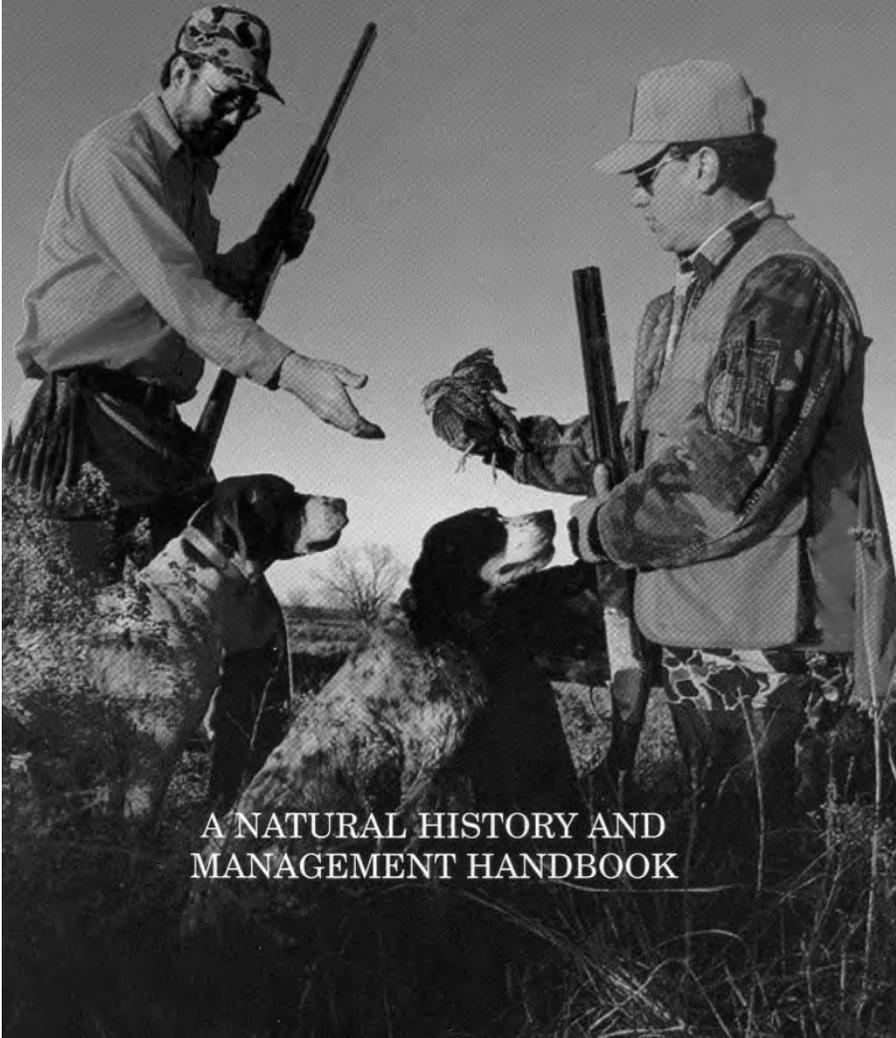


Bobwhite Quail in Oklahoma



A NATURAL HISTORY AND
MANAGEMENT HANDBOOK

Dear Quail Enthusiast,

Quail have been in Oklahoma forever.
The reason? Well, it is simple. HABITAT!

Quail thrive in areas containing large expanses of native warm-season grasses and scattered clumps of low-growing woody cover. Oklahoma is covered by this kind of habitat, making the state a special place for the sportsmen and women who call themselves "bird hunters." The memories of crisp, cool autumn days, friends, favorite guns, good bird dogs, and flushing quail last a lifetime.

Oklahoma bird hunters enjoy some of the best quail hunting in the World! Oklahoma is consistently considered one of the top three quail hunting states in the country. The average Oklahoma quail hunter hunts about seven days per season, harvests about three birds per day for a seasonal harvest of about 24 birds. On average, about 50,000 hunters annually harvest around two million quail across the sooner state. Even in poor years, Oklahoma hunters harvest over one million quail!

Quail hunting is big business in Oklahoma. In 2001, it was estimated that resident and non-resident bird hunters spent more than \$875,000 in Oklahoma. Estimates attribute 700 jobs in the state to bird hunting. The estimate of state income tax revenue generated by bird hunting was more than \$800,000. Without a doubt, fall and winter are profitable times for many Oklahoma communities due to the revenue generated by bird hunters.

Quail and quail hunting will remain part of the Oklahoma landscape if we learn from, and don't repeat, mistakes that have occurred throughout much of the eastern portion of the bobwhite's range. The bobwhite's decline in the east can be attributed to land use changes including changes in agricultural practices, the introduction of non-native plant species, increased human population and urban sprawl.

Oklahoma's many large tracts of native habitat are used by quail. However, the fragmentation of these tracts will harm quail populations. The introduction of non-native plant species such as bermudagrass, tall fescue, Old World bluestem, weeping lovegrass and sericea lespedeza decreases the quality of quail habitat.

We are working with other conservation groups to minimize habitat loss and population declines. But because 95 percent of Oklahoma is privately owned, we cannot do it alone. That is why this book was developed. It is intended as a resource for bird hunters and landowners who want to improve quail habitat on their land. With your help, we can make sure that quail continue to thrive and provide memories of heart-stopping covey rises well into the future.

Good Hunting!

Female quail can only nest once per nesting season.

Oklahoma Quail

Replacing *Myth* with **Facts**

Female quail can only nest once per nesting season.

Quail nest from late May until early October.

Female quail can produce up to three successful nests per nesting season.

Male quail won't incubate nests.

Quail don't mate for life.

Male bobwhites will incubate up to 30 percent of the nests each year.

Male quail won't raise chicks.

If a male bobwhite incubates a nest, it will also care for the chicks.

Chick survival is equal despite the sex of the adult raising it.

Predators are the main cause for low quail numbers.

Habitat conditions and weather are primary factors controlling quail populations.

Wild quail can escape predators if suitable habitat is available.

Coccidiosis is a major threat for wild quail populations.

Coccidiosis is more of a problem for pen-raised birds.

Research in western Oklahoma has shown no quail mortality because of disease.

Pen-reared quail released into the wild survive as well as wild quail.

Pen-reared quail have lower survival rates than wild quail.

Quail that are not raised in the wild do not have the survival instinct that wild birds have.

Pen-reared quail can re-establish wild quail populations.

Pen-reared birds are of little use in managing wild quail populations.

Pen-reared birds are useful in commercial hunting preserves, dog training, etc.

Food availability is a problem for most wild quail populations.

Food very rarely limits wild quail populations.

Insects are an important food source for quail and chicks during the spring and summer.

Food plots or quail feeders are needed to have quail.

Native quail foods are nutritionally superior to food plots or quail feeders.

Native quail foods are adapted to the environment where management is conducted.

Most quail live a year or more.

The average wild quail lifespan is about seven months.

Only 20 percent survive from one October until the next.

Cattle egrets, snakes and wild turkeys aggressively seek quail chicks as food.

Few predators seek only one type of food (i.e., just quail or quail chicks).

These animals are opportunistic feeders and are not significant predators of quail chicks.

Quail live in small areas.

Quail need nesting cover, brood-rearing cover, escape cover, loafing cover and food to live in an area.

Quail will use areas 20 acres and larger depending on the availability of habitat components required.

Quail cannot move large distances.

Research shows quail can move 50 miles or more.

Quail spend little time flying, most travel is by walking or running.

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The northern bobwhite (*Colinus virginianus*) occurs throughout Oklahoma, thriving on the weed (forb) seeds and insects that rapidly invade areas of soil disturbance, but diminishing where climax grasses or mature forests predominate. The greatest numbers of these birds occurred in years past when small farming operations were common. Weeds were prolific, fields were small with brush along the fence rows and draws, and stocking rates for cattle were lower. These factors left needed cover for bobwhite.

Bobwhite have suffered successive setbacks with the advent of clean farming operations, use of agri-chemicals, conversion of native grasses to introduced grasses, increased grazing pressure, intensive fire control, larger fields and pastures, removal of timber and brush over broad areas, and the spraying and mowing of highway and utility rights-of-way. But the bobwhite reproduces rapidly and there are enough to bounce back in high numbers whenever the land manager provides the components needed for survival and puts those components sufficiently close together.

The primary factors controlling bobwhite populations in Oklahoma are weather and habitat - a place where all requirements for survival occur in close proximity. We can exercise little control over weather; so bobwhite management is actually habitat management, or manipulation of vegetation to benefit bobwhite. If you don't have good bobwhite populations, you have not manipulated the vegetation properly or the weather has not been



Weather and habitat are the two most important factors affecting Oklahoma bobwhite populations.

Dean Graham

cooperative. Bobwhite are the judge. If you can't satisfy them there won't be any.

There have been many attempts to improve bobwhite numbers in other ways including predator control, reduced bag limits, reduced season lengths, hunting on alternate days, closed seasons and restocking with pen-raised or wild-trapped birds. Although these may be beneficial in certain circumstances, they usually do not have lasting benefits, and some have been detrimental.

If native bobwhite are not thriving on your land, it means that one or more of their life needs are not present or are located too far apart. When native bobwhite are not thriving, you can be certain that exotics, hybrids and pen-raised birds will not last long either.

With some understanding of bobwhite requirements, you can manage habitat to meet their needs and thus witness their sudden and seemingly mysterious reappearance. The objective of this booklet is to impart such understanding.

Natural History

Taxonomy

Two subspecies of bobwhite occur in Oklahoma. The plains bobwhite (*C. virginianus taylori*) is found throughout most of the state. The eastern bobwhite (*C. virginianus virginianus*) occurs only in the extreme southeastern corner.

