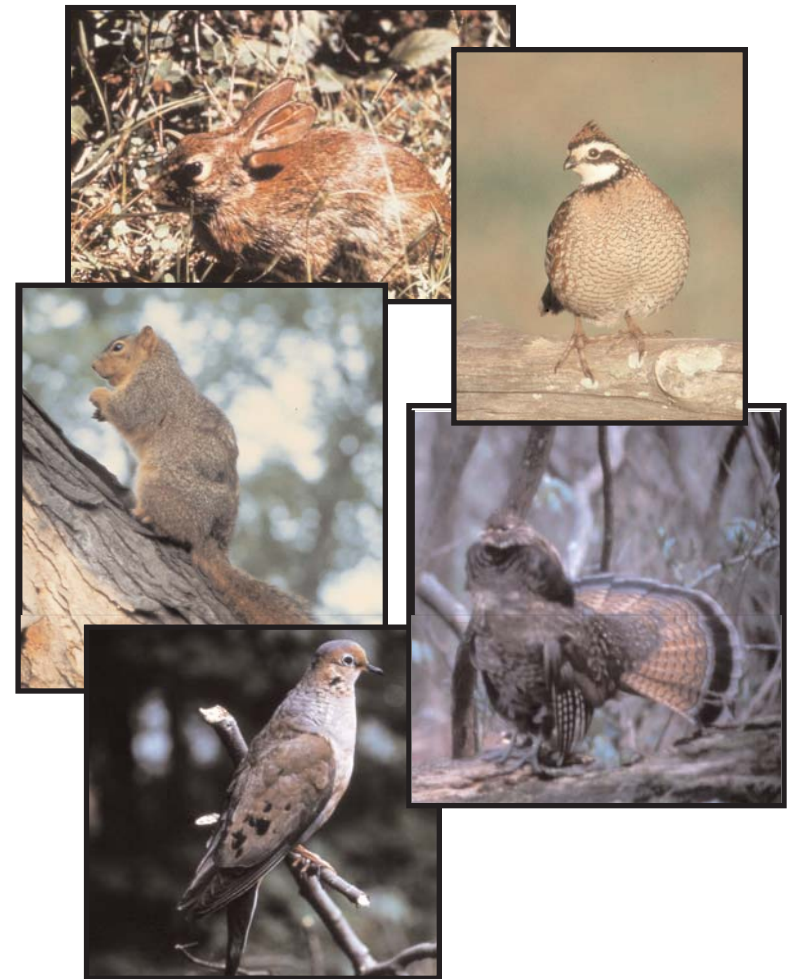


Small Game Management in Georgia



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Wildlife Resources Division
Game Management Section

Small Game Management in Georgia

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Preface

Wildlife biologists serving on the Georgia Department of Natural Resources' Small Game Committee prepared this booklet. This is the first revision and second printing of this publication. It is intended to serve as a source of general information for those with a casual interest in small game animals and as a more detailed guide for landowners and managers who want to improve small game populations on their properties. Technical assistance in developing land management plans is available from WRD biologists. For additional help, contact the nearest Game Management Office listed below.

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INTRODUCTION

In the early 1900's, America was in danger of losing many of its wildlife species. Destruction and loss of habitat, industrialization and overexploitation of certain animals resulted in a major decline of many species including the white-tailed deer and eastern wild turkey. Facing this threat, hunters, the sport hunting industry and other conservationists joined together in supporting legislation to develop the Wildlife Restoration Program of 1937. This legislation is often referred to as the Pittman-Robertson Act.

Hunting and target shooting purchases have supported wildlife conservation for over half a century. The Wildlife Restoration Program is funded with money received from taxes on the sale of sporting guns and ammunition. In the 1970's, tax receipts from the sale of handguns and archery equipment were added to the Program fund. As a result, over four billion dollars have been generated for wildlife conservation.

More than 45 million acres of land funded by the Wildlife Restoration Program are maintained for wildlife across the country. The Pittman Robertson Act funds essential research by more than 25,000 professional wildlife biologists nationwide. The program also supports the training of more than 750,000 people annually in firearms and archery safety. In addition, hundreds of public shooting ranges have been built with Program dollars. Hunters and shooters have been investing in the future of America's wildlife since 1937.

Many hunters (particularly "baby-boomers") grew up hunting rabbits, squirrels and quail. There were few big game hunting opportunities available during the 1950's - 1970's. In the 1970's, deer herds were small, but growing, and turkey populations didn't increase significantly until the 1980's. Thus small game species provided most of the hunting opportunity.

As the deer and turkey populations grew, small game populations declined. Hunting leases became more popular and interest in small game hunting declined. Declining populations of quail and rabbits as a result of habitat loss coupled with reduced access for hunting small game, resulted in a tremendous decline of quail and rabbit hunters. Dove hunting has continued to remain popular during this period. Squirrel hunting has declined but not as much as quail or rabbit hunting.

Whether you enjoy hunting quail with a fine English setter, treeing a squirrel with a Jack Russell terrier or listening to a pack of beagles trail a rabbit, small game hunting is special. For most of us, it means quality time spent with our family or friends. Hunting is not just recreation. Research has indicated that there is something much deeper. Hunting is an important social and psychological activity for hunters (Wildlife and the American Mind, 1998).

Aldo Leopold stated in his 1949 essay, "Goose Music" that *"It is not merely an acquired taste: the instinct that finds delight in the sight and pursuit of game is bred into the very fiber of the race. Golf is sophisticated exercise, but the love of hunting is almost a psychological characteristic. A man may not care for golf and still be human. But the man who does not like to see, hunt, photograph, or otherwise outwit birds or animals is hardly normal. He is supercivilized, and I for one do not know how to deal with him. We are dealing therefore with some thing that lies very deep."*

The Wildlife Restoration success stories for big game, including white-tailed deer, wild turkey, Rocky Mountain elk and pronghorn antelope, have been outstanding. However, some small game species such as rabbits and particularly quail have experienced dramatic population declines during the past 40 years. The declines are primarily the result of habitat loss.

The following chapters on small game species discuss the biology, habitats and management needed to assist interested landowners and managers in creating good small game habitat on the properties they manage.





BOBWHITE QUAIL

For many years Georgia was recognized as the "Quail Capital of the World." This title was justified by the state's excellent population of bobwhite quail (*Colinus virginianus*). Georgia's high quail population was the accidental byproduct of low intensity agriculture and forestry practices commonly applied throughout most of the state during the late 1800s - mid 1900s. However, veteran quail hunters are well aware that quail abundance has dropped dramatically, making hunting much less productive. Data from the U.S. Fish and Wildlife Service Breeding Bird Survey indicates that from 1966 to 1998 Georgia's quail population declined by more than 70 percent. This decline has led to a reduction in the number of quail hunters and quail harvested. In 1962, an estimated 135,000 hunters harvested about four million quail, but by 1998 the number of hunters declined to 42,000 and the reported quail harvest to about 900,000.

Primarily, land use changes are responsible for the quail population decline. More specifically these changes include: the loss of agricultural land, "clean farming" practices, larger agricultural fields, increased use of pesticides, conversion of farmland and native rangeland to exotic grass pastures, increased acreage in intensively managed short rotation pine plantations, decreased use of prescribed fire and increased urbanization.

The good news is that wildlife biologists know more 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. For a quail population increase to occur, management practices must address the factor that is most limiting the quail population. For example, planting food plots to increase fall foods will not result in more birds if brood habitat is the limiting factor (which often is the case). Game Management Section wildlife biologists are available to assist landowners with development of management plans to improve habitat conditions for quail and other wildlife species. Also, a detailed booklet on quail management, "Bobwhite Quail In Georgia: History, Biology and Management" is available from the Georgia Department of Natural Resources, Wildlife Resources Division.



LIFE HISTORY

Reproduction

The familiar "bob-bob-white" whistle heralds the beginning of the breeding season for quail. Increases in day length and temperature trigger breeding activity. Pairing begins with covey break up, usually in March. Remnant coveys may be found until early May. In March, coveys often break up during the day and reform just before dark.

Quail are generally monogamous, one male mating with one female. However, studies reveal that polygamous behavior, several different mates during a breeding season, is more common than previously thought. Populations consist of about 15 percent more males (cocks) than females (hens). This uneven sex ratio is a result of hen mortality during the nesting season. Most of the "bob-whiting" in mid and late summer is by unmated cocks in search of hens.

The most important months for nesting are May through August, but some nesting occurs as early as March and as late as October. Preferred nesting areas are those where ground vegetation contains clump-type grasses that cover about 50 percent of the total ground area. Cover of this type 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 continue to re-nest throughout the nesting season if previous attempts are unsuccessful. Hens that are in excellent physical condition may re-nest after hatching a brood. Also, some cocks may be left to complete incubation while hens find another mate and begin another nesting attempt. The number of eggs laid per nest (clutch) decreases with each attempt, ranging from an average of 16 eggs in April to only nine in August. The incubation period is 23-24 days.



Hatching is a major survival accomplishment for these chicks. Only 20-25 percent of quail nests successfully hatch.

A pair of quail generally raises only one brood of chicks per year. However, it is not unusual to see chicks of different ages with an adult bird. Both cocks and hens have strong brooding instincts and will adopt strayed or orphaned young.

Mortality

Quail are a prey species and are near the bottom of the ecological food pyramid. In Georgia, more than 20 different wildlife species have been identified that prey on quail and/or their eggs. Annual mortality rates for quail vary from 60-80 percent depending on habitat quality, weather, predator densities, hunting pressure and other factors.

