

Two Species in One Ecosystem: Management of Northern Bobwhite and Red-cockaded Woodpecker in the Red Hills¹

R. Todd Engstrom^{2,3} and William E. Palmer²

Abstract

Sport hunting for Northern Bobwhites (*Colinus virginianus*) is the reason that approximately 300,000 acres of semi-wild lands still exist in the Red Hills region of north Florida and south Georgia. Use of fire for management and relatively large (400 to 4,000 ha), contiguous land ownerships permitted populations of bobwhite and Red-cockaded Woodpecker (*Picoides borealis*) to persist in the Red Hills as regional populations of these two species declined precipitously. Three factors play important roles in the habitat shared by these species: canopy cover, canopy tree species composition, and ground cover composition. These factors affect quality of fuel, which influences the occurrence of fire (ecological stability) and the costs of land management (economic stability). We used simple habitat models for these species to examine tradeoffs that optimize habitat conditions for each species. Maintaining conditions that enable healthy populations of both species to co-exist into the 21st century will require innovative management tools, including habitat restoration, and serious interest in conservation within the community of landowners.

Introduction

Hunting estates have protected some of the finest examples of relatively undisturbed ecosystems in the world. For example, Bialowieza National Park, hunting grounds of the czar of Russia in eastern Poland, has extremely rare European old-growth deciduous and pine forests (Agrawal 2000). Likewise, the Hluhluwe-Umfolzi National Park in northeastern South Africa was the personal hunting area for Shaka, king of the Zulus (MacKenzie 1997). Protection from heavy exploitation of timber resources and development of agricultural systems for the purpose of hunting is the reason that these regions were preserved. The Red Hills

physiographic region of north Florida and south Georgia in the United States has the potential to be another such ecological preserve, albeit one that will likely continue to be privately owned.

Several studies have shown that bird species common to open-structured, upland pinelands in the Southeast, including the Northern Bobwhite, benefit from restoration efforts to improve habitat for the endangered Red-cockaded Woodpecker (Askins 1993, Brennan et al. 1995, Wilson et al. 1995, Plentovich et al. 1998, Masters et al. 2002). The most important habitat restoration technique is removal of mid- and over-story hardwood trees, which permits more light to reach the ground and increases growth of herbaceous ground-cover plant species, and facilitates use of prescribed fire. However, no two species have exactly the same habitat requirements. It is possible to maintain good habitat for Red-cockaded Woodpeckers that supports relatively few Northern Bobwhites, while excellent habitat for bobwhite may be completely unsuitable for the woodpecker. The current reason for existence of many of the plantations in the Red Hills is production of populations of Northern Bobwhites for hunting. We explore the point at which habitat that is suitable or excellent for bobwhite is no longer suitable for Red-cockaded Woodpeckers. We propose that management for both species is better than management for bobwhites alone, because Red-cockaded Woodpecker life history characteristics introduce ecological features that enhance ecosystem resilience and stability.

The Red Hills

Hunting estates comprise approximately 1,220 km² within the 2,400 km² Red Hills physiographic region (fig. 1a) (Cox et al. 2001, Ambrose 2001). The pattern of vegetation composition and structure in the Red Hills is a product of natural variation in life history traits of each plant species (Gleason 1926), the history of land use, and natural disturbances, such as hurricanes and fire. Briefly, the history of land use within the Florida portion of the Red Hills is one of agriculture by the native Apalachee farmers and subsequent American settlers. In the decades after the Civil War, Northern industrialists converted many of these properties into hunting preserves (Paisley 1989; pg. 210-211).

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²Tall Timbers Research Station, 13093 Henry Beadel Drive, Tallahassee, Florida 32312-0918.

³Current address: The Nature Conservancy, 4340 Highway 84 West, Thomasville, Georgia 31792. E-mail: tengstrom@tnc.org.

