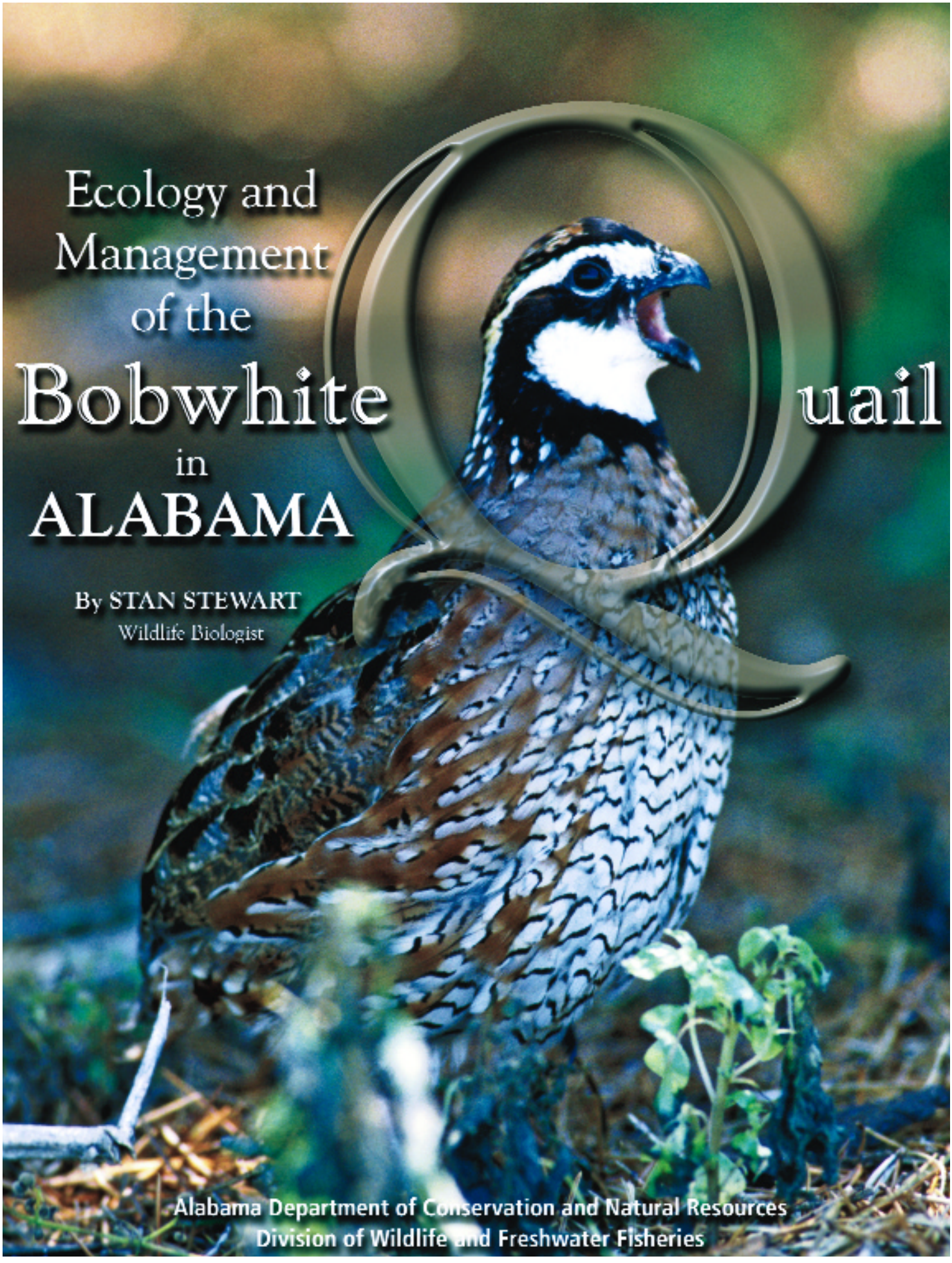
Ecology and Management of the Bobwhite Quail in ALABAMA



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Division of Wildlife and Freshwater Fisheries

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Foreword

Wildlife conservationist Aldo Leopold said "a thicket without the potential roar of a quail covey is only a thorny place."[26] He viewed a land without quail as somehow incomplete and missing a valuable element of life. Only a quail hunter could make such a lament. Many of us long to again experience the rise of a favorite covey in front of a white statue of sinew and steel. But, the old haunts have changed, replaced by the disputable marks of "progress." In days past quail just happened. We didn't give much thought to why they were there. We just expected them to be there, like the sun coming up. Those days are gone.

Associated with quiet countrysides, patch farms, idle fields and open woodlands, the bobwhite earned the reputation of the gentleman's game bird. Today's southern landscape is vastly different from the one that fostered our quail hunting tradition. Perhaps only the dedicated old-time quail hunters know how drastically quail hunting has changed. Because the younger generation does not really understand the stark changes in quail abundance, it does not have the passionate sense of loss that fosters a desire for restoration. It is a painful irony that this bird, once so benefited by man's actions, is now so displaced by man's actions.

The bobwhite's future is bright in one sense. We no longer have to depend on quail just happening. We can make them happen. In recent years managers and researchers have re-visited sound bobwhite biology and have made new discoveries about bobwhite behavior, ecology and management. Individuals who are applying this knowledge are currently experiencing unprecedented bobwhite management successes and population highs. The message is clear. Quail do not have to be just a part of the past. They respond to management. Supply the birds a favorable environment and they usually increase rapidly.

It is not foreseeable that bobwhites will again be inadvertently abundant. For populations to increase, all who are concerned about the bobwhite, including wildlife agencies, wildlife managers, landowners, advocacy organizations and hunters must learn to think differently about the occurrence of bobwhites in contemporary landscapes. We must become more precisely knowledgeable of their requirements. We must look for innovative ways to include quail habitat in land uses. We must be proactive and cooperative, concentrating on proven methods, both old and new.

At the Fourth National Quail Symposium, long time bobwhite researcher John L. Roseberry, speaking from the heart of quail plantation country where the bobwhite is still supreme, said "We have sufficient knowledge and skill to produce locally abundant quail populations. To be a viable game species, however, [quail] must be reasonably abundant over relatively large portions of the landscape."[35] Identifying opportunities to incorporate reasonable amounts of quail habitat across landscapes and into major land uses is today's challenge.

The Northern Bobwhite Conservation Initiative (NBCI), prepared by the Southeast Quail Study Group at the request of the Directors of the Southeastern Association of Fish and Wildlife Agencies, was released in 2002. NBCI is essentially a rangewide bobwhite recovery plan that quantifies the habitat additions needed in agricultural, pasture and forest landscapes to restore bobwhite populations to 1980 levels, when they were still reasonably abundant over much of the landscape. In Alabama at that time, bobwhite populations were declining at a rate of only 2 percent annually. From the mid 1980s to mid 1990s the quail loss accelerated to a 9 percent per year average annual rate of decline. The landscape conditions that prevailed in 1980 were clearly more suitable to bobwhites than current landscapes.

As a direct result of the Northern Bobwhite Conservation Initiative, the United States Department of Agriculture in 2004 announced, by no less a spokesman than the President himself, a far-reaching Northern Bobwhite Quail Habitat Initiative within the Conservation Reserve Program. The implications for quail restoration are enormous because CRP is such a popular and well-funded program of national scope. The initiative is designed so that any landowner with active cropland who wants more quail back on the farm now has the financial resources available through CRP to install productive quail habitat along the borders of farm fields. Participants who meet basic CRP eligibility rules and who apply for CRP conservation practice CP33, Habitat Buffers for Upland Birds, are automatically approved for enrollment. Enrollment provides financial assistance to install the practice and annual rental payments for at least ten years to maintain the practice. It also includes a very attractive up-front bonus payment for electing to enroll farm land in this practice with high conservation value. The future for quail is indeed bright if conservation initiatives such as this are implemented on the landscape.

Stan Stewart

Acknowledgments

This book is a product of the author's ideas, experience and review of the published works of others. I am grateful to the individuals who read the manuscript and offered suggestions for improvement.

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Lastly, I want to thank my uncle Paul Johnson for taking me into the quail fields from an early age, for giving me Dan, my first bird dog, and for according me equal status as a hunter among men dedicated to all things quail.

Stan Stewart

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Chapter 1

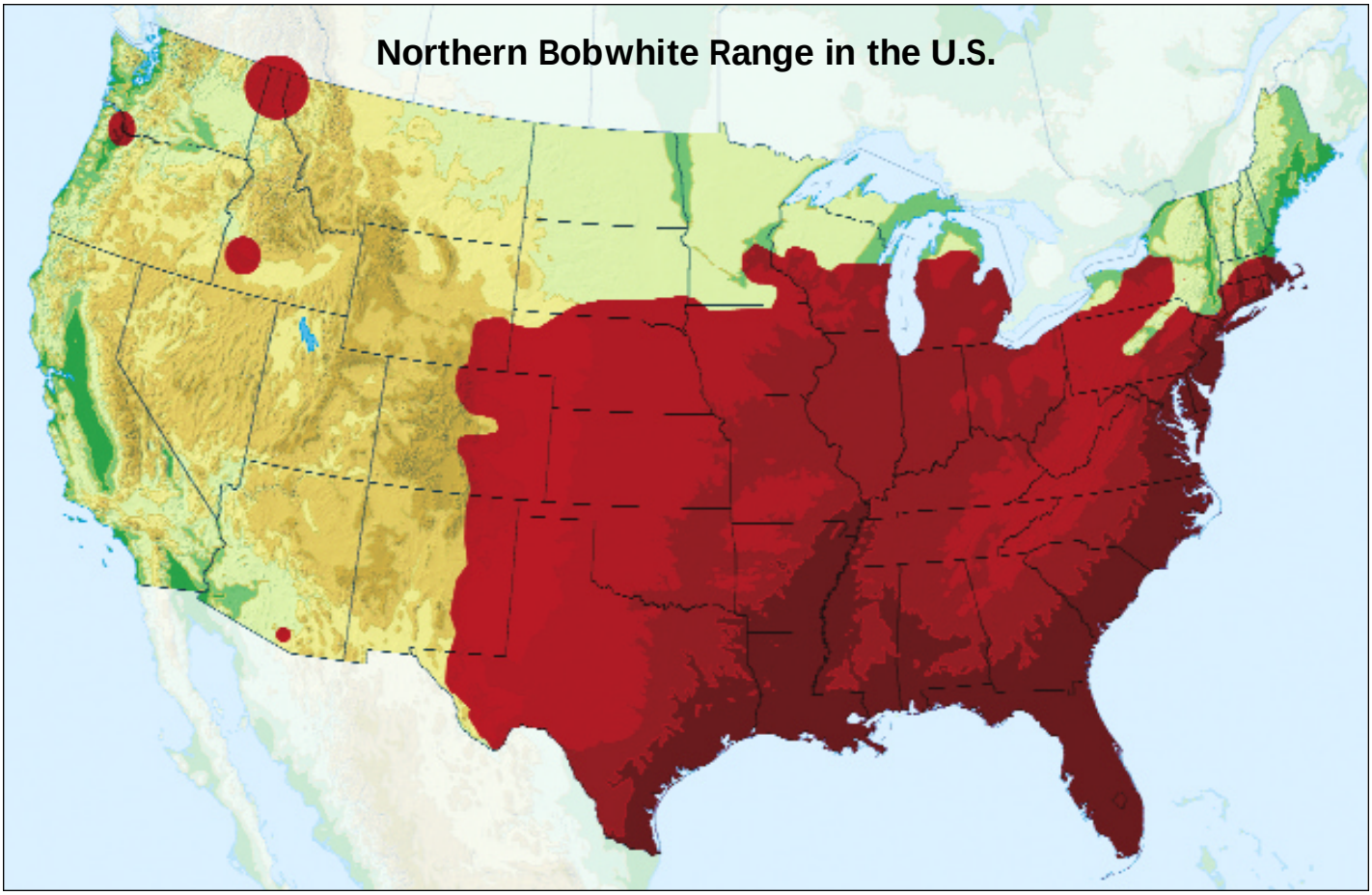
TAXONOMY, DESCRIPTION AND DISTRIBUTION

Colinus virginianus, the northern bobwhite, belongs to the order *Galliformes*, which is from the Latin gallinaceus meaning "of poultry." They are in the same order of birds as domestic fowl, which also includes turkeys, pheasants, grouse, partridges and other quail. It is part of the family *Odontophoridae*, the New World quails, which have a serrated lower mandible. The next time you are lucky enough to hold a bobwhite in hand, you can observe this characteristic. The genus name Colinus derives from an Aztec word meaning "quail." There are four species of *Colinus* (bobwhites) in North, Central, and South America. Only the northern bobwhite, *Colinus virginianus*, occurs in the United States.

The bobwhite's common name derives from the sound of the male's breeding call, a two- or three-note whistle that sounds like "bob-white" or "ah-bob-white;" the first syllables are low monotones followed by the final resounding, rising note.

Male bobwhites have a white feathered throat patch and eye stripe bordered with black. In females, these areas are a deep buff color. The crown of the head, neck, upper breast, upper back and wing coverts are russet, many feathers barred on the edge with black or gray. The nape and upper breast are streaked with white.

Male bobwhites have a white feathered throat patch and eye stripe bordered with black. In females, these areas are a deep buff color.
JIM RATHERT/MISSOURI DEPT. OF CONSERVATION



The tail is gray. The abdomen is white or buffy white with black barring and tawny striping on the flanks. The beak is black and legs are tannish gray. Adult bobwhites are about eight inches in length. Average weights vary from a little less than six ounces for birds from warm southern climates to slightly more than seven ounces for birds from the cold northern portions of its range.[37] Alabama bobwhites average about six ounces.[41]

The northern bobwhite has an extensive range, from southeastern New York to southern Ontario, west to south central South Dakota, eastern Wyoming, eastern Colorado, eastern New Mexico, and south through the Gulf States and most of Mexico and Central America. They were introduced to the Pacific Northwest, and scattered populations still exist in valleys along tributaries of the Snake and Columbia rivers in Idaho, Oregon, Washington, Montana, and British Columbia. Also, the masked bobwhite (*Colinus virginianus ridgwayi*), an endangered subspecies, has been reintroduced to southern Arizona. Introduced populations of bobwhites also occur in Cuba, Haiti, the Dominican Republic, and New Zealand.

A female bobwhite.
JIM RATHERT/MISSOURI DEPT. OF CONSERVATION

Chapter 2

HISTORY AND STATUS

There is serious concern about the status of bobwhite quail populations and the decline in quail hunting opportunities across the Southeast, including Alabama. Bobwhite numbers are declining over much of the bird's U.S. range. Traditional quail hunting is almost gone in the Southeast, where quail hunting has a storied history and bobwhites were a customary part of the landscape. What happened? And, what can we do?

No records or accounts exist that conclusively tell us of the status of the bobwhite quail in the South and East at the time of European settlement. We know that potential quail habitat was available as a result of the shifting agriculture and the widely applied burning practices of aboriginals that maintained open land and open forest. Eastern Indians cleared a great amount of landscape for farming, and even after abandonment these areas remained open from broadcast burning. Early Europeans described these open lands as "barrens," and they were by all accounts prevalent. There was little in a heavily wooded forest to attract Indians. Wherever possible they replaced them with a mosaic of open lands and open woodlands. The forest that existed was often lightly stocked and free of underbrush.[31] Even the name Alabama is a Choctaw Indian word meaning "thicket clearers."[50]

On his travels through Georgia and Alabama in the 1780s, botanist William Bartram described the central portions of these states as "diversified with hills and dales, savannas and vast cane meadows…sublime forests contrasted by expansive illumined green fields, native meadows and cane brakes…open airy groves of the superb terebinthine pines…pellucid brooks meandering through an expansive green savanna…a delightful varied landscape, consisting of extensive grassy fields and detached groves of high forest trees." South of the Tallapoosa and Alabama rivers were "expansive, illumined grassy plains…invested by high forests…which project into the plains on each side, dividing them into many vast fields…the surface of the plains clad with tall grass, intermixed with a variety of herbage. In south Alabama he encountered "one vast flat grassy savanna, intersected…with narrow forests and groves on the banks of creeks…with long leaved pines, scatteringly planted amongst the grass."[4]

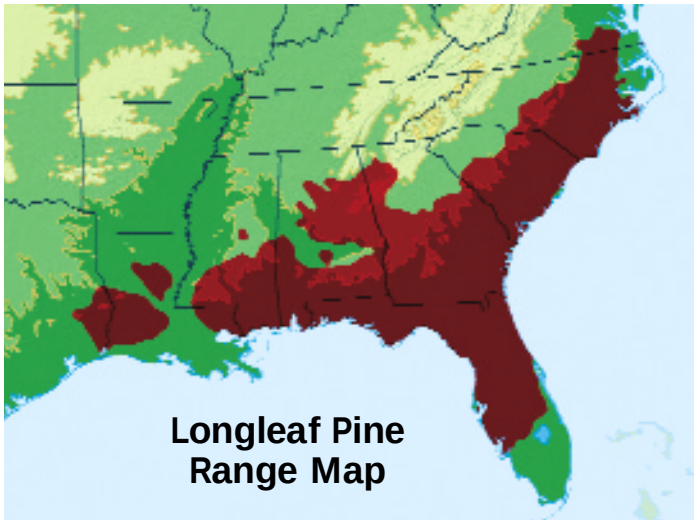
Indians fired the woods annually for hunting and brush control to maintain open lands and open woods. There are no records of actual quail numbers occurring in these regimes. We do know that bobwhites were widely distributed, although little utilized by aboriginals. Stoddard reported studying in the 1920s an unhunted bobwhite population living under natural conditions on a 10,000-acre tract of open virgin pine forest in Florida, an area representative of much of the original piney woods of the southern coastal plain. He determined the quail population to be relatively abundant, about one bird per four to five acres in winter.[51]

Records indicate that "virgin" forests across most of the southern coastal plain were not heavily timbered. They were not truly virgin since they already had a long history of human influence by the time of European discovery. Surveys conducted in the 1890s in Mobile County, Alabama showed that one acre of untouched forest, very open and free of smaller trees and undergrowth, contained 16 trees, most of which were 16 to 18 inches in diameter at breast height. Another one-acre plot considered exceptionally heavily timbered contained 45 trees, the majority of which were 16 to 18 inches in diameter at breast height.[50] Today, a comparable stand of trees considered fully stocked for timber production would have 50 to 65 trees per acre.

