

NORTHERN BOBWHITE QUAIL MANAGEMENT IN GEORGIA

July 2020

NORTHERN BOBWHITE QUAIL IN GEORGIA:

History, Biology and Management

Georgia Department of Natural Resources
Wildlife Resources Division, Game Management Section

AUTHORS

Reggie Thackston and Mark Whitney,
Senior Wildlife Biologists

Updated: Dallas Ingram, Brad Alexander, Buck Marchinton, Allison Colter, Diana McGrath, Mary Frances Neiminen (GA DNR) and Dr. Jessica McGuire (Quail Forever)

PREFACE

This booklet is intended to serve as source of general information both for those with a casual interest in Northern bobwhite quail and as a guide for land managers. The authors hope that this book will provide useful information and help to ensure our state game bird's well-being for generations to come.

ACKNOWLEDGEMENTS

Original content was provided by: Clay Sisson, Auburn University Albany Area Quail Project; Bobby Bond, Joy Bornhoeft, Dan Forster, Adam Hammond, Walter Lane and Forrest Marchinton, Georgia Department of Natural Resources. We also thank Georgia Department of Natural Resources for booklet design, layout and editorial input.

TABLE OF CONTENTS

Introduction	5
Life History	7
<i>Covey Formation</i>	7
<i>Nesting & Reproduction</i>	8
<i>Annual Survival & Mortality</i>	9
<i>Sex & Age Determination</i>	11
Habitat Requirements	13
<i>Nesting & Brood Habitat</i>	14
<i>Food Habits</i>	15
<i>Cover Component</i>	15
Planning Habitat Improvements	17
<i>Developing a Plan</i>	17
<i>Getting Technical Assistance</i>	17
Habitat Management	21
<i>Managing for Quail in Agricultural Habitats</i>	21
Croplands.....	21
Fallow Areas.....	23
Grazing Lands & Hayfields	24
<i>Managing for Quail in Forested Habitats</i>	25
Pine Forest Management Practices.....	25
Forest Management Methods	26
Pine Species Selection	27
Site Preparation	28
Seedling Spacing.....	29
Thinning	30
Rotation Age	32
Managing Hardwoods Within Pine Stands	32
Prescribed Burning.....	33
Forest Openings, Roads & Permanent Firebreaks.....	35
Other Considerations	37
<i>Managing Harvest</i>	37
<i>Pen-reared Quail</i>	37
<i>Supplemental Feeding</i>	38
<i>Predator Management</i>	39
<i>Management Costs & Benefits</i>	40
Summary	43
<i>Primary Quail Management Recommendations</i>	43
Appendix	45
Glossary.....	45
Figures	47
Figure 1.....	47
Figure 2	47
Figure 3	48
Figures 4 and 5	48
<i>Predator Index Survey</i>	49

1 INTRODUCTION

For many years, Georgia has been known as the “Quail Capital of the World.” This title was justified by the state’s excellent population of wild Northern Bobwhite (*Colinus virginianus*), or bobwhite quail. The early colonials called them partridges and some still refer to them as “pah-tidges” today. As the colony of Georgia was settled, small farms and clearing increased and the settlers continued to burn the woods off each year just as the Indians had done before. Georgia’s high quail population resulted from these low intensity agriculture and forestry practices that were commonly applied throughout most of the state, especially during the late 1800s through the mid-1900s. While no one knows when quail became a popular game bird, it was likely in the 1800s with the invention of the scattergun. In the early 1900s, Georgia became known as the quail capital of the world and in 1970, the bobwhite quail was designated as Georgia’s official state game bird.

However, as quail hunters and other wildlife conservationists know, quail populations throughout the U.S. and Georgia have declined dramatically. Data from the U.S. Fish and Wildlife Service’s Breeding Bird Survey indicate that from 1966 to 2018, Georgia’s quail population declined by more than 72% (**Figure 1, Appendix**). This decline has led to a reduction in the number of quail hunters and quail harvest. In 1962, an estimated 135,000 hunters harvested about 4 million quail in Georgia, but by 2019, the number of hunters had declined to 12,742, and the reported quail harvest to about 279,291 (**Figure 2, Appendix**)—with nine out of ten being pen-raised birds.

Quail populations have declined dramatically due to the significant loss of quality habitat and a variety of land-use changes. Compounding landscape level changes, such as “clean farming” practices, larger agricultural fields, increased use of agricultural pesticides and conversion of farmland and native rangeland to

exotic grass pastures have resulted in a precipitous decline. In addition, increased acreage in intensively managed short rotation pine plantations, decreased use of prescribed fire and increased urbanization have all led to the loss of habitat connectivity (**Photo 1**). Quail in Georgia will likely never return to the widespread abundance experienced in the early 1900s, but their numbers have increased in many areas due to improved management.

The good news is that more is known about managing bobwhite quail than any other upland game bird. The first step to improving habitat conditions for quail is developing a management plan that considers the entire life history of the bobwhite relative to the current habitat conditions. To increase quail populations, management practices must address the factor that is **most limiting** the quail population in each situation. For example, planting food plots to increase fall foods will not result in more birds if the limiting factor is brood habitat.

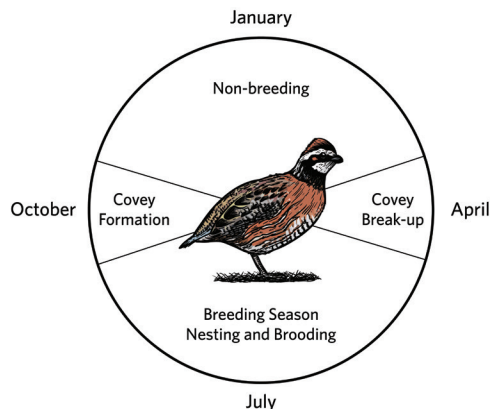


Photo 1. Intensification in farming and forestry, conversion of farmlands to pasture and woodlands, and increased urbanization are the primary reasons for the long-term decline in Georgia's quail population. Photos of same area in 1947 (left) and 2012 (right).

2 LIFE HISTORY

Covey Formation

As summer ends and fall approaches, quail get ready for over-winter survival by forming into groups called coveys. Quail are gregarious, meaning they are social and help each other survive throughout the winter by foraging together and taking turns watching out for predators. They establish these groups typically in October through November by calling out to each other right around first light with the “koi-lee” call. This calling behavior helps tell quail throughout the landscape who else might be out there and where. The period when birds are establishing coveys is called the “fall shuffle” because it can take several weeks for birds to decide with whom and where they want to spend the duration of the winter. The average covey size is 12 to 15 birds and usually consists of birds from two or more broods (groups of young raised together). Occasionally two or more coveys may be found together resulting in the “40 bird” covey that quail hunters often talk about. If covey size becomes low during the fall and winter, the remaining birds may join with another covey for the remainder of the winter. For this reason, it is not advisable to use covey size as the determinant factor in deciding whether to harvest additional quail from an area during the hunting season. The quail remain in coveys until spring approaches, when they “break up” and disperse to begin the mating season. In March, coveys often break up during the day and reform just before dark. Remnant coveys may be found until early May.



Annual life cycle of the Bobwhite quail.

Nesting & Reproduction

The familiar “*bob-bob-white*” whistle heralds the beginning of the breeding season. In spring, increasing day length and warmer temperatures trigger breeding activity. Pairing begins with covey break up, usually in March. During breeding season, quail spend their time alone, in pairs, or with chicks.

Quail are generally monogamous, one male (cock) mating with one female (hen). However, studies have shown that promiscuous behavior, that is, having several different mates during the breeding season, is more common than previously thought. Throughout the breeding season quail typically pair off, one female to one male at any given time. However, this might be more for social reasons than genetic ones as studies have shown upwards of 5 or more males may sire a single nest. Populations consist of about 15 percent more cocks than hens, which is likely the result of hen mortality during the nesting season. In addition, social mates change throughout the breeding season as some birds are killed or take over brooding duties. Most of the “bob-whiting” in mid-summer through late summer is by unmated cocks in search of a hen.