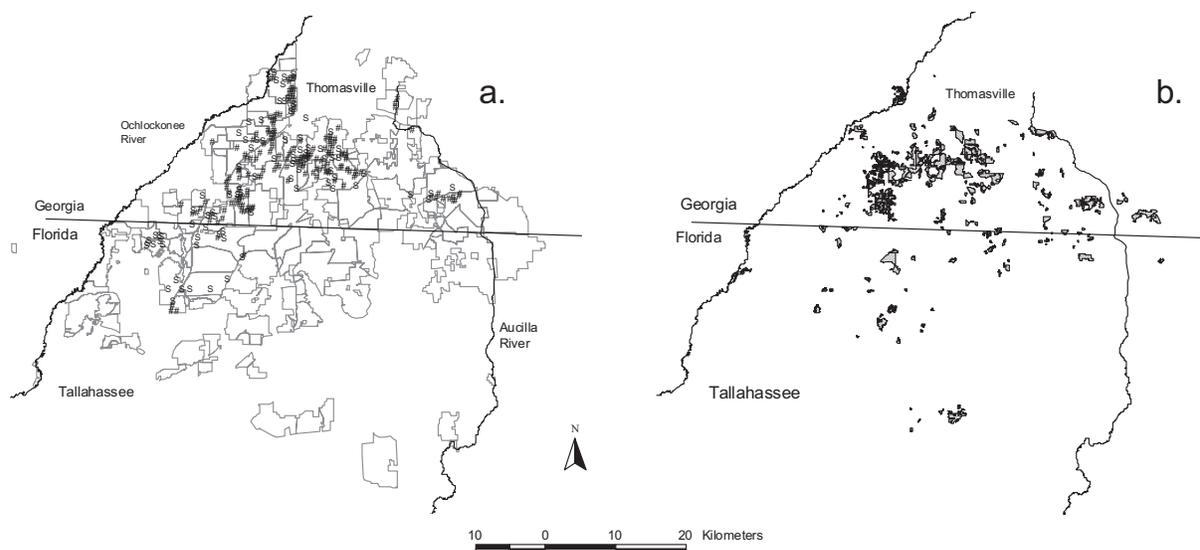


Figure 1— The Red Hills physiographic region between Tallahassee, Florida, and Thomasville, Georgia, is bounded by the Ochlockonee and Aucilla rivers. The Cody escarpment (an ancient shoreline) is the boundary that we use as the southern edge of the Red Hills. Although it is not indicated in this figure, it runs diagonally between the mapped southern endpoints of the rivers. (a) Quail hunting estates are indicated in outline and active Red-cockaded Woodpecker clusters are indicated by solid dots and inactive clusters indicated by open circles. Note: 98 percent of the Red-cockaded Woodpecker population is located in the Georgia portion of the Red Hills. (b) Blocks of relatively undisturbed ground cover within the Red Hills are indicated as polygons (Ambrose 2001).

Patterns of vegetation in northern Florida at the time of early Anglo-European settlement indicate that the Red Hills region was one of the few areas of north Florida in which pinelands were less abundant in relation to upland oaks (*Quercus* sp.) (Schwartz 1994). This may reflect the fact that many of the largest cotton plantations were located in Leon County, Florida, while the largest areas of unplowed land occurred between the Florida-Georgia state line and Thomasville, Georgia (Ambrose 2001). The relatively intact longleaf pine (*Pinus palustris*) wiregrass communities in Thomas County, Georgia, are some of the best remaining examples of mesic longleaf pine woodlands (Means and Grow 1985, Platt et al. 1988, Means 1996, Platt 1999).

Pine-dominated upland vegetation in the Red Hills physiographic area ranges from virtual monocultures of longleaf pine (Platt et al. 1988) to mixtures of “old field” pines, such as shortleaf (*Pinus echinata*), loblolly (*Pinus taeda*), lesser numbers of slash (*Pinus elliotii*) and longleaf pines (Clewell 1980, 1986). One hypothesis that accounts for the distribution of old field pines on sites that are typically dominated by longleaf is that longleaf pine trees were largely eliminated by American Indian and subsequent European settlers’ agriculture. Loblolly and shortleaf pines, which are typically found in mesic or transitional dry slopes respectively (Landers 1991), colonized and essentially replaced longleaf as the dominant pine species (fig. 2).

