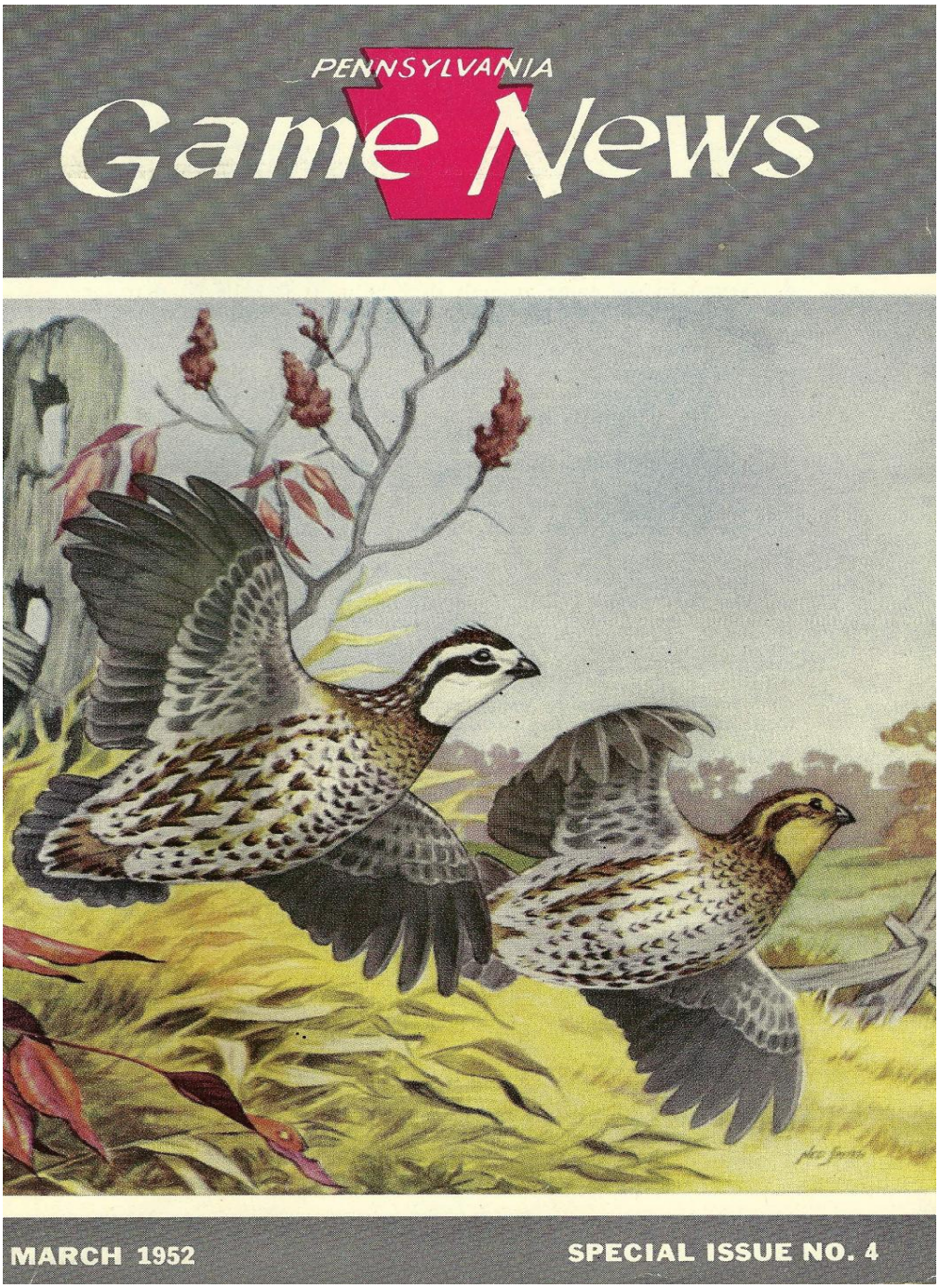
Northern Bobwhite Quail Management Plan for Pennsylvania 2011-2020



Northern Bobwhite Quail Management Plan for Pennsylvania 2011-2020

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October 31, 2011

EXECUTIVE SUMMARY

The northern bobwhite quail is one of the most popular game birds in North America. Its native range included most of the eastern United States north to southern Maine, southern New York, southern Ontario, central Wisconsin and south central Minnesota, west to very southeastern Wyoming, eastern Colorado, eastern New Mexico, and eastern Mexico south to Chiapas. Twenty-two subspecies have been recognized. Since the mid 1960's, the bobwhite's range and populations have declined dramatically. Northern bobwhites were relatively common across southern Pennsylvania farmland and brush lands until about 1945. Populations declined rapidly between 1945-1955, but made a recovery in the early 1960's. Since 1966, the range and populations of bobwhites have declined to the point that most counties in the commonwealth no longer have bobwhites as a breeding species.

The mission of the Northern Bobwhite Quail Management Plan for Pennsylvania is "*to maintain and restore wild breeding populations of Northern Bobwhite Quail in suitable habitats.*"

To support this mission statement, the plan identifies supporting goals, objectives and strategies for guiding restoration and management decisions over a 10-year horizon, 2011-2020. This plan provides a comprehensive look at the northern bobwhite in PA. Information on taxonomy, biology, habitat relationships, population and habitat trends, propagation, hunting, restoration and partnerships are discussed in detail. The most important part of this Plan is Section I, which outlines the management goals, objectives and strategies. In addition, Appendix I contains an implementation schedule, and Appendix II includes public comments on the plan.

There are 6 strategic goals identified in the plan. Goal 1 calls for determining the current distribution, population status, and trends of northern bobwhite in PA and protecting any residual wild populations. To accomplish this goal, multiple biological and hunter/landowner surveys will need to be conducted. The number of propagated bobwhite quail being released in the state will need to be determined. New genetic techniques will be used to help in determining if existing northern bobwhite quail in PA are wild or pen-reared and released birds. Museum specimens will be used to determine the genetics of northern bobwhites in PA to help in determining the subspecies adapted to PA. If wild northern bobwhites are confirmed breeding in PA, regulations will be proposed to the Commission to protect those populations from hunting and the release of pen-reared bobwhite quail within the Wildlife Management Unit (WMUs). WMUs without wild populations will be open to northern bobwhite quail hunting and the release of pen-reared northern bobwhite quail.

Goal 2 seeks to determine the amount and type of habitat found where northern bobwhites exist in PA and calls for developing a model to determine potential northern bobwhite habitat in PA. In addition, this goal calls for identifying priority habitats for maintaining or reintroducing self-sustaining northern bobwhite quail populations in suitable habitat by establishing Bobwhite Quail Focus Areas (BQFAs). Habitat improvements will be implemented to meet habitat targets within BQFAs. The Plan proposes to use adaptive management by developing several models to predict and test bobwhite quail recovery efforts under different land-use conditions in BQFAs.

Maintaining and enhancing the quality and quantity of northern bobwhite quail habitat within BQFAs will be critical to restoring bobwhite populations (Goal 3). Partnerships will be necessary to achieve habitat targets in BQFAs. USDA, PF/QF, public access cooperators and other partners will need to work with the PGC to enroll BQFAs acres in Farm Bill Programs and other federal and state habitat conservation programs (e.g., target CREP acres (native grasses and forbs, and field borders)) to provide needed bobwhite quail breeding, brood rearing, and winter cover requirements identified in the Bobwhite Quail Habitat Manual.

Goal 4 calls for assessing baseline northern bobwhite populations on BQFAs and establishing wild northern bobwhite quail populations on BQFAs through the trap and transfer of wild northern bobwhite quail. A minimum of 50 wild trapped northern bobwhites will be released annually on BQFAs for 3 years. Northern bobwhite quail populations will be monitored to determine whether they are self-sustaining. Northern bobwhite quail hunting shall be closed on BQFAs, no pen-reared bobwhite quail shall be released and dog training for game birds shall be prohibited within BQFAs. If wild bobwhite quail are not available in the numbers needed to establish a founding population, the plan recommends investigating the feasibility of using a smaller number of wild northern bobwhite quail to develop a wild, captive breeding program for northern bobwhite quail recovery.

An informed public will be key to successfully implementing the Northern Bobwhite Quail Management Plan. Goal 5 calls for assessing public knowledge and attitudes about bobwhite quail and their recovery and informing them about recovery activities. The first 5 Goals identified in this plan seek to identify, maintain and re-establish wild self-sustaining northern bobwhite populations in PA. BQFAs will be used to determine, if and where, we can maintain viable wild northern bobwhite populations. In order to sustain hunting of bobwhites again, the next step will be to increase these populations and the distribution of bobwhites to all identified suitable habitat in PA (Goal 6). If we can create and maintain early-successional habitats on public and private lands, we believe bobwhite populations can be restored. Restoring northern bobwhite quail to Pennsylvania will require a substantial annual expenditure on habitat improvements and monitoring and research. Many species of greatest conservation concern in PA would benefit from this investment in farmland habitat.

This Plan will require the support of the sportsmen and women of PA and all Pennsylvanians. Most importantly, it will require working with farmers, private landowners, and public landowners, the USDA, PF/QF and other conservation partners to restore farmland ecosystems to accommodate bobwhites.

SECTION I. MANAGEMENT GOALS, OBJECTIVES AND STRATEGIES

MISSION STATEMENT: ***To maintain and restore wild breeding populations of Northern Bobwhite Quail in suitable habitats in Pennsylvania.***

GOAL 1. Determine current distribution, population status, and trends of Northern Bobwhite in PA and protect any residual wild populations.

Objective 1.1: Determine the current distribution of breeding northern bobwhite populations in PA.

Strategies

1.1.1. Review and analyze Breeding Bird Atlas data.
1.1.2. Review and analyze Breeding Bird Survey data and Christmas Bird Count data.
1.1.3. Review existing citizen science information (e-Bird, PSO, PA Birds, etc.).
1.1.4. Survey quail hunters identified via the Game Take Survey to determine what quail they are hunting and where.
1.1.5. Survey (conduct breeding call counts) in all areas where existing data suggest wild breeding quail are present.

Objective 1.2: Determine where, when and how many propagated bobwhite quail are being released in the areas identified in Objective 1.1.

Strategies

1.2.1. Identify all quail propagators in these areas.
1.2.2. Survey quail propagators/clients to determine numbers raised and released.

Objective 1.3: Determine whether areas with northern bobwhite quail on the landscape are "wild" quail or "propagated" quail.

Strategies

1.3.1. Determine the genetics of our historical wild northern bobwhite quail using museum specimens.
1.3.2. Determine the genetics of PA propagated northern bobwhite quail in the vicinity of areas that appear to have existing quail populations.
1.3.3. Obtain samples of genetic material of wild northern bobwhite quail from adjoining states (Maryland, West Virginia, New Jersey, Delaware and Ohio) for comparison.
1.3.3. Sample Northern Bobwhite quail from areas in PA with "wild" quail and determine their genetic make-up; compare with quail from neighboring states and propagated birds.

Objective 1.4: Protect existing wild northern bobwhite quail populations.

Strategies

1.4.1. Establish seasons and bag limits and other regulations as necessary to conserve wild northern bobwhite quail populations.

GOAL 2. Determine the amount and distribution of occupied and potentially suitable northern bobwhite habitats in PA.

Objective 2.1: Develop a northern bobwhite habitat model to identify occupied and potentially suitable habitats.

Strategies

2.1.1. Review NBCI and other existing northern bobwhite models.
2.1.2. Quantify habitat characteristics of where bobwhite quail currently exist in PA and adjoining states.
2.1.3. Identify critical habitat and environmental factors that impact quail survival and sustainability.
2.1.4. Develop a GIS-based PA northern bobwhite habitat model that accurately predicts occupied habitats and identifies potentially suitable habitats.

Objective 2.2: Using the northern bobwhite model identify areas on the PA landscape that can or might support sustainable wild breeding northern bobwhite populations.

Strategies

2.2.1. Based on ecological needs of quail and current population data, determine minimum area size for sustainable wild quail populations.
2.2.2. Identify priority habitats that meet minimum area requirements (potential Bobwhite Quail Focus Areas (BQFAs)) on the PA landscape for maintaining and restoring wild, breeding quail populations.
2.2.3. Prioritize BQFAs based on wild quail presence, current habitat suitability but devoid of wild quail, and potential for habitat enhancement to make them suitable for quail recovery.

GOAL 3. Maintain and enhance the quantity and quality of habitat in BQFAs.

Objective 3.1: Develop or identify Best Management Practices for quail habitat.

Strategies

3.1.1. Review literature to identify best habitat management practices to benefit quail nesting, brood rearing and winter cover.
3.1.2. Select those practices that are applicable to PA ecosystems.
3.1.3. Develop a PA Bobwhite Quail Habitat Manual.

3.1.4. Provide training to PGC field employees, USDA employees, PF/QF, Audubon, PA Society of Ornithology, PA Bird Clubs and other partners on Farm Bill, state, and NGO habitat programs beneficial to bobwhite quail recovery.

Objective 3.2: Initiate quail habitat enhancement projects on priority BQFAs utilizing BMPs.

Strategies

3.2.1. Notify landowners and potential partners in the BQFA about the initiative, and conduct local workshops informing them of bobwhite quail habitat needs and requirements for population recovery.
3.2.2. Within each BQFA, working with landowners and partners, establish the landuses/habitat types in the ratios specified in the Bobwhite Quail Habitat Manual.
3.2.3. Work with USDA, PF/QF, public access cooperators and other partners to enroll BQFAs acres in Farm Bill programs and other federal and state habitat conservation programs (e.g., target CREP acres (native grasses and forbs, and field borders)) to provide needed bobwhite quail breeding, brood rearing, and winter cover requirements identified in the Bobwhite Quail Habitat Manual.
3.2.4. Annually monitor and quantify BQFA habitat and the changes that are occurring.

GOAL 4. Within each BQFA assess bobwhite quail populations and maintain or establish wild northern bobwhite quail populations on restored habitats that meet BMPs specified in the Bobwhite Quail Habitat Manual.

Objective 4.1: Monitor bobwhite quail populations on BQFAs.

Strategies

4.1.1. Identify protocols for annually assessing population levels/trends and demographics of bobwhite quail on BQFAs.
4.1.2. Implement annual surveys to assess bobwhite quail presence, population levels, and demographics.

Objective 4.2: Establish self-sustaining populations of wild northern bobwhite quail on BQFAs.

Strategies

4.2.1. Establish and implement criteria and protocols for wild northern bobwhite quail acquisitions and releases on BQFAs.
4.2.2. Identify and contact states and partners to obtain via multi-year agreements wild northern bobwhite quail for release on PA BQFAs.
4.2.3. Implement standard protocols for monitoring the survival, dispersal, population levels and demographics of wild bobwhite quail released on BQFAs.
4.2.4. By regulation close all bobwhite quail hunting on BQFA, allow no pen-reared bobwhite releases, and prohibit dog training for game birds within the BQFA according to criteria and protocols in Strategy 4.2.1.

4.2.5. Release wild bobwhites according to criteria and protocols in Strategy 4.2.1.
4.2.6. If wild bobwhite quail are not available in the numbers needed to establish a founding population, investigate the feasibility of using wild quail to develop a wild captive breeding program for northern bobwhite quail recovery.

GOAL 5. Inform and educate the public, landowners and hunters about efforts to restore wild northern bobwhite quail populations in PA and assess their attitudes, preferences and support for wild bobwhite quail recovery.

Objective 5.1: Conduct surveys targeted to appropriate stakeholder groups.

Strategies

5.1.1. Develop and conduct a survey to determine baseline attitudes, preferences and support for wild quail recovery in PA.
5.1.2. Develop and conduct follow-up surveys every 5 years to obtain information and feedback on public attitudes, preferences and support for bobwhite quail recovery.
5.1.3. Survey PGC Public Access Cooperators and CREP landowners every 5 years to determine their knowledge of and interest in PA bobwhite recovery efforts and the incentives required for participation in a wildlife habitat improvement program.

Objective 5.2: Inform the public about Northern Bobwhite Quail recovery activities.

Strategies

5.2.1. Use all forms of media to educate the public on the PGC Northern Bobwhite Quail Management Plan.
5.2.2. Annually report research findings and conclusions, population trends and program results to the public through various media.

GOAL 6. Maintain and enhance potentially suitable bobwhite quail habitats across PA.

Objective 6.1: Establish formal partnerships with federal, state and nongovernmental organizations to facilitate establishing and enhancing sufficient habitat across PA that would support huntable wild bobwhite quail populations.

Strategies

6.1.1. Establish agreements between PF/QF, USDA, the USFWS Partners for Fish and Wildlife, and other programs that restore at a landscape scale habitats benefitting bobwhite quail.
6.1.2. Coordinate with the PDA, PA Farm Bureau, and other farm organizations to incorporate bobwhite quail habitat management into technical and financial assistance farm programs.
6.1.3. Coordinate individual, government and NGO efforts to improve bobwhite quail habitat. Integrate bobwhite quail recovery efforts with other habitat enhancement and conservation programs, such as EPA Stream Bank Fencing program, Chesapeake Bay Program, and the DCNR Riparian Buffer Initiative.

6.1.4. Collaborate with state and federal agencies, legislature, counties, townships, and NGOs on planning, zoning, tax incentives, and easements to improve bobwhite quail habitat.

Objective 6.2: Collaborate with regional and national northern bobwhite quail program initiatives to capitalize on expertise outside the state and influence national and regional funding that will support large scale habitat restoration work on farm landscapes in PA.

Strategies

6.2.1. Support the National Bobwhite Conservation Initiative by serving on technical and steering committees.
6.2.2. Serve on pertinent Association of Fish and Wildlife Agencies (AFWA) committees that are addressing quail and quail habitat restoration (Bird Conservation Committee, Resident Game Bird Working Group, and Agricultural Conservation Committee).
6.2.3. Serve as a member of the Northeast Upland Game Bird Technical Committee and the Northeast Habitat Technical Committee.
6.2.4. Participate in other bird and wildlife conservation initiatives (e.g., Joint Ventures, Landscape Conservation Cooperatives).

Objective 6.3: Seek additional funding to implement the Northern Bobwhite Quail Management Plan for PA.

Strategies

6.3.1. Seek grants from Foundations, partners and other sources to support quail habitat restoration.

ACKNOWLEDGEMENTS

This Plan would not have been possible without the support and efforts of many others.

Staff from the PGC were very helpful in completing this Plan. John Dunn, Chief of the Game Management Division provided a careful and thorough review. Ian Gregg, Game Bird Section Chief, carefully reviewed the final drafts. Cal DuBrock, Director of the Bureau of Wildlife Management, reviewed the Plan and made many helpful recommendations and improvements. Bob Boyd, Chief of the Wildlife Services Division, wrote the Hunting Section of this Plan. I received constructive comments from Tammy Colt and Samara Trusso, Southwest Region Wildlife Biologist and Wildlife Management Supervisor, Doug Gross, Endangered and Nongame Bird Section Chief and from Ben Jones, Mike Pruss, and Eric Miller in the Bureau of Wildlife Habitat Management. PGC Executive Director, Carl Roe, has been very supportive in completing a Northern Bobwhite Quail Plan for PA.

Bill Foose, Retired Conservation Program Manager, with PA Farm Service Agency and Barry Isaacs, PA NRCS State Biologist provided up to date USDA habitat data and have been strong supporters of restoring farmland wildlife in PA.

Special thanks to the Mississippi State University Extension Service for allowing me to use much of the material they have collected and distributed on the ecology of the Northern Bobwhite Quail. Special thanks to Nick Bolgiano, State College, PA, a fellow birder and statistics wizard who spent over 600 hours reviewing the historical literature on Northern Bobwhites in PA and published a History of the Northern Bobwhite in PA Birds. Much of his work is incorporated into this plan.

I thank my fellow Bobwhite quail biologists across the country that are working with the Northern Bobwhite Conservation Initiative to help restore northern bobwhites across their historic range.

I thank the PGC Board of Commissioners for caring about northern bobwhite quail and being patient enough to allow us the time to complete the first comprehensive Northern Bobwhite Quail Plan in PA history.

All data contained herein are subject to revision from corrections, improved analyses, and/or regrouping of data.

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SECTION II. TAXONOMY AND RANGE

Taxonomy and Native Range

Northern bobwhite quail (*Colinus virginianus*) are birds of the order Galliformes and the family Odontophoridae. This family includes 9 genera and 32 species of new world quail (Madge and McGowan 2002). North and South American quail were formerly considered in the Phasianidae family. However, recent DNA studies have shown that they are only very distantly related to old world pheasants and quail.

Johnsgard (1973) recognized 21 subspecies of the northern bobwhite. In the USA he recognized the following subspecies: 1) *Colinus v. virginianus* (Eastern bobwhite) resident from Virginia to northcentral Georgia and southeastern Alabama and northern Florida (mostly along the Atlantic coast and Piedmont; 2) *C. v. marilandicus* (New England bobwhite) resident from southern Maine to east-central New York, all of Pennsylvania, and ridge and valley in Virginia/West Virginia south to Maryland and Delaware; 3) *C. v. mexicanus* (Interior bobwhite) resident of much of the eastern United States east of the Great Plains, but not including the coastal plain and most of the piedmont; 4) *C. v. floridanus* (Florida bobwhite) resident of most of Florida; 5) *C. v. texanus* (Texas bobwhite) resident of most of southern Texas into northern Mexico; 6) *C. v. taylori* (Plains bobwhite) resident from South Dakota south to northern Texas and east to western Missouri and northwest Arkansas; and 7) *C. v. ridgwayi* (masked bobwhite) resident of Sonora, Mexico and possibly southern Arizona. The United States Fish and Wildlife Service also identified 7 subspecies in the USA and provided data on the historic and current (1955) distribution of the northern bobwhite quail.

Both Johnsgard (1973) and Aldrich and Duvall (1955) considered the historic range of the northern bobwhite to include all of Pennsylvania. However, Aldrich and Duvall (1955) considered the range in 1955 to be restricted to southern and western Pennsylvania counties. Johnsgard (1973) considered all of Pennsylvania to be *C. v. marilandicus.* The USFWS considered eastern Pennsylvania to be *C. v. marilandicus* and western Pennsylvania to be *C.v.mexicanus*. Edminster (1954) also reported the bobwhite was restricted to southern and western Pennsylvania (Figure 1). He identified different races of bobwhites based on geography. Pennsylvania was considered to be on the northern fringe of the species' range.

Analysis of Breeding Bird Survey (BBS) data in 2007, suggested that northern bobwhites may now be restricted to very southern southcentral and southeastern counties and possibly parts of extreme southwestern Pennsylvania (Veech 2006) (Figure 2).

In the latter part of the 20th century and continuing into the 21st century, northern bobwhite populations have been declining range wide. Range wide contraction has also been observed over the past 30-40 years. Populations on the northern edge of the species range have been collapsing. These range contractions and population declines have been associated with changes in land use and extreme winter weather events on the northern edge of the species' range.

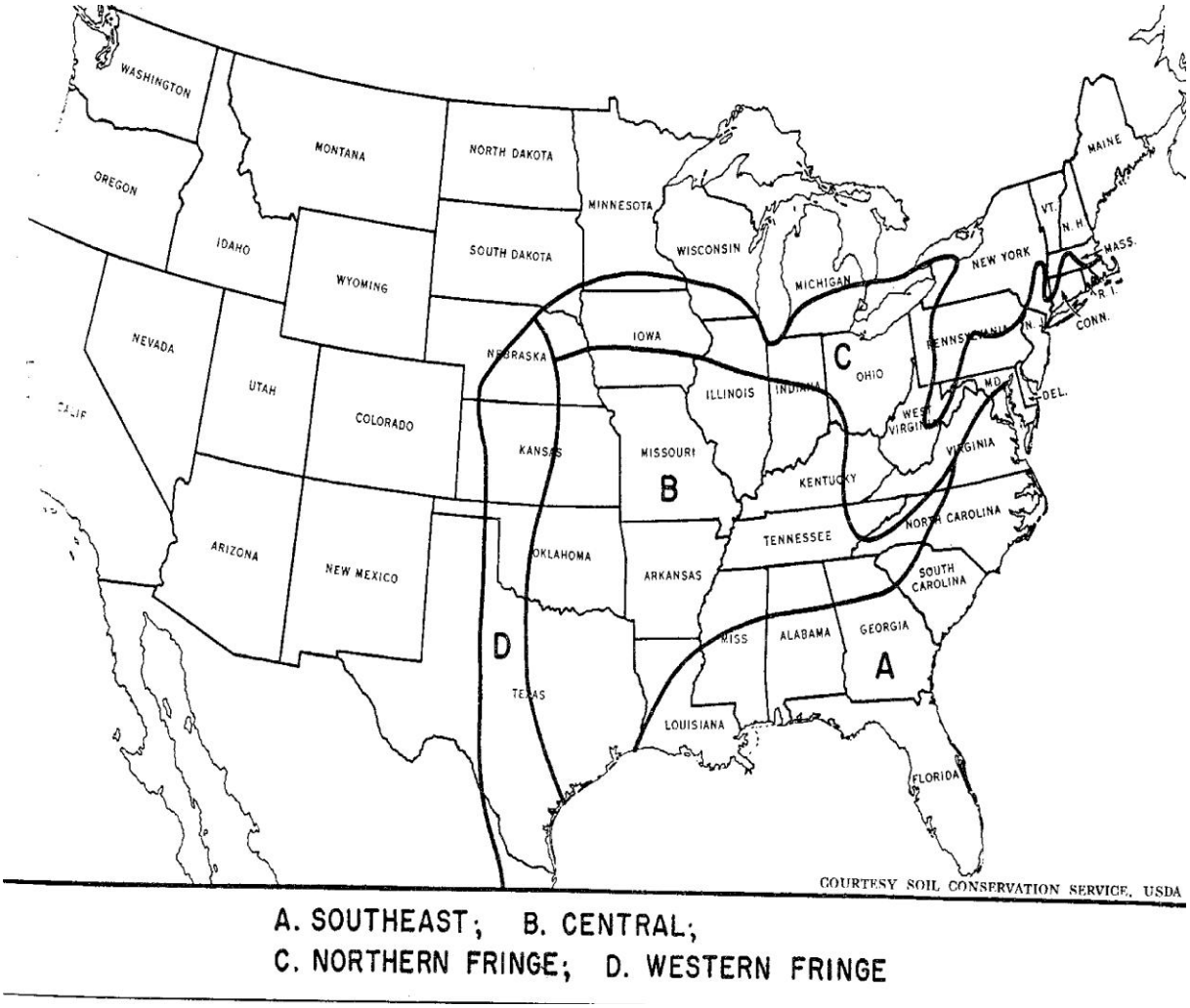

Figure 1. Range of the Northern Bobwhite USA (Edminster 1954).

Figure 2. Range of the Northern Bobwhite in the USA in 2007 based on analysis of BBS Data (Veech 2006).