May through August are the typical months for nesting, but some nesting occurs as early as March and as late as October. These later nests can have a huge impact on fall population numbers as there is less time that chicks must survive to make it to hunting season. Preferred nesting areas are those where ground vegetation is comprised of clump-type grasses that cover about 30–50 percent of the total ground area. This type of cover offers optimum nest concealment while providing adequate passageways for quail movement.

Both hens and cocks collect materials used in nest construction, primarily grasses and pine needles, from within a few feet of nest sites. Hens will lay 1–4 nests per summer. Each nest contains an average of 12–14 eggs. However, some nests have been found to have as high as 31 eggs; these nests are assumed to be “dump

nests” meaning that multiple females have deposited eggs in it. This behavior may occur when a hen’s own nest is destroyed prior to her completing laying. Quail eggs are white, oval shaped and about 1 inch long. The hen may incubate the nest herself, but sometimes, the cocks are left to complete incubation and brood chicks if hens are killed by predators or when hens find another mate and begin another nesting attempt. On average, it takes about 18 days for a hen to lay a clutch of eggs and the incubation period is 23–24 days.

Newly hatched chicks are about the size of a bumblebee (approximately 5 grams) and can walk and follow the parent(s) within an hour of hatching. Biologists call this life strategy “precocial”. It also means that quail chicks learn how to be a quail from adult quail, a stage of life referred to as “brooding”. They can fly when 2 weeks old and reach adult size in 3–4 months. Brooding behavior can vary in length and often depends on the timing in the season, whether the adult has enough resources to re-nest, and if there are other brooding adults around that they can “dump” the chicks on. Later in the season some older “adolescent” staged quail will gather together into groups, without adults, often in high numbers. These groups of young quail can be over 20 birds and are called beveys.

Annual Survival & Mortality

Since bobwhites spend most of their time on the ground, they are highly vulnerable to predation. More than 25 different wildlife species have been identified that prey on quail and/or their eggs. Common predators include; various raptor species including hawks and owls, bobcats and snakes (primarily breeding season). Common nest predators include meso-mammal species such as raccoons, opossums and armadillos. Annual mortality rates average 80 percent depending on habitat quality, weather, predator densities, hunting pressure and other factors. In other words, if there are 100 quail on your property at the beginning of hunting season, on average, 1 year later, just 20 of those same birds will still be alive. Over-winter survival can be increased through proper

habitat management and appropriate levels of quail harvest. Proper harvesting allows more adults to enter the nesting season, thereby increasing reproductive potential and recruitment into the fall population.

Studies suggest quail chick mortality is 50 percent or more between hatching and 14 days of age (when they can fly to help evade predators). This loss can be reduced by improving brood habitat, particularly by creating large blocks (two to five acres) of annual weeds such as ragweed, partridge pea, or beggarweed that are canopied above but open underneath. During the first few weeks of life, chicks require a high protein diet provided by animal matter, primarily insects. Management practices, such as winter disking or prescribed burning, which produce an abundance of insects at or near ground level with a protective weed canopy overhead, increase chick survival.

The quality of available habitat controls the size of a quail population. Summer quail production usually exceeds the ability of the habitat to support the young through an entire year. Natural mortality occurs from factors such as predation, disease, accidents, weather and starvation. Studies have shown that an 80 percent annual loss is common, whether or not an area is hunted—although late-season hunting may have a greater impact to the total losses. Therefore, depending on habitat quality and the current year's reproduction, a hunter harvest of up to 20 percent of a fall population, including crippling losses, may replace part of the natural losses without endangering next year's population (**Photo 2**).

Weather can also be an important mortality factor for quail. Prolonged drought during the spring and summer creates a negative impact on quail populations by reducing weed seed production, available cover and insect abundance. These factors ultimately result in lowered quail reproduction, survival and recruitment into the fall population. The best safeguard against negative impacts of drought is to provide high quality habitat, especially nesting cover,

brood habitat and food, so that when rainfall does occur, quail populations can respond quickly. On the other hand, extended heavy rain events during the summer months can be harsh on chick survival as quail lack the ability to thermoregulate until 21 days of age.

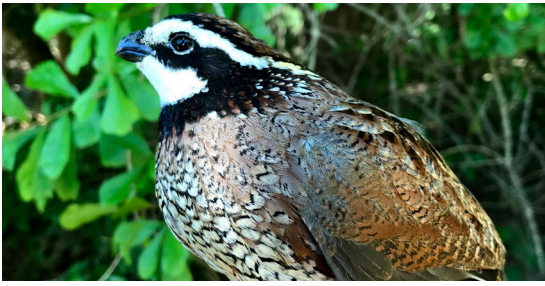


Photo 2. Depending on habitat quality and the previous year's reproductive success, a hunter harvest of 15–20% of a fall population may replace part of a quail population's natural mortality. It is important to track harvest numbers to ensure enough birds are surviving to breeding season.

During breeding season, adults are extremely vulnerable to predation while incubating nests. Even under good habitat conditions, breeding season mortality can equal that of winter. Late winter and early spring are another period of high mortality for bobwhites. During this time, habitat conditions have degraded as cover has deteriorated and food availability is reduced. Migratory hawks are abundant during this time and are efficient predators of quail. To safeguard against losses during this period, it is important to provide plenty of cover, such as shrub thickets and late winter food sources, such as beggarweed and partridge pea or supplemental feeding into cover. Even on well managed lands, only about 50% of quail survive the winter.

Sex & Age Determination

Quail exhibit sexual dimorphism, meaning that males and females differ in appearance. The primary visual difference in quail sexes is in feather coloration, especially noticeable on their heads. Both sexes have a dark stripe that originates at the beak and runs through the eye to the base of the skull. In males, the stripe above and below the eye is white, as is the throat patch. In females, this stripe and throat patch are a buff-brown tan color. Males have brown and white head feathers and females have brown and tan or



yellowish head feathers
(**Photo 3**).



Determining age ratios in the fall hunter harvest can lend insight into the previous summer's reproductive output and success. Age determination can be somewhat more difficult than sex determination, but can be accomplished with a little practice. Biologists group quail into two different age classes: adults and juveniles. A juvenile is a bird that is

Photo 3. Quail exhibit sexual dimorphism whereby cocks have brown, black and white head feathers, and females have brown and tan head feathers.

under one year old. The key to determining age is to locate the greater primary coverts, the group of feathers overlaying the primary flight feathers. In juveniles, the greater primary coverts will have buff-brown, or tan, tips (**Figure 3, Appendix**).

Additionally, juveniles molt the primary flight feathers, which are replaced gradually during the first 150 days. Prior to 150 days, based on the length of the primary flight feathers, experienced quail managers can determine peak hatching dates. After the 150 days, juveniles can be distinguished from adults by the buff-tipped greater primary coverts. However, hatching dates cannot be determined because the first eight primary feathers will have been fully replaced (which distinguishes these birds as juveniles greater than 150 days).

Quail hunters and managers should attempt to record age and sex of each bird harvested on a tract of land in each year. Over time, this information can help the active manager determine what conditions are favorable to the local quail populations and help predict future reproduction and hunter harvest levels.

3

HABITAT REQUIREMENTS

Bobwhite quail are an early successional habitat specialist. They need an interspersed cover that is ideally a third annual and perennial weeds and legumes, a third clumped native warm season grasses and a third brush cover that is a mosaic distribution of briar and shrub thickets. Biologists refer to this as the Rule of Thirds. Quail densities are highest and respond best to management in areas where there is a contiguous distribution of suitable habitat (perhaps 2,500 acres or more). Fragmented landscapes comprised of small isolated blocks or “islands” of habitat are not capable of sustaining high densities of quail and these habitat fragments may limit the potential of quail to respond to management. These fragmented populations are also more susceptible to catastrophic losses that can result in the extirpation of local populations.