Studies suggest quail chick mortality is 50 percent or more between hatching and 15 weeks of age. This loss can be reduced by improving brood habitat, particularly by creating large blocks (2 - 5 acres) of annual weeds that are canopied above but open underneath. During the first few weeks of life, chicks require the high protein diet provided by animal matter, primarily insects. Management practices, such as winter disking and prescribed burning, produce an abundance of insect life at or near ground level. These management practices also provide chicks with an overhead canopy of annual weeds. This protective canopy of weeds can help to increase chick survival by protecting them from the heat of the sun and from predators.

In addition to summer losses of chicks, another significant loss of bobwhites occurs during either the hunting season or the breeding season. If habitat conditions on an area are good and hunter harvest is low, spring and summer mortality will equal or exceed that of winter. 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 from factors such as predation, disease, and, in some cases, starvation must occur. Studies show that annual losses of 60-80 percent remain fairly constant, whether or not an area is hunted. Therefore, a hunter harvest of 25-35 percent of a fall population may replace part of the natural losses without endangering next year's population.

Weather also can be an important mortality factor for quail. In Georgia the worst weather scenario is prolonged drought during the spring and summer. Drought negatively impacts quail populations by reducing weed seed production, available cover and insect abundance. These factors ultimately result in decreased quail reproduction, survival and recruitment into the fall population. The best buffer against drought is the continued provision of quality habitat, especially nesting cover, brood habitat and food resources. When rainfall does occur, quail populations can respond quickly.

Food Habits

Food resources utilized by quail vary by season and depend on the natural availability of food items and the quail's nutritive needs. Peak fruit consumption, for example, occurs in the late spring and summer while mostly insects are eaten during the summer and fall. The typical annual bobwhite diet consists of 60-65 percent seeds, 15-20 percent fruits, 15 percent animal matter and five percent green vegetation. Bobwhites in Georgia can survive without drinking water, provided succulent vegetation and insects are readily available. However, a quail population needs some form of free water (rain, dew, etc.) to thrive, particularly in more arid regions.

Behavior and Movement Patterns

As summer ends and fall approaches, quail form into groups of individuals called coveys. The average covey size is about 12-15 birds and usually consists of birds from two or more broods. Occasionally two or more coveys may be found together resulting in the "40 bird" covey that quail hunters often talk and dream about hunting. 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 or not to harvest additional quail from an area during the hunting season. Birds remain in coveys until spring approaches, when they "break up" and disperse to begin the mating season.

Habitat Requirements

Bobwhite quail are an early succession edge species. They need an interspersed cover that is predominated by annual and perennial weeds and legumes, clumped native warm season grasses, and a mosaic distribution of briar and shrub thickets. Quail densities are highest, and respond best to management, in areas where there is a contiguous distribution of suitable habitat (perhaps 5,000 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. Soil conditions also are important to consider when managing land for quail. Soils with the greatest quail management potential are the well-drained sandy loams and clays. Deep sands and wet soils limit prospects for improving quail populations. Due to site conditions and current land use patterns in Georgia, the Upper Coastal Plain generally offers greater potential for quail management than does the Ridge and Valley, Blue Ridge Mountains, Piedmont or Lower Coastal Plain physiographic provinces. The Southwestern portion of the Upper Coastal Plain tends to have the best quail potential because of high soil fertility and summer rainfall. 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 that are missing for quail populations to rebound are nesting cover, brood range and year-round food availability. Most lands have vegetative cover that is either too dense or too sparse at ground level.

MANAGEMENT

Agricultural fields and woodlands can be enhanced for quail through the judicious application of management practices. As previously mentioned, 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. This is best accomplished by developing a detailed management plan that is tailored to the property under management consideration. At a minimum, a management plan should include an inventory of current habitat conditions and specific recommendations relative to the type, timing, location and costs of needed management practices.



Croplands

Providing suitable conditions for quail on as little as 2-5 percent of commercial crop fields can result in substantial increases in the bird population. Croplands can be enhanced for quail through the management of fallow habitats including field borders, hedgerows, field corners, ditch banks, wetland borders and fallow fields or patches. Combinations of winter disking, 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 and winter.

When establishing linear practices like field borders, hedgerows, wetland borders and ditch banks the best rule to remember is wider is better. They should be at least 10 feet in width and widths of 30-100 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 provide significant benefits to quail. When feasible, all fallow habitats should be connected to facilitate the protected movement of quail throughout the cropland area.

Strip disking during fall/winter can be used to maintain favorable structure and plant species composition for quail in fallow habitats. For example 1/3-1/2 of the site can be disked each year (November through February) and allowed to remain fallow the following summer. Fall/winter disking encourages the development of ragweed, partridge pea, beggarweeds and other quail food and cover plants. As a general rule, fallow habitats should not be disked, or otherwise disturbed, during spring and summer as this encourages undesirable plants like coffeeweed, sicklepod, Johnson grass and Bermuda grass. Also, disking in the spring and summer may destroy nests or disturb birds on nests.

Planting also can be used as an integral part of managing these fallow habitats for quail (see Appendix 1 for specific recommendations). Plant annual grains like corn, Egyptian wheat, brown top millet and grain sorghum in the spring and summer to provide food and cover in the fall and winter. 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, kobe lespedeza and beggarweed, then encourage these to reseed with periodic fall/winter disking. Plant only a small portion of the managed site (generally less than 25 percent) in any given year, maintaining the remainder in desirable weeds and grasses to provide adequate nesting cover and brood habitat.

Periodically, the use of herbicides may be needed to control the invasion of trees and/or exotic grasses into fallow habitats. Even with frequent soil disturbance, sweetgum and other light-seeded trees may invade fallow areas and shade out desirable food and cover plants. Spot spraying with an approved herbicide can address this problem. Another common problem is the invasion of Bermuda and other exotic grasses, into and underneath the weed canopy in fallow habitats. 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. Many of the fallow habitats that once provided excellent food and cover for quail have gradually succeeded into trees. These areas can be restored through mechanical and/or chemical treatments to remove the trees and restore the weeds, grasses and briars that quail need. For specific herbicide types and rates, managers should consult their county extension agent or an herbicide company representative.

Grazing Lands and Hayfields

Moderate to heavy grazing by livestock of native rangeland detrimentally affects 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. Heavy grazing reduces the abundance of cover, making quail more vulnerable to predators. On native rangelands where quail management is one of the objectives, low stocking densities 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 successional wildlife species. Common exotic pasture grasses in Georgia include fescue, bahia and Bermuda grass. None of these grasses provide suitable food or cover for quail, and they tend to out-compete desirable plants. The best approach for blending quail management with these land uses is to fence out, or set aside, corners, borders, drainage courses and other odd areas. These set aside areas can be managed with the same techniques previously described for 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. Herbicide treatments are necessary for successful conversion of exotic grasses to native warm season grasses. As with the other management practices, landowners should contact their local wildlife biologist for technical assistance before management practices are initiated.



***Long-rotation,
open understory
timber management
is more compatible
with quail
management
than short
pulpwood rotations.***

Forested Habitats

In Georgia, longleaf/slash, loblolly/shortleaf and oak/pine forests comprise a substantial proportion of the bobwhite's geographic range. However, the primary benefit of pine trees for quail management is the provision of pine needles, which serve as a fuel to facilitate prescribed burning. In addition, pine seeds are utilized by quail as a fall food source. 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 high priority nongame birds is strongly associated with the structure and composition of the ground layer vegetation.

In general, quail are favored by grass and forb ground cover that develops in open and frequently burned pinewoods and for the first 2-4 years following forest regeneration cuts. Management for maximum economic return is not consistent with providing optimum habitat for quail. However, through careful planning, timber can be managed for reasonable economic returns while maintaining viable and 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, the establishment and management of openings and prescribed burning.

Forest Management Methods

All-aged and even-aged management are the two primary methods of forest management. All-aged management results from harvesting a portion of a timber stand and by selecting individual trees or groups of trees for harvest throughout the life of a stand. The stand then will be comprised of trees of all ages.

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 clear-cutting with artificial regeneration, seed tree and shelterwood cuts. Even-aged management is less complex and less costly to implement on an extensive scale than all-aged management. Quail populations often increase during the first 2-4 years after a stand has been cleared for regeneration. However, even-aged management results in entire stands of trees passing through the sapling stage (age 4-15 years depending on the site) at stocking densities that are not conducive to providing quality habitat or desirable hunting conditions for quail.

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

Pine Species Selection

All pine forest types can be managed to enhance habitat conditions for quail. However, longleaf pine, within its historic range, 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 seed that is nutrient rich and highly preferred by quail; 4) it is relatively disease and insect resistant; 5) it is less prone to wind-throw; and 6) it can be burned while in the grass stage and most other stages as well (even as a sapling).

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. Unfortunately, the longleaf 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 low intensity, like prescribed burning, to high intensity, like shearing, raking, piling, burning and/or herbicides. The method(s) used affects plant succession. Prescribed burning and intense mechanical methods, especially when applied during winter months, seem to produce the most desirable food and cover conditions for quail in Georgia in general.

Seedling Spacing

Pine stand re-establishment requires artificial or natural regeneration. Seedling spacing determines the number of years until the tree crowns overlap and shade out the understory. With artificial regeneration, wide tree 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 for a longer period of the stand rotation.

Natural regeneration by seed tree or shelterwood often results in dense seedling stands that quickly out-compete grasses and forbs. These 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.



Thick pine stands should be thinned and prescribe burned to encourage understory vegetation favorable to quail.