The Historic Range and Status of the Northern Bobwhite Quail in PA

The northern bobwhite quail has been a resident of Pennsylvania for at least 11,000 years. We have little data on their abundance prior to the 1900's. However, we have numerous anecdotal accounts over the past 300 years. Bolgiano (2000) provided a comprehensive review of the available literature and data available on the northern bobwhite quail in PA. The following summary is from Bolgiano:

> "During the 1960s, Bobwhites were commonly found throughout much of Ohio and into southern Michigan and southern Ontario. They were commonly found throughout much of Virginia, Maryland, Delaware, New Jersey, Long Island, and southern New England. In Pennsylvania, the highest counts were at Chambersburg, New Bloomfield, Harrisburg, York, Lititz, Reading, Elverson, and Glenolden. After the 1960s, Bobwhite populations retracted along the northern part of their range and became much fewer in number where they remained. The only Pennsylvania site where they have been consistently reported after the 1970s is Southern Lancaster County.
>
> Bobwhites were probably present in all Pennsylvania counties prior to 1850. They likely reached their greatest abundance and distribution between 1820-1860. Their range during the first half of the 20th century contracted to southern Pennsylvania and the border with Ohio. They were probably most concentrated between Fulton and Chester counties and counties bordering the Susquehanna to Sunbury (Harlow 1913; Jenkins 1942; Latham and Studholme 1952; Brauning 1992). Populations began declining in the

mid-1940's and made a recovery in the early 1960s. Since 1966, the Northern Bobwhite Quail has declined by 98% based on BBS data.

PA bobwhites' historical abundance followed a common pattern. Before human settlement, a small number of bobwhites lived around natural forest openings. Then the fires and crude agriculture of humans created landscape mosaics and bobwhite populations reached their zenith. As farming was practiced more intensively, bobwhite populations declined in response to the diminished food and cover, although they sometimes temporarily increased as farm abandonment once again created favorable habitat (Leopold 1933; Schorger 1944). USDA longer term set aside programs, such as the Soil Bank Program, were very beneficial to Bobwhites in Pennsylvania from 1958-1964 (Klinger et al. 1998)."

Today, we know little about the status and distribution of bobwhites in PA. The only extensive research on the northern bobwhite was conducted in the late 1940's and published in a special edition of the PA Game News in 1952. The latest PA Breeding Bird Atlas 2004-2009, confirmed that bobwhites have continued to decline in PA. Only 18 sites were confirmed as having breeding northern bobwhites. Because of the release of nearly 60,000 pen-reared bobwhites annually in PA, it is very difficult to estimate wild northern bobwhite quail population densities. Our best guess is that northern bobwhite populations in PA may range from 0-1000 breeding birds in 2010. If populations remain, they are most likely restricted to extreme southwestern and southcentral Pennsylvania along the Maryland border in the lower Octoraro Creek Valley and in the Serpentine Barrens. The Serpentine Barrens include Chrome, Goat Hill, New Texas, and Nottingham Barrens of southwestern Chester County, or collectively the State Line Barrens. The State Line Barrens is an Important Bird Area (Crossley 1999) and is one of the few areas where breeding of bobwhites has been documented in recent years (Gross 1999). The northern bobwhite quail is currently listed as a species of special concern in the PA Wildlife Action Plan.

SECTION III. BIOLOGY AND HABITAT REQUIREMENTS

Habitat Requirements

Bobwhites require early-successional habitats and a mixture of cover types in close proximity. Leopold (1933) characterized bobwhite habitat as well-interspersed woodland, brushland, grassland, and cultivated land. Grassland may constitute a higher percentage of their habitat in the western part of their range (Taylor et al. 1999). Characteristics of bobwhite habitat nationwide are grassy areas for nesting, interspersed with brush for escape cover, and crops or native plants for food (Edminster 1954) (Table 1).

Table 1. General Land-Use Patterns for Good Northern Bobwhite Quail Range (cover, percent cover, mean field size, composition - from Edminster 1954).

Cover	% Cover	Field Size	Composition
GRASS	0-40%	5-20 acres	Good grass-legume mixture with Korean lespedeza where adaptable; full use of opportunities for protected grass in roadsides, field boundaries, diversion terraces, waterways. Native warm season grasses and forbs. Bare ground and open areas. Stands not too thick. Lots of annual and perennial weeds.
CROP FIELDS	0-60%	1-5 acres	Corn and small grains in rotation. Lots of weeds.
BRUSHY COVER	5-20%	¼-1 acre	Bicolor lespedeza woods borders, multiflora rose living fence hedges wherever suitable; honeysuckle, grape, greenbrier, plum, briar, scrub oak thickets on suitable odd areas; no fire; no grazing.
WOODLAND	5-40%	5-20 acres	In small units except for old longleaf pine stands handled with prescribed burning; no grazing; abundance of good mast species like oaks, pines, sweet gum, and fruiting trees.

Within any particular region, the long term abundance of bobwhites is mainly a function of habitat conditions, specifically the quantity, quality, and distribution of resources, such as food, cover, and nesting habitat (Roseberry and Klimstra 1984). In general, cover is a limiting factor in the northern portion of this quail's range, and is ample or overabundant in most southern areas (Rosene 1969). Early spring is most often the period of greatest food scarcity. Roseberry and Klimstra (1984) described land-use for bobwhites on the Carbondale Research Area in Illinois as 29% cropland-mostly row crops, 35% grass cover-including small grains, 15% in old fields-weedy habitat (including 9% in idle fields-soil bank mostly), 13% woods-mostly deciduous woodlots, 2% brush/shrub cover, and 6% human dominated.

Bobwhites' preferred nesting cover in eastern North America consists of scattered shrubs and briars interspersed with moderately dense herbaceous or grassy vegetation. Too much grass

or woody vegetation is undesirable. Nests tend to be concentrated on idle land, especially if it is about two-three years past agricultural use, in pastures, hayfields, roadsides, or fencerows, although not where these occur in isolated patches. This habitat requirement means that bobwhites have a relatively short window of nesting opportunity during the plant succession cycle. After about 7-10 years, too much woody vegetation has grown and a disturbance, such as fire or disking-ground disturbance by humans, is needed to maintain the successional mosaic (Klimstra and Roseberry 1975; Roseberry and Klimstra 1984; Taylor et al. 1999).

Food Habits

The bobwhite is primarily a seed-eating bird (Edminster 1954). Plants provide from 97% to 99% of their diet, except during summer, when insects and spiders make up about one-fourth of the total. Edminster (1954) categorized bobwhite foods into the following groups: wild seeds (primarily from annual forbs); legume seeds; cultivated grains; mast; fruits; grass seeds; greens; and insects. Bobwhites eat a large variety of seeds from both wild and cultivated plants (Kabat and Thompson 1963), and the importance of specific foods may change between geographic locations, depending on food availability (Reid and Goodrum 1979). The bulk of information on food habits for bobwhites is from fall and winter. A summary of 27 food habits studies (mostly fall and winter) from the Southeast included data from approximately 20,000 bobwhites. This summary noted that over 650 different types of seeds were eaten, of which 78 comprised 1% or more of the food volume in one or more of the studies. Plants with both a high percent volume and high percent frequency in bobwhite crops included beggarweeds, ragweeds, lespedezas, corn, partridge peas, oaks, sumacs, pines, soybeans, and cowpeas.

Common ragweed comprised 21% of the food volume and was the single most important winter food in Virginia (Baldwin and Handley 1946). Percent volume of other major foods eaten were as follows: native and naturalized legumes (29%); cultivated legumes (14%); cultivated grains (11%); mast (10%); miscellaneous seeds (7%); fruits (4%); forage and grasses (2%); and animal matter (2%). Important winter foods in Illinois included corn, soybeans, acorns, and ragweed (Bookhout 1958; Larimer 1960). Soybeans, corn, wheat, black locust seeds, common ragweed, animal matter, and foxtail were the most important winter foods in Indiana (Priddy 1976). Black locust seeds were heavily used during periods of snow cover. In Missouri, Korean lespedeza, common ragweed, and corn were predominant winter foods (Korschgen 1948; Korschgen 1952). Annual plants were favored fall and winter foods in Oklahoma. Major fall and winter foods in Georgia and northern Florida included acorns, corn, and pine seeds (McRae et al. 1979). Spring and summer food items included panic grass seeds, leafy greens, and berries. Oak mast was the preferred food when it was available. Murray and Frye (1957) recommended that, in order to provide bobwhite food, mast producing trees 25.4 cm dbh or larger be left standing when forests are being cut or thinned. The average expected yield of acorns for several large growth form oaks in Louisiana and east Texas was 0.6 kg/tree for trees that were 17.8 to 22.6 cm dbh and 1.47 kg/tree for trees that were 22.9 to 27.7 cm dbh (Goodrum et al. 1971). Most oaks < 17.8 cm dbh produced no mast at all.

Robel et al. (1974) examined quail crops taken within 600 m of food plots and at distances greater than 900 m from food plots on Fort Riley, Kansas. From January through April, sorghum was the most abundant food item used by quail taken within 600 m of food plots as

compared to sumac for quail collected at distances greater than 900 m from food plots. Robel et al. (1974) found no correlation between the volume of a food item consumed and its energy value, and they concluded that availability, not energy value, was the chief determinant as to what a quail would consume. Sorghum and corn were rated excellent for metabolizable energy and acceptability to quail, shrub lespedeza and hemp were mediocre, red oak acorns were poor, and switch grass was extremely poor (Robel et al. 1979a). Low quality foods reported from Maryland included wax myrtle, poison-oak and dwarf sumac (Wilson and Vaughn 1944). Loss of quail in Illinois was correlated with the quality of the range, especially the availability of grain foods (Roseberry 1964). The value of croplands in providing winter food for bobwhites is related to the type of crop, time and method of harvest, weather conditions, and the location of suitable access cover (Roseberry and Klimstra 1984). Unharvested grain left standing over winter has a favorable impact on bobwhites. Corn and soybeans are about equally important as bobwhite foods based on the range occupancy rates of quail. The use of certain pesticides can be very damaging to northern bobwhite populations. Early spring is the most difficult time for bobwhites due to the low availability of seed and fruit crops (Reid and Goodrum 1979). Bobwhites must rely on the early seed and fruit crop, and the residual crop from the last growing season for survival during the early spring. Preacher (1978) studied deterioration rates and bobwhite preference of seeds from 35 food plants in South Carolina. Six of the top 10 fresh seeds that were preferred were also in the top 10 after 120 days of being on the ground. These 6 plants were poison ivy, sorghum, chiwapa millet, pearl millet, browntop millet, and Japanese millet. Soybeans accounted for 71 and 40% of the volume of foods eaten during winter and spring, respectively, in western Tennessee (Eubanks and Dimmick 1974). The abundance of such a nutritious food source during this critical period may have been an important factor in maintaining the dense bobwhite population in this study area. Later studies on the same area, however, showed a negative correlation between increasing soybean acreage and bobwhite populations (Exum et al. 1982). The increase in the soybean food supply apparently failed to compensate for a corresponding dramatic loss of security cover and nest cover.

A free-ranging quail requires 74 Kcal of energy per day at an ambient temperature of 2°C for a photoperiod of 10L:14D for normal body maintenance (Robel et al. 1979a). The average adult quail will normally consume about 17 g of food during a 10-hour period (Robel 1974). Robel et al. (1979b) ranked quail foods according to the amount of daily metabolic energy these foods would provide if quail consumed 17 g over a 10-hour period. The metabolic energy values and rankings for plant species that can be grown or that occur naturally in Pennsylvania were: giant ragweed – excellent; common ragweed, corn, soybeans, sorghum, sunflowers, and osage-orange – good; millet, Korean lespedeza, wheat, red oak, and thistle – low; and black locust, hemp, partridge pea, smartweed, multiflora rose, switch grass, and smooth sumac – poor. Daily energy requirements for quail increase as temperature decrease. For example, at 0°C, the existence energy requirements for a quail are about 49.107 K cal/day as compared to 23.588 K cal/day at 30°C (Case and Robel 1974:649). Consequently quail have a difficult time surviving in colder climates. Because quail have higher energy requirements at lower temperatures, only southern Pennsylvania has much potential for maintaining good quail populations. Even in this part of the state special measures to provide high energy foods that will be available above the snow during any prolonged period of snow cover may be necessary for long term quail population maintenance. Quail can literally starve to death on full crops of multiflora rose hips, sumac or acorns. For example, in a controlled experiment in which the temperature was

maintained at 1°C with a photoperiod of 10L:14D, quail fed a diet of switch grass seed and acorns lost 24% of their body weight in 6 days (Robel et al. 1979b). A weight loss of 25% is generally fatal. In contrast, quail fed corn or sorghum were able to maintain their body weights. Based on these research results, it is obvious that standing corn and sorghum are valuable winter quail foods in Pennsylvania. These crops would normally be available above the snow and they have a very high energy value. Other high energy foods such as ragweed and sunflowers make excellent fall foods, but they may not be available all winter.

We know of only one food habits study conducted in PA for northern bobwhite quail. The crops of 61 bobwhites collected from hunters during the 1938 quail season contained 21 known species of vegetable food, 5 groups of insects, and gravel. Vegetable matter occurred 132 times; animal matter, 12 times; and gravel, 6 times. Seven of the 61 crops were empty. Common ragweed was the most important food taken by the bobwhite. Twenty-five percent of the total volume of all crops was this prolific weed. Corn was a close second, representing 21% of the total volume. Other foods included foxtail, smartweed, wheat, black locust, buckwheat, grapes, acorns, giant ragweed, and clover seed (Bennett and English 1939).

Food Habits (Chicks)

Newly hatched bobwhites require a diet high in protein for rapid growth during their first few months. This is provided by insects that can most easily be found in low-growing herbaceous vegetation, preferably where there is bare ground for easy movement of chicks and a plant canopy to shield the birds from predators (Rosene 1969, DeVos and Mueller 1993). Arthropods are an important source of essential amino acids and protein for growth, feather development, and maintenance in chicks of most gallinaceous birds (Savory 1989). As such, several studies (Hurst 1972, Tobler and Lewis 1980, Burger et al. 1993, Manley et al. 1994) have focused on estimating habitat-specific arthropod abundance as an index to brood-habitat suitability for northern bobwhites.

Insects were the most important foods of Mississippi quail chicks 2 to 20 days old (Hurst 1972). Insect abundance is highest in brood habitats containing legumes and mixed forbs. Animal foods, primarily beetles (Coleoptera), bugs (Hemiptera), and grasshoppers (Orthoptera), provided 94.1% of the foods eaten during the first 2 weeks of life of bobwhite chicks in Tennessee (Eubanks and Dimmick 1974). The feeding habits of young quail are similar to those of adults when the young reach 7 to 9 weeks of age. Bobwhites forage primarily on the ground or in a light litter layer < 5.1 cm deep (Rosene 1969). They cannot feed in thick mats of vegetation, and snow > 7.6 cm deep causes the birds to feed on seeds within reach that have not yet fallen. Ideal foraging habitat consists of open vegetation with some bare ground and a light litter of small-leaved leguminous plants with protective cover nearby. Foraging cover can be of various heights, if plant growth is open enough to permit ease of movement (Davis 1964).

We know of no studies in PA of brood habitat or food items of bobwhite chicks. However, we assume that animal matter makes up a very large portion of young chicks diets. We do not know if arthropod abundance is a limiting factor for recovery of northern bobwhites in PA.

Summary of Food Habits

Bobwhites in Kansas depended on early seral stage communities for food and obtained very little food in climax plant communities (Robinson 1957). Bobwhites in Oklahoma showed similar preferences as early seral stages in abandoned fields provided the best foods, while climax prairies provided little quail food (Baumgartner et al. 1952). Ellis et al. (1969) noted that in Illinois: "As plant succession progresses, the density of vegetation rapidly increases, the percent of bare ground decreases, a "rough" develops, and the incidence of the desirable shade-intolerant quail food plants such as the ragweeds and beggar-ticks is greatly reduced. The necessity for **moderately open stands dominated by seed-producing weedy forbs cannot be overemphasized in quail management**. Apparently, lesser ragweed is an important indicator species of the early-successional stage so critical in quail management." Plowing disking, or chopping (Rosene 1969) can be used to maintain these early seral stages. Burning old fields tends to remove litter and increase insect abundance, providing good habitat for bobwhite chicks (Hurst 1972). However, periodic burning (3 to 5 years apart) of openings in Tennessee produced dense grass stands that were poor bobwhite habitat (Whitehead and McConnell 1979). Annual burning, mowing, plowing or disking was necessary to decrease grass cover and increase forbs and legumes in these openings. Seeding cool season grasses is undesirable for bobwhites because the grasses compete with preferred native plants and soon form dense, matted sods that inhibit bobwhite movements and reduce the diversity of foods present (Ellis et al. 1969). Addition of phosphorus to certain areas in Alabama resulted in large increases in legume coverage and legume seed production (Speake et al. 1975). Old fields in the Alabama Piedmont that were 1 to 2 years past cultivation contained mostly grasses and composites, and few native legumes (Speake 1966, Speake 1967). Fields 3 to 5 years past cultivation had 22.4% canopy cover of quail food legumes, the highest density noted. As fields reached 11 to 12 years, quail food legumes decreased to 14% coverage, and as fields approached 15 to 25 years, quail food legumes and actual bobwhite use continued to decrease steadily. There may be considerable variation in the specific age at which old fields no longer support bobwhites.

In PA, where we average over 40 inches of rain annually, the best bobwhite habitat is probably reached within 3 years of cropland abandonment. After 5 years, perennials and shrubs and trees start to invade without some type of disturbance, such as prescribed fire or disking. Cropland habitats that are left over winter as rough stubble with annual weeds present provide good feeding areas for bobwhites (Edminster 1954). Croplands where almost all residues and annual weeds are removed or that are fall plowed are of little value (Edminster 1954; Heitmeyer 1980). Food is probably not a limiting factor in habitats that provide crop residues and their attendant weeds, and even moderate amounts of native food plants (Burger and Linduska 1967). Persistent overgrazing caused elimination of quail from an experimental pasture in Oklahoma (Baumgartner 1945). Overgrazing in another Oklahoma study area favored the increase of several important bobwhite foods (Baumgartner et al. 1952).

We do not know if food is a limiting factor to recovery of bobwhites in PA. Summer and fall foods are probably not limiting; however, late winter and early spring food availability may be, particularly in years with deep snows. Water is not a limiting factor in PA.

Roosting Habitat

Bobwhites prefer areas where approximately 50% of the ground is exposed, and 50% contains upright growth of herbaceous and woody vegetation for roosting (Rosene 1969). Each covey range requires one to three shrubby thickets 0.05 to 0.2 ha in size. Plum patches that grow to a height of 1.2 m to 1.5 m are ideal. Bobwhites use dense woody vegetation during midday (Robinson 1957; Roseberry and Klimstra 1984). Bobwhites in Kansas typically foraged in open areas in the early morning hours, then occupied the woody "headquarters" until late afternoon, when they resumed foraging in the open until evening (Robinson 1957). Bobwhites may choose habitats and regulate their daily movements in response to the intensity of light at ground level. Their use of areas of high light intensity was restricted, probably as an avoidance of diurnal predators. "Headquarters" areas should be at least 188 m^2 and dense enough to reduce midday light to less than 1,000 footcandles. Davis (1964) described escape cover as usually consisting of dense woody vegetation 1.0 m or more in height. Multiflora rose provides adequate overhead cover, but may be too dense near the ground, and inhibits bobwhite visibility and movements (Hanson and Miller 1961). Japanese honeysuckle provides excellent dense understory cover for use as "headquarters" (Roseberry and Klimstra 1984).

Wiseman and Lewis (1981) reported that fall and winter roosting habitat in tall grass rangeland had a mean stem density of 108 stems/m^2. Seasonal differences ranged from 239 stems/m^2 in the spring to 144 stems/m^2 in the fall to 136 stems/m^2 in the winter. Klimstra and Ziccardi (1963) reported stem densities of 181 stems/m^2 were typical of winter roosting habitat. Mean stem heights of typical winter roosting cover averaged 59 cm in Illinois (Klimstra and Ziccardi 1963) to 68 cm in Oklahoma (Wiseman and Lewis 1981). Preferred winter roosting covers in Oklahoma's tall grass rangeland were short shrub types, grasslands, and large-seeded forbs in nearly equal proportions. Klimstra and Ziccardi (1963) reported that the most common vegetation at winter roosting sites were late-flowering composites and perennial and cool-season grasses in association with goldenrods, common ragweed, broom sedge, wild onions, asters, and bluegrasses. However, they indicated that the best winter roosting cover on their study area was wheat stubble resulting from combining that had some annual and a few biennial plants such as ragweed, panic grass, smartweed, bidens, and foxtail in it. In addition, idle areas with patches of broom sedge interspersed with annual weeds and grasses; lightly grazed brome, blue grass, and pastures; corn fields with about 1/4 acre patches of smartweed and other forbs, railroad right of ways that were burned annually; and fallow-intertill areas with herbaceous weeds and early perennials were good roosting cover. The types of roosting cover selected afforded good protection from the wind. Elevation and aspect of winter roosting cover were also important. Quail tended to select roosting areas that had a south or southwest aspect and to move from higher to lower elevations during increased wind movement (Klimstra and Ziccardi 1963).

The physical characteristics of vegetation at roost sites are more important than the species of vegetation (Klimstra and Ziccardi 1963). Bobwhites in Oklahoma roosted on the ground, in areas surrounded by herbaceous vegetation 0.3 m tall, of low to moderate density, and with little overhead canopy or obstruction (Davis 1964). Sixty percent of roosts in Illinois were on bare ground and 31% on duff (Klimstra and Ziccardi 1963). Matted or dense herbaceous cover was avoided. Eighty percent of the roosts were in herbaceous vegetation 30.0 to 90.0 cm tall, and the average stem density was 171.0/m^2. The average height of the tallest vegetation at

roost sites in Oklahoma was 68.0 cm and the average stem density was 168.0/m^2 (Wiseman and Lewis 1981). Ideal roosts in Illinois were on bare ground or light duff in vegetation 30.0 to 60.0 cm tall (Ellis et al. 1969). Preferred night roosting habitat is provided by wheat stubble fields and other land uses that provide an open canopy, sparse and short vegetation, and a ground surface nearly devoid of dead vegetation (Klimstra and Ziccardi 1963).

Winter Habitat

Late winter is often a critical period for bobwhites due to low food supplies and poor protective cover (Edminster 1954). Dense thickets of low brush or young pine stands provide the best winter cover. Winter cover in the northern portions of the bobwhite's range is relatively scarce, and the need for such cover is greater than in the South (Rosene 1969). Winter is the critical season for Wisconsin bobwhites due to the lack of high quality food and cover (Errington 1933). Primary winter cover in Wisconsin farmlands is provided by woody hedgerows at least 1.8 m wide (Kabat and Thompson 1963). From 1931 to 1950, this Wisconsin study area had about 23 birds/mile of hedgerow. Bobwhite populations were eliminated as the amount of hedgerows was reduced from 1 km/113 ha to 1 km/164 ha. Bobwhites on the northern edge of their range preferred wooded areas with dense understory for cover and loafing, accessible agricultural grains or weed seeds, and low, grassy cover for roosting (Rosene 1969; Roseberry and Klimstra 1984).

Winter cover in Oklahoma was confined to wooded ravines and patches of oaks that were bordered by idle or active croplands (Baumgartner 1945). Rank growths of tall weeds provided some winter cover. Bobwhite coveys in Tennessee spent little time during winter in croplands (Yoho and Dimmick 1972). The presence of Japanese honeysuckle was important, and honeysuckle patches provided 63 of 107 roost sites. Roosting and loafing sites switched from open to woody cover during periods of prolonged snow cover in Illinois (Roseberry 1964). In addition, coveys were more sedentary and range size decreased. Bobwhites in the Southeast generally located their roosts in relatively open areas of herbaceous vegetation, and avoided dense tangles (Stoddard 1931). Rosene (1969) reported that winter roosts in the Southeast generally were in scattered herbaceous vegetation about 0.6 m tall, open at ground level and above. Roost sites shifted to denser cover as cold, snow, or wind became severe.

The main vegetation type utilized by quail in a Fulton County, PA study was Japanese honeysuckle. The dense thicket-like growth of this non-native plant provided ideal shelter for the bobwhite (Latham and Studholme 1952). Handley (1945) emphasized the value of honeysuckle as a wildlife cover and food plant in Virginia and other Southern states. Since the leaves are only partially deciduous, the dense foliage provides protection for wildlife from high velocity winds, and this plant is resistant to grazing, fire, cutting, and spraying. Despite these positive attributes, Japanese honeysuckle is a highly invasive species and thus not recommended for future quail management in PA. Attempts should be made to identify native shrubs providing similar food and cover characteristics for use where quail management is a desired aspect of land use in southcentral PA.

Seckinger et al. (2008) altered landscape structure and composition by converting approximately 33% of timber stands to early-successional herbaceous plant communities on 2

treatment sites, which reduced percentage of landscape and edge density of closed canopy forest and increased percentage of landscape in early-successional herbaceous communities, and left 2 control sites in their former composition. During one pretreatment year (1998–1999) and 3 post treatment years (1999–2000, 2000–2001, 2001–2002), they estimated winter (15 October - 10 April) survival on treatment and control sites from a radio-marked sample of 920 bobwhites. They used Cox Proportional Hazard models to test for effects of treatment (forest conversion) and covariates describing landscape structure and composition (% closed canopy forest, % early-successional herbaceous, wooded edge density) on winter survival at multiple spatial scales. Winter survival on the treatment sites pooled across the 4 winter seasons was 41% compared to 32% for control sites. Additionally, for each 1 m/ha increase in closed canopy woods edge density within winter covey ranges, risk of mortality increased 0.3%. Their results suggest composition at the landscape scale and landscape structure at the local scale influence winter survival of bobwhite. Management strategies that alter composition and structure and increase usable space may be effective in mitigating winter mortality thereby altering population trajectories. Typical bobwhite management plans focus on improving quality of herbaceous vegetation structure within existing herbaceous patches; however, population processes may work at larger spatial scales.

Williams et al. (2000) conducted a comparative study of winter bobwhite ecology on rangeland and cropland ecosystems in east-central Kansas (11 November - 31 January 1993-1996). They considered woody cover type on the study areas to be an escape cover for quail. They used radio-telemetry to investigate survival, movement, and cover-type selection. Over the 3-year period, they monitored 91 individuals on a cropland study area (CSA) and 66 birds on a rangeland study area (RSA). Survival was higher on the CSA (0.46) than on the RSA (0.27) ($P = 0.03$); the difference was due to increased harvest mortality on the RSA ($P = 0.04$). Mean daily covey movement was higher on the RSA than on the CSA ($P < 0.01$). Comparing cover-type selection between study areas, it was found that bobwhites selected cropland more on the RSA than on the CSA ($P < 0.01$). On the RSA, increased daily movement correlated with decreased selection for woody cover and increased selection for cropland ($P < 0.02$). On the CSA, increased woody-cover selection decreased natural predation ($P = 0.03$). On the RSA, decreased movement, increased woody cover, and decreased pasture selection reduced natural predation ($P < 0.05$). However, increased woody-cover selection increased harvest mortality ($P < 0.01$). Consequently, they considered the selection for woody cover to be an important variable in bobwhite survival on the RSA. It is suggested that landowners on rangelands could reduce natural mortality by taking advantage of programs available from federal and state governments and nongovernmental organizations, to increase woody cover for bobwhites.