Soil conditions are also important to consider when managing land for quail. Soils with the highest quail management potential are the well-drained sandy loams and clays. Deep sands and wet soils provide poor quality food and cover for quail, therefore limiting prospects for improving populations. Due to site conditions and current land use patterns in Georgia, the Upper Coastal Plain generally offers greater potential for quail management (**Figure 4, Appendix**). Within the Upper Coastal Plain, the best zone tends to be in Southwest Georgia due to better soil fertility, higher rainfall and a greater abundance of lands being managed for quail. This is not to say that quail management is futile in other regions, but expectations must be tempered with realization of the bird’s habitat needs and the condition of the land.

Across Georgia’s rural landscape, the primary habitat components missing for quail are nesting cover and brood range along with year-round food availability. Most lands have vegetative cover that is either too dense or too sparse at ground level.

Nesting & Brood Habitat

Quail construct their nests on the ground from the previous year's dead vegetation. Nesting cover must be clumped with open space between the clumps to facilitate freedom of movement for both adults and chicks. Broomsedge and other native warm season grasses occur throughout Georgia and provide ideal nesting cover when managed to maintain a clumped structure (**Photo 4**). However, left unmanaged, these grasses can also become too thick for quail. Periodic disturbance by fire or winter disking is necessary to maintain the desired structure and distribution.



Photo 4. Broomsedge, and other native warm season grasses, occur throughout Georgia and when managed with fire or disking to maintain a clumped structure provide ideal nesting cover.

Quail typically nest near brood rearing habitat. Erect weeds, like ragweed, partridge pea and beggarweed, that are canopied above but open at ground level, provide ideal habitat for brood rearing (**Photo 5**). These plants provide an abundance of insects and seed at ground level while providing protective cover above. The bare ground that resides under the legumes and forbs, as well as among the clump-forming grasses is a vital part of nesting and brood rearing habitat components. Bare ground, made possible from periodic prescribed burns and winter disking, facilitates easier maneuvering for chicks and adults in addition to more accessible seeds for foraging adults. These areas should be maintained in early succession by periodically burning or winter disking and controlling volunteer trees.

Food Habits

Bobwhite quail eat a variety of seeds, insects and fruit, depending on seasonal availability and nutritional needs. The annual bobwhite diet consists of 60–65 percent seeds, 15–20 percent fruits, 15 percent animal matter and 5 percent green vegetation. The most important foods during the fall and winter are seeds of

various annual and perennial plants such as ragweed, beggarweed, partridge peas, wild beans, native lespedezas, sumacs, oaks and pines. The lack of late winter food sources is often a limiting factor on a property. During spring and summer, the quail's diet shifts to green vegetation, insects, fleshy fruits and seeds of grasses and other early seeding plants. Ninety percent of a quail chick's diet is insects. Quail can survive without drinking water, when succulent vegetation and insects are readily available. Blackberry, plum and other shrub thickets provide fruit during the nesting season while also providing sources of roosting, escape and loafing cover that bobwhites need.

Cover Component

Plum, hawthorn and various other upright shrubs provide screening cover and areas for loafing. Bobwhite quail need shaded areas in between times of feeding to properly regulate temperature while simultaneously being concealed from predators. Blackberry thickets provide additional cover for roosting and escape cover from predators. Like other habitat components, thickets will need to be maintained with fire, mechanical, or chemical means to avoid overabundance of one habitat need. Winter cover is also a very important puzzle piece to carry quail back around to the spring breeding season once again. Briars and vines can provide an important cover resource for quail when many other plants' fleshy vegetation has died back for the dormant season.



Photo 5. Erect weeds that form a canopy above but have open conditions at ground level provide habitat for quail broods.

4

PLANNING HABITAT IMPROVEMENTS

Developing a Plan

Agricultural fields and woodlands can be enhanced for quail through the proper application of management practices. However, management must address the limiting factor if the quail population is to increase. Additionally, both harvest and habitat management should be conducted in anticipation of the worst weather conditions—populations that are healthy will rebound from inclement weather events more readily than stressed populations. This is best accomplished by developing a detailed management plan that is tailored to the property and goals of the landowner. At a minimum, the plan should include specific population and harvest goals, an inventory of current habitat conditions and specific recommendations relative to the type, timing, location and costs of needed management practices as well as a plan for monitoring progress. Landscape context should always be considered when setting goals. This considers not just the property being managed but the surrounding area, which is especially important on smaller properties. For example, a 100-acre property in SW Georgia that is adjacent to a large quail plantation will have much more success than a 100-acre tract in the upper Piedmont that is surrounded by overgrown hardwood stands and unmanaged pines.

Getting Technical Assistance

Identifying limiting factors and determining the correct management tools to use can be difficult for many landowners. Enlist the help of a professional wildlife biologist who can assess the property by examining existing habitats and current management practices (**Photo 6**). After viewing a tract of land, the biologist then can discuss the landowner's objectives relative to the capacity of the property to meet the owner's needs and begin developing the management plan.

To assist in developing a detailed management plan, the landowner will need to define their objectives and gather some information about the property. Clearly defined objectives are



essential to developing a management plan that meets the landowners needs. For example, different management techniques will need to be used on properties where deer hunting or timber revenue are important objectives of the landowner versus a property that is strictly focused on quail. Other

Photo 6. Site visit.

helpful information that a landowner can gather includes aerial photos, soils maps, timber stand descriptions, past management practices, neighboring management activities and a list of any restrictions on the property such as rights-of-way agreements or contracts for federal programs.

In 1999, WRD began the Bobwhite Quail Initiative (BQI). BQI is a program designed to provide free technical assistance and/or financial incentives to private landowners for improving quail habitat. BQI is funded through sales of the “Support Wildlife” license plate and other federal and non-federal grants. BQI biologists can help develop management plans for landowners and guide them through different options for financial and technical assistance.

Often landowners want someone who can write a management plan, conduct the recommended management practices and provide frequent on-site visits. Private consultants are available to fill this need. If you are deciding to hire a wildlife consultant to write the management plan, look for one who has quail management experience and ask for references.

Quail management can be expensive because of the constant effort necessary to maintain early plant succession. However, programs administered by the federal government, state government, private industry and conservation organizations may help offset the cost of some management practices. The person who develops the management plan should be familiar with the types of land eligible for these programs.

Lastly, be realistic in your expectations. It is the responsibility of the biologist assisting you to tell you if what you want to accomplish will work. If your desire is to own land that will support heavy hunting pressure for wild bobwhite quail, you must have a large tract of land comprised of suitable soils and a good source population. Be ready to work hard and continuously to manage the habitat. Most land managers can expect some success when appropriate management is applied and expectations are based on a reasonable assessment of the land's potential and landscape context. Plans need to be periodically updated as the goals of the landowner and condition of the property changes. This will allow you to fine tune your management and achieve the greatest success.

5 HABITAT MANAGEMENT

Managing for Quail in Agricultural Habitats

CROPLANDS

Providing suitable conditions for quail on as little as two to five percent of the area of a commercial crop field can result in substantial increases in the bird population. Croplands can be enhanced for quail by providing fallow habitats through the management of field borders, hedgerows, pivot corners, ditch banks, roadsides,



Photo 7. Agricultural land habitat.

wetland borders and other marginal sites (**Photo 7**). Combinations of winter disking, burning, planting and selective application of herbicides can be used on these sites to provide nesting cover and brood habitat during the spring/summer and food and cover during the fall/winter. Precision farming has demonstrated that

field edges (two outside rows) are often marginally productive for crops, at best. Utilizing precision agriculture technology to develop new management strategies for these areas, farmers can often improve profit margins by reducing inputs into low productive areas. Additionally, research has shown that weedy borders harbor many beneficial insects that prey on crop pests, thereby providing a biological pest control. By utilizing these sites, quail management can often be integrated with agriculture without significant impacts and possibly improve economic returns, reduce erosion and improve water quality on the farm.