Description

The newly hatched bobwhite chick weighs about a fourth of an ounce and is covered by buff-colored down. The down, which is not water-repellent, is gradually replaced by juvenile plumage that becomes visible in two weeks and covers the chick by four weeks. Adult feathers begin to appear on the breast at eight weeks, and by fifteen weeks of age the plumage is nearly identical to that of an adult bird (Fig. 1).

Adult body coloration is typically reddish brown and gray above, whitish below. Breast feathers have narrow, V-shaped barring. Tail feathers are slate-gray. Males have a white forehead, chin and throat, and a wide white line continuing back from the beak, just above and behind the eye; in the females these areas are a buff color. Abnormal body colorations have been reported in the bobwhite as in other wildlife species. The most striking of these are white phase and red phase birds.

The approximate age of a bobwhite may be determined by examining the wing feathers. Since the primary feathers are grown and replaced in a certain time sequence, one can look for the growing feather and determine where the bird is in that sequence (Fig. 2). Birds examined during the hunting season are more than 150 days old if the primary feathers are all the

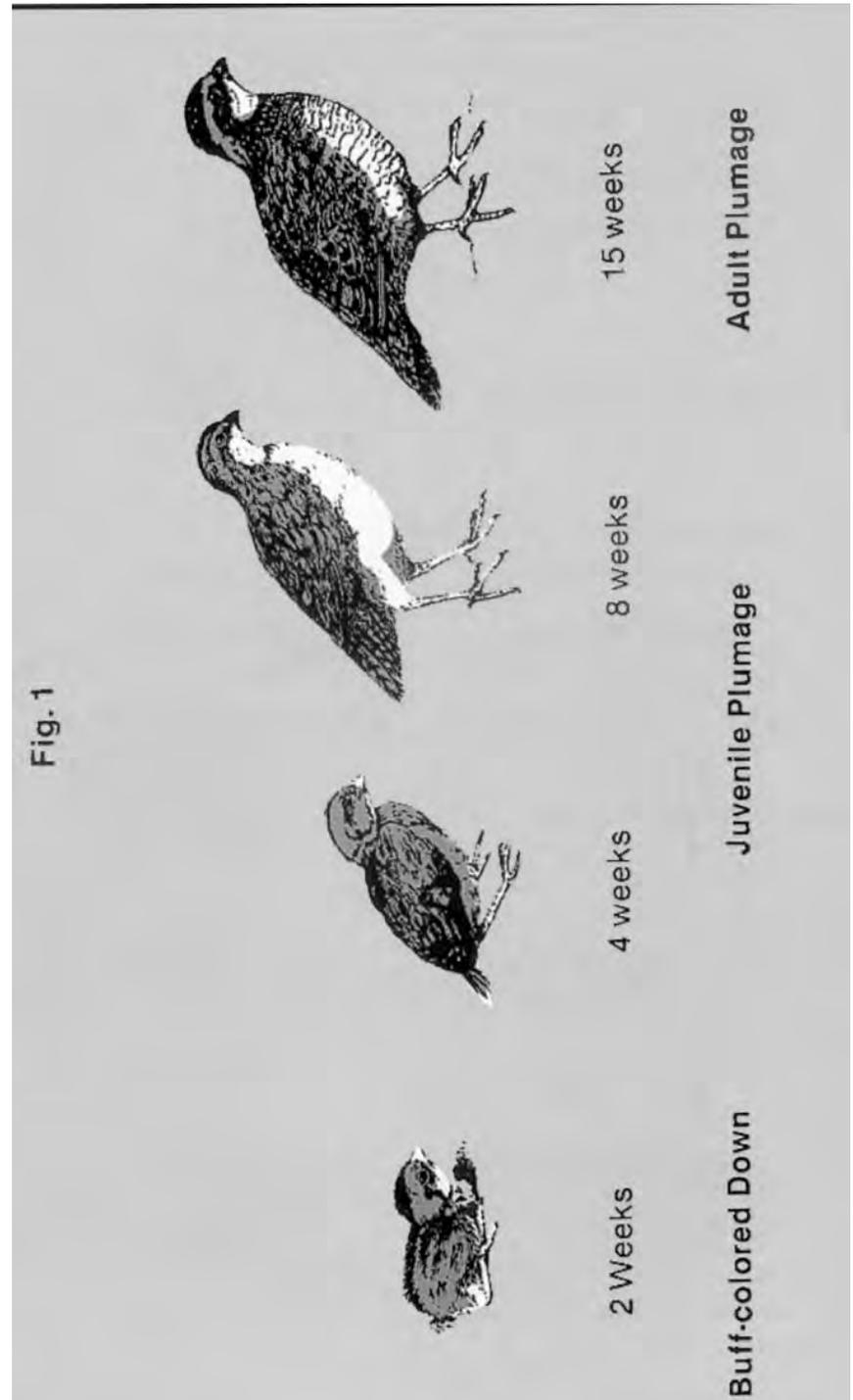
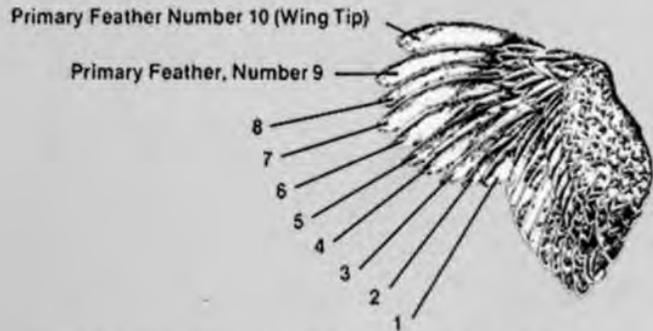
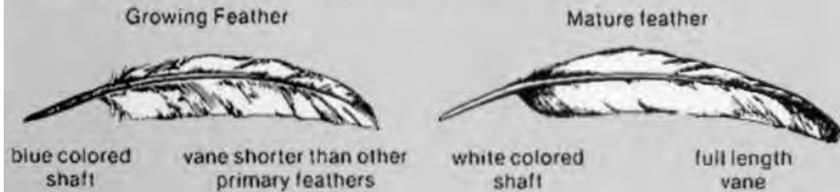


Fig. 2
How Old Is Your Quail?

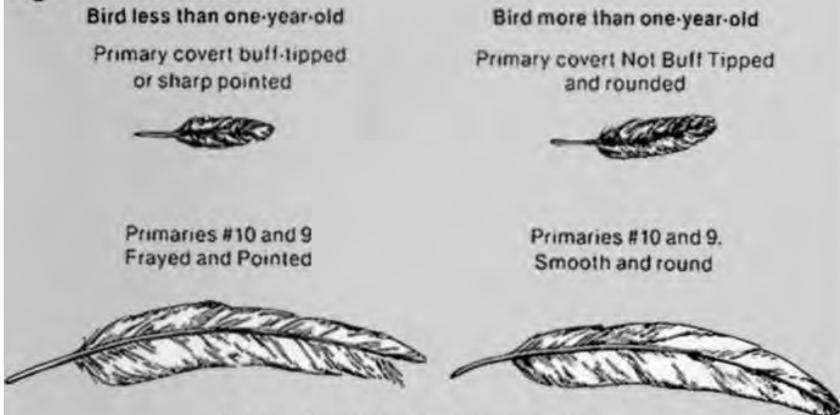
Wing Nomenclature



Primary Feather Growth Characteristics



Age Characteristics



Primary Feather Replacement Sequence
— look for the growing feathers —

Growing primary feather	1	2	3	4	5	6	7	8	9	10
Quail Age— feather growth	4 wks.	5 wks.	6 wks.	7 wks.	8 wks.	9 wks.	10 wks.	14 wks.	Not replaced this season	

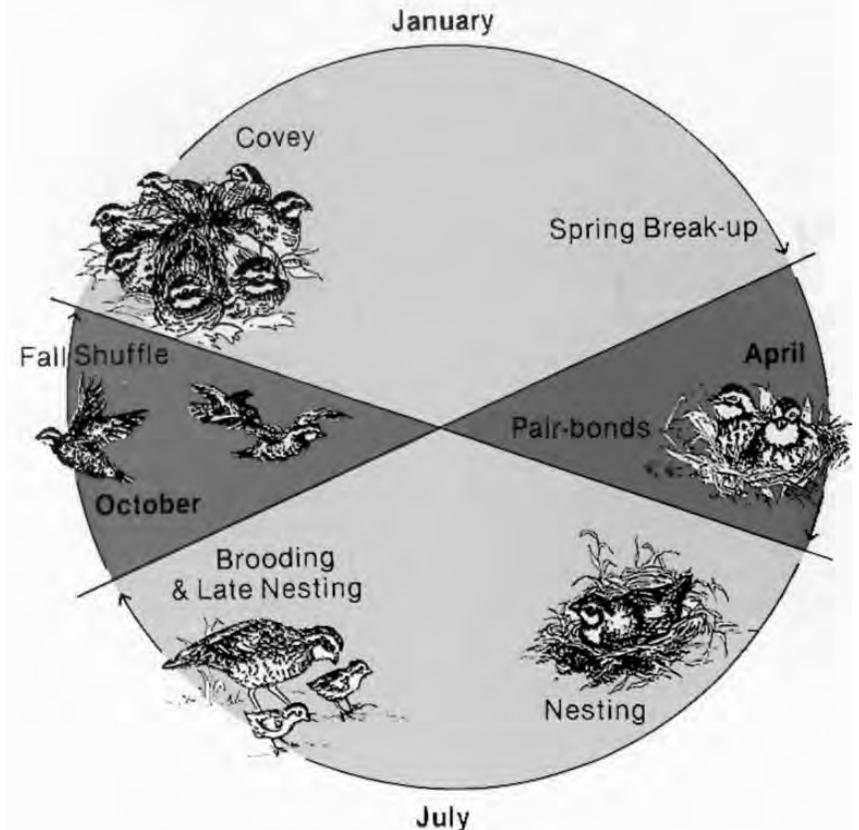
same length. Another way to discriminate adults from young-of-the-year is to check the primary covert feathers. For birds less than one year old, these feathers have sharp-pointed, buff-colored tips. On adult birds the primary covert feathers are rounded and are completely slate gray with no buff-colored tips.