As European settlement progressed, forests were cleared and old Indian agricultural fields were adopted for the major livelihood of farming. The Europeans also practiced shifting agriculture. Sequences of slash-and-burn land clearing were followed by temporary cultivation, field abandonment and new clearing.

In Alabama, the first settlers were itinerant herdsmen. Indian burning practices were thoroughly adopted by them for hunting, grazing range improvement and pest control. An "Alabama boom" in the 1820s brought many new settlers who cleared the best land for planting cotton. Cotton farming quickly wore out the land, mandating a continual process of shifting agriculture.

Following the collapse of the plantation system after the Civil War, share cropping and "patch farming" became the norm. Burning practices continued in the open piney woods. Areas around home sites were burned annually, but cattle ranges were not burned as often, creating a mosaic of new growth and slightly older "rough."[31] This pattern of land use continued until the end of the nineteenth century. Most of the landscape was good for quail, and they flourished in this atmosphere. Southeastern bob-



Bobwhites were relatively abundant in much of the original piney woods of the southeast. Today only four percent of longleaf forests remain.

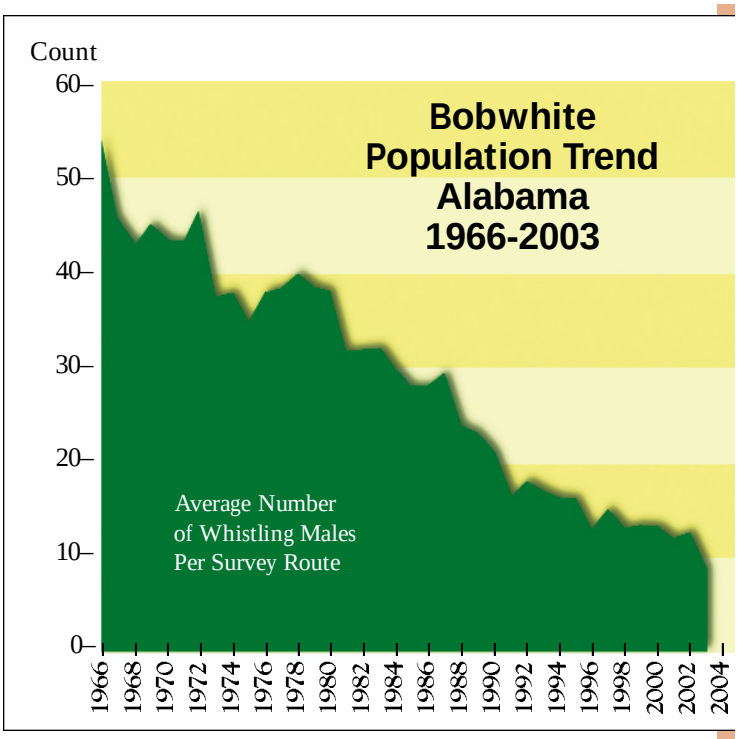
white populations peaked just prior to the turn of the twentieth century and remained at relatively high levels until about 1940.[37]

From 1930 to 1960 farming in Alabama diminished rapidly as society industrialized. In 1930 Alabama had more than 250,000 farms with an average farm size of about 60 acres. By 1960 farm numbers had declined to 120,000 and farm size doubled. Currently, farms number less than 50,000 and average farm size is about 190 acres.[54] The shift from widespread crude agriculture to other land uses has had a major impact on bobwhite populations across the state. Alabamians boasted of having more bobwhites than any other state in the 1920s, with a roughly estimated 17,000,000 acres of suitable habitat.[1] A report on an inventory of the state's wildlife resources in 1942 noted a declining quail population due to loss of fallow fields, clearing of hedgerows, increases in field size, and reforestation.[2]

The quail population changes on a 4,000-acre quail research area in Barbour County, Alabama exemplify the quail declines of this period. Quail hunting records from the 1920s to 1940s showed that two hunters could expect to move 20 to 35 coveys in a day's hunt. During the 1940s tenant farming ended, and the land was converted over time to timber and cattle production. Research from 1954 to 1958 showed the area was then 43 percent pine woods, 39 percent hardwoods, 10 percent improved pasture, and 8 percent cropland. Census work during the study period determined that the winter quail population varied from one bird per 5.1 to 7.5 acres, and quail hunting was considered poor compared to earlier times.[24]

Alabama's farms, presently with about 4 million acres of agricultural croplands,[38] have become large, mechanized operations with little idle land. Much former agricultural land has been converted to cattle forages using introduced pasture grasses, with about 5 million acres now in this land use.[3] A great deal of land has naturally regenerated to dense forest or has been converted to timber production. Very little of the state's current 23 million acres of forest[21] is good quail habitat. Following the advent of forest restoration efforts in the South, fire was generally removed from the landscape as major efforts were directed toward fire prevention beginning in 1924.[50] Population growth and increasing urbanization have further precluded use of fire.

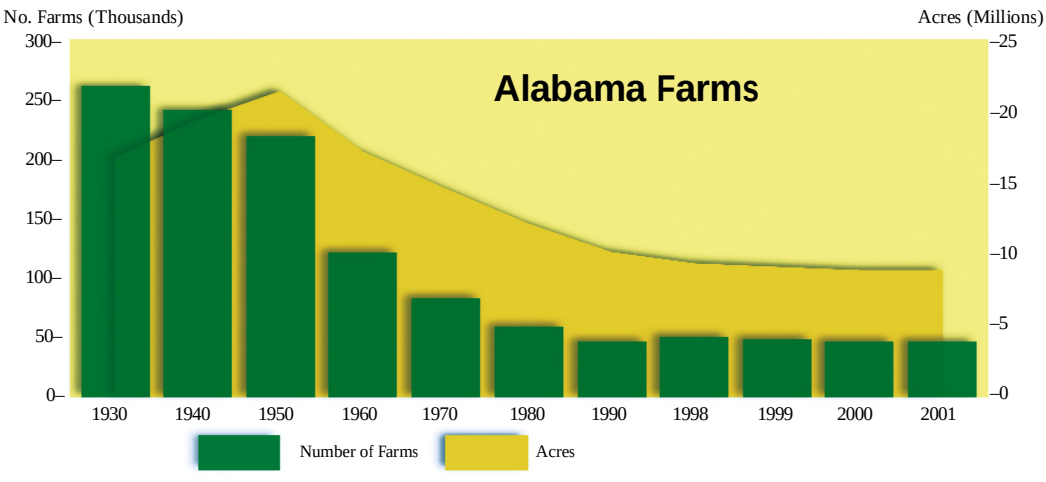
Breeding bird survey data documents a 4 percent per year decline in bobwhite abundance in Alabama since the 1960s, and an accelerated 9 percent per year decline in the mid 1980s to mid 1990s.[39] Alabama's quail population in less than 20 percent of what it was when surveys began in 1966. To put this in perspective, where there were five coveys a few decades ago, there is now only one covey. And, those isolated coveys continue to disappear.



Annual quail harvests as high as 2.8 million birds in the 1960s have declined to recent harvest levels of only 160,000.[8] Currently, quail harvests are less than 5 percent of those of the 1960s. Although equivalent data is not available, anecdotal accounts suggest that bobwhite numbers in the 1960s were only a fraction of populations in earlier times.

A landscape that once highly favored quail over large areas has now become an environment offering very few of the habitat types that quail need to flourish. Bobwhites have been in decline in the Southeast for about a century, precipitously for the past 30 years. From the historical descriptions, it is likely that bobwhites were more abundant in pre-colonial landscapes than in those of the present.

On most landscapes across Alabama, quail occurrence is incidental; chronically low, semi-isolated populations are now the rule. Bringing quail back to some level of abundance on these areas requires planned habitat developments, with emphasis on increasing the quantity and quality of reproductive habitats. Bobwhites are short-lived, annually produced animals. Eighty percent or more of the birds alive during early fall will be dead by the next fall. Population levels, therefore, are determined by annual production, which is controlled by cover and environmental conditions that prevail during each summer reproductive season. Since quail populations can vary widely from year to year, bobwhite management requires constant vigilance. On locations where appropriate management practices have been routinely applied, quail numbers fluctuate annually with environmental conditions, but have remained abundant over time.



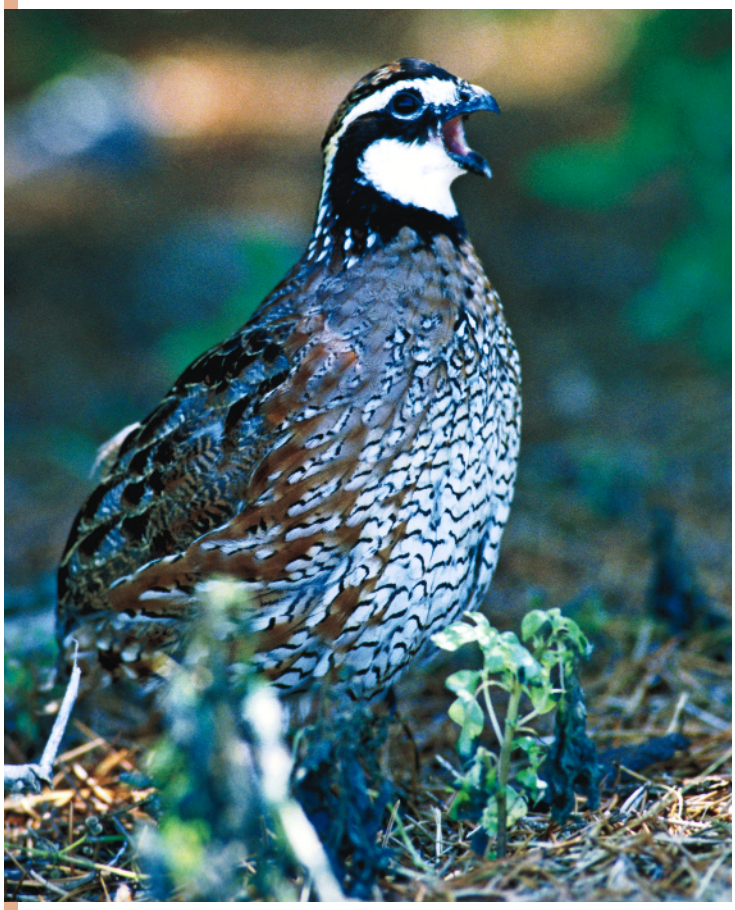
Chapter 3

HABITS

REPRODUCTIVE ECOLOGY

Breeding Season

During winter, bobwhites live in a covey, a group usually composed of 12 to 18 individuals. The covey moves and feeds together on the ground during the day, roosts on the ground in a tight circle to conserve heat a night, and functions as a unit to avoid predators. As spring approaches, the covey assembly, which serves bobwhites so well in winter, begins to weaken. Warming days bring on behavioral changes as pair-bonding begins. Males often pair with females within the covey, which at this time is composed of mostly unrelated individuals. During loafing periods, covey members are more dispersed as pairs rest away from others in the covey.



The first "bobwhite" whistle usually happens in early to mid-April in Alabama, signaling the beginning of the breeding season.
JIM RATHERT/MISSOURI DEPT. OF CONSERVATION

The first "bobwhite" whistle usually happens in early to mid-April in Alabama, signaling the beginning of the breeding season. Occasionally, during periods of unseasonably warm weather, male bobwhites may whistle as early as February, or even in January. Most bobwhite calling activity occurs from mid-June to mid-July at the height of nesting season when hens are near the end of incubation and their mates are left alone.

Nesting activity normally gets underway in late April, following covey break-up. Bobwhites are indeterminate nesters and will continue to nest throughout the summer as long as weather and cover conditions are suitable. Mild summers with frequent rainfall tend to be most favorable for nesting and brood rearing in Alabama. Hot and droughty conditions during breeding season are harmful to quail reproductive success. Drought is especially detrimental to quail populations when recurrent over a period of years.

By the end of August most nests have hatched. Rarely, a few nests may still be incubated as late as October and hatch in November.

Covey Dispersal and Individual Movements

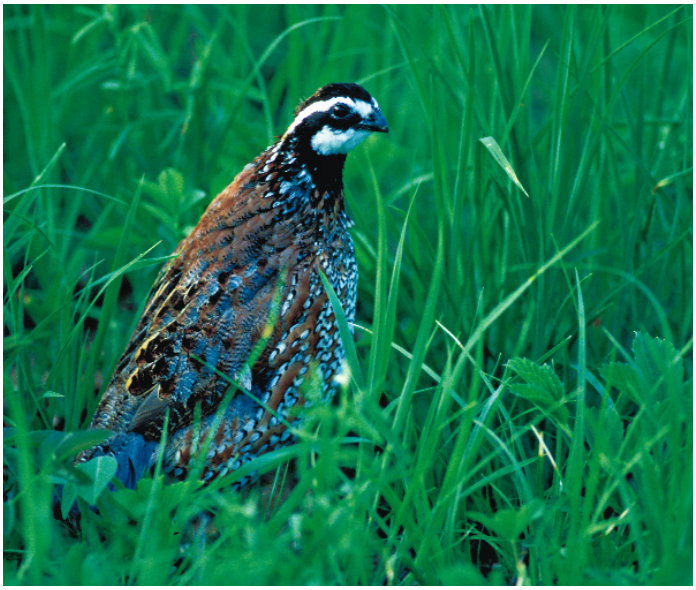
Coveys typically break up in late April, when the first nests are constructed. Spring is a transitional period, and birds will rejoin to loaf and roost as a group during cold or inclement weather. In Alabama, bobwhites typically move short distances, usually less than a mile, when shifting from winter covey ranges to sum-

In breeding season bobwhites select weedy-grassy habitats. The summer home range of adult bobwhites is 30 to 40 acres.
STAN STEWART

mer breeding ranges. Though uncommon, spring movements greater than seven miles have been documented.[18] In summer, birds are located in more open, grassy habitats compared to winter ranges, which are associated with woody and brushy protective covers. The summer home range of adult bobwhites is 30 to 40 acres.

Mating Systems

Bobwhites exhibit a variety of mating systems. During the course of a breeding season that involves continuous mortality and varied mating systems to produce young, nearly all breeding birds will be associated with more than one mate.[6,10,12] Some pairs remain together during nesting and re-nesting attempts. Some females mate and lay a clutch that is incubated by the male. The hen may then lay and incubate another clutch alone, or mate and produce a nest with another male. Up to one-fourth of nests may be incubated solely by males.[6] Bobwhite breeding mechanisms act to overcome high natural mortality of nests, chicks, and adults, and to cope with weather changes during breeding season.



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JIM RATHERT/MISSOURI DEPT. OF CONSERVATION

Nesting Behavior

Pairs begin building nests in late April. Natural herbaceous cover in open woods, fallow fields, field borders, fence rows and roadsides are common nest locations.[51] Sites selected for nest construction characteristically have open, scattered growths of bunch type grasses that combine bare ground and overhead concealment. In Alabama, this ideal composition occurs in natural herbaceous plants that grew the previous summer and remain standing for the current nesting season.[37] A mixed stand of broomsedge, dewberry, blackberry, legumes and other broad-leafed weeds provides ideal nesting cover. Such cover types offer dead grass (broomsedge) leaves for nest material. They are tall enough, about 18 inches or more, to conceal the nest and birds. And, they afford open travel ways to and from the nest.

Bobwhite nest sites typically have a mix of bunch grasses and broadleaf weeds that offer bare ground and overhead concealment.
JERRY DEBIN

Nest distribution is not uniform. Many nests may occur close together. One four-acre field in Tennessee, for example, was documented to contain 41 bobwhite nests during a single nesting season, 12 of these with eggs.[14] On landscapes subjected to burning, disproportionate numbers of nests are constructed in unburned areas than in areas burned immediately preceding the nesting season.[14]

The male and female construct the nest of primarily dead grass material, often of broomsedge leaves. The nest may be placed in or at the base of a broomsedge clump for concealment. Pine needles are also used for nest material, especially where grass is sparse. The birds scratch and peck out a slight depression on bare ground, line it with dead grass blades, small leaves, plant stems or pine needles and often arch it over the top with dead grass, stems or needles. If nest material is scarce, as on ground just recently burned, the arched top may not be present. Late summer nests may also be more poorly constructed, without an arched top. Such nests are more exposed and vulnerable to predation.[37]

Nest building in spring may occur over the course of a week and include construction or partial construction of nests that are never utilized. Once a nest site is chosen, the hen lays one egg

Bobwhite nests are often placed in or at the base of a broomsedge clump for concealment. Look closely for the incubating hen on the nest.
JERRY DEBIN

each day until the clutch is complete. Clutches average 12 eggs.[15,41] Incubation begins after the clutch is laid and requires 24 days. The female and male do not share incubation. Some males incubate the nest solely, or may take over incubation if the hen is killed.