Thinning

Thinning can be used in pine stands to improve quail habitat, upgrade timber quality and provide revenue to the landowner. Stands should be thinned so that 40-60 percent of the ground is in direct sunlight at noon. Heavier thinnings are necessary on infertile soils to produce the desired ground cover.

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. Rotation length 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.

Prescribed Burning

Prescribed burning is one of the most cost effective and efficient tools available for managing quail habitat. Prescribed fire increases insect, legume and soft mast abundance; improves ground-layer vegetation structure to enhance nesting cover, brood range, insect and seed foraging conditions; controls hardwood invasion into the forest midstory; and decreases the abundance of invertebrates that parasitize quail. Prescribed burns should be applied to stands that have recently been thinned and have at least 30 percent of the ground in sunlight. Burning is of little value in forest stands where sunlight cannot reach the forest floor. Prescribed burns should be conducted annually with 30-50 percent of the land left un-burned to provide food, nesting and escape cover. Another alternative is to establish permanent firebreaks that divide the site in a checkerboard fashion into 10-50 acre blocks (smaller is better). These blocks can then be burned in a mosaic pattern on a 2-year cycle where one half of the woodlands are burned each year. A 3-year cycle may be sufficient on infertile soils.

On most sites, prescribed burns should be conducted during winter-early spring. Occasional growing season burns may be needed to control hardwood encroachment into pine stands. More specifically, pine stands established on old agricultural fields have fuel conditions that are best suited to winter-spring 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 stands can be burned in their second year when seedlings are still in the grass stage. Other pine species can usually be burned for the first time when they are 10-15 feet tall. Timber stands managed under all-aged systems require special consideration for prescribed fire. Prior to prescribed burning, young pine regeneration areas scattered throughout the stand, must be protected by firebreaks. An exception to this is the longleaf pine type where seedlings in the grass stage can and should be burned 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 quail plants. However, if the sprouts are more than 1 ½ inches in diameter at chest height, mechanical means such as cutting, rotary mowing and bulldozing may be required in initial control attempts. Herbicide control also may be needed but care should be taken not to destroy desirable vegetation.

Inexperienced persons should not attempt prescribed burning. Important preparations including adequate firebreaks, proper equipment, personnel and burn permits are necessary. A person experienced in fire behavior must evaluate fuel type, timing of the burn with relative humidity, fuel moisture and wind speed and direction. Smoke sensitive areas must be identified before burning. The Georgia Forestry Commission and the Department of Natural Resources can make recommendations for prescribed burning.

For specific methods of forest management contact a wildlife biologist at your local Game Management office. He or she can develop a detailed management plan for quail to meet site-specific needs or conditions. For more detailed forest management practices, review the Wildlife Resources Division publication entitled - "The Bobwhite Quail In Georgia: History, Biology and Management." This book provides specific information regarding pine timber management for greater quail production.



Prescribed burning during the proper conditions is a valuable tool for improving wildlife habitat.

Forest Openings, Roads and Permanent Firebreaks

Idle openings are critical for providing brood range, food and cover for quail. As previously indicated, 15-40 percent of each forest stand should be maintained in openings that are 2-5 acres in size. Rotational winter disking, planting, and burning should be applied to these openings so that 1/3 - 2/3 of each opening remains fallow each year. Herbicides will be needed if exotic grasses and/or hardwoods invade the site. Roads and firebreaks are necessary components of timber management and also can be managed as fallow opening habitat.

PEN-RAISED QUAIL

A common misconception is that pen-raised quail can be used to restore wild quail populations. A number of research studies have shown that survival rates are 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 not well-documented scientifically, but include disease, increased predation and genetic degradation of wild quail populations.

SUMMARY OF PRIMARY QUAIL MANAGEMENT RECOMMENDATIONS

- * Prior to implementing management practices: determine specific harvest and habitat management objectives.
- * 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.
- * Convert portions of exotic grass pastures and fields to native warm season grasses and implement rotational haying or grazing.
- * Within its original range, favor longleaf pine over other pine species.
- * Use wide seedling spacing, such as 8 feet by 10 feet or 8 feet by 12 feet when regenerating pine stands.
- * Thin pine stands regularly to maintain 40-60 percent of the ground in direct sunlight.
- * Prescribe burn so that 50-70 percent of the area is burned yearly.
- * Manage forest stands on long rotations.
- * Establish 15-40 percent of forest stands in openings that are 2-5 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.

More quail can be produced through management, but the old saying, "you can't get something for nothing" is all too true. Effort and money are required. The amount required is based on the habitat development needed and the density of quail desired. Where maximum quail production is the objective both direct costs and opportunity costs can be great. However, huntable populations can be sustained at reasonable costs to the landowner provided that there is enough appropriately located land with suitable soils and vegetative cover.



MOURNING DOVE

The mourning dove (*Zenaida macroura*) nests in all 48 contiguous states. In the southern states, the year-round resident dove population is joined each fall by northern migrants. The ever-present dove is Georgia's most popular and numerous game bird. It is hunted by more Georgians than any game species except deer, and the dove harvest is by far the highest of any species in the state. This bird's popularity does not stop with the hunter, since it also is a favorite of bird watchers and nature photographers.

In contrast to most other game birds, the mourning dove has benefited from most modern agriculture practices. It has adapted to urbanization and remains widespread and abundant while other species, such as bobwhite quail, have decreased significantly or have required intensive management to maintain local populations.

The mourning dove is a member of the pigeon family, *Columbidae*, characterized by the production of "pigeon milk" in its crop for feeding its young. It is a streamlined bird with a small head and a long pointed tail. Adults range in total length from 11-13 inches and appear, at a distance, slate gray in coloration with large white spots on the tail. Adult males exhibit a light blue crown and nape with rosy breast feathers blending to a reddish fawn color on their sides. Females normally have a tan or brownish crown, nape and breast feathers. Immature doves are best identified by the whitish or buff-colored edging on their wing coverts and when very young, appear mottled on the breast, head and neck areas.

LIFE HISTORY

Reproduction

Doves have been known to nest year round in parts of Georgia, but most nesting occurs between February and October. The nesting peak normally occurs during the spring months. Usually two eggs (rarely three) are laid in a flimsy nest that consists of a few twigs on the fork of a limb or other fairly flat place. Occasionally, doves use abandoned nests of other birds as a platform on which to construct a nest. Ground nesting can occur but is uncommon. Incubation duties are shared by the breeding pair during the 14-day incubation period. Upon hatching, the nestlings (called "squabs") are fed for the first few days with pigeon milk regurgitated by the adults. The milk is gradually replaced by seeds, and in 12-14 days the young leave the nest. After staying with the adults for a short time, the young begin congregating to form the flocks seen during summer. The adults soon repeat the nesting cycle, usually producing from 3-5 broods each season.

Mortality

It is estimated that 70 percent of the dove population will die each year. Approximately three-fourths of this mortality is from natural causes, and 15-20 percent is from legal hunting.

Nest failures limit dove populations more than any other factor. Only one nest in four successfully fledges young. The flimsy character of dove nests makes them particularly vulnerable to storms and other severe weather and probably accounts for the largest percentage of nesting failures. A variety of nest predators, including blue jays, crows, squirrels, raccoons and snakes, also destroy dove nests.

Widespread ice and snow sometimes take a heavy toll on wintering dove populations by making food unavailable. There are two diseases that are important mortality factors in doves. The most prevalent is trichomoniasis, a parasitic disease of the upper digestive tract that causes serious die-offs. Trichomoniasis is characterized by the formation of a cheese-like substance in the mouth, throat or crop, which interferes with the ingestion of food and usually causes death from starvation. Dove pox, a viral infection, produces symptoms similar to trichomoniasis, but is less common and much less devastating to dove populations.

Food Habits

Doves feed on seeds from a variety of cultivated and wild plants. Some favorite cultivated species include wheat, corn, browntop millet, proso millet, grain sorghum, peanuts, oats, rye, peas, sunflower and benne (sesame).

Wild plants that are most important in the diet of Georgia doves include wooly croton (dove weed), pokeweed, ragweed, foxtail grasses, wild millet, morning glory, partridge pea, crabgrass, chickweed and Johnson grass.

Animal foods make up a very small portion of the dove's food intake. Insects are rarely consumed, but snail shells are sometimes found in dove crops, presumably because they provide needed minerals. Small amounts of grit are eaten by doves to aid with grinding food in the gizzard.

Habitat Requirements

Although it is considered to be a farm game species, the mourning dove is found throughout Georgia. Typical dove habitat is not easily defined because doves have adapted to so many habitat types. However, their basic requirements include food, water, nesting cover, roosting cover and resting sites.

Because doves have neither strong beaks nor feet developed for scratching, they must feed primarily on grain and other seeds lying free on the ground. Therefore, open grain fields are preferred over areas with thick ground cover.

Most doves nest around fields or clearings that supply food during the nesting season. Nests commonly are found in overgrown fencerows, hedgerows, scrub oak brush, young pine plantations, peach orchards, large hardwoods and pines and ornamental shrubbery.

Roosting and resting cover is provided by various habitat types including pine plantations, mature hardwoods, brushy thickets, dead snags and power-lines. Cover is seldom a limiting factor of dove populations in Georgia.

Unlike quail, which can obtain adequate water from foodstuffs and dew, doves must have a daily source of surface water such as lakes, ponds, streams or even mud puddles. Preferred watering sites have bare ground next to the water to provide easy access. Doves may fly considerable distances to favored watering sites, especially during droughts.

Nest failures limit dove populations more than any other factor. The flimsy character of dove nests makes them vulnerable to severe weather.