It is likely that suitable roost cover is a limiting factor in certain habitats (Klimstra and Ziccardi 1963). Although dense, woody thickets provide optimum shelter during severe winter conditions, the open roosting cover that bobwhites prefer during milder weather is more important on a year-to-year basis. We do not know if winter cover is a limiting factor for the recovery of bobwhite quail in PA. However, because of very small and isolated populations, during winters with greater than 40 inches of snow, winter cover could be a limiting factor in PA. Good bobwhite management must stress the manipulation of natural succession (Roseberry 1979). Deteriorating habitat conditions in southern Illinois caused an 85% decline in a bobwhite population. Secondary succession eliminated preferred food species, replaced weedy and grassy

nesting cover with dense woody growth, and reduced the amount of prime roosting habitat. Large changes in carrying capacity can be caused by slow and subtle land use changes and secondary succession.

Nesting Habitat

Bobwhite nests are generally domed, sphere-shaped structures built on the ground with dead grass stems (Klimstra and Roseberry 1975). Bobwhites prefer to nest in open areas, where the ground is only partly covered by vegetation (Rosene 1969). Eighty-two percent of nests observed by Stoddard (1931) were in open growth allowing ease of movement, and 89% were placed in growth of the previous year. Prime nesting cover in Illinois was generally characterized by scattered shrubs and briars interspersed with moderately dense stands of herbaceous and grassy vegetation such as golden rods, panic grasses, cheat, broom sedge, and bluegrass. This type of cover was most evident in idle fields that were in the perennial weed stage (Klimstra and Roseberry 1975; Roseberry and Klimstra 1984) (Table 2). Cover that was too dense to provide bare or sparsely vegetated areas was avoided. These conditions were most often found in old fields during the latter part of the perennial weed stage and the early part of the bramble and shrub stage (Roseberry and Klimstra 1984). Fifty-six percent of all nest sites (1.0 m^2 area around the nest) contained woody vegetation.

Table 2. Northern Bobwhite Quail nests in southern Illinois (Roseberry and Klimstra 1984).

Land Use Category	Nests/100 hectares
Idle Fields	46.5
Fence Rows	Similar to roadsides
Hay Fields	16.1
Fallow-intertilled	4.6
Fallow-forage small grain	16.8
Roadsides	184.8
Pastures	14.1
Soil Bank	12.8

Ninety-five percent of the nests in an Iowa study were made of, and placed in, grass (Klimstra 1950). Dead grass stems provide important support for the nest; areas in annual weeds are poor nest sites due to a lack of dead grass stems (Roseberry and Klimstra 1984). In southern Illinois, Klimstra and Roseberry (1975:14) reported that cheat grass was found in 42.3% of the nests, broom sedge in 26.0% of the nests, bluegrasses in 22.8% of the nests, and panic grasses in 11.1% of the nests. Plants occurring in less than 5% of the nests were as follows: tickle grass, annual lespedezas, meadow fescues, timothy, fox tail, red clover, orchard grass, alfalfa, slender fescue, and red top. Dead stems of most agricultural and pasture crops were the least preferred nesting materials. In southern Illinois most nests were built within 5 m of a noticeable break in vegetative cover.

Klimstra (1950) reported that 61% of the nests were in, or at the edge of, woody cover. Almost 90% of the nests were in well drained locations while only 2% were in poorly drained locations. Townsend et al. (2001) reported that nest sites were located at points with greater structural complexity than random points. Further, successful nests were more concealed than failed nests. Fifty-six percent of nests in a southeastern study were in broom sedge fields, 16% in

open woodland, 15% in 1- or 2-year-old fallow fields, and 4% in cultivated fields (Stoddard 1931). Preferred nest sites in west Tennessee were old fields dominated by broom sedge or similar grasses 0.3 to 0.6 m tall (Dimmick 1968). Alfalfa fields provide poor nesting cover (Rosene 1969). "The amount and quality of nesting cover available in nonagricultural areas is largely dependent upon natural plant succession" (Klimstra and Roseberry 1975). Intermediate successional stages provide better nesting habitat than late or early seral stages. Early annual weed stages have a scarcity of dead grass stems needed for nest building. However, establishment of planted fields of tame forage plants does not improve bobwhite nesting. Acreage diversion programs of croplands would be most useful to nesting bobwhites if allowed to undergo natural secondary succession for 5 to 10 years. Nesting use in Illinois was maximum when preferred nest sites were associated with open field habitats. Small, isolated patches of potential nest cover located in or near non-breeding habitats, such as croplands or forests, were not frequently used.

Nest success in Illinois was highest in idle fields and lowest in hayfields (Klimstra and Roseberry 1975). Overall, 33.7% of 863 nests were successful, with predators accounting for 55% of nest failures, and farming activities causing 18% of failures. Standing vegetation at nest sites should be < 51 cm tall (Rosene 1969). The average height of cover at nest sites in Illinois was 49.5 cm and stem densities within 1.0 m^2 around the nest averaged 1,048 (Klimstra and Roseberry 1975). Areas with an average herbaceous height of < 7.6 cm are unacceptable for nesting bobwhites (Lehmann 1984). Herbaceous cover around late summer nest sites ranged from a low of 10% to a high of 85% (Harshbarger and Simpson 1970). Seventy-three percent of these nests were found in areas where herbaceous canopy cover was between 21% and 60%. Optimal herbaceous cover was about 50%.

Latham and Studholme (1952) examined 60 quail nests during the spring and summer of 1944 when a fair population of quail existed over much of the study area in Fulton County, PA. Twenty-one nests were found in fields of mixed clover and timothy hay. Nine were located in fallow fields which had lain idle at least one year. The same number was built along the edges of roads. Eight were in alfalfa fields, and one was found in each of the following: a field of barley, a wheat field, a peach orchard, a country cemetery lot, and a clump of ornamental shrubbery. The number of nests in hay fields might seem to indicate a preference for this type of nesting cover. However, a high percentage of the total number of nests in these locations was probably discovered during harvesting operations. The availability of suitable construction materials, and the presence of sufficient plant growth in which to hide the nests, were probably the important deciding factors in the selection of any one certain spot by a pair of mated bobwhites.

They also found that most nests were on well drained soils and faced in a southerly direction. Active nests as close together as 30 yards were observed. Three were found along 250 yards of the same farm lane. Twelve nests were found in one 6-acre field. The use of dead material in the form of grasses, weeds and/or leaves was apparent in the construction of every nest. This material was available within very short distances of the chosen sites. The stems and leaves of the softer grasses of the *Poa* family were widely used. This material was easily woven into the walls and roofs of typical structures. Idle fields are important nesting areas for bobwhites.

Brood Habitat

During the egg-laying and nestling-rearing periods, female grassland birds require a large proportion of protein in their diet, which is acquired through the increased intake of invertebrates (Wiens and Rotenberry 1979, Moreby 2003). Protein is important for the development of many functions, but it is especially important in the development of feathers and muscle. For instance, amount of protein is an important determinant in age at fledging; chicks on low insect diets take longer to fledge than chicks on high insect diets (Nestler et al. 1942, Woodard et al. 1977). The longer it takes to fledge, the greater the probability of depredation. Therefore, populations with a high-insect diet create an antipredator advantage (Potts 1997).

Before fledging, unimpeded mobility is important for chicks to escape predation and to access insects. Restricted movements limit the chick's ability to locate areas of high insect abundance and may result in the chicks selecting areas with poorer quantity and/or quality insects. This may lead to increased foraging time that will increase the probability of predation and starvation (Potts 1986). Doxon and Caroll (2010) showed that pheasant chicks had higher rates of selection of Homoptera, Hemiptera, and Coleoptera, and bobwhite chicks had higher rates of selection of Araneae, Lepidoptera, and Hymenoptera in Kansas. Bobwhite chicks consumed 22 invertebrate families. Bobwhite chicks consumed Hymenoptera (ants and ichneumon wasps) and Coleoptera (beetles) more frequently. Bobwhite chicks foraging in Kansas consumed higher rates of insects than bobwhites foraging in agricultural lands in Georgia, but lower rates than bobwhites foraging in North Carolina. The foraging rates of bobwhite chicks have varied in previous studies: from 0.01–0.04 g per chick per 30 minutes in agricultural fields in Georgia (Maidens 2001), to 0.04–0.09 g per chick per 30 minutes in field borders in Mississippi, (Smith and Burger 2005), to 0.1–0.6 g per chick per 30 minutes in agricultural fields in North Carolina (Palmer 1995).

Soon after hatching, broods leave the nest and are cared for by one or both adults. To ensure best brood survival, it is important that quality brood-raising cover be available. Young chicks must be able to move easily on semi-bare ground so they can catch insects. Overhead cover is also needed to protect chicks from predators and harsh weather. A mixture of annual grasses and forbs (such as ragweed, partridge pea and annual lespedezas) provide cover and high protein foods (insects) needed by bobwhite chicks (Rosene 1969). We hypothesize that brood habitat is probably a limiting factor to restoring bobwhites in PA.

Interspersion of Habitat Types

Management for the bobwhite must consider the type of cover needed, the amount of each type needed, and their juxtaposition (Edminster 1954). It is important to have food and cover resources in close proximity (Roseberry and Klimstra 1984). The vulnerability of a winter covey is related to the quality and quantity of escape cover, and the distance between food and cover resources. The interspersion of seasonal resources need not be as tight as those resources needed on a daily basis. Several occupied bobwhite ranges in southern Illinois that generally were devoid of nesting habitat were located 1.0 km from areas that contained extensively used nest cover.

The highest bobwhite populations occur where a large variety of plants exist (Rosene 1969). Such conditions are best provided in habitats with a mix of woodlands and open fields, with a transition band between them. Bobwhite populations in Illinois were positively correlated with the amount of edge between brushy pastures and cultivated fields (Hanson and Miller 1961). However, there was no correlation between bobwhite numbers and the total amount of all edges, because many edges were not used. Eubanks and Dimmick (1974) believed that the total amount of edge was less important than the abundance of adequate protective cover adjacent to foraging areas. The proximity of woody cover to herbaceous cover was also an important factor influencing bobwhite use of Remington Farms in Maryland (Burger and Linduska 1967). The formation of new quail coveys was most rapid where adequate herbaceous cover was immediately adjacent to either shrub hedgerows or forest boundaries.

Bobwhites can do well in areas where the percentage of land in cropland, forest, or idle land varies tremendously, if the areas are properly managed (Rosene 1969). Good habitat can range from 10% to 90% cropland and 10% to 90% forest, with the best habitats containing 50% in non-woody growth and 50% brush or woodlands. Improved pastures should not be large and should total less than 20% of the area. Edminster (1954) estimated proportions of various cover types necessary to provide good bobwhite habitat. Native grasses and forbs, used primarily for nesting, should make up 30% to 40% of the area, in 2- to 4-ha units. Croplands provide fall and winter food and should comprise 40% to 60% of the habitat in 0.4- to 2-ha units. Brushy areas, providing escape cover, fall and winter food, and roosting habitat, should total 5% to 20% of the area in 0.1- to 0.4-ha units. Woodlands provide the same needs as brushy cover and should make up 5% to 40% of the total cover in units between 2 and 8 ha in size. An appropriate distribution of cover in relation to food producing areas is critical in managing bobwhites on agricultural lands (Eubanks and Dimmick 1974).

Very high bobwhite densities were observed in portions of a Tennessee study area that contained as much as 80% of the area in row crops. Bobwhites may find adequate cover in habitats with either a few areas of high quality woody vegetation or in areas with a large quantity of lower quality woody vegetation (Lehmann 1984). Riddle (2007) established narrow linear (approx. 3-m-wide) and nonlinear field borders on farms in agriculture-dominated and forest-dominated landscapes in the Coastal Plain of North Carolina, after collecting pretreatment data on summer bobwhite abundance. After establishment of field borders, summer bobwhite abundance nearly doubled on farms in agriculture-dominated landscapes and increased approximately 57% on farms with nonlinear field borders. Summer bobwhite abundance did not increase on farms with linear field borders in forest-dominated landscapes. Northern Bobwhites are dependent on a very high interspersion of habitat types in close proximity. In order to maximize bobwhite abundance, all habitat needs should be well interspersed within a 1-mi^2 area.

The kinds of habitats and resources bobwhites need must be developed at proper scales to maintain populations. Because bobwhites are not migratory, they need large portions of the landscape maintained in suitable habitat. Some science-based estimates suggest 1,000 to 4,000 acres of usable habitat is required to sustain viable bobwhite populations (Terhune et al. 2006). Relatively small (less than 1,000 acres), isolated land holdings managed for bobwhite can be productive habitat, and small acreages managed for bobwhite can help survival and reproduction. However, populations inhabiting small acreages are more susceptible to random environmental

catastrophes (such as drought, ice storms, snow storms, etc.), and processes such as gene flow and successful dispersal of individuals among populations may be minimal. We do not know the minimum size area to maintain a viable population of northern bobwhites in PA. An important part of this plan is determining the minimum area needed to support a sustainable wild northern bobwhite quail population.

Life History

The bobwhite is a resident bird and essentially sedentary and does not undertake large movements. Bobwhites form coveys during late summer and early fall and may move several kilometers to habitats where food and cover will be available through the winter (Rosene 1969). However, bobwhites in adequate habitats often rear their broods and establish winter covey ranges within a few hundred yards of where they were hatched (Agee 1957). Most fall and winter movements of Missouri coveys were < 0.4 to 0.6 km in their greatest dimension (Murphy and Baskett 1952). Approximately one-half of the bobwhites in this study had a lifetime cruising radius of < 0.8 km. Eighty-six percent of the bobwhites in a Florida study moved < 400 m in a 1- to 5-year period (Smith 1980). Average home range of coveys in Oklahoma was 4.4 ha and ranges were centered along stream channels (Wiseman and Lewis 1981). Home range size did not vary from fall through spring. Winter ranges in Alabama and South Carolina varied from 1.6 to 31.2 ha (Rosene 1969). The average size of winter ranges in Tennessee was 6.8 ha (Yoho and Dimmick 1972). Four late winter ranges in southern Illinois varied in size from 12 to 19 ha, with an average size of 15 ha, whereas 4 ranges in a year of prolonged snow cover averaged 9 ha (Roseberry and Klimstra 1984). The minimum area needed to support a covey of bobwhite quail in this critical winter season is approximately 4.9 ha (Robinson 1957). We estimate that a home range of 0.5-1 km^2 is probably a large home range for most northern bobwhites.

Early spring is a time of dispersal for bobwhites preparing for reproduction. Habitat use shifts from shrubby and woody habitats used in winter to more open, grassy portions of the landscape. During the breeding season, it is not uncommon for about 25% of the population that survives the winter to move to new areas more than 2 kilometers from their winter range. These birds are likely looking for mates and new habitats. The familiar two- or three-note “bobwhite” whistle of males in early spring to attract a female is the earliest sign the reproductive season is starting. Courting pairs form in late March and April. Pairs may form and break up then reform throughout the breeding season, from late May through early September. The long breeding season provides opportunities for multiple nest attempts and contributes to the bobwhite’s high reproductive potential. Individual nesting attempts may require from 35 to 48 days from making the nest to hatching. Peak hatch is around mid-July. Some broods may hatch as early May and as late as early October. Nests are incubated by either the male or the female, but bobwhites rarely share incubation duties.

Latham and Studholme (1952) reported that 59 nests found in Fulton County, PA showed that May and June were the peak nesting months. Two nests were completed in April; 25 each in May and June, and 7 in August. Reliable reports were received of hen quail incubating in September.

Females incubate most of the early-season nesting attempts, but males incubate an average of 25% to 30% of all nests. Male incubation is most common during the middle of the breeding season. Often the female initiates and incubates a clutch, while the male incubates a clutch the female laid earlier. Bobwhites readily renest when nests are destroyed by predation, weather, or human activities. Some females may produce more than one brood per season. Bobwhites usually select a nest site where native grasses are the main plant type. Good nesting cover has fairly dense, upright grass cover close to areas with ample bare ground concealed by overhead grass, forb, and shrub cover. These more open, weedy areas provide foraging habitat for the newly hatched chicks. Male bobwhites build nests in a slight depression in the soil, using available grasses and debris, which often include broomsedge or other bunch grasses from the previous year. Nest building takes about a day, and the hen generally lays about one egg daily until she has produced the complete clutch of eggs (average clutch size is 12 eggs). This usually requires from 15 to 20 days after the nest is built, often with a slight delay between building and the beginning of egg-laying. Within two to five days of laying the last egg, the female or male starts incubation. Both attending adults and nests are highly vulnerable to mortality during incubation. Predators, agricultural machinery, or weather events destroy about 55% to 70% of nests. The attending adult is killed in about 25% of nest failures. Because females incubate 70% to 75% of nests, they typically experience greater mortality than males during the nesting season. If the nest is successful, the eggs hatch after about 23 days of incubation. Once hatching begins, most chicks emerge within one to two hours. About 33% of birds succeed on the first nesting attempt, and bobwhite hens may re-nest two to three times, whether the first brood was successful or not. Despite this high reproductive potential, not all pairs successfully produce a brood because of weather, predation, and other disturbances. Through repeated re-nesting, about 75% of the birds surviving the breeding season ultimately hatch one or more clutches.

When bobwhite chicks hatch, they are covered in down, with eyes open, and can move around. Newly hatched chicks weigh about 7 g, and can forage for themselves soon after hatching. As soon as the chicks are dry, the hen leads them away from the nest to begin foraging on insects and other invertebrates. They are very alert, move around on the ground quite readily, and cannot fly for the first two weeks after hatching. Attending adults watch the chicks closely, and the brood may cover from 2 to 100 acres during the flightless period. Hens take the chicks to insect-rich areas with overhead cover for protection from predators, intense heat, or wet conditions and in which small chicks can move freely along the ground and through vegetation to feed. Annual plant communities provide good brood cover. The first two weeks after hatching are the most critical, because 50% or more of chicks may be lost to predation or bad weather. The attending adult broods, or covers the chicks with its wings during the night and much of the day to keep them warm and protect them from predators. Bobwhites are dedicated parents and hesitate to leave flightless chicks, even when attacked by a predator. Although predation is high during incubation, adult mortality associated with attending flightless chicks is twice as great as incubating a nest. Between weeks 2 and 6 chicks develop juvenile plumage and flight abilities. By 6 weeks of age, chick diets shift from only insects to insects along with seeds, berries, and other plant material. At 8 weeks, hens are readily distinguishable from cocks by the brown feathering in the throat patch, whereas cocks have a white throat patch and a black eye stripe and collar. At 12 to 16 weeks, the size of young closely resembles that of adults. By the age of 21 weeks, bobwhites have the plumage they wear into the next breeding season. Juveniles can still be identified from adults for a full year by the more-pointed ninth and tenth primary wing

feathers and buff-colored tips of the greater primary coverts. Summer life for birds of all ages consists of daytime activities of traveling, feeding, dusting to clean feathers, and loafing. They may feed during early morning, rest during mid-morning, loaf, sleep, and dust during the middle of the day, and feed during the two to three hours before dark. The bobwhite's preferred way to travel is on foot. Flying requires more energy than walking and running and exposes birds to predators such as hawks and owls. Shrubby cover such as honeysuckle, plum thickets or briar patches provide both secure loafing cover and escape cover for bobwhites during these daily activities.

By late summer bobwhites begin to show the characteristic night roosting habits of forming a circle on the ground with tails together and heads pointing out. This may have important social, escape, and heat conservation benefits. In late summer and early fall, birds begin to mix from brood to brood and form coveys, or social groups, of 20 to 30 birds. These coveys may reduce to groups of 10 to 15 birds as each covey settles into its winter range. This period is often called the "fall shuffle," and populations have reached their peak for the year. As fall arrives, food is most abundant, birds move about less, and the tight-knit coveys are 75% to 80% juvenile birds. Depending on habitat quality, each covey may require from 20 to 160 acres or more to meet its needs.

As much as 50% to 75% of the early fall population may die by the following spring. As winter progresses, cover and food resources become more limited. Preferred winter habitat consists of wooded areas with dense understory used for cover and loafing, accessible agricultural grains or weed seeds, and low, grassy cover for roosting (Roselle 1969; Roseberry and Klimstra 1984). Protective cover such as shrub thickets or briar patches throughout an area can provide critical cover after grass and forb covers have deteriorated during winter. For birds that survive winter, longer daylight and warmer weather in spring trigger the gradual breakup of coveys. The bobwhite calls begin in earnest, and pairing begins again as the next breeding season arrives.

Population Biology

Recruitment, mortality, survivorship, and dispersal, and the influence of habitat, weather, disease, genetics, and predation on these demographic factors, are complex and often difficult to determine in wild bobwhite populations. Some of these population parameters may be density dependent, further complicating the analysis of bobwhite population dynamics. To understand bobwhite populations and to be able to predict future population densities requires knowing or estimating these population parameters. The more assumptions and lack of data on any bobwhite population, the less accurate and precise will be the population estimates.

Population Densities

The number of bobwhites in the autumn population is the sum of the number of adults and juveniles surviving through the breeding season. Maximum bobwhite densities are generally believed to be 250 birds/100 ha (Edminster 1954; Rosene 1969). However, densities up to 500-750 birds/100 ha have been noted in southern Georgia and northern Florida (Kellogg et al. 1972), and densities of 250-500/100 ha are common on good range in southwestern Georgia (F. E. Kellogg, Southeastern Cooperative Wildlife Disease Study, personal communication). Fall

populations of bobwhites in Illinois had a mean density of 62.0 birds/ 100 hectares, very close to the highest reported for unmanaged quail habitat; this contrasted with 42.8-153.2 for means on quail-managed areas. Annual rates of population increases (summer gain) by quail were inversely correlated with (1) days of snow cover > 2.54 cm and (2) days of snow cover x the birds' winter density over K, K being an equilibrium (almost a mean) density (Roseberry and Klimstra 1984).

Fecundity

Northern bobwhites have several reproductive strategies to enhance recruitment including large clutch size, multiple clutches, and male incubation (Burger et al. 1995a). The first documentation of multiple-brooding in northern bobwhites (Sermons and Speake 1987) and the subsequent observance of polyandry (Curtis et al. 1993, Burger et al. 1995a) generated a series of studies on the breeding behavior of these birds. The ensuing empirical (Taylor 1991, DeVos and Mueller 1993, Suchy and Munkel 1993) and theoretical (Guthery and Kuvlesky 1998) results have changed biological understanding of reproduction behavior in this species. That is, the hypotheses that bobwhites are monogamous and raise at most 1 brood (Stoddard 1931, Leopold 1933, Davison 1949, Rosene 1969) have been proven wrong. Curtis et al. (1993), DeVos and Mueller (1993), Suchy and Munkel (1993), and Burger et al. (1995b) reported that 14-28% of males incubated eggs. Burger et al. (1995a) observed that 40.2% of females and 13.5% of males alive 15 April hatched ≥1 nest. Burger et al. (1995a) also observed 74% of females and 26% of males that survived the nesting season hatched ≥1 nest. Collins et al. (2009) located 23 northern bobwhite nests in New Jersey, of which 21 were usable for survival analyses. The estimated probability that an individual that entered the breeding season would initiate incubation of at least 1 nest was 68.7% for females and 20.2% for males.

Rollins and Carroll (2001) reviewed 11 studies of bobwhite nest-success rates and found a weighted mean of 28%. The highest reported rate was 50% (Peoples et al. 1996). The lowest rate reported was 12% based on a small sample (n=34) from north Texas (Jackson 1947). Collins et al.(2009) estimated incubation period nest survival in NJ was 45.8%. Burger et al. (1995b) reported an incubation period nest survival of 43.7% in Missouri. Other northern bobwhite nesting studies have reported apparent nest success (e.g., DeVos and Mueller 1993, Suchy and Munkel 1993, Taylor et al. 1999, Cox et al. 2005). Apparent nest success overestimates nest survival (Mayfield 1961, Johnson 1979), but apparent nest success is less biased in northern bobwhite studies because most nests are found at a similar stage of incubation (Cox et al. 2004). Sandercock et al. (2008) reported published estimates (range-wide average 42%, range 25%-63%) for bobwhites (Table 3).

In PA, Latham and Studholme (1952) found 8 nests in alfalfa fields during 1944. Every one of these was a failure. This was due to the fact that alfalfa matures early and is sometimes harvested in May before the nesting quail are able to complete egg laying and incubation. All of these nests were lost as a result of harvesting operations. Eight of the 21 nests (38%) located in mixed clover and timothy hay fields were successful largely because the birds were able to hatch the eggs before harvest time. Of 9 located in fallow fields, 44% were successful. Two, or 22%, of the 9 located in fencerows were successful. The fencerows were very narrow and supported sparse cover. Nine nests were found along the edges of roads. Of this number, 66% were

successfully hatched. It appeared that nests located in this type of cover had the best chance of producing young birds. All the remaining nests, located one each in a barley field, a wheat field, a peach orchard, a country cemetery lot, and in ornamental shrubbery were failures. Overall nest success was estimated to be 32.8%.

Cox et al. (2005) studied bobwhite nesting in western Oklahoma where clutch size declined by 1 egg for every 14–20 elapsed days in the nesting season and the rate of decline was independent of incubation attempt (1 or 2). This result suggests that lower clutch sizes later in the nest season were not necessarily a function of re-nesting. Ending of nest-incubation attempts (1, 2, 3) occurred within an 8-day period from 26 August–2 September. These results implied that early-season nesting cover is a management concern and that high nest success is possible in the absence of nest predator suppression where abundant nest sites occur across the landscape.

Clutch sizes have been reported from 10-14.0 eggs and 85–95% fertility, respectively (Sandercock et al. 2008). Re-nesting estimates have ranged from 25-69% (Sandercock et al. 2008). Researchers have reported a double-clutch rate (percent females with a successful first clutch that initiated incubation of a second clutch) in bobwhites ranging from 12% (Burger et al. 1995b) to 60% (Terhune et al. 2006). Cox et al (2005) observed 161 completed (hatched) clutches. The average clutch contained 13.6 eggs, of which 12.2 hatched. The percent hatch rate for eggs within clutches was 90.2 %. Latham and Studholme (1952) reported nests with 10-30 eggs and an average of 16 eggs per clutch in PA.

Table 3. Annual estimates of 5 components of fecundity from field studies of northern bobwhites in the United States (Sandercock et al. 2008).