Photo 8. Con till.

When establishing linear practices like field borders, hedgerows, wetlands borders and ditch banks, remember that wider is better. They should be at least 15 feet in width and widths of 30 to 100 feet are preferred. A good approach is to use the width of the available disc harrow, or multiples of the width, which will facilitate strip management. When possible, field borders should be maintained

around the entire crop field. However, field borders even on one side of a crop field may still provide significant benefits to quail. When feasible, all fallow habitats should be connected to facilitate the protected movement of quail throughout the cropland area.

EXOTIC GRASSES: A common problem in fallow habitats is the invasion of Bermuda, Bahia and other exotic grasses, into and underneath the weed canopy. These grasses restrict quail movement and can become so thick as to out-compete desirable vegetation. The best solution is broadcast spraying of an approved herbicide to control exotic grasses within and adjacent to fallow habitats prior to establishment. For specific herbicide types and rates, managers should consult their county extension agent or a herbicide professional.

CONSERVATION TILLAGE: In recent years, interest has grown in the use of conservation tillage as a farming practice that reduces soil erosion and conserves water. Conservation tillage is the process whereby the current year's crop is planted into the previous year's crop residue or stubble. Research has shown that crop fields managed with conservation tillage can provide superior brood range over fields managed by conventional tillage (**Photo 8**). This is due to the greater abundance of insects associated with the previous year's residue of the cover crop. When conservation tillage is combined with the proper management of field borders, field corners, hedgerows, fallow patches and other idle areas, the effects can be synergistic.

FALLOW AREAS

DISKING: Strip disking during late fall through winter can be used to maintain favorable structure and plant species composition for quail (**Photo 9**). For example, one-third to one-half of the site can be lightly disked each year in November through February and allowed to remain fallow the following



Photo 9. Disking.

summer. Fall/winter disking encourages the development of ragweed, partridge pea, beggarweeds and other important food and cover plants. Generally, fallow habitats should not be disked, or otherwise disturbed, during spring and summer as this may disrupt nesting activity. Disking during spring and summer also encourages undesirable plants like coffee weed, sicklepod, Johnson grass and Bermuda grass. Disking should also not be done in areas with good native grass cover. These areas are better maintained with prescribed fire since the native grass cover will be reduced with regular disking.

PLANTING: Planting can be used as an integral part of managing fallow habitats for quail but it is generally not a substitute for management of native plant communities. Plantings can also be incorporated into field borders and hedgerows that are being managed by fall/winter disking. Plant annual grains like corn, Egyptian wheat, brown top millet and grain sorghum in the spring and summer to provide food and cover into the fall and winter. Avoid corn in areas that have issues with feral hogs. Wheat or oats can be planted during late fall. Plantings should be established in strips and then allowed to remain fallow the following year and rotated across the site. Another option is to plant reseeding annuals like partridge pea and beggarweed, then encourage these to reseed with periodic fall/winter disking or burning. Plant only a small portion of the managed site (generally less than 25 percent) in any given year, maintaining the remainder in desirable weeds,

grasses and briars to provide adequate nesting cover, brood habitat and escape cover.

HERBICIDES: Periodically, the use of herbicides and/or mechanical treatments may be needed to control the invasion of trees and/or exotic grasses into fallow habitats. Even with frequent soil disturbance, sweetgum, pine and other light-seeded trees may invade fallow areas and shade out desirable food and cover plants. When this occurs, practices should be implemented to remove the trees and restore the weeds, grasses and briars that quail need. It is beneficial to leave an occasional waxmyrtle, sumac or plum thicket within these sites.

GRAZING LANDS & HAYFIELDS

Moderate to heavy grazing by livestock of native rangeland can detrimentally affect food and cover conditions for quail. At high stocking densities, livestock may trample and destroy quail nests. Livestock also utilize many of the foods preferred by quail and heavy grazing reduces the abundance of cover thereby making quail more vulnerable to predators. On native rangelands where quail management is part of the objective, low stocking levels and rotational grazing systems are recommended to protect and maintain the quantity and quality of food and cover.

The conversion of native cover to improved pastures and hayfields greatly degrades habitat conditions for quail, songbirds and other early succession wildlife. Common exotic pasture grasses in Georgia include fescue, bahia and Bermuda grass. None of these



Photo 10. Exotic pasture grasses vs. native.

grasses provide suitable food or cover for quail and other wildlife and they tend to out-compete desirable plants. The best approach for blending quail management with improved pasture management is to fence out, or set aside, corners, borders, drainage courses and other odd areas. Manage these with the same techniques previously described for fallow areas in croplands.

Additionally, with hayfields or where rotational grazing is a management option, conversion of a portion of the exotic grass fields or pastures to native warm season grasses can enhance habitat values for quail and other wildlife (**Photo 10**). Intensive chemical site prep is necessary for successfully converting exotic grasses to native warm season grasses. As with the other management practices, landowners should contact their local wildlife biologist for technical assistance before initiating management practices.

Managing for Quail in Forested Habitats

PINE FOREST MANAGEMENT PRACTICES

In Georgia, longleaf/slash, loblolly/shortleaf and oak/pine forests comprise a substantial proportion of the bobwhite's geographic range. Pines produce seeds, which are used by quail as fall food, and large quantities of pine needles, which serve as a fuel for prescribed burning. However, on many sites, trees occur at densities that shade and out-compete desirable food and cover plants. Within pine forests, the abundance of quail and several priority nongame birds is strongly associated with the structure and composition of the ground layer vegetation.

In general, quail benefit from a grass and forb ground cover that develops in open and frequently burned pine forests and during the first two to four years following a clear-cut. Management for maximum economic return from timber is not consistent with providing optimum habitat for quail. However, through careful planning, timber can be managed for reasonable economic returns while maintaining huntable quail populations.

A variety of silvicultural techniques and habitat management practices can be used to integrate quail habitat with pine forest management. These practices include timber harvest and regeneration, establishment and management of openings and prescribed burning. The specific timing and intensity of implementing these practices often must be varied to meet site-specific conditions. However, there are some general management guidelines that can be followed to enhance habitat for quail and other early succession wildlife in pine forests.

FOREST MANAGEMENT METHODS

Uneven-aged and even-aged management are the two primary methods of forest management. Uneven-aged management results from harvesting a portion of a timber stand and by selecting individual trees or small groups of trees throughout the life of a stand and during each subsequent harvest. This harvest method allows for natural regeneration to occur within the stand while leaving some timber to be harvested in the future. After a series of several harvest events, the stand will be comprised of trees of various ages. When appropriately applied, this is the most complex and intensive method of forest management. It requires an extensive access system throughout the forest stand and increases the complexity of prescribed burning since young pine regeneration areas (except for longleaf pine) must be protected from fire. Since southern pines are shade intolerant, uneven-aged management necessitates maintaining a low density of overstory trees for successful regeneration of pines, which also enhances ground cover conditions for quail.