Once incubation begins, the bird stays on the nest except for short periods, during which time it leaves the nest to feed. Incubating birds need an abundance of foods near the nest site. This allows them to forage nearby, quickly regain energy, and reduce their time away from the nest. Dewberries and blackberries are preferred foods during nesting season. Insects and early maturing seeds are also important foods.

From beginning of nest building to hatching requires about 50 days, with a first peak of hatching around mid-June.
JERRY DEBIN

From beginning of nest building to hatching requires about 50 days, with early nests hatching in late May.[37] However, incubation of most nests begins in late May and results in a first peak of hatching around mid-June. Second and third hatching peaks may occur in July and August following re-nesting activity. The bobwhite range should be managed to make the most of first nesting attempts and the first hatching peak.[37] As summer progresses, weather becomes hotter, dryer and less favorable for nesting. Fewer birds are alive to breed, and the breeding condition of remaining birds declines.

Nesting effort varies significantly with rainfall fluctuations. In Alabama, above average July and August rainfall increases and extends nesting. Summer drought ends nesting activity prematurely.[41] During very hot and dry weather hens may not attempt to nest, but shortly after summer rains that create moist, warm conditions and new plant growth, nesting activity resumes.[25]

Most nests are not successful. Only one-third to one-half of incubated nests results in a brood.[41,51] Of those hens alive at the beginning of breeding season, less than half hatch a nest,[53] a con-

About three-fourths of hens and one-fourth of males that survive the breeding season hatch a brood.
NORTH CAROLINA WILDLIFE RESOURCES COMMISSION

Predators cause at least three-fourths of nest failures. The destroyed nest in the background and recovered radio of a telemetered hen indicate a mammalian predator.
JERRY DEBIN

sequence of continuous breeding season mortality.[5] Bobwhites are persistent nesters, and most hens (about three-fourths) surviving at the end of breeding season hatch a successful nest due to re-nesting.[12] In addition, male incubation of nests contributes substantially to annual production. Males incubate more than one-fourth of nests.[6] Of those males alive at the end of breeding season, one-fourth hatch a brood.[6]

Most hens that fail on an initial nesting attempt will re-nest. Because of high nest losses, hens must initiate two or three nests to produce one that is successful.[33] Attempts to raise second broods, after successfully raising a first brood, are not uncommon. In an Alabama study, four of 16 radio-marked hens successfully hatching first broods re-nested, and two successfully hatched second broods.[42] Although rare, third broods have been documented in early-laying hens.[28] Though multiple broods occur, their usual incidence makes only minor numerical difference in autumn bobwhite populations.[19] Double clutches are a regular component of bobwhite reproduction, but are not necessary to replace populations during normal conditions.[34] Variation in the rate of second clutches could substantially affect reproduction,[6] primarily when bobwhites are recovering from population lows.

The largest contributor to nest loss is depredation by egg eating predators. Predators account for at least three-fourths of nest failures. Nest depredations along with predation of incubating adults, both on and away from the nest, may account for 90 to 100 percent of nest losses.[12,41] Nest predators include snakes, raccoons, opossums, skunks, armadillos, rats, weasels, squirrels, foxes, coyotes, bobcats, dogs, cats, hogs, turkeys, crows, jays and ants. The list of egg-destroying predators is so long that it becomes apparent that nest predation cannot be eliminated. However, nest predation can be moderated by habitat management and judicious control of major egg predators. Nest predation is generally highest early in the nesting season and declines as summer progresses. This is the time when cover is greater and alternative predator foods such as fruits and insects are abundant. Nest depredations are also higher during dry summers when covers are thinner and natural food production is low. The bobwhite's persistence to re-nest helps overcome high nest losses.

Adult mortality contributes substantially to nest failure. An Alabama study documented that about one-fourth of all unsuccessful nests resulted from death of the incubating hen and that mortality was greatest during recesses away from the nest.[41] In the study, the predation rate of adult bobwhite hens during breeding season was 60 percent and most losses were to avian predators.

Nest abandonment can result in the failure of 10 to 20 percent of nests.[12,51] Reasons for abandonment are not always apparent, but birds are sensitive to disturbance during the laying period and will readily desert the nest.[51] Human disturbance, such as mowing agricultural areas during the nesting season, causes nest desertion and destruction.[34] Flooding, heavy rains and extreme drought also contribute to nest abandonment.[51]

The total number of nests produced each season[14] and number of chicks hatched[34] (nesting success) are the primary determinants of annual quail production and quail population fluctuations. Small differences in nesting success dramatically affect the numbers of juvenile birds in the fall population[19] and may mean the difference between an increasing or a declining population.[51]

Hatching

A couple of days before incubation ends the chicks begin to peep and pip their shells. With its egg tooth, the heaving chick eventually cracks a small hole in the shell near the large end of the egg. Once a hole is made hatching progresses rapidly as the chick pips an arc around the large end of the shell until the area is weak enough for the chick to push the "hinged" portion of the shell free and emerge. Most of the eggs will hatch within an hour or so of the first chick's emergence. In over half the nests, all eggs hatch. On average, about 8 percent of incubated eggs do not hatch due to infertility or dead embryos.[34] In the warm summer air, the wet chicks dry quickly as the parent on the nest fluffs out its feathers and broods them. The active brood is led away from the nest, usually within a few hours of hatching. If a hen hatched the brood, the family may join with the cock bird waiting nearby.

Brood Rearing

The newly hatched chicks only weigh about six to seven grams each, less than a quarter of an ounce. They are alert and can move quickly to hide and "freeze" when confronted with danger while the parent(s) may perform a crippled wing act to lead an enemy away. The chicks feed at once, searching for small insects, tender leaves, berries and seeds. Most of the time during the first week is spent brooding. A parent fluffs out its feathers to cover the downy chicks and keep them from getting chilled or takes them into a shady area to escape heat. The chicks may be brooded by one or both parents. Abandoned broods and orphaned chicks are often adopted and raised by lone adults, both female and male.[12]

By the end of the first week the chicks' wings are strong enough for them to fly a few feet, and by two weeks of age they will flush when disturbed. During this time the weekly home range of broods may vary from as small as four acres up to about 15 acres in size.[41] The chicks feed almost continuously. Their diet consists predominantly of insects — mostly beetles, true bugs and small grasshoppers — as well as some caterpillars, moths and spiders.[22,51] The seeds of early maturing grasses, primarily those of panic grasses, are also taken frequently by chicks.[22] The adults, particularly the hen, are feeding on the same insects, although their diet still mostly consists of soft fruits and weed and grass seeds. In summer, quail are often taking fruits and seeds directly from plants, seed pods, and seed heads, whereas in winter they are retrieving seeds fallen to the ground.[51]

More than half of quail chicks die within two weeks of hatching, mostly from predation.[12,41] After two weeks of growth, chicks experience much lower mortality. By this time they are feathered enough for short flights and can better escape predators. After the

More than half of quail chicks die within two weeks of hatching.
NORTH CAROLINA WILDLIFE RESOURCES COMMISSION

age of two weeks, their diet shifts to include more soft fruits, berries and grass seeds. Quail populations are highest, however briefly, in mid-summer after most nests have hatched. This population high does not last long because so many chicks die within two weeks of hatching.

At three to five weeks of age broods are capable of surviving independently of parents. Some hens abandon broods by this time and re-nest.[41] By this age the broods may have ranged over more than 40 acres.[41] At seven weeks of age, the young birds roost in a circle as the adults and survive rainstorms without brooding. At eight weeks hens and cocks are identifiable by the respective buff or white and black throat patch. They weigh a little more than half that of adults and are capable of strong flights of 100 yards or more. They are increasingly feeding on summer maturing grass and other seeds. At 12 weeks they are nearly mature in size and weight, and at 15 weeks their plumage is almost indistinguishable from that of adults. Fully grown birds, at least 21 weeks old, are 165 to 180 grams in weight, or about six ounces.[37]

Out of a successful bobwhite nest of 12 eggs, about 11 eggs hatch, five chicks are alive after two weeks, and three or four chicks make it into the fall population. Based on average population dynamics, if one-third of quail chicks survive to autumn, 80 percent of the fall population will be birds produced that year, and the quail population will have doubled from spring to fall. This is good production. In less productive years, the quail population does not double itself from spring through summer.

The quail population at its autumn high may average six or more young birds per surviving adult hen in a good production year. During excessively hot and dry summers, production may be three or fewer young per hen. Of those birds that make up an autumn population, 20 percent or less will survive to the following autumn.

FALL AND WINTER BEHAVIOR

Covey Formation and Winter Range Selection

The covey assembly is a behavior mechanism that promotes bobwhite survival during the harsh environment of winter. Concentration of birds into a group lowers the chance of encounters with predators, and the watchful eyes of the group assist in predator detection. The close association of birds into a roosting disk conserves heat and energy during cold winter nights. In autumn, bobwhite coveys form into group sizes that are presumably optimal for fall and winter survival. Fall coveys space themselves on ranges that have accessible food sources near protective cover.

During late summer and early fall, large associations of birds may be encountered. Several adults with broods of various ages form large combination coveys of 30 or more birds. These are often encountered in field areas where weed growth is at its rankest and large quantities of seeds are beginning to fall. As nights become chilly and the weed covers thin, the birds re-form into smaller winter coveys of 12 to 18 birds. This is the fall shuffle. Birds select locations that offer brushy security cover and woodlands for escape. This is usually near field borders and in open woods that are rank with grass, legume and other seeds.

After the fall shuffle, the covey is typically composed of a couple of adults or pairs with surviving broods and a few adults that did not successfully produce young. The average covey is 14 birds, the size of which is partially dictated by their behavior of roosting in a circle or disk, heads out, sides and tails tightly pressed together. It takes a certain number of birds to form an adequate heat-conserving roosting disk. With too few or too many birds, the roosting structure does not perform efficiently.[37] For this same reason, late winter coveys tend to be about the same size as fall coveys if the range is well populated and coveys are close enough to interact and join together as bird numbers decline.

Most individuals in a covey are raised within a quarter to a half mile of the winter covey range. A few birds may move longer distances during the fall transition period. Of 213 banded bobwhites in one Alabama study, 201 moved one-half mile or less, and only two moved slightly in excess of two miles during the fall.[24] Daily movements in winter are normally short and even more restricted during cold, rainy or windy weather. On excellent range, a covey may move only a few hundred yards throughout the course of a day, with a winter seasonal home range of less than 20 acres. In less favorable habitat, a covey may have to range over 80 acres or more during winter.

Daily Activity

On clear, still autumn mornings bobwhite coveys often whistle at dawn. Their “koi-lee” calls begin about a half hour before sunrise just after the coveys break from their roosting disks. An initial call rings out, and it is presently answered by callers from other sites until a chorus of whistling coveys are pronouncing their locations across the countryside. Then, after brief minutes, the covey calls end with daylight’s rapid advance. Bobwhite coveys are somewhat territorial, and morning covey calling in autumn is believed to be a spacing behavior as the coveys settle into winter ranges. Only one to a few birds in a covey will call, and all coveys do not call each morning. Calling rates in Alabama are highest on cool, calm, fair mornings in late October and early November.

Coveys may linger at their roost sites on chilly autumn mornings if cold dew soaks the vegetation. They will be off to feed early when days are mild and dry. The birds have to feed for only short periods on fall days because grass, legume and other weed seeds are

Coveys have one or more small activity centers associated with thicket areas. Most of the day, particularly mid-day, is spent loafing in or near plum, sumac, hon - eysuckle or other thicket areas, and often engaging in dust baths.
TED DEVOS

at their greatest abundance. Coveys will feed in open woods and field borders lush with plants dropping their seed. In some years when pine mast is abundant they will use it heavily. As seed abundance declines, acorns may become important, especially on marginal range, and the birds will move into thicker woods.

Coveys have one or more small activity centers associated with thicket areas within their home range.[58] Most of the day, particularly mid-day, is spent loafing in or near plum, sumac, honeysuckle or other thicket areas, and often engaging in dust baths. In mid to late afternoon the coveys move to feed again, typically where protective or concealing covers are nearby. The birds feed more heavily in the afternoon than in morning, taking in energy reserves to power them through a chilly night.

When threatened, the birds prefer to stay on the ground. They may freeze and remain motionless for minutes to escape detection. If pressed, they will run considerable distances, sometimes several hundred yards. When necessary, the covey launches into clamorous flight, usually heading for some familiar retreat.

At dusk the coveys go to roost in open broomsedge or in scattered honeysuckle or briars. Usually they move to the location on foot, but may fly to roost to elude ground predators. They may roost in the same vicinity several nights in a row. Roost sites are often on upland locations, in part because elevated sites are warmer at night than low elevations, a result of temperature inversions. In extreme winter weather coveys seek thermal protection of dense honeysuckle or thickets for roosting, and on cold, raw days may form day roosts.

During the course of fall and winter, roosting locations will change according to weather, and winter ranges will shift with available foods, but the daily routine remains much the same. In late winter when most seeds are gone and food reserves are low, the birds may have to wander farther to feed. Fortunately, days are becoming milder, and the birds can afford longer movements without expending too much energy. Cover will be much thinner following winter rains and cold. The birds that survive to this point will be savvy and likely to run or flush at a distance when disturbed or threatened. During the late winter to early spring transition, coveys are generally moving to more open habitats than they utilized in winter. This is in preparation for occupying spring breeding ranges when the coveys disintegrate in late April.

On excellent quail range where winter mortality is low, 60 percent or more of the birds present in November will be alive to enter breeding season.[32,45] Winter survival could be less than 20 percent in areas of poor habitat, extreme weather, heavy predation, or heavy hunting.[9,16] High winter survival means that more birds enter the breeding season with the potential to produce more nests, more broods, and a high fall population.

Chapter 4

HABITAT REQUIREMENTS

SPRING AND SUMMER RANGE

The breeding season is the most critical period of the year for quail populations. Yet, it often receives the least attention from quail hunters or even from quail managers. Most of the thoughts and preparations are focused toward the hunting season. Breeding birds are assumed to be capable of nesting and raising young in whatever environment exists. The fact is, quail need very specialized environments for successful reproduction. With quail mortality in excess of 80 percent annually, a failed reproductive season or a series of poor reproductive years can result in dramatic declines in quail numbers. Because bobwhite nest, chick, and adult mortality is high, primary management emphasis should be directed toward the reproductive season and the development of reproductive habitat. Due to the natural behavior of bobwhites, space (land area) requirements during breeding season are greater than during winter, so bobwhites need an abundance of breeding range, something very deficient in most current landscapes.

Reproductive habitat for quail includes nesting covers and brood rearing habitat, each distinctly different in composition. These are the keys to quail population maintenance and restoration. Quail nesting and brood rearing habitats are composed of specific grasses and weeds that are transitional in nature. Productive quail habitat does not remain productive for many years without periodic disturbance and management that keeps required plant structures in the environment.

Quail must have plant types that afford an overhead canopy for concealment and bare ground for unhampered movement. For this reason, sod-forming grasses and solid ground covers are little used by quail. Landscapes dominated by bermuda grass, bahia grass or fescue will produce few quail until these grasses are eliminated. Old fields of dense broomsedge, heavy goldenrod or dog fennel are also poor habitat for quail production and require periodic disturbance.

Nesting Habitat

Ideal nesting cover is composed of moderately dense broomsedge, such that the grass clumps are scattered, bare ground is present and plants other than broomsedge can also grow. Other herbaceous plants may include a variety of legumes, panic and paspalum grasses, goldenrod, dog fennel and other forbs. Good nesting habitat is also characterized by the presence of a scattered woody component of dewberry, blackberry and shrubs. The cover is a mixture of these things, not a solid stand of any one. The structure forms a canopy above the quail, but has lots of bare ground underneath so that birds can scurry through easily. The plant mixture provides nest construction materials as well as nest concealment.

Most bobwhite nests are located in grassy-weedy plant covers from the previous growing season. The cover must be intact at the onset of nesting in April and May, which means it must escape disturbance such as burning, plowing or mowing for at least one year. Too frequent nesting habitat disturbance is detrimental to quail nesting success. Ideal nesting cover for quail contains broomsedge clumps from the previous summer. Birds locate nests in or against the standing clumps and use dead broomsedge leaves in nest construction. Introduction and maintenance of suitable amounts of nesting habitat in the landscape are critical to quail populations.

Left alone, plant covers quickly become too thick for quail use. Ground cover becomes dense, plant litter builds and food-bearing plants are crowded out. Birds can no longer negotiate the cover or find the things they need. After only three or four years of plant growth, bare ground disappears and the cover loses value for quail production. Eventually heavy brush and young trees take over. By this point the chances for quail reproduction are severely reduced, and the population becomes chronically low. Infrequent as well as too frequent cover disturbances rob quail of nesting areas.

The herbaceous plant associations suitable for bobwhite reproduction naturally persist for only a few years in southeastern landscapes, so appropriate periodic cover disturbances are indispensable. Maintenance frequency of the cover areas set aside for nesting is critical. If all cover is burned, plowed, or mowed every year, adequate cover is not available at the beginning of spring nesting season. If not disturbed often enough, the cover becomes too thick for quail use. Prescribed burning and disking are the preferred methods for managing quail nesting habitat, but they must be applied at the right times, amounts and frequency. Nesting habitat should be burned in late winter/early spring every other year or disked about once every three years depending on cover growth. Control of hardwood sprouts, especially sweetgum, might be accomplished with herbicide applications.

Brood Habitat

Brood habitat is critical for developing chicks. Flightless chicks and attentive parents are highly vulnerable to predators. Adults with broods select weed rich covers that form a protective screen above them, with open ground under the weed canopy for easy travel and secure feeding. Chicks and adults find an abundance of insect foods in weedy covers. Extensive brood habitats are needed to enhance chick survival as broods feed and range over the landscape.