	Parameter estimate			Sample size					
Parameter	**Median**	**Min.**	**Max.**	**Median**	**Min.**	**Max.**	**N**	**State**	**Source**
Clutch size (TCL)	14.0	11.4	14.9	26	12	54	12	IL	Roseberry and Klimstra 1984
	13.9	11.5	15.6	17	12	22	6	MO	Burger et al. 1995b
	13.6			161			1	OK	Cox et al. 2005
	12.9			59			1	TX	Parmalee 1955
	12.8			54			1	FL	DeVos and Mueller 1993
	12.0			52	34	69	2	TX	Hernandez et al. 2005
	11.9	11.8	12.2	66	25	92	4	TX	Hernandez et al. 2007
	11.7			28			1	NC	Puckett et al. 1995
	11.7			21			1	MS	Taylor and Burger 1997
	11.5	11.2	13.4	27	20	53	7	TN	Dimmick 1974
Nest survival (NEST)	0.63	0.56	0.70	59	37	81	2	TX	Hernandez et al. 2005
	0.63			59			1	TX	Parmalee 1955
	0.61	0.55	0.67	26	18	33	2	KS	Taylor et al. 1999
	0.55	0.33	0.65	19	13	26	4	IA	Suchy and Munkel 1993
	0.54			53			1	NC	Palmer et al. 1998
	0.50	0.38	0.58	24	10	47	3	TX	Hernandez et al. 2003
	0.50	0.43	0.58	26	17	39	4	GA	Terhune et al. 2006
	0.49	0.41	0.59	65	13	81	4	TX	Hernandez et al. 2007
	0.48			331			1	OK	Cox et al. 2005
	0.48			50			1	TX	Hernandez et al. 2001
	0.44	0.26	0.54	19	11	26	8	MO	Burger et al. 1995b
	0.45	0.36	0.54	26	25	26	2	FL	DeVos and Mueller 1993
	0.44	0.33	0.55	52	30	74	2	FL/GA	Staller et al. 2002
	0.44	0.42	0.46	99	59	139	2	FL/GA	Staller et al. 2005
	0.41	0.33	0.49				2	GA	Hughes et al. 2005
	0.41	0.23	0.50	9	7	20	7	TN	Dimmick 1974
	0.39	0.27	0.50	27	16	37	2	NC	Puckett et al. 1995
	0.38			21			1	TX	Carter et al. 2002
	0.33	0.27	0.39	30	26	33	2	TX	Lusk et al. 2006
	0.32			41			1	TX	Parsons et al. 2000
	0.31	0.21	0.53	53	18	124	13	IL	Roseberry and Klimstra 1984
	0.25	0.19	0.27	9	5	9	3	MS	Taylor and Burger 1997
Hatchability (HATCH)	0.95			35			1	TX	Mueller et al. 1999
	0.94	0.87	0.96	28	16	39	9	IL	Roseberry and Klimstra 1984
	0.93			121			1	NC	Puckett et al. 1995
	0.92			14			1	FL	DeVos and Mueller 1993
	0.92			20			1	TX	Parmalee 1955
	0.90			161			1	OK	Cox et al. 2005
	0.88	0.87	0.88	26	18	33	2	KS	Taylor et al. 1999
	0.86	0.82	0.90	36	13	63	4	TX	Hernandez et al. 2007
	0.85	0.80	0.90	35	24	45	2	TX	Hernandez et al. 2005
P of renesting (RENEST)	0.69	0.69	1.00	13	12	13	3	MO	Burger et al. 1995b
	0.54	0.20	0.87				2	TX	Hernandez et al. 2005
	0.37			30			1	NC	Puckett et al. 1995
	0.25	0	0.50	11	11	18	3	MS	Taylor and Burger 1997
P of second clutch	0.31	0.28	0.34	25	18	32	2	GA	Terhune et al. 2006
	0.25			16			1	AL	Sermons and Speake 1987
	0.26	0.15	0.42	12	10	13	3	MO	Burger et al. 1995b

Until recently, it was thought that northern bobwhites raise only their own hatchlings. Post-hatching brood amalgamation (hereafter brood amalgamation) occurs when birds incubate and hatch their own young then group their offspring with those of other individuals. Faircloth et al. (2005) in Florida reported minimum frequencies of brood amalgamation within bobwhite broods were 6.7% at 3–4 days and 20.7% for 10–12 day-old broods in 2002. During 2003, minimum frequencies of brood amalgamation ranged from 0.0% at 3–4 days to 22.2% for 10–12-day-old broods. Their results indicate bobwhites exhibit higher rates and earlier onset of brood amalgamation than previously documented among the Galliformes. Gang-brooding has been observed in other species of quail, including California quail (*Callipepla californica*) (Lott and Mastrup 1999) and Gambel's quail (*C. gambelii*) (Brown et al. 1998). Lott and Mastrup (1999) demonstrated that California quail which raised communal broods lived longer and hatched more eggs. Brooks and Rollins (2007) report the occurrence of gang-brooding (i.e., communal brood-rearing) in a population of northern bobwhites in western Texas. Combinations of adult quail (2 mated pairs, 2 males, and 2 females) were observed with broods on several occasions. Chicks of communal broods were similar in age (within 1 week). Proximity in age and location may be important for initiating combining of broods (Lott and Mastrup 1999). This behavior may be an adaptation to relatively short-lived optimal nesting conditions allowing them to invest maximally in chicks rather than in multiple-clutch attempts. Causes of brood amalgamation in bobwhite may differ from those proposed for waterfowl due to the bobwhite's limited mobility, short lifespan, gregarious behavior, and resulting potential for relatedness among individuals. Molecular techniques should be used to assess the effects of inclusive fitness losses and gains among bobwhites that donate and receive chicks. Bobwhite researchers should recognize the potential bias in chick survival estimates caused by high rates of brood amalgamation.

Survival and Mortality

To date, adult survival has received the most research attention, and the survival rate of chicks is among the least investigated aspects of bobwhite ecology (Roseberry and Klimstra 1984; Guthery 2002). Knowledge of the demography of bobwhite chicks during the first few weeks of life is essential for understanding fluctuations in autumn populations. For short-lived species such as the bobwhite, population growth rate is most sensitive to changes in fecundity (Lebreton and Clobert 1991) and, inasmuch as it is related to fecundity, recruitment. For bobwhites, 66% of the variation in recruitment was explained by the number of chicks hatched per hen (fecundity) (Klimstra and Roseberry 1975). Increasing juvenile mortality by 45% (from 15% to 60% mortality) had a 2.53 times greater impact on recruitment than a 60% increase (from 20% to 80% mortality) in adult mortality (Roseberry 1974). Roseberry and Klimstra (1984) suggested that, because of this relationship between fecundity and recruitment, juvenile survival might play a secondary role in determining autumn population size. However, the effect of juvenile survival on recruitment and autumn population size is still considerable. Roseberry (1974) reported that fecundity and juvenile survival were equally important to recruitment.

Lusk et al. (2004) used radio telemetry to track individually marked chicks during 1997–2002 in Oklahoma. This allowed them to follow survival of chicks past the brood-rearing stage. They modeled survival using a Cox proportional hazards model. Given the best survival model, they then modeled the growth rate of bobwhite chicks as a function of time since hatch to better understand the relationship between mass and survival rate through time. They also estimated

hatch-to-November survival of chicks that was independent of telemetry data; this was done to check telemetry-based survival estimates, which are usually biased low for bobwhites (Guthery and Lusk 2004). Their telemetry-independent estimate of survival over an approximately 19-week period of 56% (61.7% survival for 16 weeks) was derived under logic similar to that of Roseberry and Klimstra (1984) and was within the range of their results. Roseberry and Klimstra (1984) reported typical survival rates of 53–75% for the first 16 weeks post-hatching. These rates translate into daily survival rates of 0.993–0.997.

The survival rate of chicks is generally thought to be lowest during the first 2 (pre-flight) to 4 (pre-thermogenesis) weeks of life and to increase subsequently (DeVos and Mueller 1993). DeMaso et al. (1997) observed a daily survival rate of 0.9526 during the first 20 days and 0.9983 during days 21–39. Other studies have reported higher survival rates than those reported above. Suchy and Munkel (1993) monitored radio-tagged chicks aged between 21 and 59 days. They reported a daily survival rate of 0.9943, or 52.7% for 16 weeks. Lusk et al. (2004) concluded that survival rate was an increasing function of mass, which in turn was an increasing function of age. An interesting point is that growth rate reached its maximum at around day 35 post-hatching and that survival became less sensitive to time since capture at around day 30. Since chicks were initially captured between 1 and 5 days after hatching, maximum growth occurred at roughly the same time that survival became independent of time since capture. This relationship was not completely surprising given the relationship between mass and survival. These data suggest that the first 30 days after hatching were the critical period for bobwhite chicks. Management to increase survival during this period would enhance recruitment and, therefore, population abundance. Such management might entail cover manipulation that reduces exposure to predation and improves the availability and accessibility of invertebrate foods.

Sandercock et al. (2008) reported on chick survival studies conducted from 1993-2005 in the USA. They found that median chick survival to 30 days ranged from 19-68% (Table 4).

Table 4. Chick survival estimates from Sandercock et al. (2008).

Chick survival			Observed survival				Sample size							
Median	Min.	Max.	Median	Min.	Max	Period (days)	Median	Min.	Max	n	Type[b]	Sex	State	Source
0.72			0.52			59	19			1	T	MF	IA	Suchy and Munkel
0.66			0.68			28	5			1	C	MF	NC	Puckett et al. 1995
0.45	0.38	0.59	0.36	0.29	0.51	39	20	17	22	3	C	MF	OK	DeMaso et al. 1997
0.29			0.29			30	22			1	C	MF	FL	DeVos and Mueller
0.28	0.14	0.41	0.40	0.25	0.54	21	22	18	25	2	C	MF	TX	Mueller et al. 1999
0.19			0.19			30	67			1	T	MF	OK	Lusk et al. 2005

[a] We calculated chick survival as $\hat{S}_c = \hat{S}_o b^{30/per}$, where $\hat{S}_o b$, was the observed survival reported by the authors, and period was the period of exposure in days.
[b] Type of estimate: C = brood counts, T = telemetry.

We have no data on brood survival or size from PA. Sandercock et al. (2008) reviewed estimates of summer survival from a number of field studies (Table 5). Summer survival of chicks ranged from 14% to 76%. Assuming an average clutch size of 14 and a 92% hatchability rate (clutch size: 13) brood sizes in the fall ranged from 2-10. Median brood survival was 46%

or a clutch size in the fall of 6 juveniles. In addition, they reviewed survival of northern bobwhites from October 1 - March 31. Winter survival varied from 0-80% with a mean in 23 studies of 35%. In most of these studies, hunting mortality was the primary cause of death. The irruptive behavior of bobwhite quail populations on the northern periphery of their range in Wisconsin, Pennsylvania, and Ontario has been described by Leopold (1937), Gerstell (1939), and Clarke (1954). They ascribed these periodic crash declines primarily to severe winter weather conditions characterized by low temperatures and deep snow associated with food shortages. Kabat and Thompson (1963) have documented the population dynamics of a bobwhite quail population studied earlier by Leopold in the 1930-1940's period. They attributed population decline to the destruction of hedgerow cover resulting from changes in land-use practices rather than climatic factors. Several PA studies were undertaken to learn more about climatic and environmental factors affecting bobwhite quail during the critical winter season (Gerstell 1939; Latham and Studholme 1952; Schemnitz 1965).

Schemnitz (1965) studied a population of bobwhites in Franklin County, PA during the winter of 1960-1961. The study area consisted of 1,852 acres in Quincy Township near Mont Alto. The months of January and February, 1961 were characterized by heavy snow depths. Over the period, over 82 inches of snow fell on the study area. Snowshoes were essential for travel on foot over the study area. The snowfall on January 19 and 20, 1961 was the greatest accumulation of snow since a similar storm of January 15-16, 1945. For most of the southern sections, it was the snowiest January on record. The snow depth diminished rapidly in late February with warmer temperatures beginning on February 14, 1961 and rains totaling 1 inch on February 23 and 24, 1961. Temperatures were below the long term normal for December (9 degrees), January (8 degrees), and February (1 degree).

Table 5. Seasonal estimates of summer survival ($\hat{S}s$) for the 6-month period between 1 April and 31 September from field studies of northern bobwhites in the United States, based on articles published between 1984 and 2007 (n = 76 estimates from 15 articles). Sandercock et al. (2008).

Summer survival ($\hat{S}s$)[a]			Observed survival ($\hat{S}_{obs}$)			Period		Sample size								
Median	Min.	Max.	Median	Min.	Max.	Start	End	DA	Median	Min	Max	n	Type[b]	Sex	State	Source
0.63	0.46	0.92	0.57	0.38	0.90	19 Mar	3 Nov	229	130	72	212	17	C	MF	IL	Roseberry and Klimstra 1984
0.47	0.33	0.53	0.47	0.33	0.53	1 Apr	30 Sep	182	70	33	116	4	T	MF	GA	Hughes et al. 2005
0.47			0.47			1 Apr	30 Sep	183	72			1	T	F	FL	Curtis et al. 1988
0.44	0.14	0.76	0.44	0.14	0.76	1 Apr	30 Sep	182				11	R	MF	GA	Terhune et al. 2007
0.36	0.17	0.55	0.69	0.55	0.82	24Apr	25 Aug	62	27			2	T	F	FL	DeVos and Mueller 1993
0.36	0.31	0.41	0.36	0.31	0.41	1 Mar	31 Aug	184	160	146	173	2	T	MF	TX	Hernandez et al. 2005
0.35	0.24	0.62	0.35	0.24	0.62	1 Apr	30 Sep	182	47	25	66	8	T	MF	IA	Suchy and Munkel 2000a
0.35	0.28	0.41	0.35	0.28	0.41	1 Apr	29 Sep	181	87	79	95	2	T	MF	NC	Puckett et al. 1995
0.34	0.33	0.38	0.34	0.33	0.38	1 Apr	30 Sep	182	54	52	58	3	T	F	MO	Burger et al. 1995a
0.34	0.16	0.50	0.35	0.17	0.51	1 Apr	27 Sep	179	45	26	52	4	T	MF	MS	Taylor et al. 2000
0.34	0.31	0.43	0.29	0.26	0.38	2 Feb	2 Sep	212	60	31	90	4	T	MF	GA	Terhune et al. 2006
0.25			0.25			1 Apr	30 Sep	183	22			1	T	MF	NC	Curtis et al. 1988
0.21	0.07	0.34	0.56	0.42	0.70	10 Apr	9 Jun	60	71			2	T	MF	AL	DeVos and Speake 1995
0.17	0.12	0.21	0.31	0.26	0.36	24 Apr	20 Aug	118	39	32	46	2	T	F	KS	Taylor et al. 1999
0.16			0.29			1 May	1 Sep	123	58			1	T	MF	TX	Carter et al. 2002
0.10	0.01	0.54	0.39	0.14	0.77	27 Apr	14 Jul	>62	54	13	71	9	T	MF	TX	Liu et al. 2000

[a] Summer Survival (Ss-1 April---31 September; Observed Survival (S_{obs})); Period-Start-End;DA=days of study;
[b] Type: C=counts, T=Telemetry,R=Markings

In January the temperature stayed below freezing (32° F) during 13 days and was below 0° F on 5 days. Despite this snowy, frigid weather, all game birds encountered during the period of this study appeared wary and flew strongly when flushed. On the basis of available kill figures, no major decline in the quail kill occurred in 1961 and subsequent years following the severe 1960-61 winter weather. On the main study area of 1,852 acres, 17 coveys were located totaling 236 quail (13.9 per covey) or 1 quail per 7.1 acres between December 1960 and April 1961. Estimated winter mortality from December through March was 24.4%.

Latham and Studholme (1952) estimated that during the winter of 1944-45, 90% of the quail resident in Fulton County, PA perished mainly from the effects of severe weather. The total snowfall during the 1944-45 winter was 52 inches. Latham and Studholme (1952) recorded a drop in the annual Pennsylvania quail kill from 540,000 in 1935 to 26,000 in 1936 and from 50,000 in 1944 to 12,000 in 1945 following winters of deep snow and low temperatures.

Ornithological literature contains numerous references to the effect of adverse weather on bird life. Witherby and Jourdain (1929) and Ticehurst and Hartley (1948) have reported bird mortality in England resulting from severe weather, while the effects of extreme cold on birds in Canada was noted by Rowan (1925). Schultz (1954) and Frenzel and Marshall (1954) have described adverse conditions as affecting avian populations in Tennessee and Minnesota,

respectively. Field observations suggest heavy avian mortality in parts of southern Illinois as a result of a prolonged period of snow coverage in early 1960.

Winter mortality data were collected in Illinois by Roseberry (1962). This study was in the vicinity of Carbondale, where the average annual number of days with 3 or more inches of ground snow is approximately 4 (Changnon 1958). Beginning February 25, 1960, at least 3 inches of snow covered the ground for 23 consecutive days; throughout most of this time, the depth of the snow was about 12 inches with a maximum of 16 inches. Minimum daily temperature during this period averaged 17.9° F, considerably below the 1950-1959 average of 33.7° F for the same period.

Meadowlarks and bobwhites constituted over 45% of all recorded avian deaths. Because these species are ground feeders exclusively they not only experienced a more critical shortage of food, but may have been more vulnerable to predation as well. Observations suggest that the relative losses of meadowlarks and quail (36 and 16 individuals, respectively) may have been roughly proportional to their comparative abundance. There were probably few, if any, actual cases of bobwhite mortality during the winter of 1959-60 that could be attributed directly to starvation or freezing. However, susceptibility to predation was increased by the shortage of food and the vulnerability of the birds while feeding against a white background of snow.

Scott and Baskett (1941) describe a severe early November snow storm of 1 day's duration which resulted in the death of 12 to 16 pheasants per section on the Winnebago Research Area in Iowa. The storm, accompanied by high winds, killed less than 10% of the pheasant population. On the Carbondale Research Area in Illinois, an estimated 17.9% of the mid-winter bobwhite population was lost during March (Roseberry and Klimstra 1984). It should be noted that a given population loss incurred immediately prior to the breeding season is of greater consequence than a similar loss coming before the hunting season. Population levels of bobwhites on the Research Area reveal that in normal years losses are greatest in late fall and early winter. During 1957-58 and 1958-59, total fall-to-spring population decline was 66.3% and 72.6%, respectively, of which 6.7% and 4.4% occurred after mid-February. In 1959-60, however, 10.6% of the total 77.2% fall-to-spring reduction was incurred in March.

Latham and Studholme (1952) in physiological studies of bobwhite quail in PA wrote: "…the reproduction of bobwhite quail is adversely affected for at least 2 seasons following severe winters." They felt that winter depletion of vitamin A, loss of fat, and catabolizing of muscle protein may result in a later and shorter nesting season, and a reduction in number and fertility of eggs. Data from the Carbondale, Illinois Research Area suggest that the severity and relative lateness of the adverse weather may similarly have had a depressing effect on spring and summer activities. The reduction of the 1960 breeding population from that of 1959 was only 33.2%, but the number of nests constructed decreased 52.5%. Observations indicated a delay in spring covey breakup, but not in the beginning of nesting. Average size of completed clutches and hatchability and fertility of eggs were not reduced. The severe weather may have had an adverse effect on bobwhite fecundity during the subsequent breeding season. A large amount of available corn and soybeans possibly prevented mortality from being much greater (Roseberry and Klimstra 1984).

Summary of Population Ecology

We have very little information on the demographics and population ecology of bobwhites in PA. Only the pioneering work of Latham and Studholme in 1944-1947 provided information on northern bobwhite demographics in PA. They concluded that the severe winter weather and prolonged snow cover with poor winter cover was the main cause for declining northern bobwhite populations in PA. However, Schemnitz's (1965) study of bobwhites in southcentral PA in 1960-1961 concluded that bobwhites can withstand hard winters in PA. Japanese honeysuckle thickets were important areas of survival. From 1958-1965, over 200,000 acres of farmland in southcentral and southeast PA was in the Soil Bank Program of USDA. This habitat may have buffered the effects of the hard winter of 1960-1961 in PA.

More recent modeling of northern bobwhite population demographics from data collected over many years and locations has provided a better assessment of important factors affecting populations (Sandercock et al 2008). Relative to other small-bodied birds, northern bobwhites have high reproductive potential with a large clutch size and high rates of egg hatchability. In addition, bobwhites can increase seasonal reproductive output with a range of different reproductive strategies, including renesting after clutch failure, double-brooding after success of a brood from a first nest, and uniparental incubation by males. However, maximum rates of reproductive output are reduced by variation in nest survival (0.19–0.70) and chick survival after hatching (0.14–0.72). Moreover, bobwhites are short-lived birds with low probabilities of survival during the 6-month summer (0.01–0.92) and winter periods (0.00–0.73).

Simulated variation in the winter survival made the greatest contribution to variance in populations (r^2-0.453), followed by summer survival of adults (r^2-0.163), and survival of chicks (r^2-0.120). Rate of population change was not sensitive to 3 demographic parameters associated with reproductive output (clutch size, nest survival, hatchability) or to 3 parameters that determined number of nesting attempts, probabilities of renesting and double-brooding. Given simulated variation in the other 8 of 9 demographic parameters in the population model, the regression equations indicate that adjustment of one parameter would require a 1-month chick survival rate of 0.67, a 6-month summer survival rate of 0.79, or a 6-month winter survival rate 0.52 to realize a stationary rate of population change. Demographic rates and life-stage simulation analysis for northern bobwhites resulted in 2 major findings. First, bobwhite demography was characterized by high reproductive potential and low seasonal survival. The demographic parameters with the greatest range of variation included clutch size, probability of renesting, and 3 survival rates. Second, variation in winter survival, summer survival, and chick survival accounted for the greatest amount of variance in rate of population change among declining populations of bobwhites. Winter survival appears to be a key factor in declining populations of northern bobwhites on the northern fringe of their range.

What level of annual survival is necessary to ensure population viability for northern bobwhites? Regressions of simulated variation in demographic parameters indicated that the population would be stationary with an annual survival rate of 0.41. An estimate of 0.41 is low, but is comparable to the lower range of estimates of annual survival reported for some species of grouse (0.3–0.5Wisdom and Mills 1997; Sandercock et al. 2005) and small-bodied songbirds (0.4– 0.6; Martin 1995; Sandercock and Jaramillo 2002; Stahl and Oli 2006). They are also close

to those estimated for hen pheasants of 30-35%. Survival estimates in this modeling study were primarily based on radio-marked birds. Published estimates of annual survival for radio-marked bobwhites are among the lowest rates of survival reported for any species of bird (0.05, Burger et al. 1995a; 0.06, Curtis et al. 1988; 0.07, Cox et al. 2004), and are lower than estimates based on banded bobwhites (0.17, Pollock et al. 1989; 0.18, Terhune et al. 2007; 0.24, Palmer and Wellendorf 2007). Nevertheless, 3 field studies based on large samples of marked birds and rigorous mark–recapture modeling have failed to detect a negative effect of radios on bobwhite survival (Parry et al. 1997, Palmer and Wellendorf 2007, Terhune et al. 2007).

Based on the literature and our own data from PA, we concur that annual northern bobwhite survival estimates of 40% are necessary to maintain sustainable populations. Survival estimates lower than this would be indicative of declining populations. Winter weather, particularly depth of snow and length of snow cover, can significantly increase mortality of adult and juvenile northern bobwhite quail. We recommend that attempts to restore wild populations of northern bobwhites be limited to areas of the state that receive no more than 40 inches of snow annually.

Dispersal and Population Genetics

Genetic information for northern bobwhite quail has not been readily available because analytical tools for delineating potential differences in genotypes have not been sufficient. The importance of genetics to population viability has been overlooked. Yet, genetics can play a major role in population demographics. Loss of genetic diversity can have adverse affects on fecundity and survival (Barrowclough 1980). Few studies have examined the genetics of northern bobwhites. Ellsworth et al. (1988) examined the biochemical genetics of wild, semi-wild, and game-farm northern bobwhites. Ellsworth.et al. (1989) reported on the genetic structure and gene flow in the northern bobwhite. Bobwhites have very small home ranges and very small dispersal ranges from areas that they are hatched. As a result, small isolated populations may quickly suffer from inbreeding depression. Habitat fragmentation from roads, changing agricultural practices, and plant succession, which reduce survivorship and recruitment of bobwhites, could reduce gene flow between populations and reduce regional and local abundance over time. Remaining isolated patches of habitat may be too small to support bobwhite populations except at very low densities. If recruitment does not keep pace with mortality, these small patches become population sinks and eventually will support no bobwhites.

We know very little about northern bobwhites in PA and nothing about their genetics. We also know very little about the impacts of pen-reared bobwhites that have been released in PA. However, we do know that over 60,000 pen-reared bobwhites are released in PA annually (Dunn et al. 2008).

Habitat has also changed dramatically over the past 80 years. This loss of habitat leads to habitat fragmentation and isolation of remaining wild bobwhite populations. Predation may increase, especially on bobwhites in isolated habitats. Inbreeding increases and leads to greater homozygosity and results in lower reproductive and survival fitness. As populations and habitats shrink, genetic drift and the founder effects may further reduce populations. This would be true

where small populations are inundated by a large number of homozygous, but less fit individuals. Overtime, this may lead to a genetic bottleneck and the population remains at very low densities or goes to extinction. Factors affecting the severity of a genetic bottleneck include the original genetic diversity of the population, the size of the population, the demographics, social structure and mating systems, and the length of time (Marcot 1994). As populations get smaller (10-120 breeding individuals) genetic drift and inbreeding increase exponentially. Bobwhite populations that become more homozygous over time are more prone to extinction.

Although we know very little about the genetics of bobwhites in PA, recent studies and new technology will allow us to monitor the genetic structure of any remaining wild bobwhites. In addition, specimens at the Carnegie Museum, Natural History Museum in Philadelphia, and the Smithsonian have many historical specimens from PA and surrounding states. Finally, working with local game bird breeders, we can analyze pen-reared bobwhite genetics and compare them to our wild populations. Rapid DNA analysis has emerged as an important tool for study of the genetics of small, fragmented populations. This technique is inexpensive, provides a potentially unlimited number of polymorphic markers and, being based on the polymerase chain reaction, requires small amounts of tissue.

Genetic analysis of PA bobwhites is important for developing guidelines for preventing the loss of genetic variability, identifying characteristics that relate to fitness in the wild, and determination of appropriate subspecies for relocation efforts. We hypothesize that as bobwhite habitat in PA declined and what was left became more fragmented, annual survivorship of bobwhites declined. Further, high levels of stocking of pen-reared bobwhites by the PGC and private individuals may have reduced the genetic diversity of bobwhites in PA. This loss of genetic diversity may be one of the reasons for the rapid decline in PA bobwhite populations over the past 3 decades. Extensive habitat restoration, reducing fragmentation of habitat, introducing wild northern bobwhites of the right genetics that are highly heterozygous, and elimination of the release of pen-reared bobwhites in potential and suitable northern bobwhite habitat will be critical to restoring northern bobwhites in PA.