MANAGEMENT

Although the mourning dove is a common game bird on Georgia's farms, the fact that it is migratory and highly mobile even during the breeding season limits the effectiveness of localized management practices. The fate of doves in Georgia depends largely upon practices carried out in the Eastern Dove Management Unit, comprising all of the eastern United States from the Atlantic Ocean to the Mississippi River. Overall harvest management of migratory birds, such as doves, is in the hands of the U.S. Fish and Wildlife Service. They set bag limits, shooting hours and a season framework that currently extends from September 1 through January 15. Within that framework, states may select either a 70-day season with a 12-bird daily limit or a 60-day season with a 15-bird daily limit.

Hunting regulations are based primarily on the results of an annual, nationwide dove call-count survey conducted in the spring to determine the status of the breeding population. The dove harvest can then be regulated by manipulating bag limits and seasons according to results of the call-counts. While breeding populations may vary somewhat from year to year, there has been no significant, long-term change in the number of doves in the Eastern Dove Management Unit since the surveys began in 1966. Consequently, regulations have changed little over the years.

General land management practices that provide for the basic year-round needs of doves can have a positive impact on local dove populations. While doves are migratory, the early season harvest is made up almost entirely of birds produced in Georgia. Migrants arrive later and make up a significant percentage of the late season bag, particularly in southern Georgia.

To help ensure good dove populations in the early fall, summer feeding fields can be provided. If normal farming practices do not make grains or other seeds available during the summer, food can be provided by leaving strips of unharvested crops or by planting small fields. Strips mowed or disked through these fields can be very attractive to doves; the same treatment is also very effective in fallow fields that are left to grow up in weeds.

Dove fields must be well planned if they are to attract large numbers of doves for hunting. For shooting purposes, a field should be a minimum of 5 acres (larger is better) and if hunters are likely to be shooting from both sides, it should be at least 100 yards wide. A good rule of thumb is to adjust hunter density to fewer than one per acre to provide for a high-quality hunting experience. Dove fields are more effective when they are irregular in shape and have borders of woodland or brushy fencerows to provide good vantage points for hunters.

Fields for dove hunting should be managed so that crops mature at least 10-14 days before the desired period for shooting. A number of cultivated grain crops offer attractive food for doves. Those commonly planted for dove fields include browntop millet, proso millet, sunflower, corn, wheat, benne (sesame) and grain sorghum. Crops planted in rows are preferable to those that are broadcast. A summary of planting recommendations is presented in Appendix 1.

For early season shooting, especially in middle and north Georgia, browntop millet has long been the preferred crop, since it is a favorite dove food and matures early with minimum attention. Browntop may be planted as a hay crop, a seed crop to be harvested after maturity, or specifically for doves either in rows or by broadcasting. Millet should be planted so that it matures at least two weeks before the first anticipated shoot. However, earlier planting allows the mowing of strips to attract and hold birds during August in the event other food is not available. Millet left standing in rows usually continues to attract doves during the entire early season. Proso millet, which takes longer to mature, is similar in attractiveness and planting requirements to browntop. In addition, wheat can be planted in the fall and then managed to provide food during the summer. When used in combination with strips of browntop millet, food can be made available from early summer through fall.

Excellent early shooting opportunities may occur in those areas where corn or grain sorghum has been cut for silage. Harvested peanut fields are prime attractants in south Georgia, often pulling doves away from other food sources. In fact, few crops attract doves in appreciable numbers when harvested peanut fields are nearby.

Late season dove shooting is limited mainly to harvested fields of late-maturing crops like grain sorghum and corn. Combined or "hogged off" corn fields can produce excellent dove hunting in December and January. Sunflowers and benne also persist into the late season providing good dove shooting opportunities. Under the right conditions, burning weedy fields may be all that is needed to attract birds. Fallow fields containing croton, ragweed, pokeweed, wild grasses or volunteer stands of small grains from the previous year can be mowed, disked or burned to free the seeds and provide an open feeding area.

Normally, a dove field is planted for either the early or late hunting season. However, it is possible to manage a field for both seasons by alternately planting strips 25-30 feet wide of various crops that mature at different times. If well planned, this technique provides dove food for the duration of the hunting season. Interspersing crops with disked strips helps maintain bare soil and increases the attractiveness of the field to doves.

Locating a dove field near a favored waterhole or roosting area can enhance the prospects for good dove hunting. Care should be taken to avoid overshooting an area by limiting hunting to once or twice a week.

Historically, the illegal practice of shooting doves over bait has been a significant problem in Georgia and other states. Often there is considerable confusion on the part of hunters and landowners over what constitutes "baiting" or a "baited field." Baiting is currently defined as "... the direct or indirect placing, exposing, depositing, distributing or scattering of grain, salt, or other feed that could serve as a lure or attraction for doves to, on or over any area where hunters are attempting to take them." A baited area is any area where bait has been placed. Any baited area is considered baited for 10 days following the complete removal of the bait. Baiting regulations do not prohibit the taking of doves on or over any land where corn, wheat, peanuts or any other feed has been distributed as a result of "normal" agricultural planting and harvesting, or as a result of manipulation of a crop or other feed on the land where it was grown for wildlife management purposes. Official recommendations of the Cooperative Extension Service of the U.S. Dept. of Agriculture are used to define normal agriculture practices. Crops may be mowed, disked, bush-hogged or knocked down and made more available to doves so long as they are not harvested and then redistributed to the field. Questions regarding baiting issues should be addressed to the DNR Wildlife Resources Division.



Doves do not stay in one place indefinitely, but do tend to return to the same area each season, with the larger concentrations occupying the most attractive places. While good dove management consists primarily of regulating the harvest over a large geographic area, local attention to the basic needs of the birds will greatly increase the chances of successful dove hunting opportunities.



Mowing mature grain next to disked strips provides seeds on bare ground which is attractive to doves.



RUFFED GROUSE

The ruffed grouse (*Bonasa umbellus*), often called the "king of the upland game birds," gets its name from the ruff of dark feathers on its neck which are commonly displayed by the male. The grouse is a beautiful bird with subtle, mottled coloration and is between the size of a quail and a pheasant.

The range of the ruffed grouse extends from Canada to northern Georgia. The grouse is a bird of the forest. In Georgia, huntable numbers are usually found in mountainous areas above 1,000 feet in elevation. These birds prefer brushy, second growth timber, shrubs and forest edges.

Grouse are usually found in extreme north Georgia. However, they have been found as far south as Clarke County and as far west as Floyd County. Grouse populations in Georgia are low, particularly when compared to populations in the northern states, such as Minnesota or Wisconsin.

LIFE HISTORY

Reproduction

The male ruffed grouse is polygamous (mating with more than one female). He attracts females by beating his wings together, known as "drumming," usually while standing on a fallen log in a dense thicket of mountain laurel or flame azalea. He also uses this sound to defend his territory against other males.

After mating, hens select a nest site at the base of a tree or other obstacle that provides them better protection from the rear while allowing good visibility in front. Nests are often located near a distinct forest edge. Hens usually lay 9-13 eggs with an average clutch size of 9-10 in the southeast. Nesting begins in early April and continues through mid-June.

Incubation of the eggs takes about 24-26 days. If the first nest is destroyed, grouse usually do not re-nest in the Appalachians. Hatching peaks in late May. Young grouse chicks are reared entirely by the hen. Studies in Georgia found that grouse preferred dense upland hardwood sapling areas and a variety of herbaceous foods for brood habitat.

Information regarding reproduction and population trends in the southern Appalachians is limited. Recent surveys indicate that a lower percentage of hens nest, clutch sizes are smaller and almost no re-nesting occurs if nests are destroyed resulting in lower productivity in the Appalachians as compared to the Great Lake States (Michigan, Minnesota and Wisconsin).

Ruffed grouse nest failure is high with only about 25 percent of nest attempts successful. Because the nest is built on the ground it is more vulnerable to predators. Common nest predators include raccoons, opossums, bobcats, cats and snakes.

Mortality

Mortality is high during the first weeks of life with only one out of four juvenile grouse surviving. Recent Appalachian studies indicate that chick survival is very low in the southeast, particularly during the first few weeks after hatching. Predators cause half of this mortality. Once the birds reach adult size, they rarely die from disease, exposure or malnutrition. Predation eliminates 50-60 percent of the adult population each year.

In the northern part of their range, grouse populations cycle up and down during a ten-year period. Most researchers agree that the cycle involves changes in the rates of movement, reproduction or mortality. There is little evidence that the cycle occurs in the southern part of their range.

Over large areas, hunting does not seem to impact grouse populations. Currently studies are underway in the southeast to evaluate the effects of late season hunting on breeding populations of grouse. The early results from these studies have shown that hunting is only a small part of the total mortality. However, late season hunting may be additive to natural mortality.

Food Habits

Ruffed grouse eat both plants and animals, but feed primarily on plants. In the Southern Appalachians, they eat more green leaves than fruits or buds. Fall and winter food studies in Georgia found leaves from a variety of plants in 97 percent of the grouse collected. Leafy material made up 93 percent of the ingested food volume. Georgia grouse eat a wide variety of plants but mountain laurel, Christmas fern and greenbriar are the most important. Mountain laurel makes up one-third of the grouse's diet during the fall and winter. Other important foods include cinquefoil, goldenrod, foam flower, trailing arbutus and clover.

Previous studies have indicated that some of the important winter foods in the Southern Appalachians, such as mountain laurel, are low in nutrition when compared to aspen buds, which are important winter foods in the Great Lake states. Foods found in the Southeast are typically lower in protein, which may result in smaller clutch sizes, poorer hatching rates, and lower survival rates.