Even-aged management is the most commonly used forest management method. It results from the harvest and regeneration of entire stands of trees at a given point in time (called the rotation age) thus creating a new stand of trees of the same age. Regeneration methods for even-aged management include artificial and natural regeneration. Artificial regeneration requires planting of seedlings (bare-root or containerized depending on the species of interest) generally on a predetermined spacing

grid. Natural regeneration methods include natural seeding through a seed tree cut (where a few parent trees are retained to provide seed for the site) or through a shelterwood cut (where more trees are retained as seed sources providing shelter from adverse conditions during early development). The selection of an appropriate regeneration method is dependent on site conditions including soils and periods of inundation, current species present and future species interest. Even-aged management is less complex and less costly to implement on an extensive scale than uneven-aged management. Quail populations often increase during the first two to four years after a stand has been cleared for regeneration. However, even-aged management results in entire stands of trees passing through the sapling stage (ages four to 15 years depending on the site and species) at stocking densities that are not conducive to providing quality habitat or desirable hunting conditions for quail. The reduction in habitat quality in sapling aged stands is due to “canopy closure”—the reduced light conditions under dense tree canopies which inhibit the growth of desirable ground vegetation.

Quail habitat can be maintained in pine forests that are managed with even-aged and uneven-aged methods. The management goals are to keep most of the ground in direct sunlight, control plant succession to maintain a diversity of grasses and forbs in the understory and to control hardwood invasion.

PINE SPECIES SELECTION

All pine forest types can be managed to enhance habitat conditions for quail. However, pine species historically indigenous to the site should be used when regenerating pine stands. Longleaf pine, within its historic range and on appropriate sites, is better suited for quail management than loblolly, shortleaf, or slash pine because: 1) it has a sparse crown thereby allowing more sunlight to reach the forest floor; 2) it is long lived thereby providing increased management flexibility and a greater percentage of the total stand life in a suitable habitat condition; 3) it has a larger seed that is nutrient rich and highly preferred by quail; 4) it is relatively



Photo 11. Within its historic range, longleaf pine is better suited for blending quail management with timber management than are the other southern pine species. Longleaf pine can be burned while in the grass stage and is relatively disease and insect resistant.

The longleaf pine ecosystem once occupied about 21 million acres in Georgia, but now only occupies about 300,000 acres.

disease and insect resistant; 5) is less prone to windthrow; and 6) it can be burned at a younger age than other species, allowing for better control of hardwoods, promoting herbaceous vegetation and providing good quail habitat for longer periods prior to canopy closure (**Photo 11**).

The longleaf pine ecosystem once occupied approximately 21 million acres in Georgia, covering most of the Upper and Lower Coastal Plain and extending into the Ridge and Valley Province (**Figure 5, Appendix**). Unfortunately, the longleaf pine ecosystem has been greatly diminished due to conversion to other forest types and land uses,

contributing substantially to the decline in quail populations.

SITE PREPARATION

Sites can be prepared for regeneration in a variety of ways ranging from those of low intensity, like prescribed burning, to those of high intensity, like shearing, raking, piling, burning and/or herbicide applications. The method(s) used ultimately affects short- and long-term plant succession. Prescribed burning and intense mechanical methods, especially when applied during winter months, tend to produce the most desirable food and cover conditions for quail. These techniques result in extensive stands of erect annual weeds including important quail food plants like ragweed, partridge pea and lespedezas providing excellent brood range, fall and winter food and protective cover.

Herbicides are commonly used for site preparation, as well as later in the life of the stand, to retard or kill competing vegetation. The impact of herbicides on quail habitat varies greatly depending on

the herbicide(s) used and the method of application. In general, using herbicides that leave legumes, blackberries and other important quail food and cover plants should be favored over those that control all vegetation. In longleaf pine plantings, preserving native grasses during site preparation treatments will allow land managers to burn stands earlier which can help control woody competition and improve stand quality. In old field sites or sites with significant exotic grass cover, several subsequent herbicide applications are needed to control species such as Bermudagrass. Banded or spot application methods are sometimes better than broadcast applications depending on current site conditions. Additional research is needed to determine the impacts of various site preparation techniques on short-term and long-term habitat conditions for quail and other wildlife.

SEEDLING SPACING

Pine stand re-establishment requires artificial or natural regeneration. For artificial regeneration, seedling spacing determines the number of years until the tree crowns overlap and shade out the understory (i.e. canopy closure). There are many options when considering seedling spacing with benefits to each. Wide tree and row spacing (such as 8 feet by 10 feet, or 8 feet by 12 feet) allows for the establishment and maintenance of grasses, forbs, legumes, soft mast producers and other desirable food and cover plants. However, tree quality may be reduced due to increased number of limbs. Narrower spacing will reduce ground cover earlier in the stand but may lead to better growth form and future timber value. No matter what spacing is used, 15 to 40 percent of each stand should be established in openings of two to five acres in size. These openings can be managed through combinations of winter disking, prescribed burning, herbicide application, mowing and planting to provide food, cover and brood range.

Natural regeneration by seed tree or shelterwood often results in dense seedling stands that quickly out-compete grasses and forbs. These seedling stands should be thinned pre-commercially or the stem density otherwise reduced by judicious skidding of residual seed or shelterwood trees at the time of their removal.

THINNING

Stands should be thinned so that 40 to 60 percent of the ground is in direct sunlight at high noon (**Photo 12**). Heavier thinning is necessary on infertile soils to produce the desired ground cover. Within pine plantations, removing every second or third row and then thinning out the diseased or deformed trees within rows is recommended.

When practical, conduct thinning operations during the winter months so that the resulting soil disturbance stimulates the growth of important quail foods and cover plants.

Thinning is among the most important practices to be conducted on a timber stand. Thinning forest stands at the appropriate time is not only beneficial to wildlife but can improve timber quality and future revenues. Conducting thinning as soon as possible will effectively improve quail habitat by opening the canopy for improved light conditions that promote herbaceous vegetation. These open stands, with new herbaceous vegetative growth, will ultimately increase the effectiveness of fire on the landscape, helping to promote prescribed fire for the perpetual maintenance of quail habitat.

Forested stands go through several phases of what is known as canopy closure. Most stands planted for timber production enter this phase between 5 and 15 years depending on the site



Photo 12. Heavy and frequent thinning with regular application of prescribed fire is required to maintain adequate ground cover within pine stands.

quality, species planted, initial planting density and survival rate. Loblolly and slash pines have a prolonged canopy closure phase due to fast growth rates and crown structure; whereas, longleaf pine maintains a relatively open canopy due to its slower growth during initial establishment and its open crown structure. When canopy closure



Photo 13. When a pine stand reaches canopy closure, very little light reaches the ground therefore, very little vegetation grows in the understory. Biologists refer to these stands as black holes and they are death traps for quail since there is no cover for protection. Wildlife generally avoid these stands entirely.

occurs, understory herbaceous vegetation is shaded out until the canopy is re-opened during canopy removal (generally thinning) in a process called understory reinitiation (**Photo 13**). By monitoring the diameter distribution of your stand periodically, thinning is recommended as soon as timber becomes merchantable. Generally, landowners want to wait to thin until markets “max-out” but this can prolong understory reinitiation and, depending on the length of the waiting period, can be harmful to the growth of residual trees. Waiting too long to initiate thinning can cause reduction in tree crown dimensions, ultimately reducing growth in tree diameter due to loss of photosynthetic capacity. Thinning as soon as possible improves stand conditions for all wildlife, especially quail, with the resurgence of understory vegetation.

Thinning rates are generally determined by the management goals that you and your forester have defined prior to implementation of any management practices. Landowners are sometimes advised to conduct forestry practices that conflict with wildlife habitat goals. If you are balancing timber revenues with wildlife value, maintaining or thinning down to residual basal areas* between 40 and 80 sq. ft. per acre will help to maintain a generally open canopy while allowing for adequate timber growth and future revenues. If optimum quail management is your main objective,

you do not need trees to maximize the birds per acres on your property. However, maintaining a residual basal area of 40-50 sq. ft. per acre will allow for future timber harvests, create the potential for natural regeneration options, provide needle cast to improve fire effectiveness of hardwood control in your quail areas and promote higher bird numbers compared to denser canopies. If forest productivity is your main objective, realize you will have reduced quail utilization if your forested stands remain at basal areas above 80 sq. ft. per acre.

