National Bobwhite Conservation Initiative:

A Range-wide Plan for Recovering Bobwhites

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Recommended Citation:

The National Bobwhite Technical Committee. 2011. Palmer, W.E., T.M. Terhune, and D.F. McKenzie (eds). The National Bobwhite Conservation Initiative: A range-wide plan for recovering bobwhites. National Bobwhite Technical Committee Technical Publication, ver. 2.0 , Knoxville, TN.

Recommended (co)Authored Chapter and Section Citations:

Long, B. and C. K. Williams. 2011. Mid-Atlantic Regional Issues in Bobwhite Conservation. Pages 149-155 in Palmer, W.E., T.M. Terhune, and D.F. McKenzie, eds. The National Bobwhite Conservation Initiative: A range-wide plan for recovering bobwhites. National Bobwhite Technical Committee Technical Publication, ver. 2.0 , Knoxville, TN.

Foreword

Bobwhite conservation found renewed hope in March 2002. That month, the Northern Bobwhite Conservation Initiative (NBCI) was published by the Southeast Quail Study Group (SEQSG), on behalf of the Southeastern Association of Fish and Wildlife Agencies (SEAFWA). The nine years since have fundamentally changed the quail game.

Sometimes a crisis is necessary. Even as conservationists were proudly heralding myriad other wildlife restoration success stories throughout the mid and late 20th century, a half century of land-use changes had quietly reduced quail bobwhite populations to unhuntable levels in many parts of their range. By the end of the 20th century, this "unfinished business" of wildlife conservation resulted in the fading of an American culture and a treasured rural heritage.

Certainly, some recognized and tried to act on the problem earlier. Quail Unlimited formed, in 1981, to alert and organize sportsmen to the growing problem. Dr. Lenny Brennan's 1991 technical paper, "How can we reverse the northern bobwhite population decline," began stirring other professionals, who developed the first framework for collective action two years later at the Quail III Symposium. Breck Carmichael went a big step further in 1995, by convening more than 60 bobwhite managers for the inaugural meeting of the SEQSG in South Carolina. These first steps were foundational, but a crisis of this magnitude demanded far more.

The turning point came in autumn 1998, when the SEAFWA Directors - lead by Gary Myers (Director of the Tennessee Wildlife Resources Agency) - charged the SEQSG to develop a regional recovery plan that would restore bobwhite populations to 1980 levels across the Southeast. That charge from the top of the very agencies on whose shoulders the authority and responsibility rested was the key that launched the movement.

The resulting NBCI, inspired by and modeled on the groundbreaking North American Waterfowl Management Plan, represented many "firsts" in bobwhite conservation. For the first time, the SEAFWA Directors' charge to the SEQSG provided authority and guiding purpose to the technical experts. For the first time, the southeastern states broke from a half-century tradition of independent, fragmented efforts, standing up as a group to provide united leadership. For the first time, more than 50 quail experts took decisive action across the region, stepping outside their academic comfort zones to develop visionary population recovery goals and habitat restoration objectives needed to reach those goals. For the first time, dozens of states and their conservation partners were uniting to solve a common problem too big for any one or any several.

These profound firsts produced a long and broad array of unprecedented achievements, far too many to list here. But for the NBCI, none of the following example accomplishments likely would have occurred:

- Bobwhite restoration became a consensus priority and a common topic of the national conservation dialogue;
- The bobwhite community earned standing among migratory bird conservationists by use of ecologically-based Bird Conservation Regions and earnest collaboration with the "Partners

in Flight" songbird conservationists on behalf of restoring native grassland ecosystems for all wildlife;

- Congress inserted into the 2002 Farm Bill report language that specifically referenced the bobwhite problem, supported the NBCI and encouraged the Secretary of Agriculture to support the goal of restoring habitat for this species;
- The USDA Farm Service Agency (FSA) approved in 2004 the Conservation Reserve Program's (CRP) CP33 "Habitat Buffers for Upland Birds" practice, which was designed, proposed and advocated by the SEQSG in support of the NBCI;
- In 2005, FSA approved the CP36 Longleaf Pine Initiative, followed by the CP38 "State Acres for Wildlife Enhancement" practice, while the USDA Natural Resources Conservation Service (NRCS) created many new grassland habitat practices;
- The USDA NRCS Agricultural Wildlife Conservation Center funded a $1.5 million, nine-state bobwhite restoration research project;
- The number of state initiatives increased from two to 18 in the next few years;
- Almost every relevant State Wildlife Action Plan prioritized bobwhites;
- Other new game bird strategic planning initiatives sprang up across the country, inspired by and modeled after the NBCI; and
- New non-government organizations dedicated to quail conservation were created to help increase the momentum.

Such positive results created additional opportunities, heavier demands and increased expectations for collective action which, in turn, required state-centered infrastructure and capacity that did not exist. The states and the bobwhite community forged ahead with another round of "firsts," selecting the University of Tennessee as the national operational center for the NBCI, and expanding all components of the Initiative to range-wide in scope. The SEQSG now is the National Bobwhite Technical Committee (NBTC), while the original SEAFWA Directors' NBCI Committee has grown into the national NBCI Management Board.

These successive and reinforcing rounds of organization and progress attracted the attention of grantors that have funded professional specialists to spearhead implementation of priority NBCI needs, further accelerating progress on behalf of all the bobwhite states and partners. This new NBCI capacity is the first-ever national infrastructure to provide collective state-based leadership and capability for a resident game bird conservation initiative.

The phenomenal bobwhite conservation progress since 2002 owes much to many. One merits special mention and thanks. Dr. Ralph Dimmick, recently retired from a prominent bobwhite research career at UT, was the right man at the right time to lead the original NBCI planning team. When few believed a plan would matter, and when even fewer were prepared to go out on a limb for a strategic approach requiring academic-straining assumptions and estimates, his professional credibility, willingness to lead, and persistence were irreplaceable in leading the bobwhite world to a place it had never been, but had to go.

When it was time to revise and update the NBCI, many more people and states were ready to engage. This 2nd edition of the NBCI - renamed the *National* Bobwhite Conservation Initiative in acknowledgement of its new broadened scope - is a light-year beyond the first, culminating 8 years of progress, experience and lessons learned. The advancements of this plan are a tribute, first, to the expertise and foresight of the coordinators of the revision process - Dr. Bill Palmer and Dr. Theron Terhune, of Tall Timbers Research Station and Land Conservancy. Just as important, this vastly improved new NBCI is the result of a ten-fold increase in the number of biologists involved and invested in the strategic planning process:more than 600 biologists across 25 states, including many non-game bird specialists, imparted their knowledge making the plan what it is today.

The original NBCI was a paper plan, though it never was allowed to sit idly on a shelf. This new NBCI no longer is a paper plan. It is a dynamic, interactive web-connected geographic information system database - the NBCI Conservation Planning Tool (CPT) - created by an innovative combination of satellite imagery, landscape-level [geo]databases and professional biological judgment. It is designed to aid planning and implementation efforts from the national to regional to state to local scales. The new NBCI identifies high, medium and low-priority areas for bobwhite restoration, to help agencies and organizations more effectively target and pool money, people and effort, to demonstrate meaningful successes more quickly, more reliably and more frequently. Eventually, the NBCI CPT can be adapted to support and integrate habitat accomplishments tracking and bird population monitoring databases across all states, which will be additional "firsts" in bobwhite conservation.

The original 2002 NBCI changed the game for bobwhite conservation; this revised NBCI will raise our game. National momentum for bobwhite conservation has grown to a point that quail enthusiasts now are beginning to speak of hope and possibilities. Indeed, there is hope. We largely know what to do; we largely know how to do it; the new NBCI shows us better than ever where to do it. Range-wide bobwhite restoration may not be easy, but it is doable; we simply must work together with common vision, unity and perseverance to make it happen.

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Acknowledgements

Funding Sources:

This revision of the NBCI was supported by Tall Timbers Research Station and Land Conservancy through its Game Bird Research Program.

Multistate Conservation Grant Program (MSCGP):

The MSCGP (Grant TN M-2-P), in cooperation with the Tennessee Wildlife Resources Agency, provided funding and support via funds from the Wildlife and Sport Fish Restoration Program of the U.S. Fish and Wildlife Service and jointly managed with the Association of Fish and Wildlife Agencies.

National Fish and Wildlife Foundation (NFWF):

The National Fish and Wildlife Foundation (Grant 2008-0045-005) generated support from the Southern Company through their Longleaf Legacy and Power of Flight programs.

Others:

The NBCI is an initiative of the states, the regional associations of the states, and the National Bobwhite Technical Committee (NBTC).

State Contacts and Biologists:

We very much thank the state contacts who helped coordinate state workshops for the development of the Biologist Ranking Information (BRI): R. Applegate, T. Bogenschutz, K. Brazil, W. Burger, B. Carner, P. Castelli, S. Demaso, B. Dukes, S. Fowler, M. Gudlin, R. Hamrick, B. Igo, A. Jeffries, P. Johansen, M. Jones, F. Kimmel, S. Klinger, G. Langell, B. Long, J. Lusk, C. McKelvy, J. Morgan, R. Perez, J. Pitman, M. Puckett, B. Robinson, M. Sams, S. Stewart, M. Smith, N. Stricker, R. Thackston, M. Wefer, C. Williams, and J. Wooding. Additionally, we would be remiss not to acknowledge the many experts, more than 600 natural resource professionals (including state, federal, NGO, academics and others), that provided their time and invaluable expertise at the workshops. Without their knowledge and support this effort, and the BRI, would NOT have been possible.

Chapter (Co)Authors:

In keeping with the tradition and spirit of the original NBCI and because the range of bobwhites is far too large to be written by only a few, this revision benefited from the expertise of numerous authors and co-authors of sections and regional chapters. We appreciate Dr. Lenny Brennan taking the time to write a superb overview on bobwhite habitat and ecology while providing the biological context necesary to stage the challenges of implementing a strategic recovery of the gamebird we all so love and enjoy. Many thanks are also in order to: Reggie Thackston and James Martin for helping with the Southeast regional chapter; Bob Long and Chris Williams for crafting the Mid-Atlantic regional chapter; Robert Perez, Jason Hardin, Chuck Kowaleski, and

Doug Schoeling for writing the Southwest regional chapter; Roger Applegate, John Morgan, Ben Robinson, Steve Fowler, and Fred Kimmel for drafting the Mid-South regional chapter; Robert Chapman, Budd Veverka, Mike Wefer, and Nathan Stricker for writing the Mid-North regional chapter; and Jim Pitman and Tom Dailey for stamping the Midwest regional chapter.

Revision Planning and Coordination:

We are duly grateful for those many folks serving as a sounding board to bounce ideas off of throughout this process: Roger Applegate, Billy Dukes, Chuck McKelvy, Marc Puckett, Reggie Thackston, Shane Wellendorf, and Chris Williams. We are also thankful for all of the Tall Timbers Research Station & Land Conservancy staff (especially Starr Askew, Lisa Bagget, Kaye Gainey, Brandon Gonzalez and Joe Noble) for helping in numerous capacities during this revision process. We also thank the NBCI team (Mike Black, Bridget Collins, Tom Dailey, John Doty) for providing comments and suggestions to the near-final drafts.

Cheers and good reading,

The Editors

Executive Summary

Northern bobwhite populations have experienced widespread declines to the point where hunting of bobwhites has been greatly marginalized across much of their range and thereby annual harvest, by most states, represent a small fraction of historical highs. Bobwhite population declines are symptomatic of a range-wide habitat loss for most species adapted to grassland-shrub habitats. The National Bobwhite Conservation Initiative is a range-wide habitat plan for recovering bobwhites to target densities set by state wildlife agencies. Developing spatially-explicit estimates of suitable landscapes for recovery of bobwhites and management needs was accomplished through 23 structured conservation workshops, with >600 natural resource-professionals participating, to inform a Geographical Information System (GIS) on major land-use opportunities for and constraints to management. This information, known as the Biologist Ranking Information (BRI), was used to demarcate priority landscapes where bobwhite and grassland conservation has a relatively high potential for success and minimal number of constraints over the long-term. Summary of the BRI ranking data for 16 BCRs identified 195 million acres (23.6%) of habitat having relatively high potential for northern bobwhite conservation. These areas provide a "first cut" for developing step-down plans which encourage increasing habitat in focal areas. Opportunities in high priority areas varied by BCR, but range-wide opportunities included increased use of prescribed fire (23.4%), field edge and field management (19.5%), compatible forest management (10.6%), conversion of sod-forming grasses to native warm season grass systems (8.4%) and brush management (8.1%), among others. In both high and medium potential regions, the greatest single need identified by biologists was increased use of prescribed fire - a major challenge for conservation of early-succession and grassland obligate species.

In the southeastern U.S., use of prescribed fire and compatible forest management were identified as the two most prevalent management opportunities, whereas in the Central and Midwestern U.S. field borders, whole field management and general CRP were noted as the most important opportunities. The discrepancy in expert opinion reflects different land use practices, habitat types, and habitat-succession changes across regions – indicating the need for spatially-explicit and regionally-specific conservation policy. Resource professionals imputed that the primary impediments to success are economic related issues associated with intensive agricultural systems and low adoption of conservation practices, as well as the lack of programs or policy requisite to applying needed management (forestry and prescribed fire). Biologist ranking data including major land use prescriptions (habitat opportunities and con-

straints) are available for viewing via individual state Web Mapping Applications or they can be viewed concurrently in a single (all state combined) web mapping application.

Range-wide monitoring of bobwhite populations lacks the rigor necessary to make strong inferences and is a major need for future versions of the NBCI. Bobwhite density is indeed the appropriate metric for tracking success of restoration actions. Lacking consistent density estimates, bobwhite densities by habitat type were estimated based on biologist's expert knowledge and density targets were set by states providing spatially-explicit benchmarks for success. As such, 2.4 million coveys will be added in high priority landscapes (4.6 million coveys for high and medium combined) following full implementation of the NBCI habitat goals. These density targets should be viewed as hypotheses and be revised over time as data-based estimates become more readily available and bobwhite responses to management are accrued through step-down plans.

NBCI Principles

Heritage:

Northern bobwhites (*Colinus virginianus*) are traditionally a valued part of our nation's cultural, rural and hunting heritage. Widespread restoration of wild quail populations to huntable levels will have myriad positive societal benefits for individuals, families, landowners, communities, cultures and rural economies.

Stewardship Responsibility:

Reversing long-term and widespread population declines of wild bobwhites, associated grassland birds, and the native grassland ecosystems in which they thrive is an important wildlife conservation objective and an overdue stewardship responsibility.

Habitat Problem:

Long-term, widespread population declines for bobwhites and grassland birds arise predominantly from subtle but significant landscape-scale changes occurring over several decades in how humans use and manage rural land.

Solution is Habitats on Working Lands:

Bobwhites and other grassland species can be increased and sustained on working public and private lands across their range by improving and managing native grassland and early-succession habitats, accomplished through modest, voluntary adjustments in how humans use rural land.

Inter-jurisdictional Responsibilities:

State fish and wildlife agencies bear legal authority and leadership responsibility for bobwhite conservation, and migratory grassland birds are a federal trust resource; however, the vast majority of actual and potential native grassland habitat is privately owned.

Partnerships and Collaboration:

Restoration success depends on a network of deliberate, vigorous and sustained collaborations with land owners and managers by state, federal and local governments as well as by corporate, non-profit, and individual private conservationists.

Strategy:

Success is reliant on long-term, range-wide strategic planning combined with coordinated, effective action at all levels of society and government, to address conservation policy barriers and opportunities that could have the needed landscape-scale influences.

Adaptive management:

Principles of adaptive resource management must be embraced to both inform and increase the efficiency of management and to satisfy multi-resource and multi-species needs.

Long term:

Following a half-century of decline, restoration of bobwhite and grassland bird habitats and populations across their range will require determined conservation leadership, priority, funding and focus for decades to come.

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1 Overview

1.1 Purpose, Structure and Goals of the NBCI Strategic Plan

Northern Bobwhites (*Colinus virginianus*) were once relatively common denizens of farms, rangelands and forests across more than 25 states. However, bobwhite populations have experienced historic declines over the past 4 decades. No region has been immune to these declines and large portions of the bobwhites' historic range are now uninhabited. Bobwhite populations have reached such low densities that in many areas of the range they may disappear within the next few decades. Some populations are a single harsh snow-storm away from being extirpated. The time to act is now if bobwhite and the ecosystems they represent are to be preserved.

The original Northern (now: *National*) Bobwhite Conservation Initiative (NBCI), released in 2002, laid the foundation for a community to come together for cooperative conservation planning. And, as a result, numerous and significant linkages and partnerships have afforded tremendous strides in bobwhite conservation, but there still exists vast room for improvement and much more work needs to be done. This revision provides the second edition of the NBCI and improves upon the foundation created in the original NBCI taking a major step forward and spring-boarding conservation planning for bobwhites and other grassland birds. Significant improvements include:

1. Spatial estimates of improvable acres as defined by land-area where habitat management can recover bobwhites and their habitats at a landscape scale;
2. Established a framework to facilitate long-term grassland ecosystem restoration planning that remains adaptable, timely, and useful to multiple conservation partners;
3. Web-based access to spatial and tabular conservation planning information;
4. Established monitoring goals and guidelines to facilitate scientific principles and an adaptive approach;
5. Estimates of current densities by habitat type and parallel expected densities if management were applied.
6. Bobwhite density targets for managers such that goals for restored landscapes could be set and measured through time to track success.

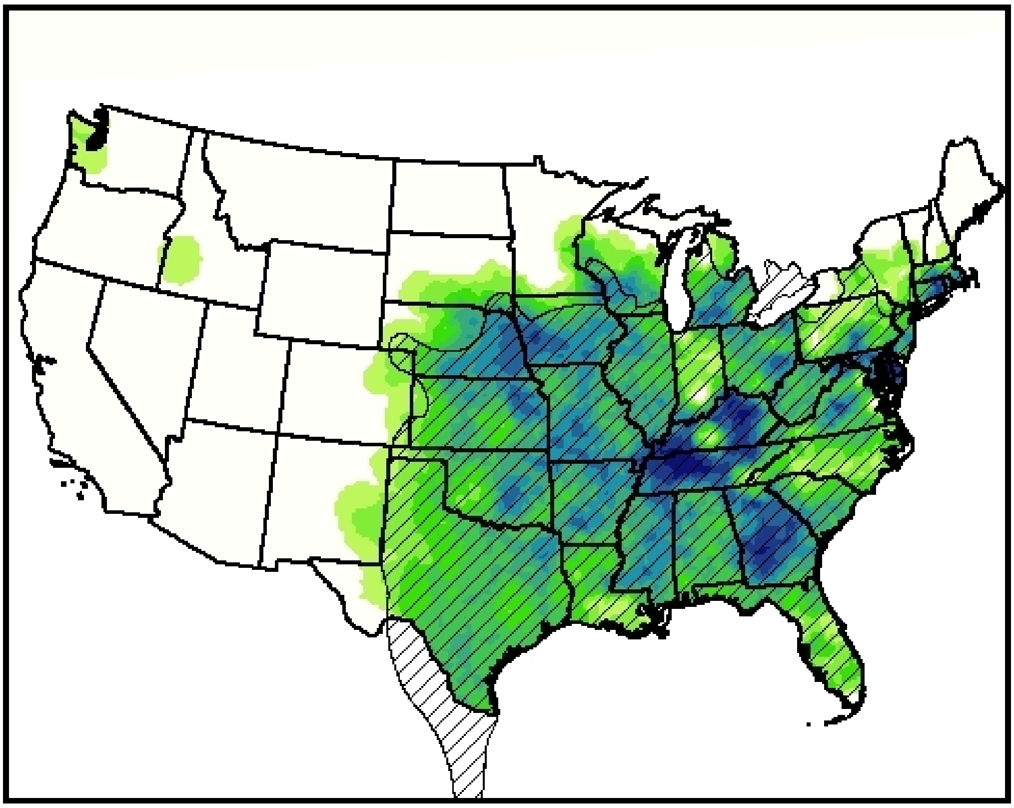


Figure 1: Northern Bobwhite range in the conterminal United States. Range developed using the Breeding Bird Survey (BBS) data and other call count data as available; shaded region on scale of light-green (lower) to dark blue (higher) represents the relative bobwhite density based on weighted point data.

From the outset, we realized that the NBCI revision must be spatially explicit, easy to use, dyanmic and updatable, extensible and scalable in order to effectively impact conservation of bobwhites, grassland birds and early-succession ecosytems. As such, the plan is now web-based utilizing a GIS-databse platform such that it can be easily shared with other conservation partners to more readily permit layering of conservation efforts. The heart of this revision is the Biologist Ranking Information (BRI): expert knowledge of landscape attributes collected through a series of workshops. The BRI identifies landscapes where biologists believe bobwhite management has the highest chance of success and those landscapes that are essentially "lost" causes. The BRI represents the collective effort and knowledge of >600 professional biologists and natural resource managers across the range of the bobwhite. These experts mapped opportunity regions for bobwhite habitat restoration and, at the same time, prescribed habitat management needs and identified constraints to habitat implementation. The wealth of knowledge within the BRI provides local, regional and national information that will help shape policy at multiple planning levels. Importantly, this information can quickly and easily be "stepped-down" to regional or local level planning as well as be incorporated into larger planning efforts (e.g., Landscape Conservation Cooperative [LCC] or Joint Venture [JV]). It also has quickly organized the thinking of over 600 upland experts as to the greatest habitat management needs and constraints such that effective policy can be developed to address both the habitat management needs and constraints.

Prior to and after the original NBCI, states began developing "step-down" plans to identify focal areas and regions for intensified efforts. These projects were stepping stones toward recovering landscapes for grassland species and a lot was learned through both the successes and failures. This revision provides a template for future development of focal areas and regions across the range, while narrowing the area of focus as recommended by biologists, to focus resources and target priority landscapes. It can be used by agricultural planning committees, conservation groups, and others in devising and implementing landowner incentive programs or building multi-agency cooperatives, encouraging efforts focused in or overlapping areas meeting the NBCI habitat needs.

This comprehensive NBCI strategic plan is organized in 6 major sections: (1) a description of bobwhite ecology and management; (2) an overview of the revision process; (3) results from the workshops; (4) regional perspectives on bobwhite conservation and policy; (5) monitoring; and (6) Appendices. Knowledge of bobwhite ecology, habitat needs, and management are necessary for developing sound conservation plans and policies. Further, because habitat needs of bobwhite overlap a suite of declining species and threatened ecosystems, broader benefits are demonstrable when bobwhite management is applied correctly. The revision process was unique in conservation planning by relying on expert knowledge around the country to inform geospatial models. This was necessary as habitat suitability modeling has not proved effective for predicting potential suitability and grassland-bird response among early-succession species. The results are presented at the state and BCR scales, consistent with other bird conservation plans, but county level summaries are available on the web and the web-based spatially-explicit database (GIS web mapping applications), including over 100 million records of habitat rankings and prescriptions available to conservation planners such that customized reports, data analysis or planning can be amassed to meet their specific needs. Collectively, these spatial databases and tools are referred to as the Conservation Planning Tool (CPT). A regional perspective elucidates variation in habitat needs, opportunities and constraints. The monitoring section highlights the importance of monitoring and substantiates the need for using density to assess NBCI success. Finally, major habitat issues facing bobwhite conservation include the restoration of pine and oak savannas, conversion of fescue and other sod-forming grasses, mined land restoration, and rangeland management; these themes are important to highlight for development of conservation policy.

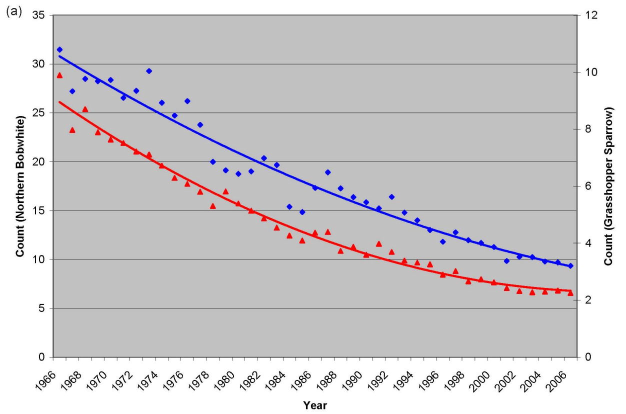
While this revision is a significant step forward there is still much to be done. The process developed should alleviate the need for 5 or 10 year revisions by providing a framework for constant improvements such that the NBCI can remain relevant as new opportunities for habitat creation are developed as well as improving functionality of the CPT itself. Future revisions should consider: Improving or creating geospatial layers associated with mined lands, urban growth models, and public lands; Incorporation of areas where active bobwhite management projects are being undertaken; Assessing and incorporating other grasslands species' models to optimize conservation efforts; Developing spatially-explicit data for Farm Bill practices; and coalescing "true" density estimates for predicting bobwhite population response.

1.2 Grasslands and Early-succession Ecosystems: heralding Northern Bobwhites as a flagship species.

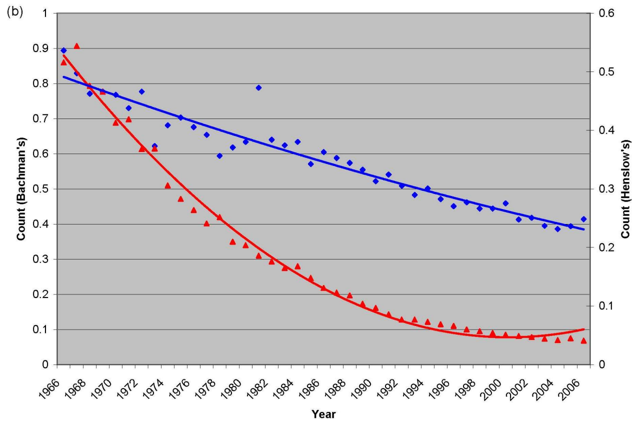
Northern bobwhites have declined an average of 3% per year since the advent of the Breeding Bird Survey in 1966, but declines were evident prior to this time (Stoddard 1931, Sauer et al. 2008). Unlike many species that often go unnoticed by much of the public, bobwhites are a valued sporting bird and sportsmen and women have mourned the loss of a traditional pastime. Except in a few states with significant native habitats with bobwhite-friendly land use patterns and where bobwhite management is a priority of private landowners (over 1 million acres), the loss of wild bobwhite populations has relegated bobwhite hunting to the past. For instance, in much of the Southeast statewide annual harvest of bobwhites was once measured in the millions whereas today it is estimated in the thousands.

Bobwhites signify the decline of an entire suite of species adapted to grassland ecosystems in the United States (see regional chapters). The root causes of the declines are the same, habitat loss at the continental scale: the near demise of the pine-barrens of the northeast; longleaf pine-wiregrass ecosystem of the south; the oak savannas of the central hardwoods; the shortleaf pine-bluestem ecosystem of the midwest; or the prairies of the southwest. These ecosystems were once maintained through fire and grazing which sustained a ground cover of vegetation with the appropriate structure and composition for bobwhites. The habitats bobwhites rely on have structural and plant composition characteristics that are shared by a myriad of species which unfortunately are also sharing a similar fate as bobwhites. For most of the 19th and 20th centuries, land use served to increase bobwhite populations but with the advent of modern agricultural and silvicultural practices following World War II, along with the stamping out of the cultural use of fire to manage forests and fields, the diverse ground cover needed by these species has mostly vanished. To stop the decline of bobwhites and return harvests to 1980 levels will take habitat restoration on farms across landscapes and it will require restoring desirable disturbance cycles, such as prescribed fire, at the appropriate scale and frequency, on our remaining native habitats on private and public lands.

While declines have been precipitous, the good news is that bobwhite populations still exist in sufficient numbers across significant portions of their range such that they will respond, in time, to sound and targeted habitat initiatives. The next few decades may be our last opportunity to halt the declines as there are already areas where bobwhites are gone. In this revision, biologists highlighted areas where bobwhites still exist on agricultural, forested, rangeland, and mined-land landscapes and where management for bobwhites can be successfully incorporated into the production systems through



(a) Population trends (mean annual BBS counts) for the Northern Bobwhite (blue) and Grasshopper Sparrow (red).



(b) Population trends (mean annual BBS counts) for the Bachman's Sparrow (red) and Henslow's Sparrow (blue).

Figure 2: Population trends (mean annual BBS counts) for four early-succession species.

adding key habitat components. One of the primary goals of this plan was to highlight regions of the country where restoring habitat for bobwhites is viable (see the BRI web mapping application), where landscapes are rural and people manage the land. We also must be vigilant in saving habitats in landscapes where bobwhite are still plentiful - these landscapes do exist - but declines are occurring in every state across the bobwhite range.

Recognizing that dollars for conservation are limited, every effort should be made to prioritize habitat practices where they have the best chance of increasing bobwhites to levels that sustain hunting and that benefit the suite of species that have also declined. In identifying areas with the greatest potential, the NBCI provides a starting point for conservation planning and as new dollars surface conservation efforts can be increased.

2 A Biological Basis for the National Bobwhite Conservation Initiative: northern bobwhite habitat and population ecology.

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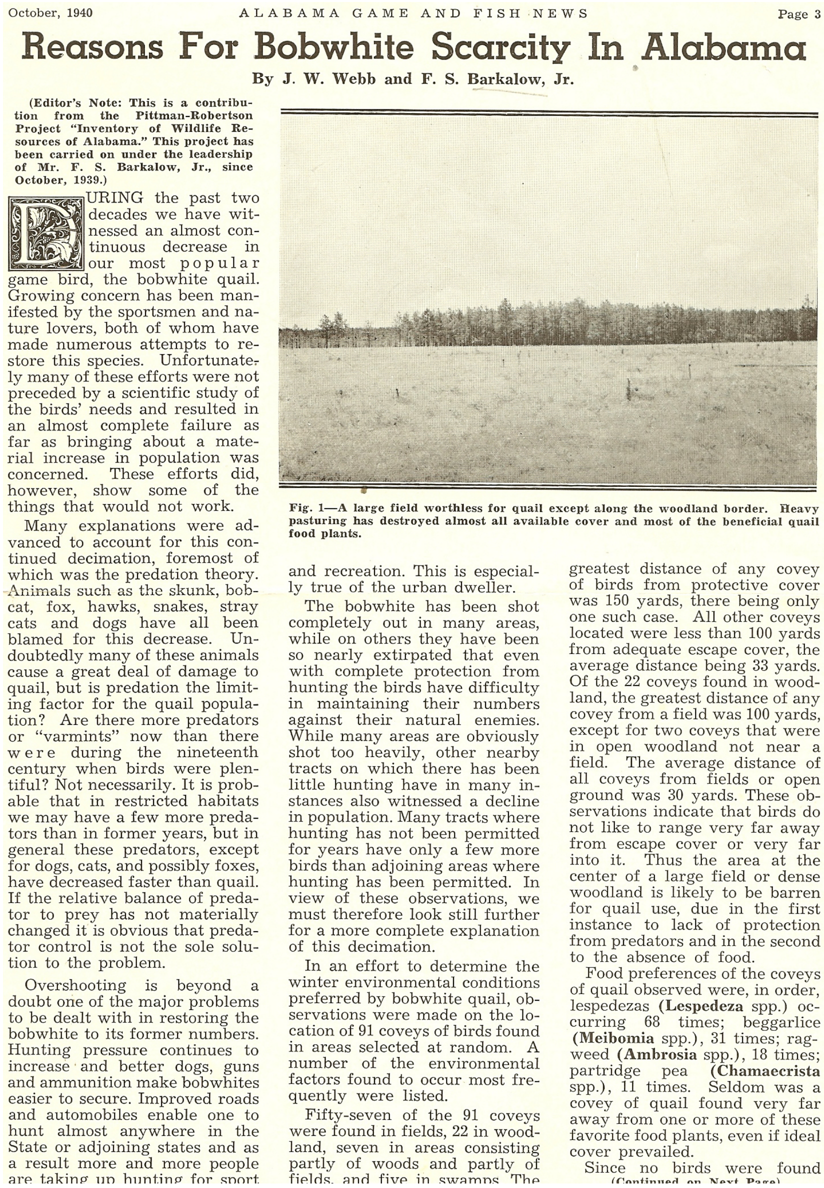
2.1 Introduction

The ongoing and widespread decline of northern bobwhite (*Colinus virginianus*) populations has become a *cause clébré* in North American wildlife science and policy during the past two decades. Nearly 20 years ago, I published a paper (Brennan 1991) that attracted some attention about the plight of bobwhites. In reality, concern about declining bobwhite populations preceded this 1991 paper by many decades (Figure 1). For example, declining bobwhite numbers were the motivation that inspired wealthy bobwhite hunters to fund research for the landmark monograph by Stoddard (1931). The erosion of bobwhite populations was also a theme found throughout two classic books by Leopold (1931, 1933). Although the plight of the northern bobwhite is clearly not new, the recent and redoubled efforts of the National Bobwhite Conservation Initiative (NBCI) is indeed something new. The NBCI is a significant and welcome element of progress in wildlife science and policy as we enter the second decade of the 21st century.

<u>The Bird.</u> – The northern bobwhite is the most widely distributed of more than two dozen species of New World Quails (Madge and McGowan 2002). It was named "northern" bobwhite by the American Ornithologists' Union Committee on Classification and Nomenclature to distinguish it from four other allopatric species of *Colinus*, all of which have geographic distributions located further south toward the Equator. Although it has been introduced to many parts of the world (Brennan and Bryant 2010), the original geographic range of the northern bobwhite is from northern Guatemala to southern New England and the north-central Lake States, including the southeast region of the Province of Ontario, Canada, and then west to the eastern edge of the arid American West. Weighing approximately six ounces, the northern bobwhite is a species adapted to a wide range of climate, rainfall, and humidity conditions. Within this wide range of temperature and hydric conditions, however, the basic habitats used by bobwhites are remarkably consistent, although different species and components of their habitats vary. The population ecology of bobwhites across this vast geographic range is also relatively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Reasons For Bobwhite Scarcity In Alabama

By J. W. Webb and F. S. Barkalow, Jr.

(Editor's Note: This is a contribution from the Pittman-Robertson Project "Inventory of Wildlife Resources of Alabama." This project has been carried on under the leadership of Mr. F. S. Barkalow, Jr., since October, 1939.)

DURING the past two decades we have witnessed an almost continuous decrease in our most popular game bird, the bobwhite quail. Growing concern has been manifested by the sportsmen and nature lovers, both of whom have made numerous attempts to restore this species. Unfortunately many of these efforts were not preceded by a scientific study of the birds' needs and resulted in an almost complete failure as far as bringing about a material increase in population was concerned. These efforts did, however, show some of the things that would not work.

Many explanations were advanced to account for this continued decimation, foremost of which was the predation theory. Animals such as the skunk, bobcat, fox, hawks, snakes, stray cats and dogs have all been blamed for this decrease. Undoubtedly many of these animals cause a great deal of damage to quail, but is predation the limiting factor for the quail population? Are there more predators or "varmints" now than there were during the nineteenth century when birds were plentiful? Not necessarily. It is probable that in restricted habitats we may have a few more predators than in former years, but in general these predators, except for dogs, cats, and possibly foxes, have decreased faster than quail. If the relative balance of predator to prey has not materially changed it is obvious that predator control is not the sole solution to the problem.

Overshooting is beyond a doubt one of the major problems to be dealt with in restoring the bobwhite to its former numbers. Hunting pressure continues to increase and better dogs, guns and ammunition make bobwhites easier to secure. Improved roads and automobiles enable one to hunt almost anywhere in the State or adjoining states and as a result more and more people are taking up hunting for sport and recreation. This is especially true of the urban dweller.

Fig. 1—A large field worthless for quail except along the woodland border. Heavy pasturing has destroyed almost all available cover and most of the beneficial quail food plants.

The bobwhite has been shot completely out in many areas, while on others they have been so nearly extirpated that even with complete protection from hunting the birds have difficulty in maintaining their numbers against their natural enemies. While many areas are obviously shot too heavily, other nearby tracts on which there has been little hunting have in many instances also witnessed a decline in population. Many tracts where hunting has not been permitted for years have only a few more birds than adjoining areas where hunting has been permitted. In view of these observations, we must therefore look still further for a more complete explanation of this decimation.

In an effort to determine the winter environmental conditions preferred by bobwhite quail, observations were made on the location of 91 coveys of birds found in areas selected at random. A number of the environmental factors found to occur most frequently were listed.

Fifty-seven of the 91 coveys were found in fields, 22 in woodland, seven in areas consisting partly of woods and partly of fields, and five in swamps. The greatest distance of any covey of birds from protective cover was 150 yards, there being only one such case. All other coveys located were less than 100 yards from adequate escape cover, the average distance being 33 yards. Of the 22 coveys found in woodland, the greatest distance of any covey from a field was 100 yards, except for two coveys that were in open woodland not near a field. The average distance of all coveys from fields or open ground was 30 yards. These observations indicate that birds do not like to range very far away from escape cover or very far into it. Thus the area at the center of a large field or dense woodland is likely to be barren for quail use, due in the first instance to lack of protection from predators and in the second to the absence of food.

Food preferences of the coveys of quail observed were, in order, lespedezas (**Lespedeza** spp.) occurring 68 times; beggarlice (**Meibomia** spp.), 31 times; ragweed (**Ambrosia** spp.), 18 times; partridge pea (**Chamaecrista** spp.), 11 times. Seldom was a covey of quail found very far away from one or more of these favorite food plants, even if ideal cover prevailed.

Since no birds were found

(Continued on Next Page)

Figure 3: Article from the Alabama Game and Fish News, October 1940, depicting the cause for bobwhite decline.

consistent, within boundaries that are fairly easy to understand.

Like any wild animal, the northern bobwhite requires a set of habitat conditions that provide resources to meet the annual life cycle needs of individuals which, if sufficient, will allow populations of these individuals to persist. The northern bobwhite is one of the most intensively and extensively studied wildlife species in the world. The vast scientific literature on this bird contains thousands of peer-reviewed articles that have quantified nearly every aspect of northern bobwhite natural history. The inspiration behind the organizations, agencies and individuals who have funded these research efforts, and the biologists who have executed these projects, has been a search for management strategies that will stabilize and elevate northern bobwhite populations for hunting. The fact that such management efforts also provide habitats that support scores of other desirable species of wild plants and animals is a convenient and politically positive by-product of national bobwhite conservation efforts (Kuvlesky and Brennan 2005, Kuvlesky 2007).

Historical Densities and Population Declines. – One of the amazing aspects of the bobwhite literature is how numerous publications have documented both historic population densities and widespread, precipitous population declines. For example, densities of >> 1-2 birds, and sometimes >3 birds per acre have been reported by Rosene (1969), Kellogg et al. (1972), and Lehmann (1984), among others (Brennan 1999). In contrast there is also ample documentation of the widespread and ongoing declines that bobwhites have experienced. See, for example, papers by Brennan (1991), Church et al. (1993), and Peterson et al. (2002), Peterson (2007), Perez (2007), Silvy (2007), Whiting (2007) among many, many others. The documentation of both phenomenal population abundances as well as continental-scale population declines makes for one of the more fascinating stories in the lore and legend of North American wildlife-except that the highs and lows of the bobwhite story are neither lore nor legend-they are true.

Purpose. – The purpose of this chapter is to provide an overview of what is known about northern bobwhite habitat and population ecology. My goal is to do this in the context of prevailing modern land uses and explain how management can be applied to mitigate the problems that these contemporary land use issues present to northern bobwhite conservation efforts. The good news is we have a set of four fundamental pillars of knowledge that support the science upon which northern bobwhite management rests (Guthery and Brennan 2007). Over the past decades, I have observed that to be successful in conservation of northern bobwhite these four important pillars cannot be overlooked-1) adaptive plasticity, 2) successional affiliation, 3) r-selection, and 4) weather influences. NBCI is correctly focused on habitat creation that is consistent with these pillars such that population recovery is possible. The alternative, which has been tried, tested and proved ineffective, is to rely on cultural management such as planting food plots or attempting to reestablish wild populations using pen-raised stock. In this chapter I present foundational concepts and then use these to construct a general framework for northern bobwhite habitat and population management and restoration.

2.2 Key Concepts about Bobwhite Life History

Adaptive Plasticity. – As noted above, the northern bobwhite has evolved to exist across a vast geographic range. The north-south distance of the northern bobwhite distribution ranges >1,900 miles, and the east-west range is >2,500 miles. Across this huge area is a rainfall gradient from >48 inches/year to about 15 inches/year that runs roughly east to west.

Clearly, any species that can persist across such an extensive geographic area must have the ability to cope with a wide range of plant communities, soils, and climate. The northern bobwhite is precisely such a species; abundant populations can function in agricultural, forest and rangeland habitats on a nearly continental scale. This is a unifying theme that allows biologists and mangers to generalize approaches to northern bobwhite management. It is also a concept that must be understood and embraced by everyone involved with implementation of the NBCI. Huntable populations of bobwhites can be found in, or restored to, the pine forests of the Southeast, mixed forest and agricultural landscapes of the Midwest, and rangelands of Texas and Oklahoma, among nearly all other places within their original geographic range, so long as the appropriate habitat components are sustained or restored and urban-suburban encroachment on these habitats is not a factor. These were the same factors biologists considered in mapping areas across the country which remain consistent with restoring bobwhite populations.

The biological mechanisms that allow bobwhite populations to function in this wide range of vegetation conditions are related to habitat components that support key life history requisites related to 1) nesting, 2) brood rearing, 3) escape cover, and 4) loafing cover. When these four requisite habitat components are present at the correct scale and configuration within the geographic range of this species, wild bobwhite populations are nearly always present. These four components can be thought of as links in a chain that holds bobwhite habitat and populations together. When even one of these key habitat components goes missing, so to do bobwhite populations, much like a weak or missing link destroys the ability of the chain to do the job for which it was intended. Additionally, it is important for managers to understand that when the key elements of bobwhite habitat are present, additional efforts that focus on cultural management are most often neutral. I cannot overemphasize these concepts. To crystallize the importance of adaptive plasticity in bobwhite management Guthery and Brennan (2007:410) noted:

> "Scientific management of quail habitat operates under the recognition that optimal habitat is a set, not an instance. Accordingly, the manager well-schooled through study and experience recognizes when habitat is beyond improvement."

Successional Affiliation. – Northern bobwhites are generally considered to be an early-succession species.

While this is certainly the case throughout the humid Southeast, the eastern seaboard and even into parts of the central Midwest, the concept tends to not hold as well in rangelands where bobwhites thrive in mid to later successional stages of habitat.

In order to understand habitat from the perspective of a bobwhite, you need to lie down and put one cheek of your face on the ground. This is a quail's eye view of the world. For a bobwhite to survive, everything they need must be found within 6-10 inches of the ground, whether it is a clump of bunchgrass to nest in, a patch of ragweed or Croton to forage for insects and seeds with broods in, or a patch of brush for escape or loafing cover. It does not matter what kind of successional stage of vegetation provides these habitat components. It only matters that these habitat components exist in appropriate configuration and scale so that bobwhites can also exist. The concept of successional affiliation is important for understanding both why and how habitat components are the fuel that runs the bobwhite population engine.

In the humid Southeast, disturbances such as logging, prescribed fire, or disking all reset the plant succession clock in one way or another. Typically, after about 3 years, the under story vegetation in an open, park like pine forest becomes choked with dense grass and brush and no longer provides nesting or brooding habitat. While escape and loafing cover may still be abundant three years post disturbance, it does not matter. Without nesting or brooding habitat, there will be no bobwhites to seek the shelter that woody cover provides from predators or excess heat. Essentially the same thing happens when clear cuts grow back into dense forests four or 5 years post logging. Brush and woody cover usurps grasses and forbs needed for nesting and brooding, and the habitat-population chain is broken.

In rangeland habitats, where plants grow much slower because moisture is limiting, mid to late successional stage vegetation often provides optimal bobwhite habitat. Although there are no pine trees to shade the ground, little bluestem (*Schizachyrium scoparium*) and croton (*Croton* spp.) on Texas rangelands are the structural homologues to broomsedge (*Andropogon virginianus*) and ragweed (*Ambrosia* spp.) of the Southeast that are the backbone of nesting and brooding habitat. It is important to understand that the *structural elements* of habitat (height, density, distribution) of herbaceous and woody vegetation are what largely drive bobwhite abundance. The names of places and plants will change as one moves from east to west or south to north across the bobwhite range. The structure of vegetation that they need to survive and thrive remains largely the same. Guthery and Brennan (2007:

409) pointed out that:

> "...the scientific manager recognizes that the successional affiliation of quails changes with the productivity (amount of rainfall, length of growing season, nature of soils) of the environment. The manager then manages for the successional stage that is consistent with the adaptations of the quail ... under management, given site productivity."

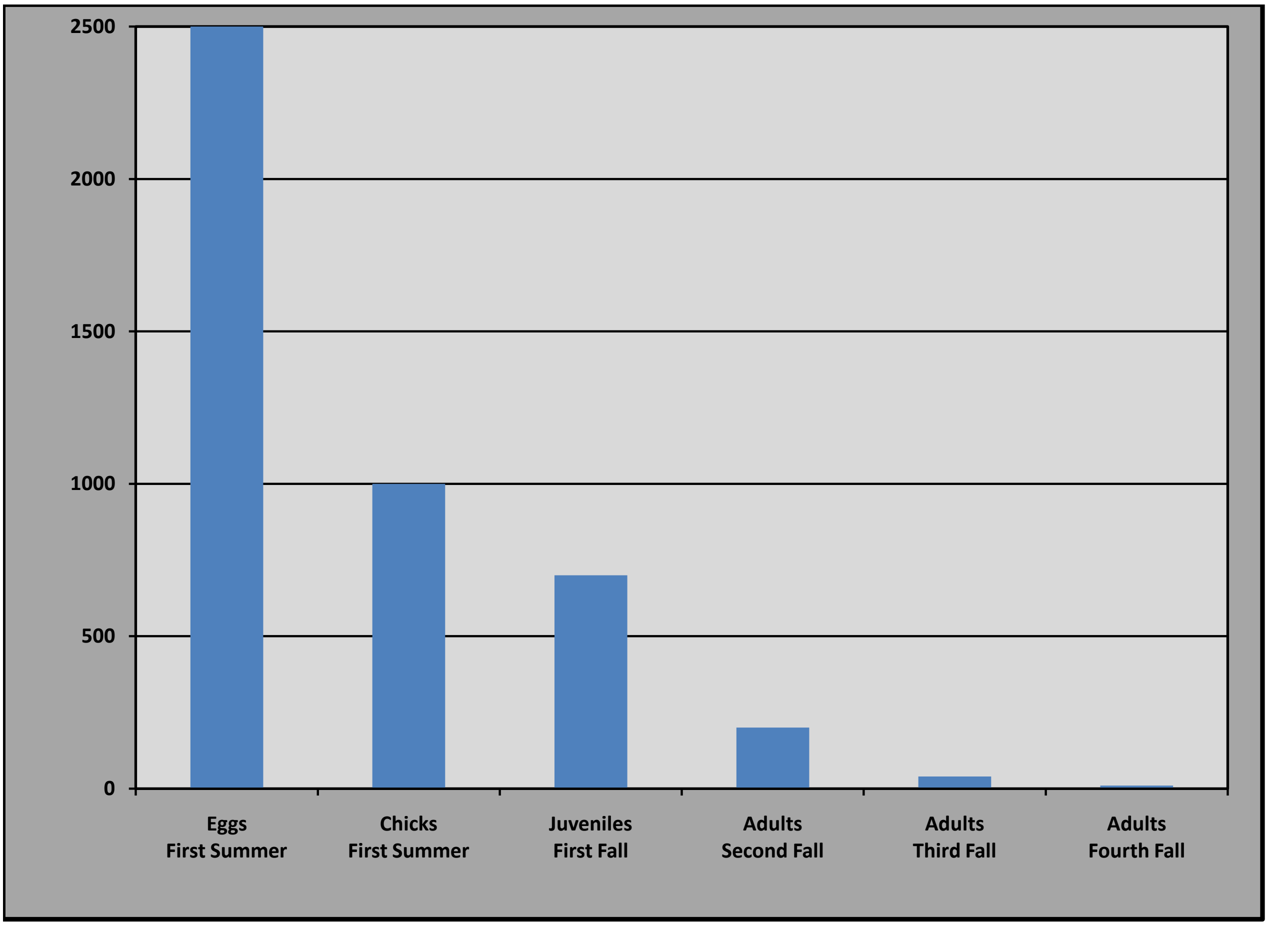

Figure 4: An example of mortality calculated from population figures on Groton Plantation, Estill, South Carolina, where percent juveniles averaged 72.9, summer loss at 58.7%, and winter loss at 28.3%.

Demography. – The terms r-selected and K-selected species, while somewhat arbitrary, are useful for understanding northern bobwhite demography. Species that are r-selected are those that tend to have low annual survival and high rates of fecundity. Species that are K-selected (such as the sandhill crane [*Grus canadensis*]) tend to have a relatively high rate of annual survival and relatively low rates of fecundity compared to a species such as the northern bobwhite.

Most quails, including bobwhites, are considered r-selected species. They have relatively short lives (average about 6-8 months, but a variable proportion obviously lives >12 months or at least long enough to breed; Figure 4) and have the ability to lay relatively large clutches (15±) of eggs. Although predation risks to ground nesting birds such as bobwhites are high; the range of nesting success varies from <30 to 70% depending on habitat conditions and predator context.

Bobwhite breeding biology is a dynamic process that is driven by both extrinsic and intrinsic factors. For an example of how extrinsic factors can operate, consider that during summers with above average rainfall, research has documented that nearly 100% of hens in a bobwhite population will attempt to nest at least once (Hernandez et al. 2005). During summers with below-average rainfall, <60% of hens will nest, and during periods of extreme drought, this number can be considerably lower, or even close to zero. The influence of intrinsic factors on bobwhite nesting are illustrated by the fact that about 20-30% of males will incubate a nest, and brood the chicks, typically in response to females who have laid a clutch of eggs but then abandoned them to cast her fate with another mate; there is no question that these adaptations are clearly mechanisms that define bobwhites as a classic r-selected species.

Chick survival is the least known, but probably most critical, period of annual bobwhite survival. Bobwhite researchers are generally in agreement that once the birds reach flight stage-about two weeks post-hatch-they have a much greater chance of surviving to become adult size (Figure 4). Thus, as an r-selected species, bobwhites have a huge potential to exhibit a rapid rate of population increase, but they can do this only when habitat and weather conditions are favorable. When conditions are lousy, bobwhite populations concomitantly exhibit a fast rate of decline. In arid or semi-arid environments, this is why bobwhites and other quails exhibit classic boom and bust cycles, generally in relation to rainfall and in conjunction with favorable habitat conditions. In the humid Southeast, this is why bobwhites can seemingly disappear from an area in a very short time when they were previously abundant; their rate of decline becomes quick and precipitous when habitat conditions are no longer favorable to support their population. This is also why, in locations with abundant moisture, but in the absence of management disturbance, vegetation quickly grows to the point where nesting and brood habitat are no longer sufficient, and bobwhite populations quickly crash. To summarize the importance of understanding r-selection in the context of quail demography, Guthery and Brennan (2007:409) stated:

> "... demographic expectations [of quail] operate within distinct boundaries for survival and reproduction and that competing risks and density-dependent population processes

dampen expectations of some response to management that alters survival-production schedules ... The scientific manager recognizes and accepts these constraints."

Weather Influences. – The vagaries of weather profoundly affect quail populations, and by and large, are outside the influence of management. Bobwhites are vulnerable to high winter mortality from cold weather and/or snow cover in both northern and cold in the southern parts of their range. Winter losses under harsh conditions can be up to 80-90%; typical winter mortality is > 50% in northern regions and >30% in southern regions; for example the heavy snows of 2009 in the Northeastern and Central Northern states resulted in heavy bobwhite losses. Rainfall during spring and summer can strongly influence annual production, both in the Southeastern states, where about 25% of annual production can be explained by rainfall (Brennan et al. 1997) and in more arid locations such as Texas, where rainfall explains about 60% of variation in annual production (Bridges et al. 2001). The recent drought of 2008-2009 where South Texas experienced a 90% rainfall deficit from September 2008-September 2009 caused a near total collapse of bobwhite productivity during the 2009 nesting season. Conversely, during years of abundant rainfall during nesting productivity in South Texas can reach record levels approaching (Keil 1976).

Along with precipitation, heat has been recognized as a factor that can limit bobwhite productivity during nesting. Poultry scientists have long known that laying hens maximize production when heat and humidity are within an optimal range. Bobwhites are apparently no different. Furthermore, the fact that operational temperature at ground level can quickly become deadly to bobwhites during peak summer periods of heat, points to the critical need to provide woody loafing cover that can mitigate this factor. Similarly, if heavy snows occur in an area without woody escape cover, bobwhites suffer higher mortality. This is partly why simply converting an agricultural field to native warm season grasses but not providing adequate woody cover, is ineffectual for providing bobwhite habitat. Therefore, while providing key habitat resources is indeed a cornerstone of bobwhite management, Guthery and Brennan (2007:411) offered an important caveat:

> "The scientific manager recognizes and essentially lives with the powerful influence of weather on quail dynamics. To a certain degree, the influence cannot be lessened through management because quails are vulnerable to thermal insult not only on the basis of their size and physiology, but also on the basis of adaptations to habitats that provide a weak shield against thermal insult. The impact of weather variation can be lessened, but not

eliminated, through provision of adequate herbaceous and woody cover."

2.3 Corralling the Pillars.

The four pillars of knowledge that support the science of bobwhite management define the boundaries of the domain in which a modern bobwhite manager must operate. There are limits that constrain any biological system, and it is crucial for a scientific bobwhite manager to understand these limits. The concepts of adaptive plasticity, successional affiliation, r-selection, and weather influences are fundamental for defining realistic expectations of both quail managers and quail hunters. While bobwhites have been able to adapt to a wide range of rainfall, temperature and vegetation, these factors also define, in many ways, the opportunities managers have and the limitations managers also face. The fact that an r-selected species such as the northern bobwhite can undergo large population increases attests to their ability to produce offspring when conditions are favorable. However, when habit or weather conditions become unfavorable, r-selection cuts the other way by causing rapid declines and even local extinctions if conditions remain unfavorable. Despite the tremendous reproductive potential of bobwhites, we know little about their ability to recolonize areas that have been vacated by local or even regional extinctions. This is why recovery times for bobwhite populations in the context of habitat restoration efforts remains an unknown, but most likely highly variable factor for the NBCI. It is these kinds of declines and local extinctions that the NBCI is being designed to mitigate through management.

Purposeful Management.

A philosophy of purposeful management can be divided into two subsets: maintenance management and restoration management. In either case, be it maintenance or restoration management, the goal of the successful bobwhite manager is to provide structural habitat components that have a known purpose for the birds.

Maintenance management operates from the perspective that some to all elements of bobwhite habitat exist on a given area, but that usable space for bobwhites might be increased or at least sustained through management. Maintenance management is founded in actions that have been proven to sustain or in some cases even elevate bobwhite populations over time. These management actions are critically important to successful implementation of the NBCI because they form the basis of restoration management actions that are at the core of the initiative. There are several locations from around the northern bobwhite geographic range that provide excellent examples of maintenance management: The

Red Hills Hunting Plantations in Southern Georgia and Northern Florida, Ranches in the Rolling Plains of Central and North and Rio Grande Plains of South Texas, the Ouachita Mountains in Arkansas, among others. The lessons learned from long-term management on such places points to the likelihood of successful applications elsewhere.

A philosophy of restoration management operates from the perspective that few or no elements of bobwhite habitat exists on an area, but that usable space for bobwhites can be restored-and then sustained-through management. In this revision, biologists that choose areas where bobwhite restoration can occur did so by selecting areas where habitat elements could be restored at appropriate time and spatial scales. Restoration management represents the most challenging domain for the scientific quail manager and given widespread declines in bobwhite is the situation most managers face. This is because they are starting from a position where both a habitat and a population deficit can often be massive.

Figure 5: Pine forest managed for an open canopy forestland and field borders implemented among agriculture landscapes are both examples of active, purposeful management that benefit bobwhites.

Maintenance Management.

The backbone of maintenance management actions is aligned with continuous provision of habitat resources that meet the annual life cycle needs of bobwhites. As noted above, these life cycle needs can be broken down into habitat features that provide nesting, brooding, escape and loafing habitat components. If adequate nesting habitat is available, roosting habitat is also usually adequate and can be considered part of a maintenance management program, as noted below.

Nesting Habitat. – Although bobwhites have been documented nesting in myriad substrates and situations, research has shown that they typically prefer to use basketball-sized clumps of bunchgrasses that are about 10-20% larger and taller than those found at random (Figure 3). The optimal density of bunchgrasses for nesting bobwhites is about 600-700 clumps per acre, and seems to reach a point were it becomes too thick at about 1,200 clumps per acre.

In both the forested habitats of the Southeast and mid South and the rangeland habitats in the Southwest, prescribed fire is an optimal and economical way to maintain good bunchgrass nesting cover for bobwhites, although return intervals for prescribed fire will vary widely between the two regions. In the Southeast, prescribed fire return intervals should typically be about 18 months to 36 months, with most lands requiring a 2 year return interval. In rangeland habitats, it depends on rainfall patterns, cattle stocking rate, and soil fertility. In areas with good soil fertility and 2-3 successive years of good rainfall, bunchgrass cover can get too thick for quail in 3-4 years. During a drought period, residual grass may desiccate to the point where it is not possible to burn for 4-5 years or longer, especially if a pasture is in the process of recovering from overgrazing. I have seen pastures with 8-10 years of continuous post-grazing growth that have still not become excessively thick for bobwhite nesting.

Brooding Habitat. – Northern bobwhite chicks are precocial; all chicks leave the nest within hours of being hatched. This means that adult bobwhites must take the chicks to their food, rather than bring food to their chicks, which is what altricial birds such as songbirds and raptors do.

Northern bobwhite chicks eat arthropods exclusively during their first two weeks of life before gradually transitioning to seeds and plant foods over the next few months. During nesting months the diet of bobwhite hens is about 25% arthropod biomass, compared to 5% for males (Brennan and Hurst 1995). Obviously bobwhite hens need a rich source of protein to produce a large clutch of eggs. The concept behind providing brooding habitat is to create a vegetation structure that is 1) rich in arthropods that live on or near the ground, 2) has numerous patches of bare ground to make it accessible to bobwhite chicks and hens who are weak scratchers, and 3) provide screening cover overhead to break up lines of sight of aerial predators who want to make a bobwhite their lunch (Figure 4).

While there are a number of species of plants that can provide good brooding cover, three of the best are ragweed, partridge pea (*Cassia* spp.) and croton or dove weed. Each of these plants provides the appropriate habitat architecture for bobwhite broods to forage in. Phytophagus (plant eating) arthropods thrive on these plants. One of the interesting cross-cutting themes of bobwhite management is that mechanical soil disturbance from disking during the cool season-usually between Halloween and St. Patrick's Day-stimulates the production of these plants. The precise mechanism that causes these important brood habitat plants to germinate in response to cool-season soil disturbance is unknown. In rangeland habitats, hoof action from cattle, if not excessive from over grazing, does the same thing.

Broods, like adult bobwhites, also require a variety of structural elements, including brushy loafing and roosting habitat. In savanna habitats in the Southeast, bobwhites prefer to brood in habitats burned within the calendar year. In agricultural areas, CRP fields and CP33 buffers may provide foraging habitat while crops and woody structure surrounding fields provide other habitat elements (Puckett et al. 1995).

Escape Habitat.-Bobwhites have evolved in response to the constant threat of predation. Their explosive flight, cryptic coloration, and generally wary nature even when undisturbed all point to the ongoing evolution of a behavioral arms race between bobwhites and their predators. Escape cover is one of the simplest elements of bobwhite habitat to provide and maintain. This is because escape cover is essentially nothing more than a patch of dense woody or herbaceous cover where a quail can either fly or run to escape a predator when they are pursued (Figure 5.). Pretty much all loafing cover can serve as escape cover, but small patches of escape cover are probably inadequate as loafing cover.

Loafing Habitat. – Bobwhites usually feed twice during their daily cycle of activity, once in the morning when they leave their nighttime roosts, and again during late afternoon before they return to roost. During the middle of the day, bobwhites generally seek cover in woody vegetation to avoid predators and digest the foods in their crops (Figure 6). Thus, bobwhites must have a place where they can spend a relatively large amount of the day in safety, both from their predators and in summer from excess and potentially lethal heat. Bobwhite loafing cover consists of shrubs that are about 3-10 feet tall and at least 5 feet in diameter. These areas can range from an isolated tree or shrub to a small group of trees and shrubs. Ideally, loafing sites should be distributed across the landscape at about the distance a person can throw a softball, rather than clustered in specific locations. In places where loafing sites are absent, a manager can encourage growth of shrubs and brush by allowing patchy areas to grow in exclusion from fire, grazing, and other disturbances. However, in many places, the problem is not too little brush but too much brush or woody cover. Thus, some of the basic concepts that pertain to brush management for bobwhites are applicable in this context. Generally the goal is to maintain about 10-30% woody cover scattered in patches or mottes across the landscape.

Roosting Habitat. – During fall, winter and early spring when bobwhites are in coveys, they spend each night roosting in a circle with their tails pointing inward and their faces pointing outward. During periods of cold weather, the birds huddle tightly in a small circle to conserve heat. During warmer periods, these roost rings tend to be more loosely formed. Typically, bobwhites roost at night in the middle of relatively large grassy areas that are as far from shrubs and woody cover as possible. While this seems counterintuitive, it makes sense from the standpoint that if disturbed, each bird can quickly escape a nighttime aerial predator by flying away in one of at least 10-12 directions without obstruction. In such cases, a landscape that has adequate bobwhite nesting cover will also most likely have adequate roosting cover.

Restoration Management.

While all wildlife management actions are context dependent, restoration management for bobwhites is even more so. In the Southeastern U.S., Brad Mueller summed up bobwhite habitat restoration as well as anyone I have heard. His strategy is to simply "Make fields out of forests and forests out of fields." While this strategy is simple, the tactics required to accomplish it are anything but simple. Despite their potential complexity, the tactics for bobwhite habitat restoration revolve around identifying the key factors that are the weak or missing links in the chain of habitat that is needed to meet the annual cycle needs of the birds, as noted earlier. In the following section I refer to three different types of "environments" in which bobwhite restoration might be attempted. I call them environments because, strictly speaking, in the context of bobwhite habitat restoration needs, they are typically lacking one or more of the essential components that make them habitat for bobwhites. In other words, these environments can not be considered bobwhite habitat until all the essential components of bobwhite habitat are present.

Agricultural Environments. – Agricultural environments once provided the lynchpin for bobwhite habitat but this is no longer the case. Clean farming methods that use aggressive applications of herbicides and other pesticides have sanitized modern agricultural environments to the point where they seldom provide habitat for any kind of wildlife, much less quail. The widespread and ongoing continental scale decline of grassland birds is but one indication of the fate that modern agriculture has brought to our wildlife legacy (Brennan and Kuvlesky 2005). In certain cases, during the time when agricultural crops such as corn or soybeans are growing, they can provide fairly decent brood habitat. Cotton farming is entirely another story with no hope for bobwhites in the horizon, so we will ignore that crop for now. The woodlots that often adjoin agricultural fields can potentially provide winter cover and food for bobwhites. Often, the critical habitat component that is missing in these agricultural environments is nesting cover. The recent CP-33 Bobwhite Borders program has been designed to provide incentives for growers to plant field borders to native grasses to provide critical nesting cover for bobwhites. Preliminary results from monitoring indicate that this program is evidently quite successful and should not only be continued but also expanded.

Forest Environments. – Modern pine silviculture has probably done as much or more to destroy bobwhite habitat than any other contemporary land use, especially in the Southeastern states. Planting high density (>700 trees per acre) loblolly pine (often on sites more suited for longleaf pine), eliminating prescribed fire, and suppressing or in some cases eliminating under story growth with herbicides is one of the most potent strategies for devastating bobwhite habitat that humans have invented. In these environments, there is no nest cover, no brood habitat, and little or no escape or loafing cover, especially after the pine canopy cover closes. The patches of bobwhite habitat that clearcuts provide are highly ephemeral, if they end up being occupied by colonizing bobwhites at all. Restoration of bobwhite habitats in southern pine forests will require a nearly seismic cultural shift in how people grow pine trees. Silvicultural regimes will need to be altered from even-aged clearcutting and high density replanting of loblolly pine to uneven-aged selective harvest, preferably with longleaf pine, followed by frequent use of prescribed fire. This can be done if strategic decisions are made and tactics are employed to encourage replacement of loblolly pines with longleaf, wherever possible within the historic range of this fire-friendly pine.

Rangeland Environments. – Although exact acreages are not available, it is safe to surmise that the bulk of remaining bobwhite habitat is currently found on millions of acres of rangelands in states like Texas, Oklahoma, Kansas, and Florida. While this situation is a relative bright spot in the current situation of a woeful lack of usable space for bobwhites on a continental scale, there are serious challenges for bobwhites in rangeland environments. The most serious of these challenges is exotic invasive grasses. In Texas, coastal bermudagrass has devastated once great areas of bobwhite habitat in the Blackland Prairies and Post Oak savanna ecoregions of the state (Peterson 2007, Silvy 2007). These so-called "improved" pasture grasses create a dense, sod forming monoculture that provides essentially nothing in the way of habitat for quail and most other grassland birds. The widespread use of fescue in pastures of the Southeastern states is a homologue to this situation. Old-world bluestems are another group of invasive exotic grasses that are negatively impacting quail and grassland bird habitats in rangeland environments. This group of invasive grasses is, among other things, allelopathic. Not only do they develop a dense monoculture, but they also essentially poison the soil, a factor that complicates most known tactics for restoration. Compared to bermudagrass and Old-world bluestems, exotic bunchgrasses such as buffelgrass (*Pennesitum ciliare*) and guinea grass (*Panicum maximum*) are somewhat less problematic for bobwhites. Recent research has shown that bobwhites will readily nest in or near these grasses because they apparently provide appropriate structure for nest building. However, areas where these grasses dominate are bereft of forbs and insects, and quail thus must direct their foraging activities to native vegetation elsewhere (Flanders et al. 2006, Sands et al. 2009).

Native Warm Season Grasses. – In the Midwest and parts of the Southeast, promotion of native warm season grasses (NWSG) for improving bobwhite habitat has become something of a mantra. Admittedly, a tremendous amount of bobwhite habitat has been lost to the proliferation of exotic, cool-season grasses such as fescue and bermudagrass. However, to be effective, use of NWSG to restore agricultural croplands for bobwhites must be done in the context of also providing the other necessary bobwhite habitat components, such as brood habitat, escape and loafing cover. A large field converted to a NWSG such as switch grass (*Panicum virgatum*) may provide adequate nesting cover, but without forb-dominated brood habitat and woody cover for escape and loafing, such an area is simply a field of switch grass and clearly not usable habitat space for bobwhites.

Scale of Management: Space and Time.

Guthery (1997) formalized the concept of maximizing usable habitat space through time as a way to unify a management philosophy for bobwhites. Admittedly, Guthery (2007) stated that this idea was nothing new; both Stoddard (1931) and Lehmann (1984) had proposed similar concepts that pointed out the need to saturate an area with habitat as a management goal. Nevertheless, the idea of approaching management of bobwhite habitat from a more formalized space-time continuum is a useful construct for both localized applications of bobwhite management, as well as broad-scale policy such as the NBCI.

The challenge-to both managers as well as policy makers-is that bobwhite habitat management is a process rather than an event. By pointing out the concept of bobwhite habitat in a space-time continuum, the need to consider the repeated management treatments required to sustain bobwhite habitat is pushed to the forefront of policy priorities. Over time, and in the absence of management intervention, the successional tendencies of vegetation will usurp usable habitat space for bobwhites, and time on the management clock will need to be reset with interventions of management disturbances that are situationally and geographically appropriate.

Minimum Habitat Area. – Like any population of wild animals, bobwhites must have a critical mass of sufficient individuals to be sustained through time. Empirically, such a value is difficult to impossible to obtain for bobwhites, or any other species. However, a first approximation simulation analysis by Guthery (2002) indicates that somewhere in the vicinity of 800 individuals are needed to have a high probability of maintaining a viable population of bobwhites over time. Therefore, simple arithmetic thus indicates that at a density of a bird per acre, an 800 acre parcel should be considered a minimum management unit. More realistically, densities of 2-4 acres per bird would dictate that somewhere between 1,600 and 3,200 acres would be required. It will be interesting to see if current investigations using molecular genetic methods to estimate minimum habitat area for bobwhite populations support these figures.

The methods, approaches and philosophies needed to achieve a critical mass of habitat areas to restore bobwhite habitats and populations will require unprecedented coordination and cooperation. The idea of wildlife management cooperatives is nothing new (Leopold 1940) but holds tremendous potential and promise for recovery and restoration of depleted bobwhite populations (DeMaso et al. 2007). Joint Venture Initiatives will also be an essential tool for bobwhite restoration across much of its geographic range (Kuvlesky and Brennan 2005), and must be considered a fundamental part of the NBCI.

Recovery Time. – Implementation of NBCI will not result in a quick fix for bobwhites in the U.S. The current bobwhite situation in the U.S. has taken decades to become manifest; it will, almost by definition, take decades to overcome. My prediction is that if NBCI is successful, it will be the next generation or two of wildlife scientists, policy makers, and hunters who will realize this success. This is a balanced and practical assessment of what I see as the tradeoffs between hope and realism with respect to bobwhite population recovery on a continental scale. Although northern bobwhites have a tremendous annual reproductive potential as noted earlier, the rate at which NBCI puts new, usable, and by definition complete habitat on the ground will be the first critical step; the rate to which bobwhites are able to colonize these areas remains unknown, but most likely will lag behind their intrinsic reproductive potential.

2.4 Putting the NBCI in Context

Williams et al. (2004) argued that bobwhite management is upside down. They presented a compelling case that bobwhite management is upside down based on the obvious fact that habitat management for bobwhites is largely conducted on the local mostly individual properties scales; and harvest policy is set at broad statewide scales. For bobwhite conservation efforts such as the NBCI to be effective, this situation needs to be reversed; habitat management needs to be conducted at a broad scale, and harvest management needs to be implemented at local or individual property scales. Implementing harvest prescriptions on individual properties is relatively easy, and can almost always be done in the context of existing statewide fixed liberal harvest regulations because such prescriptions are always more stringent (Brennan et al. 2008). Furthermore, recent modeling efforts have allowed us to understand how to modulate hunting pressure in order to achieve a pre-determined daily bag limit (Hardin et al. 2005). Implementing broad-scale habitat restoration is another story, and one that will be much more difficult to accomplish. The NBCI is, to date, the first real attempt to tackle such an undertaking.

The growth and maturation of the NBCI is one of the most significant steps ever taken with respect to promoting bobwhite habitat management and conservation on a broad, landscape scale. Arguably, the NBCI is the largest and most comprehensive policy effort developed to promote the conservation of a resident game bird; it crosses not only ecoregion boundaries, but also state and political boundaries. This is as it should be. This is what the northern bobwhite needs. This is what the wildlife management and conservation community needs to do.

Acknowledgments

The Caesar Kleberg Wildlife Research Institute and the Richard M. Kleberg, Jr. Center for Quail Research allowed me to inhabit the space-time continuum required to write this chapter, which was done in partial fulfillment of my duties as the C. C. "Charlie" Winn Chair for Quail Research.