SECTION IV. POPULATION TRENDS

Latham and Studholme (1952) estimated that the northern bobwhite quail population in PA in 1934 was probably over 1,000,000 birds statewide. Figure 3 summarizes the annual PA northern bobwhite quail harvest and releases of pen-reared birds from 1920-1946.

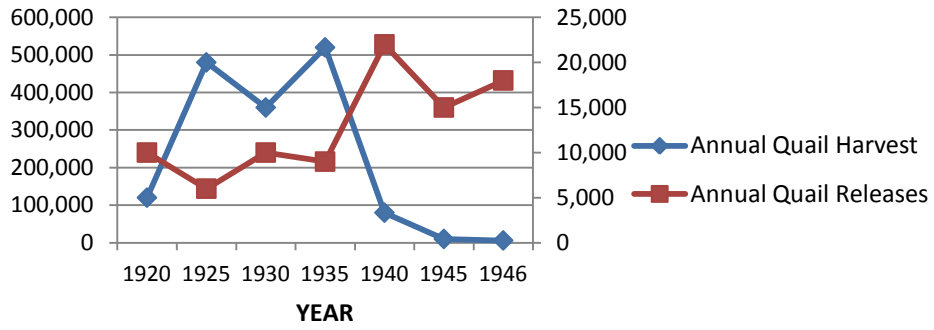

Figure 3. Annual harvest and annual release of Northern Bobwhites in PA 1920-1946. (Latham and Studholme 1952).

Partners in Flight (PIF) estimated land bird populations by physiographic region, bird conservation region (BCR), and state. They estimated the statewide population of bobwhite quail in PA in the spring of 2004 at 3,400 birds (Rich et al. 2004). In 2010, we may have a few isolated populations of northern bobwhites near the southern border of PA. Populations are much more fragmented and isolated. It is very difficult to estimate population densities because of the release of a large number of pen-reared quail annually in PA.

Breeding Bird Survey (BBS)

Several surveys provide long-term data on the trends in bobwhite quail populations on a regional and statewide basis. The BBS is a long-term, large-scale, international avian monitoring program initiated in 1966 to track the status and trends of North American bird populations. The USGS and the Canadian Wildlife Service coordinate the BBS program. Each year during the height of the avian breeding season (June for most of the U.S. and Canada), participants skilled in avian identification collect bird population data along roadside survey routes. More than 3,700 survey routes are located across the continental U.S. and Canada. Once analyzed, BBS data provide an index of population abundance that can be used to determine population trends and relative abundances at various geographic scales (Sauer et al. 1997).

We used breeding bird survey data from all routes in PA to estimate trends and relative abundance of breeding male northern bobwhites from 1966-2010. Northern bobwhite population trends declined by 10% per year from 1966 to 1980 and have been at all time low levels since 1990. Based on relative abundance, bobwhites have declined by 98% since 1966 and are essentially no longer a breeding species in much of PA. We do not know how many of these males seen or heard calling were stocked birds (Figure 4).

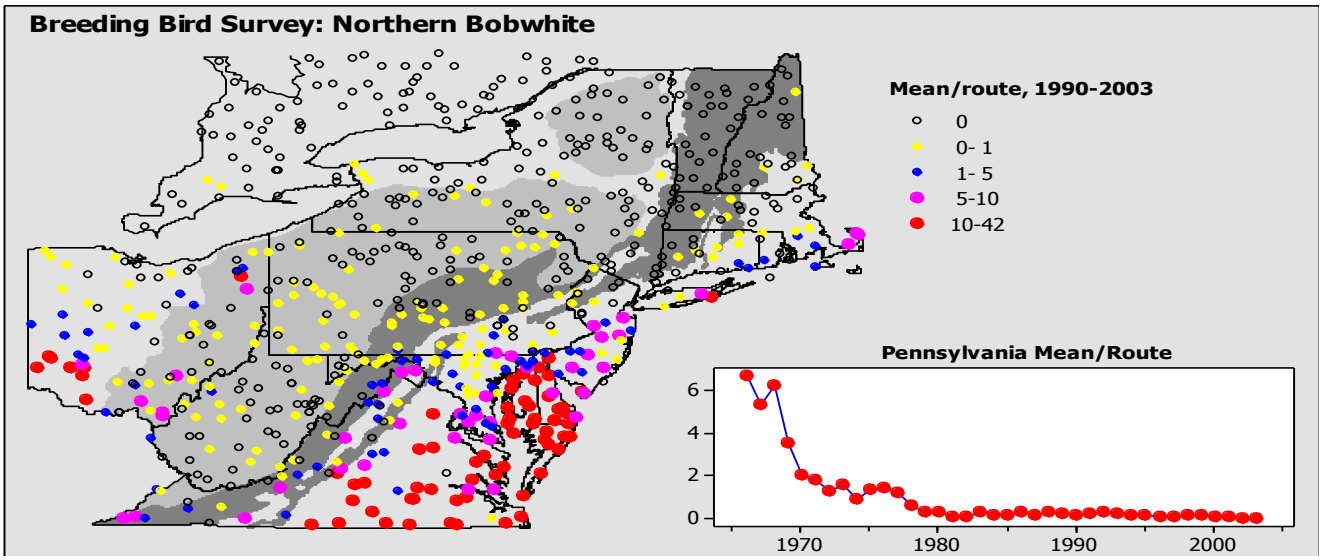

Figure 4. Trends in Northern Bobwhite abundance in the Mid-Atlantic based on Breeding Bird Survey data (1990-2003). (Prepared by Nick Bolgiano).

Christmas Bird Count (CBC)

The National Audubon Society Christmas Bird Count (CBC) is an early-winter survey of birds. The sample area for a count is a circle that is 15 miles in diameter. Varying numbers of volunteers count all birds they see in the circle during a single day within 2 weeks of 25 December (Butcher 1990). The number of circles and participants has changed dramatically since the early years. The number of birds counted is a function of effort, and analysis of change over time must incorporate some effort adjustment (Butcher and McCulloch 1990).

Bolgiano (1999) was the first to propose that CBC data could be used to evaluate the trends and relative abundance of northern bobwhite quail and pheasants in PA. Although the CBC has the disadvantage of being less standardized, he felt it was superior to BBS data because a complete database for PA exists for every year since 1900. He analyzed CBC data from 1920-1997 (we completed the analysis for 1997-2010) and corrected the data for effort based on birds/foot hour (Figure 5).

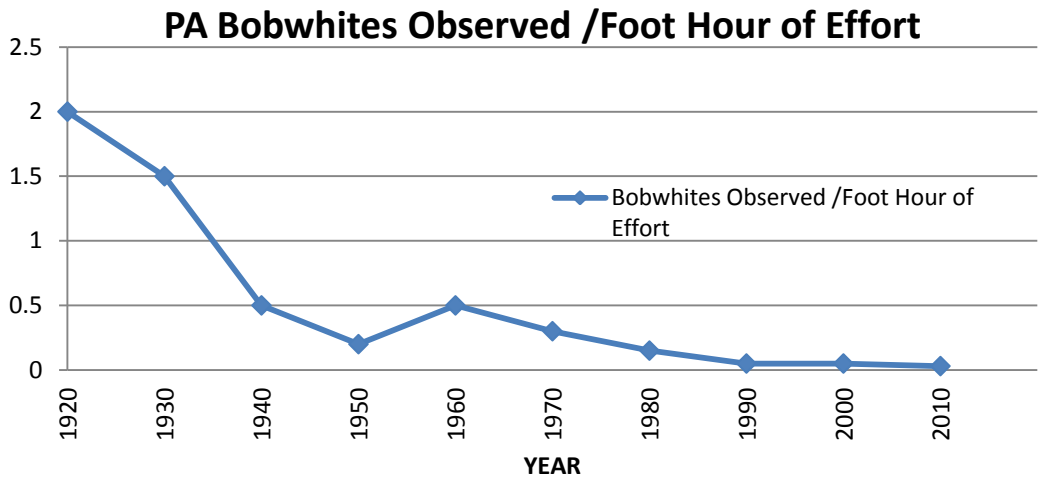

Figure 5. Number of bobwhites seen/party hour on CBC in PA from 1920 to 2010 from National Audubon Society 2010.

Bobwhites were most abundant in the 1920's. Populations declined through the 1950's and then made a recovery between 1958-1963. Based on CBC data, northern bobwhites have declined dramatically as a breeding species in PA.

PA Breeding Bird Atlas (PBBA)

Another source of data on breeding birds is the PA Breeding Bird Atlas (PBBA). Over 4,900 atlas blocks were surveyed for breeding birds from 1983-1989 (Brauning 1992). The second breeding bird atlas was completed from 2004-2008 (Mulvihill 2008).

We compared 1983-1989 and 2004-2008 PBBA data to determine the change in distribution of breeding bobwhites in the state (Figure 6). In 1983-1989 bobwhites were confirmed breeding in 87 blocks. In 2004-2008 they were confirmed breeding in just 18 blocks statewide.

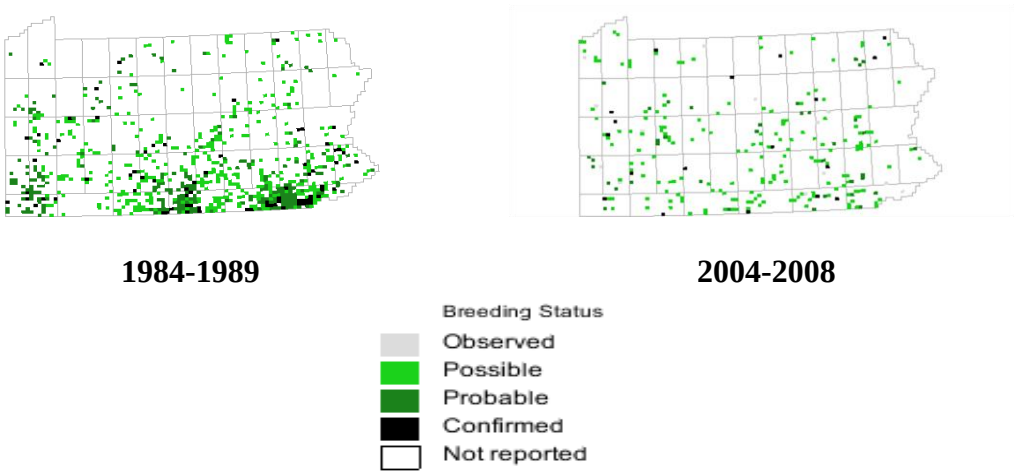

Figure 6. Breeding status of northern bobwhite quail in Pennsylvania 1984-1989 and 2004-2008. (Mulvihill 2008).).

PGC Bobwhite Quail Surveys

Recognizing that bobwhites were in steep declines, the PGC established bobwhite quail whistle count surveys in known habitats of wild bobwhites in southcentral PA in 1986.

Annual bobwhite call count surveys designed to measure northern bobwhite quail population trends in southeastern and southcentral Pennsylvania were conducted from June 1986-1994. Routes were selected on the basis of prior evidence of quail presence. Total calls and total individual males heard were recorded during three-minute intervals at 10 stops located one-half mile apart along 20 routes.

Trends in the number of bobwhites heard, number of calls heard, and the average number of calls per bird were evaluated using simple linear regression of pooled annual data. Slopes of the regression analysis were considered different from 0 if $P<0.05$. Bobwhite quail surveys were run for nine consecutive years. Bobwhites were heard on only one of the 20 routes during the last survey year (1994). Prior to 1994, birds were typically heard along three to eight routes. Although call counts are not available for any of the routes prior to 1986, the absence of quail on all but one route indicates a decrease in occupied range within the state. Extreme cold temperatures and snow cover during the 1994 winter may have had a significant impact on bobwhite survival statewide. However, it is difficult to determine whether these unusual weather conditions in 1994 were directly responsible for the low number of calling males heard.

No quail were heard during the nine years of call counts along six survey routes. Also, after 1991, no birds were heard on ten additional routes. Only four routes with calling males were heard over the final three years (1992-1994) of the study. Quail were recorded consistently for all nine years of the survey on only the Airville route.

The trend in the annual number of bobwhite calls heard decreased ($P=0.007$; $Y=94.55-0.03X$; $R^2=0.67$) over the nine-year survey period. This downward trend closely paralleled the trend

in the number of survey routes on which calling males were heard. Although these indices are dependent, they suggest a reduction in bobwhite range and probable population decline.

The lack of quail in formerly-occupied areas indicates probable extirpation from these areas and continual disappearance from some areas where they were found in the late 1980's.

Declining trends in the number of calls heard and number of survey routes with calling males indicate a reduction in population density and range in Pennsylvania during the survey period. It was recommended that the PGC develop a comprehensive statewide management plan and an updated research prospectus on bobwhite quail status and management (Hardisky 1996).

Population Status Summary

Recent breeding bird atlas data suggests that while very limited in abundance and locations, breeding bobwhites still exist in the state. Confounding determination of presence of wild bobwhites is the release of 60,000 pen-reared northern bobwhite annually by game bird breeders, sportsmen's clubs and private individuals.

Northern bobwhites were once native to all counties in the Commonwealth; however, since at least 1960, they have been restricted to the lower 1/3 of the state. Suitable habitat may exist, but because bobwhites are resident birds with very small home ranges, and the nearest populations are on the eastern shore of Maryland, a relocation effort would be needed to establish breeding populations in suitable habitat. Loss of idle weedy grasslands/legume fields, woody/brushy hedge rows and the close interspersion of these habitats along with advancing forest succession and suburban sprawl have greatly reduced bobwhite numbers in PA. Increased stocking of pen-reared bobwhites probably reduced genetic diversity. Significant improvements in habitat and increased genetic diversity will be necessary to restore wild northern bobwhites to parts of their historic range in PA.

We agree with Bolgiano (1999) that without the USDA Soil Bank and possibly the Feed Grain and Wheat set aside programs from 1956-1974, northern bobwhites would have declined much sooner in PA.

Because bobwhites have a small home range, we hypothesize that we may be able to maintain viable populations of bobwhites on small landscapes. We recommend working with public landowners to identify farmland properties to test whether or not we can restore northern bobwhite populations with intensive management.

We recommend that BBS and CREP surveys continue to be used to monitor the trends in breeding bobwhite populations on a regional and statewide basis. CBC should be used to monitor trends in winter bobwhite population trends. These data may be biased because of the release of pen-raised bobwhites. However, the survivorship of pen-raised bobwhites is low and likely has little influence on long-term population trends. The CBC data needs to be adjusted for effort and is more likely to be influenced by the release of pen-raised bobwhites. The CREP surveys are conducted during the peak of bobwhite breeding and are stratified to farmland ecosystems. They will probably provide the best data on actual bobwhite breeding numbers on a regional scale.

In addition, we recommend that intensive surveys be conducted during the breeding season based on the PA Breeding Bird Atlas data. Areas that reported breeding bobwhites between 2004-2009 should be intensively surveyed. Bobwhites should be captured and genetic DNA analysis conducted to compare them to local pen-raised bobwhites and wild bobwhites from other surrounding states and historical specimens.

SECTION V. HABITAT TRENDS

Farmland Habitat Trends

In PA, northern bobwhites are closely tied to farmland ecosystems. Changes in farming and USDA programs have greatly influenced bobwhite populations throughout their range. In PA, wild bobwhite populations have been and are dependent on suitable farmland habitats.

Farmland habitat has changed dramatically over the past 40 years in PA. These changes have had negative impacts on bobwhites and other grassland bird populations. Loss of farmland to development, conversion to forest and intensification of land use on remaining agricultural lands have been linked to declines of bobwhite, pheasant and other grassland birds in the northeast (Staback and Klinger 1998). In 1964 over 4,100,000 acres of farmland was present in 22 southcentral and southeast counties (Adams, Berks, Bucks, Chester, Columbia, Cumberland, Dauphin, Delaware, Franklin, Juniata, Lancaster, Lebanon, Lehigh, Montgomery, Montour, Northampton, Northumberland, Perry, Schuylkill, Snyder, Union, and York) in PA (U.S. Bureau of Census 1967). By 1992 this acreage had been reduced to 2,889,000 acres. The loss of farmland acres was greatest from 1964-1974. Since 1992, the rate of loss has slowed and the number of farmland acres in the heart of bobwhite range is 3,040,000 (USDA 2004, Figure 7). The Census of Agriculture began using a new method in 1997 to classify farms. The North American Industrial Classification System (NAICS) replaced the Standard Industrial Classification (SIC). As a result, direct comparisons of data from 1997 and 2002 to previous years may be biased.

In addition, changes in crops planted and the methods and timing of crop harvesting have been devastating to bobwhites in PA. During the past 25 years alfalfa hay has increased by 45% while other hays have declined by 17% (U.S. Bureau of the Census 1984 and USDA 2004). The goal has been to produce more hay per acre and of higher quality. Bigger and faster mowing machines have replaced the sickle bar mower and hay rake to improve efficiency and cut hay fields much closer to the ground. The peak of hay cutting has shifted to earlier and more frequent cutting of hay fields. In 1950, the mean first cutting date for timothy and clover hay was July 5. By 1970 these same hayfields were being harvested on June 15 and by 1990 the first cutting of timothy and clover was June 5 (USDA 1997). The peak hatching period for bobwhites is June 25-July 15.

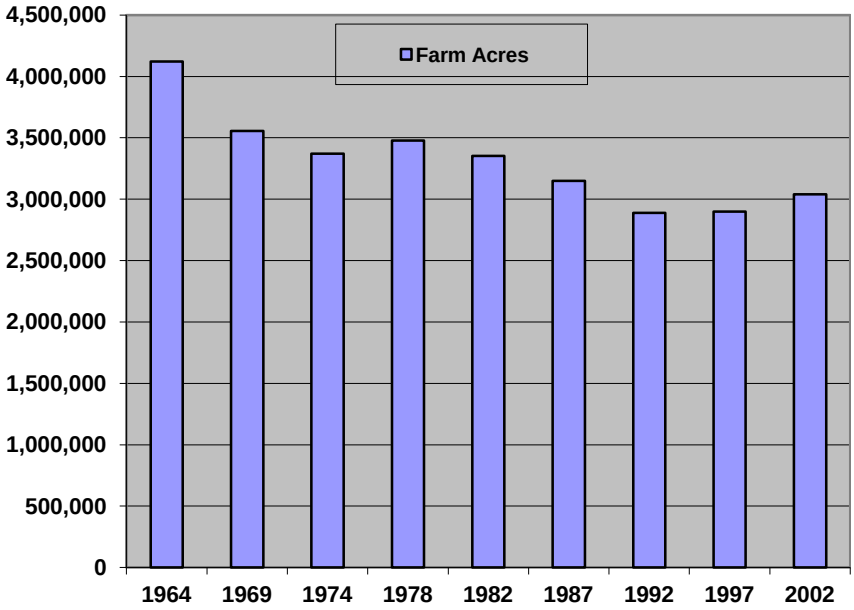

Figure 7. Change in farmland acres in primary bobwhite range, 1964-2002, PA (U.S. Bureau of the Census 1967, 1972A, 1977, 1981, 1984, 1989, 1994; USDA 1999, 2004).

Despite the fact that corn acreage has actually increased over the past 30 years, these cornfields are much different than 30 years ago. Unlike cornfields in the 1960's, with many weeds and stubble left standing following harvest, today's cornfields are virtually weed-free and little stubble is left after harvest. As a result, winter food and cover is reduced. Increased use of pesticides and herbicides have increased corn yields, but at a very high price to farmland wildlife. Prior to 1960, practically no soybeans were planted in PA. Today, nearly 400,000 acres are in soybeans as farmers turn to high value soybeans to supplement farm income (USDA 2004). Soybean fields, after harvest, provide very little winter cover for any wildlife. These changes in agricultural practices have increased per acre crop yields and farm income. Farmers continue to find ways to more intensively squeeze the maximum production from the land leaving little room for northern bobwhites, pheasants and other farmland wildlife.

Corn, soybeans and wheat prices are at all time highs (USA Today 2011). While this is good for grain farmers, it creates higher feed costs for dairy cows, hogs and chickens. Because of these high prices, farmers may put more land in production. Hay may be eliminated in crop rotations. The use of pesticides and herbicides will increase. It is likely that these trends in agriculture will continue and will have a negative impact on farmland wildlife, soil erosion and water quality.

USDA Program Trends

The final blow for the rapid decline of bobwhites in PA beginning in the late 1960's and early 1970's, was the loss of USDA set aside acres. Between 1961 and 1973, over 295,000 acres of idle fields were set aside in the 23 southern tier counties (USDA PA ASCS 1956-1977). This amounted to 7-10% of the cropland in these counties (Figure 8).

The USDA Soil Bank Conservation Reserve (CR) program from 1956-1961 paid farmers an annual rental payment to take cropland out of production and place it in a conservation cover, such as grasses and legumes. In PA, that usually meant timothy and red clover – or simply leaving the previous crop unharvested—creating ideal brood and nesting cover for bobwhites. The idle acres could not be mowed in the nesting season and land had to be placed in the program for 3, 5 or 10 years. On average, 100,000 acres was idled under the Soil Bank CR program between 1960 and 1969. Approximately 8% of farm landowners participated in the program (USDA PA ASCS 1956-1977).

In addition, the Soil Bank program had an Acreage Reserve program (AR) from 1956-1958. The AR was an annual set aside program and paid farmers to reduce production of corn and wheat by placing a percentage of their corn and wheat base acres on the farm into a conservation use. In Pennsylvania, most farmers diverted hay fields or simply left the crop in the field unharvested. Under the CR and AR, no crop could be harvested from the diverted acres nor could the lands be grazed. AR acres could be plowed and planted the following spring and other acres diverted. AR acres peaked in 1958 at 84,135 acres on 5,327 farms (15% of eligible farms) in southcentral PA (USDA PA ASCS 1956-1977).

The Food and Agricultural Act of 1965 authorized the Cropland Adjustment Program (CAP). Under this USDA program, farmers were paid to shift cropland into 5 to 10 year conservation, recreation or open space uses. Payment rates were determined based on the crop diverted and the production of that crop on the farm. Additional payments were made to farmers that agreed to open their land to public hunting, trapping, fishing and hiking. Between 1966 and 1976, farmers diverted 41,237 acres (1967) to a low of 7,700 acres in 1975. At its peak, CAP enrolled 1,082 farms (4% of eligible farms) in PA southern tier counties (USDA PA ASCS 1956-1977).

The acreage in the Soil Bank and CAP would be surpassed by another USDA program introduced in 1961 - the Feed Grain and Wheat price support programs. Under these programs, farmers were paid a rental for diverted acres of cropland placed in a conservation cover. They were required to place a certain percentage of their crop acreage in conservation cover in order to be eligible for price supports for corn, wheat, soybeans, and barley. These diverted acres amounted to about 20% of participating farmers' total cropland acres. Between 21-54% of eligible farmers participated annually in the Feed Grain and Wheat programs. Acres diverted to a conserving use between 1961 and 1973 reached a peak in 1970 at 246,231 acres. The low year was 1973 with 50,366 acres enrolled (USDA PA ASCS 1956-1977). Farmers diverted existing hayfields annually from production or left previous year's crop residue in the field. These diverted acres could not be harvested or mowed during the nesting season, except for weed control. A recent evaluation of the Soil Bank and Feed Grain programs in PA's southern counties showed that secure nesting and brood cover declined by over 86% between 1966 and 1992 (Klinger and Hardisky 1998).

Between 1962-1997, USDA set-aside program acres declined by 250,000 acres in 23 southern and central PA counties. As a result, undisturbed idle/grassland/annual weed nesting cover has become an endangered habitat (Figure 8). Although the annual set aside programs may have provided some secure nesting cover for bobwhites, we believe the annual set aside was

much more valuable to pheasants. The Soil Bank and other 3-5-10 year land idle programs were probably much more beneficial to bobwhites. This was particularly true for fields that had a lot of annual and perennial weeds for 3-5 years following cropland.

Since 1974, habitat trends on farmland in PA have not been favorable for bobwhites or pheasants. In 1974, the new U.S. Secretary of Agriculture announced the elimination of all set-aside programs (USDA PA ASCS 1956-1977). Instead, farmers would be paid to drain wetlands, pull out hedgerows and bring more acres into production. From 1976-1985 various annual set aside acres programs would be implemented in order to affect total grain production and prices. None of these would require establishment of secure nesting cover on diverted acres. In fact, farmers were required to keep weeds under control by multiple mowings or herbicide treatments.

The 1985 Farm Bill established the Conservation Reserve Program (CRP), a long term (10-15 years) set-aside program required to place cropland in soil conserving use. By 1992, over 35 million acres were enrolled nationwide and over 100,000 acres in PA. Few acres were enrolled in PA's southern and southeastern counties - prime bobwhite range (28,000 acres were idled under CRP and 50% of this acreage was in just 3 counties (USDA FSA 1993)). Although participants were not permitted to mow CRP fields during the nesting season, many landowners did.

The 1997 Farm Bill established wildlife conservation as a coequal objective with soil and water conservation under the CRP. It also authorized the Conservation Reserve Enhancement Program (CREP). Although it kept price support payments for farmers, it required no diversion of cropland to receive those annual payments. Since 1997, no annual set aside of cropland has been required to participate in USDA programs. The CRP was capped at 39.2 million acres nationwide.

In 1998, less than 1% of PA's cropland was in CRP. In Iowa, South Dakota and Montana >10% of cropland was enrolled in CRP. The great benefits of CRP in these states have not been realized in PA because most farmers will not participate due to very low rental rates offered. While rental rates in Iowa average $112.00/acre, a dairy farmer can expect to get only $45.00/acre in PA. Soil rental rates offered by USDA simply do not reflect land values in PA.

In March of 1998, the PGC prepared and presented to the USDA State Technical Committee a plan to restore farmland ecosystems. The proposal called for placing 325,000 acres in 41 PA counties in a grass/legume cover for 10-15 years and 25,000 acres in forested riparian buffers for 15 years (Klinger and Hardisky 1998). This program would form the basic foundation for the PA Conservation Reserve Enhancement Program (CREP) approved by Governor Ridge and U.S. Secretary of Agriculture Glickman in April 2000.