Behavior and Movement Patterns

The adult male ruffed grouse does not typically associate with other grouse outside the breeding season. Radio telemetry studies show that the male's home range is about 50 acres. The home range of males is considerably smaller than females. Males spend a lot of time near their drumming logs particularly during the spring and fall.

The home range for a hen is small during the incubation period. After hatching, hens with broods become very mobile as they search for good food and cover for their young chicks. Home ranges are larger for hens with broods than those without broods. Winter home ranges for hens may be as large as 100 acres.

Young grouse become more independent as they mature. By fall, broods break up and disperse into new habitats. During the winter, younger birds typically move more than adults as they search for food or territory.



Habitat Requirements

Grouse require cover for escape, nesting, brooding and protection from the weather in winter. Recent studies in the Appalachians found that grouse preferred habitat with high densities of saplings associated with 10 year-old hardwood clearcuts. They frequent more densely forested areas during the winter and the spring nesting seasons for cover and protection for broods. Open, brushy habitats are used during summer and fall because of greater food availability and higher insect populations. In north Georgia, evergreen shrub thickets and forest regeneration areas provide quality habitat for adult birds in the summer.

Drumming logs are very important to a male bird because much of an adult male's life is spent in the vicinity of chosen logs. Most males use more than one drumming log but usually have one primary log. Drumming logs typically are located in dense thickets on sloping hillsides, permitting a maximum field of view. Critical drumming site habitat includes a well dispersed shrub thicket understory.

Georgia grouse populations are usually 3-4 times lower than densities reported in many northern states. Poor habitat and less nutritious foods may contribute to lower southern populations. Lack of quality habitat makes grouse more susceptible to predation.



Adult male grouse spend much of their time near drumming logs.

MANAGEMENT

Ruffed grouse are a species that prefers second-growth forests with a brushy midstory. Recent habitat management studies concluded that clearcutting (even-aged silviculture) has a positive effect on grouse populations in oak-hickory forests. These studies found that grouse use of clearcuts for summer adult/brood habitat, fall and winter cover and drumming habitat is greatest 6-15 years following timber harvests.

Horizontal structure, like logging slash, blow-down trees or other forest debris, provides good cover in open areas. However, too much horizontal cover can be detrimental to grouse because it conceals predators, reduces the grouse's ability to see and impedes grouse movements on the forest floor.

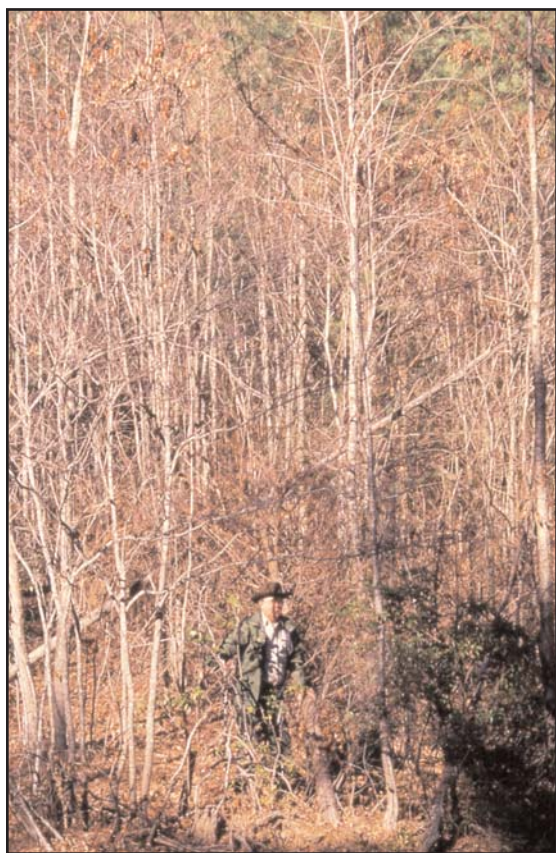
Small clearcuts in mountain hardwoods are an effective forest management practice for improving grouse habitat. This technique requires removal of all trees except oak seedlings or saplings and small clumps of food-producing trees beneficial to grouse. Cuts of 5-20 acres are most desirable, but cuts up to 40 acres are acceptable if arranged in irregularly shaped strips or blocks. Highest grouse populations occur on areas where hardwood regeneration (6-15 years old) make up more than 14 percent of the total area.

Therefore, habitat management should include regeneration areas that maintain a good balance between partial canopy closure and high basal areas to enhance grouse habitat. Oak stands are most productive for grouse in the sapling stage when they provide dense understory and overhead cover. Many researchers agree that winter cover, not brood habitat, ultimately determines grouse population densities in many areas.

Seeded roads or linear forest openings are preferred over fields because they reduce grouse' susceptibility to predation. Cleanly mowed openings are less desirable than strip-mowed fields that leave some weed and brush cover remaining. Wildlife openings with a brushy edge can be created by leaving the outer few feet of openings un-mowed for one or two years. Brushy edges can be created to improve grouse habitat by "day lighting," or cutting down mature trees in 50-foot strips around fields or along roads.



Ruffed grouse are truly a challenge for upland game hunters in Georgia because they are found only in mountainous areas with rough terrain and thick brushy cover. The management of our north Georgia forests, particularly oaks, is critical in providing the cover and food necessary to support future ruffed grouse populations.



An important part of grouse habitat management is maintaining a good distribution of dense vertical growth of 15-25 foot saplings.



RABBITS

Rabbits became abundant when early settlers cleared the forests, providing a valuable food source for early Americans and they are still considered an important small game animal in the United States today. In Georgia, they rank third (behind doves and squirrels) in small game hunting popularity.

Rabbit hunting was very popular in Georgia during the early 1960s when about 117,000 hunters harvested 1.27 million rabbits annually. Wildlife Harvest Surveys show a steady decline in rabbit hunting since the 1960s with 50,237 hunters harvesting 338,597 rabbits during the 1998-99 hunting season. This decline resulted from several factors including loss of rabbit habitat because of "clean" farming practices that remove protective cover and urban expansion that eliminate cover and limit hunter access. Deer hunting has become increasingly popular and competes with small game hunting. The leasing of hunting rights for other primary uses also limits access to many acres of good rabbit habitat.

Four species of rabbits live in Georgia. The most common is the Eastern cottontail (*Sylvilagus floridanus*). This rabbit has dense brown to gray fur on its back with a white underside and tail. There is usually a white spot on its forehead. The sexes are similar in appearance for all rabbit species. Cottontails are found throughout the state. Their habitat includes upland areas associated with agricultural fields, pine woodlands and brushy areas.

The Swamp rabbit (*Sylvilagus aquaticus*), often called a "cane cutter," is the largest rabbit in Georgia. It has black to rusty-brown fur with a white underside. Swamp rabbits are found in bottomland hardwood and beaver pond habitats along rivers and creeks in the Piedmont.

The Marsh rabbit (*Sylvilagus palustris*), is the smallest rabbit found in Georgia. It has a blackish to reddish-brown back with a brownish-gray underside, not white as in the other three species. Its ears and tail also are smaller. Marsh rabbits usually are found in open marsh areas associated with the Coastal Plain and coastal river systems.

The Appalachian cottontail (*Sylvilagus obscurus*) is similar in size and appearance to the Eastern cottontail. However, instead of a white spot on the forehead, they often have a black spot between the ears. Appalachian cottontails are confined to high mountain elevations. Georgia is at the southern end of Appalachian cottontail range and sightings of this rabbit are rare. The Appalachian cottontail is included on Georgia's Protected Wildlife list.



LIFE HISTORY

Reproduction

In Georgia, rabbits begin breeding after the first warm days in February and typically continue until early November. Gestation averages 28 days for cottontails, 33 days for marsh rabbits and 37 days for swamp rabbits. Before giving birth, the female selects a dry location to build a nest. Early spring nesting habitat for cottontails is characterized by grassy areas with vegetation less than eight inches high. Later nests are commonly located in hay fields and areas of native grass. The female cottontail digs a nest cavity in the ground and lines it with grass and fur. Swamp rabbit's fur-lined nests are built on top of the ground under low-growing bushes or in plant debris, such as fallen limbs, using dried weed stalks.

Rabbits in Georgia are usually one year-old before they breed. They can have 3-7 litters per year and typically select different nest locations for each litter. A female rabbit will breed on the same day that she gives birth. Litter sizes range from 3-5 young. They are born blind and helpless, but develop quickly. Their eyes open in about one week, and they leave the nest about two weeks after birth. The mother returns to the nest to nurse the young at dawn and dusk; but once the young leave the nest they are on their own. Female rabbits produce an average of 20 young per year. More males are born than females, and males remain more numerous in the adult population.



*Young rabbits
are completely
on their own after
two weeks of age.*

Mortality

Approximately 80 percent of the rabbit population dies each year. A major cause of this mortality is predation. Rabbits rank high on the list of preferred foods for many predators. Predation is normal for most wildlife populations, and rabbit reproduction makes up for these losses if adequate escape cover is available.

Rabbits are host to several species of ticks, fleas, warbles and chiggers. These parasites seldom cause death in rabbits. However, they can infest rabbits to such a degree that they become easier for predators to catch or diminish their reproductive condition.

Warbles, or "wolves," are larvae of botflies that lay eggs around holes and burrow entrances. The eggs become attached to the rabbit's fur and are ingested when the rabbit cleans itself. They hatch inside the rabbit and the larvae migrate through the rabbit's body to the skin, often in the neck area. The larvae often exceed one inch in length as they grow under the skin, feeding on body fluids. When mature, the larvae emerge and drop to the ground, pupating to become a fly. Warbles also may come out of dead rabbits in a hunter's bag. The presence of warbles may cause the hunter to discard the carcass, even though the meat is unaffected and quite edible.

