.
- Interseed wildlife friendly legumes (December–April) or forbs (December–January) into the sprayed area. **Do not** plant sericea lespedeza, bird's-foot trefoil, sweet clovers, or crown vetch.
- Re-treat sprayed areas as needed to maintain desired plant diversity.

Maintenance

- Re-treat sprayed areas as needed to maintain desired plant diversity.
- Use herbicides to suppress invasive vegetation and to control noxious weeds.
- Use disking or prescribed burning in areas with heavy ground litter.

DISKING FOR EARLY SUCCESSIONAL HABITAT

Purpose

Reduce residue, create bare ground, and promote desirable broad-leaved plants that produce seed and attract insects at a much lower cost than planting food plots. To be effective, strip disk in grassland habitats next to areas of usable shrubby cover such as covey headquarters, downed tree structures, edge feathering, or native shrub thickets. To promote broad-leaved plants, disk in the fall. To promote cool-season grasses, disk in the spring.

Specifications

- Disk at least 4–6 inches deep to expose 30–70 percent bare soil.
- Disk in strips 30–75 feet wide. Disk each field in thirds on the contour. Each disked strip should be separated by an area of undisturbed vegetation twice as wide as the disked strip. In subsequent years, disk the next strip. This develops adjacent strips of vegetation of three different ages.
- Disked strips should be as long as possible and should follow the contour of the field to prevent erosion.
- Avoid disking in areas where concentrated flow is a concern.
- On flat ground, such as ridgetops and creek bottoms, the disked areas can be in 30–75 foot wide blocks. Disk the numbered block in the year shown (1, 2, or 3), and repeat the process again in year four.
- Disk between July 16 and March 31. Late summer/fall disking tends to favor broadleaves. Spring disking tends to favor weedy grasses. Disk before February to get the best response from desirable quail food plants such as ragweed.
- Native wildflowers and wildlife friendly legumes can be interseeded into the disked strips to improve diversity. **Do not** plant sericea lespedeza, bird's-foot trefoil, sweet clovers, or crown vetch. Refer to Native Forb and Non-Native Legume Interseeding on Page 64 for specific details on interseeding.

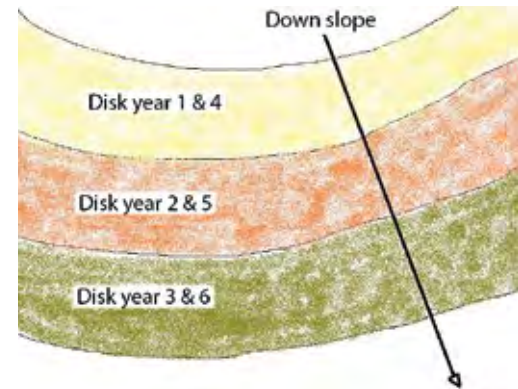
Maintenance

- Maintain the disking rotation.
- Use herbicides to suppress invasive vegetation and to control noxious weeds.

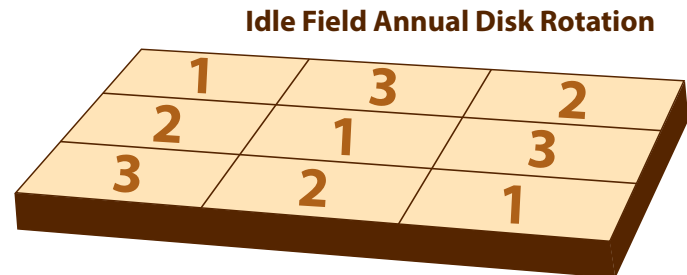


Above: Illustration shows herbicide application. Apply herbicide in 25- to 75-foot-wide strips.

Below: Field showing disking in rotation performed on the contour.



Right: Flat ground can be disked in blocks for added diversity.





Above: Quail prefer small-grained crops, such as grain sorghum, for emergency food during the winter.

FOOD PLOTS

Purpose

Provide a wide variety of foods for quail. Although food is seldom the primary limiting habitat component for quail in Missouri, the use of food plots can provide important food and cover plants — both planted and natural — resulting in an increased abundance and diversity of foods available to a wide range of wildlife species. Grain plots also create important brooding/bareground habitat.

Specifications

Food plots come in two main types: (1) grain plots designed to provide seed, and (2) green browse food plots, which offer succulent vegetation for wildlife forage. In some instances, the two can be combined. Food plots can also be created by leaving unharvested grain strips along edges of crop fields.

- For grain food plots, planting should be done early enough to allow adequate time for the crop to produce mature seed. Planting grain mixtures rather than monoculture crops will enhance benefits to a wider range of wildlife species.
- In general, grain plots or unharvested grain crop strips should be a minimum of 0.25 acres in size, at least 30 feet in width, and preferably located adjacent or within 70 feet of good woody escape cover and diverse herbaceous cover. Create long, winding plots to divide large fields or block plantings where strips are not desired. Establish plots so that soil loss is within tolerable limits, and planting on the contour is recommended. Curved or winding food plots create more edge than straight ones do.
- Food plots should not be placed in natural communities such as glades, savannas, or prairies. When possible, utilize no-till planting methods. The residue left by practicing no-till planting methods will harbor insects beneficial to wildlife.
- Food plots should be adequately fertilized and protected from livestock grazing. In most cases weed control should be limited, as the natural foods provided by annual weedy plants are important to many wildlife species. Plots next to woodland edges may need to be wider than 30 feet to lessen the impact of reduced production due to competition for sunlight and moisture. In general, one plot per 40 acres of farmland is a minimum.
- Seeds produced on small plots are often exhausted by wildlife early in the winter. Where possible, consider increasing the plot size to 1–2 acres to provide longer-term benefits. In general, plots larger than 4 acres in size are unneeded.

Grain mixtures:

- Grain sorghum = 8 pounds per acre; Soybeans = 12 pounds per acre
- Grain sorghum = 8 pounds per acre; Soybeans = 8 pounds per acre; German millet = 2 pounds per acre
- Grain sorghum = 12 pounds per acre; Sunflowers = 8 pounds per acre
- Grain sorghum = 8 pounds per acre; Corn = 8 pounds per acre *(This mixture is best used if planted in separate rows. For example, two rows of corn and two rows of grain sorghum.)*

Single species grain planting options: If planting only one species, grain sorghum (milo) will generally provide the best results.

Species	Broadcast seeding rate (pounds per acre)	Time of year to sow
Grain sorghum	16 pounds	May – early June
Corn	15 pounds	April – early May
Sunflowers	8 pounds	April – early June
Oats	50 pounds	Fall – early spring
Wheat	50 pounds	September – early November
Buckwheat	40 pounds	May – June
Millets	20 pounds	April – June
Soybeans	45 pounds	April – May
“Bobwhite” trailing soybeans	6 pounds for pure stand, or 4 pounds for mixtures	April – May

To allow native food plants (annual broadleaves and grasses) to establish, practice a rotation where half of the grain plots are left fallow each year. Replant this fallow area the next year, and leave the other half of the grain plot fallow. Including a legume, such as alfalfa or annual lespedeza, every 3–5 years will help build and maintain soil fertility.

NATIVE FORB AND NON-NATIVE LEGUME INTERSEEDING

Purpose

Increase plant diversity in wildlife-friendly warm- and cool-season grass plantings or in old field habitats. Interseeding not only provides wildlife, including native pollinators, with a food source, it can also create excellent brood habitat for upland wildlife during the summer. Interseeding is best accomplished after a management practice, such as prescribed burning, strip disking, or herbicide strip spraying, has been completed.