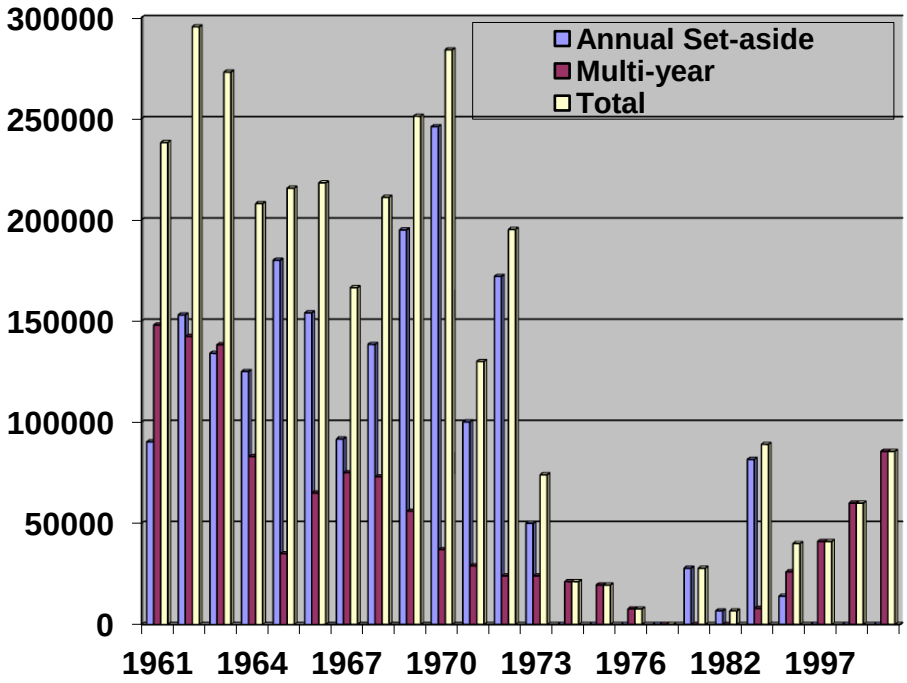

Figure 8. Changes in acres enrolled in conservation cover under the USDA Feed Grain and Wheat programs (Annual Set-Asides) and Soil Bank, CAP and CRP (Multi-year Set-Aside) in southern counties, PA 1961-2008 (USDA PA ASCS 1961-1977; U.S. Bureau of the Census 1981, 1984, 1989, 1994; USDA 1999, 2004; USDA FSA 2008).

Funded at $210 million, CREP targeted agricultural lands in 20 southern and central counties in the Chesapeake Bay Watershed. One of the objectives of PA CREP is to restore grassland habitats and declining grassland bird populations. In addition to much higher annual rental payments ($102 per acre) for 10-15 years, the USDA and the Commonwealth of PA provided 100% reimbursement for establishing conservation cover. The goal was to establish 100,000 acres of conservation cover (Klinger and Hardisky 1998). By the spring of 2005, over 100,000 acres were enrolled in the targeted counties and no further enrollment, except for forested riparian buffers, was permitted.

The PGC and USDA Natural Resources Conservation Service (NRCS) entered into a cooperative agreement in June 2000 to establish 10 wildlife biologist positions in the 20 PA CREP counties. In addition, the PGC established an outreach coordinator to educate and market the program to interested groups and private landowners. The PGC pheasant and quail research biologist devoted 100% of his time to CREP and USDA Farm Bill programs. NRCS staff provided technical assistance. All of these positions were critical in providing technical assistance to private landowners interested in CREP. PGC land managers and food and cover employees planted and coordinated planting of native warm season grasses. The PA Department of Environmental Protection (DEP) provided significant Growing Greener state funding to pay 50% of the costs to establish conservation practices. The USDA Farm Service Agency (FSA) committed over $150 million over 15 years to the program. PA FSA and its county offices administer the program.

In June of 2003, Governor Rendell and FSA signed an amendment to expand CREP by 100,000 acres and to target an additional 21 counties in the Chesapeake Bay Watershed. In October 2004, the Governor and FSA signed a new CREP agreement for the Ohio River Basin for 65,000 acres and 16 counties in western PA. FSA committed $400 million of new federal funding to PA over 15 years. PA has committed $100 million over 15 years. The state is required to submit annual reports to USDA and to monitor water quality and wildlife habitat and population responses to CREP (PACD 2001).

Not since the Soil Bank program of the 1960's have so many cropland acres been placed in long term set aside conservation cover. By March of 2008, 194,000 acres had been enrolled in PA CREP. In addition, 32,000 acres were enrolled in regular CRP. However, unlike the 1970's, the CREP acres, so far, are not well distributed in primary bobwhite quail counties (USDA FSA 2008, Figure 9).

It is very likely that CREP will be extended in the next Farm Bill because it is a very popular program. Unless we can double the current regular CRP rental payments, regular CRP is not an option for PA. As of March 2008, 85,517 acres of CRP were enrolled in 23 southern tier counties on 2,976 farms (13% of eligible farms , USDA FSA 2008).

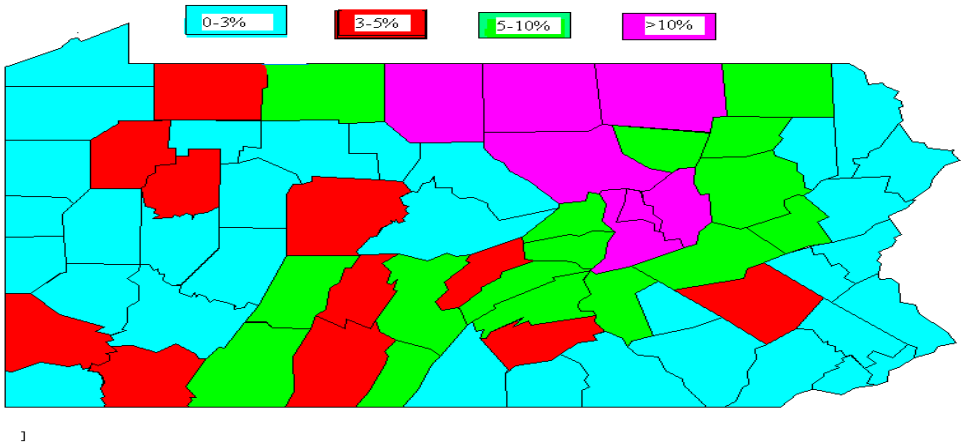

Figure 9. Percent of cropland enrolled in CRP in PA, 2008. (USDA FSA March 2008 CRP Report).

Wildlife managers in the Midwest are strong supporters of CRP (multi-year set-asides), but they oppose annual set-asides of cropland for conservation cover. However, annual or 2 year set asides, with the proper regulations, could be very beneficial to the recovery of northern bobwhite quail in the Northeast. They could also be very beneficial to farmers by helping to stabilize prices, return organic matter to the soil and sequester carbon.

Most recently, the PGC was awarded a USDA FSA grant of $1.5 million annually for two years in support of the PGC Public Access Program. The intent is to use some of this funding to target pheasant and northern bobwhite quail habitat recovery on private lands open to public hunting.

USDA programs have had and will continue to have a dramatic impact on farmers, farmland ecosystems and farmland wildlife. The 5-year Farm Bill, approved by the U.S. Congress, provides the federal funding and sets the direction for agricultural policy. Programs may or may not benefit wildlife. Careful monitoring and involvement by the PGC will be critical to ensure programs are beneficial to PA wildlife. Keeping CREP in the next Farm Bill and expanding CREP acres will be critical to restoring northern bobwhites in PA. Also, working closely with FSA and NRCS on other programs to establish farmland habitat will be necessary.

The PGC needs to provide technical and financial assistance to farmers to help them produce beneficial wildlife and not just more corn and soybeans. In the future, innovative programs will need to be implemented and farmers and hunters will need to reach common ground in order to restore northern bobwhites and other farmland wildlife. The alternative will be the continuing decline in farmland wildlife, hunters, and family farmers in PA.

Between 1964 and 1987, farmland habitat was converted to commercial and residential development at an alarming rate (U.S. Bureau of the Census 1967, 1989). Roads have expanded to support this development. Farmland habitats have become smaller and more isolated. Since 1990 the rate of farmland lost to development has been reduced by 80%. PA currently ranks 48th in population growth. Economic and political forces will drive the future loss of farmland.

SECTION VI. HUNTING

Seasons, Bag Limits and Hunting Areas

Beginning in 1915, daily, weekly and season bag limits were in place (8, 25 and 40, respectively) for quail in Pennsylvania, and the season was held from October 15 through November 30. By 1917 the season bag limit was lowered to 25 per season.

In 1928 the Commission shortened the season by only allowing quail hunting on Thursdays, Fridays, and Saturdays, but maintained the 8 per day and 25 per season bag limits. These bag limits remained the same until 1932 when the season total was dropped to 24 per season, and daily limit was lowered to 6 per day and the season was varied from between 12 days and 4 weeks. From 1936 to 1971 the season length, and daily and season bag limits varied between 2-4 weeks, 4-5 per day (always 4 after 1945), and 12-20 per season (always 20 after 1963); seasons ran from November 1 or the last Saturday in October to the Saturday after Thanksgiving.

In 1972 a possession limit of 8 was established and remained unchanged. The hunting season was reduced to 2 weeks in 1978-79, and 1 week in 1979 and 1980 seasons. The season was closed in 1981 and 1982. In 1983 the season was reopened in portions of PA, but remained closed in Adams, Chester, Cumberland, Dauphin, Delaware, Franklin, Fulton, Juniata, Lancaster, Lebanon, Perry, Snyder, and York Counties. For 1983 and 1984 the season was limited to 3 weeks, and was only open in 54 counties. The season was expanded to 4 weeks in 1985 through 1997, but remained closed in the previously mentioned counties. The season was expanded to 6 weeks in 1998, but was limited to 4 weeks in the following years, still in only 54 counties. In 2003 with the switch to Wildlife Management Units (WMUs) the season was closed in WMUs 4A, 4B, 5A, 5B, 5C, and 5D, and has remained that way through the 2009-2010 hunting season.

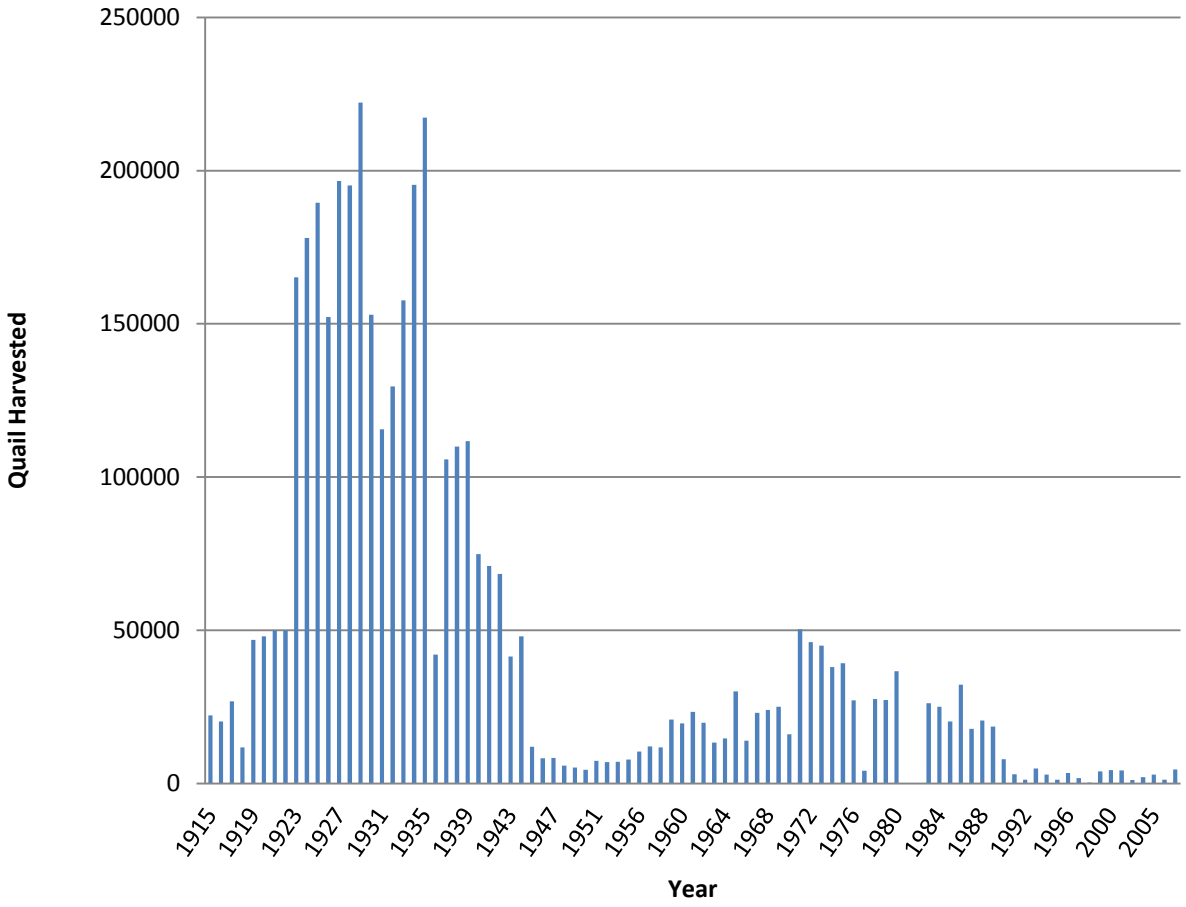

Figure 10. Quail harvest in PA 1915-2007 (PGC).

Harvests

The PGC has compiled quail harvest statistics since 1915 (Figure 10). Techniques have varied over time, from Game Protector estimates (1915-1936, and 1945-1964), to mandatory reporting (1937-1944), and a survey handed out to a sample of hunters by Game Protectors (1965-1970). The Game Take Survey, based on a random sample of license buyers, has been in place since 1971. Even procedures for this survey changed over time. However, consistent procedures have been in place since 1983. Beginning in 1990, the number of quail harvested does not include quail harvested on shooting preserves. Due to changes in techniques for estimating harvests, results may not be directly comparable across years. The number of quail hunters has been recorded since 1979 (Figure 11).

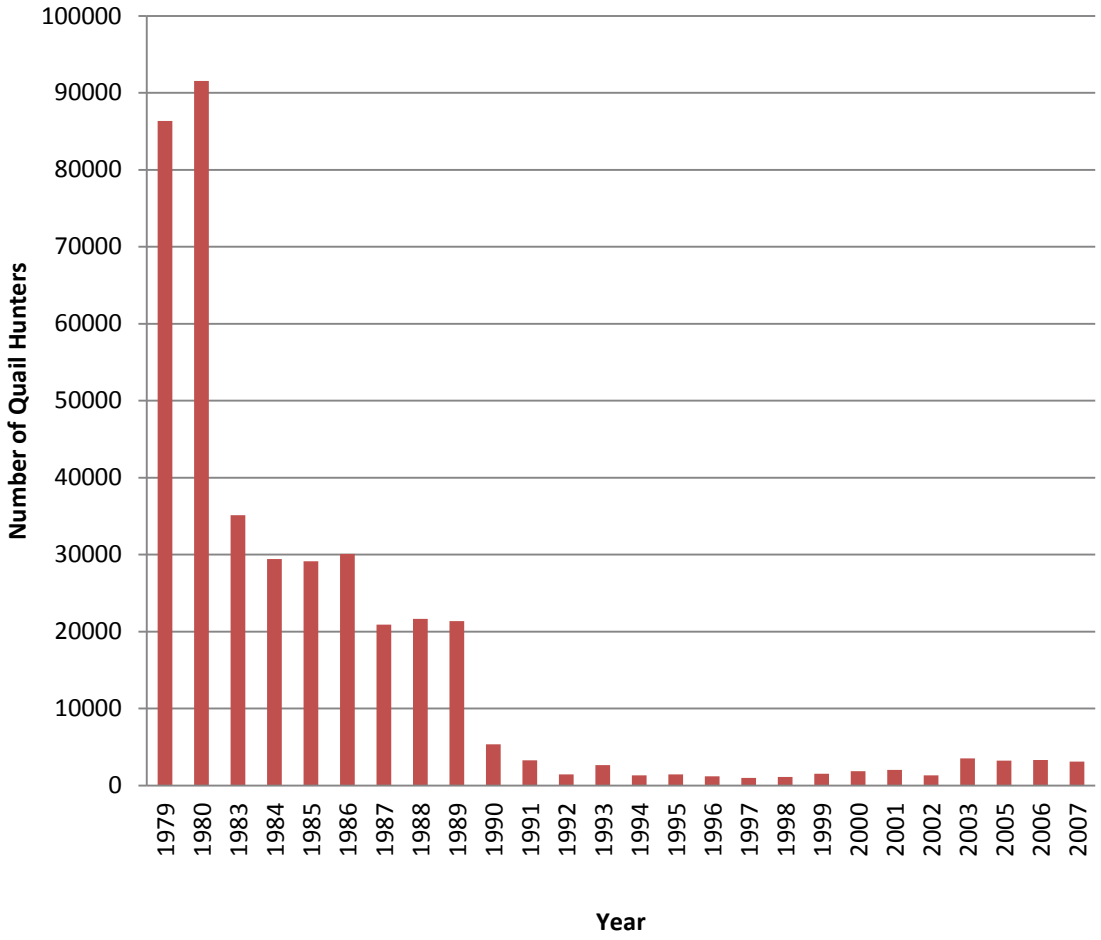

Figure 11. Number of quail hunters in PA, 1979-2007 (PGC Game Take Survey data; missing data 2004).

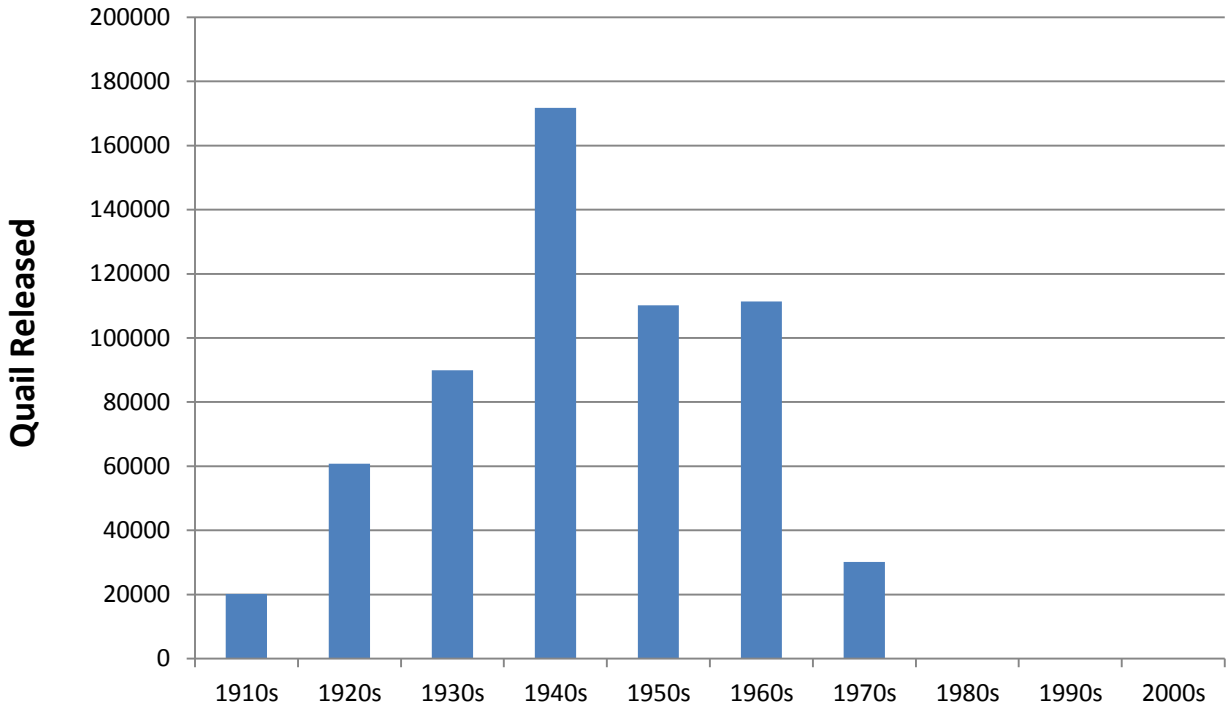

Figure 12. PGC quail releases by decade (The last year of quail release was 1982).

Bobwhite Quail Propagation

The PGC propagation of bobwhite quail to supplement wild populations began in 1910. By the 1940's, the Commission was raising and releasing 170,000 quail annually. By the mid 1970's the number had been reduced to 30,000 annually. The last year of quail releases was 1982 (Figure 12).

Despite the large number of pen-reared bobwhites raised and released, the northern bobwhite harvest and populations continued to decline. Survival of pen-reared bobwhites is extremely poor. Although the PGC no longer releases bobwhites, sportsmen's clubs and private individuals annually release over 60,000 birds in the state (Dunn et al. 2008).

SECTION VII. RESTORATION

Increased Stocking

Northern bobwhite populations in PA reached a peak in the mid-1920's and declined following WWII and the mechanization of agriculture. Farm abandonment probably played a major role in improving habitat for bobwhites in the short term. However, forest succession and the intensification of agriculture would ensure that bobwhites would not reach those numbers again. Still, thanks to the USDA Soil Bank Program in the late 1950's and early 1960's, bobwhites made a comeback in the late 1960's and early 1970's.

Since the 1970's populations have been dramatically reduced and the range of the bobwhite is collapsing southward. The PGC dramatically increased stocking of pen-reared bobwhites through the early 1980's. This was probably very detrimental to existing small isolated populations of bobwhites left in the wild. The hard winters of 1978-79 were the final blow to the northern bobwhite in PA. By the mid-1980's the PGC recognized that pen-reared stock were not the answer to recovery of the northern bobwhite.

Past Trap and Transfer

Attempts were made to re-establish a population of wild quail on public hunting lands in Pennsylvania in 1986. Fifty-four wild bobwhite quail obtained from Maryland and Ohio in 1986 and 1987 were released on a quail habitat management area (QHMA) in compartment 2 of State Game Lands (SGL) 249, in Adams County (Shope 1993). They also released 40 quail obtained from Ohio in 1989 on a standard management area (SMA) in compartment 1 of SGL 249. From the year of the initial stockings on each area through July 1992, they attempted to locate individual calling male bobwhites during June and July within a 2.4 km (1.5 miles) radius of release sites. Hunters were also asked to report their quail flushes and hours hunted at QHMA on the first day of the regular small game seasons from 1986 to 1992. After 1989 no quail were ever found or heard again at SMA, but quail were located every year at QHMA. Although the number of individual calling males heard in the QHMA summer survey area decreased after 1989, the number of quail flushed/100 man-hours did not peak on QHMA until 1991. Survey data indicated that quail remained on QHMA 5 years following the last stocking. Probabilities of success for translocations based on Griffith et al.'s (1989) model suggest that habitat quality was probably the key reason for success at QHMA and failure at SMA. It was recommended that the quail habitat management plan at QHMA be continued and that additional testing of quail relocations and QHMA management practices be tried in other suitable areas.

Habitat Evaluation

We have not developed any habitat models to predict to the potential for areas of the state to support a viable bobwhite quail population.

The Northern Bobwhite Conservation Initiative (NBCI) is a multi-state effort to restore northern bobwhite populations throughout their range. PA is a member of this multi-state effort.

Working with the NBCI we used their methodology to make a first cut to select focus areas for bobwhite restoration.

Based on data from PA provided by the Tall Timbers Research Station, biologists and land managers interested in northern bobwhites met at the SW Regional Office of the PGC in July 2010 to evaluate and prioritize the potential areas for restoring northern bobwhites in PA. GIS data on major land-use cover types, percent farmland by county, CRP acres by county, human population density by county, and other geographic data were used to prioritize areas for northern bobwhite recovery efforts. Figure 13 identifies, by county, high and medium priority areas identified to focus recovery of northern bobwhites in PA.

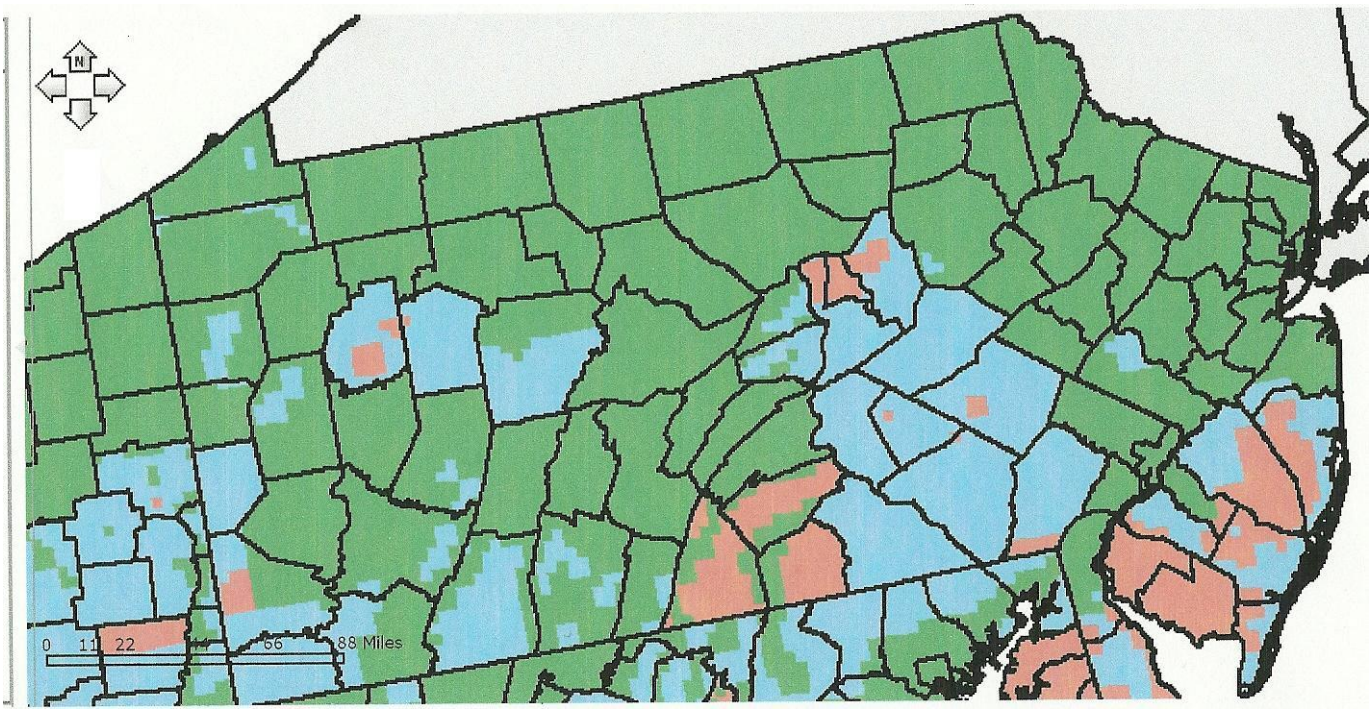

Figure 13. High (red) and Medium (blue) priority areas identified for Northern Bobwhite Recovery in PA. (The National Bobwhite Technical Committee. 2011).

However, this analysis did not take into account temperature and snowfall and it was conducted in one day. More detailed analysis will need to be conducted to develop models to identify potential Northern Bobwhite Quail Focus Areas (BQFAs) in PA.