Many kinds of roundworms and tapeworms also infect rabbits. The species most important to hunters is the canine tapeworm. Some rabbits ingest tapeworm eggs while feeding. The eggs hatch in the intestines and the larvae travel into the body cavity where they form a clear, bladder-like structure with a white center. This formation, called a cysticercus, rarely harms the rabbit. The larvae mature into adult worms after they are ingested by mammalian predators, like coyotes or foxes, which have eaten an infected rabbit. Some hunters allow their dogs to eat "innards," or viscera, from harvested rabbits. If the rabbit is infected with canine tapeworm larvae, the hunter may be promoting infection in his dog.

Fleas and ticks may carry the bacteria that cause Tularemia (rabbit fever). Infected rabbits are sluggish and usually die within 10 days of getting the disease. Humans can become infected when they handle sick rabbits or eat undercooked meat. The disease can be life-threatening to humans, and people should not handle sick rabbits. Hunters should wear rubber gloves when cleaning rabbits, apply iodine to cuts and scratches incurred during the cleaning process and thoroughly cook rabbit meat.

Weather also can impact rabbit populations. Heavy rains during the nesting season can drown young rabbits. Extended drought, which decreases the availability of young and tender vegetation, can reduce pregnancy rates. Drought also forces rabbits to search longer and in less protected areas for food, making them more available to predators.

Thousands of rabbits are killed each year by vehicles. Peak roadside use coincides with springtime breeding activity and an increase in herbaceous food found along these roadsides.

Food Habits

Rabbits eat parts of over 100 species of plants. They prefer herbaceous plants whenever available. Woody plants are used mainly during the winter months. However, marsh rabbits make more year-round use of woody vegetation than other species.

Winter foods include honeysuckle, lespedeza, blackberry, greenbrier, a variety of grasses and dried vegetation. Bark, twigs and buds from sumac, black cherry, willow, holly and dogwood also are eaten. Agricultural crops consumed during the winter include rye, wheat, alfalfa, clover, corn, peanuts and ryegrass. Cottontails may damage fruit orchards by eating the bark of fruit trees. Buds of seedlings in pine plantations also may be eaten during the winter.

Foods during warmer months include a variety of sedges, grasses and other herbaceous plants. Important species include paspalum, panic grass, plantain, dandelion, crabgrass, ragweed, croton, clover and lespedeza. Agricultural crops eaten during the summer include clover, alfalfa, soybeans, peanuts and garden vegetables.

Rabbits pass two types of pellets from their digestive system. Hard, brown, fecal pellets are undigested plant material. Soft, green, food pellets containing vitamin B and other nutrients are reingested by the rabbit. Eating fecal material, called "coprophagy," allows rabbits to more efficiently absorb nutrients from their diet.

Rabbits do not require surface water for drinking. They obtain moisture from rainfall, dew and the herbaceous vegetation in their diets.

Behavior and Movement Patterns

Home ranges of cottontails are usually less than 11 acres. Males have larger home ranges than females, and adults have larger home ranges than young cottontails. Home ranges overlap when preferred food is less abundant in late fall and winter. Adult female home ranges usually do not overlap during the breeding season. Dispersal into areas of suitable habitat is usually by younger rabbits that have not bred.

During spring and summer, cottontails use herbaceous vegetation for feeding and resting. Open areas with shorter vegetation are used at night. They use thicker vegetation containing tangles of vines and low-growing, thorny bushes for resting during the day. Cottontails use woody vegetation more for resting sites during the fall and winter when herbaceous vegetation is dead. Fall populations in good habitat range between 1-2 rabbits per acre.

Home ranges of swamp rabbits vary from 4-17 acres. Densities range from 1 rabbit per 1 1/2-18 acres. Home ranges for marsh rabbits are reported as less than one acre and their densities may exceed two rabbits per acre.

Habitat Requirements

Areas with a mixture of grassy and brushy vegetation provide excellent habitat for cottontails. Because rabbits rate high on the menu of many predators, quality escape cover located close to a food source is the key ingredient to maintaining a high rabbit population. Old fields, utility right-of-ways, shrubby areas between fields and woods, hedgerows, shelter belts and young pine plantations provide good habitat.

Swamp and marsh rabbits, as their names imply, are always found close to water. Swamp rabbits inhabit wooded swamp and marshy areas along rivers and streams. Suitable swamp rabbit habitat has thickets of cane, privet, blackberry, honeysuckle or greenbriar for escape cover. Logs, fallen trees and downed limbs provide shelter. Small forest openings and the edges of beaver ponds provide additional food and cover.

Marsh rabbits inhabit open, marshy areas containing scattered shrub thickets. They often are the major occupants of land next to open marsh along Georgia's coast. Brackish marshes containing cord grass, juncus, spartina and panicums are heavily used. As with cottontails, maintenance of quality escape cover and abundant food sources are essential for high populations of both marsh and swamp rabbits.

MANAGEMENT

Agricultural Fields for Cottontails

Agricultural fields are improved for rabbits by allowing edges and corners to grow into thickets of blackberry, honeysuckle, plum or other dense, low-growing vegetation. Similar vegetation, grown as hedgerows across fields, provides cover strips that break up large fields. Plum, blackberry and honeysuckle thickets should be encouraged in these strips. Hedgerows and cover strips provide travel lanes that allow rabbits access to more of the field.

Nesting cover and food production are improved by creating field borders. These field borders are areas 30-60 feet wide where natural vegetation can develop. Annual weeds and grasses grow during the first summer, followed by perennial and woody plants in following years. Mowing or disking part of this field border every 2-3 years keeps vegetation at the desired stage and prevents woody plants, like sweetgum and pine, from becoming too large.

Preferred foods also may be planted in or adjacent to field borders (Appendix 1). Disking provides similar benefits to mowing and promotes the growth of additional food plants like ragweed and crabgrass. The quality and quantity of food for cottontails improve when these managed areas are fertilized.

Natural vegetation around fields, overgrown fence rows, ditch banks and wet areas provide food and cover for cottontails. When protective cover becomes too thick, strips should be mowed or disked through overgrown vegetation to stimulate new growth.

Cottontails often use brush piles for cover, especially during the winter when the availability of protective herbaceous vegetation has declined. Brush piles should be 5-8 feet high and 10-16 feet wide, placing larger logs and debris at the bottom. If equipment is used, keep from pushing dirt into the pile to allow rabbits easier access. Brush piles should be located near a preferred food source and within 300 feet of other cover. A brush pile only lasts a few years and should be replaced before its value for rabbits is lost. Brush piles can quickly provide protective cover for rabbits where it is lacking. However, they cannot replace the value of more permanent, live vegetative cover.

Pastures grazed by livestock are poorly suited for rabbits. Livestock compete with rabbits for preferred food plants, especially legumes, and they trample and graze vegetation until it is too sparse to provide protective cover. Pastures can be improved for rabbits by fencing livestock out of adjacent woodlands and allowing fencerows and field corners to develop protective cover.

Fescue, a cool-season grass, is planted in many pastures throughout Georgia's Piedmont. Fescue's dense growth competes with more desirable plants and restricts the movements of young rabbits. A fungus that grows on fescue causes reproductive problems in cattle and may affect other animals that eat it. Although rabbits seldom eat fescue, they may resort to this grass if other foods are not available. Fescue fields that remain idle for a number of years and succeed into blackberry, broomsedge, vetch and other preferred plants provide good habitat for rabbits. In areas where fescue occurs, serious rabbit management includes an aggressive program to convert pasture from fescue to native vegetation.

Woodlands for Cottontails

Cottontails are found in a variety of woodland habitats. Pine or mixed pine-hardwood forests have the most potential for rabbit habitat improvement.

Timber stands should be maintained at densities that allow food and protective cover to grow in the understory. Thinning pine stands to a basal area of 50-65 square feet per acre allows enough sunlight for the understory to develop. If higher timber densities are desired, rabbit habitat can still be improved by creating small, scattered openings that can develop into shrub-thicket areas.

Pine stands reach their maximum potential for wildlife when thinned and prescribed burned. Burning helps control hardwood competition, releases nutrients back into the soil and stimulates the growth of food and cover plants for rabbits. The best time for burning is between January and early March, before spring green-up. Later burns may endanger nestling rabbits. Burning scattered, 20-30 acre blocks within larger pine stands provides better habitat diversity than burning the entire stand the same year. Rotate burned areas each year to create a three to four-year burning cycle. Protect several 1/2 acre areas within each burned block with a firebreak. These areas should contain blackberry, honeysuckle or other thicket-forming vegetation to provide escape cover while the burned areas regenerate. Mast producing trees within and next to burn areas should be protected from fire.

Only persons experienced with fire behavior should conduct control burns. A burn plan that describes suitable conditions for burning, smoke management and safety precautions helps insure the desired results. A permit is required from the Georgia Forestry Commission before burning. Additional information on controlled burning is available from the Georgia Forestry Commission and Wildlife Resources Division.

Firebreaks are important parts of timber and wildlife management. A permanent firebreak system should be developed and maintained on an annual basis by mowing or disking. Permanent firebreaks improve fire control and provide additional access to hunting areas. Periodic soil disturbance from firebreak maintenance increases plant diversity, which provides more food for rabbits.

Creating scattered 1/4-1/2 acre openings provides additional food and cover for rabbits. These openings can be managed for native vegetation or planted in clover, wheat or other suitable crops. Loading docks, skid trails, firebreaks and roads also can be maintained in rabbit plantings.