Below: Native forbs attract insects for quail broods and provide a winter food source.

Specifications

Interseed non-native legumes any time from:

- December 1–May 31 or August 1–October 15 in north Missouri
- December 16–May 15 or August 16–October 15 in south Missouri
- Native forbs should be interseeded from November 16–March 15 in north Missouri, December 1–February 29 in south Missouri. Interseeding should be used in conjunction with a management practice. Prescribed burning, strip disking, or herbicide strip spraying are excellent choices. Prescribed grazing may also be used to prepare fields for interseeding. Be aware that program policies may completely restrict or limit grazing activities.
- Conduct a management practice (such as summer burning or fall strip disking a warm season-grass-dominated field) at a time of the year that will set back the dominant grasses and vegetation. Generally, management practices should be completed in the summer or fall/winter period to prepare the site for interseeding during the dormant or spring season.
- Seed may be broadcasted or no-till drilled. Native forb seed may need to be mixed with an inert carrier such as cat litter, pelletized lime, and sawdust or rice hulls to evenly distribute the seed across the entire field. Use a 50:50 ratio of seed to carrier.
- **Do not** interseed with sericea lespedeza, bird’s-foot trefoil, crown vetch, or sweet clover. Interseed native forbs at the rate of 3–5 pure-live-seed (PLS) pounds per acre with a minimum of nine species, with annuals and biennials not to exceed 10 percent of the mix. No single species shall exceed 15 percent or less than 1 percent of the mix.

Maintenance

- Use approved herbicides to suppress invasive vegetation and to control noxious weeds.
- Continue to disturb fields on a two or three year rotation by burning, disking, or spraying herbicides. Prescribed grazing may also be used on a two- or three-year rotation to create a periodic disturbance. These practices will set back grasses and



create bare-ground habitat. If possible, disturb no more than one-third of the field in a year.

- Good non-native legumes to interseed include red clover, ladino clover, alfalfa, and annual/common lespedeza. Non-native legumes are the best choice for cool-season grass fields. Legume inoculants should be used to ensure good germination and plant vigor.

WOODY COVER CONTROL

Purpose

Keep open areas open. Prairie, glade, savanna, and open woodland communities were once a common sight across Missouri. These communities have largely disappeared due to the introduction of invasive species, conversion to agriculture use, and the elimination of disturbances such as fire. Where fire has been eliminated, invasion of dense shrubs and trees has occurred, most notably red cedar in southern Missouri and elm, locust, and Osage orange in northern Missouri. This woody vegetation has shaded out the native grasses and forbs that once dominated these areas. Removing this woody vegetation with a process known as “woody cover control” (WCC) and adding prescribed fire will help restore these declining communities.

Specifications

- Where practical, only use chainsaws or other hand methods (hack-and-squirt, basal spraying, etc.) to remove targeted unwanted woody vegetation.
- Bulldozer use is not an acceptable restoration method for prairie, glade, savanna, or open woodland.
- Use of clippers or tree shears is generally not an acceptable restoration method for glade, savanna, or open woodland sites.
- Woody vegetation may be cut down or girdled and left standing. Where possible, cut all stumps at ground level. Treat all stumps and cuts immediately with the appropriate



Above: Shortleaf pine woodlands were once a common plant community in portions of the Ozarks.



Jim Rathert

***Above:** Prescribed burning is required when managing fire-dependent communities.*

***Below:** A glade responds well to cedar removal and prescribed burning.*



MDC photo

herbicide to prevent re-sprouting. Eastern red cedar stumps do not need a herbicide application when cut below the lowest branch with green growth.

- The remaining canopy trees should consist primarily of characteristic species for the community being restored. Leave scattered shrub islands for additional diversity and cover. Any downed woody material not marketable should be left to burn or used as firewood. Allow woody material to cure for 6–12 months before conducting a controlled burn. If the ground is completely covered with cedar slash and other debris, wait 1–2 years before conducting a controlled burn. Delaying the first prescribed burn will ensure a more complete burn of the cut material and reduce the amount of volatile fuels and damage to desirable vegetation. Remove any volatile fuels (for example, red cedar trees) from within 50 feet of a firebreak.
- To reduce fuel load, it may be desirable to stack the remaining woody material and burn the piles when there is snow on the ground or shortly after a rain. Do not place slash piles next to desirable trees or on highly erodible slopes. Do not use heavy equipment to push the cut woody material into piles.

Maintenance

- Prairie, glade, savanna, and open woodland are fire dependent communities and **prescribed burning is required** when restoring and managing these communities.
- Prescribed burns once every 1–3 years during the initial stages of the habitat restoration will be used to maintain control of woody invasion and restore herbaceous vegetation.
- After the community is restored, prescribed burns will be conducted on a 3-to-5-year rotation, preferably sometime between November and February, or as recommended by a resource planning professional.
- Additional woody cover control will be necessary during the restoration process as the canopy matures.

GLADE RESTORATION

Purpose

Restore an existing degraded glade to provide suitable habitat for quail and other species dependent on this natural community.

Specifications

Site preparation is planned as follows:

Site has been identified as a **Glade** complex — at least 50 percent of the field with shallow soils (<20 inches) or rock outcrops.

Existing woody vegetation will need to be removed to restore the desired plant community. After removal of woody vegetation canopy coverage will be less than 30 percent. Cut stumps, other than cedar or pine, should be treated with an approved herbicide to prevent resprouting. A combination of practices may be used to reach your objectives:

- Chemical control of invasive or aggressive herbaceous vegetation
- Mechanical methods for woody vegetation removal is chainsaw by hand (**heavy equipment is not an acceptable restoration method**)
- Prescribed burning based on a current approved written prescribed burn plan

Planting: Implementation of prescribed burning and reducing woody vegetation cover will usually restore plant communities on these rare habitats. Planting is not recommended until after evaluating the response of vegetation to these management practices.



Operation and Maintenance: Care After Restoration

Prescribed burning is essential to the restoration and management of glade communities. Long term management is not feasible without prescribed burning even if other management methods are used. Never conduct a fire without a written prescribed burn plan.

First-year maintenance: The use of approved herbicides may be needed to control noxious weeds and undesirable plants during the establishment period. Avoid the use of broad spectrum herbicides, instead spot treat infestations with a selective herbicide.

Long-term management: Once the glade is restored, prescribed fire will be applied as necessary to maintain the glade community.

Above: Glade restoration must include prescribed burning on a regular basis.

OPEN WOODLAND/OAK SAVANNA RESTORATION

Purpose

Restore an existing degraded open woodland or oak savanna to provide suitable habitat for quail and other species dependant on these natural communities.

Specifications

Site preparation is planned as follows:

Site has been identified as an **open woodland** complex — transitional/timber soils that comprise at least 50 percent of the field.

Site has been identified as an **oak savanna** complex — transitional soils comprise at least 50 percent of the Removal of excessive stocking of woody vegetation.