The adult bobwhite is approximately eight inches long and usually weighs six to seven ounces. Occasionally a bird will weigh up to nine ounces.

Nesting and Reproduction

Bobwhite are found in groups called coveys. A covey remains together during most of its daily and nightly activities. The birds scatter

Fig. 3
Annual Cycle of Social and Reproductive Behavior of the Bobwhite





LLOYD B. HILL

when flushed but soon reunite through calling. The size of a covey is generally 12 to 15 birds; the composition in the early fall usually includes one to three adult pairs, their surviving young, and one to several unmated cocks or pairs that failed to produce broods. Bobwhite lost from one covey may join another so that birds of several different ages may be found together. The covey roosts in a tight circle with tails toward the center and heads oriented outward. This formation is primarily for the detection of predators (Fig. 3). Roosting sites typically contain vegetation no taller than six inches, allowing rapid escape from predators.

During March and April, covey bonds weaken and the covey begins to dissolve. This is called *spring break-up*, a period during which mates are chosen and *pair-bonds* are formed in preparation for mating and nesting. These pair-bonds usually exist for one mating and brooding season. Both mated and unmated males use the common two- or three-note whistle to attract a mate, establish a territory, or both. The nesting season, initiated by selection of a mate and territory, begins in late April and lasts through September. However, as birds nest later in the season, the average clutch size and percentage of eggs hatching tend to

decrease, resulting in smaller broods.

Nests are usually constructed on the ground in bowl-shaped depressions, in areas of light to moderately dense vegetation and ground litter. Typically, nests are found in dried clumps of last year's residual growth of warm season grasses. They may be modest or intricate, with the latter occasionally topped by an arched or dome-shaped roof and access limited to a small side opening.

Once the nest is completed to the hen's satisfaction, she may delay egg laying for several days. Then, visiting the nest one or more times each day, she will lay eggs until the clutch is complete. The average clutch size ranges from 12-15 eggs; although clutch sizes as low as six and as high as 28 have been reported. After egg laying is completed, there may be a delay before incubation begins.

The incubation period is 23 days. From 45 to 55 days are usually required to complete the nesting and incubation process. The majority of the hatch is complete by mid-July. The cock may occasionally assist the hen in incubating the eggs and can continue brood hatching and rearing activities even in the absence of the hen. Except for one or two short feeding periods per day, the setting bird stays on the nest. The preferred diet of birds during the reproductive period when protein and energy requirements are high is insects. Bobwhite chicks generally hatch within an hour or two of each other. Those hatching later are left behind.

Bobwhite can renest several times during a season in an attempt to raise a brood if early nests are destroyed by predators or activities related to farming. Farmers harvesting warm-season grasses for hay before July 1 may cause significant nest disturbance. Second broods may occasionally be produced by successful early-nesting hens. Chicks observed late in the nesting season may even be the result of a third nesting attempt.

Bobwhite chicks are able to leave the nest and seek food with the adults as soon as their down dries. Early departure from the nest may serve to reduce the risk of predation from animals attracted by the scent of newly hatched chicks.

Young chicks forage for



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Bobwhite nest on the ground in areas of moderately dense vegetation. Once the down has dried on young chicks they begin to forage for small insects alongside adults.

small high-protein insects in an area that is relatively open at ground level for freedom of movement, and contains lush, green growth with overhead concealment called brood rearing habitat or the *bugging* area. It is important that cover for refuge from predators is close by and that the area is free of tangled vegetation at ground level. This feeding area used by the brood may cover from two to 100 acres.

The most critical period for chicks is the first two weeks. Their initial covering of natal down provides little protection from wetting, but by about two weeks of age down begins being replaced by juvenile plumage. However, only short flights are possible at this time. Predation plus adverse weather during this period may account for a loss of 50 percent or more of the hatch.

Parents protect chicks during the night as well as a considerable portion of the day by covering or brooding them. Sometimes parents lure predators away from their young using a broken wing display.

Six-week-old chicks primarily have juvenile plumage, are capable of extended flights and weigh about 2 1/2 ounces. At this age, the diet of the chick often includes berries and seeds in addition to insects. Adult size and appearance are reached by four months of age, but these subadult birds can still be distinguished from adults by their growing primary wing feathers and buff-colored tips on their primary covert feathers.

Much movement and mixing of bobwhite, called the fall shuffle, occurs in early fall when coveys are forming on their winter ranges. They select an area where food is abundant and suitable cover is near. The mixing of birds during the fall shuffle and spring break-up limits inbreeding. Movement of several miles to a winter range has been observed, but in quality habitat, movement of less than one-fourth mile is common.

Bobwhite in northwestern Oklahoma use highlands in summer, but shift their ranges to brushy canyons in winter. Interchange between coveys continues to occur all winter. Coveys may lose or gain a new member every two or three days.



Dean Graham

Mortality

In the animal world (including humans) there are at least two different ways to achieve species survival. One is to produce a few offspring and take very good care of them to insure that most survive. The other is to produce excessive numbers of offspring to compensate for high losses. Aspiring wildlife managers and all others must understand which applies to the bobwhite because the harvest rationale hinges on this point.

Bobwhite produce many young to sustain the population, typically losing most of them to the environment. This means that disease, predation, hunting and starvation will kill most of the young birds before they are one year old. One way or another, a large percentage of the bobwhite in a given population die before the year is out.

Bobwhite, like corn and apples, are an annual crop. When weather and habitat conditions interact to produce a bumper crop, the sportsman had best take full advantage of the bounty. Attempts to increase next year's crop of quail by trying to preserve this year's crop at high levels is usually futile.

Predation

Although predation on adult and young bobwhite can be a serious factor in some situations, normally it has little overall impact. Predators that take bobwhite also take quail competitors such as rodents, and nest predators such as snakes, which may benefit quail populations. This is part of nature's cycle.

Extremely heavy predation can limit bobwhite nesting success in local situations. Modern clean farming practices may increase predator pressure on quail by concentrating birds into small remnants of cover. High densities of small mammals could, by attracting large numbers of predators, increase the chances of nests being discovered and destroyed by predators. House cats, stray dogs, opossums, skunks, raccoons and snakes are usually the most serious nest predators. Normally, bobwhite populations are not controlled by predators and re-nesting counteracts nest predation.

Assessing the overall effect predators have on bobwhite populations is complicated because in addition to removing quail, they also remove small mammals that compete with bobwhite for nesting sites and food, thus ultimately benefiting the bobwhite. Predatory animals falling into this category include such diverse animals as red-tailed and Swainson's hawks, coyotes, bobcats, foxes, and snakes. Sharp-shinned and Coopers hawks, however, prey mainly on small birds and are skilled quail predators.

Predator control is usually of little value in increasing bobwhite populations and is particularly difficult and short term because surrounding areas and natural reproduction soon replenish the predators removed. Removal of one species of predator may only enhance the opportunity for another species. Predator control to increase bobwhite populations is usually not feasible, desirable, or effective.

Parasites and Diseases

Bobwhite are susceptible to a variety of diseases and external and internal parasites. A few specific problems will be mentioned and further information should be obtained from more extensive publications.

Many of the viral, bacterial, and fungal diseases affecting domestic poultry also affect bobwhite. These include chronic respiratory disease, Newcastle disease, fowl pox, fowl cholera, pullorum, crop mycosis and others. Bobwhite diseases of public health significance include equine encephalitis, erysipelas, and avian tuberculosis, but transmission of disease from bobwhite to humans is extremely rare. Coccidia are protozoan parasites often found in bobwhite but are usually a problem associated with pen-reared quail and rarely affect free-ranging birds. Forty species of helminths (roundworms, tapeworms and flukes) have been recorded from the bobwhite. Bobwhite in western

Oklahoma are sometimes found with a condition that appears similar to rice breast, which occurs in waterfowl. In bobwhite this is the result of whitish encapsulated parasites that resemble rice grains appearing just beneath the surface of breast skin. While the cysts may present an unwholesome appearance, they do not constitute a public health problem; thorough cooking renders infected birds safe for consumption.

External quail parasites include mites, ticks, lice, louse flies, and fleas. Most of the bobwhite's external parasites are not found on domestic poultry, but those that are found on both chickens and bobwhite include the large chicken body louse, two species of fleas, chiggers, and the rabbit tick. Dusting areas are necessary for the bobwhite to control external parasites and to regulate excess oil on feathers.

Studies of Oklahoma bobwhite found the presence of the organism that causes blackhead in turkeys and numerous domestic birds. This may influence the success of the wild turkey restoration program in some areas since blackhead is harmful to turkey populations and may limit their density. It was also found that 30 percent of the quail sampled had a protozoan, *Chilomastix*, that can cause extremely high mortality in bobwhite chicks.

When quail feeders are used, birds are unnaturally concentrated in the feeder area. It has been hypothesized but not proven that this can, by contaminating the area around the feeders, facilitate the spread of parasites and disease between birds as they feed in their own feces. The obvious solution to this problem is not to concentrate birds with feeders but to work toward improving the habitat.