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3 The Revision

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A primary goal established from the outset was to produce a strategic Conservation Planning Tool (CPT) that was both spatially and temporally explicit while pragmatic, flexible and dynamic, extensible and usable by various organizations. A tool of this capacity could easily and seamlessly be integrated into multiple conservation plans or tiled with other geospatial layers to identify priority conservation areas and to meet the immediate needs of the NBCI. To accomplish this, we had to rely heavily on various spatial data layers. Many spatial data layers, however, such as land cover, aerial imagery, and general geospatial layers (e.g., roads) often lack accuracy or have certain associated biases due to classification error, improper scalability, photo distortion, or measurement error, to name a few, or they are simply obsolete before becoming readily available. The Biologist Ranking Information (BRI) layer was developed as a means to mitigate these errors by tapping into the breadth of knowledge that biologists throughout the range of bobwhites have of the landscape and its characteristics. Despite potential regional or state perspective bias(es), the inclusion of biologist ranking information provides up-to-date and on-the-ground knowledge of habitat potential, including social and economic aspects as well as knowledge of land areas that is not easily, if at all, attainable through remote sensed data, theoretical, or habitat modeling. In order to tabulate and capture this knowledge we held 22 individual state workshops and 1 multi-state (Mid-Atlantic: MD, DE, NJ) workshop to create a spatially explicit BRI-layer encompassing a majority (25 states) of the species' range. Below we describe the general process taken and criteria established to successfully host multiple workshops; obtain spatially accurate and regionally-specific BRI data; and provide editing and refinement opportunities of the newly created BRI data. In addition, we describe procedures for using the BRI data, data access and data archiving, and, finally, we outline future considerations for the NBCI and the BRI.

3.1 State Workshops

We hosted the first NBCI-revision workshop in Georgia during September 2008 and completed 4 pilot workshops by the end of 2008. These first few workshops provided the basis for receiving valuable feedback and input to help refine our geodatabase, GIS, and user-interface tools. After refining the BRI workshop and ranking process accordingly, we used a Recreational Vehicle (RV) to travel throughout the conterminous bobwhite range, during March - May 2009, conducting 1-5 workshops each month. We completed the last 2 workshops in late July 2009.

The primary purpose of these workshops was to spatially highlight opportunities for conservation of early-succession habitats and the species inhabiting them. However, we deemed it just as important to highlight the major impediments that might inhibit successful habitat management. It was also important to us to utilize these workshops as a platform for building a consensus and synergy for bobwhite conservation, while creating a tool for improving policy and incorporating multi-species groups' interests to better inform the BRI and increase its capacity for success. As such, we contacted 1-3 biologists from each state to serve as "state contacts". State contacts were put in charge of inviting biologists with expert knowledge of the landscape and championing workshop participation; as a paltry attempt as incentive to attend the workshops we provided lunch for all participants which was coordinated by the state contacts. We used a web-based calendar to announce and coordinate the workshop date, time and venue. Workshops were generally held in a centralized location to allow adequate participation throughout the state. We encouraged and had participation from multiple conservation minded individuals and organizations including, but not limited to: academic institutions (Arkansas State University, Auburn University, Clemson University, Mississippi University, Texas State University, Texas Tech University, University of Arkansas, University of Delaware, University of Georgia, University of South Carolina, University of Tennessee), conservation organizations and NGOs (Audubon Society, Joint Ventures, Joseph Jones Ecological Center, National Wild Turkey Federation [NWTF], Quail Unlimited [QU], Quail Forever[QF], Noble Foundation, Pheasants Forever [PF], Partners in Flight [PIF], Tall Timbers Research Station & Land Conservancy), governmental and federal agencies (state department of natural resources, state Forestry Commissions, Natural Resources Conservation Service [NRCS], The Nature Conservancy [TNC], United States Fish and Wildlife Service [USFWS], United States Forest Service [USFS], and United States Geological Survey [USGS]).

Prior to each workshop, participants were provided some basic information about the workshop and asked to peruse the NBCI-revision website to familiarize themselves with the BRI process, expectations and potential outcomes of the workshop. Upon arrival to the workshop, workshop participants were given a Workshop Booklet providing an overview of the workshop, an itinerary, history of the NBCI, relevant historical state information, explanation of the ranking process, definitions of the major land use opportunities and constraints, maps of relevant geospatial data for the state and region, an ArcGIS user guide, and a BRI user guide. Then, following introductions of all participants, we provided a 45-60 minute Powerpoint presentation on the vision and purpose of the NBCI-revision and explained the BRI process, biologist ranking criteria, major land use opportunities and constraints, and provided some practical, real-life examples (see Biologist Ranking Information section below for more details of the ranking process). During this time a sign-up sheet was distributed to obtain general participant contact information for future correspondence. This was followed by a 15-20 minute demonstration on how to rank selected areas (counties or grid cells) using ArcGIS software; during this time we also ranked 1-2 counties as an entire group to provide consistency of ranking among groups within a state. After workshop participants were familiar with the ranking process, we broke participants up into 3-8 groups depending on the size of the state and assigned biologists to the group whereby they had the most knowledge of the landscape and its habitat attributes. Each group was provided a laptop or computer with pre-installed ArcGIS® software and map documents with pre-loaded geospatial data (see Pre-Workshop Preparation section below for more details and data types). For the remainder of the day, biologists ranked their respective region at first the county level and then refined the ranks at the sub-county level, or BRI grid cell scale. During the workshop, Bill Palmer and Theron Terhune migrated from group to group answering questions on the ranking process and providing guidance as needed. The duration of the workshops ranged from 6 to 10 hours with the average workshop lasting 7.5 hours.

3.1.1 Pre-Workshop Preparation: data compilation, visualization & presentation

In order to facilitate timely, spatially explicit and accurate archiving of biologist ranks and associated major land use opportunities and constraints, we created a Graphical User Interface (GUI; see Figure) using Visual Basic (VB) programming language. This BRI-GUI was embedded into ArcGIS for direct access, integration, and use with geospatial data layers so that workshop participants did not have to exit multiple programs to view or record data. The GUI was equipped with drop-down menus coding for the biologist overall rank (High, Medium, or Low), designated major land use opportunities and constraints, and associated confidence values. In addition to the BRI-GUI, we created three user tools using either VB or Python to expedite common functions used during the workshop and provide extended GIS capabilities not included in the out-of-the-box functionality of ArcGIS. These tools in-

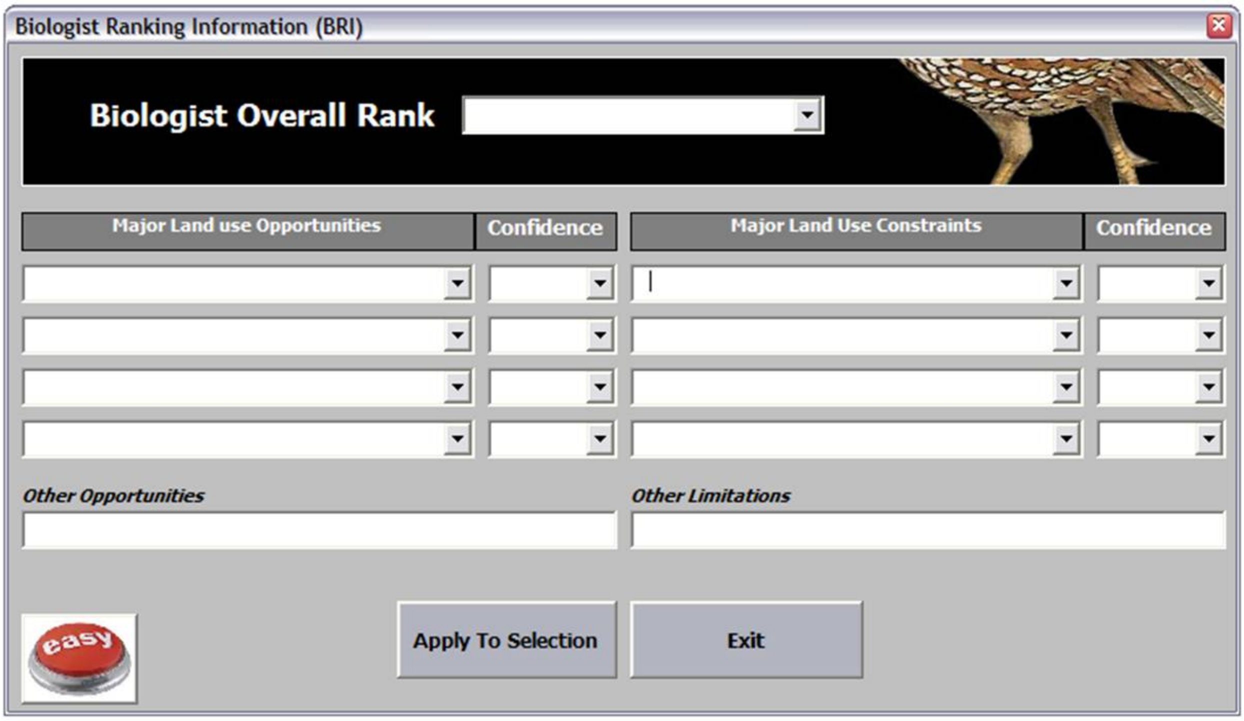


Figure 6: Biologist Ranking Information, Graphical User Interface used for archiving biologist ranks and habitat opportunities and constraints in ArcGIS during NBCI workshops.

cluded an irregular polygon selection tool, an attribute table tool, and a Google Map tool. Finally, a BRI grid (comprised of approximately 6,400 acre blocks or approximately 10 sq. miles) was created for the entire bobwhite range. This BRI grid was the spatial storage feature class for the biologist ranking information.

For each workshop, substantial time and effort was additionally required to coalesce relevant GIS and demographic data, and to create workshop booklets for participant reference during the workshop. GIS data collected for each state consisted of both vector and raster data types. We built a separate file geodatabase for each state which became the repository, or container, for each state's GIS data. Vector data collected included: transportation data (roads [US interstates, US highways, and secondary roads], railroad networks, etc.); water resources (lakes and ponds, rivers, streams); conservation areas (e.g., National Forests, Wildlife Management Areas, conservation easement properties); urban areas (cities, towns, municipalities); BRI grid; physiographic/soils data; and political boundaries (state, county) as accessible. Raster data included land cover data; either one or more of the following was available during each workshop: 2001 National Land Cover Data (NLCD 2001), National Oceanic and Atmospheric Administration data, 2008 National Agriculture Statistic (NASS) Services Cropland Data Layer, or 2001 GAP Land Cover data. Regardless of the specific land cover type(s) used, we reclassified habitat types to generalize and reduce the number to a more manageable and biologically relevant set. These reclassified habitat classes followed this general schema: 0, background; 1, grassland herbaceous; 2, agriculture; 3, pasture/sod-forming grass; 4, fallow/early-succession; 5, orchard; 6, riparian wetland; 7, water; 8, urban; 9, barren; 10, hardwood; 11, pine/evergreen; 12, mixed forest; and 13, other. Additionally, state-level National Resources Inventory data was provided in graphical form in the workshop booklet. Demographic data was also collected, tabulated, organized and joined to the GIS county feature class; this data included: 2007 Agriculture Census Data, Conservation Reserve Program (CRP) data delineated by conservation practice and county (CP1 - CP38), and Census data (e.g., human population size). All vector, raster and demographic data was placed in the state's geodatabase to allow easy access for querying and identification aiding biologists in ranking decisions made during the workshop. We displayed these data in a map document (i.e., .mxd file) in ArcGIS using various symbology, transparency, and categorization themes to increase user compliance and present as much information as possible for the workshop participants to aid accurate, informed habitat ranking and prioritization.

3.1.2 Biologist Ranking Information

The BRI provides information that is not easily modeled using Geographical Information Systems (GIS), complex statistical models, and/or other means. Whereas many geospatially-derived models help to depict habitat (in the past) and land cover types as well as estimate current species population levels, their utility to predict potential habitat given alteration via specific management and the potential impact on a species is limited. The BRI, however, provides "on-the-ground" knowledge germane to successful application of management practices and the likely response of bobwhites. Suitability was categorized in terms of the likelihood (on a scale of Low to High) that bobwhite populations will respond to proposed management action(s) and, importantly, render enough habitat to maintain viable population levels given appropriate conservation policy (e.g., is burning possible or restricted?, urbanization too great?, land ownerships too small?). Notably, the level of suitabiliy and assignment of ranks and confidence values varied somewhat from region to region or even state to state depending on the group's perspective on bobwhite conservation. That said, the same ranking criteria and major land use opportunities and constraints were provided for each state – which would ideally mitigate some of the ranking disparity among states and regions.

To facilitate collection of this information, we broke workshop attendees into groups based on their level of knowledge of a particular region in a state. Each group of biologists ranked areas based on their knowledge of the landscape within that region. To rank areas, we used a two-phased process: (1) each group selected and ranked either a single county or a collection of counties, at the county-scale, until **All** counties were ranked within their specified region and, then, (2) as a group they selected individual or a collection of grid cells within each county that would receive different ranking classifications than the rest of the county as previously assigned. In order to best utilize the expert knowledge of the entire group (all individuals), we provided paper maps in workshop booklets and digital spatial layers directly in the GIS (ArcMap®). We encouraged group discussion to highlight the major landscape features having potential habitat improvement opportunity benefiting bobwhites. The same was also true for identifying the major constraints, or barriers, to successful habitat management. Following group discussion and upon reaching a general consensus, ranks (decisions) were assigned to individual counties and grid cells.

Areas selected as a group (of counties or cells) should have had similar land use and habitat patterns at the landscape scale (pine plantations/rural, center pivot row crop, dry land farming etc.). The entire selection would be assigned a rank as to the likelihood it could be quality habitat and that bobwhite would readily respond to the management prescribed for the entire area selected. For a step by step procedure of the ranking process see Appendix 1.

3.1.3 Overall Biologist Rank

The following ranking criteria was provided for workshop attendees to aid in the assignment of the "Overall Biologist Rank" for each selected area (county or grid cell):

- **High:** Land use is compatible with managing for bobwhites and other early-succession species at the landscape scale. Pine forests, row crops, fire and thinning is conducted, and timber operations provide opportunities for management. Relative to mine reclamation, removing houses, or converting sod-forming grasses to warm season grasses, it is "easy" to create habitat from existing habitat by changing the structure of the habitat (not the composition). For instance, burning and thinning of timber stands to promote grasses and forbs that are present or field border management of native vegetation around crop fields, or hardwood mid-story removal to open upland pine forests. Management is compatible with many conservation values, such as threatened species, water quality, or soil conservation results in low resistance from constituent groups. Land ownership (or land conglomerates) is (are) relatively large (>500 acres). Large blocks of publicly-owned lands provide opportunities for large-scale, long-term management investment.

Region is distant from large urban areas and urban sprawl and not likely to be impacted by urbanization in the near future.

- **Medium:** As above but more difficult to convert habitat in present condition to habitat suitable for bobwhites and other early-succession species. For instance, landscapes dominated by sod-forming grass pastures and closed-canopy hardwoods. Converting these to bobwhite suitable habitat is possible, but difficult and expensive, and likely outside of the land use culture of the area. Another example may be row crop/pine areas where land ownership size is small (<100 acres) and thus achieving landscape scale change would be possible but more difficult.

- **Low:** Not possible to convert to habitat and/or maintain habitat at a landscape scale. This is a catch all category for areas that will never likely be bobwhite habitat for many reasons (even though isolated patches may exist or be possible to manage). Land ownership size too small and/or habitat simply not suitable for bobwhite - landscapes dominated by swampland or burn bans make management of pine forest difficult.

- **None:** Areas already urbanized automatically received a rank of zero. Nearly impossible to convert to bobwhite habitat. Participants did not need to rank obvious urbanized areas, but we encouraged ranking the periphery urban areas based on their knowledge of directional population growth around individual cities or towns.

Major Opportunities & and Major Constraints.

Once an area was selected and ranked (low, medium or high) participants ascribed major land use opportunities and major land use constraints with associated confidence scores for each selected county or cell. Major land use opportunities prescribed would have ideally consisted of realistic habitat management opportunities that, if implemented, would have a major impact on the landscape being ranked. The confidence score, ranging from low to high, was a value assigned to each opportunity or constraint gauging the biologists confidence in each management prescription as to its likelihood for success, if implemented. For instance, in a region that comprised a lot of CRP pine, one might prescribe the management recommendation of thinning and burning and they might be certain that, if implemented, this practice would positively impact early-succession habitat on the landscape being ranked – and, as a result, a high confidence value would be assigned. In contrast, if a management practice was less likely to benefit early-succession habitat, or species, biologists might have assigned a lower confidence value. For example, an area with moderate amounts of pasture or sod-forming grass could in reality be converted to quality habitat and therefore a major land use opportunity for such an area is “Conversion of Pastures to Warm-Season Grasses”. However, because biologists with knowledge of the landscape know that this habitat type while widespread does not comprise a majority of the landscape and it exists in small patches that are distributed among many landowners, then they would have likely assigned a confidence value of medium or low due to its lower likelihood of improving the overall habitat in that landscape being ranked.

After selecting areas with common land-use/habitat potential, biologists chose the best (4 most prevalent) habitat opportunities within the area selected. To do so, they determined which habitat management practices were needed to restore bobwhites and listed those practices most needed and most likley to successfully improve early-succession habitat in the area. We provided the following criteria and definitions to aid in assigning specific habitat recommendations:

- **Forest Management/Woodland Savanna:** creating open pine forest or oak savanna that is maintained by frequent use of prescribed fire on a 1-3 year fire frequency.
- **Conversion of Pastures to Warm-Season Grasses:** sod-forming grasses are poor habitat for bobwhites; conversion to warm season grasses is a potential component of bobwhite management along with managing other fields and forests.
- **Brush Management:** management of brush and/or early-succession habitat types - this category was created to address prevalent brush issues in Texas.
- **Field Borders/Farm Field Management:** existing conservation assistance programs provide proven techniques for managing field borders or whole fields in fallow vegetation habitats that favor bobwhites.
- **General CRP Signup(whole field):** general sign-up of conservation reserve program whereby the whole field is enrolled differentiating it from field border practices.
- **Prescribed Fire:** the region would benefit from increased application of prescribed fire long-term. National forest lands or military base lands that may have appropriate timber densities but fire frequency is too low, say 1 fire per 4 or more years when 1 per 2 is needed.

- **Restoration to Native Longleaf Pine:** initiatives to restore LLP on retired farm lands are viable long-term opportunities to promote bobwhite habitat.

- **Existing Conservation Areas: (private plantations/public management areas)** Longterm habitat management opportunities that are not necessarily managed with bobwhites and grassland birds being a primary objective.

- **Existing Quail Habitat Conservation Areas: (private plantations/public management areas managed specifically for bobwhites)** Source habitats and existing populations are available in the region to provide prototype management and potential sources of birds for the region. This may include state focal areas and associated success of management and response.

- **Reclamation of Mined Lands:** early succession habitats created by mined land reclamation can result in bobwhite habitat creation.

- **Other Species Management:** habitat management conducted for other species (e.g. Pheasants) that is complementary, and likely beneficial, to bobwhite habitat management.

- **Other:** type in other opportunities that are not included in the drop-down selection list.

Similar to the major opportunities biologists listed the 4 most prevalent constraints that would inhibit the likelihood of bobwhite recovery if practices were implemented. We provided the following criteria and definitions to aid in the assignment of specific constraints to habitat management:

- **Inappropriate Vegetation Cover Types:** areas with high wetland components are not suitable for bobwhites. Source habitats for predators may reduce suitability, such as swamplands, river bottoms, and urban fringe.

- **Small Farm/Landholding Size:** landholding or working farms <200 acres are more difficult to convert to bobwhite habitat unless there is an economic rationale for landowners or its location is situated among prime habitat conditions (e.g. bobwhite plantations).

- **Current or Future Urbanization:** Urbanization is not just urban area, but includes all types of developed lands, including roads, schools, buildings, houses, and etc. When >20% of an area becomes "urbanized" the likelihood of increasing bobwhites diminishes.

- **Low Bobwhite Populations:** there may be areas that few, if any, bobwhites exist, such as the Piedmont, where despite management on a farm there would be low chance of success, or success may be slow coming and therefore reduce interest by landowners.

- **Difficulty of Fire Use:** county bans, high urbanization, can make burning impractical. Without fire frequencies of 1 per 2 years, vegetation becomes dominated by hardwoods and the suitability for bobwhites declines.

- **Limited Financial Assistance or Landowner Programs:** for the existing opportunities, there is little, if any, potential assistance available to get landowners interested in the opportunity.

- **Intensive Farming:** Row crop farming with center-pivot irrigation may not provide habitat opportunities similar to dry land farming or areas with a mix of smaller fields.

- **Sod-forming Grasses:** large blocks of sod-forming grasses (e.g., Bahia, Fescue, Bermuda) are poor habitat for bobwhites. Typically an issue specific to pasture lands and cattle operations.

- **Economics:** farm programs, incentive programs not competitive with other values gained from land use.

- **Industrial Forest Ownership:** forest industry has been resistant to thin heavier and use prescribed fire necessary to sustain bobwhite habitats.

- **Lack of Funding/Staff on Public Lands to Implement Habitat Practices:** public ownership may provide an opportunity for habitat improvement but funding may limit the application of management.

- **Low Adoption:** some areas demonstrate low adoption rates of new practices or farm programs.

- **Grazing Pressure:** like intensive farming, intensive grazing systems offer little opportunity for bobwhite management.

- **Historical Species Range Limitation:** historically bobwhites have not inhabited, or known to inhabit, this area and thereby the probability of bobwhite population establishment/persistence is limited.

- **Other Species Management:** habitat management conducted for other species may inhibit, and may even be counter-productive, to bobwhite habitat management.

- **Other:** type in other constraints that are not included in the drop-down selection list.

After each group completed the ranking process for their entire region, we merged each group's ranking data into a single spatial layer. We projected the merged map categorized by BRI rank with a color-coding theme. As a group, we discussed the combined BRI product and made changes as deemed appropriate via the whole group. When all workshop participants were amenable that the final merged product was an accurate depiction of the state we adjourned the workshop.

3.2 Post-Workshop Data

3.2.1 Biologist Ranking Information Editing

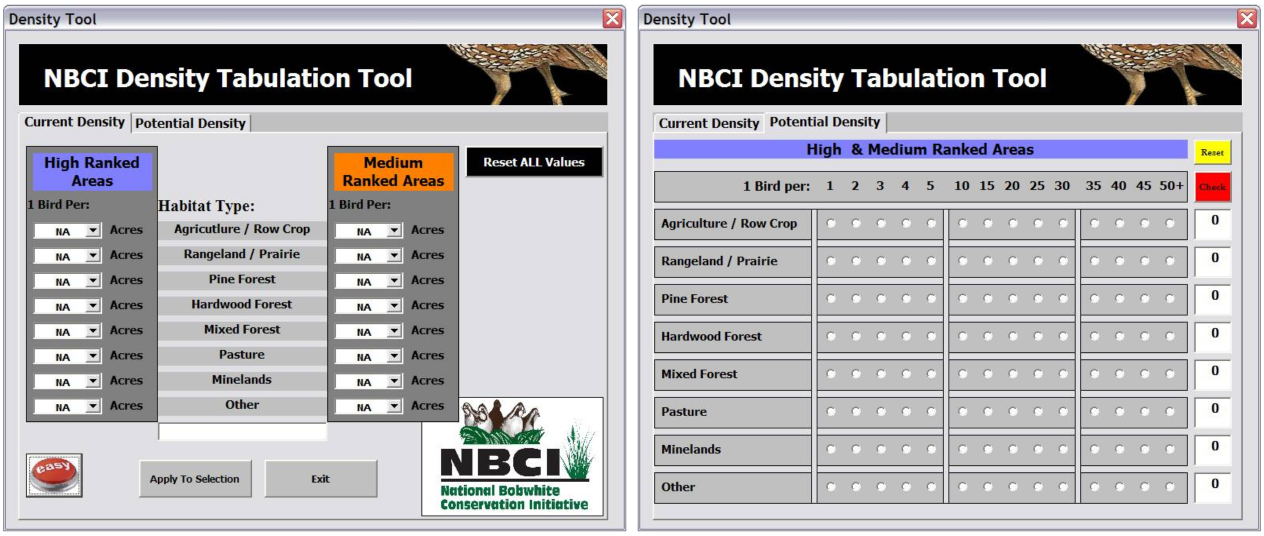
After completion of each workshop, an individual state web mapping application was created with all GIS data layers used during the workshop and the newly created BRI layer. We emailed state contacts and workshop participants, links to the state web mapping application and the overall (i.e., all state BRI layers combined) web mapping application. To view the web mapping applications only a web-browser was needed. Biologists at this point could review the ranks and determine whether any further changes needed to occur for their area of expertise. Following the completion of the final workshop in July 2009, we created the following process to allow biologists attending, and those not able to attend the workshop, an opportunity to edit the original BRI ranks.

1. Biologists reviewed the BRI layer. We created 4 different ways to view and review the BRI layer: (a) using the state Web Mapping Application via a web browser biologists could peruse and view the BRI data as desired; (b) biologists could download the actual shapefiles, or feature classes, and load them into ArcGIS; (c) biologists could download the KML file that we created with built in HTML pop-ups and view it in ArcGIS Explorer; and (d) biologists could download the KML file that we created with built in HTML pop-ups and view it in Google Earth. Both ArcGIS Explorer and Google Earth are freeware programs. Biologists could download individual data from the NBCI-revision website on the workshop web-page. We created general user guides to aid biologists in viewing the BRI data layers using either the Web Mapping Applications, ArcGIS Explorer, or Google Earth.

2. Submit requested changes, if any. Biologists could submit changes for the BRI layer either through participation in a Web-Conference or using a paper protocol. For each state, a Web-Conference was conducted using GoToMeeting, an on-line mediated web conferencing software,

whereby biologists could call and participate in changing the ranks and major land use opportunities and constraints remotely. The process used during the Web-Conference was identical to the pyhsical workshop except that the meeting was conducted on-line. Paper changes could be submitted using any one of the viewing methods above. The process for submitting paper changes was outlined in the following general user guides for the Web Mapping Applications, ArcGIS Explorer, or Google Earth. On the last page of each user guide we provided a form for biologists to fill out and record specific changes; after completion, biologists sent these forms to either the state contact or to Theron Terhune who would then approve or reject the changes.

3. Biologists and state contacts reviewed the final edited BRI product. After all changes were made for a state, changes were either confirmed or rejected by the state contact.



(a) Current density estimation tab. (b) Potential density estimation tab.

Figure 7: Graphical User Interface (GUI) built into ArcGIS/ArcMAP to aid in the collection of density data for individual states.

3.2.2 Population Density Estimation

The need for population density estimation has been substantiated (see the Monitoring Chapter) by numerous groups, individuals, and among conservation plans, and this is for good reason: it provides a relative abundance value that is comparable across many boundaries (habitat, political, etc.). Whereas density estimation is receiving more attention, current density estimates are nearly non-existent or are severely limited in terms of spatial and temporal validity. In addition, because of the numerous caveats, assumptions and biases associated with counts being conducted on broad scales we decided to once again tap into the experts in state agencies to provide cursory, but realistic density estimates for their states. Although we recognize there is error associated with this technique we believe that it will provide a good starting point for developing and evaluating density-based hypotheses. As such, we asked biologists to utilize the abundance data available on public and privates lands, call count data (e.g., BBS generated counts), harvest records, historical records and, importantly, their experience to assign realistic density values for each county containing high and medium BRI-ranked sites.

We developed a Density Estimation Tool using Visual Basic that was built into ArcGIS/ArcMAP (see Figure 7). We also created map documents with the BRI data included along with county and state boundary geospatial layers. We distributed the process, a density tool user guide, and tool to the state contacts to assign density estimates either in a group with other state biologists, on their own, or with other conservation organizations. We also hosted online web conferences and meetings to facilitate the density estimation process as needed. After installation of the density tool, biologists assigned densities by county, or a group of counties together, and by habitat type: agriculture/row crop; rangeland/prairie; pine forest; hardwood forest; mixed forest; pasture; mined lands and other. They assigned both an estimated current density and potential density by ascribing how many acres were needed to support 1 bird (i.e., 1 bird per 20 acres). We view these density estimates as hypotheses, both in the sense that current density (CD) is a best estimate based on current data available and managed density (MD) is the potential response of bobwhites to habitat management which needs to be tested through measurement. Upon completion of density estimation, state contacts sent the data back to us for archiving and analysis.

Given certain management prescriptions and density estimates provided by state biologists we developed the likely response of bobwhites to management in varying key habitat types. We used the hypothesized Estimated (Current) Density (ED) and hypothesized Managed (Potential) Density (MD) to ascertain a managed density and a predicted bobwhite response (i.e., number of birds added given complete habitat implementation). We calculated the number of birds added (BA) as follows:

$$BA = D_P - D_C \equiv \frac{\Delta D}{No.Acres} \tag{1}$$

As such, we calculated the number of birds added proportioned by habitat type and biologist rank (High or Medium BRI) as:

$$BA_i = \left(\frac{1}{D_M} - \frac{1}{D_E}\right) * (Acres_i) \quad (2)$$

where i is the habitat type and D_M and D_E are managed density and estimated density, respectively. We then summed across habitat types to derive the total birds added delineated by biologist rank (High, Medium BRI). Thus:

$$BA_{SubTotal(k)} = \Sigma \left[BA * No.Acres_k\right]_l \quad (3)$$

where k is BRI rank and l is habitat type represents the sub-total birds added for . To derive the total birds added under the condition of full implementation of NBCI habitat prescriptions, we then summed across ranks (High, Medium BRI):

$$BA_{Total} = \Sigma \left[BA * No.Acres_{high}\right]_l + \Sigma \left[BA * No.Acres_{medium}\right]_l \quad (4)$$

Finally, to obtain total coveys added we divided the total birds added by the assumed average covey size (n=12):

$$(TotalCoveysAdded) = \left(\frac{BA_{Total}}{12}\right) \quad (5)$$

3.2.3 Data Mining: summarization, tabulation, data storage and spatial presentation

We coalesced, summarized, and tabulated the BRI data by habitat type and boundary classification (i.e., BCR, region, state, county). We used program Python and ArcGIS to obtain the geospatial intersection of BRI ranks and specific habitat types. To do so, we used the NASS land cover layer as our base habitat layer to extract habitat types for intersection with the BRI data. Whereas the NASS land cover layer is cropland-centric, it was, at the time of data analysis, the most recent (2008) data available that consistently covered the entire bobwhite range. In comparison, the most recent classification for National Land Cover Data (NLCD) at this time was 2001. Numerous errors have been identified with the GAP land cover data including misclassification errors and longleaf biased classification schema. The NOAA was high quality data where available but this data lacked complete spatial coverage of the species range. The 2008 NASS cropland data layer relatively accurately depicted the agricultural habitats and defaulted to the NLCD 2001 classification for non-agriculture habitats. Intersecting the NASS data layer with the BRI data layer was quite complex because the formats are not 100% compatible; the BRI layer was in vector format and the NASS layer was in raster format. We used Python scripts to successfully intersect these layers producing biologist ranking information associated with each specific habitat type (defined at the pixel [60mx60m] level) as classified in the NASS layer. This resulted in >100 million records.

Due to individual files size limitations in both MS Office software (e.g., MS Excel) and ArcGIS, combined with the large geographic area involved (25 states), the amount of data was, and is, not manageable using conventional data/file types. Therefore, we used Python to import data from multiple GIS (.dbf) files into a MySQL database delineated by both states and bird conservation region. The spatial representation of the BRI data remains in ArcGIS feature class format, but the bulk of the habitat type and intersected BRI data is housed in MySQL. The MySQL database holding the BRI data is approximately 93 GB and when combined with all the other geospatial data layers created and used for the NBCI-revision process the total data comprises nearly 1.5 TB.

3.2.4 Data Access

Currently, data can easily be accessed in one of three ways:

1. NBCI Revision Website. Individual state shapefiles, or feature classes, can be directly downloaded on the NBCI-revision website from the workshop web-page. The shapefile can be used in any OpenGIS (e.g., QuantumGIS, GRASS) software or commercial GIS products such as ArcGIS.

2. KML Download & Third Party GIS Viewers. KML files can also be downloaded from the workshop web-page, but to view these one must first download and install a GIS viewer such as Google Earth or ArcGIS Explorer.

3. GIS Web Applications. The final and likely simplest method to view the data is via the web using the Web Mapping Applications created for each state: Alabama; Arkansas; Delaware; Florida; Georgia; Illinois; Indiana; Iowa; Kansas; Kentucky; Lousiana; Maryland; Mississippi; Missouri; Nebraska; New Jersey; North Carolina; Ohio; Oklahoma; Pennsylvania; South Carolina; Tennessee; Texas; Virginia; West Virginia. All states' BRI data can also be viewed on the combined web mapping application.

3.2.5 *Future Considerations*

There are several considerations for improvement of the BRI in future revisions to make the BRI more useful and more accurate. First, is the need for creation of numerous spatial data layers to more accurately estimate habitat potential in terms of exact acres or hectares. Here are a few of these layers:

- Urban Areas and Predictive Models. A more recent and accurate urban areas layer is important because for most states 2002 is the most recent urban layer and large amounts of urbanization has occurred during the past 8 years in some areas. In that vein, a predictive GIS model of urban growth and development would be ideal.

- Public Lands Database. An accurate conservation area layer would be beneficial. Many of the conservation, or stewardship, layers available are subject to double coverage inflating the total acreage, and many conservation areas are precluded from several of these geospatial layers. Additionally, spatial data is often maintained and updated separately by different organizations (e.g., U.S. Forest Service, National Park Services, Bureau of Land Management, etc.).

- Private Lands & Easement Database. Numerous acres are privately owned and managed for bobwhites which benefit early-succession species and habitat creating a nexus for establishment of new populations following habitat management. Similarly, conservation easements provide long-term management opportunity.

- Mined land Database. A major land-use opportunity for development of early-succession habitat is reclaimed mined land sites. However, spatial representation of these mined land sites is currently extremely limited, if existing.

- CRP Habitats and enrollment. Currently, Farm Bill program enrollment is available by county and state but the spatial depiction of these habitats is uncertain. Therefore, a spatial layer representing where current and past CRP is located on the landscape would greatly improve modeling and ranking efforts for potential of conservation.

- Aerial Imagery Modeling. The advent of technological advances provides great opportunity to model and even programmatically digitize habitat from aerial photography. As such, given the spatial and temporal coverage of aerial imagery one could create a quick, cursory landscape analysis and habitat change to inform future habitat decisions.

- Pine and Hardwood Habitat. In this revision, we did not extensively distinguish between upland and bottomland hardwoods or upland and bottomland pine forests. However, given the time and spatial data available (e.g., National Wetlands Inventory [NWI] data) this level of discernment could be accomplished facilitating more accurate habitat prioritization.

Second, the development and refinement of Web Mapping Applications to allow editing directly on-line through remote access would increase the flexibility of future revisions as well as improve data accuracy, timeliness and accessibility. Third, multiple BRI layers addressing other species needs through potential opportunities and constraints would provide a platform to create multi-species conservation planning tools and simplify layering of geospatial data to meet a suite of species' needs. Finally, adding all state early-succession focal area projects would provide a real-time estimate of habitat management projects.

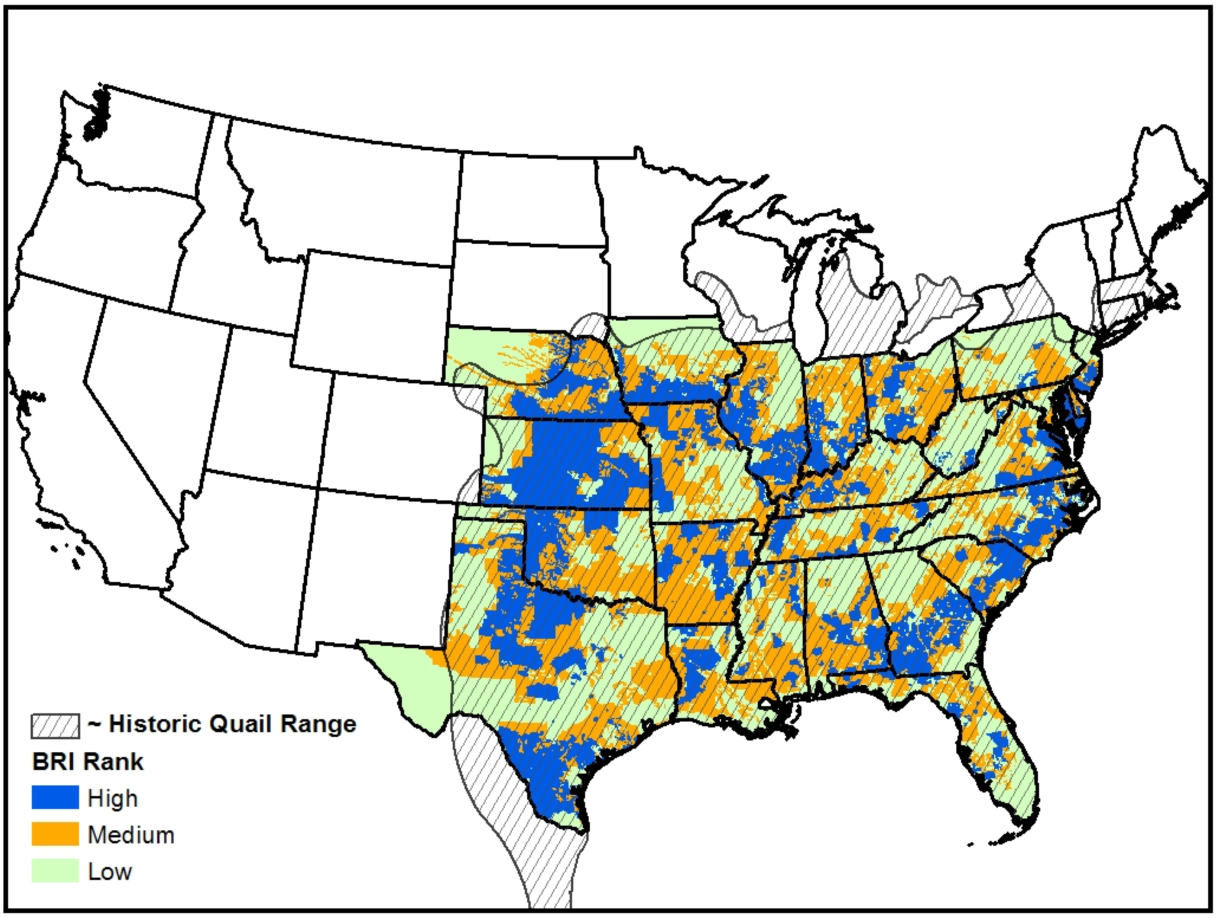


Figure 8: Biologist Ranking Information layer for all states combined overlaid with the approximate historic northern bobwhite quail range.

3.3 Workshop Results

A key outcome of the workshop process was establishing where experts viewed the greatest management opportunities for bobwhite and grassland bird conservation. This core concept of the NBCI formulates the Biological Ranking Information (BRI) which identifies 195 million acres with a high potential for long-term conservation (Figure 8). The BRI should be viewed as a "first-cut" for establishing where to employ habitat management efforts to yield the highest probability for successful bird response. For example, NRCS could integrate the BRI such that areas ranked "high potential" are given priority for Farm Bill programs designed to promote bobwhite conservation. Further, using practices identified as major land-use opportunities in the conservation planning tool, agencies can refine certain programs (e.g., LIP, CREP, SAFE) to address spatially-explicit habitat needs. Future work will allow conservation planners and decision makers to compare the outcome of changes in bobwhite density relative to which management opportunities are proposed for an area.

The BRI and associated habitat opportunities and constraints are presented in 2 main sections that represent different planning scales. First, the number of improvable acres delineated by habitat type and the predicted number of coveys added to the landscape, following full NBCI implementation, are presented in tabular format for each state. To aid in developing step-down plans, each state has access to smaller planning scales (e.g., county data or sub-county; see Appendix 6.3) via the Conservation Planning Tool that includes its own web mapping application (e.g. Florida BRI), the conservation databases, and the ArcGIS toolbox. Second, we present data summarized by Bird Conservation Region to remain consistent with the 2002 NBCI plan.

3.3.1 State Summaries

3.3.2 Density Approach and Coveys Added Goals

The overall NBCI plan identifies 195 million acres of habitat with high spatially-explicit habitat-management potential identified by biologists for bobwhite restoration. A total of 2.4 million coveys would be added to the high potential landscapes based on biologists' perception of estimated current and managed densities. We view these estimates as hypotheses concerning bobwhite population status and response following full NBCI implementation of management opportunities. We encourage states to embed these into their step-down plans and then test predictions of bobwhite response using denisty-based monitoring techniques. Ideally this would occur in an adaptive management framework which over time will better inform the NBCI on habitat management opportunities and needed conservation practices to optimally guide future bobwhite conservation efforts.

Biologists weighed many factors when determining current densities for bobwhites and potential density response following habitat management. These included landscape features, habitat potentials on the landscape, likelihood of future management and more. There was significant variation in density estimates for specific habitat types among states which may have reflected differing experience with estimating bobwhite densities and/or differing experience with bobwhite response to habitat-specific management. At workshops, biologists with significant monitoring experience were more confident in their estimates of density than biologists from regions where a history of monitoring did not include estimating density. The lack of consistent information on bobwhite densities by habitat types suggests there is a need for the NBTC community to develop information on bobwhite densities across the landscape. Currently, there are significant monitoring efforts underway in almost all regions of the bobwhite range for testing and developing novel methods to estimate density and/or occupancy. Further, many wildlife agencies have begun to utilize existing techniques to monitor bobwhite densities on their focal areas and/or wildlife management areas; this data is warranted to better inform future population estimates and associated bobwhite response. For instance, the range-wide effort to monitor the bobwhite density response to application of the "Buffers for Bobwhites" program (CP33) successfully established bobwhite density information on agriculture-dominated landscapes. Therefore, there appears to be a growing awareness in the bobwhite conservation community that density is the appropriate metric. We strongly urge states to focus on methods which produce density (occupancy when density is not feasible) in their future monitoring programs and when assessing the success of habitat management efforts.

Coveys Added. Despite an entirely different process, the total coveys added to the landscape (Table 1) from management of all areas with high restoration potential is very similar to the overall coveys added established in the 2002 NBCI (2.8 million coveys). The 2002 NBCI established the number of coveys needed to restore bobwhites to 1980 densities, an important "stake in the sand" approved by the SEAFWA Directors, for the expressed purpose of establishing a meaningful restoration goal. The 2011 revision goal recasts the message set in 2002 that a massive, collaborative effort is needed to recover bobwhites. Meeting habitat and population goals will continue to require focused attention of all agencies and conservation partners. *The loss of this tremendous number of coveys, in each and every state, stands as testimony of how universal habitat loss has been and how severe the consequence remains for bobwhites.*

Table 1: State summary of Biologist Ranking Information (BRI) summarized by habitat type (Acres x 1,000) for areas ranked High and Moderate with associated number of coveys predicted to be added (Coveys Added) to current population levels. Coveys added are considered potentials without a time scale, where potential is dependent on realizing the habitat management goals as stipulated in the NBCI. Coveys added depict crude estimates of population targets for states and can be viewed properly as hypotheses to be tested (i.e., models) in an adaptive framework.

State	Rank	Row Crop	Range	Hardwood	Mixed Forest	Pasture	Upland Pine	Coveys Added
Alabama	High	250	1,053	1,770	366	856	2,281	63,643
	Medium	175	1,632	3,026	841	1,240	3,903	98,857
Arkansas	High	1,658	151	2,590	201	1,587	784	118,405
	Medium	2,827	966	5,159	422	2,667	5,072	222,692
Delaware	High	115	0.8	115	4.8	13	17	570
	Medium	236	1.6	154	8.2	22	12	1,039
Florida	High	320	633	266	59	687	1,471	59,312
	Medium	672	1,535	855	80	1,825	3,186	80,206
Georgia	High	1,806	1,919	1,534	255	559	3,429	118,877
	Medium	594	1,241	2,122	130	180	3,154	52,284
Illinois	High	6,196	73	3,358	2.3	2,332	6.2	22,416
	Medium	6,872	25	1,741	1.0	1,286	26	25,895
Indiana	High	2,624	74	2,227	0.8	1,026	29	64,368
	Medium	5,614	150	2,207	2.7	1,141	21	70,604
Iowa	High	2,957	230	1,222	3.9	2,944	1.6	103,494
	Medium	4,688	295	608	0.8	1,243	0.5	49,204
Kansas	High	13,176	13,654	966	25	2,074	3.3	609,170
	Medium	3,538	2,653	575	10	1,794	3.6	183,613
Kentucky	High	566	94	2,614	2.4	716	66	30,178
	Medium	1,527	298	5,115	39	1,286	103	83,633

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Table 1 – Cont'd

State	Rank	Row Crop	Range	Hardwood	Mixed Forest	Pasture	Upland Pine	Coveys Added
Louisiana	High	117	980	49	104	378	2,524	30,870
	Medium	1,439	1,208	112	119	1,890	2,310	69,947
Maryland	High	586	5.6	455	18	77	130	26,545
	Medium	401	10.0	766	4.7	258	41	9,424
Mississippi	High	515	424	389	218	874	813	76,280
	Medium	795	2,019	2,130	996	2,402	2,806	211,832
Missouri	High	2,109	13.8	1,841	1.4	4,778	5.2	76,861
	Medium	3,789	66.4	5,662	27	6,951	133	296,591
Nebraska	High	5,662	6,114	458	4.8	152	5.9	67,099
	Medium	6,908	6,434	211	16	68	28	97,412
NewJersey	High	141	15.6	259	5.3	10	310	979
	Medium	91	20.2	150	2.0	4	38	458
NorthCarolina	High	1,981	559	1,194	169	444	1,970	73,057
	Medium	1,202	377	2,818	104	802	1,342	47,018
Ohio	High	2,800	57	1,266	3.8	923	13	2,023
	Medium	3,770	118	5,180	1.4	2,354	70	9,501
Oklahoma	High	1,975	8,759	775	63	132	237	252,262
	Medium	2,744	7,186	4,507	147	1,807	1,158	176,734
Pennsylvania	High	498	14	274	16	93	9.1	1,330
	Medium	1,592	83	3,259	98	350	116	5,433
SouthCarolina	High	1,101	568	439	358	280	1,725	34,801
	Medium	635	329	1,215	183	303	2,020	26,573

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Table 1 – Cont'd

State	Rank	Row Crop	Range	Hardwood	Mixed Forest	Pasture	Upland Pine	Coveys Added
Tennessee	High	1,127	278	2,017	60	560	140	45,344
	Medium	636	712	5,492	213	943	280	120,192
Texas	High	2,457	33,566	1,129	16	2,924	996	464,552
	Medium	3,271	24,347	2,016	279	5,521	4,129	334,491
Virginia	High	1,184	190	2,472	33	99	1,209	18,667
	Medium	1,927	221	3,921	55	295	785	34,693
West Virginia	High	211	38	1,067	1.5	99	8.8	3,066
	Medium	138	9.7	1,438	4.4	115	16	3,536
TOTAL	High	52,134	69,462	30,747	1,992	24,619	18,184	2,364,169
	Medium	56,081	51,935	60,436	3,783	36,746	30,754	2,311,862

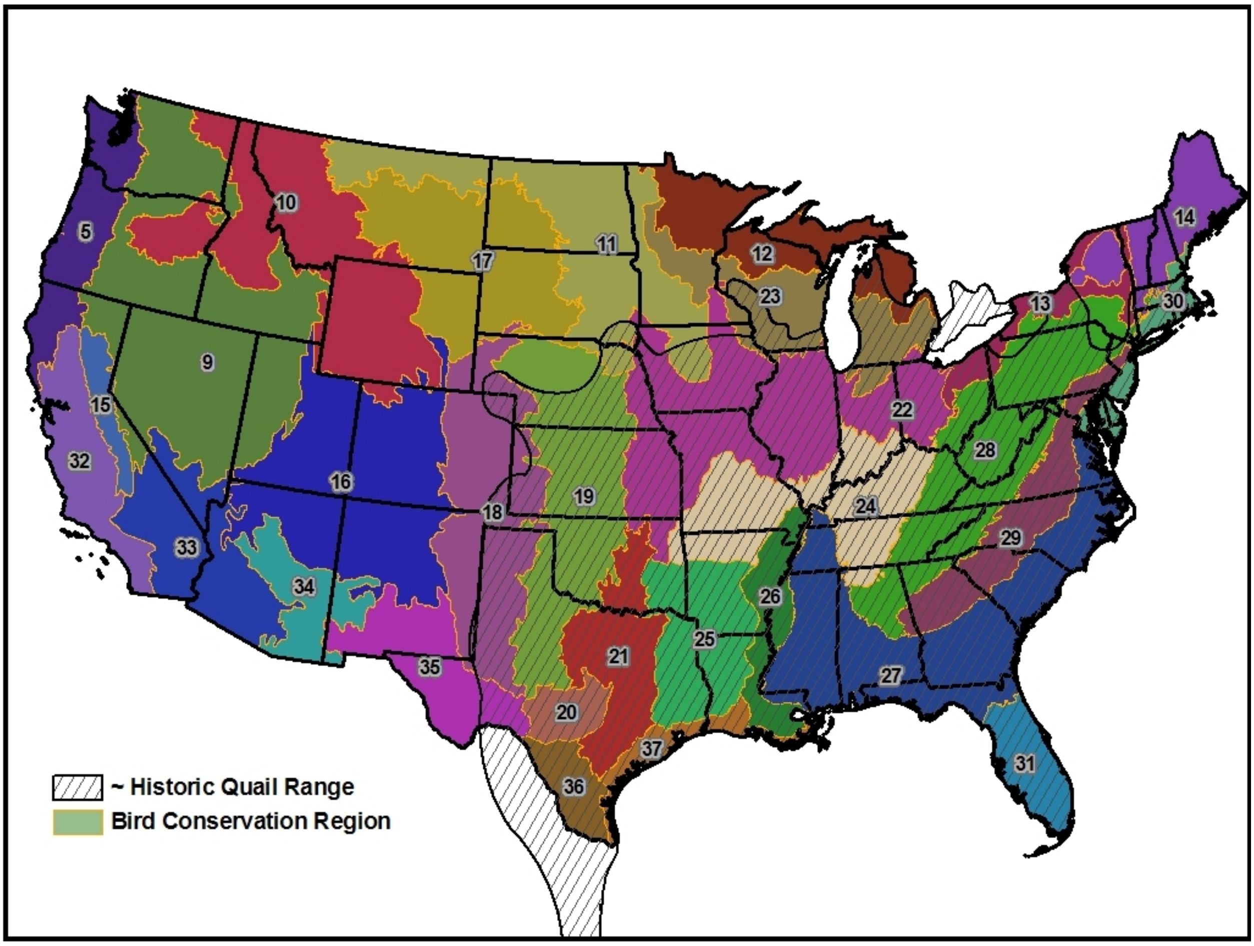

Figure 9: Individual states overlayed with designated Bird Conservation Regions and the approximate historic northern bobwhite quail range.

3.3.3 All Bird Conservation Regions (BCR)

The historic range of northern bobwhite overlaps 35 individual states (Brennan 1991), encompassing 11 whole Bird Conservation Regions and portions of 8 others (Figure 9). To be consistent with the original NBCI (2002) we summarized workshop results at the Bird Conservation Region planning level. To do so, we first provide a summary table displaying the number of acres demarcated by habitat types in regions with BRI ranks of High, Medium and Low (Table 2). Second, we graphically display the top-most 6 major land-use opportunities and constraints (Table 3) for areas with some potential for bobwhite restoration (i.e., BRI ranked High and Medium only) by BCR. Table 3 provides a snapshot of the different management issues among BCRs and provides the information justifying why some regions were ranked as Medium BRI versus High BRI. For instance, in the Shortgrass Prairie BCR, biologists identified grazing pressure, low existing bobwhite populations, and difficulty of fire use as important impediments to management among Medium ranked areas as compared to areas ranked High where these constraints were not as prevalent. Finally, we present bobwhite density results summarized by BCR (Table 4). In this table, we present biologists' estimates of estimated (current) bobwhite density and future managed density by each habitat type. For example, in BCR 27, Upland Pine habitats in areas receiving a High BRI rank were thought to have current densities averaging one bobwhite per 15 acres but following adequate habitat management density could be increased to 1 bobwhite per 3 acres. This was the average for the BCR, but by using the Conservation Planning Tool one can easily assess each region within a BCR and evaluate different density estimates relative to habitat type. For instance, a pine stand in S. Georgia would likely have different density estimates than one in N. Georgia because the perceived opportunities, constraints, and landscapes are different.

Table 2: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for all Bird Conservation Regions within the National Bobwhite Conservation Initiative range.

BCR	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
BCR 13	High	189	49,728	43,520	56,331	329	0
	Medium	12,055	405,356	523,094	589,893	6,679	1,355
	Low	143,695	691,283	703,271	1,888,312	45,345	14,284
BCR 18	High	2,547,772	1,540,947	105,554	3,361	1,391	3
	Medium	9,448,071	1,901,652	110,650	5,170	32,601	21
	Low	16,429,610	12,102,590	163,623	7,510	175,345	828
BCR 19	High	33,070,964	17,346,731	228,615	729,015	435,736	79,218
	Medium	13,342,084	9,104,582	81,886	301,741	135,739	39,383
	Low	13,316,251	3,341,926	44,147	125,204	15,673	17,745
BCR 20	High	1,704,120	15,004	6,857	65,645	380,605	16
	Medium	2,969,060	30,814	4,226	100,564	573,688	7
	Low	5,837,834	32,173	5,477	349,480	1,878,101	78
BCR 21	High	7,391,247	716,151	1,234,647	1,406,589	375,448	6,926
	Medium	7,987,707	665,597	3,868,351	3,568,232	816,242	62,271
	Low	4,351,536	1,296,798	4,366,900	2,427,548	304,235	272,760
BCR 22	High	5,304,419	16,661,560	11,218,372	7,371,860	11,436	32,794
	Medium	2,595,350	22,853,460	8,682,948	5,098,986	10,572	16,606
	Low	1,497,778	17,565,496	5,008,069	3,698,636	23,390	20,684
BCR 24	High	195,503	3,330,949	3,957,556	7,494,666	260,856	98,759
	Medium	329,064	2,473,015	6,298,700	14,729,463	653,777	161,942
	Low	468,139	1,079,567	6,205,491	16,669,066	681,511	154,580

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Table 2 – Cont'd

BCR	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
BCR 25	High	1,040,546	73,423	1,061,710	894,458	3,118,972	188,604
	Medium	3,078,204	234,740	3,832,678	4,549,413	10,160,020	734,222
	Low	1,424,477	224,259	3,895,278	2,470,936	2,289,970	761,829
BCR 26	High	84,240	2,135,679	268,019	156,551	49,026	28,310
	Medium	253,467	5,384,537	922,219	290,332	133,983	24,817
	Low	142,687	5,240,980	772,506	156,308	38,613	30,155
BCR 27	High	4,676,021	7,034,512	3,246,738	5,496,375	10,451,448	1,379,356
	Medium	5,929,438	2,705,103	4,739,473	6,835,332	12,147,519	2,153,810
	Low	3,889,515	1,750,924	2,290,959	4,874,005	8,041,931	1,101,677
BCR 28	High	318,178	625,294	513,944	3,345,557	442,038	79,843
	Medium	988,288	2,326,648	2,211,277	14,474,561	952,988	395,430
	Low	1,700,647	3,798,423	2,417,997	43,969,196	2,440,249	2,040,203
BCR 29	High	312,255	784,079	243,148	2,304,878	1,250,717	64,870
	Medium	941,633	2,785,597	1,415,935	7,872,718	4,015,956	160,126
	Low	683,328	1,871,083	809,514	7,077,407	2,001,471	85,250
BCR 30	High	21,958	995,455	107,053	926,380	539,055	29,437
	Medium	26,025	459,562	59,001	774,485	112,690	15,062
	Low	22,343	189,493	31,480	409,691	57,143	4,069
BCR 31	High	347,929	120,198	564,182	224,327	599,881	81
	Medium	661,567	341,814	1,494,848	687,571	1,047,072	15,551
	Low	520,328	1,162,784	1,220,109	1,327,769	1,085,661	19,681

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Table 2 – Cont'd

BCR	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
BCR 36	High	10,945,946	133,654	1,038,483	28,416	20,017	350
	Medium	931,466	166,477	210,874	46,759	29,083	248
	Low	705,031	718,387	300,054	26,237	4,860	125
BCR 37	High	853,556	137,299	744,429	65,704	31,112	299
	Medium	336,260	769,755	1,633,496	55,145	122,601	1,998
	Low	486,061	990,446	1,207,043	37,377	39,371	5,972
Total	High	68,814,843	51,700,663	24,582,827	30,570,112	17,968,067	1,988,866
	Medium	49,829,738	52,608,708	36,089,657	59,980,365	30,951,212	3,782,850
	Low	51,619,259	52,056,612	29,441,916	85,514,682	19,122,868	4,529,918

Table 3: Summarization of Management-based Major Land-Use Opportunities & Major Land-Use Constraints for all Bird Conservation Regions within the National Bobwhite Conservation Initiative range.

Major Land Use Opportunities		**Major Land Use Constraints**	
High	**Medium**	**High**	**Medium**
Lower Great Lakes/St. Lawrence Plain (BCR 13)			
Field Borders (33.3)	Conv. Pasture (24.0)	Economics (16.3)	Int. Farming (22.3)
Conv. Pasture (17.3)	Field Borders (23.4)	Low Adoption (14.5)	Economics (16.7)
Grass, Prairie (17.3)	Grass, Prairie (21.7)	Graz. Pressure (14.5)	Inapp. Veg. (16.2)
Forest Mgmt (15.9)	Gen CRP (19.3)	Sod Grass (14.5)	Low Adoption (15.3)
Gen CRP (15.9)	Forest Mgmt (4.28)	Diff. Fire use (13.3)	Sod Grass (9.88)
	Pres Fire (2.88)	Int. Farming (13.3)	Urban (7.46)
Shortgrass Prairie (BCR 18)			
Pres Fire (36.02)	Pres Fire (27.4)	Economics (27.3)	Graz. Pressure (23.9)
Field Borders (23.12)	Other Species (24.6)	Graz. Pressure (27.2)	Low Bob. Pop. (20.2)
Gen CRP (23.12)	Brush Mgmt (16.4)	Low Adoption (18.1)	Diff. Fire use (18.5)
Exist Q Cons Area (12.25)	Field Borders (10.3)	Int. Farming (17.5)	Int. Farming (11.3)
Brush Mgmt (5.49)	Gen CRP (8.98)	Diff. Fire use (9.71)	Economics (10.1)
	Grass, Prairie (5.26)		Inapp. Veg. (6.69)
Central Mixed Grass Prairie (BCR 19)			
Pres Fire (31.49)	Pres Fire (26.6)	Graz. Pressure (25.0)	Int. Farming (17.7)
Field Borders (25.59)	Field Borders (22.8)	Economics (16.6)	Graz. Pressure (17.2)
Brush Mgmt (15.15)	Gen CRP (17.0)	Diff. Fire use (14.3)	Low Adoption (10.9)
Gen CRP (10.69)	Brush Mgmt (16.6)	Int. Farming (14.2)	Diff. Fire use (10.4)
Exist Q Cons Area (7.39)	Other Species (6.97)	Low Adoption (10.9)	Economics (9.09)
Gen CRP (5.35)	Conv. Pasture (6.53)	Inapp. Veg. (9.63)	Low Bob. Pop. (8.85)

Continued on Next Page...

Table 3 – Cont'd

Major Land Use Opportunities		**Major Land Use Constraints**	
High	**Medium**	**High**	**Medium**
Edwards Plateau (BCR 20)			
Brush Mgmt (38.32)	Pres Fire (36.6)	Diff. Fire use (25.1)	Graz. Pressure (26.3)
Pres Fire (31.83)	Brush Mgmt (36.6)	Graz. Pressure (25.0)	Diff. Fire use (26.0)
Gen CRP (22.60)	Other Species (26.4)	Low Bob. Pop. (21.9)	Low Bob. Pop. (15.7)
Exist Cons Area (5.43)	Conv. Pasture (0.39)	Sod Grass (14.1)	Low Adoption (12.9)
Conv. Pasture (1.78)		Small Farm (4.47)	Int. Farming (5.50)
		Economics (2.74)	Urban (5.50)
Oaks and Prairies (BCR 21)			
Brush Mgmt (47.00)	Pres Fire (28.1)	Graz. Pressure (25.2)	Graz. Pressure (21.1)
Pres Fire (30.96)	Conv. Pasture (22.9)	Diff. Fire use (22.1)	Small Farm (16.4)
Conv. Pasture (7.79)	Brush Mgmt (21.3)	Inapp. Veg. (11.1)	Sod Grass (14.8)
Field Borders (5.10)	Grass, Prairie (9.99)	Economics (9.54)	Diff. Fire use (12.6)
Gen CRP (3.74)	Field Borders (5.71)	Small Farm (9.26)	Urban (10.4)
Forest Mgmt (3.56)	Forest Mgmt (4.52)	Other Species mgmt (6.32)	Low Bob. Pop. (9.65)
Eastern Tall Grass Prairie (BCR 22)			
Field Borders (29.9)	Field Borders (35.3)	Int. Farming (29.1)	Int. Farming (20.6)
Pres Fire (17.3)	Conv. Pasture (13.9)	Economics (27.6)	Economics (19.7)
Gen CRP (13.4)	Gen CRP (13.2)	Sod Grass (18.0)	Low Adoption (11.4)
Conv. Pasture (13.1)	Pres Fire (13.1)	Graz. Pressure (15.0)	Sod Grass (9.08)
Forest Mgmt (8.36)	Grass, Prairie (11.0)	Low Adoption (9.88)	Urban (8.17)
Grass, Prairie (5.25)	Forest Mgmt (10.4)		Low Bob. Pop. (6.32)

Continued on Next Page…

Table 3 – Cont'd

Major Land Use Opportunities		**Major Land Use Constraints**	
High	**Medium**	**High**	**Medium**
Central Hardwoods (BCR 24)			
Field Borders (28.5)	Conv. Pasture (25.8)	Sod Grass (23.2)	Sod Grass (23.7)
Conv. Pasture (22.4)	Forest Mgmt (22.3)	Low Adoption (12.1)	Graz. Pressure (13.3)
Pres Fire (18.7)	Pres Fire (21.5)	Economics (11.4)	Low Adoption (10.2)
Forest Mgmt (8.26)	Field Borders (18.0)	Graz. Pressure (10.8)	Small Farm (9.00)
Gen CRP (6.26)	Grass, Prairie (7.92)	Int. Farming (10.7)	Economics (8.37)
Brush Mgmt (6.21)	Gen CRP (2.53)	Small Farm (10.7)	Inapp. Veg. (6.58)
West Gulf Coastal Plain / Ouachitas (BCR 25)			
Forest Mgmt (32.1)	Pres Fire (28.3)	Ind. Forest (19.1)	Ind. Forest (19.5)
Pres Fire (26.0)	Forest Mgmt (28.0)	Sod Grass (15.8)	Sod Grass (13.0)
Conv. Pasture (16.7)	Conv. Pasture (16.0)	Small Farm (14.3)	Economics (11.6)
Ref. Nat. LL (10.2)	Exist Cons Area (13.8)	Lim Fin Asst /Prog (9.71)	Diff. Fire use (9.91)
Exist Cons Area (7.61)	Field Borders (6.83)	Low Bob. Pop. (9.43)	Small Farm (8.58)
Exist Q Cons Area (4.71)	Ref. Nat. LL (2.63)	Low Adoption (7.10)	Lim Fin Asst /Prog (8.56)
Mississippi Alluvial Valley (BCR 26)			
Field Borders (33.2)	Field Borders (38.0)	Int. Farming (31.7)	Int. Farming (25.1)
Pres Fire (28.8)	Pres Fire (21.8)	Economics (23.9)	Economics (16.9)
Forest Mgmt (24.2)	Forest Mgmt (19.4)	Urban (10.3)	Low Adoption (12.4)
Conv. Pasture (11.7)	Conv. Pasture (16.7)	Low Adoption (9.56)	Low Bob. Pop. (9.24)
Recl. Mine Lands (1.86)	Grass, Prairie (2.79)	Inapp. Veg. (8.05)	Inapp. Veg. (8.02)
	Ref. Nat. LL (1.23)	Diff. Fire use (4.44)	Diff. Fire use (5.71)

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Table 3 – Cont'd

Major Land Use Opportunities		Major Land Use Constraints	
High	**Medium**	**High**	**Medium**
Southeastern Coastal Plain (BCR 27)			
Forest Mgmt (27.2)	Forest Mgmt (29.7)	Economics (22.1)	Lim Fin Asst /Prog (12.9)
Pres Fire (25.6)	Pres Fire (27.9)	Int. Farming (14.1)	Diff. Fire use (12.9)
Field Borders (22.3)	Ref. Nat. LL (15.6)	Sod Grass (12.7)	Economics (11.9)
Ref. Nat. LL (19.7)	Conv. Pasture (13.3)	Low Adoption (9.00)	Inapp. Veg. (11.4)
Conv. Pasture (4.13)	Field Borders (13.1)	Diff. Fire use (7.74)	Sod Grass (11.3)
Recl. Mine Lands (0.82)	Recl. Mine Lands (0.21)	Urban (6.71)	Urban (10.8)
Appalachian Mountains (BCR 28)			
Conv. Pasture (26.1)	Conv. Pasture (23.2)	Sod Grass (21.0)	Sod Grass (20.7)
Field Borders (19.5)	Pres Fire (16.8)	Small Farm (17.6)	Inapp. Veg. (15.3)
Pres Fire (14.2)	Forest Mgmt (16.7)	Inapp. Veg. (11.8)	Small Farm (12.8)
Forest Mgmt (11.9)	Field Borders (16.4)	Graz. Pressure (9.33)	Low Adoption (11.3)
Brush Mgmt (7.12)	Recl. Mine Lands (8.63)	Economics (6.35)	Low Bob. Pop. (8.26)
Gen CRP (6.60)	Gen CRP (6.16)	Urban (5.45)	Urban (7.10)
Piedmont (BCR 29)			
Pres Fire (27.2)	Forest Mgmt (28.1)	Sod Grass (22.3)	Small Farm (18.5)
Forest Mgmt (26.9)	Pres Fire (26.4)	Small Farm (15.1)	Sod Grass (18.0)
Conv. Pasture (22.6)	Conv. Pasture (24.7)	Low Adoption (12.6)	Urban (11.7)
Field Borders (17.0)	Field Borders (10.6)	Lim Fin Asst /Prog (10.5)	Low Bob. Pop. (9.64)
Ref. Nat. LL (3.90)	Ref. Nat. LL (3.90)	Economics (8.57)	Low Adoption (8.92)
Gen CRP (1.31)	Gen CRP (3.05)	Graz. Pressure (8.56)	Economics (8.51)

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Table 3 – Cont'd

Major Land Use Opportunities		Major Land Use Constraints	
High	**Medium**	**High**	**Medium**
New England / Mid-Atlantic Coast (BCR 30)			
Pres Fire (35.5)	Field Borders (40.5)	Diff. Fire use (24.0)	Urban (25.7)
Field Borders (33.6)	Pres Fire (34.4)	Int. Farming (21.4)	Diff. Fire use (15.8)
Forest Mgmt (28.2)	Forest Mgmt (22.1)	Low Adoption (19.4)	Int. Farming (10.5)
Conv. Pasture (2.58)	Conv. Pasture (2.86)	Economics (17.3)	Low Adoption (10.1)
		Low Bob. Pop. (9.81)	Inapp. Veg. (9.34)
		Lack of Fund./Staff (7.26)	Low Bob. Pop. (9.32)
Peninsular Florida (BCR 31)			
Pres Fire (29.8)	Pres Fire (38.0)	Sod Grass (22.2)	Sod Grass (21.0)
Forest Mgmt (22.1)	Forest Mgmt (25.8)	Economics (13.9)	Economics (17.8)
Ref. Nat. LL (17.9)	Ref. Nat. LL (21.9)	Graz. Pressure (13.0)	Urban (12.8)
Conv. Pasture (17.6)	Conv. Pasture (13.3)	Low Adoption (8.78)	Small Farm (8.41)
	Field Borders (0.80)	Urban (8.75)	Low Bob. Pop. (8.20)
		Small Farm (7.15)	Graz. Pressure (6.61)
Tamaulipan Brushlands (BCR 36)			
Pres Fire (33.5)	Pres Fire (26.0)	Graz. Pressure (24.5)	Int. Farming (21.4)
Brush Mgmt (33.5)	Brush Mgmt (20.5)	Other Species mgmt (23.4)	Graz. Pressure (16.2)
Other Species (18.0)	Conv. Pasture (15.4)	Diff. Fire use (21.0)	Diff. Fire use (12.5)
Exist Cons Area (8.26)	Other Species (13.8)	Small Farm (9.68)	Urban (8.84)
Exist Q Cons Area (4.26)	Field Borders (11.3)	Int. Farming (8.45)	Low Adoption (8.46)
Conv. Pasture (1.58)	Grass, Prairie (6.36)	Economics (7.69)	Small Farm (7.49)

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Table 3 – Cont'd

Major Land Use Opportunities		**Major Land Use Constraints**	
High	**Medium**	**High**	**Medium**
Gulf Coastal Prairie (BCR 37)			
Pres Fire (36.5)	Pres Fire (22.7)	Graz. Pressure (32.2)	Low Bob. Pop. (19.5)
Brush Mgmt (27.2)	Field Borders (18.5)	Diff. Fire use (17.6)	Int. Farming (17.9)
Gen CRP (15.0)	Conv. Pasture (18.1)	Low Adoption (15.9)	Inapp. Veg. (14.0)
Forest Mgmt (8.71)	Grass, Prairie (15.6)	Lim Fin Asst /Prog (12.7)	Sod Grass (12.2)
Exist Cons Area (5.96)	Exist Cons Area (14.9)	Int. Farming (6.26)	Economics (11.3)
Exist Q Cons Area (3.09)	Forest Mgmt (5.68)	Small Farm (6.09)	Urban (8.35)
Total (All BCRs)			
Pres Fire (23.4)	Pres Fire (22.0)	Economics (16.2)	Sod Grass (12.5)
Field Borders (19.5)	Forest Mgmt (16.1)	Graz. Pressure (14.4)	Economics (11.2)
Forest Mgmt (10.6)	Field Borders (16.0)	Int. Farming (13.8)	Int. Farming (8.94)
Conv. Pasture (8.40)	Conv. Pasture (15.0)	Diff. Fire use (10.3)	Diff. Fire use (8.61)
Brush Mgmt (8.09)	Exist Cons Area (6.46)	Sod Grass (9.52)	Small Farm (8.51)
Other Species (5.53)	Brush Mgmt (4.88)	Low Adoption (8.87)	Graz. Pressure (8.12)

Table 4: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for All Bird Conservation Regions (BCR) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
BCR	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
BCR 13	High	66	48	0	0	89	50	0	0	68	50	0	0	80
	Medium	117	48	573	43	100	50	0	0	101	50	0	0	1,294
BCR 18	High	20	7	6	3	80	30	0	0	44	21	0	0	30,123
	Medium	20	7	10	4	80	30	0	0	44	21	0	0	162,141
BCR 19	High	9	3	6	2	29	6	0	0	15	8	0	0	904,910
	Medium	13	5	9	3	29	6	0	0	15	8	40	15	282,172
BCR 20	High	35	11	18	5	88	36	0	0	43	21	0	0	15,773
	Medium	35	11	22	5	88	36	0	0	67	24	0	0	36,918
BCR 21	High	27	13	14	6	35	9	0	0	39	16	0	0	69,299
	Medium	37	16	19	7	38	9	50	20	50	25	65	24	90,989
BCR 22	High	12	5	9	3	30	8	0	0	29	9	0	0	340,154
	Medium	28	6	13	3	63	8	0	0	65	11	40	15	401,741
BCR 23	High	14	9	25	15	54	23	0	0	54	20	0	0	68
	Medium	25	9	27	18	58	23	0	0	54	20	0	0	9,359
BCR 24	High	7	3	7	2	39	7	34	7	18	6	22	7	140,659
	Medium	14	3	19	3	66	7	42	7	39	8	27	9	269,127
BCR 25	High	21	4	15	5	42	7	33	5	22	5	29	8	63,284
	Medium	26	4	21	5	47	9	46	8	22	6	46	11	165,732
BCR 26	High	19	3	22	2	52	14	50	7	38	6	38	10	56,538
	Medium	25	3	26	3	73	14	50	7	57	8	38	10	151,138

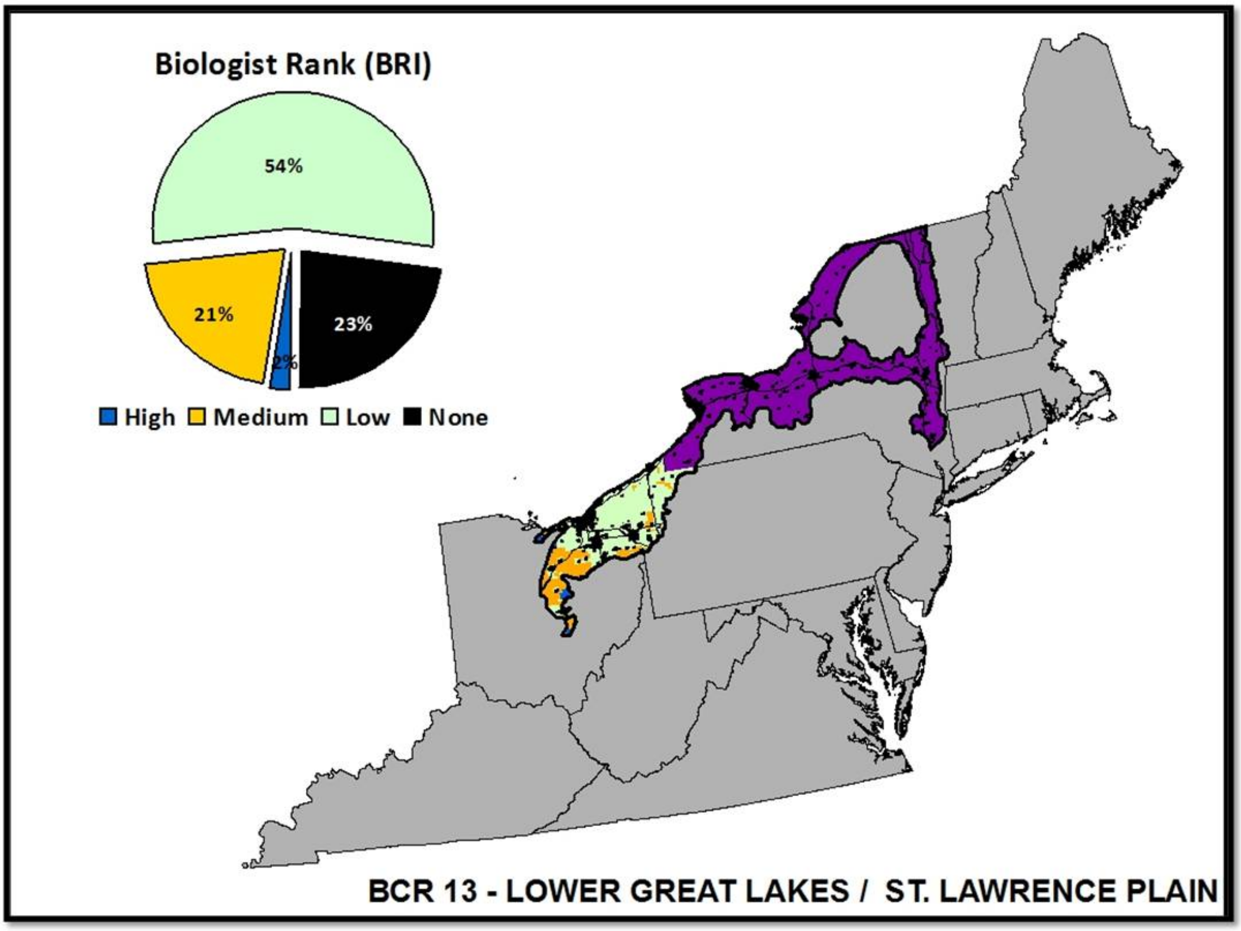
Continued on Next Page…

Table 4 – Cont'd

BCR	Rank	Row Crop ED	Row Crop MD	Range ED	Range MD	Hardwood ED	Hardwood MD	Mixed Forest ED	Mixed Forest MD	Pasture ED	Pasture MD	Upland Pine ED	Upland Pine MD	Coveys Added
BCR 27	High	9	3	19	5	39	6	30	6	29	5	15	3	405,972
	Medium	11	3	19	5	69	6	45	6	36	5	31	4	455,023
BCR 28	High	47	10	40	8	95	8	70	5	60	24	35	5	34,376
	Medium	47	10	40	8	97	13	70	6	82	27	40	6	99,422
BCR 29	High	11	5	31	11	40	21	29	15	43	9	24	9	20,044
	Medium	20	7	33	11	62	22	47	20	50	10	47	12	66,739
BCR 30	High	16	3	71	25	66	23	51	17	37	6	46	12	31,925
	Medium	50	10	86	29	82	27	64	28	68	14	66	14	5,620
BCR 31	High	10	5	5	3	67	25	38	25	26	5	27	7	19,222
	Medium	18	7	5	3	70	25	43	25	26	6	37	8	35,943
BCR 36	High	14	6	7	3	70	30	0	0	13	6	0	0	207,208
	Medium	25	8	13	3	90	30	0	0	18	6	0	0	20,108
BCR 37	High	17	5	6	3	48	26	30	5	24	11	25	10	19,588
	Medium	31	5	15	3	95	36	50	5	71	14	35	10	24,796
Total														4,637,485

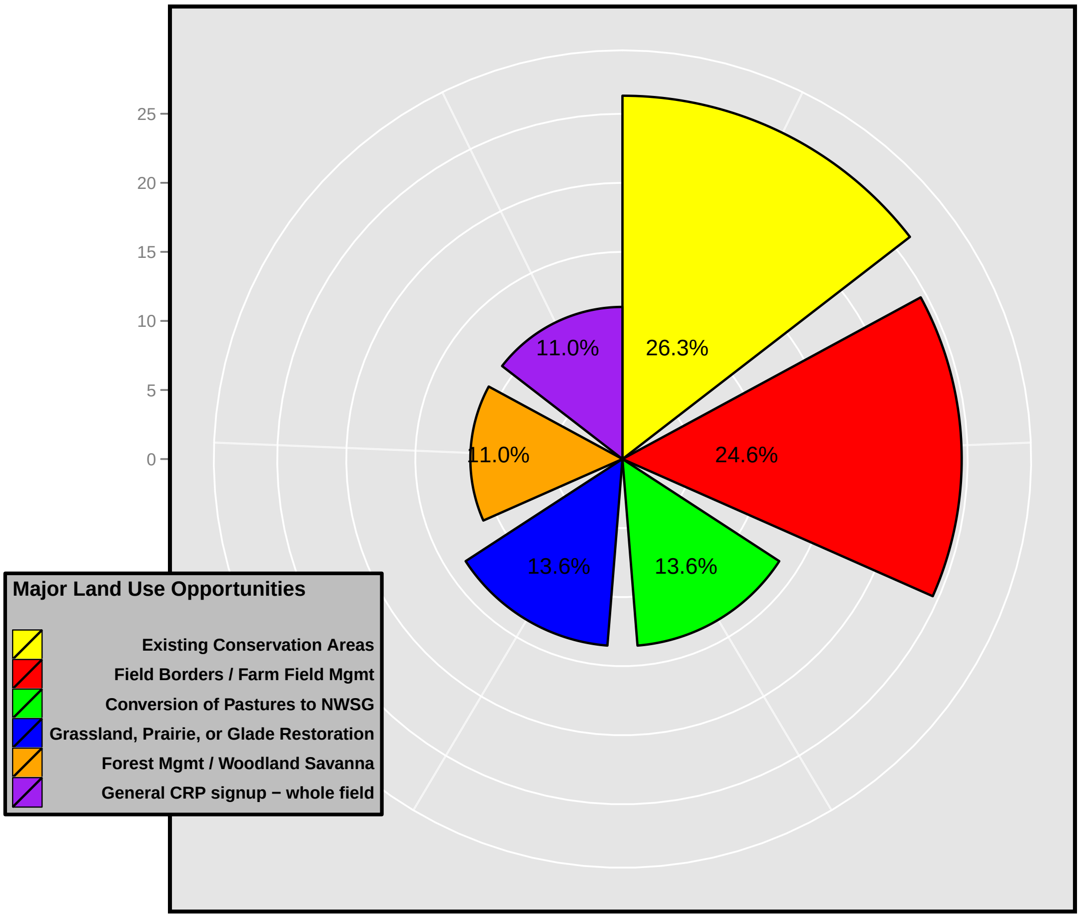
3.3.4 Issues influencing bobwhite conservation for each BCR

In the following BCR sections we include a map of the BCR with BRI ranks (High, Medium, Low) and figures showing the most important opportunities and constraints for each BCR. These figures represent the proportion at which each major land-use opportunity and constraint was applied to the landscape assigned by biologists during the state workshops. The colors in the figures represent the relative importance of the opportunity or constraint. That is, yellow is always the most important opportunity or constraint, followed by red, then green, etc. These figures present a quick "snap shot" of how experts for that BCR viewed the conservation needs of the landscape and are a first step at considering how conservation policies in a BCR align with real world issues.