Ground cover composition within the pine woodlands also varies from a relatively undisturbed plant community dominated by perennials (Peet and Allard 1995) to a plant community dominated by annuals (Clewell 1986). Ambrose (2001) found that approximately 12,000 ha (5.3 percent) of the least disturbed (i.e., not plowed) patches of vegetation remain within a hypothesized 225,000 ha of pre-agricultural upland forest in a recent inventory of the Red Hills.

Northern Bobwhites and Red-cockaded Woodpeckers

Populations of Northern Bobwhites have declined 70 to 90 percent across much of their range since Breeding Bird Surveys began in the 1960s (Church et al. 1993). Regional loss of habitat from land use changes is considered the main reason for the decline (Brennan 1991). State wildlife agencies in the Southeast have developed a regional plan (Dimmick et al. 2001) to help address long-term habitat declines. In the Red Hills, where populations have been actively managed on a landscape scale, populations are at least stable if not at historical highs on some properties (Brennan et al. 2000).

The Northern Bobwhite is adapted to grassland-shrub vegetation that is periodically disturbed. Suitable habitats for bobwhites in the southeast are diverse and

range from agricultural landscapes to open pine or pine-hardwood forests. Adults and juveniles form mixed family groups from October to April at which time they are largely seedeaters. During breeding season hens and young chicks require an arthropod-rich diet. Bobwhites show ambisexual polygamy and in good habitats individual hens can raise >1 brood per year (Curtis et al. 1993). Despite high productivity rates, population growth can be limited by low seasonal or annual survival rates, and this may be directly related to coverage and quality of the ground cover vegetation in relation to the predator community on an area (W.E. Palmer, pers. obs.).

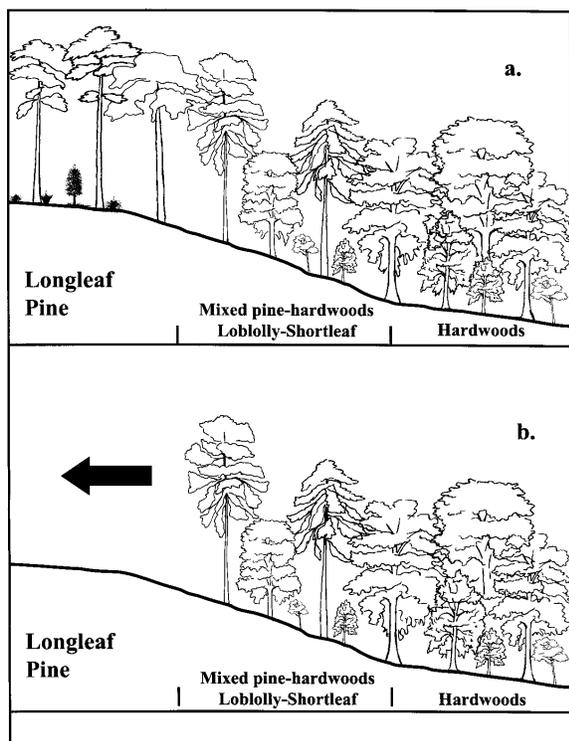


Figure 2— Hypothetical changes in forest composition as a result of clearing for agriculture in the Red Hills physiographic region. Longleaf pine dominated uplands, because it had superior adaptations to frequent fire, but it had relatively poor dispersal ability and was not an effective colonizing species. Loblolly and shortleaf pines are less fire tolerant during the first 5 years after establishment and were largely restricted to ecotones. Following widespread clearing of the uplands for agriculture, loblolly and shortleaf pines rapidly colonized the uplands and effectively replaced longleaf in the uplands.

Bobwhite management in the Red Hills has been refined from a century of research and management (Stoddard 1931). On forested areas typical of the Red Hills, fall densities are greatest (4 to 7 bobwhites/ha) on areas with low timber stocking, typically <14 m²/ha. While bobwhites persist at low densities (0.25 to 1 bobwhites/ha) in timber stands with greater densities,

their populations greatly diminish as ground cover disappears due to shading. Annual and biennial use of prescribed fire is the most important management tool to maintain a grass-shrub ground cover although mechanical and herbicidal treatment of hardwoods is equally important on old-field lands.