Restoration Protocol

Development of standards for selecting potential restoration sites based on existing habitat, weather, and landscape features is critical to selecting areas feasible for bobwhite restoration attempts. Likewise, the use of standard population monitoring techniques and procedures is essential for valid comparison of restoration success among study areas. Multiple study areas will be necessary to evaluate whether or not we can restore viable northern bobwhite populations in the state.

Habitat Targets-Selection of Restoration Areas

Improving bobwhite habitat within these focus areas will be essential for restoring viable populations of bobwhites in PA. Based on habitat suitability models developed for the northern bobwhite, we will be able to evaluate each focus area and develop a management plan for each site. The importance of grasslands, croplands, early successional forest/shrublands, forest lands and weather will need to be evaluated and included in the model.We recommend concentrating efforts on a limited number of Bobwhite Quail Focus Areas (BQFAs) in high priority areas. Public lands that are or can be closed to hunting during the restoration period should be a high priority for these research study sites.

During this period, verification of breeding populations will be made at the sites identified in the PA Breeding Bird Atlas project and other known sites. Genetic evaluation of wild birds and pen-reared birds from cooperating bobwhite quail propagators will be completed during this period. This will be our best tool for determining if any wild populations still exist in PA and what subspecies they may be. After we have determined the current distribution of any wild populations of northern bobwhites in PA, we will recommend those areas to be closed for bobwhite quail hunting and those areas that should be open for put and take quail hunting.

Population Monitoring

The BBS, CREPS and CBC should be used to estimate population densities and trends in populations at the regional landscape level. In BQFAs we need to estimate local annual densities. To estimate densities, we will need information on spring breeding populations and sex ratios. We propose to obtain information on spring breeding male populations from bobwhite quail whistle counts and flushing surveys in February-March to count the number of coveys and size of coveys. Radio-telemetry should be conducted to determine survival of trans-located northern bobwhites and sex ratios should be determined through live-trapping on the BQFAs.

Research on translocation of wild-trapped northern bobwhite quail clearly has shown that pen-reared bobwhites have much lower survivorship and produce much smaller broods. Because wild populations are essentially gone, or have been genetically diluted by the heavy stocking of pen-reared quail over the past 20 years, the trap and transfer of wild bobwhites will be necessary in PA. BQFAs should be mapped and identified based on our knowledge of the life requirements of bobwhites. Populations need to be monitored and adaptive management used to change BQFAs. At this time, the number of wild bobwhite quail areas and the number of bobwhites they can produce is not known. However, through population modeling, we will be able to test many of our assumptions on bobwhite population dynamics. Northern bobwhites adapted to more northern climates should be used as a source for translocated birds, if possible. DNA analysis should be conducted on all released birds.

Captive Breeding Program

Because northern bobwhites are declining range wide, it may be difficult to obtain wild birds for the BQFAs. Captive breeding programs have been used successfully to restore

numerous endangered and threatened species populations. Captive breeding programs are not game farm operations with mass production facilities.

If we are unable to obtain a sufficient number of wild-trapped bobwhites, we propose to explore the feasibility of establishing a wild, captive-breeding flock of bobwhites for the purpose of providing wild bobwhite for reintroduction efforts. Because northern bobwhites have relatively small home ranges (5-20 acres), we might establish a breeding flock with suitable nesting and winter cover inside a predator-proof fence. Birds would be free to reproduce with little or no human disturbance. Juveniles would be trapped and released on BQFAs in the fall of each year.

Dog Training and Quail Hunting

Bobwhite quail hunting and the stocking of pen-reared bobwhite quail should be eliminated in WMUs where wild quail populations exist. Additionally, dog training for game birds (excluding waterfowl) should be restricted in BQFAs from the first Sunday in February through July 31. Once we have identified breeding populations and BQFAs, the remainder of the state may be open to quail hunting and the release of pen-reared bobwhites for sport hunting.

SECTION VIII. PARTNERSHIPS TO IMPROVE HABITAT

Partnerships

Restoring wild bobwhite populations will require cooperation and building partnerships. Several key NGOs have played a major role in trying to restore pheasants and quail in PA. Pheasants Forever/Quail Forever is dedicated to the conservation of pheasants, quail and other wildlife through habitat improvements, public awareness, education and land management policies and programs. There are more than 650 PF/QF chapters across the U.S. and Canada, accounting for 115,000 current members. PA has 16 active chapters. Since the first chapter formed in the mid-1980's, PF/QF chapters have spent $2,054,000 towards habitat and public awareness in PA. A total of 54,125 acres of habitat has been enhanced and/or protected since inception, including 29,167 acres of nesting cover, 21,300 acres of food plots, 2,023 acres of wetland restoration, 1,325 acres of woody/shrub cover, and 310 acres of land acquisition

The National Wild Turkey Federation (NWTF) has 75 chapters in PA and annually through its habitat programs improves thousands of acres of upland habitat. Ducks Unlimited works in the state to improve upland and wetland habitats. The PA Federation of Sportsman's Clubs (PFSC) was formed in 1932. Membership is made up of affiliated clubs and individual members. They currently represent approximately 95,000 members. The mission of PFSC is to provide a statewide, united voice for the concerns of all sportsmen and conservationists; to insure their rights and interests are protected, and to protect and enhance the environment and our natural resources. PFSC has over 300 affiliated local sportsman's clubs throughout the state. These clubs improve thousands of acres of habitat every year. Many other conservation and sportsman NGOs are interested in the future of pheasant hunting in PA. Developing and expanding partnerships with those interested in restoring bobwhites and farmland ecosystems must be a major emphasis in the future.

Because farmers own the majority of potential bobwhite habitat in the state, we need to work closely with partners such as the PA Farm Bureau, PA Farmers Union, Chesapeake Bay Foundation, The PA Association of Conservation Districts and other less traditional groups. Foundations, such as the Richard King Mellon Foundation, will need to be key funding partners. In addition, we need to work with many public and private landowners such as the National Park Service, Department of Veteran and Military Affairs, Department of the Army, State Parks, and municipalities and utility companies.

Although the PGC is the lead agency in restoring the native bobwhite quail in PA, other federal and state agencies and universities will be key partners in helping to restore bobwhites, and farmland ecosystems, including the PDA, DEP, DCNR, Fish and Boat Commission, State Conservation Commission, Center for Rural PA, The PA State University, and California University of PA. County Conservation Districts, county planners and township supervisors will need to be partners. For this plan to have any chance of succeeding in restoring wild northern bobwhites to PA, USDA, PA FSA and PA NRCS will need to be major partners. The USFWS Partners for Fish and Wildlife Program has provided technical assistance and funding to improve thousands of acres of wetlands and upland habitats. They will be important partners to ensure the success of this management plan.

Private Landowner Assistance

PA is blessed with many conservation partners. However, the future of bobwhites in PA will rest with the 80,000 private landowners that own over 95% of PA farmland. More and more private farmland landowners in PA are not farmers or are retiring from farming. Many care about wildlife. A strong PGC Private Landowner Assistance Program will be required to make progress in implementing this plan. The PGC may need to enhance its Private Lands Assistance Program. This program provides technical assistance in wildlife habitat and population management to private landowners. Additional private lands biologist positions may be needed in certain PGC regions. Farm Bill programs can put more habitat on private lands than any other programs. However, the limiting factor in PA has been adequate technical assistance. Without adequate technical staff to work with private landowners, restoring farmland ecosystems likely will not be possible. These biologists are critical for delivering CREP and other farm programs to private landowners.

USDA Programs

No programs can improve more farmland habitat than USDA programs administered by FSA and NRCS. However, the details of these programs determine whether they improve wildlife habitat or not. The PGC needs to be represented on the PA USDA State Technical Committee and AFWA Agriculture and Resident Game Bird Committees to influence national and state policies. The past three Farm Bills have shaped more conservation programs for a longer period of time, and put more funding behind those programs, than any other suite of legislation. The more than $5 billion the USDA spends on conservation each year is two-and-a-half times larger than the entire U.S. Fish and Wildlife Service budget. Several key programs can provide bobwhite habitat in PA.

Conservation Reserve Program (CRP)

CRP offers annual payments for 10-15 year contracts to participants who establish grass, shrub and tree cover on environmentally sensitive lands. Enrollment offers are ranked for selection using the Environmental Benefits Index (EBI), which weighs six environmental factors and cost.

CRP also includes CREP, Farmable Wetlands Program (FWP) and State Acres for Wildlife Enhancement (SAFE). FWP has not been very valuable in PA. But no program since the days of the Soil Bank has put more conservation cover on the ground in PA in the past 5 years than the PA CREP. CREP is similar to CRP, but signup is continuous and CREP rental rates are 2-3 times higher than CRP rental rates. So far, over 190,000 acres of CREP are under contract. The cap is 265,000 acres. CREP is our most important tool for getting secure nesting cover on cropland. Under SAFE, state and local agencies, non-profit organizations and other conservation partners determined geographic areas where enrollment of farmland in CRP would benefit threatened, endangered or other high priority species. Project partners then developed conservation proposals that included enrolling land in the designated geographic areas in CRP using existing CRP practices for the benefit of specific species of concern. Last year, USDA

accepted SAFE proposals developed by these organizations. FSA evaluated SAFE proposals to determine whether the selected practices would create the desired habitat. To be accepted by FSA, SAFE proposals had to be approved by qualified wildlife professionals and include a wildlife monitoring and evaluation plan. SAFE is a wildlife management tool that helps state and regional agencies, non-profit organizations and others to address local wildlife objectives through habitat restoration. SAFE is limited to 500,000 acres nationwide and is a continuous signup. Unfortunately for PA, regular CRP rental rates under this program are too low and landowners are not likely to participate. CP33-Field Borders for the NBCI, are directly targeted toward the recovery of northern bobwhites, unfortunately, because of the lack of technical assistance, and the very low rental rates offered, no acres have been enrolled in PA.

Wetlands Reserve Program (WRP)

WRP allows for the purchase of long-term or perpetual easements and cost-share to producers who agree to restore wetlands on agricultural land.

Wildlife Habitat Incentives Program (WHIP)

WHIP provides cost-share for projects developing or enhancing wildlife habitat through 5- and 10-year contracts.

Farmland Protection Program (FPP)

FPP provides funds to states, tribal or local governments and nonprofit organizations to help purchase development easements on productive farmland. Eligible lands include cropland, rangeland, grassland, pastureland and forestland.

Conservation Security Program (CSP)

The new CSP provides payments to producers for adopting various management, practices (vegetative and structural) that benefit a "resource of concern" such as soil, water and wildlife habitat. Both cropland and grazing lands are eligible.

Grassland Reserve Program (GRP)

GRP assists landowners through long-term contracts or easements in restoring and conserving grassland and native prairie.

Environmental Quality Incentives Program (EQIP)

EQIP provides technical assistance and cost-share payments to assist crop and livestock producers with environmental and conservation improvements. Wildlife habitat practices are specifically maintained as a purpose of the program.

3rd Party Technical Assistance (TA)

TA for program implementation is to come directly from individual program accounts. The Secretary of Agriculture is directed to develop and implement a system for approving third party providers, including nonprofit organizations.

The PGC needs to work with USDA FSA, DEP and the Governors Office to: 1) open the original 20 CREP counties to further CREP enrollment and to increase the CREP acres cap in PA from 265,000 to 350,000 acres; 2) raise annual rental payments for regular CRP and CREP to insure a minimum of 300,000 acres are enrolled by 2015; 3) work with USDA FSA to insure all CREP contracts can be automatically re-enrolled for another 15 years; and 4) enroll 200,000 acres in original CREP counties by 2015 (130,000 acres in cool season grass and legumes, 50,000 acres in native warm season grasses and forbs and 20,000 acres in riparian forest stream buffers). The PGC needs to work with USDA, AFWA, PF/QF, NWTF and other partners and our congressional delegation to develop a short term set aside program to reduce soil erosion, return organic matter to the soil, sequester carbon, reduce fertilizer inputs, improve water quality, improve wildlife habitat and improve net farm income. This program should be established as a USDA Farm Bill program by 2012. The PGC should evaluate other Farm Bill programs and determine their value to PA wildlife and changes that are needed to make them more responsive to wildlife.

USFWS Programs

Since 1987, the USFWS has administered the Partners for Fish and Wildlife program. The Partners program was established with a core group of biologists and a small budget for on-the-ground wetland restoration projects on private lands. This successful results-oriented program has garnered support through the years and has grown into a larger and more diversified habitat restoration program assisting thousands of private landowners across the nation. The Partners for Fish and Wildlife program in PA works with other partners to put thousands of acres of habitat on the ground.

The North American Wetlands Conservation Act established a grants program to improve upland and wetland habitats. It has been annually funded at $65 million, and the grants are administered by the USFWS through partnerships called Joint Ventures. PA is currently in the Atlantic Coast and Appalachian Mountains Joint Ventures. These federal funds could be used to improve grassland habitat in PA. Unfortunately, because of technical staffing limitations, the PGC has received very few of these grants because they have not developed the grant applications.

State Programs

Few state programs exist that provide financial incentives to directly improve wildlife habitat on private lands. Both the PGC and DEP have provided additional funding to CREP to be used for cost share or incentives for placing conservation practices on the land. Growing Greener funding has been used by County Conservation Districts primarily for water quality conservation practices. In some cases, these practices may indirectly improve habitat for wildlife.

The PGC does have a public and private landowner hunter access program. Cooperating farmers agree to open their land to public hunting and the Commission provides technical assistance in wildlife habitat management and game law enforcement. More information on this important program can be obtained from the PGC website (www.pgc.state.pa.us).

Recently, the USDA FSA awarded a 3-year grant to the PGC for improving its hunter access program efforts. The grant will provide $3 million in federal funds over a 3-year period.

The current level of technical and financial assistance on cooperative hunter access areas has not been sufficient to prevent rapid declines in farmland wildlife on these farms. The current program will not be adequate to restore northern bobwhites in PA. An enhanced Private Land Assistance Program to provide technical advice to private landowners and financial incentives may be required to meet the necessary habitat goals to restore farmland wildlife in PA. Landowners should be paid an annual incentive that will improve northern bobwhite and grassland bird habitat and still fit into their farming operations. Farmers and other landowners will need to be surveyed to determine what level of participation and incentives will be necessary for them to participate in programs to restore farmland wildlife habitat. Personal contacts with landowners within BQFAs by staff with biological knowledge of bobwhites, agriculture, and Farm Bill programs will be essential for the success of this plan. The PGC will need to find ways to provide financial incentives to farmers and other landowners to establish and maintain habitat.

SECTION IX. FUNDING THE PLAN

The restoration of northern bobwhite quail populations in PA will not be easy and will not happen quickly. The Plan does not seek to accomplish the restoration of huntable bobwhite quail populations across multiple counties. However, the long term goals for the northern bobwhite, beyond this Plan's horizon, should be to continue the focus on restoring farmland habitat for northern bobwhites not only in BQFAs, but in all counties identified as having potential to restore bobwhites and other grassland birds.

The estimated costs for research, monitoring, and translocation to support the recovery of northern bobwhites are $60,000 annually for each BQFA. The cost of habitat restoration within each BQFA is estimated to be $50,000 annually. The cost of habitat restoration in suitable habitat outside of BQFAs is estimated to be $1.5 million annually and will improve farmland habitat across 1 million acres.

The PGC will need funding support from many partners to support the Northern Bobwhite Quail Management Plan for PA.

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APPENDIX I. IMPLEMENTATION SCHEDULE

	By End of Year										
Objectives and Strategies	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Responsible Bureau or Region**
Objective 1.1: Determine the current distribution of breeding northern bobwhite populations in PA.											
Strategies:											
1.1.1 Review and analyze Breeding Bird Atlas data		●	●								**BWM**
1.1.2 Review and analyze Breeding Bird Survey data and Christmas Bird Count data.		●	●								**BWM**
1.1.3 Review existing citizen science information (e-Bird, PSO, PA Birds, etc.).		●	●	●							**BWM**
1.1.4 Survey quail hunters identified via the Game Take Survey to determine what quail they are hunting and where.		●	●	●							**BWM**
1.1.5 Survey (conduct breeding call counts) in all areas where existing data suggest wild breeding quail are present.		●	●	●	●	●	●	●	●	●	**BWM/REGIONS**
Objective 1.2: Determine where, when and how many propagated bobwhite quail are being released in the areas identified in Objective 1.1.											
Strategies:											
1.2.1 Identify all quail propagators in these areas.		●	●	●	●	●	●	●	●	●	**BWM/BWP/REGIONS**
1.2.2 Survey quail propagators/clients to determine numbers raised and released.		●	●	●	●	●	●	●			**BWM/BWP**
Objective 1.3: Determine whether areas with northern bobwhite quail on the landscape are "wild" quail or "propagated" quail.											
Strategies:											
1.3.1 Determine the genetics of our historical wild northern bobwhite quail using museum specimens.	●	●	●	●							**BWM**
1.3.2 Determine the genetics of PA propagated northern bobwhite quail in the vicinity of areas that appear to have existing quail populations.	●	●	●	●							**BWM**
1.3.3 Obtain samples of genetic material of wild northern bobwhite quail from adjoining states (Maryland, West Virginia, New Jersey, Delaware and Ohio) for comparison.	●	●	●	●							**BWM**
1.3.4 Sample northern bobwhite quail from areas in PA with "wild" quail and determine their genetic make-up; compare with quail from neighboring states and propagated birds.		●	●	●	●						**BWM**

Objectives and Strategies	By End of Year 2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Responsible Bureau or Region
Objective 1.4: Protect existing wild northern bobwhite quail populations from exploitation.											
Strategy:											
1.4.1 Establish seasons and bag limits and other regulations as necessary to conserve wild northern bobwhite quail.			●	●	●	●	●	●	●	●	**BWM/BWP**
Objective 2.1: Develop a northern bobwhite habitat model to identify occupied and potentially suitable habitats.											
Strategies:											
2.1.1 Review NBCI and other existing northern bobwhite models.	●	●	●								**BWM/BWHM**
2.1.2 Quantify habitat characteristics of where bobwhite quail currently exist in PA and adjoining states.		●	●								**BWM/BWHM**
2.1.3 Identify critical habitat and environmental factors that impact quail survival and sustainability.		●	●								**BWM/BWHM**
2.1.4 Develop a GIS-based PA northern bobwhite habitat model that accurately predicts occupied habitats and identifies potentially suitable habitats.		●	●								**BWM/BWHM**
Objective 2.2: Using the northern bobwhite model identify areas on the PA landscape that can or might support sustainable wild breeding northern bobwhite populations.											
Strategies:											
2.2.1 Based on ecological needs of quail and current population data, determine minimum area size for sustainable wild quail populations.	●	●									**BWM/BWHM**
2.2.2 Identify priority habitats that meet minimum area requirements (potential Bobwhite Quail Focus Areas (BQFAs)) on the PA landscape for maintaining and restoring wild, breeding quail populations.		●	●								**BWM/BWHM/REGIONS**
2.2.3 Prioritize BQFAs based on wild quail presence, current habitat suitability but devoid of wild quail, and potential for habitat enhancement to make them suitable for quail recovery.		●	●								**BWM/BWHM/REGIONS**

	By End of Year										
Objectives and Strategies	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Responsible Bureau or Region**
Objective 3.1: Develop or identify Best Management Practices for quail habitat.											
Strategies:											
3.1.1 Review literature to identify best habitat management practices to benefit quail nesting, brood rearing and winter cover.	●	●									**BWM/BWHM**
3.1.2 Select those practices that are applicable to PA ecosystems.		●	●								**BWM/BWHM**
3.1.3 Develop a PA Bobwhite Quail Habitat Manual.		●	●								**BWM/BWHM**
3.1.4 Provide training to PGC field employees, USDA employees, PF/QF, Audubon, PA Society of Ornithology, PA Bird Clubs and other partners on Farm Bill, state, and NGO habitat programs beneficial to bobwhite quail recovery.	●	●	●	●	●	●	●	●	●	●	**BWHM/REGIONS/BWM**
Objective 3.2: Initiate quail habitat enhancement projects on priority BQFAs utilizing BMPs.											
Strategies:											
3.2.1 Notify landowners and potential partners in the BQFA about the initiative, and conduct local workshops informing them of bobwhite quail habitat needs and requirements for population recovery.		●	●	●	●	●	●				**BIE/BWHM/BWM**
3.2.2 Within each BQFA, working with landowners and partners, establish the landuses/habitat types in the ratios specified in the Bobwhite Quail Habitat Manual.		●	●	●	●	●	●				**BWHM/REGIONS**
3.2.3 Work with USDA, PF/QF, public access cooperators and other partners to enroll BQFAs acres in Farm Bill programs and other federal and state habitat conservation programs (e.g., target CREP acres (native grasses and forbs, and field borders)) to provide needed bobwhite quail breeding, brood rearing, and winter cover requirements identified in the Bobwhite Quail Habitat Manual.		●	●	●	●	●	●				**BWHM/REGIONS**
3.2.4 Annually monitor and quantify BQFA habitat and the changes that are occurring.		●	●	●	●	●	●	●			**BWM/BWHM**

Objectives and Strategies	By End of Year 2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Responsible Bureau or Region
Objective 4.1: Monitor bobwhite quail populations on BQFAs.											
Strategies:											
4.1.1 Identify protocols for annually assessing population levels/trends and demographics of bobwhite quail on BQFAs	●	●									**BWM**
4.1.2 Implement annual surveys to assess bobwhite quail presence, population levels, and demographics.		●	●	●	●	●	●				**BWM**
Objective 4.2: Establish self-sustaining populations of wild northern bobwhite quail on BQFAs.											
Strategies:											
4.2.1 Establish and implement criteria and protocols for wild northern bobwhite quail acquisitions and releases on BQFAs.	●	●									**BWM**
4.2.2 Identify and contact states and partners to obtain via multi-year agreements wild northern bobwhite quail for release on PA BQFAs.	●	●	●	●	●						**BWM**
4.2.3 Implement standard protocols for monitoring the survival, dispersal, population levels and demographics of wild bobwhite quail released on BQFAs.		●	●	●	●	●	●				**BWM**
4.2.4 By regulation close all bobwhite quail hunting on BQFA, allow no pen-reared bobwhite releases, and prohibit dog training for game birds within the BQFA according to criteria and protocols in Strategy 4.2.1.				●	●	●	●				**BWM/BWP**
4.2.5 Release wild bobwhites according to criteria and protocols in Strategy 4.2.1.				●	●	●					**BWM**
4.2.6 If wild bobwhite quail are not available in the numbers needed to establish a founding population, investigate the feasibility of using wild quail to develop a wild captive breeding program for northern bobwhite quail recovery.			●	●	●	●					**BWM**

	By End of Year										
Objectives and Strategies	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Responsible Bureau or Region**
Objective 5.1: Conduct surveys targeted to appropriate stakeholder groups.											
Strategies:											
5.1.1 Develop and conduct a survey to determine baseline attitudes, preferences and support for wild quail recovery in PA.		●									**BWM/BIE**
5.1.2 Develop and conduct follow-up surveys every 5 years to obtain information and feedback on public attitudes, preferences and support for bobwhite quail recovery.							●				**BWM/BIE**
5.1.3 Survey PGC Public Access Cooperators and CREP landowners every 5 years to determine their knowledge of and interest in PA bobwhite recovery efforts and the incentives required for participation in a wildlife habitat improvement program.		●					●				**BWM/BIE/BWHM**
Objective 5.2: Inform the public about northern bobwhite quail recovery activities.											
Strategies:											
5.2.1 Use all forms of media to educate the public on the PGC Northern Bobwhite Quail Management Plan.	●	●	●	●	●	●	●	●	●	●	**BIE/REGIONS**
5.2.2 Annually report research findings and conclusions, population trends and program results to the public through various media.	●	●	●	●	●	●	●	●	●	●	**BWM**

By End of Year											
Objectives and Strategies	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Responsible Bureau or Region**
Objective 6.1: Establish formal partnerships with federal, state and nongovernmental organizations to facilitate establishing and enhancing sufficient habitat across PA that would support huntable wild bobwhite quail populations.											
Strategies:											
6.1.1 Establish agreements between PF/QF, USDA, the USFWS Partners for Fish and Wildlife and other programs that restore at a landscape scale habitats benefitting bobwhite quail.							●	●	●	●	**BWHM/BWM**
6.1.2 Coordinate with the PDA, PA Farm Bureau, and other farm organizations to incorporate bobwhite quail habitat management into technical and financial assistance farm programs.							●	●	●	●	**BWHM**
6.1.3 Coordinate individual, government and NGO efforts to improve bobwhite quail habitat. Integrate bobwhite quail recovery efforts with other habitat enhancement and conservation programs, such as EPA Stream Bank Fencing program, Chesapeake Bay Program, and the DCNR Riparian Buffer Initiative.							●	●	●	●	**BWHM/REGIONS/BWM**
6.1.4 Collaborate with state and federal agencies, legislature, counties, townships, and NGOs on planning, zoning, tax incentives, and easements to improve bobwhite quail habitat.							●	●	●	●	**BWHM/REGIONS/BWM**

	By End of Year										
Objectives and Strategies	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Responsible Bureau or Region**
Objective 6.2: Collaborate with regional and national northern bobwhite quail recovery program initiatives to capitalize on expertise outside the state and influence national and regional funding that will support large scale habitat restoration work on farm landscapes in PA.											
Strategies:											
6.2.1 Support the National Bobwhite Conservation Initiative by serving on technical and steering committees.	●	●	●	●	●	●	●	●	●	●	**BWM**
6.2.2 Serve on pertinent Association of Fish and Wildlife Agencies (AFWA) committees that are addressing quail and quail habitat restoration (Bird Conservation Committee, Resident Game Bird Working Group, and Agricultural Conservation Committee).	●	●	●	●	●	●	●	●	●	●	**BWM/BWHM**
6.2.3 Serve as a member of the Northeast Upland Game Bird Technical Committee and the Northeast Habitat Technical Committee.	●	●	●	●	●	●	●	●	●	●	**BWM/BWHM**
6.2.4 Participate in other bird and wildlife conservation initiatives (e.g., Joint Ventures, Landscape Conservation Cooperatives).											**BWM**
Objective 6.3: Seek additional funding to implement the Northern Bobwhite Management Plan for PA.											
Strategies:											
6.3.2 Seek grants from Foundations, partners and other sources to support quail habitat restoration.		●	●	●	●	●	●	●	●	●	**BWM/BWHM**

APPENDIX II. SUMMARY OF PUBLIC COMMENTS

The draft PA Northern Bobwhite Quail Management Plan was made available for a 75-day public comment period from July 1 to September 15, 2011. A news release and posting on the Pennsylvania Game Commission's web page announced the public comment period. The document was available electronically through the Game Commission's web page, or in printed format by request. The news release was widely published throughout the Commonwealth. Comments could be submitted via the web page, through e-mail, or in writing to the agency's Harrisburg office.