Lush weedy groundcovers that grow in open pine woodlands after late winter and early spring burns supply excellent brood range.[12] These areas will include plants such as partridge peas, butterfly pea, beggarweed, lespedezas and other legumes, common ragweed, goldenrods, sunflowers and other asters, blackberries, dewberries, panic grasses and re-growing bluestems.[41] Insects are abundant in the growing plants, many of which also produce fruits

NESTING COVER AND BROOD HABITAT ARE THE KEYS TO QUAIL RESTORATION

Ideal quail nesting cover is composed of moderately dense broomsedge, such that the grass clumps are scattered, bare ground is present and plants other than broomsedge can also grow. Most bobwhite nests are located in grassy-weedy plant covers from the previous growing season. The cover must be intact at the onset of nesting in April and May, which means it must escape disturbance such as burning, plowing or mowing for at least one year.
(Left:JERRY DEBIN, Right:STAN STEWART)

Lush weedy groundcovers that grow in open pine woodlands after late winter and early spring burns supply excellent quail brood range in summer. Fallow fields of annual weeds, especially common ragweed and partridge pea, provide excellent brood habitat if the fields are large enough for secure brood movements.
STAN STEWART

and seeds. The plant canopy provides protective cover above the birds and bare ground beneath for easy travel.

Fallow fields of annual weeds, especially common ragweed and partridge pea, provide excellent brood habitat if the fields are large enough for secure brood movements.[57] This plant community grows in thick stands following annual fall/winter disking. The plants form an overhead canopy that conceals quail chicks from predators, shields them from rain, shades them from summer sun, and produces an abundance of insects that young quail must have for growth. The canopy shades out other plant growth beneath so chicks have plenty of bare ground to move easily and find food. Ragweed patches are well developed by mid-summer when broods are hatching. The patches may continue to hold quail into the fall as birds begin feeding on ragweed and other seed.

Annually planted food patches that are allowed to lie fallow the following summer will also grow annual weeds and grasses used by quail broods. The plant composition is different than that which occurs with dormant season (fall/winter) disking and includes more crabgrass, florida pussley, and other spring and summer annuals in addition to ragweed. These plants do not have the cover characteristics of ragweed, but they still produce insects and small seeds that quail chicks require.

Actively growing annual food patches also have value as brood habitat. Some of the most valuable annually planted food patches for broods include kobe lespedeza and browntop millet.[22,37]

FALL AND WINTER RANGE

Feeding Areas

The winter diet of bobwhites is composed primarily of seeds picked up from the ground. Consequently the birds need seed-bearing plants that drop their seed on relatively bare ground where it can be easily seen or scratched. Because the birds are highly conditioned to avoid detection by predators, the seeds must be available in and near concealing cover.

Quail utilize a variety of seeds. Seeds of legumes, the pea family, are frequently used. This is not only because the seeds are preferred, but also because many of the plants have a growth habit that affords overhead concealment for the feeding birds and bare ground underneath for moving and finding the seeds. Legume seeds taken by quail include annual and perennial lespedezas, beggarweeds, butterfly peas, wild beans, milk peas, partridge peas, clovers, and vetches. Ragweed and croton seeds are often used in fall and early winter. Ragweed, as previously mentioned, offers excellent cover. Various grass seeds are eaten throughout the summer and fall, particularly those of the genera *Panicum* and *Paspalum*. Important tree seeds include those of pine, oak, sweetgum, dogwood, sumac and sassafras. Agricultural food crops highly used in fall and winter include corn, sorghum, peanuts and soybeans. In late winter and spring many sprouting weeds are eaten. The birds also eat granules of sand and small stones (grit) to aid in seed digestion. Some is ingested incidental to feeding, and considerable sand is picked up directly when dust bathing. Since bobwhites use such a wide variety of seeds, it is evident that the winter range of bobwhites should be managed for a diversity of herbaceous and woody plants.

The winter diet of bobwhites is composed primarily of seeds picked up from the ground, so the birds need seed-bearing plants that drop their seed on relatively bare ground. Seeds of legumes, the pea family, are frequently used.
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TABLE 1
IMPORTANT WILD AND CULTIVATED PLANTS FOR BOBWHITES IN ALABAMA

	Native (N) Introduced (I) Cultivar (C)	Annual (A) Perennial (P)
LEGUMES		
Beggarweeds *(Desmodium spp.)*	N	P
Beggarweed, Florida *(Desmodium tortuosum)*	I	A
Butterfly Pea *(Centrosema virginianum)*	N	P
Cow Pea (*Vigna unguiculata)*	C	A
Lespedeza, Bicolor (*Lespedeza bicolor)*	I	P
Lespedeza, Common *(Lespedeza striata)*	I	A
Lespedeza, Kobe (*Lespedeza striata)*	C	A
Lespedezas, Perennial *(Lespedeza spp.)*	N	P
Lespedeza, Thunburg *(Lespedeza thunburgii)*	I	P
Milk Peas (*Galactia spp.)*	N	P
Partridge Peas (*Cassia spp.)*	N	A
Soybean *(Glycine max)*	C	A
Wild Beans (*Strophostyles spp.)*	N	P
GRASSES		
Browntop Millet *(Panicum fasciculatum)*	C	A
Broomsedges *(Andropogon spp.)*	N	P
Bull Grass (*Paspalum boscianum*)	N	A
Corn *(Zea mays)*	C	A
Crab Grass (*Digitaria sanguinalis)*	N	A
Crowfoot Grass *(Dactyloctenium aegyptium)*	N	A
Foxtail (*Setaria spp.)*	N	A,P
Panic Grass *(Panicum spp.)*	N	A,P
Paspalum (*Paspalum spp.)*	N	A,P
Sorghum *(Sorghum vulgare)*	C	A
OTHER HERBACEOUS		
Common Ragweed *(Ambrosia artemisiifolia)*	N	A
Dove Weed *(Croton glandulosus)*	N	A
Sunflowers *(Helianthus spp.)*	N	A,P
Woolly Croton *(Croton capitatus)*	N	A
TREES, SHRUBS AND VINES		
Blackberry *(Rubus argutus)*	N	P
Black Cherry *(Prunus serotina)*	N	P
Black Gum *(Nyssa sylvatica)*	N	P
Blueberries *(Vaccinium spp.)*	N	P
Chickasaw Plum (*Prunus angustifolia)*	N	P
Dewberry *(Rubus trivialis)*	N	P
Flowering Dogwood *(Cornus florida)*	N	P
Hackberry *(Celtis occidentalis)*	N	P
Huckleberries (*Gaylussacia spp.)*	N	P
Japanese Honeysuckle *(Lonicera japonica)*	I	P
Oaks (*Quercus spp.)*	N	P
Pines *(Pinus spp.)*	N	P
Sassafras (*Sassafras albidum)*	N	P
Sweetgum *(Liquidambar styraciflua)*	N	P
Sumacs *(Rhus spp.)*	N	P

Chickasaw plum, Prunus angustifolia, *is a much branched, thicket-forming shrub that grows to about six feet tall and exemplifies ideal protective cover for quail.* STAN STEWART

Protective Cover

Bobwhite winter covey ranges are strongly associated with woody and brushy protective covers that provide secure loafing and escape areas. Each covey usually has one or more headquarters or small activity centers in and near some type of thicket cover.[58] Identified headquarters covers include plum patches, other dense shrub and sprout stands, and Japanese honeysuckle thickets. Shrub covers and thickets are particularly important as weed and grass covers thin during winter.

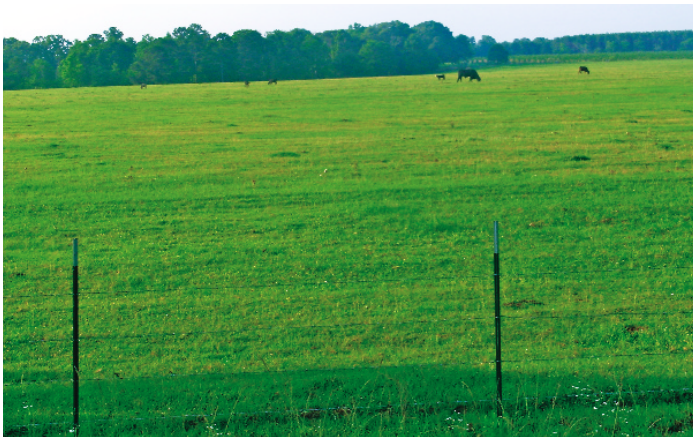
Chickasaw plum, *Prunus angustifolia*, is a much branched, thicket-forming shrub that grows to about six feet tall and exemplifies ideal protective cover for quail. It offers the characteristics attractive to bobwhites: a low overhead canopy with bare ground beneath. Coveys can avoid avian predators beneath the canopy or run into the thicket to escape ground predators. It grows best on sandy or low fertility soils and is often found in open woods, field borders and fencerows. Its presence should be encouraged on the quail range.

Winter coveys spend a large portion of the day loafing in brushy thicket cover and as little time as necessary feeding. This minimizes exposure to predators. Feeding is a risky activity. The more time coveys spend moving and feeding, the greater the chances of detection by predators. If food is abundant and close to loafing cover, bobwhite survival is enhanced. When food supplies become scarce, birds venture away from cover for longer periods to acquire food, exposure to predators is greater, and mortality increases.[45] In severe weather, coveys with adequate food near cover experience light mortality, whereas coveys without this arrangement may exhibit unusual movements and suffer heavier losses.[34]

Bobwhites are animals of low mobility. Winter daily movements are typically short, often less than a few hundred yards. Therefore, protective cover and foods should be arranged in close proximity to enhance bobwhite survival and optimize numbers of bobwhite coveys.

Chapter 5

HABITAT MANAGEMENT



Most of the current Alabama landscape affords poor habitat for quail.
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A MANAGEMENT APPROACH

The Alabama landscape can be differentiated into two broad cover types: fields and forests. Of the open lands, 4 million acres are agricultural croplands,[38] and about 5 million acres are in pasture, hay, forage crops and other grassland.[3] Forest lands occupy about 23 million acres; about 17 million acres are held by non-industrial private owners, 5 million acres are owned by forest industry and other corporations, and 1 million acres are owned by government.[21] On a landscape level, very little of Alabama's 33 million acres currently affords adequate habitat for quail.

Giving Bobwhites the Edge

The current arrangement of cover types in the landscape presents a likely zone in which to begin quail habitat developments. The border areas of field and forest make up an extensive zone across the landscape. This, for the most part, is where bobwhites are still holding on in remnants of available cover. However, the ubiquitous sharp change from field to dense woodland offers few of the habitat types required by quail. Numbers are chronically low in these environments because the birds have no suitable area in which to expand, mostly due to inadequate reproductive habitat.

Naturally vegetated field borders have been demonstrated to increase bobwhite breeding activity and populations in agricultural lands. This is an initial step toward increasing quail numbers.
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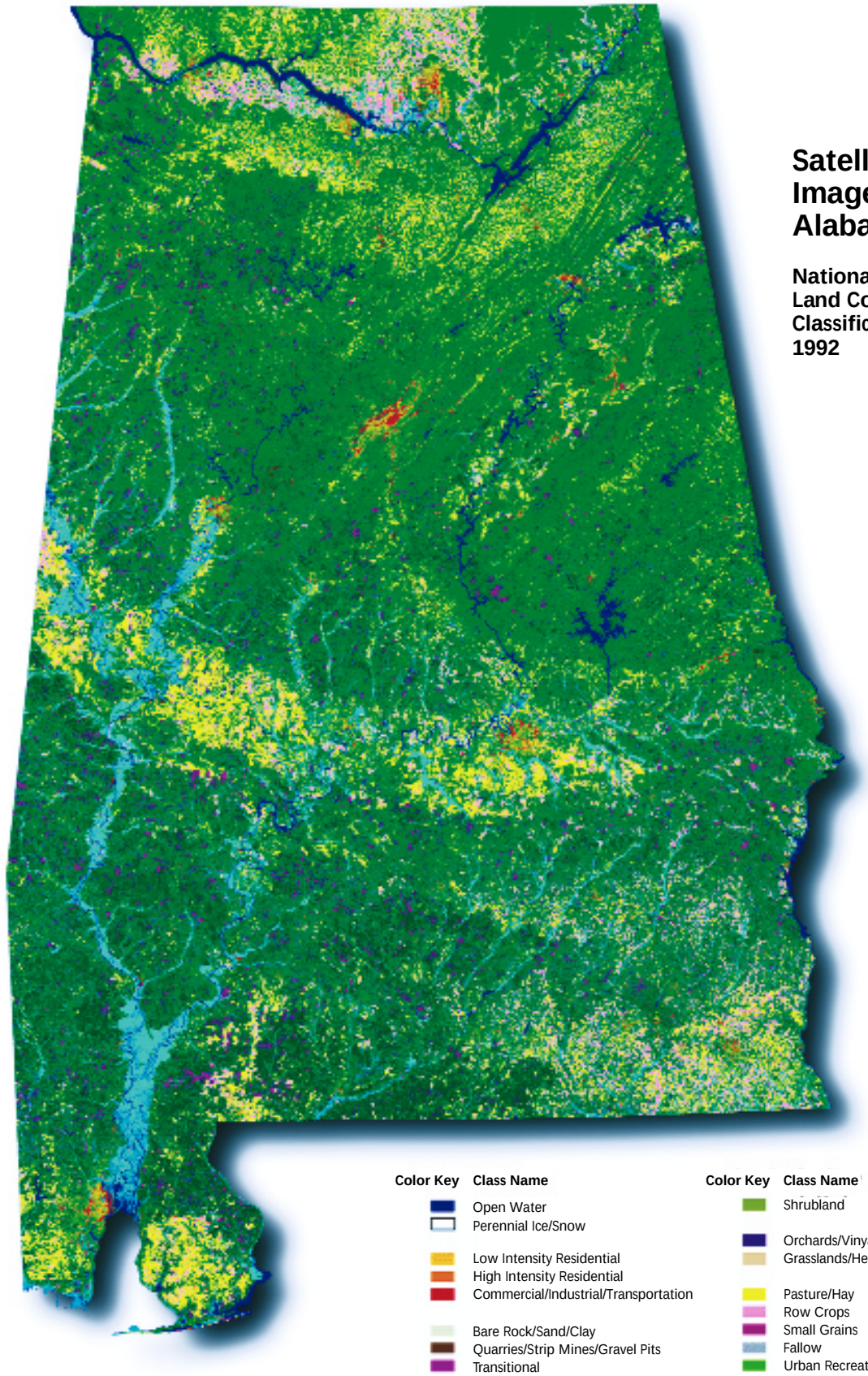
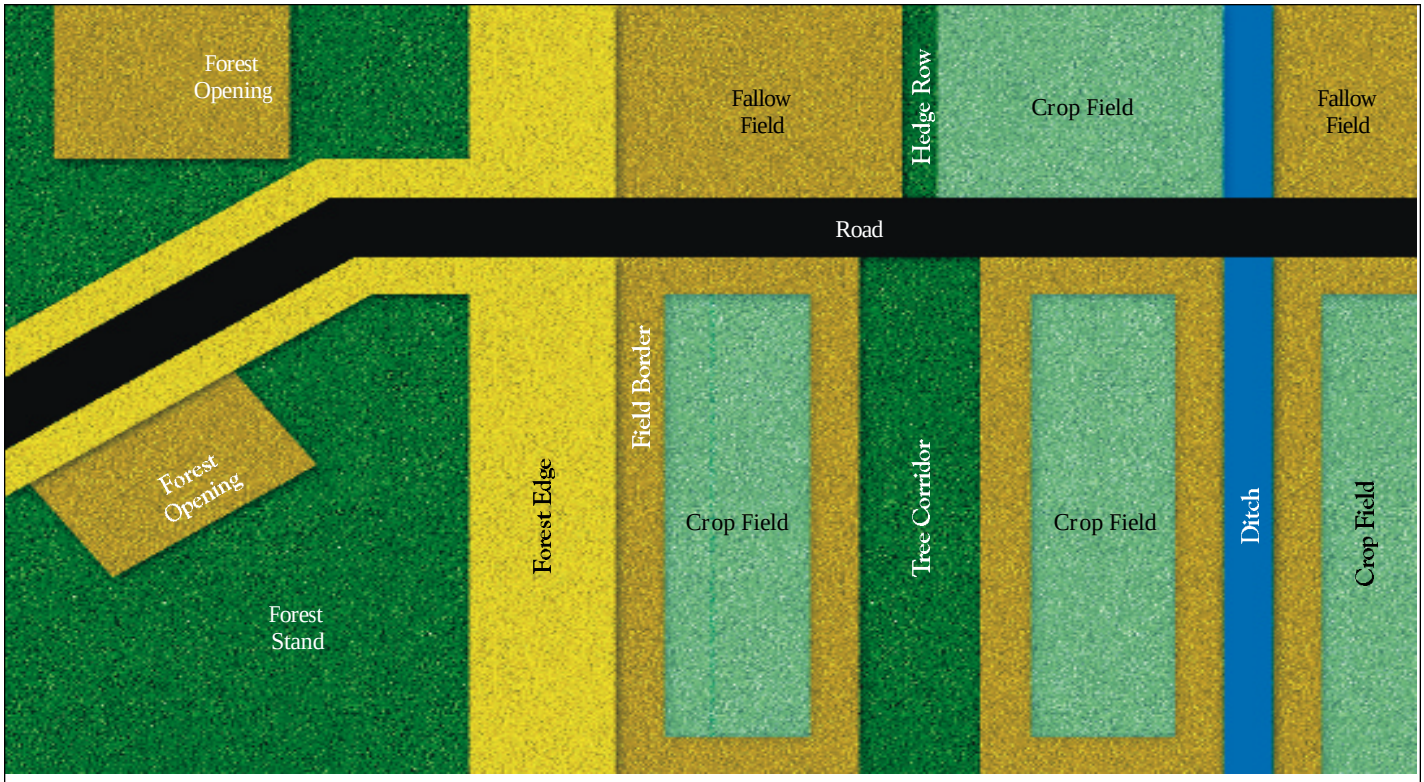


Satellite Imagery of Alabama

National Land Cover Dataset Classification 1992

Color Key	Class Name
	Open Water
	Perennial Ice/Snow
	Low Intensity Residential
	High Intensity Residential
	Commercial/Industrial/Transportation
	Bare Rock/Sand/Clay
	Quarries/Strip Mines/Gravel Pits
	Transitional
	Deciduous Forest
	Evergreen Forest
	Mixed Forest

Color Key	Class Name
	Shrubland
	Orchards/Vinyards
	Grasslands/Herbaceous
	Pasture/Hay
	Row Crops
	Small Grains
	Fallow
	Urban Recreational Grasses
	Woody Wetlands
	Emergent Herbaceous Wetlands



Quail Habitat A Management Approach

Forests

1. Thin Forest Edge
2. Thin Along Forest Roads
3. Create Forest Openings
4. Thin Forest Stands

Fields

1. Create Field Border Along Forest Edge
2. Extend Field Borders Along Field Roads, Ditch Banks, and Fence Rows
3. Establish Hedge Rows, Tree Corridors
4. Create Fallow Fields

Field Borders

Development of naturally vegetated field borders has been demonstrated to increase bobwhite breeding activity and populations in agricultural lands. This is an initial step toward increasing quail numbers. Habitat can be extended by creating additional natural weed-grass covers along field roads, ditch banks, and fence

Thinning a forest to open the canopy and stimulate herbaceous groundcover allows the quail population to expand. TED DEVOS

Natural weed-grass field borders are valuable wildlife habitat in farm land - scapes, and benefit bobwhites as well as numerous other birds and animals that use similar plant associations for raising young in summer and/or feeding in win - ter. STAN STEWART

rows. These areas provide quality summer range that will attract breeding birds following covey dispersal. Rank weed growth in field borders provides adequate security cover for the birds during summer in these mostly open habitats.