Clearcuts and pine regeneration areas less than seven years old provide good rabbit habitat. These areas usually contain a mixture of herbaceous plants, thickets and brush-piles until the trees begin to shade out the understory. Planting pine seedlings on an 8' by 12' or wider spacing will delay crown closure and lengthen the period of good rabbit habitat.



Dense thickets provide critical protective cover for rabbits.

Swamp and Marsh Rabbits

Swamp and marsh rabbits are dependent on bottomland hardwood or marsh wetland habitats. Protection of these critical habitats is the most important aspect of managing for these species. Timber management practices that reduce bottomland hardwood stands to narrow bands along creeks or rivers can eliminate swamp rabbit populations. Stream channelization, wetland drainage and conversion of bottomland hardwoods to pines or agricultural crops destroys valuable habitat.

Selectively thinning bottomland hardwoods allows sunlight to reach the forest floor and increases herbaceous growth, thus improving habitat for swamp and marsh rabbits. In closed-canopy stands, the creation of 1/4-1 acre clearings will improve habitat for these rabbits. Where clearcuts must be conducted in bottomland areas, they should be limited to 10 acres or less. No more than 20 percent of a stand should be regenerated in a 10-year period. Both swamp rabbits and marsh rabbits readily respond to increased food production associated with winter burning of marsh grass areas.

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During most years, high rabbit populations result from the presence of adequate escape cover next to a quality food source. Management practices that maintain these conditions are most beneficial to rabbits.



GRAY AND FOX SQUIRRELS

The gray squirrel (*Sciurus carolinensis*) and the fox squirrel (*Sciurus niger*) are found throughout Georgia. The generic name, *Sciurus*, means "squirrel" in Latin and was derived from two Greek words, "skia" (shadow) and "oura" (tail). Taken literally, the name means "an animal that sits in the shadow of its tail," which both species can do.

The tail is a squirrel's most distinctive physical feature. It provides balance while running, jumping and climbing, and acts as a parachute to break an unexpected fall. It supplies warmth in cold weather and shade on sunny days. When rapidly flicked back and forth, the tail acts as a warning signal, or a decoy to distract enemies.

The gray squirrel is predominantly gray with white underparts. The fox squirrel has several color phases varying from silver-gray with a predominantly black head, to solid black, to a light buff or brown color tinged with reddish-yellow. Fox squirrels are larger than grays with some adults exceeding three pounds. Gray squirrels appear more slender-bodied with adults weighing 1-1 1/2 pounds.

It is hard to imagine any type of hunting more linked with American history and tradition than squirrel hunting. The famous Kentucky long rifle, developed in the early 1700's by German gunsmiths in Pennsylvania, was often referred to by many early pioneers as their "squirrel rifle." Superbly hand-made and extremely functional, the rifles were amazingly accurate in the hands of these early hunters.

Evidence of exactly how capable these master riflemen were was seen later that century when Pennsylvania placed a bounty of three pence each on the common bushytails. Many men simply quit work and went squirrel hunting, and within one year the Pennsylvania treasury was drained of eight thousand pounds sterling.

Until logging spelled their eventual demise in the early 1900's, the virgin forests of the east continued to support tremendous squirrel populations. Historical records state that as recently as 1901, market hunters were accounting for 50 or more squirrels in a single morning's hunt. Although the combination of cleared land and thinner woodlands drastically reduced squirrel numbers over the next half-century, the adaptable bushytail continued to be the most popular game animal across eastern rural America.

Over the last three decades, successful wildlife restoration efforts involving white-tailed deer and wild turkeys have dropped the squirrel from its top ranking in most states. By the late 1970's, more Georgia hunters were pursuing deer instead of squirrels.

Nevertheless, each fall as mornings turn cooler and hickory trees begin to yellow, many hunters across the Peach State return to their roots. For a number of Georgians, especially those raised in rural counties, squirrels often provide the very first hunting experience, and it is hard to break with tradition.

Still-hunting or slowly stalk hunting are the techniques most squirrel hunters prefer. However, in recent years the use of dogs has rapidly gained popularity.

What exactly is a squirrel dog? It is a dog, either purebred or crossbred, that works with its human handler to tree squirrels. Today, the most popular squirrel dogs are the cur and feist breeds which were specifically developed to be treeing dogs.

Squirrel dogs can display various hunting styles, some of which may be attributed to the specific breed, but most often is dependant on the personal preferences of its handler. Generally, the dogs range out on their own to hunt, but stay close enough to check back with their handlers at regular intervals. In this regard they are much easier to control than trail dogs involved with hunting other game species. Additionally, most squirrel dogs are silent while working a scent trail and bark only when a squirrel is treed.

While it is possible to squirrel hunt with dogs anytime during the season, it is much more enjoyable, not to mention successful, to wait until late fall and winter when the leaves have fallen from the trees. Otherwise, the bushytails hide in the dense foliage and are nearly impossible to locate.

Another very important reason to wait is that most of Georgia's private woodlands are leased to deer hunting clubs, and it is difficult to gain access. In early January, after deer season closes, many of these same clubs will allow squirrel hunters permission to hunt the land.

In regard to public land, the state's Wildlife Management Areas (WMA) provide over a million acres of hunting opportunity. Squirrel hunting is allowed on these WMAs at specified times during the statewide squirrel season. Hunters should check the hunting regulations for specific WMAs and dates.

Today, squirrel hunting, with its strong traditional ties and its association with a way of life that unfortunately has nearly disappeared, is one of the brighter developments regarding the future outlook for small game hunting. Hopefully, this positive trend will continue.

LIFE HISTORY

Reproduction

Squirrels normally have two distinct breeding periods in Georgia. The first occurs in December and early January followed by a second in June and early July. Females usually produce their first litter at one year of age. The gestation period for both species is approximately 45 days and litter sizes range from 1-5, with an average of three.

Gray and fox squirrels have two types of homes, dens and leaf nests. Dens are located in tree cavities and usually are filled with leaves and bark. Den trees usually are large, mature hardwoods having cavities formed from weather or insect damage. Leaf nests are located in the forks of limbs or built around several intertwining branches. They consist of a rough twig framework, approximately 15-25 inches across, interlaced with layers of leaves. The inside cavity is 10-12 inches in diameter and is accessed through a hole in the side of the nest. Squirrels gather nest material from the tree in which the nest is located. Leaf nests can be constructed in less than 12 hours and last for several months. One squirrel may build many different nests during the year.

Den trees are more secure than leaf nests for raising young and are preferred by gray squirrels. Fox squirrels, on the other hand, frequently raise their young in leaf nests. Most nests are in the upper 40 percent of the tree with adult females usually occupying the highest nests.

Young squirrels are born hairless with their eyes closed. At three weeks of age their bodies are covered with short hair, and their eyes open a week or two later. The young begin to venture out of the nest or den at six weeks and are half-grown at eight weeks. Mother squirrels raise their young alone and aggressively defend the nest tree. Good parental care results in high survival rates for the young when compared to other small game species.

Mortality

Life expectancy of squirrels in the wild is 1-2 years with about 50 percent of the population lost to predation, accidents and disease. Hunting has little impact on squirrel populations, except on small woodlots that are heavily hunted. Annual harvest rates are normally 10-20 percent of the population.

Many predators, including hawks, owls, bobcats, coyotes and rattlesnakes, eat squirrels. These losses are normal and usually are offset by reproduction each year. Squirrels have few serious parasites or diseases. Mites, ticks, fleas, roundworms and tapeworms sometimes infest squirrels, but seldom cause serious problems. Occasionally, an outbreak of mange or scabies (a severe skin condition caused by mites) results in mortality.

During September and October, squirrels often are infested with botfly larvae, sometimes called warbles or "wolves." These larvae develop under the squirrel's skin, similar to the warbles described in the chapter on rabbits. Although these warbles are not fatal to the squirrel or harmful to the hunter, the ugly lesions prompt many hunters to discard infested squirrels. The discarding of warble infested squirrels is unfortunate. Even though these lesions are unsightly, the squirrel's meat is quite edible. By late October, most warbles have left their host.

Food Habits

An adult squirrel consumes about two pounds of food each week. Food preferences are similar for both gray and fox squirrels. However, types of food are extremely variable depending on locale, abundance and availability. Major fall foods include "mast" or nut crops (acorns, hickory nuts, beech nuts, pecans and walnuts), pine seed and the fleshy fruits of dogwood and blackgum. Spring and summer foods include buds, seeds, flowers of elm, maple, poplar, hophornbeam and other trees and shrubs. Squirrels also eat mushrooms and a variety of fruits including mulberries, wild cherries, blackberries and wild grapes. Animal foods, mainly insect larvae and bird eggs, occasionally are eaten. Squirrels are quick to take advantage of agricultural crops when available, especially corn, peanuts and sunflowers. Pecan orchards are favorite places for squirrels in late summer and early fall. Squirrels do not require open water but obtain the moisture they need from their diet, dew and rain.

Squirrel populations vary between years and depend on food availability. Populations are influenced strongly by the fall mast crop. When there is good mast production, squirrels enter the following spring and summer breeding seasons in excellent condition and produce more and healthier young. Following a poor mast year some females only have one litter, and many one year-old females will not produce young.

Behavior and Movement Patterns

Fox squirrels have larger home ranges than gray squirrels and males of both species have larger home ranges than females, especially during the breeding season. Although fox squirrels can move over one mile in a day, both species typically use less than five acres surrounding the den tree. Habitat use is influenced by food availability and changes in behavior during the breeding season. The total area used during the year is usually less than 30 acres.