ROTATION AGE

The time to harvest and regenerate pine stands depends on economic, wildlife and aesthetic objectives, pine species present, site fertility and overall stand health. Where quail are part of the management objective, long rotations should be favored. This can be over 60 years for loblolly, slash and shortleaf pine and over 200 years for longleaf pine. Long rotations present managers with the opportunity to maintain a greater percentage of the total stand life in a suitable condition for quail. They also offer greater flexibility and ease in management. However, huntable populations of quail can be maintained on sites under short rotation management if careful planning occurs to ensure the establishment and maintenance of suitable ground cover conditions. Where short rotations are used, special consideration should be given to the location and distribution of forest regeneration areas, establishment and maintenance of openings and the management of roads and roadsides to provide food, cover and travel avenues for quail.

MANAGING HARDWOODS WITHIN PINE STANDS

Most pine stands have drainage courses, depressional wetlands, or other types of hardwood inclusions. These areas provide critical habitat for many wildlife species. However, they shade-out understory quail food and cover, and may serve to increase the abundance of predators that impact quail reproduction and survival. Thinning the hardwoods combined with prescribed burning along the edges and within these habitats will result

in improved ground cover for quail and may reduce predator abundance and efficiency. However, the manager must be aware that this can result in lower habitat quality for a variety of game and nongame species that require closed canopy hardwoods and abundant hard mast such as acorns.

Likewise, when hardwoods invade and occupy the midstory of pine stands they shade out the grass and forb ground cover needed by quail. This condition can be controlled using growing season prescribed fire. However, in pine stands established on old field sites, it may be necessary to periodically use mechanical or chemical techniques in conjunction with prescribed fire to remove the hardwoods and restore desirable ground cover conditions.

PRESCRIBED BURNING

When used correctly, prescribed burning is the most cost-effective and efficient tool available for managing quail habitat (**Photo 14**). Prescribed fire: 1) increases insect, legume and soft mast abundance; 2) improves ground layer vegetative structure to enhance nesting cover, brood range and insect and seed foraging conditions; 3) helps to control hardwood invasion into the forest midstory; 4) decreases the abundance of invertebrates that parasitize quail; and 5) decreases the chances of wild fire.



Photo 14. Prescribed fire is one of the most cost effective and efficient tools available for managing quail habitat. The decreased use of prescribed fire is a primary factor contributing to the quail decline.

Prescribed burns should be applied to recently-thinned stands that have at least 40 percent of the ground in sunlight. Burning is of little wildlife value in forest stands where sunlight cannot reach the forest floor. Prescribed burns should be conducted annually, with approximately 30 to 50 percent of the land left unburned to provide food, nesting and escape cover. Alternate unburned patches each year, so that no portion of the stand goes longer than two years without being burned.

Another alternative is to establish permanent firebreaks that divide the site in a checkerboard fashion into 10-acre to 50-acre blocks where possible (smaller is better). Then, these blocks can be burned in a mosaic pattern on a two-year cycle where one half of the woodlands are burned each year. On infertile soils, burning on a three-year or longer cycle may be sufficient. On most sites, prescribed burns should be conducted during winter through early spring. Occasional growing season burns may be needed to more effectively control hardwood encroachment into pine stands. More specifically, pine stands established on old agricultural fields have fuel conditions that are best suited to winter burning, while longleaf/wiregrass stands are well adapted for growing season fires.

Prescribed burning should be initiated in pine stands at the earliest possible age. Longleaf pine stands can be burned in their second year when seedlings are still in the grass stage. Other pine species usually can be burned for the first time when they are 10 to 15 feet tall. Timber stands managed under uneven-aged systems require special consideration for prescribed fire. Prior to prescribed burning, young pine regeneration areas which are scattered throughout the stand, must be protected by firebreaks. Longleaf pine seedlings are the exception, and should be burned when in the grass stage to control brown spot disease.

Dense scrub hardwood stands have little value for quail and are difficult to manage. Repeated late spring burning helps open the stand, allowing the growth of beneficial plants for quail. However, if the sprouts are more than one and one-half inches in diameter at

chest height, mechanical means such as cutting, rotary mowing or bulldozing, may be required in initial control attempts. Herbicides provide another alternative for hardwood control.

Before burning, a person experienced in fire behavior must evaluate the property's fuel type, planning the timing of the burn with relative humidity, fuel moisture, wind speed and direction. The fire plan should allow for adequate firebreaks and identification of smoke sensitive areas. Burn permits and proper equipment are required. Permits may be obtained from the Georgia Forestry Commission (GFC). The GFC and the Georgia Department of Natural Resources can make recommendations for prescribed burning.

FOREST OPENINGS, ROADS & PERMANENT FIREBREAKS

Idle openings are critical for providing brood range, food and cover for quail. As previously indicated, at least 15 to 40 percent of each forest stand should be maintained in openings that are two to five acres in size (**Photo 15**). Rotational winter disking, planting and burning, should be applied to these openings so that one-third to two-thirds of each opening remains fallow each year. Herbicides may be needed if exotic grasses and/or hardwoods begin to invade the site.



Photo 15. Idle or fallow openings are critical for quail and should comprise at least 15% to 40% of forest stands. Openings can be planted, left fallow or a mixture of both.

Roads and firebreaks are necessary components of timber management and can be managed as fallow opening habitat. They can be especially important for providing food, cover and travel avenues for quail while young pine stands are in the sapling stage. When a stand is regenerated, or thinned, roadsides can be widened to 20 feet to 40 feet on each side, and these areas can be managed

as long, linear fallow fields. Roads and firebreaks with north-south orientation are best suited for planting as they receive the most sunlight during the growing season. These linear habitats can be used to connect fallow openings within pine stands.

6

OTHER CONSIDERATIONS

Managing Harvest

How many quail are enough? Research suggests that a viable sustainable population of bobwhite quail (meaning one that is likely to survive a century or more of normal fluctuation) requires a fall population of 400-700 birds. If the habitat is interconnected over the broader landscape, this number can be achieved at densities as low as a bird per 20 acres. However, to maintain hunter interest with frequent covey finds, a bird per three-to-five acres is more appropriate.

When the goal is a sustainable huntable population, developing and maintaining high-quality habitat is only part of equation; managers must also reasonably limit hunting pressure. Hunters should harvest no more than 20% of the fall quail population (including crippling loss of 20%). Fall populations can be estimated by conducting fall covey counts. Your biologist can help you set up counts on your property. Bear in mind that harvesting quail later in the season can have a greater impact of the spring nesting population than does an early season harvest.

Hunters should also record their hunting efforts to help track population trends and distribution of quail on a property. Recording items such as date, number of hunters, weather, hours hunted, number of dogs, coveys flushed and birds killed can be useful. On many of public lands, managers ask hunters to provide this information after each hunt to help biologists provide better hunting opportunities.

Pen-reared Quail

A common misconception is that pen-raised quail can be used to restore or augment wild quail populations. Several research studies have found that survival is very low for pen-raised quail

released into the wild. Pen-raised birds that do survive may pair and mate with wild birds, but so few birds survive that they will not significantly contribute to the establishment or maintenance of a wild population. Also, there may be potential risks to wild quail and wild turkeys from the release of pen-raised quail. These risks are poorly understood, but include disease introduction, increased predation and genetic degradation.

The use of pen-raised quail should be viewed strictly as a means provide the desired level of shooting on areas that are not capable of producing enough wild birds to meet the objective. Obtaining quality birds and releasing these in areas with good habitat structure and with a protective feeding system is the key to providing good shooting. You are required to obtain a special permit to raise, sell or release pen-reared birds for hunting. Releasing birds for the training of bird dogs does not require a permit, however, you must retain proof of purchase. It is illegal to trap wild quail or collect wild quail eggs. People considering the release of pen-raised quail should check with the Wildlife Resources Division to ensure compliance with laws and regulations.