The Red-cockaded Woodpecker is a relatively sedentary, cooperative breeding species that lives in upland pine forests in the southeastern United States (Jackson 1994, Conner et al. 2001). Life history requisites are living, old pine trees that are used for nesting and roosting cavities and foraging, widely spaced stems with few hardwoods that provide an open structure, and spatial proximity to other groups within a population to ensure demographic exchange. Recommendations for maintaining an adequate forest structure for Red-cockaded Woodpecker foraging and nesting include: maintaining a minimum of 50 ha of good quality habitat (within 0.8 km of the cavity trees) that is defined as having (1) ≥ 45 pines/ha that are at least 35 cm diameter breast height (DBH) and ≥ 60 years old, (2) a basal area of pines ≥ 10 cm DBH between 9.2 to 18.4 m²/ha, (3) 40 percent herbaceous ground cover, and (4) a minimal number of hardwoods in the midstory and canopy (U.S. Fish and Wildlife Service 2000). The upper end of the basal area found in recommendation 2 for trees >10 cm DBH may be an underestimate of good habitat conditions (R.T. Engstrom pers. obs.).

The Red Hills has the largest population of Red-cockaded Woodpeckers on private lands, and the sixth largest population overall (James 1995). This is a result of unusual historical factors (i.e., relatively contiguous forested habitat, conservative application of single-tree selection harvest, and regular use of prescribed fire to maintain open habitat conditions), but it also should be seen as an indicator of the intact longleaf pine ecosystem. The woodpecker population has been relatively stable to slightly declining within the past 10 years (Cox et al. 2001). The intact ecosystem can be economically managed for populations of bobwhite, limited timber production, and populations of Red-cockaded Woodpeckers.

Land Management Trends in the Red Hills

Prescribed fire is the most cost-effective way of controlling ground cover composition and structure. Reduction of overstory and disruption of groundcover may interfere with the efficacy of use of fire for management. The relative stability of upland pine ecosystems is strongly dependent on fire to control hardwood competition that will eventually shade pine seedlings and groundcover. The ability to burn the vegetation is

linked to the quality of the fuels. Pine needles and grasses are the principal fuels that sustain fire in this region. Removing pine overstory that provides pine needles and elimination of the most pyrogenic ground cover species will eventually increase the cost of maintaining the open structured forest that both bird species—bobwhite and Red-cockaded Woodpeckers—depend upon.

Canopy Cover

Two principal land management goals—elevating Northern Bobwhite populations and deriving income from timber--drive vegetation manipulation on hunting estates in the Red Hills. These two factors can act synergistically to justify reduction of overstory basal area. Ground-cover vegetation growth and vigor are inversely related to overstory cover because the overstory acts to shade understory plants (*fig. 3*). Therefore, land managers are interested in providing sunlight on the ground to enhance maximal growth of understory plants. Understory vegetation density and composition are critical for Northern Bobwhite because they provide food (e.g., seeds, insects, fruits) and cover from predation. Revenue from timber harvest is typically needed to offset the expenses of maintaining the estates for hunting. Current cost estimates for hunting estate land management range from 1 dollar to 10 dollars per acre per year, depending on ground cover conditions (Moser 2001). These costs cover prescribed fire, use of herbicides, tractor work (mowing, roller chopping, etc.), provision of supplemental foods, and predator control. Another periodic land management activity is removing hardwoods. The net result of hardwood removal can range from a loss to a gain for the landowner depending on the quality, quantity, and market value of trees removed. Habitat quality on the single axis of overstory pine basal area for Northern Bobwhite and Red-cockaded Woodpecker overlaps across a range of overstory basal area from approximately 7 to 18 m²/ha (*fig. 4*). Red-cockaded Woodpeckers obviously need some trees and Northern Bobwhite habitat quality is diminished as the overstory of large trees shades understory plants. Variation in management costs, particularly use of prescribed fire, is driven, in part, by the ecological condition of the land. Management costs will rise when the overstory is significantly reduced (*fig. 4*). Ground cover and overstory composition also affect the quality of the fuels and hence the costs of management.