Existing woody vegetation will need to be removed to restore the desired plant community. After removal of woody vegetation, 30–80 percent canopy coverage should remain for a open

Below: An open woodland has a sparse canopy, which allows sunlight to reach the ground promoting growth of a diversity of forbs, grasses, and sedges.



woodland, and 10–30 percent for a oak savanna community. Cut stumps, other than cedar or pine, should be treated with an approved herbicide to prevent resprouting. A combination of practices may be used to reach your objectives:

- Chemical control of invasive or aggressive herbaceous vegetation
- Mechanical methods for woody vegetation removal, preferred is chainsaw by hand — **heavy equipment crushes soil structure and plants.**
- Prescribed burning based on a current approved prescribed burn plan

Planting: Implementation of prescribed burning and reducing woody vegetation cover will usually restore plant communities on these rare habitats. **Both communities require prescribed burning.** Never conduct a fire without a prescribed burn plan. Planting is not recommended until after evaluating the response of vegetation to this management.

Once a remnant open woodland or oak savanna complex has had the selected overstocked woody vegetation removed from it and management implemented, a seeding is not typically needed. There is usually an adequate seed bank in the soil. The prescribed burning that will take place to maintain the health of the community will provide the grasses and forbs within the seedbank the opportunity to naturally regenerate. Therefore it is recommended not to attempt any herbaceous planting until after implementing at least one prescribed burn and monitoring natural response. Some natural community systems will take longer to respond in that case you may want to overseed or establish a new plant community. Dormant seeding is the preferred method of establishment for native forbs, grasses and sedges (most successful plantings are completed between November 16 and January 31).

The site, when needed, will be planted:

- Dormant seeding (November 16–March 15 for northern Missouri)
- Dormant seeding (December 1–February 29 for southern Missouri)

Planting methods: Planting methods will vary from site to site, depending upon the conditions of the site. Broadcasting seed by hand may be the most practical way of planting restored open woodlands and oak savannas that are areas less than 3 acres. For hand seeding, mix the seed with an inert carrier such as cat litter, sawdust, or sand to better distribute the seed over the entire area. Mix the seed and carrier at a 1:1 or 1:2 ratio. For small areas an ATV-mounted spreader or seeder can also be used.

Seeding mixes and location and layout:

- Open woodland and oak savanna seedings require the use of Missouri-source native plant materials (genetically originated from within Missouri). **Improved varieties or cultivars should not be used for open woodland and savanna restoration projects.** Depending upon the level of restoration required, some sites may only need native forbs or grasses or both native forbs and grasses.



Aaron Jeffries

Above: *Oak savanna restorations first require removal of at least 50 percent of woody vegetation.*

- The forb mixture for **both open woodland and oak savannas** will be seeded at a minimum of 3 PLS pounds per acre for open woodland restoration. The forb mix will contain a minimum of 10 species with no single species making up more than 15 percent of the mix and the mix having no more than 15 percent annuals/biennials species combined.
- The native grass mixture for **oak savanna** will be planted at 4 PLS pounds per acre and require a minimum of 4 species. The mix must contain little bluestem at 2.8 PLS pounds per acre and all other grasses will be limited to not more than 0.4 PLS pounds per acre each. Additional grass species can be added for diversity to equal the total mix pounds.

- The native grass mixture for **open woodland** will be planted at 3 PLS pounds per acre and requires a minimum of three species. The mix must contain one of the following (sideoats grama or broom sedge) at 1.4 PLS pounds per acre and little bluestem at 1.2 PLS pounds per acre. All other grasses will be limited to not more than 0.4 PLS pounds per acre each. Additional grass species can be added for diversity to equal the total mix pounds.

Operation and Maintenance: Care After Planting

Prescribed burning is essential to the restoration and management of both open woodland and oak savanna communities. Long-term management is not feasible without prescribed burning even if other management methods are used.

- **First year maintenance:** Removal of competing vegetation is normally carried out for one growing season following establishment. The use of approved herbicides may be needed to control noxious weeds and undesirable plants during the establishment period. Avoid the use of broad-spectrum herbicides and spot treat infestations with a selective herbicide.
- **Long-term management:** Once the stand is established, the introduction of management practices, such as prescribed burning, is essential to maintain the vegetative community.

Planting in open woodlands and savannas is not recommended until after evaluating the response of vegetation to this management.

Below: A combination of woody vegetation removal and prescribed burning is essential to restore an open woodland for wildlife such as bobwhite quail.





Step 3: Evaluate and Fine-Tune Your Management

You can spend a considerable amount of time and money trying to create good habitat. Unfortunately, you may make minor mistakes when completing management practices or may not recognize an easier way to create better quail habitat. As a result, you may have less-than-ideal habitat conditions for bobwhite quail. The following section will identify some of the common mistakes landowners make when managing for quail, but it also emphasizes the importance of creating good shrubby, nesting, and brooding cover for quail. Information in this guide is best suited for the landowner who is two or more years into an active quail management plan.

We will refer to fields on your property as *quail management units*. Your ultimate goal is to have a covey of quail in each unit by providing all the basic habitat requirements in that unit. Depending on how intensive you manage your property, each quail management unit should be 15–40 acres in size — realizing the smaller the unit the more intensive the management will be. In each quail management unit, strive to have 10–25 percent of the area in shrubby cover, at least 30 percent of the area in nesting cover, and at least 40 percent of the area in early successional habitat/brooding cover. You should also try to have all cover types intermixed within 150 feet of each other in each quail unit.

HABITAT GOAL: DIVERSE GRASSLAND HABITAT

If you are managing your property for quail, a majority of your efforts should be spent developing and maintaining **diverse** grassland habitat. Quail will use diverse grassland habitat throughout the year for nesting, brooding, roosting, and feeding cover. Ask yourself the following questions about the grassland habitat in each quail-management unit to determine if there is any way you can improve quail habitat on your property.

1. Do I have tall fescue or smooth brome borders around my native warm-season grass fields, croplands, woody draws, hedgerows, fencerows, or woodland edges? If so, see Herbicide Application for Plant Succession Management on Page 60. A tall fescue or smooth brome field border will eventually encroach into native grass and shrub plantings, and it will make edge feathering useless if not treated before cutting the trees.

2. Does each field have a variety of wildlife-friendly grasses, legumes, and forbs? Most fields, including most established native warm-season grass fields, do not have good forb and legume diversity for grassland wildlife. Forbs and legumes should comprise 25–50 percent of the vegetation (canopy coverage) in a management unit to provide good nesting and brooding cover. Scout your fields in June or July to determine if there is a good mix of grasses, forbs, and legumes. You can improve plant diversity in each field by conducting a management practice and then overseeding legumes and/or forbs. Native forbs should be seeded between late

You should try to have all cover types within 150 feet of each other in each quail unit.

Free Habitat Management Calendar

Keeping management tips in daily view helps you keep habitat in top condition. See ordering details under Free Publications on Page 92.



Above: This grassland would provide adequate nesting and brood rearing cover due to the amount of bare ground.

Nesting and brooding habitat are the most important habitat components for bobwhite quail.

November and early February for best results. See Page 64 for interseeding specifications.

3. Does each field have adequate bare-ground habitat for nesting and brooding habitat? Your goal is to have 30–70 percent bareground between clumps of vegetation so quail can easily move through a field, but still have overhead protection from predators. Evaluate each field in June or July to determine if you have good bare-ground habitat, which can be created by setting back the dominant vegetation in the field with light disking, herbicide application, or prescribed burning.

4. Does each field have adequate nesting cover that is close to adequate brooding cover? From early May through August, about 30 percent of each field should be available as good nesting cover. Ideal nesting cover is made up of the previous year's growth of wildlife-friendly cool-

or warm-season grasses with a mix of forbs, legumes, and bareground habitat between the grass clumps. Good nesting cover should be within 75 feet of good brooding habitat so newly hatched chicks will have a place to forage and easily move through.