3.3.5 BCR 13: Lower Great Lakes / St. Lawrence Plain

This bird conservation region was not part of the original NBCI. Participants (n=38) attending state workshops in the Lower Great Lakes/St. Lawrence Plain identified 150,000 acres of landscape with a high potential for long-term habitat conservation, or 3% of the area. Twenty-one percent of the area (Table 5) was considered of moderate value and the remainder considered low potential for conservation of bobwhite and grassland species. In this BCR, all habitats ranked high occurred in Ohio and were primarily composed of agricultural areas with row crops, pasture, and hardwood forests. The primary opportunities for management were field borders and field management systems, conversion of pastures to native warm season grass mixtures, followed by restoration of prairies and savanna habitats (Figure 3.3.1). Primary constraints inhibiting conservation success were nearly equally split among classes, but generally related to incorporation of habitat into intensive farming and grazing systems. Despite high potential management opportunity in Ohio, this area is prone to lake effect snows which may relegate management implementation in a single season similar to those observed during the late 1970s. As such, over-winter cover may be an important component to successful management. Successful establishment of habitat on all moderate and high areas in this BCR would result in adding approximately 1,374 bobwhite coveys, based on estimates of current and managed densities of bobwhites on these areas (Table 6).


25
20
15
10
5
0
26.3%
24.6%
13.6%
13.6%
11.0%
11.0%
Major Land Use Opportunities
Existing Conservation Areas
Field Borders / Farm Field Mgmt
Conversion of Pastures to NWSG
Grassland, Prairie, or Glade Restoration
Forest Mgmt / Woodland Savanna
General CRP signup – whole field

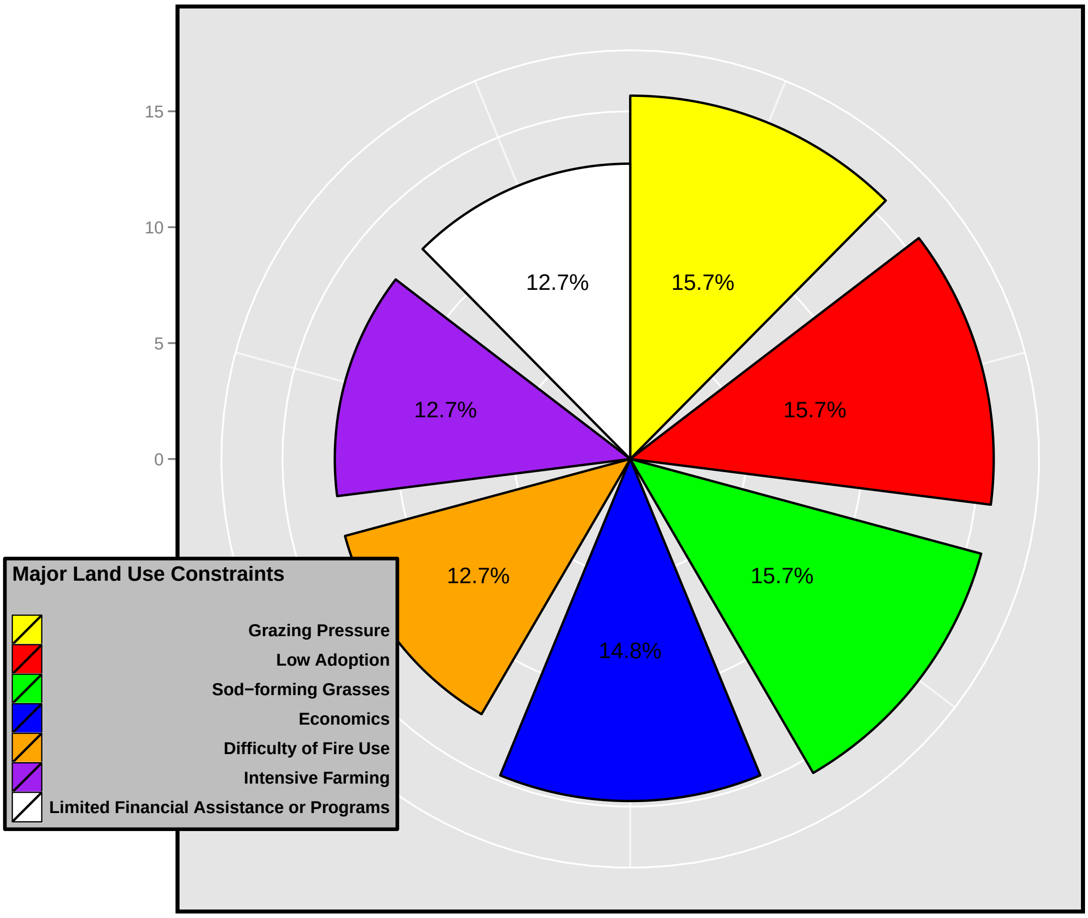
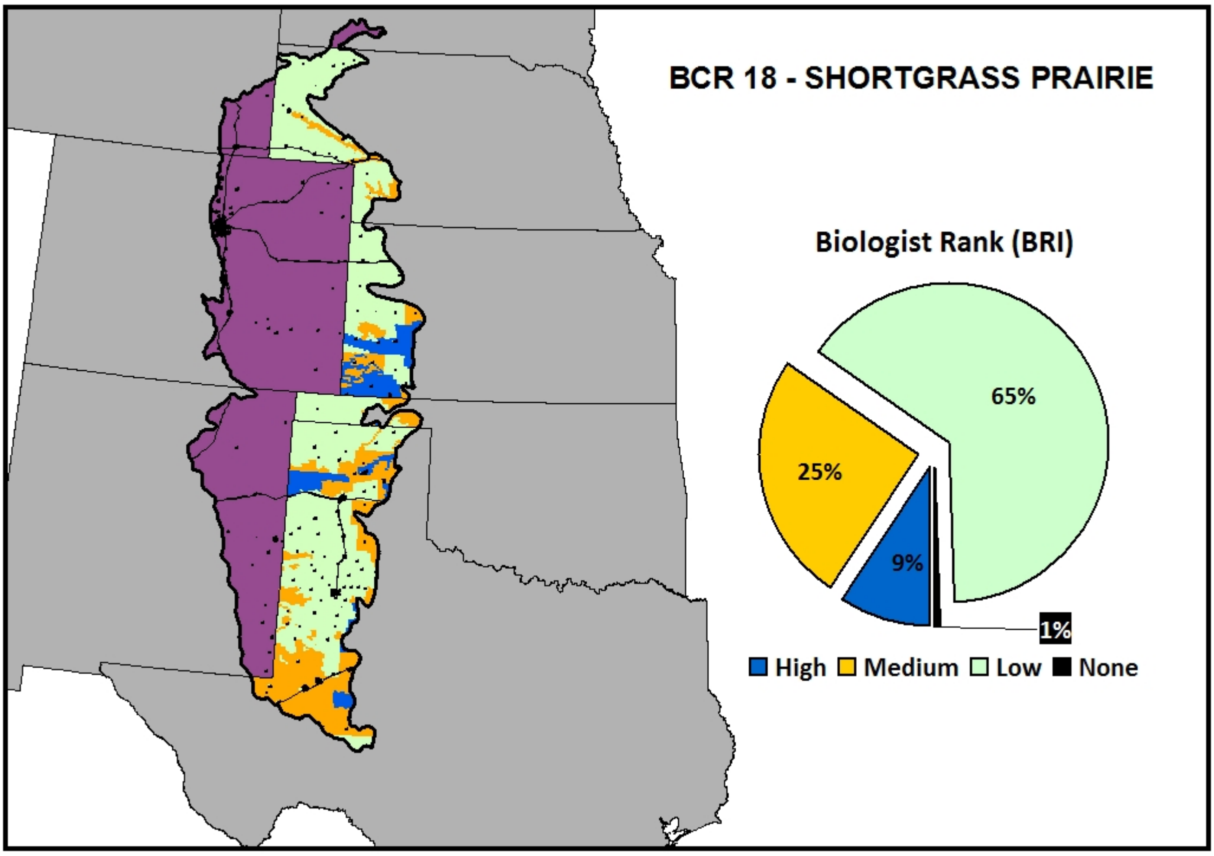

15
10
5
0
15.7%
15.7%
15.7%
14.8%
12.7%
12.7%
12.7%
Major Land Use Constraints
Grazing Pressure
Low Adoption
Sod–forming Grasses
Economics
Difficulty of Fire Use
Intensive Farming
Limited Financial Assistance or Programs

Table 5: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Lower Great Lakes/St. Lawrence Plain Bird Conservation Region (BCR 13) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Ohio	High	189.1	49,727.6	43,519.6	56,330.7	329.3	0.0
	Medium	1,598.7	343,092.3	515,726.4	497,970.6	3,202.8	4.7
	Low	40,110.9	251,992.4	655,895.2	1,017,546.1	7,364.9	20.1
Pennsylvania	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	10,456.0	62,263.5	7,368.0	91,922.9	3,476.3	1,350.7
	Low	103,583.9	439,290.4	47,375.7	870,765.7	37,979.7	14,264.0
Total	High	189.1	49,727.6	43,519.6	56,330.7	329.3	0.0
	Medium	12,054.8	405,355.8	523,094.4	589,893.5	6,679.1	1,355.3
	Low	143,694.8	691,282.8	703,270.9	1,888,311.8	45,344.6	14,284.2

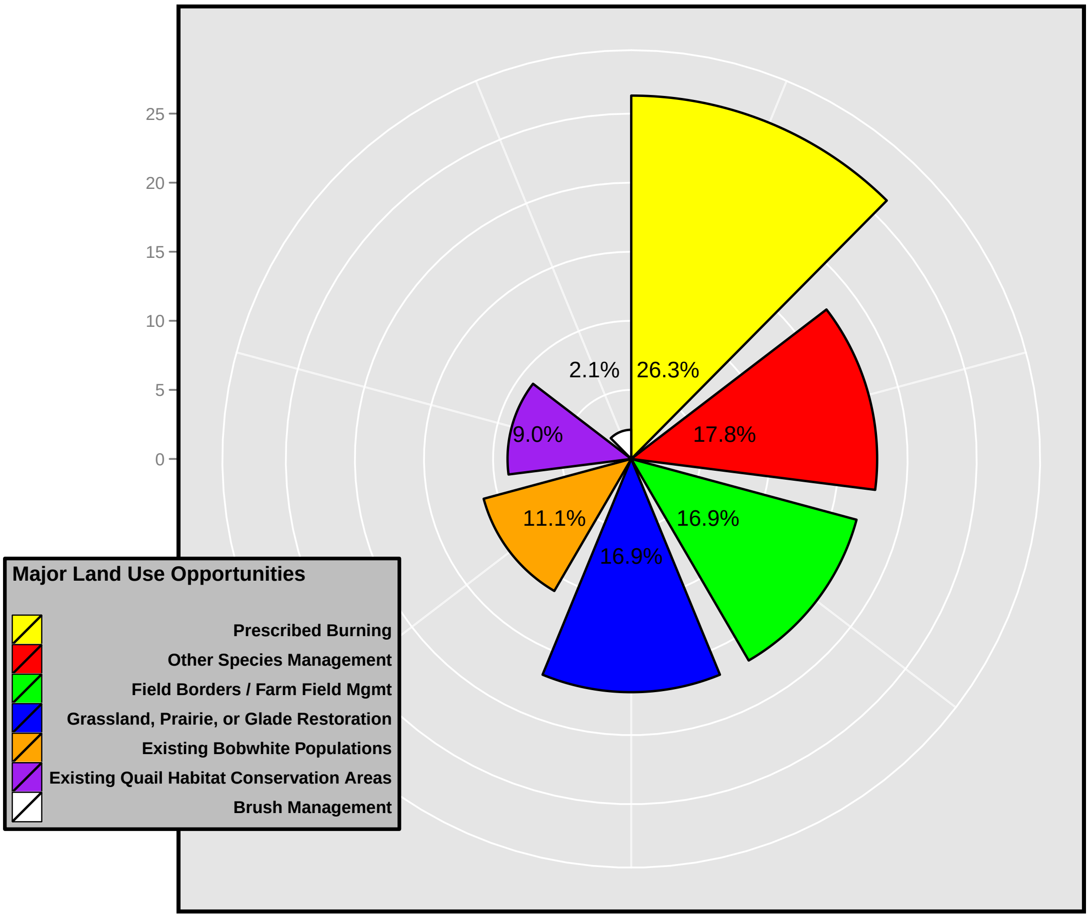
Table 6: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the Lower Great Lakes/St. Lawrence Plain Bird Conservation Region (BCR 13) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Ohio	High	66	50	0	0	89	50	0	0	68	50	0	0	80
	Medium	100	50	100	50	100	50	0	0	100	50	0	0	1,132
Pennsylvania	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	1905	40	1905	42	0	0	0	0	1905	40	0	0	162
Total														1,374



BCR 18: Shortgrass Prairie

The Shortgrass Prairie Bird Conservation Region encompasses over 95 million acres occurring in 8 separate states, but only those portions of the BCR in Kansas, Nebraska, Oklahoma, and Texas were considered within the range of the Northern Bobwhite, or approximately 44.6 million acres. Biologists (n = 133) in these 4 states identified 4.2 million acres (9.4%) as having high long-term potential for bobwhite management, primarily in Kansas and Texas (Table 7). This is significantly lower than the estimated 27 million improvable acres in the 2002 NBCI. Primary land use opportunities were designated as prescribed burning (36%), agricultural field management and field borders (23%) and grassland/prairie/glade restoration (23%). Biologists also believed that existing populations of quail and quail management areas were an important opportunity. Full implementation of habitat objectives across all high acreage would add 30,123 coveys to those landscapes, or approximately 1 bobwhite per 12 acres (Table 8). Primary constraints were related to the economics of conservation and low adoption, grazing pressure and intensive farming. Difficulty of fire use was also a primary land management constraint. This BCR has a significant amount of CRP acreage which would benefit from prescribed fire. Use of prescribed fire, shrub plantings, brush control and riparian protection and management to improve suitability of grasslands and CRP habitats would be important conservation actions in this BCR. Large areas of center pivot agriculture have limited potential for long-term bobwhite conservation due to intensive farming practices.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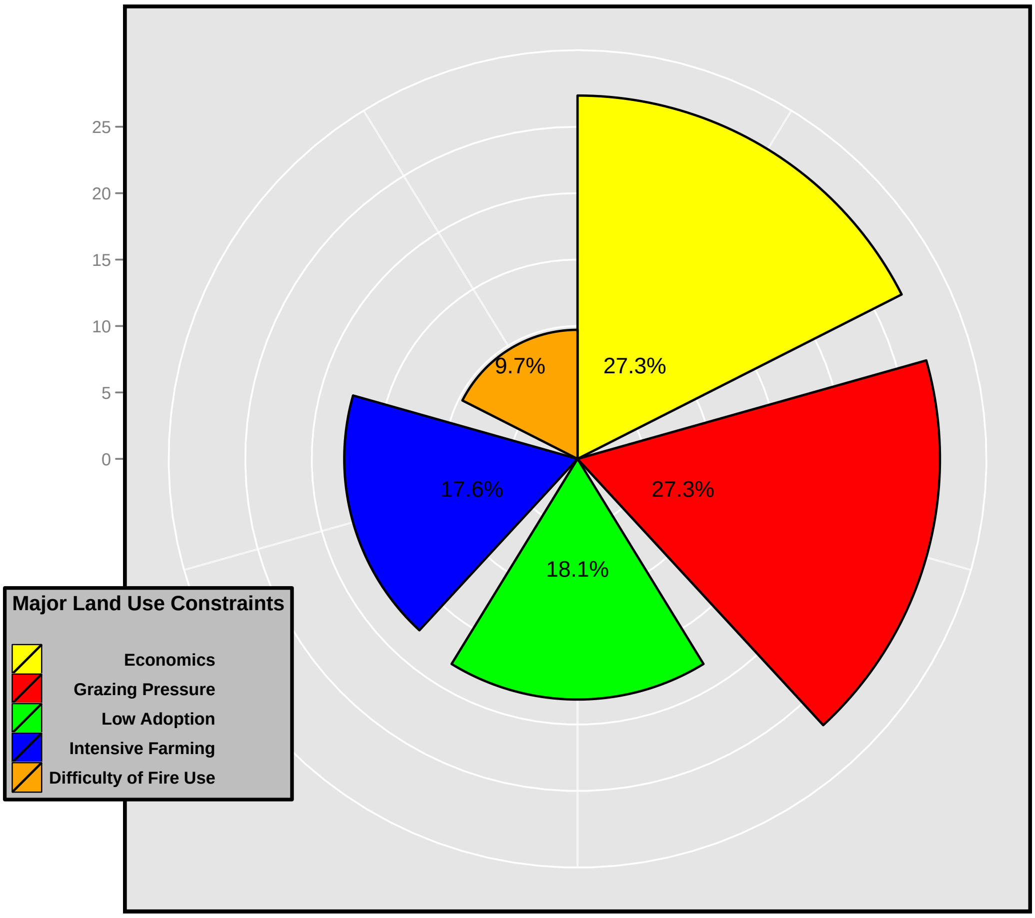
Other Species Management
Field Borders / Farm Field Mgmt
Grassland, Prairie, or Glade Restoration
Existing Bobwhite Populations
Existing Quail Habitat Conservation Areas
Brush Management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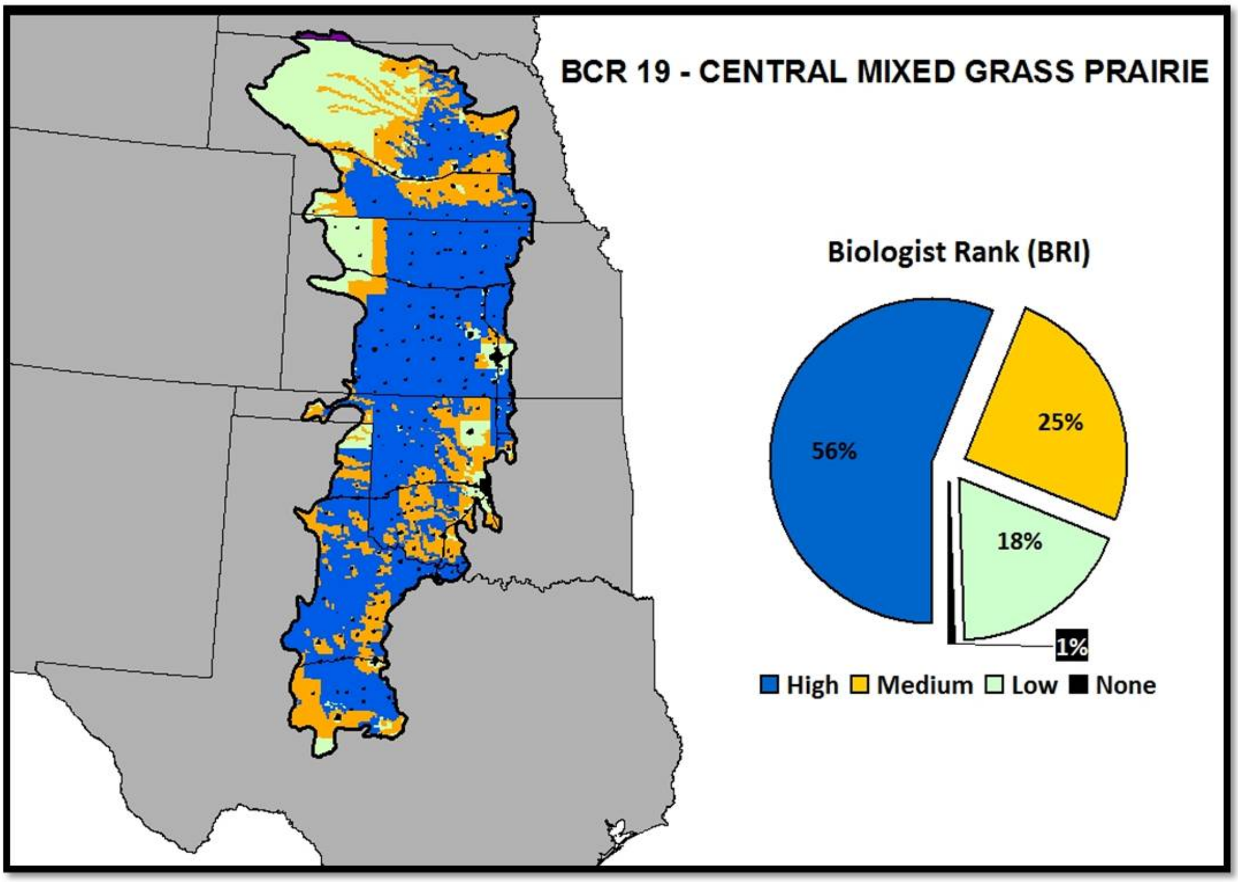
Major Land Use Constraints
Economics
Grazing Pressure
Low Adoption
Intensive Farming
Difficulty of Fire Use

Table 7: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Shortgrass Prairie (BCR 18) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Kansas	High	899,106.3	1,497,546.2	105,548.2	3,180.5	43.8	2.7
	Medium	216,812.3	953,217.2	107,046.7	1,193.4	24.2	10.5
	Low	1,372,821.0	3,543,192.3	147,878.4	2,660.1	12.9	11.3
Nebraska	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	614,628.2	226,602.1	3,450.8	1,161.6	795.9	0.8
	Low	5,547,626.0	1,737,336.0	14,064.2	2,618.6	172,336.6	669.5
Oklahoma	High	32,485.5	2,149.6	0.0	0.8	0.0	0.0
	Medium	441,484.2	105,337.5	1.6	10.8	0.0	0.0
	Low	1,675,175.5	386,269.4	5.4	17.8	616.8	0.0
Texas	High	1,616,179.9	41,250.7	5.4	179.8	1,347.6	0.0
	Medium	8,175,146.2	616,495.0	151.1	2,803.7	31,781.1	9.3
	Low	7,833,987.4	6,435,792.4	1,675.4	2,213.2	2,379.0	147.2
Total	High	2,547,771.7	1,540,946.5	105,553.6	3,361.0	1,391.4	2.7
	Medium	9,448,070.9	1,901,651.9	110,650.1	5,169.5	32,601.2	20.5
	Low	16,429,609.9	12,102,590.0	163,623.4	7,509.7	175,345.4	828.1

Table 8: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the Shortgrass Prairie (BCR 18) delineated by habitat type.

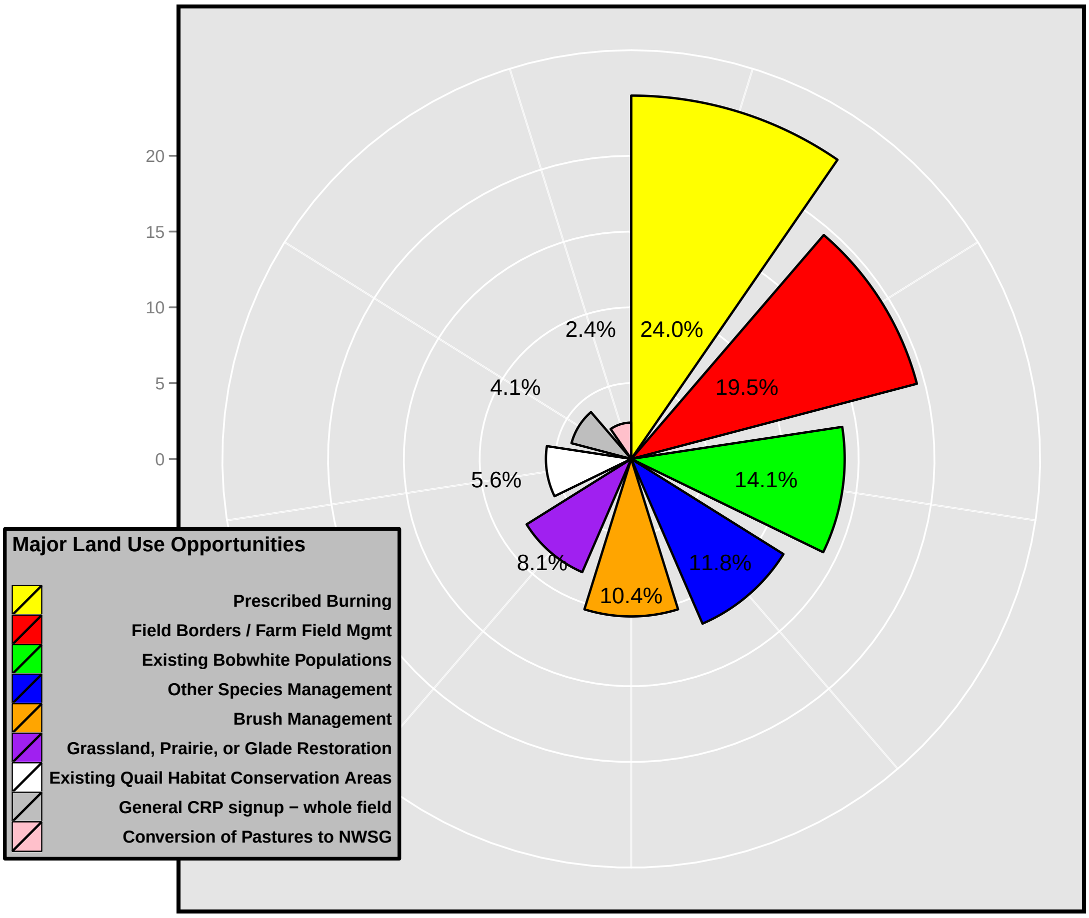
State	Rank	Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
		ED	MD	ED	MD	ED	MD	ED	MD	ED	MD	ED	MD	Added
Kansas	High	22	7	10	4	80	30	0	0	45	23	0	0	10,014
	Medium	22	7	14	4	80	30	0	0	51	23	0	0	12,351
Nebraska	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	17	11	14	9	0	0	0	0	9	6	0	0	2,618
Oklahoma	High	23	20	3	1	0	0	0	0	0	0	0	0	1,808
	Medium	23	20	11	1	0	0	0	0	35	35	0	0	33,389
Texas	High	10	5	5	3	0	0	0	0	15	10	0	0	18,301
	Medium	17	6	10	4	0	0	0	0	26	11	0	0	113,783
Total														192,264



BCR 19: Central Mixed Grass Prairie

Spanning over 91.8 million acres the Central Mixed Grass Prairie BCR has some of the greatest opportunity for bobwhite conservation in the country, sustaining significant and stable bobwhite populations over large regions. Biologists from Texas, Oklahoma, Kansas and Nebraska identified 51.9 million acres of landscapes with high bobwhite conservation potential, including 33 million acres of range/grasslands and 17 million acres of Row Crop (Table 9). This represents 57% of the entire BCR (excluding South Dakota) which is still lower than the original NBCI which identified 80 million acres of improvable landscapes.

Prescribed fire was the greatest land management opportunity, similar to other grassland-rich regions of the country, followed by field borders and farm field management (CRP and CREP), brush management, and grassland and glade restoration. Biologists also recognized that existing quail habitat conservation areas were important to long-term conservation planning in this region. Implementation of the NBCI on all areas of high potential would add 904,900 coveys to the landscape, or about 1 bobwhite per 5 acres (Table 10). The 5 most important impediments to conservation of bobwhite management and grassland restoration were identified as intensive grazing pressure, economics for landowners, difficulty of fire use, intensive farming and an overall low adoption of conservation practices. However, due to water shortage issues related to crop irrigation incentives available for landowners through the Farm Bill programs may alleviate economic constraints to habitat conservation.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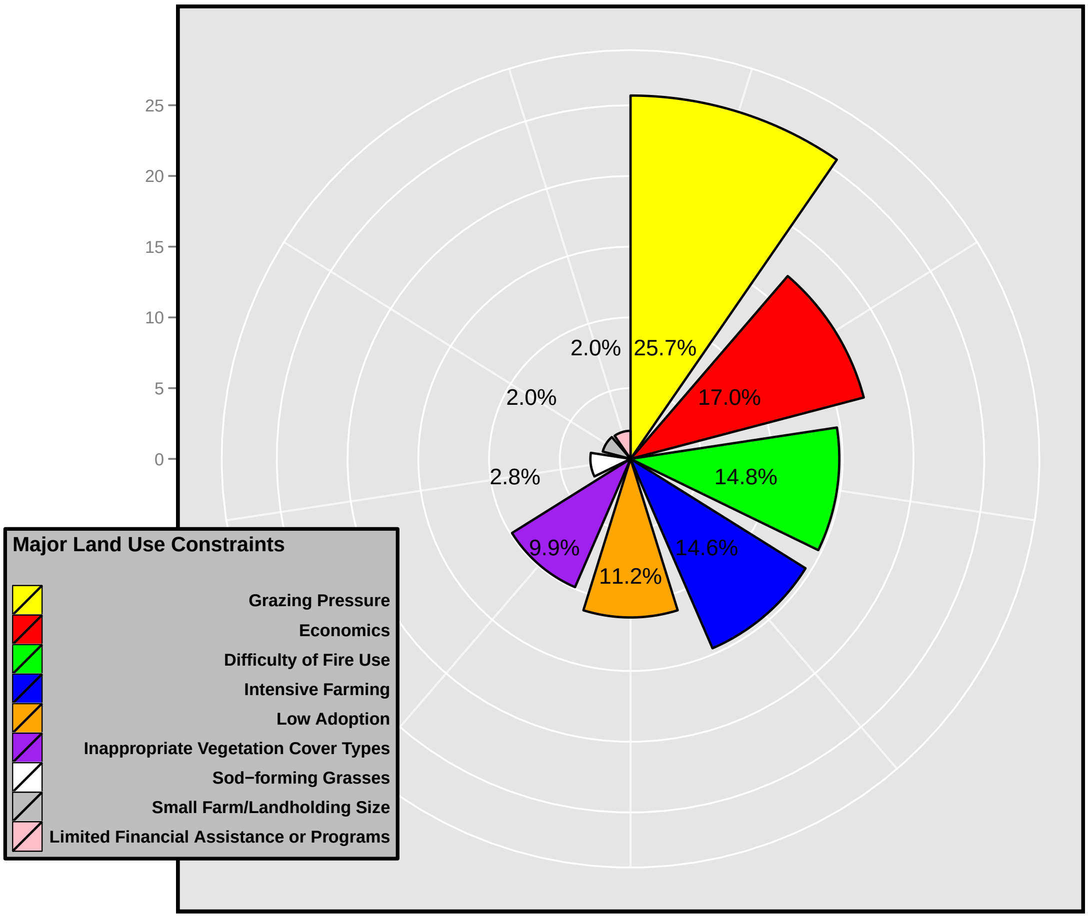
Major Land Use Opportunities
Prescribed Burning
Field Borders / Farm Field Mgmt
Existing Bobwhite Populations
Other Species Management
Brush Management
Grassland, Prairie, or Glade Restoration
Existing Quail Habitat Conservation Areas
General CRP signup − whole field
Conversion of Pastures to NWSG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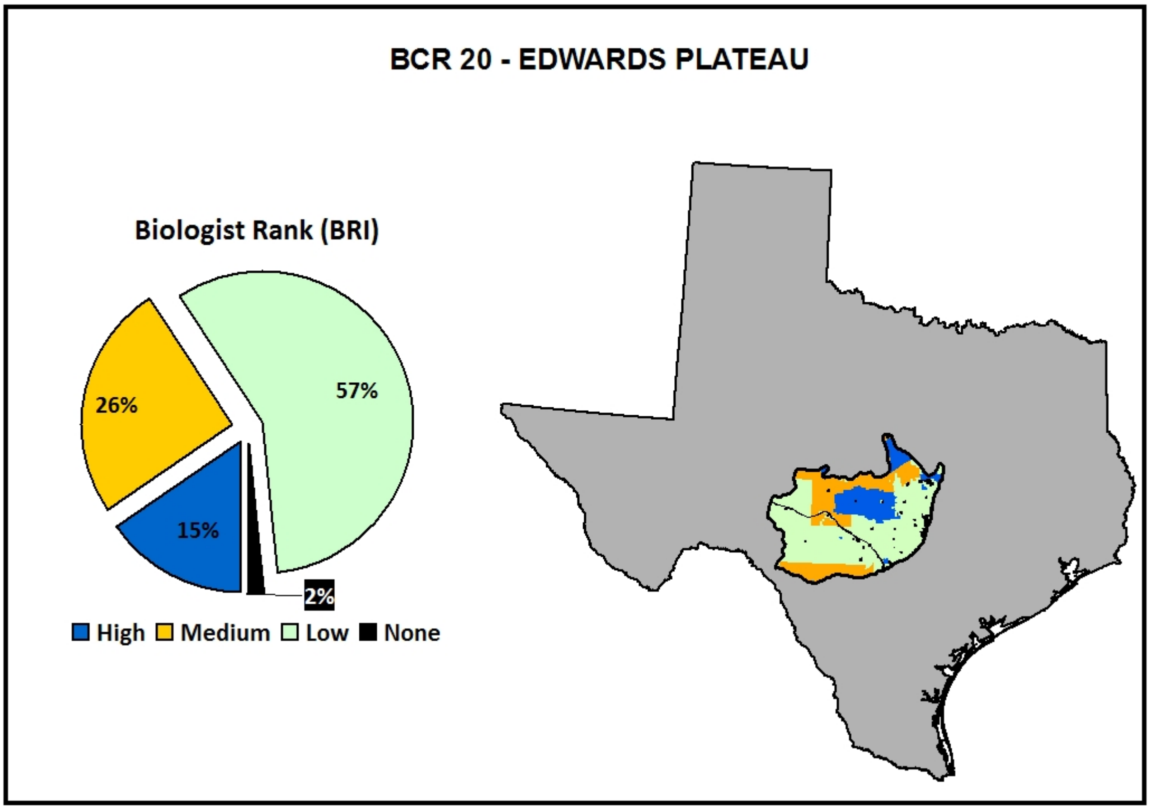
Major Land Use Constraints
Grazing Pressure
Economics
Difficulty of Fire Use
Intensive Farming
Low Adoption
Inappropriate Vegetation Cover Types
Sod−forming Grasses
Small Farm/Landholding Size
Limited Financial Assistance or Programs

Table 9: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Central Mixed Grass Prairie (BCR 19) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Kansas	High	9,120,728.6	10,307,043.6	169,153.6	341,952.9	508.8	2,569.6
	Medium	806,704.6	903,867.1	14,119.2	14,686.5	89.0	118.8
	Low	1,489,923.6	1,974,793.5	23,293.2	36,969.2	26.9	318.3
Nebraska	High	4,698,304.0	3,658,109.2	42,672.8	144,181.4	2,048.1	4,493.0
	Medium	4,515,176.6	4,089,097.8	47,922.9	67,724.5	16,804.2	14,297.4
	Low	10,054,458.9	701,080.2	8,472.3	9,310.8	8,868.3	17,006.5
Oklahoma	High	7,263,464.8	1,879,943.4	13,453.5	169,121.5	236,725.7	63,465.5
	Medium	3,213,354.1	2,522,437.0	17,285.5	185,531.2	30,484.0	18,409.1
	Low	733,108.5	564,858.1	10,829.6	75,611.5	3,298.1	286.7
Texas	High	11,988,466.8	1,501,634.7	3,335.3	73,758.8	196,453.8	8,690.0
	Medium	4,806,848.8	1,589,180.0	2,558.1	33,799.1	88,362.1	6,558.2
	Low	1,038,759.6	101,194.0	1,552.2	3,312.0	3,480.2	133.3
Total	High	33,070,964.3	17,346,730.9	228,615.2	729,014.5	435,736.5	79,218.1
	Medium	13,342,084.2	9,104,582.1	81,885.6	301,741.3	135,739.2	39,383.4
	Low	13,316,250.6	3,341,925.9	44,147.3	125,203.5	15,673.5	17,744.7

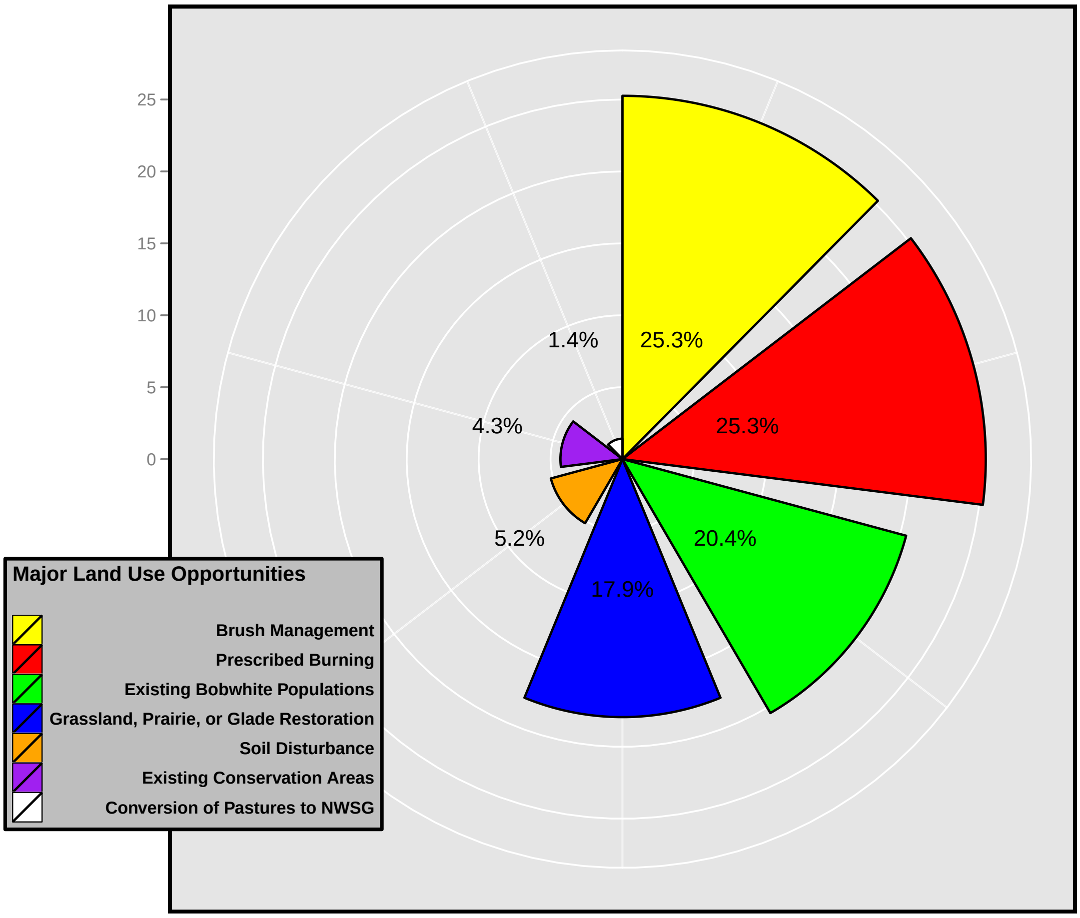
Table 10: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for Central Mixed Grass Prairie (BCR 19) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Kansas	High	8	2	10	2	83	33	0	0	49	13	0	0	476,036
	Medium	12	2	13	2	85	34	0	0	55	13	0	0	55,210
Nebraska	High	8	5	5	4	0	0	0	0	7	5	0	0	46,482
	Medium	10	5	10	5	0	0	0	0	11	5	0	0	63,795
Oklahoma	High	12	6	4	1	16	5	0	0	28	22	0	0	240,351
	Medium	22	11	9	3	25	5	0	0	42	35	40	15	70,914
Texas	High	12	5	5	3	60	25	0	0	18	12	0	0	142,040
	Medium	15	5	7	3	60	25	0	0	29	12	0	0	92,253
Total														1,187,081



BCR 20: Edwards Plateau

The Edwards Plateau Bird Conservation Region comprises 14.5 million acres in central Texas. This hilly area is clearly demarcated by the Balcones Fault escarpment to the east and south, but grades into the Chihuahuan Desert to the west and the Great Plains to the north. The Edwards Plateau was originally a grass-dominated savanna with the most common trees being mesquite, juniper, and live oaks. Some of this community type still remains, but agricultural practices have heavily modified most of the area. Unlike BCR 19, bobwhite populations in this area have declined precipitously during the past 30 years. Biologists (n = 51) identified 16% of this BCR as having high long-term potential for bobwhite conservation, most of which (1.7 million acres) are in range/grassland/early-succession habitats, which is a significant reduction compared to the 2002 NBCI (Table 11). Biologists identified 5 major land use and management opportunities, which included brush management (38%), prescribed fire (32%), grassland habitat restoration (23%), and conversion of pastures to native warm season grass habitats. Existing conservation areas within the Edwards Plateau were also considered important in planning future conservation efforts. The majority of restoration for bobwhites in BCR 20 can be accomplished by increasing the acreage devoted to a mixture of native warm and cool season grasses interspersed with low growing woody cover. Bobwhite habitat restoration can be accomplished using any or a combination of cedar removal, prescribed burning, and rotational grazing systems and/or decreasing the stocking rates of exotic wildlife species, goats, sheep, and cattle on rangeland. Implementation of NBCI on all high landscapes would add approximately 15,773 coveys to the landscape, or about 1 bobwhite per 11 acres (Table 12). Major constraints included, among others, difficulty with use of prescribed fire, grazing pressure, low existing bobwhite populations, sod-forming grasses, and small f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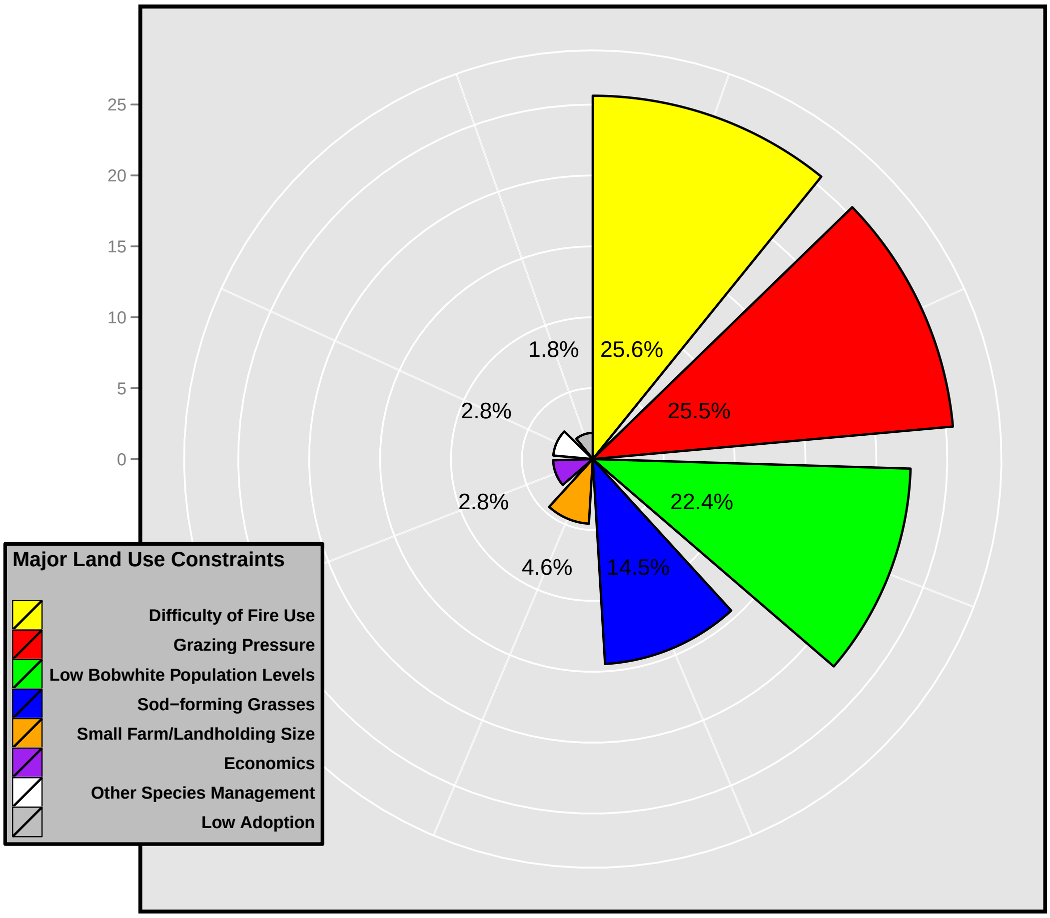
Major Land Use Opportunities
Brush Management
Prescribed Burning
Existing Bobwhite Populations
Grassland, Prairie, or Glade Restoration
Soil Disturbance
Existing Conservation Areas
Conversion of Pastures to NWSG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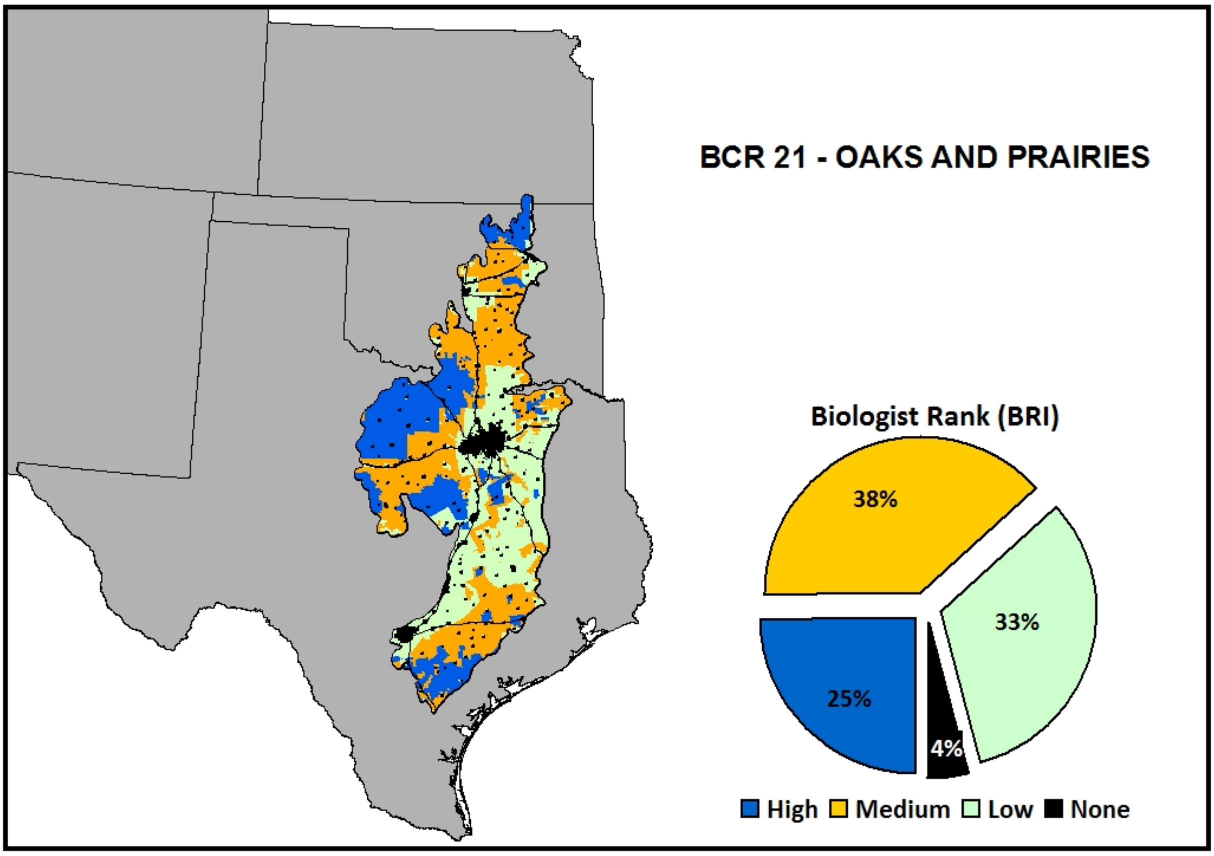
Major Land Use Constraints
Difficulty of Fire Use
Grazing Pressure
Low Bobwhite Population Levels
Sod−forming Grasses
Small Farm/Landholding Size
Economics
Other Species Management
Low Adoption

Table 11: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Edwards Plateau (BCR 20) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Texas	High	1,704,119.6	15,004.1	6,856.5	65,645.2	380,604.7	16.3
	Medium	2,969,060.4	30,814.0	4,226.5	100,564.0	573,688.3	7.0
	Low	5,837,834.3	32,173.3	5,477.2	349,480.0	1,878,100.6	78.3
Total		10,511,014.4	77,991.4	16,560.2	515,689.3	2,832,393.6	101.5

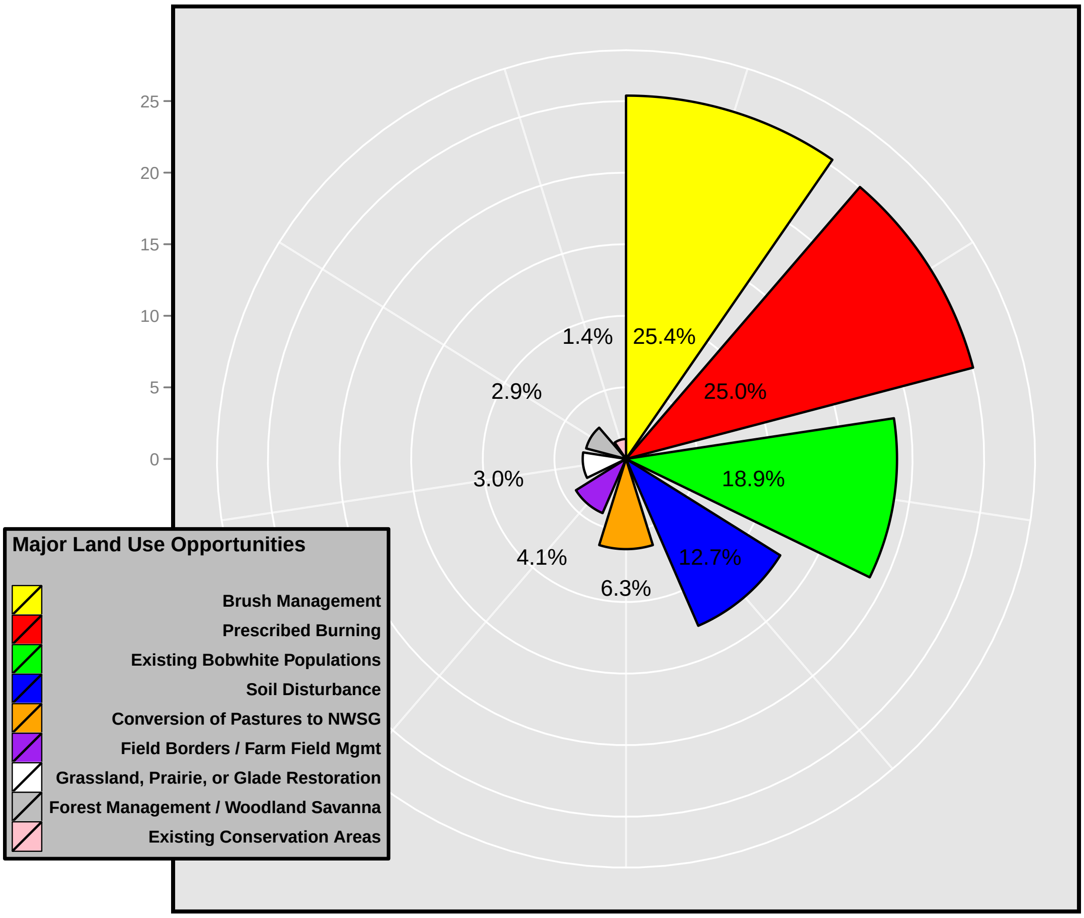
Table 12: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the Edwards Plateau (BCR 20) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Texas	High	35	11	18	5	88	36	0	0	43	21	0	0	15,773
	Medium	35	11	22	5	88	36	0	0	67	24	0	0	36,918
Total														52,691



BCR 21: Oaks and Prairies

Comprising some 41 million acres, the Oaks and Prairies Bird Conservation Region (BCR 21) extends from just beyond the northern border of Oklahoma south to Live Oak County, Texas. This BCR is comprised of rolling savannas with tall grass prairie and scattered oaks. Historically, this plant community was a consequence of fire, herbivory, and weather extremes. Unfortunately, fire suppression and changing land use practices, including intensive grazing of livestock, exotic grasses, and agricultural practices have altered or eliminated much of the native savanna communities important to bobwhite and other birds. Yet, biologists (n = 74) identified over 11 million acres (27%) that have relatively high long-term potential for bobwhite conservation, principally through restoration/recovery of native savannas (Table 13). Primary conservation opportunities identified by biologists were brush management (41%) and prescribed fire (34%) to help restore habitats. Other opportunities included conversion of pasture grasses to native warm season grasses and field borders. Implementation of the NBCI would result in adding 69,298 coveys to the high opportunity landscapes in the BCR, approximately adding 1 bobwhite per 13 acres(Table 14). Biologists' identified 12 constraints to implementing conservation practices, including grazing pressures, and inappropriate vegetation types, economics and difficulty using prescribed fire. Key to long-term bobwhite population growth is the establishment of grass-forb-shrub communities with the appropriate structure for bobwhites to thrive.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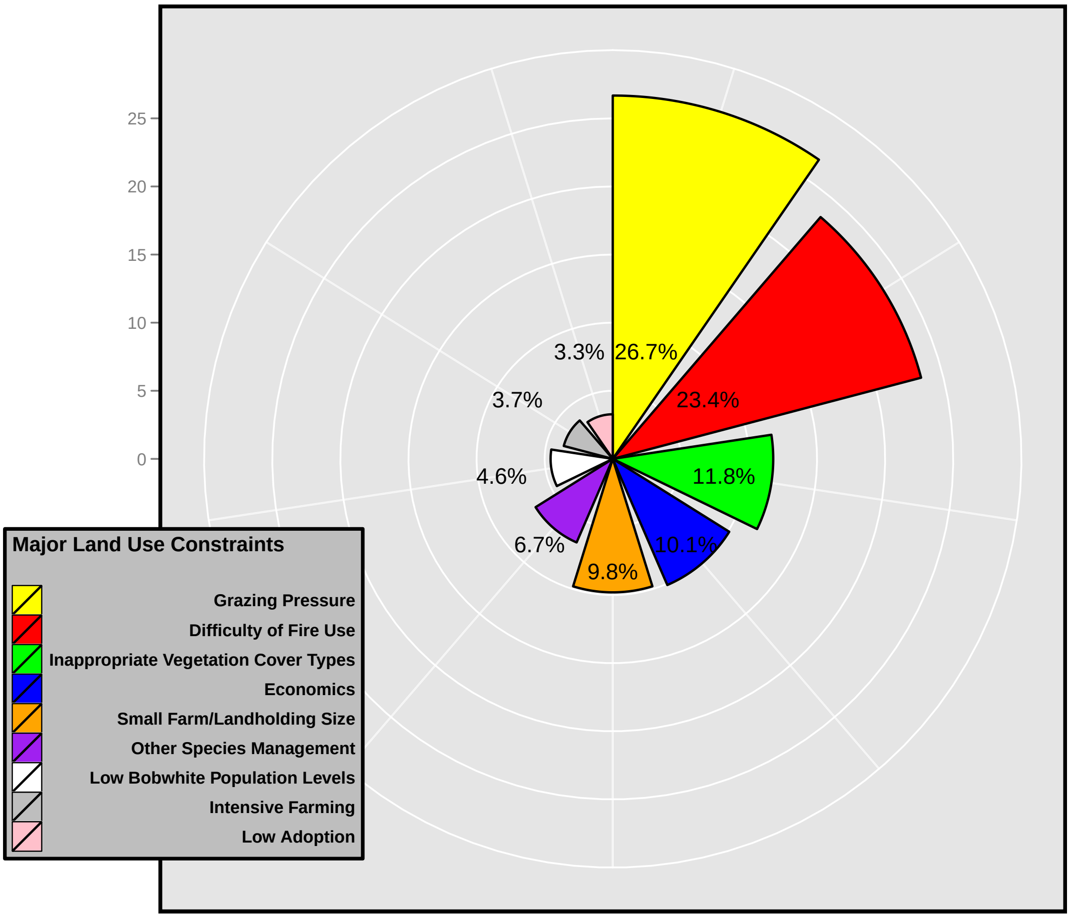
Major Land Use Opportunities
Brush Management
Prescribed Burning
Existing Bobwhite Populations
Soil Disturbance
Conversion of Pastures to NWSG
Field Borders / Farm Field Mgmt
Grassland, Prairie, or Glade Restoration
Forest Management / Woodland Savanna
Existing Conservation Areas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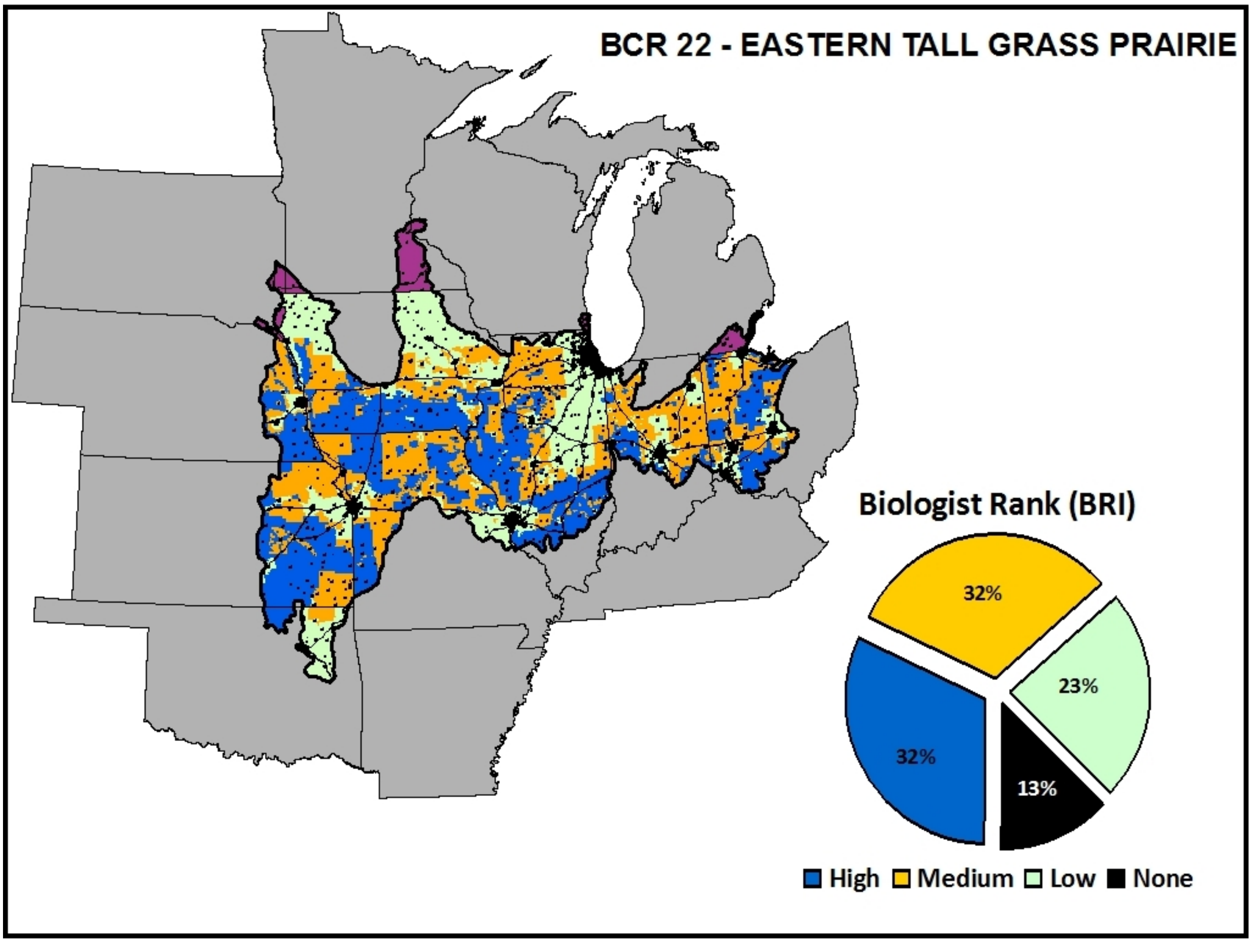
Major Land Use Constraints
Grazing Pressure
Difficulty of Fire Use
Inappropriate Vegetation Cover Types
Economics
Small Farm/Landholding Size
Other Species Management
Low Bobwhite Population Levels
Intensive Farming
Low Adoption

Table 13: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Oaks and Prairies (BCR 21) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Kansas	High	23,315.7	3,611.7	15,246.9	17,143.8	165.7	0.0
	Medium	0.0	0.0	0.0	0.0	0.0	0.0
	Low	0.0	0.0	0.0	0.0	0.0	0.0
Oklahoma	High	912,342.6	83,289.5	93,843.9	514,195.2	502.9	0.8
	Medium	2,958,947.1	94,813.4	622,086.1	2,114,275.3	32,418.9	566.5
	Low	792,484.6	33,180.7	256,740.4	636,501.2	3,279.5	785.0
Texas	High	6,455,588.6	629,250.3	1,125,556.3	875,250.2	374,778.9	6,924.7
	Medium	5,028,759.5	570,783.9	3,246,265.0	1,453,956.8	783,823.3	61,704.0
	Low	3,559,051.7	1,263,617.3	4,110,159.4	1,791,046.5	300,955.2	271,974.6
Total	High	7,391,246.9	716,151.4	1,234,647.2	1,406,589.1	375,447.5	6,925.5
	Medium	7,987,706.6	665,597.3	3,868,351.1	3,568,232.2	816,242.2	62,270.5
	Low	4,351,536.2	1,296,798.0	4,366,899.7	2,427,547.7	304,234.7	272,759.6