Weather

Weather plays an important role in bobwhite reproduction and survival. Reproductive success is usually greater during years with normal or above normal amounts of rainfall and temperatures no higher than normal during the spring and summer months. Reproduction is usually below normal in hot, dry years. This kind of weather results in high ground temperatures and decreased availability of lush, green vegetation for dietary water. This can lead to decreased egg production and may cause addled eggs, dead embryos or hatchlings as well as reduced availability of insect food items for chicks. Excessive rains may cause increased nest desertion.

Heavy rains can also cause direct mortality in young bobwhite. Chicks are most vulnerable to rain and cold at one to four days of age because they have only natal down for protection. Down does not repel moisture, dew or rain. Mortality may be from exposure or drowning or as a result of an infection in a bird weakened by dampness and chills.

Winter precipitation and temperatures can have severe effects on adult bobwhite survival. Heavy snowfalls or ice storms can cover

quail foods for extended periods and make feeding difficult or impossible. Birds weakened by starvation may die of disease or predation.

Severe cold and snow may cause high breeder losses, lower productivity the following year and reduced hunting success. Lower productivity can be the result of fewer nests and fewer chicks per breeding pair.

Some years insufficient rainfall in western Oklahoma reduces food and cover availability and probably is responsible for fluctuating bobwhite populations in that region. In the eastern part of the state, rainfall is normally adequate and populations are more stable.



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During their first four days of life, young chicks are vulnerable to cold, wet conditions.

Habitat Requirements

Bobwhite populations fluctuate with habitat quality and weather conditions. Habitat quality is a function of the amount and types of food and cover available; weather affects reproduction and survival of birds and also influences habitat. Because little can be done about the weather, habitat management is the best approach to sustain or increase bobwhite populations.

The bobwhite has three basic requirements for life: cover, food and water. These requirements must be present in the proper amount and arrangement for quail to thrive. Successful management lies in understanding that each one of these factors means life or death to bobwhite. An overabundance of one need does little toward compensating for a scarcity of another. The need that is in shortest supply limits quail populations and is called the limiting factor. The primary objective in managing for bobwhite is to identify the limiting factor(s) and take corrective action.

Interspersion

Bobwhite are relatively sedentary. Although seasonal shifts in covey ranges may be large, daily movements are usually restricted to a relatively small area depending on the quality of habitat. Therefore, the best bobwhite habitat has adequate food and cover in closest possible association with connecting travel lanes. This close mixing of habitat



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An understanding of the habitat requirements of bobwhite allows landowners to manipulate the primary elements of food, cover and water to enhance quail populations on their land.

requirements is called interspersion. It does little good to have a food source in the middle of a large field and cover along the fence row. Food and ample cover must occur together to benefit bobwhite.

Diversity

Diversity of food and cover types is also important. Bobwhite require a variety of cover types to meet their daily and seasonal needs as well as a variety of foods for their nutritional needs. Bobwhite will eat almost any seed of suitable size. Managing for a variety of plant species, rather than emphasizing a single species, increases the probability of the proper food being available. This is because different plants produce seeds at different times during the growing season and different types of seeds provide different nutrients. Some seeds deteriorate faster than others and weather can cause complete seed crop failures in some species.

Edge

Bobwhite are picky about their surroundings, or to look at it another way, if their surroundings aren't right they won't be there. Bobwhite prosper around *edges*. An edge is a conceptual transition zone from one vegetative type to another. If you clear a field in the woods and plant it, you will find a band of forbs, grasses, and brush around the field that is different from both the field and the woods.

Bobwhite using this edge zone can go into the field and find insects and forb sprouts, and dust for feather oil regulation and parasites. If threatened, they can dash back into escape cover along the edge for security. They can move into the woods to forage for acorns and other mast, scratch for insects and seeds, and return to escape cover when threatened. The edge zone provides a secure highway to travel all around the field for food as well as nesting cover in areas where native grasses are allowed to reach maturity.

The habitat zone associated with the edge is composed of the greatest variety of vegetation in an area. For this reason it is a smorgasbord of tasty delights for the bird. Bobwhite require variety in their food supply, sometimes switching from an abundant food source to a less abundant one. Short-term weather conditions usually have little effect on the variety of edge plants available.

Benefits of the edge zone are destroyed by plowing right up to fences, spraying herbicides on weeds and brush around fences, overgrazing by livestock on both sides of fences, mowing highway shoulders, removing fence rows to make bigger agricultural fields or pastures, taking out windrows and shelter-belts, and clearing draws. People's passion for expansion and neatness is reducing bobwhite populations. The habitat zone associated with an edge only two feet wide is not suitable for quail; 20 to 30 feet is more appropriate.

Cover

Cover is a general term used to describe all types of protective vegetation used by animals. Cover is required for protection from weather (heat, cold, rain, etc.) and predators. Within limits, the amount of cover needed depends on its quality. An area of high quality cover only 50 feet square may satisfy a covey all winter, while several acres may be needed when cover is of poor quality. The best time to evaluate cover is late winter because winter cover is critical to bobwhite survival and is usually the most durable and best available.



The key to prime bobwhite habitat is a variety of cover types including nesting, roosting, loafing, screening and escape cover. This sand plum thicket provides excellent loafing habitat.

The best cover provides a thick overhead canopy but is open within a foot or so of the ground. Bobwhite generally prefer to range where about one-half of the ground is exposed and the other half has an upright growth of herbaceous and woody plants. Remember, quail look at their world from about four inches above the ground.

Bobwhite require a variety of cover to meet their daily and seasonal needs. Types of cover needed include nesting, roosting, loafing, screening and escape.

Nesting cover is essential for successful reproduction.

Perennial bunch grass is the preferred nesting cover, although other types of vegetation are used. One- or two-year-old residual clumps of grass are preferred over younger or older stands. Young stands of grass may have too little overhead cover, while older stands may have too much litter on the ground. Quail seldom use areas where the soil is covered by thick plant litter or where the vegetation is too dense for easy walking. In Oklahoma the grasses most commonly used for nesting are tall warm season grasses such as sideoats grama, native bluestems, switchgrass and Indian grass. The choice nesting spots are clumps of grass with at least a 12-inch diameter and eight or more inches tall. When evaluating a pasture, walk back and forth across the land observ-

ing the distance between likely nesting clumps. If they occur only every 15 to 20 steps, nesting cover is satisfactory.

Roosting cover

preferred by quail is usually vegetation with low, sparse, open canopies that provides some warmth at ground level while reducing the chance of collisions with obstacles should flight during the night become necessary.

A loafing or headquarters area is an important component of the required cover. This cover type is used for resting, dusting, and loafing between morning and

evening feeding periods. Loafing cover should be thick several feet above the ground but relatively bare for several inches above ground level. Low shrubs and vines in clumps providing a continuous overhead canopy afford security needed by the bobwhite. Sand plum thickets, shinnery oak, and sumac mottes make excellent loafing cover. Clumps should be at least 30 to 50 feet across. Outside the canopy, herbs need to be short enough to allow quail to see and escape with ease if necessary.

Selection of cover by bobwhite varies with the season. During fall and early winter cover is selected primarily for concealment and almost any clump of vegetation is acceptable. During the coldest part of winter, cover offering protection from wind is selected. As the nesting season approaches bobwhite seek cover that is tall with a dense canopy. Temperatures in areas of deep shade may be 30 to 50 degrees cooler than areas receiving direct sunlight. During peak heat periods, quail seek the cooling benefits of summer breezes by perching somewhat above ground level.

Essential to the loafing area is a dusting site where bobwhite clean their feathers of excess oil. This prevents matting and in turn reduces external parasites such as mites and lice that feed on oil. They accomplish this by rolling and kicking up dust into their feathers then shaking it out. Bobwhite make a dust bowl by scratching and pecking at bare soil to form a fine powder.



Screening cover is necessary to provide safety from predators while traveling or feeding. Although not as easily recognized as loafing or escape cover, it is extremely important. Inadequate screening cover may result in a covey being pinned to a safe area for most of a day by a hawk. A covey may even be forced by predators or weather to abandon the area entirely. Screening cover may be low shrubs or herbaceous material. Herbaceous screening cover may not substitute very well for woody cover because it tends to deteriorate through the winter. Bobwhite need a travel lane of screening cover going across open areas to allow safe access to food sources.

Maintaining highway ditches in tall grass and weeds will greatly increase the amount of edge zone available to bobwhite. In many areas of Oklahoma this roadside vegetation provides the only travel lanes and nesting cover available.

Escape cover is necessary for eluding predators. A thick stand of grass, coarse weeds, or dense brush serves well for escape.

Food

Bobwhite eat a variety of wild and cultivated seeds, fruits, leaves, stems and insects. Seeds (especially those of native annual plants) constitute the majority of fall and winter foods; green plant parts are used all seasons. March is normally the low point in food availabili-



ty. At that time no new seed crop has been produced and the previous crop is in short supply. Insects constitute the bulk of the diet and are the important protein, energy, mineral and water source for young chicks and are readily eaten by adults.

Some important native quail food plants in Oklahoma include ragweeds, sunflowers, wild beans, oaks, panic grasses, spurge, bull grasses, crotons, beggar's ticks, chittamwood, partridge peas, milk peas, smart-weeds, dayflowers, black locust and Illinois bundleflower.

Cultivated plants important to bobwhite in Oklahoma include Kobe and Korean lespedezas, soybeans, grain sorghum, wheat, millet, rye and corn.

Quail foods within 8 inches of the ground are most readily used. Bare soil or only a thin litter layer is best because bobwhite are weak scratchers. Plant seeds that fall into a dense mat of leaf litter or mulch are inaccessible.

Bobwhite usually eat larger quantities and greater varieties of legume seeds than seeds of any other plant family. Seeds of forbs (non-grass herbaceous plants) such as ragweed, croton and sunflower are important; and among the grasses, quail prefer annuals over perennials. Fruits and seeds from woody plants such as acorns and chittam are also readily eaten.