We received 54 correspondences from individuals, Pheasants Forever, the PA Audubon Society, PA Society of Ornithology, and the United States Department of Agriculture. Duplicate correspondences were excluded. Most correspondences contained more than one comment. We received 122 total comments, which we narrowed down to 63 distinct comments (some specific comments were repeated by multiple respondents). These comments were grouped by the following categories: Support the Bobwhite Plan, Do Not Support the Bobwhite Plan, Predators, Habitat, Funding the Plan, Hunting and Stocking Pen-reared Quail, and Specific Comments on the Plan Goals and Objectives.

We received 50 comments in support of implementing the PA Northern Bobwhite Management Plan, and 4 opposed. Opponents expressed a perception that restoration of bobwhite quail is not feasible given habitat conditions and resource constraints. Many of those supporting the plan also recognized that successful implementation will be a daunting challenge, but indicated they believe that attempting to restore a native species that can provide recreational benefits to a broad constituency of Pennsylvanians is worth the effort.

Predators were a major issue identified in 10 comments. Most comments on this theme focused on the need for some type of predator control program. We recognize that predation may be a factor in recovery of wild northern bobwhite quail populations. However, we do not have information on predator population densities and predator-prey relationships are very complex. We have chosen to focus on habitat restoration, which has proven to be successful in restoring declining wildlife populations. We concur that research to determine the impact of predators on bobwhite populations in BQFAs should be part of our monitoring efforts.

Twenty-eight comments were received on habitat. Many of these comments recognized the need to give landowners incentives to provide bobwhite quail habitat on private lands. Prescribed burning was mentioned as an important management tool to manage grassland habitats, and the need to create early-successional shrubland habitats was emphasized. CREP was specifically mentioned as a major tool in the tool box to restore both bobwhite and pheasant habitat and it was suggested that CREP should be one of the PGC's highest priorities. Private lands technical assistance for landowners was recognized as an important program that needs to be expanded beyond the current PGC Wildlife Diversity Biologists. Both sportsmen's groups and birding organizations supported the concept of biologists dedicated to implementing USDA Farm Bill and PGC incentive programs. Without technical assistance at the county level, habitat restoration efforts will likely not succeed. Also, some comments focused on the need to use native vegetation in habitat programs. Several comments emphasized the need to focus habitat

efforts for bobwhites, grouse, woodcock and golden-winged warblers and other early-successional species in a larger effort to restore all species in a holistic approach to management. We concur that habitat will be the key to restoring northern bobwhite quail in PA and we also recognize that incentives for landowners - and adequate technical assistance to deliver these habitat programs - are key to restoring farmland ecosystems and the species that inhabit them.

We received 8 comments related to funding the Plan. Comments ranged from supporting a hunting license increase to support for a specific game bird stamp for pheasant/quail hunting. Several comments supported a habitat stamp required of all hunters to support small game habitat restoration. One comment recommended a habitat stamp of $5-10 annually. Another commenter recommended closing the pheasant Game Farms and using the savings to fund small game recovery. We recognize that restoring northern bobwhite quail (and wild ring-necked pheasant) populations on farmland will require a substantial investment of funds for habitat restoration on a landscape scale. Hopefully, USDA Farm Bill programs can provide the majority of these funds, but additional state funding will also be necessary. Our best estimate for restoring pheasant and quail populations across remaining PA farmland is between $1.5 million and $2.0 million annually. The cost for testing if we can restore northern bobwhites in BQFAs is less, and is estimated to be $350,000 annually over a 6-year period.

We received 8 comments on stocking pen-reared quail and hunting quail. The PA Northern Bobwhite Quail Management Plan emphasis is on protecting existing remaining bobwhite quail and reintroducing wild bobwhite quail to suitable habitat, not on providing additional hunting recreation through a propagation program. The first 5 goals of the Plan are related to accomplishing wild bobwhite restoration in at least 4 BQFAs. Goal 6 calls for restoring huntable populations of bobwhites, assuming we are successful in the BQFAs. One comment we received recognized that releasing pen-reared quail does not work in establishing wild populations. We also have evidence that the release of pen-reared quail may have long-term negative impacts on wild populations. The majority of comments we received were in support of the Plan and the elimination of stocking pen-reared quail in BQFAs.

Finally, we received 14 comments on specific goals and objectives of the Plan. We received strong support for the science and monitoring efforts identified in the Plan from several groups. Specifically, completing the genetics study was deemed of critical importance to determine the best suited bobwhite subspecies for trap and transfer to PA. In addition, identifying remaining wild populations by following up on Breeding Bird Atlas data was strongly supported.

Others thought that while science is important, the bobwhite quail is one of the most studied game birds in North America, and we should rely on other studies and use experts from other states in our evaluations. Specifically mentioned was the Tall Timbers Research Station in Florida and Georgia. The thought was that this approach will permit us to implement the Plan in a more timely manner. We agree that consulting with other experts is important. The PGC is a member of the National Bobwhite Conservation Initiative; the Wildlife Management Bureau Director serves on the Board of Directors for this initiative. The agency's pheasant/quail biologist previously served as the Northeast Representative on the Steering Committee, and is now a member of the National Bobwhite Technical Committee. PA is included in the latest version of the National Northern Bobwhite Management Plan. PGC staff along with quail

experts from other agencies met with Tall Timbers Research Station staff to identify potential high priority areas for quail recovery at the PGC Southwest Regional Office in July 2010. Also, an expert team evaluated numerous sites for quail restoration in 2009. That report is available and was referenced in the Plan. We will continue this collaborative approach to bobwhite restoration. However, we emphasize that the monitoring and research identified in the PA Northern Bobwhite Quail Management Plan is not a duplication of studies already conducted. These studies will provide us with data that we currently lack, and that are necessary to effectively implement and evaluate the recovery of bobwhites in PA.

One group recommended the elimination of the objective to examine the feasibility of establishing a wild captive breeding program for wild northern bobwhites, if we find that northern bobwhites are not available from other states. The concern was that pen-reared bobwhites are not suitable for restoration efforts. We concur that pen-reared bobwhites should not be released in BQFAs. However, a wild captive breeding program is not equivalent to pen-rearing. Our rationale for including this objective was to investigate the possibility and costs of raising wild bobwhites in their natural habitat in an enclosed 50-60 acre site, at very low densities, and using the progeny for BQFAs. This would only be used as a last resort, should we not be able to obtain acceptable numbers of wild birds from acceptable states. It may be very difficult to gain approval from other states to obtain northern bobwhites in the future. The captive breeding program is an option we preferred to investigate and present to the Commission for review/approval, rather than eliminate prematurely from the Plan.

We received strong support for implementing the PA Northern Bobwhite Quail Management Plan from sportsmen and women, Pheasants Forever/Quail Forever, Audubon, birders, and the general public. Many comments provided helpful input that was incorporated into the supporting text of the final Plan. Other than these editorial revisions, however, public comments did not result in substantive changes to the Plan; the direction, goals, and objectives remain identical to those presented in the preliminary Plan.

We thank everyone that took the time to comment on the PA Bobwhite Quail Management Plan. The northern bobwhite has been in decline in PA for over 40 years. We are not going to turn this population around in 6 years, or even 10 years. This recovery effort will require a long-term commitment of resources and a lot of support and patience to be successful. Many wildlife species dependent upon farmland and early-successional habitats will benefit from the implementation of this plan. Working together, we have a chance to restore part of our wildlife heritage and leave a lasting legacy for future generations.

PUBLIC COMMENTS ON THE PA NORTHERN BOBWHITE QUAIL MANAGEMENT PLAN		
COMMENTS		**NUMBER**
SUPPORT THE BOBWHITE PLAN		**50**
1.	General support for plan / restoration of wild bobwhite quail.	37
2.	I am very excited that your game commission has come up with a plan.	1
3.	After reading through the plan, I entirely support the PGC continuing with developing and implementing the plan. As a PA hunter, I value and support establishing once native species.	1
4.	Please push forward with this project. I have seen first hand the wild pheasant recovery program can work.	1
5.	I applaud the start of your effort for the restoration of quail in PA. It's long overdue.	1
6.	Great idea gentlemen. I am in support of it. I commend you gentlemen for having the courage to give it a try. I am glad you were not afraid to take on such a big challenge.	1
7.	Great plan, long overdue, even if you never get the population large enough to hunt it is just great to have this bird back in Pennsylvania. Don't be afraid to ask for assistance from hunters for money and time.	1
8.	Awesome plan! I enjoyed the read very much.	1
9.	I support bringing wild bobwhite quail back to southwestern PA where they were once native.	1
10.	I am not a hunter so I don't know exactly what can be done but I am open to ANY suggestion. I miss the sound of the quail, and would love to hear them in their natural habitat again.	1
11.	I really appreciate the plan to study and establish wild bobwhite quail populations in PA. As both an avid hunter and birder, the plan appeals to me greatly. Keep up the good work.	1
12.	I applaud your efforts and concerns for the bobwhite quail. I would love to see them once again be present in Pennsylvania in a self sustaining, huntable population. With the current nationwide trend of bobwhite populations, I think it is an uphill battle. Is it worth it? Yes, as long as there is ground gained. I think that at some point the reality of success or failure needs to be realized and at that point a determination on whether or not to carry on with program.	1
13.	I think it is a wonderful idea. PA has become a national leader in innovation with the pheasant program and it will be great to see the same type of effort with the Quail. It is great to know that you folks are trying so hard to get them reestablished, you are to be commended. Keep up the great effort and thank you.	1
14.	We are very pleased that the Pennsylvania Game Commission is finally taking a serious look at restoring the northern bobwhite quail to suitable habitat in the state. We commend the Staff, the Executive Director and the Commissioners for making this program a priority. The authors of the plan are to be complimented for the thorough and detailed work that they have done. The plan is very comprehensive and ambitious.	1
DO NOT SUPPORT THE BOBWHITE PLAN		**4**
15.	General lack of support for plan / focusing PGC efforts on quail.	3
16.	Stop! Give Up! Do not waste any resources or money on a quail management plan that is going to fail. PA was never a great quail hunting state-- even back in the day (1960's). This is a classic example of an agency biting off more than it can chew. Put the money toward your pheasant restoration program and grouse habitat improvement programs.	1

PREDATORS		**10**
17.	General sentiment that predators / predation are a major influence on population trends and possibility of restoration success.	5
18.	I would add that I have several friends that live in Georgia that manage quail habitat and they tell me predator control is paramount to successful quail populations. Also, I am beginning to wonder about wild turkeys destroying habitat and eating young fledgling birds. We have a lot of turkeys!	1
19.	I had some pheasants hatch on my farm. The fact that they hatched is great but they have little cover available and many, many predators, most in the form of hawks. When I pulled into my driveway just yesterday, I scared away a Northern Harrier that was chasing down one of the two roosters that made it through winter. On any given day, I could point out at least 2 red-tailed hawks to you within 10 minutes of searching.	1
20.	If you wish to re-introduce quail to PA you MUST provide a safe area where they can covey, when predators come in the area. Quail seem to be good at hiding and freezing in place, but they are otherwise helpless. Flight does not help at night. If they are provided large wired cages with food (protected from the weather) and water, they can squeeze through to eat and drink, but predators cannot, they could survive. This structure would need to be covered on all sides, with a door to allow for feed and water to be provided. They would need to be kept in there when first introduced to the area (with a very small wire cover) for several weeks for them to know this is a safe place, and then the small wire removed and allow the larger wire to remain. Brush piles need to be scattered about the area for daytime protection from hawks. Cooperative farmers/sportsmen would be in charge of providing fresh food and water for them in the large cages. A planting of grains and seeds would be helpful. The properties would have to have water and mixed fields and forested areas. NO HAY could be harvested on the farms or in the area until late June or early July. If you do not take these precautions…DO NOT EVEN BOTHER TO SPEND ANY MONEY ON THE BOBWHITE. I promise you... they will not survive!	1
21.	It is my opinion that there is still extremely too many predators both on the ground and in the sky. I have seen an increase in predation on my hunting grounds with fishers, coyote, fox, hawks, owls, and bobcats. I and others believe that without some sort of control of the explosion of avian predators, i.e. hawks and owls, neither quail nor pheasants have a fighting chance to re-establish themselves. I own a small farm in Venango County. Each year we release both quail and pheasants to hunt and to watch. A number of them survive both our guns and the winters here, only to perish each spring when the hawks return and relentlessly pursue them. I see the same thing happening on State Game Lands #39 adjoining our property.	1
22.	No plan will work until the problem of predators and feral cats are addressed. We are overrun with foxes, skunks, opossums, coons, and hawks. No plan for any small game can have a chance of succeeding until these numbers are controlled. You guys keep blaming it on habitat. I live on the same farm I was born on. We have cover but no small game and yes we had quail when I was a kid. I want my grand kids to hunt, but hunt what? We are in a dream world thinking any program has a chance to succeed without predator control.	1
HABITAT		**28**
23.	General agreement that habitat is most important influence on population trends and possibility of restoration success.	14
24.	Yes, as a young hunter in Snyder Co. I was able to hunt them--However that was 45 years ago--I believe that the problem- with almost all small game hunting in PA - is the result of the loss of fence rows in farming. As well as the loss of the family farming model.	1

25.	Please push forward with this project. I have seen first hand the wild pheasant recovery program can work, but the key is a sufficient amount of acceptable habitat on the ground. I feel the pheasant recovery may be compromised if the amount of habitat is not expanded. Is there any way to promote more habitat on private land? Possibly a habitat stamp would help the matter.	1
26.	My grandmother, who owns the farm, leases the farming to our neighbors to pay the taxes on the land. They are very proficient in maximizing the potential of the available land. This is the only way farmers can survive today. The problem is they leave no cover and no food to help the wildlife avoid predators and get through the winter. So, how do we overcome the predators and modern farming practices to sustain quail and pheasants? No one in our family has extra money to pour into our land. Are there options available?	1
27.	One recommendation I would offer is that you look at the Middle Creek WMA as a prime location for some of your efforts. With over 5000 acres, it provides ample area for closely controlled propagation efforts. Only a small portion of the MCWMA is open to the public and even less is open to hunting of any type. It would be easy to convert some of the cornfields to crops of smaller grains more suitable to quail and to leave much of it standing over the winter months. Much of the habitat in the MCWMA is similar to that of the areas where I hunted quail in the Southeast and Midwest. Again I support your efforts and wish you luck. At 66 I would love to hunt quail in Lancaster Co. before I'm too old.	1
28.	Thank you for your concern for the future of the Bobwhite Quail. I would classify them in Huntingdon County as almost extinct. My father-in-law stated there where quail on this farm in the 1940s and 1950s. When brush kill and DDT were allowed on farms, the quail all died out. They have not returned.	1
29.	I have hunted quail in Virginia, Colorado (eastern Plains), Nebraska, and observed a couple covey in Adams county Pa in the early '90's. Have seen ones and two's in Crawford County PA in the last couple of years. Fear the recent sightings in Crawford Co. were farm raised. Every quail I have shot has been within 500 yds of sorghum, corn and foxtail. The best hunting I have had is in 3 year burn-overs near water. Water should always be considered. I always felt my old home state of PA would do well for quail. Nebraska farms the same way. Killed 2 times the quail in that state than any other. Every state game land that is targeted should ring trees within 25 yards of water and plant white pine, and clear cut another 50 yards into the woods. Plant a mixture of sorghum and legumes. Foxtail the edge. Please don't forget to burn half the cut every 3 years. Bring in some western wild quail. Close the season for 5 years. Always make it as easy for the bird as possible. These areas will boom. God bless and good luck.	1
30.	I just wanted to express my support for the restoration program. I grew up in Georgia for a few years in my youth. Bobwhite calls were a regular part of morning and dusk. I would love for my young daughter to experience the sounds as well. Our family has 160+ acres of farmland in southern Adams County. It would be nice if we could become a part of the restoration efforts.	1
31.	Don't be afraid to ask for assistance from hunters for money and time. Organizations like Quail Unlimited, bird watching groups, etc. It is all about land management, best of luck. I hope it comes to fruition in my lifetime, I'm 60 years old.	1
32.	The plan lacks an aggressive approach to securing more land in CREP. Everything points to habitat loss (so it says). I would think this would be priority #1!!! I know the science is important but creation of this additional habitat will benefit many species.	1

33.	My grandparents once had Bobwhite Quail by their home in the early 1990's outside of the river town of Craley. At that time the farms surrounding their home kept the lower portion of the corn stalks on after harvesting and the hedgerows were grown up with briers and all types of vegetation. The roadsides were also grown up with all types of weeds and vegetation. It seems very obvious to me that with farmers under more and more pressure to turn a dollar on their land and with all the tools and capabilities to farm every square inch of their property that wildlife habitat has diminished greatly. I have looked over portions of the Bobwhite Quail Management plan and I am sure that the Game Commission is well aware of this same problem. My suggestion is that the Game Commission fined some way through the use of their funds or through the use of other agency, groups, or sportsman's clubs to reestablish those hedgerows and habitat with farmers by reimbursing farmers for that land if necessary. The habitat that bobwhites need would also benefit other small game species such as pheasants and rabbits. Perhaps a program could be created specifically for Small Game only. Imagine if you could have farms... a list of farms for each wildlife management area that bought into a program where they would work hand in hand with the Game Commission or local sportsmen clubs to improve habitat for small game species. The Game Commission would then stock or establish breeding populations of quail or pheasant or other small game. The farmers would get a stipend or be reimbursed in some way through license sales of a new small game privilege tag or be reimbursed by the Game Commission otherwise. Farms participating in the program could be on a rotation to open up every so many years to hunting to allow populations to remain stable.	1
34.	I'm firmly convinced that increasing small game hunting opportunities is THE KEY that will spark interest in our future generation of hunters. I also support individual game bird stamps that will improve habitat. I also would like to see the pheasant stocking program eliminated and the funding used for habitat improvement and hunting access to more farms. Your wild pheasant recovery program seems to be headed in the right direction and I firmly applaud your efforts. Willing to pay $5.00-$10.00 stamp to pay for the program of pheasant/quail recovery.	1
35.	I have felt that if a plan similar to the pheasant plan was used for quail that the Gettysburg Battlefield in Adams County would be a good place to release some wild birds. It’s an area that is already closed to all hunting so it may have less of an impact on local hunters. The battlefield has recently had numerous trees removed in an effort to make it more like the time of the battle which was a time when quail were more numerous.	1

36.	Technical assistance for private landowners and funding for habitat establishment and management on private lands will be vital to Northern Bobwhite and associated species. The management plan should greatly expand on proposed methods that the Game Commission and partnering organizations will utilize to accomplish this goal, including methods for working with both large and small landowners. Existing resources for technical assistance on private lands, such as the Game Commission's Private Landowner Assistance Program, do not currently have sufficient capacity to reach the number of landowners that would be required to accomplish the goals of this plan, while still advancing other initiatives. Further, the topic of sources of funding to implement management recommendations on private lands requires substantially more detail. The plan includes a thorough explanation of why programs such as CRP are not working well in Pennsylvania, but does not provide much detail on what kind of incentive programs might be implemented to fill the void. Several portions of the plan mention the bobwhite's use of multiflora rose and honeysuckle for cover. While bobwhites certainly do utilize these plants, the plan does not adequately make clear that plans for future habitat work should focus more on establishing native plants that function equally as well, if not better, as sources of food and cover. Also, in the southern-tier counties where native bobwhites may persist, it is likely that intensive agriculture is having a negative effect on populations. The plan should more comprehensively address how the issues of frequent mowing and pesticide application will be handled within the Bobwhite Quail Focus Areas.	1
37.	More support in Western PA, especially those counties which abut the Ohio border and are generally non-forested, flat and contain a large amount of working and abandoned farmland and strip mines and those West of the Allegheny River.	1
FUNDING THE PLAN		**8**
38.	It is a worthwhile plan. Also, I know that funding is a concern. As a lifetime PA hunter, I support a license increase as well. I would rather have my money going to support the wildlife and habitat of PA.	1
39.	Support a dedicated stamp to fund pheasant / quail programs.	2
40.	Don't be afraid to ask for assistance from hunters for money and time.	1
41.	I also support individual game bird stamps that will improve habitat. I also would like to see the pheasant stocking program eliminated and the funding used for habitat improvement and hunting access to more farms.	1
42.	USDA funding will be vital to success of program.	3
HUNTING AND STOCKING PEN-REARED QUAIL		**8**
43.	I am from West Virginia and hunted quail as a very young man in the orchards of the eastern panhandle of West Virginia. The bad snow and pesticides had its demise of the quail there. They were my first hunting experience and I am proud that your state is taking this initiative to bring them back. You understand to keep our young kids hunting we must bring back the small game.	1
44.	At one time I even raised and released several hundred Bobwhites, went back in a day or so to train my dogs and found very few. Pen-reared quail don't work.	1
45.	Plan should address the concept of surrogators in quail restoration – we need to educate the public that this is not an effective approach.	1
46.	I then thought it would be nice to raise bobwhites and release them back into the wild or if the game commission would create a program similar to raising of pheasants. Now here it is. It was a joy to see my kids watch that bobwhite that day in the car, and hope some day other children can see the bobwhite quail in the wild and respect the PGC in their attempt and effort in restoring the bobwhite quail for the future.	1
47.	I am in favor of reviving the quail pop. At least my kids will have something to hunt in the coming years.	1

48.	I'm firmly convinced that increasing small game hunting opportunities is THE KEY that will spark interest in our future generation of hunters.	1
49.	Reintroduce raised birds in large numbers.	2
SPECIFIC COMMENTS ON THE PLAN GOALS AND OBJECTIVES		**14**
50.	With the recent creation of management plans for American Woodcock, Northern Bobwhite, and Ruffed Grouse – three game species dependent on early-successional habitats – Audubon urges the Game Commission to approach the management of these species and associated non-game species holistically. Each of these plans contains ambitious goals, but the connections among them are not clearly evident. Additionally, the Game Commission should ensure that all of its recommendations and strategies are tightly aligned with best management practices for non-game species of conservation concern, such as the recommendations of the Golden-Winged Warbler Working Group.	1
51.	The draft plan's initial focus on genetic research to document the current status of "wild" bobwhite in Pennsylvania is critically important. Pennsylvania must make this investment in genetic research or else any efforts to protect and restore bobwhite in the Commonwealth are likely to fail. Once areas with native bobwhite populations are identified, the proposal to delineate Bobwhite Quail Focus Areas with restrictions against hunting, releasing penned birds, and training dogs in these areas seems warranted and prudent.	1
52.	Following up on records of potential breeding bobwhites from the Breeding Bird Atlas is also a wise move. Audubon, with the help of its network of local chapters, would be more than willing to assist in connecting the Game Commission with capable volunteer monitors to assist in this effort.	1
53.	The plan references numerous studies to be performed. We understand the need to have solid science as a basis for moving the plan to the implementation phase, but we are concerned that too much emphasis may be placed on studying one of the most studied game birds in North America. We encourage the Commission to take advantage of existing research and the expertise available in other state agencies, universities, and especially the Tall Timbers Research Station and Land Conservancy. The implementation of the plan can be moved forward by several years if outside expertise is used. While everyone will be interested in the studies, nothing will show success like on-the-ground results.	1
54.	In our view, it is highly unlikely that any populations of bobwhite quail exist in southwest Pennsylvania. We have many hunters and dog enthusiasts in our chapter and no one has reported seeing any wild bobwhites in many years. When conducting our pheasant crowing counts, we have included bobwhites as one of the species that we listen for and have never heard a bobwhite. We are not aware of anyone reporting hearing a bobwhite on any of the other WPRA surveys.	1
55.	While we understand the necessity of checking all the bases, we recommend that this phase be limited in geographic scope of the areas that have some possibility of having wild quail. Figure 4 of the plan indicates that there are several areas on the MD border that may have some potential and the rumors of quail in the marshes surrounding Philadelphia persist.	1

56.	**GOAL 2. Determine the amount and distribution of occupied and potentially suitable Northern Bobwhite habitats in PA.** This goal overlaps with Goal 1. We reiterate that this task should be limited in scope with regard to the existing population work. We have seen products prepared by your staff for the potential Mercer County WPRA and believe that a GIS based project would be a good start on this effort. We repeat our general comment here and recommend that the Commission engage several of the top quail experts in the country to look at the areas that show promise.	1
57.	**2.2.2. Identify priority habitats that meet minimum areas requirements (potential Bobwhite Quail Focus Areas (BQFA)) on the PA landscape for maintaining and restoring wild, breeding quail populations.** We suggest that existing Pheasant restoration areas should be seriously evaluated as potential quail restoration areas. You already have most of the components in place, including a willing PF/QF chapter that can focus effort on landowners that are already cooperators in our habitat programs.	1
58.	**GOAL 3. Maintain and enhance the quantity and quality of habitat in BQFAs.** Pheasants Forever and Quail Forever stand ready to assist you in this effort. We are confident that significant resources can be made available to assist you in this effort. We have extensive effort working with private landowners and a long history of close cooperation with your field staff.	1
59.	**3.1.3. Develop a PA Bobwhite Quail Habitat Manual.** There are several very good quail manuals already in print and thousands of research articles and pamphlets. We suggest that the task of developing a quail management plan for Pennsylvania should be contracted to someone with extensive experience in quail management. We understand that we are on the northern fringe of the US quail range, but we do not believe that implementation of the plan should be delayed while a management manual is being developed.	1
60.	**GOAL 4. Within each BQFA assess bobwhite quail populations and maintain or establish wild Northern Bobwhite quail populations on restored habitats that meet BMPs specified in the Bobwhite Quail Habitat Manual.** Our members would be happy to assist with assessing the presence or absence of wild quail on any proposed BQFA.	1
61.	**4.2.6 If wild bobwhite quail are not available in the numbers needed to establish a founding population, investigate the feasibility of using wild quail to develop a wild captive breeding program for Northern Bobwhite Quail Recovery.** Since only 50 bobwhites are considered the minimum number needed to initiate a release in a BQFA, we are highly skeptical of this approach. Quail are relatively easy to trap and acquiring 50 birds does not seem to be any near the problem that we faced in the early years of pheasant acquisition. With all of the dangers associated with game farm birds we recommend that section 4.2.6 be deleted from the plan. Intensive habitat work on a PGC propagation area or on other state of federal property with limited public access is a process that we would support.	1
62.	**GOAL 5. Inform and educate the public, landowners and hunters about efforts to restore wild Northern Bobwhite quail populations in PA and assess their attitudes, preferences, and support for wild bobwhite quail recovery.** Again these goals are reasonable and necessary. Our Chapter is willing to assist with this goal in any manner we can. Hunter and landowner education is a basic function of PF/QF Chapters.	1

63.	**GOAL 6. Maintain and enhance potentially suitable bobwhite quail habitats across PA.** Chapters throughout the state will be willing to assist the PGC on this goal. **Objective 6.2: Collaborate with regional and national Northern Bobwhite Quail recovery program initiatives to capitalize on expertise outside the state and influence national and regional funding that will support large scale habitat restoration work on farm landscapes** We strongly support this goal and believe that collaboration with other experts in the field will significantly improve the quality of the program and reduce the time it takes to show results on the ground.	1