Shrub Covers and Tree Corridors

Weed structure is not durable enough to remain intact through winter and is not adequate protection for winter coveys. Woody cover is required for this. Protective shrub covers installed at intervals within field borders enhance the value of the zones to bobwhites.

Tree corridors established across open fields can create protective habitat and locations for holding winter coveys. Tree corridors should have naturally vegetated field borders developed along each side and protective shrub covers installed at intervals within the field borders. This arrangement supplies year-round habitat for bobwhites in open field environments where quail would not otherwise exist.

Fallow Fields

Tree corridors break large fields into smaller fields. With small fields, a pattern of rotational cropping, seasonal disking, and fallow fields can be instituted to further increase reproductive habitat. This landscape arrangement approximates the "patch farming" regime once so productive of bobwhites.

Thinned Forest Corridors

Forests can also be improved for quail, beginning with thinning operations along the forest edge. In conjunction with established field borders, thinning creates more nesting habitat and winter range. Thinning can extend into the forest along road systems, creating open forest corridors of quail habitat.

Permanent Forest Openings

Bobwhites require open lands maintained in natural weeds and grasses, especially during the spring and summer breeding season. A distribution of forest openings should be created and managed to supply habitat for bobwhites in forest landscapes. Openings are most beneficial when adjacent to or surrounded by open canopy forest. Forest openings for quail do not necessarily require planted food crops. Greatest bobwhite benefits are achieved if forest openings are maintained by seasonal disking to encourage natural herbaceous plants that quail use for cover and food.

Open Forest Stands

Thinning and timber harvesting operations in a forest allow the quail population to expand. If all stands are thinned to create

A MANAGEMENT UNIT

Bobwhites have several critical habitat requirements that must be met for the birds to survive and for populations to flourish. The critical components of quail habitat structure include nesting cover, brood habitat, protective cover and feeding areas. The nature and composition of these habitat types are described in *Chapter 4, Habitat Requirements*.

In any location chosen for quail management, a complete habitat unit that includes all of these necessary elements must be developed for quail to increase. Concentration on a single element will not bring success. For example, efforts to increase quail numbers often fail because practitioners tend to focus on food provision. Other less understood habitat requirements are not addressed, and no quail population improvement follows the management practice. Subsequently, the practitioner gives up on habitat improvement and quickly concludes that some other factor, such as predators or a mysterious environmental phenomenon, has rendered quail increase impossible. A single element of quail habitat, no matter how good, cannot alone produce quail.

The goal of quail habitat management is to bring all of the essentials for survival and reproduction into close association as a complete habitat unit. This reduces the land area necessary to support breeding birds and winter coveys, and increases the number of birds the land can sustain. Frequently, it is not the quantity of any one habitat component that limits wildlife numbers, but the spatial relationship to other requirements. This is especially true of animals of low mobility like bobwhites. Properly arranging habitat components in close proximity enhances survival. A habitat unit includes nesting cover, brood habitat, protective cover, and feeding areas.

In this sense, management is a task of arranging habitat requirements on the landscape in units that produce and support a covey of quail, then duplicating these across the landscape to increase quail numbers. The winter home range of a covey of quail may be 20 to 30 acres when all winter feeding and protective cover requirements are available to them. This is a workable habitat unit size.

The critical components of quail habitat structure include nesting cover, brood habitat, protective cover and feeding areas. In any location chosen for quail management, a complete habitat unit that includes all of these neces - sary elements must be developed for quail to increase. STAN STEWART

A MANAGEMENT SEQUENCE

A knowledge of the seasonal habitat requirements of bobwhites suggests a sequence of management actions for restoring and increasing quail populations.

Produce

Assuming a breeding population is present, the first and most important management action is to produce more birds in the landscape. This requires nesting cover. Since 80 percent or more of a quail population dies annually, substantial annual nest production is critical to restore the population. The composition of nesting cover is described in *Chapter 4, Habitat Requirements*.

Raise

After hatching, chicks need the best chance of survival. High quality brood habitat is needed to raise chicks. Brood habitat is profuse with annual herbaceous plants that support high insect populations, the primary food for growing chicks. Ideal brood range includes fields of ragweed and partridge pea, and open, burned pine woodlands lush with new herbaceous plant growth.

Protect

Because predation pressure on quail is always high, escape cover and travel zones are needed to protect birds from enemies. Quail need a secure zone to travel in and feed nearby, a concealed area to loaf, and a place to fly into to escape a threat. A dispersion of shrub growth, thickets of plum, Japanese honeysuckle, hardwood sprouts, and tree covers offer protection from predators and extreme weather.

Feed

Finally, food is a continual requirement, so birds must be supplied with food resources and areas in which to feed. The orderly sequence to develop nesting habitat, brood habitat, and protective covers inherently enhances natural food production as part of the system. Many cover plants produce food and food plants offer cover. Often, natural food sources are not obvious because they are intermingled with cover. This however, is the desired condition because birds are feeding in their normal covers in relative security. Supplemental feeding, whether in the form of plantings or direct feeding, should follow the same principle of supplying food in or near cover.

an open canopy forest, all of the forestland can become suitable quail range. The culmination of this approach is a quail plantation, but landowners can choose any management intensity based on how much of the landscape is desired as quail range.

MANAGEMENT PRACTICES FOR AGRICULTURAL LAND

Field Border Systems

Stoddard recommended that cultivation "should be held back a few rods" from hedgerows and thickets on agricultural lands because such border covers are productive and favored feeding grounds of bobwhites.[51] Rosene advocated the development of 15 to 60 foot wide grassy-weedy transition cover bands along borders of agricultural fields to provide nesting habitat, insects for chicks and adults in summer, and seeds in winter.[37]

Recent research in North Carolina and Virginia demonstrated that farms with 15-foot wide field borders of natural vegetation such as broomsedge, goldenrod, ragweed and blackberry had almost twice the number of fall coveys after one year of field border establishment than very similar farms without the field border treatments.[55]

Utilization of farm field edges for bobwhite habitat development is desirable for several reasons. Bobwhites naturally travel in this zone, feeding and raising young along field edges, and finding security in adjacent woodland or brushy hedgerows. Natural weed-grass field borders are valuable wildlife habitat in farm landscapes, and benefit bobwhites as well as numerous other birds and animals that use similar plant associations for raising young in summer and/or feeding in winter.

Field borders and filter strips of natural vegetation trap sediments, pesticides and nutrients contained in agricultural field runoff. Soil bacteria associated with the plants' root systems nitrify excess nitrogen fertilizers.[20] Field borders and filter strips are effective structures that minimize agricultural pollution. Crop monitoring for precision agriculture shows that field borders adjacent to tree lines are usually low crop yield zones where farming is not profitable. The zones are much more useful for achieving soil protection and water quality benefits as part of overall farm conservation efforts than farming them for minimal crop yields.

The typical sharp change from crop field to dense woodland offers little of what quail or other wildlife need. The vital natural weeds and grasses they depend on are absent or diminished in this environment. The poor habitat picture may be further complicated by the presence of sod-forming tame grasses that compete with native plants. Reproductive covers are severely limited, so bobwhites, if present, persist in chronically low numbers. The most important component that field border systems create in this landscape is additional reproductive habitat, a critical requirement for populations to expand. In North Carolina, farm fields with filter strips that occupied less than 10 percent of the area contained 44 incubated bobwhite nests, and comparable fields without filter strips contained nine incubated nests, a more than four-fold difference.[30]

Field border establishment may require nothing more than excluding the zone from cropping, allowing it to become fallow ground that grows natural weeds and grasses. Initial disking of the site during the dormant season will encourage the growth of plants most beneficial to bobwhites. Remedial herbicide treatment will be necessary if bermuda grass, bahia grass or fescue are present.

Field borders as narrow as 15 feet offer some benefits, but wider borders of 30 to 60 feet provide more usable quail habitat. A 30-foot wide field border around a 40-acre square field occupies a little more than 3 1/2 acres of land. That is not a lot of land to remove from cropping systems, especially since it is the least productive land for crops. While not as profitable for crops, it can be a very productive habitat zone for quail.

Bobwhites will begin using border covers for nesting during the first growing season of establishment, but two or three years of plant growth may be needed for the site to develop ideal nesting habitat that contains broomsedge. After three or four seasons of growth, habitat quality begins a rapid decline as plant growth changes, becomes too rank, and bare ground diminishes. Many of the annual plants and the bare ground that quail require will be

disappearing by this time. Perennial plants such as goldenrods and broomsedge become dominant, and trees and shrubs begin to invade. Routine management will be needed to maintain an appropriate mix of plant types.

Periodic ground disturbance is essential to expose bare ground and encourage production of annual seed-bearing plants on portions of the field borders. The majority of the border covers, however, should remain standing each year so that most of the zones offers suitable nesting habitat.

To maintain desired cover types and amounts, field borders should be managed with a rotational system of late winter or early spring disking. Disk one-fourth to one-third of an established field border system each year in convenient segments. A segment, for example, may be one side of a field. Rotate disking to an adjacent segment each following year. The rotational disking regime will perpetually maintain different stages and types of herbaceous plant growth that quail require. Without this routine management, field borders will lose their value for quail.

Annual plantings such as browntop millet and kobe lespedeza can be made in portions of recently disked field borders. Farm

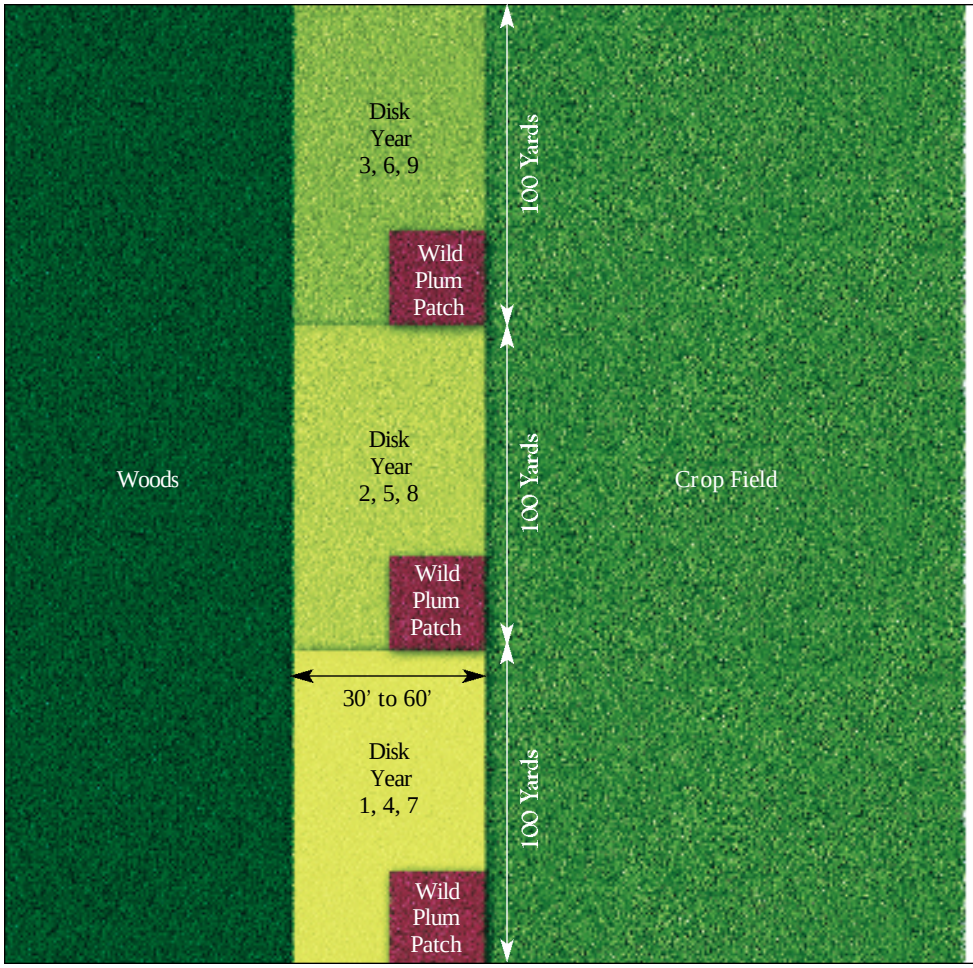
Field borders may also be established with planted native grasses.
STAN STEWART

Field border habitats are enhanced with the addition of shrub cover patches such as Chickasaw plums that provide loafing and protective cover for quail.
STAN STEWART

CRP CP33
HABITAT BUFFERS FOR UPLAND BIRDS

The U.S. Department of Agriculture announced its Northern Bobwhite Quail Habitat Initiative, effective October 1, 2004 through December 31, 2007, to restore bobwhite quail habitat to farm landscapes in 35 states across the bobwhite's range. This initiative is implemented through the USDA Farm Service Agency's highly popular Conservation Reserve Program with a new CRP practice, CP33 Habitat Buffers for Upland Birds. The practice will create critical nesting and brood-rearing cover for bobwhites and other upland birds by installing habitat buffers of native grasses and weeds along agricultural field borders. The habitat buffers will also reduce soil erosion, protect water quality and enhance overall farm conservation.

- Program sign-up at local Farm Service Agency offices will run on a continuous basis, meaning eligible land may be enrolled at any time.
- To be eligible for enrollment, land must have been cropped at least four years during 1996 to 2001.
- Contracts will last for ten years during which time landowners will receive annual rental payments of 120 percent of the rental rate for comparable land and a $5 per acre per year maintenance payment.
- Landowners also receive an up-front Signing Incentive Payment of $100 per acre, and 50 percent cost-share reimbursement for practice establishment plus an additional 40 percent Practice Incentive Payment for establishment costs.
- Habitat buffers must be established in natural volunteer herbaceous vegetation suitable for bobwhites or appropriate buffer vegetation may be planted if needed. Buffer species may include native warm season grasses, legumes, wildflowers, forbs, and limited shrub plantings.
- Buffers must be a minimum width of 30 feet and may be up to 120 feet wide.
- Buffer vegetation must be managed by:
    - Fall-winter disking of one-third of the buffer area each year in a prescribed rotational pattern.
    - Control of exotic grasses like tall fescue, Bermuda grass and bahia grass, and undesirable woody plants with herbicides as necessary.
    - Exclusion of buffer from use as an area for turn rows, roads, or equipment and crop storage.
    - Protection of habitat buffer from mowing, disking or other disturbance during the nesting season.



Field Border Management

1. Disk entire field border zone in fall/winter of year 0.
2. Plant wild (chickasaw) plum patches every 300'. Patches should be at least 30' x 30'. Protect from any disturbance.
3. Field border vegetation may be enhanced by planting 7-10 pounds per acre common ragweed or a mix of 7-10 pounds per acre ragweed and 5 pounds per acre partridge pea in late winter-early spring.
4. Manage herbaceous habitat and control undesired woody vegetation by disking 300' segments in rotation each fall/winter.
5. Control tame grasses (tall fescue, Bermuda grass, Bahia grass, Johnson grass) throughout field border with application of approved herbicide according to label.

machinery should not disturb field border covers except for scheduled management. Field borders should not be used as turn rows or disturbed any time during the nesting season.

The installation of natural weed-grass field border systems around fields, along ditches, beside field roads, along fencerows, hedgerows and tree lines will increase quail production on farm lands because it adds needed reproductive habitat in landscapes where little or none currently exists.