Supplemental Feeding

A frequent topic of discussion among quail hunters and managers concerns the provision of supplemental feed to increase quail populations. Supplemental feeding is not a “silver bullet” and cannot take the place of providing quality habitat. However, research has shown that a well-designed supplemental feeding program can increase over-winter survival, body weights and reproduction in quail. Specifically: 1) the benefits of supplemental feeding are most pronounced during drought years; 2) feeding does not increase the probability of finding a covey while hunting; and 3) does not increase predation. However, it is important to note that these studies were conducted on sites where nesting cover and brood habitat were excellent.

Where supplemental feeding is being considered as a quail management practice, landowners should: 1) provide feed year-

round; 2) provide feed throughout portions of the property being managed for quail; and 3) provide feed under protective cover. If hunting is planned on the property, consult Wildlife Resources Division hunting regulations to make sure that feeding is conducted so as not to constitute an illegal lure or attraction, commonly referred to as baiting.

Predator Management

The control or management of predators to increase quail populations is a controversial and complex subject. At first glance, it would seem logical that if an animal is eating quail and you remove that animal, the result would be more quail. However, this may not be the case. For example, coyotes eat quail, but they also eat snakes, foxes and other animals that eat quail and destroy nests. Controlling coyotes may increase populations of these other predators, which will increase predation on quail. As previously discussed, habitat loss and change is the primary cause of the quail decline.

Quail are a prey species and a variety of predators consume them at all seasons of the year and at all stages of their lives. Predation can be beneficial in removing diseased birds from the population, and it helped mold the bobwhite quail into the sporting game bird that it is today. However, in certain situations predator pressure may be preventing the quail population from fully utilizing the available habitat. In these situations, management practices that reduce predation may allow for quail population increases.

Providing high quality habitat that reduces the exposure of the birds to predators can minimize predation impacts. For example, removing trees from hedgerows improves the ground cover and takes away perch sites for avian predators. Thinning and burning woodlands improves food and cover for quail and reduces the efficiency of avian and mammalian predators; planning burns so that there is plenty of winter cover protects quail during the season when groundcover is sparse. Locating nesting cover and brood range away from creek drains and other predator sources may increase nesting success.

If you have developed quality habitat and are appropriately managing hunter harvest pressure but quail numbers have not increased, you may want to conduct a predator scent station survey (see the Appendix for instructions). This survey indicates the relative abundance of common predators of quail and their nests, such as raccoons, opossums and armadillos. A predator index of .20 or higher decreases the odds of a good hatch. (**Photo 16**).



Photo 16. Predator scent station.

Management Costs & Benefits

More quail can be produced through management, but the old saying, “You can’t get something for nothing” is all too true. Increasing quail populations requires ongoing effort and money. The amount required is based on the current habitat conditions, habitat development needed and the density of quail desired. Where maximum quail production is the objective both direct costs and opportunity costs can be substantial. However, with enough land that has suitable soils and vegetative cover, and is appropriately located, huntable populations can be sustained at reasonable costs to the landowner. In some cases, particularly with croplands, integrating quail management with other land management objectives may increase total economic potential through the returns realized from quail hunting leases. There

may be governmental programs which can provide cost-share assistance in implementing habitat improvements on your land. For more information contact the Game Management Section's Private Lands Program.

The bobwhite quail is a bird worth working for and an important part of Georgia's heritage. Quail hunting is a great way to introduce a young person to the outdoors and to keep the tradition alive (**Photo 17**).



Photo 17. Quail hunting has been and always will be a great way to introduce a young person to the outdoors.

7 SUMMARY

Primary Quail Management Recommendations

- Prior to implementing management practices: determine specific harvest and habitat management objectives; contact a professional wildlife biologist for technical assistance; and develop a detailed management plan.
- Use combinations of winter disking, planting, burning, or herbicides to establish and maintain fallow fields, field borders, hedgerows, field corners, ditch banks, wetland borders, forest openings, widened roadsides, thinned pine stands and other habitats in a mixture of erect weeds, cultivated plantings, clumped native grasses and briars.
- Restore ground cover to existing hedgerows and other fallow habitats by using mechanical or chemical methods to remove trees.
- Convert portions of exotic grass pastures and fields to native warm season grasses and implement rotational haying or grazing.
- Within its historic range and on appropriate sites, favor longleaf pine over other pine species.
- Thin pine stands regularly to maintain 40 to 60 percent of the ground in direct sunlight.
- Prescribe burn so that 50 to 70 percent of area is burned yearly in small blocks.
- Manage forest stands on long rotations.
- Use prescribed fire, chemical and/or mechanical methods to control hardwood invasion of pine stands.
- Establish 15 to 40 percent of forest stands in openings that are two to five acres in size.
- Maintain openings as fallow fields with combinations of winter disking, planting, burning and herbicides.
- Do NOT disk, mow or otherwise disturb field borders, openings, or other fallow habitats during the April through October nesting and brood rearing season.

8 APPENDIX

Glossary

BASAL AREA: the cross-sectional area occupied by the stems of all trees at breast height (4.5 ft.) on a given acre. Generally, this is estimated through plot sampling conducted by a forester or forest technician to describe stand density and size distribution. Sampling methods vary based on stand structure and diameter variability.

CANOPY CLOSURE: the proportion of the sky that is obscured by vegetation when viewed from a single point. Complete canopy closure occurs when the tree crowns allow very little sunlight through to the forest floor. This results in very little vegetation growth in the understory.

COVEY: a small flock of birds.

ESCAPE COVER: vegetation that assists the escape of animals from their predators.

FORB: a herbaceous flowering plant other than a grass.

HERBACEOUS: plants that little to no woody tissues. They usually die back in winter.

HERBICIDE: a substance that is toxic to plants.

HABITAT: the natural home or environment of an animal or plant.

LANDSCAPE CONTEXT: Landscape is all the visible features of an area, including land, vegetation types, and land uses. Properties are nested within landscapes that are nested with in larger landscapes, and so on. The function and diversity of each property is related to landscape(s) it is contained within.

MID STORY: the layer of vegetation that is between the heights of the tallest trees (overstory) and understory. It usually consists of tall shrubs and young trees.

OVERSTORY: the highest layer of vegetation in a forest, normally the taller trees, which forms a canopy over the forest floor.

PESTICIDE: a substance this is used to destroy insect, fungal or animal pests.

PREDATION: the killing of one living organism (prey) by another (predator) for food.

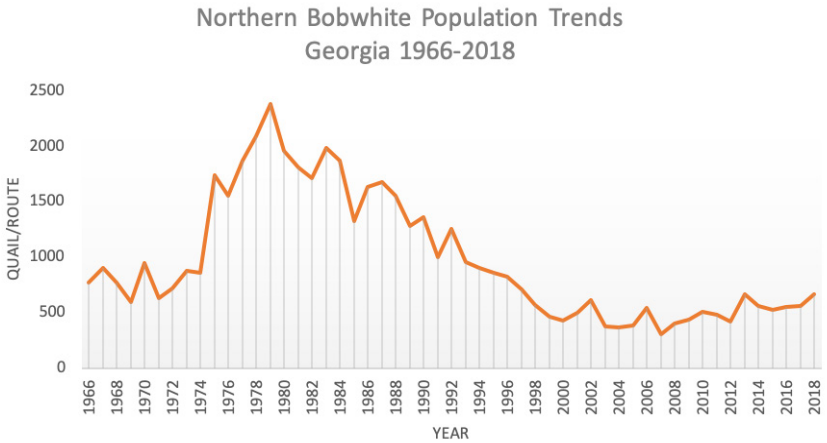
REGENERATION: the process of establishing new tree cover after the previous trees have been harvested or died.