Leaving scattered mast and den trees in pine stands provides better habitat for squirrels.



Besides mast production, gray squirrel densities are influenced by the availability of tree cavities for dens. Seasonal changes occur as squirrels respond to the availability of preferred foods. Pecan orchards attract many squirrels from surrounding woods. When hardwood mast is scarce, squirrels spend more time in adjacent pine woodlands eating pine seed. These movements give the appearance of abundance in some areas and scarcity in adjacent habitats.

Neither species of squirrel hibernates. However, during high winds, heavy rains or extreme cold, they seldom leave their den or nest. Both gray and fox squirrels have major activity peaks during the morning and afternoon hours. Gray squirrels are generally more active early and late, while fox squirrels often move during the middle of the day.

Although fox and gray squirrels are considered tree dwellers, both spend a considerable amount of time on the ground foraging for food. Fox squirrels readily venture into open agricultural fields and pastures. Grays seldom travel through large open areas, preferring to stay along the woods borders near the protection of trees.

Habitat Requirements

Although fox and gray squirrel habitats overlap, better gray squirrel habitat is found in mature hardwoods having a well-developed hardwood midstory with associated vines. This type of habitat is typical of hardwood forests where fire has been excluded. Gray squirrels also use pine-hardwood forests, but only the borders of pine plantations. Tree cavities for dens are essential for good gray squirrel habitat.

Fox squirrels prefer open forests without a hardwood midstory. Fox squirrel habitat includes mature upland pine and pine-hardwood forests that have been burned periodically. They use edges of forests and open lands and will feed in large pastures or fields hundreds of yards from the nearest tree. Another favorite habitat of fox squirrels is mature longleaf pines with an open wiregrass understory.

MANAGEMENT

Squirrel management often conflicts with modern timber management practices. Squirrel populations are extremely low in large tracts of even-aged pines managed on a short rotation. Squirrels need mast-producing hardwoods for food and cavity trees for den sites, and pine plantations lack these habitat components.

Although short rotation pine plantations are not desirable for squirrels, modifications to this management can improve squirrel habitat.

To enhance pine stands for squirrels, landowners should:

- * Leave hardwood corridors along streamsides and in drainages unsuitable for pines. Leave strips of hardwoods between pine stands.
- * Clearcuts should be 50 acres or less.
- * Protect large mast producing hardwoods and den trees within pine regeneration areas.
- * Combine prescribed burning with thinning in pine stands to create and maintain an open understory. The resulting habitat is desirable for fox squirrels.
- * During controlled burns, protect adjacent hardwood trees and shrubs, including food producers such as dogwood, blackgum, oak, hickory, beech and other mast trees.

Within hardwood stands landowners should:

- * Exclude fire from existing hardwood timber.
- * When harvesting hardwoods, leave at least one den tree (cavity tree) and five mast trees per acre. These are minimum requirements. Not every mast tree will produce each year, so the more nut producing trees that are left, the better.
- * Thin young hardwood stands to favor mast trees and promote faster growth and crown development.
- * Protect understory trees, shrubs, and vines. Many of these understory plants produce important food for squirrels.
- * Fertilize hardwoods to enhance mast production.

In areas lacking adequate den trees, artificial nest boxes provide secure den locations and improve gray squirrel production. A nest box should be two feet deep, 8-10 inches square, with an entrance hole three inches in diameter. Many companies that produce bird houses also offer squirrel boxes.

Supplemental feeding is not practical for squirrels. However, both species will use small strips or patches of corn when they are planted along woods borders.

Squirrels often are unwanted guests at backyard bird feeders. An inverted metal, cone-shaped collar placed 4-5 feet from the base of the feeder or adjacent trees can prevent squirrels from climbing onto feeders.



The most important habitat components to provide for gray squirrels are mature, mast-producing hardwoods and large cavity-producing trees. Fox squirrel habitat includes mature, open pine forests having a variety of mast-producing trees. Most oaks and hickories require over 40 years to reach optimum mast production and cavity development. Forest management decisions, once carried out, are not quickly changed and have long-term impacts on squirrels. It is important for landowners to wisely manage their forests if the continued benefit of squirrels and other hardwood dependent wildlife is among their objectives.

Hardwood corridors left in clearcuts greatly enhance these areas for squirrels.



Appendix 1: Planting Guide for Small Game

CROP	PLANTING RATES PER ACRE	PLANTING DATES	DAYS TO MATURITY	SPECIES UTILIZATION/COMMENTS
Millet, Browntop	Broadcast 20 lbs Drill 15 lbs	April-June	60-70	Good dove food and early fall food for quail/Apply 40-60 lbs/ac nitrogen at planting
Millet, Proso	Broadcast 20 lbs Drill 15 lbs	April-June	75-110	A preferred food for doves/Apply 40-60 lbs/ac nitrogen at planting
Large Partridge Pea	Broadcast 15 lbs	March-April	150	Excellent quail food/Maintain pH above 6.0
Oats, Wheat, Rye	Broadcast or Drill 2 bushels	Mid-Sept. to Mid-Dec.	180	Apply 40-60 lbs/ac nitrogen at planting and again in early spring. Plant seed varieties of wheat to hold through the summer for doves.
Seasame	Broadcast 10 lbs 36" rows 5 lbs	Soil Temp. 75 degrees	85-100	Doves/Deer Resistant
Grain Sorghum	Broadcast 8-10 lbs or 36" rows 4-6 lbs	April-June	95-130	Doves and quail/Apply 8-100 lbs/ac nitrogen at planting, split application on sandy soils. Some varieties may suffer damage from black birds.
Sunflower	Broadcast 5 lbs 36" rows 5 lbs	May-July	100	Excellent food for doves and quail/Deer may feed on young plants
Corn	Rows 7 lbs	March-May	80-100	Doves and quail/Apply 80-100 lbs/ac nitrogen at planting, split application on sandy soils
White Clover	Broadcast 8 lbs	Sept.-Oct.	-----	Rabbits/Innoculate seed, maintain pH above 6.5, mow in late summer if weedy
Crimson Clover	Broadcast 20 lbs	Sept.-Oct.	-----	Rabbits/Innoculate seed, maintain pH above 6.0, mow in late summer if weedy
Red Clover	Broadcast 10 lbs	Sept.-Oct.	-----	Rabbits/Innoculate seed, maintain pH above 6.0, mow in late summer if weedy
Lespedeza: Common, Korean, Kobe	Broadcast 30 lbs	Feb.-May	-----	Good late winter quail food/Maintain pH above 6.0
Lespedeza: Bicolor	Broadcast 15 lbs or Seedlings 18" in 36" rows	March-April or Jan.-Feb.	-----	Excellent late winter quail food/Deer may feed on young plants, seed available Fall-Winter, pH above 6.0
Lespedeza: Thunbergii	Broadcast 15 lbs or Seedlings 18" in 36" rows	March-April or Jan.-Feb.	-----	Excellent later winter quail food/Deer resistant, seed available Fall-Winter, maintain pH above 6.0
Egyptian Wheat	36" rows 10 lbs	April-June	90-105	Provides food and cover for quail/Apply 80-100 lbs/ac nitrogen at planting, split application on sandy soils
Cowpeas	Broadcast or rows	April-July	60-70	Good quail food
Fla. Beggarweed	Broadcast 10 lbs	April-May	150-180	Excellent quail food/Use scarified seed, maintain pH above 6.0

**Apply fertilizer per soil test recommendations for best results.*

**Consult your local county extension agent for variety and cultural recommendations specific to your area.*

LITERATURE SOURCES

A Sand County Almanac. Aldo Leopold. 1949. Oxford University Press. New York, NY. 226 pp.

Appalachian Cooperative Grouse Research Project Report - Phase I. Mike C. Reynolds, Dean F. Stauffer, Roy L. Kirkpatrick and Gary W. Norman. 2000. Virginia Tech and Virginia Game and Inland Fisheries. 14 pp.

The Ecology and Management of the Mourning Dove. Edited by Thomas S. Baskett, Mark W. Sayre, Roy E. Tomlinson and Ralph E. Mirarchi. 1993. Wildlife Management Institute. Stackpole Books, Harrisburg, PA. 567 pp.

The Bobwhite Quail: Its Habits, Preservation, and Increase. H.L. Stoddard, Sr. 1931. Charles Scribner's Sons, New York, NY. 559 pp.

The Bobwhite Quail: Its Life and Management. Walter Rosene. 1984. The Sun Press, Hartwell, GA. 418 pp.

Bobwhite Quail Management: A Habitat Approach. J.L. Landers and B.S. Mueller. 1986. Tall Timbers Research Station Misc. Pub. No. 6. Tallahassee, FL. 39 pp.

Ruffed Grouse - The Wildlife Series. Edited by S. Atwater and J. Snell. 1989. Stackpole Books, Harrisburg, PA. 370 pp.

The Ruffed Grouse: Life History, Propagation, Management. G. Bump, R.W. Darrow, F.C. Edminister, and W.F. Crissey. 1947. (Reprint 1978) New York State Conservation Dept. Albany, 915 pp.

Oak Forests: A Management Opportunity for Ruffed Grouse and Other Wildlife. J.F. Kubisiak. 1987. The Ruffed Grouse Society. Coraopolis, PA. 16 pp.

Wildlife and The American Mind. M.D. Duda, S.J. Bissell and K.C. Young. 1998. Responsive Management. Harrisonburg, VA.

Wild Mammals of North America. Edited by Joseph A. Chapman and George A. Feldhamer. 1982. The John Hopkins University Press. Baltimore, MD. 1147 pp.