Protective Shrub Covers

Field border habitats are enhanced with the addition of shrub cover patches that provide loafing and protective cover for quail. Winter coveys will often establish a headquarters area and loafing site around one or more shrub patches.

Chickasaw plum, *Prunus angustifolia*, provides ideal protective cover for quail. Plum seedlings can be planted within field borders to establish protective cover patches. Patches should be at least 30 feet across. Space plum seedlings four feet apart at planting. Patches should be spaced about every 100 to 200 yards to be easily accessible to quail. Existing plum growth should be identified and protected from disturbance. Plum is very susceptible to fire and precautions should be taken to exclude fire with disked lanes around patches.

Shrub patches in field borders serve other useful functions. Once established, they form a permanent visible structure that demarcates the width of a field border system. It is easy for farm equipment operators to encroach on a stand of weeds. The permanent shrub patches help set the zone apart from farm operations. The established shrub patches also physically segment the field border systems for rotational disking patterns.

The establishment of tree corridors through agricultural fields creates quail habitat where none would otherwise exist. Tree corridors such as these young planted pines and associated field borders supply bobwhites with suitable year round habitat and increase the number of winter coveys in agricultural landscapes.
STAN STEWART

Tree Corridors

Natural grasses and weeds supply excellent summer range but generally do not afford enough protective cover for winter covey locations. More substantial plant structures are required in the

form of shrub covers and tree corridors. When coveys form in the fall, they will naturally select winter ranges associated with woody protective cover.

The establishment of tree corridors through large agricultural fields creates habitat for winter coveys across areas where none would otherwise exist. Tree corridors can provide a secure zone for birds to travel along and escape into. Corridors at least 100 feet wide provide better habitat and management opportunities than narrower strips that may not offer sufficient cover to hold winter coveys. The corridors should connect with existing woodland, except to allow for vehicle and equipment passage. Field borders with protective shrub patches should be placed along each side of the corridor.

For maximum bobwhite benefit, tree corridors should be spaced 100 to 200 yards apart and follow land contours. High populations of bobwhites can be expected where about half the land area is in fields and half is in woods or brush.[37] Tree corridors 100 yards wide separated by 100-yard wide fields would create this habitat composition for quail, as well as provide substantial land in timber production.

Pine tree plantings develop woody corridors quickly. They must be planted in a manner that permits ground and shrub covers to also establish and continue to grow in the corridor. Ten or more rows of trees spaced 10 feet apart, with individual trees planted eight or 10 feet apart in the row, will create cover suitable for winter coveys. This spacing is open enough to prolong other plant growth as the trees become dominant and still allow self-pruning of loblolly and slash pine timber. Establishing a relatively wide corridor also contributes to useful timber production from the zone, with more interior rows of better formed trees.

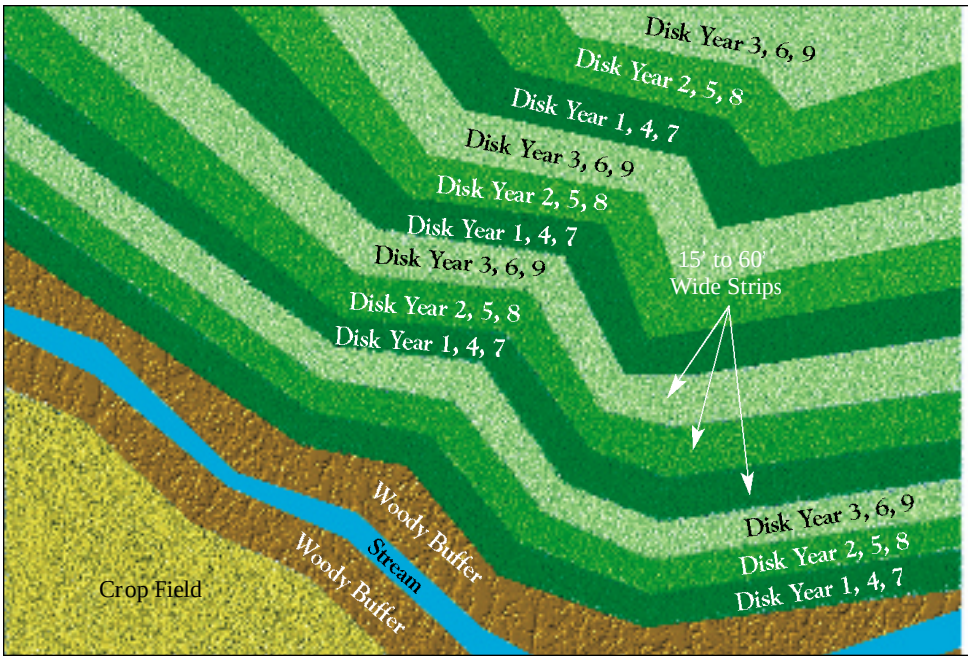
Longleaf pine is the most desirable pine species to plant for bobwhites, where feasible. Its small crown size allows more sunlight and weed growth within the tree corridor. Other pine species require early thinning to maintain an open canopy. Longleaf can be planted on wider spacings than other pines and still develop good tree form, due to its fewer limbs. Longleaf plantings on 12-foot by 12-foot spacings (302 trees per acre) create open stand conditions favorable to quail and other wildlife. Additionally, longleaf is very tolerant of fire except when emerging from the grass stage, and this permits early and frequent fire management of ground covers.

Whole fields or substantial portions of them in natural grasses and weeds provide more summer range and better quality reproductive habitat than field borders only.
STAN STEWART

Tree canopies must remain open for optimal bobwhite use. Canopy closure will shade out needed food and cover plants. Prescribed burning is also necessary to maintain appropriate cover conditions. With correct development and management, tree corridors and associated field borders with protective shrub covers will supply bobwhites with suitable year round habitat and increase the number of winter coveys.

Fallow Fields

Dividing large agricultural fields into a series of small fields introduces an opportunity for a system of rotational cropping and temporarily idle lands. A system such as this could approximate the patch farming regimen that formerly produced high quail populations. Whole fields or substantial portions of them in natural grasses and weeds provide more summer range and better quality reproductive habitat than field borders only. For maximum bob-



Fallow Field Management

1. Disk a strip 15'-60' wide through fallow herbaceous vegetation in fall/winter in year 1, following land contour.
2. Leave standing vegetation twice the width of the disked strip.
3 Repeat disked /undisked pattern across field.
4. Disk new strips adjacent to old strips in subsequent years.
5. Control tame grasses (tall fescue, Bermuda grass, Bahia grass, Johnson grass) throughout the field with application of approved herbicide according to label.

white habitat development, given fields should be cropped about once every three years, with other fields in varied stages of natural weed-grass cover. A pattern of cropped and idle fields can be designed based on this rotation period. An alternative to this system is rotational strip cropping or strip disking within selected fields.

Idle field utilization by nesting bobwhites is enhanced with the inclusion of strip disking because bobwhites prefer to nest along edges near bare ground.[36] Periodic disturbance of idle fields is required to maintain appropriate plant composition. Strip disking can be performed any time from fall to early spring to encourage desired plants and not interfere with nesting. Disk strips 15 to 60 feet wide through idle fields. Separate them by bands of standing cover that are two or three times the width of the disked strip. In subsequent years, disk new strips adjacent to strips that were disked the previous year. Such a pattern of rotational strip disking will perpetually maintain idle fields in a plant composition that is ideal for bobwhite reproduction.

MANAGEMENT PRACTICES FOR PASTURE LAND

Improved pastures and hay fields of tame grasses such as tall fescue, Bermuda grass and bahia grass provide extremely poor habitat for quail because they rarely exhibit the physical plant structure and composition required for quail survival at any season of the year. Tall cover with bare ground underneath is lacking, and food producing plants are eliminated. To support quail in appreciable numbers, these landscapes require eradication of tame grasses, conversion to more quail friendly land use, and habitat management on those areas where quail are desired.

Alternative pasture management that includes native warm season forage grasses in the grazing system offers potential habitat for bobwhites. Eastern gammagrass, switchgrass, indiangrass, sideoats grama, big bluestem, and little bluestem are examples of warm season grasses with a widespread natural range that includes Alabama. They are found naturally in prairie and savanna landscapes. Native grasses produce excellent cattle forage and are still the primary grazing plants of the Great Plains rangelands. Their current natural occurrence in Alabama and the Southeast is greatly reduced due to past overgrazing, introduction of tame grasses, agricultural development and fire protection. Native warm season grasses can still be seen in varying amounts in open woodlands with a long fire history, such as quail plantations, and along roadsides that are not dominated by tame grasses.

Pasture management that includes native warm season forage grasses offers potential habitat for bobwhites.
STAN STEWART

Native grass pastures that are rotationally grazed or properly hayed contain plant cover tall enough for bobwhites to use for nesting.[7] The grasses generally grow in clumps with bare ground between, a plant structure that is attractive to quail. Specialized equipment and techniques are necessary for establishment of some native warm season grasses. Native grasses cannot withstand overgrazing because removal of too much leaf growth weakens the root systems. Landowners should closely follow recommended planting and cultural practices to grow native grasses successfully.

Grazing systems that include legumes, especially kobe and common lespedeza, also provide habitat for bobwhites. Kobe and common lespedeza produce insects for broods during summer and seed for winter food.

Improved pastures and hay fields of tame grasses such as tall fescue, Bermuda grass and bahia grass provide extremely poor habitat for quail.
STAN STEWART

CONTROLLING PASTURE GRASSES WITH HERBICIDES

TALL FESCUE

- 2 Quar ts/Acr e Roundup Ultra (Glyphosate)
- 6.4 Ounces Nonionic Sur factant
- 10 Gallons/Acre W ater

Mow or burn fescue in late winter for spring kill or late summer for fall kill. Apply herbicide uniformly with ground spray equipment when plants are vigorously growing and fescue leaves are 8-12 inches tall. Applications made at time of seedhead production will be less effective. Do not mow or disturb site for at least one week after treatment. Follow-up with periodic spot treatments as needed.

BERMUDA GRASS

- 18-24 Ounces/Acre Arsenal Applicators Concentrate (Imazapyr)
- 3.2 Ounces Nonionic Sur factant
- 10 Gallons/Acre W ater

Mow or burn Bermuda grass prior to treatment to insure herbicide contact with actively growing plants. Apply herbicide uniformly with ground spray equipment when plants are vigorously growing and before seedhead production occurs. For best effect do not disturb the site during the remainder of growing season. Follow-up with periodic spot treatments as needed. Arsenal is foliar and soil active and may kill nearby trees or shrubs by root absorption. Residual soil activity may continue for several months.

BAHIAGRASS

- 0.33-0.50 Ounces/Acre Escort XP (Metsulfuron Methyl)
- 3.2 Ounces Nonionic Sur factant
- 10 Gallons/Acre W ater

Mow bahiagrass prior to treatment to stimulate new plant growth. Apply herbicide uniformly with ground spray equipment when plants are vigorously growing and before seedhead production occurs. For best effect do not disturb the site during the remainder of growing season. Follow-up with periodic spot treatments as needed. Escort is foliar and soil active and may kill nearby trees or shrubs by root absorption. Residual soil activity may continue for several months.

JOHNSON GRASS

- 1.33 Ounces/Acre Outrider (Sulfosulfur on)
- 6.4 Ounces Nonionic Sur factant
- 10 Gallons/Acre W ater

Mow Johnson grass at least two weeks prior to treatment to stimulate new plant growth. Apply herbicide uniformly with ground spray equipment when plants are vigorously growing and before seedhead production occurs. Do not mow or disturb site for at least two weeks after treatment. Follow up with periodic spot treatments as needed. Outrider is a selective herbicide that may be used over the top of native warm season grasses. Outrider is foliar and soil active, although soil activity lasts for only about two weeks.

In addition to suitable grasses and other herbaceous plants, pastures require adequate protective cover to support bobwhites year round, especially during winter. Open pastures require islands of woody cover, at least one-fourth acre in size, protected from grazing,[37] or corridors of shrubby escape cover.

MANAGEMENT PRACTICES FOR FOREST LAND

Forest Conditions That Favor Quail

The general structure of productive quail habitat in southeastern forest consists of open pine woodland with a distribution of small fields and adequate dispersion of thicket cover through-

Productive quail habitat in southeastern forest consists of open woodland with native grass-weed groundcovers.
STAN STEWART

To support an abundance of quail, forests must be open enough so that about half of the ground area receives full sunlight at mid-day. This allows the growth of grasses and weeds that quail require for reproduction and food.
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Pine Forest with Basal Area of 40 or less permits an optimal environment for quail
STAN STEWART

Pine Forest with Basal Area of 60 permits a favorable environment for quail
STAN STEWART

out the habitat. The open woodland and field edges should be managed for nesting habitat and winter range. The small fields can be managed primarily for brood habitat.

Although most forestland in Alabama is poor quail habitat, pine forests can be excellent habitat when managed with period-

BASAL AREA AND TREES PER ACRE BY DIAMETER AT BREAST HEIGHT

BASAL AREA (Square Feet)			
	40	60	80
DBH (Inches)	TREES PER ACRE		
5	293	440	587
6	204	306	408
7	150	224	299
8	115	172	229
9	91	136	181
10	73	110	147
11	61	91	121
12	51	76	102
13	43	65	97
14	37	56	75
15	33	49	65
16	29	43	57
17	25	38	51
18	23	34	45
19	20	30	41
20	18	28	37

Pine Forest with BA of 40 or less permits an optimal environment for quail
Pine Forest with BA of 60 permits a favorable environment for quail
Pine Forest with BA of 80 or greater af fords a poor environment for quail

Pine Forest with Basal Area of 80 or greater affords a poor environment for quail
STAN STEWART

ic thinnings and prescribed burning. The forest must have an open canopy to support quail. The tree canopy should be open enough to allow about half of the ground area to receive full sunlight at mid-day. This will allow the growth of grasses and weeds that quail require for reproduction and food.

Tree covers compete with herbaceous ground covers for sunlight, water and nutrients, so tree stocking must be reduced for desired quail food and cover plants to grow. In silvicultural terms, the stand should be managed at a basal area of 40 to 60 square feet per acre or less, depending on pine species. (Basal area is the cumulative cross sectional area of each tree within a given land area; the trees are measured at breast height, 4.5 feet above ground). For example, a stand of 14-inch diameter trees managed for optimal quail habitat would have no more than 37 to 56 trees per acre. The same stand fully stocked for timber production would have 75 to 85 trees per acre.

Longleaf pine has a small crown with fewer limbs compared to other pine species. For this reason, it is well suited to quail management in forests. Stands of longleaf can be managed at the upper

Longleaf pine forest is well suited to quail management because stands can be managed with open canopies and frequent fire.
STAN STEWART

recommended stocking, about 60 basal area, and still maintain the open canopy necessary for bobwhites. Longleaf is also very tolerant of the regular burning required in quail management. Where applicable, and in its range, longleaf is the preferred timber tree when quail are also managed. Because loblolly and shortleaf pines have large spreading crowns, they must be carried at lower stockings of about 40 basal area or less to maintain open canopies. Slash pine crowns are intermediate in size between longleaf and loblolly, and stand densities can be managed accordingly.

Bobwhite numbers are generally very low in hardwood forests because the heavy canopy typical of hardwood stands shades out ground covers required by quail. For these landscapes to support quail, the hardwoods must be thinned and managed as a hardwood savanna or converted to open pine forest managed for quail.

Thinned Forest Corridors

Forest landowners may not want to give up optimal timber production to create quail habitat in all stands. When thinnings are made, selected locations can be thinned to the stand conditions suitable for quail. A thinned forest zone as narrow as 100 feet wide can create usable quail habitat. Thinning forest edges that are adjacent to established field borders will increase available nesting habitat and winter covey ranges. Thinnings along forest road systems create open forest corridors of quail habitat in woodland. To be effective, enough trees must be removed so that the thinned zones retain open canopies. Routine prescribed burning and other quail habitat management applicable to open forest must be performed.

When commercial thinning operations begin, loblolly plantations managed for quail should be thinned to about 100-150 trees per acre.
STAN STEWART

Permanent Forest Openings

A distribution of forest openings created in connection with open woodland areas can provide year-round quail habitat that includes nesting cover, brood rearing areas, feeding areas and winter covey ranges. With appropriate management, bobwhites will nest in field borders and open woods near fields, raise broods in the fields and open woodland, and establish winter covey ranges in the same general landscape.

Ideally, 20 to 40 percent of the quail range should be in three- to five-acre fields that are evenly distributed over the forest landscape. A field 100 yards wide and 200 yards long will occupy about 4 1/8 acres. Small fields of this size distributed at a rate of one per 20 acres will occupy about 20 percent of the land and can create many new quail ranges in forest land.

Twenty to forty percent of the quail range should be in three to five acre fields that are evenly distributed over the forest landscape. Fields located in open woodland should be managed primarily for brood habitat.
STAN STEWART

Fields located in open woodland should be managed primarily for brood habitat. Ideal quail brood habitat is composed of annual weeds, plants that grow one year and come back from seed. The plants must be attended to every year to keep them coming back. A mixture of common ragweed and partridge pea provides excellent habitat for quail broods. Annual dormant season (October to March) disking promotes and maintains a summer ground cover of these desired annual plants that offer protective cover and attract insects for quail broods.