THERMAL COVER: vegetation that provides shelter from extreme temperatures.

UNDERSTORY: the layer of plants and shrubs beneath the main canopy of a forest (at ground level).

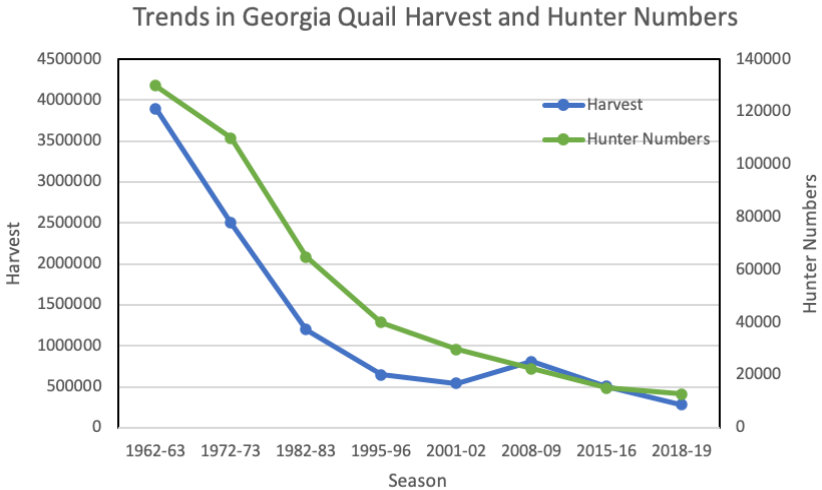
Figures

FIGURE 1



In Georgia, between 1966 and 2018 bobwhite quail declined by more than 70%. U.S. fish and Wildlife Service Breeding Bird Survey.

FIGURE 2



The decline in Georgia's quail population has resulted in a dramatic decrease in the number of quail hunters and quail harvest. The graph shows total harvest for both wild and pen-reared birds.

Primaries 1 through 10

Prior to 150 days, based on the length of the primary flight feathers, hatching dates can be determined.

Secondaries

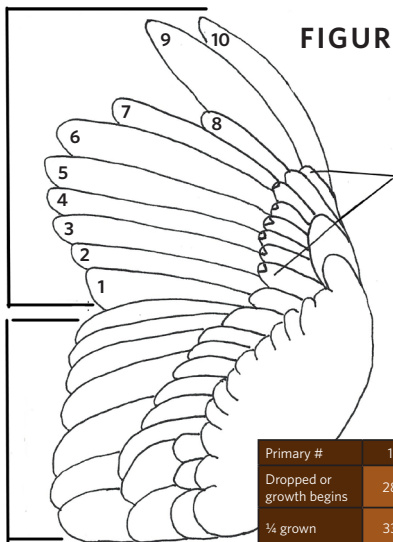


FIGURE 3

Greater primary coverts 1-7 are buff tipped or edged in juvenile but are slate grey in adults.

Primary #	1	2	3	4	5	6	7	8
Dropped or growth begins	28	35	42	47	54	62	74	101
¼ grown	33	42	47	53	60	68	83	111
½ grown	41	47	51	57	65	74	93	119
¾ grown	45	52	56	62	73	82	105	127
Fully grown	53	56	62	76	85	103	124	150

Quail can be classified as adults or juveniles based on the coloration of the tips of the greater primary coverts. Hatching dates can be estimated using the chart below. For this wing, the 8th primary is ½ grown. This bird would be around 119 days old.

FIGURES 4 & 5

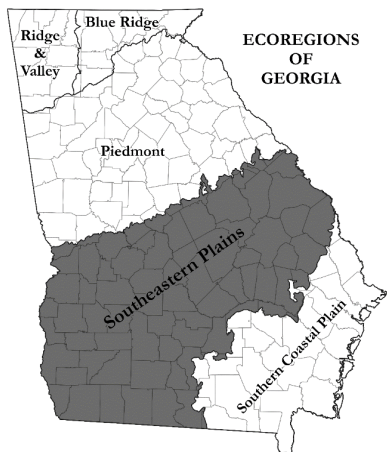


Figure 4. The Upper Coastal Plain is the region in Georgia with the greatest potential for quail management success.

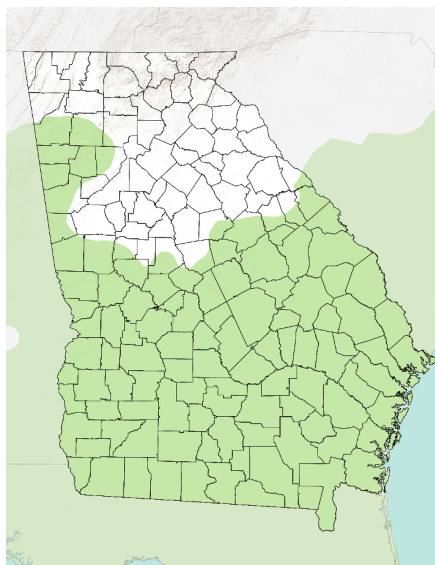


Figure 5. The historic range of Longleaf Pine in Georgia.

Predator Index Survey

A scent station survey works by attracting and identifying attract mammals such as furbearers that destroy quail nests during the summer and may catch adult quail year-round. A yearly predator survey, when compared with your regular quail surveys, will help you determine if wild hunters and nest predators are keeping your coveys from making full use of your property.

1. Locate scent station points >500 feet apart along dirt roads, firebreaks or other travel lanes. Distribute stations evenly across the property.
2. Place stations on alternating sides of the road or trail, within 20 feet of the road edge, but far enough that vehicles won't disturb the station's surface.
3. Reuse sites from year to year for consistency.
4. Each station should consist of a 3-foot diameter circle on a level surface.
5. Fill the circle with fine-textured sand (such as sandbox sand mixed with a little mineral oil) to a depth of about an inch, using a wire mesh (e.g. screen door mesh), so that the surface is even and will take tracks well.
6. Clear nearby vegetation so the wind doesn't brush stems or leaves across the sand and obscure tracks.
7. In the center of the circle, place a fatty acid tablet (available from Pocatello Supply Depot, 238 E Dillon St., Pocatello, ID 83201). This is the attractant for the scent station; if you can't find these tablets, another scent (such as bobcat urine) can be used (**Photo 17**).
8. Surveys are usually conducted in October or November; however, you may run the survey any time predators are active. For best results, be consistent in your timing each year. Choose a five-day stretch when it is unlikely to rain.

9. For the next 5 mornings, identify and record the tracks at each station. Then smooth out the sand and sift a little more on the circle. Replace the attractant as needed.
10. Write down the types of tracks seen at each station—if Station 4 shows both bobcat and opossum, mark both down for that station.
11. Take the total number of visitations by nest predators (armadillos, bobcats, foxes, opossums, raccoons and skunks), then divide by the total number of station-days. Don't count stations that were rained on, driven-over, or otherwise unreadable. The number you come up with will be your predator index. Example: You have 30 stations, surveyed over 5 days. Rain or vehicles damaged 8 stations during the survey. Predator visits were recorded 23 times. Number of visits (23) divided by station-days (30 stations x 5 days = 150 station-days - 8 unreadable station days = 142 station-days) = 0.16.
12. If your predator index is above 0.20, predators are likely limiting quail population and some form of predator management may be warranted.

For additional information, check out “Measuring the Predator Context on Your Land to Manage Predation of Bobwhites” by William Palmer on the Tall Timbers Research Station website: <http://talltimbers.org/measuring-the-predator-context-on-your-land-to-manage-predation-of-bobwhites/>.

BOBWHITE QUAIL INITIATIVE



Thank you to Quail Forever for their generous contribution to the printing of this book.