Brooding habitat should have bareground with an overhead canopy of wildlife-friendly grasses, legumes, forbs, and annual grasses (weeds). You can provide nesting and brooding cover in close proximity to each other by burning, disking, or spraying only one-third of a field annually. By dividing fields over five acres into smaller management units, you will create a patchy mix of disturbed and undisturbed areas and ultimately better habitat for quail.

5. In my wildlife-friendly grass fields, what percentage of the field has been invaded by undesirable grasses? Tall fescue, smooth brome, reed canary grass and bermudagrass can dominate native grass and wildlife-friendly cool-season grass fields. If left untreated these grasses will quickly spread throughout the field, eventually suppressing desirable vegetation and degrading nesting and brooding habitat. If more than 25 percent of the field is infested with undesirable grasses, consider spraying the field with a selective herbicide, spraying with a non-selective herbicide when the native grasses are dormant in the fall, or conducting a management practice that will setback the undesirable grasses (such as burning in late spring to setback cool-season grasses).

6. Do I regularly scout fields and field borders for non-native plants such as reed canary grass, tall fescue, sericea lespedeza, crown vetch, honeysuckle, or autumn olive? Non-

native plants are here to stay. By scouting each field in the spring, summer and early fall, you will have adequate time to control the spread of these wildlife-threatening plants. Remember, one sericea lespedeza plant can produce thousands of seeds in a growing season. It is easier and less expensive to treat small infestations in part of a field instead of the entire field at a later date.

7. What species of warm-season grass or wildlife friendly cool-season grasses do I have in each quail-management unit? The preferred grassland cover is little bluestem, broomsedge, and sideoats grama with a good mix of native forbs and legumes. Taller native warm-season grasses such as big bluestem, Indian grass, and switchgrass also make good quail habitat, but they may require more frequent or intensive management to keep stands open enough for quail. Undesirable cool-season grasses can easily overtake wildlife-friendly cool-season grasses such as timothy and orchardgrass. Managing a wildlife-friendly, cool-season-grass field infested with tall fescue or smooth brome will be difficult since it will be nearly impossible to eradicate the unwanted vegetation without killing the wildlife-friendly cool-season grasses. Figure on replanting every few years if this is the case.

Nesting and brooding habitat are the most important habitat components for bobwhite quail and the habitats most often overlooked by many landowners. Grass fields are vulnerable to invasion from non-native vegetation, such as tall fescue or sericea lespedeza. Monitor your grass fields throughout the growing season to determine if you are providing adequate nesting and brooding cover and to identify any undesirable plants that might have invaded your fields in the past year.

MANAGEMENT GOAL: EFFECTIVE GRASSLAND MANAGEMENT PRACTICES

Bobwhite quail require grassland and early successional habitat that provides nesting and brooding cover in close proximity to each other. This can be accomplished by disturbing a different portion of the field or management unit annually with a management practice or combination of management practices. Disturbed areas will provide good brooding cover while undisturbed areas will provide nesting cover.

1. Do I burn or complete a management practice at the same time of the year or use the same management practice every year? Vary the time of the year you complete a management practice to maintain or increase plant diversity

Quick Tip

Toss a golf ball to the ground. If it bounces and rolls, then you have enough bare ground for quail to move around.

Below: Prescribed fire is a required tool for the quail manager.



Don't always install firebreaks and field roads along fence lines or other edgy areas. This is where quail want to be. Move field roads and fire lanes at least 70 feet from edgy areas.

Below: Strip disking has provided the bare ground and added diversity to make this grassland suitable for quail.



and plant structure. If possible, consider using a different management technique to create a different vegetative response. If you have always burned in the spring, try burning in the summer or fall, or try strip disking in the fall instead.

2. Do I prepare firebreaks around each field in the summer or early fall, or do I wait until right before burning? Many landowners wait until the last minute to prepare their firebreaks. Often they are delayed by inclement weather, which ultimately delays the burning until later in the year. If possible, disk firebreaks in the summer or early fall. Disked lines are preferred over cool-season grass mowed lines since there is less of a chance of fire escaping. Disked firebreaks also inhibit undesirable cool-season grasses from eventually spreading into the field. If you use mowed lines they should be mowed as short as possible and often to reduce the amount of duff on the line. It is also important to mow fire lines in late April or early May to prevent cool-season grasses from setting seed. Another way to maintain fire lines is to plant the disked lines to grain or green browse food plots. The food plot/fire line can be planted before or after burning depending on the time of the year you conduct the prescribed fire.

3. When I complete a management practice on a grass field, do I overseed native forbs and/or nonnative legumes afterwards? Even with management, many native grass fields lack the plant diversity needed to support good quail populations. Forbs and legumes are needed to provide good brooding and nesting cover. Consider overseeding native forbs or non-native legumes after strip disking, burning or applying herbicides on the portion of the field disturbed. Overseed native forbs in December or January to ensure good germination that spring. See Page 64 for interseeding specifications.

4. Do I expose enough soil when strip disking? Overgrown fields will be difficult to strip disk unless the portion of the field to be disked is mowed ahead of time. In fields with deep thatch, lightweight disks will just ride over the top of the ground, barely scratching the soil surface. Strip disking should expose 30–70 percent mineral soil, which may mean you have to go over the same area two or three times. Strip disking should be completed between July 16 and April 1, but the most desirable vegetative response occurs when the disking is completed before February 1. Fall disking usually promotes ragweed and other broad-leaved plants while disking in spring will encourage foxtail and crabgrass. See Page 61 for disking specifications.

5. Do I only treat one-third to one-half of each field with a management practice annually?

By treating only one-third to one-half of each field, a portion of the field will have good nesting cover while disturbed areas will provide good brooding cover. These two habitat components must be in close proximity to each other to provide optimal quail habitat. Treat a different part of the field the following year. If possible, try to break the one-third to one-half that will be treated into smaller units so the disturbed acres are throughout the unit instead of in just one corner. For example, instead of burning the west one-third of a 20-acre unit, try to distribute the one-third that will be disturbed throughout the unit by creating smaller 1 to 3-acre burn units.

6. Do I mow for fun? Recreational mowing of old fields and idle corners destroys possible habitat. In some cases, it may be necessary to mow areas to control invasive plants or to maintain service roads or firebreaks. If possible, avoid the urge to mow idle areas. Instead, consider converting these areas to warm-season grasses, food plots, or shrubby cover for quail.

7. Do I use a combination of management practices? Try strip-disking part of a field and burning another area to create greater diversity within each management unit. Alternatively, in rank stands of grass, do not be afraid to use a combination of practices on the same acres to really setback the grasses. For example, consider burning a rank stand of warm-season grass in late summer and then strip-disking a portion of the burned area that fall to further setback the grass. Maintaining diverse grassland habitat is one key to creating good quail habitat. Diverse grassland habitat should contain a mix of wildlife-friendly grasses, legumes and forbs. Disturb one-third of each unit to provide bareground habitat for brooding cover, while the remaining portion should remain undisturbed for nesting cover. Try breaking each unit into smaller management units to create a patchy grassland of disturbed and undisturbed areas to maximize nesting and brooding habitat. Consider using food plots as firebreaks or to subdivide fields into smaller management units. Legumes and forbs should be overseeded in disturbed areas to improve plant diversity and plant structure. Monitor your fields during the summer to determine if the completed management practice is creating adequate nesting and brooding cover for quail. If not, change the time of the year you conduct the management practice or try a different technique.