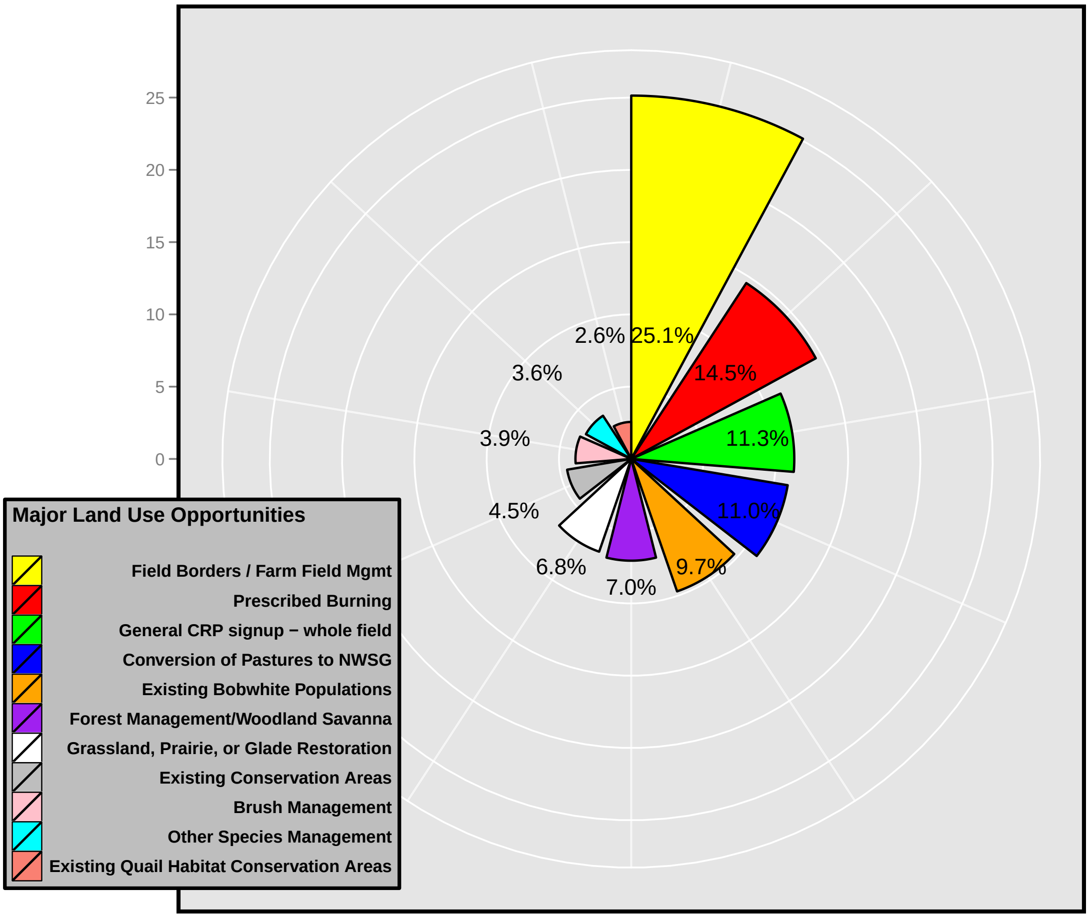
Table 14: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the Oaks and Prairies (BCR 21) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Kansas	High	10	3	10	3	80	30	0	0	60	10	0	0	646
	Medium	0	0	0	0	0	0	0	0	0	0	0	0	0
Oklahoma	High	21	15	5	4	16	5	0	0	30	25	0	0	6,936
	Medium	24	15	11	5	27	5	50	20	41	35	40	15	49,700
Texas	High	28	13	17	6	77	46	0	0	38	16	0	0	61,716
	Medium	43	16	35	9	83	46	0	0	52	24	100	36	41,289
Total														160,287



BCR 22: Eastern Tall Grass Prairie

The Eastern Tall Grass Prairie Bird Conservation Region comprises 127.4 million acres of land in 8 mid-western states. Participants (n=211) attending 8 state workshops in the Eastern Tall Grass Prairie identified 40.6 million acres of landscapes with high potential for long-term bobwhite conservation. This refined estimate of improvable acreage was significantly less than the 93.9 million acres identified in the 2002 NBCI. Landscapes with high potential for bobwhite conservation were primarily agriculture and range mixed with pasture and hardwood forests (Table 15). The primary spatially-explicit opportunities in this BCR were identified as field borders and other field management systems, prescribed burning to restore prairies, glades and woodland savannas, whole field CRP, and the presence of existing bobwhite populations (Figure 3.3.1). Full implementation of NBCI on landscapes with high potential would add 340,153 coveys, or approximately 1 bobwhite per 10 acres across this landscape (Table 16). Primary constraints to success included intensive farming, economics of installing conservation practices, presence of sod-forming grasses and grazing pressures. Indiana and portions of Illinois, similar to parts of Ohio suffer from periodic harsh winter-weather and potentially prolonged snow events resulting from their proximity to the Great Lakes. Additionally, Bush Honeysuckle and other non-native exotics present management problems in this area. Many portions of Missouri have dense sod-forming grass issues, such as fescue, making it a priority to control these undesirable grasses prior to planting native warm season grasses and implementing field borders.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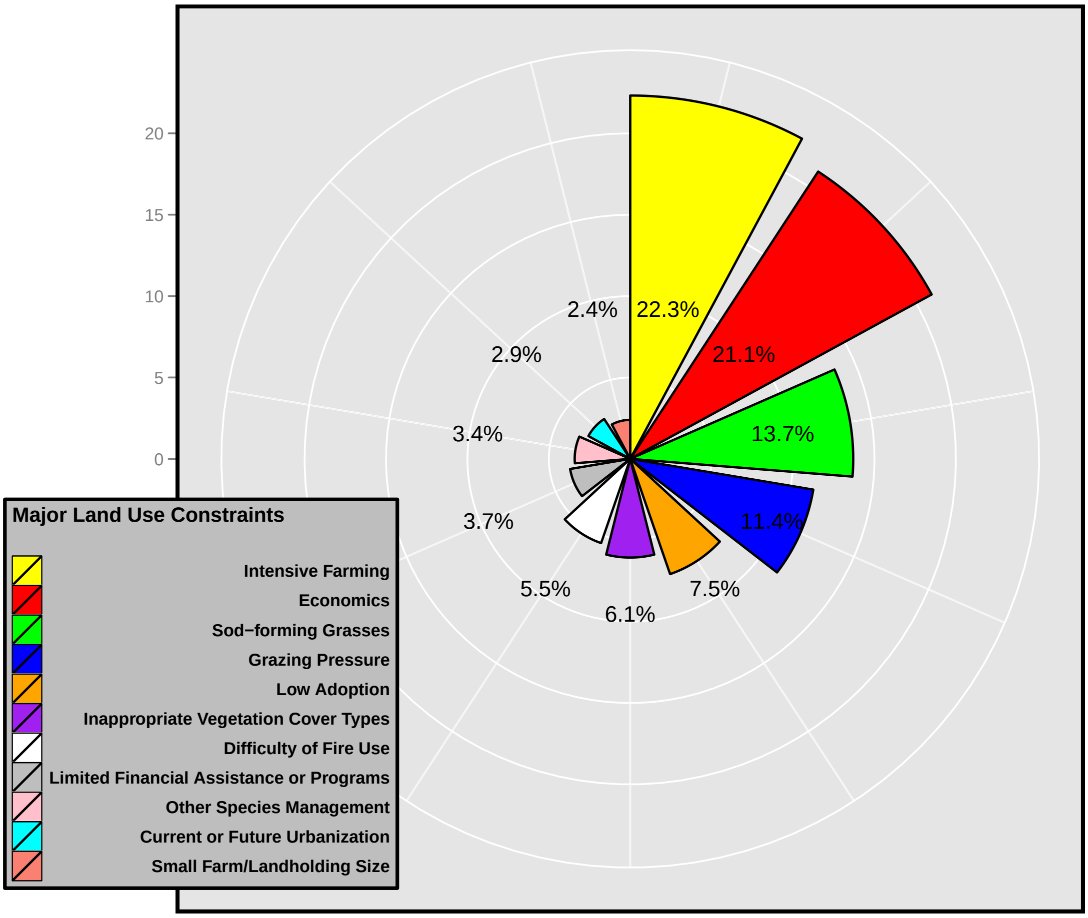
Major Land Use Opportunities
Field Borders / Farm Field Mgmt
Prescribed Burning
General CRP signup − whole field
Conversion of Pastures to NWSG
Existing Bobwhite Populations
Forest Management/Woodland Savanna
Grassland, Prairie, or Glade Restoration
Existing Conservation Areas
Brush Management
Other Species Management
Existing Quail Habitat Conservation Areas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Major Land Use Constraints
Intensive Farming
Economics
Sod−forming Grasses
Grazing Pressure
Low Adoption
Inappropriate Vegetation Cover Types
Difficulty of Fire Use
Limited Financial Assistance or Programs
Other Species Management
Current or Future Urbanization
Small Farm/Landholding Size

Table 15: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Eastern Tall Grass Prairie Bird Conservation Region (BCR 22) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Illinois	High	60,593.8	5,194,872.7	1,756,678.9	2,688,861.0	1,813.3	1,374.8
	Medium	13,316.4	6,277,447.9	764,800.5	878,117.4	354.9	644.8
	Low	84,029.7	5,753,949.0	647,780.2	634,076.5	148.0	1,684.7
Indiana	High	16,139.3	1,011,110.3	183,555.1	388,225.3	304.6	163.5
	Medium	85,647.7	4,020,123.5	427,803.8	630,848.9	1,015.2	771.1
	Low	63,503.4	1,521,348.7	255,441.6	300,279.4	295.3	395.2
Iowa	High	229,521.4	2,950,501.9	2,943,445.5	1,222,218.7	1,636.7	3,863.8
	Medium	260,680.9	3,901,529.4	1,136,100.0	494,588.9	429.3	727.7
	Low	546,465.4	8,492,306.6	990,233.3	448,173.5	469.6	7,887.2
Kansas	High	3,611,116.1	1,367,598.3	1,784,538.3	603,862.6	2,574.9	22,671.9
	Medium	1,629,509.7	1,679,512.3	1,670,066.1	557,085.6	3,430.4	9,909.5
	Low	331,537.8	375,532.6	713,647.1	277,803.9	1,199.2	7,239.6
Missouri	High	12,309.1	1,804,573.7	3,709,447.8	1,392,585.4	1,031.5	870.3
	Medium	48,685.6	2,466,840.2	3,896,445.2	1,908,597.7	2,860.3	3,341.5
	Low	5,350.9	315,648.4	876,001.1	1,128,143.0	17,661.3	3,094.3
Nebraska	High	774,797.0	1,616,385.2	103,532.0	245,676.0	172.8	284.4
	Medium	366,078.1	1,171,802.1	9,332.4	82,674.9	51.9	89.1
	Low	117,965.7	251,509.6	6,409.4	28,737.2	48.0	23.3
Ohio	High	49,391.4	2,706,794.2	712,542.8	739,071.5	3,876.2	3,544.5
	Medium	65,650.0	3,328,285.1	503,649.3	465,210.0	2,388.3	1,119.0
	Low	17,507.1	762,385.0	343,744.8	374,973.4	3,158.6	323.2

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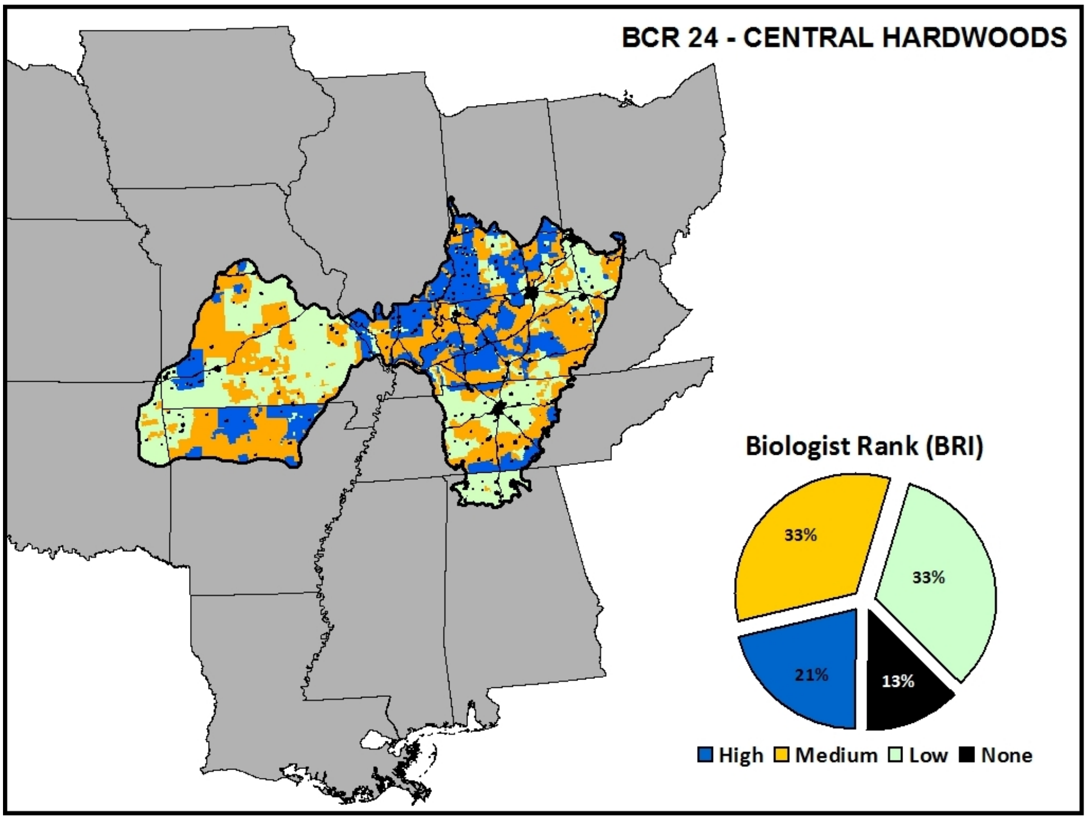
Table 15 – Cont'd

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Oklahoma	High	550,550.7	9,723.7	24,631.7	91,359.5	25.6	20.9
	Medium	125,781.5	7,919.7	274,750.3	81,862.8	41.9	3.1
	Low	331,418.1	92,816.4	1,174,811.2	506,449.1	409.9	36.4
Total	High	5,304,418.8	16,661,560.0	11,218,372.1	7,371,860.0	11,435.5	32,794.1
	Medium	2,595,350.0	22,853,460.3	8,682,947.6	5,098,986.4	10,572.3	16,605.8
	Low	1,497,778.1	17,565,496.4	5,008,068.6	3,698,635.9	23,389.9	20,683.9

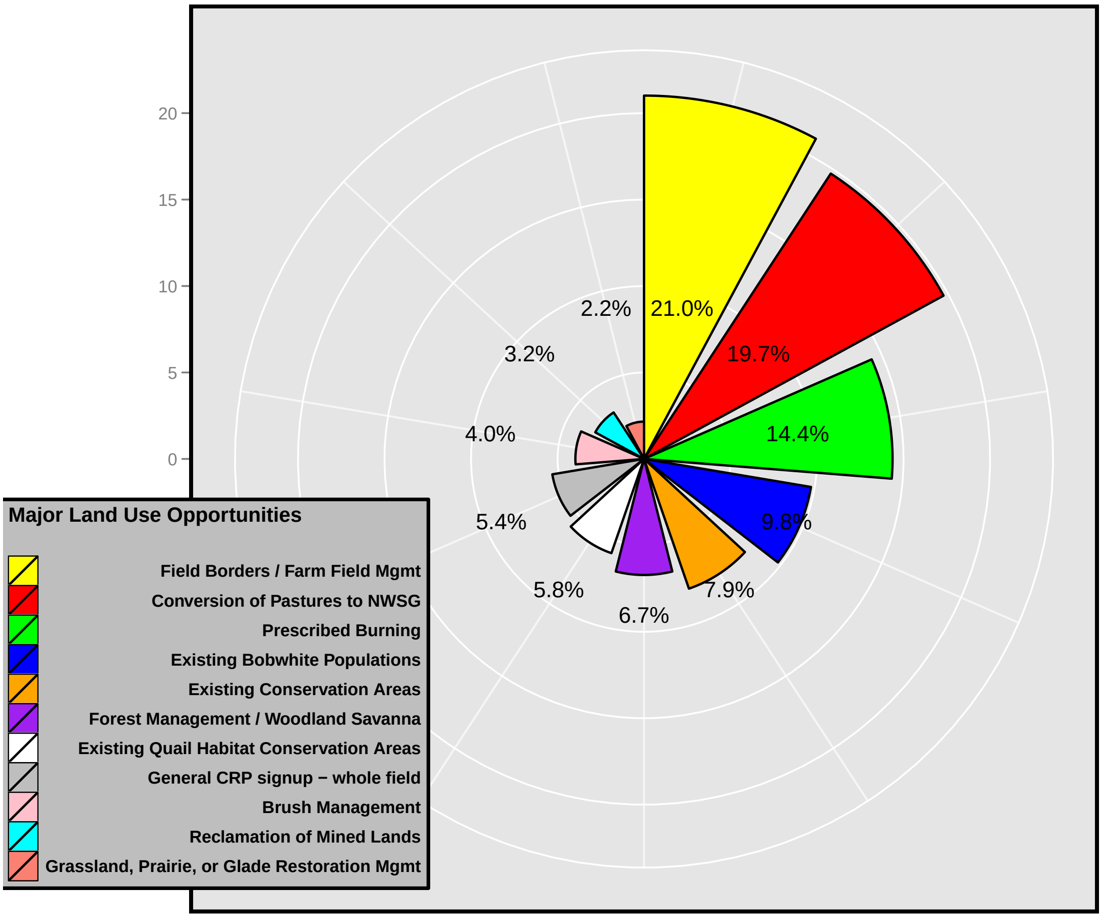
Table 16: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the Eastern Tall Grass Prairie Bird Conservation Region (BCR 22) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Illinois	High	25	14	29	16	49	29	0	0	100	50	0	0	17,645
	Medium	63	18	57	22	99	37	0	0	100	50	0	0	22,341
Indiana	High	15	5	11	10	33	17	0	0	17	8	0	0	14,370
	Medium	23	6	25	19	44	21	0	0	25	9	0	0	46,163
Iowa	High	23	5	17	3	21	5	0	0	41	5	0	0	103,467
	Medium	56	11	27	4	43	7	0	0	68	8	0	0	45,087
Kansas	High	7	2	10	2	80	30	0	0	58	10	0	0	122,474
	Medium	13	2	13	2	80	30	0	0	60	10	0	0	115,989
Missouri	High	3	2	3	2	16	4	0	0	16	10	0	0	61,740
	Medium	13	2	13	2	67	4	0	0	67	10	0	0	154,021
Nebraska	High	8	4	5	2	0	0	0	0	6	2	0	0	15,697
	Medium	11	5	8	4	0	0	0	0	10	5	0	0	13,282
Ohio	High	66	50	0	0	83	50	0	0	66	50	0	0	1,594
	Medium	100	50	100	50	100	50	0	0	100	50	0	0	3,629
Oklahoma	High	25	10	5	4	15	5	0	0	30	25	0	0	3,166
	Medium	30	10	15	10	16	5	0	0	50	35	40	15	1,228
Total														741,893



BCR 24: Central Hardwoods

The Central Hardwoods Bird Conservation region comprises 74.8 million acres of land in 8 central and mid-south states. Participants in the 8 state workshops (n=221) designated 21% of the BCR as having high potential for bobwhite and grassland conservation, or approximately 15 million acres (Table 17). The original NBCI identified 34 million improvable acres. Land use and land cover within the areas given a high BRI rank included pasture (3.9 million acres), agriculture (3.3 million acres), hardwood forests (7.5 million acres), and upland pine, range, and mixed forests (Table 17). Spatially-explicit land management opportunities for the BCR were, in order of prevalence, field management in row crops, such as CP 33, conversion of pasture/hay and range to warm season grass-forb systems, prescribed burning and forest management in both shortleaf pine and oak fire-maintained systems (Figure 3.3.1). Existing bobwhite populations were also a significant opportunity on a large portion of the landscape. Full implementation of management opportunities on landscapes with high potential would add 140,659 coveys or about 1 bobwhite per 9 acres across the landscape (Table 18). Opportunities were offset by primary constraints to habitat implementation success including sod-forming grasses which are poor habitat for bobwhites, low adoption of conservation practices, economic trade-offs, which are related to intensive grazing and farming practices. Small land-holding size was also a relatively important constraint for these highly-ranked regions in the BCR. Within the BCR, restoration of mined lands likely overlap with restoration of pasture landscapes and presents an interesting opportunity to reclaim land for conservation. Biologists in this region, especially in Kentucky, suggested that large land-holdings of rangeland or pastureland was indicative of a deep equestrian community and thus presented low potential for habitat restoration.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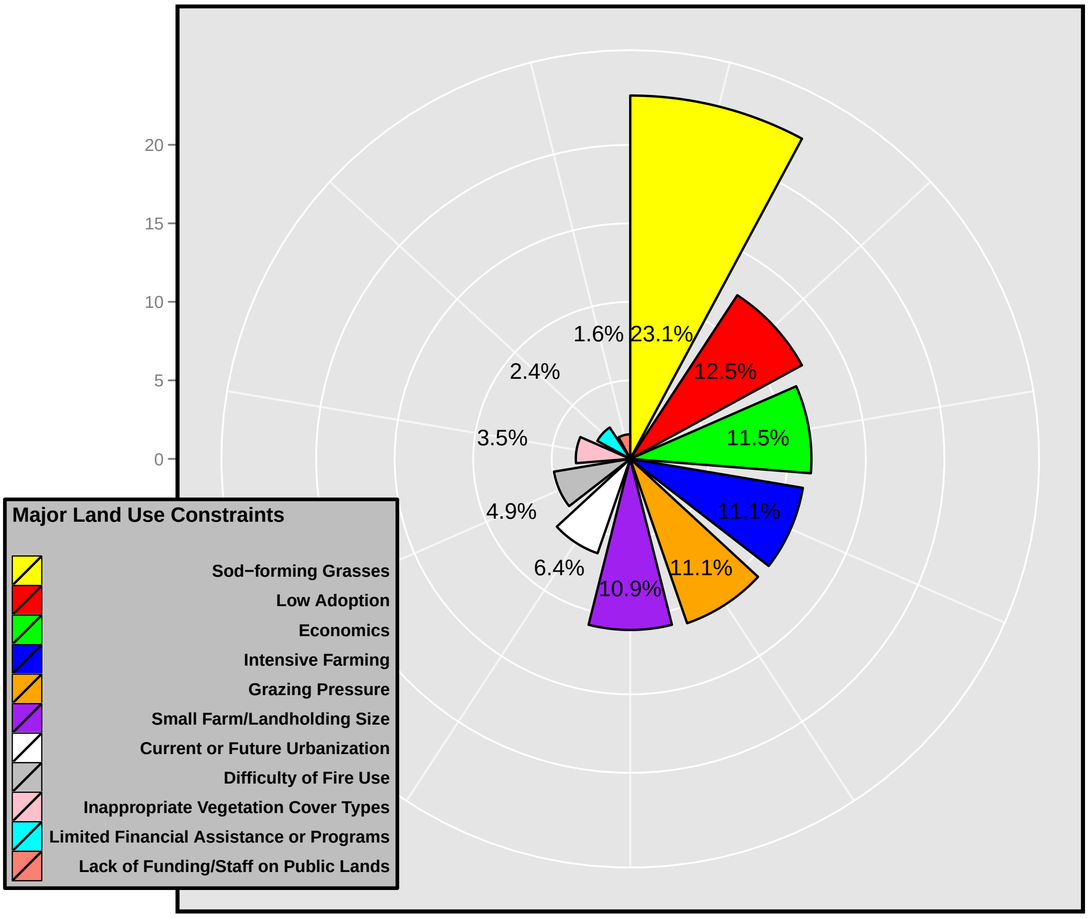
Major Land Use Opportunities
Field Borders / Farm Field Mgmt
Conversion of Pastures to NWSG
Prescribed Burning
Existing Bobwhite Populations
Existing Conservation Areas
Forest Management / Woodland Savanna
Existing Quail Habitat Conservation Areas
General CRP signup − whole field
Brush Management
Reclamation of Mined Lands
Grassland, Prairie, or Glade Restoration Mgmt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Major Land Use Constraints
Sod−forming Grasses
Low Adoption
Economics
Intensive Farming
Grazing Pressure
Small Farm/Landholding Size
Current or Future Urbanization
Difficulty of Fire Use
Inappropriate Vegetation Cover Types
Limited Financial Assistance or Programs
Lack of Funding/Staff on Public Lands

Table 17: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Central Hardwoods Bird Conservation Region (BCR 24) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Alabama	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	792.0	8,465.3	2,106.2	4,045.9	649.4	171.3
	Low	126,453.4	277,843.1	449,772.0	549,440.2	65,658.4	22,508.4
Arkansas	High	10,776.9	2,311.6	682,195.3	1,625,443.3	132,403.3	87,726.7
	Medium	17,767.5	14,560.8	882,142.3	2,823,830.7	278,683.9	98,887.1
	Low	2,026.4	3,253.9	427,891.3	450,293.5	11,537.8	5,869.3
Illinois	High	11,121.0	998,795.3	568,324.3	652,321.3	4,399.3	968.7
	Medium	7,797.3	420,481.5	305,435.7	749,708.8	24,954.1	311.5
	Low	2,364.3	64,823.0	61,428.9	86,357.4	272.0	10.1
Indiana	High	57,718.7	1,609,488.5	842,047.9	1,834,740.6	28,292.5	621.5
	Medium	41,717.2	446,642.1	371,390.1	1,292,261.5	19,153.8	193.0
	Low	24,011.0	170,654.2	225,284.7	855,294.4	12,342.2	81.4
Kansas	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	241.5	1,626.6	2,443.2	2,490.8	12.0	4.2
	Low	974.1	544.6	8,087.6	6,903.8	32.0	13.1
Kentucky	High	87,321.4	444,724.2	655,413.2	2,400,549.5	64,814.6	2,392.2
	Medium	148,042.9	1,225,643.8	1,207,871.8	3,879,017.1	100,412.3	16,426.9
	Low	108,220.4	288,042.6	1,046,679.3	2,668,541.7	84,296.9	7,879.5
Missouri	High	753.3	127,023.0	1,049,284.6	433,005.0	3,467.8	409.2
	Medium	16,645.6	183,590.0	2,952,727.5	3,698,185.8	129,895.7	22,990.5
	Low	24,044.6	88,399.3	2,853,840.5	7,769,112.5	321,484.5	81,927.3

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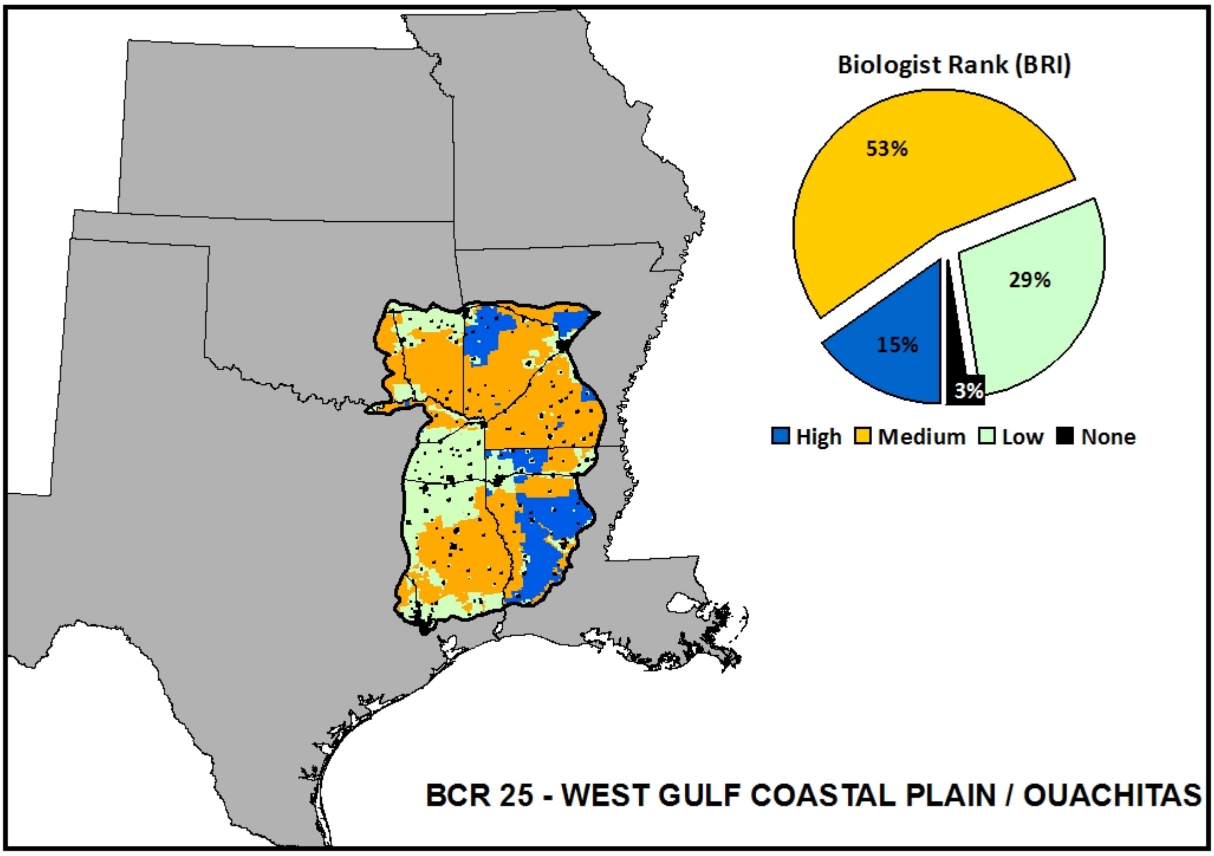
Table 17 – Cont'd

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Ohio	High	1,167.0	5,133.1	40,891.9	67,555.4	3,701.0	198.4
	Medium	1,329.8	3,399.6	35,086.2	93,887.3	5,118.4	254.2
	Low	668.0	4,791.3	15,070.7	47,156.4	471.2	42.6
Oklahoma	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	3,569.3	236.4	99,037.4	125,659.9	2,753.3	25.6
	Low	30,684.6	1,997.8	613,016.4	843,050.6	8,985.2	717.6
Tennessee	High	26,644.2	143,473.0	119,399.3	481,051.0	23,777.7	6,442.7
	Medium	91,160.4	168,369.0	440,459.0	2,060,375.5	92,144.5	22,678.2
	Low	148,692.2	179,217.2	504,419.6	3,392,915.2	176,430.5	35,530.3
Total	High	195,502.5	3,330,948.7	3,957,556.4	7,494,666.0	260,856.2	98,759.3
	Medium	329,063.5	2,473,015.0	6,298,699.5	14,729,463.4	653,777.3	161,942.5
	Low	468,139.1	1,079,567.1	6,205,490.9	16,669,065.6	681,510.8	154,579.5

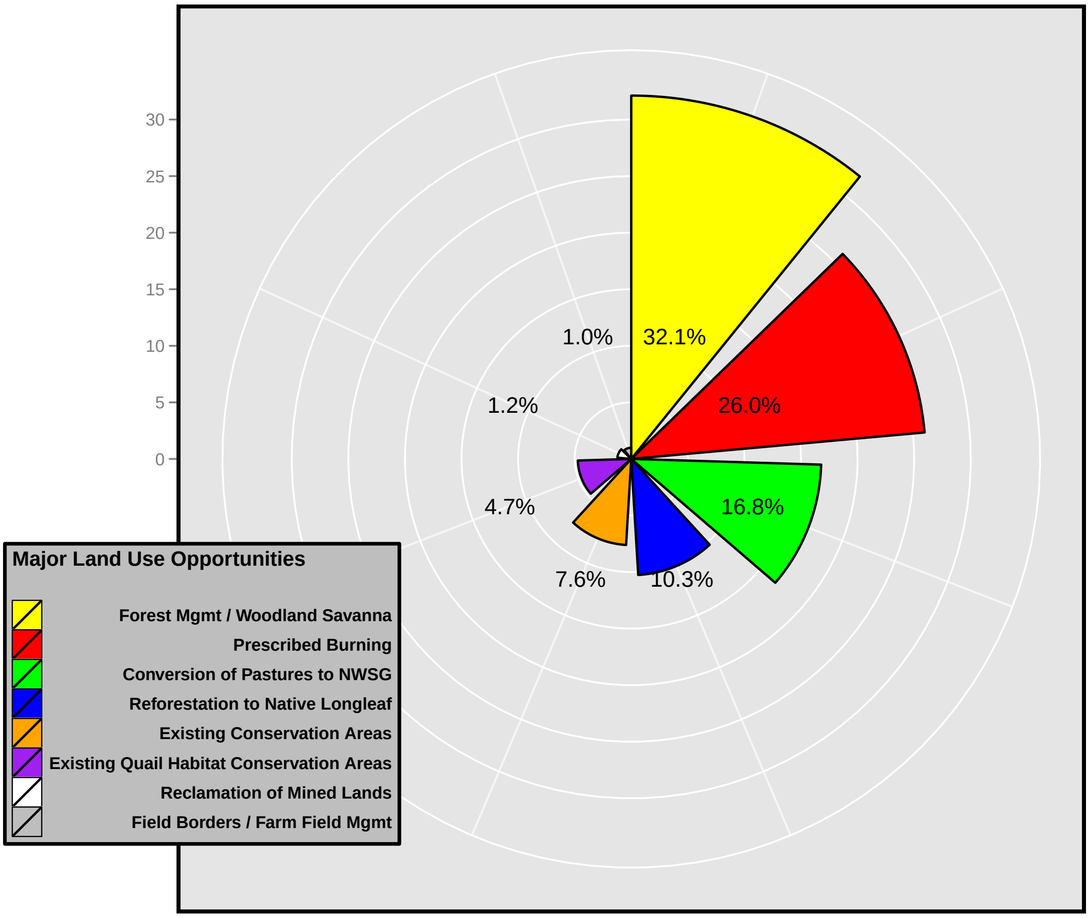
Table 18: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the Central Hardwoods Bird Conservation Region (BCR 24) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Alabama	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	40	10	38	8	0	0	60	15	45	10	30	10	77
Arkansas	High	10	3	11	2	40	8	33	9	11	2	22	7	37,323
	Medium	10	3	13	3	46	10	37	9	15	3	27	9	38,862
Illinois	High	22	12	29	16	48	26	0	0	99	50	0	0	4,749
	Medium	59	15	57	22	99	46	0	0	100	50	0	0	2,751
Indiana	High	5	2	11	10	23	13	0	0	17	8	0	0	49,959
	Medium	10	3	25	19	36	14	0	0	24	8	0	0	16,372
Kansas	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	15	3	15	3	80	30	0	0	60	10	0	0	63
Kentucky	High	5	2	4	1	100	25	0	0	21	7	0	0	26,252
	Medium	11	2	12	2	100	25	0	0	42	7	0	0	66,177
Missouri	High	3	2	3	2	16	4	0	0	16	10	0	0	12,041
	Medium	13	2	13	2	67	4	0	0	67	10	0	0	100,418
Ohio	High	0	0	0	0	80	50	0	0	65	50	0	0	45
	Medium	100	50	100	50	100	50	0	0	100	50	0	0	111
Oklahoma	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	30	10	15	5	40	10	0	0	50	35	40	15	905
Tennessee	High	60	40	82	16	100	4	100	4	56	20	0	0	10,290
	Medium	75	40	85	16	100	4	100	4	56	20	0	0	43,391
Total														409,786



BCR 25: West Gulf Coastal Plain / Ouachitas

The West Gulf Coastal Plain Bird Conservation Region (BCR 25) stretches across Arkansas, Louisiana, Oklahoma, and Texas. This BCR is comprised of two distinct regions, the Gulf Coastal Plain in the southern two-thirds and the Ouachita Mountains to the north. One-hundred and twenty-six biologists from 4 states identified 6.3 million acres of land, or 16% of this BCR, that had relatively high potential for bobwhite conservation (Table 19). This is substantially lower than the original NBCI estimate of over 40 million acres. Primary land use opportunities included restoring fire maintained pine and oak savanna habitats (32%), prescribed burning (26%), conversion of pastures to warm season grasses (17%), and existing conservation lands, notably the Ouachita National Forest, and existing bobwhite populations. Interestingly, use of field borders was not identified by biologists as a major land management opportunity. Full implementation of management opportunities would yield some 63,284 coveys on landscapes with high potential, or about 1 bobwhite per 8.3 acres (Table 20). Biologists identified 13 constraints to successful conservation on northern bobwhite and their habitats. The top 5 constraints were industrial/corporate ownership of forestlands, sod-forming grasses throughout much of the BCR, small farm and land ownership patterns, limited financial and incentive programs for landowners, and low bobwhite populations. Most of the remaining constraints were socio-economic, except for inappropriate vegetation cover types. There is a huge potential in BCR 25 but to achieve this potential both a massive effort and appropriate, carefully designed conservation policies are needed.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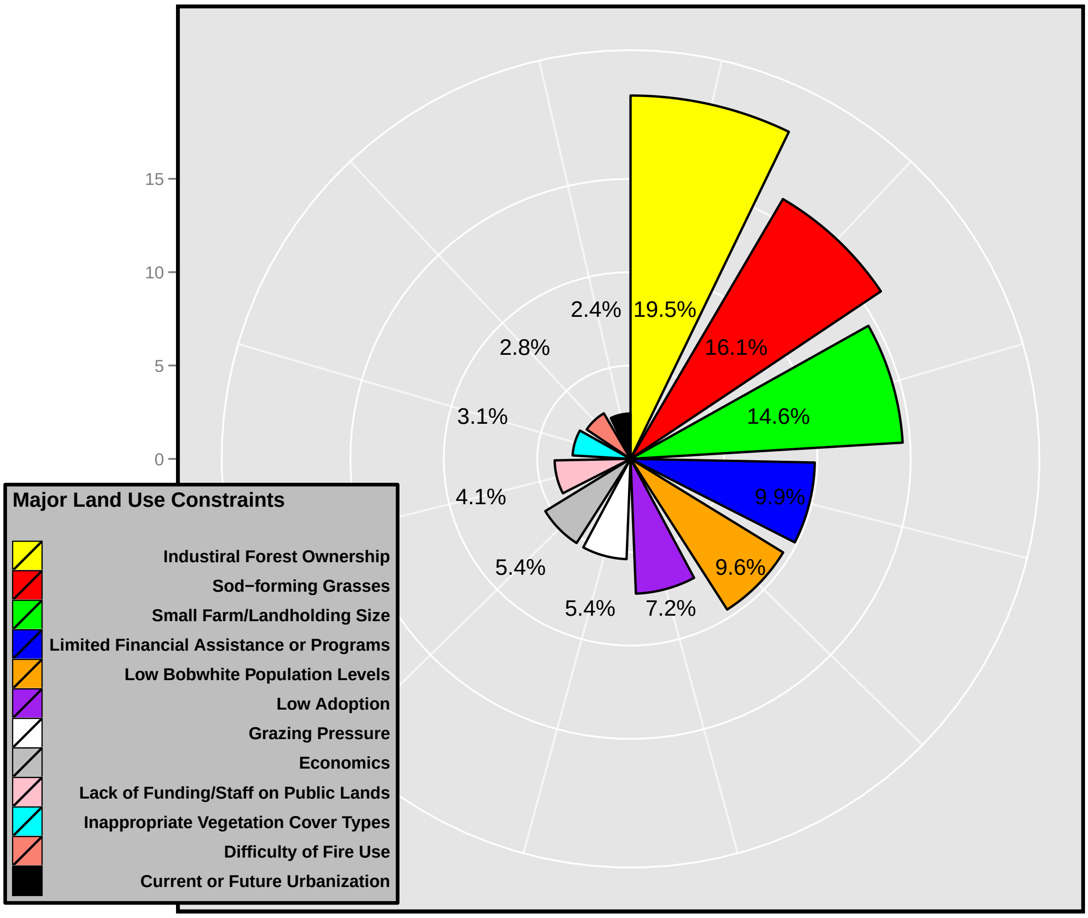
Major Land Use Opportunities
Forest Mgmt / Woodland Savanna
Prescribed Burning
Conversion of Pastures to NWSG
Reforestation to Native Longleaf
Existing Conservation Areas
Existing Quail Habitat Conservation Areas
Reclamation of Mined Lands
Field Borders / Farm Field Mgmt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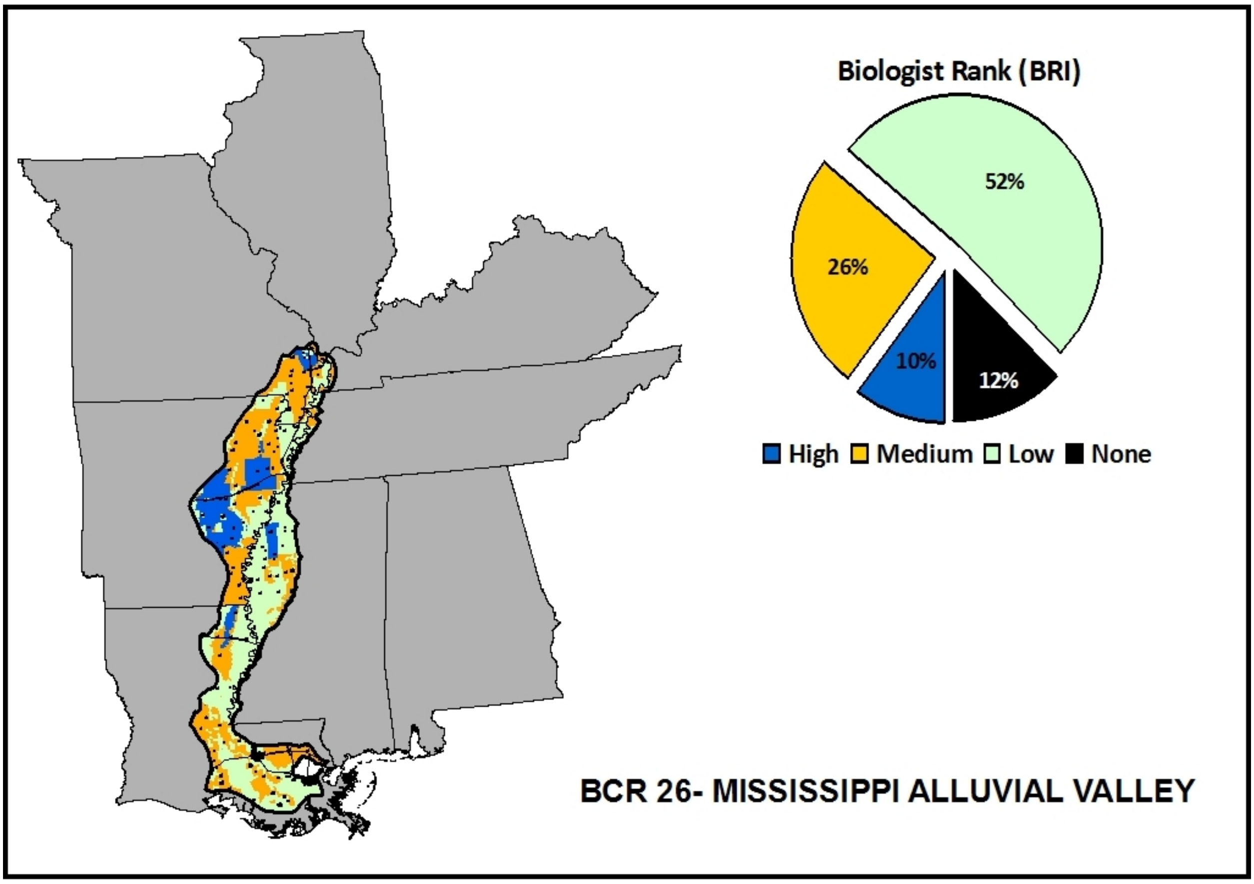
Major Land Use Constraints
Industiral Forest Ownership
Sod−forming Grasses
Small Farm/Landholding Size
Limited Financial Assistance or Programs
Low Bobwhite Population Levels
Low Adoption
Grazing Pressure
Economics
Lack of Funding/Staff on Public Lands
Inappropriate Vegetation Cover Types
Difficulty of Fire Use
Current or Future Urbanization

Table 19: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the West Gulf Coastal Plain / Ouachitas (BCR 25) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Arkansas	High	68,334.3	34,811.8	746,030.3	825,896.1	616,652.3	90,506.3
	Medium	857,562.0	157,595.3	1,639,733.8	2,184,288.8	4,779,572.4	314,753.5
	Low	54,382.5	14,584.1	241,087.7	355,523.6	257,561.0	24,229.5
Louisiana	High	967,933.3	38,258.0	306,430.0	48,077.0	2,502,053.5	98,062.6
	Medium	742,482.8	35,552.8	250,527.8	42,800.6	1,750,917.2	82,320.1
	Low	266,702.0	156,297.3	246,769.4	48,882.1	526,109.6	92,871.4
Oklahoma	High	3.9	0.0	0.0	36.4	0.0	0.0
	Medium	442,557.6	13,287.6	793,344.7	1,999,363.6	1,091,880.6	127,955.2
	Low	223,573.7	21,655.2	1,004,946.6	839,172.9	36,789.5	21,863.7
Texas	High	4,274.5	353.4	9,249.5	20,448.7	265.8	34.9
	Medium	1,035,601.8	28,304.1	1,149,071.3	322,959.8	2,537,650.3	209,193.4
	Low	879,818.4	31,722.3	2,402,474.3	1,227,357.9	1,469,510.3	622,864.1
Total	High	1,040,546.0	73,423.2	1,061,709.8	894,458.2	3,118,971.6	188,603.8
	Medium	3,078,204.2	234,739.7	3,832,677.7	4,549,412.8	10,160,020.5	734,222.3
	Low	1,424,476.7	224,258.8	3,895,278.1	2,470,936.5	2,289,970.4	761,828.8

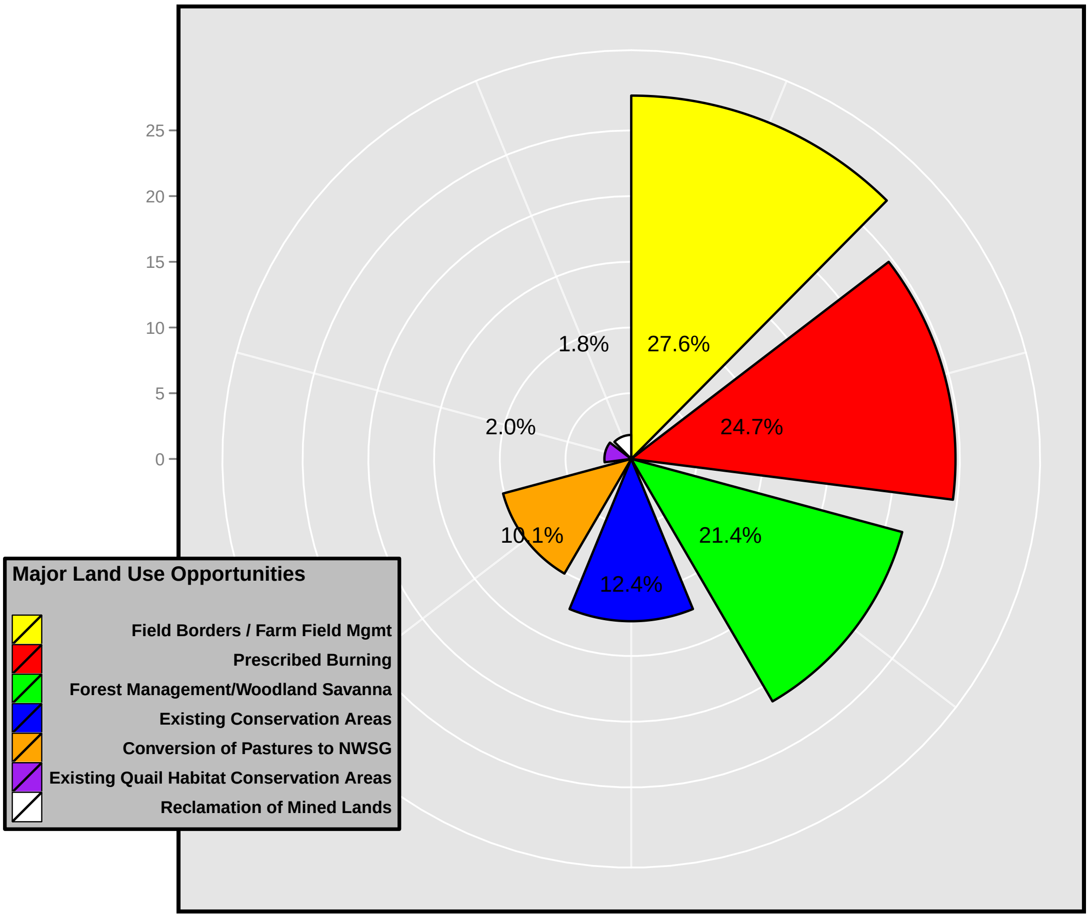
Table 20: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the West Gulf Coastal Plain / Ouachitas (BCR 25) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Arkansas	High	26	3	14	2	41	6	37	6	16	4	23	5	34,393
	Medium	26	4	20	3	53	8	44	7	16	4	36	8	112,133
Louisiana	High	15	4	15	5	61	40	30	5	53	10	31	10	28,855
	Medium	26	4	25	5	61	40	50	5	73	10	53	10	25,394
Oklahoma	High	0	0	9	5	20	5	0	0	0	0	0	0	0
	Medium	25	15	10	5	40	10	50	20	30	25	40	15	20,597
Texas	High	100	35	32	25	74	50	0	0	39	35	0	0	36
	Medium	0	0	32	25	82	50	0	0	39	35	100	25	7,608
Total														229,016



BCR 26: Mississippi Alluvial Valley

The Mississippi Alluvial Valley Bird Conservation Region comprises some 28 million acres of land in 6 southeastern states. Workshop participants (n=98) identified 10% of this BCR as having high potential for bobwhite conservation over the long-term, or approximately 2.72 million acres (Table 21). This is a significantly lower area than the 23 million acres identified for management in the original NBCI - this is primarily because most of the BCR was ranked as low or medium conservation value for bobwhites. Row crop agriculture was the predominate land use in this BCR with about 2.1 million of improvable acres (Table 21). Workshop participants identified 7 spatially-explicit opportunities for the high BRI ranked regions, including field borders/field management, prescribed burning applied to fallow and forested lands, forest management, and conversion of pastures and sod-forming grasses to warm season grasses and forb systems (Figure 3.3.1). The presence of existing conservation areas and extant bobwhite populations was identified as a conservation opportunity to be considered in planning habitat programs. Full implementation of management opportunities would add approximately 56,538 coveys, or about 1 bobwhite per 4 acres across the high potential landscapes within this BCR (Table 22). For this region of relatively intensive agriculture, spatially-explicit land use management constraints within the high potential conservation regions included economic trade-offs for landowners, intensive farming practices, presence of sod-forming grasses, and low adoption as well as impediments to prescribed fire use, and future urbanization.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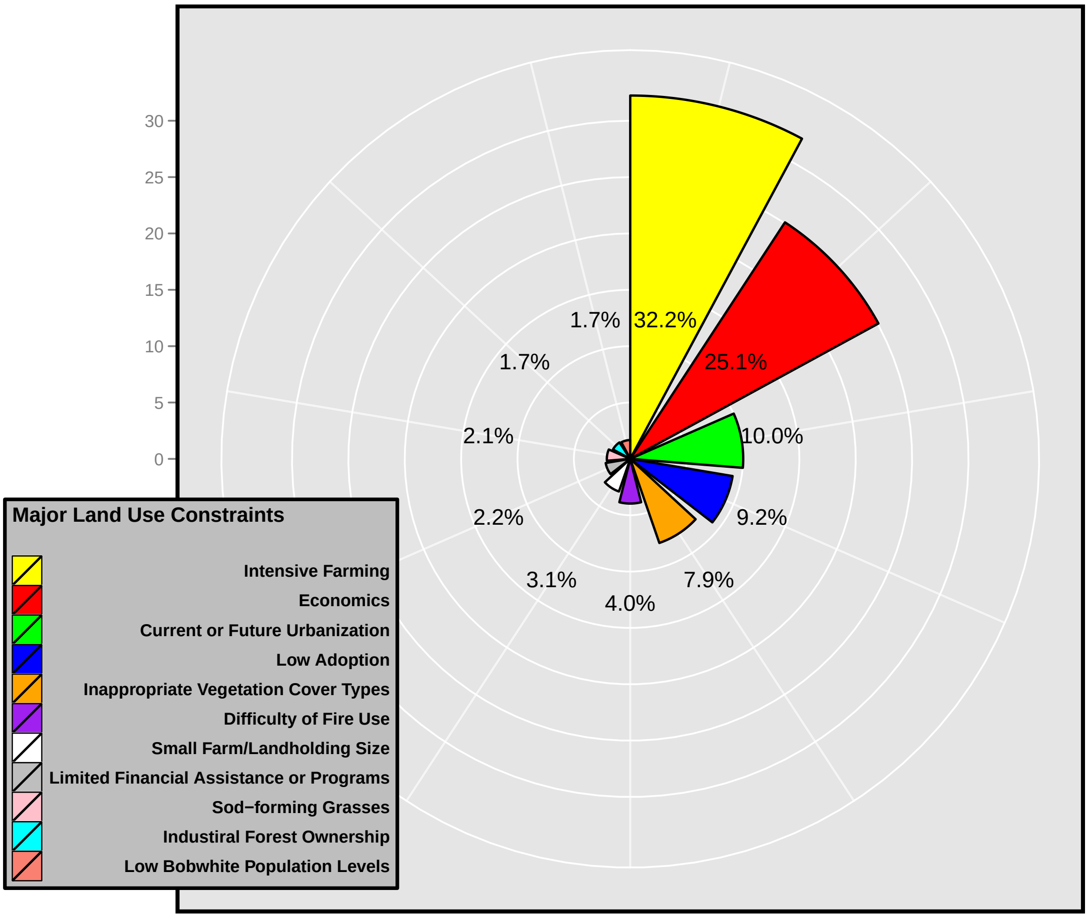
Major Land Use Opportunities
Field Borders / Farm Field Mgmt
Prescribed Burning
Forest Management/Woodland Savanna
Existing Conservation Areas
Conversion of Pastures to NWSG
Existing Quail Habitat Conservation Areas
Reclamation of Mined Lands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Major Land Use Constraints
Intensive Farming
Economics
Current or Future Urbanization
Low Adoption
Inappropriate Vegetation Cover Types
Difficulty of Fire Use
Small Farm/Landholding Size
Limited Financial Assistance or Programs
Sod−forming Grasses
Industiral Forest Ownership
Low Bobwhite Population Levels

Table 21: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Mississippi Alluvial Valley Bird Conservation Region (BCR 26) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Arkansas	High	71,843.1	1,621,191.3	158,764.6	139,031.2	35,155.2	22,386.8
	Medium	90,313.4	2,654,443.5	144,842.4	150,398.6	13,471.3	8,718.7
	Low	31,740.9	1,392,365.2	96,499.6	69,194.4	6,977.4	5,738.3
Illinois	High	0.0	756.3	38.0	199.9	0.0	0.0
	Medium	2,578.9	27,921.2	5,232.3	30,819.4	15.5	8.5
	Low	2.3	3,454.6	549.4	1,315.0	0.8	0.0
Kentucky	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	317.7	57,341.9	5,602.7	37,944.1	68.2	86.8
	Low	20.9	16,417.5	165.1	10,837.3	12.4	19.4
Louisiana	High	9,370.4	78,028.5	67,920.4	893.5	13,131.1	5,775.5
	Medium	152,906.3	898,596.3	616,928.2	6,489.2	120,158.0	15,071.5
	Low	62,958.0	1,146,840.4	390,267.3	7,185.9	31,167.5	22,470.5
Mississippi	High	2,313.2	248,419.2	22,041.9	1,046.9	24.8	38.0
	Medium	6,149.8	493,289.3	46,758.8	6,753.5	189.1	179.8
	Low	45,407.4	1,976,725.8	244,315.3	14,506.6	316.2	1,182.6
Missouri	High	713.7	177,568.8	19,079.4	15,041.2	714.5	110.0
	Medium	1,106.6	1,138,764.9	101,580.7	55,108.6	80.6	750.1
	Low	1,464.6	567,757.8	38,908.9	49,251.0	72.8	723.8
Tennessee	High	0.0	9,714.4	175.1	338.6	0.8	0.0
	Medium	93.8	114,179.4	1,274.0	2,818.4	0.8	1.6
	Low	1,092.6	137,418.6	1,800.2	4,018.0	65.9	20.2

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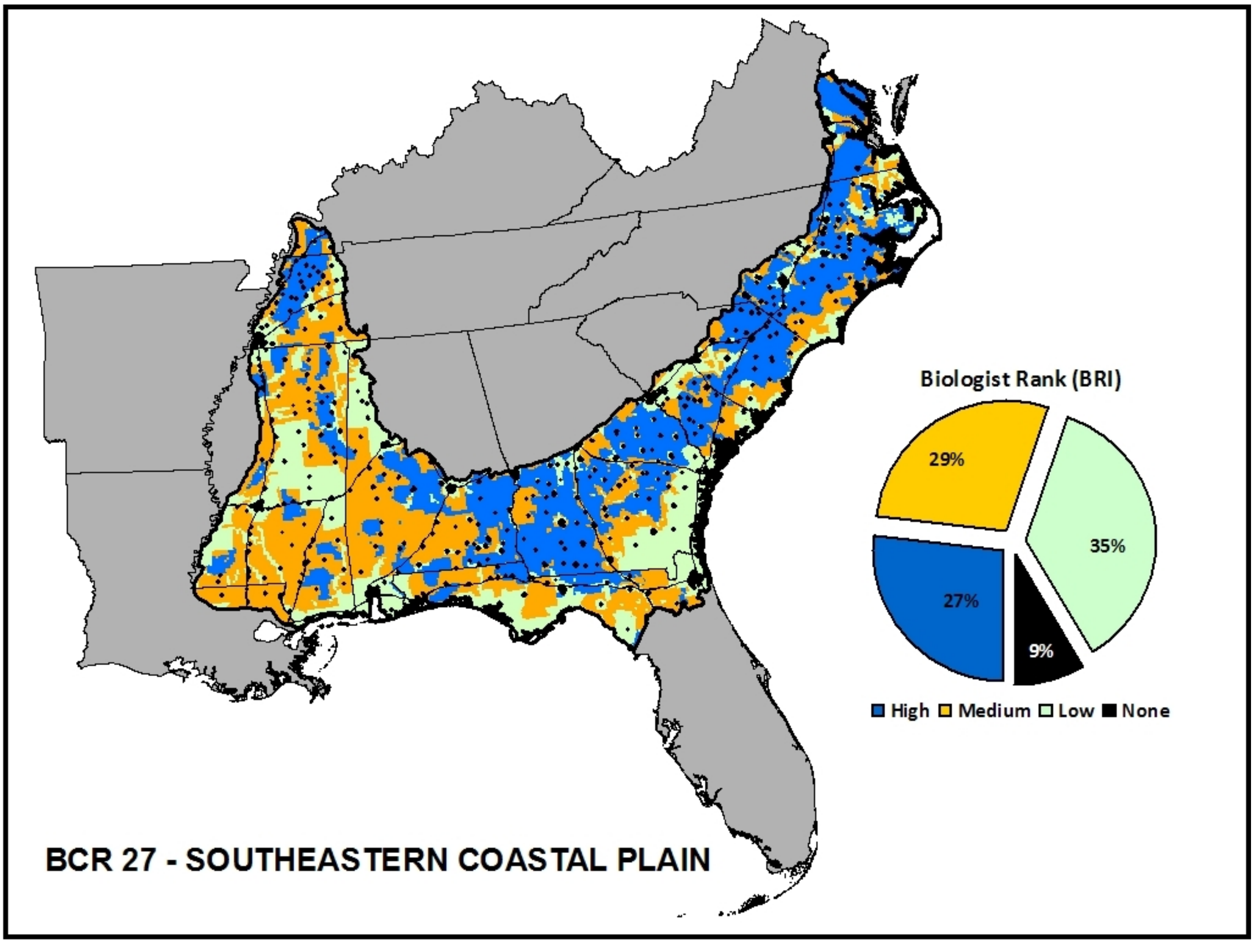
Table 21 – Cont'd

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Total	High	84,240.4	2,135,678.6	268,019.4	156,551.4	49,026.3	28,310.3
	Medium	253,466.5	5,384,536.6	922,219.1	290,331.8	133,983.4	24,817.0
	Low	142,686.8	5,240,979.8	772,505.7	156,308.2	38,613.0	30,154.7

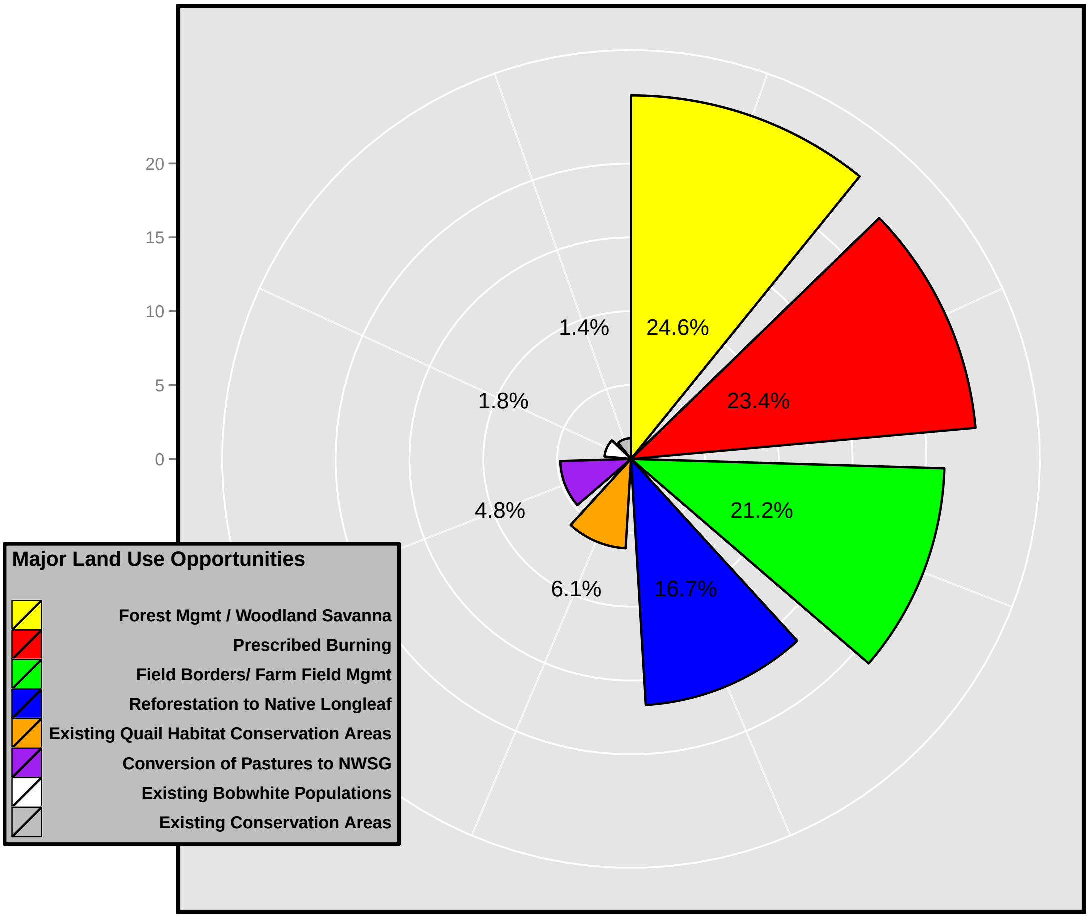
Table 22: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the Mississippi Alluvial Valley Bird Conservation Region (BCR 26) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Arkansas	High	31	3	25	2	67	37	50	16	26	4	55	10	46,690
	Medium	31	3	26	2	67	37	50	16	26	4	55	10	71,698
Illinois	High	40	20	0	0	80	50	0	0	90	50	0	0	2
	Medium	80	20	57	22	100	50	0	0	100	50	0	0	123
Kentucky	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	10	2	8	1	100	25	0	0	30	10	0	0	2,061
Louisiana	High	40	5	15	5	80	40	30	5	80	10	37	10	1,904
	Medium	54	5	25	5	94	40	50	5	80	10	37	10	21,493
Mississippi	High	27	3	37	3	0	0	40	3	35	3	35	2	4,845
	Medium	27	3	40	3	0	0	45	3	35	3	35	2	13,472
Missouri	High	3	2	3	2	16	4	0	0	16	10	0	0	3,080
	Medium	13	2	13	2	67	4	0	0	67	10	0	0	42,151
Tennessee	High	60	40	0	0	100	4	0	0	90	20	0	0	17
	Medium	60	40	85	16	100	4	100	4	90	20	0	0	140
Total														207,676



BCR 27: Southeastern Coastal Plain

The Southeastern Coastal Plain Bird Conservation Region comprises 122 million acres of land spanning across 10 southeastern states. Participants (n=218) in the 10 state workshops demarcated 26% of the BCR as high potential for long-term bobwhite and grassland bird conservation, or 32.2 million acres (Table 23). The original NBCI identified 64 million acres of improvable habitats, including row crop and forested lands. Most of the opportunities identified for development of habitat were in pine and mixed forests (11.7 million acres) and row crop (7 million acres). It is not surprising therefore that the most prevalent major land use opportunities for bobwhite conservation in the Southeast were related to forest management (forest and savanna management 25%, restoration of longleaf, 18%, and prescribed fire 24%) (Figure 3.3.1). Field borders and whole field management were considered a major opportunity for agricultural acreage (21%). These four opportunities comprised 88% of the opportunities in the Southeastern Coastal Plain, demonstrating the need for policy directed at forest management and prescribed fire in this BCR within the historic core of the bobwhite range. Full implementation of habitat opportunities would result in adding approximately 405,972, or about 1 bobwhite per 6.6 acres (Table 24). Primary constraints were economics, intensive farming, sod forming grasses, low adoption and difficulty of prescribed fire use (Figure 3.3.1); this varied by state, however.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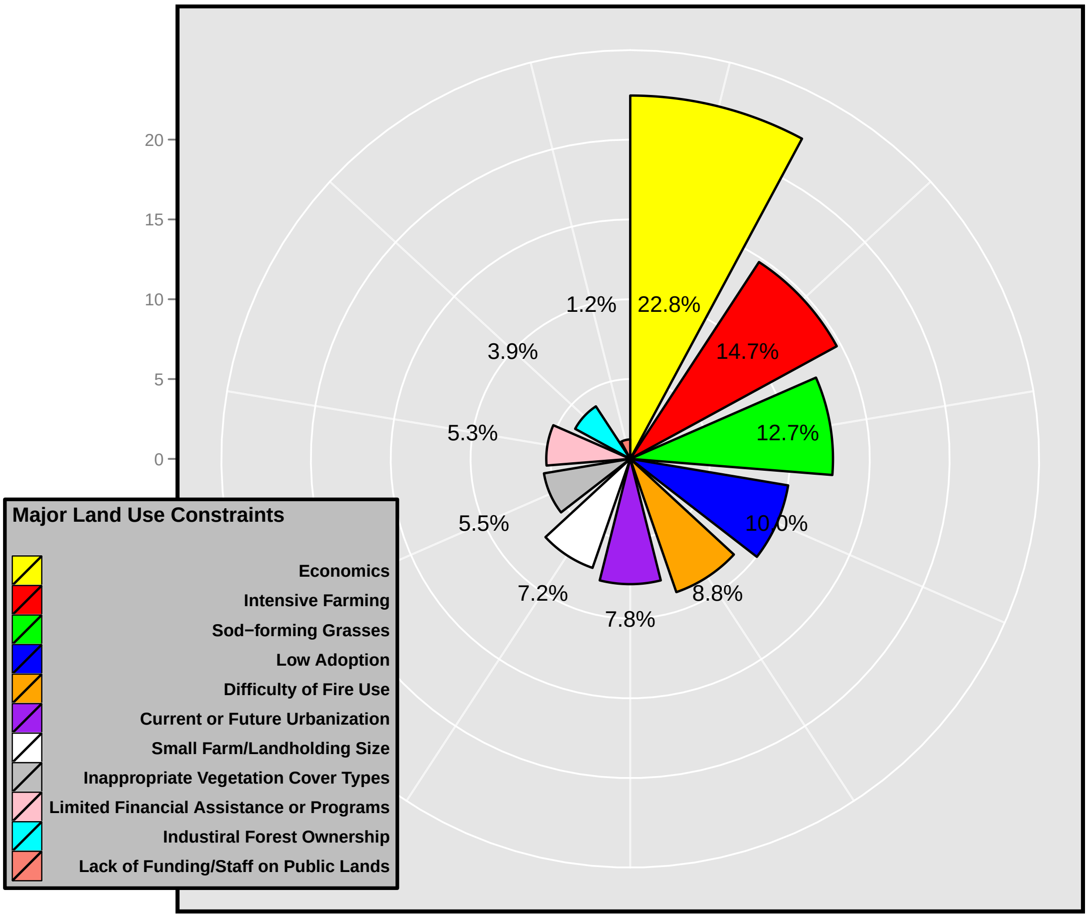
Major Land Use Opportunities
Forest Mgmt / Woodland Savanna
Prescribed Burning
Field Borders/ Farm Field Mgmt
Reforestation to Native Longleaf
Existing Quail Habitat Conservation Areas
Conversion of Pastures to NWSG
Existing Bobwhite Populations
Existing Conservation Areas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1.2%
Major Land Use Constraints
Economics
Intensive Farming
Sod−forming Grasses
Low Adoption
Difficulty of Fire Use
Current or Future Urbanization
Small Farm/Landholding Size
Inappropriate Vegetation Cover Types
Limited Financial Assistance or Programs
Industiral Forest Ownership
Lack of Funding/Staff on Public Lands