Seeds of cultivated species are not always reliable for late winter foods because many of them deteriorate faster than native species. Because late winter is a very critical period, a variety of native foods will usually improve bobwhite survival more than cultivated species.

Some plant species such as buttonweed, grape, greenbriar, hackberry, perennial lespedezas, sericea, poison ivy, rose and sumac are important because they may enhance survival through short periods of extreme winter weather, but they have little nutritional value.

Water

Water requirements of the bobwhite vary according to locality and weather. In years of adequate rainfall, bobwhite can usually meet their water requirements from moisture derived from dew, insects, succulent vegetation, seeds and metabolic water (produced during digestion). Sources of surface water (ponds, streams, etc.) are usually not required but may be used if available.

Plant Succession

Plant communities (groups of different plant species in a certain location) are usually not static. The types and abundance of plants present on any particular area change in response to weather and disturbances such as livestock grazing, cultivation and fire. The resulting series of changing plant communities in one location is called *plant succession*. Eventually a near stable *climax* is usually reached, however, in

many situations plant succession is constantly changing. Early plant succession results in a different plant community every year or two while a climax can usually renew itself indefinitely.

The first two stages of plant succession are most beneficial for bobwhite. The native annual forbs and grasses occurring on an area the first year after soil disturbance are called pioneer plants. Many of these are important quail foods. Depending on soil type, rainfall and land use, the second and third years after soil disturbance usually start to show a decline in annual forbs and an increase in perennial forbs and grasses. In the following years, tall grasses or woody plants usually begin to dominate. After several years, important plants that produced quail food have been crowded out and bobwhite populations will decline unless action is taken. With climax grasses, the little food that is available is often buried in the thick ground litter.

For bobwhite food production you should control the plant successional stage to maintain annual plants for high seed production and variety. This is a basic part of most bobwhite management programs. Various ways to set back succession to favor bobwhite are discussed later under Techniques in Management.

Bobwhite do not occur on an area accidentally. They are found in certain localities because the right combinations of habitat requirements are present. Bobwhite are a product of disturbance in plant communities and they thrive in areas supporting early successional plants.

Habitat Management

Planning

The planning sequence for habitat management is the same whether for bobwhite, deer or waterfowl. It is as follows:

1. determine what vegetation you have and how it is distributed;
2. determine what you need, and how it must be distributed;
3. do it.

To get started, make a map. Mapping will tell you what the vegetative components are, how much there is of each, and the position of each component relative to the other.

The easiest way to obtain an accurate outline map is by tracing an aerial photograph, available at local U.S.D.A. Soil Conservation Service Offices, or by using a topographic map. The prominent land features and vegetative types should be sketched in. Check your drawing for accuracy by comparing it in the field to the area you are working with. By tracing onto graph paper you can easily enlarge the map if needed.

You can also produce your own map from scratch. Look over your land and pick out the prominent features that may be used as ref-

reference points in mapping. These can be ridges, draws, creeks, roads or powerlines. Choose a map scale that will allow you to show the habitat components present. If you have much variety, use a standard 8-1/2 x 11 sheet per half section. If you have little variety, one sheet per section may be adequate. Using a compass, prepare your map in segments between the reference features. Put the reference features on it first so you won't run off the page, stepping off the distances for these purposes. Graph paper, with one square equal to a specified number of steps, will be helpful. After putting in the outline of your area, then put in the boundaries of each vegetative type. Next, identify and describe each type. Make up your own symbols.

When finished, your recorded observations should be detailed enough to make management decisions. For example, rather than just recording grass, make observations of the following nature: G = grass; T = tame; N = native; 0 = none; 1 = dispersed; 2 = moderate; 3 = dense. Then expand your coverage: F = forbs; C = cover; F = forest; M = mast.

You can go far with these categories alone. With some experience you can categorize cover-screening, escape, loafing, roosting or nesting.

You are now ready to evaluate your land. Draw several imaginary lines across the land spaced such that they pass through each vegetative type, and start walking along the lines. After taking 50 steps, look down and evaluate. How thick is the grass, what kind is it, are there forbs? Make a summary evaluation. It might be as follows: GT3FOC2. Continue your evaluation at 50-step intervals.



PAUL MOORE

Once the basic principles of bobwhite management are understood, a written plan helps the landowner organize and implement changes.

You have grass-tame-dense; forbs-none; cover-moderate. You have rated the pasture unsuitable for bobwhite food production, and you should draw in the boundaries of that area of unsuitability. You can now make your management decision. That

may be to improve it for bobwhite food production, leave it for roost cover or concentrate your efforts on another part of your property that offers more for quail as is and would be less costly to improve.

This little mapping exercise is important for two reasons. It helps you understand how the needed habitat components are situated relative to each other. For instance, is the cover near a food source and is the cover extensive enough? The mapping exercise makes you look right down at the ground and evaluate the quality of the habitat. It is not sufficient to evaluate bobwhite habitat in broad sweeping glances from a distance. You need to know thickness of vegetation, depth of ground litter,



PAUL MOORE

There is no substitute for first-hand evaluation of your land. Rather than evaluating bobwhite habitat in broad sweeping glances from a distance, details about the thickness of vegetation, depth of ground litter and quality and quantity of seed production need to be determined by close observation

and quality and quantity of seed production to evaluate food potential. So after you identify what you have, you evaluate it for bobwhite. To get the best return for your investment, start your habitat manipulation in the places where the limiting factors are easiest to overcome. Plan your improvements on your map. It is essential that food, cover and travel lanes be located in a usable configuration.

If you put in a food patch, place it next to some natural edge and ample woody cover (30-50 feet in width). Know what woody cover is and do not try to establish a food patch in the middle of a vast tame pasture. Develop the food patch along the edge of a woodlot where there is a variety of native vegetation, much of which is in the early successional stages, and where screening cover provides travel lanes.

Plan to provide all the covey's requirements within 20- to 30-acre plots.

It is generally better to have less intensive management for bobwhite over large areas than to have intensive management on very small areas. For example, either rotational or continuous grazing at the proper stocking rate or a prescribed burning program will benefit more coveys than planting several food plots. More birds can be produced for the same amount of money using less intensive management on a broad scale.

Food plots should not be considered an alternative to good, broad-scale management, but rather a means of providing the third of the three limiting factors. The most efficient food enhancement management practices are those designed to increase seed production by native quail food plants. Domestic grains are usually less nutritional and less drought resistant than native forbs, and they usually fail in those critically dry years when bobwhite foods are most needed.

Plantings of domestic woody species for quail cover may be advisable in some areas where native cover is sparse or lacking. Examples of such areas might be parts of central and western Oklahoma. It should be stressed, however, that problems with plantings for cover are similar to problems with plantings for food. They are expensive and may be hard or impossible to establish and maintain in some locations. Some people have had success using commercial weed barriers to eliminate competition from other plants and condense moisture for use by woody plantings. However, it is best to manipulate or protect native cover if at all possible. Fire is very detrimental to sand plum, a very important plant to the bobwhite and difficult to re-establish. Help in planting shelterbelts may be obtained from the Soil Conservation Service county offices or state forestry department if you decide to try it.

Management with Grazing

Maximum numbers of bobwhite and maximum numbers of livestock are incompatible. However, there may be only a fine line between an overgrazed pasture and good bobwhite habitat. Heavy grazing slows down plant succession which can be good for bobwhite management, but it may also eliminate important quail food plants and cover. On the other hand, no grazing in the absence of other disturbance factors allows dense grass and accumulated plant litter to crowd out quail food plants and make travel and foraging difficult for quail, but provides escape cover.

A responsible grazing program using proper stocking rates can be used as a tool to benefit bobwhite. By avoiding extensive overgrazing you can maintain a pasture's future cattle production potential and have bobwhite as a valuable by-product.

Several techniques can be used to establish and maintain proper conditions on pastures for bobwhite. Controlled burning is a useful tool for keeping herbaceous and woody cover in proper condition and for increasing bobwhite food, particularly legumes.

In conjunction with grazing, late winter to early spring (February and March) burning is recommended every second or third year in the tall grass prairie. The area being managed should be subdivided so that only a portion of the total area is burned each year to ensure that adequate escape and nesting cover is available on the unburned area. Disking is a good method for dividing the area, providing fireguards, protecting valuable woody cover such as sand plum thickets, and producing bobwhite food at the same time.

Woody cover may be limiting on some pastures. Brush should constitute 5 to 10 percent of the covey's home range. Remember that cover for quail means cover down to within six to 12 inches of the ground, not cover that starts six feet up. Cover spots 50-60 feet across can be created by fencing off areas to exclude livestock. These cover spots should be protected from frequent fire. Some plantings for cover and food may be desirable. Covey headquarters areas (woody cover) approximately 30 by 60 feet in size and no more numerous than one per five acres of land is recommended.

If pastures are mowed for weed control, strips next to woody cover should be left unmowed or mowed only on a rotation basis. Spraying pastures for weed control can also be detrimental to bobwhite both directly and indirectly. Besides eliminating a valuable food source, herbicides can cause direct harm to quail.

A mile-long strip of land 16 feet wide contains only two acres. Little grazing revenue would be lost if such a strip were left, but this would be a big gain for bobwhite habitat if placed in the right spot.

Strip disking near woody cover enhances plant diversity and the bobwhite populations that depend upon it. Adjacent strips should

be disked on alternating years to increase the variety of herbaceous growth. Remember to try to meet all quail habitat requirements on 20- to 30-acre tracts.