MANAGEMENT GOAL: DIVERSE FOOD SOURCES

One of the most common mistakes landowners make is focusing on food plots and forgetting about nesting, brooding, and shrubby cover. Most landowners enjoy planting food plots because they can see instant results, and this is a great way of enjoying the outdoors. Remember, establishing and maintaining good nesting, brooding, and shrubby cover should always take priority over food plots, especially if your farm is in an intensive row-crop area. If established properly and near good cover, food plots can provide quail and other wildlife a dependable food source throughout the winter.

Below: The left half of this food plot is being left idle, providing ideal brood habitat.



Cliff White

1. Do I replant food plots every year? Replanting an entire food plot each year destroys ideal brooding habitat for quail. Food plots not only provide a food source for quail but also create excellent brooding cover for one to three years. Consider dividing each food plot in half and leaving one-half idle for an entire growing season (do not disk under the unplanted half). Replant the idled half the following year and leave the other half idle.

2. Do I fertilize my food plots each year and take a soil test every three or four years? The purpose of a food plot for quail should be to provide brood-rearing cover and food during a difficult winter. It does not have to look like a production agriculture field that is producing 160 bushels of corn to the acre. So don't put on 100 pounds of nitrogen every year. On most soils, it may take as little as 25 pounds of nitrogen and nominal amounts of phosphorus and potassium to get at least some production of grain for those exceptionally tough winter months.

3. Are my food plots too small? Food plots should be at least 30 feet wide and at least $\frac{1}{4}$ acre in size. Plant long, winding food plots with the contour to create more edge. Food plots smaller than $\frac{1}{4}$ acre are easily over browsed by deer and will be of little value to wildlife that winter. In areas with high deer populations, food plots should be at least 1 acre in size. Avoid using milo or soybeans in areas with high deer densities, and switch to millets or forage sorghums.

4. Do I plant food plots too thick? More often than not, managers plant food plots way too thick. The results are often little or no seed production — one goal of planting a food plot. Review the Food Plots section on Page 62 for recommended food plot mixes and seeding rates.

5. Do I leave unharvested grain in cropfields? Consider leaving a 30-foot wide strip of unharvested grain next to a field border and brushy cover. Consider not spraying these strips with herbicides during the growing season to provide additional food and cover from annual weeds.

6. Where are my food plots located in the field? Food plots should be located in close proximity to shrubby cover. That means food plots for quail should be no more than 70 feet from existing shrubs, edge feathering, briars, or downed tree structures. Consider planting shrubs, creating downed tree structures, or edge feathering around food plots. Plant $\frac{1}{4}$ – $\frac{1}{2}$ acres of food plots per 40 acres of habitat.

7. Do I plant a variety of different food plots? If you plant all your food plots to milo, what would happen if the crop failed that year? Planting a variety of different grains, forages, and legumes in different plots ensures at least one crop will produce adequate food that year. It is also a good idea to rotate annual lespedeza, alfalfa, red clover, or ladino clover into your food plot rotation for one or two years to rebuild soil fertility.

8. Do I use herbicides on my food plots if weeds become a problem? Sometimes food plots can fail because the plot was overtaken by annual weeds such as foxtail. To avoid a complete failure, consider spraying an herbicide on your food plots if weeds are canoping over the planted crop. Check with your local agriservice for recommended herbicides. Many landowners feel the purpose of a food plot is to provide bobwhite quail with a high-energy food source during the winter. Food plots can provide a dependable food source, but only if the plots are managed properly. Landowners should remember that habitat, not food, is often the greatest limiting factor for bobwhite quail in Missouri. Management efforts should still focus on creating nesting, brooding and shrubby cover for bobwhite quail.

MANAGEMENT GOAL: SHRUBBY COVER QUALITY AND PLACEMENT

Shrubby cover in the form of edge feathering, existing shrubs, briars, and downed tree structures should make up 10–25 percent of each quail management unit. Shrubby cover should have bareground underneath for easy movement and be 3–12 feet tall and thick enough to impede predators. A good example is edge feathering or a wild plum thicket. A warm-season grass field surrounded by woods provides little shrubby cover for quail. This missing component can mean the difference between having or not having quail. Evaluate your fields to determine if you have enough good shrubby cover.

1. Do I complete edge feathering correctly? Edge feathering is one of the quickest and easiest ways of creating good brushy cover for quail. Most people do not edge feather deep enough into the woods to create adequate brushy cover. The minimum width for edge feathering is 30 feet deep into the woods, but 50 or 60 feet is even better. “Chop and drop” nearly all the trees for the first 30 feet, and leave more trees standing as you move deeper into the woods. Each edge-feathered strip should be at least 50–100 feet long.

2. Do I treat cut stumps or girdles with an herbicide when edge feathering or conducting woody cover control? Edge feathering and woody-cover control are hard work and nobody wants to do it over. If you do not treat the cut stumps with an herbicide (except cedar and pine) you will be cutting the same trees again in five years. Forget to treat a honey or black locust stump, and you will be living with annoying sprouts for years. Make sure you treat stumps with an herbicide.

3. If I have mature hedgerows and narrow woody draws, do I rejuvenate these areas by edge feathering them also? Mature fencerows and hedgerows provide little cover for quail. Consider cutting nearly all the trees in narrow woody draws, fencerows, and hedgerows. Do not treat all the stumps. You will want to allow some of the trees and hedges to regrow, especially if the woody draw is less than 40 or 50 feet wide. Treat the stumps of undesirable trees such as locust to avoid resprouting.

4. Do I complete some edge feathering each year? By completing a small amount of edge feathering each year, you will create a variety of different plant succession stages. More variety will mean better habitat for wildlife. Consider edge feathering some each winter. You will be amazed by the amount of edge feathering you can complete with a chainsaw and one tank of gas.

5. When I edge feather, do I leave the trees where they fall or do I push them into a dense pile? Cut trees should be left where they fall. Quail and most other wildlife prefer open, loose, brushy cover. Do not stack or push the trees into dense brushpiles. Move cut trees only if they fall into cropfields or roads. Otherwise, leave the trees where they fall.

6. Do I eradicate invasive cool-season grasses before edge feathering? It is critical that you spray tall fescue or smooth brome under the trees before you complete any edge feathering. If undesirable cool-season grasses are left untreated, they will quickly spread into the feathered area — making all your hard work useless for wildlife. Ideally, spray the field edge in the fall and complete the edge feathering that winter.

Below: Eradicate grass in covey headquarters or before edge feathering.



7. Do I have tall fescue or smooth brome underneath existing shrubs and briar patches? Many existing shrub patches have an understory of tall fescue or smooth brome that makes these areas virtually useless for quail. In the fall (after leaf drop) or in the spring (before bud break) spray the cool-season grass understory with glyphosate to make these areas usable cover. The herbicide will not harm the shrubs since they are not actively growing, or use a selective herbicide after bud break that targets only grasses.

8. Do I have native shrubs invading parts of my fields? Take a close look at your grass fields. You will often find scattered patches of seedling blackberry, sumac, and wild plum. This is natural plant succession action. Consider managing these patches of native shrubs as future covey headquarters. Kill the competing grass in each volunteer shrub patch and protect the future covey headquarter from fire by disking a firebreak around

each island. Remember, each covey headquarter should be at least 30 feet wide.