When disking, leave a 30-foot or wider band of vegetation standing along a border of the field to provide some cover for quail during spring and early summer while the disked areas are re-growing sufficient cover. In spring, fruiting of dewberries and blackberries, seeding of early maturing grasses and weeds, and insect pro-

A mixture of common ragweed and partridge pea provides excellent habitat for quail broods. Ragweed volunteers well on most sites disturbed by fall-winter disk - ing, and seed can also be planted. Disk and fertilize fields, then broadcast ten pounds per acre common ragweed seed and lightly cover in late winter or spring. Disk annually in fall-winter to maintain stand.
STAN STEWART

duction will occur in the border cover. All are foods that will be utilized by nesting hens and early broods. Early nesting activity may also occur in this band. The cover band should alternate to the opposite field border the following year to maintain suitable cover composition.

Delaying the disking of some fields or portions of fields to late winter allows quail coveys to utilize the covers for feeding and security as part of their fall and winter range. Quail eat ragweed seeds in the fall, and the hard seeds of partridge pea are used later in winter when many other seeds are gone. Delayed disking, however, also means that new cover growth is not as advanced in spring and summer when hens are searching for brood habitat. A combination of fall disking and late winter disking provides the most diverse benefits in annual weed fields.

Hardwood brush quickly dominates open forest and crowds out herbaceous plants that support quail. Frequent prescribed fire is the best tool to control dense brush. This stand was not burned for four years.
STAN STEWART

Common ragweed volunteers well on most disturbed sites, but can be planted to rapidly develop a field for brood habitat. Fertilization of ragweed fields during early spring, especially on poorer soils, will stimulate more rapid weed growth and provide well-developed, secure cover for early hatching broods.

Portions of fall disked fields can be planted in winter grains such as wheat, oats, and rye for deer forage crops if the planting rates are reduced by one-third. Conversely, deer forage plots can provide brood habitat for quail if allowed to grow up in weed covers during summer.

Fields located in dense woodlands have reduced value to quail. Essentially, the fields are the only usable habitat, especially as reproductive range. Such fields can be managed with strip disking to supply nesting habitat, brood range and some natural food production. Quail production may be poor in these small and isolated habitats.

Open Canopy Forest

Open canopy forest can supply bobwhites with nesting habitat, brood range and winter covey ranges. As described earlier, the tree canopy must be open enough to allow half or more of the ground area to receive full sunlight at mid day. Herbaceous ground covers that quail require for reproduction and food can grow profusely in these open forest conditions. Hardwood brush and sprouts also grow rapidly. Without control, they quickly dominate the site and crowd out the herbaceous plants that support quail.

Prescribed Burning

Prescribed burning is the best tool to control dense brush and maintain a favorable environment of grasses, weeds and scattered shrubs that quail use for nesting, food and protection. To achieve a burn that benefits quail, the tree canopy must remain open so that ground covers can grow following the burn. Also, burning should be repeated often, with some burning done each year to adequately control hardwood brush and to favor grasses and weeds.

Most successful quail nests are located in one-year-old broomsedge cover because it has the desired characteristics for

When prescribed burning, care must be taken to leave unburned grassy cover on well-drained upland sites for spring nesting. Twenty-five to fifty percent of the quail range should be in well distributed unburned upland spring nesting cover.
STAN STEWART

nest construction and concealment. Care must be taken to leave some of this cover unburned on well-drained upland sites for spring nesting. These sites should be at least two or three acres in size, preferably near open fields managed for brood habitat. Ideally, 25 to 50 percent of the quail range should be in well distributed unburned upland spring nesting cover.

Nesting cover can be excluded from fire by utilizing roads, streams, or constructed firebreaks around selected locations. Firebreak establishment should begin well before actual burning so that enough locations for fire exclusion are planned and installed.

To maintain proper cover characteristics, unburned sites should escape fire only one year. Different sites for nest cover retention should be selected the following year. If the same sites were habitually excluded from fire, the cover would advance to stages of plants unsuitable for nesting. Hardwood brush would soon take over and become difficult to control.

Annual burning that leaves selected unburned areas each year for early nesting activity is the preferred approach on most quail ranges. Biennial burns are practical if burn units are around 60 acres or less and adjacent units are alternately burned.

Generally, prescribed burning should be conducted in late winter and early spring. Spring burning when plants are growing can control hardwood brush, but may also destroy early sprouting legumes which produce important quail foods. The timing of burns can be varied between the growing season and dormant season to maintain the herbaceous plant types that quail require. Locations dominated with hardwood brush may benefit from growing season burns done in May or later. Sites with mid-story hardwoods will require mechanical clean-up and/or herbicide treatments followed with a fire regime.

Extensive burning leaves few spring nesting sites for quail. In rolling terrain particularly, fire cleanly burns the upland covers that are preferred for nesting. Fires burn less intensely along drainages, and some cover remains intact. Quail will nest in these locations, but the nests are vulnerable to flooding and predation.

The insidious effects of excessive burning are not immediately apparent. Since bobwhites are indeterminate nesters, they will attempt nests throughout the summer when weather is favorable. If they are unsuccessful in early nesting, later attempts can still result in good reproduction. Success is characteristically low for nests constructed prior to July on areas burned in the spring.[43] The covers normally grow back rapidly after the burn and may be suitable for nesting by July. Reproduction may still be good to excellent on these areas if favorable weather occurs, with normal to above normal rainfall. Production declines, however, if hot and droughty weather prevails. Early nest production is poor by reason of over-burning. Late production does not materialize because of heat and drought. Effectively, there has been little or no nesting season. During continuing drought years, the quail population declines severely with the excessive burning regimen. This limiting factor may not be apparent because the habitat continues to look excellent during hunting season. The scarcity of birds is the

The herbaceous groundcovers that follow late winter and spring burns in open woods supply excellent brood range for quail. By mid-summer the plant growth is tall enough to protect broods and conceal late nests. The cover will be ideal for nesting the following spring if left unburned.
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The quail range should include a good dispersion of thicket cover, with one to three shrub thickets for each covey range. STAN STEWART

only clue, but excessive burning is often not recognized as a reason for the poor production.

Protective Cover

The quail range should include a good dispersion of thicket cover, with one to three shrub thickets for each covey range.[37] Such sites will often serve as covey headquarters, particularly as weed and grass covers thin during winter.

Chickasaw plum patches can be established along the borders of forest openings. Plums should be established and managed as previously described. Naturally occurring plum growth should be noted and patches excluded from fire with disked lanes. If undisturbed, plum patches will last for many years and retain the characteristics attractive to quail.

Bobwhites also use thickets of Japanese honeysuckle as headquarters or activity centers, often for loafing and roosting.[58] Honeysuckle thickets should be retained.

Reforestation and Regeneration

Fields and harvested woodlands established to pine plantations support quail during the first few years of the new forest when natural weeds and grasses are dominant. As the tree canopy closes, ground covers are shaded out, reproductive habitats are lost, and few quail are present for many years. If continued quail production is desired on these sites, management practices must be planned prior to stand establishment.

Plantations established on pastures or hay fields will require herbicide treatment prior to tree planting to eradicate tame grasses adverse to quail. Agricultural fields with a history of Bermuda grass must be inspected and the Bermuda grass controlled prior to tree planting. Band spraying only the tree rows to control grass competition is not adequate.

Tree planting rates should be modified to delay canopy closure. Loblolly pine trees planted on 8-foot by 10-foot spacings (544 trees per acre) create a well stocked but relatively open stand that permits growth of ground covers suitable for quail. Longleaf pines planted on 12-foot by 12-foot spacings (302 trees per acre) create a forest environment that may remain favorable for quail throughout the life of a managed stand.

Permanent openings should be planned. At least one four-acre field for each 20 acres of land (20 percent in openings) is needed to allow for good quail production. Fields should be well distributed through plantations. Their locations should be determined and marked on the ground prior to tree planting operations. Open corridors through stands can be developed as an alternative. Leave at least 20 percent of the land area open in 100-foot or wider corridors. If trees are planted in 10-foot rows, a pattern of 40 rows of trees separated by the equivalent of 10 unplanted rows will create the desired open land.

Initially, nesting habitat will develop in the young pine stands. The fields or corridors can be managed with annual disking to supply brood habitat. Nesting habitat will be lost after a few years if the tree canopy closes. The openings will become critical for all reproductive habitat requirements, and the management regime should be modified. In this circumstance the best approach is to rotationally disk one-third of each field/corridor annually. This will permit some of the cover to advance to a stage of perennial bunchgrass (broomsedge) for nesting, while a portion of the site is maintained in annual weeds.

Thinning operations should be conducted in closed-canopy pine plantations as early as practicable. A stand with an open tree canopy that allows about half of the ground area to receive full sunlight at mid-day can support good quail populations. Following this rule, a loblolly pine plantation with six-inch diameter trees should be thinned to about 200 trees per acre. A stand of eight-inch diameter loblolly pine should be thinned to about 115 trees per acre. A prescribed burning regimen will be necessary to manage groundcovers after the tree canopy is opened.

FOOD PROVISION AND FEEDING AREAS

Natural Foods and Feeding Areas

Bobwhites utilize a variety of foods throughout the course of a year. Chicks and adults require an abundance of insects, fruits and seeds in summer. The bulk of the bobwhite winter diet is made up of seeds of a variety of forbs (broad-leaf herbaceous plants), legumes in particular. Their winter range, therefore, should be managed to produce an abundance of such plants.

As previously noted, natural food production, particularly of the seed-bearing plants used in winter, can be an inherent result of other habitat development practices. Plants that offer necessary seasonal covers may also produce fruits and seeds. Practices that develop and maintain appropriate cover composition, such as prescribed burning and disking, also promote growth of natural foods. Many natural food producing plants are also cover plants on the quail range. This is the desired condition because birds can feed in their normal covers in relative security.

A prerequisite to abundant natural food production on the quail range is the development of open land and open canopy forest because most quail food plants are not tolerant of shade conditions and require almost full sunlight to grow. Dense forest and extensive brush are unproductive of quail. Thinning operations must be conducted to maintain open forest conditions. A substantial portion of the quail range must be in open lands to permit growth of quail food and cover plants and to achieve adequate responses to ongoing management practices.

Disking and prescribed burning are simple tools that encourage growth of natural quail foods in profusion when correctly and systematically applied. Conversely, when applied haphazardly without an understanding of the plant regime bobwhites need, the effect will likely be more destructive than beneficial.

Normal plant succession is such that bare, disturbed ground is initially colonized by annual plants. In following growing seasons, perennial grasses gradually replace the broad-leaf plants and eventually dominate the site. This may happen as early as three or four years after disturbance in Alabama. Bobwhites require both herbaceous plant types. The grasses provide nesting habitat, screening cover, roosting sites, and some seed. The broad-leaf plants produce most of the seed and fruits and attract most of the insects on which bobwhites depend. Management must balance these plant

components to create natural food supplies that will carry bobwhites year-round and provide other critical needs.

Annual groundcover disturbance produces bobwhite food plants in great abundance. However, if all of the bobwhite range were subjected to annual disking and burning, nesting habitat supplied by perennial grasses would be in disastrously short supply. The practices must be systematically applied to balance natural food supplies and nesting habitat. Food producing plants and productivity of the quail range decline rapidly in the absence of systematic disturbance.

Disking encourages seed-bearing plants used by quail, especially when performed from fall to early spring. Annual fall/winter disking of the same site (as in small fields managed for brood habitat) will create annual plant communities of just a few species, primarily common ragweed and partridge pea. Disking on longer rotations (strip disking of fields and open woodlands) will develop more varied plant communities composed of annual and perennial plants. Both methods should be employed on the quail range to produce a diversity of food plants.

Prescribed burning promotes production of legumes and other quail food plants. Burning controls competing plant growth, removes ground litter and dead vegetation, exposes mineral soil, scarifies seeds and thereby encourages abundance of seed-bearing plants. However, fire can also destroy quail food plants. Annual fire will diminish food producing plants, particularly the legumes, when applied after the plants have sprouted and are actively growing. To minimize injury to legume production, it is best to finish the burning of uplands by early March.[51] But, this must be balanced against the need to perform the amount of prescribed burning necessary to properly manage the quail range.

Annual fire is necessary to maintain appropriate plant associations, but substantial portions of the quail range must remain unburned for spring nesting. This is also the appropriate management regime for soft mast such as blackberries and dewberries. Because these plants require a year of growth before first bearing fruit, they must be permitted to escape fire at least one season for fruit production. Portions of field borders that are reserved from disking will similarly produce blackberries and dewberries.

Plantings

The values of plantings for bobwhite quail are generally summarized by the example of the widespread application of *Lespedeza bicolor* as a quail management practice. Rosene performed an extensive appraisal of the use of bicolor plantings as a quail habitat improvement. He determined that the seeds were a preferred winter food of bobwhites and tended to attract and localize coveys in winter. As a management measure, however, the plantings did not increase quail populations. Such plantings might result in excessive harvest on areas where hunting pressure is high. He concluded that other factors, particularly the availability of nesting cover, had greater effect on quail populations than presence or absence of bicolor.[36]

The establishment of plantings, food patches and food strips should not be primary in bobwhite habitat management. They generally do not produce additional quail in the environment. Their effect is to attract and provide an additional food source for winter coveys. The value of plantings is often over estimated because quail are often located in and near food strips and are very visible in these locations. Plantings have utility but must not replace more important management actions.

Planting operations during the nesting season can destroy nests. Planting sites should be prepared for seeding, at least by predisking, prior to the onset of nesting season to minimize nest destruction. Cultural practices for selected plantings are listed in the *Appendix*.

Direct Feeding

Direct feeding is occasionally employed to improve quail survival and/or reproduction and assumes that lack of food is a population limiting factor. Supplemental feeding only addresses food supply limitations and cannot compensate for other habitat deficiencies.

Environmental conditions can cause poor natural food production and availability in otherwise favorable habitat. Poor production of bobwhite winter foods is generally associated with summer droughts, but other circumstances also create food shortages. A severe quail population decline in Texas was attributed to winter food deficiency. In this case, excessive summer rains encouraged growth of grasses that were suitable for quail reproduction, but which limited the growth of plants that produced winter foods.[23] A bobwhite population decline occurred in western Tennessee due to loss of a winter food supply. Mild weather caused mid-winter sprouting and deterioration of waste soybeans, resulting in a sharp population decline after the loss of this staple winter food.[15]

The success of feeding programs varies, depending on natural food availability and other necessary habitat components. In south Texas, feeding increased winter survival of quail on deep sand sites where food production was poor, but did not improve survival on more productive sites.[17] Quail feeders did not increase bobwhite survival or populations in an Oklahoma study.[11]

An intensive quail feeder project in Alabama determined that feed had little effect on a quail population in habitat that was unmanaged and in a stage of plant succession not very productive for quail.[24] Feeders were distributed over 2,000 acres at a rate of one for each 40 acres, and were maintained with scratch feed (cracked corn and wheat) year-round for 3 1/2 years of study.

Studies on quail plantations with high quality habitats in southwest Georgia documented higher winter survival of quail with access to supplemental feed from October to June, especially in years with poor native food and cover resulting from drought. Higher survival was due to reduced daily feeding movements that lessened exposure to predators. Fed birds entering breeding season weighed more, and had a higher reproductive output, with more nests and chicks per hen than unfed birds.[47]

Supplemental feeding throughout the year on quail plantations in northwest Florida resulted in earlier nesting, a longer nesting season, and more nests per hen than areas without feed.[29] Feeding appeared to reduce the impact of weather (drought) on reproductive performance, and also increased production during a normal weather year.

Supplemental feeding has been demonstrated to benefit quail populations in terms of survival and reproduction in some instances. Supplemental feeding should not divert the attention of quail managers from a comprehensive habitat management program that addresses all of the bobwhite's life requirements at each season of the year.

Water

Bobwhites require water for survival and reproduction. However, free ranging bobwhites generally do not require or regularly utilize surface water.[51] Succulent leaves, fruits, seeds and insects in their diet supply water in varied content, and some water is created when food is metabolized.[19] Bobwhites also acquire water in the form of morning dew by moving the open mandible along moisture-laden grass blades, collecting water drops into the lower mandible.[49] For these reasons, the provision of surface water is not a concern in bobwhite management in Alabama.

Chapter 6

PREDATION AND PREDATOR MANAGEMENT

PREDATION

By all accounts, most of the individuals in a bobwhite population live less than one year. The proportion of juveniles in fall populations is typically 70 to 80 percent, as determined by age ratio analysis of hunter harvested birds. Recent radio telemetry studies of declining bobwhite populations in current landscapes have shown annual mortality in excess of 90 percent.[5,9] Telemetry has demonstrated that most bobwhite deaths occur from avian and mammalian predators, which may cause more than 80 percent of annual mortality.[45]

About two-thirds of the bobwhite mortality that occurs in winter is caused by raptors. Predation by mammals increases during the nesting season.
TED DEVOS

During winter months, raptors may account for two-thirds of bobwhite losses.[31] Cooper's hawks and the less numerous sharp-shinned hawks are the most efficient quail predators,[51] but other raptors such as red-tailed hawks, red-shouldered hawks, and the various species of owls also capture quail.[41,45]

Avian predation of quail remains high,[12,41] and predation by mammals increases during the bobwhite's breeding season.[5,9] Predatory mammals may account for more than 40 percent of adult summer mortality.[12] Bobwhite males call from exposed perches during breeding season, and consequently suffer higher losses to raptors during summer than do females.[5] Bobwhite females experience physiological strains from laying and incubating eggs and become increasingly vulnerable to predators as renesting occurs.[41] Overall, summer mortality of adult males and females does not differ.[5] Some 30 to 60 percent of the adult bobwhites alive at the beginning of breeding season die by autumn, largely a result of predation.[12,41]

PREDATOR MANAGEMENT

Conflicting professional opinions exist about the ecological impact of predators on bobwhite populations, though all agree that predators are the major cause of mortality. Consequently, recommendations about predator management vary. Stoddard recommended rational and intelligent control of the worst natural enemies of the bobwhite as a requisite of any program to build bobwhite populations, and reasoned that control of natural enemies was needed to offset losses to hunting.[51]

This, however, is not to say that bobwhite numbers cannot increase without predator control. Rosene cited examples of rapid bobwhite population increases in response to habitat management, with no efforts to control predators; as well, he described an example of intense predator control that did not improve bobwhite numbers in habitat not highly favorable to quail.[37] He concluded that predator control is generally not recommended in quail management, and instead emphasized improving the bobwhite's environment.