Management with Agriculture

A mixture of small agricultural fields, fallow fields, fence rows, and clumps of brush all situated within a 20- to 30-acre tract is ideal for bobwhite. They can nest and feed in one- to three-year-old fallow fields, travel the fence rows from one area to the next, take their broods into the row crop area where the needed insects are abundant, dust and rest in the brush, and spend the night in the fallow field. This idyllic situation deteriorates as fields become bigger, as brush and fence rows are removed or minimized, and diversity of agriculture or other ground cover is reduced.

By letting fence rows grow to about six feet tall, herbaceous plants and shrubs such as plum and sumac, useful as cover for bobwhite, can be created. This type of cover will have little effect on adjacent crops. A study in east-central Illinois showed a multiflora rose hedge caused a reduction in corn yield of only 25 percent in the first row immediately next to the hedge. No significant adverse effects were observed anywhere else in the field.

A wildlife border or edge zone 35 feet wide between wooded areas and cropland can greatly benefit bobwhite. About 20 feet of this should be native shrubs with six to eight feet of herbaceous plants on either side.

Leaving unmowed strips around pastures and meadows and leaving a strip of unharvested grain near cover are good bobwhite management practices.

Management with Forestry

Forestry operations that remove most of the trees generally benefit bobwhite. Clear cutting and breaking up the soil surface will enhance seed producing annual plants for several years. The woody vegetation that sprouts on these areas usually provides needed cover. After several years, the area tends to convert to perennial grasses and trees not suited for bobwhite. This trend can be retarded by burning and intense grazing for short periods—two to three months. Eventually the seedling pines usually planted on these areas grow to the point where the ground is partially shaded. Thereafter, bobwhite production declines to near zero until the site is logged again or is adequately thinned to allow herbaceous vegetative growth.

Closed canopy forests have insufficient sunlight at ground level to support the herbaceous and shrubby vegetation that provide food and cover for quail. Thinning, or creating openings in solid stands of timber, will enhance bobwhite habitat. When thinning, enough trees



STEVE WAGNER

Management for bobwhite can be compatible with many agricultural practices including moderate levels of grazing.

should be removed so that direct sunlight strikes at least 60 percent of the forest floor in large patches at one time. If openings are created, they should be from one-half to one acre in size with a maximum spacing of one-fourth mile. As a rule of thumb, openings should be at least twice as wide as the surrounding trees are tall.

In commercial hardwood stands, thinning trees or making openings would probably be more desirable than burning because fire should be excluded. Long, winding strips or odd shapes are more beneficial for quail than square or rectangular blocks because they create more edge. Adjacent openings should be maintained in alternating years to enhance diversity. Disking, mowing, and/or burning are suitable methods for controlling succession. Brush coverts or clumps should be encouraged around the edges of openings. Some tree removal may be necessary to encourage shrubs. Brush piles, half-cut trees or branches bent to the ground provide immediate protection and encourage future shrubby growth. Pairs or triplets of tepee-type brush piles 10-15 feet wide should be provided at 75 yard intervals within each covey's home range.



Techniques in Management

Disking

Fallow plowing or disking is usually a good method to set back succession and produce native bobwhite food plants. Disking should be done next to cover in strips from 10-20 feet wide and not less than 100 feet long. Adjacent strips should be disked on a two to three year rotation during January, February or March. A few strips can be prepared in succession until early summer for greater diversity (Fig. 4).

Burning

Prescribed burning is sometimes useful for removing an accumulated rough (several years' growth of dead grass and tree litter) and retarding succession to benefit bobwhite. Prescribed burning is a complex tool and should be used carefully. Varying results can be achieved under different environmental influences such as temperature, wind, humidity, soil and fuel moisture, season and type of fire. Late winter or early spring burns in a checkerboard or strip pattern every two to three years using backfires or strip-head fires are recommended for bobwhite. In the drier portion of extreme western Oklahoma, longer intervals between fires should be used (Fig. 5).

Wind speed should be constant in direction at about five to 18 mph. This gives a wind speed of two to 10 mph in forest stands. Little or no wind may be needed in open areas. Relative humidity should be about 30-50 percent. Air temperatures of 20-50 degrees F. are recommended for late winter or early spring burns. Adequate soil moisture levels are generally achieved when one-half to one inch of rain falls one to three days before a prescribed burn. The amount of moisture in the material to be burned should be in the range of seven to 20 percent.

Backfiring or burning into the wind is probably the safest method of burning. To speed the process, a line of fire can be set in front of a backfire and allowed to burn into it. This method is called a strip-head fire (Fig. 6).

In preparing for a burn, plow adequate fire breaks 8-10 times as wide as the tallest vegetation on the perimeter and choose, as nearly as possible, the ideal burning conditions. Fireguards should be in place to protect valuable loafing coverts. Sand plum is very sensitive to fire and should be guarded against burning. Consult your local weather service for up-to-date information. Local wildlife or forestry personnel can also be helpful in planning a burn. Take safety precautions just in case the fire gets out-of-bounds. Have fire fighting equipment handy and be sure to contact your local fire department ahead of time.



This half-cut tree demonstrates how this technique can provide needed cover for bobwhite.

a 15-20 foot herbaceous border. Taller trees should be planted in the middle with the shrubs on the outside. Trees and shrubs can be planted from December through March. Individual trees should be planted six to 10 feet apart, shrubs a little closer. It may be necessary initially to cultivate your plantings once or twice a year or use a commercial weed barrier to eliminate competition. Fertilizer should be applied at recommended rates. Fencing is usually required. A drip irrigation system may be necessary in western Oklahoma.

Planting for Food

Food plots are attractive to the hunter as well as the nonhunter because various kinds of game can often be seen around them. However, the management value of bobwhite food plots is debatable.

Planting for Cover

If cover is found to be a limiting factor, it can be provided in a variety of ways. Fencing small areas allows native shrubs and vines to grow and may be the most viable method to develop cover. If no potential exists for improving or developing native cover plants, plantings can be made in odd areas, near woodlots, or along fence rows. Cover plantings can be made in strips or in clumps (Fig. 7).

It is less time consuming to plow fireguards around strips of cover than a large number of clumps. However, the configuration of the planting will depend upon your local situation.

The selection of species to plant will depend upon your local soil and moisture conditions as well as availability of stock. Select native species if possible. Species often planted include sand plum, skunkbush sumac, Osage orange, black locust, red cedar, blackberry, dogwood, autumn olive and multiflora rose. Autumn olive and multiflora rose grow better in the eastern half of Oklahoma.

Cover strips should have two to five rows of woody plants with

able. Food plots are not practical in areas with less than 25 inches of annual rainfall. Food plots can be effective at improving inferior habitat by carrying birds through weather emergencies where native food is unavailable. Food plots can also help increase the harvest by concentrating birds and making them easier to locate. However, most food plots do not provide food during late winter and early spring when shortages are more likely to occur.

When considering food plots, first decide if they are desirable. Alternative techniques and/or native species may be more productive, have a higher nutritive value and be less expensive. Native forbs such as ragweed, sunflowers and crotons are usually not highly palatable to livestock and therefore would not require the expense of fencing.

Generally, a one acre food plot per 15-30 acres could be considered intensive management. Plots should be long and narrow and/or odd shaped to maximize the amount of edge, should be near cover and should be fenced to exclude livestock (Figs. 8 and 9). Application of a complete fertilizer will enhance seed production. However, if only native