Ground Cover Composition

A common Red Hills management practice to improve habitat for bobwhite is to disturb the soil, which creates patches of desirable food plants (Buckner et al. 1979) and important structural characteristics for young bobwhite. Soil disturbance is typically accomplished by

harrowing and roller drum chopping. In the remaining patches of relatively undisturbed native ground cover, this can result in elimination or severe disruption of some of the long-lived perennial ground cover plants characteristic of the longleaf ecosystem. Some of these plants, particularly wiregrass, are strongly pyrogenic and highly flammable (Clewell 1989). Loss of these plants can reduce flammability of the vegetation by shifting herbaceous composition to less pyrogenic species and by increasing invasion by hardwoods. In addition, disking previously undisturbed vegetation in longleaf systems may result in poorer quality habitats for bobwhites (Olinde 2000, Hammond 2001).

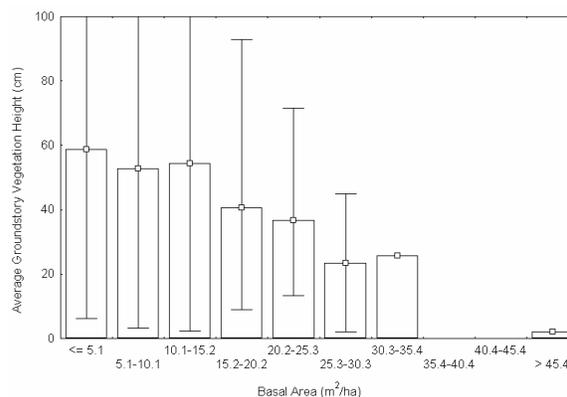


Figure 3— Relationship between basal area of trees in the overstory and height of ground cover vegetation on Tall Timbers Research Station.

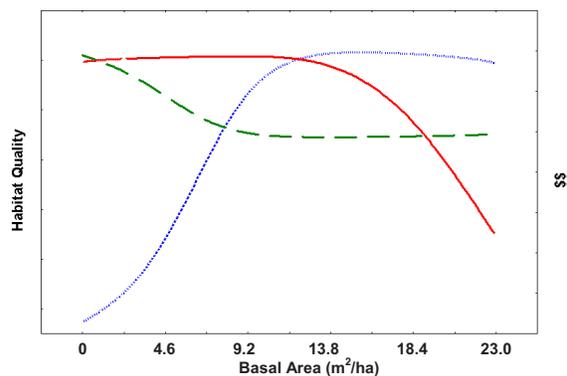


Figure 4— Hypothetical relationship between basal area (m²/ha), habitat quality for bobwhite (solid line), habitat quality for red-cockaded woodpeckers (dotted line), and management costs (dashed line).

As noted earlier, much of the southern part of the Red Hills in Florida was used extensively for agriculture (Clewell 1980). In some places, successional replacement of pyrogenic ground cover plant species occurred decades or even a century or more previously. The effects of continually re-disturbing old-field vegetation, regardless how long that vegetation has been resident are unknown.

Canopy Cover Composition

Longleaf pine likely dominated uplands throughout the Red Hills before Native American and European settler agriculture (Clewell 1980). Longleaf has many physical (e.g., thin canopy, long, resinous needles, high resin production, and thick bark) and life history (e.g., growth in phases, shade intolerance) traits that are beneficial within a regime of frequent (1 to 5 year fire interval), low to intensity fires (Landers 1991). Besides widespread harvest, relatively poor dispersal ability, long mast intervals, and modification of the historic fire regime are likely the key reasons that longleaf pine has been displaced in favor of loblolly and shortleaf pines within the Red Hills. Resistance to insects and disease, tolerance of fire in the youngest age classes, and tolerance of wind and drought make longleaf pine a superior tree species for conditions in the uplands of the southeastern coastal plain (Wahlenberg 1946). In addition, density of its wood and other characteristics makes it one of the most valuable timber species in the region.