9. Do I replant shrubs into existing shrub plantings two or three years after the original planting? Even with good site preparation and weed control you can expect some of the shrubs seedlings to die. Consider replanting seedlings the second or third year if more than 50 percent of the shrubs die in the original planting.

10. When I plant shrubs, do I begin preparation in the fall by eradicating undesirable cool-season grasses where the shrubs will be planted? It is virtually impossible to adequately kill fescue or brome in the spring with only one herbicide application. Skips and misses will be a problem, and eventually the fescue or brome will recover and spread through the planting. A well-timed herbicide application in the fall and again in the spring before planting is the proper way to prepare a site for a shrub planting.

11. Do I drag cut trees into the middle of newly planted shrub islands? Dragging a few trees into the middle of a shrub planting will provide instant brushy cover for quail and act as a marker for each shrub planting. Typically it will take a shrub planting 5–7 years to provide adequate shrubby cover for wildlife. Before or after you plant the shrubs, drag at least three trees into the middle of the planting. Oak, hedge, hickory, and cedar all make good downed tree structures, which will provide instant brushy cover for three to five years. By that time, the shrub planting should provide adequate shrubby cover.

12. How far apart are areas of shrubby or brushy cover in each field? Quail generally stay within 70 feet of shrubby cover. Most landowners only provide shrubby cover along the edges of a field, leaving the middle of the field unusable habitat for quail. The same is also true for buffers. Most landowners only plant the minimum amount of shrubs or do the minimum amount of edge feathering. To maximize quail habitat, have 10–25 percent of each management unit in usable shrubby cover. If the field is more than 150 feet wide, consider scattering shrub islands or downed tree structures in the middle of the field or edge feathering narrow draws that run through the field. Disk firebreaks around each island to provide dusting areas and to avoid destroying the shrub islands when you conduct a prescribed burn.



MDC photo

Above: Before planting shrubs, eliminate the vegetative competition, especially cool-season grasses.



The key to accurate year-to-year or place-to-place counts is to be consistent about everything you can control:

- Same people listening
- Same locations
- Same kind of clear, windless days
- Same week of the year
- Same time of the day

To keep tabs on the quail population, the most successful managers use whistle counts outside of the hunting season, during June and October. Counts in June provide an index of whistling males, which gives an idea of how many quail survived the winter. Although males whistle throughout the day, the most consistent measurements occur during the first two hours of daylight.

Fall covey whistle counts, on the other hand, require different tactics and provide different biological information. Fall whistling lasts only minutes each day, and it gives an estimate of production and pre-hunting season conditions.

Both methods can help you evaluate your situation and management techniques. The greatest insight will come if you do whistle counts before and after starting management. Along the way, year-to-year counts will allow you to relate quail numbers to weather, local habitat conditions, and other changes on the landscape.

WHISTLE COUNT PROCEDURES

Successful counts require considerable preparation. Before going afield, carefully study habitat maps and photos and decide what area or areas you want to survey. The maximum distance a quail whistle can be heard is about 800 yards when sound is carried by a light breeze. Under most circumstances the farthest distance is about 500 yards, but trees or tall native grasses can substantially reduce the distance. Biologists commonly use the 500-yard hearing distance

Step 4: Track Quail Numbers

when choosing listening stations. To ensure that you are not counting the same birds twice, space listening stations at least 1,000 yards apart, or stand at the edge of your property where large barriers (such as forests) prevent sound traveling from areas you do not want to sample or recount.

Be sure to permanently mark your listening stations. Because October counts begin before sunrise, mark a post or tree with reflective tape so that it can be located in the dark with a flashlight. If you drive to the station, park far enough away so that the engine cooling noises do not interfere with hearing. Stand at the same point each year so you can track change over time. A compass can be helpful in distinguishing among different quail and locations.

Listen only on clear days when the wind is less than 5 mph. When you are in position, point the compass at the whistling bird, jot down the bearing, and get ready for another location. If you place this azimuth line on an aerial photo, you'll later be able to identify occupied habitats and locate birds to flush and count.

EVALUATE BREEDING BIRDS

To get an index of birds that survived the winter and are available for breeding, listen for whistling males for 1–2 hours after sunrise during June. Nesting by females is at its peak this month, so males are actively calling. Count the number of individual birds you hear. Because quail can whistle for hours, be careful not to recount the same bird. If you listen every year at the same spot, within one week of the same date, and at about the same time, you can track how well birds are surviving winter in relation to your management.

PRE-SEASON EVALUATION

To get a measurement of production before hunting season, listen for covey calls during the last three weeks of October. Begin listening 45 minutes before sunrise. Continue until birds whistle or until sunrise if you hear no whistling. Fall coveys usually whistle about 25 minutes before sunrise and for less than 30 seconds. The intensity of whistling in your area will depend on how many quail there are to answer the initial call. Conservation Department research found that not all coveys in an area will whistle, and that the percentage of coveys that whistle increases when there are more coveys to stimulate each other. To better estimate how many coveys are in your listening area, the actual number heard can be corrected. Correction rates are 53 percent when only one covey is heard, 85 percent when 2–4 coveys whistle, and 94 percent when five or more coveys are heard. For example, if you hear one covey, divide by 0.53 to estimate 1.9 coveys, and if you hear 10 coveys, divide by 0.94 to estimate 10.6 coveys.

Vocalizations

To hear the differences between the bobwhite's spring mating call and the fall covey call, visit mdc.mo.gov/node/4708.



Find more resources for assessing quail populations on Page 92.



Rely on Research, Not Common Myths

Although habitat is the key to restoring quail populations, many people think that predator control, stocking, and artificial feeding are the answers. People reach for simpler solutions because the needed habitat changes are complex, extensive, and require hard, dirty work. However, habitat restoration is the only technique that is backed by research and brings lasting results.

Landowners have long practiced predator control throughout quail range, but only habitat management improves quail numbers.

PREDATOR CONTROL: CAN IT WORK?

Quail and other grassland bird populations have experienced severe declines, and land managers and private landowners are always searching for the silver bullet to improving bird populations on their property. One of those so-called solutions is predator control. The success of predator control on established habitat relies on many factors such as size of the area, regional location, removal methods, removal duration, etc. On the Tall Timbers Research Station in southwest Georgia, a current research project is having moderate success controlling predators on a year-round basis. A full time trapper with a substantial budget is needed in order to make the project a success. However, the plantation is surrounded with quality habitat and the weather isn't as much a factor as it is in Missouri. Other research projects have concluded that woody areas near quail habitat show an increase of predation by birds and reptiles. Several other studies have illustrated that some predators are actually good for quail. In fact, one study showed that bobcats eat a lot more quail predators than they do quail.

Predator control has been practiced for years throughout bobwhite range, but it has never proven to be a substitute for habitat management. The most definitive study of habitat management and predator control occurred in North Carolina in the late 1990s. For three years, biologists measured quail numbers under four habitat types:

- Good habitat: crop fields with wildlife-friendly borders
- Poor habitat: crop fields without wildlife-friendly borders
- Good habitat and predator control: crop fields with borders and predator removal
- Poor habitat and predator control: crop fields without borders and with predator removal.

Predator removal consisted of trapping all the common furbearers during late winter and spring. Trapping in spring just before quail nesting was necessary to prevent repopulation of new predators moving into the area after harvest.