Figure 4

Disking Native Habitat

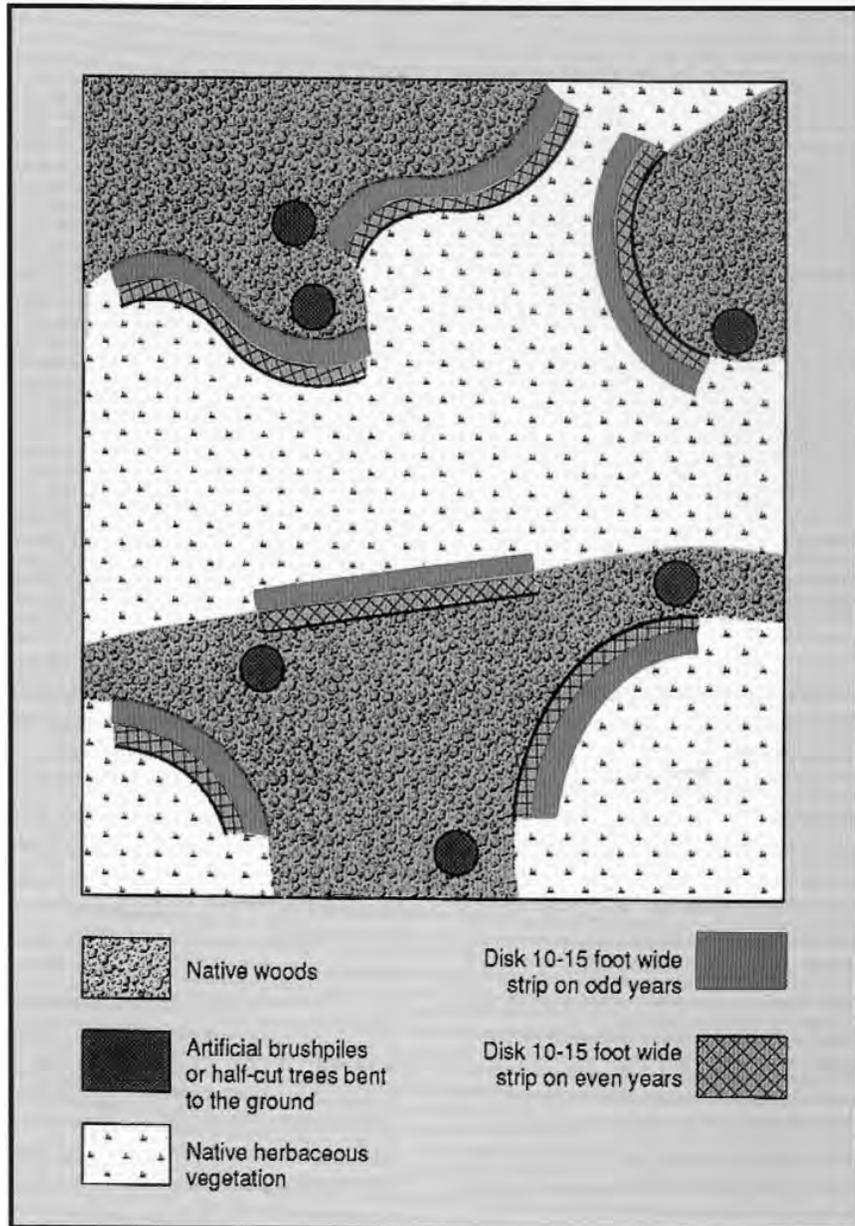


Figure 5

Prescribed Burning of Native Habitat

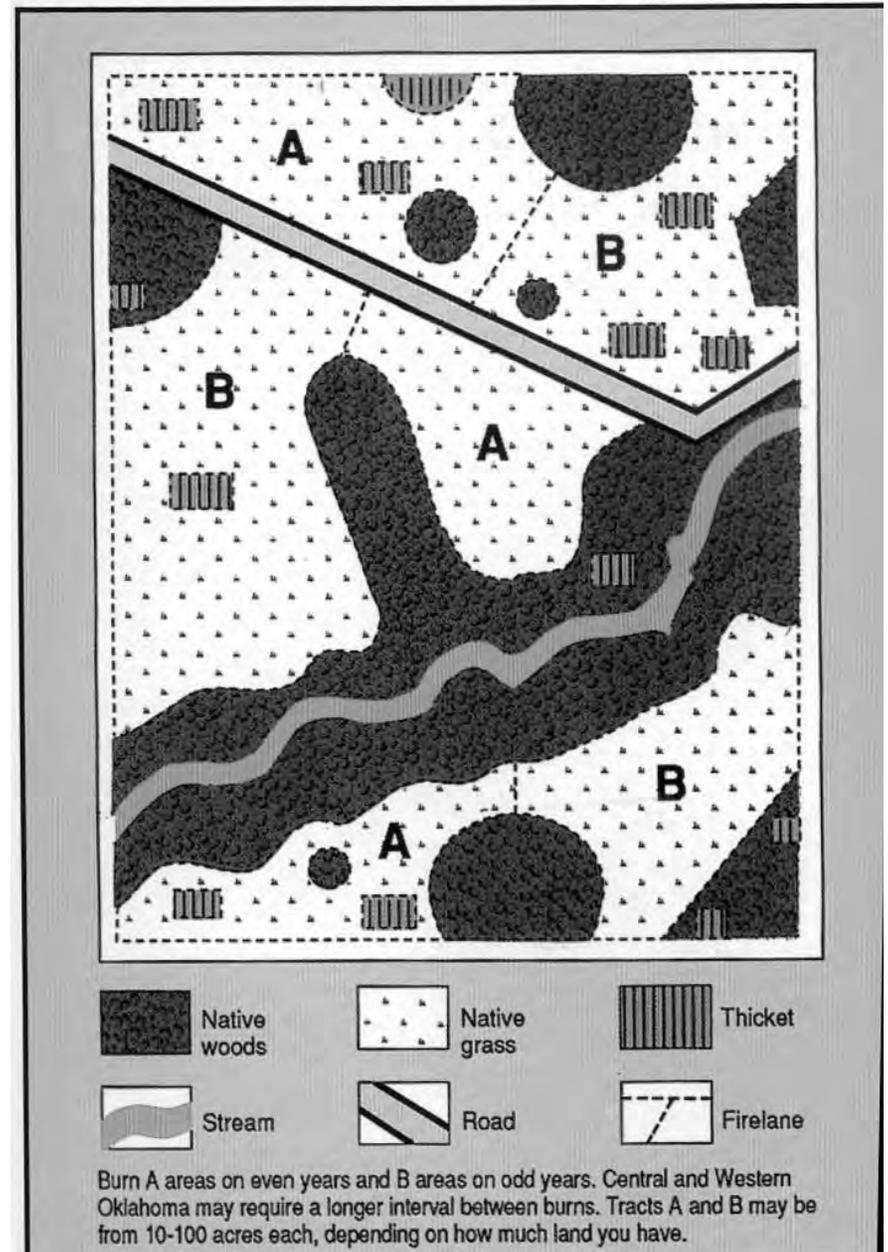
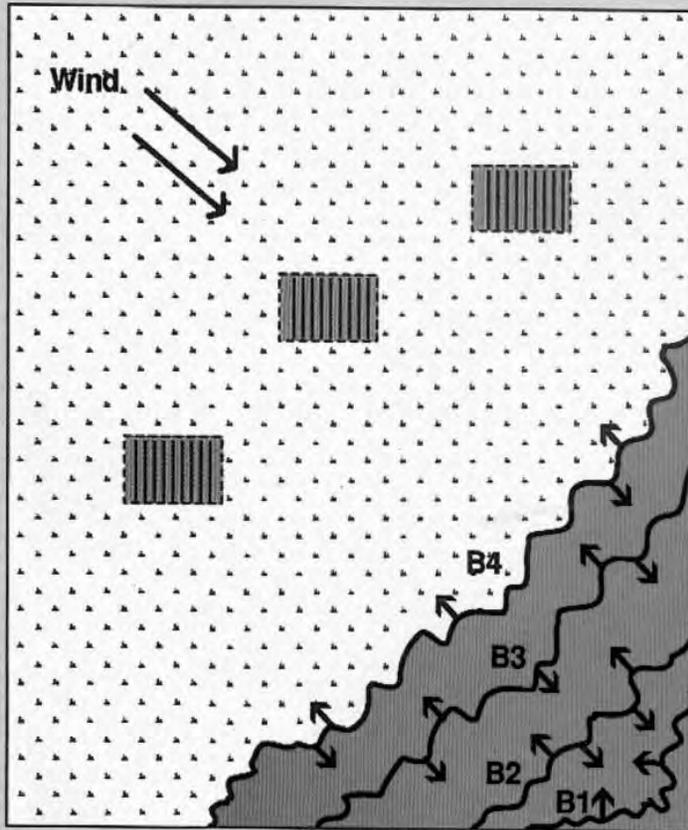


Figure 6

Controlled Burning Technique



- Steps:
1. Plow firelanes.
 2. Check weather conditions.
 3. Set backfire (B1) next to firelane and allow it to advance into the wind for 20-30 yards.
 4. Set line of fire (B2) 40-50 yards in front of backfire.
 5. When 2 lines of fire meet, set another line of fire (B3) 50 yards upwind.
 6. Continue until whole area is burned.

species are to be encouraged, phosphorus will increase forbs while nitrogen will encourage grasses, which may not be desirable for bobwhite management.

If adequate numbers of plots are available, rotating maintenance on a two to three year interval of whole or portions of plots may enhance their effectiveness. This rotation system not only saves work, but during the resting period plots not replanted will produce native food species that normally follow cultivation and fertilization. Thus, a rotation food plot system will make available at all times both native and cultivated foods and increase an area's diversity.

Food plots should contain native plants as well as domestic crops. Many cultivated crops deteriorate rapidly or are eaten by other birds and mammals. Few seeds are left in late winter when food shortages normally occur. Seeds from native plants usually have higher resistance to deterioration.

Food plot seed should not be broadcast onto untilled soil because this provides a crop of stems and leaves instead of the desired seed crop. Drilling the seed into a prepared seedbed is likely to result in



Controlled burning, when used with care, is a useful tool for removing several year's growth of dead grass and tree litter.

higher seed yields and allow invasion by native plants that are valuable seed producers for quail. This invasion adds diversity to a food plot and enhances its usefulness for bobwhite.

When selecting a crop to plant, consider its adaptability to local conditions and the amount of competition for that crop from other animals. For instance, blackbirds can clean out a field of grain sorghum in a few days. Plant species that seed in late fall or early winter and resist deterioration are preferable. Combinations of crops are superior to single crops.

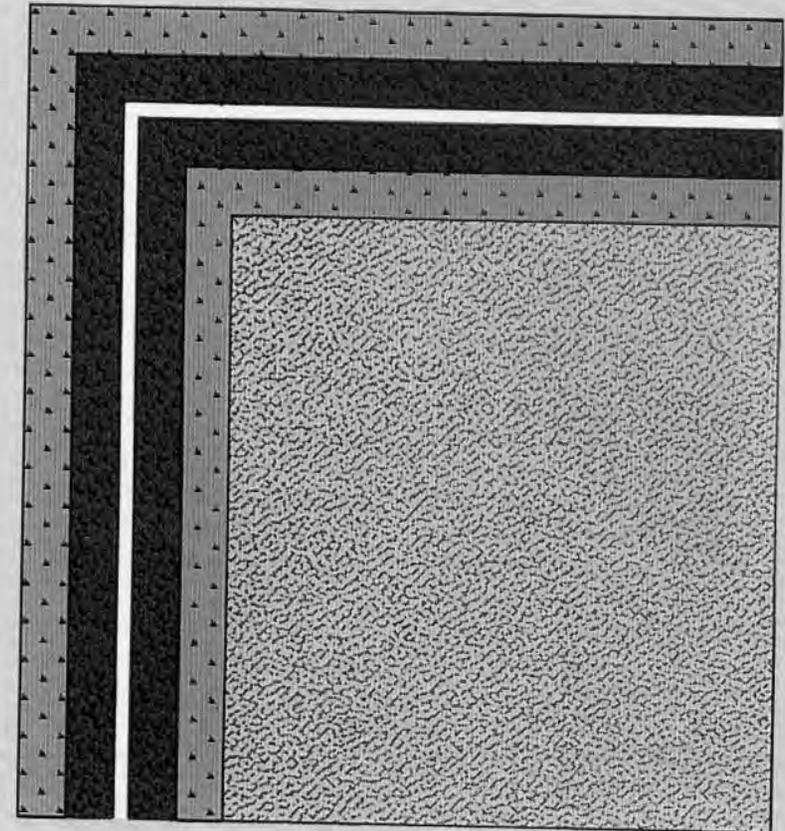
Agricultural crops that can be planted for bobwhite include corn, grain sorghum, wheat, millet, soybeans, cowpeas and mung beans. Lespedezas and clovers can be planted to attract insects. Corn



Trees and shrubs selected to provide bobwhite cover are best planted between December and March. A commercial weed barrier to eliminate competition plus the use of fertilizer helps young plants get a good start.