Table 23: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Southeastern Coastal Plain Bird Conservation Region (BCR 27) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Alabama	High	939,909.8	243,804.6	801,081.6	1,158,827.7	1,840,146.5	353,399.6
	Medium	1,306,430.4	127,740.7	987,205.6	1,808,702.5	3,106,974.3	767,460.1
	Low	564,018.9	137,572.8	397,887.9	1,097,095.8	961,267.4	178,833.6
Florida	High	285,381.6	199,514.2	122,927.7	42,018.6	871,548.1	59,301.2
	Medium	873,058.0	330,373.4	329,771.1	167,438.7	2,138,883.3	63,955.7
	Low	759,694.4	184,942.0	170,162.8	149,533.4	1,806,892.3	103,648.0
Georgia	High	1,903,859.4	1,805,619.9	558,384.5	1,494,397.8	3,381,000.8	253,282.0
	Medium	734,486.4	371,001.2	144,415.4	671,275.1	1,619,420.6	99,648.1
	Low	881,315.6	130,052.2	71,633.1	320,273.2	2,213,095.7	62,511.6
Kentucky	High	561.8	121,180.1	60,444.7	179,514.7	1,384.8	16.3
	Medium	296.0	236,517.2	50,458.3	155,239.5	1,010.5	320.0
	Low	57.3	20,617.6	5,709.6	26,839.4	225.5	135.6
Louisiana	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	262,361.6	3,358.5	297,495.1	62,221.7	401,082.8	20,822.2
	Low	11,358.8	742.4	29,853.9	1,349.1	13,947.1	206.9
Mississippi	High	421,494.4	266,893.4	852,094.7	387,727.9	812,627.1	218,060.9
	Medium	2,012,488.0	302,184.3	2,355,399.5	2,123,273.0	2,806,167.2	995,615.1
	Low	1,162,752.8	167,839.1	1,236,181.3	1,987,463.9	1,640,227.4	601,467.0
NorthCarolina	High	510,447.7	1,851,907.5	310,282.1	566,074.8	1,632,043.4	143,305.7
	Medium	251,610.4	645,255.5	117,891.3	249,141.5	851,970.7	46,276.9
	Low	167,598.7	583,889.4	120,862.4	248,765.7	566,792.3	35,996.8

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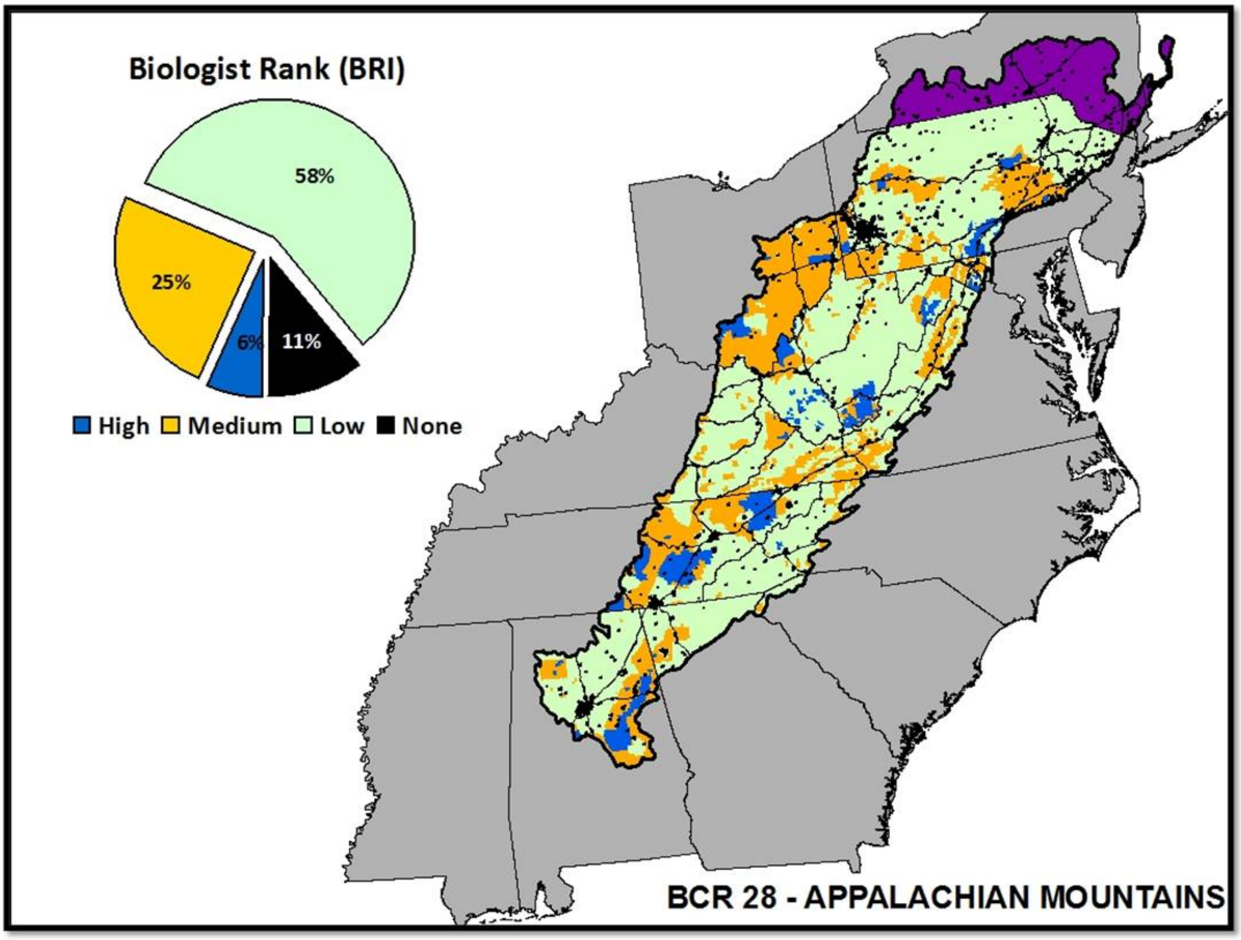
Table 23 – Cont'd

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
SouthCarolina	High	553,028.9	1,045,293.8	226,148.8	197,945.5	1,273,809.1	343,517.8
	Medium	276,565.2	220,367.1	108,652.7	174,988.4	998,410.9	135,564.2
	Low	251,845.2	225,706.3	73,850.1	203,072.4	749,035.4	113,836.9
Tennessee	High	60,129.4	945,097.8	247,697.8	418,446.5	16,892.6	3,672.4
	Medium	211,598.9	328,297.5	331,343.7	1,110,305.9	100,954.6	22,617.7
	Low	89,591.2	218,009.7	172,457.5	628,126.6	26,214.9	4,159.8
Virginia	High	1,208.1	555,201.0	67,676.4	1,051,421.1	621,995.4	4,800.7
	Medium	543.2	140,007.6	16,840.6	312,745.5	122,643.9	1,530.5
	Low	1,281.7	81,552.9	12,360.0	211,485.7	64,232.6	881.1
Total	High	4,676,021.1	7,034,512.2	3,246,738.2	5,496,374.5	10,451,447.8	1,379,356.4
	Medium	5,929,438.2	2,705,102.9	4,739,473.3	6,835,331.7	12,147,519.0	2,153,810.5
	Low	3,889,514.7	1,750,924.3	2,290,958.5	4,874,005.2	8,041,930.5	1,101,677.3

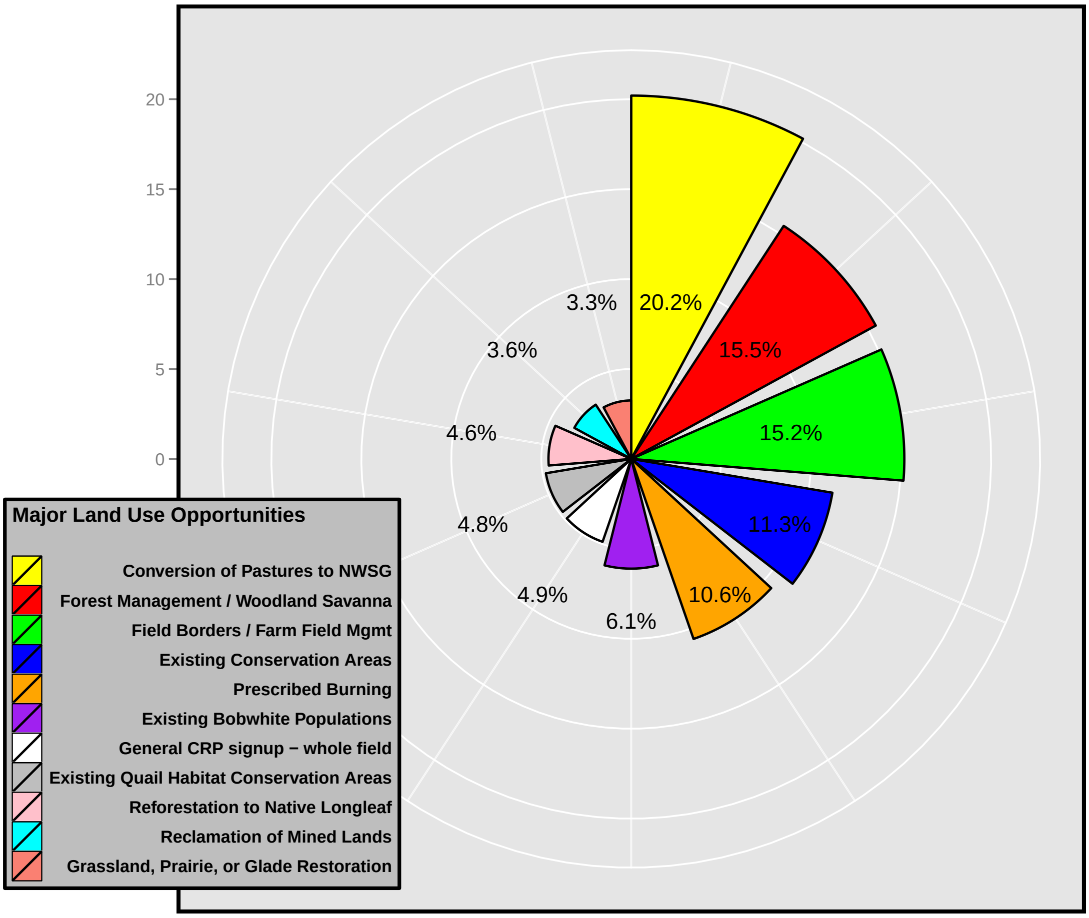
Table 24: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the Southeastern Coastal Plain Bird Conservation Region (BCR 27) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Alabama	High	20	6	34	8	0	0	43	10	30	7	30	3	56,156
	Medium	23	6	38	8	0	0	48	10	33	7	38	4	83,424
Florida	High	13	3	5	3	32	11	18	6	43	20	9	2	40,089
	Medium	24	7	5	3	76	27	49	11	50	25	28	5	44,263
Georgia	High	12	4	24	10	0	0	27	8	35	11	12	3	117,913
	Medium	18	4	29	11	0	0	34	10	43	11	19	3	41,684
Kentucky	High	5	2	4	1	100	25	0	0	15	10	0	0	3,681
	Medium	10	2	8	1	100	25	0	0	30	10	0	0	8,574
Louisiana	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	27	4	25	5	92	40	50	5	62	10	36	10	8,420
Mississippi	High	16	2	37	3	0	0	46	4	20	3	34	2	71,435
	Medium	18	2	40	3	0	0	46	4	30	3	46	3	198,360
NorthCarolina	High	5	2	15	9	15	10	15	10	50	10	10	5	65,769
	Medium	5	2	26	12	23	11	22	11	50	10	21	5	28,963
SouthCarolina	High	15	5	31	5	0	0	30	10	25	5	30	10	31,413
	Medium	15	5	31	5	0	0	38	12	30	5	31	10	13,826
Tennessee	High	60	40	82	16	100	4	100	4	88	20	0	0	10,482
	Medium	60	40	85	16	100	4	100	4	88	20	0	0	24,842
Virginia	High	8	4	42	16	78	28	75	24	41	12	30	20	9,034
	Medium	19	5	54	18	91	30	90	28	73	13	41	20	2,667
Total														860,995



BCR 28: Appalachian Mountains

The Appalachian Mountain Bird Conservation Region comprises 95 million acres in portions of 8 southeastern and Midwestern states. Participants (n=226) in state workshops identified 5.3 million acres (6%) as having high long-term potential for bobwhite and grassland bird conservation. By including spatially-explicit data, this substantially reduced the amount of improvable acres from the original NBCI (27 million acres). Agriculture, pasture and hardwoods dominated the cover types within the high priority areas identified in this BCR, although a significant amount of pine and mixed forests also were identified (Table 25). Thirteen different spatially-explicit land use opportunities were identified. Primarily, however, conversion of pastures and sod-forming grasses to warm season grass-forb communities, field border and field management systems, prescribed burning, and forest and savanna management were the most prevalent opportunities identified (Figure 3.3.1). With full implementation of the NBCI, approximately 34,377 coveys would be added to the areas with high potential, or an average of 1 bobwhite per 13 acres (Table 26). Within the high potential regions of this BCR, participants identified 14 constraints and barriers to successful implementation of management opportunities. Sod-forming grasses, inappropriate vegetation cover types, small- landholding sizes, grazing pressure and economics were significant barriers that would need to be overcome to implement management in these areas.



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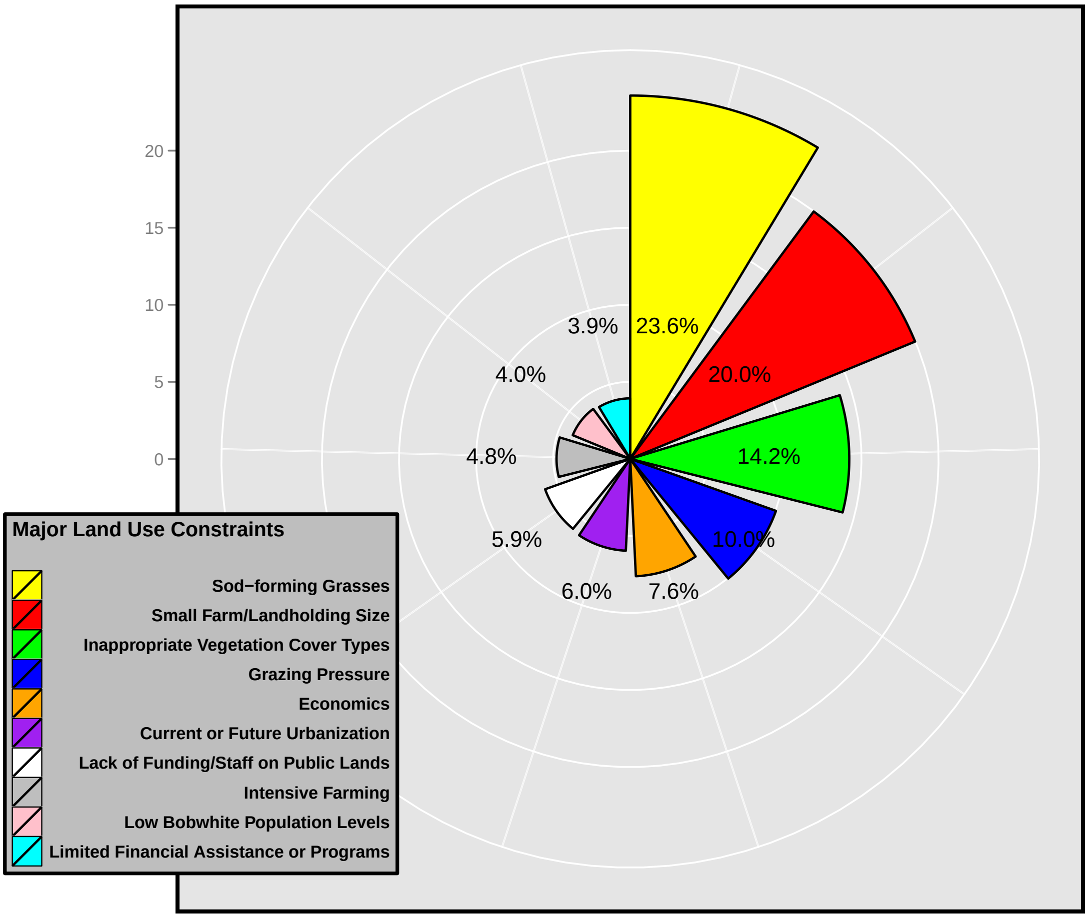
Major Land Use Opportunities
Conversion of Pastures to NWSG
Forest Management / Woodland Savanna
Field Borders / Farm Field Mgmt
Existing Conservation Areas
Prescribed Burning
Existing Bobwhite Populations
General CRP signup − whole field
Existing Quail Habitat Conservation Areas
Reforestation to Native Longleaf
Reclamation of Mined Lands
Grassland, Prairie, or Glade Restoration



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Major Land Use Constraints
Sod−forming Grasses
Small Farm/Landholding Size
Inappropriate Vegetation Cover Types
Grazing Pressure
Economics
Current or Future Urbanization
Lack of Funding/Staff on Public Lands
Intensive Farming
Low Bobwhite Population Levels
Limited Financial Assistance or Programs

Table 25: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Appalachian Mountains Bird Conservation Region (BCR 28) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Alabama	High	64,274.4	4,937.0	29,499.8	491,108.7	315,575.6	11,934.6
	Medium	232,328.0	37,366.0	177,272.1	837,979.5	547,712.1	72,432.0
	Low	455,560.8	123,136.0	763,810.2	2,702,688.7	823,810.8	199,951.7
Georgia	High	2,907.5	4.7	0.0	1,985.4	3,611.1	975.6
	Medium	23,509.6	0.0	0.0	104,164.3	43,396.4	19,069.3
	Low	188,693.7	2,220.9	13,008.6	2,311,942.5	417,420.6	116,033.8
Kentucky	High	6,076.9	524.6	49.6	34,364.7	4.7	15.5
	Medium	149,023.8	7,247.1	22,532.4	1,042,385.4	1,227.5	22,084.5
	Low	361,785.1	11,652.6	42,814.5	4,924,092.3	13,813.1	237,312.3
Maryland	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	1,597.9	52,004.3	17,527.2	64,488.3	1,086.4	96.9
	Low	1,521.2	24,220.2	22,373.6	683,928.8	16,931.3	1,189.5
New Jersey	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	0.0	0.0	0.0	0.0	0.0	0.0
	Low	31,709.1	108,518.6	7,573.3	448,063.3	1,370.1	30,530.4
North Carolina	High	118.6	4,837.8	5,312.1	13,782.8	1,855.2	27.9
	Medium	8,373.0	73,589.7	16,987.1	315,408.2	25,569.4	1,815.6
	Low	33,433.3	154,525.0	107,322.2	3,759,563.6	97,466.0	8,636.6
Ohio	High	6,373.0	33,486.0	113,091.4	400,178.5	5,161.8	20.1
	Medium	49,261.2	94,931.2	1,299,426.5	4,122,710.8	59,782.3	61.2
	Low	3,228.4	18,943.0	124,943.1	438,644.9	6,603.1	0.0

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Table 25 – Cont'd

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Pennsylvania	High	9,756.3	342,121.3	74,354.6	220,469.3	7,825.2	15,965.0
	Medium	48,469.9	927,977.5	220,672.4	2,704,057.9	107,553.1	95,655.7
	Low	272,991.6	2,224,030.8	682,806.8	10,774,408.4	506,440.7	1,219,226.0
South Carolina	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	259.6	1,853.6	32.5	37,095.5	7,199.8	1,194.9
	Low	1,054.7	21,583.9	508.4	299,859.4	34,183.4	2,687.4
Tennessee	High	191,040.1	28,431.2	192,652.0	1,117,051.6	99,166.1	49,392.0
	Medium	409,532.7	25,185.8	170,387.7	2,318,770.3	87,353.2	167,501.1
	Low	181,400.2	25,341.6	234,787.6	2,755,654.6	223,675.2	98,612.8
Virginia	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	56,219.9	968,314.5	170,985.1	1,489,137.6	55,909.9	11,090.7
	Low	66,324.2	744,333.3	90,751.3	5,025,221.2	156,545.3	31,868.0
West Virginia	High	37,631.0	210,951.7	98,984.7	1,066,616.5	8,838.0	1,512.7
	Medium	9,712.1	138,178.0	115,454.2	1,438,363.1	16,197.5	4,427.9
	Low	102,944.7	339,917.5	327,297.2	9,845,129.0	141,989.2	94,154.0
Total	High	318,177.9	625,294.3	513,944.2	3,345,557.4	442,037.6	79,843.4
	Medium	988,287.8	2,326,647.7	2,211,277.2	14,474,560.9	952,987.6	395,430.0
	Low	1,700,646.9	3,798,423.5	2,417,996.7	43,969,196.5	2,440,248.7	2,040,202.7

Table 26: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the Appalachian Mountains Bird Conservation Region (BCR 28) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Alabama	High	25	10	34	8	0	0	48	11	35	10	34	5	5,158
	Medium	26	10	38	8	0	0	48	11	38	10	38	6	10,571
Georgia	High	20	10	24	10	0	0	34	15	0	0	50	10	43
	Medium	0	0	29	11	0	0	34	15	0	0	50	10	469
Kentucky	High	0	0	8	2	100	25	0	0	25	8	0	0	245
	Medium	16	8	14	3	100	25	0	0	37	8	0	0	6,822
Maryland	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	38	5	60	14	76	30	76	30	52	15	66	15	942
NewJersey	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	0	0	0	0	0	0	0	0	0	0	0	0	0
NorthCarolina	High	7	5	15	9	25	20	25	20	50	10	25	10	80
	Medium	7	5	26	12	50	20	50	20	50	10	50	10	1,459
Ohio	High	71	50	0	0	82	50	0	0	65	50	0	0	294
	Medium	100	50	100	50	100	50	0	0	100	50	0	0	4,627
Pennsylvania	High	748	32	1125	42	0	0	0	0	1261	37	0	0	937
	Medium	1697	32	1905	42	0	0	0	0	1858	37	0	0	2,967
SouthCarolina	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	20	5	31	5	0	0	38	20	30	5	50	15	58
Tennessee	High	60	40	82	16	100	4	100	4	40	20	0	0	24,554
	Medium	66	40	85	16	100	4	100	4	40	20	0	0	51,819

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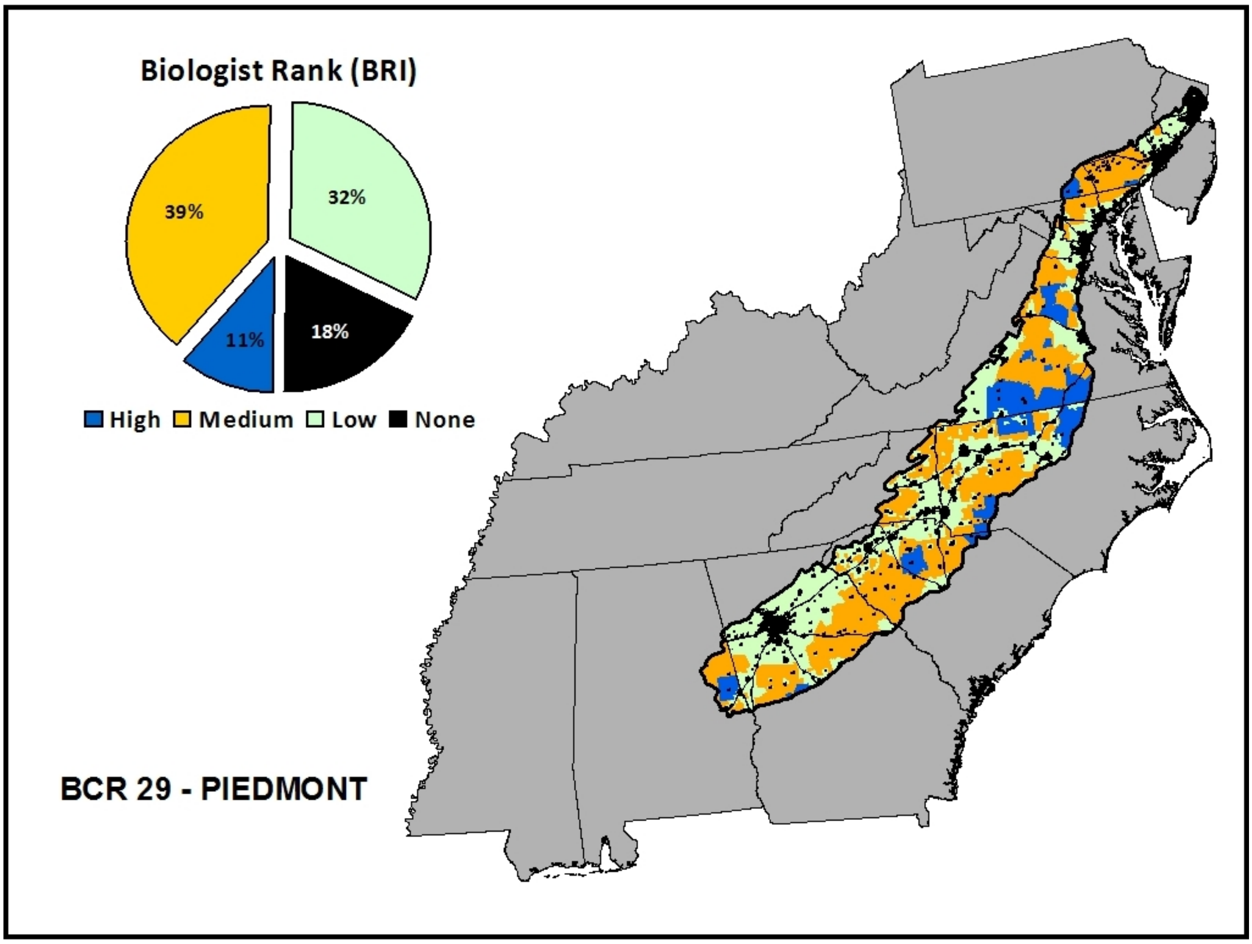
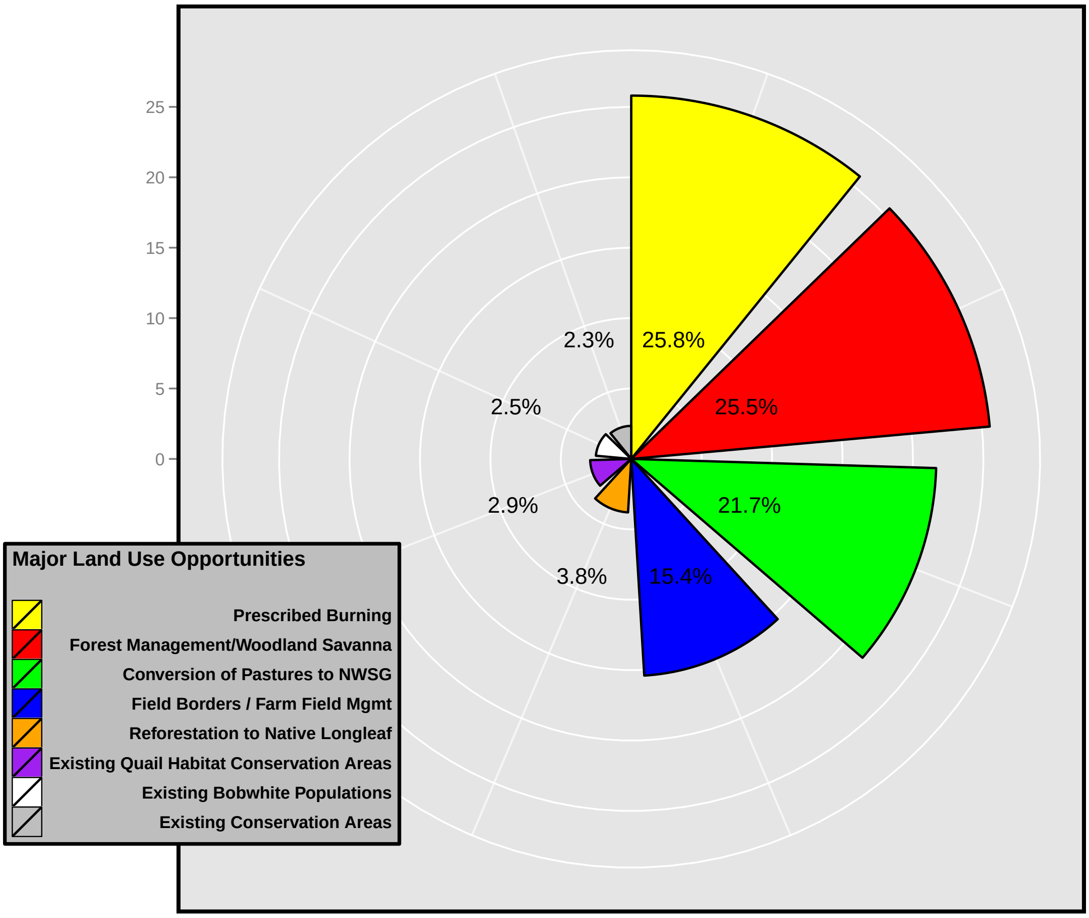
Table 26 – Cont'd

State	Rank	Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
		ED	MD	ED	MD	ED	MD	ED	MD	ED	MD	ED	MD	Added
Virginia	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	30	6	54	18	100	21	90	19	70	14	43	19	16,152
West Virginia	High	100	20	100	28	100	30	100	30	100	30	100	35	3,066
	Medium	100	20	100	28	100	30	100	30	100	30	100	35	3,536
Total														133,799



BCR 29: Piedmont

The Piedmont Bird Conservation Region encompasses 46 million acres in 6 southeastern states. Participants (n=155) of the 6 workshops in this BCR identified 11% of the land as having high potential for grassland bird conservation over the long-term, or about 5 million acres. The original NBCI identified 21 million acres in this BCR. The primary spatially-explicit habitat types were about 1 million acres of agriculture and pasture, and 1.3 million acres pine and mixed forests (Table 27). The 4 most prevalent land management needs in this BCR included prescribed burning and savanna restoration (25%), conversion of pastures to warm-season grass-forb communities, and field borders and farm field management (Figure 3.3.1). Recovery of pine and hardwood savannas and restoration of longleaf communities are paramount to success of bobwhite conservation. Full implementation of NBCI management opportunities would produce about 1 bobwhite per 21 acres, or 20,000 coveys, in the high potential areas of this BCR (Table 28). The most often-cited major constraint to success were sod forming grasses, followed by concerns over small landholding sizes, low adoption of conservation practices, limited financial assistance programs, and economics. However, a total of 13 constraints were identified in this BCR.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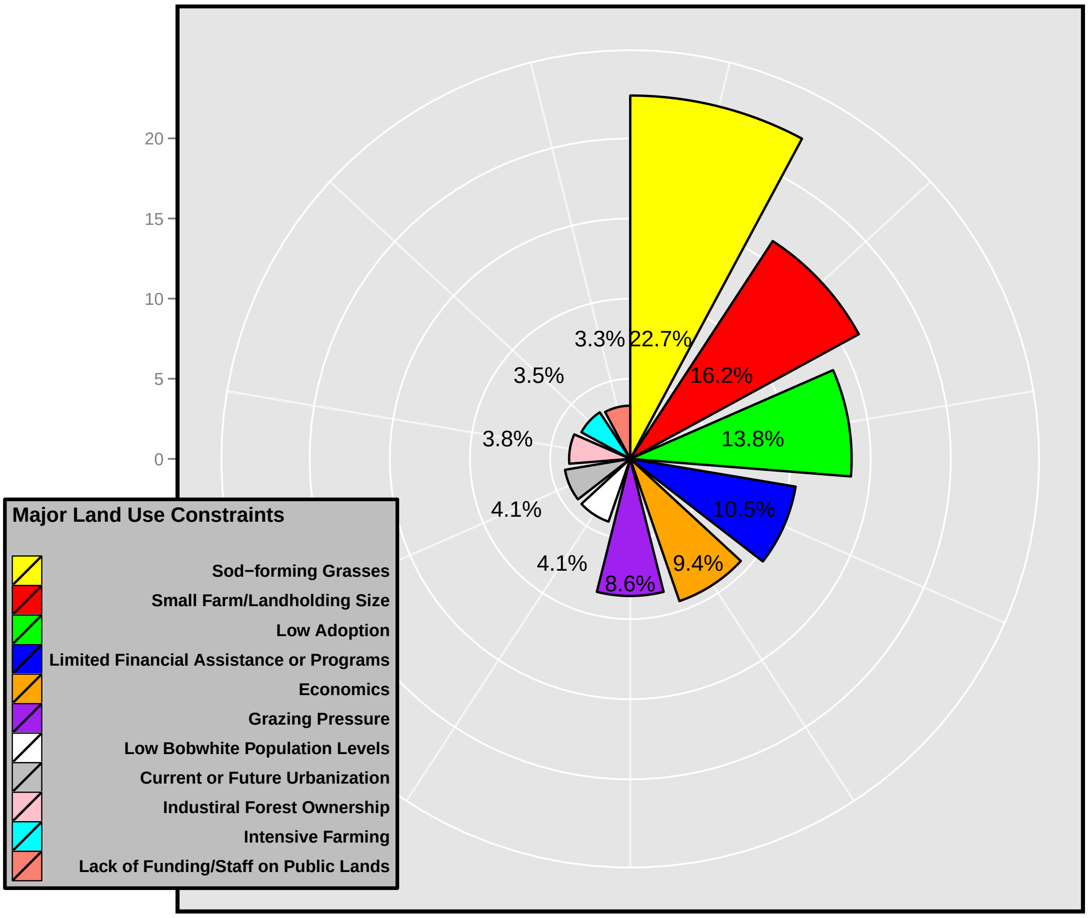
Major Land Use Opportunities
Prescribed Burning
Forest Management/Woodland Savanna
Conversion of Pastures to NWSG
Field Borders / Farm Field Mgmt
Reforestation to Native Longleaf
Existing Quail Habitat Conservation Areas
Existing Bobwhite Populations
Existing Conservation Areas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Major Land Use Constraints
Sod−forming Grasses
Small Farm/Landholding Size
Low Adoption
Limited Financial Assistance or Programs
Economics
Grazing Pressure
Low Bobwhite Population Levels
Current or Future Urbanization
Industiral Forest Ownership
Intensive Farming
Lack of Funding/Staff on Public Lands

Table 27: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Piedmont Bird Conservation Region (BCR 29) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Alabama	High	48,471.4	881.1	25,192.7	119,593.8	125,523.5	166.6
	Medium	92,122.8	1,143.0	73,223.2	375,478.6	247,296.4	1,225.2
	Low	14,481.0	255.7	7,305.2	54,450.7	43,171.7	1,043.0
Georgia	High	11,753.3	328.6	475.8	37,412.5	43,948.2	669.5
	Medium	483,404.5	222,931.3	35,726.3	1,346,361.2	1,491,453.0	11,262.8
	Low	464,526.7	248,720.0	92,408.0	2,253,284.8	1,031,204.9	10,292.7
Maryland	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	4,121.0	229,580.1	209,926.5	264,632.2	6,370.7	833.1
	Low	2,686.7	87,319.8	108,172.2	211,729.7	4,846.4	787.3
New Jersey	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	0.0	0.0	0.0	0.0	0.0	0.0
	Low	19,580.8	82,448.7	5,653.8	129,126.9	3,868.4	193.7
North Carolina	High	48,729.5	124,476.6	128,860.3	614,006.7	336,456.6	26,042.1
	Medium	116,756.1	482,972.0	666,780.5	2,253,486.2	464,607.1	55,448.8
	Low	84,418.5	361,828.4	400,528.0	1,703,097.5	390,183.6	36,858.5
Pennsylvania	High	3,952.1	155,912.9	18,660.1	54,017.5	1,267.0	52.7
	Medium	24,138.1	602,224.8	122,320.0	462,590.8	5,308.2	912.1
	Low	7,284.3	211,488.7	28,328.1	178,350.0	2,350.3	270.5
South Carolina	High	10,394.0	26,726.3	44,782.8	156,362.3	238,879.9	11,462.7
	Medium	56,441.5	441,269.6	203,340.5	1,086,036.1	1,223,965.3	49,005.4
	Low	38,364.1	329,638.1	92,947.3	836,354.5	277,967.0	18,630.7

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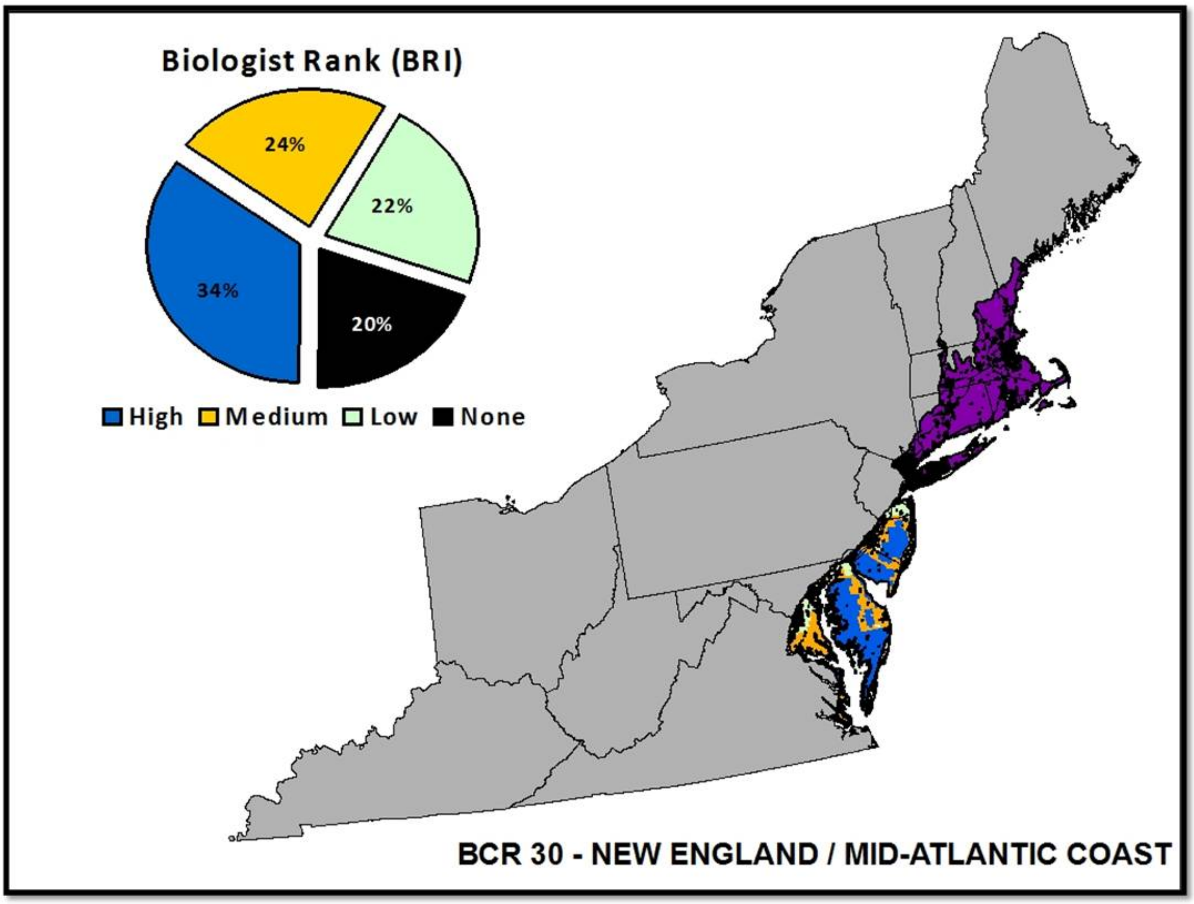
Table 27 – Cont'd

State	**Rank**	**Range**	**Row Crop**	**Pasture**	**Hardwood**	**Upland Pine**	**Mixed Forest**
Virginia	High	188,954.8	475,753.6	25,176.5	1,323,484.7	504,642.0	26,476.0
	Medium	164,648.6	805,476.2	104,618.5	2,084,133.1	576,955.4	41,438.3
	Low	51,985.7	549,383.7	74,171.8	1,711,013.4	247,878.4	17,173.1
Total	High	312,255.1	784,079.0	243,148.3	2,304,877.5	1,250,717.2	64,869.6
	Medium	941,632.6	2,785,597.0	1,415,935.5	7,872,718.2	4,015,956.1	160,125.6
	Low	683,327.8	1,871,083.0	809,514.5	7,077,407.4	2,001,470.7	85,249.5

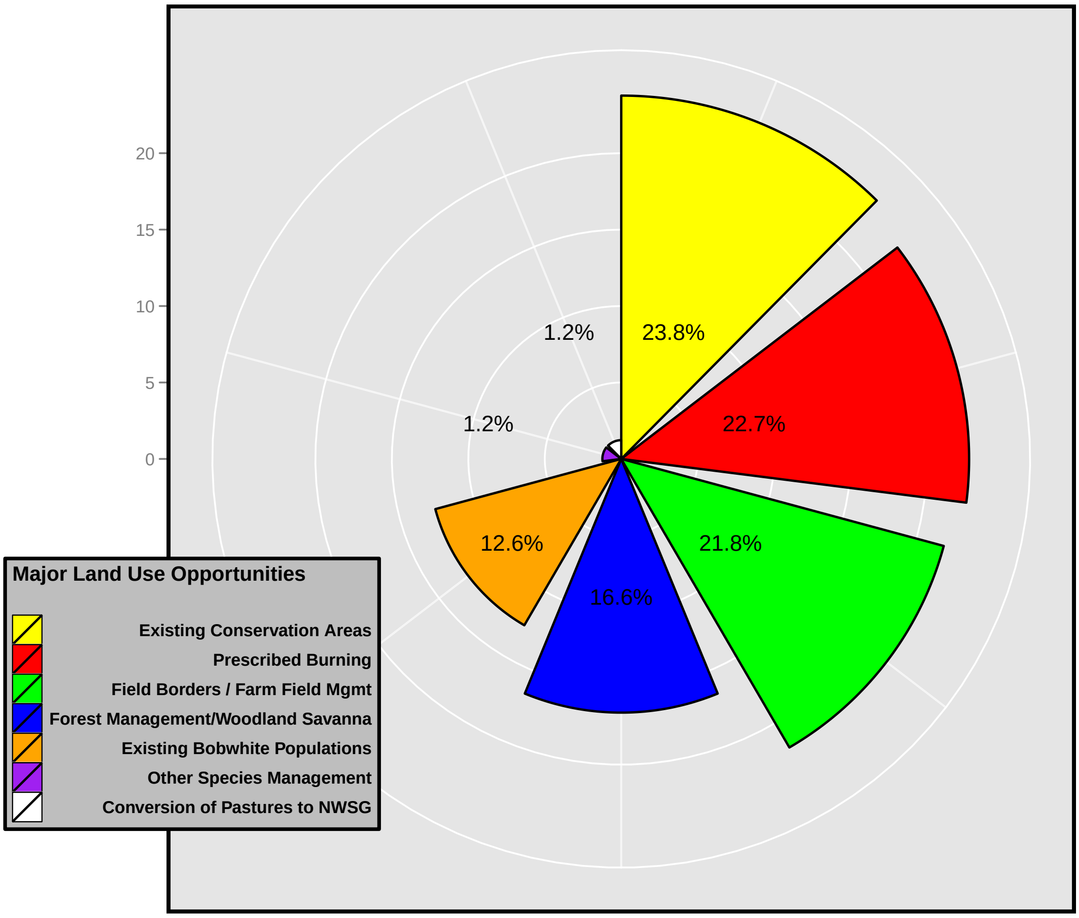
Table 28: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the Piedmont Bird Conservation Region (BCR 29) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Alabama	High	25	10	34	8	0	0	48	10	35	10	35	5	2,329
	Medium	25	10	38	8	0	0	48	10	36	10	40	5	4,785
Delaware	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	0	0	0	0	0	0	0	0	0	0	0	0	0
Georgia	High	15	5	24	10	0	0	30	15	35	15	10	3	922
	Medium	30	19	29	11	0	0	35	23	78	24	50	13	10,130
Maryland	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	38	5	60	14	76	30	76	30	52	15	66	15	4,641
NewJersey	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	0	0	0	0	0	0	0	0	0	0	0	0	0
NorthCarolina	High	6	2	15	9	18	13	16	11	50	10	11	5	7,209
	Medium	7	5	26	12	47	19	44	18	50	10	44	9	16,597
Pennsylvania	High	1391	25	1125	42	0	0	0	0	1070	35	0	0	393
	Medium	1501	25	1905	42	0	0	0	0	1501	35	0	0	2,304
SouthCarolina	High	19	5	31	5	0	0	39	14	25	5	48	15	3,388
	Medium	20	5	31	5	0	0	39	20	30	5	50	15	12,690
Virginia	High	9	5	42	16	86	25	84	21	56	13	42	18	5,803
	Medium	24	6	54	18	93	25	84	21	70	13	44	18	15,592
Total														86,783



BCR 30: New England / Mid-Atlantic Coast

The New England/Mid-Atlantic Coast Bird Conservation Region covers 8.3 million acres stretching from southeastern Virginia to Maine. Only Maryland and Virginia were included in the original NBCI, identifying 2.1 million acres of agricultural and pine acreage. In this revision, workshops occurred in VA, MD, DE and NJ to identify landscapes with long-term potential for bobwhite conservation. Thirty-one percent of the region was considered to have high potential for bobwhite and grassland bird conservation! Within this area, participants identified nearly 1 million acres of agricultural and pasture acreage, and 1.5 million acres of hardwood, pine and mixed forest habitats (Table 29). Much of the pine habitat occurs in the New Jersey Pine Barrens which is in dire need of thinning and burning, and the agricultural regions of Maryland (particularly in the Eastern Shore) and Delaware provide opportunities for Farm Bill programs, such as CREP and CRP, to impact existing bobwhite populations. However, over-winter cover is proving to be an important component in this region, as observed during recent research in MD; therefore, it is important to manage woodlands nearby farm field management and field border habitats. Primary opportunities included presence of existing protected conservation areas, prescribed burning, field borders and whole field management and areas with existing bobwhite populations (Figure 3.3.1). Implementation of habitat opportunities across high potential regions would add 31,924 coveys, or approximately 1 bobwhite per 7 acres (Table 30). Difficulty of fire use was the most important constraint, followed by intensive farming and low adoption of conservation practices due to economic constraints (Figure 3.3.1).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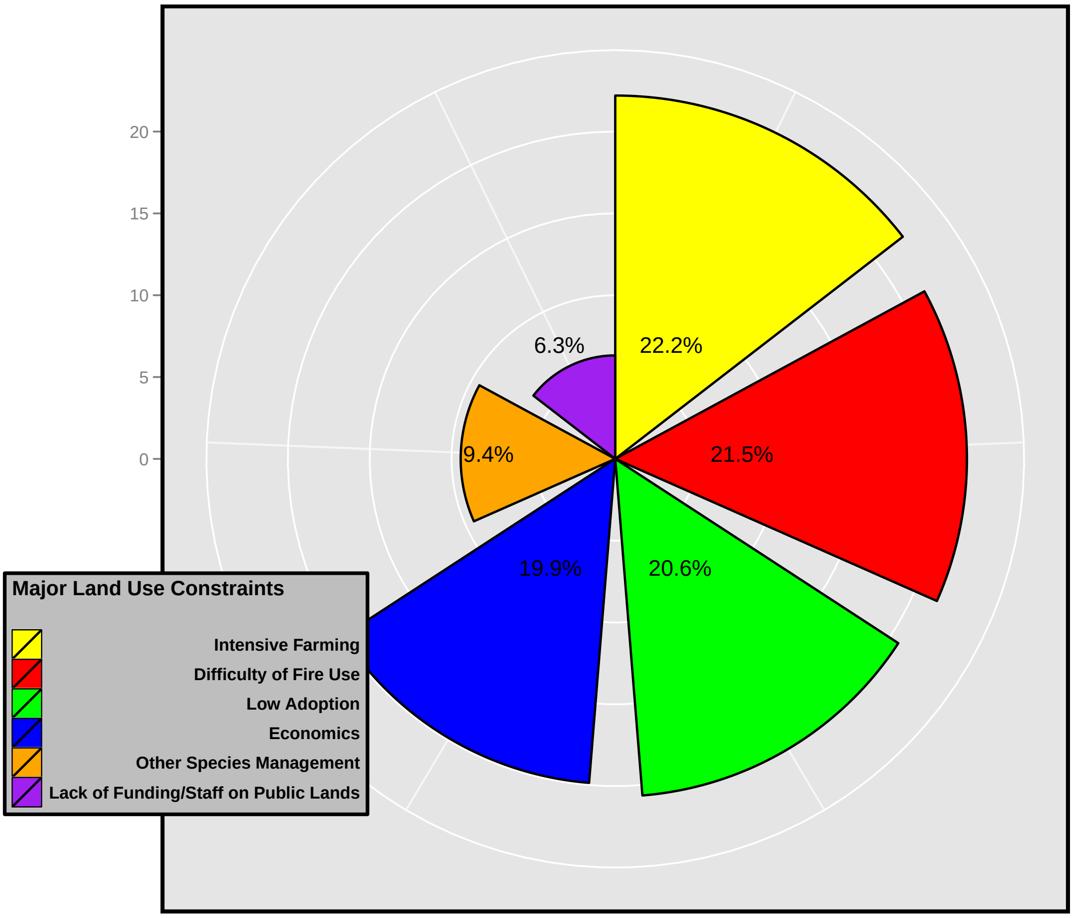
Major Land Use Opportunities
Existing Conservation Areas
Prescribed Burning
Field Borders / Farm Field Mgmt
Forest Management/Woodland Savanna
Existing Bobwhite Populations
Other Species Management
Conversion of Pastures to NWSG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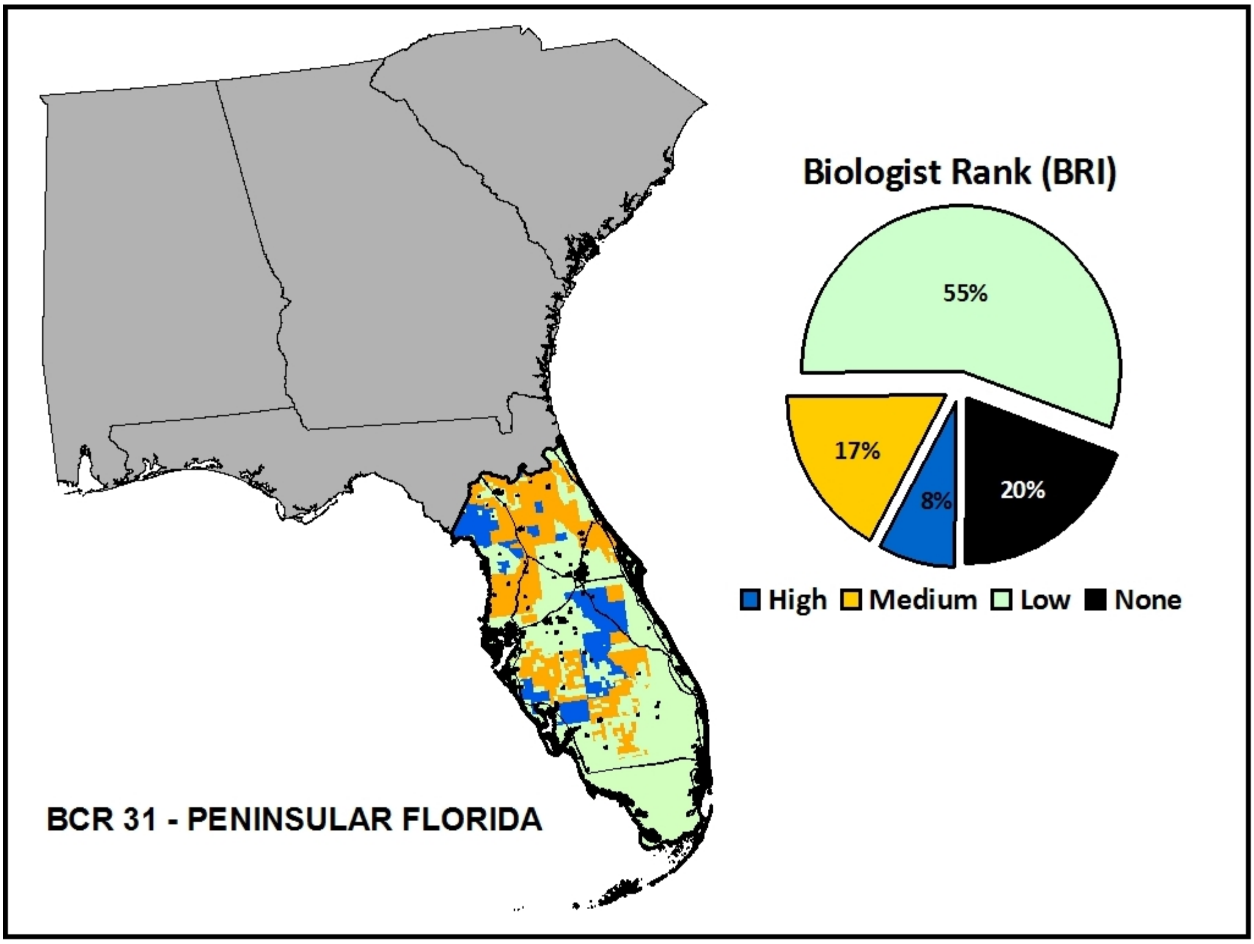
Major Land Use Constraints
Intensive Farming
Difficulty of Fire Use
Low Adoption
Economics
Other Species Management
Lack of Funding/Staff on Public Lands

Table 29: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the New England / Mid-Atlantic Coast Bird Conservation Region (BCR 30) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Delaware	High	786.6	114,810.2	13,152.8	114,746.6	16,823.6	4,840.2
	Medium	1,559.2	235,757.8	22,193.8	153,719.8	12,098.1	8,237.4
	Low	1,997.8	77,532.5	13,926.1	50,539.7	3,555.3	1,506.5
Maryland	High	5,612.0	586,359.1	77,242.0	455,363.8	130,354.4	18,068.1
	Medium	4,297.7	119,035.1	30,247.6	436,388.3	33,142.7	3,768.5
	Low	1,831.9	46,665.1	14,085.0	194,847.3	12,871.5	1,475.5
New Jersey	High	15,555.8	141,330.4	10,134.4	259,081.4	309,980.6	5,288.1
	Medium	20,168.1	91,189.0	3,968.4	149,799.5	37,805.4	2,034.2
	Low	18,512.9	63,593.2	2,985.8	159,087.7	38,459.4	977.2
Pennsylvania	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	0.0	0.0	0.0	0.0	0.0	0.0
	Low	0.0	0.0	0.0	21.7	0.0	0.0
Virginia	High	3.9	152,955.8	6,524.1	97,188.5	81,896.1	1,240.7
	Medium	0.0	13,580.5	2,591.3	34,577.0	29,643.9	1,022.1
	Low	0.0	1,701.7	482.8	5,194.3	2,256.6	110.0
Total	High	21,958.2	995,455.4	107,053.3	926,380.3	539,054.7	29,437.0
	Medium	26,025.0	459,562.4	59,001.1	774,484.7	112,690.0	15,062.2
	Low	22,342.6	189,492.6	31,479.7	409,690.7	57,142.8	4,069.1

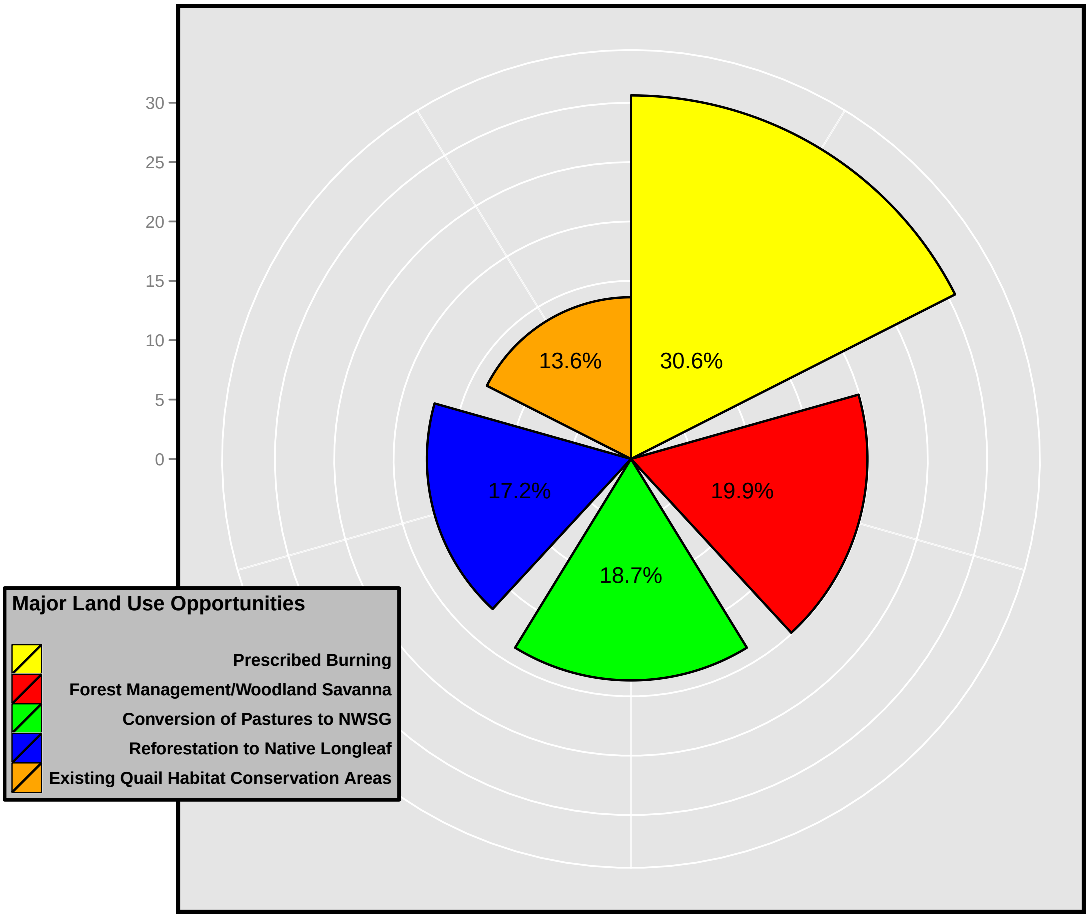
Table 30: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the New England / Mid-Atlantic Coast Bird Conservation Region (BCR 30) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Delaware	High	37	18	41	23	50	40	42	30	70	19	40	5	570
	Medium	50	18	51	26	50	40	50	30	70	19	60	5	1,039
Maryland	High	19	2	42	13	56	16	52	15	31	5	30	5	26,545
	Medium	44	4	60	14	97	22	93	21	64	11	84	9	3,841
NewJersey	High	100	25	100	38	100	45	0	0	100	25	100	45	979
	Medium	100	25	100	38	100	45	100	45	100	25	100	45	458
Pennsylvania	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	0	0	0	0	0	0	0	0	0	0	0	0	0
Virginia	High	5	2	42	16	85	24	85	24	60	12	21	11	3,830
	Medium	16	5	0	0	91	31	90	29	70	15	41	20	281
Total														37,543



BCR 31: Peninsular Florida

The Peninsular Florida Bird Conservation Region comprises some 23 million acres of land. Participants (n=14) in this workshop identified 8% of the landscape as having high potential for bobwhite conservation and grassland restoration, or 1.9 million acres (significantly less than the 11 million acres identified in the original NBCI). The principal opportunities occurred in the pasture/rangeland complex of habitats, longleaf-wiregrass and dry prairie habitats (Table 31). Prescribed burning, woodland savanna reforestation to longleaf, and conversion of pastures to native grasses and forbs were major opportunities in this BCR (Figure 3.3.1). Existing quail habitat conservation areas on public and private lands added long-term potential to this BCR for meeting NBCI population goals as Florida has millions of acres of publicly-owned habitats and conservation easements on private lands. Implementation of management opportunities to all high potential landscapes would add 19,222 coveys, or approximately 1 bobwhite per 8 acres (Table 32). Presence of sod-forming grasses, economics, grazing pressures and future urbanization were the four most-often identified impediments to success of conservation for bobwhite, although a total of 12 constraints were identified (Figure 3.3.1). Recent research indicates a relatively healthy population of bobwhites exists on these remaining habitats and that bobwhite and other grassland birds respond favorably to these management prescriptions.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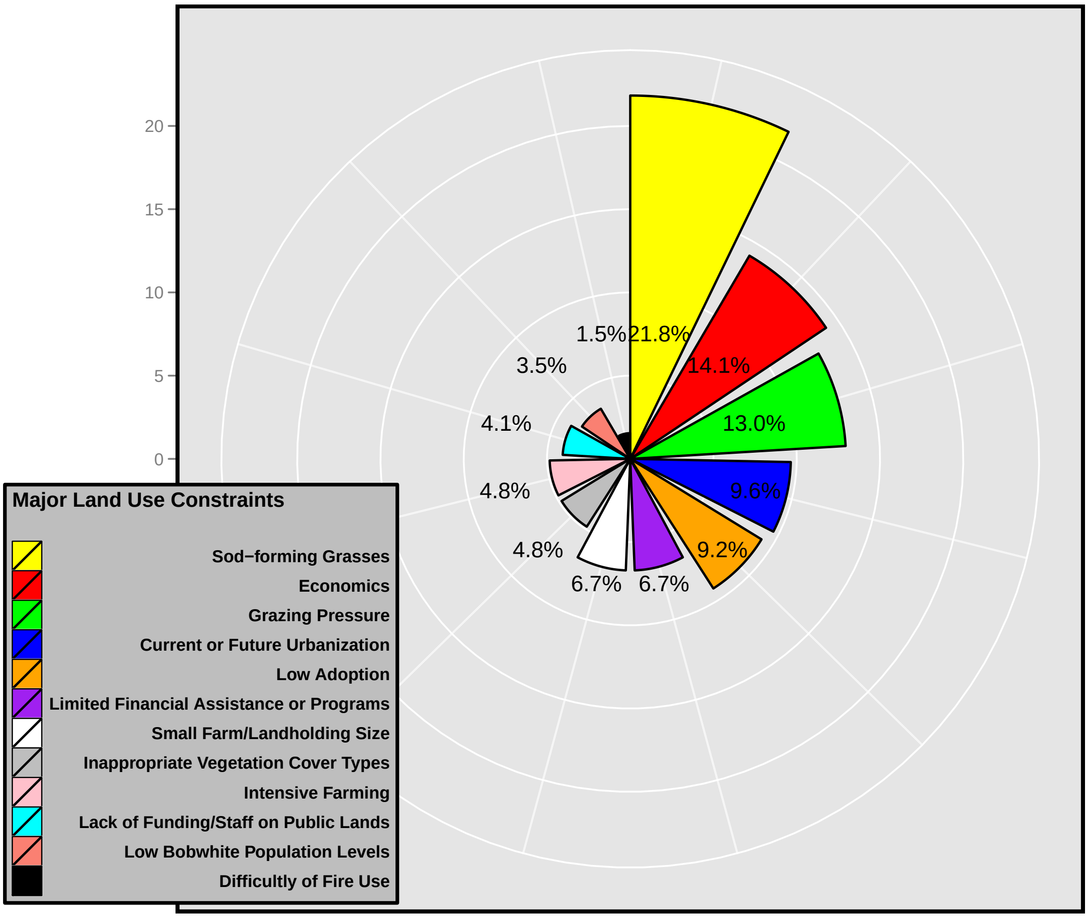
Prescribed Burning
Forest Management/Woodland Savanna
Conversion of Pastures to NWSG
Reforestation to Native Longleaf
Existing Quail Habitat Conservation Areas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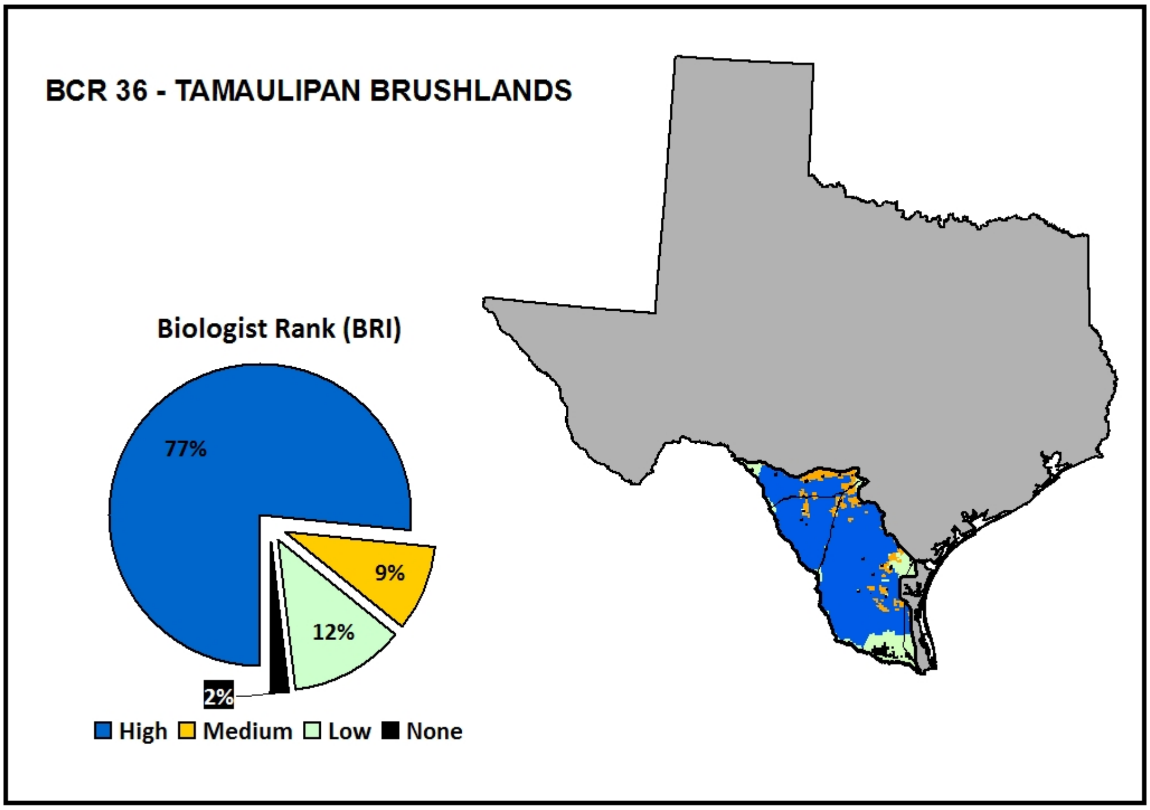
Major Land Use Constraints
Sod−forming Grasses
Economics
Grazing Pressure
Current or Future Urbanization
Low Adoption
Limited Financial Assistance or Programs
Small Farm/Landholding Size
Inappropriate Vegetation Cover Types
Intensive Farming
Lack of Funding/Staff on Public Lands
Low Bobwhite Population Levels
Difficultly of Fire Use

Table 31: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Peninsular Florida Bird Conservation Region (BCR31) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Florida	High	347,929.4	120,197.5	564,181.9	224,326.6	599,881.4	81.2
	Medium	661,567.2	341,813.6	1,494,848.3	687,570.6	1,047,071.7	15,551.2
	Low	520,328.2	1,162,783.7	1,220,108.9	1,327,769.3	1,085,661.0	19,680.8
Total		1,529,824.8	1,624,794.8	3,279,139.2	2,239,666.5	2,732,614.1	35,313.2

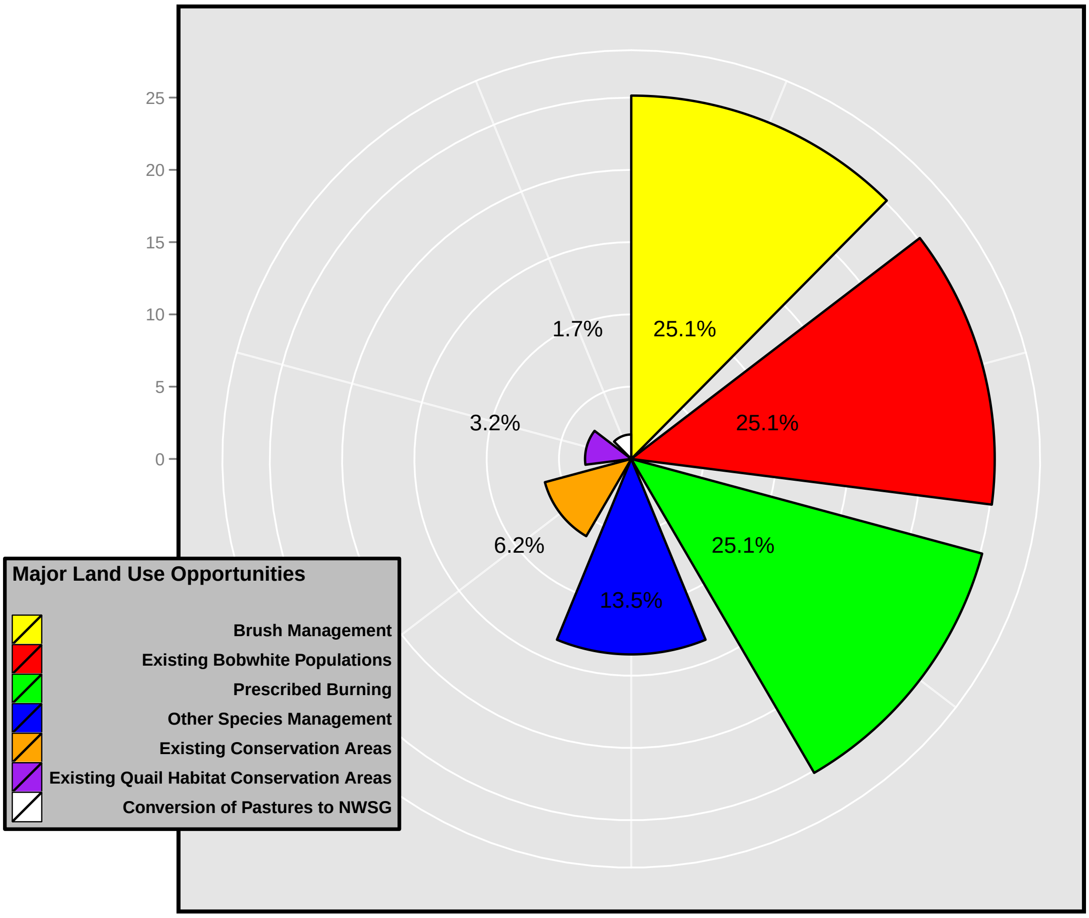
Table 32: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the Peninsular Florida Bird Conservation Region (BCR31) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Florida	High	10	5	5	3	67	25	38	25	26	5	27	7	19,222
	Medium	18	7	5	3	70	25	43	25	26	6	37	8	35,943
Total														55,165