Red-cockaded Woodpeckers use several species of southern pines for its roosting and nesting cavities (Baker 1971, Jackson 1994), but longleaf has long been identified as the preferred tree species (Conner et al. 2001). Longleaf pine has certain qualities (e.g., resin flow, longevity, and wood strength) that may make it a better tree for use by the woodpecker. For example, the percentage of longleaf pine trees within a Red-cockaded Woodpecker cluster was the best predictor of whether a particular cluster was going to remain active or become abandoned by the woodpecker in a recent study within the Red Hills (Cox et al. 2001). It is no coincidence that active Red-cockaded Woodpecker clusters occur within the most intact stands of longleaf pine and the least disturbed ground cover within the Red Hills (Ambrose 2001) (*figs. 1a, b*).

Social Trends

A seemingly inevitable reduction in estate size is taking place within the Red Hills, because each property has tended to be subdivided among heirs during estate inheritance. Inheritance produces new challenges and opportunities for conservation. First, landowners must modify their expectations for the hunting experience because the land bases of the subdivided estates are smaller. Second, the same management functions (e.g., application of prescribed fire, road maintenance, food plots, etc.) that occurred on large estates must take place on smaller estates to maintain populations of bobwhites for hunting. This reduces economies of scale for bobwhite management at some point. Third, divergence of land uses among

the subdivided estates could result in habitat fragmentation, increased suburbanization, increased opposition to the use of prescribed fire, and splintering of the hunting social community. At the same time, heirs of large estates are often interested in tax benefits available through conservation easements that can be structured to balance personal interests and values with regional conservation needs.

Conclusions

The key issue that we have chosen to examine is the functional interaction between pine canopy cover (using basal area as an index), habitat quality for the Northern Bobwhite and Red-cockaded Woodpecker, and the economics of land management (*fig. 4*). Clearly, good habitat for both species and lower management costs exists when overstory basal area is at an intermediate level. This observation is consistent with what is almost a truism in wildlife management: manipulations to maximize any one species will be both expensive and ecologically unstable.

Red Hills hunting estates, because they have been managed for similar purposes and are largely contiguous, can be viewed as a single functional landscape. The trajectory of the Red Hills landscape will be determined by economics, ecological relationships, and human social systems, as in all issues of conservation of natural resources (Gunderson and Holling 2002). Economic issues include wealth of individual landowners, costs of land management for hunting, and revenues generated by timber harvest. Management of the Northern Bobwhite—the primary species of interest for hunting—is the reason that these estates exist. The strength of hunting as a social phenomenon that provides the essential cohesion to the Red Hills must also be considered. How these factors can be shaped to permit change is the fundamental challenge for conservation of the unusual wildland character of the region.

We draw three conclusions from this preliminary exploration of ecological use of fire for vegetation management of the Northern Bobwhite and the Red-cockaded Woodpecker within the Red Hills:

(1) Loss of longleaf as the overstory dominant through agricultural conversion of vegetation has resulted in the ecological replacement on upland sites of longleaf by loblolly and shortleaf pines—species that are not as tolerant of fire in the earliest stages of development and provide inferior fine fuels from their needles. Shortleaf and loblolly, probably because of reduced resin flow and longevity in comparison to longleaf, are inferior cavity trees for the Red-cockaded Woodpecker (Cox et al. 2001).

(2) Maintenance of a basal area of older age class pine trees within a range of 9.2 to 18.4m²/ha would provide ecological and economic benefits by providing excellent habitat for bobwhite and Red-cockaded Woodpeckers and needles that are an important source of fine fuel for using prescribed fire to manage vegetation.

(3) Strategic restoration of longleaf pine and wiregrass to sites that are currently dominated by post-agricultural plant species. This would increase the flammability of the vegetation, thereby decreasing the cost of controlling hardwoods within upland pine systems by methods other than fire.

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Two Species in One Ecosystem – Engstrom and Palmer

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