An analysis of the effect of hunting on bobwhite populations indicated that populations can stabilize at different levels across a range of harvest regimes.[34] Hunting is a form of predation, and it is reasonable that natural predation can cause similar population responses.

Improvement of bobwhite environments and expansion of those environments in the landscape are without question the foundation of quail population increase. Habitat management can create quail abundance suitable to many. In circumstances where intensive quail management is the goal, predator management is an additional tool. Researchers monitored nest predator abundance and productivity of radio tagged bobwhite hens on northwest Florida quail plantations. On sites where mammalian predator abundance was low, bobwhite productivity ranged from 60 to 90 successful nests per 100 hens alive on April 1. On a similar site with relatively high abundance of nest predators, hen productivity was only 16 successful nests per 100 hens.[27] A Tennessee study determined that total nest production provided the strongest correlation with December bobwhite population densities.[15] The management of nest predators can increase the production of bobwhite nests and broods, and elevate bobwhite population densities.

Many predators of quail utilize hardwood trees for nesting and denning. Mechanical removal of upland hardwoods on ranges managed for quail has been shown to reduce quail predator abundance and increase bobwhite survival and reproduction.
TED DEVOS

To increase quail abundance, Stoddard recommended reasonable and rational control of major bobwhite nest predators, such as raccoons, opossums and skunks, by trapping and hunting.[51] He stressed that such efforts must be continual to be effective. Trapping and hunting impact only certain quail predators and may alter the incidence of nest depredations by other species. Predator management must be conducted in accordance with state and federal wildlife laws and regulations. All raptors are protected by federal and state law. Mammalian predators may be trapped and hunted according to state seasons and regulations.

Predator populations can be managed through practices that create habitat types suitable for quail and that remove habitats favoring predator species. Many of the major natural predators of quail, such as Cooper's hawks, owls, snakes, raccoons and opossums, utilize hardwood trees for nesting and denning. The hardwoods also create shade conditions and prevent the growth of groundcovers that bobwhites require. Removal of canopy level and mid story hardwoods on ranges managed for quail has been demonstrated to improve habitat conditions for quail and reduce predator abundance.[48] Bobwhite adult survival, nest production, nesting success, and brood survival improved dramatically following mechanical hardwood removal on research sites in southwest Georgia.[46]

Chapter 7

HUNTING

HUNTING AND HARVESTS

Traditional views have been that hunting has no impact on small game populations that experience high annual turnover. Since most of these animals die annually, they may as well be utilized through hunting. This view is sound up to a point. Animals experience mortality, hunted or not. So, it is certainly not unsound to propose hunting as a means of utilizing a portion of the population that will be lost anyway. The view becomes unsound when an assumption is made that hunting mortality can entirely replace all other forms of mortality.

It is an error to assume that hunting mortality entirely compensates for natural mortality or that small game populations cannot be over hunted. Even though annual mortality rates may be similar in hunted and non-hunted populations, seasonal mortality rates differ. Most mortality occurs before breeding season in hunted populations, so these individuals do not contribute to reproduction. Non-hunted populations experience higher mortality during breeding season, and more birds reproduce before death.[33]

Relationships between bobwhite winter losses and hunting were documented in the Southeast. On a quail plantation in Alabama where annual hunting harvests were very restricted, mortality in winter (November 20-March 1) averaged about 13 percent. On a heavily hunted plantation in South Carolina, winter losses averaged 57 percent.[37] Hunted bobwhite populations in North Carolina experienced direct hunting mortality that averaged 14 percent, lower survival (45 percent) in winter (November-February), and lower summer whistle count indices than unhunted populations (67 percent winter survival).[32]

A long-term bobwhite investigation in Illinois led researchers to conclude that hunting mortality only partially compensates for other losses.[34] In addition, the later in winter that hunting losses occur, the more additive they become since a bird removed from the population in late winter would most likely have become a breeding bird. Population modeling indicated that hunting tended to reduce long-term bobwhite population densities compared to a nonhunted population, even though hunted populations might remain stable at lowered densities. The modeling indicated that harvests at or below 40 percent of the fall population caused only moderate reductions (14 percent) in long-term population levels.[33] The calculation of a "safe" harvest is not easily done because population levels and environmental conditions vary each year. Bobwhite populations exhibit density dependence, a process in which populations of low density are more productive than high density populations. This process influences the effects of hunting on quail populations.[19]

The abundance of wild bobwhites on some quail plantations illustrates the value of an environment optimally managed to produce quail. The quail populations are carefully guarded in all aspects, including harvest. Annual harvests are often less than 10 percent of the fall population. Such an approach contributes to long-term quail abundance. Some would consider this approach an under utilization of the resource since higher harvests could be sustained over time. However, the goal for such areas is not maximum harvests, but rather, maximum covey encounters as a measure of a quality hunting experience. Conversely, lands subjected to high harvests will exhibit a lower threshold of bobwhite abundance. The trade-off between high harvests and high bobwhite abundance is real. In the purest sense, quail hunters cannot have their birds and shoot them, too. If the goal is to maintain highest population levels, then high harvests are not compatible with that goal. Managers and hunters must take this reality into account when choosing harvest strategies.

The practice of limiting quail harvests by shooting coveys down to a predetermined level, such as six or eight birds, is not necessarily a sound conservation measure. As a method to limit harvests, it could actually result in over-shooting. Hence, the individual covey is not the appropriate focus for harvest limitations. This is because coveys tend to maintain a certain functional size. As coveys become small from attrition, they combine to form normal size coveys. As winter progresses, the number of coveys declines, but covey size may remain relatively constant. So, a rule of shooting coveys down to six or eight birds could result in over harvests of late season populations.

A more appropriate method of controlling harvests is to remove a certain percentage of the pre-hunt fall population. When this harvest level is attained, harvests cease. An accurate estimate of the fall population is a prerequisite. Subsequent to this, a harvest level must be decided and accurate hunting records kept during the season.

Based on telemetry of radio tagged birds, a technique of counting morning covey calls during autumn is being quantified as a reasonably accurate population density estimator. At this time of year, coveys often call shortly after daybreak. All coveys do not call each morning, and calling rates vary with weather, date, and population density.[40] More coveys call on calm, fair mornings. Calling rates are consistently highest in late October to early November[56] when mornings are typically cool, calm and fair. The calling rate is greater in higher density quail populations, the presence of other nearby coveys stimulating calls.

HUNTING SUCCESS

In a study of 838 radio marked covey encounters with hunting parties on the Albany Area Quail Management Project,[52] on average, about half (53 percent) of the coveys on hunting courses were seen by hunters. About a third (32 percent) of the coveys

COUNTING COVEYS

In autumn, bobwhite populations form into coveys composed of 12 to 18 birds. The coveys select ranges that offer food and security for the fall and winter seasons. During this autumn transition period, coveys frequently call just after daybreak. The calling behavior is believed to play a role in the coveys spacing themselves across the landscape.

One or two birds in a covey will call, and the calling stimulates nearby coveys to answer. Some coveys in an area may not call on a given morning. Calling begins about 30 minutes before sunrise, rapidly increases with most coveys calling simultaneously, and quickly ends after a few minutes. Covey call rates are consistently highest on calm, fair mornings from late October to early November. Autumn covey call surveys based on these observed behaviors can provide reasonable estimates of bobwhite abundance.

Conducting a Covey Call Survey

The best time of year to conduct a covey call survey is during the last two weeks of October and first week of November. The best time of day is 25 minutes before sunrise, although the time fluctuates slightly from day to day. The best weather conditions are clear and calm. Fewer coveys will call on cloudy, windy mornings. Listeners can hear calls out to about 500 meters (547 yards, 0.31 miles) in open, agricultural terrain. To conduct a call count, observation points should be placed 0.62 miles apart to minimize overlap. The stations should be located at open, upland sites that permit good hearing. Observation points should be located on a map or aerial photo and copies given to each observer when the survey is conducted. Listeners will use the map to mark approximate locations of each calling covey.

Observers should be in place at the pre-selected listening points at least 45 minutes before sunrise and remain at their stations until 10 minutes before sunrise.

This allows them time to set up at the stations, orient maps and be ready to record when calling begins. Calling intensity rapidly increases following the first covey calls and the calling lasts for only a few minutes. Listeners should mark on their maps the estimated locations of each calling covey and assign covey locations according to two distance categories of 0-250 meters away and greater than 250 meters away from the observer. This is because the listener detection rate declines at greater distance. Where coveys are numerous and call rates are high, discerning each covey can become a challenge. Following the survey, each observer should have a map of the locations of individual coveys heard in the area surrounding the assigned listening station. The surveys can be conducted at all listening points on a single morning if enough observers are available. If possible, repeat the surveys over multiple mornings and use the highest covey count obtained for each point. When observers are limited, survey new locations on subsequent mornings until all stations are surveyed. The counts of individual coveys heard during the survey provide an index or measure of relative abundance to compare different areas/sites and the same areas over years.

Estimating Bobwhite Density

Reasonable estimates of autumn bobwhite population density can be obtained using point covey counts. Assuming a listening radius of 500 meters, the observer is surveying an estimated area of 194 acres. Research has shown that even experienced observers do not detect all of the calling coveys within the listening area. Listeners detect 90 percent of calling coveys within a 250 meter radius and only 40 percent between 250 and 500 meters. Listeners should group calls into near (within 250 meters) and distant (beyond 250 meters) coveys to adjust an observed count for density estimates. For example, if 3 coveys are heard within the near area and 3 coveys within the distant area, the adjusted count is:

$$3/0.9 + 3/0.4 = 10.8 \text{ estimated coveys}$$

A major factor that influences covey call rates is the presence of other calling coveys. Call counts at each station also should be adjusted according to the following information on calling rates:

Coveys Hear d	2	3	4	5	6	7	8	9	10	11	12	13+
Calling Rate	.53	.61	.76	.82	.87	.90	.93	.95	.96	.97	.98	.99

In the example, 6 coveys were heard and the adjusted count is:

$$(3/0.9 + 3/0.4)/0.87 = 12.4 \text{ estimated coveys}$$

Weather factors such as cloud cover, wind speed and barometric pressure also affect calling rates, but these effects are minimized when call count surveys are conducted on mornings when weather is clear and calm.

Flush counts of autumn coveys have shown average covey size is 12 to 14 birds. In the above example with 6 observed coveys, bobwhite density is estimated as:

$$(12.4 \text{ coveys} \times 12 \text{ birds/covey})/194 \text{ acres} = 0.76 \text{ birds/acre}$$

Density estimates are only approximations due to variability in covey call rates, listening area and observer accuracy.

Adapted From: Wellendorf, S., and W. E. Palmer. 2004. How many bobwhite coveys are there? Tall Timbers Research Station, Tallahassee, FL. 9pp.

Pointing dogs locate about half of the quail coveys on a hunting course. Coveys not found are either not actively feeding or run away to avoid approaching hunters.
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Quail hunting on managed plantations may annually remove only about ten percent of the estimated fall populations of bobwhites. Such an approach may contribute to long-term quail abundance on a local scale.
TED DEVOS

were pointed by dogs and shot into, the desired hunting outcome.

An additional 9 percent of coveys were pointed by dogs, but flushed wild. Twelve percent of coveys were seen to flush wild ahead of the hunting parties, and 7 percent flushed without being seen. In all, more than one-fourth (28 percent) of all coveys flushed wild. During a hunting season of thin winter cover resulting from dry summer weather and unusually severe winter weather, wild flushing coveys occurred in almost 40 percent of all covey encounters with hunting parties.[44]

When encountering hunting parties, 40 percent of the coveys stayed on the ground. Twenty-four percent held tight as dogs and hunters passed by, and 14 percent ran off. (Two percent of coveys were pointed by dogs, but held tight and never flushed for hunters).

Pointing dogs, on average, located 43 percent of quail coveys on hunting courses. In most cases, birds that were passed by were not actively feeding. When dogs pointed, about 13 percent of radio tagged covey finds were concluded by hunters to be false points because no birds were seen. In fact, the birds had been there, but ran away or flushed wild before hunters arrived. In some cases, birds were still there, but would not flush.

SUMMARY

Armed with knowledge of the bobwhite's life requirements, reasonable habitat measures can be introduced into current forest and farm landscapes to elevate quail populations from their depressed status. The practices not only have the potential to increase quail, they also have utility in soil and water conservation, land use economy, forest productivity, general wildlife habitat quality, as well as aesthetic and recreational enhancement.

Quail habitat management practices recently employed on a central Alabama cattle ranch demonstrate the positive response that can occur when low quail populations are presented a favorable environment.[13] A 1,800-acre portion of a 5,500-acre ranch, typical of much of the current Alabama landscape, was 54 percent pasture, 10 percent cropland, 23 percent planted loblolly pine, 13 percent mature natural pine, and supported only two known coveys of quail. After six years of major habitat renovations including eradication of pasture grasses and conversion to fallow fields, longleaf pine establishment, aggressive thinning of natural and planted pine stands, establishment of permanent openings and introduction of prescribed fire in the woodland, and supplemental feeding, a landscape that was inhospitable to quail is now quail friendly. The ranch area developed for quail is now 24 percent managed weed fields and rotationally disked fallow fields, 10 percent cropland, 10 percent annual and perennial food plantings, 20 percent planted longleaf, and 36 percent open pine forest with 15 percent of this area in small fields. In 2003 the ranch area managed for quail supported a fall population of 74 coveys of quail or about 0.55 quail per acre, as estimated by autumn covey call counts.

Bobwhites can again flourish given the simple habitat types they need: a field bordered with native grasses and weeds, a landscape with fallow fields, a shrubby hedgerow or tree corridor through a field, and open forests with natural grass cover and weedy clearings. Where we provide more of these habitat requirements, especially those used for nesting and raising broods, the bobwhite's summer call will ring frequently. We can again experience the days when a hunter will leave the field listening to a scattered covey's soft whistles at dusk.

Bobwhites can again flourish given the habitat types they need. A covey of quail utilizes this area because it includes the necessary elements of bobwhite habitat: nesting cover, brood habitat, protective cover and feeding areas. No quail existed here three years earlier when the site was a field of fescue.
STAN STEWART

Appendix

CULTURAL PRACTICES FOR SELECTED PLANTS IN BOBWHITE MANAGEMENT

Species	Method	Planting Rate	Planting Dates	Planting Depth (in)	Fertilizer (lb/ac)	Culture/Comments
Partridge Pea	Broadcast	15 lb/ac	Feb-Apr	1/4-1/2	200 (0-20-20)	Grows best on moist bottoms, does well on uplands except deep sand. Plant in strips or patches of at least 1/8 ac. Re-seeds well. Burn in Feb. each year; disk lightly but thoroughly in Feb. every other year. Provides excellent brood habitat in summer and seed in winter.
Kobe Lespedeza	Broadcast	30 lb/ac	Feb-Apr	1/4-1/2	200 (0-14-14)	Grows best on moist bottoms, will grow on infertile clay soils. Plant in strips or patches of at least 1/8 ac. Will re-seed if annually burned or disked, and fertilized in Feb. before seeds sprout. Provides excellent brood habitat in summer and seed in fall-winter.
Browntop Millet	Broadcast	20 lb/ac	Apr-Jul	1/2-1	300 (10-10-10)	Does best on well drained soils. Plant in strips or patches of at least 1/4 ac. Provides a good seed source for young quail in late summer-early fall.
Grain Sorghum	Broadcast Rows	20 lb/ac 8-15 lb/ac	Apr-Jul	3/4-1	300 (10-10-10)	Plant on well drained productive soil in strips or patches of at least 1/4 ac. Rotate planting to an adjacent location the following year and leave previous site in undisturbed weeds for 1 or 2 seasons.
Egyptian Wheat	Broadcast Rows	20 lb/ac 8-15 lb/ac	May-Jun	1/2-1	300 (10-10-10)	Plant on well drained productive soil in strips or patches of at least 1/4 ac. Rotate planting to an adjacent location the following year and leave previous site in undisturbed weeds for 1 or 2 seasons.
Bicolor Lespedeza Thunburg Lespedeza	Seedlings	500 plants/ plot	Dec-Feb		300 (0-20-20)	Plant on well drained soils, avoid deep sands. Establish a patch 5 rows wide, 150 ft. in length, seedlings 1.5 ft. apart in rows 3 ft. apart (100 seedlings per row, 500 seedlings per plot). Mow plants and fertilize in Feb. every 3-5 years. Thunburg less subject to deer damage. NOTE: Shrub lespedezas are non-native perennials that become invasive when burned, especially on clay soils. To minimize spreading, exclude from fire with a disked lane, control sprouts outside of patch with herbicide (Escor t XP, metsulfuron methyl), and clean seed fr om tractor and mower within the patch after mowing.
Chickasaw Plum	Seedlings		Dec-Feb			Grows on variety of soils, does well on sandy land. Plant seedlings 3 ft. apart in rows 4 ft. apart. Establish patches with minimum of 30 ft. dimensions, spaced 100-200 yards apart. Exclude fire. Provides excellent protective and loafing cover.

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