BCR 36: Tamaulipan Brushlands

The Tamaulipan Brushland Bird Conservation Region (BCR 36) comprises some 15 million acres of land in southern Texas. This area is dominated by chaparral, or brush land habitat, and agricultural fields. However, much of this region also includes fairly extensive grasslands, oak forests, and some tall riparian forests. Much of the acreage in BCR 36 is used for livestock and commercial / recreational wildlife operations. Biologists in Texas identified 77% of this BCR as having high long-term potential for bobwhite conservation (Table 33). While this BCR will likely have wild bobwhite populations across large land ownerships (ranches), there are many opportunities to increase bobwhite populations. This is largely due to the fact that much of this area is economically supported by quail and other recreational wildlife leases. Biologists recognize that through brush management, prescribed fire and careful grazing, a diverse ground-story community can be maintained which will expand and increase bobwhite populations. To that end, biologists identified 4 primary management opportunities for increasing bobwhite including; prescribed fire use and brush management, together comprising 82% of the management opportunities, and conversion of pastures to warm season grass-forb systems/ grassland restoration (3%). Existing conservation areas and existing bobwhite populations were important as well comprising 15% of the landscape opportunity for recovering bobwhite. Implementation of management opportunities on high potential areas would result in adding 207,208 coveys, or 1 bobwhite per 5 acres (Table 34). Primary constraints were grazing pressures as grazing is the main land use. Management for other species, including big game species and exotic game, was also seen as a constraint toward bobwhite conservation. Difficulty of prescribed fire use, small land ownership size, along with intensive farming, and economics were important constraints as well.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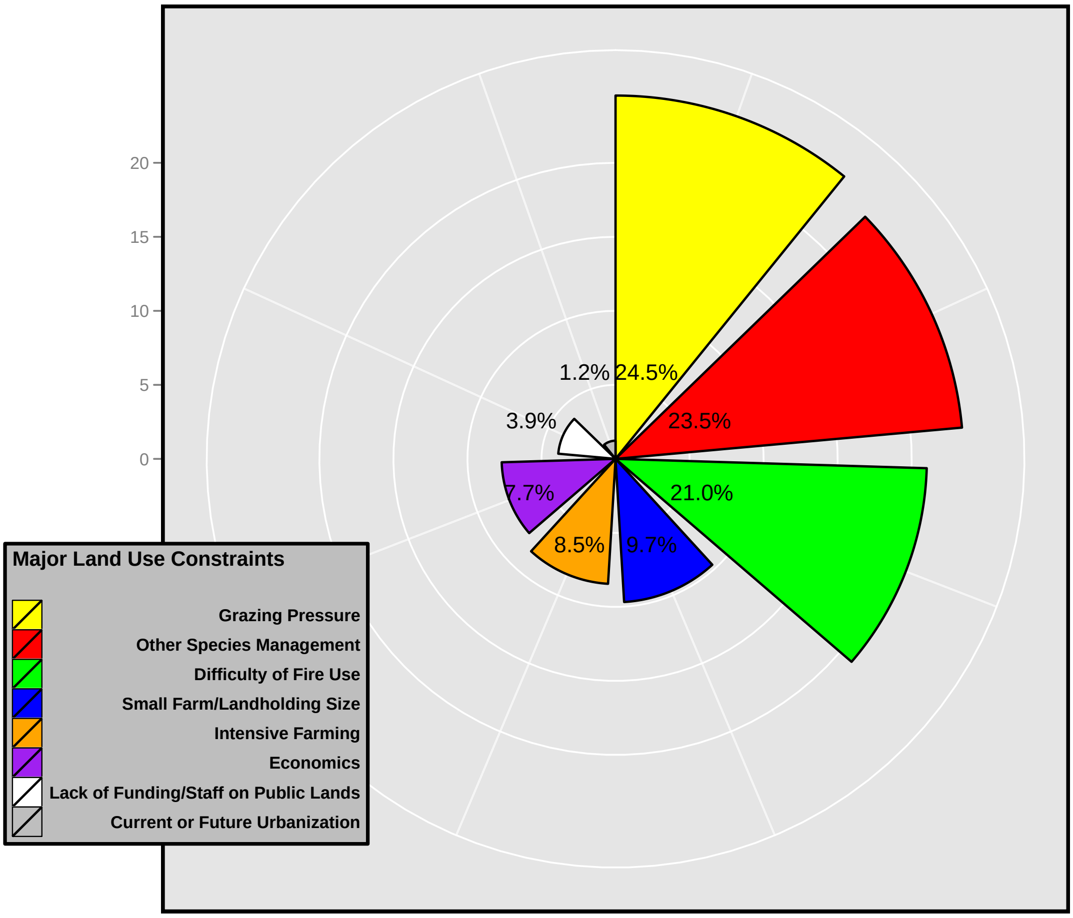
Major Land Use Opportunities
Brush Management
Existing Bobwhite Populations
Prescribed Burning
Other Species Management
Existing Conservation Areas
Existing Quail Habitat Conservation Areas
Conversion of Pastures to NWSG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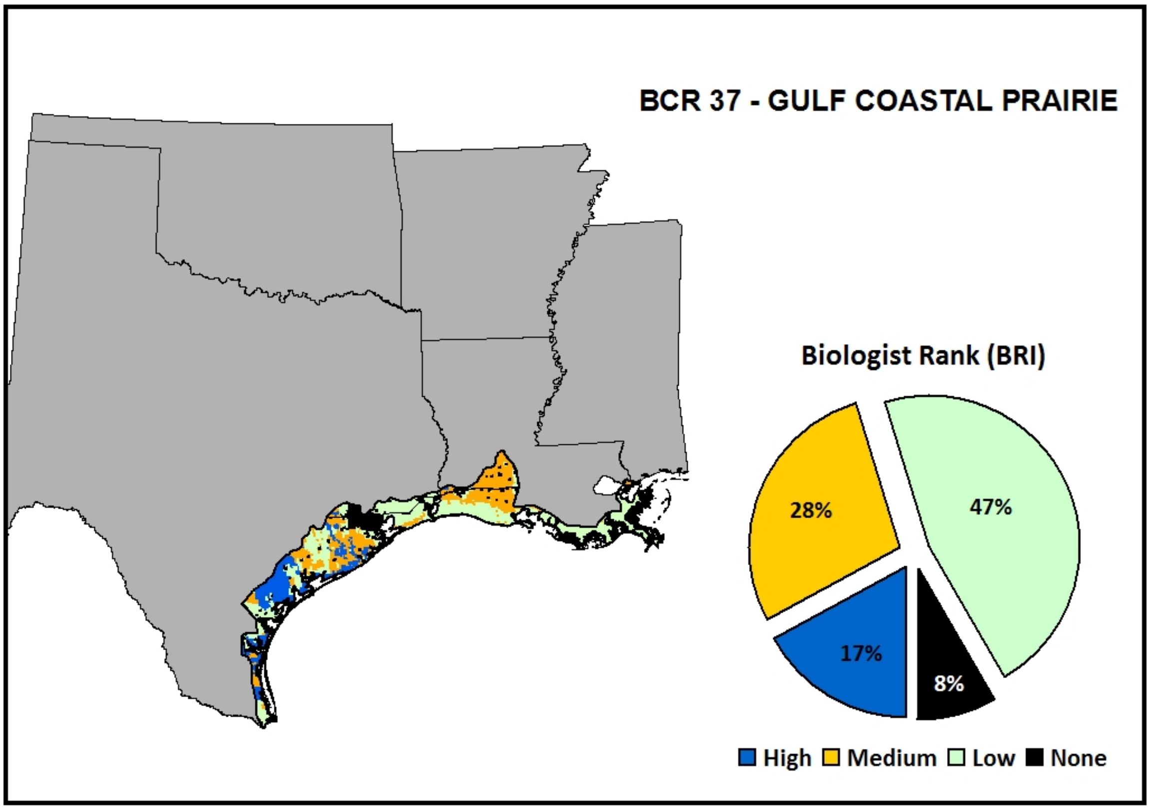
Major Land Use Constraints
Grazing Pressure
Other Species Management
Difficulty of Fire Use
Small Farm/Landholding Size
Intensive Farming
Economics
Lack of Funding/Staff on Public Lands
Current or Future Urbanization

Table 33: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Tamaulipan Brushlands (BCR 36) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Texas	High	10,945,945.8	133,654.1	1,038,482.9	28,415.7	20,017.1	349.5
	Medium	931,466.1	166,477.4	210,874.2	46,758.8	29,082.9	248.0
	Low	705,031.5	718,387.2	300,053.9	26,237.3	4,860.3	124.8
Total		12,582,443.4	1,018,518.7	1,549,411.0	101,411.9	53,960.2	722.3

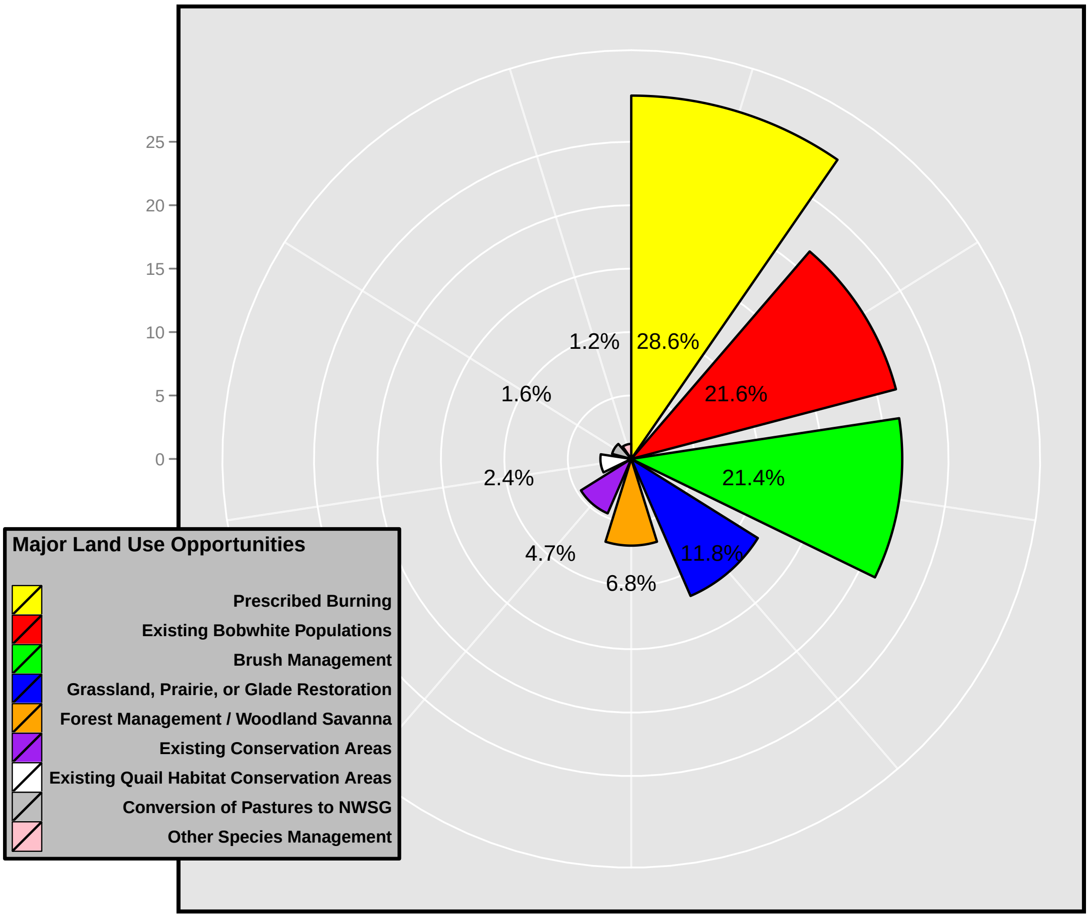
Table 34: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the Tamaulipan Brushlands (BCR 36) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Texas	High	14	6	7	3	70	30	0	0	13	6	0	0	207,208
	Medium	25	8	13	3	90	30	0	0	18	6	0	0	20,108
Total														227,316

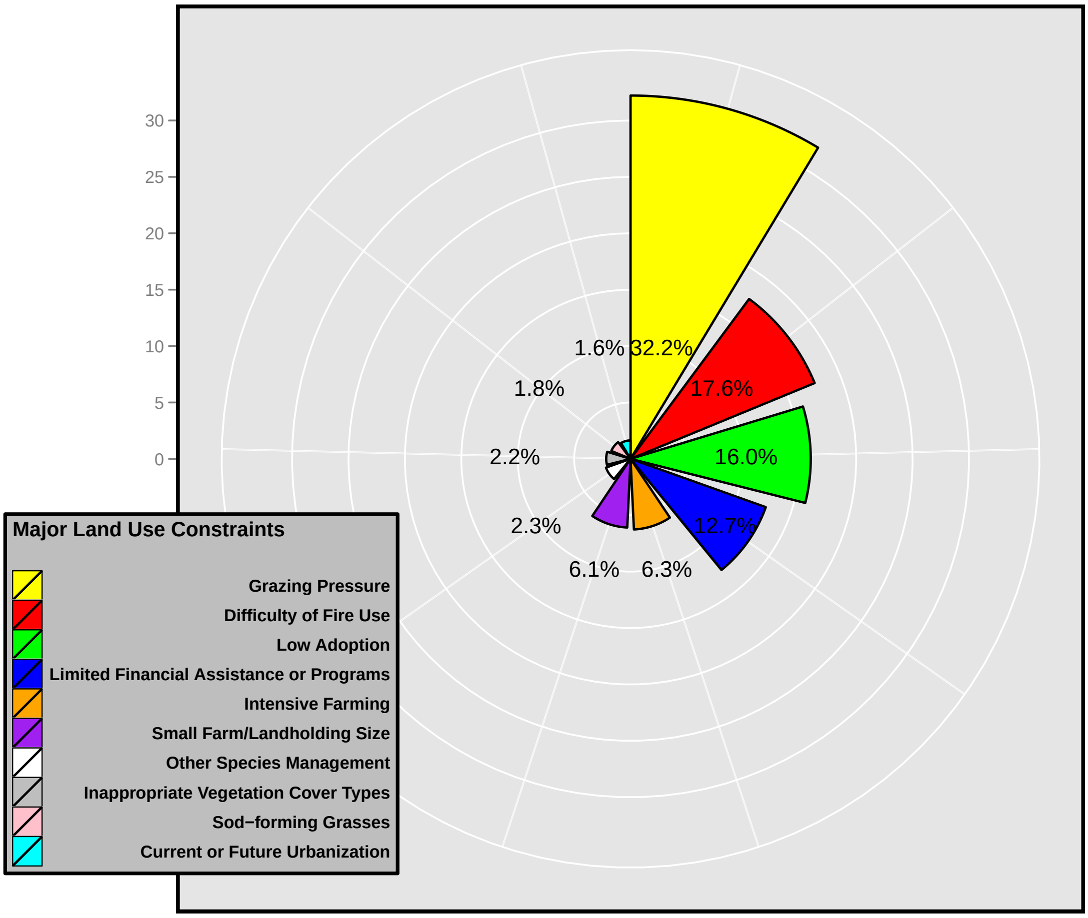


BCR 37: Gulf Coastal Prairie

The Gulf Coastal Prairie Bird Conservation Region (BCR 37) comprises about 29 million acres of land stretching from Mississippi through the Gulf Coast of Texas. This region contains a complex of marshes and upland grassland and a small amount of forested habitat. Nearly all grasslands (99%) have been converted to agriculture habitats. Most of the natural communities of BCR 37 have experienced tremendous alteration. Marsh habitats have been lost or changed because of saltwater intrusion caused by oil and gas development, dredging, channelization, impoundments, land subsidence, and other factors. Cattle are commonly grazed in marsh, grassland and wooded habitats, further degrading bird habitat. Invasion by non-native plants, such as Chinese tallow, has changed diverse natural habitats to monotypic stands covering hundreds of hectares. Continuing human development of higher ground is likely as human population pressures increase. Despite these challenges, biologists identified 17% of landscapes in this BCR as having relatively high potential for bobwhite conservation, mostly in the southwestern portion of the Texas gulf coast (Table 35). Land use opportunities identified included prescribed burning, brush management, and grassland and forest savanna restoration to restore plant diversity in degraded grassland and savanna habitats. Existing conservation areas and existing quail habitat conservation areas were important to future conservation planning efforts. Implementation of management opportunities would result in adding 19,588 coveys to high potential areas, or approximately 1 bobwhite per 16 acres (Table 36). Biologists identified 11 constraints to applying conservation practices. The top 5 constraints included grazing pressures, difficulty of fire use, low adoption of conservation practices by landowners, limited financial assistance programs targeted at conservation needs and intensive farming.



25
20
15
10
5
0
1.2%
28.6%
21.6%
1.6%
21.4%
2.4%
4.7%
11.8%
6.8%
Major Land Use Opportunities
Prescribed Burning
Existing Bobwhite Populations
Brush Management
Grassland, Prairie, or Glade Restoration
Forest Management / Woodland Savanna
Existing Conservation Areas
Existing Quail Habitat Conservation Areas
Conversion of Pastures to NWSG
Other Species Management



30
25
20
15
10
5
0
1.6%
32.2%
1.8%
17.6%
2.2%
16.0%
2.3%
12.7%
6.1%
6.3%
Major Land Use Constraints
Grazing Pressure
Difficulty of Fire Use
Low Adoption
Limited Financial Assistance or Programs
Intensive Farming
Small Farm/Landholding Size
Other Species Management
Inappropriate Vegetation Cover Types
Sod−forming Grasses
Current or Future Urbanization

Table 35: Biologist Ranking Information (BRI) data summarized by habitat type (acres) for the Gulf Coastal Prairie (BCR 37) delineated by state and biologist rank.

State	Rank	Range	Row Crop	Pasture	Hardwood	Upland Pine	Mixed Forest
Louisiana	High	2,543.3	1,061.6	3,606.5	22.5	8,358.3	91.4
	Medium	50,110.4	501,272.6	725,425.9	219.3	37,736.4	1,192.6
	Low	9,563.4	34,068.7	168,093.9	251.1	3,580.2	183.7
Mississippi	High	0.0	0.0	0.0	0.0	0.0	0.0
	Medium	0.0	0.0	0.0	0.0	0.0	0.0
	Low	188.3	2.3	157.3	0.0	658.7	1.6
Texas	High	851,012.9	136,237.6	740,822.0	65,681.7	22,754.1	207.7
	Medium	286,149.4	268,482.0	908,069.7	54,925.7	84,864.9	805.2
	Low	476,309.2	956,374.5	1,038,791.3	37,125.8	35,131.9	5,787.1
Total	High	853,556.2	137,299.2	744,428.5	65,704.1	31,112.4	299.1
	Medium	336,259.9	769,754.6	1,633,495.5	55,145.1	122,601.3	1,997.8
	Low	486,060.9	990,445.5	1,207,042.5	37,376.9	39,370.8	5,972.4

Table 36: Proposed Estimated Density (ED), Managed Density (MD), and potential coveys added for the Gulf Coastal Prairie (BCR 37) delineated by habitat type.

		Row Crop		Range		Hardwood		Mixed Forest		Pasture		Upland Pine		Coveys
State	**Rank**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**ED**	**MD**	**Added**
Louisiana	High	15	4	15	5	0	0	30	5	50	10	25	10	112
	Medium	26	4	25	5	61	40	50	5	63	10	35	10	14,641
Mississippi	High	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium	0	0	0	0	0	0	0	0	0	0	0	0	0
Texas	High	17	9	6	3	48	26	0	0	24	11	0	0	19,476
	Medium	53	14	14	3	95	36	0	0	81	19	100	26	10,155
Total														44,834

4 Regional Issues in Bobwhite Conservation: ecosystems, processes, and populations.

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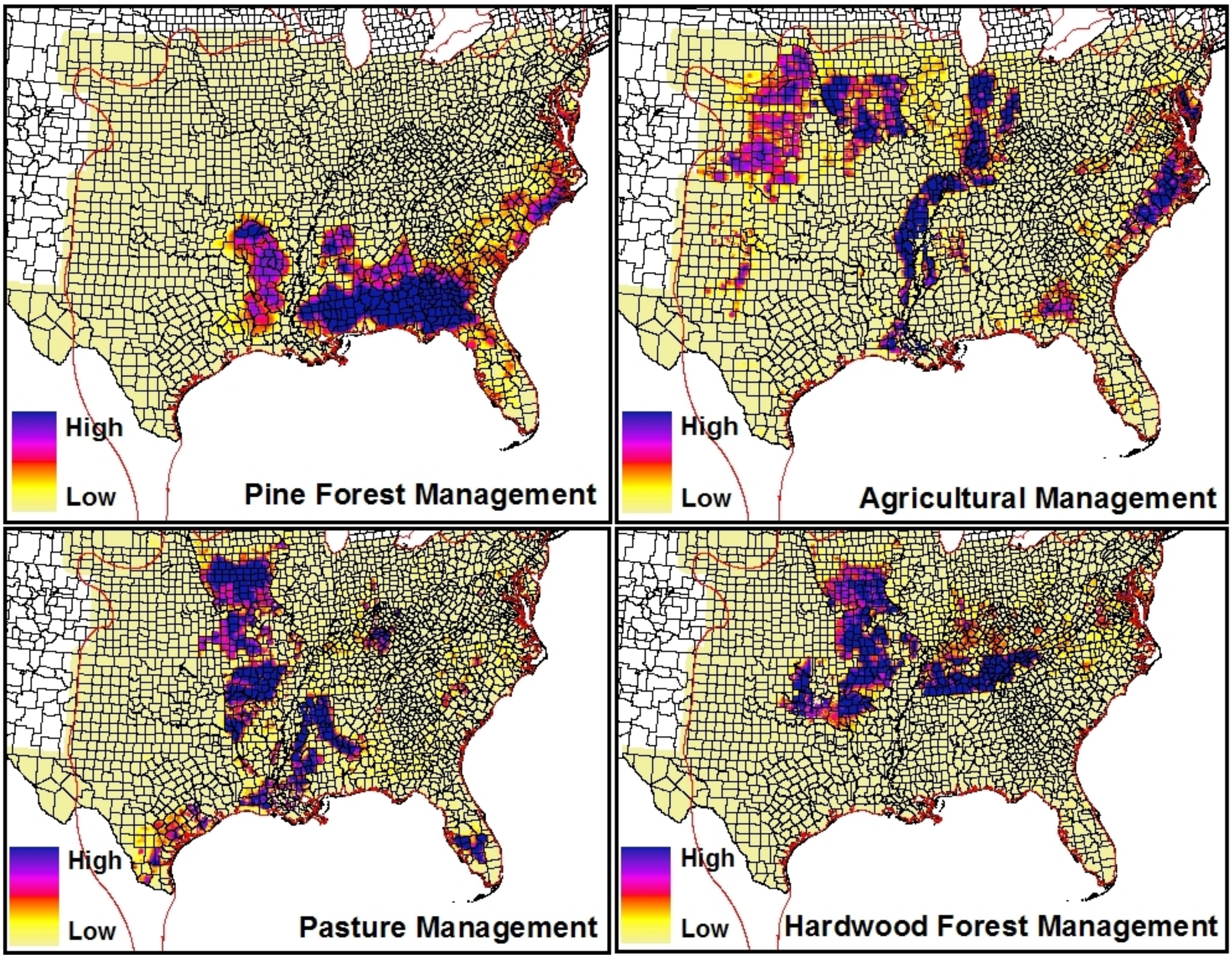

Figure 10: Bobwhite predictive response (on scale of high to low) to management of varying habitat types.

We divided the Northern Bobwhite range into six regions (Midwest, Southwest, Mid-north, Mid-south, Mid-Atlantic, and Southeast) to highlight the major regional issues in bobwhite conservation. We then tasked (co)authors with describing the primary habitats germane to their region and outlining both the opportunities and challenges faced when managing for bobwhites within that region. In doing so, it became evident that while there are obvious distinctions among regions there are also some common paradigms. The intersection of these differences and commonalities among regions may very well help to guide conservation efforts for bobwhites and grassland birds.

It is well known that bobwhite populations in all regions have experienced precipitous declines during the past several decades which has been unequivocally associated with widespread habitat loss. However, despite dramatic habitat loss in each region, there still remains one to several habitat management *opportunities* within the scope of the NBCI to abate these population declines. All regional authors suggested that successful bobwhite restoration would require landscape-scale changes and would likely involve management of multiple habitat types. To date, this is no single conservation practice to recover landscapes for bobwhites and to best restore these landscapes state biologists must creatively stack multiple conservation practices to provide adequate incentive for landowner compliance.

In both the BRI workshops and the following regional chapters the diversity of habitat types occurring in each state and region illustrate the diverse ecological land-forms bobwhites may utilize throughout their range; this diversity is reflected in the number of BCRs occurring in each region ranging from as few as 3 to as many as 9 BCRs in a region. Whereas the diversity of eco-types (Figure 3.3.1) presents some challenges when managing for bobwhites and grassland birds it also provides ample opportunity for diverse management actions. Today, states are also expected to do more with less; that is, despite budget cuts and reduced personnel habitat management is expected to remain consistent with previous years or even be intensified.

A management action pervading all habitats and central to all regions is **prescribed fire**. Indeed, whereas the appropriate scale and season at which fire is implemented may vary among region, the need for frequent fire is requisite to maintaining a lush, diverse ground cover meeting adequate structure needs for bobwhites - after all the bobwhite is the “fire bird”. Notwithstanding the dire need to return a regular fire interval to the landscape and its importance to grasslands obligate species, few-to-none conservation programs provide private landowners the monetary incentive necessary to get the job done. It is apparent that in oder to successfully restore bobwhites across their range we MUST find a way to offset cost and liability of prescribed fire for private landowners. Furthermore, the NBCI recommends that smaller scale (<500 acres and preferably <250 acres) burning regimes should be implemented to maximize benefits to bobwhites.

Two major impediments to habitat management common to all regions are the prevalence of sod-forming (exotic) grasses and weather. In the Mid-Atlantic heavy annual snows take a toll on bobwhite populations - in particular, extreme and recurrent snowfall events such as those experienced during the 2009/10 winter and the late 1970s all but extirpated bobwhites from the region. In the northern most areas of the Midsouth and Midwest, heavy snows are prevalent and when combined with recurrent snowfall caused following Great Lake effects some states (e.g., Indiana, Ohio, and Illinois) or relegate the possibility of habitat management in some areas altogether. Typically, bobwhites are resilient to harsh winter weather but the cumulative snows and extended, expansive snow cover is what poses problems - bobwhites are unable to scratch for food in such cases. Over-winter cover in the form of brush thickets and shrub plantings may offer some respite from harsh snows (see Regional chapters for more insight into habitat management opportunities). Whereas the Southwest, Midsouth and Southeast, are for the most part precluded from harsh winter weather they are faced with other weather related constraints such as droughts and hurricanes.

The emergence of **exotic, sod-forming grass** (e.g., Bahia grass, Fescue, Orchard grass, etc.) in every region is significant. This odious trend is highlighted in the BRI and the individual chapters wherein habitat management opportunities exist in all regions and most states to reclaim these areas through conversion of sod-forming grasses to native warm season grasses (NWSG). There is still much to be learned about converting these habitats to NWSG but organizations like the Center for Native Grasslands Management are making large strides toward effectively recovering these working landscapes. However, similar to prescribed burning conservation programs targeting this restoration opportunity are necessary to provide landowners adequate incentive to manage to benefit bobwhites.

The BRI is transparent in that it allows viewers to understand why the habitat rankings were established for a region, how ranks were assigned, and what opportunities and constraints exist. There are real differences separating areas considered to have high potential from moderate potential (see Tables 1 and 2). Opportunities for areas with moderate potential are more likely to include some form of pasture restoration to native warm season grass communities and impediments to management are more likely to include presence of sod-forming grasses and closed-canopy hardwoods. In areas with high potential, addition of field borders and CRP practices to row crop agriculture are the dominant opportunities in the Central and Midwestern states versus forest management and prescribed fire in the Southeastern states. Regardless, biologists viewed changing existing vegetation structure as a key to success versus eradication of exotic species, such as sod-forming grasses. That said, in some states or portions of BCRs, the major opportunities include modifying pastureland, such as Kentucky and Tennessee, and these states are having success when doing so. However, in BCR 27, 29, 30 and 31, the major opportunities for restoration of early-succession species is the use of prescribed fire, woodland management and longleaf restoration. Both within a BCR and across BCRs it is clear that policy for bobwhite conservation needs to be spatially and regionally explicit and the NBCI Conservation Planning Tool provides a means of estimating both acres of habitat management needed, and where those acres exist, to support establishing new efforts. While woodland management and prescribed fire are important in BCRs 13, 22, and 24, they are secondary to programs focusing on adding habitat to row crop fields, such as CP33 and CRP whole field enrollment. Biologists are having success applying existing programs to the landscape, especially in Missouri, Kansas, and Iowa, and for some programs such as CREP and CP33, successful increases of bobwhite populations are ensuing. The NBCI demonstrates that if the correct policy is available to implement habitat, and economics are acceptable to landowners, then habitat can be improved on private lands. These conservation policies should be encouraged, but we need to fill the gaps that exist in current policy across the range of bobwhites to be successful.

Harvest Management on Public Lands.

In almost all regions of the bobwhite range, publicly-owned lands have tremendous importance for meeting the goals of the NBCI (see Regional Chapters). Public lands provide long-term conservation opportunities, reliable access to the public for recreation, and may serve as core focus areas or demonstration sites for private landowners interesting interested in bobwhite and early-successional species. However, if hunting pressure is excessive and is not restricted, excessive harvest may result in lower bobwhite populations or hinder bobwhite response to new management actions.

Research indicates that harvest may act as an additive source of mortality for bobwhite populations (Williams et al. 2004, Rolland et al. 2010, Sands 2010); that is, bobwhite populations are influenced by harvest such that total mortality rate is greater when hunting occurs. Scientists now advocate shifting from a concept of a harvestable surplus having little-to-no impact on bobwhite populations to one recognizing that harvest may deleteriously impact bobwhite populations. It has become more apparent that survival rate of bobwhites is a key demographic variable in determining bobwhite population change (Sandercock et al. 2008). As populations are sensitive to survival and harvest is additive, public managers need to be cognizant that harvest pressure can reduce the chances for bobwhite populations to respond to habitat opportunities created on the landscape.

High hunting pressure may occur on public lands because there is often few other places for hunters to go. However, for ardent quail hunters who are often passionate about traditional quail hunting and a chance to work their dogs may be more important than the rate of covey finds. Therefore, hunter groups may be more interested in maintaining access at the highest levels even if there is a reduction in overall population size and harvest. Studies have documented harvest rates in excess of 40% of the fall population and in some cases much higher (Rolland et al. 2010). Contrast this with long-term sustainable populations that occur on private lands in the southeastern U.S. where harvest rates rarely exceed 15%, and are more typically less than 10%, even including crippling loss (Burger et al. 1998). Managers should be cognizant that while higher harvest rates (25%) may provide for stable bobwhite populations in southern latitudes (Sands 2010), when attempting to increase populations on focal areas a more conservative harvest (or no harvest at all) may be advisable until populations reach a desired threshold. Therefore, the NBCI recommends that agencies incorporate harvest strategies into their step-down plans to keep harvest rates at levels that do not diminish quail population targets. In southern latitudes this level appears to be at or below 20%, with rates above 30% being unsustainable through the long-term (Sands 2010, Rolland et al. 2010). For northern latitudes, the level at which harvest becomes unsustainable is unknown, but several studies point to general latitudinal trends in bobwhite demographics with lower survival and higher production in northern latitudes compared to southern latitudes (Roseberry and Klimstra 1984, Guthery 1997, Guthery 2002). If this relationship holds true one could infer that higher harvest rates in northern latitudes is feasible.

With harvest rates at appropriate levels, the size and number of restoration areas needs to be considered in step-down plans. Conservative harvest that has minimal impact on annual survival rate is an important concept to be included in planning focal areas on public lands. For instance on a 10,000-acre management area with a fall population density of 0.33 bobwhite/acre, a crippling loss of 1 quail per every 3 harvested, a 15% harvest rate as a maximum, total harvest to hand should be about 331 quail. The best way for management to increase the harvest is to increase density on the property and to do so requires keeping harvest rates to a minimum. Another important point is that agencies need to consider the value of managing small properties intensively for bobwhites. For instance, a 1,000 acre property may only be able to support a harvest of 33 quail. Consideration of harvest in relation to the size of properties is an important process in determining which areas are best suited for public lands management.

Summary.

Aside from habitat ranking, regulating harvest, management opportunities and region-specific challenges, each region and state is challenged with having to change the perception of certain management actions (such as prescribed fire) among private landowners. As such, the need for developing collaborative efforts and partnerships with multiple organizations (e.g., USFWS, USFS, USDA-NRCS, PIF, WTF, QU, QF, and etc.) is key to restoring habitat, improving policy to render appropriate habitat management, changing human perceptions and biases towards the utility of fire and other management, and more efficiently make a landscape-scale impact on bobwhites and grassland birds, as a whole.

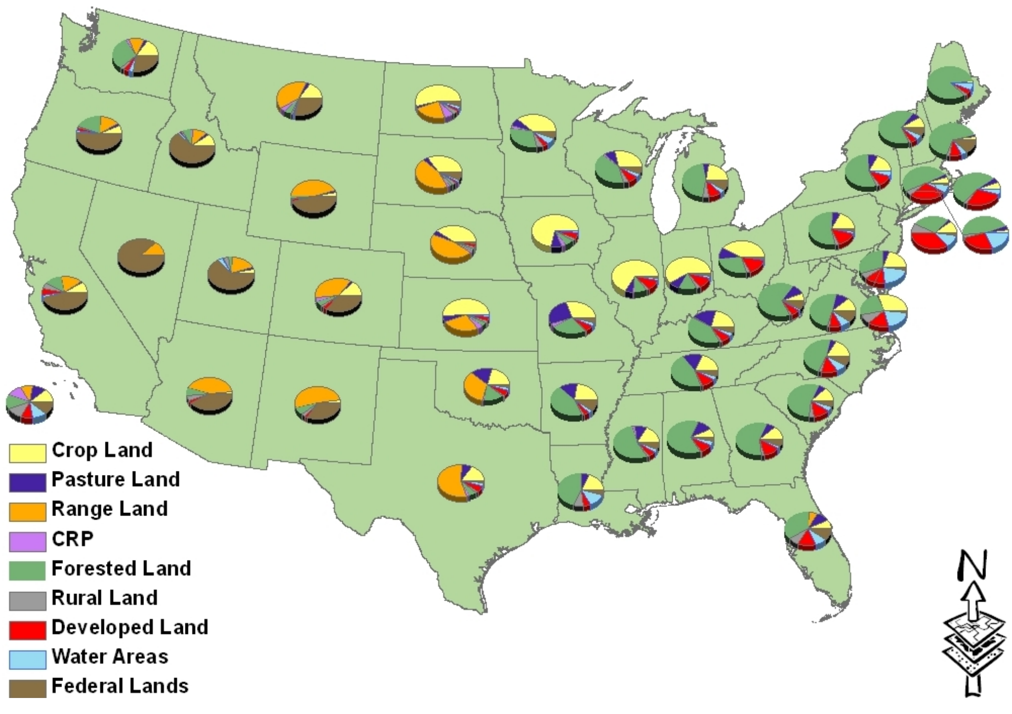

Figure 11: National Resources Inventory Land Use Classification data (2003). This graphic illustrates the disparity of dominant habitat types related to region. For example, the Midwest region is predominantly farmlands compared to the heavily forested lands seen in the Southeast region. These differences underscore the importance of region-specific habitat management and corresponding conservation practice needed to help guide management efforts for recovery of bobwhites region-wide (Regional chapters discuss these opportunities in more detail).

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4.1 Mid West Regional Issues in Bobwhite Conservation.

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The Midwest region of Kansas, Nebraska, and Missouri contains approximately 146,784,300 acres of land (National Resources Inventory 2007). Cropland represents the major land use type in the Midwest region followed by rangeland, pastureland, and forestland (Table 1). Differences in soil type and a major gradation in average rainfall from east to the west (Figure 12) lead to a great deal of vegetative diversity across the region. Correspondingly, there are 8 bird conservation regions (BCRs) that intersect the Midwest but the majority of the region is contained within the following 4 BCRs: Shortgrass Prairie (BCR 18), Central Mixed-grass Prairie (BCR 19), Eastern Tallgrass Prairie (BCR 22), and Central Hardwoods (BCR 24) (Figure 13). Bobwhites reach the northwestern extent of their range in BCRs 18 and 19 within this region. Populations at the fringe of the bird's range fluctuate greatly due to frequent drought and occasional deep snow cover.

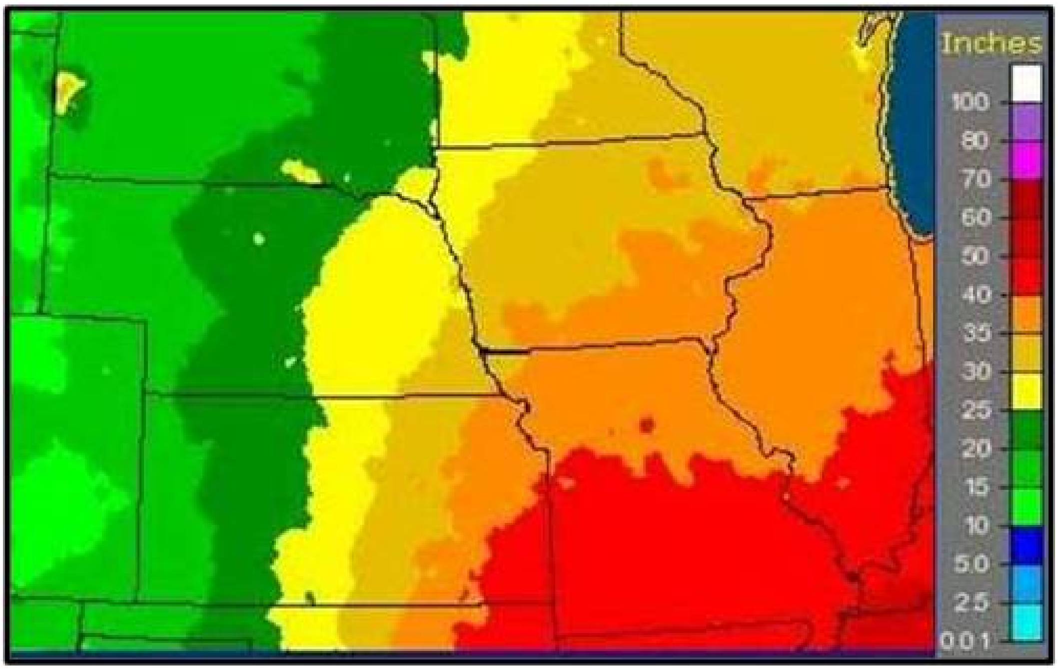

Figure 12: Average annual rainfall amounts in the Midwest region, 1961-1990 (National Weather Service, 26 Jan. 2011).

4.1.1 Habitats.

Bobwhite populations have declined rapidly in the central and eastern portions of the Midwest region since the 1960s (Figures 14 & 15). However, populations have remained fairly stable in the western and northern portions of the region. Existing bobwhite habitat in the region consists of restored grasslands (CRP) within agriculturally dominated landscapes, native rangeland containing a shrubby component, oak savannas, and herbaceous plant communities in the early stages of woodland succession.

Factors negatively influencing populations of bobwhites and other grassland birds in the Midwest region include: woody encroachment into native prairies; lack of shrubs and residual grass cover in annually burnt rangelands; natural succession of herbaceous plant communities into closed canopy forests; lack of native grasslands due to agriculture, conversion to non-native species, or urban development; and over-utilization by livestock (Fitzgerald et al. 2005, Vodehnal and Haufler 2007). Many of these problematic factors have developed as a result of inadequate disturbance frequencies (e.g., fire, grazing, logging, etc.).

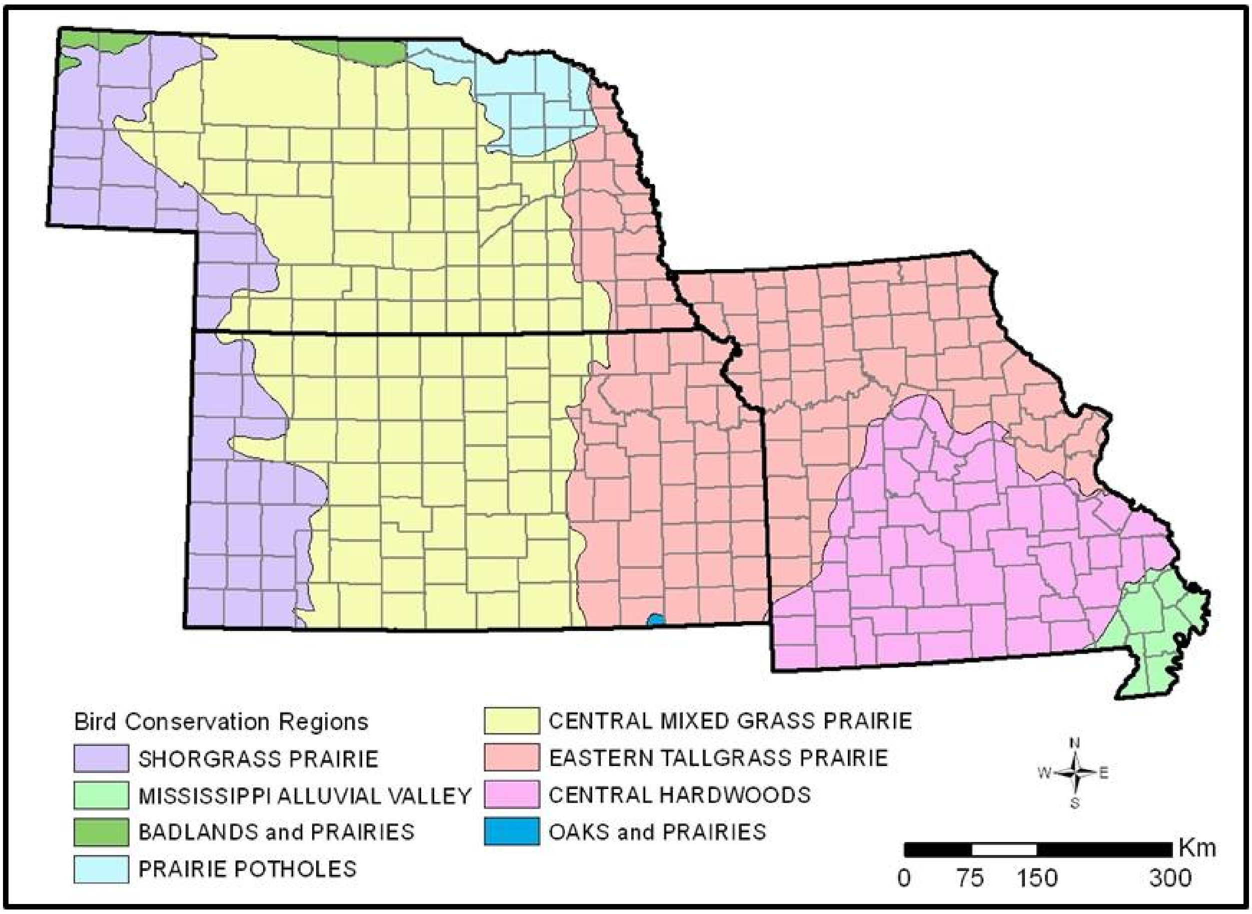

Figure 13: Bird conservation regions that intersect the Midwest states.

4.1.2 Opportunities & Challenges.

Shortgrass Prairie. Historically, bobwhite habitat in the shortgrass prairie BCR was probably limited to lowland areas adjacent to riparian corridors and sand sagebrush prairie in the southern portion of the region. The north-western extent of the bobwhite's range is in northwestern Kansas and southwestern Nebraska where suitable habitat is sparse and harsh winter conditions are fairly common.

The majority of the native prairie north of the Arkansas River is dominated by short grasses and few shrubs and doesn't provide adequate concealment for bobwhites. When the conservation reserve program (CRP) was implemented in the 1980s bobwhite populations in the shortgrass prairie BCR increased and expanded; especially north of the Arkansas River. The CRP consisted mostly of mixed and tallgrass species and provided 2-3 million acres of useable space throughout the BCR where little or none previously existed.

The shortgrass prairie is one of the few places in the country where bobwhite populations have increased and expanded over the last 25 years. However, there are still problematic areas within the region where habitat improvements would provide great benefit to bobwhites. Much of the sand sagebrush rangeland south of the Arkansas River is grazed too heavily to provide optimal cover for nesting bobwhites and other grassland birds. Landowner incentives to decrease stocking rates and/or implement different grazing systems (e.g. rest/rotation) would be an area of opportunity in this portion of the region.

Much of the CRP in the region has received little or no disturbance since establishment. The use of fire is not accepted by most landowners in this BCR and recent droughts have caused many counties to impose burn bans. As a result, the stands have shifted to predominately grass with few forbs reducing their functionality for bobwhites. Grassland wildlife in this region might benefit greatly if landowner outreach programs were developed to increase use and acceptance of fire as a management tool. Along those same lines, increased landowner incentives for implementing more frequent disturbance and to inter-seed forbs into CRP sites would also be beneficial. Additionally, most CRP stands in the region do not have a shrub component. The value of those tracts would be greatly increased to bobwhites if additional incentives could be created to encourage more landowners to incorporate shrubs into their stands. Shrubs are especially critical to bobwhites in the shorgrass prairie BCR because they provide thermal cover to help bobwhites endure the excessive heat, drought, and harsh winter conditions that are fairly common to the region.

Central Mixed-grass Prairie. Bobwhites can be found in good numbers throughout the southern portion of the mixed-grass prairie BCR in the Midwest region. The northern reaches of the BCR within the region are at the fringe of the species' range due to the regularity of deep snow cover and harsh winter conditions. Bobwhite populations have remained fairly stable over the last 35 years in this BCR. Landowners have willingly enrolled millions of acres of CRP throughout the region providing useable space where agriculture once existed. This increase in habitat has nearly offset the degradation that has occurred to other portions of the landscape contained within the region.

Many of the native rangelands in the eastern portion of the region have been invaded with trees over the last 30 years; especially eastern red cedar. This invasion has occurred as a result of fire suppression and relatively high rainfall compared to further west in the BCR (Figure 12). The exact acreage of rangeland that has been affected by woody encroachment is not known but certainly numbers in the

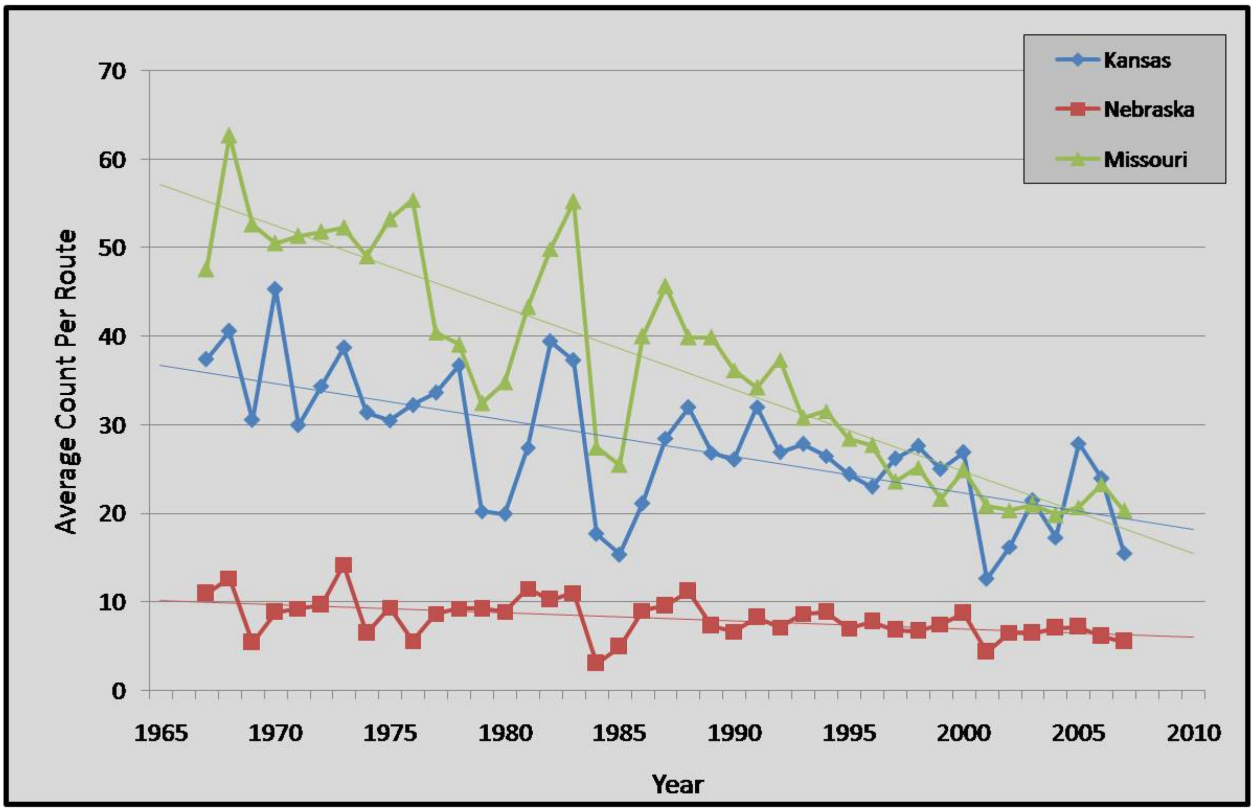

Figure 14: Northern bobwhite trend within Kansas, Missouri, and Nebraska from the breeding bird survey (BBS) count data, 1966-2007 (Sauer et al. 2008).

millions. This degradation has resulted in habitat that is less suitable or unusable by bobwhites and numerous other grassland wildlife species. Additionally, much of the rangeland throughout the region has been over-utilized by livestock. Bobwhites would benefit most in this region if increased incentives and additional funding were available to landowners for tree shearing and adoption of grazing and burning plans developed by resource professionals.

There are millions of acres of CRP in the region and most of those stands do not provide optimal structure or composition for bobwhites. The existing CRP is certainly better habitat than the agriculture that was replaced but inadequate disturbance since establishment has greatly degraded the wildlife value of many of these stands. Bobwhite populations in this region would benefit from landowner outreach programs and additional incentives designed to encourage landowners to increase disturbance, inter-seed forbs, and incorporate native shrubs into their CRP stands.

Eastern Tallgrass Prairie. Bobwhites can be found throughout the eastern tallgrass prairie BCR within the Midwest region. However, their populations have declined sharply over the last 35 years (Figure 15). Suitable bobwhite habitat within this BCR is relatively sparse compared to further west within the Midwest region. The remaining tracts of good habitat consist of well managed private rangeland, CRP, and government-operated natural areas.

Approximately 96% of the eastern tallgrass prairie has been replaced by agriculture or urbanization making it one of the most degraded ecoregions in the world (Sampson and Knopf 1994). Most of the remaining tallgrass prairie can be found in one relatively contiguous block within the Flint Hills physiographic region of Kansas. The thin soil profile, exposed rocks, and rough topography spared this region of the tallgrass prairie from the plow. Unfortunately, management of this remaining large block of rangeland over the last 35 years has been less than ideal for bobwhites and many other grassland birds.

Starting in the early 1980s the frequency of fire in the core of the Flint Hills began to increase to the point where most landowners are now burning annually. At the same time, landowners began switching to a grazing system known as intensive early stocking (IES) to increase their profits. An IES system calls for yearling steers stocked at twice the 180 day rate for a 90 day grazing season that starts shortly after spring burning is complete. Annual burning and IES provides little nesting cover because all the residual grass cover is consumed by fire each year and spring regrowth seldom attains a suitable height for concealment. Burning annually for several consecutive years also eliminates shrubby cover and as a result of the increased fire frequency the core of the Flint Hills is now almost totally void of native shrubs. Prior to the early 1980s, burning in the Flint Hills was more periodic and most of the ranchers were running cow-calf operations utilizing 180 day stocking rates and grazing seasons. The "traditional" style of management was much more favorable to bobwhites because much more suitable cover for nesting and protection was provided compared to the current management system.

The native prairie along the fringe of the Flint Hills and the small tracts sparsely spread across the remainder of region are generally invaded with trees as a result of infrequent disturbance. Additionally, most of the remaining tracts of grassland east of the Flint Hills have long ago been converted from native grasses to monotypic stands of tall fescue or smooth brome which has made them almost totally unusable to many species of grassland wildlife (including bobwhites). There is over a million acres of CRP spread across the agriculturally dominated portions of this BCR but due to inadequate disturbance frequency many of those tracts are much too dense to provide suitable habitat for bobwhites.

The greatest opportunities for increasing bobwhite populations within the eastern tallgrass prairie BCR include: 1.) additional incentives and funding to encourage landowners to increase the frequency of disturbance within existing CRP, 2.) additional incentives and funding for tree shearing and adoption of prescribed burning plans on privately owned grassland, 3.) additional incentives and funding to encourage landowners to adopt grazing plans developed by resource professionals, 4.) additional incentives and substantially more funding to help landowners convert exotic pastures back to native grasslands, and 5.) increased public outreach to private landowners regarding the ecological importance and financial benefits of proper fire frequency.

Central Hardwoods. Prior to the 1800s, bobwhites in the Central Hardwoods BCR benefited from an abundance of native grassland and pine woodland. Bobwhites flourished during a brief period in

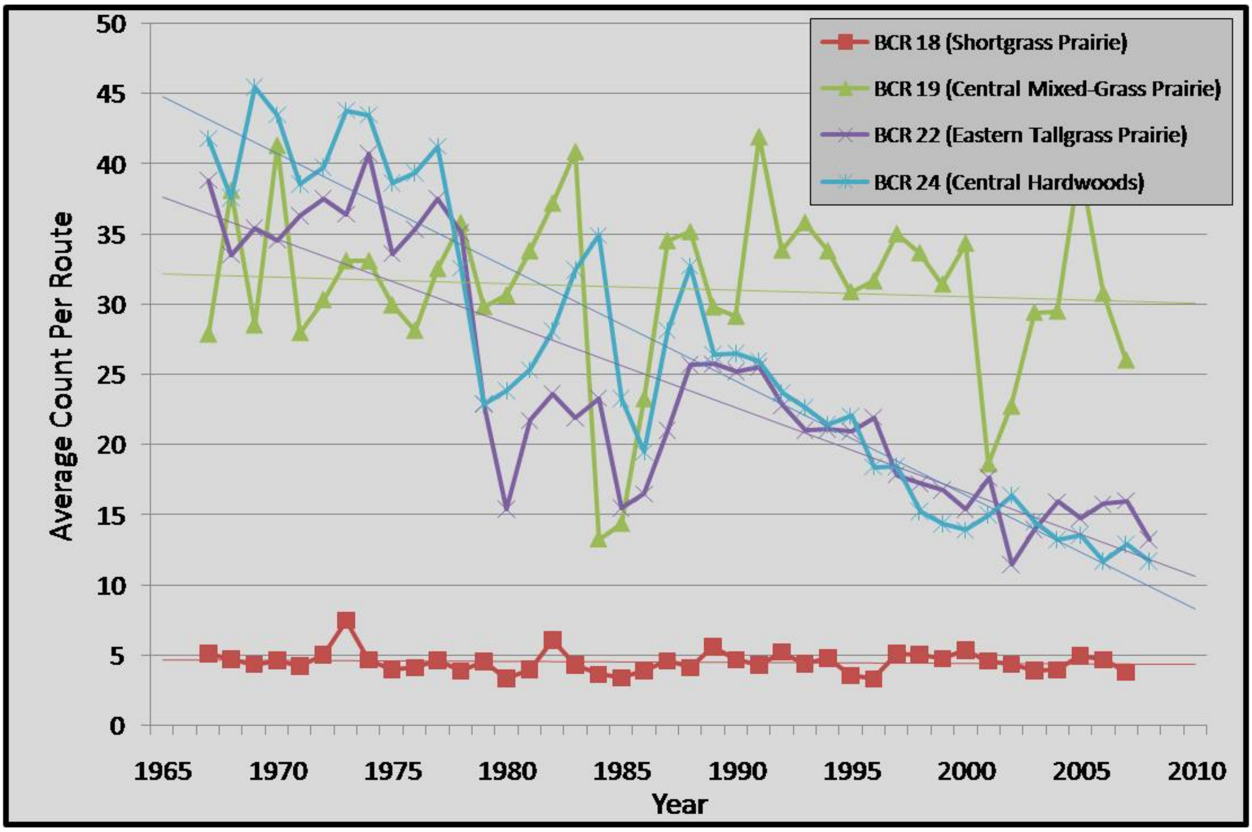

Figure 15: Northern Bobwhite trends, from the breeding bird survey (BBS) count data, within the four most prominent bird conservation regions that intersect the Midwest region, 1966-2007.

1800s when European settlers cleared trees from portions of the landscape and created a patchwork of weedy agricultural fields. Today, bobwhites are scarce because agriculture is too intensive, with most of the native grasslands converted to large row crop fields or large pastures of exotic grasses (typically monotypic stands of tall fescue), and the pine woodlands have largely been converted to oak or oak-pine forests, primarily as a result of fire suppression.

The restoration potential of the Central Hardwoods BCR for birds has been extensively evaluated under the leadership of Partners In Flight (PIF) (Fitzgerald et al. 2005), and bobwhites were identified as a priority species for the pine woodlands (scattered shortleaf pine with extensive grass, forb and shrub understory) and grass shrublands (open grasslands with scattered shrubs). To achieve landscape-scale restoration, PIF recommended a primary focus on the large tracts of public land common in the Central Hardwoods BCR. On these public lands, bobwhites will benefit from a return to the native plant communities of the early 1800s, and this will require carefully designed prescribed burning, removal or suppression of undesirable herbaceous and woody species via mechanical, grazing or chemical treatments, and reseeding of native plants in some cases.

Along with these core restored public lands, adjacent private lands should also be a focus of management. The most cost-efficient way to increase bobwhite habitat and populations on private land would be to encourage landowners to retire existing agriculture fields into planted stands of native grasslands (e.g., CRP or CCRP). This can be done with increased incentive payments and conservation priority areas to help target enrollment into areas where bobwhites would receive the most benefit. It will also be critical in this BCR to encourage frequent disturbance of those introduced stands because natural succession occurs quickly when average annual precipitation is >30 inches (Figure 12). Public outreach efforts should also be expanded in the region to promote the benefits of fire on the landscape to increase public acceptance of prescribed burning. Other efforts that would increase bobwhite populations in the region include: 1.) increased cost-share and funding to assist landowners in converting non-native pasturelands back to native warm-season grasses, 2.) increased incentives and funding to encourage landowners to adopt grazing plans developed by resource professionals for native grasslands, and 3.) increased public outreach to landowners about the benefits that warm-season grasses provide to livestock producers.

4.1.3 Partnerships.

Successful restoration of deteriorating bobwhite habitat in the Midwest region will depend upon the establishment of numerous partnerships between the following entities: state wildlife and forestry agencies, U.S. Fish and Wildlife Service, U.S. Forest Service, Natural Resources Conservation Service, Farm Service Agency, Department of Defense, National Wild Turkey Federation, Quail Unlimited, Quail Forever, Pheasants Forever, Quail and Upland Wildlife Federation, Soil and Water Conservation Districts, universities, numerous grazing associations, and many other local and regional agricultural and conservation organizations. Because conservation dollars are limited it will be important for these entities to pool their resources and actively seek out other funding sources where they can leverage their money.

Within the Midwest region, it will be especially critical for the conservation organizations to establish or maintain good relationships with the Farm Service Agency and the Natural Resources Conservation Service if bobwhites are to be successfully restored. Those agencies have well-funded, existing programs capable of addressing bobwhite habitat limitations within agricultural and grassland systems which are the dominant land uses within the region. When possible, the conservation community should assist in the development and implementation of their programs because they currently have the greatest potential to restore bobwhite populations within the region.

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4.2 Southwest Regional Issues in Bobwhite Conservation.

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The Southwest region of Texas and Oklahoma contains approximately 215,790,000 acres of land (National Resources Inventory 2003). Rangeland represents the major land use type in the Southwest followed by cropland, pastureland, and forestland (2003 National Resource Inventory; Table 1). Bobwhites reach the western extent of their range in this region where weather plays a major role in annual variation in populations. Despite harsh conditions bobwhites reach densities in excess of a quail per acre in portions of BCRs 36 and 19 in certain years (Figure 16). In the region as a whole, bobwhites have experienced long term decline (Figure 17). There is a long list of factors that are often blamed for the demise of quail including fire ants and feral hogs. In reality, entire regions of Texas and Oklahoma have been drastically altered by changes in agricultural practices, fire suppression, and human population growth. These changes occurred slowly over the past century resulting in an overall loss of native habitat. Priorities for the Southwest include maintaining usable habitat where it exists and restoring prairie and savanna ecosystems. The Gulf Coastal Prairie and Oaks and Prairies BCRs (Figure 18) have the greatest restoration potential for quail and other grassland birds.

4.2.1 Habitats.

Prairie, oak savanna, and mesquite savanna are the key ecosystems important to shrubland and grassland birds in the Southwest Region. These ecosystems are found in the Southern Great Plains, Gulf Coastal Prairies and the Tamaulipan Brushlands. Although pine savanna historically supported high densities of bobwhite, increasingly smaller land ownerships, Smokey Bear, and the economics of timber make quail recovery improbable except on Federal, State and reclaimed lands, land trusts, and wildlife cooperatives (Masters et al. 2003, Wilkins et al. 2003, Perez et al. 2005).

<u>Southern Great Plains.</u> The savanna and prairie habitat types of the Southern Great Plains once found in the Edwards Plateau, Oaks and Prairies, Central Mixed-grass Prairie, Short-grass Prairie, and Gulf Coastal Prairie have been reduced to a mere fraction of their former distribution. Historically, this expanse of grasslands was a dynamic system driven by natural fire and grazing animals. At any given time, patches of burned, grazed, or undisturbed prairie were strewn across the landscape in a patchwork quilt (TGFOC 1945, Dyksterhuis 1948, Wright and Bailey 1982:82, Bachand 2001, Fuhlendorf and Engle 2001). Bobwhites likely only utilized parts of the quilt, unable to persist in areas with no shrubs or in areas too thick with undisturbed climax grasses.

Post-European settlement, fire suppression and grazing led to the encroachment of woody species

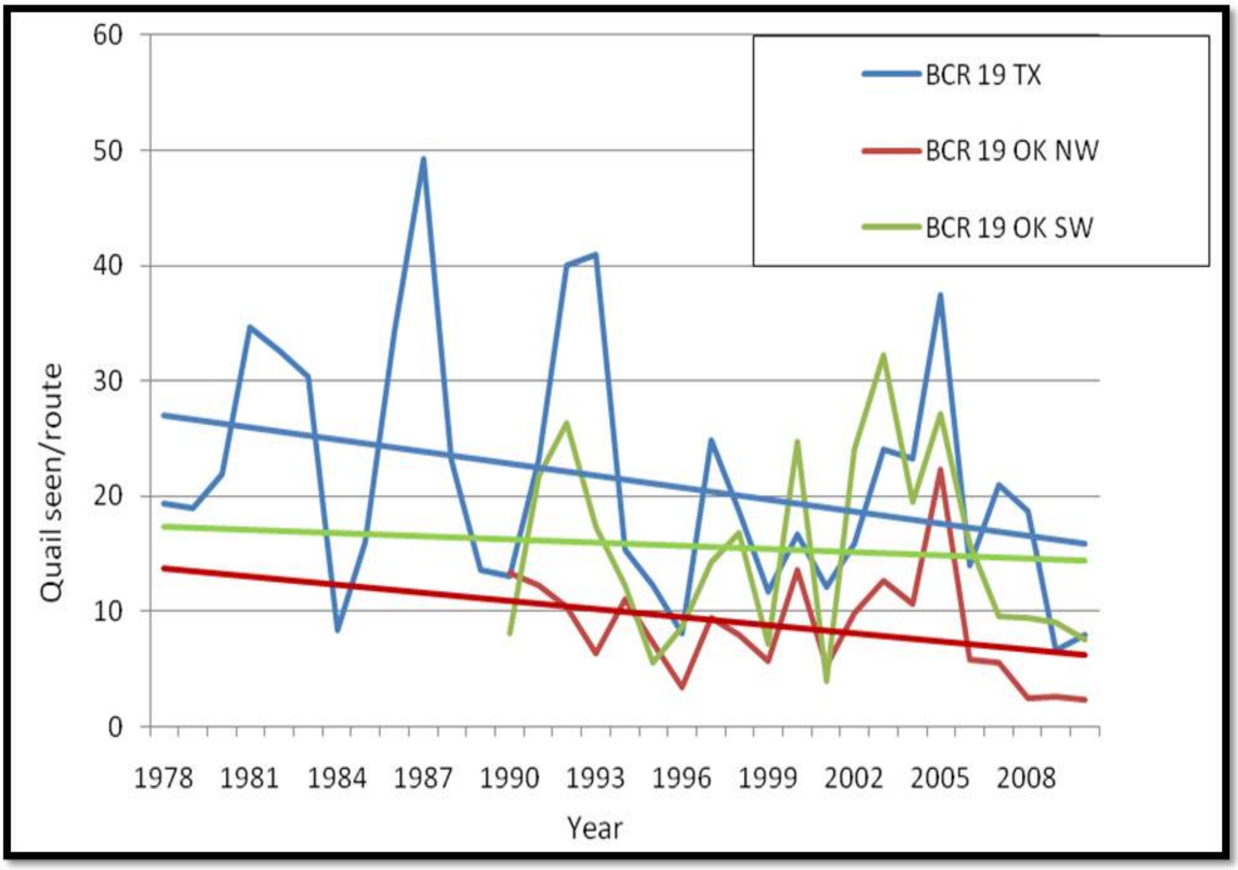

Figure 16: Trend in Northern Bobwhite population in BCR 19 within the Southwest region from state wildlife agency August Roadside Survey data, 1978-2010 (ODWC 2010, TPWD 2010).

from areas protected from fire. As prairie and savanna transformed to shrubland or woodland habitats, more permanent cover became available for quail. Grazing and small scale farming also created more seed-producing forbs that provided bobwhite with food and brooding cover. At one time or another, robust bobwhite populations have been recorded across the majority of the Southern Great Plains (TGFOC 1945:46-60, Dyksterhuis 1948). But woody cover gradually became too dense (>50%) and native bunchgrasses were greatly reduced by improper grazing or replaced by exotic grasses like Bermudagrass (Cynodon dactylon), which rendered much of the Southern Great Plains unusable by bobwhite (TGFOC 1945:46-60, Jackson 1965). Today, the only remaining stable bobwhite populations in the Southern Great Plains are within the Kansas, Oklahoma and Texas portions of BCR 19 and in BCR 36 where land use on native rangelands still produces suitable bobwhite habitat (Sauer et al. 2008, DeMaso et al. 2002). There are certainly bobwhites in other regions, especially where bobwhite needs are a part of the overall management objectives.

<u>Gulf Coast Prairie.</u> The Gulf Coastal Prairie was once a vast area of mid to tall grasses populated by bison (*Bison bison*), pronghorn antelope (*Antilocapra americana*), prairie chicken (*Tympanuchus* spp.), and other species associated with fire-dependent prairie habitats. It is estimated that <1% of the Gulf

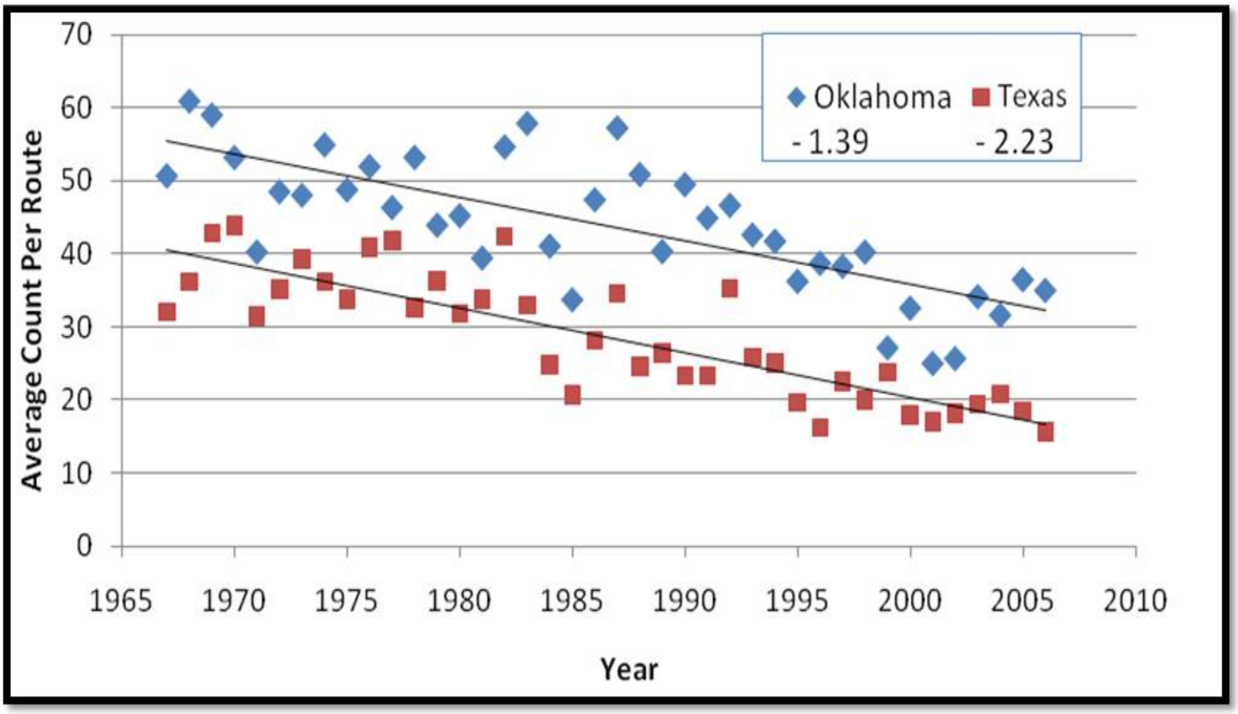

Figure 17: Trend in Northern Bobwhite population in the Southwest region from Breeding Bird Survey count data, 1966-2007 (Sauer et al. 2008).

Coastal Prairie remains today as a result of the same processes that altered the Pine Savanna and Southern Great Plains regions in Texas (Inglis 1964:74, Smeins et al. 1991:270, Schmidly 2002:390). Bobwhites increased in abundance along with woody plant species and small farms up until the 1940s. Post-World War II pressures on habitat have gradually transformed the Gulf Prairies into a region that provides very little usable space for bobwhites. The bison and antelope have been long gone and only a handful of the endangered Attwater's prairie chicken (*Tympanuchus cupido attwateri*) remain, but the lower Gulf Coast still has areas of remnant prairie in Goliad, Victoria, and Refugio Counties where bobwhites are holding their own. The Coastal Prairie Conservation Initiative and Audubon Texas' Quail and Grassland Bird Initiative are examples of partnerships of state, federal, non-governmental agencies and most importantly private landowners that have made great efforts to provide habitat in this area for viable prairie wildlife populations including bobwhite. Prescribed burning, proper grazing management, and soil disturbance are integral to bobwhite management in the Gulf Coastal Prairies.

Tamaulipan Brushland. The more arid Rio Grande Plains of Southern Texas supports stable populations of bobwhite and is a popular destination for quail hunters from across the nation (DeMaso et al. 2002, Perez et al. 2005, Sauer et al. 2008). Early explorers described this region as a mesquite-savanna with smaller areas of dense chaparral (Inglis 1964). In 1722, Pena observed "a great number of turkey and quail" in Atascosa County and also mentioned numerous quail in Zavala County. Researchers hypothesize that the Rio Grande Plain has shifted from savanna to dense chaparral (brushland) over the past 150 years as a result of fire suppression and heavy grazing pressure (Johnston 1963, Archer et al. 1988).