Researchers found the highest quail numbers in those areas where the field borders and predator removal occurred together. Close behind were the areas where only crop field

Below: Predator control can be effective if the right habitat is in place, but it can be time consuming, costly, and potentially have a snowball effect on your population.



Above: Striped skunks and other predators eat quail eggs, but in good habitat, quail can withstand the loss.



Above: Focusing predator management on one particular species can allow for several other species to increase in population.

Below: Turkeys are insignificant quail predators. However, more good turkey habitat means less quality quail habitat.



borders were present. However, because of the high cost to remove the predators, the authors concluded that predator control was not practical for the small gains achieved. The money spent on predator removal could have easily had more benefit to quail if it was used to install or manage quail-friendly habitat. Several food-habit studies of mid-sized predators, including bobcats and coyotes, indicate that these animals eat more raccoons and opossums than they eat quail. Their eating habits might actually benefit quail.

Quail can co-exist with predators, but they cannot overcome the loss of habitat. They must be able to reproduce with high numbers to offset the losses suffered from predation. The maturation of quality habitat into large canopy trees, fescue/brome pastures, and row-crop production is the real reason we continue to see a decline in the quail populations. By converting the trees into shrub piles, spraying the fields and fencerows heavily choked with fescue and brome, and installing and managing quail-friendly practices on your farm, you will be doing your part in reducing the predation of quail on your property.

TURKEYS AS PREDATORS

Turkeys are widely rumored to be a major culprit in the demise of quail. Coincidentally with the decrease of quail late in the 20th century, wild turkey populations have increased across much of the United States. Hunters' perception of the rise of turkeys and fall of quail is colored by the reintroduction of wild turkeys into many areas containing suitable turkey habitat, where quail had previously flourished.

Is there a link between the rise of turkeys and fall of quail? Yes, it's habitat. Turkeys and quail have some similar habitat needs, for example, weedy areas for bugging by chicks and row crops for winter food. However, the trees that turkeys require for roosting spell trouble for quail. While quail require brush, briars and tangles to protect them from winter elements, natural plant succession leads to the replacement of these vegetation types by large-canopied trees. With this tree growth, quail lose their hiding places while the large trees provide handy perches for quail predators, such as hawks and owls. Lacking specific management for quail, Missouri's landscape has slowly evolved into poorer cover for quail and better cover for turkeys and deer.

Although instances of turkeys eating quail chicks have been reported, the phenomenon is extremely rare. Indeed, with the exception of a single biological report in Florida of indirect evidence of turkeys eating quail eggs or chicks in the early 1900s, no biological study since that time has documented the phenomenon. This lack of solid evidence is remarkable because of the proliferation of turkey and quail research during the past 50

years. Turkey researchers have not found a single quail while examining thousands of turkey stomachs. In addition, quail researchers using radio transmitters and remote cameras have documented thousands of cases of predation by snakes, furbearers, and crows, as well as deer and armadillos. No turkey, however, has yet been caught in the act.

STOCKING

At first glance, stocking seems to be an easy way for state agencies to restore quail populations. But like most quick fixes, it doesn't bring lasting results. By the turn of the 21st century, all state natural resource agencies had abandoned release of pen-raised quail for restoration because the practice was not economical and didn't permanently increase quail populations. Stocked birds must come from game farms or from the wild. Game-farm quail simply lack survival skills. Wild birds have to be live trapped, which is difficult and expensive.

Hunters often ask why we don't restore quail through trapping and transplanting as we did with deer and turkeys. The answer is habitat. If the habitat in the area is too poor to support wild quail, stocked birds can't survive there, either. Any birds released in such conditions are doomed from the start. Without good protective cover, they're as safe from predators as fish in a barrel. And without a combination of cover and food, any birds that do manage to avoid being eaten stand little chance of surviving the winter and nesting successfully. Deer and turkey, on the other hand, have thrived because Missouri's landscape now provides better cover for them.

In the past few years, some entrepreneurs have gained attention for their attempts at quail propagation. Most involve some kind of shelter to protect birds and provide food, and predator control to decrease the chances of the less-than-wild quail being eaten by something other than the hunter who paid for the birds and the equipment. Researchers in Virginia tested one of the most popular systems: the anchor covey or covey base camp. Wild and pen-raised quail were equipped with radio transmitters and monitored to determine how long they would survive. The pen-raised quail died at a high rate and within weeks all were gone, demonstrating their inability to avoid predators.

ARTIFICIAL FEEDING

Some studies have shown benefits from broadcasting grain over large areas — earlier nesting and more production — *when habitat is suitable*. However, we do not recommend it as a substitute for increasing and improving suitable habitat. Scattering piles of grain here and there may put some food into the crops of a few birds, but it also attracts predators to the concentration of feeding birds. Even when artificial feeding works perfectly, it benefits a miniscule fraction of the total population. At worst, it creates a false sense of accomplishment and merely clouds the real problem — dwindling habitat.



Tall Timbers Research Station

Above: Quail are prolific producers if given the correct habitat conditions.

If the habitat is too poor to support wild quail, stocked birds can't survive there, either.

Glossary

Broad-spectrum herbicides: Those that kill both grasses and broad-leaved plants (everything that is green)

Broadcast: A method of scattering seed or minerals by hand or mechanically over a large area

Clearcut: Timberland that has recently undergone a complete harvest

Cultivars: Plants have been propagated vegetatively (via stem cuttings, for example) and not from seed

Diversity: The variation of life at all levels that sustains ecological systems and human cultures.

Dormant seeding: Planting when temperatures are too low for seed to germinate

Exotic species: Also known as alien or non-native species, these plants and animals occur outside their natural range boundaries, usually through human activity (examples are European starling and Johnson grass).

Fallow: Land on which the soil has been recently worked, perhaps cropped, then left unattended. Major plants species are annual forbs.

Forbs: Nonwoody broad-leaved plants, including most annual and perennial plants commonly called weeds

Group cut: Timberland where a small group of trees is cut, but the cleared area is still surrounded by trees.

Habitat: The environment in which the life needs of an organism, population, or community are supplied

Herbaceous cover: Nonwoody plants, such as grasses and forbs

Invasive species: According to the USDA, these are introduced, non-native plants and animals that cause harm to the economy, environment, or human health.

Legumes: Plants that produce a pea- or bean-type seed and enrich the soil with nitrogen. Examples include lespedeza, clover, beggarweeds, and partridge peas.

Litter: Dead leaves, grass, and forbs covering the soil's surface

Mast: Plant fruit, such as acorns, beechnuts, walnuts, and conifer seeds, especially when used as food by animals

Native cool-season grasses (NCSG): Historically native to Missouri's prairies, savannas, and woodlands, these grasses grow best when temperatures are between 65-80F, mainly in the spring and fall (examples are Virginia wild rye and June grass).

Native warm-season grasses (NWSG): Historically native to American tallgrass prairies, these grasses grow best when temperatures are between 75-90F, mainly in the summer (examples are little bluestem, switchgrass, and eastern gama grass).

Noxious: Describes plants and animals that harm the environment, crops, livestock, or human health (examples are invasive, non-native musk thistle, kudzu, and feral hogs).

PLS: Stands for pure live seed, which is a seed lot's percentage of seed that is pure and viable

Pollinators: Any living thing (such as a bee, butterfly, or hummingbird) that moves pollen from the male part of a flower to the female part of a flower to accomplish fertilization

Vegetative succession: The progressive development of vegetation toward its highest ecological expression, the climax; the replacement of one plant community by another, such as grasslands to woody brush to forest

Lots of Help for Hard Work

For help managing quail and developing other conservation practices on your property, contact the following experts. You can also visit the Missouri Department of Conservation's website at mdc.mo.gov.