Figure 7

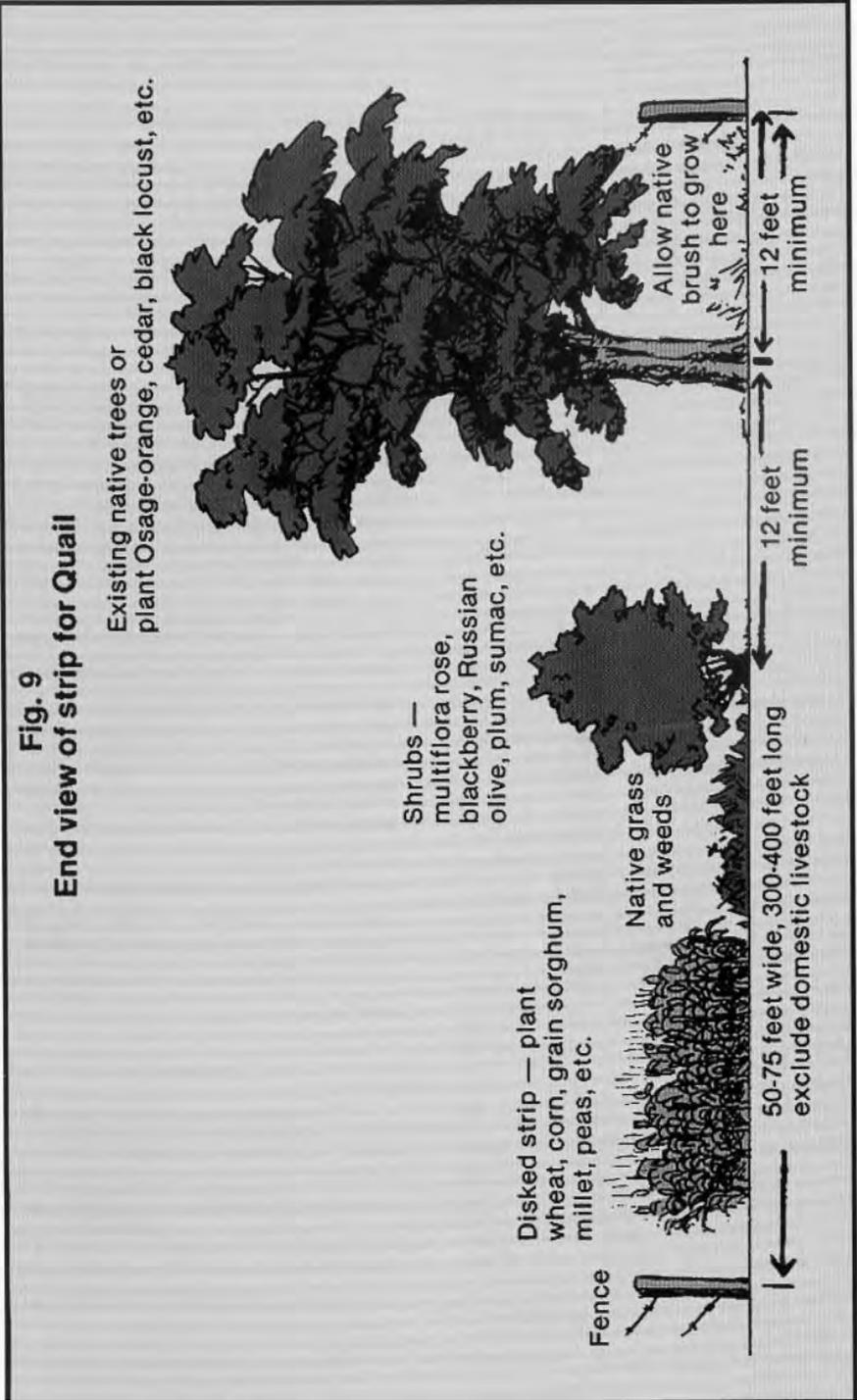
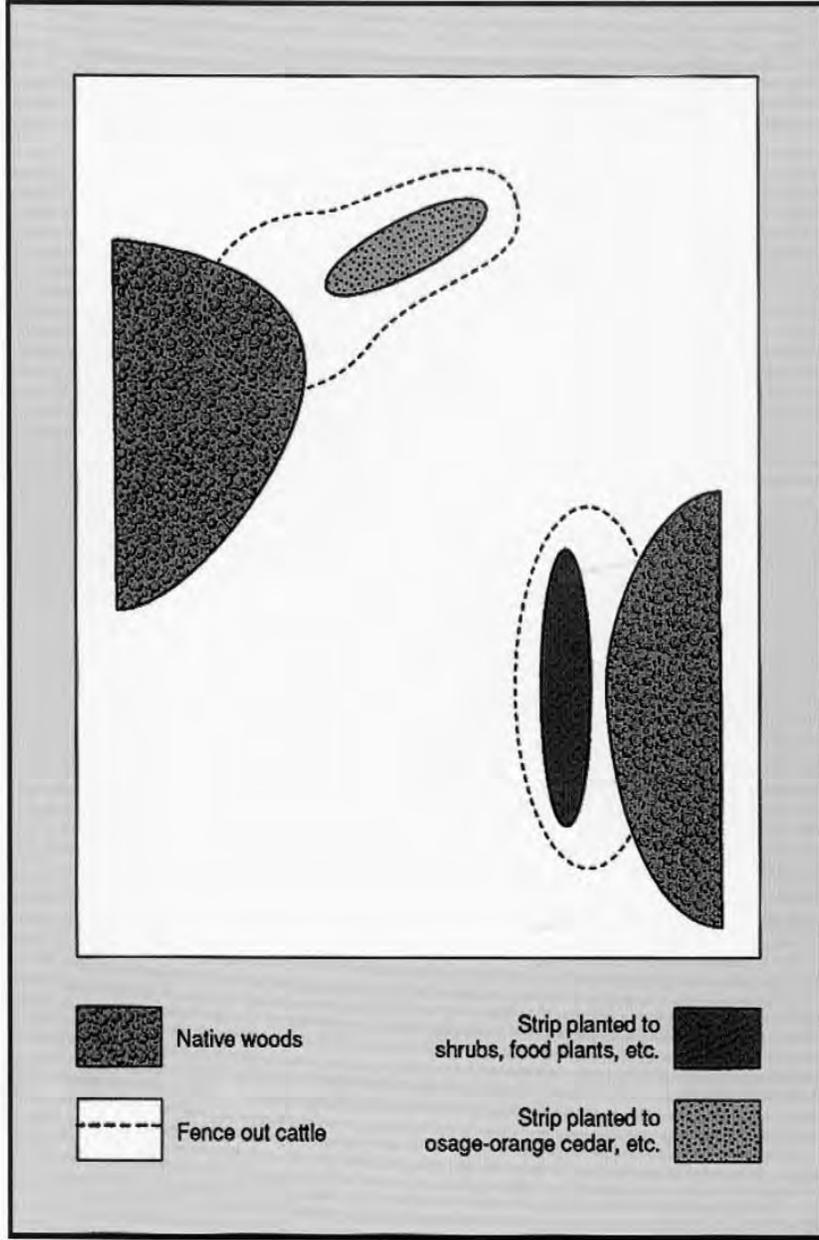
Planting With Crops



-  Cultivated crops
-  Native herbaceous plants
-  Shrubs

Figure 8

Planting Profiles—Food and Cover



on the cob will last until late winter when food may be in short supply. Corn also provides insects and overhead cover for young quail during summer. Millet matures in early summer and provides young birds with an early abundant seed supply. Soybeans and cowpeas shatter slowly and are available over a long period of time.

Your local Soil Conservation Service office can supply you with specific information on the adaptability of plants to your particular soil type.

Summary

The bobwhite is an important native Oklahoma game bird. It abounds in areas supporting abundant forb growth next to adequate cover. Bobwhite populations are determined primarily by habitat quantity and quality with weather playing a secondary role.

Many methods have been tried to increase bobwhite numbers. Among them are predator control, reducing bag limits and season lengths, bans on hunting and stocking pen-raised birds. None of these methods resulted in much success. The critical factor is still habitat. The basic requirements of food and cover are the essentials to good bobwhite populations.

Encroaching civilization in the form of cities and housing developments, coupled with "improvements" in farming and ranching technology, spells doom for high quail populations. Quail are a product of the land. They require proper food in close association to cover, and proper cover to combat severe weather and elude predators.

By making some minor concessions to your present land use policies, you can continue to enjoy this sporty game bird. Who knows, many of these concessions may be of much greater benefit to your farming or ranching operations than just increasing bobwhite populations.

Acknowledgement

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