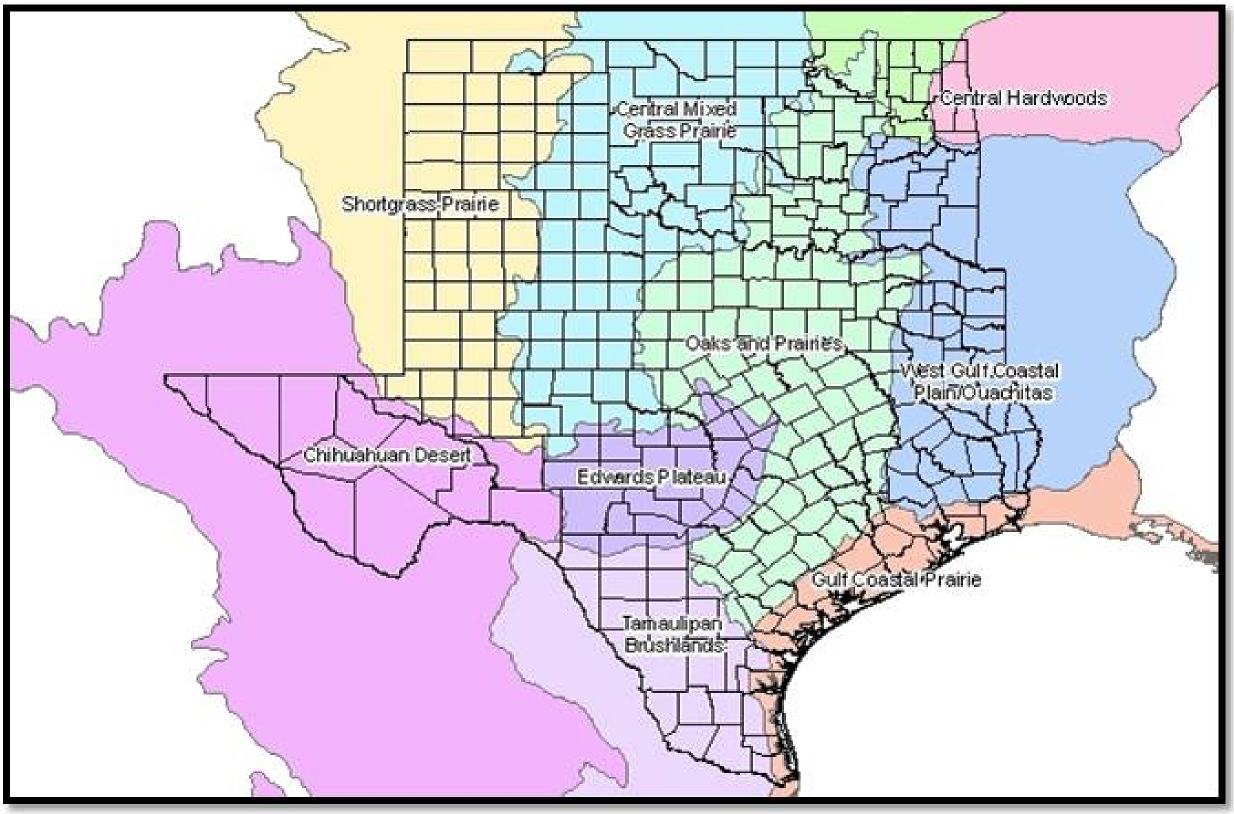

Figure 18: Bird Conservation Regions located within the Southwest States.

Bobwhite are most abundant where diverse brush makes up <40% of a given area and range condition is high (Spears 1993, Guthery 1986). Since brush recovery can take 3 - 5 years before it provides loafing cover, most managers leave mottes or strips of brush to ensure interspersion of adequate cover (Lehman 1984:259, Howard 1996). The semi-arid conditions of the Rio Grande Plains make burning improbable during drought years and beneficial to bobwhite only when combined with proper grazing management (Howard 1996, Ruthven et al. 2002).

Bobwhite are generally thought of as being an "early successional" species (Allen 1962:69, Dasmann 1966:86). However, the successional stage to which bobwhite are best adapted changes with climate. Bobwhites are clearly a lower successional species in rich environments - those with high rainfall, good soils, and long growing seasons. Higher successional stages, however, work best in poorer environments (Spears et al. 1993, Guthery 2000). This is an important concept to remember when choosing management and restoration practices in drier climates.

4.2.2 Opportunities.

Priority areas identified within the region through the NBCI revision process include savanna and prairie bird habitats. The landscapes of these priority areas can be described as either native rangelands that hold sustainable populations of bobwhite (BCRs 19 and 36) or grasslands/woodlands that support only marginal populations of bobwhite (BCRs 21 and 37) (Figure 3).

Opportunities in native rangelands include EQIP and WHIP emphasis areas that cost share habitat practices that enhance upland habitat. Practices have included payments for deferred or planned grazing. For example, over the past 4 years, 2.5 million of federal Farm Bill funding has been used in EQIP Quail Priority areas in Texas. The majority of Habitat Buffers for Upland Birds (Bobwhite Buffers; CP-33) and State Acres for Wildlife Enhancement (SAFE; CP-38) have been established in high priority areas for bobwhites and Lesser Prairie-chicken. The Great Plains LCC, Playa Lakes Joint Venture, Rio Grande Joint Venture, USFWS Partners Program, additional SAFE acres and targeted national WHIP funding are all future cost-share opportunities in these regions.

Opportunities in woodlands and grasslands include the Landowner Incentive Program, Pastures for Upland Birds (Texas), Quail Habitat Restoration Initiative (Oklahoma), Audubon Texas Grassland Bird Initiative, The Nature Conservancy Texas Fire Management Program, NRCS Conservation Innovation Grant (Texas), and WHIP and EQIP funding. Future opportunities include additional CIG grants, CCPI, LCC, CRP and state grants. The formation of new landowner cooperatives is essential to success in these areas. Partners are working to develop landowner cooperative incentives. Fortunately the Southwest region is home to many conservation minded organizations with programs targeting the restoration and conservation of quail and other grassland birds.

4.2.3 Challenges.

Landscape level changes make restoration a daunting task indeed. Bobwhites face many challenges for their survival but the major factors that have had an enormous impact on the Southwest Region landscape include improper grazing, lack of fire, exotic grasses and habitat fragmentation as described in the habitat section of this chapter.

High quality nesting cover appears to be a limiting factor across the Southwest region. There is a need to form new partnerships and programs targeting enhancing rangelands for quail and offering additional technical and financial incentives.

The suppression of fire is another major challenge that will require changes in both perception and policies. Resource agencies need to provide additional equipment and training for field staff. All conservation groups should work together to support fire in the farm bill and increase education and outreach efforts.

Exotic grasses provide very little habitat for quail and other wildlife. Supporting research on how to replace exotics with more wildlife friendly plant communities is a top priority in the Southwest region. Rising fuel and fertilizer costs have made exotic grasses less appealing compared to native grasses which require very little input. If researchers and conservationists can clearly demonstrate the economic advantages to native pastures, landowners will be far more likely to participate in restoration programs.

When fragments of habitat become small and distant from one another, quail can easily become locally extirpated with no source of birds to re-establish. Quail management cooperatives like the Wildlife Habitat Federation and the Western Navarro Bobwhite Restoration Initiative in the Oaks and Prairies of Texas have shown us that it is possible to restore quail in fragmented landscapes. We need to take successful models like these and reproduce across the range of the bobwhite.

4.2.4 Partnerships.

Successful quail restoration and conservation in the Southwest region includes becoming more efficient with existing resources, leveraging funds and partnering with outside agencies and organizations where possible. Playing an active role in shaping Federal Farm Bill programs is also very important. Only a strategic, focused approach will ensure positive results.

Partnerships in the Southwest region should include, but not be limited too, state wildlife and forestry agencies, US Fish and Wildlife Service, US Forest Service, NRCS, FSA, Soil and Water Conservation Districts, The Nature Conservancy, Quail Coalition, Quail Forever, National Wild Turkey Federation, Audubon Texas, private consultants, industry (surface mining and reclamation, energy) and research institutions and universities.

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4.3 Mid-North Regional Issues in Bobwhite Conservation.

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The Mid North region of Illinois, Indiana, and Ohio contains approximately 85,661,700 acres of land (National Resources Inventory 2003). Cropland represents the major land use type in the Mid North, followed by forest land, developed land, and pastureland (see Figure 3.3.1). Although there are six major Bird Conservation Regions (BCR) located within the Mid North region: the Eastern Tallgrass Prairie (BCR 22) and Central Hardwoods (BCR 24) BCRs comprise the majority of the region (Figure 9) and contain the greatest potential for shrubland and grassland bird restoration, including Northern Bobwhites.

Bobwhite populations in the Mid North region are proving resilient despite long-term declines. These declines were exacerbated during a period of extreme winter weather from 1977 - 1984 (Figure 19). The winter of 1977-1978 in particular brought 18 severe winter storms to the region, including record snow falls and a severe ice storm. Snow cover of at least ten inches remained from 19 - 60 days and average daily temperatures for January 1978 did not reach above 6.6 °C (Changnon and Changnon 1978; National Weather Service http://www.erh.noaa.gov/iln/PSACMH.htm). Many areas of northern Illinois, northern Indiana, and northern Ohio continue to have no bobwhites. However, portions of northeast Illinois and northwest Indiana have recently experienced positive trends in bobwhite populations. Populations in the southern portions of the region seem to fluctuate according to winter and spring weather, with some years experiencing positive population trends while other years show decline. Population declines due to habitat loss in the Mid North region are not limited to bobwhites. Many species of birds with similar habitat requirements as bobwhites, such as Loggerhead Shrikes, Yellow-breasted Chats, Field Sparrows, and Prairie Warblers have also experienced population declines throughout the Mid North (Sauer et al. 2008).

4.3.1 Habitat.

Prairie, oak savanna, and open oak woodlands are key ecosystems important to shrubland and grassland birds in the Mid North Region. While many examples of these ecosystems still exist in the region, they are small in size and extremely isolated. Management activities on these habitat fragments should mimic natural ecological processes and include prescribed fire and prescribed grazing where appropriate. Management of early-succession habitats will be most effective when incorporated within mixed landscapes of row crop agriculture, pasturelands, and woodlands.

4.3.2 Management Opportunities.

Several priority areas suitable for shrubland and grassland bird conservation in the region have

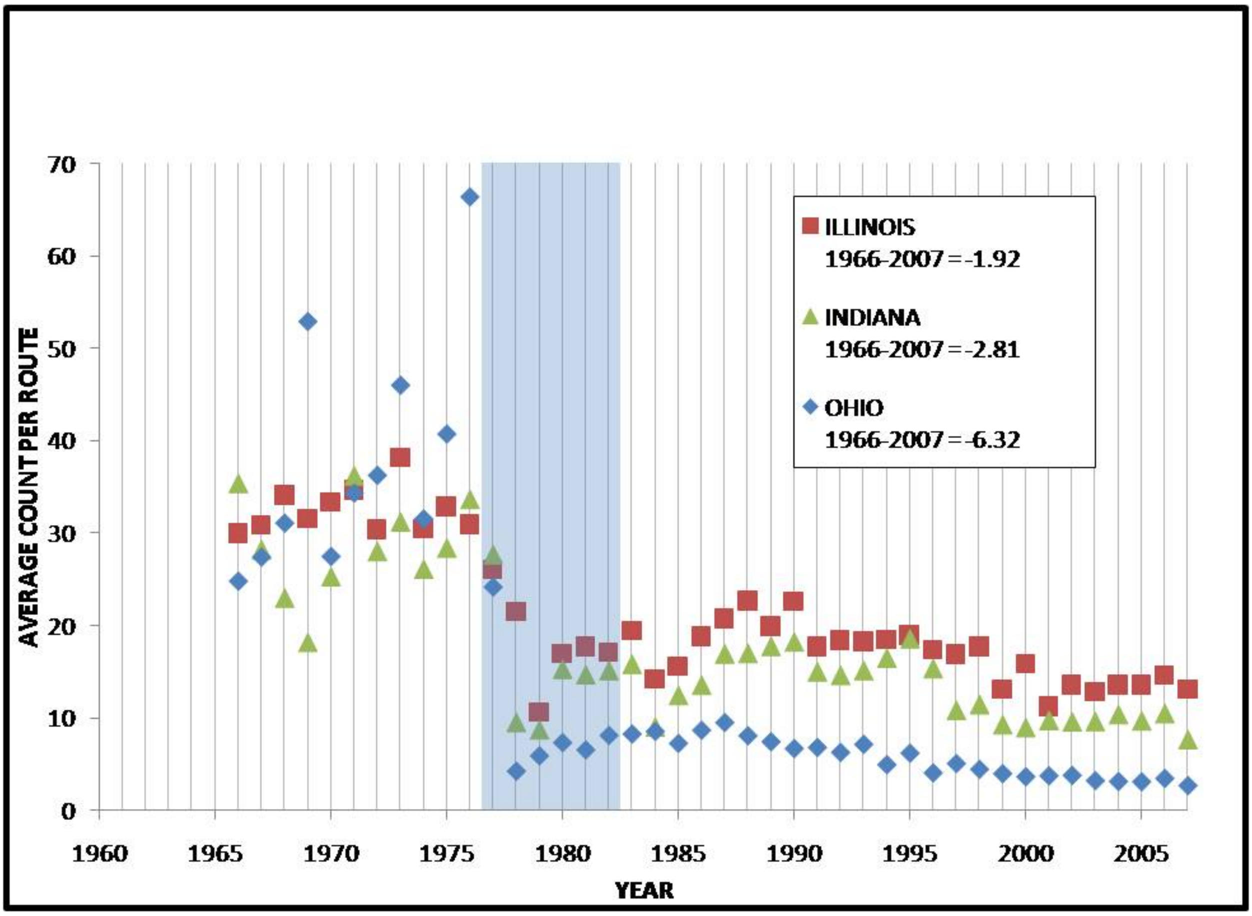
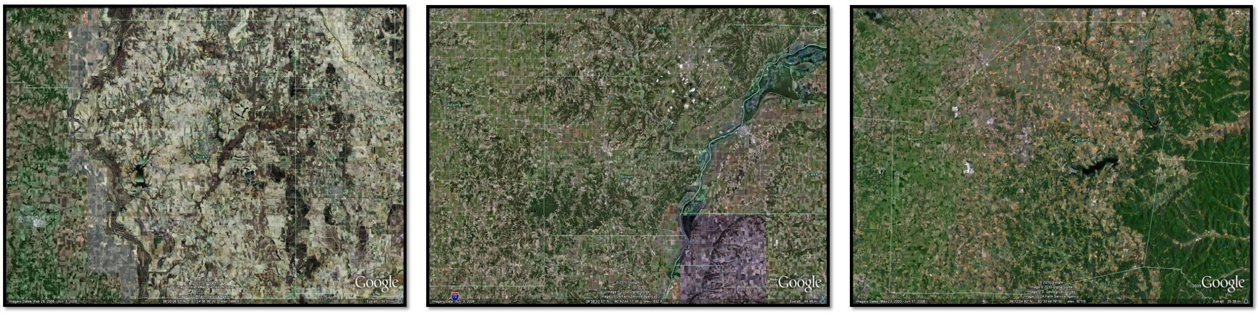


Figure 19: Trend in Northern Bobwhite population in the Mid North region from Breeding Bird Survey count data, 1966-2007 (Sauer et al. 2008). Shaded area represents period of severe winters from 1977-1984.

been identified within the region by the NBCI. The landscapes of these priority areas contain a mix of cropland and/or pastureland dissected by wooded riparian corridors and woodlots (Figure 20). The dendritic pattern of the woodlands in these landscapes provides curvilinear edge that is missing from the medium priority areas in which the landscapes are predominantly cropland with few woodlands. These woodland edges provide significant opportunity for edge enhancements to benefit grassland and shrubland birds, including bobwhites, through increased establishment of native grass buffers and edge feathering. The majority of Habitat Buffers for Upland Birds (Bobwhite Buffers; CP-33) and State Acres for Wildlife Enhancement (SAFE; CP-38) have been targeted and established in the high priority areas. Likewise, many of the bobwhite focus areas for private lands and bobwhite emphasis areas on public lands can be found within these priority areas. The bobwhite focus and emphasis areas contain core areas of bobwhites and grassland birds from which populations can more quickly respond to management programs and efforts.

Increases in soil rental rates and landowner incentives show promise to increase bobwhite and grassland bird habitat. The Scioto River Watershed Conservation Reserve Enhancement Program (Scioto

CREP) in Ohio is expected to add 70,000 acres of wildlife friendly habitat, including cool-season and warm-season grass filter strips, riparian buffers, wetlands, and tree and shrub plantings. Incentives in the Scioto CREP include 175 to 200% per acre soil rental rate payments, 50% cost-share to install practices, bonus incentive payments, and $5-$10 per acre annually for maintenance practices. Combinations of different incentive programs also show promise to increase shrubland and grassland bird habitat. A landowner in Pike County Indiana used incentives from WHIP and Indiana DNR cost share on 68 acres of tall fescue, smooth brome, sericea lespedeza, autumn olive, and black locust. The site was bulldozed and treated with herbicides then planted to native warm-season grasses and forbs. Bobwhite coveys increased from two in 2004 to six by 2009. An additional 25 acres will be restored using the Landowner Incentive Program of the US Fish and Wildlife Service in 2010. The Pike County, IN property and the Scioto CREP demonstrate the added value of partnerships in support of shrubland and grassland bird conservation. Expansion of increased incentive structure and combining incentive programs in other areas of the Mid North region will not only aid in meeting bobwhite population goals as stated in the NBCI, but also to positively impact populations of grassland and early successional birds as stated in Comprehensive Wildlife Strategies for the region.



(a) Sullivan County, Indiana. (b) Brown County, Illinois. (c) Highland County, Ohio

Figure 20: Aerial Imagery in three counties in the Mid-North Region depicting disparate habitat management potential amongst a diverse landscape.

4.3.3 Regional Challenges.

Limiting factors influencing bobwhites and other early-succession birds include lack of adequate nesting and brood rearing cover. Advanced regeneration of old fields and fence rows have severely reduced the quantity and quality of nesting and brood rearing cover. Hard edges typify borders of fields and forests where agricultural fields abut mature hardwoods. Exotic shrubs exacerbate the lack of nesting cover where softer field/forest edges do occur. Edge feathering practices could potentially increase available nesting and escape cover adjacent to woodlands. Changes to grass waterway management, including less frequent mowing and encouragement of native grass waterways, could also provide improved nesting conditions in the Mid North. Winter weather continues to be a major limiting factor for bobwhite and early-succession birds. The declines in bobwhite populations during the late 1970s and early 1980s as a result of extreme winter weather have been well documented. The winter of 2009 and 2010 has also been challenging to bobwhite populations. Covey densities in Highland County, OH were down 50%, with 30% mortality occurring in one week during the last storm of winter (Dr. Robert Gates, personal communications). Evidence of winter weather affects on bobwhites were evident through rapid weight decline, increased rates of avian predation, and increased reliance on honeysuckle in the diets (Dr. Gates, personal communications). Winter mortality can be buffered by increasing the availability of dense shrub cover near areas of food production. Edge feathering, CP-33, and other cost-share programs that incorporate woody cover with habitat management prove to increase the quantity and quality of winter cover needs. Furthermore, increased landscape level management programs will ensure sufficient travel corridors are available to aid in re-populating areas affected by excessive winter mortality.

Modern agricultural practices, uncompetitive soil rental rates, conversion of hay and small grains fields to corn and soybeans, and ex-urban expansion continue to be challenges facing bobwhite and grassland bird conservation. Existing programs should be modified or new ones created to overcome some of these challenges. For example, the current mid contract management protocol for CRP could be more flexible to provide more frequent disturbances in order to maintain adequate brood-rearing habitat. Mid contract management should be modified to allow disturbance as frequently as every 2-3 years and include prescribed burning, strip disking, and herbicide applications.

4.3.4 Developing Partnerships.

Partnership in the Mid North region should include, but not be limited too, state wildlife and forestry agencies, US Fish and Wildlife Service, US Forest Service, NRCS, FSA, Soil and Water Conservation Districts, The Nature Conservancy, Quail Unlimited, Quail Forever, Pheasants Forever, National Wild Turkey Federation, Audubon, and research institutions and universities. Private consultant companies are vital, often overlooked, groups that should be included in partnership building. Consultants often work with influential members of the public and may have equipment resources to assist landowners in establishing conservation practices. Current partnerships need to be strengthened and new partnerships and joint ventures formed in order for shrubland and grassland bird conservation to thrive in the current political and financial climate.

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4.4 Mid-South Regional Issues in Bobwhite Conservation.

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The 1.1 billion acre land base of the Mid-South Region (Arkansas, Louisiana, Kentucky, Tennessee) consists primarily of hardwood forests, mixed pine-hardwood forests, pine forests, pine plantations, barrens, cedar glades, mountain balds, coastal prairies, as well as croplands and exotic pastures. The vast diversity of habitats in this region are exemplified by the 6 Bird Conservation Regions (BCRs) located in the states of Kentucky, Tennessee, Arkansas, and Louisiana. These include the Appalachian Mountains, Central Hardwoods, East and West Gulf Coastal Plains, Mississippi Alluvial Valley, and Gulf Coastal Prairies. Landscape Conservation Cooperatives (LCC) including these BCRs are also being established.

4.4.1 Habitats.

Historically, bobwhites occurred in all of the BCRs in this region. The Central Hardwoods, East and West Gulf Coastal Plains, and Gulf Coastal Prairies (Figure 21) offer some of the best opportunities for enhancing bobwhite densities. They are typified by croplands, grazing and haylands, pine and oak forests that have potential for habitat enhancement.

While bobwhites certainly occur in the Mississippi Alluvial Valley (MAV), the potential of this BCR for large-scale restoration is limited by intensive agriculture and flooding. Much of the habitat work in the MAV is focused on restoration of bottomland hardwood forests. Early establishment of tree plantings would provide potential bobwhite habitat, but after canopy closure, the habitat quality for bobwhites would be poor to non-existent. Similarly, high elevation grass balds in the Appalachian Mountains once provided bobwhite habitat, but these areas are now greatly reduced in size. Plant succession and vast, unbroken expanses of closed-canopy forest limit opportunities in this BCR. Large areas of commercial timberlands have been sold to landowners having interest in management for white-tailed deer, wild turkeys, or general recreation. Yet, elk restoration efforts and mine reclamation pose unique opportunities in the Appalachians for bobwhite.

Land ownership patterns pose one of the greatest obstacles for bobwhite conservation in the Mid-South Region. Based on public land ownership data compiled by the National Wilderness Institute in 1995, 91.3% of the land is owned by private landowners. The goal of region-wide bobwhite restoration can only be accomplished by an unprecedented effort of selling conservation to private landowners.

Public lands must serve as strong demonstration areas and sources of bobwhite populations with focal areas on private lands a high priority. Short-run restoration success stories will serve as the catalyst for widespread bobwhite restoration across the region.

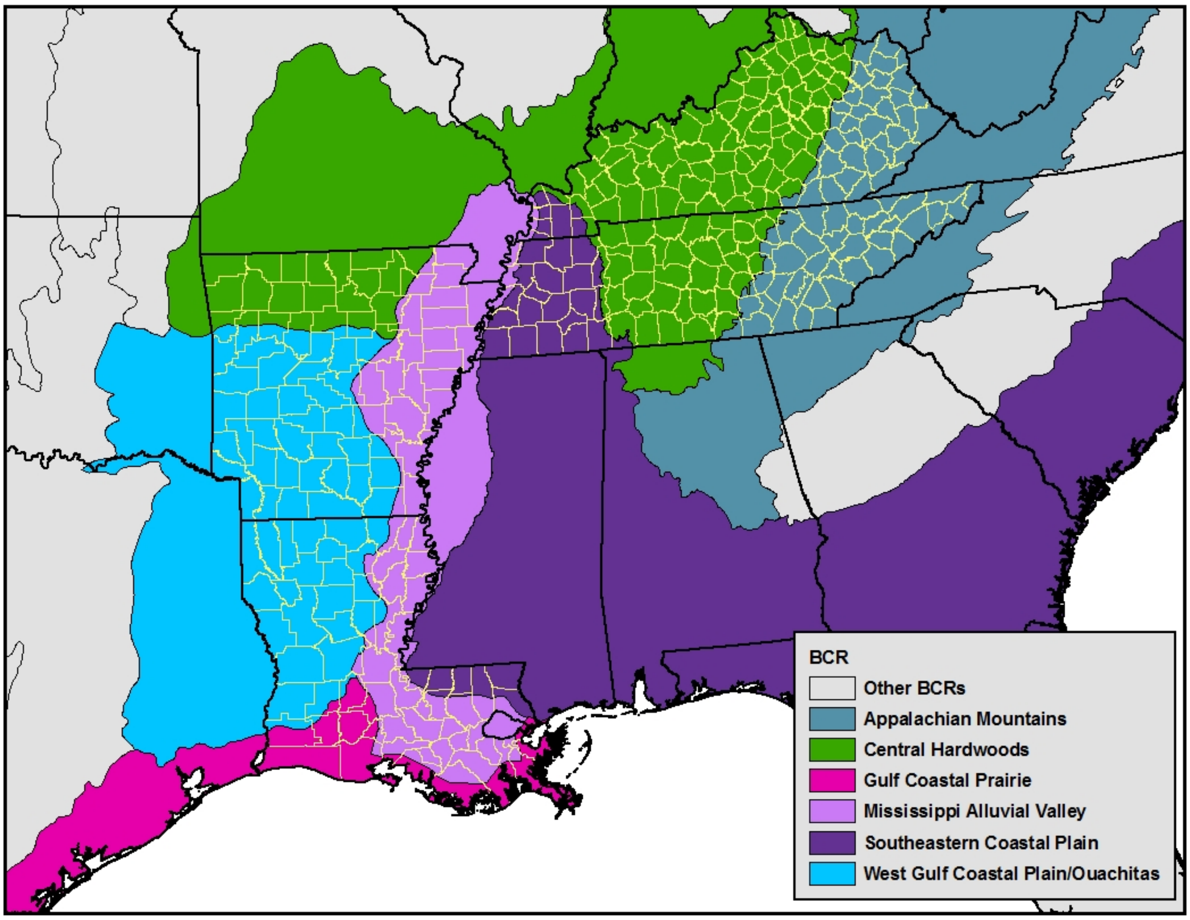

Figure 21: Bird conservation regions (BCR) that intersect the Midsouth states.

4.4.2 Opportunities.

The Mid-South's diversity of land forms presents a myriad of opportunities to manage for bobwhites. Human land use drives habitat quantity and quality. Changes in land use over the last century are at the core of the bobwhite decline. Ultimately, those changes were driven by economics, but it was also influenced by values inherent to the landowner. For example, the manicured management of croplands is not solely a function of being profitable, but the result of an aesthetic desire for clean farming. The same perception carries over to many types of land uses today.

Therefore, opportunities to restore bobwhite must not only be supported by economics, but by a public education campaign on intrinsic values of conservation and land stewardship. The Farm Bill conservation programs have helped pave the way for conservation delivery on agricultural lands making croplands the most significant target for restoration in the Mid-South. Its economic underpinnings have helped overcome landowner resistance to the appearance of wildlife habitat. Grazing and haylands also provide significant opportunities that are supported by economics and Farm Bill programs. Unfortunately, woodland and savanna habitats, mined lands, and shortleaf pine forests are not as well supported through conservation funding, nor are the economics for managing bobwhite habitat as favorable. None-the-less, these areas demand attention for bobwhite restoration across the Mid-South Region. In addition, improvements to many state and Federally-owned lands need to be re-evaluated in terms of providing and demonstrating good principles of bobwhite management.

Croplands. Technological advancements in row crop agriculture over the last century have prevented America's landscape from being solely dedicated to food production. Yet, those advances did come at a cost, especially for bobwhite. Increases in production have been accomplished through widespread and "clean" farming. Herbicides and pesticides virtually eliminate competition, and fertilizers and genetic engineering have massively improved yields. Mechanization created an opportunity for a dearth of farmers to feed the masses. Large fields, few weeds and insects, and the loss of fencerows eliminated the niche that was created between bobwhite and agriculture.

The 1985 Food Securities Act began to transform the face of agriculture. The Conservation Reserve Program (CRP) retired marginal croplands to more perennial vegetative cover that not only held the soil in place, but provided benefits for water quality and wildlife. Over the last quarter century, CRP and a host conservation programs have continued to re-install cover that can benefit bobwhite.

The Mid-South Region needs to maximize opportunities that are available through the Farm Bill. The economics and history of Farm Bill utilization in the row crop system make it one of the easiest strategies to employ. Habitat Buffers for Upland Birds (CP-33) is an example of how the Farm Bill can be molded to benefit bobwhite. Continued promotion of the practice is needed to fully reach its potential. Also, mid-contract management must be conducted to maintain the wildlife benefits of the practice. The same holds true on whole field enrollments through CRP.

Continuous and general CRP still fall short of creating all of the needs for the bobwhite's annual life cycle. Shrubby cover is often absent and even discouraged through some of its programs. The lack of a flex fallow option through Farm Bill conservation provisions leaves a huge gap in what was once a common agricultural practice (i.e., fallowing in crop rotations). Heavy fertilization has also created establishment problems for conservation plantings that can bolster invasive plants like Johnson grass and sericea lespedeza. More flexibility in the establishment of conservation plantings may help alleviate nutrient loads and provide time to control invasive exotics. Finally, it is critical that limited public funds maximize public benefits. Conservation covers, like fescue, should not be supported through conservation plantings. Huge gains could be made by simply planting native cover in many Farm Bill programs.

Grazing and Haylands. Livestock are a prominent feature across the Mid-South Region. Pastures and haylands present one of largest opportunities for bobwhite restoration. The northern portions of the region are largely dominated by fescue, whereas the more southern extent by Bahia and Bermuda grass. These forages are non-native and form a heavy sod that minimizes wildlife use.

Similar to the row crop agricultural system, the Farm Bill has the power to facilitate change. The Environmental Quality Incentives Program (EQIP) is often focused on the enhancement of livestock operations. Native warm season grasses present tremendous promise as forage in the region. Fescue is a cool season grass, so it has low potential for forage in the summer months. Bahia and Bermuda grass are warm season grasses, but need substantial investment in fertilization. Native grasses provide an economic advantage to the producer, because they eliminate the fescue summer slump and minimize fertilizer costs compared to Bermuda and Bahia.

EQIP can be used to promote these conversions. In Kentucky, three grassland focal areas have been established that overlap bobwhite focal areas. EQIP practices provide opportunity for pasture conversion, fence setbacks (i.e., a pasture field border), shrub and forestland enhancement, and pasture deferments. Deferments could also be used in hayland situations.

Often, the greatest barrier to producers is the establishment period for native warm season grasses. It typically takes 2 to 3 years to establish a forage quality stand. Therefore, EQIP practices should be designed to offset the supplemental feeding costs needed for establishment period. The Grassland Reserve Program (GRP) may also provide an economic engine for native grass management.

A long growing season coupled with abundant rainfall make biofuels production a growing issue in the Mid-South Region. The movement towards renewable, "green" energy can have significant consequence for bobwhite restoration. Unfortunately, a planting aimed at production typically offers little opportunity for wildlife habitat. Research in the value of diverse plantings of native grasses and wildflowers may help carve a benefit for bobwhite. Public policy should include provisions that make "green" energy as conservation friendly as possible. Practices could include deferments and two-stage harvest allowing some structure to stand over winter. Investigations should consider maximizing native grass production so that more yield may be produced on smaller tracts of land. Doing this will afford more space for natural forests and grasslands.

Woodland and Savanna. Forested lands of the mid-south consist of hardwood, pine/hardwood, pine, and plantation pine forests. Many forested areas in the mid-south are comprised of densely stocked oak and hickory stands that are moderate to high basal area and/or dense canopied. Many have nearly 100 percent canopy closure. Historically forested lands in this region were disturbed by Native American fire and clearing, or after Euro-American settlement, cleared for subsistence agriculture. Many were grazed by cattle and hogs or were burned by farmers to facilitate grazing, weed control, or pest control. Many forests were open structured, either as open woodland, or savanna.

A reasonable working definition for open woodland is 30-40 percent canopy closure. The ground cover of open woodlands will be rich in grasses and forbs and have a sparse understory. A savanna, on the other hand, may typically be <30 percent canopy closure and ground cover rich in grasses and forbs, and sparse understory. In savannas, prairie plants will often be common. In these rules-of-thumb, forest vegetation is defined by canopy-closure rather than basal area, as is typical of many forestry based approaches. Forest managers will need to carefully consider the canopy closure of stands as they relate to standing and target basal areas of timber products.

Either open woodlands or savannas were likely ideal habitats for bobwhites as long as disturbance maintained these ecosystems. Thinning can steadily restore open woodland or savanna conditions to many acres of forests and provide usable space for bobwhites.

Catoosa Wildlife Management Area on the Cumberland Plateau in Tennessee is an example of a savanna/open woodland restoration that has re-created habitats with the structure usable by bobwhites. Thinning of hardwoods and salvage removal of dead Virginia pine lead to this restoration. After thinning of the overstory, many prairie plants, including most native warm-season grasses, regenerated from the natural seed bank in the forest soil. Many native plants, including prairie plants, remain viable for decades in the soil and once proper conditions for occur, can germinate and contribute to the vegetation. In Catoosa, many of the seed contributing to the resulting ground cover were likely in the soil >100 years.

Many forested areas in the mid-south are likely to be similar to Catoosa in that they were once more like open woodland and savanna that at present. Seed banks may well contain sufficient source material to develop these communities with little or no need for planting. Because thinning such forests could also be profitable to the owner, open woodland and savanna restoration could be a cost-effective way to achieve bobwhite restoration goals.

<u>Mined Lands.</u> The reclamation of mined lands across the Mid-South Region provides a unique opportunity for bobwhite restoration. Reclaimed grasslands spawned elk restoration efforts as well, creating a great opportunity for partnership. Coal is abundant in many areas of this region and with today's energy demands, mining operations are plentiful.

Following the excavation of minerals, mining companies are required by law to reclaim the site. Several reclamation options are available to companies. When properly completed, they can result in thousands of acres of quality open grassland and scrub-shrub habitat. Proper planning on the front-end of the reclamation process can be the difference between a mine site reclaimed with native warm season grasses and wildflowers and shrubs versus fescue and sericea lespedeza.

Currently, there is little incentive for mining operations to reclaim with native vegetation because of higher seed costs and slower establishment. Under the current paradigm, high rates of exotic seeds are planted in addition to large quantities of soil amendments (agricultural lime and fertilizer). Researchers in Kentucky are hopeful that they can show how native plants can establish on these areas using reduced rates of soil amendments. While native grass and forb seed is costly, money saved by reducing expensive fertilizer should prove to be economical to mining operations.

It is important to note that not all mined lands are created equal. In the eastern portion of this region, reclaimed mine sites are virtually void of topsoil. Areas are comprised of rocky, acidic substrate making grassland management difficult. Poor, compacted soils equate to less need for frequent disturbance. As you move further west within the region, limited amounts of topsoil can be found on reclaimed mine sites. More traditional disturbance regimes such as fire and disking can be utilized.

Unfortunately, the economics of mine reclamation do not favor native plant establishment. Yet, there are other benefits to coal companies beyond saving money on reclamation. Improving their environmental image is paramount, and partnering on wildlife restoration projects helps in that regard. Building relationships with the coal industry could provide a non-traditional bobwhite restoration opportunity.

Shortleaf Pine. The management of shortleaf pine systems in the Mid South Region provides a significant opportunity for bobwhite restoration in forest dominated landscapes. Managing shortleaf pine for appropriately placed savanna and woodland communities can provide habitat for bobwhite in areas that may otherwise be of little to no value to bobwhite. Areas that are or were historically short leaf pine are abundant in the Mid South Region. Much of what was once shortleaf pine has been converted to loblolly pine for pulp production. These loblolly pines can be managed in the same fashion as shortleaf and still provide quality bobwhite habitat.

Managing mature shortleaf pine involves two basic tools: mechanical thinning and fire. To create quality bobwhite habitat, shortleaf pine typically needs to be thinned to a density that creates savanna or woodland conditions. A mosaic of savanna, open woodland, and forest conditions throughout a shortleaf pine community makes for an ideal forest condition for a variety of wildlife species including Northern Bobwhite.

However, mechanical thinning alone will not create good savanna and/or woodland habitat that will be appropriate for bobwhite restoration. Fire will need to be introduced to the shortleaf pine system to help keep the forest open, especially the understory, by killing hardwood sprouts and other excessive woody vegetation. Fire will help to keep an open condition in a shortleaf pine system that will allow herbaceous plants the light and space needed to germinate and grow. This herbaceous and shrub layer is what provides quality habitat for bobwhite.

Most areas in the Mid South Region have native warm season grasses and forbs already in the seed bank. These seeds will germinate in pine communities if properly managed by opening up the forest with mechanical thinning and reintroducing fire. Both elements are essential to establishing a good herbaceous understory. Without mechanical thinning, there will not be enough light reaching the ground to support herbaceous growth, and without fire there will be too much woody competition for the establishment of herbaceous plants needed for bobwhite. Also, most of the time it takes several fires before woody competition is under good control and a high quality herbaceous layer is established.

One good example of a large scale short leaf pine restoration that has benefited bobwhite greatly is the "pine-bluestem" restoration efforts by the US Forest Service in the Poteau Ranger District of the Ouachita National Forest. This restoration of a pine-bluestem community is targeted at the restoration efforts for Red-cockaded Woodpeckers (RCW). This project is creating quality habitat for RCW, and numbers of RCW are increasing in that area. The two major tools being used on the Poteau District are mechanical thinning and fire. These two practices over time have created a large expanse of grassland underneath the existing shortleaf pine community. This has resulted in a large increase in bobwhite numbers that have created a huntable population in an area that previously had a suppressed population.

Opportunities for managing shortleaf and other pine systems do exist on private lands. Forestry practices are available in the Environmental Quality Incentive Program (EQUIP) and the Wildlife Habitat Incentive Program (WHIP) to manage pine lands for a more open condition and reintroduce fire into those systems. In Arkansas, the NRCS is also utilizing the Healthy Forest Initiative (HFI) in pine lands to manage private lands for RCW's. The HFI is an easement program similar to the Wetland Reserve Program (WRP). Its focus on RCW habitat will without a doubt have benefits for bobwhite, and this management can be replicated on any shortleaf or loblolly pine community. Mid-contract management thinning of Conservation Reserve Program (CRP) pine also presents a good opportunity to increase bobwhite habitat as long as fire is also introduced into the management of those pine stands. Utilizing all these Farm Bill programs will greatly help in restoring bobwhite populations in the Mid South Region.

<u>Longleaf Pine.</u> Longleaf pine was once the dominant upland forest type across 60 million acres of the Gulf Coastal Plain. Longleaf pine forests were typically forested grasslands, maintained by fire. Replacement of longleaf by loblolly and slash pine for commercial production along with suppression of fire has reduced the longleaf ecosystem to only about 4 million acres. However, many land managers now recognize the benefits of longleaf pine and this is a positive development for bobwhite in forested habitats of the southeast.

Bobwhites are associated with longleaf pine habitat because longleaf pine stands often contain the diverse grass/forb understory that bobwhites require. Longleaf pine is very fire resistant and unlike loblolly or slash pine, longleaf pine can be burned throughout its lifetime. Longleaf often grows in open stands and the longleaf crown is generally more compact than of loblolly and slash, permitting abundant sunlight to reach the ground. This combination of sunlight and frequent fire can create good bobwhite habitat.

For many years after the original longleaf pine stands were cut, reforestation was accomplished with loblolly or slash pine. Longleaf was considered a poor investment because it was thought too difficult to establish and slow growing. However, experience and advancements in technology have made longleaf an attractive alternative to loblolly and slash for many landowners. Planting techniques have advanced to the point where landowners can experience very high success with longleaf plantings. The availability of high quality seedlings, a better understanding of the impacts of competing vegetation, and advances in development of herbicides, have made longleaf pine plantings a practical alternative to loblolly and slash pine for many landowners.

Longleaf compares favorably to loblolly and slash pine in terms of financial return if the landowner has a time horizon beyond 20-30 years. Longleaf is not well suited to situations were fiber production is the desired forest product. However, where landowners are willing to invest for a longer period, longleaf pine can outperform loblolly and slash by producing high-value forest products such as poles and pilings. The variety of products from a longleaf forest offers economic security to landowners by enabling them to produce a diverse array of forest products.

In recent years, USDA Conservation Programs have offered financial assistance to landowners for establishment of longleaf, further enhancing its economic advantages. The Conservation Reserve Program (CRP) offers a continuous sign-up for its Longleaf Pine Initiative with the goal of restoring longleaf on 250,000 acres in 9 southern states. Most of the land enrolled in the CRP Longleaf Initiative has been in the eastern portion of the longleaf range, since much of the longleaf suitable land in the western part of the range does not have the cropping history necessary to qualify for CRP. Other programs such as the Wildlife Habitat Incentive Program (WHIP) and Environmental Quality Incentives Program (EQIP) also offer financial incentives to landowners and are often applicable on land that does not qualify for CRP. In addition, state programs or other federal programs such as the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife may offer assistance to landowners for longleaf establishment or management.

4.4.3 Challenges.

The Mid-South is characterized by a diverse array of habitats, land uses, and restoration opportunities. The privately-dominated land ownership provides a tremendous challenge for bobwhite restoration. Tools to modify croplands and grazing lands are in place, but the programs require some modifications, focus, and promotion. Mined lands and oak and pine woodlands create other unique opportunities for the region. Unfortunately, their economics are not as favorable for widespread success in the short-run. Public lands may offer some of the best opportunities to demonstrate how these systems can benefit bobwhite and other species and provide sources of birds for populating other lands.

Bobwhite restoration is about how people use and view the land. Without changing landowner's perceptions of land management, investments and any immediate success will be ephemeral. A decade or more of private lands conservation has shown that a localized effort will be required. Emphasis on areas with moderate bobwhite densities at scales (10,000 to 100,000 acres) that can be aggressively managed will be the key to short-run success. To succeed will require a significant public education campaign deployed to tell the bobwhite's story.

4.4.4 Partnerships.

The challenge facing bobwhite in the Mid- South is too great to overcome alone. Professionals leading the restoration effort will need to be creative by working with groups outside their normal comfort zone. Groups like Quail Unlimited, Quail Forever, and Quail and Upland Wildlife Federation are at the forefront of the bobwhite restoration effort, but other wildlife groups like Rocky Mountain Elk Foundation, Quality Deer Management Association, and National Wild Turkey Federation should join the cause. Any one of those groups could readily find benefits associated with their interests through bobwhite conservation.

Non-hunting conservation groups also need to be utilized and engaged in bobwhite conservation. The State Wildlife Action Plans of Kentucky, Arkansas, and Louisiana list the northern bobwhite as a "species of greatest conservation need." A myriad of declining songbirds share the bobwhite's habitat preferences and subsequent plight; as a result, the restoration effort for this species suite are centered on the management of native habitats using the bobwhite as an "umbrella" species. Installing management practices for bobwhite can benefit imperiled species such as the red-cockaded woodpecker, Henslow's and Bachman's sparrow, and blue-winged and golden-winged warbler. All are also listed as species of greatest conservation need in the Mid-South Region. Ironically, the grasshopper sparrow, sedge wren, prairie warbler, and Bell's vireo comprise 4 of the 7 species that overlap each state's Wildlife Action Plan, and they share early successional habitat needs like bobwhite. The American Bird Conservancy, The Nature Conservancy, Sierra Club, Audubon Society, and state and local ornithological societies are among many organizations working to benefit grassland systems. Joining forces is critical, but all parties must get past the divisiveness associated with hunting. Joint Ventures and LCC may be the perfect avenue to overcome small differences among organizations to accomplish large-scale objectives.

Historically, the wildlife and agricultural community have been at odds. However, bobwhites have served as a rural icon for decades, and they are not a concern for crop depredation. The Prince of Gamebirds could be used to help dispel the need for clean farms which would help minimize input costs and provide environmental benefits beyond wildlife. Additionally, public support for bobwhite can yield economic benefits through conservation programs that increase the producers bottom-line. Partnership opportunities exist with hosts of agricultural groups including the Corn Growers, Cattleman's Association, and Future Farmers of America. These relationships may be the most difficult to forge, but they have the potential to yield some of the greatest benefits.

Restoration of bobwhite in the region will hinge on the ability of partners to work together. Landowners, state and government agencies, universities, and a host of non-governmental organizations will need to find common ground to generate success. The partners must engage a new and growing challenge with biofuels. It presents opportunity for an abundance of unwanted woody fiber in the forest, but it also provides great concern in the form of high-production grasslands. Nontraditional uses of forests and other lands, including development of new markets, will be important items to be worked on into the future.

4.5 Mid-Atlantic Regional Issues in Bobwhite Conservation.

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The Mid-Atlantic region encompasses 5 states (Delaware, Maryland, New Jersey, Pennsylvania, West Virginia) and portions of 3 BCRs. The NBCI has identified 4.6 million, high-priority acres for bobwhite and bird conservation in these states totaling 14 million acres. Although these states lie on the northern fringe of current bobwhite range bobwhites were historically widespread and abundant in the region. Some of the steepest population declines have been recorded in the Mid-Atlantic region of the U.S. For example since 1996 bobwhite populations in the Mid-Atlantic have declined 6%/year; within that, there are worrisome declines such as a 13%/year decline in New Jersey since 1980. The regional declines are especially troublesome when in 1966 the national Breeding Bird Survey recorded the highest densities of bobwhite in the country right in Delaware (Figure 22).

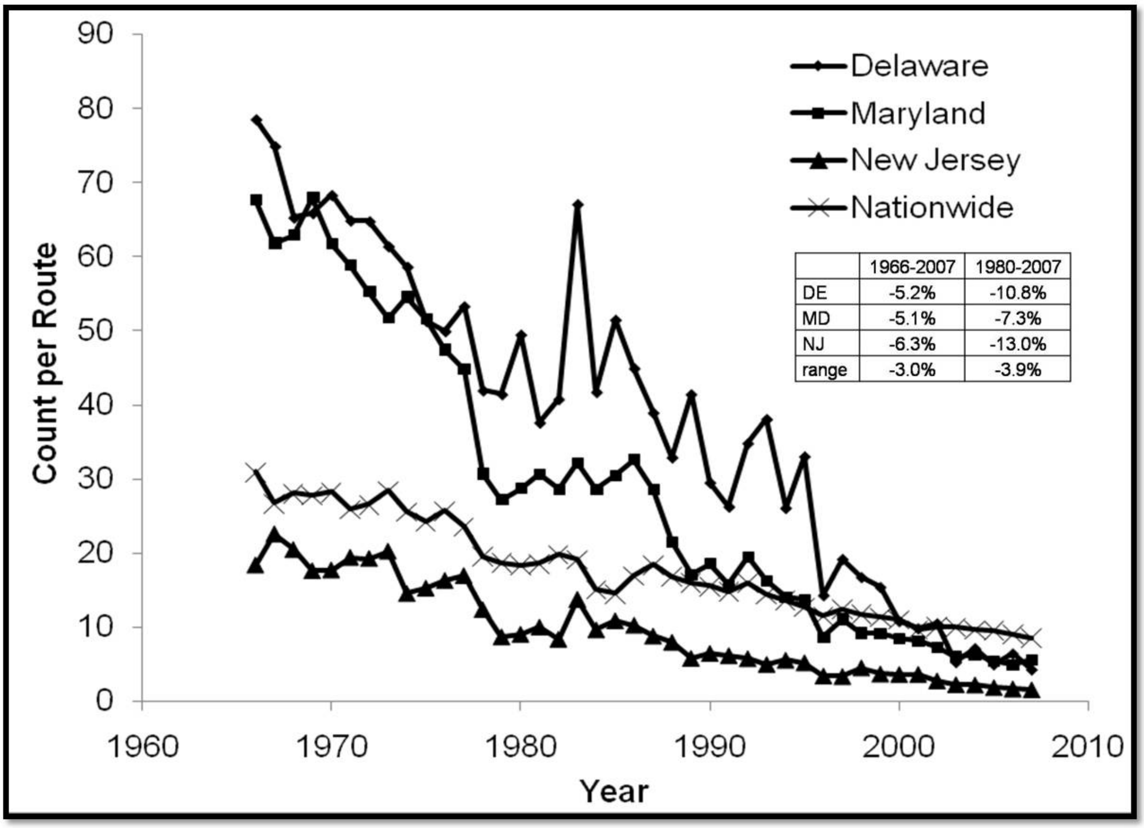
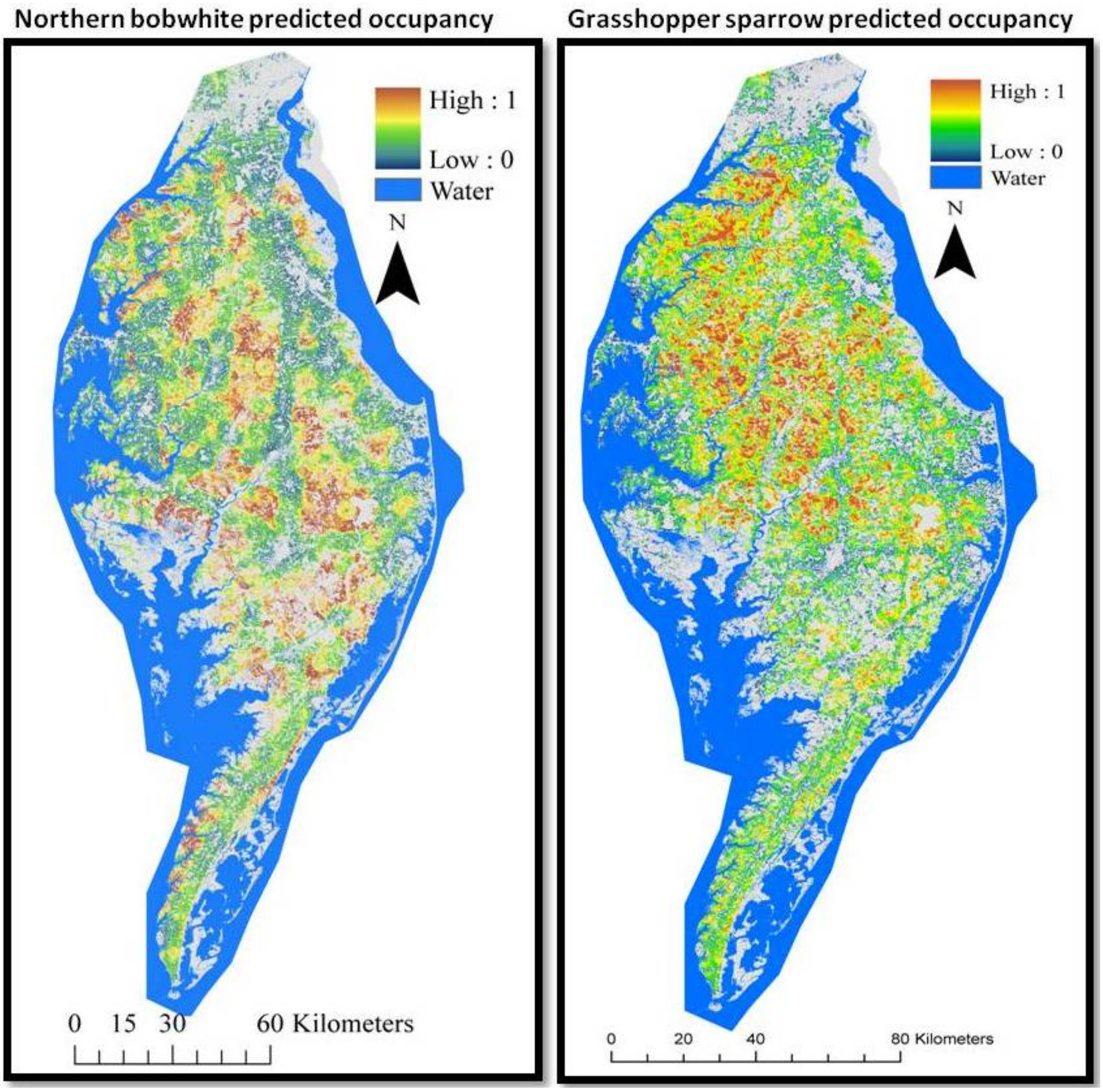


Figure 22: Northern bobwhite population trends in three Mid-Atlantic states (New Jersey, Delaware, and Maryland) between 1966-1979 and 1980-2007 as estimated from the Breeding Bird Survey.

Box 1:

Duren et al. (2010) recently created a predictive breeding habitat occupancy model for the northern bobwhite within the Delmarva Peninsula that incorporates site scale and landscape-scale variables. In the left hand figure below (a) hot colors indicate lands that have a greater potential for supporting bobwhite (regardless of whether they are currently present or not). However, concurrent research has created a predictive habitat occupancy model for grasshopper sparrow (*Ammodrammus savannarum*) on the Delmarva Peninsula (b) Grasshopper sparrows are an obligate grassland songbird that prefers short and sparse vegetation and is a species of conservation concern within Delaware. Populations have declined by 65% since 1967. But potentially targeting land conservation efforts for bobwhite we have the potential to improve sympatric songbird species.



4.5.1 Habitat Issues.

Important landscape types associated with bobwhites in this region include areas dominated by row-crop agriculture in the coastal plain of Maryland, Delaware, and New Jersey, the pasture/woodland mosaics of Pennsylvania and West Virginia, and the unique pine barren ecosystem of New Jersey. Unfortunately, land-use patterns have been altered significantly in the Mid-Atlantic, perhaps more than any other region, by the large and increasing human population. For example, in New Jersey, suburban/urban sprawl has converted farmlands, forests, and other open space areas at a rate 14,000 acres/year from 1995 to 2002. Such conversions not only reduce habitat but reduce the quality of remaining habitats (Box 2). Of those 14,000 acres per year, 64% comes from agricultural lands. Additionally, habitat quality on remaining agricultural lands is increasingly compromised by the long-term trend from smaller to larger farms, a shift in crop interests from cereals to vegetables or horticultural products, more efficient machinery, increased pesticide use, and "clean" farming practices.

Box 2: urban and suburban sprawl

Urban and suburban sprawl not only affect quantity of useable space for bobwhite but also has the potential to affect quality. Recent habitat suitability modeling efforts in New Jersey and the Delmarva peninsula show negative effects of low and high development on occupancy of bobwhite. Additionally, in cases where suitable lands become fragmented islands, they have the potential to become ecological traps with increased predation. In the presence of suburban sprawl, the domestic cat can become a noticeable predator to small mammals, birds, reptiles, and amphibians (The Wildlife Society 2001). Recently Lohr et al. (2010) found that of 17% of the overwinter mortality of radio-collared birds in New Jersey was due to feral cats.

4.5.2 Management Opportunities.

Opportunities for bobwhite restoration exist in each of these landscapes. In row-crop and pasture-dominated agriculture systems of the coastal plain and piedmont, significant funding is available for state and federal programs designed to protect water quality and enhance wildlife habitat. Most states in the region offer numerous cost-share opportunities in programs such as the Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), Wildlife Habitat Incentive Program (WHIP), and Landowner Incentive Program (LIP). With these and other programs, a significant amount of bobwhite habitat could be restored relatively easily on farmland throughout the region.

One of the most significant opportunities for landscape-level increases in the amount of bobwhite habitat in agricultural areas is via Farm Bill programs. Extensive funding is available for buffer programs designed with a primary purpose of protecting water quality in the Chesapeake and Delaware Bay Watersheds (Box 3 for example). However these programs also can be used to successfully create and maintain grassland and shrubland habitat. Bobwhite populations will benefit from a wide range of practices that are permitted under these programs. Appropriately planned warm-season grass and shrub plantings can provide suitable habitat throughout the year. Conversion of fescue pastures to more quail-friendly cover is also eligible for cost-share in many programs. Enrolled acreage is often located between the woodland edge and agricultural fields, creating an ideal situation where feeding, loafing, and escape cover is all located in close proximity. Other practices, such as the CRP's CP-33 Buffers for Upland Birds can be used to provide additional fallow field habitat along field edges. Maintenance and management of established habitat via prescribed burning or disking is vital in order to ensure continued benefits. Bobwhite densities on properties containing adequate amounts of appropriately-managed CRP and CREP plantings can reach 1 bird per 2-3 acres in the region.

Although all state agencies are working to maintain early-succession habitat on their Wildlife Management Areas (WMA, See Box 4 for example), the 2009 New Jersey Northern Bobwhite Action Plan presents a new and innovative approach to maintaining and creating early-succession habitats on WMA within the bobwhite's range has been developed through the use of in-kind services in lieu of payment from contract farmers. "Beginning in 2010, farmers that lease State-owned farmland will be required to plant, mow, disk, and otherwise maintain early-succession habitats in proximity to their leased farmland. The amount of habitat work to be done is based on the value of the lease established by a bidding process and the value of in-kind services as determined by the US Department of Agriculture and other knowledgeable sources. Under this program, thousands of additional acres of early-succession habitat can be created and maintained on WMAs without the need for increased operational funding".

Any efforts to restore grassland habitat will also need to recognize the importance of winter cover in the Mid-Atlantic region. Recent research in New Jersey (Lohr et al. 2010) and Maryland identified low winter survival as a probable limiting factor on bobwhite populations. Additionally, BBS data and anecdotal information suggest winter weather played an important role in the contraction of the bobwhite range in the region. Although quail populations were declining steadily throughout the late 1960's and early 1970's, the historically-severe winters of 1977 and 1978 (See Figure 2) are thought to have reduced numbers (in some cases to local extinction) throughout much of Pennsylvania, northern New Jersey, West Virginia, and western and central Maryland. Even if grassland or fallow areas are restored, quail populations will not persist unless adequate shrubby winter and escape cover is provided. Practices such as shrub planting, edge feathering, and hedgerow establishment should be an important component in any habitat management plan. Within New Jersey, it is additionally worth noting that approximately 116,000 acres occur in unmanaged, closed canopy, pine-dominated woodlands in the New Jersey Pinelands Area. This area once harbored substantial numbers of bobwhite when the woodlands were fire dominated and had a more open canopy and well-developed understory of native herbaceous and woody plants. However over the past 30 years, fire suppression efforts combined with the lack of management has resulted in the succession of much of the Pinelands habitats beyond the early-succession stages useful to bobwhite. Despite historic regulation to reduce/remove fire from this system, it is anticipated that in the near future an improved process for implementing habitat projects in the Pinelands Area will be possible. Therefore, the Pinelands may represent the greatest potential growth area for wild bobwhite within their range in New Jersey. Forest stewardship plans are currently being developed for WMAs within the Pinelands that would restore more natural fire regimes and plant assemblages in this region. These plans will produce early-succession habitats that will greatly benefit bobwhite and other species that depend on these habitats.

Box 3: Maryland's CREP

Maryland's CREP provides an example of the tremendous potential of well-funded landowner incentive programs. Over 70,000 acres of sensitive agricultural lands have been enrolled in Maryland's CREP since initiated in 1997, representing nearly 4% of the farmed landscape. Riparian tree and shrub plantings and warm and cool-season grass filter strips were the primary practices implemented. Quail populations quickly responded to the newly created habitat on some farms. Unfortunately the benefits were often short-lived. Warm-season grasses were planted at too high of a rate, and without appropriate management such as prescribed fire and disking, stands quickly became too dense and monotypic to facilitate wildlife use.

Wildlife response to new tree plantings was also initially positive, but as trees grew and shaded out volunteer herbaceous vegetation, the benefits diminished. Many of these issues have been resolved in the last decade. Grass planting rates have been reduced, cost-share is available for beneficial mid-term management practices, and knowledge about bobwhite habitat requirements by technical assistance providers has increased. If funding levels and landowner interest can remain high for programs like the Maryland CREP, substantial amounts of bobwhite habitat could be restored in the region, benefitting a diverse suite of declining species.

4.5.3 Challenges.

Although bobwhite restoration opportunities exist in the Mid-Atlantic Region, numerous limitations and challenges must be considered. Landowner economics do not favor bobwhites. In many areas, land values are exceptional high due to development potential and soil fertility. Soil rental rates are high, limiting the effectiveness of cost-share programs in providing habitat at the landscape level. Even when program payments are competitive with current agricultural values, landowners are often hesitant to enroll lands for the required 10 or more years due to market uncertainty or the loss of development potential. We recommend State and Federal cost-share habitat management programs consider focusing increased rental rates in identified core bobwhite areas.

Low or non-existent bobwhite numbers may be the greatest limiting factor in restoring bobwhite populations to previous levels across the Mid-Atlantic. Based on existing data and biologist opinion, bobwhites are not currently present across much of this region. Low to moderate densities can be found in the coastal plain region of southern New Jersey, Delaware, and Maryland. Any wild populations still persisting in the piedmont and Appalachian Mountain regions of Maryland, Pennsylvania, West Virginia, and New Jersey are likely isolated and at-risk of extinction.

4.5.4 Species Benefits.

Habitat restoration efforts in these areas may not increase bobwhite populations in the short-term. However they will provide equally important habitat for other declining bird species in the Mid-Atlantic region. Grassland songbirds such as bobolink, dicksissel, eastern meadowlark, field sparrow, grasshopper sparrow, Henslow's sparrow, vesper sparrow, and loggerhead shrike are listed as species of greatest conservation need in most Mid-Atlantic States' Wildlife Action Plans (Box 1). Other game species will also benefit from habitat improvements. Significant interest exists in Pennsylvania to restore grassland habitat for declining ring-necked pheasant populations. Additionally, wild turkeys use early-succession habitat for nesting and brood-rearing and cottontail rabbits thrive in areas managed as quail escape cover. Restored bobwhite habitat, even if not recolonized by bobwhites, provides critical habitat for many species, and should be supported by a variety of interests and conservation groups.

Box 4: New Jersey WMA

The New Jersey Division of Fish and Wildlife manages approximately 200,000 acres of potential bobwhite habitat in southern New Jersey. Of that, 84,000 acres are located within traditional farmland associated bobwhite habitats. Management for early successional species birds like bobwhite is a high priority on Wildlife Management Areas. Controlled burning and mowing/disking by Division crews are used to maintain over 2,000 acres per year in a successional stage useable by bobwhite. Additionally they are committed to actively restoring 200 acres of native grassland habitat and 100 acres of early successional woody/brushy cover per year.

4.5.5 Partnerships.

Partnerships will be a critical aspect of restoration efforts in the Mid-Atlantic. State agencies need to work with universities and other research entities to fill in the knowledge gaps about bobwhite population dynamics and habitat requirements on the northern fringe of the range. Other emerging research needs include the refinement of translocation methodology and the gathering of information about genetic differences between wild bobwhites in the Mid-Atlantic and other regions. In many areas, a source population of bobwhites is not present near blocks of restored habitat or areas that have high occupancy potential (See Box 1). Guidelines regarding the efficacy and suitability of wild quail translocations will be needed in order for quail populations to be restored across much of the region.

State, federal, and local agencies and jurisdictions will need to work together to bring about a landscape change as well. NRCS, FSA, and Soil Conservation District staff needs to be knowledgeable about bobwhite habitat requirements and encourage landowners to utilize cost-share programs to effectively restore habitat. State agencies should guide Farm Bill and state-level landowner assistance programs to ensure that restoration work is focused in priority areas (see Box 1). State and federally-owned lands are abundant in some parts of the Mid-Atlantic. Managers of these lands need to implement sound bobwhite habitat management practices on suitable sites, both to provide important habitat in priority areas and to serve as demonstration areas for other agency staff and private landowners.

Stabilization and recovery of bobwhite populations in the Mid-Atlantic region will not be an easy task. Programs that provide competitive financial incentives for landowners may provide the best opportunity to positively impact the landscape in agricultural areas. But managers should not overlook the value of managing other habitats, such as in the Pine Barrens, for the diverse array of wildlife that will benefit. Land managers and government agencies will need to focus efforts on creating and maintaining year-round habitat for bobwhites and other early-succession wildlife, with a particular emphasis on providing the necessary winter cover at the northern fringe of the range. Management of public lands can provide important core focus areas and places to demonstrate effective practices. However, widespread recovery will only occur if methods that integrate bobwhite habitat restoration into private land stewardship programs are developed, well-funded, and implemented across the Mid-Atlantic region.

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4.6 Southeast Regional Issues in Bobwhite Conservation.

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The Southeastern region encompasses 7 states (Alabama, Georgia, Florida, Mississippi, North Carolina, South Carolina, and Virginia) and 4 primary Bird Conservation Regions (Figure 23). Bobwhites have long been an important game bird in the Southeast (Stoddard 1931) and not long ago they were both plentiful and widespread throughout the region by way of compatible land use practices. Naturally, bobwhites were once a familiar pursuit for hunters in the rural southeast. For instance, in 1960-61 there were approximately 142,000 bobwhite hunters in Georgia which comprised 50% of the state's licensed resident hunters. These hunters harvested an estimated 3,365,000 (SE = 888,000) bobwhites (Georgia Game and Fish Commission 1961). Unfortunately Georgia's bobwhite population is estimated to have declined by over 85% since 1966 as a result of changing land use. By the 2008 - 2009 hunting season, the number of bobwhite hunters in Georgia had dropped to less than 22,423 and comprised only 10% of licensed resident hunters. These hunters harvested an estimated 808,036 (SE = 39,977) bobwhites, of which approximately 97% were reported as pen-reared birds (Duda et al. 2009). Similarly, in 1970, one-third of licensed hunters in Virginia hunted bobwhites and harvested 1.4 million quail compared to less than 84,000 today most of which are pen-reared and released. Between 1991 and 2004, in Virginia, the Department of Game and Inland Fisheries estimated the total loss from expenditures related to quail hunting at an average of $1.7 million annually.

Despite the severity of discouraging population declines, the outlook is optimistic because bobwhite populations still remain across much of the managed forested and agricultural landscapes of the Southeastern Coastal Plain BCR and the Florida Peninsula BCR, albeit at low densities (one quail per 10-30 acres) in most places. Further, studies and experience indicate that where management is applied at a meaningful scale, bobwhite populations positively respond (Palmer et al. 2005, Singleton et al. 2010). In addition, the Southeast has approximately one million acres of private lands managed for wild bobwhite populations, principally in FL, GA, AL and SC, which help maintain the culture of wild bobwhite hunting and provide core habitats to facilitate bobwhite restoration to adjacent lands. Unfortunately, bobwhite restoration and management in the Piedmont and Appalachian mountain regions is not considered feasible across most landscapes and sustaining long-term viable bobwhite populations is dubious. Exceptions include some large(r) properties, private and public, that may in the future be successful in restoring bobwhites; however, these opportunities are rarer than in the coastal plain.

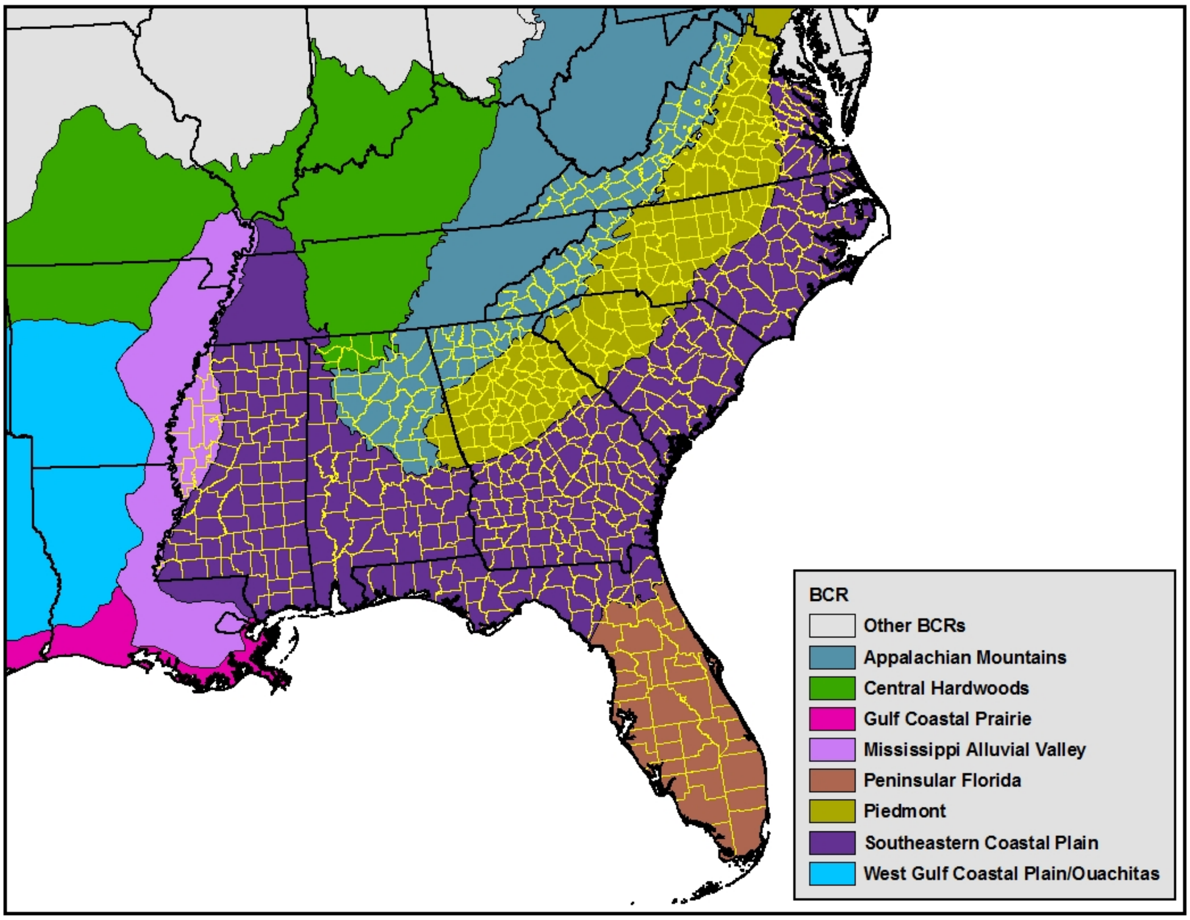
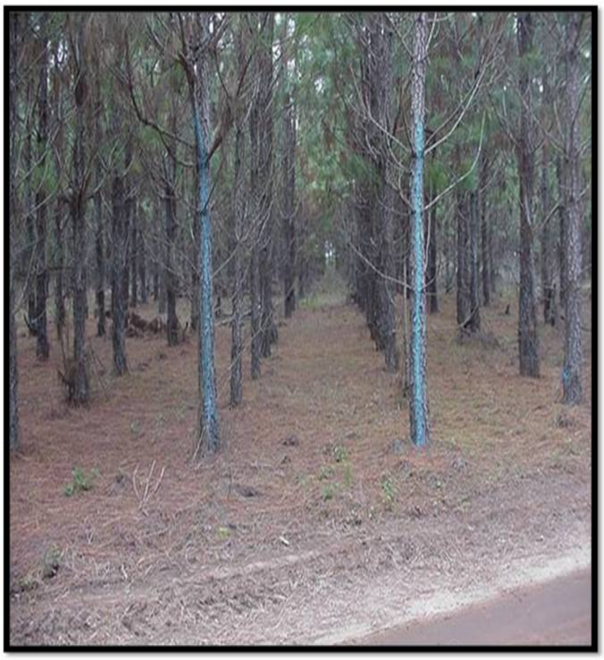
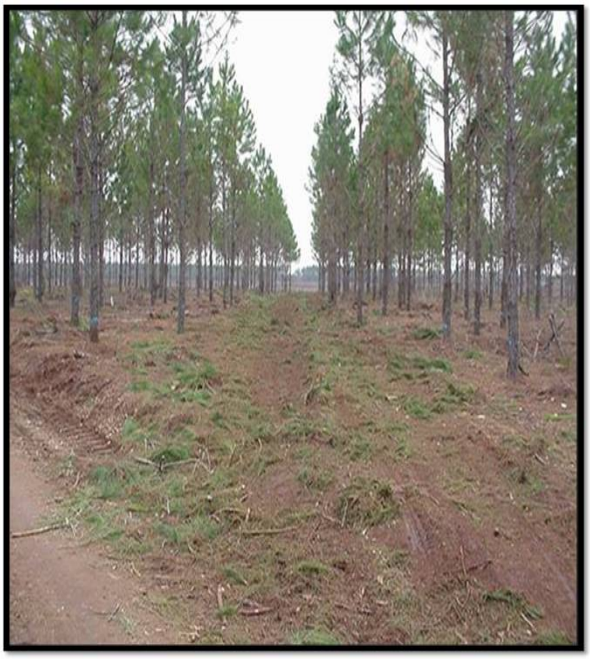


Figure 23: Bird conservation regions (BCR) that intersect the Southeastern states.