MISSOURI DEPARTMENT OF CONSERVATION

The Department's staff is available to help you develop and manage quail habitat on your property. They can provide technical support and supply information about cost-share and training opportunities. To find help, call your regional Department office, which is listed in the sidebar to the right. If you're online, visit the Public Contacts Directory at mdc.mo.gov/node/19935 to find all the Department staff in your county.



Central Region

3500 East Gans Road
Columbia, MO 65201
573-815-7900

Kansas City Region

12405 SE Ranson Road
Lee's Summit, MO 64082
816-622-0900

Northeast Region

3500 S. Baltimore
Kirksville, MO 63501
660-785-2424

Northwest Region

701 James McCarthy Drive
St. Joseph, MO 64507
816-271-3100

Ozark Region

551 Joe Jones Blvd.
West Plains, MO 65775
417-256-7161

Southeast Region

2302 County Park Drive
Cape Girardeau, MO 63701
573-290-5730

Southwest Region

2630 N. Mayfair
Springfield, MO 65803
417-895-6880

St. Louis Region

2360 Highway D
St. Charles, MO 63304
636-441-4554



GROW NATIVE!

A program of the Missouri Prairie Foundation, Grow Native! helps farmers and ranchers find the Missouri native plant seeds, materials, and services they need to re-establish superior quail habitat and fulfill other farm conservation programs. For more information, call 573-356-7828, send a message to grownative@moprairie.com, or visit grownative.org/resources/farm-guide/.

NATURAL RESOURCES CONSERVATION SERVICE

Locally known as NRCS, this U.S. Department of Agriculture (USDA) unit works closely with the Farm Service Agency to administer technical aspects of USDA programs at the local level.

Local NRCS staff can assist in developing detailed conservation plans that will help protect your land from erosion, improve water quality, and create better fish and wildlife habitat. They also make forage and crop management recommendations, help with the design of terraces, waterways and ponds, and suggest plant species that best meet your resource needs. Find your local NRCS office in the United States government section of your phone book, or browse 1.usa.gov/1qg04ZY.

UNIVERSITY OUTREACH AND EXTENSION

University Outreach and Extension, formerly called Missouri Cooperative Extension Service, provides technical assistance for agricultural projects. These county offices serve printed material on a wide number of topics, including agriculture, forestry, horticulture, home economics, wildlife conservation, and wildlife damage to property and crops. Your university outreach and extension office will also do soil testing and help you interpret the results.

Find your county office in the county government section of your phone book, or visit their website at outreach.missouri.edu.



SOIL AND WATER CONSERVATION DISTRICT (SWCD)

A local organization under the Soil and Water District Commission of the Missouri Department of Natural Resources (DNR), each SWCD district is guided by an elected volunteer board of directors made up of local landowners. The districts administer state cost-share conservation programs. Many SWCD offices also participate in cooperative cost-share programs with the Missouri Department of Conservation. Local SWCD offices usually have the same phone number as the county NRCS office.

QUAIL FOREVER

In 2005, Pheasants Forever, a habitat organization, started Quail Forever (QF) to address the continuing loss of quail habitat and the subsequent, unchecked quail population decline. QF chapters promote local, state, and federal conservation programs that help landowners protect habitat for quail and other wildlife. Your QF regional biologist is a member of the NRCS state technical committee.

To find out more about QF and locate chapters in your area, go to quailforever.org or call 1-866-45-QUAIL.



QUAIL AND UPLAND WILDLIFE FEDERATION, INC.

Quail and Upland Wildlife Federation, Inc. (QUWF) began in 2009 after 27 states' conservation leaders began a new organization whose business model better reflected the future needs of conservation for quail and all upland wildlife. Today QUWF chapters are "turnin-the-dirt"™ at the local level, on both public and private lands, with flexible programs addressing multiple species.

Local chapters keep the dollars raised for immediate hands-on habitat work and youth outreach, with no strings from a national administrative or biological review. For details on QUWF, visit QUWF.net or call 417-345-5960.



Recommended References

ONLINE RESOURCES

Covey Headquarters Newsletter. Appearing four times a year, this quarterly publication serves detailed, seasonal quail-management information and training opportunities. Browse and subscribe at mdc.mo.gov/node/9261.

Ecology of Northern Bobwhite Quail in Missouri. This University of Missouri Extension Web page provides an in-depth look at the life history and needs of bobwhite quail in Missouri. Find it at extension.missouri.edu/p/G9431.

Methods for Counting Quail on Your Property. This University Extension Web page serves a detailed, illustrated description of how to monitor bobwhite quail populations on your property. Find it at extension.missouri.edu/p/G9433.

Missouri Bobwhite Quail Habitat Appraisal Guide and related DVD. This University Extension Web page includes photos, illustrations, a detailed worksheet, and tips to help you determine what quail habitat elements are missing from your property. Find the page and DVD link at extension.missouri.edu/p/MP902.

MORE Quail blog. The Missouri Department of Conservation's quail guys share periodic tips and insights that will help you create high-quality habitat in every season. Follow the blog at mdc.mo.gov/node/8728.

The Natural Resources Conservation Service Missouri website serves a list of technical specifications and detailed information on wildlife practices and plant-community management. Browse the list at 1.usa.gov/1nCqY9u.

FREE PUBLICATIONS FROM MISSOURI DEPARTMENT OF CONSERVATION

Quail Friendly Plants of the Midwest. This full-color guide covers the most common quail foods in Missouri. To order, write to MDC, *Quail Friendly Plants of the Midwest*, P.O. Box 180, Jefferson City, MO 65102, or email pubstaff@mdc.mo.gov.

Missouri Habitat Management Calendar. Follow timely habitat management tips, dates, and small game life-cycle information throughout the year. To order, write to MDC, *Missouri Habitat Management Calendar*, P.O. Box 180, Jefferson City, MO 65102, or email pubstaff@mdc.mo.gov.

Seedling ID Guide for Native Prairie Plants. This four-color pictorial guide helps you identify the seedling stage of 40 native prairie plants commonly planted for wildlife. To order, write to MDC, *Seedling ID Guide for Native Prairie Plants*, P.O. Box 180, Jefferson City, MO 65102, or email pubstaff@mdc.mo.gov.

Wildlife Management for Missouri Landowners. This booklet details habitat practices for small game and other wildlife, including technical specification and recommended seeding mixtures and rates. To order, write to MDC, *Wildlife Management for Missouri Landowners*, P.O. Box 180, Jefferson City, MO 65102, or email pubstaff@mdc.mo.gov.



Need More Information?

To request copies of this booklet, call Missouri Department of Conservation at 573-522-4115, ext. 3237, or email pubstaff@mdc.mo.gov.

For a free list of nurseries that carry native seed adapted to Missouri, call Private Land Services at the above phone number.

To purchase Missouri Department of Conservation videos, books, and other gift shop items, visit mdcnatureshop.com, or call the Nature Shop at 877-521-8632 from 8 a.m. to 5 p.m. CST, Monday through Friday except holidays. The Nature Shop number is for purchases only. If you have a question about conservation issues, call a number on Page 89.

Below: The future of Missouri's quail depends on neighbors working with their local natural resource professionals to restore and improve habitat.

mdc.mo.gov



David Stonner