The "Fire Bird". Bobwhite and fire are inextricably linked in virtually all habitats of this region (Stoddard 1931). Historically, fires occurred at a frequency of 1-3 years throughout most of the Southeastern Coastal Plain BCR and the Florida Peninsular BCR (Frost 1998). Frequent occurrence of natural lightning-ignited fires and application of prescribed fire by people once maintained large expanses of diverse ecosystem-types including: pine and oak savannas; prairies in the Black belt regions of Mississippi and Alabama; and the rangelands of peninsular Florida. Recurrent fire maintained a rich diversity of ground cover creating excellent habitat for bobwhites and a guild of species now also succumbing severe decline. A cultural shift from fire use to fire suppression created widespread habitat loss for bobwhites in this region (Brennan et al. 1998). It is not, therefore, surprising that for these states **the NBCI indicates that 67% of the management needed to restore bobwhite relates to the application of frequent prescribed fire and thinning of closed canopied forests**. Early-successional habitats associated with row crop helped maintain huntable bobwhite populations in some areas of the coastal plain, but the loss of this habitat during the past 3-4 decades to reforestation and fire suppression along with evolution of more efficient agronomic practices has only resulted in steeper declines in bobwhite populations across the region.



(a) Before Thinning.



(b) After Thinning.

(c) 2 years post-thinning.

Figure 24: This was an 11-year old slash pine plantation. When young pine stands are thinned every third or fifth row and within rows the benefits to bobwhites can be observed rather quickly; here, in only 2 years suitable habitat was created.

4.6.1 Habitats and their Management.

Upland Pine Forests. Over 13 million acres of pine forests have been identified as having high potential for bobwhite conservation in the Southeast. Longleaf pine and the associated grass-dominated understories once spanned 70 million acres of the region but have been reduced to a low 2.5 million acres. This diverse ecosystem if managed with thinning and frequent fire provides excellent opportunities to sustain huntable bobwhite populations as well as declining and threatened birds, amphibians and reptiles (Brennan et al. 1998). Restoration of native longleaf, shortleaf, loblolly and South Florida slash pine forests with thinning, reducing off-site hardwoods species, and frequent prescribed fire over the long-term is consistent with management for bobwhites and a host of other declining plants and animals (Figure 24). Approximately 3 million acres of CRP planted pines, mostly loblolly pines, occur in this region and need to be thinned and burned frequently in order to sustain bobwhite habitat. In general, piedmont regions have lower potential for bobwhite restoration because of severely low, patchily distributed bobwhite numbers as well as extensive invasion of developed land. However, there are some areas that provide opportunities for restoration of oak and pine-oak savanna which if large enough could provide excellent bobwhite habitat.

There are tremendous opportunities for bobwhite restoration in pine and oak savanna restoration in the Southeastern Coastal Plain. Habitat for bobwhites is provided by frequently prescribed burned pine forests maintained at 20 to 70 ft/ac basal area, and oak forests maintained at 10-40 basal area. This type of management, when properly applied, provides many ecosystem benefits including bobwhite restoration. Fire frequency and scale are critical to the success of management in these systems. Many states are using SAFE (State Enhancement of Wildlife Habitats) to focus on restoring natural fire regimes to private lands or restoring threatened grasslands. In most cases a 2-year fire return interval for pine forests, and a 3 year return interval for oak savannas, are necessary to promote grass-forb communities needed by early successional wildlife.

Agricultural Lands. The NBCI identified over 7 million acres of agricultural lands in the Southeastern Region that have a high potential for restoring bobwhite populations. Row crop fields can be improved as nesting and brooding areas for bobwhites if field borders or other fallow patches are incorporated on farms (Palmer et al. 2005). Field border practice CP33 increased bobwhite densities on farms versus control farms as well as increased songbird use of farm fields (Singleton et al. 2010). That said, in much of the Southeast, farms provide summer habitat but improvements in bobwhite numbers are hindered without managing for winter habitat which includes improving adjacent woodlands for bobwhite habitat. Some programs, like the Bobwhite Quail Initiative in Georgia were successful at matching farm field practices with practices to thin and burn pine planted pivot corners (Figure 25), CRP pine stands, and other woodland habitats. States can design their SAFE programs to benefit bobwhite by balancing the habitat needs of bobwhite in both summer and winter through including thinning and burning incentives.

Savannas and Prairies. Both dry prairie and flatwoods in the Florida Peninsular BCR are impor-

(a) Hard Pine Edge.

(b) Field Border Next to Thinned Pine.

Figure 25: Establishing field borders but placing them next to dense pine plantations may be an ecological trap.

tant fire-maintained habitats. These systems together represent the only rangelands in the Southeast making them unique in management opportunities and constraints. The NBCI identified over 600,000 acres of prairie habitats that have high potential for long-term restoration in Florida. Some of these habitats occur in relatively large patches of up to 60,000 acres are publically-owned. These ecosystems are typically treeless (dry prairie) or have a low density of slash or longleaf overstory (flatwoods). Management for bobwhites and other species is application of prescribed fire on a 1.5 - 2.5 year frequency at the appropriate scale (size and extent) such that a mosaic of different burn frequencies remains. Fires for cattle management were historically applied in winter to increase forage for cattle during time of limited forage supply. However, these habitats evolved with lightning-season fire and the repeated use of dormant season fire has simplified the plant community more towards species that withstand repeated grazing pressure (increasers). Furthermore, saw palmetto, a native shrub, has increased in percent composition through time from grazing pressure and the altered fire regime. In bobwhite management, palmetto should be 15-30% of the groundcover and dispersed in small clumps (Figure 26). Fortunately, this can be achieved through the use of mechanical treatment (e.g., roller chopping) and the reintroduction of lightning season fire. The dynamics of grazing cattle on rangelands has changed in the last 30 years because of the increased emphasis of using exotic forages.

The Blackland Prairies of Mississippi and Alabama represent a region with potential for bobwhite restoration and already in-progress restoration effort. In 2004, Wildlife Mississippi, in cooperation with the MDWFP and other state and federal partners, began the Blackland Prairie Restoration Initiative which sought to restore, enhance and protect native prairie habitat within Black Belt Region of Mississippi and Alabama. As of 2010, approximately 8,000 acres have been restored and or enhanced

(a) Pre-Roller chopping (April 2007).

(b) 18 months post-chop and burn (January 2009).

Figure 26: South Florida flatwoods landscape dominated by Saw Palmetto: (A) site prior to roller-chop treatment and (B) 18 months following roller-chop treatment and prescribed fire. Photos provided courtesy of G. Hagan, the Upland Ecosystem Restoration Project (UERP).

under the initiative with several more projects underway. Almost all of these restoration activities have occurred on private lands. Intensive agriculture has reduced pristine prairie to a few remnant tracts. However, with the aforementioned efforts, patches of semi-natural prairie have been established and functionally these are suitable bobwhite habitat. A significant portion of the region is marginal cropland making conservation programs attractive to producers. The pastureland portion of the landscape, as in other regions, is the most difficult to restore or enhance. Fescue and Bermuda grass pastures are roadblocks to success, but much of the NBCI goals can be achieved on row-crop acreage.

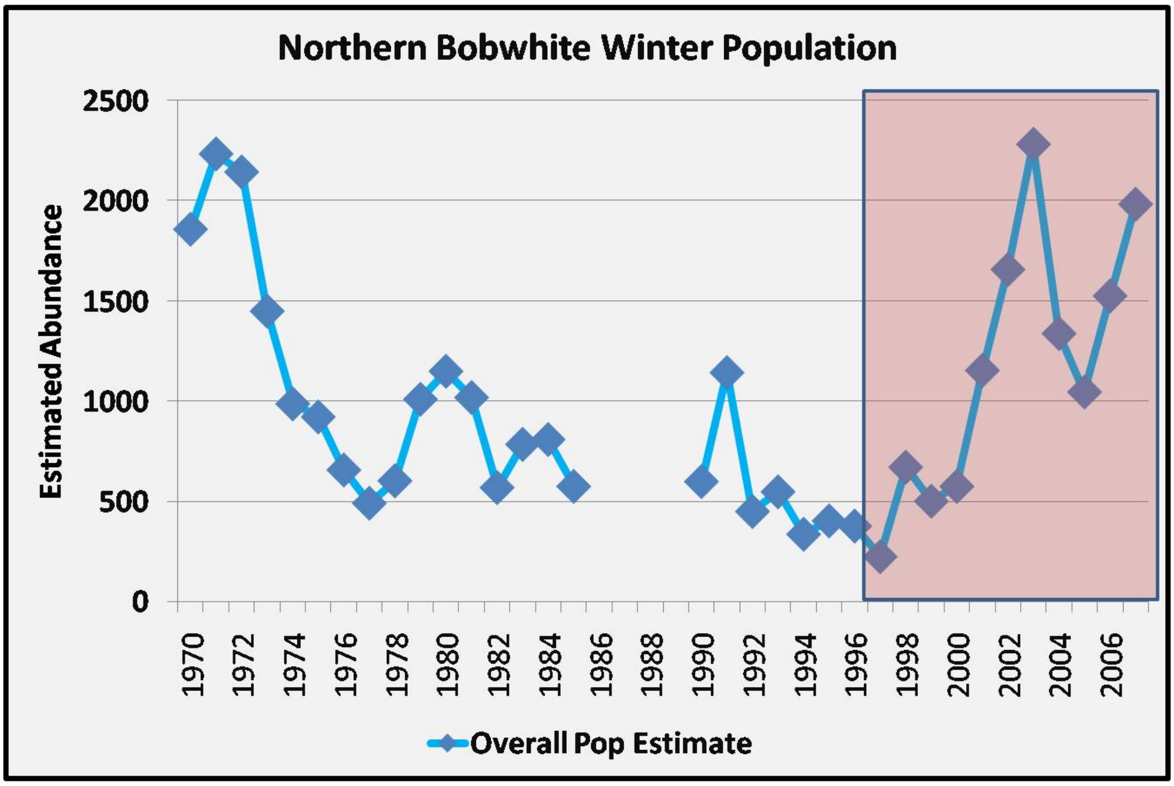
4.6.2 Opportunities.

At the state level, Georgia, Virginia, Florida, and North Carolina have provided incentive and cost-share for habitat actions. Significant Farm Bill conservation programs have been developed for this region, including CP33 field border practice, and the longleaf CPA, CP 36 and CP 38, WHIP, EQIP, and WRP. Additionally, other organizations have programs to provide TA and/or FA (e.g., NWTF Uplands Program, QU, QF, USFWS Partners for Fish and Wildlife Program etc.) can be used to assist landowners in enhancing bobwhite habitat. Building on past success and experience implementing landscape scale habitat programs is a major opportunity. Further, a significant amount of bobwhite research has been conducted in the Southeast which provides the knowledge by which to manage for the species. Safe Harbor program for Red-Cockaded woodpeckers often provides landowner incentives for burning and thinning. Similarly, programs that manage for threatened gopher tortoises provide landowner incentives.

Other opportunities are related to educating the public on the value of quail habitat and its management for the suite of declining species. The concept of restoring pine and oak savannas should be made an issue that decision makers understand similarly to how important wetlands are for society. In many parts of the Southeast, there are no good examples of landscapes managed for wild bobwhites. In these areas agencies could strive for developing demonstration areas to both test management ideas, solve localized habitat issues that relate to landowners, and a template for management.

(a) Prior to Pine Restoration.

(b) After Pine Restoration.



(c) Population trend before and after restoration.

Figure 27: Response of northern bobwhite population abundance to a pine-savanna restoration on Tall Timbers Research Station, Tallahassee, Florida, 1970-2008. Declining quail numbers during 1970-1996 were a result of infrequent application of prescribed fire and resulting hardwood-pine mixed forest; increasing quail numbers during 1997-2008 (red-shaded region) mid-story reduction and frequent prescribed fire.

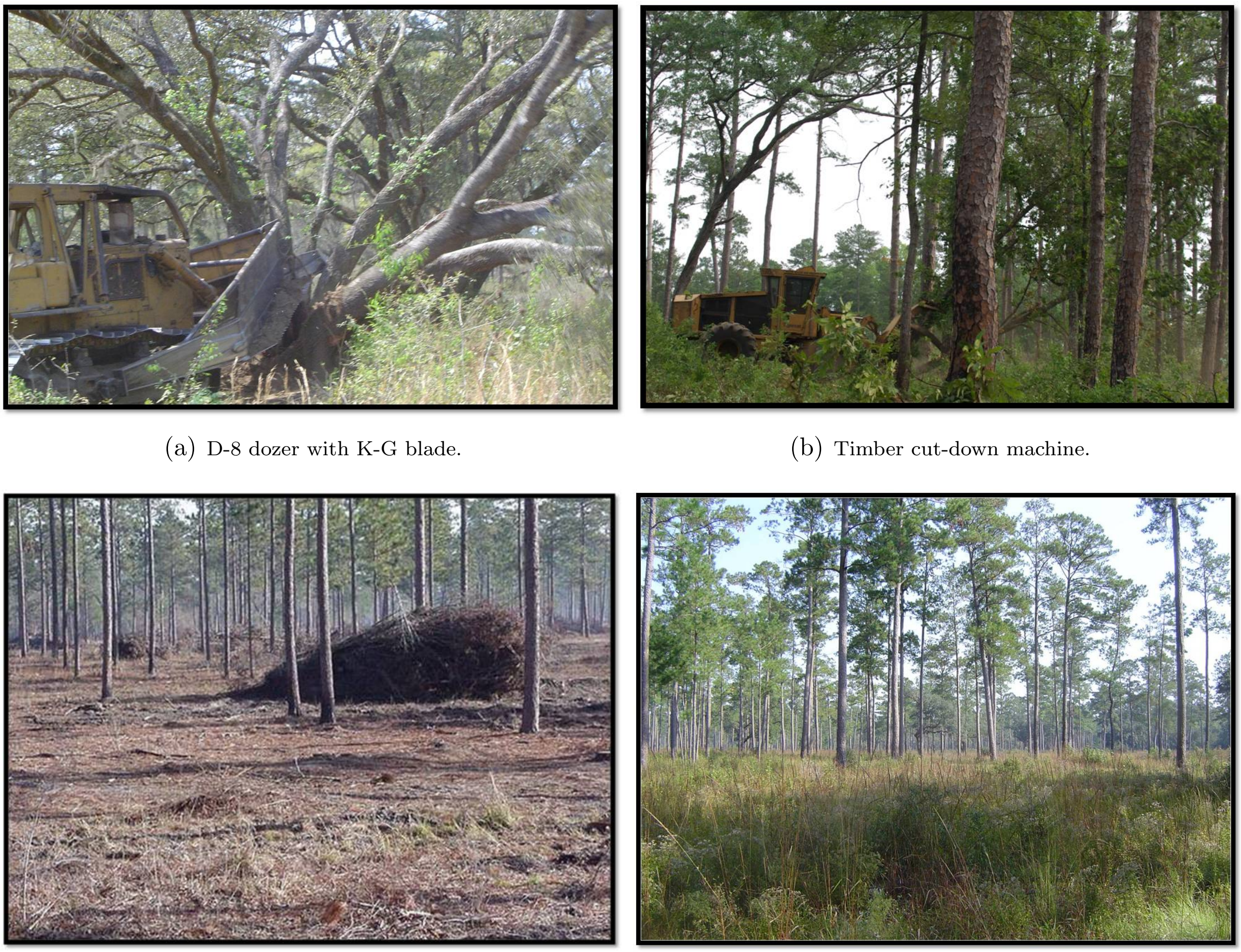
Forest Systems. Important strides have been made to help recover longleaf pine ecosystems. Through the CRP, longleaf acre enrollment is over 300,000, over 176,000 acres in Georgia due to collaborative efforts among FSA, NRCS, GFC, GA DNR, and others. To date the primary focus has been on planting longleaf, and in some cases planting native ground cover, which is an important first step to ecosystem restoration. However, additional focus and funding are needed to ensure adequate control of exotic grasses, and to apply frequent fire and thinning to facilitate native ground cover development so as to ultimately restore ecosystem structure and function and achieve CRP programmatic intent.

Biofuels present an opportunity where undesirable hardwood understory and midstory species can be removed to open stands where fuel loadings are excessive for burning. They also present a challenge because of the potential to remove bobwhite habitat and replace it with monocultures for biofuels. Biofuel production has the potential to negatively impact bobwhites at the landscape scale. Where farm or forest policy promotes or provides subsidies for biofuel production steps should be taken to make certain that: 1) there is no net loss of native forest ecosystems i.e. do not promote conversion of native forests including recent longleaf plantings on agricultural lands to biofuel production; 2) incentives are provided to enhance habitat within and adjacent to sites planted to biofuel crops; and 3) biofuel programs and practices do not work at cross purposes with funding directed at restoring native ecosystems or benefiting wildlife species of conservation concern.

Private Landowner. The Southeast has a long history of privately owned lands managed for bobwhite and other wildlife. Today, at least 1 million acres are principally managed for wild bobwhites (Figure 27). These properties are both clumped and dispersed but collectively provide source areas for wild bobwhites such that habitat created in proximity is soon colonized. Through long-term management and research, private landowners have developed highly effective management techniques that may be used on public lands in the region. Education and policies that encourage development of new locations managed for wild bobwhites should be encouraged. For instance, areas with high density bobwhites provide source birds for translocation is useful for encouraging habitat development where no wild bobwhites currently remain.

4.6.3 Challenges.

Personnel and Collaboration. Achieving NBCI goals and objectives will require that state, federal and NGOs give priority to directing programmatic manpower and funding into landscapes prioritized for bobwhite and grassland obligate habitat restoration. This can be accomplished through using an environmental benefits index or ranking system that gives priority to all or significant portions of programmatic funding to NBCI focal areas; and should give highest value in ranking and funding to landowners who are willing to apply multiple practices to enhance habitat across a landscape matrix of agricultural and forest lands. Programmatic priority should also be given to expanding existing and newly created core bobwhite landscapes and the creation of landowner cooperatives that exceed a defined threshold of usable space. Building capacity for providing technical and financial assistance to landowners is a major impediment to bobwhite conservation in the Southeast. Some states have been successful in cost-sharing positions with NRCS or NGOs to increase the personnel. Funding



(a) D-8 dozer with K-G blade. (b) Timber cut-down machine.

(c) Hardwood clean-up. (d) First growing season following hardwood clean-up.

Figure 28: Removing unwanted hardwoods mechanically using various heavy equipment (photos A & B) increases the amount of usable space and helps disturb the soil creating a "new ground" effect where vegetation response is stellar for 2-3 years post-treatment.

must be adequate to retain employees to promote sustainable relationships with private landowners and property managers. States should strive to make sure that bobwhite restoration and NBCI priority landscape maps are included in other conservation plans e.g., State Wildlife Action Plans, State Forestry Assessments etc. Memorandums of Agreements are needed between state fish and wildlife agencies and other state, fed and NGO conservation partners to NBCI support and implementation.

Building Landscapes and Stacking Practices. In agricultural regions of the Southeast it is important to bring together multiple conservation practices to build landscapes suitable for sustaining huntable bobwhite populations. Therefore, field border practices improve crop fields as brood habitat, thinning CRP pines and burning provides both nesting and winter habitat. The challenge on many landscapes is developing incentive programs in which landowners receive increasing benefit by applying multiple programs. While CP33 provided a boost in bobwhite numbers, the results can be much greater if a landscape approach is applied. Restoration efforts have produced positive bobwhite responses at local scales, but a critical mass of landscape area to trigger larger scale response have not been met. In forested regions, application of prescribed fire in conjunction with thinning upland stands is a major constraint to successful restoration of bobwhite populations. Thinning without burning or burning without thinning will not result in suitable habitat. To restore pine and oak savanna in the Southeast, we desperately need incentive programs which will more than fill the gap between production forestry which maximizes fiber production, and conservation forestry which produces wood products but also provides habitat for wildlife. In addition, prescribe fire programs which provide funds to support expert burn teams to conduct prescribed fires for landowners is needed to help reintroduce prescribed fire back to the rural southeast. Without carefully thought out thinning and prescribed fire conservation programs, it is doubtful bobwhite and associated species can be recovered in southeastern states.

Fire and Public Lands. One of the greatest challenges for bobwhite management on public forested lands is the application of prescribed fire at the correct combination of season, extent and frequency. Long intervals between prescribed fires used for fuel reduction ultimately select for a groundstory of hardwoods and vines and encourage excessive regeneration of tree species resulting in development of a dense midstory (Figures 28 & 29). Fire must be applied on a 1-3 year frequency, with specific prescriptions depending on site characteristics in order to maintain bobwhite habitat. In addition to frequency, the size of individual burns and the distribution of burns on the landscape have huge implications for bobwhite. To be compatible with bobwhite, fire size should be no more than 500 acres, preferably $<$ 250 acres. Burning adjacent blocks within the 6 months should be avoided. Unfortunately, to reach burn targets, public lands are often burned at larger extents followed by burning adjacent blocks in short order. Burn scale is a major issue that is just now beginning to receive research which suggests bobwhite demographics are sensitive to fire size and that as burn size increases quail populations and demographics decline. Additional research on the effect of burn size is needed if we are to expect public lands to support bobwhite populations at huntable levels.

Financial Incentives. Financial incentive programs are badly needed for restoring and managing longleaf and other woodland savannas on lands without a cropping history. These incentives must be adequate to cover direct and indirect establishment and management costs and to compete with alternative markets (e.g. bio-fuels and pine straw). To encourage landowner enrollment at levels necessary to enhance bobwhite habitat at the landscape scale financial incentives must cover both direct and opportunity costs and be competitive with alternative markets. For example, in Georgia‘s BQI landowner enrollment increased dramatically when practice incentives exceeded the USDA Crop Rental Rate; and in a survey of BQI landowners only 24% of program participants reported that they would have implemented any BQI practices had economic incentives not been available. In the long-term, increasing commodity prices resulting from global food supply and demands will drive producer decisions on land use. The NBCI and the conservation community must develop tools and program mechanisms to remain economically relevant with cost-shares and incentive payments. The realms of precision agriculture, targeted conservation, and NBCI must work together with FSA.

(a) 1966: site selected for fire exclusion study.

(b) 1981: 15 years later with no burn.

(c) 2001: 25 years later with no burn.

Figure 29: Photo point depicting an upland site set aside in 1966 (Photo A) for fire exclusion. Photo B was taken from the exact same spot as photo A 15 years later: the canopy has begun to close and a mid-story of loblolly and shortleaf pine dominates. Twenty-five years later (Photo C, R.E. Masters) and still no fire the site has shifted to mid-story still retains some pine but is heavily encroached by pin water oak and sweetgum.

Exotic Grasses. Bahia grass pasture is functionally poor habitat for bobwhites given the low structure and limited plant diversity. The shift in focus from rangeland cattle production to pastureland has presents a significant challenge to bobwhites in Peninsular Florida where bahia grass pastureland has supplanted almost 2 million acres of rangelands. Significant economic constraints occur with adapting pastureland to a resemblance of bobwhite habitat. Farm Bill practices are scant that target improvement of these acres for bobwhites. The invasive nature of most exotic forages will prove difficult to implement any practice within these systems. Also, we have incomplete understanding on how we can manage cattle in these systems for bobwhites. Some evidence suggests that deferment rotational system compared to a continual system can improve conditions for bobwhites, but more research is needed. There also is need for additional research on the use of fire and patch grazing systems to incorporate quail management into grazing systems.

4.6.4 Partnerships.

In forest habitats, there are many opportunities to partner with private landowners and NGOs with a common interest in restoring pine-grassland communities. Groups like the Longleaf Alliance, Tall Timbers Research Station, Quail Unlimited, Quail Forever, SEPARC, SEPIF, and more have a common interest in increasing acreage of pine and oak savanna habitats. A common theme presented to policy makers promoting policies that demonstrate benefits to multiple species and ecosystems is more robust than working in isolation.

To be successful on private and public lands will require cooperative projects with all agencies involved in land management or providing technical assistance to landowners. Attempts should be made to move beyond MOUs and develop meaningful management solutions to low fire frequency and excessive timber density. A good example in Florida is the Upland Ecosystem Restoration Project, a multiple agency project, working together to improve habitat on approximately 100,000 acres of public lands to increase a suite of declining birds. On private lands, the Georgia Bobwhite Quail Initiative has provided incentive funds and partnered with FSA, NRCS and the Georgia Forestry Commission to promote the adoption of habitat programs adding habitat on the ground.

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5 Incorporating Effective Monitoring into the National Bobwhite Conservation Initiative.

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The utility and effectiveness of the National Bobwhite Conservation Initiative (NBCI) is predicated on its ability to provide direction for those entities (e.g., state, federal, non-governmental) working to recover sustainable bobwhite populations. Establishment of specific and measurable objectives is essential for effective implementation of the NBCI strategic plan; however, success in meeting those objectives has typically been framed in terms of habitat acreage as a surrogate measure of population response. Assessment of improved habitat acreage is very important, but it is an inappropriate measure of bobwhite recovery. The metric that will be most valuable to assess conservation actions, inform conservation policy, facilitate adaptive management and evaluate the effectiveness of NBCI is through measurement of population response using density estimation. *Standardized* measures of population response must become a fundamental link between NBCI-based habitat efforts and progress, or measured success, of bobwhite recovery. This can be accomplished through appropriate design and implementation of monitoring in an adaptive context to help meet NBCI recovery objectives. In this chapter, we discuss the current needs for NBCI monitoring, the utility of effective monitoring, and considerations for assessing bobwhite populations. We provide 5 key recommendations (see recommendation boxes) for development and improvement of monitoring protocols to obtain reliable population inference.

NBCI Recommendation 1:

Development of a comprehensive and flexible monitoring strategy is needed across the species range!

The NBCI needs bobwhite population monitoring to assess plan progress, evaluate specific management actions, and augment future conservation plans and management decisions.

5.1 NBCI Monitoring Needs

Monitoring can be implemented at many levels; however, range-wide bobwhite recovery goals warrant development of a flexible but comprehensive population monitoring strategy spanning the endemic range (recommendation 1). A range-wide population monitoring strategy, combined with a centralized data management system, will provide necessary measures that are comparable across geographic boundaries and allow for assessment of bobwhite recovery at the national level.

As the NBCI develops a comprehensive population monitoring strategy, it should strive to include methods that allow for population inference through measures of density (e.g., bobwhite per acre; see recommendation 2). Population density is a flexible metric that incorporates area, so it can be scaled based on survey effort, temporal scale, or spatial coverage without sacrificing the meaning of the estimate. Population density estimation, with associated measures of variance, provides biologically and politically (bobwhite hunters and policy-makers) meaningful information at multiple scales and will provide the spatial context necessary to allow direct evaluation of population response to NBCI management actions across the landscape and over time. Density estimates will also provide valid assessment of population trends over time. Therefore, bobwhite status can be compared within and across agency, political, and ecological boundaries. Density estimates are also appropriate for an adaptive resource management (ARM) approach to assessing whether or not NBCI management prescriptions achieve desired bobwhite objectives relative to established target densities, and further reducing management uncertainty while improving overall NBCI implementation.

Adaptive Resource Management (ARM):

NBCI must be implemented using an Adaptive Resource Management framework: scientists and managers working together in the decision-making process, testing hypotheses about how bobwhite populations respond to NBCI habitat prescriptions is a key element to region-wide, long-term success. NBCI evaluation should be focused on the information most useful for management decisions and bobwhite population density.

5.2 The Utility of Effective Monitoring

Inventory monitoring is an extensive point-in-time survey to determine the presence/absence, location, or condition of a resource. It provides a means to delineate baseline bobwhite population levels (i.e., assess status) upon which local, regional and range-wide target recovery densities can be more pragmatically defined. If implemented appropriately, inventory monitoring can provide reliable long-term data sets that can be synthesized to provide multi-scale estimates of bobwhite abundance, long-term population trends, and develop linkages between populations and habitat needs. Inventory monitoring also provides a means to verify maintenance of existing and newly established populations, thus tracking population gains and losses over time. ***Monitoring*** in the adaptive management context consists of the systematic and repeatable collection of data to obtain information regarding changes in population condition or evaluate progress toward meeting a management objective (Elzinga et al. 2001). In this context, monitoring is a critical component of what should be an iterative process of management, where responses to conservation actions are evaluated, and information gained through evaluation is integrated into future conservation decisions (IAFWA 2004, NABCI 2007). It also plays an important role in policy decisions, and is the only source of evidence that conservation investments for bobwhite are producing worthwhile results (IAFWA 2004). In this respect, incorporation of monitoring may powerfully influence future policy decisions by generating proof of success for key NBCI partners (e.g., National Fish and Wildlife Foundation) and ultimately stimulate public interest in bobwhite conservation. Monitoring may also be utilized in the research context, where a rigorous experimental approach (often involving hypothesis testing) is applied to the systematic collection of data, with the objective of gaining reliable knowledge of relationships among populations and some other variable of interest.

NBCI Recommendation 2:

The parameter of interest should be density.

The NBCI needs to incorporate density as a consistent and reliable metric to render valid temporal and spatial comparison throughout the bobwhite's range.

Many large-scale bird conservation initiatives (e.g., North American Bird Conservation Initiative, North American Waterfowl Management Plan) have recently emphasized integration of monitoring into management plans. These initiatives include: recommendations for coordination and/or standardization of monitoring for larger spatial inference; improvement of design, field methodology and analysis of survey data; and maintenance of data in coordinated management systems (NABCI 2007, Lambert et al. 2009). The NBCI and its constituents have been progressive in implementing all of these elements with development of a large-scale, coordinated wildlife monitoring effort evaluating bobwhite and upland songbird response to Continuous Conservation Reserve Program (CRP) practice 33 (CP33; Habitat Buffers for Upland Birds) (see Case Study: CP33 Monitoring above). Incentive-based conservation provisions, like those found in the USDA Farm Bill are key examples where well-designed monitoring is applicable and valuable, and will be of benefit when planning and promoting future Farm Bill conservation programs and practices for wildlife.

5.2.1 Standardized or Coordinated Monitoring - Is there a difference?

To ensure that monitoring is a valuable component of any NBCI-based management plan, cooperators must clearly delineate objectives and understand limitations of monitoring to allow for economical and effective implementation. Likewise, at the national level, many state, federal and private organizations must work together to monitor populations across the bobwhite range. Therefore, data must be collected in such a way to allow seamless integration and afford valid range-wide comparisons.

When discussing organized monitoring efforts, the terms "coordinated" and "standardized" are often used interchangeably. Although both can be important components of a successful monitoring program, the terms are not completely synonymous. A coordinated monitoring program consists of a coalition of entities working together to implement a monitoring effort (e.g., North American Breeding Bird Survey (BBS)) (Bart and Ralph 2005). Generally, coordinated monitoring is implemented over a broad geographic scale and is overseen by a single entity that delivers a recommended monitoring protocol to participating organizations. Coordinated monitoring can be helpful in deriving range-wide or regional population or trend estimates while avoiding redundancy of sampling and increasing sample size for analysis (Bart and Ralph 2005).

Case Study: CP33 Monitoring

In 2004 the USDA-Farm Service Agency established "Habitat Buffers for Upland Birds," or CP33 under the Continuous Conservation Reserve Program, and allocated 250,000 CP33 acres to 35 states for establishment of native herbaceous vegetative communities along CCRP-eligible crop-field margins. CP33 was unprecedented in that it was the first Farm Bill conservation practice specifically designed to help meet the objectives of a large-scale wildlife conservation initiative (the NBCI), and was the first CCRP practice to require evaluation of wildlife response following implementation. When CP33 was initiated, the FSA stressed the need for a coordinated monitoring effort to produce reliable measures of bobwhite and upland songbird response to CP33 over a large geographic extent. This recommendation eventually became the CP33 monitoring program, which includes coordinated monitoring on nearly 600 CP33 fields (paired with reference fields without field buffers) in 14 states containing 80% of established CP33 acreage. The CP33 monitoring program was an overwhelming success, exhibiting that coordination of efforts and standardization of monitoring across multiple agencies and organizations is feasible and provides useful information to inform future policy decisions.

Source: Burger et al. 2006, USDA 2004

Although a coordinated monitoring program is generally standardized, standardization of monitoring does not necessitate coordination. In reality, monitoring programs for bobwhites and other birds will vary by logistic and financial resources available within geopolitical boundaries and by habitat structure or ecological region. In standardized monitoring, multiple entities implement independent monitoring programs that provide comparable outputs (i.e., density). Standardization allows for differences among monitoring protocols, while providing minimum criteria that permit coalescence of data across a wider range of inference.

Whether monitoring programs are coordinated or standardized, or both, it is important that they be objective-driven and science-based (Bart and Ralph 2005). Prior to implementation, considerations regarding study design, limitations of survey methods, logistic and financial resources, and desired parameters of interest must be addressed for program success. In doing so, the integration of monitoring efforts for bobwhites into multiple bird monitoring programs (e.g., NABCI) is simplified. Whereas coordination and standardization should be the ultimate objective of a monitoring program, when coordinated monitoring is not an option, the NBCI should minimally strive for ***standardization*** of monitoring, possibly under the framework of a flexible comprehensive monitoring protocol (recommendation 3). Standardization of monitoring programs that address NBCI objectives will allow for multi-scale inference via comparable outputs across the bobwhite range and provide a platform for effective monitoring.

NBCI Recommendation 3:

We should strive for standardization (and if possible, coordination) of monitoring.

In order to facilitate valid comparison through density estimation, monitoring protocols must incorporate specific information (e.g., distance, replication/repeat counts) to allow estimation of density.

5.3 Considerations for Population Assessment

The objective of a national or regional bobwhite monitoring program such as the NBCI should be to provide accurate density estimates within the scope of available logistic and financial resources while keeping in mind range-wide monitoring objectives. The first step is clearly delineating what the population of inference and parameter of interest should be (Elphick 2008). Based on the level of inference chosen, the next step is to develop monitoring protocols that adequately provide data needed to validate such inference. In most cases, researchers rarely have the opportunity to obtain absolute abundance (i.e., conduct a census) of the population of interest, and therefore must rely on sampling techniques to estimate abundance through surveying (sampling) a proportion of a population (Elphick 2008). While sampling substantially reduces cost and effort, the tradeoff is a potential increase in bias (error) and variation of estimates obtained. Therefore, to maximize the efficacy of a monitoring program, sampling design must be clearly defined to avoid the pitfalls of retrofitting data to a statistical analysis method.

One key component to an effective sampling design is to implement randomization (i.e., survey locations randomly selected from the population of potential survey locations). The NBCI recommends that survey locations be selected based on probabilistic sampling (i.e., be randomized) when implementing a monitoring effort. However, in situations that preclude true randomization of samples (e.g., limited access), we encourage random assignment of survey routes (e.g., roads). If survey routes are limited to roads, we suggest use of secondary roads (similar to BBS) to minimize noise disturbance. However, we caution the interpretation of data collected along roads as habitat types and structure may not be representative of the surrounding landscape. The acceptability of this bias should be determined by those using the data for decision making, but not ignored entirely.

Definitions of Key Concepts:

Abundance: total numbers of animals in population at a specified time and over a defined geographic area.
Census: a complete, exact count of abundance.
Density: number of animals per unit area in a population at a particular time.
Index: any measure or count of a species based on direct observation or observation of a sign of the species that provides some numerical scale of observation without a measure of detection rate.
Sampling Design: method for selection of sampling units from a sampled population so as to obtain reliable estimates.

Source: Conroy and Carroll 2009

5.3.1 Adapting Current Monitoring Protocols to Meet NBCI Needs

In general, abundance techniques fall into two primary categories: an index or density. Although each type has its value and each its caveats, density estimation, as discussed previously, is the metric needed to move the NBCI forward. It is encouraging to see that most states currently collect relative abundance data but the disparity of the methods and resulting data types among states is large. A cursory review of these methods indicated that the most prevalent types of population assessment among states are indices (e.g., quail/point). Examples of such indices include the BBS, rural mail counts, and summer cock counts. Whereas index methods such as these are typically easier to implement, cost relatively less, and can provide data for trend information, the utility of indices to make inference beyond simple comparisons is severely limited. Population indices lack spatially explicit information (i.e., birds/unit area), which renders abundance estimates virtually incomparable across studies. Many indices do not provide adequate spatial coverage (i.e., sampling units cover very small portions of the landscape) to broadly apply counts to larger landscapes. Further, when detection of individuals (wildlife) is dissimilar across time or space conclusions about comparative abundances and habitat relationships are confounded with detection probability and may be erroneous (Thompson 2002). However, coupling index methods with ancillary information to account for detection will greatly increase their accuracy and utility.

What causes variation in detectability?

Variation in detection probability, or detectability (i.e., the probability of detecting an individual bobwhite or covey during a survey), is frequently incorporated into statistical analysis to generate robust measures of density. The purpose is to account for quail that may be present, but not detected. But what are the main causes of variation in detectability? Detectability can be influenced by many factors including observer differences, distance of the individual from the observer, environmental and climatic variables, and habitat structure. Behavior of the quail (e.g., individual movement, behaving inconspicuously, avoiding the observer) and availability of quail for detection can also greatly influence detectability and can complicate data collection. Carefully trained observers can help to mitigate issues of detectability, but in most cases it is inappropriate to assume that detectability is constant across observers or habitats.

Source: MacKenzie et al. 2006, Williams et al. 2001

A simple, but realistic example demonstrates this point. Say an agency is conducting fall covey counts on 2 Wildlife Management Areas (WMAs) in hopes to obtain estimates of bobwhite density on each area. The area surveyed is assumed to be 50 acres and the mean covey size on both WMAs is 12 birds. On WMA #1 there are 5 coveys heard (detected) in the 50 acre survey area, whereas only 1 covey is detected on WMA #2. If the probability of detection is assumed to be 100% on both areas, then density on WMA #1 would be 1.2 bobwhite/acre (density = [number of coveys x mean number of birds per covey] / [area surveyed x probability of detection]), and 0.24 bobwhite/acre on WMA #2. This would indicate that management on WMA #1 was producing 5 times greater density of bobwhite than that of WMA #2. However, collection of ancillary data reveals that the probability of detection on WMA #1 is 90%, whereas the probability of detection on WMA #2, due to noise from a nearby major highway, is only 10%. There are a multitude of other conditions that could reduce an observer's ability to hear (detect) a calling individual (in this case: covey) including high wind speed, presence of tall vegetation, hilly terrain, etc. Accounting for the variation in probability of detection would give a density of 1.33 bobwhite/acre on WMA #1, and 2.4 bobwhite/acre on WMA #2. This suggests there is actually a greater bobwhite density on WMA #2 than on WMA #1. Clearly, differences in probability of detection can strongly affect estimated densities and failure to account for those differences can severely bias results. More importantly, the biased results could have caused misguided decisions in harvest and habitat management for the respective WMAs.

Fortunately, most methods that provide for estimation of density by incorporating variation in detection probability and other extrinsic factors require only minor adjustments to existing methodologies (Farnsworth et al. 2005, Elphick 2008) (recommendation 4). Careful sampling design and collection of ancillary data in the field will greatly improve the reliability of comparative density estimates by accounting for these extrinsic sources of variation (Thompson 2002, Bart 2005, Farnsworth et al. 2005, Elphick 2008, Pollock et al. 2002). As such, adequate sampling design is warranted to ensure that monitoring protocols yield the appropriate data to effectively evaluate population response to management.

NBCI Recommendation 4:

Variation in detection probability should be incorporated into population estimates.

Simple count data, lacking detection information, is no longer acceptable in most situations because other methods accounting for estimation of detection probability (e.g., distance measurement, double observer, double sampling) are available. Further, collection of ancillary data (e.g., habitat, weather conditions, observer, climactic variables) must become a staple part of any monitoring program to allow for robust estimation of parameters of interest.

5.3.2 Sampling Design for Monitoring

As most are already keenly aware, bobwhite density may vary based on a multitude of geographic, habitat, and climactic factors. It should then be the goal that monitoring protocols provide robust measures of density that account for these extrinsic factors. This will aid in assessment of NBCI progress by allowing synthesis and comparison across multiple studies or larger geographic extents and longer time frames. There are several sampling frameworks based on count data that are useful in providing robust density estimates necessary to track NBCI progress that account for variation in detectability.

Distance sampling, an extension of plot sampling, uses distance of a calling or observed bobwhite or covey to estimate a detection probability - and this detection probability is used to calculate density (Buckland et al. 2001). The collection of additional information such as habitat or climatic variables will allow the calculation of more accurate detection probabilities and subsequently more accurate density estimates. Distance sampling requires little extra resources (basically, the collection of distance to the observed individual or group and optional ancillary data) when compared to index counts, but it does require that distances are measured or assigned accurately among several other assumptions.

Double sampling is a method that involves rapid sampling at all survey points (e.g., using point counts), followed by intensive sampling (e.g., territory mapping) at a subset of survey points to estimate a detection probability (Cochran 1977). Double sampling can be very effective, but may require substantial resources if detection probabilities must be estimated across multiple habitat types (Johnson 2008).

Sampling based on mark-recapture methodologies including those that involve marked animals (e.g., bands and/or telemetry), and those that are based on replicate observation methods (e.g., double/multiple observer, removal models, time-to-detection) are also useful in estimating detection probabilities. Double/multiple observer methods make use of 2 or more observers working either independently or collaboratively to account for individuals missed by each observer (Nichols et al. 2000). Removal models delineate the survey into distinct time periods (e.g., 0-3, 4-5, 6-10 min) and use detections (i.e., captures) within time periods to develop a detection probability across the entire sampling unit (Farnsworth et al. 2002). Time-to-detection methods (or cue-counting) use multiple discrete vocalizations of individuals to develop a detection probability within a mark-recapture framework (Alldredge et al. 2007). There are many combination methods as well that attempt to further refine estimation of density (e.g., double-observer distance sampling).

Occupancy modeling builds on simple presence/absence methods and develops a probability of detection and probability of site occupancy based on repeat surveys at the same site, which can be later used to estimate abundance or density (MacKenzie et al. 2006). The link between occupancy and density has not been completely developed and is still under scrutiny, but for low density populations, occupancy may be the best metric to use for monitoring bobwhite populations. Occupancy may also be useful in determining distribution of bobwhites across the landscape, particularly in discrete habitat patches where [bobwhite] presence has not yet been determined.

Each survey method varies in amount of resources required for implementation, and each has a list of critical assumptions that, if violated, will bias results. However, several (e.g., distance sampling, removal modeling, double-observer) require only minor refinement of current survey methodologies with relatively little extra investment of time, effort or money, and they will provide robust density estimates when implemented properly. Depending on monitoring objectives, distance sampling or removal/time-to-detection would be the least intensive methods (i.e., require the same time investment as index methods with no increase in personnel), requiring collection of only ancillary distance or time data while conducting the survey. However the validity of these methods relies strongly on the assumptions that observations and observed distances are accurately recorded.

When evaluating what type of monitoring to implement, agencies should first consider existing monitoring protocols to determine whether: 1) they can be modified to incorporate detection probability or 2) they cannot provide robust measures of density under the NBCI-suggested framework and warrant development of new protocols. If establishing new monitoring protocols (e.g., CP38 SAFE), agencies must first consider resource limitations, and evaluate the availability of extramural funding or collaboration/coordination to carry out monitoring efforts. Agencies then can determine the right method for the region of inference (e.g., state-wide, focal area, or single property) and available resources, keeping in mind that some methods require adequate sample sizes to provide robust estimates. Determining the sample unit of interest and the number of sampling units required to produce a density estimate with acceptable precision (<20% coefficient of variation (CV)) will be key components in sampling method decisions. Smith et al. (2009) estimated with distance sampling that <15% CV could be achieved with 50 points at an abundance of 1 covey/point, or 20 points at an abundance of 2 coveys/point. We strongly recommend conducting a pilot or simulation study to determine if methods provide estimates with appropriate measures of precision. Whether developing new monitoring protocols or refining old ones, most of these monitoring methods are practical and achievable, and will be instrumental in providing a "feedback" mechanism for conservation investments.

Recommended NBCI Monitoring Methods (count data):

- Distance sampling (point or line transect)
- Double sampling
- Mark-recapture methods
  - Animals Marked
    - Telemetry
    - Band-recovery
  - Animals Not Marked
    - Double/Multiple observer
    - Removal Methods
    - Time-to-detection
- Combination Methods
  - Double-observer distance sampling
  - Cue-count distance sampling
  - Distance-removal methods

Method currently under NBCI evaluation:

- Occupancy modeling

5.3.3 Data Management

Adequate monitoring design and data collection will allow managers to make informed management decisions and is essential for sound wildlife conservation. However, well collected data is functionally useless without proper storage and integrity. Data integrity assures data is maintained in a consistent and correct fashion. The type of data-storage software chosen should meet this basic criterion: maintains integrity, allows easy and fast access, ability to be backed-up, and allows multiple users of the same data. There are essentially two types of data storage file types: a flat type and a relational type. An example of a flat type, Microsoft Excel, does not allow indexing of data; therefore, queries are not easily performed. A relational type (e.g. Microsoft Access®, MySQL) allows for one-to-many relationships and, therefore, queries are easily conducted within the data-set. Since wildlife monitoring data is naturally hierarchical with nested levels of organization (e.g., a single property with numerous sampling locations), we recommend choosing a relational type database for most wildlife applications.

Specifically related to NBCI, data management will become an increasingly important component to tracking progress of recovery efforts. Data sharing across political boundaries will be a necessity for tracking success stories, building large-scale habitat models, monitoring long-term trends, and coupling datasets to improve precision on abundance estimates. Much like monitoring itself, if data storage is standardized and coordinated the exchange of information will be virtually seamless.

NBCI Recommendation 5:

A centralized data repository is needed.

Numerous states have population data dating back several decades; however, the format of this data ranges from electronic (database, Excel) to the only paper copies stored in file cabinets or boxes. The development of a centralized database will provide a platform for states to enter population data as it is collected and this will in turn facilitate future use of the data and ease evaluation through analysis.

5.3.4 Centralized Data Management: where will the data be stored?

As the NBCI moves into a range-wide conservation plan, an integral aspect of management at that scale is the dissemination and availability of information (data). A centralized database that houses monitoring data and is accessible by all NBCI cooperators would be invaluable to tracking progress of NBCI objectives (recommendation 5). These data would allow managers to tap into a larger resource than a single entity could produce on its own, assuming some level of standardized methodology (e.g., BBS). However, the idea of where data will be stored crosses many technical, philosophical, and political boundaries. For instance, who owns the data and who will have access to it? These are not easy questions to answer and the answers are ostensibly driven by legalities rather than the utility of the data for conservation. Unlike with BBS, which utilizes citizen science (i.e., data collected by volunteers), the NBCI will have to rely on a myriad of funding sources to collect the necessary monitoring data. Therefore, data will be owned by numerous entities. For the NBCI to be successful at monitoring and tracking its success a mechanism is needed to encourage data entry and to provide an incentive for entities to allow data access. Without the NBCI's intellectual and financial ownership in bobwhite monitoring data it will not be able to meet the range-wide monitoring goals.

5.4 NBCI Monitoring Recommendations

The vision for evaluation of range-wide bobwhite recovery is to provide a resource for improved standardization of bobwhite monitoring such that recovery efforts are targeted, efficient, and guided by sound science. Monitoring is fundamental to NBCI recovery efforts because it serves as the only available "litmus test" to evaluate bobwhite response to habitat improvements. However, the bobwhite's range is wide and monitoring is often logistically difficult to implement, requiring substantial fiscal resources. **For NBCI recovery efforts to be successful, the paradigm of monitoring as a "follow-up" to habitat improvements must be shifted to the view that monitoring is a critical component of any conservation initiative.** When accomplished, monitoring will ultimately help guide the NBCI regarding which conservation investments produce worthwhile dividends. Thus, cooperation among NBCI-constituents, whenever possible, is greatly needed to help make monitoring cost-effective. Depending on study design, monitoring to meet NBCI objectives can be easily integrated into other bird monitoring programs to help offset resource costs.

The multitude of available monitoring options can be overwhelming; however, there are some key points that may help steer those creating or re-evaluating monitoring programs in a desirable direction.

1. Monitoring of bobwhite populations is absolutely critical to track the progress and success of NBCI recovery efforts, and should be a fundamental component of any management plan. In the next decade the NBCI seeks to develop a range-wide bobwhite monitoring strategy that provides a flexible framework to implement monitoring to provide range-wide measures of density.

2. To be successful, NBCI monitoring efforts must produce comparable outputs. Currently, density is the only reliable output that renders a robust estimate for comparison both spatially and temporally.

3. Standardization (and, if possible, coordination) of monitoring is essential to ensure adequate data collection to obtain reliable and comparable density estimates.

4. The probability of detection should be incorporated in whatever way possible to account for missed individuals in population estimates. Simple count data is no longer sufficient in most situations where other methods that allow for estimation of probability of detection are available. Further, collection of ancillary data (e.g., habitat, observer, climactic variables) must become a staple part of any monitoring program to allow for robust estimation of parameters of interest.

5. Data archiving into a central database is needed to facilitate data comparison across spatial and temporal scales throughout the distribution of bobwhites.

5.5 Acknowledgements

We sincerely appreciate the vision and editorial suggestions provided by Bill Palmer during development of this chapter. We also gratefully acknowledge Reggie Thackston, Chris Williams, Dave Buehler, Rua Mordecai, and Steve DeMaso for their insightful reviews.

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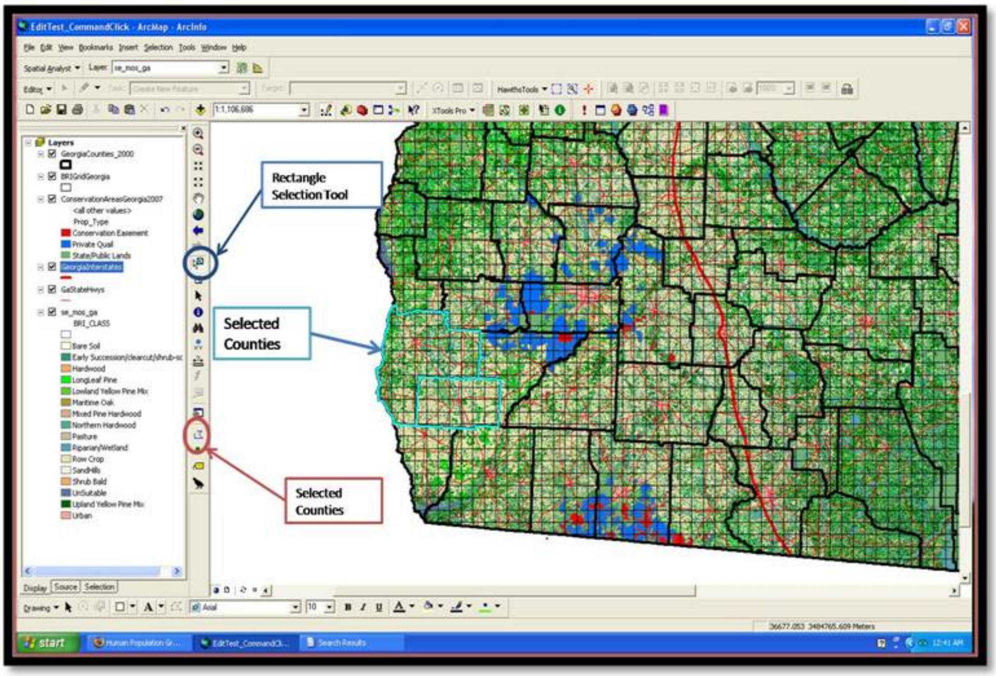
6 Appendices

6.1 Assigning Ranks using ArcGIS

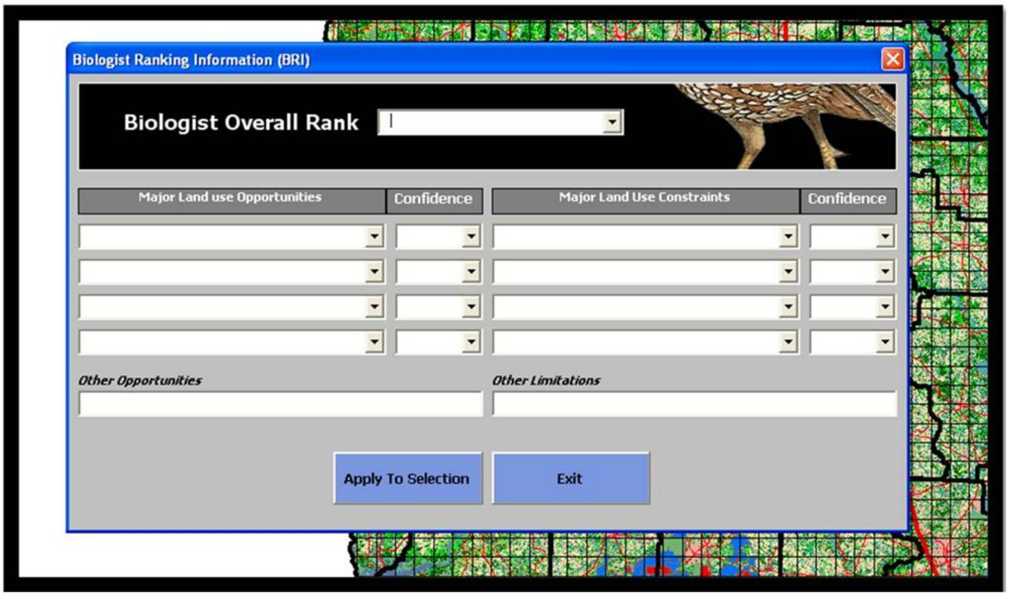
To rank regions you will use a Graphical User Interface (GUI) created with the relevant ranking criteria for overall biologist rank (High, Med, and Low), major opportunities and major constraints. To rank areas, we will use a two-phased process: (1) as a group select and rank all counties within your specified region either individually or as a collection and then (2) as a group select an individual or collection of grid cells within each county that have different ranking classifications than the rest of the county as previously assigned. In order to best utilize the expert knowledge of the entire group (all individuals), it is recommended to use the paper maps and digital geographical layers provided to discuss among the group the major landscape features that have potential habitat improvement opportunity to benefit bobwhites and discuss the major opportunities for management and the major constraints potentially inhibiting management and then assign those ranks (decisions) to individual counties and grid cells.

PHASE I: The general process for selecting counties (and cells) is as follows:

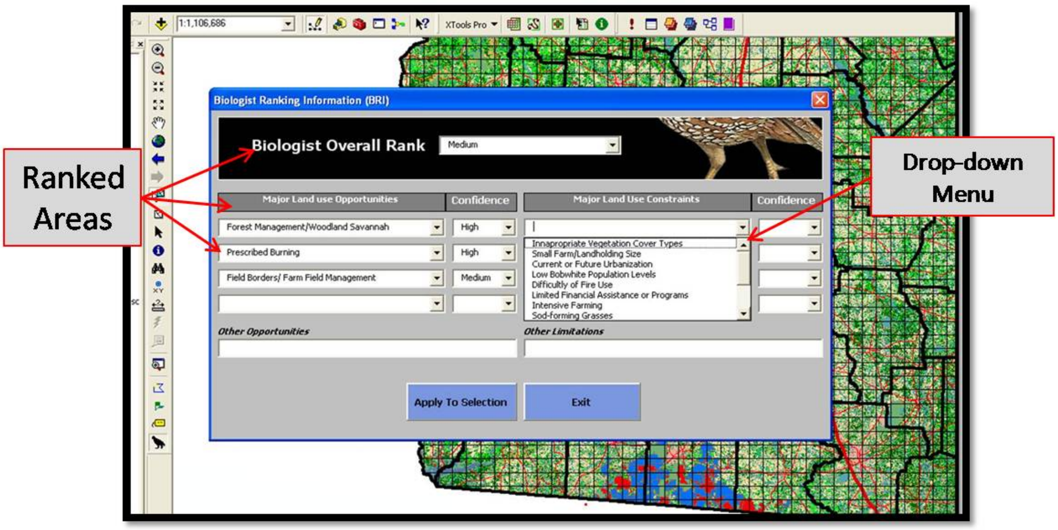
1. Using ArcGIS, select a single county or a collection of counties with similar landscape features (that will receive the same rank) using either the irregular polygon tool (see red circle below) or the rectangular selection tool (see blue circle below). Simply click on the tool, move the cursor to target features to select and click (w/ left mouse button) and drag the cursor to select the target area.



2. After selecting target counties, click on the quail icon at the bottom of the standard toolbar (see orange-circled region above). This should spawn a GUI (new window: the Biologist Ranking Information [BRI] window) which has several drop-down menus to assign ranks.



3. Now assign the group's overall biologist rank, major opportunities and constraints for the selected area by simply clicking the drop-down menu for each box and choosing the desired content. Also assign a Confidence value to each opportunity and constraint selected; this value is your relative "belief" that the given opportunity or constraint will benefit or inhibit, respectively, management in the selected area for which you are currently ranking.

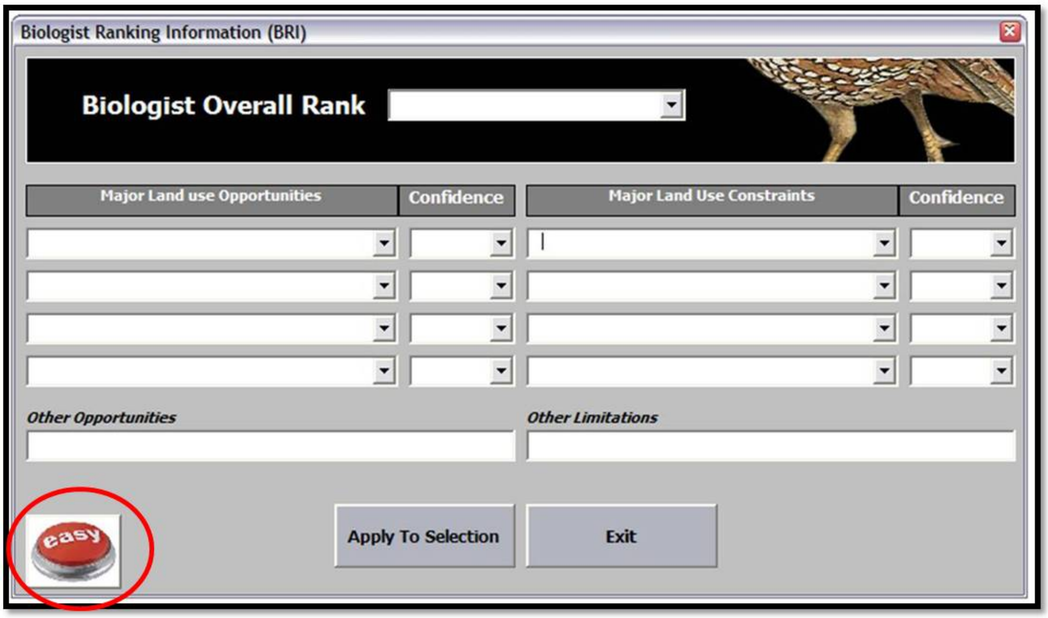


4. After the entire group is satisfied with the rank chosen and the assigned opportunities and constraints click "Apply To Selection" to apply the assigned rankings to the selected area(s) and to save the information. Clicking the "Apply To Selection" button will close the BRI window. Note: there is also an option to type in other opportunities and constraints if we have failed to include it as a selection item in the drop-down menu and you deem it a valid or needed addition. *****IMPORTANT NOTE:*** after you apply the selection and the BRI window closes you should see the counties change color based on the overall biologist rank assigned to it (high-low). So if the county does not change colors then something did not work correctly - although, I am confident that this will not happen (keep your fingers crossed).

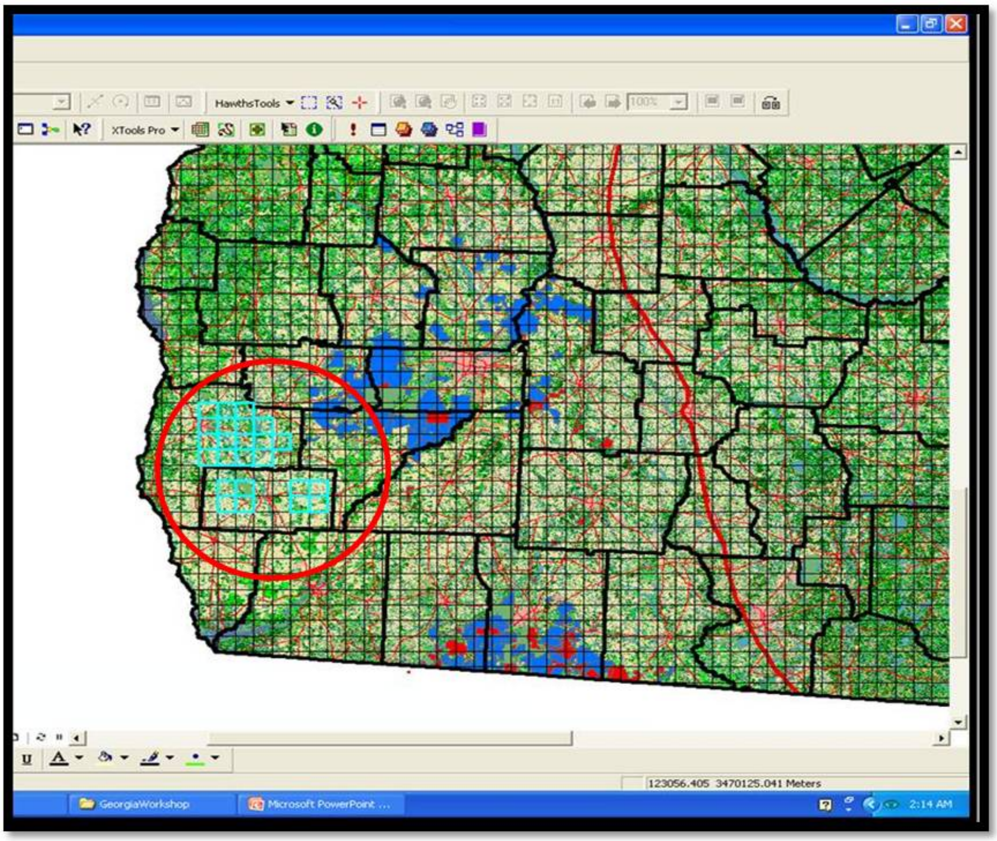
5. Repeat the same process until each county has been ranked according to the group's general consensus.

6. Upon completion of your entire region, inform either Bill or Theron and we will prepare your computer for the second ranking phase.

7. If you should make a mistake, re-select the county, open the BRI-GUI and click on the "easy-button" (see red-circled region below). This will populate the GUI based on the previously assigned ranks and information.



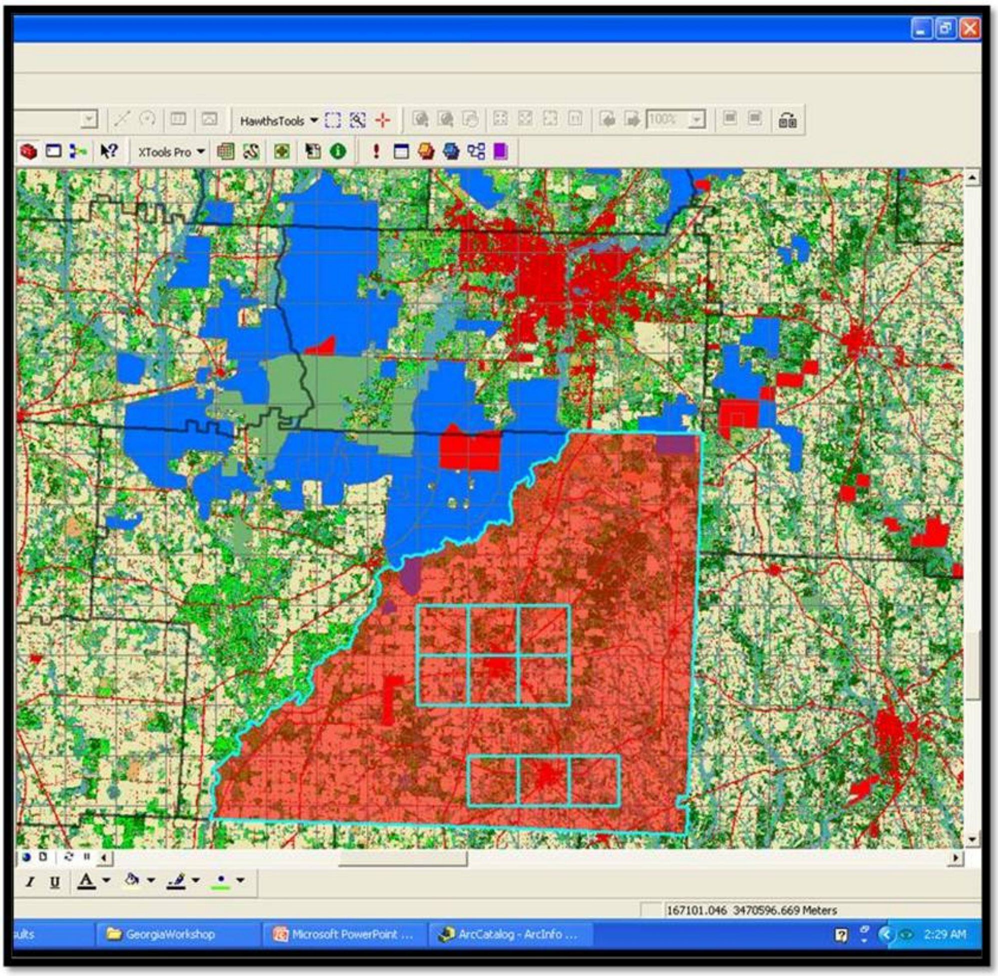
PHASE II: For the second phase of ranking, select individual grid cells or a collection of grid cells that should receive a different rank than that assigned to the entire county during the phase I.



The idea here is NOT to re-rank all the cells but to pick only the cells or areas that differ for various reasons as compared to the rest of the county and thus warranting separate ranks, opportunities and constraints. For example, you might have ranked Mitchell county as high, as indicated by the red shaded region below, because it is located nearby intensively managed private quail properties and it provides other land use opportunities (e.g., field border management, prescribed burning) to improve habitat for quail; however, in the cells surrounding Camilla and Pelham (cells highlighted in blue below) you might consider those to be less favorable and rank them as medium to low based on the potential urban expansion and difficulty of fire implementation.

After selecting the cells to be changed (as seen below), open the BRI-GUI, and click the "easy-button". This will automatically populate the GUI with the previously assigned ranks and values. Change those ranks and major land use opportunities and constraints as needed and submit changes by clicking "Apply To Selection."

Repeat this process for the entire region.



Your expertise and input is invaluable to this process and is greatly appreciated. THANK YOU!!

6.2 Common Acronyms

AFWA - Association of Fish and Wildlife Agencies
ARM - Adaptive Resource Management
BA - Birds Added
BBS -Breeding Bird Survey
BCR - Bird Conservation Region
BQI - Bobwhite Quail Initiative
BRI - Biologist Ranking Information
CCPI - Cooperative Conservation Partner Initiative
CCRP - Continuous Conservation Research Program
CIG - Conservation Innovation Grants
CP - Conservation Practice
CPA - Conservation Program Application; also Conservation Priority Area if in CRP context
CPT - National Bobwhite Conservation Initiative's Conservation Planning Tool
CREP - Conservation Reserve Enhancement Program
CRP - Conservation Reserve Program
CV - Coefficient of Variation
DNR - Department of Natural Resources
ED - Estimated Density
EQIP - Environmental Quality Incentives Program
FA - Financial Assistance
FSA - Farm Service Agency
GADNR - Georgia Department of Natural Resources
GAP - Gap Analysis Project
GFC - Georgian Forestry Commission
GIS - Geographic Information System
GUI - Graphical User Interface
HFI - Healthy Forest Initiative
HTML - HyperText Markup Language
IES - Intensive Early Stocking
JV - Joint Venture
KM - Kilometers
KML - Keyhole Markup Language
LCC - Landscape Conservation Cooperative
LIP - Landowner Incentive Program
LLP - Longleaf Pine
LP - Loblolly Pine
MAV - Mississippi Alluvial Valley
MD - Managed Density
MDWFP - Mississippi Division of Wildlife, Fisheries and Parks
MS - Microsoft
MSCGP - Multi-State Conservation Grant Program
NABCI - North American Bird Conservation Initiative
NASS - National Agricultural and Statistics Service
NBCI - National Bobwhite Conservation Initiative
NBTC - National Bobwhite Technical Committee
NFWF - National Fish and Wildlife Foundation
NGO - Non-governmental Organization
NLCD - National Land Cover Data

NRCS - Natural Resource Conservation Service
NWI - National Wetlands Inventory
NWSG - Native Warm Season Grasses
NWTF - National Wild Turkey Federation
ODWC - Oklahoma Department of Wildlife Conservation
PF - Pheasants Forever
PIF - Partners in Flight
QF - Quail Forever
QU - Quail Unlimited
QUWF - Quail and Upland Wildlife Federation
RCW - Red-cockaded Woodpecker
SAFE - State Acres for Wildlife Enhancement/State Enhancement of Wildlife Habitats)
SEAFWA - Southeastern Association of Fish and Wildlife Agencies
SEQSG - Southeast Quail Study Group
SLP - Shortleaf Pine
SPP. - Species (plural)
TA - Technical Assistance
TB - Terabyte
TGFOC - Texas Game, Fish and Oyster Commission
TNC - The Nature Conservancy
TPWD - Texas Parks and Wildlife Department
UERP - Upland Ecosystem Restoration Project
U.S. - United States
USDA - United States Department of Agriculture
USFS - United States Forest Service
USFWS - United States Fish and Wildlife Service
USGS - United States Geological Survey
UT - University of Tennessee
VB - Visual Basic
WHIP - Wildlife Habitat Incentive Program
WMA - Wildlife Management Area
WRP - Wetland Reserve Program

6.3 Links to State BRI Data Summarized by County & Web Mapping Applications

State	County Data Link	WMA Link
Alabama	AL- County Data	AL - Web App
Arkansas	AR - County Data	AR - Web App
Delaware	DE - County Data	DE - Web App
Florida	FL - County Data	FL - Web App
Georgia	GA - County Data	GA - Web App
Illinois	IL - County Data	IL - Web App
Indiana	IN - County Data	IN - Web App
Iowa	IA - County Data	IA - Web App
Kansas	KS - County Data	KS - Web App
Kentucky	KY - County Data	KY - Web App
Louisiana	LA - County Data	LA - Web App
Maryland	MD - County Data	MD - Web App
Mississippi	MS - County Data	MS - Web App
Missouri	MO - County Data	MO - Web App
Nebraska	NE - County Data	NE - Web App
New Jersey	NJ - County Data	NJ - Web App
North Carolina	NC - County Data	NC - Web App
Ohio	OH - County Data	OH - Web App
Oklahoma	OK - County Data	OK - Web App
Pennsylvania	PA - County Data	PA - Web App
South Carolina	SC - County Data	SC - Web App
Tennessee	TN - County Data	TN - Web App
Texas	TX - County Data	TX - Web App
Virginia	VA - County Data	VA - Web App
West Virginia	WV - County Data	WV - Web App

NBCI

National Bobwhite Conservation Initiative

National Bobwhite Technical Committee

TALL TIMBERS

Research Station & Land Conservancy